



CASHLESS TOLLING

TA 19-1, Contract D800002

DB CONTRACT DOCUMENTS PART 8

SPECIAL SPECIFICATIONS / EQUIPMENT CUT SHEETS

DRAFT February 7, 2019

This *Part 8 – Special Specifications* provides access to, and details the Project-specific requirements for the use of, the following documents:

1. NYSDOT/Authority Standard Specifications and Construction Materials
2. NYSDOT/Authority Engineering Information Issuances
3. NYSDOT/Authority Special Specifications.

NYSDOT Standard Specifications and Construction Materials

The Design-Builder shall use the NYSDOT Standard Specifications Construction Materials in coordination with *Part 5 – Special Provisions*.

The NYSDOT Standard Specifications Construction Materials can be accessed at the following internet link:

<https://www.dot.ny.gov/main/business-center/engineering/specifications/busi-e-standards-usc>.

NYSDOT/Authority Engineering Information Issuances

The Design-Builder shall use the relevant NYSDOT/Authority engineering information issuances, which include:

1. Engineering Instructions (EI);
2. Engineering Bulletins (EB);
3. Engineering Directives (ED).

The above listed engineering information issuances can be accessed at the following internet link:

<https://www.dot.ny.gov/main/business-center/consultants/forms-publications-and-instructions/engineering-information-issuance-system>

NYSDOT Special Specifications

The Design-Builder *may* submit to use NYSDOT/Authority Special Specifications which are listed in the Electronic Pay Item Catalog (e-PIC) (requires Authority acceptance) and which have received General Approval, and **shall** use any NYSDOT/Authority Special Specifications which are referenced in this Part 8 or elsewhere in the Contract Documents. Delete and ignore sections in the NYSDOT/Authority Special Specifications titled *Method of Measurement* and *Basis of Payment* from the NYSDOT/Authority Special Specifications.

NYSDOT Special Specifications can be accessed at the following internet link:

<https://www.dot.ny.gov/main/business-center/engineering/specifications/special-specifications-us>.

The NYSTA Special Specifications may be accessed

Via a written request provided at the One on One meetings with names of firm's personnel needing access.

The following Special Specifications are attached herein:

ITEM 502.90010018 – CLEAN AND FILL CRACKS AND JOINTS IN PORTLAND CEMENT CONCRETE (PCC) PAVEMENT, ASTM D 6690 TYPE IV

ITEM 606.9575--25 - MEDIAN BARRIER GATE SYSTEM (INSTALLED)

ITEM 637.11----25 – ENGINEER'S FIELD OFFICE TYPE 1

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED - DB

ITEM 645.4520--25 - TOLL LANE VARIABLE MESSAGE SIGN

ITEM 646.0603--25 – INSTALL DELINEATOR OR TENTH MILE MARKER ON POST

ITEM 646.0604--25 – INSTALL DELINEATOR OR TENTH MILE MARKER, BACK-TO-BACK ON POST

ITEM 646.0610--25 – INSTALL DELINEATOR OR TENTH MILE MARKER, BAND OR BRACKET MOUNTED

ITEM 646.0612--25 – INSTALL DELINEATOR OR TENTH MILE MARKER, BACK-TO-BACK, BAND OR BRACKET MOUNTED

ITEM 646.0626--25 – INSTALL MILE MARKERS

ITEM 646.0801--25 – INSTALL SNOWPLOW MARKER, SINGLE UNIT

ITEM 646.0802--25 – INSTALL SNOWPLOW MARKER, DOUBLE UNIT

ITEM 646.10320025 – RESET EXISTING DELINEATORS OR MARKERS

ITEM 646.50----25 – REMOVE AND DISPOSE DELINEATORS AND MARKERS

ITEM 651.02001525 – CCTV CAMERA MOUNTING POLE

ITEM 651.0201-25 – CAMERA LOWERING DEVICE

ITEM 651.9908XX25 – FIBER OPTIC COMPONENTS – DB

ITEM 662.74125325 – HDPE INNERDUCT 1.25 INCH ID – DB

ITEM 680.5830--25 – PREFORMED INDUCTANCE LOOP DETECTOR (CAST IN PLACE) INSTALLATION

ITEM 680.5860--25 – PREFORMED INDUCTANCE LOOP DETECTOR (ASPHALT OVERLAY) INSTALLATION

ITEM 680.8020XX25 – CABINETS FOR ITS EQUIPMENT

ITEM 683.6730--25 – CCTV CAMERA SITE EQUIPMENT - PEDESTAL MOUNT

ITEM 683.9805XX--25 – TOLL FACILITY SECURITY SYSTEM SERIALIZED – DB

ITEM 685.17XX--25 – HIGHLY REFLECTORIZED TRIPLE DROP EPOXY
PAVEMENT STRIPES, 6 INCH WIDTH

ITEM 690.6202--25 – INSTALLATION OF TOLL TREADLE FRAME 1

ITEM 697.0203--25 – FIELD CHANGE ORDER (THRUWAY)

ITEM 800.01000015 – DESIGN BUILD – DESIGN SERVICES

ITEM 800.02000015 – DESIGN BUILD – CONSTRUCTION INSPECTION SERVICES

ITEM 800.03000015 – DESIGN BUILD – QUALITY CONTROL SERVICES

ITEM 800.04000025 – DESIGN BUILD – FORCE ACCOUNT WORK

ITEM 800.05000015 – DESIGN BUILD – SITE MOBILIZATION

ITEM 800.0600NN15 – DESIGN BUILD – CONSTRUCTION WORK

In the event of a discrepancy between the version of any Special Specification attached herein and the version available from the NYSDOT/Authority web site listed above, the version included in these Contract Documents shall apply.

ITEM 502.90010018 - CLEAN AND FILL CRACKS AND JOINTS IN PORTLAND CEMENT CONCRETE (PCC) PAVEMENT, ASTM D 6690 TYPE IV

DESCRIPTION. Clean and fill the following cracks and joints that are 1/4 - 1 inch wide at the locations indicated in the contract documents:

- New transverse contraction joints within full depth repairs.
- Existing transverse and longitudinal joints outside new full depth repairs.
- Existing cracks.

Do not clean and fill:

- Transverse and longitudinal joints that define new full depth repair boundaries.
- New longitudinal joints within full depth repairs.

MATERIALS.

Highway Joint Sealants (ASTM D 6690 Type IV)..... 705-02
Backer Rods..... ASTM D5249 (Type 1)

In addition to meeting the requirement of ASTM D5249 (Type 1), backer rods must have a diameter at least 25% wider than the location of the crack it is placed into.

The Department may perform supplementary sampling and testing of the sealant. Deliver sealant in the Manufacturer's original sealed container legibly marked with the:

- Manufacturer's name.
- Trade name of the sealant.
- Manufacturer's batch or lot number.
- ASTM D 6690, Type IV.
- Minimum application temperature.
- Maximum (or Safe) heating temperature.

CONSTRUCTION DETAILS. If diamond grinding is included in the contract documents, prepare the joints and cracks, diamond grind the pavement, then clean and fill the joints and cracks.

Prepare New Transverse Contraction Joints Within Full Depth Repairs. Widen the joint to 1/4 – 3/8 inch for a depth of 1 inch if the first stage saw cut is less than 1/4 inch wide. Use diamond blade saws equipped with cutting guides, blade guards, water cooling systems, dust controls, and cut depth control. Immediately wash the slurry from the pavement such that it does not re-enter the joint. Do not place backer rod in these joints.

Prepare Existing Transverse and Longitudinal Joints. Use a 1/8 – 1/4 inch wide, 1 5/8 inches deep saw cut to dislodge debris and existing sealant or filler from the joint without damaging the joint faces. Follow the saw cut with a compressed air blast to remove the dislodged debris to the bottom of the existing joint sealant reservoir or to a depth of 3 inches if there is no existing reservoir. Install a trap or other device on the compressed air equipment to prevent oil from contaminating the joint surfaces. Supplement the air blast with mechanical removal, such as a screwdriver, if it is not sufficient to remove the debris. Do not damage the joint faces. Immediately wash or sweep the dislodged debris from the pavement such that it does not re-enter the joint. Do not place backer rod in these joints.

Prepare Existing Cracks. Remove all debris from existing cracks as deep as possible using a compressed air blast supplemented with mechanical removal. Install a trap or other device on the compressed air

**ITEM 502.90010018 - CLEAN AND FILL CRACKS AND JOINTS IN PORTLAND CEMENT
CONCRETE (PCC) PAVEMENT, ASTM D 6690 TYPE IV**

equipment to prevent oil from contaminating the crack surfaces. Immediately wash or sweep the dislodged debris from the pavement such that it does not re-enter the joint. Backer rod may be placed after cleaning provided it is at least 25 % wider than the crack everywhere along the crack and is placed 2 inches beneath the pavement surface.

Cleaning. Clean the joints and cracks by abrasive blasting before filling. Do not allow any traffic on the pavement between cleaning and filling. Reclean if it rains between cleaning and filling.

Sealant Melting. Provide the Engineer a copy of the sealant Manufacturer's recommendations for heating and application at least 24 business hours before filling. Follow those recommendations for heating and application. Unless stated otherwise, the recommended pouring temperature is 10°F below the Manufacturer's designated safe heating temperature, with an allowable variation of ± 10°F. Heat the sealant in a melter constructed either:

- As a double boiler with the space between inner and outer shells filled with a heat-transfer medium.
- With internal tubes or coils carrying the sealant through a heated oil bath and into a heated double wall hopper.

Do not use direct heating. Use a melter capable of maintaining the pouring temperature that is equipped with:

- Positive temperature controls.
- Mechanical agitation or a re-circulation pump capable of providing homogeneous sealant.
- Separate thermometers indicating the temperatures of the heat transfer medium and the sealant in the hopper. Do not place any sealant if the thermometers are defective or missing.

Prior to any sealing, measure the sealant temperature at discharge from the applicator wand. The temperature must be equal to or above the Manufacturer's recommended minimum pouring temperature and equal to or below the Manufacturer's recommended safe heating temperature. Discharge sealant into a vessel and measure the sealant temperature in the presence of the Engineer or the Engineer's representative. Provide 2 thermometers each having an 18 inches stem. Alternate methods to measure the sealant discharge temperature are subject to the Engineer's approval.

Use a discharge hose equipped with a thermostatically controlled heating apparatus or sufficiently insulated to maintain the proper sealant pouring temperature.

Do not use sealant heated beyond the safe heating temperature. Sealant may be reheated or heated in excess of six hours if allowed by the Manufacturer's heating and application recommendations. In these cases, recharge the melter with fresh sealant amounting to at least 20 % of the sealant volume remaining in the melter.

Filling. Fill within 8 hours of cleaning. Fill the joint or crack to within ¼ - ⅜ inch of the pavement surface. Fill when the:

- Air and surface temperatures are 40°F or warmer.
- Air temperature is above the dew point.
- Pavement surface and vertical joint\crack surfaces are dry.

Open to traffic after the sealant has cured to prevent tracking. A water mist may be used to accelerate curing. Do not blot with fine aggregate.

**ITEM 502.90010018 - CLEAN AND FILL CRACKS AND JOINTS IN PORTLAND CEMENT
CONCRETE (PCC) PAVEMENT, ASTM D 6690 TYPE IV**

METHOD OF MEASUREMENT. The work will be measured for payment as the number of feet of joints/cracks satisfactorily filled.

BASIS OF PAYMENT. Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for Clean and Fill Cracks and Joints in Portland Cement Concrete (PCC) Pavement, ASTM D 6690, Type IV.

ITEM 606.9575--25 - MEDIAN BARRIER GATE SYSTEM (INSTALLED)

1. DESCRIPTION:

1.01 This work shall consist of furnishing and installing a median barrier gate system at the locations indicated on the Contract Plans.

2. MATERIALS:

2.01 The barrier gate system shall be Barrier Gate 1.5 obtained from Energy Absorption Systems Inc., 35 East Wacker Drive, Suite 1100, Chicago Illinois 60601, or other approved supplier that can provide materials meeting all requirements of this specifications and geometric constraints of the project site.

2.02 Basis of Acceptance for barrier gate system shall be certification from the manufacture that the barrier gate system has been crash tested to NCHRP 350 Test Level 3.

2.03 Shop drawings of the barrier gate system shall be submitted to the Engineer. The shop drawings shall show the field assembly of all components for each complete gate system, and detail the required opening in the concrete barrier for installation of the gate system. Detailed fabrication drawings of the individual gate components are not required. The drawings shall conform to the size and type requirements for Shop Drawings set forth in the New York State Steel Construction Manual.

2.04 At least ten (10) days before start of work, the Contractor shall provide the Engineer with three (3) copies of the manufacturer's written instructions for the installation, operation and maintenance of the gate system and end assemblies.

2.05 All steel components in the barrier gate system and end assemblies shall be galvanized in accordance with §719-01 Galvanized Coatings and Repair Methods.

2.06 The barrier gate system shall be capable of operating between -25°F to 120°F in the absence of snow and ice and/or severe debris buildup.

3. CONSTRUCTION DETAILS:

3.01 The Contractor shall install the barrier gate system as shown on the Contract Plans, and in accordance with shop drawings and manufacturer's instructions.

3.02 Transition assemblies shall be anchored to the roadway pavement in accordance with the shop drawings and manufacturer's instructions.

3.03 The manufacturer's technical representative shall be made available for a minimum of five (5) working days to facilitate the barrier system installation and to provide training to Authority staff on the operation and maintenance of the gate system and installation of the end assemblies.

4. METHOD OF MEASUREMENT:

4.01 Measurement for Median Barrier Gate System will be the number of complete gate systems satisfactorily installed.

5. BASIS OF PAYMENT:

5.01 The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

- ITEM 637.11---25 – ENGINEER’S FIELD OFFICE – TYPE 1**
- ITEM 637.12---25 – ENGINEER’S FIELD OFFICE – TYPE 2**
- ITEM 637.13---25 – ENGINEER’S FIELD OFFICE – TYPE 3**
- ITEM 637.14---25 – ENGINEER’S FIELD OFFICE – TYPE 4**
- ITEM 637.15---25 – ENGINEER’S FIELD OFFICE – TYPE 5**

1. **DESCRIPTION.** This work shall consist of providing, for the Engineer’s use a building, or a portion thereof, or a modular trailer of a specified type erected at a location approved by the Engineer. In addition, all computer hardware, software and internet communications described in this specification shall be provided for the duration of the contract.

2. **MATERIALS:**

2.01 **Engineer’s Field Office.** The Engineer’s Field Office shall be within a secured, weatherproof building or mobile trailer. If two (2) or more mobile trailer units are provided, they shall be joined with weatherproof connections. Mobile trailers shall be in new or like new condition. The Contractor may furnish equivalent facilities in an existing building, provided that the building is located to provide convenient service. The Contractor shall supply the Engineer with a copy of the Certificate of Occupancy for the existing building.

The Engineer’s Field Office shall be in accordance with the requirements of the New York State Uniform Fire Prevention and Building Code, 19 NYCRR, and any applicable local codes.

The electrical system shall be able to continuously operate all equipment and be provided with adequate receptacles. To accommodate computer equipment, the field office shall be provided with a dedicated 20 amp electrical service and a vacant floor-to-ceiling area with a 39 inch by 39 inch footprint along a wall for the installation of a computer hardware rack/cabinet. Electric light shall be provided by non glare-type luminaires to provide a minimum illumination level of 1,000 lux at desk-height level. An ambient air temperature of 70 °F ±10 °F shall be maintained.

Fire extinguishers and smoke and carbon monoxide detectors shall be provided and installed.

The Engineer’s Field Office shall be partitioned to provide separate rooms, defined as either “small” or “large”, with adjoining doors. Table 637-1 contains the minimum area requirements for each of the office types.

TABLE 637-1 ENGINEER’S FIELD OFFICE AREA REQUIREMENTS					
Physical Requirement	Engineer’s Field Office Type				
	1	2	3	4	5
Min. total floor area (ft ²)	540	860	1300	2475	2700
Min. number of small rooms	2	3	2	3	6
Min. floor area of each small room (ft ²)	100	100	120	150	175
Min. number of large rooms	1	1	2	2	2
Min. floor area of each large room (ft ²)	200	200	240	300	350

A. **Potable Water.** From a local municipal water supply, certified well or bottled with a heating/refrigerator unit to provide hot and cold water. An exterior frost-free hose bib shall be provided in a location adjacent to the Engineer’s Field Office. The hose bib need not be installed on a potable water line, and if the water in the line is not potable, it shall be clearly marked as such.

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- B. **Restroom.** A separately enclosed room, lockable from the inside, that is properly ventilated and in compliance with applicable sanitary codes. The Contractor shall provide all lavatory amenities, necessary paper and soap products, hot and cold running water and a toilet. The toilet shall be flush-type where sanitary facilities are available, and a type approved by the Engineer prior to installation where sanitary facilities are not available. The minimum required number of restrooms to be provided is specified in Table 637-2.
- C. **Parking Area.** The Contractor shall provide and/or construct paved or hard surfaced (gravel or bankrun material) secure parking area with dedicated parking spaces adjacent to the Engineer’s Field Office. Each parking space shall be 9 feet by 18 feet, and the minimum required number of spaces to be provided is specified in Table 637-2.
- D. **Field Office Signs.** The sign panel material shall be aluminum, fiberglass, plywood or lightweight plastic. The sign sheeting shall be ASTM Type III. The sign panel shall be 36 inches high by 48 inches wide with white legend on green background with the phrases as positioned and described below. If erected at a location where the sign might be struck by an errant vehicle, the sign support shall be a breakaway type.

The letters in the phrase "FIELD OFFICE" shall be 6 inch C series with the top of the letters 6 inches below the top of the panel. The letters in the phrase "ENGINEER-IN-CHARGE" shall be 6 inch B series with the top of the letters 18 inches below the top of the panel. The letters in the phrase "N.Y.S. THRUWAY AUTHORITY" shall be 1½ inch E series with the top of the letters 30 inches below the top of the panel. All phrases shall be centered horizontally on the panel.

If the Engineer’s Field Office is not located within or adjacent to the contract limits, two (2) additional signs shall be displayed conspicuously within the contract limits. The signs shall be similar to the above description, except that they shall be 48 inches high by 64 inches wide and have an additional bottom line of text containing the street address of the Engineer’s Field Office. The letters in the street address shall be 6 inch B series with the top of the letters 36 inches below the top of the panel and centered horizontally on the panel.

- E. **Mailbox.** Standard mailbox (with post if necessary) or post office box meeting the requirements of the U.S. Postal Service.
- F. **Telephone and Answering System.** A separate telephone and digital answering system for the exclusive use of the inspection staff. The minimum required number of telephone voice lines to be provided is specified in Table 637-2 (these lines are in addition to the separate lines to be provided for the facsimile machine and dial-up computer access if high speed internet access is not available where the field office is located). The telephone and answering system shall provide the ability to answer all voice lines from each voice line, transfer calls to all voice lines and be equipped with a single, dedicated answering system.

A minimum of one (1) telephone shall be cordless and a minimum of one (1) telephone shall be equipped with speaker and conference call capability. The remaining telephones, at least one (1) per required voice line, shall be extension telephones with minimum 25 foot long cords. The digital answering system shall be capable of recording outgoing messages up to 60 seconds long and receiving a minimum of 40 incoming messages of 60 seconds duration. The system must include automated voice marking of time

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and day of each message received and provide a message mark so that new messages may be played back without erasing old messages. The system shall include remote programming of playback, backspace, and outgoing message re-record and allow for the retrieval of messages without a remote control unit.

- G. **Facsimile Machine.** Plain paper laser or inkjet facsimile machine with a dedicated telephone line. The machine shall be capable of sending and printing a maximum paper size of 8½ x 14 inches, have a minimum 20-page memory storage, a minimum 20-sheet document feeder, a minimum 50-sheet paper capacity, transmit at least 6 pages per minute and have an autodial/redial with a minimum of 50 phone number memory. The machine shall be capable of storing and printing outgoing message confirmation information and printing the sender’s name, fax number and page number on incoming faxes.

- H. **Photocopier.** Heavy duty, electric, dry-process photocopying machine. The machine shall be an all-in-one copy machine with black & white and color copying, black & white and color printing and black & white and color scanning capabilities. Machine shall have at least three paper bins (8½ x 11 inches, 8½ x 14 inches and 11 x 17 inches), enlarging and reducing capabilities, and collating, sorting stapling and double-sided copying. Set-up, printer drivers, software and networking are required. All on-site staff email addresses shall be set up and programmed for ease of scanning. Maintenance shall be provided, as required, including repairs and all necessary toner cartridges and staples for the life of the contract and until final completion. One (1) case (5,000 sheets, 20 lb, white) of each paper size shall be provided as initial stock.

- I. **Paper Shredder.** Automatic start, heavy duty cross-cut paper shredder. The shredder shall be able to receive 8½ inch wide paper and shred a minimum of 15 sheets simultaneously along with CDs and staples.

- J. **Pencil Sharpener.** Manual or electric pencil sharpener, minimum 1 per room.

- K. **Exterior Bulletin Board.** An installed 4 foot by 8 foot weatherproof bulletin board in front of or adjacent to the Engineer’s Field Office. The bulletin board may be attached to an outside wall of the office. The location selected must be handicapped accessible and clearly visible.

- L. **Interior Bulletin Board.** An installed, wall-mounted 4 foot by 6 foot bulletin board made of cork or similar material in a large room, and one (1) 2 foot by 4 foot wall mounted bulletin board installed per room.

- M. **Dry Erase Board.** Installed, wall-mounted 2 foot by 4 foot dry erase boards, minimum one (1) per room.

- N. **Storage Locker.** Metal or wood storage locker with shelves, a tumbler lock and two (2) keys for the storage of survey, GPS and testing equipment. The total locker space footprint provided shall be a minimum of 9 square feet with a minimum height of 6 feet.

- O. **Fire Resistant Cabinet.** Fire resistant, legal size filing cabinet with locks and two (2) keys each, meeting the requirements of ANSI/UL Standard 72 for Insulated Filing Devices, Class 350-1 hour. Each office shall be provided with two (2) 2-drawer cabinets, and the required number of additional 4-drawer cabinets as specified in Table 637-2.

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- P. **Bookcase.** Self-standing, 3-shelf metal or wood bookcase, approximately 4 feet high, 4 feet wide and 1 foot deep. The minimum required number of bookcases to be provided is specified in Table 637-2.
- Q. **Wastebasket.** Minimum 7 gallon wastebasket, minimum one (1) per desk.
- R. **Refrigerator.** Electric, top-freezer type providing a minimum storage space of 15 cubic feet for Engineer’s Field Office Types 1 and 2, and a minimum storage space of 21 cubic feet for Types 3, 4 and 5.
- S. **Kitchenette.** To include a minimum 1 cubic foot, 1,300 watt microwave oven, a sink with hot and cold running water with minimum dimensions of 15 inch by 15 inch by 6 inch deep, usable counter space with minimum dimensions of 5 feet long by 2 feet deep and cabinet space with minimum dimensions of 5 feet long by 1½ feet deep by 2½ feet high. If the water in the sink is not potable, it shall be clearly marked as such.
- T. **Stove.** Electric, propane or bottle gas stove with a minimum of two (2) burners adequate for rapid drying of soil samples, including fuel or electrical supply. A stove is required when a separate Field Laboratory is not included.
- U. **First Aid Kit.** A Type III kit in accordance with ANSI Z308.1 *Minimum Requirements for Workplace First Aid Kits*. The minimum number of first aid kits to be provided is specified in Table 637-2.
- V. **Thermometer.** A minimum-maximum thermometer displaying in degrees Fahrenheit and mounted with an external probe to give the temperature both indoors and outdoors.
- W. **Coat Rack.** A metal or wood coat rack or closet capable of holding at least 4 coats. The minimum required number of coat racks to be provided is specified in Table 637-2. A single coat rack may be provided as long as it holds the minimum number of coats as per Table 637-2.
- X. **Office Desk and Chair.** Fully assembled freestanding office desks and chairs. Each desk shall have a 5 foot long by 2½ foot wide work surface and a height of 30 inches, at least 2 lockable drawers and include an adjustable shelf approximately 1 foot wide and no less than 2½ feet long. Each desk shall also be provided with an adjustable chair with arms, 5 legs with casters and be adjustable from approximately 16 inches to 24 inches in height. Each desk shall have a dedicated electrical outlet receptacle. The required number of office desks and chairs to be provided is specified in Table 637-2.

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TABLE 637-2 ENGINEER’S FIELD OFFICE FURNISHING REQUIREMENTS					
Furnishing Description	Required Number per Engineer’s Field Office Type				
	1	2	3	4	5
Restrooms	1	1	2	2	3
Parking Spaces	6	8	12	18	22
Telephone Voice Lines	2	3	4	4	5
Telephone Line for Computers (when high speed internet is unavailable)	1	1	1	1	1
Telephone Line for Facsimile	1	1	1	1	1
Fire Resistant Cabinets (4-drawer)	2	3	4	6	8
Bookcases	5	7	10	12	16
First Aid Kits	1	1	1	2	2
Coat Racks	1	2	3	4	5
Office Desks and Chairs	4	8	12	18	22
Office/Conference Tables	2	2	3	4	5
Folding Chairs	8	10	10	12	15
Drafting Tables	1	1	2	3	3
Drafting Stools	2	2	4	6	6
Vertical Plan Filing Racks	1	1	2	3	8
Roll File Units	1	1	1	2	4
Flatbed Scanner	1	1	1	1	1
Personal Computer (Hardware and Software)	2	4	6	8	8
LaserJet printer	1	2	3	3	3
Additional Software	1	1	2	2	3
Digital Camera with Motion Picture Functionality	1	1	1	2	2

- Y. **Office/Conference Table.** Commercial-grade rectangular table with weather/spill resistant top a minimum of 8 feet long by 2½ feet wide by 30 inches high. The minimum required number of office/conference tables to be provided is specified in Table 637-2.
- Z. **Folding Chair.** Commercial-grade, folding steel chair with approximate overall dimensions of 30 inches by 19 inches wide by 21 inches deep. The minimum required number of folding chairs to be provided is specified in Table 637-2.
- AA. **Drafting Table.** Adjustable height, tilting top drafting table with brackets and legs and approximate dimensions of 6 feet long by 3 feet wide by 3 feet high. The minimum required number of drafting tables to be provided is specified in Table 637-2.
- BB. **Drafting Stools.** Adjustable height stool with backrest. The minimum required number of drafting stools to be provided is specified in Table 637-2.

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CC. **Vertical Plan Filing Rack.** Constructed of metal, capable of hanging up to 12 sets of plan drawings up to 3 feet by 4 feet in size, 12 hanging clamps included. The minimum required number of vertical plan filing racks to be provided is specified in Table 637-2.

DD. **Roll File Unit.** Twelve (12) compartments, each measuring approximately 6 inches by 6 inches. The minimum required number of roll file units to be provided is specified in Table 637-2.

2.02 **Information Technology.** The minimum required number of personal computers to be provided is specified in Table 637-2. The minimum requirements for each personal computer are:

A. Hardware

- CPU to operate Windows 8.1 for Business (32 bit or 64 bit edition) and all other software listed in this specification;
- Optical Drive – CD-RW/DVD-RW;
- 500 GB minimum hard drive;
- 8 GB minimum RAM;
- USB Port(s);
- 24” LCD monitor (1920 x 1080 resolution minimum);
- One (1) 500 GB External Hard Drive;
- Locking cabinet(s) which encloses all computer hardware;
- Surge protection device;
- External 3 button optical scroll mouse;
- External Speakers;
- Modem with separate phone line for computer (if high speed internet service is unavailable), (minimum 56K baud rate).

B. Software. Substitutions for the specified software shall not be permitted unless noted otherwise. All manuals shall be provided.

- Windows 8.1 for Business (32 bit or 64 bit edition);
- Microsoft Word (2013 version or later);
- Microsoft Excel (2013 version or later);
- WINZIP 15;
- Norton Internet Security (latest version for Windows 8) set up to run in Auto-Protect Mode and Auto Update Mode (monthly), or McAfee Internet Security Suite (latest version);

Note: Microsoft Office 2013 Standard Edition, or later version, may be used in lieu of Word 2013 and Excel 2013.

C. Additional Software. The following software shall also be provided on the number of personal computers specified in Table 637-2:

- Microsoft Photo Editor (latest version);
- Adobe Acrobat XI Professional (latest version);

- ITEM 637.11---25 – ENGINEER’S FIELD OFFICE – TYPE 1
- ITEM 637.12---25 – ENGINEER’S FIELD OFFICE – TYPE 2
- ITEM 637.13---25 – ENGINEER’S FIELD OFFICE – TYPE 3
- ITEM 637.14---25 – ENGINEER’S FIELD OFFICE – TYPE 4
- ITEM 637.15---25 – ENGINEER’S FIELD OFFICE – TYPE 5

- Primavera scheduling software capable of meeting all scheduling requirements of the NYS Thruway Authority Addendum to the Standard Specifications §108-01 *Start and Progress of Work* and compatible with the operating system supplied under this specification.

D. Internet Communication.

- **Cable Internet Service.** 10/100 Ethernet cable network card and high-speed cable modem capable of transferring data at a minimum of 50 megabits per second;
- Subscription to an Internet Service Provider capable of providing high-speed Internet service;
- Network/Wireless – Ethernet or wireless card to be compatible with the selected internet and office network connections.

E. LaserJet Printer. Photo-quality color LaserJet printer capable of printing on 8½ by 11 inch and 8½ by 14 inch paper. Supply with spare toner cartridge, standard LaserJet and photo paper, diskettes and read/write CDs.

F. Digital Camera. The digital camera system shall meet the requirements below. All necessary hardware, cables, operating manuals, and other pertinent media required for the operation of the camera unit itself, including connecting the camera to the office computer system shall be provided. The camera must be able to download the images to a computer without any proprietary software having to be installed on a computer.

- Minimum 16.0 megapixel resolution with 20x optical zoom and autofocus operation;
- 3 inch LCD screen and optical viewfinder;
- Built-in intelligent flash (auto/on/off);
- Time/date stamp on each picture;
- A total of two (2) rechargeable sets of batteries (Lithium-Ion) and high-capacity (approximately 1 hour) charging unit;
- Two (2) SDHC highest capacity and speed (Class) memory cards that are compatible with the camera;
- Soft storage/carry case with shoulder strap;
- Motion Video: 640 x 480 resolution capability at 30 frames per second (MPEG Video).

3. CONSTRUCTION DETAILS. The Contractor shall be responsible, until use and occupancy is relinquished by the Authority, for any and all damage, direct or indirect, of whatever nature, occurring to the property of the Authority and property of the inspection staff which is kept in the Engineer's Field Office. The Engineer will provide the Contractor with a detailed list of items kept in the office, with corresponding dollar values, and will provide the Contractor with updates when something on the list changes. Non-Authority-owned property shall only be those items used in the performance of contract-related work activities. Such property shall be replaced within 30 days of the reported damages and would include any loss caused by, but not limited to, fire, theft, vandalism or malicious mischief. The Contractor shall not be responsible for items kept in the Engineer's Field Office that are not on this list.

The Contractor shall install the Engineer’s Field Office sign at a location approved by the Engineer. If the Engineer’s Field Office is not located within or adjacent to the contract limits, two (2) additional signs shall be displayed conspicuously within the contract limits in locations directed by the Engineer.

ITEM 637.11----25 – ENGINEER’S FIELD OFFICE – TYPE 1
ITEM 637.12----25 – ENGINEER’S FIELD OFFICE – TYPE 2
ITEM 637.13----25 – ENGINEER’S FIELD OFFICE – TYPE 3
ITEM 637.14----25 – ENGINEER’S FIELD OFFICE – TYPE 4
ITEM 637.15----25 – ENGINEER’S FIELD OFFICE – TYPE 5

The Engineer’s Field Office shall be fully equipped and made available for use and occupancy by the inspection staff prior to the start of any contract work, and shall be made available after contract final acceptance as directed in writing by the Division Construction Engineer.

All furniture and equipment shall be fully assembled, operational, clean and serviceable. The Engineer’s Field Office shall be cleaned weekly or more often if required, and the timing of the cleaning operations shall be coordinated with the Engineer. The Contractor shall remove and dispose of all rubbish generated in the office and shall keep the office free from pests. The Contractor shall remove snow from all areas subject to vehicular circulation and parking.

After completion, all portable buildings or trailers, fencing, surfacing and utilities shall be removed from the location and the areas cleaned, loamed and restored as required. The Contractor shall be responsible for providing all necessary computer hardware, software and peripheral devices as well as high-speed Internet service to the Engineer’s Field Office until use and occupancy of the Engineer’s Field Office is relinquished by the Authority. Only internet services that can provide a minimum data transfer rate of 768 kilobits per second will be considered acceptable. The Contractor shall be responsible for providing all necessary service connections to the Engineer’s Field Office and Engineer’s Field Office computer(s). In addition, the Contractor shall provide a cable or DSL modem and any other equipment necessary to provide the minimum specified data transfer rate.

4. **METHOD OF MEASUREMENT.** The Engineer’s Field Office will be measured for payment as the number of months satisfactorily provided, measured to the nearest 0.25 months.
5. **BASIS OF PAYMENT.** The unit price bid per month for the Engineer’s Field Office shall include the cost of all labor, materials and equipment necessary to complete the work including property rental, utility charges and incidental expenses. Payment will be made for each month of availability for occupancy by the Engineer and inspection field staff.

No payment will be made under Engineer's Field Office when deficiencies in compliance with these requirements are not promptly addressed by the Contractor after notification by the Engineer. Should the aggregate of non-compliance days exceed 3 days in any one month, no payment shall be made for the entire month in which deficiencies were cited.

Monthly payments may be terminated prior to contract final acceptance by written notification by the Division Construction Engineer that such office will no longer be required on the contract. Payment for each month's occupancy of the Engineer’s Field Office after the date of contract final acceptance will be made as part of the final contract payment. Failure of the Contractor to supply documentation required to complete the final estimate may result in nonpayment during this delaying period.

During periods of contract extension of time where Engineering Charges are assessed, no payment will be made for occupancy and services, except that payment for each month's occupancy after the date of final acceptance will be made as part of the final estimate.

ITEM 645.4520--25 - TOLL LANE VARIABLE MESSAGE SIGN

1. DESCRIPTION:

1.01 This work shall consist of furnishing and installing a toll lane variable message sign (VMS) in accordance with the Contract Documents.

2. MATERIALS:

2.01 Materials shall include the following:

- A. Variable message sign (Fiberdyne FA 4x7 LED pixel matrix, 12-inch character height display with rail mount kit, or approved equal;
- B. Outdoor canopy structural mount;
- C. Connections to power;
- D. Control box (Fiberdyne GOT812 with NYS Thruway display programming included, or approved equal;
- E. Control box and power supply mounts in toll booth; and
- F. Connections to control box.

3. CONSTRUCTION DETAILS:

3.01 The Contractor shall furnish and install a suitable mount for each toll lane VMS. All structural details shall be designed and stamped by a New York State Licensed Professional Structural Engineer, submitted to the Engineer via the shop drawing process. Sign housing, framing and structure shall be designed for wind-loading criteria in accordance with the current *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*.

3.02 A control box mount shall be furnished and installed to hold the control box in the toll booth communication area on the side of the booth where space permits (without installed telephone instruments). Such a mount may be formed from a 2x4 screwed into the backboard to support the suspension mount for the control box. A power supply 'brick' shall be supplied with the control box. The Contractor shall mount and install the power brick and furnish power from a UPS source for control of the toll lane VMS on the canopy.

3.03 Testing for proper operation shall be done in accordance with the manufacturer's recommendations.

4. METHOD OF MEASUREMENT:

4.01 This work will be measured as the number of complete toll lane VMS units furnished and installed in accordance with the Contract Documents.

5. BASIS OF PAYMENT:

5.01 The unit price bid for each toll lane VMS unit shall include the cost of all labor, materials and equipment necessary to satisfactorily complete the work.

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

1. DESCRIPTION:

- 1.01 This work item shall consist of furnishing and installing a complete front access, full matrix, LED Dynamic Message Sign (DMS) assembly at locations indicated in the contract documents. This item shall include all sign modules, sign housings, controllers, fittings and cabling to make the sign compatible with the control software defined in this document. All other components necessary to support this sign will be covered under separate items.

2. MATERIALS:

2.01 General Requirements

Unless otherwise specified on the contract plans the DMS equipment shall include, but not limited to, the following components:

- DMS display modules and associated attachment hardware, capable of full matrix alphanumeric and special character messages including displaying message with a character height of 18” and character width of 9.6”.
- DMS controller(s).
- DMS software (where required).
- All required surge suppression, power and data cabling, and miscellaneous ancillaries.
- Sign mounting hardware (size and type to be as approved by the manufacturer).
- Power Supplies

2.02 Sign Requirements

- A. The complete LED DMS assembly shall conform to the requirements of the current National Electrical Manufacturers Association (NEMA) Standard No. TS-4 - Section 2, Environmental Standards and Test Procedures. The manufacturer shall provide certification for equipment compliance with NEMA environmental standards in accordance with NEMA testing procedures.
- B. Materials not specifically covered in these specifications shall be in accordance with the accepted standards of the NEMA, the Underwriters Laboratories (UL) Inc., the National Electrical Code (NEC), and the American Society for Testing and Materials (ASTM).
- C. Operating range shall be from - 30° F to + 165° F; relative humidity 0% to 95% non-condensing.
- D. For all message boards the use of heaters, fans, and filters shall not be permitted in order to reduce the maintenance requirements for servicing the signs.
- E. All electronic setup and adjustments for the display shall be enabled from the adjacent equipment cabinet.
- F. All materials to be furnished, assembled, fabricated or installed shall be new, corrosion resistant and in accordance with the details as shown on the Plans or as specified in the Contract documents.

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

2. MATERIALS: (cont'd)

2.02 **Sign Requirements** (cont'd)

- G. The DMS front face borders shall be constructed with vertically and horizontal channeled trim to provide a high-contrast background. The trim pieces shall be fabricated using aluminum sheeting. The trim shall border the entire DMS display.
- H. All DMS front face trim pieces that are visible shall be powder coated with a textured black Rohm and Haas 31-7091TGIC polyester finish, or approved equal.
- I. Unless otherwise specified by the manufacturer the DMS shall use standard extruded aluminum clamps and bolts which will secure the DMS to the specified support members. In all installed applications the support clips and hardware shall be in accordance with the manufactures standard installation guidelines and shall be supplied by the manufacturer.
- J. For ground-mounted installation, the DMS shall be constructed of such a size, depth and weight to allow installation on breakaway posts.
- K. The sign assembly and mounting hardware shall be designed to meet the loading and fatigue requirements specified in the following documents:
 - “NYSDOT Design Specification for Overhead Sign Structures Carrying Variable Message Signs” dated October, 1998; and the revisions to this document contained in Engineering Bulletin EB 01-049, “Overhead Sign Structure Interim Design Criteria”, dated 10/01/01; Engineering Instruction EI 99-038 “Design Loads for Permanent Variable Message Signs”, dated 12/31/99; and any other subsequent revisions.
- L. The control cabinet containing the sign controller, communications, and power supplies shall be paid under separate item(s) in this contract. Unless otherwise noted all internal components and mounting hardware shall be paid for under this contract item.

Cabinet foundation, work pads, or buried conduit shall be paid for under various contract items as noted on the plans.

Whenever possible the cabinets shall come pre-wired from the manufacturer to expedite installation and ensure quality control of communications and power component installation.

Internal component hardware (nuts, bolts, screws, standoffs, rivets, fasteners, etc.) shall be fabricated from hot dipped galvanized steel, stainless steel, aluminum, nylon or other durable corrosion-resistant materials suitable for roadway signage applications.

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

2. MATERIALS: (cont'd)

2.03 **LED Requirements**

- A. LED's shall be Amber in color with a minimum of 5 LED's per pixel, traceable to the manufacturer, with a typical luminous intensity of 3500 millicandela per LED when driven at 20 mA. The LED's used in the display shall be obtained from batches sorted for luminous output, where the highest luminosity LED shall not be more than fifty percent more luminous than the lowest luminosity LED. The brightness and color of each pixel shall be uniform over the entire face of the sign, within the required cone of vision, at a distance of 100 to 1100 feet, in all lighting conditions. The LEDs shall be protected from degradation due to sunlight and shall be untinted, non- diffused, an aluminum indium gallium phosphide (AlInGaP) amber LED with a peak wavelength 590 +/-5 nanometers.
- B. Unless otherwise shown on the contract plans the LED pixel and module construction technique shall result in a viewing cone of 30 degrees horizontal and 15 degrees vertical.
- C. Each display module shall be completely environmentally sealed. The protective face of the LED module shall be a solar grade polycarbonate material. All masks that are used to enhance the LED contrast or readability shall be UV inhibited.
- D. Each display module shall be based on a single printed circuit board. Designs using multiple levels of control electronics including daughter boards shall not be allowed.
- E. Each module shall be configured via the communication wiring harness and connector without individually addressing each module.
- F. The module shall have IP64 certification for dust and water protection under the International Standard IEC 60529 Edition 2.1.
- G. Each module shall be identical and interchangeable; to be removed and replaced easily using simple hand tools without affecting the operation of the remaining modules. The mounting design shall use mechanical fasteners that are resistant to vibration and vandalism.

2.04 **Circuit Board Electronics**

- A. All printed circuit boards shall be FR-4 0.06 in. material, minimum 28 gram copper, double sided with plated holes meeting environmental requirements with moisture proofing conformal coating.
- B. The DMS back plate shall include a NEMA rated distribution cabinet where all sign power and communication is to be terminated onto separate terminal blocks. One terminal block shall be for incoming DC power and the other shall be for incoming DMS signal cabling or a communications line. The distribution cabinet shall be located on the sign panel such that it is closest to the controller cabinet.

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

2. MATERIALS: (cont'd)

2.05 **Power Requirements**

A. AC Option: The DMS system power supply shall operate from a 120/240 VAC, 60Hz, single-phase power source, including neutral and earth ground. All cabinet and sign components including display modules shall operate from a 12 VDC power supply. The power supplies shall be rated to supply the required amperage for all DC powered installed equipment and with all LED modules set at full brightness plus twenty-five percent.

B. SOLAR/DC Option: The DMS system power supply shall operate from a 12VDC system. The system shall consist of photovoltaic solar panels, battery storage, and a multipoint power tracking charger to regulate solar-to-battery charging. All cabinet and sign components including display modules shall operate from this 12 VDC power supply. Batteries shall be housed in a separate 3R cabinet. The battery cabinet shall be paid under a separate item.

1. **Solar Charging Regulator:**

The solar charging regulator shall be of the maximum power point tracking (MPPT) type and shall meet the following requirements:

- Rated Solar Current: 30A (MIN)
- Rated Load Current: 30A (MIN)
- System Voltage: 12V/24V/48V
- Ambient Temperature: -40°F to +113°F
- Storage Temperature: -67°F to +2°F
- Humidity 100% non-condensing
- Peak Efficiency: 99%
- Nominal System DC Voltage: 12, 24, 36 or 48
- Max. Solar Open Circuit DC Voltage 150
- Battery Operating DC Voltage Range: 8-72
- Maximum Self-consumption: 2.7 Watts
- Transient Surge Protection: 4500 Watts/port

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

2. MATERIALS: (cont'd)

2.05 Power Requirements (cont'd)

2. **Batteries:** All supplied batteries shall be a valve regulated lead Acid AGM (Absorption Glass Mat) type. To ensure adequate capacity a minimum of eight (8) deep cycle batteries shall be used and capable of being wired as a 12 volt system. Each battery must have nominal dimensions equal to or less than 10.25”L x 7”W x 11.25”H and be rated for a minimum of 225 Amp-Hr.

The batteries and solar panels shall be rated to supply the required amperage. The sign shall run continuously with 40% of the pixels on for 144 hours on battery only. The solar panels must supply a minimum total of 720W.

3. **Surge Suppression:** The DMS distribution box shall contain surge suppression for both the DC power and sign communications. The sign power surge suppression shall consist of thermal resettable fuses conforming to SAE specification J53 Type 1. The sign communication shall consist of a surge suppression device capable of withstanding a 10kA peak surge in < 1 nanosecond.

2.06 DMS Controller

- A. The controller shall capable of providing all the necessary functions to control and monitor the DMS locally and from the Traffic Management Center (TMC). Local control shall be made possible in the field by either an alphanumeric keypad or optional QWERTY keyboard connected to the controller with and LCD display.
- B. The controller shall be mounted in the cabinet as shown in the contract plans or as provided by the manufacturer. The communication signals from sign controller to the DMS shall be RS-232 for distances up to 50 feet and RS-485 for distances up to 4,000 feet. Optional TCP/IP communications will also be an acceptable communications technology.

2.07 Photocell

Each sign assembly shall include photo cells for automatic pixel brightness adjustment to suit ambient lighting conditions. Brightness shall also be manually settable from the front panel of the controller and remotely from the DMS Central Control System in about 5% increments. Control shall be returnable to automatic from both the sign controller and the central computer.

2.08 Fonts and Messaging

Message text shall be configurable for variable character height, width, character spacing, and line spacing. The DMS font messaging requirements for this specification shall be capable of displaying the specified number of characters based on a maximum character height of 18 inches. The font style, height, and messages displayed shall conform to all applicable standards as described in the Manual on Uniform Traffic Control Devices, 2009 Edition, Chapter 2L, and all applicable NYSDOT supplements:

- Spacing between characters in a word should be between 25 to 40 percent of the letter height.

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

2. MATERIALS: (cont'd)

2.08 **Fonts and Messaging** (cont'd)

- Spacing between words in a message should be between 75 and 100 percent of the letter height.
- Spacing between the message lines should be between 50 and 75 percent of the letter height.
- The minimum letter height should be 18 inches for changeable message signs on roadways with speed limits of 45 mph or higher.
- The minimum letter height should be 12 inches for changeable message signs on roadways with speed limits of less than 45 mph.
- The character display width shall be capable of at least 9.6 inches.

Users shall configure the fonts supported by the sign on an alphanumeric keyboard.

Message text shall be configurable for variable character height, width, character spacing, and line spacing.

2.09 **National Transportation Communications for ITS Protocol (NTCIP)**

The controller shall communicate using the NTCIP standards listed here and all current revisions released at the time of bidding. The manufacturer shall be required to provide the NTCIP test results to verify conformance with the minimum standards as outlined here. Any published amendments to these standards at the time of contract advertisement shall be also be effective on this contract.

The following requirements defines those MIB objects which are expected to be used for the communications to the DMS:

- NTCIP 1103 V03– Transportation Management Protocols NTCIP 2104:2003 v01.11 - Ethernet Subnetwork Profile
- NTCIP 2202: 2001 - Internet (TCP/IP and UDP/IP) Transport Profile

The following table defines those MIB objects which are expected to be used by the DMS:

CONFORMANCE GROUP OBJECTS	REFERENCE	CONFORMANCE REQUIREMENT	PROJECT REQUIREMENT
1201: GLOBAL OBJECT (GO) DEFINITIONS			
2.2 - Configuration			
globalSetIDParameter	NTCIP 1201	optional	Yes
globalMaxModules	NTCIP 1201	mandatory	Yes
globalModuleTable	NTCIP 1201	mandatory	Yes
moduleNumber	NTCIP 1201	mandatory	Yes
moduleDeviceNode	NTCIP 1201	mandatory	Yes
moduleMake	NTCIP 1201	mandatory	Yes
moduleModel	NTCIP 1201	mandatory	Yes
moduleVersion	NTCIP 1201	mandatory	Yes
moduleType	NTCIP 1201	mandatory	Yes

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CONFORMANCE GROUP OBJECTS	REFERENCE	CONFORMANCE REQUIREMENT	PROJECT REQUIREMENT
2.3 Database Management			
Database Management (ALL)	NTCIP 1201	Optional Group	No
2.4 Time Management			
globalTime	NTCIP 1201	mandatory	Yes
globalDaylightSaving	NTCIP 1201	mandatory	Yes
globalLocalTimeDifferential	NTCIP 1201	mandatory	Yes
maxTimeBaseScheduleEntries	NTCIP 1201	mandatory	Yes
timeBaseScheduleTable	NTCIP 1201	mandatory	Yes
timeBaseScheduleNumber	NTCIP 1201	mandatory	Yes
timeBaseScheduleMonth	NTCIP 1201	mandatory	Yes
timeBaseScheduleDay	NTCIP 1201	mandatory	Yes
timeBaseScheduleDate	NTCIP 1201	mandatory	Yes
timeBaseScheduleDayPlan	NTCIP 1201	mandatory	Yes
maxDayPlans	NTCIP 1201	mandatory	Yes
maxDayPlanEvents	NTCIP 1201	mandatory	Yes
timeBaseDayPlanTable	NTCIP 1201	mandatory	Yes
dayPlanNumber	NTCIP 1201	mandatory	Yes
dayPlanEventNumber	NTCIP 1201	mandatory	Yes
dayPlanHour	NTCIP 1201	mandatory	Yes
dayPlanMinute	NTCIP 1201	mandatory	Yes
dayPlanActionNumberOID	NTCIP 1201	mandatory	Yes
dayPlanStatus	NTCIP 1201	mandatory	Yes
2.7 - PMPP			
maxGroupAddresses	NTCIP 1201	mandatory	Yes
hdlcGroupAddressTable	NTCIP 1201	mandatory	Yes
hdlcGroupAddressIndex	NTCIP 1201	mandatory	Yes
hdlcGroupAddress	NTCIP 1201	mandatory	Yes
1203: OBJECT DEFINITIONS FOR DYNAMIC MESSAGE SIGNS (DMS) MIB			
5.2 - SIGN CONFIGURATION AND CAPABILITY			
dmsSignAccess	NTCIP 1203	mandatory	Yes
dmsSignType	NTCIP 1203	mandatory	Yes
dmsSignHeight	NTCIP 1203	mandatory	Yes
dmsSignWidth	NTCIP 1203	mandatory	Yes
dmsHorizontalBorder	NTCIP 1203	mandatory	Yes
dmsVerticalBorder	NTCIP 1203	mandatory	Yes
dmsLegend	NTCIP 1203	mandatory	Yes
dmsBeaconType	NTCIP 1203	mandatory	Yes
dmsSignTechnology	NTCIP 1203	mandatory	Yes
5.3 - VMS Configuration			
vmsCharacterHeightPixels	NTCIP 1203	mandatory	Yes
vmsCharacterWidthPixels	NTCIP 1203	mandatory	Yes
vmsSignHeightPixels	NTCIP 1203	mandatory	Yes
vmsSignWidthPixels	NTCIP 1203	mandatory	Yes
vmsHorizontalPitch	NTCIP 1203	mandatory	Yes
vmsVerticalPitch	NTCIP 1203	mandatory	Yes
monochromeColor	NTCIP 1203	mandatory	Yes
5.4 - Font Definition			
numFonts	NTCIP 1203	mandatory	Yes
fontTable	NTCIP 1203	mandatory	Yes

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

CONFORMANCE GROUP OBJECTS	REFERENCE	CONFORMANCE REQUIREMENT	PROJECT REQUIREMENT
5.4 - Font Definition (cont'd)			
fontEntry	NTCIP 1203	mandatory	Yes
fontIndex	NTCIP 1203	mandatory	Yes
fontNumber	NTCIP 1203	mandatory	Yes
fontName	NTCIP 1203	mandatory	Yes
fontHeight	NTCIP 1203	mandatory	Yes
fontCharSpacing	NTCIP 1203	mandatory	Yes
fontLineSpacing	NTCIP 1203	mandatory	Yes
fontVersionID	NTCIP 1203	mandatory	Yes
fontStatusID	NTCIP 1203	mandatory	Yes
maxFontCharacters	NTCIP 1203	mandatory	Yes
characterTable	NTCIP 1203	mandatory	Yes
characterNumber	NTCIP 1203	mandatory	Yes
characterWidth	NTCIP 1203	mandatory	Yes
characterBitmap	NTCIP 1203	mandatory	Yes
fontMaxCharacterSize	NTCIP 1203	mandatory	Yes
5.5 - MULTI Configuration			
defaultBackgroundColor	NTCIP 1203	mandatory	Yes
defaultForegroundColor	NTCIP 1203	mandatory	Yes
defaultFlashOn	NTCIP 1203	optional	No
defaultFlashOnActivate	NTCIP 1203	optional	No
defaultFlashOff	NTCIP 1203	optional	No
defaultFlashOffActivate	NTCIP 1203	optional	No
defaultFont	NTCIP 1203	mandatory	Yes
defaultFontActivate	NTCIP 1203	optional	No
defaultJustificationLine	NTCIP 1203	mandatory	Yes
defaultJustificationLineActivate	NTCIP 1203	optional	No
defaultJustificationPage	NTCIP 1203	mandatory	Yes
defaultJustificationPageActivate	NTCIP 1203	optional	No
defaultPageOnTime	NTCIP 1203	mandatory	Yes
defaultPageOnTimeActivate	NTCIP 1203	optional	No
defaultPageOffTime	NTCIP 1203	mandatory	Yes
defaultPageOffTime	NTCIP 1203	optional	No
defaultCharacterSet	NTCIP 1203	mandatory	Yes
defaultBackgroundRGB	NTCIP 1203	optional	No
defaultBackgroundRGBActivate	NTCIP 1203	optional	No
defaultForegroundRGB	NTCIP 1203	optional	No
defaultForegroundRGBActivate	NTCIP 1203	optional	No
defaultCharacterSet	NTCIP 1203	optional	No
dmsColorScheme	NTCIP 1203	optional	No
dmsSupportedMultiTags	NTCIP 1203	mandatory	Yes
dmsMaxNumberPages	NTCIP 1203	mandatory	Yes
dmsMaxMultiStringLength	NTCIP 1203	mandatory	Yes
5.6 Message Objects			
dmsNumPermanentMsg	NTCIP 1203	mandatory	Yes
dmsNumChangeableMsg	NTCIP 1203	mandatory	Yes
dmsMaxChangeableMsg	NTCIP 1203	mandatory	Yes
dmsFreeChangeableMemory	NTCIP 1203	mandatory	Yes
dmsNumVolatileMsg	NTCIP 1203	mandatory	Yes
dmsMaxVolatileMsg	NTCIP 1203	mandatory	Yes

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CONFORMANCE GROUP OBJECTS	REFERENCE	CONFORMANCE REQUIREMENT	PROJECT REQUIREMENT
5.6 Message Objects (cont'd)			
dmsFreeVolatileMemory	NTCIP 1203	mandatory	Yes
dmsMessageTable	NTCIP 1203	mandatory	Yes
dmsMessageEntry	NTCIP 1203	mandatory	Yes
dmsMessageMemoryType	NTCIP 1203	mandatory	Yes
dmsMessageNumber	NTCIP 1203	mandatory	Yes
dmsMessageMultiString	NTCIP 1203	mandatory	Yes
dmsMessageOwner	NTCIP 1203	mandatory	Yes
dmsMessageCRC	NTCIP 1203	mandatory	Yes
dmsMessageBeacon	NTCIP 1203	optional	No
dmsMessagePixelService	NTCIP 1203	optional	No
dmsMessageRunTimePriority	NTCIP 1203	mandatory	Yes
dmsMessageMsgStatus	NTCIP 1203	mandatory	Yes
dmsValidateMessageError	NTCIP 1203	mandatory	Yes
5.7 Sign Control			
dmsControlMode	NTCIP 1203	mandatory	Yes
dmsSWReset	NTCIP 1203	optional	Yes
dmsActivateMessage	NTCIP 1203	mandatory	Yes
dmsMessageTimeRemaining	NTCIP 1203	optional	Yes
dmsMsgTableSource	NTCIP 1203	mandatory	Yes
dmsMsgRequesterID	NTCIP 1203	mandatory	Yes
dmsMsgSourceMode	NTCIP 1203	mandatory	Yes
dmsShortPowerRecoveryMessage	NTCIP 1203	optional	Yes
dmsLongPowerRecoveryMessage	NTCIP 1203	optional	Yes
dmsShortPowerLossTime	NTCIP 1203	optional	Yes
dmsResetMessage	NTCIP 1203	optional	Yes
dmsCommunicationsLossMessage	NTCIP 1203	optional	Yes
dmsTimeCommLoss	NTCIP 1203	optional	Yes
dmsPowerLossMessage	NTCIP 1203	optional	Yes
dmsEndDurationMessage	NTCIP 1203	optional	Yes
dmsMemoryMgmt	NTCIP 1203	mandatory	Yes
dmsActivateMsgError	NTCIP 1203	mandatory	Yes
dmsMultiSyntaxError	NTCIP 1203	mandatory	Yes
dmsMultiSyntaxErrorPosition	NTCIP 1203	mandatory	Yes
dmsMultiOtherErrorDescription	NTCIP 1203	optional	Yes
vmsPixelServiceDuration	NTCIP 1203	optional	No
vmsPixelServiceFrequency	NTCIP 1203	optional	No
vmsPixelServiceTime	NTCIP 1203	optional	No
dmsActivateErrorMsgCode	NTCIP 1203	optional	No
dmsActivateMessageState	NTCIP 1203	optional	No
5.8 – ILLUMINATION BRIGHTNESS			
dmsIllumControl	NTCIP 1203	mandatory	Yes
dmsIllumMaxPhotocellLevel	NTCIP 1203	mandatory	Yes
dmsIllumPhotocellLevelStatus	NTCIP 1203	mandatory	Yes
dmsIllumNumBrightLevels	NTCIP 1203	mandatory	Yes
dmsIllumBrightLevelStatus	NTCIP 1203	mandatory	Yes
dmsIllumManLevel	NTCIP 1203	mandatory	Yes
dmsIllumBrightnessValues	NTCIP 1203	mandatory	Yes
dmsIllumBrightnessValulesError	NTCIP 1203	mandatory	Yes
dmsIllumLightOutputStatus	NTCIP 1203	optional	Yes

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

CONFORMANCE GROUP OBJECTS	REFERENCE	CONFORMANCE REQUIREMENT	PROJECT REQUIREMENT
5.9 - SCHEDULING ACTION			
numActionTableEntries	NTCIP 1203	mandatory	Yes
dmsActionTable	NTCIP 1203	mandatory	Yes
dmsActionEntry	NTCIP 1203	mandatory	Yes
dmsActionIndex	NTCIP 1203	mandatory	Yes
dmsActionMsgCode	NTCIP 1203	mandatory	Yes
5.11 - SIGN STATUS			
Core Status			
statMultiFieldRows	NTCIP 1203	mandatory	Yes
statMultiFieldTable	NTCIP 1203	mandatory	Yes
statMultiFieldIndex	NTCIP 1203	mandatory	Yes
statMultiFieldCode	NTCIP 1203	mandatory	Yes
statMultiCurrentFieldValue	NTCIP 1203	mandatory	Yes
dmsCurrentSpeed	NTCIP 1203	optional	No
dmsCurrentSpeedLimit	NTCIP 1203	optional	No
watchdogFailureCount	NTCIP 1203	mandatory	Yes
dmsStatDoorOpen	NTCIP 1203	mandatory	Yes
Controller Status			
shortErrorStatus	NTCIP 1203	mandatory	Yes
controllerErrorStatus	NTCIP 1203	mandatory	Yes
Power Status			
dmsPowerFailureStatusMap	NTCIP 1203	mandatory	Yes
dmsPowerNumRows	NTCIP 1203	mandatory	Yes
dmsPowerStatusTable	NTCIP 1203	mandatory	Yes
dmsPowerIndex	NTCIP 1203	mandatory	Yes
dmsPowerDescription	NTCIP 1203	mandatory	Yes
dmsPowerMfrStatus	NTCIP 1203	mandatory	Yes
dmsPowerStatus	NTCIP 1203	mandatory	Yes
dmsPowerVoltage	NTCIP 1203	mandatory	Yes
dmsPowerType	NTCIP 1203	mandatory	Yes
Climate Controlled Status Data			
dmsClimateCtrlNumRows	NTCIP 1203	optional	No
dmsClimateCtrlStatusMap	NTCIP 1203	optional	No
dmsClimateCtrlStatusTable	NTCIP 1203	optional	No
dmsClimateCtrlIndex	NTCIP 1203	optional	No
dmsClimateCtrlDescription	NTCIP 1203	optional	No
dmsClimateCtrlMfrStatus	NTCIP 1203	optional	No
dmsClimateCtrlErrorStatus	NTCIP 1203	optional	No
dmsClimateCtrlOnStatus	NTCIP 1203	optional	No
dmsClimateCtrlTestActivation	NTCIP 1203	optional	No
dmsClimateCtrlAbortReason	NTCIP 1203	optional	No
dmsClimateCtrlType	NTCIP 1203	optional	No
Pixel Failure Data			
pixelFailureTableNumRows	NTCIP 1203	mandatory	Yes
PixelFailureTable	NTCIP 1203	mandatory	Yes
pixelFailureDetectionType	NTCIP 1203	mandatory	Yes
pixelFailureIndex	NTCIP 1203	mandatory	Yes
pixelFailureXLocation	NTCIP 1203	mandatory	Yes
pixelFailureYLocation	NTCIP 1203	mandatory	Yes
pixelFailureStatus	NTCIP 1203	mandatory	Yes

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

CONFORMANCE GROUP OBJECTS	REFERENCE	CONFORMANCE REQUIREMENT	PROJECT REQUIREMENT
5.11 - SIGN STATUS			
Pixel Failure Data (cont'd)			
pixelTestActivation	NTCIP 1203	mandatory	Yes
pixelStatusTable	NTCIP 1203	mandatory	Yes
dmsPixelStatusIndex	NTCIP 1203	mandatory	Yes
dmsPixelStatus	NTCIP 1203	mandatory	Yes
dmsPixelFailureTestRows	NTCIP 1203	mandatory	Yes
dmsPixelFailureMessageRows	NTCIP 1203	mandatory	Yes
Lamp Error Status (ALL)	NTCIP 1203	Optional Group	No
Drum Status Data (ALL)	NTCIP 1203	Optional Group	No
Light Sensor Status Data			
dmsLightSensorStatusMap	NTCIP 1203	mandatory	Yes
dmsLightSensorNumRows	NTCIP 1203	mandatory	Yes
dmsLightSensorStatusTable	NTCIP 1203	mandatory	Yes
CONFORMANCE GROUP OBJECTS	REFERENCE	CONFORMANCE REQUIREMENT	PROJECT REQUIREMENT
5.11 - SIGN STATUS			
Light Sensor Status Data (cont'd)			
dmsLightSensorIndex	NTCIP 1203	mandatory	Yes
dmsLightSensorDescription	NTCIP 1203	mandatory	Yes
dmsLightSensorCurrentReading	NTCIP 1203	mandatory	Yes
dmsLightSensorStatus	NTCIP 1203	mandatory	Yes
Humidity Data (ALL)	NTCIP 1203	Optional Group	No
Temperature Sensor Data			
dmsTempSensorStatusMap	NTCIP 1203	mandatory	Yes
dmsTempSensorNumRows	NTCIP 1203	mandatory	Yes
dmsTempSensorStatusTable	NTCIP 1203	mandatory	Yes
dmsTempSensorIndex	NTCIP 1203	mandatory	Yes
dmsTempSensorDescription	NTCIP 1203	mandatory	Yes
dmsTempSensorCurrentReading	NTCIP 1203	mandatory	Yes
dmsTempSensorHighWarningTemperature	NTCIP 1203	mandatory	Yes
dmsTempSensorHighCriticalTemperature	NTCIP 1203	mandatory	Yes
dmsTempSensorLowCriticalTemperature	NTCIP 1203	mandatory	Yes
dmsTempSensorStatus	NTCIP 1203	mandatory	Yes
dmsTempSensorHighestCriticalTempThreshold	NTCIP 1203	mandatory	Yes
dmsTempSensorLowestCriticalTempThreshold	NTCIP 1203	mandatory	Yes
Power Status Objects			
signVolts	NTCIP 1203	mandatory	Yes
lineVolts	NTCIP 1203	mandatory	Yes
powerSource	NTCIP 1203	mandatory	Yes
Temperature Status	NTCIP 1203	Optional Group	Yes
5.12 – GRAPHIC DEFINITION			
Graphic Definition Objects (ALL)	NTCIP 1203	Optional Group	No

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

2. MATERIALS: (cont'd)

2.10 Documentation

Full documentation of proposed sign equipment, specifications and assembly details, including posts and equipment cabinet, shall be provided to the Engineer for approval.

Software shall be supplied with full documentation, including a CD-ROM containing ASCII versions of the following Management Information Base (MIB) files in Abstract Syntax Notation 1 (ASN.1) format:

- The relevant version of each official standard MIB Module referenced by the device functionality.
- If the device does not support the full range of any given object within a Standard MIB Module, a manufacturer-specific version of the official Standard MIB Module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the associated OBJECT TYPE macro shall be provided. The filename of this file shall be identical to the standard MIB Module, except that it shall have the extension “.man”.
- A MIB Module in ASN.1 format containing any and all manufacturer-specific (or agency-specific) objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.
- A MIB containing any other objects supported by the device.

2.11 Intellectual Property Rights

The manufacturer shall allow the use of any and all of this documentation by any party authorized by the Procuring Agency for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

2.12 Central Software

Unless otherwise specified in the contract plans, the Contractor shall supply DMS central control software necessary to interface sign functions remotely from the TMC. All control software shall be delivered on CD-ROM and installed on the DMS computer and workstations as directed by the TMC manager. The TMC should be contacted for specifics of the communications protocols and software in place.

The software shall be of a client-server design, in which users can connect to, configure, monitor, and control signs from workstations in the TMC and also from workstations connected to the DMS computer by a TCP/IP 100-BaseT network. Some workstations may use dial-up telephone lines or other low-speed connections to reach the network via the LAN server. The DMS computer shall communicate with the signs via either multipoint EIA-232 communication channels or over TCP/IP Ethernet protocol. The DMS central software shall support at least 30 users and workstations, and 100 signs.

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

2. MATERIALS: (cont'd)

2.12 **Central Software** (cont'd)

The software shall provide the following capabilities to users at the workstations and DMS computer:

1. See a list of messages stored in the sign or on the sign controller with an indication of which is currently being displayed on the monitor screen exactly as it appears to motorist.
2. Cause a different message to be displayed.
3. Upload and download new message files between the sign controllers and the DMS computer.
4. Automatically detect malfunctions, including loss of communication or power, and errors.
5. Create and edit fonts and messages and storing them on the DMS computer's disk drive for subsequent downloading to one or more signs.
6. Create an activity log for all signs.
7. Allow existing, or future, NTCIP based signs to be incorporated, configured, controlled, and monitored.
8. On screen notification/alarm of cabinet door open, malfunctions, errors, and out of range environmental conditions.

3. CONSTRUCTION DETAILS:

3.01 The DMS will be installed on either new or existing sign posts or overhead structures as shown in the contract documents. Posts, post foundations, and other supporting structures shall be paid for under other contract items as shown in the plans.

3.02 **Installation Certification**

All controller(s), LED display modules, and mounting hardware shall be installed in accordance with manufacturer's instructions and recommendations. To ensure the sign was installed properly the Contractor shall submit to the Engineer documentation which that states either a) the manufacturer, or the manufacturer's authorized supplier, verifies that the Contractor has been trained on the installation, operation, testing and maintenance of the equipment or b) provides documentation from the manufacturer that the installation has been inspected and approved by the manufacturer or authorized representative.

3.03 **Testing**

Requirements Test Plan:

The manufacturer shall provide a test plan, 30-days prior to each test, for review and approval by the Engineer, for each of the three types of acceptance testing required: Factory Acceptance Testing, Stand-alone Acceptance Testing, and System Acceptance Testing.

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

3. CONSTRUCTION DETAILS:

3.03 **Testing** (cont'd)

Requirements Test Plan: (cont'd)

The test plans shall clearly identify each function and element being tested, the setup conditions, the steps to be followed during the test, and the anticipated test results. The test plan shall exercise all required functions and capabilities under this item.

The following is a typical, but non-exhaustive list of the type of requirements that the test plan shall verify:

- Downloading, uploading, displaying, entering, editing, and deleting sign messages and fonts.
- Displaying of all characters, all messages, and all symbols on the sign.
- Switching between several different messages and flashing a part of a message.
- Recovery from simulated communications errors, simulated watchdog timer errors, and simulated sign controller errors.
- Demonstration of the operation of the thermostatically controlled fans, automatic LED temperature shutdown and dimming, and environmental warnings.
- Demonstration of automatic restart after a simulated short-term and simulated long-term power failure.
- Demonstration of the operation of the variation of the LED intensity based on various levels of ambient light.

Test Equipment:

The test plan shall identify all equipment required to perform the tests. This equipment shall be provided by the Contractor for the duration of the testing program. As a minimum, functional testing equipment shall include the latest version of the Device Tester for NTCIP, software by Intelligent Devices Inc, or approved equal.

Test Performance:

The test shall be coordinated with NYSTA at least three (3) weeks prior to the actual date. The Contractor shall conduct all tests, in the presence of the Engineer and/or up to two (2) other representatives. The Engineer may waive the right to witness certain tests. The utilized software shall be in recording/capturing mode while performing the test procedures.

Test Reports:

The Contractor shall maintain a complete record of each test performed including the results of the test and a record of who witnessed the test. At the completion of each test, the test documentation shall be completed and provided to the Engineer for review. This documentation shall be the basis for acceptance or rejection by the Engineer. All test reports shall be signed by the Contractor's authorized testing representative.

3. CONSTRUCTION DETAILS:

3.03 **Testing** (cont'd)

Test Failure:

The unit shall be corrected or another unit substituted in its place and the test successfully repeated. The substitute unit shall have passed all other tests successfully. If any DMS equipment or software/firmware modifications are necessary as a result of any test or demonstration failure, full retesting for compliance with these specifications may be required and a test report shall be prepared and delivered to the Engineer prior to retesting of the equipment. The report shall describe the nature of the failure and corrective action taken. If a failure pattern, as defined by the Engineer, develops, the Engineer may direct that design and construction modifications be made to all units without additional cost to the State, other involved agencies, or extension of the contract period.

Test Specifics:

1. **On-Site Stand-Alone and System Performance Test:**

The Contractor shall conduct approved stand-alone tests of the equipment installed in the field and at the TMC. The tests shall, as a minimum, exercise all stand-alone (non- network) functional operations of the field equipment, including NTCIP compliance, and TMC equipment and software with all the equipment installed per the plans as directed by the Engineer. Approved data forms shall be completed and turned over to the Engineer as the basis for review and rejection or acceptance.

Each unit of equipment shall be operated long enough to permit equipment temperature stabilization, and to check and record an adequate number of performance characteristics to ensure compliance with the requirements of this specification. The test shall, as a minimum, exercise all the input and output functions of the unit and demonstrate all operational features.

Following successful completion of the On-Site Stand-Alone tests the entire complement of subsystems and equipment shall be integrated into one system. Interface tests shall then be performed to verify the transfer of information between field equipment elements and the TMC.

System performance testing shall exercise all functional operations of each unit of field equipment from the TMC, and demonstrate compliance with all contract requirements. The tests shall include multiple combinations of functions including infrequent combinations, input validation, and stress testing. Compliance with all performance requirements shall be demonstrated. Where there are multiple units of the same item of equipment used, compliance with performance parameter requirements may be demonstrated on sample units with approval of the Engineer.

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

3. CONSTRUCTION DETAILS:

3.03 **Testing** (cont'd)

Test Specifics: (cont'd)

2. **90-Day Operational Test:**

Following successful completion of the system performance tests, a 90-calendar day test shall be performed. The test shall start at the same time for all system elements unless a waiver is received from the Engineer.

The purpose of the Operational Tests is to demonstrate the reliability of system equipment for a 90 day period. In the event of a failure of any contractor supplied components, or of any existing system elements that may be affected, that portion of the system shall be subjected to an additional 30 day test period. Failure shall be defined as any interruption of operation that can be contributed to the DMS components. If a failure occurs, the test shall be stopped until the failure has been resolved. If the same failure occurs three (3) times, the failure shall be resolved and the 90-day test shall begin anew.

In the event that greater than 20% of similar equipment items malfunction during the test period, the Engineer may declare a system defect and require replacement of all items of that equipment. When a system defect is declared, the 90 day test period shall be restarted for the affected equipment after replacement.

During the Operational Test period the Contractor shall provide support for all installed equipment including problem troubleshooting and replacement of items not operating as specified. The Contractor shall maintain detailed daily records in the form of a maintenance and activity log. The log shall include the identity of equipment on which work is performed, the cost of equipment malfunction, if any, a description of the work performed, materials or special equipment used and the time required to complete the activity. The log shall contain the current test status of all equipment items. The maintenance and activity log shall be available to the Engineer upon request.

The final acceptance shall be based on the satisfactory completion of all 90-Day tests.

3.04 **Training Requirements**

Contractor Training:

Prior to the installation of any specified equipment, the Contractor's personnel shall have received training from the supplier on installation, operations, testing and maintenance of all equipment. No equipment will be accepted without detailed documentation from the equipment supplier certifying that the training has taken place.

ITEM 645.4530--25 – DYNAMIC MESSAGE SIGN (DMS) FULL MATRIX, FRONT ACCESS LED

3. CONSTRUCTION DETAILS:

3.04 **Training Requirements** (cont'd)

NYSTA Training:

Unless otherwise specified on the contract plans, the contractor and/or DMS manufacture shall be responsible for providing a one (1) day training seminar in the operations and maintenance of the DMS for NYSTA management, engineering, operations, and maintenance personnel. The contractor shall contact the Engineer to verify the requirements and number of personnel scheduled for training. Training sessions shall be conducted at the TMC and in the field, consisting of both classroom and “hands-on” training using installed system equipment. Training shall not exceed 8 hours with a maximum of twelve students. The Contractor shall submit two copies of the course outline, training materials, and instructors’ qualifications to the Engineer for approval 30 calendar days prior to the anticipated start of training. Following approval of the material the Contractor shall submit enough copies of the course material for use by the NYSTA during the training program.

The costs for instructors, course materials, handouts, etc. shall be included in the costs of this item. No separate payment for training will be made to the Contractor.

4. METHOD OF MEASUREMENT:

4.01 The DMS will be measured for payment as each unit installed, tested, and made fully operational.

5. BASIS OF PAYMENT:

5.01 The unit price bid for each DMS shall include the cost of furnishing all labor, materials, tools, software, equipment and incidentals as necessary to complete the work. This includes hardware necessary for mounting the DMS to the support structure.

Progress payment will be made as follows:

Fifty percent (50%) of the bid price of each item will be paid when it is installed.

Forty percent (40%) of the bid price will be paid upon satisfactory completion of the On-Site Stand-Alone and System Performance Test.

Ten percent (10%) of the bid price will be paid upon satisfactory completion of the 90 Day Operational Test.

- ITEM 646.0603--25 - INSTALL DELINEATOR OR TENTH MILE MARKER ON POST**
ITEM 646.0604--25 - INSTALL DELINEATOR OR TENTH MILE MARKER, BACK-TO-BACK ON POST
ITEM 646.0610--25 - INSTALL DELINEATOR OR TENTH MILE MARKER, BAND OR BRACKET MOUNTED
ITEM 646.0612--25 - INSTALL DELINEATOR OR TENTH MILE MARKER, BACK-TO-BACK, BAND OR BRACKET MOUNTED
ITEM 646.0801--25 - INSTALL SNOWPLOW MARKER, SINGLE UNIT
ITEM 646.0802--25 - INSTALL SNOWPLOW MARKER, DOUBLE UNIT

1. DESCRIPTION:

- 1.01 The work shall consist of furnishing and installing delineator and/or snowplow marker posts, bands, brackets and all necessary hardware for mounting delineators or snowplow markers as shown on the plans.

2. MATERIALS:

- 2.01 The posts shall conform to the requirements of Section 646-2 of the Standard Specifications and as shown on the plans.

3. CONSTRUCTION DETAILS:

- 3.01 The Contractor shall install the delineators or snowplow markers in accordance with Section 646-3 of the Standard Specifications and as shown on the plans.

4. METHOD OF MEASUREMENT:

- 4.01 The work shall be measured as the number of complete delineators or snowplow markers installed.

5. BASIS OF PAYMENT:

- 5.01 The unit price bid for each delineator or snowplow marker shall include the cost of all equipment, labor and materials including posts, bands, brackets and hardware necessary to satisfactorily mount and install the delineator or snowplow marker. Also included is the cost to pick up the delineator or snowplow marker panels from the Authority.

ITEM 646.0626--25 - INSTALL MILE MARKERS

1. DESCRIPTION:

1.01 The work shall consist of furnishing and installing mile marker posts and hardware for mounting mile markers as shown on the plans. The mile marker panels will be furnished to the Contractor by the Authority.

2. MATERIALS:

2.01 The posts shall conform to the requirements of Section 646-2 of the Standard Specifications.

3. CONSTRUCTION DETAILS:

3.01 The Contractor shall install the posts in accordance with Section 646-3 of the Standard Specifications at locations shown on the plans and as directed by the Engineer.

4. METHOD OF MEASUREMENT:

4.01 The work shall be measured on an each basis for installation of the markers.

5. BASIS OF PAYMENT:

5.01 The unit bid price for each mile marker installed shall include the cost of all equipment, labor, and materials including posts and mounting hardware necessary to mount the panel and install the marker. Also included is the cost to pick up the marker panels from the Authority.

- ITEM 646.0603--25 - INSTALL DELINEATOR OR TENTH MILE MARKER ON POST**
ITEM 646.0604--25 - INSTALL DELINEATOR OR TENTH MILE MARKER, BACK-TO-BACK ON POST
ITEM 646.0610--25 - INSTALL DELINEATOR OR TENTH MILE MARKER, BAND OR BRACKET MOUNTED
ITEM 646.0612--25 - INSTALL DELINEATOR OR TENTH MILE MARKER, BACK-TO-BACK, BAND OR BRACKET MOUNTED
ITEM 646.0801--25 - INSTALL SNOWPLOW MARKER, SINGLE UNIT
ITEM 646.0802--25 - INSTALL SNOWPLOW MARKER, DOUBLE UNIT

1. DESCRIPTION:

- 1.01 The work shall consist of furnishing and installing delineator and/or snowplow marker posts, bands, brackets and all necessary hardware for mounting delineators or snowplow markers as shown on the plans.

2. MATERIALS:

- 2.01 The posts shall conform to the requirements of Section 646-2 of the Standard Specifications and as shown on the plans.

3. CONSTRUCTION DETAILS:

- 3.01 The Contractor shall install the delineators or snowplow markers in accordance with Section 646-3 of the Standard Specifications and as shown on the plans.

4. METHOD OF MEASUREMENT:

- 4.01 The work shall be measured as the number of complete delineators or snowplow markers installed.

5. BASIS OF PAYMENT:

- 5.01 The unit price bid for each delineator or snowplow marker shall include the cost of all equipment, labor and materials including posts, bands, brackets and hardware necessary to satisfactorily mount and install the delineator or snowplow marker. Also included is the cost to pick up the delineator or snowplow marker panels from the Authority.

ITEM 646.10320025 - RESET EXISTING DELINEATORS OR MARKERS

1. DESCRIPTION:

- 1.01 Under this item the Contractor shall carefully disassemble, remove, store, reset and assemble existing roadway delineators, snowplowing markers, tenth mile markers, and mile markers, as shown on the plans or as specified by the Engineer.

2. MATERIALS:

- 2.01 None

3. CONSTRUCTION DETAILS:

- 3.01 **General.** The Contractor shall remove the existing delineators, snowplowing markers, tenth mile markers, and mile markers, and neatly store all component parts in separate piles at secure locations for reuse, resetting or salvage. Removal shall be limited to that area of shoulder excavation on a day to day basis. The work shall be done in a workmanlike manner so as to salvage all usable components of each delineator, snowplowing marker, tenth mile marker, and mile marker. Extra care shall be taken in handling the reflector grommet when disassembling and when resetting each delineator, snowplowing marker, tenth mile marker, and mile marker. The Contractor shall replace at his own expense any delineator, snowplowing marker, tenth mile marker, and mile marker, or its component parts damaged by him in handling. All replacement parts and accessories for unusable delineators, snowplowing markers, tenth mile markers, and mile markers, shall be furnished by the Thruway Authority to the Contractor for resetting. Resetting of delineators, snowplowing markers, tenth mile markers, and mile markers, will immediately follow final grading of the new shoulder on a day to day basis. The posts shall be so erected that the delineators, snowplowing markers, tenth mile markers, and mile markers, will be at the elevations called for on the plans and/or AOB, be true to line and grade and be truly vertical. The posts may be either driven or set. If driven by either hand or mechanical devices, they shall be plumb above the ground, and firm in the ground, spaced as specified, and driven to the required lines and grades.

After driving, the top of the posts shall have substantially the same cross-sectional dimensions as the body of the posts and no battered heads will be permitted. Any posts bent or otherwise damaged to the extent that they are, in the opinion of the Engineer, unfit for use in the finished work shall be removed from the site and replaced by the Contractor at his own expense. When Posts are driven, a suitable driving cap shall be used.

- 3.02 **Location.** Locations of existing delineators, snowplowing markers, tenth mile markers, and mile markers shall be maintained when resetting each delineator, snowplowing marker, tenth mile marker, and mile marker. Particular care shall be taken in locating double amber delineators along deceleration and acceleration ramps as shown on the plans or as directed by the Engineer.

4. METHOD OF MEASUREMENT:

- 4.01 Payment will be made for the number of delineators, snowplowing markers, tenth mile markers, and/or mile markers, removed and reset in accordance with these specifications and the orders of the Engineer.

5. BASIS OF PAYMENT:

- 5.01 The price bid for each delineator, snowplowing marker tenth mile marker, and mile marker shall include the cost of all labor, materials and equipment necessary to properly complete the work as specified or ordered by the Engineer.

ITEM 646.50----25 - REMOVE AND DISPOSE DELINEATORS AND MARKERS

1. DESCRIPTION:

1.01 This work shall consist of removing and disposing delineators, mile markers, tenth-mile markers and snowplow markers, including posts, in accordance with the contract documents and as directed by the Engineer.

2. MATERIALS:

2.01 None specified.

3. CONSTRUCTION DETAILS:

3.01 The Contractor shall remove and dispose delineators, mile markers, tenth-mile markers and snowplow markers, including posts, in a manner satisfactory to the Engineer.

4. METHOD OF MEASUREMENT:

4.01 The quantity to be measured for payment will be the number of delineators and/or markers removed and disposed.

5. BASIS OF PAYMENT:

5.01 The unit price bid for removal and disposal of each delineator and/or mile marker shall include the cost of all labor and equipment necessary to complete the work.

ITEM 651.02001525 - CCTV CAMERA MOUNTING POLE

1. DESCRIPTION:

1.01 This item consists of furnishing and installing 50 ft poles for mounting CCTV cameras in accordance with the Contract Drawings, Specifications, Standard Sheets and as directed by the Engineer. Furnishing and installing a camera lowering device is also included.

2. MATERIALS:

2.01 Materials used in the fabrication and erection of CCTV mounting poles shall meet the requirements of the following Subsection included in the NYSDOT Standard Specifications:

Traffic Signal Poles 724-03

2.02 In addition, the camera lowering device furnished with the 50 ft. pole shall meet the following requirements:

- A. All pulleys for the camera lowering device and portable lowering tool shall have sealed, self lubricated bearings or oil-tight bronze bearings. The lowering cable shall be a minimum 1/8" diameter stainless steel aircraft cable with a minimum breaking strength of 1740 lb. with (7) strands of 19 wire each.
- B. The interface and locking components shall be made of stainless steel. All external components of the lowering device shall be made of corrosion resistant materials. All components fabricated from steel or cast iron shall be galvanized in accordance with Subsection 719-01 – Galvanizing and Repair Methods Type II.
- C. The contact unit housing shall have a replaceable neoprene gasket.
- D. The lowering tool shall be made of stainless steel components.
- E. The multiple socket and contact connectors on the camera lowering device shall be constructed using brass pin contacts permanently molded into a polymer Hypalon body.

3. CONSTRUCTION DETAILS:

3.01 The Contractor shall stake-out the CCTV pole locations for approval by the Engineer prior to any prefabrication or related construction.

3.02 **Poles:**

- A. Poles shall be erected as specified on the Plans, Standard Sheets, and as directed by the Engineer.
- B. The maximum allowable pole top deflection, with camera(s) and lowering device installed and a 1/2" ice coating under sustained 30 mph wind gusts shall be 1 in. The entire device shall withstand wind forces of 100 mph with a 30 percent gust factor using a 1.65 safety factor.

ITEM 651.02001525 - CCTV CAMERA MOUNTING POLE

3. CONSTRUCTION DETAILS: (cont'd)

3.02 **Poles:** (cont'd)

- C. Pole and camera locations shown on the Contract Plans shall be field checked for any condition that may affect their placement. Where changes are necessary the exact location will be determined by the Engineer.
- D. Pole erection shall include installation of camera lowering devices and attachment of fittings as specified on the Plans and Standard Sheets as follows:
 - 1. Anchor bolt covers as specified.
 - 2. Weather heads and couplings.
 - 3. Pole cap.
 - 4. Cabinet mounting fittings, plates, brackets as needed.
 - 5. Reinforced couplings for wire entrances to cabinets.
 - 6. Ground rod, including wiring
- E. In addition, the Engineer may require the Contractor to submit, at any time, design computations for any or all of the CCTV poles and mounting plates in the Contract. The design computations must be approved, stamped, and signed by a Professional Engineer licensed in New York State. The Engineer shall have twenty (20) working days to review the design computations for one CCTV pole and an additional two (2) for each additional CCTV pole.
- F. If the Engineer's review of a pole's design indicates a problem, the Contractor will be notified within the time allotted for review.

3.03 **Grounding:**

- A. A copper clad ground rod, ground wire and fittings shall be installed as shown on Standard Sheets, or as directed by the Engineer. The ground system shall be electrically connected to the grounding terminal on the pole and cabinet.
- B. The grounding system when completed shall be tested in accordance with Subsection 680-3.15 of the Standard Specifications. If the requirements of the test are not met additional ground rods, ground rod extensions, electrical bonding of metallic conduit or other means may be required as directed by the Engineer.

3.04 **Camera Lowering Device:**

- A. The lowering device shall be manufactured by:

MG Squared, Inc.
3233 Oak Hill Drive, Suite 201
Birmingham, AL 35216

No Substitutions will be accepted.

ITEM 651.02001525 - CCTV CAMERA MOUNTING POLE

3. CONSTRUCTION DETAILS: (cont'd)

3.04 Camera Lowering Device: (cont'd)

- B. The camera lowering device shall be designed to support and lower a cylindrical non-dome closed circuit television camera, lens, housing, PTZ mechanism, cabling, connectors and other supporting field components without damage or causing degradation of camera operations. The lowering device shall consist of a suspension contact unit, support arm and a pole adapter to attach standard mast arm signal pole. The support arm and receiver brackets shall be designed to self-align the contact unit with the pole center line during installation and to insure the contact unit cannot twist under high wind conditions.
- C. The lowering device manufacturer shall furnish a factory representative to assist the electrical Contractor with the assembly and testing of the first lowering system onto the pole assembly. The manufacturer shall furnish documentation certifying that the electrical Contractor has been instructed on the installation, operation and safety features of the lowering device. The Contractor shall be responsible for providing NYSTA maintenance personnel "on site" operational instructions.
- D. The lower device's suspension contact unit shall have a load capacity of 200 lbs with a 4 to 1 safety factor. There shall be a locking mechanism between the fixed and moveable components of the lowering device. The movable assembly shall have a minimum of 2 latches. This latching mechanism shall securely hold the camera and its control equipment free of vibration or motion between the components. The latching mechanism shall operate by alternately raising and lowering the assembly using the winch and lowering cable. When latched, all weight shall be removed from the lowering cable. The fixed unit shall have a heavy duty cast tracking guide and means to allow latching in the same position each time. The contact unit housing shall be weatherproof with a replaceable gasket provided to seal the interior from dust and moisture.
- E. All electrical and video coaxial connections between the fixed and movable lowering device components shall be protected from exposure to the weather by a waterproof seal to prevent degradation of the electrical contacts. The electrical connections between the fixed and movable lowering device components shall be designed to conduct high frequency data bits and one (1) volt peak to peak video signals as well as the power requirements for operation of environmental controls.
- F. The prefabricated components of the lift unit support system shall be designed to preclude the lifting cable from contacting the power, camera control cables or video cabling. The only cable permitted to move within the pole or lowering device during lowering or raising shall be the lowering cable. All other cables shall remain stable and secure during lowering and raising operations.
- G. The Contractor shall provide weights and/or counterweights as necessary to assure that the alignment of pins and connectors are proper for the camera support to be raised into position without binding. The lowering unit will have sufficient weight to disengage the camera and its control components in order that it can be lowered properly.

ITEM 651.02001525 - CCTV CAMERA MOUNTING POLE

3. CONSTRUCTION DETAILS: (cont'd)

3.05 Lowering Tool:

- A. The camera lowering device shall be operated by use of a portable lowering tool. The tool shall consist of a lightweight metal frame and winch assembly with cable as described herein, a quick release cable connector, an adjustable safety clutch and a variable speed industrial duty electric drill motor. This tool shall be compatible with accessing the support cable through the hand hole of the pole. When attached to the hand hole, the tool will support itself and the load assuring and hoisting lowering operations and provide a means to prevent free wheeling when loaded. The lowering tool shall be operable either manually with a handle supplied with the lowering tool or by a heavy duty drill motor described herein.
- B. Two lowering tools shall be delivered upon project completion. Only two lowering tools shall be provided per contract, regardless of the number of items. The lowering tools shall have a reduction gear to reduce the manual effort required to operate the lifting handle to raise and lower a capacity load. They shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism. Lowering tools shall be equipped with a positive locking mechanism to secure the cable reel during raising and lowering operations. The Contractor shall provide a variable speed (500 rpm maximum), heavy duty drill motor and any additional tools required by plan notes for each lowering tool. The heavy duty drill motor shall operate within the power supplied by the convenience outlet in the field cabinet.

3.06 **“C” Bracket:** A “C” shaped bracket shall be provided for mounting the camera to the lowering device. The bracket shall be fabricated of 2.5” square steel tubing. Dimensions shall be as illustrated in the contract plans. A camera mounting plate shall be affixed to the top face of the bottom of the arm as indicated on the plans. The bracket shall have a rust resistant finish such as powder coating or hot-dipped galvanizing.

4. METHOD OF MEASUREMENT:

4.01 CCTV pole shall be measured as the number of complete poles furnished and satisfactorily erected in accordance with the Plans, Specifications, Standard Sheets, and directions of the Engineer.

5. BASIS OF PAYMENT:

5.01 The unit price bid for each CCTV pole shall include all materials, labor, equipment, tools, incidentals, and meeting of the U.S. Department of Labor Occupational Safety and Health Standards as necessary to satisfactorily complete the work as described in this specification. The item installed in place shall meet all testing requirements to the satisfaction of the Engineer. The installation of the necessary grounding system, anchor bolts, lifting devices, pole assembly, erection and field galvanizing as required shall be included in the bid price.

ITEM 651.0201-25 - CAMERA LOWERING DEVICE

1. DESCRIPTION:

- 1.01 Under this item, the Contractor shall furnish, install, and test a lowering device at the locations shown on the plans, as directed by the Engineer, and as specified herein.
- 1.02 The components to be furnished shall be the products of manufacturers with a minimum of ten (10) years experience in the successful manufacturing of such components.

2. MATERIALS:

- 2.01 The lowering device shall include the arm, attachment to the structure, the lower access box, lowering winch, lowering cable, "C" shaped bracket, and all necessary hardware for mounting and operation.
- 2.02 **Lowering Device:** The lowering device assembly shall meet the following requirements:
 - A. All pulleys for the camera lowering device and portable lowering tool shall have sealed, self lubricated bearings or oil-tight bronze bearings. The lowering cable shall be a minimum 1/8 inch diameter stainless steel aircraft cable with a minimum breaking strength of 1740 lbs. (7) strands of 19 wires each.
 - B. The interface and locking components shall be made of stainless steel. All external components of the lowering device shall be made of corrosion resistant materials. All components fabricated from steel or cast iron shall be galvanized in accordance with Subsection 719-01 – Galvanizing and Repair Methods Type II.
 - C. The contact unit housing shall have replaceable neoprene gasket.
 - D. The lowering tool shall be made of steel, cast iron or aluminum components. Galvanizing shall be done in accordance with Subsection 719-01 – Galvanizing and Repair Methods Type II.
 - E. The multiple socket and contact connectors on the camera lowering device shall be constructed using brass pin contacts permanently molded into a UL94, V-O rated thermosetting synthetic rubber body.
 - F. The lowering device shall be manufactured by MG Squared, Inc., Birmingham, AL 35216. No substitutions will be accepted.
 - G. The electrical contact connector must meet Mil Spec Q-9858 Mil Spec I-45208.
 - H. Where an upright camera is to be used (e.g. Pelco Esprit), a "C" shaped bracket shall be provided for mounting the camera to the lowering device.

3. CONSTRUCTION DETAILS:

3.01 Lowering Device:

- A. The camera lowering device shall be designed to support and lower a closed circuit television camera, lens, housing, PTZ mechanism, cabling, connectors and other supporting field components without damage or causing degradation of camera operations. Camera may be inverted (e.g. dome type, Bosch IP, etc.) or pedestal type.

3. CONSTRUCTION DETAILS: (cont'd)

ITEM 651.0201-25 - CAMERA LOWERING DEVICE

3.01 **Lowering Device:** (cont'd)

- B. The lowering device shall consist of a suspension contact unit, support arm and a pole adapter to attach the mast arm. The support arm and receiver brackets shall be designed to self-align the contact unit with the pole center line during installation and to insure the contact unit cannot twist under design wind conditions.
- C. The lowering device's suspension contact unit shall have a load capacity of 600 lbs. with a 4 to 1 safety factor. There shall be a locking mechanism between the fixed and moveable components of the lowering device. The movable assembly shall have a minimum of 2 latches. This latching mechanism shall securely hold the camera and its control equipment free of vibration or motion between the components. The latching mechanism shall operate by alternately raising and lowering the assembly using the winch and lowering cable. When latched, all weight shall be removed from the lowering cable. The fixed unit shall have a heavy duty cast tracking guide and means to allow latching in the same position each time. The contact unit housing shall be weatherproof with a replaceable gasket provided to seal the interior from dust and moisture. The entire unit shall have an operating temperature range of -400°F to 190°F (-40°C to 90°C).
- D. All electrical and video coaxial connections between the fixed and movable lowering device components shall be protected from exposure to the weather by a waterproof seal to prevent degradation of the electrical contacts. The electrical connections between the fixed and movable lowering device components shall be designed to conduct high frequency data bits and one (1) volt peak to peak video signals as well as the power requirements for operation of environmental controls.
- E. The prefabricated components of the lift unit support system shall be designed to preclude the lifting cable from contacting the power, camera control cables or video cabling. The only cable permitted to move within the pole or lowering device during lowering or raising shall be the lowering cable. All other cables shall remain stable and secure during lowering and raising operations.
- F. The Contractor shall provide weights and/or counterweights as necessary to assure that the alignment of pins and connectors are proper for the camera support to be raised into position without binding. The lowering unit will have sufficient weight to disengage the camera and its control components in order that it can be lowered properly.
- G. The lowering device manufacturer shall furnish a factory representative to assist the electrical Contractor with the assembly and testing of the first lowering system onto the pole assembly. The manufacturer shall furnish documentation certifying that the electrical Contractor has been instructed on the installation, operation and safety features of the lowering device. The Contractor shall be responsible for providing maintenance personnel "on site" operational instructions.
- H. The "C" shaped bracket shall be fabricated of 2.5" square steel tubing. Dimensions shall be as illustrated in the contract plans. A camera mounting plate shall be affixed to the top face of the bottom of the arm as indicated on the plans. The bracket shall have a rust resistant finish such as powder coating or hot-dipped galvanizing.

ITEM 651.0201-25 - CAMERA LOWERING DEVICE

3. CONSTRUCTION DETAILS: (cont'd)

3.02 Lowering Tool:

- A. The camera lowering device shall be operated by use of a portable lowering tool. The tool shall consist of a lightweight metal frame and winch assembly with cable as described herein, a quick release cable connector, an adjustable safety clutch and a variable speed industrial duty electric drill motor. This tool shall be compatible with accessing the support cable through the hand hole of the pole. When attached to the hand hole, the tool will support itself and the load assuring and hoisting lowering operations and provide a means to prevent free wheeling when loaded. The lowering tool shall be operable either manually with a handle supplied with the lowering tool or by a heavy duty drill motor described herein.
- B. The lowering tool shall have a reduction gear to reduce the manual effort required to operate the lifting handle to raise and lower a capacity load. They shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism. Lowering tools shall be equipped with a positive locking mechanism to secure the cable reel during raising and lowering operations. The lowering device provider shall provide a compatible variable speed (500 rpm maximum), heavy duty drill motor and any additional tools required by plan notes for each lowering tool. The heavy duty drill motor shall operate within the power supplied by the convenience outlet in the field cabinet.

3.03 Testing:

- A. The manufacturer shall provide a test plan to the Engineer for review and approval. The test plan shall cover each step of the testing. The test shall be conducted after complete installation of the lowering device. At the option of the Engineer, the test may be combined with the CCTV camera assembly On-Site Stand-Alone Test.
- B. As a minimum, the test shall demonstrate the lowering mechanism at each camera pole site. The Contractor shall coordinate a convenient time to demonstrate the operation of the lowering device in the presence of maintenance staff. This demonstration may coincide with the testing phase after the successful testing of at least one (1) lowering device assembly.
- C. The Contractor shall conduct all tests and shall provide qualified individuals to perform each test. The Engineer may waive the right to witness certain tests.
- D. Neither the witnessing of a test by the Engineer, nor the waiving of the right to witness a test, will relieve the Contractor of the responsibility of providing equipment that is in compliance with this specification. The witness of any tests by the Engineer, or a representative of the Engineer, will not be deemed as acceptance of the equipment or systems under test. The Engineer reserves the right to send up to three (3) representatives to witness a particular test. The test shall be coordinated with the Engineer at least three (3) weeks prior to the actual test date.
- E. The Contractor shall maintain a complete record of each test performed including the results of the test and a record of who witnessed the test. Each test case shall have a checkbox to indicate pass or fail during the execution of the test. At the completion of each test, the test forms shall be completed and provided to the Engineer for review within ten (10) days of completing the test, whether pass or fail. This document shall be the basis for acceptance or rejection. All test reports shall be signed by the supplier's authorized representative.

ITEM 651.0201-25 - CAMERA LOWERING DEVICE

3. CONSTRUCTION DETAILS: (cont'd)

3.03 **Testing:** (cont'd)

- F. If a unit is modified as a result of any test or demonstration failure, a report shall be prepared and delivered to the Engineer prior to shipment of the unit. The report shall describe the nature of the failure and the corrective action taken. If a failure pattern is identified, the Engineer may direct the modifications be made to all similar units without additional cost. A failure shall be defined as any test procedure that cannot be executed as defined in the agreed-upon test plan. A failure pattern is defined as a series of failures of a similar problem that occurred in subsequent test procedures; however, the Engineer, at his/her discretion, might determine during the execution of the test procedures that failures occurring during the tests are related and therefore must be considered a failure pattern.
- G. Completion of the on-site testing without failure will constitute acceptance of the lowering device assembly.

3.04 **Electrical Protection, Documentation, Warranty**

- A. In order to protect all different parts of the variable message sign assembly from electric and electromagnetic surges, all necessary equipment shall be supplied as part of the variable message sign assembly. AC input transient and surge protection must meet or exceed the UL 1449 standard.
 - 1. Surge suppressor for the LED display and the digital control unit
 - 2. Lightning arrester for the LED display and the digital control unit
 - 3. Data line protector
 - 4. Telephone line noise and surge protection where communication's by land line
- B. The sign assembly, cabinet and structure shall be electrically bonded to assure proper grounding of all components.
- C. The Contractor shall provide four (4) sets of the maintenance manual for the LED dynamic message sign, digital control unit and auxiliary equipment supplied for each LED dynamic message sign assembly furnished. Also four (4) complete sets of schematics of the electronics for the LED display and all boards shall be furnished.
- D. Four (4) complete sets of manuals for all software shall be provided.

ITEM 651.0201-25 - CAMERA LOWERING DEVICE

2. CONSTRUCTION DETAILS: (cont'd)

3.04 **Electrical Protection, Documentation, Warranty** (cont'd)

WARRANTY: All of the mechanical and electronic equipment specified to make the system operational and functional shall be warranted for a period of two (2) years. The warranties shall be issued to the New York State Thruway Authority by the respective manufacturer and/or system fabricator. The warranties shall cover the repair or replacement of the component or device. Replacements shall be new units. The Authority will be responsible for removing and re-installing the component or device after the Contractors initial warranty period. The warranties shall be effective from the date of final acceptance.

The Contractor shall comply with Subsection 104-08 of the Standard Specifications for the initial warranty period.

Nothing contained in these Special Specifications shall relieve the Contractor of the implied warranty that the equipment, system, and service provided are both first quality, fit, and merchantable for the uses intended as indicated herein.

4. METHOD OF MEASUREMENT:

4.01 This item shall be measured for payment on an each basis, for each item installed, tested and accepted in accordance with the contract documents and as directed by the Engineer.

5. BASIS OF PAYMENT:

5.01 The unit price bid for each camera lowering device assembly shall include all materials, labor, equipment, tools, incidentals, and meeting of the U.S. Department of Labor Occupational Safety and Health Standards as necessary to complete the work as described in this specification. The item installed in place shall meet all testing requirements to the satisfaction of the Engineer. The lowering device, attachment fittings, installation and testing as required shall be included in the bid price for each lowering device assembly.

5.02 Payment for each item will be made on a partial payment staged basis as follows:

<u>Milestone No.</u>	<u>Description</u>	<u>Payment Percentage</u>
1	Completion of Installation	90%
2	Completion of On-Site Testing	10%

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

1. DESCRIPTION:

- 1.01 Under this item the Contractor shall install, and test a fiber optic communications system at the locations shown on the plans, as directed by the Engineer, and as specified herein. This work shall consist of furnishing and installing single mode fiber optic cable used for the communications backbone, distribution network and equipment drops, passive components and miscellaneous equipment necessary for a complete cable plant as shown in the plans and as directed by the Engineer.
- 1.02 **Manufacturer Experience:** The fiber optic system components to be furnished shall be the products of manufacturers with a minimum of five (5) years experience in the successful manufacturing of such components. The fiber manufacturer and cabler shall be ISO 9001 certified.
- 1.03 **Installer Experience:**
- A. The installer of the fiber optic system shall be established in the installation of such equipment and shall have installed, as a minimum, three (3) systems of this magnitude, with each system having been in satisfactory operation for a minimum of five (5) years.
 - B. The installer shall provide the names, addresses, and telephone numbers of references who can be contacted regarding these systems.
 - C. The Contractor shall submit as proof resumes of the personnel listing their names, addresses, telephone numbers and project worked on and the names of references who can be contacted regarding the installed fiber optic systems. Personnel shall meet the following requirements:
 - 1. Splicers shall have been trained and certified in fiber optic cable installation and handling procedures by the manufacturer of the fiber optic cable to be used.
 - 2. Installers shall have been trained and certified in fiber optic cable installation and handling procedures by the manufacturer of the fiber optic cable to be used.
 - 3. Personnel involved in testing shall have been trained and certified by the manufacturer of the fiber optic cable test equipment to be used, in fiber optic cable testing procedures.
 - 4. Proof of the appropriate training shall be submitted to the Engineer for approval a minimum of twenty (20) working days prior to start of installation.
- 1.04 **Existing Fiber Optic System:** The fiber optic system provided under this specification shall connect with existing fiber optic cable if so indicated in the plans. The Contractor shall be responsible for testing the existing fiber prior to splicing into it. When splices are complete, the Contractor shall perform end-to-end testing, inclusive of the existing fiber.

2. MATERIALS:

- 2.01 **General Description of Materials and Services:** The fiber optic communications system to be provided under this specification consists of the following major components:
- A. Fiber Optic Trunk (Backbone) Cable
 - B. Fiber Optic Drop (Distribution) Cable
 - C. Fiber Optic Splice Enclosures
 - D. Fiber Optic Patch Panels
 - E. Wall mounted Fiber Splice Box
 - F. Miscellaneous Fiber Work
 - G. Submittals and Documentation
 - H. Testing.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

2. MATERIALS: (cont'd)

2.01 General Description of Materials and Services: (cont'd)

The Trunk Cable shall interconnect the head-end communication equipment with the field communication equipment. The Drop Cable shall interconnect the Trunk Cable with the Patch panel in cabinets. The Fiber Optic Patch Cord Cable shall interconnect the Drop Cable with the communication equipment in cabinets.

The quantity of fibers contained in each cable shall be in accordance with the plans.

All work shall be done in accordance with the manufacturer's recommendations, the Contract Documents, and as ordered by the Engineer.

2.02 Number of Fibers: The number of single mode fiber specified for each cable as shown in the Contract Drawings shall be the guaranteed minimum number of fiber (i.e., minimum number of fibers in the cable which when installed shall comply with the specification). If no fiber count is shown, the number of fibers shall be six (6).

2.03 Fiber Optic Trunk Cable:

A. The single mode fiber optic cable shall incorporate a water swellable tape, loose buffer tube cable design. The fiber optic cable shall be suitable for installation in conduit or lashed to messenger cable in an outside cable plant environment. The cable shall be all dielectric and shall consist of the number of fibers specified in the plans.

B. The cable shall meet the following requirements:

1. United States Department of Agriculture Rural Utility Service (RUS) 7 CFR1755.900
2. The requirements of ANSI/ICEA Standard for Fiber Optic Outside Plant Communications Cable,
3. ANSI/ICEA S-87-640-1999
4. ITU-T G.652 (Categories A,B,C, & D)
5. TIA/EIA 492-CAAB
6. Telcordia GR-20

C. The cable shall meet the following requirements:

1. **Optical Requirements:** The fiber shall meet the requirements of EIA/TIA-492CAAA "Detail Specification for Class IVa Dispersion – Unshifted Single-Mode Optical Fibers":

a. **Attenuation:** The nominal attenuation shall not exceed 0.4 dB/km at a wavelength of 1310 nm and 0.3 dB/km at a wavelength of 1550 nm. Fiber attenuation shall be uniform with no discontinuities greater than 0.1 dB. The attenuation at 1383±3 nm shall not exceed 2.1 dB/km. The attenuation measurements shall be in accordance with EIA/TIA Standards FOTP-20, 59, 61 and 78. The average change in attenuation at extreme operational temperatures (-76°F to 185°F) shall not exceed 0.05 dB/km at 1550 nm. The magnitude of the maximum attenuation change of each individual fiber shall not be greater than 0.15 dB/km at 1550 nm. The change in attenuation measurements shall be in accordance with EIA/TIA Standard FOTP-3.

b. **Cutoff Wavelength:** Not to exceed 1260 nm.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

2. MATERIALS: (cont'd)

2.03 Fiber Optic Trunk Cable: (cont'd)

- c. **Mode-Field Diameter:**
 - $9.20 \pm 0.4 \text{ }\Phi\text{m}$ at 1310 nm.
 - $10.4 \pm 1.00 \text{ }\Phi\text{m}$ at 1550 nm.
- d. **Zero Dispersion Wavelength:** 1313 nm.
- e. **Zero Dispersion Slope:** Not to exceed $0.086 \text{ ps}/(\text{nm}^2 \bullet \text{km})$.
- f. **Polarization Mode Dispersion:** Not to exceed $0.2 \text{ ps}/\text{km}^{1/2}$.
- g. **Dispersion:** Less than $3.5 \text{ ps}/(\text{nm} \bullet \text{km})$ for 1285 nm through 1330 nm and less than $18 \text{ ps}/(\text{nm} \bullet \text{km})$ at 1550 nm as measured in accordance with EIA/TIA Standard FOTP-169.

2. Mechanical Requirements:

- a. **Fibers:** All optical fibers shall be Corning glass fibers (SMF28e) or approved equivalent. All fibers within a given cable shall be from the same manufacturer, and shall contain no factory splices. Each fiber shall conform to the following minimum requirements:

- 1) Typical Core Diameter: $8.2 \text{ }\Phi\text{m}$
- 2) Cladding Diameter: $125 \pm 0.7 \text{ }\Phi\text{m}$
- 3) Core-to Cladding Offset: Not to exceed $0.5 \text{ }\Phi\text{m}$
- 4) Cladding Non-Circularity: Not to exceed 0.7%.

- b. **Color Coating:** Each fiber shall have a color coating applied to it by the manufacturer. The coating shall not affect the optical characteristics of the fiber. The basic color configuration shall be as follows, in accordance with EIA/TIA-598-A:

- | | | |
|-----------|----------|------------|
| 1) Blue | 5) Slate | 9) Yellow |
| 2) Orange | 6) White | 10) Violet |
| 3) Green | 7) Red | 11) Rose |
| 4) Brown | 8) Black | 12) Aqua |

The nominal colored fiber diameter shall be $250 \text{ }\Phi\text{m}$.

- c. **Primary Coating:** Each fiber shall have a dual layered, UV acrylate coating applied to it by the manufacturer. The coating shall be mechanically strippable without damaging the fiber. The coating diameter shall be $245 \pm 5 \text{ }\Phi\text{m}$.
- d. **Central Strength Member:** The strength member shall consist of a dielectric, glass-reinforced plastic rod.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

2. MATERIALS: (cont'd)

2.03 Fiber Optic Trunk Cable: (cont'd)

2. Mechanical Requirements: (cont'd)

e. **Buffering:** All fibers shall be enclosed in non-conductive loose buffer tubes. Each buffer tube shall contain twelve (12) fibers. The Contractor shall submit the fiber count per buffer tube and the buffer tube count configuration to the Engineer for approval. The fiber shall not adhere to the inside of the buffer tube. Each buffer tube containing fibers shall be color coded in a similar scheme as the fiber color. The basic color configuration shall be as follows, in accordance with EIA/TIA-598-A:

1) Blue	5) Slate	9) Yellow
2) Orange	6) White	10) Violet
3) Green	7) Red	11) Rose
4) Brown	8) Black	12) Aqua

Cables requiring additional buffer tubes (greater than 144 strand) shall follow the same color scheme, except dashed.

In buffer tubes containing multiple fibers, the colors shall be stable during temperature cycling and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together. Buffer tubes shall be of dual-layer construction.

The buffer tubes shall be filled with a non-hygroscopic gel to prevent water and moisture penetration. The gel shall contain anti-oxidant additives, and the gel shall be readily removable with conventional solvents. The gel shall be non-toxic and dermatologically safe to exposed skin. It shall be chemically and mechanically compatible with all cable components, non-nutritive to fungus, and electrically non-conductive.

f. **Filler Rods:** Fill rods shall be used to fill all unused buffer tubes, or shall be used instead of unused buffer tubes. The filler rod shall be a solid polyethylene material and shall be natural in color. The filler rods shall maintain the concentricity of the cable cross section where required.

g. **Stranding:** The buffer tubes shall be stranded around the central strength member using the reverse oscillation (S-Z) stranding process. Water swellable yarns shall be applied longitudinally along the central member during stranding.

h. **Water Swellable Tape:** A water swellable tape shall be applied longitudinally over the stranded tubes/fillers. The water swellable tape shall be non-nutritive to fungus, electrically non-conductive and homogenous. It shall also be free from dirt and foreign matter.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

2. MATERIALS: (cont'd)

2.03 Fiber Optic Trunk Cable: (cont'd)

2. Mechanical Requirements: (cont'd)

- i. **Tensile Strength Provisions:** Aramid yarn shall be helically stranded evenly around the cable core to provide tensile strength. The yarn shall enable the cable to withstand a maximum pulling force of 600 lb. during installation and 200 lb. long term installed without changing the characteristics of the optical fibers. Each length of cable shall have sufficient strength to be installed in continuous lengths as specified on the plans.
- j. **Outer Jacket:** A medium density polyethylene (or approved equal) outer jacket shall be applied over the entire cable assembly. The outer jacket shall have a minimum nominal jacket thickness of 1.25 mm. The polyethylene shall contain carbon black and shall not promote the growth of fungus. Jacketing material shall be applied directly over the strength members and the water swellable tape. The outer jacket shall contain no metallic elements and shall be of a consistent thickness.

The MDPE jacket material shall be as defined in ASTM D1248, Type II, Class C and Grades J4, E7 and E8.

- k. **Markings:** The outer cable jacket shall have sequential length markings in feet. The actual length of the cable shall be within $\pm 1\%$ of the length markings. The marking shall be in a contrasting color to the cable jacket. The height of the marking shall be approximately 2.5 mm.

The jacket shall be marked in contrasting color at three (3) foot intervals with the following information:

- Name of Cable Manufacturer
- Manufacturer's Catalog Number that includes information on type of fiber and fiber count
- NYSTA FIBER OPTIC CABLE – YYYY, where YYYY shall be the year that the cable was manufactured.

- l. **Ripcord:** The cable shall contain a ripcord under the sheath to facilitate cable preparation.
- m. **Bend Radius:** The cable shall be capable of withstanding a minimum bending radius of ten (10) times its outer diameter during operation and fifteen (15) times its outer diameter during installation without changing the characteristics of the optical fibers.
- n. **Fish Line:** Fish line shall be nylon or polypropylene material with a minimum test strength of 90 lb.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

2. MATERIALS: (cont'd)

2.03 **Fiber Optic Trunk Cable:** (cont'd)

3. **Manufacturer's Certification:** The cable manufacturer shall certify that each reel of cable furnished, meets or exceeds all of the optical and mechanical requirements mentioned above, plus the following specifications:
 - a. **Fluid Penetration:** When a three (3) foot static head of water or equivalent continuous pressure is applied at one end of a three (3) foot length of filled cable for one (1) hour, no water shall leak through the open cable end. The water penetration testing shall be performed in accordance with EIA/TIA Standard FOTP-82.
 - b. **Filling Compound Flow:** When tested in accordance with EIA/TIA Standard FOTP-81, the cable shall exhibit no flow (drip or leak) of filling or flooding compound at 160°F.
 - c. **Compressive Strength:** When tested in accordance with EIA/TIA Standard FOTP-41, the cable shall withstand a minimum compressive load of 22N/mm applied uniformly over the length of the sample and applied at the rate of 2.5 mm per minute. The load shall be maintained for a period of one (1) minute and then decreased to 110N/cm. The 110N/cm load shall be maintained for a period of ten (10) minutes. Attenuation measurements shall be performed before release of the 16 psi load. The change in attenuation shall not exceed 0.15 dB at 1550N/cm.
 - d. **Tensile Loading and Bending:** When tested in accordance with EIA/TIA Standard FOTP-33, using a maximum mandrel and sheave diameter of 22 inches, the cable shall withstand a rated tensile load of 600 pounds and a residual load of 30% of the rated installation load. The axial fiber strain shall be 20% of the fiber proof level after completion of ten (10) minutes of conditioning and while the cable is under the residual load. The change in attenuation at residual load and after load removal shall not exceed 0.15 dB at 1550 nm.
 - e. **Impact Resistance:** When tested in accordance with EIA/TIA Standard FOTP-25, except that the number of cycles shall be two at three locations along a three (3) foot cable length and the impact energy shall be at least 4.4Nm (in accordance with ICEA S-87-640), the change in attenuation shall not exceed 0.15 dB at 155 nm.
 - f. **Cable Flex:** When tested in accordance with EIA/TIA Standard FOTP-104, the cable shall withstand 25 mechanical flexing cycles around a sheave diameter not greater than 20 times the cable diameter. The fibers shall not experience an attenuation change greater than 0.15 dB at 1550 nm. The cable jacket shall exhibit no cracking or splitting when observed under 5X magnification.
 - g. **Temperature Cycling:** When tested in accordance with EIA/TIA Standard FOTP-3, the change in attenuation at extreme temperatures (-76°F to +185°F) shall not exceed 0.05 dB/km at 1550 nm.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

2. MATERIALS: (cont'd)

2.03 Fiber Optic Trunk Cable: (cont'd)

3. Manufacturer's Certification: (cont'd)

- h. **Low or High Temperature Bending:** When tested in accordance with EIA/TIA Standard FOTP-37, the cable shall withstand four full turns around a mandrel of 20 times the cable diameter for four (4) hours at test temperatures of -22°F and +140°F. Neither the inner or outer surfaces of the jacket shall exhibit visible cracks, splits, tears or other openings. The fibers shall not exhibit a change in attenuation greater than .30 dB/km at 1550 nm.
- i. **Cable Twist:** When tested in accordance with EIA/TIA Standard FOTP-85, a length of cable no longer than six (6) feet shall withstand 10 cycles of mechanical twisting. The fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm. The cable jacket shall exhibit no cracking or splitting when observed under 5X magnification.

2.04 Fiber Optic Drop Cable

- A. **Optical Requirements:** The fiber optic Drop Cables shall have identical optical characteristics as the single-mode fiber optic Trunk Cable specified above.
- B. **Material Requirements:** The Drop Cable shall have the identical physical configuration as the single-mode fiber optic Trunk Cable specified above except for the fiber count in each buffer tube. The Contractor shall submit the Drop Cable buffer tube count configuration and fiber count per buffer tube to the Engineer for approval.
- C. **Manufacturer's Certification:** The fiber optic Drop Cables shall have identical manufacturer's certification as the single-mode fiber optic Trunk Cable specified above.

2.05 Packing and Shipment: All fiber cable shall be supplied on reels. Each reel shall have the following information clearly labeled on it:

- A. Customer
- B. Customer order number
- C. Reel number
- D. Destination
- E. Ship date
- F. Manufactured date (glass and cable)
- G. Manufacturer's name (glass and cable)
- H. Cable code
- I. Length of cable.

2.06 Splice Enclosures:

- A. The Contractor shall furnish and install fiber optic Splice Enclosures in locations where splices require protection and as indicated in the plans. The Splice Enclosures shall meet the following minimum requirements:

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2. MATERIALS: (cont'd)

2.06 Splice Enclosures: (cont'd)

1. The Outdoor Splice Enclosure shall be suitable for outdoor applications with a temperature range of -22°F to 140°F.
 2. The Outdoor Splice Enclosure shall be sized for placement as shown in the Contract Drawings and shall provide sufficient space to allow entry of fiber optic cable without exceeding the cable minimum bending radius.
 3. The Outer Enclosure shall protect the splices from moisture and mechanical damage and shall be resistant to salt corrosion. All materials in the enclosure shall be non-reactive and shall not support galvanic cell action.
 4. The enclosure shall be waterproof, re-enterable and shall be sealed with a gasket.
 5. The enclosure shall permit selective splicing to allow one (1) or more fibers to be cut and spliced to the Drop Cable without disrupting other fibers.
 6. The outer enclosure shall have strain relief for the Trunk Cable to prevent accidental tension from disturbing the splices.
 7. When installed, the case shall be capable of withstanding severe conditions of moisture, vibration, impact, cable stress and temperature extremes.
 8. The case shall be capable of holding the type of splice trays specified herein, for fusion splices. The case shall have the capability of holding trays from various manufacturers.
 9. The basic case shall have the input/output capacity of four (4) cables.
 10. The case shall be re-enterable without disturbing the fibers or the fiber splices. No special tools shall be required for installation or maintenance of the case. All hardware and miscellaneous parts shall be standard industry equipment.
 11. The splice case shall be mountable to standard U-shaped sign channels using stainless steel hardware, or manufacturer approved hardware. Mounting shall be as shown on the details.
 12. The splice case shall have a termination block to terminate the central strength members of the fiber optic cables.
- B. Splice Trays:** The Contractor shall furnish and install fiber optic splice trays to organize and store splices. The trays shall be compatible with the fiber optic splices and Splice Enclosures specified herein and shall meet the following minimum requirements:
1. The Splice Tray shall be compatible with the outer enclosure and be constructed of rigid plastic or metal. The number of Splice Trays per enclosure shall accommodate the number of splices required under the Contract.
 2. Polyethylene tubes shall be supplied to protect exposed individual fibers within the enclosure.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

2. MATERIALS: (cont'd)

2.06 Splice Enclosures: (cont'd)

3. Vinyl markers shall be supplied to identify each fiber to be spliced within the enclosure.
4. Each splice shall be individually mounted and mechanically protected on the splice tray.
5. The loose tube buffers shall be secured with a tube guide or channel snap. No cable ties are to be used.
6. Slack fiber within the tray shall be placed in an oval shape along an inside wall of the tray.
7. The fiber optic splice trays shall be stackable within the splice case. Any tray within a stack shall be accessible without disassembly of any of the other trays.

C. **Fiber Optic Breakout Kits:** The fiber optic breakout kits contain all the tools and materials necessary to complete the installation of the fiber optic backbone and Drop Cables. It shall include, as a minimum, the following equipment:

1. Pulling eyes with protective covering for the installation of preterminated fiber optic Drop Cable.
2. Fiber optic installer test equipment, fusion splicers, test cables, connector adapters, inspection tools, attenuators, tracers, continuity checkers, consumables and all ancillary equipment.

2.07 **Patch Panel:** Designated Drop Cable fibers shall terminate within a patch at locations shown in the plans. Patch panels shall be completed (pre-loaded) with splice trays and connector panels of suitable capacity for all Drop Cables as specified in the Contract.

Each Patch Panel shall have capacity for at least six (6) connections or as indicated in the drawings.

Fan-out kits of suitable capacity shall be provided with each Patch Panel.

Each interconnect panel shall be compatible for connection to the AT&T SC type connectors of the fiber Drop Cables and fiber optic patch cables.

A. **Fiber Optic Connectors:** Fiber optic connectors shall be factory installed. The connectors shall meet the following requirements:

1. The connector shall have a ceramic ferrule with a nickel plated nut and body.
2. The connector shall be an AT&T SC style compatible field mountable connector.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

2. MATERIALS: (cont'd)

2.07 Patch Panel: (cont'd)

A. Fiber Optic Connectors: (cont'd)

3. The connector shall be compatible with a physical contact (PC) finish. All connectors shall be polished to a PC finish such that the return loss per mated pair of connectors is at least 25 dB. The return loss when the connector is mated with previously installed connectors shall be at least 18 dB.
4. The connector mean loss shall not be greater than 0.5 dB with a standard deviation of not greater than 0.2 dB.
5. Index matching fluids or gels shall not be used.
6. The connector loss shall not vary more than 0.2 dB after 1000 repeated matings.
7. The connector shall withstand an axial load of 135N.
8. The connectors shall be compatible with the optical fiber surrounding jacket and shall be installed on one end of the optical fiber in accordance with the manufacturer's recommended materials, equipment and practices.
9. The connector shall be suitable for the intended environment and shall meet the following environmental conditions:
 - a. Operating Temperature: -4°F to 122°F
 - b. Storage Temperature: -22°F to 140°F
10. The connector loss shall not vary more than 0.2 dB over the operating temperature range.
11. Connectors shall be protected by a suitable installed waterproof protection cap.

B. Fiber Jumper Cables:

1. Factory assembled single mode fiber jumper cables shall be provided to connect fibers terminated in a Patch Panel to the communications equipment in field cabinets.
2. Jumper cables shall be housed individually in protective jackets. Both ends of the cable shall be connectorized in the factory.
3. The cable shall be suitable for operation over the temperature range of -22°F to +140°F.
4. Jumper cables shall be of suitable length to be connected between the rack mounted interconnect panel and the communication equipment (e.g., modems, etc.). Sufficient slack shall be left to allow relocation of the equipment anywhere within the cabinet.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

2. MATERIALS: (cont'd)

2.07 Patch Panel: (cont'd)

B. Fiber Jumper Cables: (cont'd)

- 5. The attenuation of a jumper cable after installation, not including the connector loss, shall not exceed 0.1 dB measured at 850 nm and 1300 nm.

2.08 Wall Mounted Fiber Splice Box: Each Wall Mounted Fiber Splice Box shall include splice trays of a suitable capacity for the Trunk Cable as specified in the contract and shall allow space for slack Trunk Cable and an interconnect panel.

- A. **Splice Trays:** Splice trays and splice kits for the wall mounted Splice Box shall be as specified under Section 2.06, B. of this specification.

The Splice Box shall contain space for a minimum of a 48-count interconnect panel. The panel provided shall be of suitable size to meet the number of fibers indicated in the Contract drawings.

- B. **Connectors and Fan-Out Kits:** Fan-out kits shall be provided for the number of fibers to be landed on the interconnect panel. Connectors and fan-out kits shall meet the requirements of Section 2.07 of this Specification.

3. CONSTRUCTION DETAILS:

3.01 General: All fiber optic cable will be installed in innerduct, steel, or PVC conduit as indicated in these Contract Documents or otherwise directed by the Engineer. All fibers in the fiber optic cable shall be spliced and/or terminated in designated field cabinets or pull boxes only.

3.02 Design Documentation: Prior to the installation of the fiber optic cable, the Contractor shall submit his proposed cable plant design to the Engineer for approval. No cable shall be installed until the proposed cable plant design submission is approved by the Engineer. The cable plant design shall include the following:

- A. Catalog cuts and shop drawings for all cable, connectors, splice equipment, Splice Enclosures, splice trays, Patch Panels, jumper cables, wall mounted cabinets, and cable installation and test equipment.
- B. Preliminary locations of all proposed splices.
- C. Preliminary fiber assignment diagrams.
- D. Fiber attenuation/loss budget. The Contractor's loss budget shall include losses for any existing fiber that is to be connected to under this Contract. The existing losses shall be obtained from the as-built documentation from the existing fiber plant. If this information is not available to the Contractor, the loss budget for existing fiber shall be determined later from testing done in Section 3.10 A. of this Specification.
- E. Proposed pull box locations where hand assists or intermediate assist winches will be required during installation.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

3. CONSTRUCTION DETAILS: (cont'd)

3.02 Design Documentation: (cont'd)

- F. Proof of the experience requirements as defined in this special specification.
- G. Cable manufacturer's recommended cable installation techniques and requirements such that the optical and mechanical properties of the cables are not degraded at the time of installation.
- H. The cable manufacturer's proposed recommendations shall include the following (that apply to this project):
 - 1. Cable manufacture's approved pulling lubricant for use on the cable and method of application. No other lubricants will be permitted.
 - 2. Installation set-up including size and types of rollers, feeder guides, tension gauge make and model number, attachment of pulling jig to jacket and direction to pull.
 - 3. Maximum pulling tensions, which shall specify both pulling from the cable's conductors and for pulling from the cable's outer jacket.
 - 4. Minimum bend radii, which shall specify a radius both loaded and unloaded.
 - 5. Method to install multiple cables.

3.03 Splicing Requirements: All optical fibers shall be spliced to provide continuous runs. Splices shall be allowed only at locations designated in the approved cable plant layout or as approved by the Engineer. All splices shall be performed in a controlled, clean environment such as a Contractor designated splicing truck or van.

The splices shall meet the following requirements:

- A. All splices shall use the fusion technique. Fusion splicing equipment shall be provided by the Contractor and shall be cleaned, calibrated and specifically adjusted to the fiber and environmental conditions at the start of each shift. Splice enclosures, tools and procedures, shall be approved by the cable manufacturer as being compatible with the cable type being delivered.
- B. Only buffered tubes containing fibers to be spliced shall be opened. The other tubes shall be neatly looped and stored in the enclosure. When buffer tubes do not need to be opened, at least 4 m of unopened buffer tube shall be coiled in the fiber optic Splice Enclosure. Unsevered fibers in an open fiber buffer tube shall be neatly coiled in the splice tray.
- C. Each spliced fiber shall be packaged in a protective sleeving or housing. Bare fibers shall be completely re-coated with a protective RTV, gel or similar substance, prior to application of the sleeve or housing, so as to protect the fiber from scoring, dirt or microbending.
- D. Rack mounted organizer trays shall be used to hold the spliced fibers, with each fiber neatly secured to the tray.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

3. CONSTRUCTION DETAILS: (cont'd)

3.03 Splicing Requirements: (cont'd)

- E. The average splice loss shall not exceed 0.1 dB per link, with a standard deviation of no more than 0.07 dB. A link is defined as the fiber optic path between two (2) active components. No splice loss shall exceed 0.15 dB. If a splice is measured to exceed 0.15 dB during the splicing process, it shall be remade until its loss falls below 0.15 dB or the Engineer waives the 0.15 dB requirement. Each attempt shall be recorded for purposes of acceptance. If the mean exceeds 0.1 dB in any link, splices in the link shall be remade until the mean loss does not exceed 0.1 dB.
- F. All splice losses shall be recorded in tabular form and submitted to the Engineer in electronic format for approval. If an optical time domain Reflectometer (OTDR) is used to record splice loss, chart recordings of the "signature" shall be submitted with the splice data with a record of all OTDR settings and the OTDR locations written on the trace.
- G. At butt-end connections, all optical fibers shall be spliced to provide continuous runs.

3.04 Cable Installation: Fiber optic cable shall be installed in accordance with the approved manufacturer's recommendations. In addition, the following requirements shall be met:

- A. Prior to any installation of cable, the Contractor shall verify that conduits are clean and free of obstructions.
- B. The number of pull boxes and their locations shall be as shown on the Contract Documents. The Contractor may be required to install the cable one pull box at a time. The direction of the cable pull shall be determined by the Contractor.
- C. Personnel equipped with two (2) way radios shall be stationed at each maintenance hole, cabinet, Splice Enclosure, communications box and junction box through which the cable is to be pulled to observe and lubricate the cable.
- D. Fish line shall be installed in all communications ducts or conduits along with fiber optic communication cables. A six (6) foot length of fish line shall be left coiled, tied and accessible in each cabinet and pull box. The fish line shall be installed according to manufacturer's specifications and shall be "free" and NOT helicoil about communications cables.
- E. A minimum of 30 feet of cable slack shall be provided in pull boxes containing splices or otherwise designated on the Contract Documents or as directed by the Engineer. Additional slack, as indicated on the approved cable installation plan, may be provided for closure preparation and splicing.
- F. The cable shall be securely fastened in place within Splice Enclosures and cabinets to prevent pull-out or shifting of the cable.
- G. The Contractor shall be responsible for ensuring the cable length is sufficient to allow for connection between the communication equipment and the Splice Enclosures including provision for slack, vertical runs, cable necessary for splicing, wastage and cable to allow for the removal of the Splice Enclosure for future splicing.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

3. CONSTRUCTION DETAILS: (cont'd)

3.04 Cable Installation: (cont'd)

- H. No fiber optic cable shall be pulled through more than one (1) 90 degree bend unless so indicated on the approved Contract Documents or specifically approved by the Engineer.
- I. The cable shall not be pulled over edges or corners, over or around obstructions, or through unnecessary curves or bends.
- J. The cable shall be looped in and out of cabinets and pull boxes to provide adequate slack and the least amount of stress on the fibers. The Contractor shall ensure that the cable is not damaged during storage or installation.
- K. Fiber optic cable ends shall be kept sealed at all times during installation, using a method recommended by the cable manufacturer and approved by the Engineer. The cable end shall remain sealed until the Contractor terminates the fiber cables. Cables that are not immediately terminated shall have a minimum of six (6) feet of slack.
- L. When using lubricants, the Contractor shall adhere to the cable manufacturer's requirements for the proper amount, application tools and method, and removal of the lubricant from the exposed cable.
- M. Optical fiber cable shall be installed in continuous lengths without intermediate splices throughout the project except where splices are indicated on the Contract Documents or approved by the Engineer. Splices shall only be in re-enterable Splice Enclosures mounted in pull boxes, junction boxes and underground vaults.
- N. The fiber optic Drop Cable shall be spliced to the backbone cable at the locations indicated in the Contract Documents or as directed by the Engineer.
- O. The maximum pulling tensions and minimum bending radii shall not be violated at any time during installation. The Contractor shall consult with the Engineer concerning existing conduit, pull boxes, and rises, which could force the violation of the minimum bending radius for the fiber optic cable. The Contractor shall obtain approval from the Engineer if modifications to these existing facilities are required. Violation of these parameters shall be cause for rejection of the installed cable.
- P. Following installation of the cable in the ducts, all duct entrances at Splice Enclosures and cabinets shall be sealed with an innerduct termination plug (provided under separate pay item) or a duct sealing compound (if plugs are not provided under separate pay item) to prevent the ingress of moisture, foreign materials, and rodents.
- Q. Where Trunk Cable terminations are left "dead ended", a minimum of 80 feet of cable shall be left coiled.
- R. Slack cable and innerduct where pulled through a pull box shall be racked to the pull box wall.

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3. CONSTRUCTION DETAILS: (cont'd)

3.05 Drop Cable:

- A. Drop cables that go to multiple Patch Panels shall be looped through intermediate cabinets and panels such that fibers not needed at that particular site pass through, splice free and uncut. The Drop Cable fiber shall be fusion spliced to the appropriate trunk fiber or left in a splice tray for future use as indicated in the drawings. The other end of the fiber shall be fusion spliced to a connector fan-out kit and mounted in the Patch Panel. Field installed connectors shall not be used without written consent of the Engineer and shall be reviewed on a site by site basis. The Contractor, at his option may propose to provide factory installed connectors on the Patch Panel side for distribution cable runs that go to only one cabinet or Patch Panel. If Drop Cable is provided with factory installed connectors, the manufacturer shall factory test the cable assembly and provide the results to the Engineer for approval.
- B. The Drop Cable shall be of sufficient length to be installed as shown on the plans, with a minimum of 10 feet of slack provided on either end or as indicated in the drawings.
- C. The Contractor shall follow the Drop Cable manufacturer's recommendation in the installation of the Drop Cables, including the individual breakout fibers.

3.06 Splice Enclosures:

- A. Splice enclosures shall be installed in accordance with the manufacturer's recommendation and as directed by the Engineer. After final assembly of the Splice Enclosure, it shall be pressure tested in accordance with the manufacturer's recommendations. If the pressure test is not passed, the enclosure shall be resealed and the test repeated. The Engineer shall be notified of any failed attempts and shall reserve the right to reject the Splice Enclosure and any others with similar problems.
- B. The Contractor shall submit the test results to the Engineer for approval and acceptance of the enclosure.

3.07 Patch Panel/Panel:

- A. All Drop Cables entering a cabinet shall connect to a Patch Panel.
- B. Fiber optic splitters and taps (FOS's and FOT's) shall be housed within the cavity of the Patch Panel.
- C. All fiber optic patch cord cables between the Patch Panel and Fiber Optic Communication Equipment shall exit the Patch Panel via the Interconnect Panel.
- D. The unused ports of the Interconnect Panel shall be provided with dust jackets for protection.

3.08 Wall Mounted Fiber Splice Boxes: At the Trunk Cable terminus, within a building, cables shall be installed in Wall Mounted Splice Boxes as indicated in the Contract Drawings.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

3. CONSTRUCTION DETAILS: (cont'd)

3.09 **Labeling:**

- A. All fiber optic cables shall be identified by circuit numbers in all cabinets, pull boxes, wireways, and other enclosures and access locations and at all terminal points. Cable designations shall be as shown on the Contractor's approved shop drawings. The tag ties shall be wrapped around all cables comprising the circuit to be identified.
- B. Cable tags shall be suitable for wet locations and shall be stainless steel tags, No. 28 gauge and 7.5 inches wide, embossed with letters and numbers approximately 3/8 inch high, fastened to the cable or wire with nylon cable ties.
- C. Tags shall indicate which subsystem and trunk or Drop Cable it is connected to and the cabinet number for the other end of the link as indicated in the Contract Drawings.
- D. The Contractor shall label the fiber connectors at the Patch Panel. The labeling scheme selected shall clearly identify the fiber number and connecting device. The labeling scheme is to be approved by the Engineer.

3.10 **Testing Requirements:**

- A. The following tests shall be conducted. All tests shall be conducted in accordance with approved test procedures. The Contractor shall submit test procedures and forms in paper and electronic formats for approval to the Engineer.
- B. As required in 3.03, the Contractor shall measure and record the splice quality of each fusion splice performed. This information shall be submitted to the Engineer as part of the final testing documentation.
- C. An OTDR shall be used for backscattered light measurements. The OTDR shall operate at a nominal wavelength of 1310 nm and 1550 nm and shall include all necessary hardware required to couple it with unconnectorized single mode fiber.
 - 1. **Existing Fiber Cable Verification Test:** Prior to splicing fibers installed under this contract to existing fibers (where designated in the plans), the Contractor shall verify and record the loss characteristics of the existing fiber. Any anomalies shall be reported to the Engineer. Testing the existing fiber and splicing to the existing fiber shall be accounted for under the work described in Section 4.7 (Miscellaneous Fiber Work) of this specification.
 - 2. **Pre-Installation Tests:**
 - a. The fiber optic cable shall be inspected and tested at the site storage area prior to installation.
 - b. Proper fiber cladding and fiber tube colors shall be verified by visual inspection. Any difference discovered from approved fiber optic cable plant layout or approved catalog cut sheets for the cable shall be grounds for rejection of the cable.

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3. CONSTRUCTION DETAILS: (cont'd)

3.10 Testing Requirements: (cont'd)

- c. Each optical fiber in the cable shall be tested from one end with an OTDR compatible with wavelength and fiber type. Testing shall check for continuity, length, anomalies, and approximate attenuation at both 1310 nm and 1550 nm wavelengths. Each measurement shall be recorded with color, location and type of fiber measure. In the event that a meaningful measurement cannot be made from one end, it shall be performed from the opposite end of that fiber.
- d. If the measured attenuation does not meet or exceed the specified performance criteria of these specifications, the cable shall be rejected.
- e. The Contractor shall assure that the specifications of the fiber optic cable are met prior to installation.

3. Proof of Performance Test:

- a. After the fiber cable has been installed, but prior to any splicing, the Contractor shall conduct a proof of performance test.
- b. The Contractor shall measure the attenuation of a minimum of 10% of the total fibers selected at random. The Contractor shall sequence the fibers which are to be measured after each pull, such that the same fibers are not measured on consecutive lengths.
- c. The Contractor shall record the reel number from which the cable came, the identification of the fibers measured and the attenuation in dB/km of the fibers measured.
- d. If the measured attenuation does not meet or exceed the specified performance criteria of these specifications, additional testing may be necessary or the cable shall be rejected.

4. Acceptance Testing: After each splice and connector installation, all optical fiber spans (including all dark/spare fibers and unconnectorized fibers) shall undergo the following tests after installation of all connectors and splices. A span is defined as a continuous length of fiber including all splices and connectors:

- a. Using an OTDR test each span bi-directionally at 1310 nm and 1550 for fiber attenuation, continuity, length, and anomalies. Each optical fiber shall meet the following acceptance criteria:
 - 1) **Attenuation:** Not to exceed 0.3 dB/km at 1550 nm and 0.4 dB/km at 1310 nm + 0.15 dB/splice + 0.5 dB/connector. The number of splices and cable attenuation shall be based upon the approved cable plant layout.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

3. CONSTRUCTION DETAILS: (cont'd)

3.10 Testing Requirements: (cont'd)

- 2) **Anomalies:** No event shall exceed 0.3 dB. If any event is detected at that value, the Contractor shall repair or replace that section of cable.
- b. Using an optical source and a power meter, measure the attenuation from both ends. The measured attenuation shall meet the criteria defined for the attenuation using the OTDR.
- c. All cable that fails to meet the aforementioned requirements shall be replaced.
- d. The Contractor shall maintain a test result record of each span and each fiber. Optical fiber spans shall be identified in the test results by identifying the fiber under test and by identifying the field cabinet at which the OTDR and power meter was connected.
- e. The test results shall include the following measurement:
 - 1) Total length of the single mode link
 - 2) Total attenuation of the single mode link
 - 3) Attenuation of each splice in the link under test
 - 4) Attenuation per kilometer of each interconnected fiber in the link under test.
- f. Attenuation shall be measured in decibels referencing optical power.
- g. Each single mode fiber and splice tested shall be tested to meet the performance requirements in accordance with the contract.
- h. The Contractor shall submit to the Engineer a tabulated list of fibers and the actual end-to-end measured values from the above tests and all traces and loss length printouts and in electronic format (with .sor file extension). This test data shall be the basis of acceptance for the fiber.
- i. For optical fibers spliced to existing fibers, this test shall be repeated between the control center and the field termination after the new and existing fibers have been spliced together. If a fiber fails to meet the loss characteristics for the spliced section fiber, the Contractor shall determine whether the excessive loss is the result of an anomaly in the new section of fiber, splice or existing section of fiber. The Contractor shall, however, be responsible for the new section of fiber and the splice between the two sections.

ITEM 651.9908XX25 - FIBER OPTIC COMPONENTS

3. CONSTRUCTION DETAILS: (cont'd)

3.11 Close-out Documentation:

- A. Five (5) complete sets of operation and maintenance manuals shall be provided. As-built drawings are required to be completed in MicroStation (.dgn) format and shall include, but not be limited to the following items: the location of the fiber facilities as determined by offsets from the edge of travel lanes (from yellow or white solid pavement stripe/markings) and depths of the facilities at every delineator; whether the facilities are bored, trenched, or attached to bridge structures; culvert locations in close proximity to the facilities; all ducts, hand holes, fiber optic cables and associated facilities. The as-builts must show every mile and tenth of a mile delineator, the Thruway ROW fence, all cross streets, ramps, streams, rivers and railroads. The beginning and end points of bores, and all culvert and hand hole/manhole locations are to be shown measured along the edge of travel lanes (from yellow or white solid pavement stripe/markings and) from the nearest tenth of a mile marker to the South or East. All splice enclosures, man/hand holes shall be located by coordinates obtained from a hand held GPS unit with minimum accuracy of ± 1 foot. As-builts also need to be organized by milepost with a reference chart to locate the desired location. If so provided under other items (such as the innerduct item), the Contractor shall obtain the electronic plan drawings of the innerduct path for use in developing the fiber plans.
- B. The manuals shall, as a minimum, include the following:
 - 1. Complete and accurate as-built plans showing the fiber optic cable plant, actual fiber distance readings (from the fiber cable jacket), and locations of all splice enclosures. Splice enclosures shall be located by coordinates (obtained from a hand help GPS unit with an accuracy of at least ± 15 feet) and shown on the as-built plans.
 - 2. Complete fiber assignment diagram. If available, the Contractor will be provided with an electronic copy of the existing fiber assignment diagrams that the Contractor shall use in the development of the as-built fiber assignment diagrams for this project.
 - 3. Complete performance data of the cable plant showing the complete fiber run, including losses at each splice joint and each terminal connector.
 - 4. Installation, splicing, terminating and testing procedures.
 - 5. Complete parts list including names of vendors.
 - 6. Complete maintenance and trouble-shooting procedures.

4. METHOD OF MEASUREMENT:

- 4.01 **Fiber Optic Trunk Cable:** The unit price bid per foot shall include procurement, storage, installation, fish line, labeling, and pre-installation testing. Work shall be considered complete when a length of cable between splice points, inclusive of the cable slack in enclosures, is satisfactorily installed, tested and accepted by the Engineer.

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4. METHOD OF MEASUREMENT: (cont'd)

- 4.02 **Fiber Optic Drop Cable:** The unit price bid per foot shall include procurement, storage, installation, fish line, labeling, and pre-installation testing. Work shall be considered complete when a length of cable between splice points, inclusive of the cable slack in enclosures, is satisfactorily installed, tested and accepted by the Engineer.
- 4.03 **Fiber Optic Splice Enclosure (Butt-End Splice):** The unit price bid per each Splice Enclosure shall include the installation and assembly of all required fiber termination components of the enclosure, splice trays, splice kits, fusion splicing, and pressure testing.
- 4.04 **Fiber Optic Splice Enclosure (Drop Cable):** The unit price bid per each Splice Enclosure shall include the installation and assembly of all required fiber termination components of the enclosure, splice trays, splice kits, fusion splicing, and pressure testing.
- 4.05 **Fiber Optic Patch Panel:** The unit price bid per each fiber optic Patch Panel shall include the procurement and installation of the Patch Panel including: bulkhead connectors, splice trays, splice kits, fan-out kits, jumper cables, and fusion splicing.
- 4.06 **Wall Mounted Fiber Splice Box:** The unit price bid per each wall mounted Fiber Splice Box shall include the procurement and installation of the Fiber Splice Box including: cross-connect panels, splice trays, splice kits, jumper cables, and fusion splicing.
- 4.07 **Miscellaneous Fiber Work:** The lump sum price bid for this item shall include all materials, labor, and incidentals necessary to complete the work as described in the Special Notes of the Contract and elsewhere within this specification. (See Section 3.10.C.1)

5. LIST OF ITEMS:

- 5.01 Each item shall include the furnishing of all equipment, materials, incidentals, labor, tools, testing equipment, documentation, and testing required to complete the work.
- 5.02 Units of measurement for each item described in this specification shall be established as outlined below:

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
651.99083025	BACKBONE FIBER OPTIC CABLE	FOOT
651.99083125	FIBER OPTIC DISTRIBUTION CABLE	FOOT
651.99083225	FIBER OPTIC SPLICE ENCLOSURE (BUTT-END)	EACH
651.99083325	FIBER OPTIC SPLICE ENCLOSURE (DROP)	EACH
651.99083425	FIBER OPTIC PATCH PANEL	EACH
651.99083525	WALL MOUNTED FIBER SPLICE BOX	EACH
651.99083625	MISCELLANEOUS FIBER WORK	LUMP SUM
651.99083725	BACKBONE FIBER OPTIC CABLE (THRUWAY SUPPLIED)	FOOT
651.99083825	BACKBONE FIBER OPTIC CABLE (48 COUNT)	FOOT
651.99083925	BACKBONE FIBER OPTIC CABLE (72 COUNT)	FOOT
651.99084025	BACKBONE FIBER OPTIC CABLE (144 COUNT)	FOOT
651.99084125	BACKBONE FIBER OPTIC CABLE (216 COUNT)	FOOT
651.99084225	BACKBONE FIBER OPTIC CABLE (288 COUNT)	FOOT

ITEM 662.74125325 - HDPE INNERDUCT 1¼ INCH ID

1. DESCRIPTION:

- 1.01 This work shall consist of furnishing all labor, tools, and equipment necessary for installing high density polyethylene (HDPE) innerduct as indicated on the plans or as directed by the Engineer. The innerduct is to be used for fiber optic cable facilities and will be placed as direct burial, drilled, or in sleeves as shown in the plans.
- 1.02 The innerduct shall include the following work items:
- A. Innerduct
 - B. Splicing
 - C. Trace Wire
 - D. Warning Tape
 - E. Path Markers
 - F. Plugs and Lashing Ties
 - G. Documentation

Conduit excavation, backfill, sleeves, and directional drilling or jacking are to be accounted for and performed under separate items as shown in the plans.

2. MATERIALS:

2.01 Innerduct.

- A. The innerduct shall be smooth-walled, inside and outside, High Density Polyethylene (HDPE) plastic Type SIDR9 deliverable to the site on reels. All innerduct shall be the same inner and outer diameter and shall be acquired from the same vendor.
- B. The innerduct shall be extruded from high-density polyethylene (HDPE) resin and conforming to the minimum standards for polyethylene PE345430B as defined in ASTM D3350.
- C. Each innerduct shall be solid color coded as shown on the plans.
- D. The innerduct shall be suitable for heat fusion welding using a fusion duct splicer.
- E. Innerducts shall be pre-lubricated during the manufacturing process such that the lubricant becomes permanently impregnated in the inner walls of the innerducts. The process shall provide a dynamic coefficient of friction of .06 to .09 in accordance with Bellcore Standard GR-TSY-356-CORE, Oct. 1995, Section 4.1.5.
- F. The lubricant shall be compatible with the proposed fiber optic cable jacket.

- 2.02 **Underground Warning Tape.** Underground Warning Tape shall be a heavy-duty polyethylene material that is compounded for direct burial service and which will resist acids, alkalis and other soil substances. The tape shall be orange with a continuous legend "CAUTION BURIED FIBER OPTIC CABLE" print in black. The underground warning tape shall be six (6) inches wide and have a minimum thickness of 4 mils.

ITEM 662.74125325 - HDPE INNERDUCT 1¼ INCH ID

- 2.03 **Path Markers.** The Contractor shall provide above-grade markers to identify the path of the buried duct. The markers shall be orange and shall bear the permanent factory-printed text as shown on the plans. The markers shall be 12 inches tall by four (4) inches wide by 1/8 inch thick and constructed of polyethylene rated for a minimum of 10 year outdoor durability. The markers shall be resistant to UV rays, scratches, fading, and cracking. Galvanized steel posts shall be provided as necessary to mount the markers in areas as indicated in the plans. Attachment hardware shall be galvanized steel, stainless steel, or other non-corrosive materials approved by the Engineer.
- 2.04 **Innerduct Plugs.** Innerduct plugs and terminating plugs shall be corrosion proof, chemical resistant, removable, reusable and provide a light, air and gas tight seal to seal the Innerduct. The terminating plug shall have an individual entry port for each installed cable.
- 2.05 **Lashing Ties.** Lashing ties shall be weather resistant nylon, non-releasable with a minimum loop tensile strength of 250 pound force.

3. CONSTRUCTION DETAILS:

3.01 Innerduct.

- A. The innerducts shall be placed as direct burial or in sleeves where shown on the plans.
- B. Innerduct shall be installed in accordance with industry standards, manufacture's written instructions, as shown on the Plans or as ordered by the Engineer. Guide wheels, bending shoes or quadrant guides shall be used to achieve a smooth transition from road grade to conduit depth. All bends in the Innerduct shall be made without kinking, flattening or appreciably reducing the internal diameter of the Innerduct and as recommended by the manufacturer.
- C. The configuration of the color-coded innerducts shall be as shown on the plans. The innerducts shall be bundled together using lashing tape every six (6) feet to prevent duct separation and entanglement.
- D. If existing pull boxes require resetting or other modifications, this work shall be completed prior to the installation of innerduct into the subject pull box.
- E. Innerduct shall be installed in continuous lengths to the extent possible. Splicing of innerduct will be permitted as required to facilitate the installation. Innerduct shall be butt-fused together using a heat fusion welder. Heat fusion welding shall be conducted using a machine specifically designed for the application and materials being used and shall have been widely used in the industry for a minimum of 5 years. The fused innerduct shall have been tested and demonstrated to provide an impermeable seal with a tensile strength equal to or greater than the duct without splices.
- F. All Innerducts shall be sealed during installation and when being stored to prevent contaminants from entering the innerduct. All Innerducts terminating in pull boxes with installed wires or cables shall have a terminating plug installed in accordance with the manufacturer's instructions. Unused innerduct shall pass through the pull boxes uncut.
- G. Where the innerducts terminate at pull boxes, the Contractor shall break into the pull box and seal the opening between the innerduct and pull box with a watertight sealer approved by the Engineer.
- H. Warning tape, trace wire and path markers shall be installed along the entire innerduct path as shown in the plans and as directed by the Engineer. Wherever possible, the markers shall be affixed to permanent roadside features within 30 feet of the conduit path. The Contractor shall submit a list of intended mounting locations for the Engineer's approval.

ITEM 662.74125325 - HDPE INNERDUCT 1¼ INCH ID

- I. After installation each innerduct shall be tested for continuity using a nominal 1¼ inch diameter non-collapsible mandrel. The testing equipment shall be approved by the Engineer. Notification of all tests shall be made at least 48 hours prior to testing. All testing shall be witnessed by the Engineer and a third party (if involved).
- J. The minimum bend radius shall be as indicated on the plans, or as recommended by the manufacturer, whichever is greater.

3.02 Documentation.

- A. As-built drawings are required to be completed in MicroStation (.dgn) format and shall include, but not be limited to the following items: the location of the fiber facilities as determined by off-sets from the edge of travel lanes (from yellow or white solid pavement stripe/markings) and depths of the facilities at every delineator; whether the facilities are bored, trenched, or attached to bridge structures; culvert locations in close proximity to the facilities; all ducts, hand holes, fiber optic cables and associated facilities. The as-builts must show every mile and tenth of a mile delineator, the Thruway ROW fence, all cross streets, ramps, streams, rivers and railroads. The beginning and end points of bores, and all culvert and hand hole/manhole locations are to be shown measured along the edge of travel lanes (from yellow or white solid pavement stripe/markings and) from the nearest tenth of a mile marker to the South or East. All splice enclosures, man/hand holes shall be located by coordinates obtained from a hand held GPS unit with minimum accuracy of ± 1 foot. As-builts also need to be organized by milepost with a reference chart to locate the desired location.

4. METHOD OF MEASUREMENT:

- 4.01 The innerducts shall be measured by feet along the axis of the innerduct, of the size and type specified, installed according to the plans, Proposal, or as directed by the Engineer. Measurement shall include all couplings and bends.

ITEM 680.5830--25 - PREFORMED INDUCTANCE LOOP DETECTOR (CAST IN PLACE) INSTALLATION

1. DESCRIPTION:

- 1.01 Under this work the Contractor shall furnish and install a “Never-Fail Loop Detector, Model C”, or approved equal, preformed inductance loop detector of the shape, size and location in accordance with the Plans and this special specification. These Loop Detectors are available from Never-Fail Loop System Inc., 5300 SE Johnson Creek Blvd, Milwaukie OR 97222 | 503-408-9248 | info@neverfailloops.com

2. MATERIALS:

- 2.01 The specific components used in construction of new preformed loop detectors shall meet the following requirements:
- A. Only 3/8 inch trade size schedule 80 polypropylene conduit having a maximum outside diameter of 1 1/16 inch shall be used for the loop portion of the detector.
 - B. Only 3/8 inch trade size rated Nylon-polypropylene flex hose shall be used to connect the loop to either conduit or first pullbox.
 - C. The detector wire shall be 14-gauge TFFN or THHN stranded, single conductor wire with PVC insulation and nylon exterior jacket. Loops shall have five (5) turns of wire or as shown on Plans.
 - D. The filler/sealant used within the loop conduit shall be an asphalt-rubber type.

3. CONSTRUCTION DETAILS:

- 3.01 Each loop shall be constructed at the factory to the dimensions and configuration as shown on the plans. The loop wire and lead-in cable shall be constructed from a continuous length of wire.
- 3.02 The wire ends shall be protected at their ends to prevent moisture and non-compressibles from reaching encased wires. Such materials shall be UL approved shrink tube of acceptable size. Silicone or similar sealing compounds should be used to achieve moisture protection.
- 3.03 The preformed inductance loop detector shall be composed of detector wire encased in a polypropylene conduit internally filled and sealed to prevent the vibration of wires within the conduit. The sealing material shall allow the wire to move transversely over long-time periods to help relieve thermal and pavement shift stress that may be placed on the system. The sealant shall adhere to both the wire and the conduit.
- 3.04 The preformed inductance loop detector conduit and fittings shall be constructed as to allow a minimum variation of $\pm 1\%$. The internal construction of the fittings and joints shall allow no water to penetrate into the conduit or to reach any part of the wire insulation. Conduit fittings shall be made fast with glue approved by the manufacturer of the preformed loop.
- 3.05 The loop lead-in wires (home run) extending from the loop portion of the detector to the first pull box shall be twisted together at a rate of three turns per foot. The lead-in wire shall be routed through a flexible Nylon-polypropylene flex hose from the preformed loop to rigid conduit. The flex hose shall be filled with the same filler/sealer used in the preformed loop.

ITEM 680.5830--25 - PREFORMED INDUCTANCE LOOP DETECTOR (CAST IN PLACE) INSTALLATION

3.06 The conduit, fittings and sealant shall protect the twisted pair wire in the same manner against water intrusion and mechanical damage as the conduit encasing the wires of the loop portion of the detector.

3. CONSTRUCTION DETAILS: (cont'd)

3.07 Prior to placing concrete the preformed loop shall be placed in the proper location and height as shown on the Plans or A.O.B.E. The Contractor shall construct the temporary support as shown on the plans or A.O.B.E. The loops shall be connected to the rigid conduit and the twisted wire pair is to be pulled through to the pullbox.

3.08 Wire splices shall only be permitted within the pullbox. Splices shall be made in accordance with Subsection 680-3.26.

3.09 The resistance of the installed loop shall be tested before the concrete is placed and after the splice is made between the loop wires (twisted pair) and shielded lead-in. Resistance to ground shall be tested in accordance with the Insulation Resistance Test in Subsection 680-3.32, except as noted in this specification. This test shall be repeated 24 hours or more after the concrete is placed for the pavement.

4. METHOD OF MEASUREMENT:

4.01 The work will be measured by the number of preformed inductance loop detectors furnished, assembled and installed in accordance with the Plans or as ordered by the Engineer.

5. BASIS OF PAYMENT:

5.01 The requirements of Subsection 680-5.01 – General, shall apply. The unit price bid for each installation shall include all materials, equipment, labor and supplies required to complete the installation as detailed in this specification. The unit price shall include the loop detector portion and the home-run portion of the detector extending from the loop detector portion to the nearest pullbox.

ITEM 680.5860--25 - PREFORMED INDUCTANCE LOOP DETECTOR (ASPHALT OVERLAY) INSTALLATION

1. DESCRIPTION:

1.01 Under this work the Contractor shall furnish and install “Never-Fail Loop Detector, Model A”, or approved equal, preformed inductance loop detector of the shape, size and location in accordance with the Plans and this special Specification. These Loop Detectors are available from Never-Fail Loop System Inc., 5300 SE Johnson Creek Blvd, Milwaukie OR 97222 | 503-408-9248 | info@neverfailloops.com

2. MATERIALS:

2.01 The specific components used in construction of new preformed loop detectors shall meet the following requirements:

- A. Only 3/8 inch trade size schedule 80 polypropylene conduit having a maximum outside diameter of 11/16 inch shall be used for the loop portion of the detector.
- B. Only 3/8 inch trade size rated Nylon-polypropylene flex hose shall be used to connect the loop to the conduit, first pullbox or equipment cabinet.
- C. The detector wire shall be 14-gauge TFFN or THHN stranded, single conductor wire with PVC insulation and nylon exterior jacket. Loops shall have five (5) turns of wire or as shown on the Plans.
- D. The filler/sealant used within the loop conduit shall be an asphalt-rubber type.

3. CONSTRUCTION DETAILS:

3.01 Each loop shall be constructed at the factory to the dimensions and configuration as shown on the plans. The loop wire and lead-in cable shall be constructed from a continuous length of wire.

3.02 The wire ends shall be protected at their ends to prevent moisture and non-compressibles from reaching encased wires. Such materials shall be UL approved shrink tube of acceptable size. Silicone or similar sealing compounds should be used to achieve moisture protection.

3.03 The preformed inductance loop detector shall be composed of detector wire encased in a polypropylene conduit internally filled and sealed to prevent the vibration of wires within the conduit. The sealing material shall allow the wire to move transversely over long time periods to help relieve thermal and pavement shift stress that may be placed on the system. The sealant shall adhere to both the wire and the conduit.

3.04 The preformed inductance loop detector conduit and fittings shall be constructed as to allow a minimum variation of $\pm 1\%$. The internal construction of the fittings and joints shall allow no water to penetrate into the conduit or to reach any part of the wire insulation. Conduit fittings shall be made fast with glue approved by the manufacturer of the preformed loop.

3.05 The loop lead-in wires (home run) extending from the loop portion of the detector to the connection point shall be twisted together at a rate of three turns per foot. The lead-in wire shall be routed through a flexible Nylon-polypropylene flex hose from the preformed loop to rigid conduit. The flex hose shall be filled with the same filler/sealer used in the preformed loop.

ITEM 680.5860--25 - PREFORMED INDUCTANCE LOOP DETECTOR (ASPHALT OVERLAY) INSTALLATION

3.06 The conduit, fittings and sealant shall protect the twisted pair wire in the same manner against water intrusion and mechanical damage as the conduit encasing the wires of the loop portion of the detector.

3. CONSTRUCTION DETAILS: (cont'd)

3.07 The inductance loop shall be placed on the newly milled asphalt surface. Prior to placing the new asphalt courses the preformed loop shall be placed in the proper location and depth as shown on the Plans or A.O.B.E. The milled surface shall be swept free of all loose material prior to placing the loop. The loop shall be temporarily held in place with tack coat, asphalt sealant or other method approved by the Engineer until the asphalt overlay is placed. Pairs of loops shall be set within ½ inch of the specified location with relation to each other loop, as measured from the longitudinal center of each transverse tube segment. The loop shall be connected to the rigid conduit and the twisted wire pair is to be pulled through to the pullbox.

3.08 Wire splices shall only be permitted within the pullbox or equipment cabinet. Splices shall be made in accordance with Subsection 680-3.26.

3.09 The resistance of the installed loop shall be tested before the concrete is placed and after the splice is made between the loop wires (twisted pair) and shielded lead-in. Resistance to ground shall be tested in accordance with the Insulation Resistance Test in Subsection 680-3.26, except as noted in this specification. This test shall be repeated 24 hours or more after the asphalt overlay is placed over the loop.

4. METHOD OF MEASUREMENT:

4.01 The work will be measured by the number of preformed inductance loop detectors furnished, assembled and installed in accordance with the Plans or as ordered by the Engineer.

5. BASIS OF PAYMENT:

5.01 The requirements of Subsection 680-5.01 – General, shall apply. The unit price bid for each installation shall include all materials, equipment, labor, and supplies required to complete the installation as detailed in this specification. The unit price shall include the loop detector portion and the home-run portion of the detector extending from the loop detector portion to the point of termination.

ITEM 680.8020XX25 - CABINETS FOR ITS EQUIPMENT

1. DESCRIPTION:

1.01 This work shall consist of furnishing and installing cabinets in accordance with this specification and as shown on the plans.

2. MATERIALS:

2.01 The cabinets shall be NEMA 4X, 14 gauge, type 304 stainless steel or aluminum cabinets with top and side sun shields sized as required to contain the specified components. The cabinets shall have a lockable, gasketed door with a heavy gauge stainless steel continuous hinge.

2.02 The following cabinets shall be used:

A. For Traffic Data Systems (TDS) or Highway Advisory Radio (HAR) Transmitter:
Model A48H3616SS6LP3PT, Manufactured by Hoffman Enclosures, Inc.

B. For HAR Sign Controller:
Model A24H2408SS6LP3PT, manufactured by Hoffman Enclosures, Inc.

C. For Closed Circuit Television (CCTV):
Model A30H2408SSLP3PT, manufactured by Hoffman Enclosures, Inc.

D. For TRANSMIT:
Model FR443624, manufactured by APX Enclosures, Inc.

Suitable alternatives will be considered.

2.03 The cabinets shall be furnished complete with all internal components and all mounting hardware necessary to provide for the installation of the field equipment specified in the Contract Documents. Interconnection to the field equipment shall be provided via the terminal facility harness, provided by the Contractor by means of a mating MS type connector except as noted otherwise in this document.

2.04 All cabinets shall be identical in size, shape, and quality. In addition, the cabinets shall be equipped internally as specified herein, and as required, for the equipment to be installed.

2.05 **ITS Equipment Cabinets** shall house the following components provided either under these items, separate items in this Contract or by others:

- Equipment to provide power to the components being housed.
- Communication equipment.
- Fiber optic, telephone communications line termination equipment or microwave transceiver.
- All conductors, terminals, and parts which could be hazardous to maintenance personnel shall be protected with suitable insulating material.

2.06 All AC powered cabinets shall have two (2) sub-cabinets mounted outside of the main cabinet as shown in the plans. The sub-cabinets shall be as follows:

A. Circuit breaker cabinet shall be a Square D Model Q011224L125GRB.

1. Fused disconnect switch – 600 volt, 2-pole, 30 amp non-enclosed fused disconnect switch. Fuse switch with Class J, fast acting current limiting 6 amp fuses.

ITEM 680.8020XX25 - CABINETS FOR ITS EQUIPMENT

2. **Secondary Circuit Breaker.** Secondary breakers shall be provided to protect the convenience outlets. The circuit breakers shall be approved and listed by the Underwriters Laboratories. The operating mechanism shall be enclosed, trip free from operating handle on overload and trip indicating. Contacts shall be silver alloy enclosed in an arc quenching chamber. Properly rated equipment circuit breaker(s) shall be provided for the equipment complement shown on the plans.

Circuit breakers shall be unaffected by ambient temperature range, relative humidity, applied power, shock and vibration range specified in NEMA TS1. Breakers shall have a minimum interrupt capacity of 5000A.

3. **Circuit Breaker Holder Terminal Block.** Provide rail mounted, circuit breaker holding terminal blocks capable of accepting .5 amp to 20 amp breakers rated for 300 volts.
- B. Noise filter cabinet shall be Hoffman Model A16H1206SSLP. The cabinet will house a Control Concepts Model IC+130 Noise Filter.
- C. AC power supply shall enter the noise filter as shown on the plans. Power out will go to the breaker cabinet. Individual circuits will be wired from the breaker panel into the main cabinet as shown in the Plans.

2.07 **Cabinet Assembly.** Each cabinet assembly shall include, but not be limited to, the following:

- Enclosure
- Door
- Latches/Locks
- Hinges and Door Catches
- Input/Communication Panel(s)
- Equipment Rack Supports and Shelving
- Fan
- Lighting
- Plastic Envelope
- Gaskets
- Heater

- A. **Door.** The cabinet shall have a full size door that is hinged on the right side. The cabinet shall not contain a police door. The door frame shall be double flanged out on all four (4) sides and shall have strikers to hold tension and hold a firm seal between the door gaskets and frame.

The door shall be sealed with a closed cell neoprene gasket bonded to the inside of the door with an oil resistant adhesive.

- B. **Hinge.** Continuous door hinge shall be provided to bolt the enclosure to the door. The hinge shall have a 0.25 inch stainless steel fixed pin. The hinge shall be attached with stainless steel carriage bolts and nylock nuts.

The door shall be provided with catches to hold the door open at both 90 and 180 ±10 degrees. The catches shall be capable of holding the door open at 90° in a 60 mi/hr wind acting at an angle perpendicular to the plane of the door.

- C. **Door Latching.** The handle shall be a minimum of 0.75 inch diameter stainless steel round bar. The door lock provided as part of this project shall be keyed the same. In addition to Grand

ITEM 680.8020XX25 - CABINETS FOR ITS EQUIPMENT

Master Key #1 – 10D, the lock shall be keyed to #2. Two #2 lock keys shall be provided for each cabinet. A padlock may be substituted for the integral lock if the cabinet is constructed as such. The latching mechanism shall be a three-point draw roller type.

When the door is closed and latched, the door shall be locked. The lock and lock support shall be rigidly mounted on the door. In the locked position, the bolt throw shall extend a minimum of 0.25 inch into the latch cam area.

Rollers shall have a minimum diameter of 0.875 inch with nylon wheels and steel ball bearings.

- D. **Gaskets.** Gaskets shall be provided on the door opening and shall be dust tight. Gaskets shall be 0.25 inch minimum thickness closed cell neoprene or silicone (BOYD R-10480 or equal) and shall be permanently bonded to the metal. If neoprene is used, the mating surfaces of the gaskets shall be covered with a silicone lubricant to prevent sticking to the mating surface. A gasket top channel shall be provided to support the top gasket on the door (prevent gasket gravitational fatigue).
- E. **Cabinet Cage.** A standard EIA 19 inch rack cage shall be installed inside the housing for rack-mounted components if identified in the plans. The rack cage shall be designed to support the equipment designated in the Contract Documents.
- F. **Top.** The cabinet shall have sloped top to prevent water accumulation.
- G. **Shelving.** Stainless steel shelves shall be provided to accommodate non-rack mountable equipment. The shelves shall meet the following requirements:
 - Constructed of 0.125 inch aluminum (minimum) with a 1-inch lip turned up along the back of the shelves.
 - Shelves shall be attached to the rack (if any).
 - Support a minimum of 55 lb.
 - Shelf mounted equipment shall be mounted flat on the shelf. Stacking of equipment is not permitted.

2.08 All surfaces, edges and corners shall be smooth and burr-free.

2.09 ITS cabinets shall be mounted as shown on plans and shall have welded stiffer plates on the top and bottom of the rear wall.

2.10 The cabinets shall contain the following:

- A. **Lighting Package.** Minimum 20 watt fluorescent bulb with wire guard. The cabinet shall have a switch that enables the enables the switch to turn on when the cabinet door is opened.
- B. **Electric Heater.** 200 watt, 120 volt with an integral fan. Control shall be with an integral air sensing thermostat adjustable from 0°F to 100°F.
- C. **Fiber Optic Splice Racks.** Provide splice racks capable of holding up to six mechanical splice connectors in cabinets where fiber optic communications shall be used.
- D. **Duplex Receptacle.** Provide one duplex GFI 20 amp receptacle for general use.
- E. **Conductors.** All conductors shall be copper type THWN. Twisted shielded conductors for signal transmission shall be in accordance with the equipment manufacturer's recommendations.

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- F. A thermostatically controlled fan for air circulation shall be furnished, mounted in the top of the cabinet and completely wired.
- G. **Plastic Envelope.** The door housing shall be equipped with metal hooks to hang a plastic envelope as specified herein. A re-sealable plastic envelope shall be mounted to the door of the cabinet. The envelope shall be sized to accommodate one (1) complete set of cabinet prints.
- H. **Thermostat Noise Suppressor.** Metal Oxide Varistors (MOV) of appropriate ratings shall be placed across the heater and blower thermostats. The MOV shall be connected to ground.
- I. **Ground Bus.** A solid copper grounding bus bar shall be permanently mounted to the inside surface of the cabinet wall. The point of contact between the ground bus bar and the cabinet wall shall have less than 1 ohm resistance. The copper ground bus bar shall have a minimum of 20 connector points, each capable of securing at least one #8 conductor. A.C. return and equipment ground wiring shall return to the ground bus bar. Where multiple ground bus bars are used, they shall be bonded to each other with bare stranded #8 copper wire. The length of the #8 ground conductor shall be as short as possible. All surge suppressor grounds shall return to this bus.
- J. The cabinet shall have the following panels:

- 1. **Input/Communications Panel.** All communication and data lines entering or leaving the cabinet shall be terminated in terminal blocks mounted on the input/ communications panel. The DC and T-1 surge protectors previously described shall be mounted on this panel.

The interconnection (cabling) between all equipment housed in the cabinet shall be via terminal blocks mounted on the Input/Communications panel.

Fiber optic splice rack shall also be installed as part of this panel for sites using fiber optic communications.

- 2. **Signal Distribution Panel.** All communication and data lines to the reader shall be terminated in terminal blocks mounted on the signal distribution panel. All surge protectors previously described shall be mounted on this panel.

- K. For Transmit cabinets where fiber optic cabling is not used, a Digi Connect Port WA VPN, Model WR31-M52A-DE1-B with power supply TDK Lambda Model DRB30-12-1 shall be included. The antenna shall be a Cell Antenna, Model CAF822.

- L. **Cabinet Wiring.** All conductors used in cabinet wiring shall terminate with properly sized non-insulated (if used, for DC logic only) or clear insulated spring-spade type terminals except when soldered to a through-panel solder lug on the rear side of the terminal block or as specified otherwise. All crimp-style connectors shall be applied with a power tool which prevents opening of the handles until the crimp is completed.

Conductors between the service terminal AC- and equipment ground and their associated bus, the equipment ground bus conductor to Power Distribution Assembly and cage rail, AC- Bus to Power Distribution Assembly shall be No. 8 or larger.

All conductors shall be labeled. Labels attached to each end of the conductor shall identify the destination of the other end of the conductor.

All conductors shall conform to the following color-code requirements:

- 1. AC neutral – continuous white or gray

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2. Ground – solid green
3. DC logic ground conductors – solid white with a red stripe
4. Ungrounded AC+ conductors – solid black wire
5. Logic ungrounded conductors – any color not specified above.

All wiring harnesses shall be neat, firm, and routed to minimize crosstalk and electrical interference. Wiring containing AC shall be routed and bundled separately or shielded separately from all logic voltage control circuits.

Cabling shall be routed to prevent conductors from being in contact with metal edges.

Cabling shall be arranged so that any removable assembly may be removed without disturbing conductors not associated with that assembly.

Within the cabinet, the DC logic ground and equipment ground shall be electrically isolated from the AC grounded conductor and each other by 500 megohms when tested at 250 VDC, with the power line surge protector disconnected.

The AC- copper terminal bus shall not be grounded to the cabinet or connected to logic ground.

The cabinets power supply DC Ground shall be connected to the DC logic ground bus using a No. 14 AWG, or larger, stranded copper wire.

- M. A self-sealing rubber grommet and a binding post shall be installed in the bottom of all cabinets where fiber optic cabling is used. The post shall be of bright tin plated brass, Pomona electronics model 3760 (Red) or approved equal.

3. CONSTRUCTION DETAILS:

- 3.01 The Contractor shall submit for approval a layout for the cabinets. The layout shall show all equipment, wiring and mounting information. No cabinet shall be installed without a schematic approved by the Engineer.
- 3.02 The heater shall be mounted in the bottom of the cabinet.
- 3.03 Grounding of the cabinets shall be in accordance with all applicable codes. A copper clad ground rod, wire, and fittings shall be installed in accordance with the latest version of Section 680-3.12 of the New York State Standard Specifications. The completed ground system shall be tested in accordance with Section 680-3.32 of the Standard Specifications.
- 3.04 All internal wiring shall be exposed.
- 3.05 **Installation of External Cables into the Cabinets.** All wire shall be cut to the appropriate length prior to installation. Insulated pre-printed sleeving shall be used to identify all wires prior to connection. Wires shall be neatly laced with nylon lacing or plastic straps. Cables shall be secured with suitable clamps.
- 3.06 **Cabinet Acceptance Test.** In addition to the environmental and design approval tests specified in the FHWA Type 170 Traffic Signal Control System Hardware Specification, the following water spray test shall be performed for each type of cabinet:

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- A. Spray water from a point directly overhead at an angle of 60° from the vertical axis of the cabinet. Repeat for each of eight equally spaced positions around the cabinet for a period of five (5) minutes in each position.

The water shall be sprayed using a domestic type sprinkling nozzle at a rate of not less than 10 gallons per minute per square foot of surface area. The cabinet shall then be inspected for leakage. Evidence of water leakage shall be cause for rejection.

3.07 Documentation

- A. **Shop Drawings.** Shop drawings and wiring lists showing the proposed cabinet layout shall be submitted to the Engineer for approval prior to the start of fabrication. Manufacturer cut sheets for all electrical equipment included in the cabinet shall be included in the submission.

The Contractor shall provide electronic version of the shop drawings in “dwg” format.

- B. **As-Built Drawings.** Four (4) copies of drawings showing the wiring for the cabinet shall be provided. One (1) copy shall be placed in the clear plastic envelope furnished as part of the cabinet. The other three (3) copies shall be delivered to the Engineer.

The Contractor shall provide electronic version of the shop drawings in “dwg” format.

- C. **Cabinet Configuration List.** Four (4) copies of a configuration of the equipment reporting to that cabinet shall be provided. The sheet shall also list field settable options for the equipment contained in the cabinet. This shall include device addresses, and output voltage settings for power supplies. One of these copies shall be placed in the clear plastic envelope furnished as part of the cabinet. The other three (3) copies shall be delivered to the Engineer.

4. METHOD OF MEASUREMENT:

- 4.01 The work shall be measured on an each basis for each cabinet installed as indicated on the drawings or as specified.

5. BASIS OF PAYMENT:

- 5.01 The unit price bid for each cabinet shall include the cost of furnishing all labor, equipment and material necessary to complete the work.

- 5.02 Payment will be made under:

<u>Item No.</u>	<u>Description</u>	<u>Pay Unit</u>
680.80200125	TDS/HAR Transmitter Cabinet	Each
680.80200225	HAR Sign Controller Cabinet	Each
680.80200325	CCTV Cabinet	Each
680.80200425	TRANSMIT Cabinet	Each

ITEM 683.6730--25 – CCTV CAMERA SITE EQUIPMENT – PEDESTAL MOUNT

1. DESCRIPTION:

- 1.01 Under this item the Contractor shall furnish and install CCTV (Closed Circuit Television) Camera Site Equipment at the locations shown on the plans and as specified herein. All work shall be done in accordance with the Contract documents and as ordered by the Engineer.
- 1.02 This document defines the Contractor’s responsibility in furnishing and installing CCTV Camera Sites (Closed Circuit Television).
- 1.03 This equipment shall be fully compatible with the existing CCTV system.
- 1.04 Post-Bid Submittal: Due to the specialized nature of this work and the requirement that the Contractor assume full responsibility for furnishing and installing the CCTV sites, the successful bidder shall be required to submit the following materials, within ten (10) days after the award:
 - A. A list of specific equipment to be used, including description, manufacturers' names and part numbers. Equipment brochures or catalog cut sheets shall be provided for each unit with the items selected clearly identified. Sufficient details must be presented to demonstrate that requirements of Section 2.06 of this document are satisfied.
 - B. Any changes proposed by the Contractor shall be requested in writing, without exception.
 - C. The materials submitted by the Contractor will be evaluated by the Engineer and the Authority for acceptance or rejection.

2. MATERIALS:

2.01 Introduction.

- A. The purpose of a CCTV Traffic Management Site is to provide a supplementary means for remotely monitoring traffic flow in a section of roadway. A full-motion video system with remote control functions of cameras, lenses, and pan/tilt units has been installed and is presently operating in the field. This system is referred to below as the Existing Video System. The Contractor shall furnish and install the CCTV traffic management sites described in this specification and in accordance with the plans. The new sites will be connected to the existing Authority wide area network via T-1, fiber, or wireless (non-cellular).
- B. All materials shall be new, unless otherwise indicated on the plans or in these Special Specifications. All incidental parts which are necessary to complete the installation, but are not specified herein or on the plans, shall be provided as necessary to complete a properly operating system.

2.02 Description.

- A. **Existing Video System.** The existing video system consists of cameras Statewide with control capabilities at the Thruway Statewide Operations Center at Headquarters and other locations.
- B. **Remote Monitoring and Control.** Current use: System Personal Computers are located at the Thruway Statewide Operations Center at Headquarters and other locations.

Functions: Each PC with appropriate rights and software can select and control camera:

PT/Zoom/Focus/Iris

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Pre-Positions
Wiper Activation

Camera and lens presets and/or individual tours can also be established and controlled from the remote keyboard.

- C. **New CCTV Camera Sites.** The Contractor shall furnish and install CCTV field equipment at the locations shown on the plans. The video and control signals will be encoded to digital format and transmitted via Fiber optic cable to the Authority’s existing Fiberoptic Network drops located in the appropriate Thruway facility, such as a toll utility building (TUB). Where no network connection is available, the contractor shall connect to a T-1 line, or wireless Ethernet. The contractor shall arrange to make all physical connections, and the Authority will be responsible for establishing the account for the leased line(s).

All identical equipment provided shall be physically, functionally, and plug interchangeable with each other and the existing system.

Documentation of the existing system and equipment will be available for the Contractor’s review.

D. **New Video System Equipment.**

1. Install high-resolution color IP cameras and communication equipment as shown on the plans.
2. Establish dependable video and data communications to and from above sites and the appropriate control facility.
3. All new camera sites shall utilize communication for camera/PTZ control from Authority owned software.
4. Install Ethernet/Fiber media converters in various locations where required.

2.03 **Deliverable Services.** This section describes the services to be supplied by the Contractor in addition to the deliverable equipment. They are necessary to assure the provision of properly functioning equipment, correct installation and operation, and complete utilization until final acceptance of the system.

- A. **Documentation.** The Contractor shall supply all documentation necessary for proper identification, fabrication, installation, operation, and maintenance of the system. This shall include, as a minimum, the following:

1. **Equipment and Materials Lists.** Equipment and materials lists shall be provided in accordance with Section 1.2. One (1) original and an electronic copy of the shop drawings shall also be required for each fabricated item.

No acceptance tests will be run until the Engineer approves equipment and materials lists, modification details, and shop drawings, in writing.

2. **Manuals.** The Contractor shall provide seven (7) copies of Installation/Operation/Maintenance manuals for each item of electronic equipment. The manuals shall meet the requirements described in Subsection 2.09.J “Documentation Requirements.” Draft copies shall be submitted thirty (30) days before delivery of equipment. Final copies of all manuals shall be delivered coincident with completion of system acceptance tests. Two (2) copies will be delivered to ITSM at NYSTA Headquarters.

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3. **Test Procedures and Data Forms.** Test procedure can be found at the end of this specification. The test procedures will indicate the use of test fixtures, instruments, and/or system equipment that is required to perform a specific test. Tests shall demonstrate all functional capabilities of the system as described in Subsection 2.10 M.

B. **Warranties and Guarantees.** All of the mechanical and electronic equipment specified to make the system operational and functional shall be warranted for a period of two (2) years. The warranties shall be issued to the New York State Thruway Authority by the respective manufacturer and/or system fabricator. This item shall not be considered complete and final payment will be withheld until all warranties are transferred to the Authority. The warranties shall cover the repair or replacement of the component or device. Replacements shall be new units. The Authority will be responsible for removing and re-installing the component or device after contract acceptance. The warranties shall be effective from the date of final acceptance of the item.

The Contractor shall comply with Subsection 104-08 of the Standard Specifications for the initial warranty period.

Nothing contained in these Special Specifications shall relieve the Contractor of the implied warranty that the equipment, system, and service provided are both first quality, fit, and merchantable for the uses intended as indicated herein.

C. **Service and Maintenance.** The Contractor shall be responsible for servicing and maintaining the equipment described in this Specification and all cable installed under other contract items that will connect the sites to the existing CCTV system. The maintenance shall commence on the integration of the site(s) into the existing system and shall continue uninterrupted through final contract acceptance.

2.04 **Standards.** All materials and work shall conform to the requirements of the latest versions of the National Electrical Code (NEC) and National Electric Safety Code (NESO), New York State Buildings Code New York State Department of Transportation Standard Specifications and the Counties in which the work will be performed insofar as they apply.

All equipment shall conform to the standards and specifications where applicable, set forth by the following agencies and organizations. In case of conflict, the more stringent standard shall prevail. These Special Specifications shall have the highest priority for all system and equipment requirements.

NEMA	National Electrical Manufacturers Association.
UL	Underwriters Laboratory.
EIA	Electronic Industries Association.
JEDEC	Joint Electronic Device Engineering Council.
IEEE	Institute of Electrical and Electronics Engineering.

2.05 **Definitions.** The following terms shall apply within the scope of this procurement specification:

A. **CCTV Camera Controller** – A CCTV Camera Controller includes the camera control receiver, cabinet, camera, lens, enclosure, encoder/decoder and pan/tilt assembly.

B. **Management System** – A management system used to control a CCTV Camera. This includes any laptop software used for field control as well as the central control software.

2.06 **Property Rights.** The manufacturer shall allow the use of any and all of this documentation by any party authorized by the Procuring Agency for systems integration purposes at any time initially or in the future, regardless of what parties are involved in the systems integration effort.

2.07 **Acceptance Testing.** As part of the overall Testing Requirements (see “Testing” Section below), the

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manufacturer shall propose to the AGENCY a set of tests that will fulfill the functional requirements.

- 2.08 **Warranties.** In addition, the developer shall provide free software upgrades for a period of 2 years from successful acceptance of the individual CCTV assemblies.
- 2.09 **General Equipment Specifications.** The following paragraphs define the general requirements that apply to all equipment unless stated otherwise.

In the selection of parts and materials, fulfillment of the requirements of these specifications shall be prime consideration. In so doing, the various equipment designs shall utilize the latest available techniques and utilize the minimum number of different parts, subassembly circuits, cards and/or modules, to maximize standardization and commonality.

All work completed under this project shall be in full conformance with the New York State Department of Transportation Standard Specifications unless amended by these Special Specifications.

The equipment shall be designed such that the failure of one piece of equipment shall not cause the failure of any other piece of equipment or failure of the complete system.

The equipment shall be modular in design such that major portions may be readily replaced in the field. Modules of unlike function shall be mechanically keyed to prevent insertion into the wrong socket or connector.

All modules and assemblies shall be clearly identified with name, model number, serial number, and any other pertinent information required to facilitate equipment maintenance.

- A. **Connectors.** Unless otherwise specified, all external connections shall be made by means of connectors. The connectors shall be keyed to preclude improper hookups. All wires to and from the connectors shall be color-coded and appropriately labeled. Labels shall indicate the origin and destination of each wire. The materials proposed for the labeling shall be submitted to the Engineer prior to use.

- B. **Fuses.** Fuses shall be used for over-current protection in each unit of equipment.

Fuse rating shall be in accordance with the NEC recommendation. The value of each fuse shall be clearly indicated by the lettering process incorporated on the panel. Fuse type shall be AGC or equal, unless otherwise approved by the Engineer.

- C. **Wiring.** All hook-up wires shall be fire retardant and shall be the stranded type. Current carrying capacity shall conform to the latest NEC.

Wires shall not be smaller than AWG No. 22.

Hook-up wires in the device shall be distinctly color coded far as practical, or as agreed upon by the Engineer, in order to facilitate testing and trouble-shooting.

Sledding over bare wires is not permitted.

Solid wires may be used in the device, provided such wires are insulated or held in place so that they do not fail or show excessive motion when the equipment is subjected to the specified service condition. Solid wires must be supported at intervals not greater than five (5) inches. Wires shall be securely connected to terminals prior to soldering, and shall not depend on solder for mechanical stability.

All wiring shall meet the requirements of the latest version of NEC. All wires shall be cut to proper

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length before assembly. No wire shall be double-backed to take up slack. Wires shall be neatly laced in cable with nylon lacing or plastic straps. Cables shall be secured with clamps.

- D. **Power Requirements.** Unless specified otherwise, the field equipment shall meet all of its specified requirements when the input power is 115 ± 15 VAC, 60+/- 3 Hz. Central equipment shall meet all of its specified requirements when the input power is 115 ± 10 VAC, 60 \pm /-0.5 Hz.

The equipment operation shall not be affected by transient voltages, surges, and sags normally experienced on commercial power lines. It is the Contractor's responsibility to check the local power service to determine if any special design is needed for the equipment. The extra cost, if required, shall be included in the bid price of this item.

- E. **Power Service Protection.** The equipment shall contain readily accessible, manually re-settable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.
- F. **Hardware.** All external screws, nuts, and locking washers shall be stainless steel; no self-tapping screws shall be used unless specifically approved by the Engineer. All screws, nuts, and locking washers used internally shall be of corrosion resistant material, or suitably plated to resist corrosion. All material furnished shall be new, first quality, and used in accordance with the highest industry practice.
- G. **Material.** All parts shall be made of corrosion resistant material, such as plastic, stainless steel, aluminum or brass; or shall be treated with corrosion resistant material such as cadmium plating or galvanizing.
- H. **Component Mounting and Identification.** Operating circuit components mounted on circuit boards shall be identified by either identifying characters which shall be legible and permanently printed on the circuit boards or by the use of complete assembly drawings showing all components with values or JEDEC numbers. The identification characters shall be referenced to their respective components in the schematic diagram in the parts list.
- I. **Environmental Design Requirements.** The equipment shall meet all its specified requirements during and after subjection to any combination of the following conditions:
- Field equipment temperature range 0 to 120°F;
 - Relative humidity range from 5 to 95%, non-condensing.

The field equipment shall not suffer any permanent damage when operating at 13° above or 13° below the ambient temperature described above.

- J. **Documentation Requirements.** Three (3) complete sets of operation and maintenance manuals shall be provided. The manuals shall, as a minimum, include the following
- Complete and accurate schematic diagrams and complete installation procedures.

Complete performance specifications (Functional, electrical, mechanical, and environmental) on the unit. Complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.

Pictorial of component layout on circuit board. Complete maintenance and trouble-shooting procedures. Complete stage-by-stage explanation of circuit theory and operations.

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K. Testing.

Acceptance Testing. As part of the overall Testing Requirements (see “Testing” Section below), the manufacturer shall propose to the AGENCY a set of tests that will fulfill the functional requirements.

Four (4) types of tests shall be required for each unit of equipment furnished under this contract: Design Approval Tests, Pre-Installation Tests, On-site stand-alone Tests, and Final Site Acceptance Test (System Integration Tests.) Each of these types of tests is described in the following paragraphs.

Additional test requirements are specified within each subsystem section.

The Contractor shall be responsible for developing detailed procedures for each type of equipment and for conducting the specified acceptance tests to verify satisfactory operation of the equipment. The test procedures shall be submitted to the Engineer for approval prior to the test. Only approved test procedures shall be used for the tests. A minimum of ten (10) days shall be allowed for the Engineer’s review and approval of the test procedures.

The Engineer shall be notified in writing a minimum of ten (10) days in advance of the time when these tests are to be conducted.

The results of each test shall be compared with the requirements specified herein. Failure to conform to the requirements of any test shall be counted as a defect, and the equipment shall be subject to rejection by the Engineer. Rejected equipment may be offered again for retest provided all non-compliance’s have been corrected and re-tested by the Contractor and evidence thereof submitted to the Engineer.

Final inspection and acceptance of equipment shall be made after installation at the locations specified unless otherwise specified herein.

- L. Design Approval Tests.** Design approval tests shall be conducted by the Contractor and ITSM on one or more sample equipment of each type, as approved by the Engineer. The purpose of including ITSM in this test the test is to determine if the design of the equipment meets the requirements of this specification. The tests shall be conducted in accordance with the approved test procedures.

In the case of standard product line equipment, the Engineer may waive the design approval tests if the manufacturers written specification (functional and environmental) are equal to or better than those in Section 2. The waiver must be requested in writing or the Contractor must provide certification by an independent testing laboratory that these design approval tests have been previously satisfactorily completed. The design approval tests may be waived for equipment identical to existing equipment currently in service.

The design approval tests shall cover the following:

1. **Temperature.** For the field equipment, Operational Tests shall be successfully performed under the following conditions in the order specified below:

The equipment shall be stabilized at 32°F. After stabilization at this temperature, the equipment shall operate without degradation for 2 hours.

The equipment shall be stabilized at 122°F. After stabilization, the equipment shall be satisfactorily operated for 2 hours without degradation or failure.

2. **Relative Humidity.** All field equipment shall meet its performance requirements when subjected to a temperature and relative humidity of 122°F and 70 percent, respectively. The equipment shall be

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maintained at the above condition for 48 hours. At the conclusion of the 48-hour soak, within 30 minutes the equipment shall meet the requirements of the Operational Test

3. **Power Variation.** The equipment shall meet the specified performance requirements when the input voltage is plus or minus 15 volts from the nominal value of 115 volts. The equipment shall be operated at the extreme limits for at least 15 minutes during which the Operations Tests shall be successfully performed.

If the unit fails the design approval test, the design fault shall be corrected and the entire design approval test shall be repeated. Deliverable units shall be modified, without additional cost to the Authority, to include design changes required to pass the design approval tests.

- M. **Pre-Installation Tests.** The Contractor shall be responsible for conducting approved pre-installation tests on all units supplied. These tests shall be performed in the presence of the Engineer.

The Engineer will determine the location of the test.

Each unit of equipment shall be operated long enough to permit equipment temperature and to check and record an adequate number of performance characteristics to ensure compliance with the requirements of this specification. The operational tests shall be as described in the equipment specification subsections.

The operational tests shall include the following functions at a minimum:

- Pan/Tilt thru range as specified in manufacturers spec.
- Zoom thru range as specified in manufacturers spec.
- Automatic iris / manual override
- Automatic focus / manual override
- Ability to set 2 independent presets and recall of each (e.g 1 & 63)
- Wiper function
- Ability to change/set internal camera parameters ... e.g. shutter speed, software zoom, backlight, etc.

If a unit fails its pre-installation test, the unit shall be corrected or another unit substituted in its place and the test successfully repeated.

If a unit has been modified as a result of a test failure, a report shall be prepared and delivered to the Engineer prior to installation of the unit. The report shall describe the nature of the failure and the corrective action taken. If a failure pattern as defined by the Engineer develops, the Engineer may direct that design and construction modifications be made to all units without additional cost to the Authority or extension of the contract period.

If a unit has been modified as a result of a test failure, a report shall be prepared and delivered to the Engineer prior to installation of the unit. The report shall describe the nature of the failure and the corrective action taken. If a failure pattern as defined by the Engineer develops, the Engineer may direct that design and construction modifications be made to all units without additional cost to the Authority or extension of the contract period.

N. On Site Stand Alone Test - Local Control.

1. Operation of all CCTV equipment exercising the pan, tilt, zoom, focus, auto iris override, auto focus override, pan/tilt/zoom position preset and auxiliary output on/off functions from ground level field

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support cabinets utilizing a ‘Desktop’ controller or lap-top PC with appropriate contractor supplied software.

Demonstration of the camera output video signal with a video monitor.

2. **Stand-Alone Tests.** The Contractor shall conduct an approved stand-alone test of equipment after installation at the field site. The test shall, as a minimum, exercise all stand-alone (non-network) functional operations of the field equipment with all the equipment installed per the plans as directed by the Engineer. Approved data forms shall be completed and turned over to the Engineer and ITSM as the basis for review and rejection or acceptance.

If a unit fails its stand-alone test, the unit shall be corrected or another unit substituted in its place and the test successfully repeated.

If a unit has been modified as a result of a stand-alone test failure, a report shall be prepared and delivered to the Engineer prior to re-testing of the unit. The report shall describe the nature of the failure and the corrective action taken. If a failure pattern, as defined by the Engineer, develops, then design and construction modifications may be required to all units without additional cost to the Authority or extension of the contract period.

- O. **Final Site Acceptance Test (System Integration Test).** Following satisfactory completion of the stand-alone test, the Contractor will connect each site to the system and a final acceptance test shall be conducted.

The final site acceptance test shall, as a minimum, exercise functional operation of each unit of equipment under this contract with existing equipment as an integrated system. The test shall also demonstrate the operations of the existing equipment in the integrated system. The test shall include a fourteen (14) day period of normal operations, which includes acceptable picture quality and all control features without any failure of equipment supplied by the Contractor. The Engineer shall review all site operations and will make the final decision on failure or acceptance.

In the event of a failure in any of the Contractor supplied equipment, the 14-day test period shall be restarted. In the event of a failure of any equipment installed by others, the test shall be suspended until the Authority makes the necessary repairs and then the test shall be resumed for the continuation of the 14-day period.

- P. **Test Procedure.** The Contractor shall provide all design approval, pre-installation, stand-alone, and data forms for the Engineer's approval. The test procedures shall include the sequence of conducting the tests. The test procedures shall have the Engineer's approval prior to submission of equipment for tests.

The final system acceptance test procedures will be provided by the Authority.

The Contractor shall furnish data forms containing all of the data taken, as well as quantitative results for all tests. An authorized representative of the Contractor shall sign the data forms. At least one copy of the data forms shall be sent to the Engineer.

- Q. **Maintenance and Set-Up Training.** The Contractor shall provide one (1) day of maintenance and set-up training for up to 10 people at a Thruway Authority location to be determined by the Engineer. The training shall be for eight (8) hours during the normal working time of the Thruway. The Contractor shall provide training materials and syllabus. These materials shall be submitted to the Engineer for approval prior to the training. This training may be waived by the Engineer, if in the opinion of the Authority, all personnel are already trained.

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2.10 CCTV Field Equipment.

- A. **Description.** The Contractor shall furnish and install the closed circuit television (CCTV) field equipment for the Traffic Management Sites at designated locations as shown on the plans, as described in these special specifications and as directed by the Engineer.
- B. **Material.** The field equipment shall include, but is not limited to, the following:
- Color camera, lens, receiver/driver, and accessories
 - Camera enclosure with wiper
 - Camera controller with integrated pan/tilt
 - Interface equipment for the mode of signal transmission
 - Fiber protocol converters (Ethernet/Fiber), T1 CSU/DSU when applicable
 - Wireless Ethernet, when applicable
- C. **Functional Requirements.** The field equipment to be provided, together with the existing central equipment in Headquarters and existing field equipment shall form a complete CCTV system to generate color video signals from the cameras in the field for display in the Thruway's Statewide Operation Center and various other Thruway locations.

The system shall be capable of providing clear, low-bloom, and low-smear color video pictures during daylight hours and usable pictures at night.

All field equipment installed shall be operational in all weather conditions and shall be able to withstand a wind load of 90 MPH in combination with ½ inch of ice on all surfaces.

Identical equipment used at each field location shall be completely interchangeable.

D. General Requirements.

1. **Controller Address.** Each unit shall have a unique address that is field settable by changing dip-switch settings. The unit shall respond to the central command if and only if it is addressed by the control data.

The receiver/driver will provide camera, pan/tilt, and lens and wiper functions described above. A control generator 'Desktop joystick' or laptop PC with appropriate software shall be provided to control the camera, pan/tilt unit, wiper and lens motions locally from the ground level cabinet.
2. **Communications Interface.** Communications signals and data exchange protocol and timing shall be compatible with the controller, and with the camera control receiver/driver and communications path.
3. **Surge Protection.** The Contractor shall furnish and install surge protection equipment for the CCTV field equipment in all locations.
4. The camera installation shall meet the following requirements:
 - a. Pole mounting adapter -- Electrically bonded to pole. Camera housing -- Electrically bonded to adapter.
 - b. Camera ground strap -- No. 6 AWG braided conductor to connect enclosure to pole mounting adapter.

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- c. Surge protectors as described herein shall be provided for all power, control, and signal conductors (including signal and ground return conductors) entering or leaving the cabinet and camera enclosure and pan/tilt unit.
5. **Connectors and Harness.** All external connections shall be made by means of connectors. The connectors shall be keyed to preclude improper hookups. Wires to and from the connectors shall be color-coded and/or appropriately marked. The video output connector of the camera shall be the BNC type and/or RJ45 type.

Connecting harness of appropriate lengths and termination with matching connectors shall be provided for interconnection with all field equipment (including that required between pole top and cabinet equipment).

E. Specific Requirements.

1. **Camera Assembly Specification.**

- a. The camera components shall consist of the camera, pan/tilt mechanism, lens, housing enclosure, receiver/driver and cabling where required.

b. **Camera Specifications.**

- High Resolution Color NTSC Bosch model MIC 7000, Camera with Pan/Tilt Enclosure and 30X Optics. No substitutions will be allowed.
- Auto Focus/Auto Iris with manual overrides;
- Programmable settings;
- Auto iris with manual over-ride;
- Variable speed pan – 0.1 to 100 degrees per second with proportional pan;
- 360 degree continuous pan rotation;
- Operational in 90 mph Wind Conditions;
- Withstand wind velocity of 130 mph;
- Preset positioning/recall;
- Outdoor application;
- Set-up of the camera functions at the camera via Serial connection using portable laptop and camera control software or via the Internet;
- All camera settings will be stored in non-volatile memory within the camera/receiver/driver electronic unit;
- Camera will restore saved settings following power loss;
- Camera, receiver/driver and pan/tilt mechanism shall be manufactured with the latest field tested and certified firmware and hardware upgrades;
- Camera must include digital video encoding and streaming;
- Must support H.264 high, main and base protocols as well as MJPEG;
- Must support at least two simultaneous streams;
- Must include support for JPEG frame captures and automatic uploads using ftp;
- Must support the following protocols: TCP/IP, UDP/IP, DNS, IPv4, HTTP, HTTPS, NTP, SSH, SSL, FTP, Multicast (IGMP) and Unicast.

c. **Lens.**

- 30X optical lens, auto-focus with manual over-ride

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- Optical alignment of the camera/lens is to be conducted and certified by the camera manufacturer.
- d. **Camera Enclosure.** The enclosure shall be a pedestal mount constructed of aluminum to protect the camera and lens in harsh conditions. The following shall also be included:
 - Window: Optically clear acrylic with digital self-controlled window heater-defogger;
 - Remote controlled wiper;
 - Weather resistant wire boots;
 - Operational at outside temperatures -40°F to 122°F.
- e. **Receiver/Driver.**
 - Pelco ‘D’ and/or ‘P’ protocol compatible;
 - 60 pre-positions with tour capability;
 - Eight programmable zones with on-screen labeling;
 - The mechanism shall be integrated with the camera enclosure;
 - Tilt travel shall provide +36 degrees to -85 degrees.

2. Video and Control Signal Transmission Modes.

a. Surge Protector.

- Surge protector shall be a Ditek model DTK-MRJ45C5E. Surge protector shall be located in the CCTV equipment cabinet. It shall be connected to the Cat 5e data cable going to the camera and the media converter.

b. Ethernet Fiber converter/Extender.

- At field camera location shall provide conversion of 10/100 base T full duplex Ethernet to single mode fiber (wire to fiber) over a distance of up to 12.5 miles, Make: COMNET model CNFE1003S2/C.
- Each camera location will require a GarrettCom S14-P-PD Magnum 4 port switch to handle the multiple Ethernet connections or Linksys 10/100 Ethernet Switch Model SD205.
- At TUB location shall provide conversion of fiber signal to 10/100 base T full duplex Ethernet from single mode fiber (fiber to wire) from a distance of up to 12.5 miles, Make: GarrettCom Magnum; 14EH-SSC-H or COMNET Model CFNE1003S2 Media Converter.
- Shall provide automated speed detection/implementation

Wireless Ethernet.

- Motorola Canopy part #5701 BHG, 5.7 GHz

- F. **Software.** The Contractor shall procure and deliver to the Thruway Authority. Deliverables shall include all disks, hardware keys, documentation, manuals, etc. The software should permit independent control of any camera to which the control data is directed via the Ethernet network.

3. CONSTRUCTION DETAILS:

- 3.01 All equipment shall be furnished, installed and configured as shown on the plans and as specified in this specification.

ITEM 683.6730--25 – CCTV CAMERA SITE EQUIPMENT – PEDESTAL MOUNT

3.02 The Contractor shall furnish, install, adjust, and test the equipment as referenced in this specification and in accordance with the manufacturers’ recommendations and as directed by the Engineer. Documentation of the individual pieces of equipment and of the system shall also be provided as specified.

4. METHOD OF MEASUREMENT:

4.01 This item shall be measured for payment on an each basis, for each CCTV site completed in accordance with the contract documents and as directed by the Engineer. A camera pole with two cameras shall be measured as two sites.

5. BASIS OF PAYMENT:

5.01 The price bid for this item shall include the cost of furnishing all equipment, materials, incidentals, labor, tools, testing equipment, documentation, and testing required to complete the work.

5.02 Camera poles, pole foundations, cabinets, conduit, cables, conductors, and utility connections are furnished and paid for under other Contract Items unless otherwise indicated on the plans.

5.03 Payment for this item will be made on a partial payment staged basis as follows:

- 30% upon satisfactory completion of the work for Milestone 1.
- 10% upon satisfactory completion of the work for Milestone 2.
- 30% upon satisfactory completion of the work for Milestone 3.
- 30% upon satisfactory completion of the work for Milestone 4.

5.04 Milestones are as follows:

<u>Milestone No.</u>	<u>Description</u>
1	Completion of design approval tests
2	Completion of pre-installation tests
3	Completion of installation and on-site Stand-alone testing of field equipment
4	Acceptance of CCTV Traffic Management Site Equipment

5.05 Test Procedures and Data Forms.

- A. To be added by section. The Contractor will supply a test procedure to the Engineer for the Contractor to perform. The test procedures will indicate the use of test fixtures, instruments, and/or system equipment that is required to perform a specific test. Tests shall demonstrate all functional capabilities of the system as described in Subsection 2.09 L – O.
- B. On the following page, one will find a copy previously used for final testing of camera sites installed on the Thruway. One can utilize this form to prepare a test form to submit to the Engineer to complete final system testing. Previously, a form of this type was submitted independently to cover daylight & nighttime observations. The nighttime form was the same as the daytime test form with the exception of its title.

DAY 1 - (Location Of) Camera
14 Day Camera a.m. Certification Test

CAMERA #: 1 Com. Port # 5 CAM LOCATION: (location)

DATE: ___/___/___ TIME: ___:___:___ (a.m.) INITIALS _____

WEATHER: (circle one) CLEAR HAZY RAIN SNOW



Image Quality

Image Good Image Fair Image Poor or Missing

Virtual Keyboard/Camera Operation Test

Camera Lens Lens Camera
Pan/Tilt Zoom/Focus Iris Override Wiper
 Working Working Working Working

Preset Test

Shot 1 Shot 2 Shot 3
 Working Working Working

Comment: _____

14 Day Camera p.m. Certification Test

CAMERA #: 1 Com. Port # 5 CAM LOCATION: (location)

DATE: ___/___/___ TIME: ___:___:___ (p.m.) INITIALS _____

WEATHER: (circle one) CLEAR HAZY RAIN SNOW



Image Quality

Image Good Image Fair Image Poor or Missing

Virtual Keyboard/Camera Operation Test

Camera Lens Lens Camera
Pan/Tilt Zoom/Focus Iris Override Wiper
 Working Working Working Working

Preset Test

Shot 1 Shot 2 Shot 3
 Working Working Working

Comment: _____

E-mail list of individuals on instruction sheet immediately if any operational failure or image degradation appears

Typical "Nice Neighbor" configuration:

ITEM 683.9805XX--25 – TOLL FACILITY SECURITY SYSTEM

1. DESCRIPTION:

- 1.01 Work under this item consists of furnishing, installing, and testing of security equipment as shown on the drawings and as specified herein. Equipment is to be installed in toll facilities and at remote monitoring locations as indicated.
- 1.02 This equipment shall be fully compatible with the NYSTA presently installed Access Control, Security Monitoring Subsystem and Alarm Monitoring Subsystem and with the equipment to be furnished and shall be installed in an access control cabinet at the site.
- 1.03 The Contractor shall either be Lenel certified, or shall have a subcontract with a Lenel certified installer or Access Control Integrator (ACI) to make connections to and install Lenel equipment.
- 1.04 Furnish, install, integrate, and test Access Control Devices at the locations shown on the Contract Documents and as specified herein. Connect all devices with manufacturer recommended cables.
- 1.05 The models of Access Control Devices submitted shall be thoroughly tested and proven in actual use in service conditions consistent with the locations shown on the Contract Drawings.

2. MATERIALS:

- 2.01 Associated components, which have their own item numbers (e.g., wire and cables) shall be installed under their respective items.
- 2.02 **PTZ CAMERAS**

The contractor shall procure, configure, install and test Bosch AutoDome 7000 HD 20x PTZ cameras, each with a corner mount as shown on the Contract Drawings. No substitutions will be accepted. The cameras shall be placed as shown on the Contract Drawings, with the final placement determined and verified in the field. Appropriate mounting and junction / back box materials shall be included, as shown on the Contract Drawings.

Cat 5E cable with appropriate connectors, from each camera shall be installed to the Security equipment location within the building interior and protected with surge suppressor as described in Section 2.04 before its connection to the network rack. The cable is to be provided under separate item.
- 2.03 **FIXED CAMERAS**

The contractor shall procure, configure, install and test Bosch FlexiDome 7000 HD fixed cameras. No substitutions will be accepted. The cameras shall be placed as shown on the Contract Drawings, with the final placement determined and verified in the field. Appropriate mounting and junction / back box materials shall be included, as shown on the Contract Drawings.

Cat 5E cable with appropriate connectors, from each camera shall be installed to the Security equipment location within the building interior and the exterior cameras shall be protected with surge suppressor as described in Section 2.04 before its connection to the network rack. The cable is to be provided under a separate item.
- 2.04 **SURGE SUPPRESSOR**

The Contractor shall furnish and install a Ditek, Cat 5E POE, model DTK110RJC6APOE (or approved equivalent) surge suppressor on each outdoor camera cable that is connected to the equipment rack.

ITEM 683.9805XX--25 – TOLL FACILITY SECURITY SYSTEM

2. MATERIALS: (cont'd)

2.05 CARD READER WITH PIN PAD

- A. Access control card readers shall be as manufactured by HID or approved equivalent. Card readers manufactured for non-Lenel access control applications shall not be acceptable.
- B. The card readers shall be compatible with the software and access control cards in current use by NYSTA.
- C. The card reader shall be designed to securely read, interpret, and authenticate access control data from 13.56 MHz contactless smart card credentials and 125 kHz proximity cards.
- D. The card reader shall be optimally designed for use in access control applications to provision of:
 - 1. Customized security protection through support of the device-independent Secure Identity Object™ (SIO) portable credential methodology to provide enhanced security and performance features.
 - 2. Unique read selection that enables reading of the Secure Identity Object™ (SIO), standard iCLASS, 125 kHz proximity, and other technologies at the same time.
 - 3. Utilizes the Trusted Identity Platform™ (TIP) architecture.
 - 4. A migration platform to upgrade from the most popular 125 kHz proximity technologies to SIO on iCLASS SE by reading both 125 kHz proximity technology and 13.56 MHz contactless smart card technology.
 - 5. Guaranteed compatibility to read all HID data formats and ensuring card-to-reader interoperability in multi-location installations and multi-card and reader populations when used with Genuine HID products.
 - 6. Backwards compatibility with legacy 13.56 MHz contactless smart card and 125 kHz proximity access control formats (E.g. 26-bit, 32, 35-bit, 37-bit, 56-bit, and HID Corporate 1000 formats). Compatibility across the product line shall be assured without the need of special programming.
 - 7. The door card readers shall be HID multiclass SE Readers model 921PTNNEK0000. No substitutions will be accepted.
- E. The Contractor shall connect the card reader to interface modules in the access control equipment cabinet with Lenel recommended 10-conductor minimum #24-gauge stranded and continuously shielded cable that is within the cable length limitation defined by the manufacturer.

2.06 MAGNETIC CONTACTS

- A. Install at the doors as described in this Section, and as shown on the Contract Drawings, in accordance with manufacturer's instructions.
 - 1. For hollow metal and storefront doors use biased, recessed type contacts wherever possible.
 - 2. Use surface mounted, biased contacts on doors that are constructed in a way that prevents the use of recessed contacts.
 - 3. For rolling grilles, sliding doors, gates and shutters use surface mounted biased contact with stainless steel jacketed lead. Contact must be rated for 3-inch gap.
 - 4. For access doors use surface mounted contact with stainless steel jacketed lead. Contact must be rated for 3-inch gap.

ITEM 683.9805XX--25 – TOLL FACILITY SECURITY SYSTEM

2. MATERIALS: (cont'd)

2.07 **CYLINDERS**

- A. Cylinders shall meet the requirements of UL437 including those for pick and drill resistance. Pick resistance shall incorporate two or more independent locking mechanisms including a pin tumbler device with seven top pin chambers with driver pins and a coded sidebar locking mechanism operated independently from the pin tumbler device. Drill resistance shall incorporate cylinder housing with fixed in-place case-hardened inserts to protect the pin tumbler shear line, cylinder plugs with case-hardened inserts to protect the pin tumbler shear line and the side bar, stainless steel driver pins and stainless-steel side pins. All cylinders shall be factory master keyed.
1. Specified Manufacturer: BEST High Security.

2.08 **KEYING**

- A. All locks and cylinders shall be construction master-keyed. All locks and cylinders to be master-keyed or grandmaster-keyed as directed by the owner. The factory shall key all locks and cylinders. Furnish the following key amounts:
1. Two (2) change keys per lock
 2. Three (3) grand master keys
 3. Six (6) master keys per master level
 4. Fifteen (15) construction/temporary keys
- B. Master keys and all high-security or restricted keyway blanks shall be sealed in tamper-proof packaged boxes when shipped from the factory. The boxes shall be shrink wrapped and imprinted to ensure the integrity of the packaging.

2.09 **MORTISE LOCKSETS**

- A. Locksets shall meet the requirements of ANSI/BHMA A156.13-1994, Operational Grade 1, and Security Grade 1 certified, SFIC Security Grade 2. All functions shall be manufactured in a single sized case formed from 12-gauge steel minimum. The lockset shall have a field-adjustable, beveled armored front, with a 0.125" minimum thickness and shall be reversible without opening the lock body. The lockset shall 2 3/4" backset with a one-piece 3/4" anti-friction stainless steel latchbolt. The deadbolt shall be a full 1" throw made of stainless steel and have 2 hardened roller inserts. All strikes shall be non-handed with a curved lip. All locks shall be provided with strike boxes. To insure proper alignment, all trim shall be thru-bolted and fully interchangeable between rose and escutcheon designs.
1. Approved Manufacturers: BEST High Security, Schlage L Series.

2.10 **ELECTRIFIED LOCKSETS**

- A. Mechanical features of locksets shall conform to standards as specified above. Locksets shall be designed for both intermittent and continuous duty. All mortise locksets shall be available with switch (Request to Exit feature) to monitor inside or outside lever handle or signal remote location. All locks shall be provided with strike boxes.
1. Approved Manufacturers: Lenel ILS Locks, Von Duprin EL Series, SDC Electrified Mortise

2.11 **INTEGRATION**

- A. All of the newly installed security elements shall be integrated into the existing systems at the Authority under a separate Item in the Contract.

ITEM 683.9805XX--25 – TOLL FACILITY SECURITY SYSTEM

2. MATERIALS: (cont'd)

2.12 SECURITY COMPONENTS

- A. All materials shall be new, unless otherwise indicated on the Contract Drawings or in these Special Specifications.
- B. Unless otherwise noted, at a minimum, the security components to be furnished, installed, tested and commissioned include the following major components:
 - Door security devices for secured doors, each with electronic lock, motion detector, access card reader and pin pad.
 - Lenel site controllers
 - Bosch Fixed cameras
 - Bosch PTZ cameras

Number of units as per Contract Drawings or as stated in the Proposal.

- C. Any incidental parts which are necessary to complete the installation but are not specified herein or on the design plans, shall be suitable for the outdoor service conditions, compatible with the camera model furnished, and shall be provided as necessary to complete a properly operating system. This includes but is not limited to mounting brackets and hardware, power supplies, low voltage power cabling, grounding and bonding jumper cables, data communications interface hardware, connectors and terminations, cable management devices, and labels.

3. CONSTRUCTION DETAILS:

- 3.01 Install the Access Control Devices as referenced in this Specification, in accordance with the manufacturer's instructions and as shown on the Contract Documents.
- 3.02 Connect the Access Control Devices with cables that are recommended by the manufacturer to the locking devices Specified herein along with appropriate modules installed by the Access Control Integrator.
- 3.03 All incidental services which are necessary to complete the installation but are not specified herein or on the design plans, shall be provided as necessary to complete a properly operating security system.
- 3.04 Tests for the security system shall be submitted by the Contractor for approval by the Engineer. Testing shall not begin until tests are approved for all Contractor installed Devices.
- 3.05 Each Security Device that does not pass testing shall be replaced at no additional cost to the Authority. Replacement devices shall be tested according to the tests for the original devices.
- 3.06 All installation work shall be performed by personnel certified by Securitas Electronic Security, Inc.

4. METHOD OF MEASUREMENT:

- 4.01 The Scope of Work of this Contract is depicted on the accompanying Contract Drawings and in the Specifications.

ITEM 683.9805XX--25 – TOLL FACILITY SECURITY SYSTEM

5. LIST OF ITEMS:

5.01 This specification shall include all conduits, cables, materials, equipment, testing and services specified herein unless separate items have been established for specific materials or portions of work. In this case, materials or work (such as fiber optic drop cable, patch panel or related testing), are to be performed under their separate items.

<u>Item No.</u>	<u>Item</u>
683.9805XX--25	Toll Facility Security System

Note: XX denotes serialized, per Toll Facility site (i.e. Interchange 18, 19, etc.)

**ITEM 685.17XX--25 - HIGHLY REFLECTORIZED TRIPLE DROP EPOXY PAVEMENT STRIPES,
6 INCH WIDTH**

1. DESCRIPTION:

- 1.01 Under this work, the Contractor shall furnish and apply highly reflectORIZED epoxy pavement markings in accordance with the contract documents or as ordered by the Engineer, and in conformance with the MUTCD and these specifications.

The epoxy marking material shall be hot-applied by spray methods onto bituminous or portland cement concrete pavement surfaces at a 6-inch width and a 20- or 25-mil wet thickness as indicated in the contract documents. The cured epoxy marking shall be an adherent, highly reflectORIZED stripe.

- 1.02 The triple drop system shall consist of a combination of highly reflective particles, defined as a structural center core surrounded by high index microcrystalline ceramic beads or glass spheres consisting of standard glass beads and wet/night visibility beads.

2. MATERIALS:

- 2.01 All provisions of Section 727-03 *Epoxy Paint* shall apply.
- 2.02 The highly reflective particles, as defined in Section 1.02, shall contain high index beads with a refractive index (R.I.) between 1.8 and 2.4.
- 2.03 When the highly reflective particles are tested in accordance with ASTM E2177 Bucket method, the test method for measuring wet recovery under the standard conditions for wetness, the minimum test results shall be 300 mcd/m²/lux.
- 2.04 The glass spheres of the highly reflective particles shall consist of Standard Glass Beads (Type 2) and Wet/Night Visibility Beads (Type 1) as defined in Section 727-05 *Glass Beads for Pavement Markings*.
- 2.05 The highly reflective particles shall match the color of the line they are being dropped in, so to not significantly alter the color appearance of the line and shall be either 3M Series A W Wet Elements Wet E, Potters VISIMAX, or approve equal.
- 2.06 Wet/Night Visibility Beads (Type 1) shall be Visibead Plus, or approved equal.

3. CONSTRUCTION DETAILS:

- 3.01 All provisions of Standard Specification §685-3 shall apply.
- 3.02 Beads shall be applied as follows:
- A. **6 inch by 20 mil applications.** The first drop shall be highly reflective particles at a rate of 5 pounds per gallon; the second drop shall be Wet/Night Visibility Beads (Type 1) at a rate of 5 pounds per gallon; and the third drop shall be Standard Glass Beads (Type 2) at a rate of 8 pounds per gallon.
- B. **6 inch by 25 mil applications.** The first drop shall be highly reflective particles at a rate of 7 pounds per gallon; the second drop shall be Wet/Night Visibility Beads (Type 2) at a rate of 7 pounds per gallon; and the third drop shall be Standard Glass Beads (Type 1) at a rate of 10 pounds per gallon.

**ITEM 685.17XX--25 - HIGHLY REFLECTORIZED TRIPLE DROP EPOXY PAVEMENT STRIPES,
6 INCH WIDTH**

4. METHOD OF MEASUREMENT:

4.01 Pavement striping will be measured in feet along the centerline of the pavement stripe and will be based on a 6-inch wide stripe. Measurement for striping with a plan width greater or lesser than the 6 inches as shown on the plans or directed by the Engineer, will be made by the following method:

$$\frac{\text{Plan Width of Striping (inches) x Feet}}{6 \text{ inches}}$$

5. BASIS OF PAYMENT:

5.01 All provisions of Standard Specification §685-5 shall apply.

Payment will be made under:

<u>Item Number</u>	<u>Item</u>	<u>Pay Unit</u>
685.1707--25	White Highly ReflectORIZED Triple Drop Epoxy Pavement Stripes – 6 in x 20 mils	LF
685.1708--25	Yellow Highly ReflectORIZED Triple Drop Epoxy Pavement Stripes – 6 in x 20 mils	LF
685.1709--25	White Highly ReflectORIZED Triple Drop Epoxy Pavement Stripes – 6 in x 25 mils	LF
685.1710--25	Yellow Highly ReflectORIZED Triple Drop Epoxy Pavement Stripes – 6 in x 25 mils	LF

ITEM 690.6202--25 - INSTALLATION OF TOLL TREADLE FRAME

1. DESCRIPTION:

1.01 The work shall consist of casting toll treadle frames into the toll lane concrete as shown on the plans and as directed by the Engineer. The treadle frames shall be fabricated by the manufacturer listed below. Under this item number, the Contractor shall also supply and install the additional materials listed in this Specification under Materials.

2. MATERIALS:

2.01 Each treadle frame installation will require the following:

- A. **Galvanized Drainage Pipe and Fittings:** 3" diameter, Schedule 40 galvanized pipe, galvanized elbows and couplings as required. Materials shall meet ASTM A53, A197 and A153.
- B. **Polyethylene Drainage Fittings:** (wyees, tees, reducing fittings, etc.): Fittings are to be sized as indicated on the drawings. Where required, fittings are to be supplied with the appropriate Type 301 stainless steel adjustable bands. Polyethylene fittings shall meet ASTM F-405.
- C. **PVC Conduit and Fittings:** 2" diameter, Schedule 40 PVC conduit and fittings as indicated on the drawings. PVC reducing joining clamp with the appropriate Type 301 stainless steel adjustable bands, PVC bushed end required where PVC conduit terminates within the toll booth pie, PVC welding solvent, and Polyurethane sealant.

2.02 Treadle Frame; reference Contract Drawings TR-1 and TR-2, manufactured by:

TRMI
PO Box 10
5120 Route 209
Accord, NY 12404
Phone: (845) 626-8655
FAX: (845) 626-2492

No substitution will be permitted.

2.03 Division ITSM shall be on site during the Engineer's inspection of the frame at the construction site. The Contractor shall contact Division ITSM through the Engineer to coordinate the inspection at least one (1) week prior to installation. Note that treadle frames have precise tolerances and the contractor should take this into consideration when ordering and scheduling inspections to prevent delays in case the frame is rejected.

3. CONSTRUCTION DETAILS:

3.01 The Contractor shall be responsible for damage to the frame of any nature. Such responsibility for damage shall continue until the official opening by the Authority of the lane in which the treadle frame is installed. The Contractor shall supply and install the treadle frames, supply and install treadle frame drain piping with connection into existing drain system, supply and install treadle frame PVC conduit including core drilling the toll booth concrete foundation wall for conduit penetration. All PVC conduit joints shall be welded with appropriate PVC solvent. PVC conduit at foundation penetration shall be sealed to prevent water from entering the toll booth foundation interior.

ITEM 690.6202--25 - INSTALLATION OF TOLL TREADLE FRAME

When placing concrete at the treadle frame, extreme care shall be taken to prevent concrete from encroaching above the bottom bars of the treadle pad's recess. Concrete must be flush with the top of these bars to provide full support for the pad.

All work shall be accomplished as shown on the plans and as directed by the Engineer.

- 3.02 The frames shall be set to conform to the adjacent transverse pavement grade (i.e., cross-slope).

The treadle frames in reversible lanes shall be installed such that their longitudinal grade is 0% (i.e., flat).

The treadle frames in one-way lanes shall be installed such that their longitudinal grade is 3% (i.e., 3/8 inch per foot) sloped so that the leading edge (the edge toward traffic) is lower than the trailing edge.

- 3.03 The treadle frames shall be secured to prevent movement during concrete pouring operations. The Contractor shall provide a partial footing as a base to support the frame as approved by the Engineer and as indicated on the Drawings.

- 3.04 Prior to concrete pouring operations, it will be the Contractor's responsibility to connect all necessary drains and conduits. These items shall be provided as indicated on the drawings.

- 3.05 The Contractor shall verify treadle frame bushing alignment and spacing prior to setting in concrete. Thread size and pitch shall be in English units.

- 3.06 After concrete pouring operations, the treadle frames shall be cleaned and prepared as directed by the Engineer for receipt of the treadle body to be supplied and installed by others.

4. METHOD OF MEASUREMENT:

- 4.01 The work shall be measured on an each basis for the number of treadle frame units, installed as described in the Contract Plans and in this specification.

5. BASIS OF PAYMENT:

- 5.01 The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the work.

ITEM 697.0203--25 - FIELD CHANGE ORDER (THRUWAY)

1. DESCRIPTION:

- 1.01 **General.** The Field Change Order (FCO) provides a contract contingency allowance for the timely payment of authorized additional work that is necessary to fulfill the intent of the plans and specifications.
- 1.02 **Eligible Work.** FCO payments shall be limited to work that is: (1) within the scope of the contract; (2) a quantity variation of existing contract pay items, or; (3) a new contract pay item introduced as a result of minor field adjustments in the details of the project. All eligible items of work shall have a known unit price, either through use of a contract bid price or through an agreed price.

2. MATERIALS:

- 2.01 None specified.

3. CONSTRUCTION DETAILS:

- 3.01 None specified.

4. METHOD OF MEASUREMENT:

- 4.01 This item will be measured for payment on a Dollars Cents basis.
- 4.02 **Bid Price.** The unit price shown in the proposal for this item will be considered as the price bid, and shall not be altered in any manner. Should the amount shown be altered, the new figure will be disregarded and the original bid price will be used to determine the total amount bid for the contract.
- 4.03 **Payments.** Work for which FCO payments are processed will be measured in accordance with the specifications governing the work.

5. BASIS OF PAYMENT:

- 5.01 All work to be paid under the FCO item must be authorized in conformance with §104-02 *Changes, Contingencies, Extra Work and Deductions*. Disputed work, force account work, work associated with §104-10 *Value Engineering Change Proposals*, or payments for time related provisions are not eligible for FCO payment.
- 5.02 FCO payments will be determined from the quantities and unit prices of eligible work that has been completed in conformance with applicable Specifications. Work for which FCO payments are processed will be paid in accordance with the specifications governing the work.
- 5.03 Prior to processing the final agreement, the FCO payments will be reconciled through a final order-on-contract, such that the amount of FCO payments are converted to the corresponding quantities of the pertinent contract pay items. When payments are transferred to the appropriate items, the remaining amount of FCO funds will be deleted.

ITEM 800.01000015 – DESIGN BUILD – DESIGN SERVICES

DESCRIPTION. This work shall consist of providing design services in accordance with the contract documents.

MATERIALS. None Specified.

CONSTRUCTION DETAILS. The Design Builder shall provide Design Services by the appropriately qualified and licensed personnel in accordance with the requirements in the contract documents.

METHOD OF MEASUREMENT. Design Build - Design Services will be measured for payment on a lump sum basis.

BASIS OF PAYMENT. The lump sum price bid for Design Build - Design Services shall include the cost of furnishing all labor, equipment and incidentals to satisfactorily complete the work. Progress payments will be made in accordance with the contract documents.

ITEM 800.02000015 – DESIGN BUILD – CONSTRUCTION INSPECTION SERVICES

DESCRIPTION. This work shall consist of providing Construction Inspection Services in accordance with the contract documents.

MATERIALS. None Specified.

CONSTRUCTION DETAILS. The Design Builder shall provide Construction Inspection Services by the appropriately qualified and licensed personnel in accordance with the requirements in the contract documents.

METHOD OF MEASUREMENT. Design Build - Construction Inspection Services will be measured for payment on a lump sum basis.

BASIS OF PAYMENT. The lump sum price bid for Design Build - Construction Inspection Services shall include the cost of furnishing all labor, equipment and incidentals to satisfactorily complete the work. Progress payments will be made in accordance with the contract documents.

ITEM 800.03000015 – DESIGN BUILD – QUALITY CONTROL SERVICES

DESCRIPTION. This work shall consist of providing Quality Control Services in accordance with the contract documents.

MATERIALS. None Specified.

CONSTRUCTION DETAILS. The Design Builder shall provide Quality Control Services by the appropriately qualified and licensed personnel in accordance with the requirements in the contract documents.

METHOD OF MEASUREMENT. Design Build - Quality Control Services will be measured for payment on a lump sum basis.

BASIS OF PAYMENT. The lump sum price bid for Design Build - Quality Control Services shall include the cost of furnishing all labor, equipment and incidentals to satisfactorily complete the work. Progress payments will be made in accordance with the contract documents.

ITEM 800.04000015 – DESIGN BUILD – FORCE ACCOUNT WORK

DESCRIPTION. This work shall consist of performing construction work in accordance with the contract documents and as directed by the Engineer.

MATERIALS. None Specified.

CONSTRUCTION DETAILS. The Design Builder shall perform construction work in accordance with the contract documents as directed by the Engineer. The Design Builder will maintain and provide agreed price or force account records to document the costs in accordance with DB section 109-9.

METHOD OF MEASUREMENT. Design Build – Force Account Work will be measured for payment on a Dollar Cents basis.

BASIS OF PAYMENT. The price shown for Design Build - Force Account Work shall include the cost of furnishing all labor, materials, equipment and incidentals to satisfactorily complete the work. The total cost shown in the itemized proposal will be considered the price bid even though payment will be made only for actual work performed. The unit price amount is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded, and the original price will be used to determine the total amount bid for the contract.

Progress payments will be made in accordance with the contract documents.

ITEM 800.05000015 – DESIGN BUILD – SITE MOBILIZATION

DESCRIPTION. This work shall consist of providing necessary bonds, insurance, prefinancing and set up of necessary general plant, including shops, storage areas, office and such sanitary and other facilities as are required by local or state law or regulation.

MATERIALS. None Specified.

CONSTRUCTION DETAILS. The Design Builder shall provide the above facilities and service for mobilization in a safe and workmanlike manner in conformance with any pertinent local or State Law, regulation or code to the extent and at the time the Contractor deems them necessary for its operations. Good housekeeping shall be maintained.

METHOD OF MEASUREMENT. Design Build – Site Mobilization will be measured for payment on a lump sum basis.

BASIS OF PAYMENT. The lump sum price bid for Design Build – Site Mobilization shall not exceed four percent (4%) of the total contract bid price for all Construction Work items. Should the bidder exceed the foregoing four percent (4%), the Department will make the necessary adjustment to determine the total amount bid based on the arithmetically correct proposal.

Progress payments in the amount of 4% of the construction work items will be made to the Contractor with the first contract payment made for other contract work at the individual itemized work site.

ITEM 800.0600NN15 – DESIGN BUILD – CONSTRUCTION WORK

DESCRIPTION. This work shall consist of construction work in accordance with the contract documents.

MATERIALS. None Specified.

CONSTRUCTION DETAILS. The Design Builder shall perform all construction work in accordance with the requirements in the contract documents.

METHOD OF MEASUREMENT. Design Build – Construction Work will be measured for payment on a lump sum basis for each location. The individual locations are identified in the contract documents.

BASIS OF PAYMENT. The lump sum price bid for Design Build – Construction Work shall include the cost of furnishing all labor, materials, equipment, management and supervision to satisfactorily complete the work. Progress payments will be made for each construction work location in accordance with the contract documents.

Note: NN in pay item number denotes serialization by location.

Kapsch Equipment Cut Sheets.

Highlighted section of Kapsch cut sheets provide the Design-Builder the dimensions and weight of each device.

EN

Kapsch VRX: ANPR/LPR camera for MLFF tolling and enforcement.



The Kapsch VRX is a high-performing and cost-efficient vehicle registration plate-reading camera designed for sophisticated ETC and ITS systems. It is an autonomous image-capturing device optimized for reading plates and for documenting traffic scenes.

Kapsch VRX uses the latest sensor and image-processing technology to provide high-resolution, high-quality image capturing and automatic registration-plate reading with the highest possible accuracy. Whether your project involves Automatic Number/License Plate Recognition (ANPR/LPR), the USDOT in the United States, or Dangerous Goods Detection (DGD/ADR) in Eurasia, Africa, or Australia – no matter the continent, the VRX will meet your needs.

At Kapsch we excel in optimizing system design and in delivering a comprehensive suite of vehicle registration systems, including MLFF video tolling; enforcement for DSRC, video, or satellite-based tolling; ITS systems such as Traffic Surveillance, Road Safety Enforcement, and Electronic Vehicle Registration Monitoring (EVR); or Commercial Vehicle Operation (CVO) systems.

Kapsch VRX may cover one lane or several lanes at a time and can be single or dual-headed. It can be set to trigger

autonomously or to receive triggers from a vehicle detection and classification subsystem, or to perform both functions simultaneously for the highest accuracy (redundant vehicle detection). Kapsch VRX is designed for high availability, robust and redundant systems. It buffers images to compensate for time delays and uncertainties in other roadside subsystems, while continuing to produce accurate high-quality images that are correlated to and synchronized with other subsystems.

Kapsch VRX offers powerful local processing. It uses state-of-the-art optical character recognition engines to read vehicle registration plates, and organizes the resulting data - including images - into a package that may be encrypted and signed with the latest cryptographic algorithms, ensuring both data security and integrity. Further security features are HW tamper detection and secure key management.

In addition, Kapsch VRX supports high-definition video streaming, which allows realtime visual monitoring of current roadway activities as well as a cost-effective method for evaluating performance and accuracy.

The Kapsch VRX is the result of continuous adaptation to the latest technology while continuing to ensure full Kapsch in-house control of critical areas such as in-time delivery, performance optimization, seamless system integration, quick and easy customer-specific adaptations, as well as long-term end-of-life management. In addition, Kapsch provides an optional ruggedized roadside controller that can run additional processing such as fingerprinting or various 3rd party algorithms to improve total system performance. The controller directly processes traffic data events supplied by the Kapsch VRX while integrating data from other subsystems as well, such as vehicle classification data and transaction data.

Technical features.

VRX Overall

- VRX offers various camera types, resolutions, lenses, and filters
- Sophisticated, video-based, software self-trigger, for vehicles with and without plates
- External real-time triggering, either digital or software based
- Post-trigger mechanism allows for time delay in external triggering system
- Automatic exposure control based on the license plate or image as a whole
- Frame synchronisation with other cameras in the roadside system
- Synchronized integrated and / or external illumination, non-distracting to drivers, with several wavelength options
- Encryption, signature and key management
- Various ANPR/LPR software packages may be used locally or remotely
- Configurable databar / black strip in the image and JPEG compression
- H264 HD streaming at full frame rate
- Continuous monitoring and status information (SNMP)
- Local buffering to avoid data loss in case of network or server failures
- Prepared for downgraded modes and redundant system design
- Prepared for dual-lane and dual-head

VRX Camera

- Standard camera sensor: 4MP, high dynamic range, monochrome and color versions. Near-infrared as well as visible light wavelengths. Other camera sensors with various resolutions available on request
- Field of view: Typically 4m at 12m (various lenses available on request)
- Integrated or external illumination: Up to 120W ($\pm 10^\circ$ FWHM)
- Enclosure: Extruded aluminium alloy, corrosion resistant
- **Dimensions (W x H x L): 197 x 228 x 459mm**
- **Weight: < 10kg**
- Ambient temperature
 - Operating: -40°C to $+55^\circ\text{C}$
 - Non-operating: -40°C to $+55^\circ\text{C}$
 - Cold start with preheating at -40°C
- Relative humidity (operating): 4% to 100%
- IEC protection rating: IP66
- Power supply: 24VDC, max. 30W (without heating)
- MTBF: > 50.000h
- Vibration: 1-9Hz 3.5mm, 9-150Hz 10m/s²
- Shock: 200m/s², 11ms
- EMC: 2004/108/EC LVD: 2006/95/EC RoHS2: 2011/65/EU FCC: 47CFR15
- Photo-Biological Safety: EN62471
- Interface: 100BASE-TX / 1000BASE-T

Optional External Illumination

- Optical power: 120W ($\pm 10^\circ$ FWHM)
- Peak wavelength 830nm (other wavelengths available on request, as well as white light)
- Spectral bandwidth 40nm
- Light emitting aperture app. 130 x 130mm
- Pulse width max. 400 μs / 700 μs
- Frequency max. 30Hz / 15Hz
- Daisy-chaining
- Enclosure: Extruded aluminium alloy, corrosion resistant
- Dimensions (W x H x L): 197 x 228 x 334mm
- Weight: < 6kg
- Ambient temperature
 - Operating: -40°C to $+55^\circ\text{C}$
 - Non-operating: -25°C to $+55^\circ\text{C}$
- Relative humidity (operating): 4% to 100%
- IEC protection rating: IP66
- Power supply: 24VDC, max. 25W
- MTBF: > 50.000h
- Vibration: 1-9Hz 3.5mm, 9-150Hz 10m/s²
- Shock: 200m/s², 11ms
- EMC: 2004/108/EC LVD: 2006/95/EC RoHS2: 2011/65/EU FCC: 47CFR15
- Photo-Biological Safety: EN62471

Optional Roadside Controller (example, other variants on request)

- Ruggedized industrial PC, Windows® XP Embedded
- Intel® Core™ 2 Duo L2400 1,66GHz, 3GB DDR2 RAM
- 160GB hard disk for 24/7 use
- Dimensions (W x H x L): 205 x 270 x 255mm
- Weight: < 9kg
- Ambient temperature
 - Operating: 0 to $+45^\circ\text{C}$
 - Non-operating: -20 to $+60^\circ\text{C}$
- Relative humidity (operating): 10% to 90% (non-condensing)
- IEC protection rating: IP20
- Power supply: 24VDC, max. 150W
- MTBF: > 50.000h
- Vibration: 2-9Hz 3.5mm, 9-200Hz 10m/s² (occasional)
2-9Hz 1.75mm, 9-200Hz 5m/s² (continuous)
- Shock: 150m/s², 11ms
- EMC: 2004/108/EC LVD: 2006/95/EC RoHS2: 2011/65/EU UL: E115267 FCC: 47CFR15

VRX Remote Manager Application

- User-friendly standard Windows® Application
- Setting of configuration parameters on VRX camera
- Image visualization: Display of the images from the lane cameras and the overview cameras
- Manual triggering of images possible
- Download of firmware for the camera modules
- Allocation of security keys for the VRX ANPR cameras
- Monitoring of input (trigger) and output (result) messages

About Kapsch Group.

Kapsch is one of Austria's most successful technology corporations to specialize in the future-oriented market segments of intelligent transport systems (ITS) and information and communications technology (ICT). Kapsch. Always one step ahead.

Technical Data External illuminating units

Mechanical details

Housing and sunshield material Extruded aluminium alloy, corrosion-resistant

Dimensions (W x H x L) 197 x 228 x 334mm

Weight app. 6kg

Environmental conditions

Ambient temperature (operating) -40 to +45°C

Relative humidity (operating) 4% - 100% (non condensating)

Ambient temperature (storage) -25 to +55°C

IEC protection rating IP66/IP67, ref. EN60529-A1 (IEC 60529)

Electrical data

Input

Power supply 24V DC

Power consumption max. 25W

Trigger voltage 8 – 26V

Trigger current max. 10mA

Output

Flash bypass voltage 24V DC (directly bypassed input voltage)

Flash bypass current max. Depending on number of connected devices (maximal output current of the source must be considered).

Flash trigger voltage Directly bypassed from the input.

Flash trigger current max. Depending on number of connected devices (maximal trigger current of the source must be considered).

(*) Device only; the consumption of devices connected in a daisy chain has to be added (up to the maximum bypass current).

Illumination (Infrared)

Peak wavelength (other wavelengths available on request, as well as white light)	830nm
Spectral bandwidth	40nm
Light emitting aperture app.	130 x 130mm
Optical power	120W (+/- 10° FWHM)
Pulse width max.	400µs / 700µs
Frequency max.	30Hz / 15Hz

Figure 23
External illuminating unit,
dimensions in [mm]

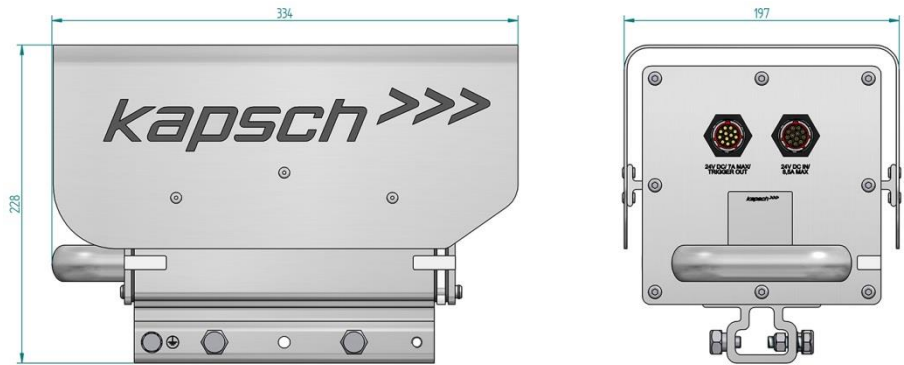


Table 11
Art. No. External illuminating unit

Product number	Description	Product name
34018600100	Infrared	VR2-IRF-DC-V03
34026100000	White light	VR2-WLF-DC-V01



Kapsch VDC for Single Gantry - A True 3D Vehicle Detection, Tracking, Triggering and Classification System

The Kapsch VDC system is designed to detect, track, trigger and classify vehicles in real time in all traffic environments

Overview

The Kapsch VDC system has true 3D-measurement functions based on image processing of stereo video images. This enables the Kapsch VDC system to determine the outline as well as the height profile and the path of the passing vehicles of all kinds. With continuous imaging processing, covering the full road width, the Kapsch VDC system has excellent performance in complex stop & go traffic situations. All without compromising the Kapsch VDC system's high-speed performance in multi lane free flow situations exceeding 200 km/h.

The Core Functionality

The Kapsch VDC system detects every vehicle and tracks it through the entire tracking zone. Through the tracking zone, the Kapsch VDC system provides real time vehicle positions, for e.g. tag correlation, and triggers to both front and rear LPN cameras. As vehicles leave the tracking zone, the Kapsch VDC system provides measurements of the vehicle dimensions and associated vehicle class. With its large field of view, the Kapsch VDC system is not depending on constant vehicle speed to accurately track and measure the vehicles. Stop & go traffic produces as accurate output as constant speed traffic. The Kapsch VDC system can also perform deeper analysis of the images and e.g. indicate whether vehicles that have the same dimensions in fact are buses, trucks or

vehicles with trailers. The Kapsch VDC system can also capture overview images of each passing vehicle, or vehicles of a certain class or shape, to aid in placing the vehicle at the scene for evidential purposes.

Scalable and Versatile

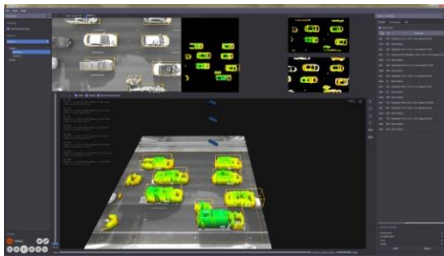
The Kapsch VDC system consists of a controller, sensors and illuminators. The numbers of sensors and illuminators to be used are decided by the road width and application. The Kapsch VDC system can cover road widths exceeding 25 m. The Kapsch VDC system uses invisible infrared light. All sensors and illuminators can be mounted on a single structure, without any extension arms, spanning the road.

System Components

- > 8633 004-989 VDC Controller 2U (VDCC)
- > 8633 004-529 VDC Sensor 4i (VDCS)
- > 8633 004-650 VDC Illuminator IR (VDCI)

Key Features

- > Full support of multi lane free flow including stop & go traffic, turning traffic and high speed traffic
- > Full support of bi-directional traffic
- > Full support of all vehicle types
- > Full support of all volumetric vehicle classes
- > Flexible real time triggers to auxiliary equipment, like front and rear LPN cameras, typically between -10 m and +10 m in the tracking zone
- > Provision of real time vehicle passage data
- > Flexible mounting height but optimized for 7.0 m
- > Flexible separation between sensors depending on application, typically between 3.5 m and 7.0 m
- > Typically one illuminator per lane
- > VDC GUI supporting installation, maintenance and live views of the traffic



VDC Controller 2U

- > Industrial standard PC featuring Intel Core i7 and Linux
- > RAID system
- > Redundant power supply
- > Rugged design

VDC Sensor 4i



- > Two stereoscopic camera pairs
- > Support for Quick Fastening Device

- > Sealed outdoor connectors
- > Gigabit Ethernet 1000Base-T, UDP/IP, CAT5e/6 outdoor cable
- > Extruded aluminium profile enclosure

VDC Illuminator IR



- > LED, infrared light
- > Support for Quick Fastening Device
- > Sealed outdoor connectors
- > Digital synchronization pulse, opto-coupled
- > RS-485 network for supervision
- > Extruded aluminium profile enclosure and polycarbonate glass

Host Interface

- > Gigabit Ethernet 1000Base-T, TCP/IP
- > Real time vehicle passage data, i.e. vehicle positions, dimensions and overview images
- > Real time triggers for e.g. front and rear LPN cameras
- > Real time supervision data
- > Configuration and control data

Power Supply and Power Consumption

- > VDCC: 110-240 VAC, 90 W typical and 150 W maximum
- > VDCS: 48 VDC, 20 W plus 0-40 W for heating depending on outdoor temperature
- > VDCI: 48 VDC, 30 W

MTBF

- > VDCC: > 50 000 hours
- > VDCS: > 50 000 hours
- > VDCI: > 50 000 hours

Dimensions and Weight

- > VDCC: 482 mm x 472 mm x 88 mm (19" by 2U), 13 kg
- > VDCS: 700 mm x 270 mm x 200 mm, 10 kg
- > VDCI: 375 mm x 230 mm x 135 mm, 4 kg

Climatic Conditions

Storage and transportation:

- > VDCC: -25 °C to +55 °C
- > VDCS: -25 °C to +55 °C
- > VDCI: -25 °C to +55 °C

Reference: IEC60721-3-1, Class 1K4, IEC60721-3-2, Class 2K2

Operational:

- > VDCC: +5 °C to +40 °C
- > VDCS: -40 °C to +55 °C
- > VDCI: -40 °C to +55 °C

Reference: IEC60721-3-3 Class 3K3, IEC60721-3-4 Class 4K2 extended to +55 °C

Humidity:

- > VDCC: 5 - 85%
- > VDCS: 5 - 100%, condensing
- > VDCI: 5 - 100%, condensing

Reference: IEC60721-3-3 Class 3K3, IEC60721-3-4 Class 4K2

Ingress Protection

- > VDCC: IP20⁽¹⁾
- > VDCS: IP65
- > VDCI: IP65

Reference: IEC60529 Class 4K2

Mechanical Conditions

Vibration:

- > VDCC: 1 - 150 Hz 2 m/s²
- > VDCS: 1 - 150 Hz 10 m/s²
- > VDCI: 1 - 150 Hz 10 m/s²

Reference: IEC60721-3-3 Class 3M2, IEC60721-3-4 Class 4M4

Shock:

- > VDCC: 150 m/s², 11 ms⁽²⁾
- > VDCS: 150 m/s², 6 ms
- > VDCI: 150 m/s², 6 ms

Reference: IEC60721-3-3 Class 3M2, IEC60721-3-4 Class 4M4

Certifications

- > VDCC: EMC 2004/108/EC, LVD 2006/95/EC, RoHS2 2011/65/EU
- > VDCS: EMC 2004/108/EC, LVD 2006/95/EC, RoHS2 2011/65/EU
- > VDCI: EMC 2004/108/EC, LVD 2006/95/EC, RoHS2 2011/65/EU, Eye safety EN 62471 Risk Group 1

VDCC = nVDC Controller
VDCS = nVDC Sensor
VDCI = nVDC Illuminator

⁽¹⁾ Data from manufacturer, optional IP52.

⁽²⁾ Data from manufacturer.

Kapsch Antenna Summary.

Parameter / Antenna:	IAG-1 Antenna	IAG-1 Antenna "B"	IAG-2 Antenna	IAG2-T Antenna	VRC Antenna	mGate Antenna
Part #	800260-011	800260-012	800260-008	800260-007	800260-010	800260-009
Lane Kit #	801692-014	801692-017	801692-012	801692-009	801692-013	801300-002 (Reader Kit)
Description	3x3 patch	3x3 patch	2x2 patch	2x2 patch	2 patch	1 patch
Size WxHxD (in)	34.75 x 31.75 x 2.3"	34.75 x 31.75 x 2.23"	17.72 x 15.47 x 1.2"	18 x 16 x 2"	17.22 x 10.22 x 1.1"	11.84 x 10.72 x 1.22"
Weight¹ (lb)	28 lb	28 lb	4 lb	4 lb	4 lb	2 lb
Horizontal Beamwidth	28 deg	28 deg	40 deg	40 deg	60 deg	55 deg
Vertical Beamwidth	28 deg	28 deg	40 deg	40 deg	40 deg	60 deg
Gain	16 dBi	16 dBi	12 dBi	12 dBi	10 dBi	9 dBi
Mounting	Horizontal	Horizontal	Horizontal	Horizontal	Vertical	Horizontal

Parameter / Antenna:	IAG-3 Antenna	IAG-4 Antenna	IAG-5 Antenna	Patch - Lab Use	Patch - Toll Booth ³	Patch - Toll Booth ⁴
Part #	800260-015	800260-016	800260-017	700257-001	700257-002	700257-003
Lane Kit #	801692-019	801692-020	801692-021	N/A	N/A	N/A
Description	3x4 dipole array	6x4 dipole array	4x4 dipole array	1 patch	1 patch	1 patch
Size WxHxD (in)	34.5 x 21.25 x 3.13"	45.6 x 38.0 x 6.25"	36.13 x 30.81 x 3.13"	7.75 x 4.625 x 2.25"	8.813 x 7.437 x 6.093"	10.781 x 7.432 x 4.091"
Weight¹ (lb)	19 lb	73 lb	32 lb	1.3 lb	3.65 lb	3.35 lb
Horizontal Beamwidth	29 deg	19 deg	22 deg	N/A	N/A	N/A
Vertical Beamwidth	40 deg	23 deg	30 deg	N/A	N/A	N/A
Gain	14 dBi	17 dBi	16.5 dBi			
Mounting²	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal

Notes:

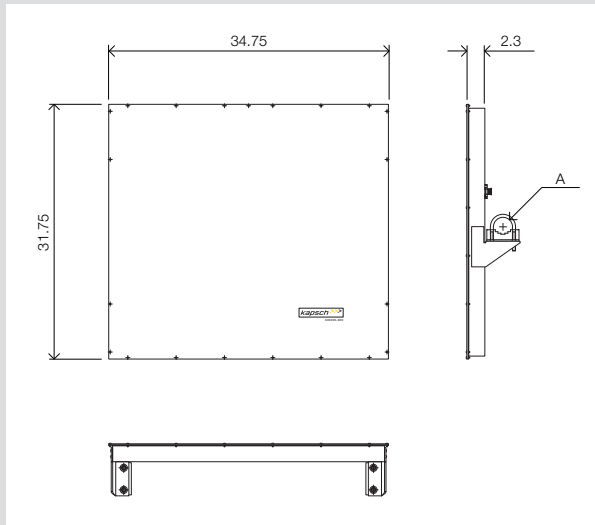
¹ Weight specified is applicable to the antenna structure only i.e. it does not include mounting hardware.

² Mounting information is provided as a guideline. Site details may require some adjustment beyond the ranges specified.

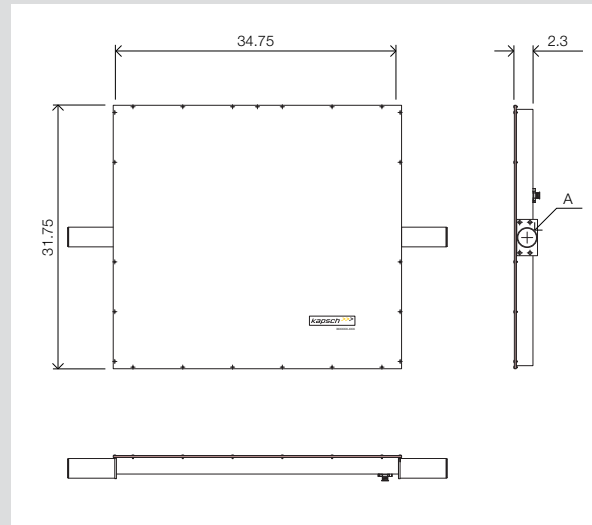
³ Includes a switch that is wired discreetly.

⁴ Includes a switch that disables the antenna directly.

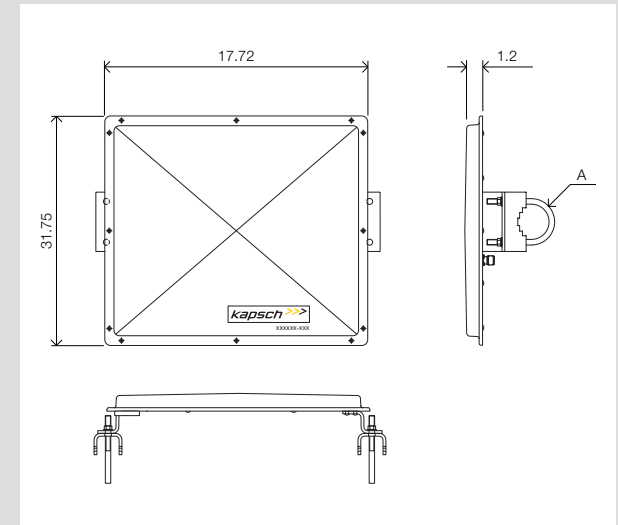
Technical Drawings



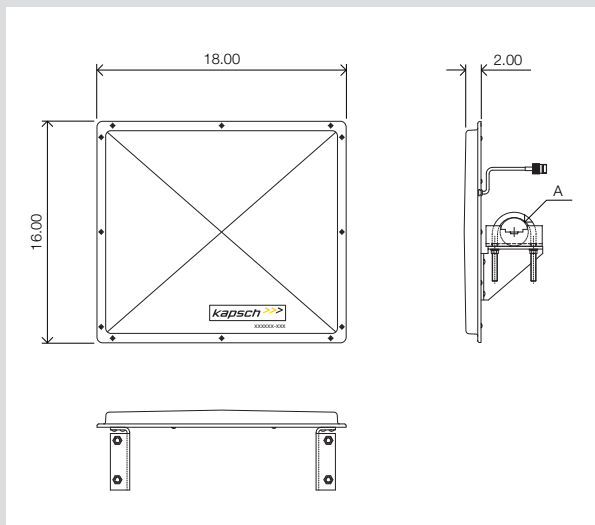
IAG-1 Antenna



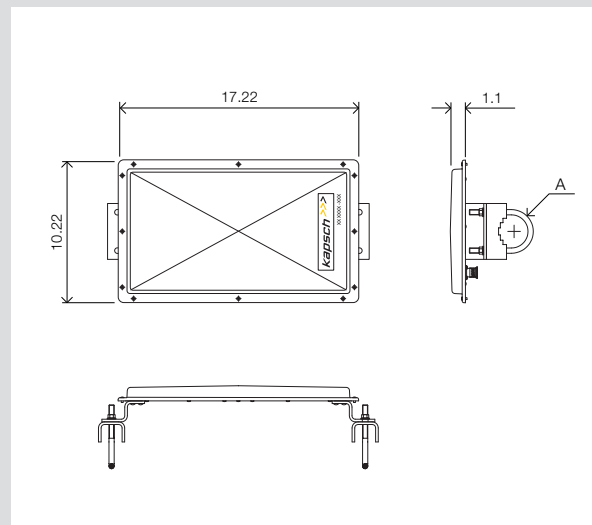
IAG-1 Antenna "B"



IAG-2 Antenna



IAG-2 T Antenna

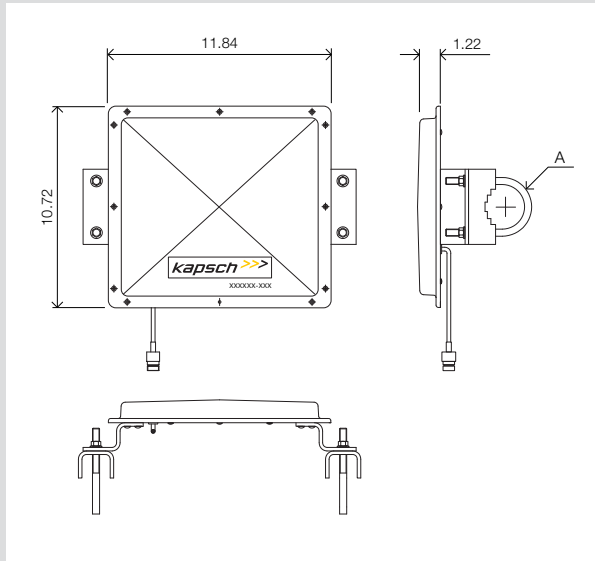


VRC Antenna

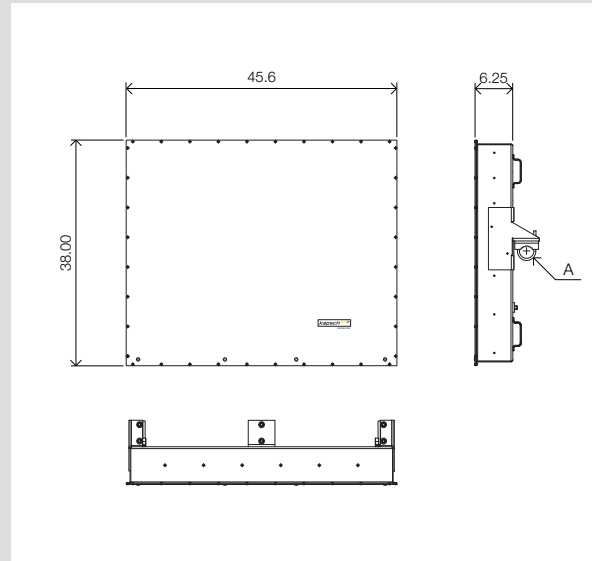
DETAIL "A": 2.00 in. diameter pole mounting.

Measurements in inches.

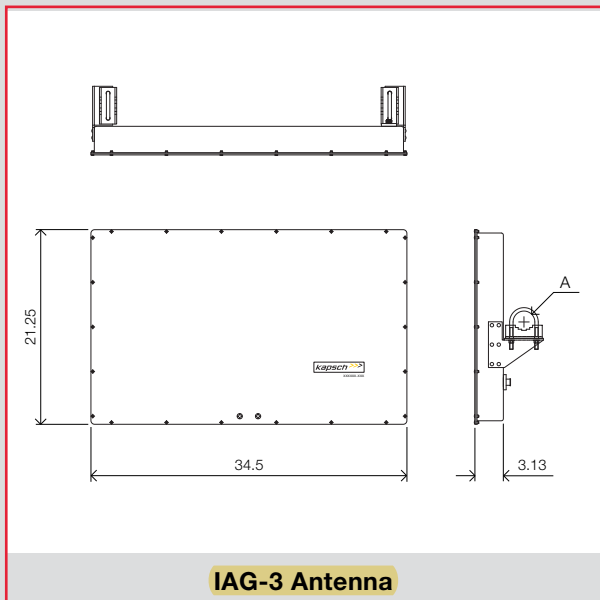
Technical Drawings



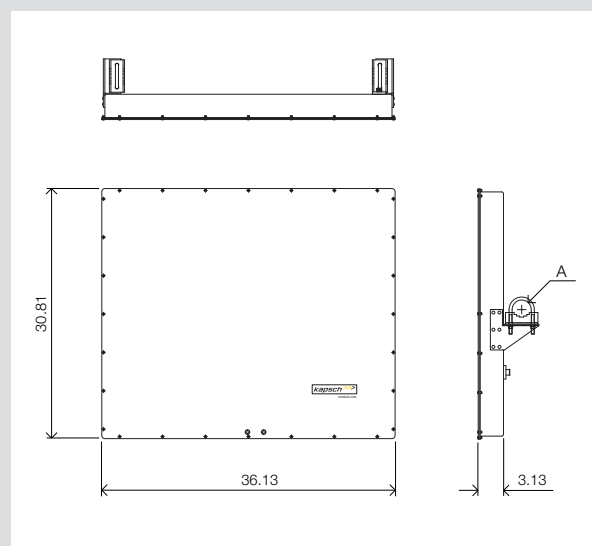
mGate Antenna



IAG-4 Antenna



IAG-3 Antenna



IAG-5 Antenna

DETAIL "A": 2.00 in. diameter pole mounting.
Measurements in inches.

Applications

Parameter / Antenna:	IAG-1 Antenna	IAG-1 Antenna "B"	IAG-2 Antenna	IAG2-T Antenna	IAG-3 Antenna	IAG-4 Antenna	IAG-5 Antenna	VRC Antenna
Standard Lane	15±1 ft height 15 deg tilt 10-12 ft lane width				IAG ORT lane 15±1 ft height 15 deg tilt 12 ft lane width	IAG high overhead mount (toll plaza) 22±2 ft height 10 deg tilt 10-12 ft lane width		407 ETR lanes for IAG and TDMA 5 deg tilt (IAG) 40 deg tilt (TDMA)
Alternate Mount		15±1 ft height 15 deg tilt 10 - 12 ft lane width						
Wide			15±1 ft height 10 deg tilt 10 - 16 ft lane width	15±1 ft height Low clearance 0 deg tilt (flat) 10 - 16 ft lane width				
Low Canopy			9-12 ft height 12 ft: 10 deg tilt 9 ft: 15 deg tilt 10-12 ft lane	9-13 ft height Low clearance 0 deg tilt (flat) 10-12 ft lane				
Traffic Management Overhead Mount								17-20 ft height 5 deg tilt 12-15 ft lane width
Side-fire Mount								17±1 ft height 30 deg pitch 45 deg yaw 12-15 ft lane width
ORT Lanes	16±1 ft height 15 deg tilt 12 ft lane width				IAG ORT lane 17±1 ft height 10 deg tilt 12 ft lane width		IAG high overhead mount (ORT) 22±2 ft height 10 deg tilt 12 ft lane width	

Kapsch Group.

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E-Mail: ktc.na@kapsch.net | www.Kapsch.us | www.kapsch.net

Version 6 Released 2/4/2019



2D LIDAR SENSORS

SICK
Sensor Intelligence.



Illustration may differ



Ordering information

Type	Part no.
LMS511-10100 PRO	1046135

Other models and accessories → www.sick.com/LMS5xx

Detailed technical data

Features

Version	Mid Range
Variant	PRO
Application	Outdoor
Resolution power	Standard Resolution
Light source	Infrared (905 nm)
Laser class	1 (IEC 60825-1:2014, EN 60825-1:2014)
Aperture angle	190°
Scanning frequency	25 Hz / 35 Hz / 50 Hz / 75 Hz / 100 Hz
Angular resolution	0.167° 0.25° 0.333° 0.5° 0.667° 1°
Heating	Yes
Working range	1 m ... 80 m
Max. range with 10 % reflectivity	40 m
Spot size	11.9 mrad
Amount of evaluated echoes	5
Fog correction	Yes

Performance

Response time	≥ 10 ms
Detectable object shape	Almost any
Systematic error	± 25 mm (1 m ... 10 m) ± 35 mm (10 m ... 20 m) ± 50 mm (20 m ... 30 m) ¹⁾
Statistical error	6 mm (1 m ... 10 m)

¹⁾ Typical value; actual value depends on environmental conditions.

	8 mm (10 m ... 20 m) 14 mm (20 m ... 30 m) ¹⁾
Integrated application	Field evaluation
Number of field sets	10 fields
Simultaneous evaluation cases	10

¹⁾ Typical value; actual value depends on environmental conditions.

Interfaces

Ethernet	✓, TCP/IP
Remark	OPC
Function	Host
Data transmission rate	10/100 MBit/s
Serial	✓, RS-232, RS-422
Function	Host
Data transmission rate	9.6 kBaud ... 500 kBaud
CAN	✓
Function	Extension of outputs
USB	✓
Remark	Mini-USB
Function	AUX
Data transmission rate	9.6 kBaud ... 500 kBaud
Switching inputs	4 (Encoders)
Switching outputs	6
Optical indicators	5 LEDs (Additional 7-segment display)

Mechanics/electronics

Electrical connection	4 x M12 round connector
Operating voltage	24 V DC
Power consumption	22 W, + 55 W heating (typical)
Housing color	Gray (RAL 7032)
Enclosure rating	IP65, IP67 (IEC 60529 Edition 2.2:2013-08)
Protection class	III (EN 60529, Section 14.2.7)
Weight	3.7 kg
Dimensions (L x W x H)	160 mm x 155 mm x 185 mm

Ambient data

Object remission	2 % ... > 1,000 % (reflectors)
Electromagnetic compatibility (EMC)	IEC 61000-6-2:2016-08 / IEC 61000-6-3:2006-07
Vibration resistance	IEC 60068-2-6:2007-12
Shock resistance	IEC 60068-2-27:2008-02
Ambient operating temperature	-30 °C ... +50 °C
Storage temperature	-30 °C ... +70 °C
Ambient light immunity	70,000 lx

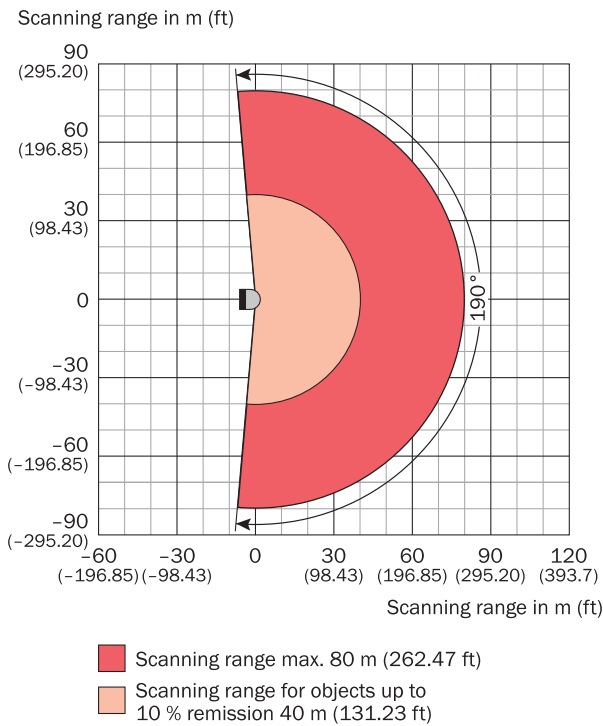
General notes

Note on use	The sensor does not constitute a safety component as defined by relevant legislation on machine safety.
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Classifications







ECl@ss 5.0	27270990
ECl@ss 5.1.4	27270990
ECl@ss 6.0	27270913
ECl@ss 6.2	27270913
ECl@ss 7.0	27270913
ECl@ss 8.0	27270913
ECl@ss 8.1	27270913
ECl@ss 9.0	27270913
ETIM 5.0	EC002550
ETIM 6.0	EC002550
UNSPSC 16.0901	46171620

Working range diagram



Recommended accessories

Other models and accessories → www.sick.com/LMS5xx

	Brief description	Type	Part no.
Device protection (mechanical)			
	Protection hood	Protection cover	2056850
Mounting brackets and plates			
	1 piece, mounting bracket for direct mounting, from the rear, on wall or machine, not adjustable	Mounting kit 1	2015623
Plug connectors and cables			
	Head A: female connector, M12, 12-pin, straight, A-coded Head B: Flying leads Cable: Power, I/O, twisted pair, PUR, halogen-free, shielded, 5 m	Connecting cable (female connector - open)	6042735
	Head A: female connector, M12, 5-pin, straight, A-coded Head B: Flying leads Cable: Power, shielded, 5 m	Connecting cable (female connector - open)	6036159
	Head A: male connector, M12, 12-pin, straight, A-coded Head B: Flying leads Cable: Power, I/O, twisted pair, PUR, halogen-free, shielded, 5 m	Connecting cable (male connector-open)	6042732
	Head A: male connector, M12, 4-pin, straight, D-coded Head B: male connector, RJ45, 8-pin, straight Cable: Ethernet, twisted pair, PUR, halogen-free, shielded, 5 m	SSL-2J04-G05ME	6034415

SICK AT A GLANCE

SICK is one of the leading manufacturers of intelligent sensors and sensor solutions for industrial applications. A unique range of products and services creates the perfect basis for controlling processes securely and efficiently, protecting individuals from accidents and preventing damage to the environment.

We have extensive experience in a wide range of industries and understand their processes and requirements. With intelligent sensors, we can deliver exactly what our customers need. In application centers in Europe, Asia and North America, system solutions are tested and optimized in accordance with customer specifications. All this makes us a reliable supplier and development partner.

Comprehensive services complete our offering: SICK LifeTime Services provide support throughout the machine life cycle and ensure safety and productivity.

For us, that is “Sensor Intelligence.”

WORLDWIDE PRESENCE:

Contacts and other locations – www.sick.com

IXE20 Series Sarix® IP Camera

2.1 MEGAPIXEL EXTENDED PLATFORM HIGH DEFINITION DIGITAL CAMERAS

Product Features

- Open IP Standards
- Up to 2.1 Megapixel Resolution (1920 x 1080)
- Up to 30 Images per Second (ips) at 1920 x 1080
- Auto Back Focus
- H.264 and MJPEG Compression Capability
- Day/Night Models
- Video Setup Jack
- Sensitivity Down to 0.03 Lux
- Power over Ethernet (IEEE 802.3af) or 24 VAC
- Up to 2 Simultaneous Video Streams
- Built-in Analytics
- Local Storage (Micro SD) for Alarm Capture

The **Sarix® IXE20 Series extended platform (EP)** is a 2.1 megapixel (Mpx) high performance day/night camera with advanced low-light technology and a mechanical IR cut filter for increased sensitivity in low-light installations.

Designed to install quickly, the camera includes automatic back focus control, built-in analytics, and other advanced features needed for demanding security applications.

Sarix technology defines the next generation of video security imaging performance, delivering high definition (HD) resolution, advanced low-light capabilities, consistent color science, and fast processing power. The H.264 compression video files are considerably smaller, making HD video more affordable.

Camera

The **IXE20 Series** has two 2.1 MPx models: color and day/night. Both models feature advanced low-light technology capabilities. The day/night model has a mechanical IR cut filter for increased sensitivity in low-light installations.

The **IXE20 Series** can support two simultaneous video streams. The two streams can be compressed in MJPEG and H.264 formats across several resolution configurations. The extended platform gives real-time video (30 ips) with HD resolution using H.264 compression for optimized bandwidth and storage efficiency. The streams can be configured to a variety of frame rates, bit rates, and GOP (group of pictures) structures for additional bandwidth administration.



(LENS NOT SUPPLIED WITH CAMERA)

- Adaptive Motion Detection
- ONVIF v1.02 Conformant
- Audio Accessory Available

Built-in Analytics

Pelco Analytics enhance the flexibility and performance of the IXE20 Series camera. Eight Pelco behaviors are preloaded and included as a standard feature of the IXE20DN. Pelco behaviors can be configured and enabled using a standard Web browser, and they are compatible with Endura® or a third-party system that supports alarms using Pelco's API. Camera models are also available with preloaded **OV Analytic Suites**.

Web Interface

The **IXE20 Series** uses a standard Web browser for powerful remote setup and administration.

Window Blanking

Window blanking is used to conceal user-defined privacy areas that cannot be viewed by an operator. The **IXE20 Series** supports up to four blanked windows. A blanked area will appear on the screen as a solid gray window.

Video Systemization

The **IXE20 Series** easily connects to Pelco IP and hybrid systems such as Endura version 2.0 (or later) and Digital Sentry® version 7.3 (or later). The camera is also compatible with Digital Sentry NVs (DS NVs), a full-featured video management software, which is available as a free download at www.pelco.com. DS NVs includes four free Pelco IP licenses and allows for the management of video from up to 64 cameras.

The **IXE20 Series** features open architecture connectivity to third-party software. Pelco offers an application programming interface (API) and software developer's kit (SDK) for interfacing with Pelco's IP cameras.



by Schneider Electric

International Standards
Organization Registered Firm,
ISO 9001 Quality System



C2955 / REVISED 3-22-12

PELCO ANALYTICS

The IXE20 series includes eight user-configurable behaviors. The camera is capable of running up to three behaviors at the same time; although, the number of behaviors is limited to the available processing power of the camera and the type of analytic being used.

Note: Available processing power is determined by the settings for compression standards, resolution, image rate, bit rate, and analytic configuration.

For each behavior, you can create several custom profiles that contain different camera settings. With these profiles, you can set up different scenarios for the behavior, which will automatically detect and trigger alarms when specific activity is detected.

Pelco Analytics are configured and enabled using a standard Web browser, and Pelco behavior alarms are compatible with Endura or a third-party system that supports Pelco's API system. Multiple Pelco behaviors can be scheduled to work during a certain time or condition. For example, during the day, a camera can be configured with Object Counting to count the number of people that enter a lobby door. At night, the operator can change the profile to Camera Sabotage to trigger an alarm if a camera is moved or obstructed. Available Pelco behaviors include:

- **Abandoned Object:** Detects objects placed in a defined zone and triggers an alarm if the object remains in the zone longer than the user-defined time allows. An airport terminal is a typical installation for this behavior. This behavior can also detect objects left behind at an ATM, signaling possible card skimming.
- **Adaptive Motion Detection:** Detects and tracks objects that enter a scene and then triggers an alarm when the objects enter a user-defined zone. This behavior is primarily used in outdoor environments with light traffic to reduce the number of false alarms caused by environmental changes.
- **Camera Sabotage:** Detects contrast changes in the field of view. An alarm is triggered if the lens is obstructed with spray paint, a cloth, or a lens cap. Any unauthorized repositioning of the camera also triggers an alarm.
- **Directional Motion:** Generates an alarm in a high traffic area when a person or object moves in a specified direction. Typical installations for this behavior include an airport gate or tunnel where cameras can detect objects moving in the opposite direction of the normal flow of traffic or an individual entering through an exit door.
- **Loitering Detection:** Identifies when people or vehicles remain in a defined zone longer than the user-defined time allows. This behavior is effective in real-time notification of suspicious behavior around ATMs, stairwells, and school grounds.
- **Object Counting:** Counts the number of objects that enter a defined zone or cross a tripwire. This behavior might be used to count the number of people at a store entrance/exit or inside a store where the traffic is light. This behavior is based on tracking and does not count people in a crowded setting.
- **Object Removal:** Triggers an alarm if an object is removed from a defined zone. This behavior is ideal for customers who want to detect the removal of high value objects, such as a painting from a wall or a statue from a pedestal.
- **Stopped Vehicle:** Detects vehicles stopped near a sensitive area longer than the user-defined time allows. This behavior is ideal for airport curbside drop-offs, parking enforcement, suspicious parking, traffic lane breakdowns, and vehicles waiting at gates.

OBJECTVIDEO (OV) ANALYTIC SUITES

ObjectVideo Analytics Suites are preloaded on selected IXE20 Series cameras and require an OV Ready system to configure the behaviors for alarm notification.

OV Security Suite

The OV Security Suite is easy to use and includes Tripwire Detection, Inside Area Detection, and Camera Tamper Detection behaviors.

- Tripwire Detection identifies objects that cross a user-defined line drawn within the camera's field of view.
- Inside Area Detection identifies objects entering, appearing, or moving within a user-defined area.
- Camera Tamper Detection identifies significant contrast changes in the camera's field of view; for example, if the lens is obstructed by spray paint, a cloth, or a lens cap.

OV Security Suite Plus

The OV Security Suite Plus includes the behaviors of the OV Security Suite plus Multi-Line Tripwire Detection, Loitering Detection, and Leave Behind Detection behaviors.

- Multi-Line Tripwire Detection identifies objects that cross two defined lines and generates an event based on defined parameters, including directionality. Defined parameters for this behavior include direction, sequential order, and time between crossing each tripwire.
- Loitering Detection identifies when people or vehicles remain within a user-defined area beyond a specified period of time. This behavior is effective for real-time notification of suspicious behavior around ATMs, stairwells, and school grounds.
- Leave Behind Detection detects objects placed in a defined zone and triggers an alarm if the object remains in the zone longer than the user-defined time allows.

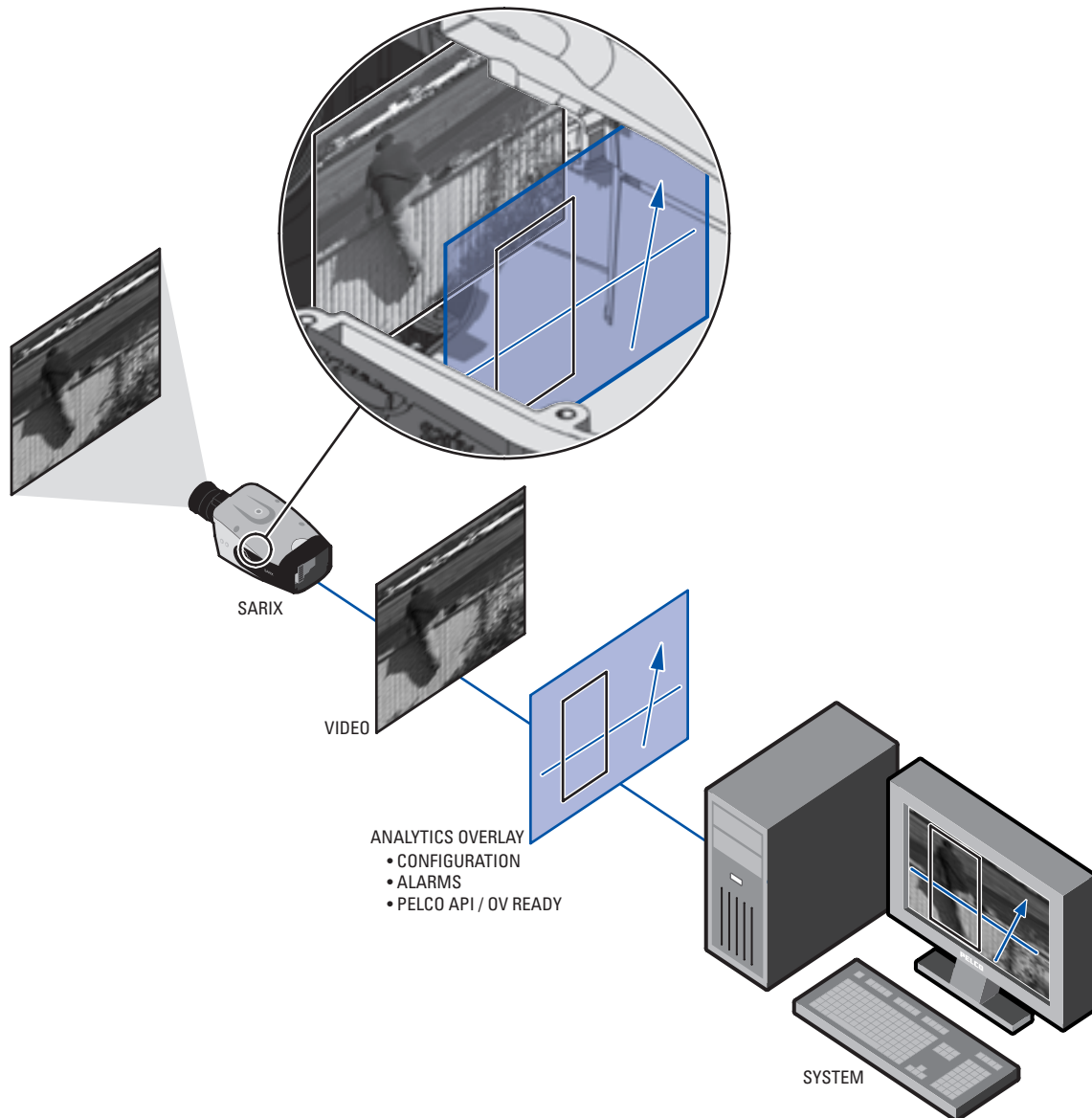
OV Event Counting Suite

The OV Event Counting Suite uses advanced object calibration and additional features for schedules, parameters, and multiple rules. The suite includes behaviors for Tripwire Counting, Enters/Exits Counting, Loiter Counting, Occupancy Sensing, and Dwell-Time Monitoring.

- Tripwire Counting counts people or objects that cross a user-defined line.
- Enters/Exits Counting calculates the number of people that enter and exit an area without using a tripwire.
- Loiter Counting is useful in analyzing how frequently people stop in front of a product, display, or other area of interest. This feature is also useful in assessing promotion effectiveness and product interest.
- Occupancy Sensing counts people and generates a new value every time the occupancy level changes. Since each occupancy output is time-stamped, the data can be used to determine average occupancy levels or to correlate data to point-of-sale or other business scenarios.
- Dwell-Time Monitoring rules can be set up to record the length of time it takes an object to enter and exit an area. Along with queue size information, wait times can also be assessed. This behavior can be used to evaluate consumer interaction for a point-of-sale display or digital advertisement.

TECHNICAL SPECIFICATIONS

The following diagram illustrates how the camera system interprets streaming video when embedded analytics are configured and enabled.



IMPORTANT NOTE: PLEASE READ. The network implementation is shown as a general representation only and is not intended to show a detailed network topology. Your actual network will differ, requiring changes or perhaps additional network equipment to accommodate the system as illustrated. Please contact your local Pelco Representative to discuss your specific requirements.

TECHNICAL SPECIFICATIONS

GENERAL

Imaging Device	1/3-inch (effective)
Imager Type	CMOS
Imager Readout	Progressive scan
Maximum Resolution	1920 x 1080
Signal-to-Noise Ratio	50 dB
Auto Iris Lens Type	DC drive
Electronic Shutter Range	1 ~ 1/100,000 sec
Wide Dynamic Range	60 dB
White Balance Range	2,000° to 10,000°K
Sensitivity	f/1.2; 2,850°K; SNR >24 dB
Color (33 ms)	0.50 lux
Color SENS (500 ms)	0.12 lux
Mono (33 ms)	0.25 lux
Mono SENS (500 ms)	0.03 lux
Weight (without lens)	0.50 kg (1.11 lb)
Shipping Weight	0.90 kg (2.00 lb)

ELECTRICAL

Port	RJ-45 connector for 100Base-TX Auto MDI/MDI-X
Cabling Type	Cat5 or better for 100Base-TX
Power Input	22 to 34 VAC; 24 VAC nominal or PoE (IEEE 802.3af class 3)
Power Consumption	<7 W
Current Consumption	
PoE	<200 mA maximum
24 VAC	<295 mA nominal; <390 mA maximum
Local Storage	Micro SD
Alarm Input	10 VDC maximum, 5 mA maximum
Alarm Output	0 to 15 VDC maximum, 75 mA maximum
Service Port	External 3-connector, 2.5 mm provides NTSC/PAL video output

MECHANICAL

Lens Mount	CS mount, adjustable
Camera Mount	0.25-inch (0.64 cm) UNC-20 screw, top and bottom of camera housing

ENVIRONMENTAL

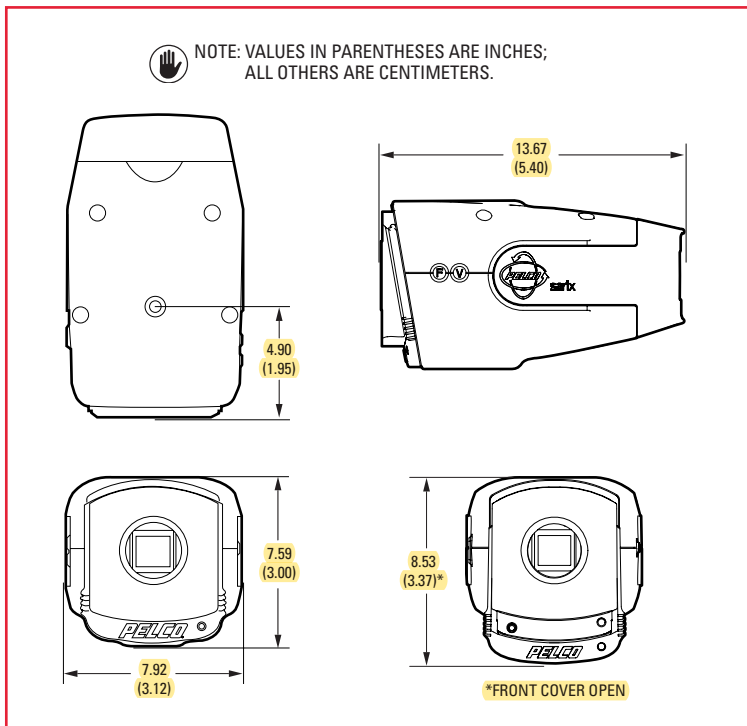
Operational Temperature	-10° to 50°C (14° to 122°F)
Storage Temperature	-10° to 70°C (14° to 158°F)
Storage Humidity	20% to 90%, noncondensing



FRONT VIEW, CAMERA ONLY
(OPENED TO EXPOSE SERVICE PORT)



REAR VIEW



TECHNICAL SPECIFICATIONS

VIDEO

Video Encoding H.264 High, Main, or Base profiles and MJPEG
 Video Streams Up to 2 simultaneous streams; the second stream is variable based on the setup of the primary stream
 Frame Rate Up to 30, 25, 24, 15, 12.5, 12, 10, 8, 7.5, 6, 5, 4, 3, 2.5, 2, 1 (dependent upon coding, resolution, and stream configuration)

Available Resolutions

Resolution				MJPEG		H.264 High Profile	
MPx	Width	Height	Aspect Ratio	Maximum IPS	Recommended Bit Rate	Maximum IPS	Recommended Bit Rate
2.1	1920	1080	16:9	15.0 ips	10.0 Mbps	30.0 ips	6.0 Mbps
1.9	1600	1200	4:3	20.0 ips	10.0 Mbps	20.0 ips	4.0 Mbps
1.3	1280	1024	5:4	20.0 ips	10.0 Mbps	20.0 ips	3.25 Mbps
1.2	1280	960	4:3	20.0 ips	10.0 Mbps	20.0 ips	3.0 Mbps
0.9	1280	720	16:9	30.0 ips	10.0 Mbps	30.0 ips	2.9 Mbps
0.5	800	600	4:3	30.0 ips	7.7 Mbps	30.0 ips	2.0 Mbps
0.3	640	480	4:3	30.0 ips	4.9 Mbps	30.0 ips	1.5 Mbps
0.1	320	240	4:3	30.0 ips	1.2 Mbps	30.0 ips	0.5 Mbps

Additional Resolutions 640 x 512, 640 x 352, 480 x 368, 480 x 272, 320 x 256, and 320 x 176
 Supported Protocols TCP/IP, UDP/IP (Unicast, Multicast IGMP), UPnP, DNS, DHCP, RTP, RTSP, NTP, IPv4, SNMP v2c/v3, QoS, HTTP, HTTPS, LDAP (client), SSH, SSL, SMTP, FTP, and 802.1x (EAP)
 Users
 Unicast Up to 20 simultaneous users depending on resolution settings (2 guaranteed streams)
 Multicast Unlimited users H.264
 Security Access Password protected
 Software Interface Web browser view and setup
 Pelco System Integration Endura 2.0 (or later) Digital Sentry 7.3 (or later)
 Open API Pelco API or ONVIF v1.02
 Minimum System Requirements
 Processor Intel® Core® 2 Duo microprocessor, 2.6 GHz
 Operating System Microsoft® Windows® XP, Windows Vista®, or Mac® OS X 10.4 (or later)
 Memory 2 GB RAM
 Network Interface Card 100 megabits (or greater)
 Monitor Minimum of 1024 x 768 resolution, 16- or 32-bit pixel color resolution
 Web Browser* Internet Explorer® 7.0 (or later) or Mozilla® Firefox® 3.5 (or later); Internet Explorer® 8.0 (or later) is recommended for configuring analytics
 Media Player† Pelco's Media Player or QuickTime® 7.6.5 for Windows XP, Windows Vista, or QuickTime 7.6.4 for Mac OS X 10.4

*Internet Explorer is not supported by Mac OS X 10.4.

†This product is not compatible with QuickTime version 7.6.4 for Windows XP or Windows Vista. If you have this version installed on your PC, you will need to upgrade to QuickTime version 7.6.5.

ANALYTICS

Required Systems for Pelco Analytics
 Pelco Interface WS5200 Advanced System Management Software on an Endura 2.0 (or later) system
 Open API The Pelco API can transmit behavior alarm data to third-party applications, available at pdn.pelco.com
 Required System for Object Video Suites OV ready-compliant system with OV Ready video management system

TECHNICAL SPECIFICATIONS

MODELS

IXE20DN	Sarix 2.1 MPx network day/night camera, extended platform with built-in Pelco Analytics
IXE20DN-OS	Sarix 2.1 MPx network day/night camera, extended platform with built-in OV Security Suite
IXE20DN-OSP	Sarix 2.1 MPx network day/night camera, extended platform with built-in OV Security Suite Plus
IXE20DN-OCP	Sarix 2.1 MPx network day/night camera, extended platform with built-in OV Event Counting Suite

CERTIFICATIONS

- CE, Class B
- FCC, Class B
- UL/cUL Listed
- C-Tick
- ONVIF v1.02

ACCESSORIES

IX-SC	Service/monitor cable, 1.22 m (4 ft); compatible with standard BNC connectors
AUD-1	External audio accessory
ALM-1	External alarm accessory

RECOMMENDED MOUNTS

C10-UM	Universal camera mount
--------	------------------------

RECOMMENDED ENCLOSURES

EH1512	Indoor/outdoor enclosure
EH3512	Outdoor enclosure
DF8	8-inch fixed mount dome

RECOMMENDED LENSES

13M2.2-6	Megapixel lens, varifocal, 2.2 ~ 6.0 mm, f/1.3 ~ 2.0
13M2.8-8	Megapixel lens, varifocal, 2.8 ~ 8.0 mm, f/1.2 ~ 1.9
13M2.8-12	Megapixel lens, varifocal, 2.8 ~ 12.0 mm, f/1.4 ~ 2.7
13M15-50	Megapixel lens, varifocal, 15.0 ~ 50.0 mm, f/1.5 ~ 2.1

Pelco megapixel lenses have been designed and tested to deliver optimal image quality for the IXE20 Series camera. The use of standard definition lenses on IXE20 Series megapixel cameras will limit the resolution of the camera, creating poor image quality.

Field of View in Degrees		Aspect Ratio		
		16:9	4:3	5:4
2.2 mm	Horizontal	109	109	109
	Vertical	63	83	89
2.8 mm	Horizontal	89	89	89
	Vertical	48	66	70
6.0 mm	Horizontal	42	42	42
	Vertical	24	32	34
8.0 mm	Horizontal	32	32	32
	Vertical	18	24	25
12.0 mm	Horizontal	21	21	21
	Vertical	12	16	17
15.0 mm	Horizontal	16	16	16
	Vertical	9	12	13
50.0 mm	Horizontal	5	5	5
	Vertical	3	4	4

Note: For 800 x 600 (or lower) resolutions in 4:3 or 5:4 aspect ratios, the field of view is smaller than listed above. Refer to the Installation/Operation manual for details.

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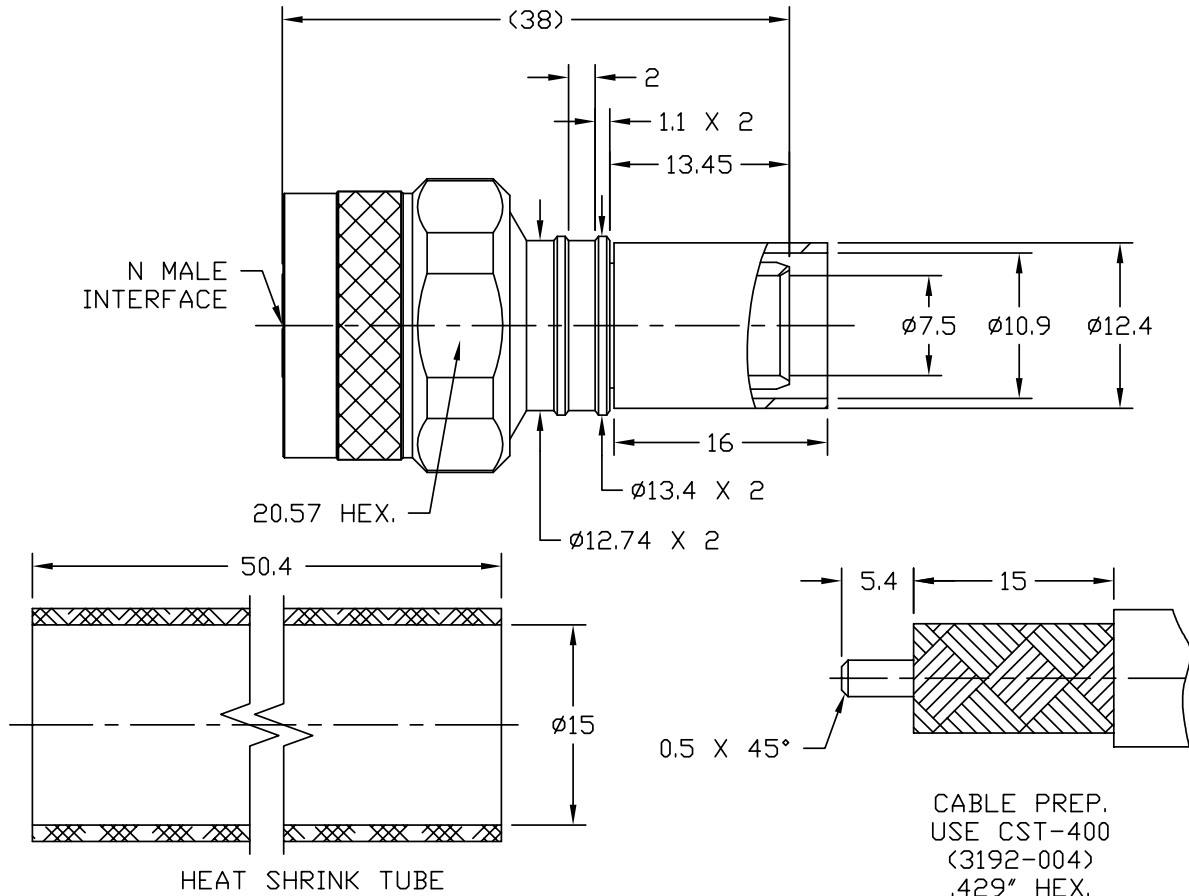
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ORT Gantry Equipment Cut Sheets

*On the following ORT Gantry Equipment cut sheets, sections enclosed in a **RED BOX** provide the Design-Builder with the dimensions and weight of each device.*

NOTICE OF PROPRIETARY RIGHTS: THIS DOCUMENT CONTAINS CONFIDENTIAL TECHNICAL DATA, INCLUDING TRADE SECRETS, PROPRIETARY TO TIMES MICROWAVE SYSTEMS. DISCLOSURE OF THIS DATA IS EXPRESSLY CONDITIONED UPON YOUR ASSENT THAT ITS USE IS LIMITED TO USE WITHIN YOUR COMPANY ONLY. ANY OTHER USE IS STRICTLY PROHIBITED WITHOUT THE PRIOR WRITTEN CONSENT OF TIMES MICROWAVE SYSTEMS.

SYM	REVISION DESCRIPTION	DFTM	DATE	APPD	DATE
A	RELEASED FOR PRODUCTION	D. J. H.	6/13/11	J. D. B.	6/27/11
B	CHANGED PER CDC #33920	D. J. H.	8/12/11	J. D. B.	8/15/11



Reference standard IEC60169-16
 I. Electric Performance
 Impedance(Ω): 50
 Frequency Range: DC-6GHz
 VSWR: ≤ 1.25
 Insert Loss: (dB) ≤ 0.05
 Insulation resistance ($M\Omega$) > 5000
 Work voltage (V) 1500
 Conductor resistance ($m\Omega$)
 outer conductor < 0.2
 inner conductor < 0.8
 II. Mechanical Performance
 Nut torque 25N.m
 (Nut) Whorl pull 1000N
 Tensile force(cable-connect) 400N
 Torsion(cable-connect) 2N.m

III. Material and plating:
 Component Material
 inner conductor Brass
 outer conductor Brass
 tube Copper
 nut Brass
 gasket Silicone rubber
 insulator PTFE

Plating
 Au50 micro inches over nickel 100 over copper
 copper tin-zinc 100-150 micro inches
 copper tin-zinc 100-150 micro inches
 copper tin-zinc 100-150 micro inches

IV. Environment
 Temp.range $-55^{\circ}C \sim +155^{\circ}C$
 Weather standard IEC 60068 55 / 155 / 56
 Thermal shock US MIL-STD 202, Meth.107, Cond.B
 Vibration US MIL-STD 202, Meth.204, Cond.B
 Shock US MIL-STD 202, Meth.213, Cond.I
 Waterproofing standard IP67

V. Assembly: inner conductor installed and outer conductor crimped

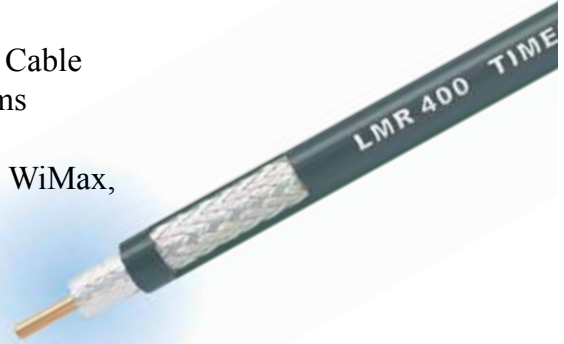
MATL:	UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS ARE IN mm MACHINED SURFACES FINISH N/A RMS MAX. REMOVE ALL BURRS N/A MAX. BREAK MACHINE CORNERS N/A MAX. FILLET R. TOLERANCES ON DECIMALS .XX \pm N/A .XXX \pm N/A ANGLES $\pm 1^{\circ}$ FRACTIONS \pm N/A	DFTM: D. J. H. DATE: 6/13/11 CHKD: J. D. B. DATE: 6/27/11 APPD: J. D. B. DATE: 6/27/11	TIMES MICROWAVE SYSTEMS EZ-400-NMH-X "N" MALE FOR LMR-400 CABLE EZ/CRIMP/NO BRAID TRIM
USED ON: 0	SCALE: N/A	DWG. SIZE: A	DO NOT SCALE DRAWING
CODE IDENT: 68999	DATE: 6/27/11	SHEET: 1 of 1	SD3190-2590 REV: B



LMR[®]-400 Flexible Low Loss Communications Coax

Ideal for...

- Drop-in replacement for RG-8/9913 Air-Dielectric type Cable
- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable
- **NEW!** Times Protect[®] LP-18-400 protector-series



- **LMR[®]** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.
- **LMR[®]-DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.
- **LMR[®]-FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated 'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.
- **LMR[®]-FR-PVC** is a general-purpose indoor cable and has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. It is less expensive than LMR-FR, however it emits toxic fumes (HCL) and greater smoke density when burned.
- **LMR[®]-PVC** is designed for low loss general-purpose applications and is somewhat more flexible than the standard polyethylene jacketed LMR.
- **LMR[®]-PVC-W** is a white-jacketed version of LMR-PVC for marine and other applications where color compatibility is desired.

- **Flexibility** and bendability are hallmarks of the LMR-400 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
- **Low Loss** is another hallmark feature of LMR-400.

Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

- **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
- **Weatherability:** LMR-400 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.
- **Connectors:** A wide variety of connectors are available for LMR-400 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.
- **Cable Assemblies:** All LMR-400 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description					Stock
Part Number	Application	Jacket	Color		Code
LMR-400	Outdoor	PE	Black		54001
LMR-400-DB	Outdoor/Watertight	PE	Black		54091
LMR-400-FR	Indoor/Outdoor Riser	CMR	FRPE	Black	54030
LMR-400-FR-PVC	Indoor/Outdoor Riser	CMR	FRPVC	Black	54073
LMR-400-PVC	General Purpose	PVC	Black		54218
LMR-400-PVC-W	General Purpose	PVC	White		54204

Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BCCAI	0.108	(2.74)
Dielectric	Foam PE	0.285	(7.24)
Outer Conductor	Aluminum Tape	0.291	(7.39)
Overall Braid	Tinned Copper	0.320	(8.13)
Jacket	(see table above)	0.405	(10.29)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.00	(25.4)
Bend Radius: repeated	in. (mm)	4.0	(101.6)
Bending Moment	ft-lb (N-m)	0.5	(0.68)
Weight	lb/ft (kg/m)	0.068	(0.10)
Tensile Strength	lb (kg)	160	(72.6)
Flat Plate Crush	lb/in. (kg/mm)	40	(0.71)

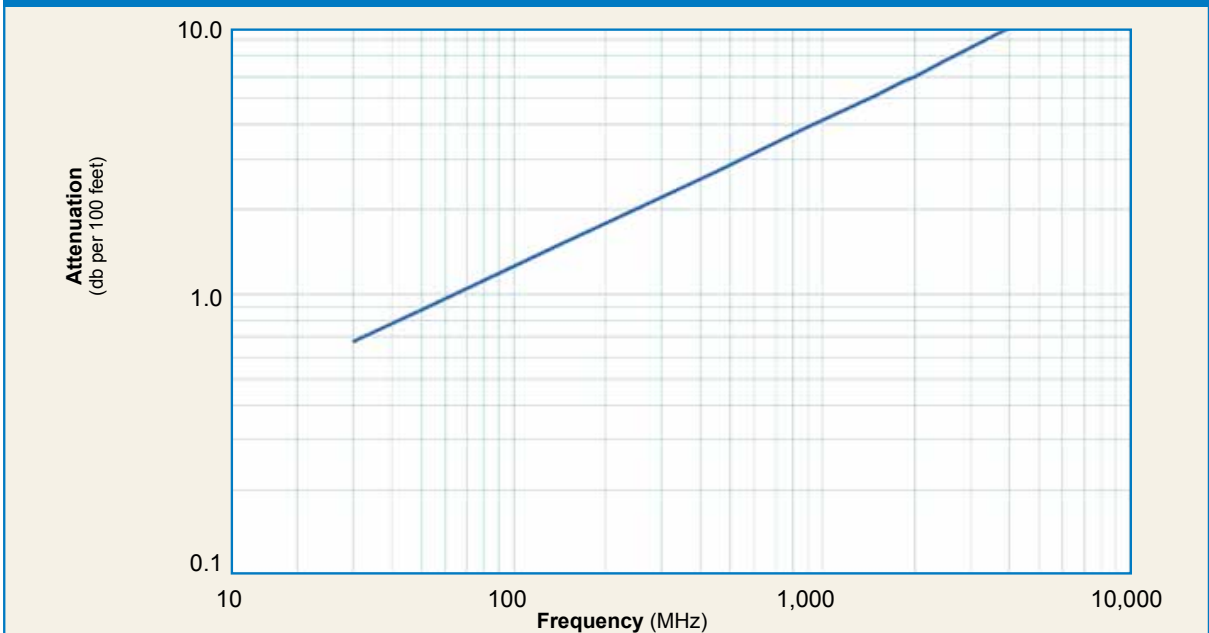
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.9	(78.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	1.39	(4.6)
Outer Conductor	ohms/1000ft (/km)	1.65	(5.4)
Voltage Withstand	Volts DC	2500	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	16	

Attenuation vs. Frequency (typical)



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.7	0.9	1.5	1.9	2.7	3.9	5.1	5.7	6.0	6.8	10.8
Attenuation dB/100 m	2.2	2.9	5.0	6.1	8.9	12.8	16.8	18.6	19.6	22.2	35.5
Avg. Power kW	3.33	2.57	1.47	1.20	0.83	0.58	0.44	0.40	0.37	0.33	0.21

Calculate Attenuation =

$(0.122290) \cdot \sqrt{\text{FMHz}} + (0.000260) \cdot \text{FMHz}$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:

VSWR=1.0 ; Ambient = +25°C (77°F)

Power:

VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS
LMR®-400

Flexible Low Loss Communications

Connectors

Interface	Description	Part Number	Stock Code	VSWR**	Coupling Freq. (GHz)	Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
1. 7-16 DIN Female	Straight Jack	TC-400-716-FC	3190-376	<1.25:1	(2.5)	NA	Solder	Clamp	S/S	1.6 (41)	1.13 (28.7)	0.281 (127.5)
2. 7-16 DIN	Right Angle	TC-400-716M-RA-D	3190-2598	<1.35:1	(6)	Hex	Solder	Crimp	A/S	1.7 (43.20)	1.98 (50.3)	0.374 (169.5)
3. 7-16 DIN Male	Straight Plug	EZ-400-716M-X	3190-2524	<1.25:1	(6)	Hex	Spring Finger	Crimp	A/G	1.6 (39.5)	1.38 (35)	0.277 (126.0)
4. 7-16 DIN Male	Straight Plug	TC-400-716-MC	3190-279	<1.25:1	(2.5)	Hex	Solder	Clamp	S/S	1.4 (36)	1.40 (35.6)	0.268 (121.6)
5. 7-16 DIN Male	Right Angle	TC-400-716MC-RA	3190-1671	<1.25:1	(<3)	Hex	Solder	Clamp	A/S	2.4 (61.5)	1.88 (47.8)	0.35 (159)
6. 7-16DIN Male	Right Angle	EZ-400-716M-RA-X	3190-2545	<1.35:1	(6)	Hex	Spring Finger	Crimp	A/G	1.6 (41.7)	1.75 (44.3)	0.374 (0.17)
7. BNC Male	Straight Plug	TC-400-BM	3190-318	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/S	1.7 (43)	0.56 (14.2)	0.063 (28.6)
8. BNC Male	Straight Plug	EZ-400-BM-X	3190-2852	<1.35:1	(2)	Knurl	Spring Finger	Crimp	A/G	1.7 (42.7)	0.56 (14.2)	0.066 (29.9)
9. BNC Male	Right Angle	EZ-400-BM-RA-X	3190-2847	<1.35:1	(2)	Knurl	Spring Finger	Crimp	A/G	1.9 (48.0)	1.32 (33.5)	0.097 (44.0)
10. HN Male	Straight Plug	TC-400-HNM	3190-923	<1.25:1	(<1)	Knurl	Solder	Clamp	S/G	2.3 (59.2)	0.88 (22.4)	0.25 (113.4)
11. HN Male	Right Angle	TC-400-HNM-RA	3190-2541	<1.25:1	(2.5)	Hex	Solder	Crimp	A/G	1.6 (41.4)	1.56 (39.6)	0.198 (90.0)
12. QDS Male	Straight Plug	TC-400-QDSM	3190-620	<1.25:1	(<3)	Knurl	Solder	Clamp	A/G	1.8 (46.6)	1.00 (25.4)	0.25 (113.4)
13. UHF Male	Straight Plug	EZ-400-UM	3190-997	<1.25:1	(2.5)	Knurl	Spring Finger	Crimp	N/G	1.8 (48)	0.80 (20.3)	0.076 (34.4)
14. Mini-UHF	Straight Plug	TC-400-MUHF	3190-520	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.1 (28)	0.50 (12.7)	0.020 (9.1)
15. N Female	Straight Jack	TC-400-NFC	3190-299	<1.25:1	(2.5)	NA	Solder	Clamp	N/S	1.6 (41)	0.75 (19.1)	0.119 (54.0)
16. N Female	Straight Jack	EZ-400-NF-X	3190-2818	<1.25:1	(2.5)	NA	Spring Finger	Crimp	N/G	1.8 (45)	0.66 (16.8)	0.105 (47.6)
17. N Female	Straight Jack	TC-400-NF-X	3190-2815	<1.25:1	(2.5)	NA	Solder	Crimp	N/G	1.8 (45)	0.66 (16.8)	0.105 (47.6)
18. N Female	Bulkhead Jack	EZ-400-NF-BH	3190-518*	<1.25:1	(2.5)	NA	Spring Finger	Crimp	N/G	1.8 (46)	0.88 (22.4)	0.102 (46.3)
19. N Female	Bulkhead Jack	TC-400-NFC-BH (A)	3190-872	<1.25:1	(2.5)	NA	Solder	Clamp	A/G	1.8 (46)	0.88 (22.4)	0.145 (65.8)
20. N Male	Straight Plug	SC-400-NM	3190-1454	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.5 (38)	0.75 (19.1)	0.090 (40.8)
21. N Male	Straight Plug	TC-400-NMC	3190-8077	<1.25:1	(2.5)	Knurl	Solder	Clamp	N/G	1.5 (38)	0.70 (17.8)	0.121 (54.9)
22. N Male	Straight Plug	EZ-400-NMC-2-D	3190-2640	<1.25:1	(2.5)	Hex/Knurl	Spring Finger	Clamp	N/G	1.5 (38)	0.75 (19.1)	0.121 (54.9)
23. N Male	Straight Plug	EZ-400-NMH-X	3190-2590	<1.25:1	(10)	Hex/Knurl	Spring Finger	Crimp	A/G	1.5 (38)	0.89 (22.6)	0.103 (46.8)
24. N Male	Straight Plug	TC-400-NMH-X	3190-2626	<1.25:1	(10)	Hex/Knurl	Solder	Crimp	A/G	1.5 (38)	0.89 (22.6)	0.113 (51.3)
25. N Male	Straight Plug	EZ-400-NMK-D	3190-661	<1.25:1	(10)	Knurl	Spring Finger	Crimp	S/G	1.5 (38)	0.75 (22.6)	0.113 (51.3)
26. N Male	Right Angle	EZ-400-NMH-RA-X	3190-2638	<1.35:1	(6)	Hex/Knurl	Spring Finger	Crimp	A/G	1.87 (47)	1.42 (36.0)	0.177 (80.2)
27. N Male	Right Angle	TC-400-NMH-RA-SS	3190-1668	<1.25:1	(2.5)	Hex	Solder	Crimp	SS/G	1.5 (38.1)	0.89 (2.6)	0.130 (59.0)
28. N Male	Right Angle	TC-400-NMH-RA-D	3190-2293*	<1.35:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.8 (46)	1.25 (31.8)	0.130 (59.0)
29. N Male	Right Angle	TC-400-NMC-RA (A)	3190-870	<1.35:1	(2.5)	Hex	Solder	Clamp	A/G	1.8 (46)	1.25 (31.8)	0.150 (68.0)
30. N Male	Reverse Polarity	TC-400-NM-RP	3190-960	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.5 (38)	0.75 (19.1)	0.090 (40.8)
31. SMA Male	Straight Plug	TC-400-SM-X	3190-3046	<1.25:1	(8)	Hex	Solder	Crimp	N/G	1.2 (29)	0.50 (12.7)	0.032 (14.5)
32. TNC Female	Reverse Polarity	TC-400-TF-RP	3190-1063	<1.25:1	(2.5)	NA	Solder	Crimp	N/G	1.8 (46)	0.55 (14.0)	0.074 (33.6)
33. TNC Female	Reverse Polarity	EZ-400-TF-RP	3190-795	<1.25:1	(2.5)	NA	Spring Finger	Crimp	A/G	1.8 (46)	0.55 (14.0)	0.074 (33.6)
34. TNC Male	Straight Plug	TC-400-TM-X	3190-2532	<1.25:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.9 (48)	0.67 (17.5)	0.075 (34.3)
35. TNC Male	Straight Plug	EZ-400-TM-X	3190-2533	<1.25:1	(6)	Hex/Knurl	Spring Finger	Crimp	A/G	1.9 (48)	0.67 (17.5)	0.075 (34.3)
36. TNC Male	Reverse Polarity	TC-400-TM-RP	3190-1062	<1.25:1	(2.5)	Knurl	Solder	Crimp	N/G	1.7 (43)	0.59 (15.0)	0.074 (33.6)
37. TNC Male	Reverse Polarity	EZ-400-TM-RP	3190-794	<1.25:1	(2.5)	Knurl	Spring Finger	Crimp	A/G	1.7 (43)	0.59 (15.0)	0.074 (33.6)
38. TNC Male	Right Angle	TC-400-TM-RA-D	3190-2671	<1.35:1	(6)	Hex/Knurl	Solder	Crimp	A/G	1.4 (35)	1.41 (35.8)	0.130 (59.0)
39. TNC Male	Right Angle	EZ-400-TM-RA-X	3190-2800	<1.24:1	(6)	Hex	Spring Finger	Crimp	A/G	2.0 (50.0)	0.62 (15.7)	0.130 (59.0)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector *Available in bulk pack

Install Tools and Hardware





Install Tools and Hardware

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1719	3190-202	.429" Hex Dies
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR 400 connectors
Crimp Rings	CR-400	3190-830	Crimp rings for TC/EZ-400 connectors (package of 10)
Strip Tool	ST-400C-2	3190-1972	Prep tool for EZ-400-NMC-2 two piece clamp style connector
Strip Tool	CST-400	3192-004	Combination prep tool for LMR-400 crimp and clamp style connectors
Mid-Span Strip Tool	GST-400	3190-2174	For ground strap attachment
Replacement Blades	RB-456	3190-421	Replacement blades for Strip Tool
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Tool Kit	TK-400EZ	3190-1601	Tool kit for LMR-400 Crimp Connectors (includes CCT-01, CST-400, CT-400/300, Tool Pouch)
Replacement Blade Kit	RB-CST	3192-086	Replacement blade kit for all CST strip tools
Ground Kit	GK-S400TT	GK-S400TT	Standard Grounding Kit (each)
Hoisting Grip	HG-400T	HG-400T	Laced Type (each)



LMR[®]-600 Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable



- **LMR[®]** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.
- **LMR[®]-DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.
- **LMR[®]-FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR is UL/NEC & CSA rated 'CMR' and 'FT4' respectively, meets FAA FAR25 requirements and is MSHA-P for mining applications.
- **LMR[®]-FR-PVC** is a general-purpose indoor cable and has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. It is less expensive than LMR-FR, however it emits toxic fumes (HCL) and greater smoke density when burned.
- **LMR[®]-PVC** is designed for low loss general-purpose applications and is somewhat more flexible than the standard polyethylene jacketed LMR.
- **LMR[®]-PVC-W** is a white-jacketed version of LMR-PVC for marine and other applications where color compatibility is desired.

- **Flexibility** and bendability are hallmarks of the LMR-600 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.
- **Low Loss** is another hallmark feature of LMR-600.

Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

- **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).
- **Weatherability:** LMR-600 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.
- **Connectors:** A wide variety of connectors are available for LMR-600 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.
- **Cable Assemblies:** All LMR-600 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				
Part Number	Application	Jacket Color	Stock Code	
LMR-600	Outdoor	PE	Black	54003
LMR-600-DB	Outdoor/Watertight	PE	Black	54093
LMR-600-FR	Indoor/Outdoor Riser	CMR FRPE	Black	54032
LMR-600-FR-PVC	Indoor/Outdoor Riser	CMR FRPVC	Black	54074
LMR-600-PVC	General Purpose	PVC	Black	54219
LMR-600-PVC-W	General Purpose	PVC	White	54206

Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BCCAI	0.176	(4.47)
Dielectric	Foam PE	0.455	(11.56)
Outer Conductor	Aluminum Tape	0.461	(11.71)
Overall Braid	Tinned Copper	0.490	(12.45)
Jacket	(see table above)	0.590	(14.99)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.50	(38.1)
Bend Radius: repeated	in. (mm)	6.0	(152.4)
Bending Moment	ft-lb (N-m)	2.75	(3.73)
Weight	lb/ft (kg/m)	0.131	(0.20)
Tensile Strength	lb (kg)	350	(158.9)
Flat Plate Crush	lb/in. (kg/mm)	60	(1.07)

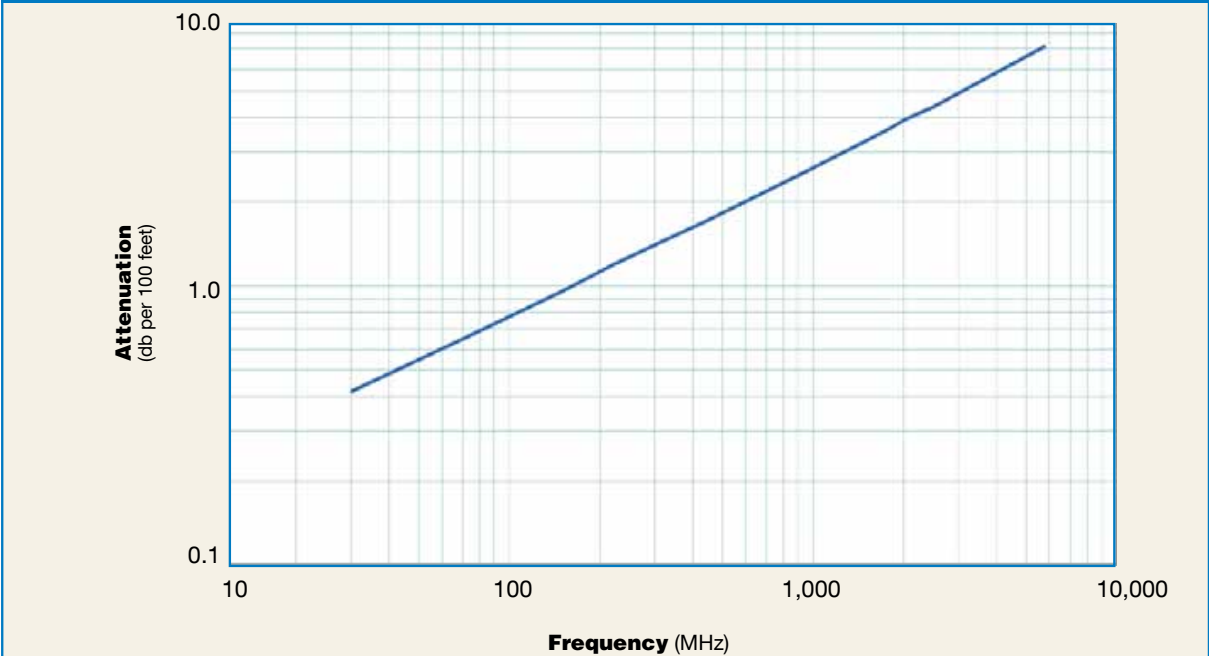
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Velocity of Propagation	%	87	
Dielectric Constant	NA	1.32	
Time Delay	nS/ft (nS/m)	1.17	(3.83)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.4	(76.6)
Inductance	uH/ft (uH/m)	0.058	(0.19)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.53	(1.7)
Outer Conductor	ohms/1000ft (/km)	1.2	(3.9)
Voltage Withstand	Volts DC	4000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	40	

Attenuation vs. Frequency (typical)



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.4	0.5	1.0	1.2	1.7	2.5	3.3	3.7	3.9	4.4	7.3
Attenuation dB/100 m	1.4	1.8	3.2	3.9	5.6	8.2	10.9	12.1	12.8	14.5	23.8
Avg. Power kW	5.51	4.24	2.41	1.97	1.35	0.93	0.70	0.63	0.59	0.52	0.32

Calculate Attenuation =
 $(0.075550) \cdot \sqrt{\text{FMHz}} + (0.000260) \cdot \text{FMHz}$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:

VSWR=1.0; Ambient = +25°C (77°F)

Power:

VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

LMR®-600
Flexible Low Loss Communications Coax



Connectors

Interface	Description	Part Number	Stock Code	VSWR**	Coupling Freq. (GHz)	Inner Contact Nut	Outer Contact Attach	Finish* Attach	Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
7/8 EIA	Flange	EZ-600-78EIA	3190-1373	<1.25:1	(2.5)	NA	Spring Finger Clamp	S/S	S/S	2.3 (58)	2.60 (66.0)	0.873 (396.0)
7-16 DIN Female	Straight Jack	TC-600-716FC	3190-375	<1.25:1	(2.5)	NA	Solder Clamp	S/S	S/S	1.1 (28)	1.00 (25.4)	0.249 (112.9)
7-16 DIN Male	Straight Plug	EZ-600-716MH	3190-503	<1.25:1	(2.5)	Hex	Spring Finger Crimp	S/S	S/S	2.0 (51)	1.30 (33.0)	0.254 (115.2)
	Straight Plug	TC-600-716MC	3190-502	<1.25:1	(2.5)	Hex	Solder Clamp	S/S	S/S	2.0 (51)	1.30 (33.0)	0.347 (157.4)
	Right Angle	TC-600-716M-RA	3190-395	<1.35:1	(2.5)	Hex	Solder Crimp	S/S	S/S	1.4 (36)	1.40 (35.6)	0.354 (160.8)
7/16 Male	Right Angle	EZ-600-716M-RA-X	3190-2546	<1.35:1	(6)	Hex	Spring Finger Crimp	A/G	A/G	1.6 (40)	1.38 (35.0)	0.462 (210.0)
	Straight Jack	EZ-600-716F	3190-2447	<1.25:1	(6)	Hex	Spring Finger Crimp	A/G	A/G	1.8 (45)	1.32 (33.6)	0.158 (71.7)
HN Male	Straight Plug	TC-600-HNM	3190-1429	<1.25:1	(<1)	Knurl	Solder Clamp	S/G	S/G	2.3 (59.2)	0.88 (22.4)	0.25 (113)
LC Male	Straight Plug	TC-600-LCM	3190-1406	<1.25:1	(<1)	Hex	Solder Clamp	N/S	N/S	3.1 (78.0)	1.62 (41.1)	1.20 (544)
N Female	Straight Jack	EZ-600-NF	3190-955	<1.25:1	(2.5)	NA	Spring Finger Crimp	S/G	S/G	2.3 (59)	0.87 (22.1)	0.150 (68.0)
	Bulkhead Jack	EZ-600-NF-BH	3190-616	<1.25:1	(2.5)	NA	Spring Finger Crimp	S/G	S/G	2.4 (61)	0.88 (22.4)	0.195 (88.5)
	Bulkhead Jack	TC-600-NF-BH	3190-589	<1.25:1	(2.5)	NA	Solder Crimp	S/G	S/G	2.4 (61)	0.88 (22.4)	0.195 (88.5)
	Bulkhead Jack	TC-600-NFC-BH	3190-466	<1.25:1	(2.5)	NA	Solder Clamp	S/G	S/G	2.2 (56)	0.94 (23.9)	0.214 (97.1)
N Male	Straight Plug	EZ-600-NMK	3190-669	<1.25:1	(2.5)	Knurl	Spring Finger Crimp	S/G	S/G	2.1 (53)	0.92 (23.4)	0.164 (74.4)
	Straight Plug	EZ-600-NMC-2-D	3190-2641	<1.25:1	(6)	Hex/Knurl	Spring Finger Clamp	A/G	A/G	2.1 (53)	0.92 (23.4)	0.202 (91.6)
	Straight Plug	TC-600-NMC	3190-357	<1.25:1	(2.5)	Hex	Solder Clamp	S/G	S/G	2.1 (53)	0.92 (23.4)	0.208 (93.4)
	Right Angle	TC-600-NMC-RA	3190-233	<1.35:1	(2)	Hex	Solder Clamp	S?G	S?G	2.2 (56.6)	1.29 (32.8)	0.270 (122.6)
	Straight Plug	EZ-600-NMH-X	3190-2627	<1.25:1	(8)	Hex/Knurl	Spring Finger Crimp	A/G	A/G	2.1 (53)	0.92 (23.4)	0.164 (74.4)
	Straight Plug	TC-600-NMH-X	3190-2628	<1.25:1	(8)	Hex/Knurl	Spring Finger Crimp	A/G	A/G	2.1 (53)	0.92 (23.4)	0.166 (75.3)
	Right Angle	EZ-600-NMH-RA-X	3190-2639	<1.35:1	(6)	Hex	Spring Finger Crimp	A/G	A/G	2.0 (50)	1.42 (36.0)	0.224 (101.7)
	Right Angle	TC-600-NMH-RA-D	3190-2427	<1.35:1	(6)	Hex	Solder Crimp	A/G	A/G	1.8 (46.5)	1.62 (41.2)	0.185 (84.3)
	Straight Plug	TC-600-NMH-75-50	3190-1610	<1.35:1	(6)	Hex	Solder Crimp	N/G	N/G	2.1 (52.8)	0.91 (23.1)	0.130 (59.0)
QDS Male	Straight Plug	TC-600-QDSM	3190-825	<1.25:1	(<1)	Knurl	Solder Clamp	A/G	A/G	2.2 (55.6)	1.00 (25.4)	0.25 (113)
	Right Angle	TC-600-QDSM-RA	3190-847	<1.25:1	(<1)	Knurl	Solder Clamp	A/G	A/G	2.4 (61.5)	1.88 (47.8)	0.35 (159)
TNC Male	Straight Plug	TC-600-TM-X	3190-2530	<1.25:1	(6)	Hex/Knurl	Solder Crimp	A/G	A/G	2.3 (57.6)	0.75 (19.0)	0.100 (45.6)
	Straight Plug	EZ-600-TM-X	3190-2531	<1.25:1	(6)	Hex/Knurl	Spring Finger Crimp	A/G	A/G	2.3 (57.6)	0.75 (19.0)	0.100 (45.6)
	Reverse Polarity	EZ-600-TM-RP	3190-796	<1.25:1	(2.5)	Knurl	Spring Finger Crimp	A/G	A/G	2.2 (56)	0.87 (22.0)	0.112 (50.8)
TNC Female	Reverse Polarity	EZ-600-TF-RP	3190-797	<1.25:1	(2.5)	NA	Spring Finger Crimp	A/G	A/G	2.3 (58)	0.87 (22.0)	0.100 (45.4)
UHF Male	Straight Plug	EZ-600-UM	3190-615	<1.25:1	(2.5)	Knurl	Spring Finger Crimp	S/G	S/G	1.7 (43)	0.88 (22.4)	0.164 (74.4)
	STRAIGHT PLUG	TC-600-UMC	3190-213	<1.25:1	(2.5)	KNURL	SOLDER CLAMP	S/G	S/G	1.7 (43)	0.88 (22.4)	0.198 (89.8)



Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1720	3190-203	.610" Hex Dies
Crimp Rings	CR-600	3190-831	Crimp Rings for TC/EZ-600 connectors (pkg of 10)
Strip Tool	CST-600	3192-052	Combination prep tool for LMR-600 crimp and clamp style connectors
Replacement Blades	RB-456	3190-421	Replacement Blades for Strip Tools
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Midspan Strip Tool	GST-600A	3190-1051	For ground strap attachment
Wrench	WR-600	3190-1435	15/16" Box Wrench (2 required for EZ-600-NMC-2)
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Replacement Blade	RB-CST	3192-086	Replacement blade kit for all CST strip tools
Tool Kit	TK-600EZ	3190-1602	Tool kit for LMR crimp/clamp connectors (includes CCT-01, CST-600, HX-4, Y1720, Tool Pouch)



Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S600TT	GK-S600TT	Standard Grounding Kit (each)
Hoisting Grip	HG-600T	HG-600T	Split/Laced Type (each)
Cold Shrink	CS-A600T	CS-A600T	Cable to Antenna Junction (each)
Cold Shrink	CS-60120T	CS-60120T	LMR-600 to -1200 Junction (each)
Cold Shrink	CS-60170T	CS-60170T	LMR-600 to -1700 Junction (each)
Hanger Blocks	CB-600T	CB-600T	Dual Cable Support Block (kit of 10)
Standard Entry			
Port Cushion	SC-600T-3	SC-600T-3	Three cables (each)
Snap-In Hangers	SH-U600T	SH-U600T	Snap-In Hangers (Kit of 10)
Hanger Block Supporting Hardware			Complete Range of Supporting Hardware & Adapters Available



Wallingford, CT, January, 2016

For immediate release
News release

Times Microwave Systems

358 Hall Avenue, Wallingford, CT 06492

T: 203 949 8400, F: 203 949 8423

www.timesmicrowave.com

New WSB Weatherproofing Kits for LMR-240 & LMR-600 Connectors from Times Microwave Systems

In addition to the popular **WSB-400** outdoor weatherproofing kit already available from Times Microwave Systems for LMR-400 connectors, kits are now also available for LMR-240 and LMR-600 connectors. The **WSB-240** and **WSB-600** kits work with the most popular LMR-240 EZ and LMR-600 EZ crimp connectors. The flexible silicone boot weatherproofing kits replace older weatherproofing methods, require no heat and only simple and easy hand assembly for valuable time saving in the field. The **WSB-240** and **WSB-600** kits are IP67 rated and both RoHS and REACH compliant.

<u>Part No.</u>	<u>Stock Code</u>	<u>Description</u>	<u>List Price</u>
WSB-240	3109-400	Weatherproofing/strain relief kit - LMR-400 crimp connectors	\$20.00/ea
WSB-400	3109-394	Weatherproofing/strain relief kit - LMR-400 crimp connectors	\$23.00/ea
WSB-600	3109-401	Weatherproofing/strain relief kit - LMR-400 crimp connectors	\$23.00/ea

Each kit comes in a package of ten (10) pieces.

About Times Microwave Systems

Times Microwave Systems has over 65 years experience in designing innovative, high-reliability, coaxial cables and assemblies for demanding interconnection problems. An engineering oriented organization, the company specializes in the design and manufacture of high performance flexible and semi-rigid coaxial cable, connectors, and cable assemblies for RF transmission from HF through microwave frequencies as well as surge arrestors for the protection of RF equipment.

For further information contact:

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DUAL SENSOR ALL-IN-ONE ALPR CAMERA SYSTEM



Dual Sensor Technology: Delivers both color and B&W infrared-illuminated images of the vehicle and license plate.



Built-in Real-Time ALPR Engine: Less than ¼ of a second plate processing time.



Multiple Flash Technology with IR Illumination System: Enables the camera to capture multiple plate images, ensuring the highest quality photo, in all lighting and weather conditions.



Anti-Glare Technology: Eliminates headlight glare, providing legible plate images with high contrast.



14' Field of View Coverage: INEX TECHNOLOGIES' Tolling products are installed in over 800 toll lanes in North America

IZA8000RT ALPR - Automatic License Plate Recognition - Camera System was designed specifically for the ITS and Video-based Tolling markets.

The all-in-one IZA8000RT combines two sensors (B&W and color), a quad core processor, and ALPR software in a single unit, delivering crystal clear images, automatically recognized license plate data, GPS coordinates, and streaming video.

The IZA8000RT all-in-one camera system delivers the most accurate license plate reading system on the market. It features real-time data processing, and maintains high accuracy in all lighting and weather conditions at vehicle speeds of up to 80 miles per hour.

The IZA8000RT enables Tolling and ITS lane operators to enforce toll violations, monitor traffic, and perform video tolling. The LPR system transmits the vehicle's license plate number and associated images to the management center for further processing, without any additional lane hardware.

The IZA8000RT all-in-one ALPR system decreases lane costs and increases recognition performance. Additional performance improvements can be achieved when the IZA8000RT is coupled with the company's proprietary InSignia™ Time & Place (TaP) Enhanced Recognition Technology.



Improve Quality of License/Number Plates Reads with IZA8000RT ALPR Series Camera System

General

Models	IZA8000RT
Operating Distance	Reflective plates: 40-95 ft (12-29 m) Non-reflective plates: 40-65 ft (12-20 m)
Field-of-View (FOV)	14 ft (4.25m)
Vehicle Speed Range	0-120 mph (0-193 km/h) (for reflective plate at center of FOV)

Internals

Sensor, ALPR	3.19MP Mono, 2064x1544p, 0.0 Lux
Sensor, OV	3.19MP Color, 2064x1544p
Lens	12-50mm, Manual
Shutter, ALPR	25-1000 µsec, Sequencer Mode
Operating System	Windows 8 Embedded
Processor	Intel® E3845, Quad Core

Environmental

Operating Temperature	-4°F to 140°F (-20°C to 60°C)
Storage Temperature	-22°F to 152°F (-30°C to 70°C)
Humidity	0% to 85% non-condensing
Salt Fog	Salt atmosphere with 5% salinity
Ingress Protection	IP67

Electrical

Input Voltage	24 VDC +/- 10%, Class 2 Low-Voltage
Power Consumption	25 Watts

Operation

Illumination	IR LEDs, Fixed Array
Supported Codecs, OV	MJPEG, H.264
Recognition Software	InSignia™ ALPR Engine
Communication	10/100/1000 Base-T Ethernet

Mechanical

Dimensions (W x H x D)	17.7" x 6.7" x 4.6" (450 mm x 171 mm x 116 mm)
Weight	5 lbs (2.2 Kg)
Connections	Ethernet: RJ45 outdoor connector Power: M12 outdoor connector

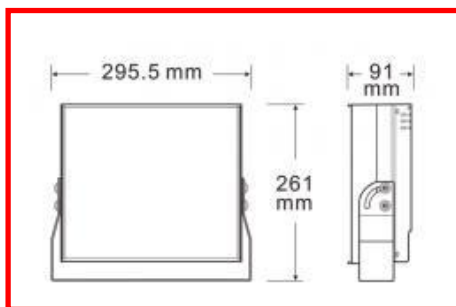
For more information about INEX TECHNOLOGIES' All-In-One ALPR/ANPR System products, and all our other solutions, please contact info@inextechnologies.com or call 865-671-1400 (for US) or +43 676 715 6066 (For International). Specifications subject to change without notice

FEATURES & BENEFITS

- ❑ Powerful **Infrared (IR)** LED light source for ANPR / LPR based applications
- ❑ Support for Multi Flash function
- ❑ Extra Long life & Very Low Maintenance
- ❑ IP66 enclosure for outdoor installation
- ❑ Pulsing range can be adjustable from 2.5K~10KHz
- ❑ External trigger or free running strobe
- ❑ Distance Up to 35 m
- ❑ Flood (30') and Spot (20') beam configurations



IZ-S2 LED Strobe



INEX-TECH's LED strobes provide a very powerful illumination, or Flashlight, source for Intelligent Traffic monitoring solutions such as ANPR (automatic number plate recognition), Red Light Violation, Open Road Tolling and Weigh-in Motion systems. Utilizing the latest high power LED technology available, the IZ-S2 illuminators series is fully integrated with internal timing, intensity control, trigger input and long distance communications.

The IZ-S2 LED strobes are IP66 rated and waterproof to three meters, sealed against intrusion by dust and dirt and ruggedly constructed to withstand demanding environments and conditions.

INEX-TECH offers a wide range of ALPR system accessories and OEM products to support your ALPR system purchase. By bringing together best-in-class product engineering with specialized designs customized for use with **INEX-TECH's** ALPR systems, customers can purchase accessories from our OEM partners with full confidence. And each OEM partner backs their products with the same commitment to pre- and post-sales service **INEX-TECH's** customers have come to expect.

Let us know how INEX-TECH can help your organization with your automatic vehicle recognition needs today.

IZ-IR LED Light Strobe

Power		Specification	
Input Supply Voltage	24VDC	LEDs	Latest High Power Technology
Power Consumption	50W	Lighting Configuration	35 meters
Rating	IP66	Light Drive Power(pulsed)	1200W
		LED Life Expectancy	50,000 hours
Environmental		Triggers Modes	1.Strobe Mode (Strobe combine with continuous limit pulse) 2.Trigger Mode (Flashes upon input pulse)
Operating Temperature	-40 C to 70 C (-40 F to 158 F)	Dimensions	
Storage Temperature	-40 C to 85 C (-40 F to 185 F)	Dimensions	(L)295 x (W)271 x (H)91 mm
Storage Humidity	0% to 95% non-condensing		
Salt Fog	Salt atmosphere with 5% salinity		
Materials	Aluminum Housing, Polycarbonate Lens		

ABOUT INEX-TECH

INEX TECHNOLOGIES has been supplying proven ALPR (Automatic License Plate Recognition) / ANPR (Automatic Number Plate Recognition) technology since 1993. We are the resource that organizations around the world turn to for license plate reader cameras and tailored solutions. Using advanced IR (infrared) LED technology, INEX TECHNOLOGIES solutions effectively capture license plate data from passing vehicles in real time at any time, day or night.

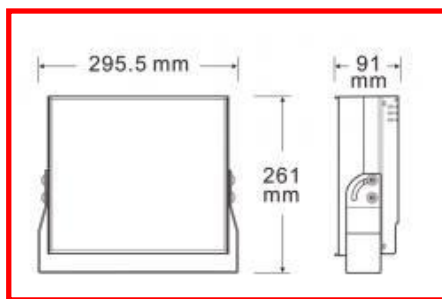
For More Information On INEX TECHNOLOGIES' IZ-IR Light Strobes, And All Our Other System Accessories And Solutions, Please Contact info@inextechnologies.com or call 865-671-1400 (for US) or +972 (2) 545 1000 (For International).

FEATURES & BENEFITS

- ❑ Powerful **White** LED light source for ANPR / LPR based applications
- ❑ Support for Multi Flash function
- ❑ Extra Long life & Very Low Maintenance
- ❑ IP66 enclosure for outdoor installation
- ❑ Pulsing range can be adjustable from 2.5K~10KHz
- ❑ External trigger or free running strobe
- ❑ Distance Up to 30 m
- ❑ Flood (30') and Spot (20') beam configurations



IZ-SW2 LED Strobe



INEX-TECH's LED strobes provide a very powerful illumination, or Flashlight, source for Intelligent Traffic monitoring solutions such as ANPR (automatic number plate recognition), Red Light Violation, Open Road Tolling and Weigh-in Motion systems. Utilizing the latest high power LED technology available, the IZ-SW2 illuminators series is fully integrated with internal timing, intensity control, trigger input and long distance communications.

The IZ-SW2 LED strobes are IP66 rated and waterproof to three meters, sealed against intrusion by dust and dirt and ruggedly constructed to withstand demanding environments and conditions.

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Let us know how INEX-TECH can help your organization with your automatic vehicle recognition needs today.

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IZ-IR LED Light Strobe

Power		Specification	
Input Supply Voltage	24VDC	LEDs	Latest High Power Technology , 5700-6500K (color temp)
Power Consumption	50W	Lighting Configuration	20-30 meters
Rating	IP66	Minimum Illumination	8K lm
		LED Life Expectancy	50,000 hours
Environmental		Triggers Modes	1. Strobe Mode (Strobe combine with continuous limit pulse) 2. Trigger Mode (Flashes upon input pulse)
Operating Temperature	-40 C to 70 C (-40 F to 158 F)	Dimensions	
Storage Temperature	-40 C to 85 C (-40 F to 185 F)	Dimensions	(L)295 x (W)271 x (H)91 mm
Storage Humidity	0% to 95% non-condensing		
Salt Fog	Salt atmosphere with 5% salinity		
Materials	Aluminum Housing, Polycarbonate Lens		

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AutoSense 615



Like its predecessor, the AutoSense II, the **AS 615** is designed to be mounted overhead in order to provide tolling and traffic management agencies with vehicle detection, separation, speed, and classification information. In addition, the AS 615 can be configured to trigger enforcement cameras.

The **AS 615** operates by emitting two laser fields beneath the sensor to scan both the roadway and the vehicles passing through the eye-safe laser. The system can be configured for open road or toll barrier applications and is sensitive enough to detect tow bars and motorcycles. Classification is determined by the vehicle's dimensional characteristics as well as detection of tow bars.

Single Lane / Multi Lane – Overhead Vehicle Detection, Separation and Classification

The **AS 615** is an ideal replacement for both light curtains and magnetic loops in barrier lane applications. In addition, when deployed in open road applications, the AS615 provides full vehicle classification information, either independently or in concert with other sensors, in order to ensure appropriate application of toll rates.

Accessories

AS 615



Mounting Kit¹
19471022-9



Power Cable^{2,3}
9291011-9-XYZ
(for AS615-UDK)



Power Cable^{2,4}
9291111-9-XYZ
(for AS615-EDK)



Comms. Cable^{2,5}
9291010-9



Surge Suppressor⁶
81000143-9



Beam Finder
9301000-9

Notes:

1. The Mounting Kit consists of a Mounting Plate (19476022-1) and Mounting Hardware (19471023-9)
2. Cables are offered in lengths of 50 ft, 100 ft, 125 ft, 150 ft and 200 ft. Part no. for e.g. 150 ft Power Cable becomes: 9291011-9-150
3. This cable is equipped with the PW06P12-3S connector
4. This cable is equipped with the PW06P12-3SY connector
5. This cable is equipped with the PW06P12-10S connector
6. Replacement Sponge for the Surge Suppressor is part no. 22NX

AutoSense – Scan rate matters!

AutoSense technology

The highly dynamic toll operation environment continues to demand very precise data collection systems which are flexible, upgradable, and able to work in tandem with legacy elements as well. With millions in revenue on the line every day, **AutoSense** delivers the level of precision and functionality you require.

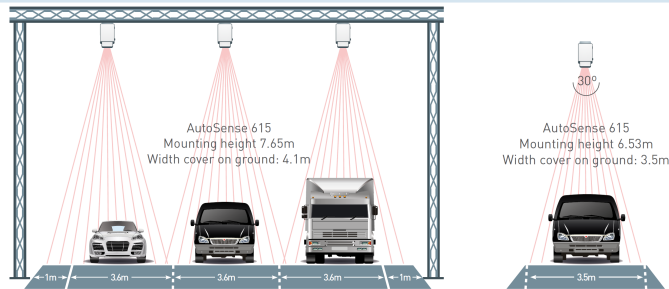
AutoSense products are developed to provide a highly sophisticated, noninvasive solution to track and analyze traffic across a wide range of applications, including toll collection, traffic flow analysis, bridge/tunnel clearance verification, weight-in motion, as well as traffic control and surveillance.

AutoSense products are also commonly used as highly accurate trigger sensors for enforcement cameras.

Concessionaires that employ **AutoSense** have realized substantially lower life cycle costs when compared to other technologies, due to ease of maintenance, extreme reliability and all-weather performance with advanced Multi-Pulse™ Logic.

Today, more than 5000 units are in the field, providing extremely accurate information via patented, eye-safe laser scanning technology that continuously self-tests to feature **vehicle detection accuracy exceeding 99%**.

AutoSense technology features unique **continuous line pixel technology** that allows accurate measurement of vehicle volumetric dimensions, vehicle speed and direction of travel.



Specifications

PERFORMANCE	AS615-JDK (120V)	AS615-EDK (240V)
Use, Single Lane	Single Lane - Open Road or Toll Barrier to achieve vehicle detection, separation, classification and camera trigger	
Use, MultiLane	MultiLane - Open Road to achieve vehicle detection, separation, classification and camera trigger when integrated with additional AS615's	
Typical mounting location	Overhead: 19.5 Ft - 25 Ft	Overhead: 5.9m - 7.6m
Field of View	30 degrees	30 degrees
Angular resolution	1 degree	1 degree
Scan rate	360 scans per second per beam	360 scans per second per beam
Vehicle Classification Categories	11 standard classes, plus 20 user-definable categories	11 standard classes, plus 20 user-definable categories
Vehicle Detection Accuracy	>99% [ORT]	>99% [ORT]
Vehicle Classification Accuracy	>95% (into 6 vehicle classes)	>95% (into 6 vehicle classes)
Vehicle Speed Accuracy	± 10%	± 10%
Vehicle Length Accuracy	± 10%	± 10%
Vehicle Height Accuracy	± 0.5 inches MAX	± 12.7 mm MAX
PHYSICAL		
Power Input	90-140 V, 50-60 Hz, 1.5 A	200-264 V, 50-60 Hz, 1.0 A
Power Consumption	35 W nominal, 157W maximum	35 W nominal, 157W maximum
Dimensions (L x W x H)	17.9 x 9.6 x 6.1 inches	455 x 244 x 155 mm
Weight	20.5 pounds	9.3 Kg
DATA INTERFACE		
RS-422	19.2, 38.4, 57.6 Kbaud [User selectable] 8 data bits, 1 start, 1 stop, no parity	
Ethernet	10/100 base-T	
ENVIRONMENTAL		
Temperature (with sun loading)	-40 to +160 degrees F	-40 to +70 degrees C
Thermal Shock		15.5 degrees C/minute
Humidity	0 to 100% condensing	0 to 100% condensing
Rain	0.8 inches/hour operating, 4 inches/hour maximum	20 mm/hour operating, 100 mm/hour maximum
Snow Loading	20 lb./ft ²	98 Kg/m ²
Wind Loading	43 knots steady, 73 knots gusts	22 m/s steady, 37 m/s gusts
Reliability (MTBF)	>35,000 hours	>35,000 hours
Maintainability	15 minutes [Mean Time to Replace]	15 minutes [Mean Time to Replace]
ACCESSORIES		
Mounting Kit	19471022-9	19471022-9
Power Cable	9291011-9 (50, 100, 125, 150 or 200 ft)	9291111-9 (15, 30, 38, 45 or 60 m)
Communications Cable	9291010-9 (50, 100, 125, 150 or 200 ft)	9291010-9 (15, 30, 38, 45 or 60 m)
Surge Suppressor RS-422	81000143-9	81000143-9
Beam Finder	9301000-9	9301000-9

Standards and Certifications

• IEC 60825-1 2007 (Class 1 Laser product) • UL 60950-1:2007 ED:2 • IEC 60950-1:2005 ED:2 • CAN/CSA C22.2 • 21 CFR 1040.10 & 1040.11

This product is manufactured in a facility certified to • AS9100B / ISO 9001:2008 • US Patent 5,546,188

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Sales: sales@osilaserscan.com
Customer Service: customerservice@osilaserscan.com



AutoSense - Scan rate matters!

www.osilaserscan.com

DEFLECTOMETER™

LMD301 Series

DEFLECTOMETER® SERIES

SINGLE CHANNEL NEMA TS-1 LOOP MONITOR



Built-in DEFLECTOMETER® Technology Provides Users With:

- ☑ Call Strength Indicator for Optimum Sensitivity Programming
- ☑ One step / One vehicle dynamic Sensitivity programming
- ☑ Frequency Meter for immediate analysis of loop frequency, avoiding loop cross-talk problems
- ☑ Push Button Programming

Why guess when you can know your detector is optimally programmed and performing for all vehicle classes!

Model Options:

- LMD301S Single Channel with Solid State outputs
- LMD301T Single Channel with Delay & Extend timing
- LMD301TS Single Channel with Delay & Extend timing & Solid State outputs

ENHANCED FEATURES

DEFLECTOMETER Call Strength Indicator:

The *Call Strength Indicator* provides the technician with a simple one-step method for accurately setting the optimum level of sensitivity that ensures accurate vehicle detection of all vehicles, including motorcycles and high-bed trucks. **NO MORE GUESSING!**

When a medium size vehicle is over the roadway loop, a DEFLECTOMETER® Call Strength value of "5" assures that the optimum sensitivity has been achieved. You can adjust the DEFLECTOMETER® reading *DYNAMICALLY* without moving the vehicle by using the front panel UP or DOWN sensitivity buttons. **IT DOES NOT GET ANY EASIER THAN THIS!**

Frequency Meter:

The built-in *Frequency Meter* reports the operating frequency of the loop network. Ensuring that adjacent loops are separated by at least 5 KHz will avoid crosstalk problems and future service calls.

Output CALL Test Mode:

The Output Call Test Mode provides a straight forward way to test that the Controller Unit is receiving an active output from the detector. This eliminates the need for cabinet test switches and associated wiring. A huge time saving feature during system set-up and trouble-shooting.

Advanced Loop Diagnostics:

The Fault (FLT) indicator displays the type of fault: Short, Open or 25% change of inductance. The Fault Monitor will report and store three types of loop faults; Open Loops, Shorted Loops, and 25% sudden changes in inductance. Each type of fault is indicated by a unique sequence of flashes allowing the user to diagnose loop failures at a glance.

Delay & Extension Timing:

The LMD301t model provides a programmable Delay time of 1 to 63 seconds, and an Extend time of 0.25 to 15.75 seconds. These parameters are set via the front panel DIP switches.

STANDARD FEATURES

- ☑ Delay & Extension Timing on LMD301t model
- ☑ Automatic Tuning
- ☑ Lightning & Surge Protection
- ☑ Four Frequency Levels
- ☑ Separate Color-Coded LED indicators
- ☑ Wide Loop Inductance Range: 20 to 2500 microHenries.

EBERLE DESIGN INC.

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Phoenix, AZ 85040 USA
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Tel (480) 968-6407
Fax (602) 437-1996



LMD301 DEFLECTOMETER® SERIES SINGLE CHANNEL INDUCTIVE LOOP VEHICLE DETECTOR SPECIFICATIONS

General Characteristics

Controls: Front panel push buttons allow the user to set the Sensitivity Level, Operational mode, and nominal Frequency independently on each channel. DIP switches allow the user to set the Delay and Extension timers on the LMD301t model.

Setting Sensitivity - Front Panel Push Buttons

The DEFLECTOMETER® (front panel 7-segment LED) aids in setting the DETECTOR quickly and easily to the most optimum sensitivity level to ensure the trouble-free detection of all vehicles, including motorcycles and high bed vehicles. For typical vehicles (mid-size vehicle / small pickup up) utilizing properly installed roadway loops, a Call Strength of 5 displayed on the DEFLECTOMETER® during the DETECT output period indicates an optimum sensitivity setting. For high profile vehicles (commercial trucks, 4x4's, etc...), a Call Strength value of 4 will be optimum. For low profile vehicles (sports cars, etc...), a Call Strength value of 6 will be optimum.

Adjusting sensitivity using the DEFLECTOMETER® (recommended):

The DEFLECTOMETER® should read zero (0) with no vehicle over the roadway loop. When a typical mid-sized vehicle is completely in the detection zone (DET indicator On), the Call Strength value should be adjusted up or down until the DEFLECTOMETER® displays the desired optimum value of 5 (or 4 or 6 as described above).

If a typical vehicle located over the roadway loop causes the Call Strength "7" to be displayed on the DEFLECTOMETER®, the sensitivity should be decreased two levels. This can be done by pressing the front panel SENS ⬇ button two times to achieve the Call Strength value of 5.

If a typical vehicle located over the roadway loop causes the number "2" to be displayed on the DEFLECTOMETER®, the sensitivity should be increased three levels. This can be done by pressing the front panel SENS ⬆ button three times to achieve the Call Strength value of 5.

NOTE: THE DEFLECTOMETER® CALL STRENGTH DYNAMICALLY UPDATES AFTER EACH SENSITIVITY LEVEL CHANGE, ALLOWING YOU TO CHANGE SENSITIVITY SETTINGS WHILE A VEHICLE REMAINS IN THE LOOP DETECTION ZONE.

Adjusting sensitivity without using the DEFLECTOMETER® (manually setting sensitivity):

The DETECTOR offers 9 levels of sensitivity (1 to 9). Level 9 is the highest sensitivity. Sensitivity Level can be manually set to any desired value by pressing the front panel SENS buttons (⬆ or ⬇) when a vehicle is NOT over the roadway loop (DET indicator Off). The first time a SENS button (⬆ or ⬇) is pressed, the current Sensitivity Level is displayed on the DEFLECTOMETER® for 3 seconds. If either SENS button (⬆ or ⬇) is pressed again before the 3 second period ends, the Sensitivity Level will increase (SENS ⬆) or decrease (SENS ⬇). The new Sensitivity Level value will be displayed on the DEFLECTOMETER® display for 3 seconds. The factory default Sensitivity setting is level 6.

Sensitivity	ΔL / L	Sensitivity	ΔL / L
9	0.01%	4	0.32%
8	0.02%	3	0.64%
7	0.04%	2	1.28%
6	0.08%	1	2.56%
5	0.16%	-	-

Loop Frequency / Loop Frequency Display: One of four frequency settings may be selected via the front panel FREQ push button to alleviate interference which may occur when loops connected to different detectors are located adjacent to one another. To help prevent or diagnose crosstalk problems, the loop frequency is displayed on the front panel DEFLECTOMETER®. The current loop frequency is displayed after pressing the FREQ button to display the current Frequency Level. The frequency is shown in KHz with a "K" symbol displayed both before and after the numeric digits shown on the DEFLECTOMETER®.

For example, after pressing the FREQ button once the display sequence might show:

"3" ⇒ "K" ⇒ "27" ⇒ "7" ⇒ "K"

This sequence would indicate Frequency Level "3" and a loop reference frequency of 27 KHz. Detectors on adjacent loops should all be separated by at least 5 KHz.

Loop Fault Monitoring: The Detector continuously checks the integrity of the loop. The system is able to detect shorted or open circuit loops, or sudden changes in inductance exceeding 25% of the nominal inductance. If a fault is detected, the OUT and FLT indicators continuously emit a sequence of flashes. Additionally, the DEFLECTOMETER® displays the letter "F" indicating a current loop fault. Each type of fault is identified by a unique flash sequence:

Flash Sequence	Fault
1 flash	Open Circuit Loop.
2 flashes	Shorted Circuit Loop.
3 flashes	25% excessive change in inductance.

If the Open or Shorted fault condition self heals, the DET indicator and DEFLECTOMETER® will return to normal operation. The FLT indicator will continue to flash with the sequence signifying the type of fault that was last detected. In the case of the excessive inductance change fault, the unit will return to the new inductance after a period of two seconds and continue operation. The fault condition will be indicated by the flash sequence of the FLT indicator.

Operational Modes

Presence: A Presence output mode may be selected from the front panel MODE push button. If presence mode is selected then a choice of short (S) or long (L) can be selected. Short Presence is defined as 30 minutes and Long Presence is defined as 120 minutes.

Pulse: A Pulse output mode (P) may be selected from the front panel MODE push button. In Pulse mode, a 125 ms ± 25ms width pulse will be output for each vehicle entering the loop.

Call: A continuous CALL output (C) may be selected from the front panel MODE push button which will simulate the presence of a vehicle. This mode is used for testing the CALL output of a channel.

Channel Off: The Channel Off (-) may be selected from the front panel Mode push button. This option turns OFF the channel and disables the oscillator.

LMD301t Selectable Options:

Call Delay Timer for Presence & Pulse Modes: A delay time of 1 to 63 seconds can be set via the DELAY DIP switches. The numeric sum of the switches in the On position is equal to the Delay time. Call Delay time starts counting down when a vehicle enters the loop detection area. During the Delay time the DET indicator will flash two times per second and the DEFLECTOMETER® will display the letter "d". Delay time can be overridden by a True (low) signal at the Timer Control input.

Call Extension Timer for Presence Mode: An extend time of 0.25 to 15.75 seconds can be set via the EXTEND DIP switches. The numeric sum of the switches in the On position is equal to the Extend time. Two modes are provided:

Extend Always (default): Call Extend time starts counting down when the last vehicle clears the loop detection zone. During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER® will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained. The Timer Control input has no effect on this mode.

Extend on Green (EOG)

Call Extend time starts counting down when the last vehicle clears the loop detection zone if the Timer Control input is True (low). During the Extend time the DET indicator will flash four times per second and the DEFLECTOMETER® will display the letter "E". Any vehicle entering the loop detection zone during the Extend time period causes the Extend timer to be reset and the output maintained.

The Extend on Green mode is enabled by a factory installed diode on the pcb. Consult the factory for details.

Timer Control Inputs: Timer Control inputs are provided for each channel to modify the operation of the Delay and Extension functions. The application of a True (low) state voltage will inhibit the Delay timing function and/or enable the Extend timing function. Timer Control inputs are primarily provided for downward compatibility.

Pin Assignment:

Pin	Function
A	Neutral (AC-)
B	Ch 1 Output Relay Common (Emitter)
C	Power (AC+)
D	Channel 1 Loop Input
E	Channel 1 Loop Input
F	Ch 1 Output Relay N.O. (Collector)
G	Ch 1 Output Relay N.C.
H	Earth Ground
I	No Connect
J	Ch 1 Timer Control (LMD301t)

N.O. is Normally Open, N.C. is Normally Closed.

Relay Contacts are shown with power applied, loops connected and no vehicle present.

AC Supply Voltage:	Minimum.....	89 Vac
	Maximum.....	270 Vcc
	Frequency.....	47 to 63 Hz
AC Timer Control Inputs:	True (active).....	Greater than 70 Vac
	False (not active).....	Less than 15 Vac
Optically Isolated Outputs:	True (low, 50 mA).....	Less than 1.5 Vdc
	Maximum Current.....	100 mA
	Relay Outputs:	AC Contact Rating.....
Environmental:	DC Contact Rating.....	5A @ 30 Vdc
	Operating Temperature Range: -30°F to 165°F (-34°C to 74°C)	
Mechanical:	Height.....	5.5 inches
	Width.....	2 inches
	Depth.....	5.412 inches

Kapsch Antenna Summary.

Parameter / Antenna:	IAG-1 Antenna	IAG-1 Antenna "B"	IAG-2 Antenna	IAG2-T Antenna	VRC Antenna	mGate Antenna
Part #	800260-011	800260-012	800260-008	800260-007	800260-010	800260-009
Lane Kit #	801692-014	801692-017	801692-012	801692-009	801692-013	801300-002 (Reader Kit)
Description	3x3 patch	3x3 patch	2x2 patch	2x2 patch	2 patch	1 patch
Size WxHxD (in)	34.75 x 31.75 x 2.3"	34.75 x 31.75 x 2.23"	17.72 x 15.47 x 1.2"	18 x 16 x 2"	17.22 x 10.22 x 1.1"	11.84 x 10.72 x 1.22"
Weight¹ (lb)	28 lb	28 lb	4 lb	4 lb	4 lb	2 lb
Horizontal Beamwidth	28 deg	28 deg	40 deg	40 deg	60 deg	55 deg
Vertical Beamwidth	28 deg	28 deg	40 deg	40 deg	40 deg	60 deg
Gain	16 dBi	16 dBi	12 dBi	12 dBi	10 dBi	9 dBi
Mounting	Horizontal	Horizontal	Horizontal	Horizontal	Vertical	Horizontal

Parameter / Antenna:	IAG-3 Antenna	IAG-4 Antenna	IAG-5 Antenna	Patch - Lab Use	Patch - Toll Booth ³	Patch - Toll Booth ⁴
Part #	800260-015	800260-016	800260-017	700257-001	700257-002	700257-003
Lane Kit #	801692-019	801692-020	801692-021	N/A	N/A	N/A
Description	3x4 dipole array	6x4 dipole array	4x4 dipole array	1 patch	1 patch	1 patch
Size WxHxD (in)	34.5 x 21.25 x 3.13"	45.6 x 38.0 x 6.25"	36.13 x 30.81 x 3.13"	7.75 x 4.625 x 2.25"	8.813 x 7.437 x 6.093"	10.781 x 7.432 x 4.091"
Weight¹ (lb)	19 lb	73 lb	32 lb	1.3 lb	3.65 lb	3.35 lb
Horizontal Beamwidth	29 deg	19 deg	22 deg	N/A	N/A	N/A
Vertical Beamwidth	40 deg	23 deg	30 deg	N/A	N/A	N/A
Gain	14 dBi	17 dBi	16.5 dBi			
Mounting²	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal	Horizontal

Notes:

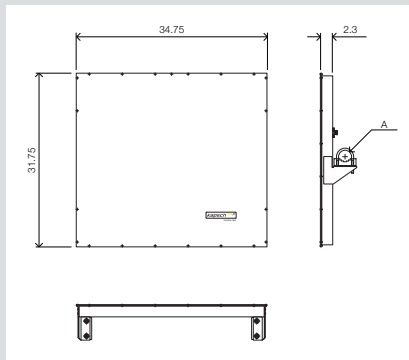
¹ Weight specified is applicable to the antenna structure only i.e. it does not include mounting hardware.

² Mounting information is provided as a guideline. Site details may require some adjustment beyond the ranges specified.

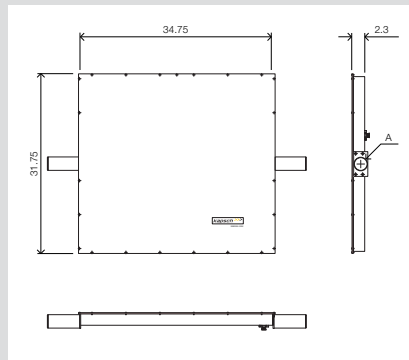
³ Includes a switch that is wired discreetly.

⁴ Includes a switch that disables the antenna directly.

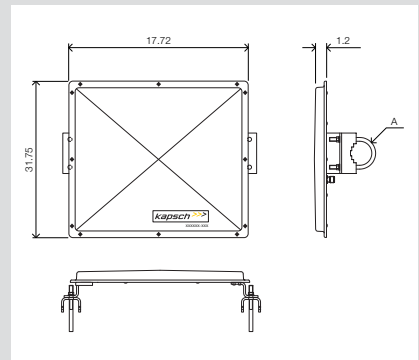
Technical Drawings



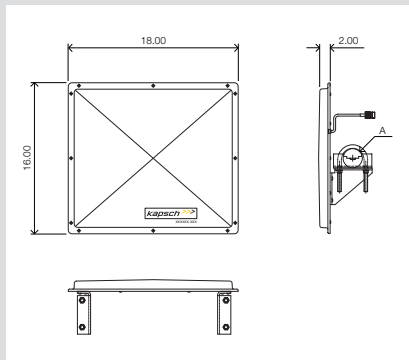
IAG-1 Antenna



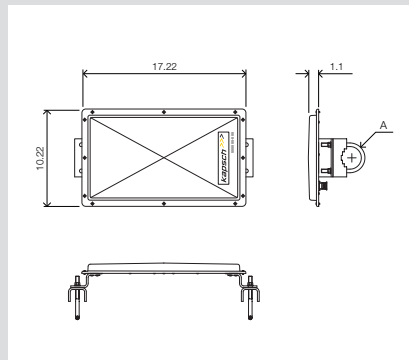
IAG-1 Antenna "B"



IAG-2 Antenna



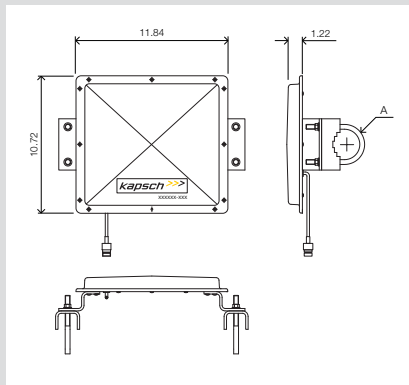
IAG-2 T Antenna



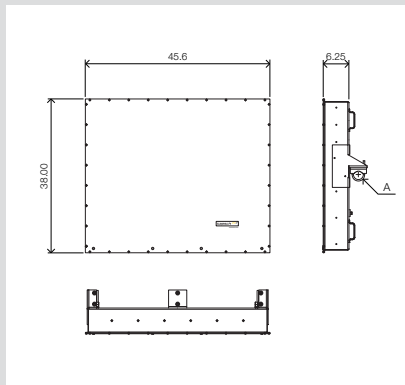
VRC Antenna

DETAIL "A": 2.00 in. diameter pole mounting.
Measurements in inches.

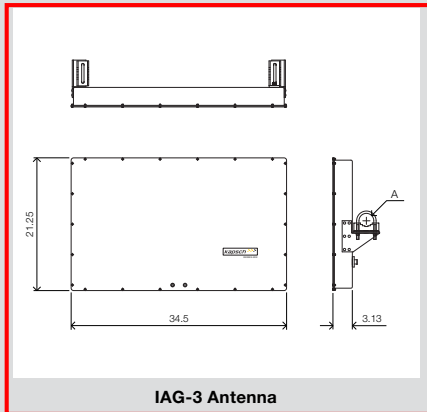
Technical Drawings



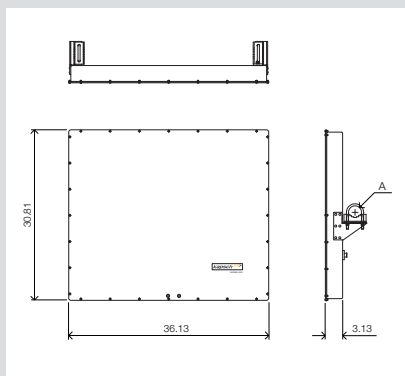
mGate Antenna



IAG-4 Antenna



IAG-3 Antenna



IAG-5 Antenna

DETAIL "A": 2.00 in. diameter pole mounting.
Measurements in inches.

Applications								
Parameter / Antenna:	IAG-1 Antenna	IAG-1 Antenna "B"	IAG-2 Antenna	IAG2-T Antenna	IAG-3 Antenna	IAG-4 Antenna	IAG-5 Antenna	VRC Antenna
Standard Lane	15±1 ft height 15 deg tilt 10-12 ft lane width				IAG ORT lane 15±1 ft height 15 deg tilt 12 ft lane width	IAG high overhead mount (toll plaza) 22±2 ft height 10 deg tilt 10-12 ft lane width		407 ETR lanes for IAG and TDMA 5 deg tilt (IAG) 40 deg tilt (TDMA)
Alternate Mount		15±1 ft height 15 deg tilt 10 - 12 ft lane width						
Wide			15±1 ft height 10 deg tilt 10 - 16 ft lane width	15±1 ft height Low clearance 0 deg tilt (flat) 10 - 16 ft lane width				
Low Canopy			9-12 ft height 12 ft: 10 deg tilt 9 ft: 15 deg tilt 10-12 ft lane	9-13 ft height Low clearance 0 deg tilt (flat) 10-12 ft lane				
Traffic Management Overhead Mount								17-20 ft height 5 deg tilt 12-15 ft lane width
Side-fire Mount								17±1 ft height 30 deg pitch 45 deg yaw 12-15 ft lane width
ORT Lanes	16±1 ft height 15 deg tilt 12 ft lane width				IAG ORT lane 17±1 ft height 10 deg tilt 12 ft lane width		IAG high overhead mount (ORT) 22±2 ft height 10 deg tilt 12 ft lane width	

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4700000692-01-EN-US



POWEREDGE R330

Powerful and versatile 1-socket rack server for small and medium businesses (SMB) and remote office/branch office (ROBO).

The Dell EMC PowerEdge R330 is an excellent first server or replacement server for SMB and also highly attractive as an affordable ROBO server for large institutions. Compared to the previous-generation PowerEdge R320, the R330 supports DDR4 memory vs. DDR3, PERC9 vs. PERC8, the integrated Dell Remote Access Controller 8 (iDRAC8) vs. iDRAC7, and an Intel® Xeon® E3 processor vs. an Intel Xeon E5 in the previous-generation server.

Discover greater versatility

Harness data growth with up to four internal 3.5-inch cabled or hot-plug hard drives, or up to eight 2.5-inch hot-plug hard drives. Grow memory capacity through time with four DIMM slots supporting up to 64GB of DDR4 memory to drive application performance and rapid response times. Adapt flexibly to changing workload conditions with a virtualization-ready server supporting Microsoft® Windows Server® with Hyper-V®, VMware® vSphere® ESXi® and Red Hat® Enterprise Virtualization.

Deliver powerful performance

Accelerate system boot time with up to two optional 1.8-inch SSDs. Drive 50% faster clock speed with enhanced DDR4 memory compared to DDR3, which is 12.5% faster than the initial 2133 MT/s implementation of DDR4. Boost I/O data throughput with two PCIe 3.0 slots for 2x data throughput compared to PCIe 2.0. Deliver 2x IOPS performance with R330/PERC9 compared to the previous-generation R320/PERC8.

Maximize operational efficiency

Deploy smoothly and rapidly with Dell OpenManage systems management solutions. Easily monitor system health and behavior with simple, intuitive OpenManage Essentials console. Gain additional levels of convenience and high availability protection with hot-plug hard drives and power supplies.

Innovative management with intelligent automation

The Dell OpenManage systems management portfolio includes innovative solutions that simplify and automate management tasks, making IT operations more efficient and more cost-effective throughout the server lifecycle. Leveraging the incomparable agent-free capabilities of the embedded iDRAC with Lifecycle Controller, server deployment, configuration and updates are rapid and worry-free. Remote monitoring and control of the R330 is provided by OpenManage Essentials and can also enable anytime, anywhere mobile access through OpenManage Mobile.

PowerEdge R330

- 1-socket rack server with a powerful Intel Xeon E3-1200 v6 processor
- Up to 4 x DDR4 DIMMs
- Up to 4 x 3.5" hard drives or up to 8 x 2.5" hard drives

Feature	Technical specification		
Form factor	1U rack server		
Dimensions and weight	<table border="1"> <tr> <td>H: 42.8 mm (1.68 in) W: 482.4 mm (18.99 in) with rack latches; 434.0 mm (17.08 in) without rack latches D (includes bezel): 677.3 mm (26.66 in) with redundant power supply unit</td> <td> Weight 4-drive bay chassis: 6.0 kg (13.22 lb) empty, 13.8 kg (30.42lb) maximum configuration 8-drive bay chassis: 6.4 kg (14.1lb) empty, 13.4 kg (29.54lb) maximum configuration </td> </tr> </table>	H: 42.8 mm (1.68 in) W: 482.4 mm (18.99 in) with rack latches; 434.0 mm (17.08 in) without rack latches D (includes bezel): 677.3 mm (26.66 in) with redundant power supply unit	Weight 4-drive bay chassis: 6.0 kg (13.22 lb) empty, 13.8 kg (30.42lb) maximum configuration 8-drive bay chassis: 6.4 kg (14.1lb) empty, 13.4 kg (29.54lb) maximum configuration
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Processor	1 processor from the following product families: <ul style="list-style-type: none"> Intel® Xeon® processor E3-1200 v6 product family Intel Pentium® Intel Core™ i3 Intel Celeron® 		
Chipset	Intel C236		
Operating system	Microsoft® Windows Server® 2016, Microsoft® Windows Server® 2012 R2, x64 Red Hat® Enterprise Linux® VMware® vSphere® ESXi® SUSE® Linux Enterprise Server		
Memory	Architecture: Up to 2400MT/s DDR4 DIMMs Memory type: UDIMMs Memory module sockets: 4 Maximum RAM: Up to 64GB		
Hypervisor support	Microsoft Windows Server with Hyper-V® VMware® vSphere® ESXi® Red Hat Enterprise Virtualization		
Storage	<table border="1"> <tr> <td> <ul style="list-style-type: none"> 1.8" SSDs 2.5" SATA SSDs 2.5" SATA 7.2k 2.5" SAS 15k HDDs </td> <td> <ul style="list-style-type: none"> 2.5" nearline SAS 7.2k 2.5" SAS 10K HDDs 3.5" Enterprise SATA 7.2k HDDs 3.5" nearline SAS 7.2k HDDs </td> </tr> </table>	<ul style="list-style-type: none"> 1.8" SSDs 2.5" SATA SSDs 2.5" SATA 7.2k 2.5" SAS 15k HDDs 	<ul style="list-style-type: none"> 2.5" nearline SAS 7.2k 2.5" SAS 10K HDDs 3.5" Enterprise SATA 7.2k HDDs 3.5" nearline SAS 7.2k HDDs
<ul style="list-style-type: none"> 1.8" SSDs 2.5" SATA SSDs 2.5" SATA 7.2k 2.5" SAS 15k HDDs 	<ul style="list-style-type: none"> 2.5" nearline SAS 7.2k 2.5" SAS 10K HDDs 3.5" Enterprise SATA 7.2k HDDs 3.5" nearline SAS 7.2k HDDs 		
Drive bays	<ul style="list-style-type: none"> Up to 4 x 3.5" cabled HDD plus optional 2 x 1.8" SSD cabled Up to 4 x 3.5" hot-swap HDD Up to 8 x 2.5" hot-swap HDD UP to 4 x 2.5" hot-swap HDD (available via hybrid drive carrier) 		
Slots	2 x PCIe 3.0 slots + 1 slot for internal storage		
RAID controllers	Internal controllers: PERC S130, PERC H330, PERC H730, PERC H830		
Network controller	2 x 1GbE		
Communications	2 x 1GbE LOM Click here for R330 supported network interface cards (NICs) and host bus adapters (HBAs) and scroll to "Additional Network Cards" section.		
Power	Up to 2 x 350W hot-plug redundant power supplies		
Management	<table border="1"> <tr> <td> Systems management <ul style="list-style-type: none"> IPMI 2.0 compliant Dell OpenManage Essentials Dell OpenManage Mobile Dell OpenManage Power Center Remote management iDRAC8 with Lifecycle Controller, iDRAC8 Express (default), iDRAC8 Enterprise (upgrade), 8GB vFlash media (upgrade), 16GB vFlash media (upgrade) </td> <td> Dell OpenManage Connections: <ul style="list-style-type: none"> HP Operations Manager, IBM Tivoli® Netcool® and CA Network and Systems Management, Dell OpenManage Plug-in for Oracle® Database Manager Dell OpenManage Integrations: <ul style="list-style-type: none"> Dell OpenManage Integration Suite for Microsoft System Center, Dell OpenManage Integration for VMware vCenter® </td> </tr> </table>	Systems management <ul style="list-style-type: none"> IPMI 2.0 compliant Dell OpenManage Essentials Dell OpenManage Mobile Dell OpenManage Power Center Remote management iDRAC8 with Lifecycle Controller, iDRAC8 Express (default), iDRAC8 Enterprise (upgrade), 8GB vFlash media (upgrade), 16GB vFlash media (upgrade)	Dell OpenManage Connections: <ul style="list-style-type: none"> HP Operations Manager, IBM Tivoli® Netcool® and CA Network and Systems Management, Dell OpenManage Plug-in for Oracle® Database Manager Dell OpenManage Integrations: <ul style="list-style-type: none"> Dell OpenManage Integration Suite for Microsoft System Center, Dell OpenManage Integration for VMware vCenter®
Systems management <ul style="list-style-type: none"> IPMI 2.0 compliant Dell OpenManage Essentials Dell OpenManage Mobile Dell OpenManage Power Center Remote management iDRAC8 with Lifecycle Controller, iDRAC8 Express (default), iDRAC8 Enterprise (upgrade), 8GB vFlash media (upgrade), 16GB vFlash media (upgrade)	Dell OpenManage Connections: <ul style="list-style-type: none"> HP Operations Manager, IBM Tivoli® Netcool® and CA Network and Systems Management, Dell OpenManage Plug-in for Oracle® Database Manager Dell OpenManage Integrations: <ul style="list-style-type: none"> Dell OpenManage Integration Suite for Microsoft System Center, Dell OpenManage Integration for VMware vCenter® 		
Device access	5 total USBs: 2 front; 2 rear; 1 internal		
Rack support	ReadyRails™ II sliding rails for tool-less mounting in 4-post racks with square or unthreaded round holes or tooled mounting in 4-post threaded hole racks, with support for optional tool-less cable management arm.		

Recommended services

ProSupport Plus with SupportAssist provides proactive and predictive support for critical systems. ProSupport provides comprehensive hardware and software support. Get more from your technology starting on day one with ProDeploy Enterprise Suite deployment offers. For more information, visit Dell.com/itlifecycleservices.

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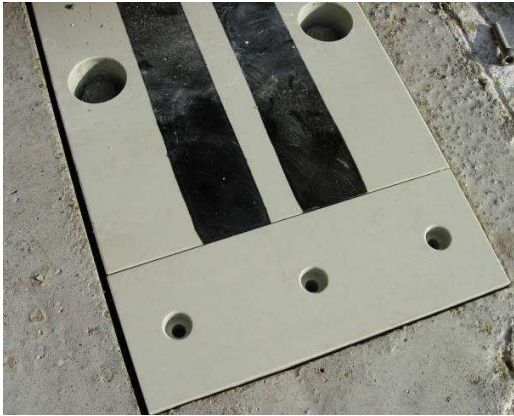
Authority Toll Server Configuration

The Authority requires the toll servers to include the following options. Any changes to this specification shall be approved by the Authority.

SKU	Description
	PowerEdge R330 - [dellstar_1065] Ubuntu Server Certified 1U Server
321-BBVE	Chassis with up to 4, 3.5" Cabled Hard Drives + 1.8" SATA SSD and Embedded SATA
340-AQHP	PowerEdge R330 Shipping
374-BBKP	Intel Xeon E3-1220 v5 3.0GHz, 8M cache, 4C/4T, turbo (80W)
412-AAGT	Standard Heat Sink for PE R230/R330
370-ADRB	2400MT/s UDIMMs
370-AAIP	Performance Optimized
780-BBTO	No RAID with Embedded SATA, Cabled Chassis
405-AACD	No Controller
542-BBCQ	On-Board LOM 1GBE Dual Port (BCM5720 GbE LOM)
385-BBIJ	iDRAC8, Basic
429-AAIQ	No Internal Optical Drive
575-BBGV	Bracket for 1.8" SSD
770-BBBM	ReadyRails Static Rails for 2/4-post Racks
325-BCJU	Dell EMC 1U Standard Bezel

384-BBBL	Performance BIOS Settings
450-AEUV	Dual Hot Plug Power Supplies 350W
631-AACK	No Systems Documentation, No OpenManage DVD Kit
619-ABVR	No Operating System
421-5736	No Media Required
332-1286	US Order
330-BBFN	PCIe Riser, 1x16 PCIe Gen3 FH slot (x8 PCIe lanes) 1x8 PCIe Gen3 LP slot (x4 PCIe lanes), R330
370-ABXV	Cooling Fan
805-9048	Dell Hardware Limited Warranty Plus On Site Service
805-9168	ProSupport: Next Business Day Onsite Service After Problem Diagnosis, 3 Year
805-9169	ProSupport: 7x24 HW / SW Tech Support and Assistance, 3 Year

989-3439	Thank you choosing Dell ProSupport. For tech support, visit http://www.dell.com/support or call 1-800- 945-3355
900-9997	On-Site Installation Declined
973-2426	Declined Remote Consulting Service
210-AFEV	PowerEdge R330 Server
329-BDKZ	PowerEdge R330 Motherboard MLK
461-AADZ	No Trusted Platform Module
370-ADPT	16GB UDIMM, 2400MT/s, Dual Rank, x8 Data Width
400-AFXX	1TB 7.2K RPM SATA 6Gbps 3.5in Cabled Hard Drive
400-ASCN	200GB Solid State Drive uSATA Mix Use Slim MLC 6Gbps 1.8in Cabled Drive for Optical Bay, Hawk-M4E
450-AALV	NEMA 5-15P to C13 Wall Plug, 125 Volt, 15 AMP, 10 Feet (3m), Power Cord, North America



EZ-TREADLE FIBER OPTIC SENSOR INSERT

SPECIFICATIONS

- ◆ Available in a variety of lengths and widths
- ◆ Strong, lightweight insert for ease of installation
- ◆ Sensors pre-embedded into insert at factory for highest reliability
- ◆ Easily manufactured with 1-4 sensors to meet existing system requirements
- ◆ Long lifetime (> 5 years or 25 million axle counts)
- ◆ Used for toll road plaza axle detection

FEATURES

- ◆ Standard warranty of 3 years or 10 million axles, whichever comes first
- ◆ Light-weight material ~ 29 kg/ square meter
- ◆ Custom lengths, widths, and sensor configurations available with detailed measurements
- ◆ Easily replaces mechanical based treadles while using same treadle bed and bolt holes
- ◆ Output via a Sensor Line analog or digital Optical Transmittance Analyzer (MA-110, 210, 310 or MD 220).
- ◆ Immune to electro-magnetic disturbances, corrosion, and lightning
- ◆ Sensor and frame design insures sensitivity to vertical pressure only
- ◆ Strips individually replaceable on site

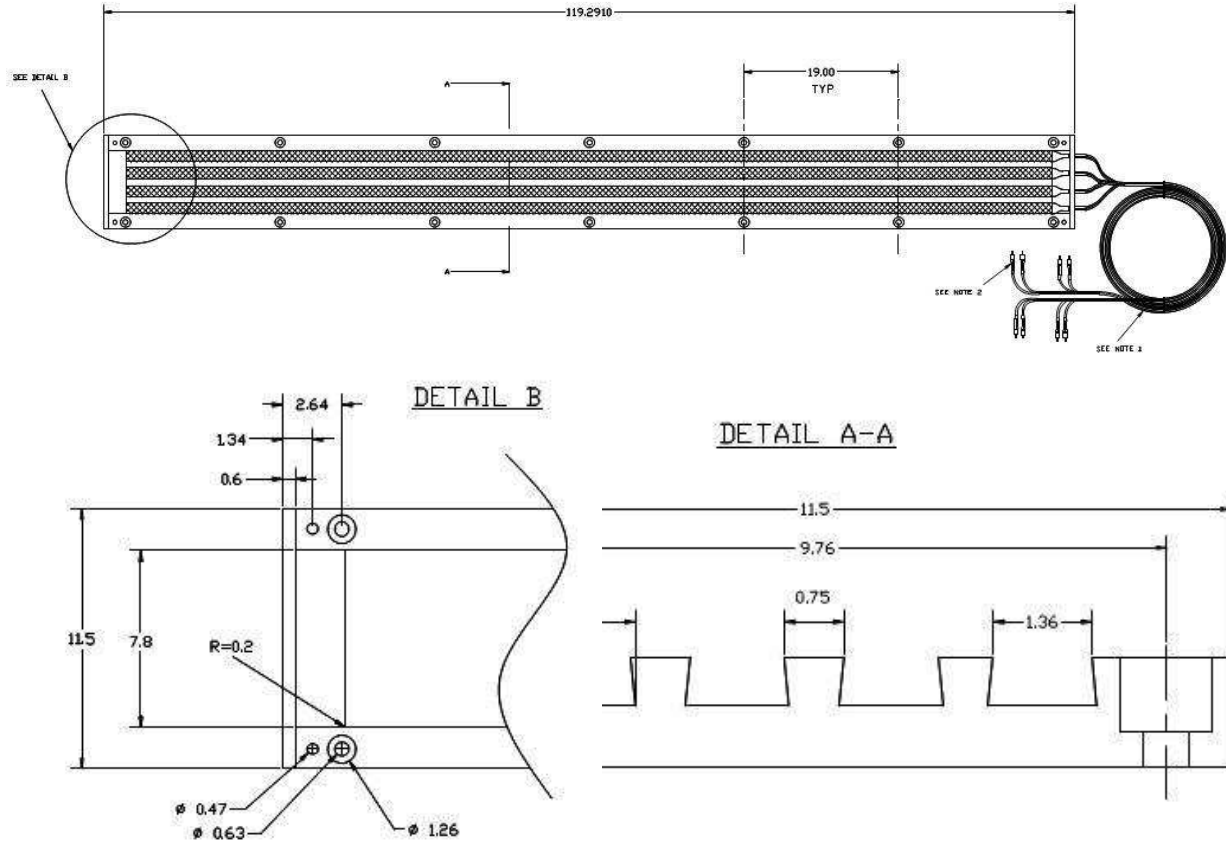
The fiber treadle insert offered by Measurement Specialties, Inc. is a compatible fiber optic sensor solution for conventional steel treadle frames. Techniques have been developed to install the sensor directly into the road, yet still have it fully replaceable.

Designed specifically for the toll industry to be installed in high volume toll lanes and high-speed lanes, the Sensor Line EZ-Treadle fiber optic sensors offer unmatched reliability and longevity while matching the accuracy of today's best toll treadle solutions. Combined with Sensor Line's state of the art interface board, the fiber optic sensors can be seamlessly integrated into any lane hardware system with no modifications.

The fiber treadle insert is made from an industry proven hard polymer material making it much lighter and easier to install than conventional treadle inserts. The fiber treadle insert has the capacity for 1-4 fiber optic sensor strips allowing for compatibility with any existing system or for any level of redundancy. The fiber optic sensors are embedded into the insert at the factory to reduce the installation time and increase the overall reliability of the treadle system.

EZ-TREADLE FIBER OPTIC SENSOR INSERT

MECHANICAL DIMENSIONS in inches (mm) [example, actual dimensions are customizable]



NOTES:

1. FIBER OPTIC FEEDER CABLE, 15M PER SENSOR
2. 8 X PLASTIC FSMA CONNECTORS MODEL NO. SL 4430-C

EZ-TREADLE FIBER OPTIC SENSOR INSERT

PERFORMANCE SPECIFICATIONS

Mechanical	
Insert Length	Multiple lengths available
Insert Width	Multiple widths available
Insert Depth	Typical 1.77" (45 mm)
Active Sensor Length	Treadle dependent
Connections	FSMA Plastic SL 4430-C
Performance	
Storage Temperature Range	-40 to 85 °C
Operating Temperature Ranger	-30 to 85 °C
Minimum Calculated MTBF of Sensors	5 years
Minimum # of Load Cycles for Sensors	Tested to 25 million without failure
Sensitivity of Sensors	10% typical light loss – car axle

NORTH AMERICA

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ASIA

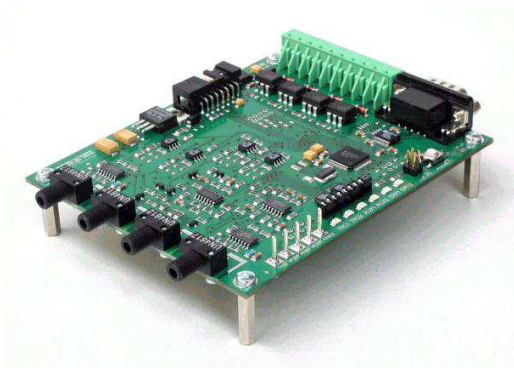
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SL MD-220

Optical Transmittance Analyzer

SPECIFICATIONS

- ◆ **2 channel digital interface**
- ◆ **Flexible optocoupler digital outputs**
- ◆ **Direct external control**
- ◆ **Minimal power consumption**
- ◆ **Adjustable trigger level impulse duration**
- ◆ **Sensor failure indication**

The Sensor Line MD-220 is a two-channel digital opto-electronic interface for Sensor Line's fiber optic load sensors. This two-channel interface supplies light to two fiber optic sensors, monitors the amount of light transmitted through the sensors and detects small changes caused by loads applied to the sensors. With its advanced circuitry, the interface can detect a load on a sensor for as long as it is applied to the sensor.

The MD-220 incorporates a TI MSP-430 embedded microcontroller, programmable via a JTAG interface. It has a 10-wire screw-clip interface with power supply terminals and four floating optocoupler outputs. It also has a RS-232 interface data transmission and troubleshooting. Direct external control is possible through the use of an 8-way SIL switch, two jumpers and a reset switch. For quicker troubleshooting, six LED status displays show the function of the interface and there are five easily accessible test points for analog measurements.

Power consumption has been minimized by circuitry that operates the transmitter diodes in series while independently controlling the current through each diode. The MD-220 uses near infrared diodes which give each channel a dynamic range of 30 dB.

FEATURES

- ◆ 2 Channel, digital interface
- ◆ Works in stop and go traffic
- ◆ Up to 30dB dynamic range
- ◆ Flexible optocoupler digital outputs (up to 60V)
- ◆ Completely software driven – easily adaptable for custom applications
- ◆ Optimized for toll applications
- ◆ Capable of dual tire detection
- ◆ RS-232 Output for use with Signal Viewer Software and Data Log capabilities
- ◆ 4 triggered outputs (2 for sensors, 1 for dual tire, and 1 for sensor failure)

SL MD-220

Optical Transmittance Analyzer

TECHNICAL DATA

Hardware	
Hardware Version	2.0c STD-1
Number of Channels	2
Size	3.54 x 4.33 x 0.75 in (100 x 110 x 19 mm)
Electrical Connections	10-wire screw terminal block
	RS-232, 3-wire*
	5 test points
Optical connections	SMA 905
LED Peak Output Wavelength	850 nm (NIR)
Maximum Sensor Loss	30 dB (NIR)
Relative Humidity	80% at 77°F (25°C)
Temperature Range	-40 to 185°F (-40 to 85°C)
Supply Voltage	+12 to +24 VDC
Supply Current	< 140 mA
Analog Output at Test Points	0-10 V
Optocoupler Outputs max.	OFF: 50 V/<1 uA
	ON: 5 V/50 mA (250 mW @ 25°C)
RS-232 connector	9-pin DSUB male
Velocity Range	Up to 155 mph (250 km/h)
Feeder Length	Up to 820 ft (250 meters)
Comparative Laser Class	3A (NIR, sensor disconnected)
EMV/EMI	Meets CE-requirements

* selectable with SIL switch

Software		
Program Name	MD220STD	
Program Version	1.3	
Program cycle time	500 μ s \pm 5%	
Watchdog expiration time	4 ms	
Triggering	Thresholds	0.2%, 0.4%, 0.8%, 1.6% change of light transmittance*
	Adaptive Threshold	0%, 6.25%, 12.5%, 25%, 50% of load signal*
	Hysteresis	\pm 2 digits
	Minimum input ON time	3 program cycles (1.5 ms)
	Minimum output ON time	3 program cycles (1.5 ms) / 40 program cycles (20 ms)** 80 program cycles (40 ms)**
	Maximum output ON time	30 s
RS-232	Baud Rate	9600 / 19200 / 115200 Baud*
	Data Bits	8
	Stop Bits	1
	Parity	N (no parity)

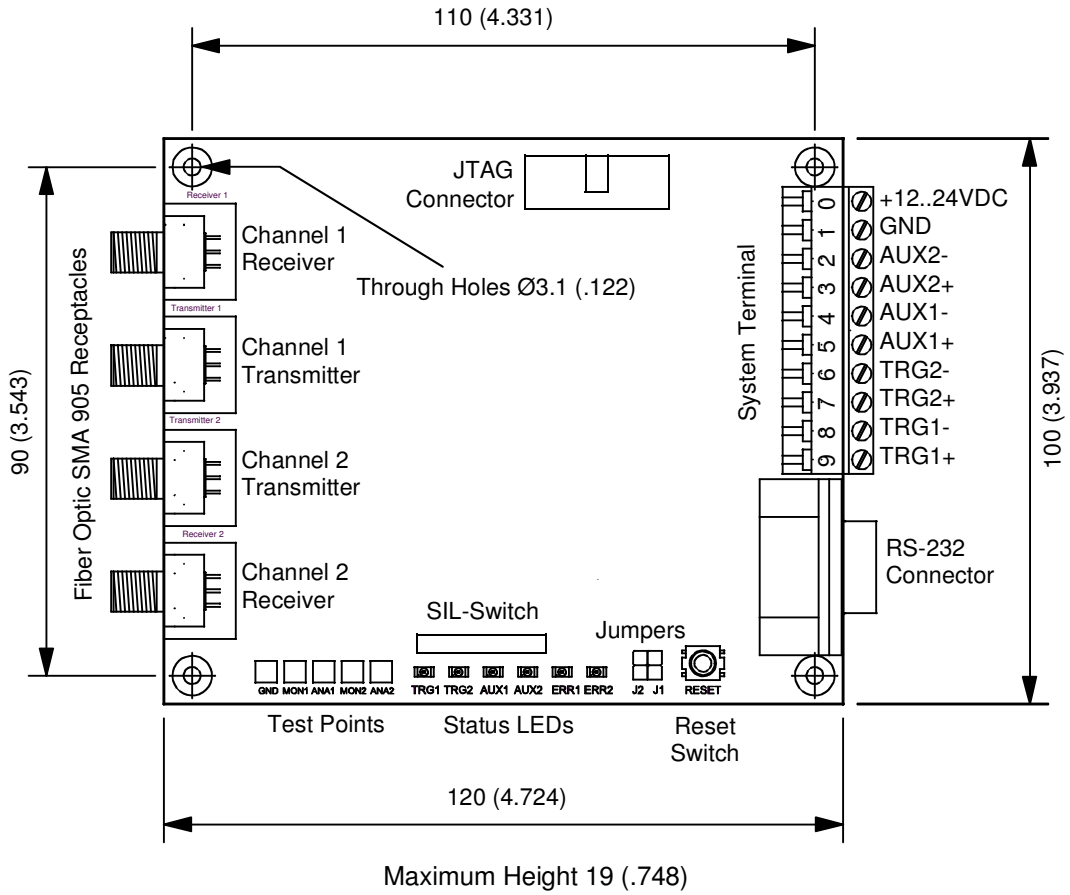
* selectable with SIL switch

** selectable with jumper J1

SL MD-220

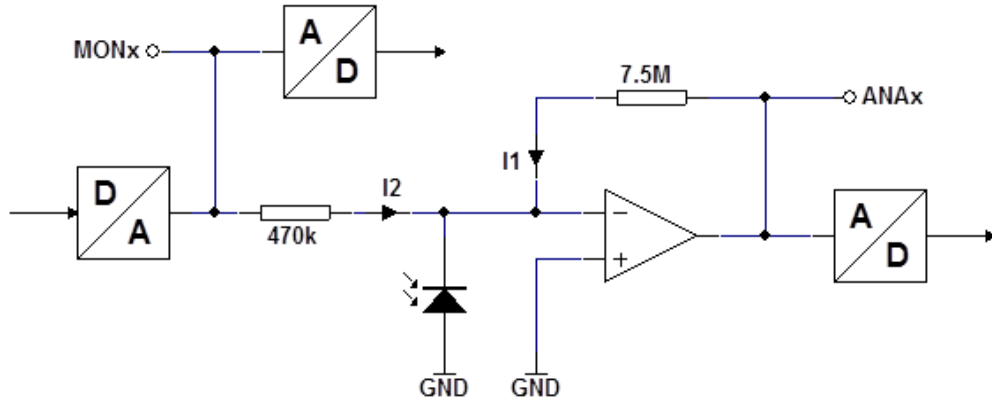
Optical Transmittance Analyzer

MECHANICAL DIMENSIONS in mm (in)



Model Number	Part Number	Laser
SL MD-200-IR	1007062-2	IR

PRINCIPLES OF OPERATION



The drawing above is a simple circuit diagram of one channel. When the photodiode is illuminated with light from the sensor it proportionally sinks a current to the incoming light power. This causes the output of the OPAMP to go high so the current is supplied across the 7.5 MΩ resistor. When the light becomes too bright the OPAMP output is clipped, and the controller supplies additional current via the DAC and the 470 k resistor until the OPAMP output is “unclipped.”

Small changes of photo current are amplified by the OPAMP by a factor of 7.5 MΩ (7.5 V/μA). The controller measures this voltage (“Analog Voltage” or VANAx) as well as the voltage produced by the A-D converter (“Monitor Voltage” or VMONx) with a resolution of 12 Bits. An additional A-D converter controls the light power fed into the sensor

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TE.com/sensorsolutions

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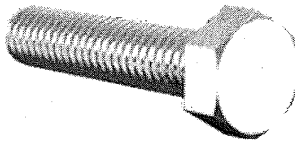
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 \$5.87 per pack of 10
 93190A587



Thread Size	5/16"-18
Length	1 1/2"
Threading	Fully Threaded
Head Width	1/2"
Head Height	13/64"
Material	316 Stainless Steel
Hardness	Rockwell B70
Tensile Strength	70,000 psi
Screw Size Decimal	0.313"
Equivalent	
Thread Type	UNC
Thread Spacing	Coarse
Thread Fit	Class 2A
Thread Direction	Right Hand
Head Type	Hex
Hex Head Profile	Standard
Drive Style	External Hex
Specifications Met	ASME B18.2.1
System of Measurement	Inch
RoHS	Compliant

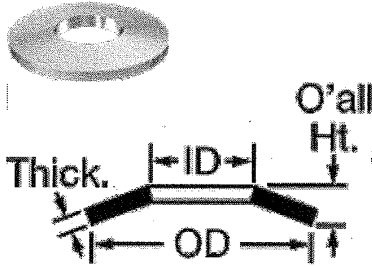
More corrosion resistant than 18-8 stainless steel screws, these screws have excellent resistance to chemicals and salt water. They may be mildly magnetic. Length is measured from under the head.

McMASTER-CARR.

Belleville Spring Lock Washer

18-8 Stainless Steel, 5/16" Screw Size, 0.324" ID, 0.807" OD

In stock
\$5.54 per pack of 10
91235A115



Material	18-8 Stainless Steel
For Screw Size	5/16"
ID	0.324"
OD	0.807"
Thickness	0.060"-0.064"
Overall Height	0.100"
Washer Type	Spring Lock
System of Measurement	Inch
Hardness	Rockwell C38
RoHS	Compliant

Also known as conical washers, these have a slightly cupped shape that gives them spring-like flexibility to grip tighter than split and tooth lock washers. They minimize loosening from wear, temperature changes, and vibration. Load-rated Belleville disc springs are also available.

18-8 stainless steel and 17-7 PH stainless steel washers have good chemical resistance and may be mildly magnetic.



Revision: May 22, 2010
 Supersedes: September 21, 2009
 Ref. #: 125242

TECHNICAL DATA SHEET



Henkel Corporation
 Professional and Consumer Adhesives
 Rocky Hill, CT 06067
 Phone 1-800-624-7767
 Fax (440) 250-7863
www.henkel.com www.loctiteproducts.com



Automotive,
 Industrial, Furniture,
 Locksets & Mowers

Item #	Package	Size
209728	Carded Tube	0.20 fl. oz.

DESCRIPTION

Loctite® Threadlocker Blue 242® is designed for the locking and sealing of threaded fasteners which require normal disassembly with standard hand tools. The product cures when confined in the absence of air between close fitting metal surfaces. It protects threads from rust and corrosion and prevents loosening from shock and vibration. Loctite® Threadlocker Blue 242® is particularly suited for applications on less active substrates such as stainless steel and plated surfaces, where disassembly is required for servicing.

RECOMMENDED FOR:

Use on metal fasteners 1/4" (6 mm) to 3/4" (19 mm) in diameter such as bolts on small engines, swing sets and furniture.

NOT RECOMMENDED FOR:

- Use on plastic parts, particularly thermoplastic materials where stress cracking of the plastic could result.
- Use in pure oxygen and/or oxygen rich systems and should not be selected as a sealant for chlorine or other strong oxidizing materials.

FEATURES & BENEFITS:

Feature	Benefits
Protects threads.....	Prevents rusting of threads
Medium strength.....	Can be removed with hand tools
Locks threads.....	Prevents loosening of metal fasteners caused by vibrations

DIRECTIONS

Tools Typically Required:
 Utility knife, damp cloth.

Safety Precautions:
 Keep out of reach of children.

Preparation:
 Protect work area. Parts to be sealed must be clean and dry. Shake the product thoroughly before use.
 Note: To prevent the product from clogging in the nozzle, avoid touching the bottle tip to the metal surface.

Application:

For Thru Holes:
 Apply several drops of the product onto the bolt at the nut engagement area.

For Blind Holes:
 Apply several drops of the product down the internal threads to the bottom of the hole.

LIEBERT® GXT4™ UPS, 500VA-3000VA

Intelligent, Reliable UPS Protection



BENEFITS

The Liebert® GXT4™ UPS package includes everything you need for a fast and easy installation:

- UPS
- Tower stands
- Rackmount rails
- Hardware
- CD with software and manuals
- Convenient lifting straps
- Cables and ties

Liebert GXT4 is a true on-line UPS that delivers continuous, high-quality AC power to connected equipment with no interruption when transferring to battery. It provides protection from blackouts, brownouts, sags, surges or noise interference.

For robust UPS protection up to 3kVA, the Liebert GXT4 UPS provides industry leading features in a compact design:

- On-line design means zero transfer time. When utility power fails, your critical load remains supported by a seamless flow of power.
- Highest level of protection available in this capacity range.
- Selectable Eco-Mode allows improved energy efficiency.
- Easy serviceability with replaceable, hot-swappable batteries.
- Controllable power to multiple devices via two independently programmable pairs of outlets.
- ENERGY STAR® qualified models available.

- Intelligent-ready networking.
- Optional Unity card offers compatibility with environmental sensors (temperature, humidity, door open status and more).

Ideally suited for:

- Mission critical applications and systems
- Network workstations
- Servers
- IDF/Network closets
- Large network peripherals
- VoIP
- Workstations



ENERGY STAR® qualified UPS models

LIEBERT® GXT4™ UPS, 500VA-3000VA

The Proven Reliability Of True On-Line Operation With The Features You Need Most

The Liebert® GXT4™ UPS requires just a slim 2U of rack space, but provides the capabilities often found only in larger systems. Get up to 3kVA of capacity and battery backup. External battery cabinets may be added for extended run time.

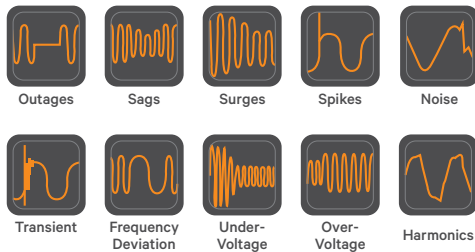
Liebert GXT4 UPS is a true on-line power source, which means power is always being conditioned and supplied to the connected device(s), whatever the quality of power coming in, a pure sinewave output results to ensure equipment is protected.

Liebert GXT4 UPS includes:

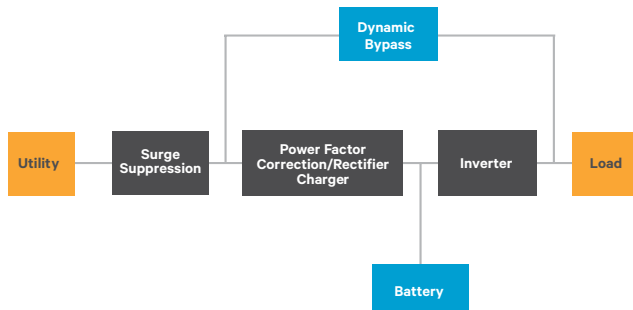
- Power factor correction
- Internal batteries
- Frequency conversion
- Internal automatic bypass to protect against adverse conditions
- Manual bypass capability
- Support for up to six external battery cabinets



Full Protection from Damaging Power Problems.



On-Line, Double Conversion UPS Protection for Critical Applications



Liebert GXT4 UPS Flexible, Reliable And Low Total Cost Features

Flexibility:

Two controllable outlet groups

can be programmed for load shedding and sequential restart if the ups is in overload or when selected backup time remains.

Rotatable display panel

The color LCD display panel rotates 90° to make the readout easy to see in rack or tower installations.

Automatic frequency sensing

The UPS automatically adjusts to the input frequency, 50hz or 60hz, and can also be programmed to convert from one to the other.

Mounting flexibility

Rack rails and tower supports included.

Intelligent communications

DCIM and BMS ready.

Power Assurance Package Provides Comprehensive On-Site Services

- **Five-year protection plan** with 100% parts coverage and 7x24 emergency service.
- **On-Site installation and start-up** to provide pain-free multi-site rollout management and free you from hazardous material disposal in your existing UPS, when applicable.
- **On-site service support** to free up time-strapped IT resources.
- **Preventative Maintenance** to reduce the worry of downtime and ensure rapid recovery.

High Availability:

Advance Early Warning of UPS System Status Multiple audible and visual alarms immediately alert you to critical issues.

3-17 minutes of Battery Backup Time at Full load Provides ample time for an orderly shutdown. Optional matching external battery cabinets offer additional backup time.

Overload Capability Designed to handle output overload conditions.

Periodic Battery Testing Provides automatic and manual self-diagnostic battery testing for peace of mind to indicate if the battery is healthy.

Replaceable Hot Swappable Batteries Easy to replace batteries to protect your investment by extending the product life.

Power-Factor Correction Prevents noise, harmonics and distortion from being passed on to connected loads or from being fed back to the utility.

Internal Automatic and Manual Bypass Capability Assures continuity of power to critical loads at all times. Convenient for times of battery maintenance.

Intelligent Battery Management Includes efficient three-stage charging technique and comprehensive discharging protection that extends battery life.

Input Circuit Breaker Provides increased protection to ease recovery from overloads.

Lightning and Surge Protection The transient voltage surge suppression (TVSS) circuitry inside Liebert® GXT4™ UPS provides additional protection for the connected equipment.

Low Total Cost Of Ownership:

High Output Power Factor Liebert GXT4 UPS rated output power factor up to 0.9 better matches switch-mode power supplies used in today's IT equipment, providing more efficient utilization of the UPS.

Selectable ECO-Mode Connected equipment can be powered through the bypass while the inverter remains idle, reducing electricity consumption.

Wide Input Voltage Window Prolongs battery life by allowing the UPS to maximize the use of utility power before transferring to battery when input voltage exceeds specified limits.

Intelligent Fan Operation Automatically changes rotation speed depending on system requirements to decrease power consumption and noise.

Warranty Protection The industry's best warranty – No-hassle two-year warranty with advanced UPS replacement in the event of problems. Shipping is free for both original UPS return and the replacement unit. Optional one-year and three-year extensions also available.

Multiple Choices For Communication, Shutdown And Reporting:

The optional Unity communications card has been enhanced with direct sensor support.

- Up to 10 Liebert sensors can be wired in series and can report a discrete SNMP trap when their status changes.

- Any SNMP monitoring and notification software, such as Liebert Nform can be used to monitor a change in state of these sensors.
- Monitor temperature, humidity, door open status, leak detection and more.

The Liebert GXT4 UPS is also fully compatible with:

- Liebert MultiLink™ shutdown software –included with the Liebert GXT4 UPS
- Liebert Nform™ monitoring software
- Liebert Multiport multiplexing unit
- Liebert Intellislot Relay Interface Card
- Liebert SiteScan
- Trellis™ Platform
- USB Communications

Optional Liebert MicroPOD™ Output Distribution And Maintenance Bypass Module

When your computer system can't be without power, even for scheduled UPS maintenance, the Liebert MicroPOD Maintenance Bypass and Output Distribution Unit ensures continuous uptime. It allows you to manually transfer connected equipment to utility power via a maintenance bypass switch, permitting scheduled service or UPS replacement without the need to shut down connected equipment. Features include:

- 2U height minimizes rack space requirements
- Installs with plug-and-play ease
- Two-year, no-hassle replacement warranty



Liebert MicroPOD

Specifications

PARAMETERS	GXT4-500RT120 (500VA/450W)	GXT4-700RT120 (700VA/630W)	GXT4-1000RT120 (1000VA/900W)	GXT4-1500RT120 (1500VA/1350W)	GXT4-2000RT120 (2000VA/1800W)	GXT4-3000RT120 (3000VA/2700W)	GXT4-3000RT208 (3000VA/2700W)
Dimensions, D × W × H, in. (mm)	16.2 x 16.9 x 3.4 (408 x 430 x 85)			19.7 x 16.9 x 3.4 (497 × 430 × 85)		23.7 x 16.9 x 3.4 (602 × 430 × 85)	
Weight, lb (kg)	40 (18.2)			54.6 (24.8)	56.1 (25.5)	71.4 (32.4)	
Input AC							
Voltage Range (typical)	120VAC nominal; variable based on output load			120VAC nominal; variable based on output load		115-280VAC	
Frequency	40Hz ~ 70Hz; Auto Sensing			40 - 70Hz; Auto Sensing			
Input Power Cord	10 ft. attached w/ NEMA 5-15P plug			10 ft. attached w/ NEMA 5-15P plug	10 ft. attached w/ NEMA L5-20P *NEMA L5-20P to NEMA 5-20P adapter Included	10 ft. attached w/ NEMA L5-30P plug	10 ft. attached w/ NEMA L6-20P plug
Output AC							
NEMA Output Receptacles	5-15R × 6			5-15R × 6	5-15/20R × 6	L5-30R×1 +5-20R×6	L6-20R×1+L6-15R×2
Voltage	110/115/120VAC (user-configurable); ±3%			110/115/120VAC (user-configurable); ±3%		208/220/230/240 VAC (user- configurable); ±3%	
Waveform	Sine wave			Sine wave			
Battery							
Type	Valve-regulated, nonspillable, lead acid			Valve-regulated, nonspillable, lead acid			
Qty × V × Rating	4 × 12V × 5.0Ah			4×12V×9.0Ah		6×12V×9.0Ah	
Battery Part #	GXT4-5A48BATKIT			GXT4-9A48BATKIT		GXT4-9A72BATKIT	
Agency							
Safety	UL 1778, cUL Listed			UL 1778, c-UL Listed			
RFI/EMI	FCC Class A			FCC Class A			
Surge Immunity	IEC 62040-2 2nd Ed			IEC 62040-2 2nd Ed			
Transportation	ISTA Procedure 1A			ISTA Procedure 1A			
ENERGY STAR® qualified	No	Yes	Yes	Yes	Yes	Yes	Yes



Liebert®

GXT4™

700VA - 3kVA

Fully Digital Dual DSP Controlled UPS



For robust UPS protection up to 3kVA, the Liebert GXT4 UPS provides industry leading features in a compact design:

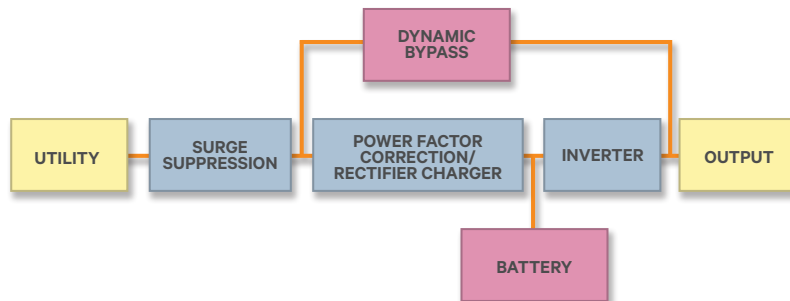
- Active Eco-Mode delivers best-in-class efficiency of up to 97% without compromising availability
- Two Programmable Outlets: can be programmed for load shedding and sequential restart if the UPS is in overload or when selected backup time remains
- User replaceable, hot-swappable batteries
- On-line design means zero transfer time. When utility power fails, your critical load remains supported by a seamless flow of power
- Array of value added accessories bundled with standard unit
- Automatic Frequency Sensing: the UPS automatically adjusts to the input frequency, 50Hz or 60Hz
- Mounting Flexibility: rack rails and tower supports included
- Intelligent Communications: DCIM and BMS ready



Increases in data center density require reliable and high performance power systems for maximum availability. In the area of critical power, organization require a dynamic power solution that gives the flexibility while lowering total cost of ownership.

Introducing the Liebert® GXT4™, a true on-line UPS that delivers continuous, high-quality AC power to connected equipment with no interruption when transferring to battery. It protects equipment from virtually all power disturbances caused by blackouts, brownouts, sags, surges or noise interference.

On-line and Double Conversion UPS for Best in Protection



ENERGY® STAR
Certified UPS models

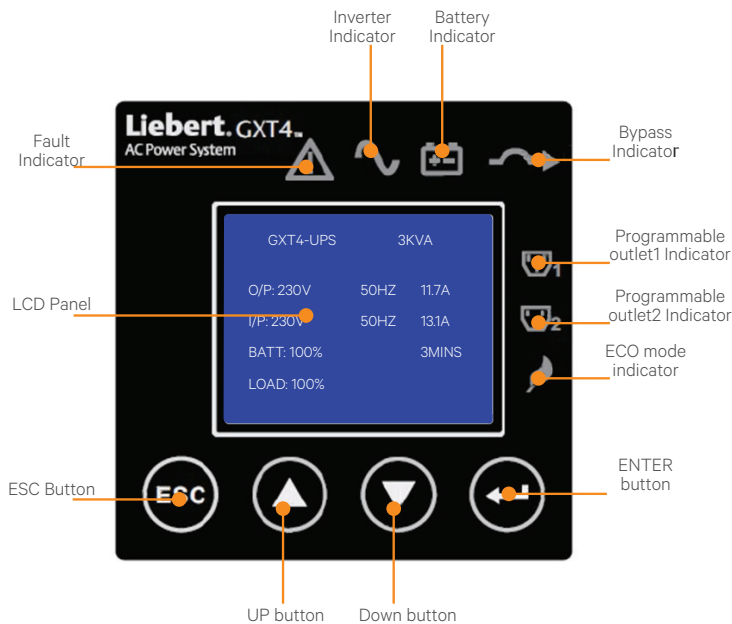
The Proven Reliability Of True On-Line Power With The Features You Need Most

The Liebert® GXT4™ provides maximum resiliency & power protection so businesses can easily adapt to changing capacity demands.

Liebert® GXT4™ UPS includes:

- Power factor correction
- Internal batteries
- Frequency conversion
- Internal automatic bypass for protection against adverse conditions
- Manual bypass capability
- Support for up to six external battery cabinets

Intuitive and Intelligent Operation

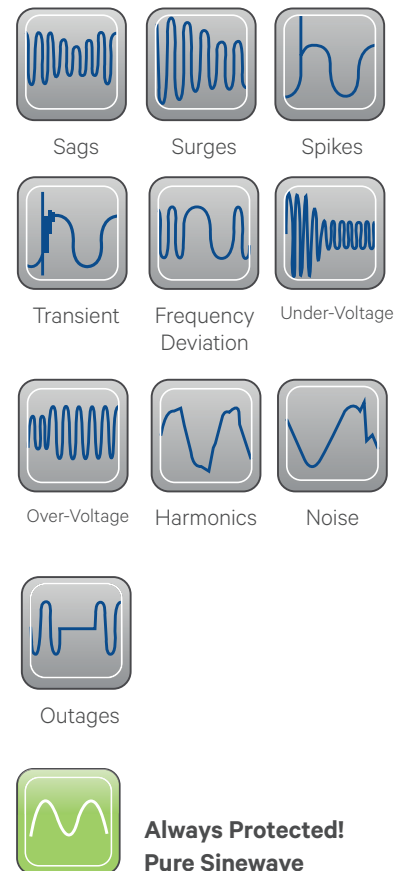


- **Intuitive LCD Screen** - easy-to-follow menu structure for UPS configuration and control.
- **Optimized UPS Monitoring and Control** - up to 6-lines of texts providing more UPS details in just one single view.
- **UPS Programming On-Demand** - no need to run configuration programs to adjust UPS parameters. LCD screen allows for straight-forward UPS programming eliminating the need for a laptop on-site.
- **Efficient UPS Troubleshooting** - LCD screen shows up the exact UPS fault or operation status which helps user respond quickly to assess and clear fault.

The Liebert® GXT4™ UPS requires just a slim 2U of rack space, but provides the capabilities often found only in larger systems. Get up to 3kVA of capacity and battery backup. External battery cabinets may be added for extended run time

Liebert® GXT4™ UPS is a true on-line power source, which means power is always being conditioned and supplied to the connected device(s), whatever the quality of power coming in, a pure sinewave output results to ensure equipment is protected

The Protection You Need from Damaging Power Problems



Multiple Choices For Communication, Shutdown And Reporting

SNMP And Web-Based Communication Options

Liebert IntelliSlot Web Card provides SNMP (including SNMPv3), IPv6 and web-based management to your Liebert GXT4 UPS. It provides the ability to monitor and control your UPS from your network management system or any PC running Microsoft Internet Explorer.

- Sends both SNMP traps and emails for event notification and automatically emails a daily UPS history
- Auto-senses 10M/100M Ethernet

The Liebert GXT4 UPS is also fully compatible with:

- Liebert Multilink™ shutdown software (included with the Liebert GXT4 UPS)
- Liebert Nform™ monitoring software
- Liebert Multiport multiplexing unit
- Liebert Intelli Relay Interface Card
- Liebert SiteScan™
- Trellis™ Platform
- USB Communications

Optional Liebert MicroPOD Output Distribution and Maintenance Bypass Module

When your computer system can't be without power, even for scheduled UPS maintenance, the Liebert MicroPOD Maintenance Bypass and Output Distribution Unit ensures continuous uptime. It allows you to manually transfer connected equipment to utility power via a maintenance bypass switch, permitting scheduled service or UPS replacement without the need to shut down connected equipment. Features include:

- 2U height minimizes rack space requirements
- Easy plug-and-play installation

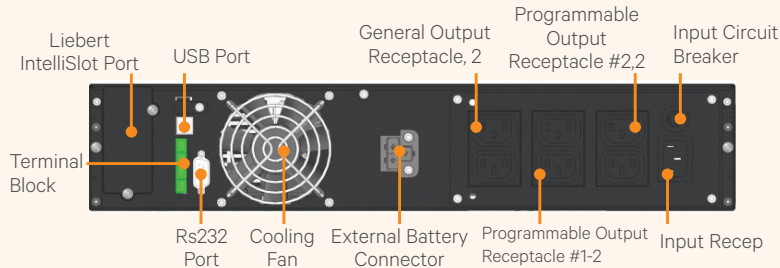
High Availability:

- **Advance Early Warning of UPS System Status** - multiple audible and visual alarms immediately alert you to critical issues
- **3-11 minutes of Battery Backup Time at Full load** - provides ample time for an orderly shutdown. Optional matching external battery cabinets offer additional backup time
- **Periodic Battery Testing** - provides automatic and manual self-diagnostic battery testing for peace of mind to indicate if the battery is healthy
- **Replaceable Hot Swappable Batteries** - easy to replace batteries to protect your investment by extending the product life
- **Power-Factor Correction** - prevents noise, harmonics and distortion from being passed on to connected loads or from being fed back to the utility
- **Intelligent Battery Charging** - includes efficient three-stage charging technique and comprehensive discharging protection that extends battery life
- **Input Circuit Breaker** - Provides increased protection to ease recovery from overloads
- **Lightning and Surge Protection** - the transient voltage surge suppression (TVSS) circuitry inside Liebert GXT4 UPS provides additional protection for the connected equipment

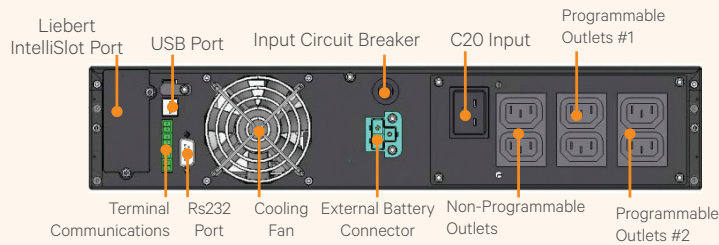
Low Total Cost Of Ownership:

- **High Output Power** - Liebert GXT4 UPS rated output power factor of up to 0.9 better matches switch-mode power supplies used in today's IT equipment, providing more efficient utilization of the UPS
- **Active Eco Mode** - connected equipment can be powered though the bypass while the inverter remains idle, reducing electricity consumption while raising efficiency up to 97% without compromise
- **Wide Input Voltage Window** - prolongs battery life by allowing the UPS to maximize the use of utility power before transferring to battery when input voltage exceeds specified limits
- **Intelligent Fan Operation** - automatically changes rotation speed depending on system requirements to decrease power consumption and noise
- **Arrays of Accessories with Standard Model** - extended amount of accessories bundled with standard model such as rail kit, IS-webcard, etc. saves capital expenses

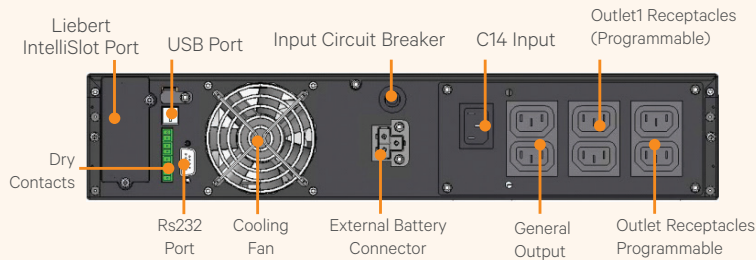
Rear View 700VA-1000VA



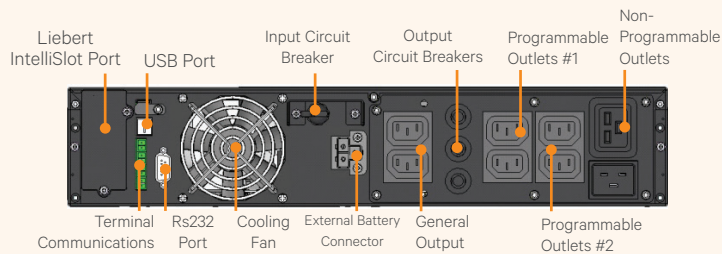
Rear View 2000VA



Rear View 1500VA



Rear View 3000VA



While today's smaller, rack-based UPS system offer relatively trouble-free operation, the growing criticality of the systems they support has increased the cost of downtime. As a result, the need to maintain these smaller UPS systems is increasingly important.

- **Extended Warranty**

Choose additional of 1-yr or 3-yr warranty on top of the 2-yr standard warranty for worry free maintenance and total peace of mind.

- **Start-up**

On-site system start up by a certified Emerson Network Power Customer Engineer assures confidence that the equipment is up and running at optimum performance

- **Preventive maintenance**

Regular visits by an Emerson Network Power Customer Engineer guarantees higher reliability and availability

- **On-site service**

Should you experience a problem, we will dispatch a certified Emerson Network Power Customer Engineer to repair or replace your equipment. Response guaranteed.

Battery Runtime Chart

Internal Battery

LOAD (%)	700VA	1kVA	1.5kVA	2kVA	3kVA
10	105	91	112	81	91
20	62	38	51	37	39
30	37	31	34	23	23
40	32	23	23	16	16
50	27	17	18	12	12
60	22	14	14	9	9
70	18	11	11	7	7
80	15	9	9	5	5
90	13	8	7	4	4
100	11	6	6	3	3

The times above are approximate. They are based on new, fully charged standard batteries at a temperature of 25°C with 100% resistive UPS loading. The listed run times can vary by +5% because of manufacturing variances of the batteries.

External Battery Specification

MODEL NUMBER	GXT4-48VBATT	GXT4-72VBATT
Used with UPS Model	GXT4-700RT230, GXT4-1000RT230, GXT4-1500RT230, GXT4-2000RT230	GXT4-3000RT230
DIMENSIONS: H X W X D, MM(IN)		
Unit (with bezel)	85(2U) x 430 x 497.7 (3.3 x 16.9 x 19.7)	85 (2U) x 430 x 602 (3.3 x 16.9 x 23.6)
WEIGHT: KG (LB)		
Unit	32 (70.5)	42 (92.6)
BATTERY PARAMETERS		
Type	Valve-regulated, non-spillable, lead acid	
Quantity x V	2 x 4 x 12V x 9.0Ah	2 x 6 x 12V x 9.0Ah
ENVIRONMENTAL		
Operating Temp, °C (°F)	0 to 40 (32 to 104)	
Storage Temp, °C (°F)	-15 to 50 (5 to 122)	
Relative Humidity	0-95% non-condensing	
Operating Elevation	Up to 3000m (10,000 ft.) at 40°C (104°F) 15000m (50,000 ft.) maximum	
AGENCY		
Safety	IEC/EN/AS 62040-1:2008, GS mark	
Transportation	FCC PART 15, Class A=CISPR22 Class A	
Safety	IEC62040-2 2nd Ed.:2006	
Transportation	ISTA Procedure 1E	

Internal Battery +1 External Battery Cabinet

LOAD (%)	700VA	1kVA	1.5kVA	2kVA	3kVA
10	427	334	330	222	302
20	303	166	160	137	139
30	164	138	128	94	95
40	145	108	97	66	66
50	126	92	72	49	48
60	106	72	54	39	41
70	94	56	46	34	34
80	78	48	38	28	27
90	69	40	34	23	23
100	61	37	31	20	21

Internal Battery +2 External Battery Cabinet

LOAD (%)	700VA	1kVA	1.5kVA	2kVA	3kVA
10	408	457	447	426	431
20	434	333	315	201	205
30	329	224	186	149	150
40	273	166	151	124	124
50	203	151	131	97	97
60	164	135	107	75	76
70	153	113	92	61	63
80	142	103	74	50	50
90	131	92	64	41	45
100	121	78	53	38	41

Internal Battery +3 External Battery Cabinet

LOAD (%)	700VA	1kVA	1.5kVA	2kVA	3kVA
10	480	480	467	451	455
20	461	442	424	322	325
30	439	337	311	195	196
40	345	305	199	154	155
50	323	208	160	136	136
60	300	166	146	111	112
70	213	155	131	96	98
80	189	144	111	78	79
90	163	132	99	68	70
100	156	122	83	56	60

Internal Battery +4 External Battery Cabinet

LOAD (%)	700VA	1kVA	1.5kVA	2kVA	3kVA
10	480	480	480	466	408
20	480	460	444	421	423
30	458	436	340	306	307
40	442	340	309	192	192
50	425	315	205	157	157
60	336	218	165	142	143
70	319	195	153	127	128
80	301	165	141	107	109
90	213	156	130	95	97
100	197	147	112	80	81

Internal Battery +5 External Battery Cabinet

LOAD (%)	700VA	1kVA	1.5kVA	2kVA	3kVA
10	480	480	480	480	480
20	480	467	457	438	440
30	465	447	431	331	332
40	452	428	333	224	225
50	438	341	307	189	189
60	425	320	208	158	159
70	344	227	167	146	147
80	329	208	158	133	135
90	315	189	148	120	122
100	301	164	139	104	106

Internal Battery +6 External Battery Cabinet

LOAD (%)	700VA	1kVA	1.5kVA	2kVA	3kVA
10	480	480	480	480	480
20	480	480	466	450	452
30	480	458	444	420	421
40	462	442	422	319	319
50	451	426	328	217	217
60	440	341	305	186	187
70	428	323	209	159	160
80	368	306	184	148	150
90	336	217	161	137	139
100	325	201	153	126	128

Technical Specifications

Parameters	GXT4-700RT230*	GXT4-1000RT230*	GXT4-1500RT230*	GXT4-2000RT230*	GXT4-3000RT230*
Rating	700VA/630W	1000VA/900W	1500VA/1350W	2000VA/1800W	3000VA/2700W
INPUT AC					
Voltage Range (typical)	230VAC nominal; variable based on output load				
Frequency Range	40Hz ~ 70Hz; Auto Sensing				
Input Power Receptacle	C14		C20		
MECHANICAL PARAMETERS					
Dimensions: H x W x D mm (in)	85 (2U) x 430 x 408 (3.4 x 16.9 x 16.2)		85 (2U) x 430 x 497 (3.3 x 16.9 x 19.6)		85 (2U) x 430 x 602 (3.3 x 16.9 x 23.7)
Weight: kg (lb)	18.2 (40)		23.2 (51.1)	25.5 (56.1)	32.4 (71.4)
OUTPUT AC					
Voltage	200/208/220/230/240VAC (user configurable); ±3%				
Frequency	50Hz or 60Hz				
Waveform	Pure Sinewave				
Mains (AC) Mode Overload	The inverter shall be capable of supplying current and voltage for overloads exceeding 100%, and 105-130% for 1 minute, 131-150% 10 seconds, 151-200% for 1 seconds, and up to >200% for 5 cycles of full load current.				
Charger Current, Amperes	1.3		1.88	2.71	2.5
Output Receptacles	C13 x 6			C13 x 6; C19 x 1	
ENVIRONMENT PARAMETERS					
Operating Temp	0°C to +40°C (+32°F to 104°F)				
Storage Temp	-15°C to +50°C (5°F to 122°F)				
Operating Elevation	Up to 3000m (10,000 ft.) at 25°C (77°F) without derating				
Audible Noise	< 46 dBA at 1 meter(3.2ft) from the rear; < 43 dBA, at 1 meter (3.2 ft) from the front or side		< 45 dBA at 1 meter (3.2ft) from the front; < 46 dBA at 1 meter (3.2ft) rear	< 48 dBA at 1 meter (3.2ft) from the front; < 48 dBA at 1 meter (3.2ft) rear	
BATTERY					
Type	Valve-regulated, non-spillable, lead acid				
Qty x V x Rating	4 x 12V x 5.0Ah		4 x 12V x 9.0Ah		6 x 12 x 9.0Ah
Recharge Time	3 hours to 90% capacity after full discharge with 100% load till UPS auto-shutdown(Internal Batteries Only)		4 hours		3 hours
AGENCY					
Safety	IEC/EN/AS 62040-1:2008, GS MARK				
RFI/EMI	IEC/EN/AS 62040-2 2nd Ed. (Category C2) = CISPR22 Class A				
Surge Immunity	IEC/EN 62040-2 2nd Ed (IEC/EN 61000-4-5)				

* Standard model includes the Rail kit for UPS and battery models

** Specifications are subject to change without any prior notification



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Liebert-GXT4-700VA-3kVA-BR-EN-AsiaV1

LIEBERT® MICROPOD™

Wrap-Around Maintenance Bypass With Output Distribution



OVERVIEW

When a computer system cannot be without power — even for maintenance — a Liebert® MicroPOD™ ensures continuous uptime. The Liebert MicroPOD provides maintenance bypass capability and power output distribution for Liebert GXT™ and Liebert PSI™ UPS models 3 kVA and below, as well as other brands of UPS systems. It allows removal of the UPS without powering down the connected equipment.

The Liebert MicroPOD maintenance bypass and power output distribution switch allows you to manually transfer the connected equipment to utility power via a maintenance bypass switch, permitting scheduled maintenance or UPS replacement without discontinuing power to the critical load. Transferring back to UPS power is just as easy — simply turn the switch to the indicated position and the load is protected by the UPS. Available in plug-and-play or hardwired options at 120V or 208V rating, units include brackets for rack mounting in any direction.



Key Benefits:

Higher Availability

- Provides utility power to attached equipment when switched to maintenance bypass mode.
- Allows UPS maintenance or replacement of the UPS without discontinuing power to critical equipment.

Flexibility

- Easily installed — the UPS and utility power are both connected to the MicroPOD with the supplied cords.
- Allows scheduled UPS maintenance to ensure continuous uptime without having to shut down protected equipment.
- Rotary switch with indicators make the unit simple to operate.

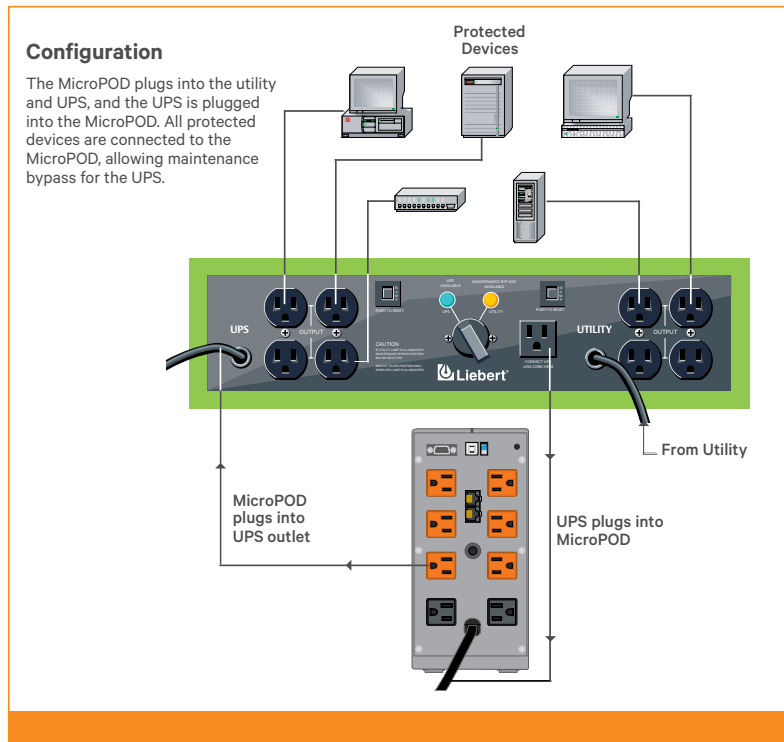
- Plug-and-play connectability for both input and output.
- Compatible with any brand of UPS system.

Lowest Total Cost Of Ownership

- Assures system uptime during maintenance activities.
- Extreme affordability.
- Two-year, no-hassle replacement warranty eliminates the cost of replacement during the warranty period.

MicroPOD™ Specifications

PART NUMBER	PLUG TO UTILITY	RECEPTACLE TO UPS INPUT	PLUG TO UPS OUTPUT	MICROPOD OUTPUT RECEPTACLES
120V UL Listed MicroPODs				
MP2-115A	5-15P	5-15R	5-15P	(8)5-15R
MP2-120C	5-20P	5-20R	5-20P	(8)5-20R (T-Slot)
MP2-130C	L5-30P	L5-30R	L5-30P	(8)5-20R (T-Slot)
MP2-130E	L5-30P	L5-30R	L5-30P	(2)5-15R, (4) 5-20R (T-Slot) (1) L5-30R
MP2-130P	L5-30P	L5-30R	L5-30P	(4) 5-15R, (2) L5-20R
MP2-115HW	Hardwired	5-15R	5-15P	Hardwired
MP2-120HW	Hardwired	5-20R	5-20P	Hardwired
MP2-130HW	Hardwired	5-30R	5-30P	Hardwired
208V UL Listed MicroPOD				
MP2-220N	L6-20P OR Hardwire Connection (plug is removable for hardwire applications)	L6-20R	L6-20P	(2) L6-20R, (2) L6-15R, OR Hardwire Connections (receptacles are removable for hardwire applications)
230V CE Marked MicroPODs				
MP2-210K	EN60320/C14	EN60320/C13	EN60320/C14	(4) EN60320/C13
MP2-220L	EN60320/C20	EN60320/C19	EN60320/C20	(4) EN60320/C13, (1)EN60320/C19





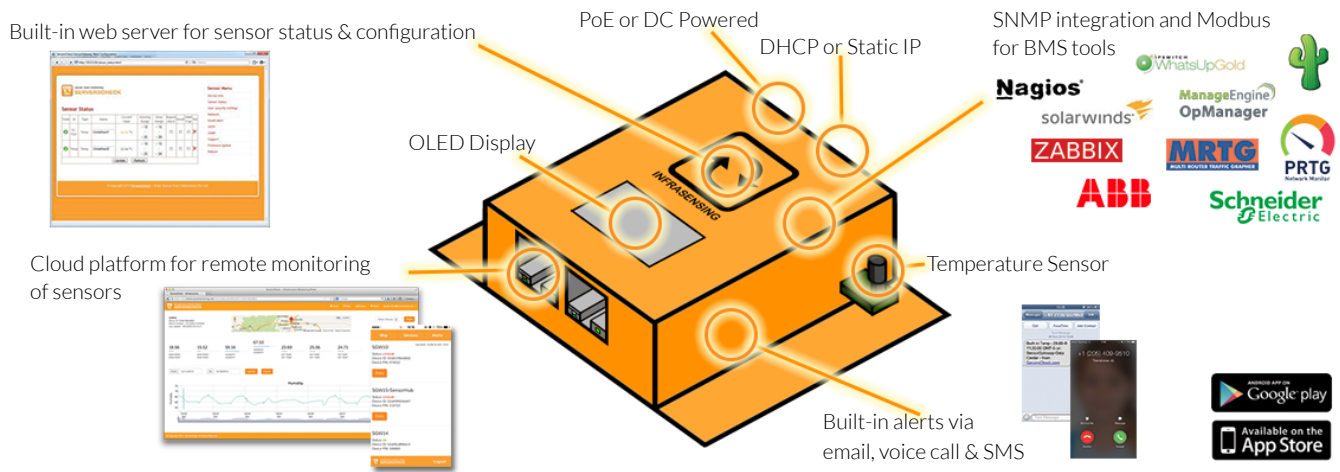
Base Unit

SensorGateway



BASE-WIRED

Display	OLED
Web Server:	HTTP/HTTPS
Built-In Alerting:	email, SNMP Traps, SMS, call
Protocols:	SNMP v1,v2,v3 Modbus TCP XML, JSON
Network:	IPv4 at 10/100 Mbps
External Probes:	2 optional probes
PoE:	IEEE 802.3af
Power Adapter:	12V DC
Operating Conditions	
Temperature:	0°C to 75°C / 32°F to 167°F
Humidity:	<90% RH (non-condensating)
Embedded Temperature Sensor	
Resolution:	0.1°C / 0.18°F
Accuracy:	± 0.5°C from -10°C to +85°C ± 1°F from 14°F to 185°F degrees Celsius or Fahrenheit



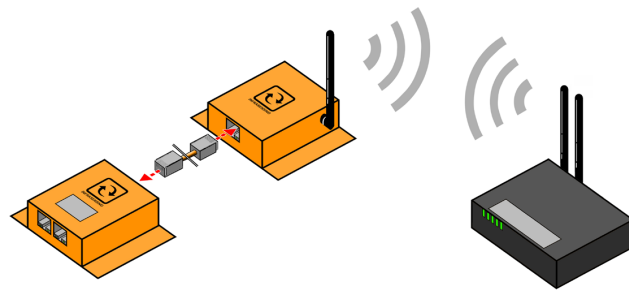


Wifi Add-On



ADDON-WIFI

Wifi Frequency:	2.4 GHz
Wifi Standards:	802.11 b/g/n
Temperature Operating Range:	-40°C to +85°C (-40°F to +185F)
Housing Dimensions:	70 mm (2.75") x 95 mm (3.74") x 20 mm (0.78")
Housing Material:	metal

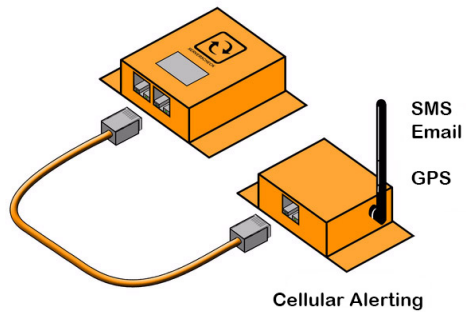


Cellular Alerting & GPS Add-On



ADDON-CELLALERT

LTE	CAT-M1/NB1 on bands B1, B2, B3, B4, B5, B8, B12, B13, B17, B18, B19, B20, B26, B28
2G Frequency:	850, 900, 1800, 1900
Position:	GPS, GALILEO
US Mobile Operator:	AT&T, Verizon
Modem Vendor:	Sierra Wireless
Regulatory Approval:	FCC, GCF, IC, JRF/JPA, NCC, PTCRB
Temperature Operating Range:	-40°C to +85°C (-40°F to +185F)
Connection:	Connects to a sensor port of the base unit or expansion hub
Power:	Powered by the base unit
Dual SIM support for redundancy	
SIM card size:	Micro SIM (12 x 15mm)



Power Monitoring Sensors

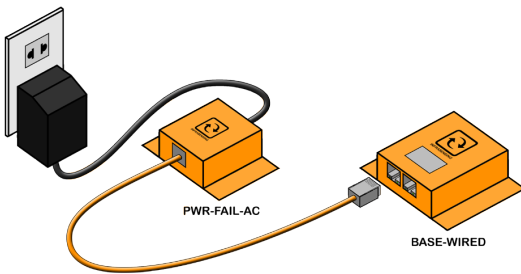


AC Single Phase Sensors

AC Power Failure Sensor

PWR-FAIL-AC

Provides a ON/OFF indication in SensorGateway

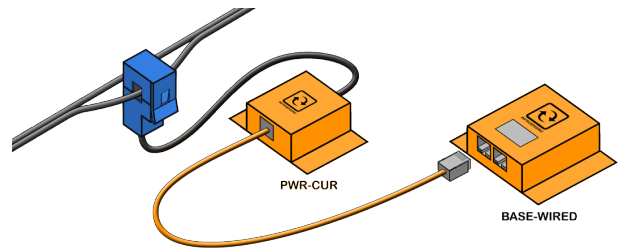


AC Current Sensor

PWR-CUR

Input Current: 0-100A AC
Non-linearity: $\pm 3\%$

Resistance Grade B
Readings in A (Ampere)
Split Core Certification: CE, RoHS

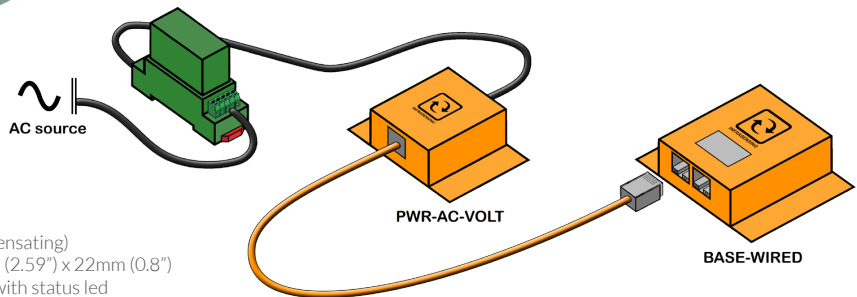


AC Power Voltage Sensor

PWR-AC-VOLT

Non-linearity: $\pm 3\%$
Voltage: 0-500V AC
Split Core Certification: CE, RoHS
Operating humidity range: $< 90\%$ rH (non-condensating)
Dimensions: 74mm (2.9") x 66mm (2.59") x 22mm (0.8")
Housing: Orange plastic case with status led
OU Rack & DIN Rail mountable

$\pm 3\%$
0-500V AC
CE, RoHS
 $< 90\%$ rH (non-condensating)
74mm (2.9") x 66mm (2.59") x 22mm (0.8")
Orange plastic case with status led





Order Form

PRICE QUOTE & ORDER FORM

SKU	Name	Quantity
Base Unit		
BASE-WIRED	SensorGateway	
BASE-PWR	Power Adapter for SensorGateway	
BASE-PWR-USB	USB Power Cable for Sensorgateway	
Add-Ons		
ADDON-CELLALERT	Cellular Alerting & GPS Add-On	
ADDON-WIFI	Wifi Add-On	
ADDON-POE-24	+24v DC Power Add-On	
ADDON-POE-48	-48v DC Power Add-On	
Expansion Hubs		
EXP-8HUB	SensorHub for SensorGateway	
EXP-4HUB	Multi-Sensor & Hub	
EXP-WHUB-ZB	Zigbee Wireless Hub	

SKU	Name	Quantity
Monitoring Platform		
MON-APPLIANCE	ServersCheck Appliance with Monitoring Software	
MON-TOUCH	ServersCheck Touch with Monitoring Software	
MON-SOFTWARE	Monitoring Software Only (to run on your own systems)	

SKU	Name	Quantity
Sensors		
ENV-THIMG-S	Thermal Imaging Sensor (small)	
ENV-THIMG-M	Thermal Imaging Sensor (medium)	
ENV-THIMG-L	Thermal Imaging Sensor (Large)	
ENV-TIR-START	IR Temperature Sensor Start Unit	
ENV-TIR-DAISY	IR Temperature Sensor Daisy Chained Unit	
ENV-THUM	Temperature and Humidity Sensor	
ENV-TEMP	Temperature Sensor	
ENV-TEMP-START	Daisy Chain Temperature Sensor Start Unit	
ENV-TEMP-DAISY	Daisy Chained Temperature Sensor Probe	
ENV-TSTAIN	Stainless Steel Temperature Sensor	
ENV-TSURFACE	Industrial Surface Temperature Sensor	
ENV-AIRFLW	Digital Airflow Sensor	
ENV-DUST	Optical Dust Particle Sensor	
ENV-WLEAK-COMBO	Water Detection & Flooding Sensor	
ENV-WLEAK-5M	Water Detection & Flooding Cable	
ENV-FLEAK-COMBO	Fuel Leak Detection Sensor	
ENV-FLEAK-6M	Fuel Leak Detection Cable	
ENV-WSPOT	Water Spot Sensor	
ENV-W-THUM	Wireless Temperature & Humidity Sensor	
ENV-W-TEMP	Wireless Temperature Sensor	
ENV-H2	Hydrogen (H2) Sensor	
ENV-CO2	CO2 & tVOC Sensor	
ENV-BLEAK-COMBO	Battery Leak Sensor Probe	
ENV-BLEAK-6M	Battery Leak Detection Cable	
PWR-CUR	AC Current (Power Usage) Sensor	
PWR-FAIL-AC	AC Power Failure Sensor	
PWR-FAIL-DC	DC Power Failure Sensor	
PWR-AC-VOLT	AC Power Voltage (0-500v)	
PWR-DC-VOLT with PWR-DC-TRANS	DC Power Voltage (0-50v) & Current	
PWR-FUEL	Ultrasonic Fuel Level Sensor	
PWR-GROUND	Grounding Sensor	
SEC-DOOR	Door Contact Sensor	
SEC-SHOCK	Digital Shock / Vibration Sensor	
SEC-SOUND	Digital Sound Metering (db) Sensor	
SEC-SMOKE	Smoke Sensor	
SEC-MOTION	Motion Sensor	
IND-IO	IO - Dry Contact Sensor	

Part Number: 5100UE



Security & Sound, 2 Conductor 14 AWG, BC, CMR

Product Description

Security & Commercial Audio Cable, Riser-CL3R-FPLR 2-14 AWG stranded bare copper conductors with polyolefin insulation, PVC jacket with ripcord

Technical Specifications

Product Overview

Environmental Space:	Indoor - Riser
Suitable Applications:	Intercom/PA Systems, Sound/Audio Systems, Fire Alarm (For color Red only)(Dual Rated)

Physical Characteristics (Overall)

Conductor

AWG	Stranding	Material	No. of Conductors
14	19x27	BC - Bare Copper	2

Conductor Count:	2
Conductor Size:	14 AWG

Insulation

Material	Nominal Wall Thickness
PP - Polypropylene	0.011 in

Color Chart

Number	Color
1	Black
2	White

Outer Shield Material

Material
Unshielded

Outer Jacket Material

Material	Nominal Diameter	Nominal Wall Thickness	Ripcord
PVC - Polyvinyl Chloride	0.230 in	0.017 in	Yes

Construction and Dimensions

Cabling

Lay Direction	Twists
Left Hand	3 twist/ft

Electrical Characteristics

Conductor DCR

Nominal Conductor DCR
2.53 Ohm/1000ft

Capacitance

Nom. Capacitance Conductor to Conductor

22 pF/ft

Inductance**Nominal Inductance**

0.15 µH/ft

Current

Element	Max. Recommended Current [A]
10C Temperature Rise	Per conductor @ 25°C ambient: 8 A

Voltage**UL Voltage Rating**

300 V RMS

Temperature Range

UL Temp Rating:	75°C
Operating Temp Range:	-20°C To +75°C

Mechanical Characteristics

Bulk Cable Weight:	35 lbs/1000ft
Max Recommended Pulling Tension:	95 lbs
Min Bend Radius/Minor Axis:	2.50 in

Standards

NEC Articles:	725, 760
NEC/(UL) Specification:	CL3R, FPLR
CPR Euroclass:	Eca

Applicable Environmental and Other Programs

EU Directive 2000/53/EC (ELV):	Yes
EU Directive 2003/96/EC (BFR):	Yes
EU Directive 2011/65/EU (ROHS II):	Yes
EU Directive 2012/19/EU (WEEE):	Yes
EU Directive 2015/863/EU:	Yes
EU Directive Compliance:	EU Directive 2003/11/EC (BFR)
EU CE Mark:	Yes
EU RoHS Compliance Date (yyyy-mm-dd):	2005-04-01
CA Prop 65 (CJ for Wire & Cable):	Yes
MII Order #39 (China RoHS):	Yes

Suitability

Suitability - Indoor:	Yes
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Flammability, LS0H, Toxicity Testing

UL Flammability:	UL1666 Vertical Riser
CSA Flammability:	FT4
UL voltage rating:	300 V RMS

Plenum/Non-Plenum

Plenum (Y/N):	N
Plenum Number:	6100UH

Part Number**Variants**

Item #	Color	Footnote
5100UE 0101000	Black	C
5100UE 010Z1000	Black	
5100UE 010Z1000	Black	
5100UE.00152	Chrome	

5100UE.00305	Chrome	
5100UE.00U305	Chrome	
5100UE 0081000	Gray	C
5100UE 008500	Gray	C
5100UE 008U1000	Gray	
5100UE.00500	Gray	
5100UE 008Z1000	Gray	
5100UE 008Z1000	Gray	
5100UE 0021000	Red	C
5100UE 002Z1000	Red	
5100UE 002Z1000	Red	

Footnote: C - CRATE REEL PUT-UP.

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Part Number: 7919A

DataTuff® Cat 5e, (4 pr) 24 AWG Solid BC, PO/PVC, Foil Shld, CMR, CMX, MSHA

[Request Sample](#)

Product Description

Four Cat 5e 24 AWG pairs solid bare copper conductors, polyolefin insulation, overall Beldfoil® shield (100% coverage), industrial grade oil- and UV-resistant PVC jacket.

Technical Specifications

Product Overview

Suitable Applications:	Industrial Ethernet Cable, Harsh Environments, 100MHz Category 5e, Gigabit Ethernet, 100BaseTX, 100BaseVG ANYLAN, 155ATM, 622ATM, NTSC/PAL Component or Composite Video, AES/EBU Digital Audio, RS-422, CMX - Outdoor, RJ-45 Compatible, Noisy Environments
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Physical Characteristics (Overall)

Conductor

AWG	Stranding	Material	No. of Pairs
24	Solid	BC - Bare Copper	4

Conductor Count:	8
Total Number of Pairs:	4
Conductor Size:	24 AWG

Insulation

Material	Nominal Wall Thickness
PO - Polyolefin	0.01 in

Bonded-Pair:	No
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Color Chart

Number	Color
1	White/Blue Stripe & Blue
2	White/Orange Stripe & Orange
3	White/Green Stripe & Green
4	White/Brown Stripe & Brown

Outer Shield Material

Type	Material	Material Trade Name	Coverage [%]	Drainwire Material	Drainwire AWG	Drainwire Construction n x D
Tape	Aluminum/Polyester	Beldfoil®	100 %	TC - Tinned Copper	24	7x32 mm

Outer Jacket Material

Material	Nominal Diameter	Ripcord
Industrial Grade PVC - Polyvinyl Chloride	0.265 in	No

Electrical Characteristics

Conductor DCR

Max. Conductor DCR	Max. DCR Unbalance
9.38 Ohm/1000ft	3 %

Capacitance

Max. Capacitance Unbalance	Nom.Mutual Capacitance
----------------------------	------------------------

330 pF/ft	15 pF/ft
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Delay

Max. Delay	Max. Delay Skew	Nominal Velocity of Propagation (VP) [%]
538 ns/100m	45 ns/100m	70 %

High Freq

Frequency [MHz]	Max. Insertion Loss (Attenuation)	Min. NEXT [dB]	Min. PSNEXT [dB]	Min. ACR [dB]	Min. PSACR [dB]	Min. ACRF (ELFEXT) [dB]	Min. PSACRF (PSELFEXT) [dB]	Min. RL (Return Loss) [dB]	Min. SRL (Structural Return Loss)	Max./Min. Input Impedance (unFitted)	Max./Min. Fitted Impedance
1 MHz	2 dB/100m	65.3 dB	62.3 dB	63 dB	60 dB	63.8 dB	60.8 dB	20 dB	23 dB	100 ± 15 Ohm	100 ± 15 Ohm
4 MHz	4.1 dB/100m	56.3 dB	53.3 dB	51 dB	49 dB	51.7 dB	48.7 dB	23 dB	23 dB	100 ± 15 Ohm	100 ± 15 Ohm
8 MHz	5.8 dB/100m	51.8 dB	48.8 dB	46 dB	43 dB	45.7 dB	42.7 dB	24.5 dB	24.5 dB	100 ± 15 Ohm	100 ± 15 Ohm
10 MHz	6.5 dB/100m	50.3 dB	47.3 dB	43 dB	41 dB	43.8 dB	40.8 dB	25 dB	25 dB	100 ± 15 Ohm	100 ± 15 Ohm
16 MHz	8.2 dB/100m	47.3 dB	44.3 dB	39 dB	36 dB	39.7 dB	36.7 dB	25 dB	25 dB	100 ± 15 Ohm	100 ± 15 Ohm
20 MHz	9.3 dB/100m	45.8 dB	42.8 dB	36.5 dB	33.5 dB	37.7 dB	34.7 dB	25 dB	25 dB	100 ± 15 Ohm	100 ± 15 Ohm
25 MHz	10.4 dB/100m	44.3 dB	41.3 dB	33.9 dB	30.9 dB	35.8 dB	32.8 dB	24.3 dB	24.3 dB	100 ± 15 Ohm	100 ± 15 Ohm
31.25 MHz	11.7 dB/100m	42.9 dB	39.9 dB	31 dB	28 dB	33.9 dB	30.9 dB	23.6 dB	23.6 dB	100 ± 15 Ohm	100 ± 15 Ohm
62.5 MHz	17 dB/100m	38.4 dB	35.4 dB	22 dB	19 dB	27.8 dB	24.8 dB	21.5 dB	21.5 dB	100 ± 15 Ohm	100 ± 15 Ohm
100 MHz	22 dB/100m	35.3 dB	32.3 dB	14 dB	11 dB	23.8 dB	20.8 dB	20.1 dB	20.1 dB	100 ± 15 Ohm	100 ± 15 Ohm

Voltage

UL Voltage Rating
300 V RMS

Temperature Range

Installation Temp Range:	-25°C To +75°C
UL Temp Rating:	60°C
Operating Temp Range:	-40°C To +75°C

Mechanical Characteristics

Bulk Cable Weight:	30 lbs/1000ft
Max Recommended Pulling Tension:	25 lbs
Min Bend Radius/Minor Axis:	1 in

Standards

NEC(UL) Specification:	CMR, CMX-Outdoor, UL 444
CEC(C/UL) Specification:	CMR
ISO/IEC Compliance:	Other Standards
CPR Euroclass:	Eca
Data Category:	Category 5e
Telecommunications Standards:	NEMA WC-63.1 Category 5e
Other Specification:	UL Verified Category 5e

Applicable Environmental and Other Programs

EU Directive 2000/53/EC (ELV):	Yes
EU Directive 2002/95/EC (RoHS):	Yes
EU Directive 2002/96/EC (WEEE):	Yes
EU Directive 2003/11/EC (BFR):	Yes
EU Directive 2011/65/EU (ROHS II):	Yes
EU Directive Compliance:	EU Directive 2003/11/EC (BFR)
EU CE Mark:	Yes
EU RoHS Compliance Date (yyyy-mm-dd):	2004-01-01
CA Prop 65 (CJ for Wire & Cable):	Yes
MII Order #39 (China RoHS):	Yes

Suitability

Suitability - Aerial:	Yes
Suitability - Indoor:	Yes
Suitability - Oil Resistance:	Yes
Suitability - Outdoor:	Yes
Suitability - Sunlight Resistance:	Yes

Flammability, LS0H, Toxicity Testing

UL Flammability:	UL1666 Riser
CSA Flammability:	FT4
IEEE Flammability:	1202
UL voltage rating:	300 V RMS

Plenum/Non-Plenum

Plenum (Y/N):	No
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Part Number

Variants

Item #	Color	Footnote
7919A 0101000	Black	C
7919A 0102000	Black	C
7919A 0105000	Black	C
7919A 01010000	Black	C
7919A 0061000	Blue	C

Footnote:	C - CRATE REEL PUT-UP.
Patent:	https://www.belden.com/resources/patents

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...competitive technologies
with compelling value

Rack Mountable High Velocity Triple Fan Blowers

Product Description

The CT-FANRK-B is a rack mountable ventilation system that incorporates 3 individual fans in a 3-rack space (5.25") housing. A single two-prong AC plug is attached to all three fans to minimize the number of outlets needed. The fans are reversible to provide either exhaust or air intake.

The CT-FANRK-B operates with a very low amount of noise while maintaining a high volume of air movement. Each individual fan is capable of moving up to 92 cubic feet of air per minute for a combined flow of up to 276 CFM.

Application

The CT-FANRK-B is highly recommended above any chassis mounted modulator set. One CT-FANRK-B should be used with each bank of modulators even when the chassis is not completely full.

Specifications

Fan number	3
AC input	110/120VAC
Rated power	17W
Operation voltage	90VAC~130VAC

Power cord length	3'
Maximum Capacity	276 CFM (Cubic Feet Per Minute)
Operating temperature	14°F - +176°F
Weight	4.85 Lbs.
Dimensions	19" W x 5.25" H x 3.8" D

Ordering Information

CT-FANRK-B	Rack mountable, horizontal high velocity triple fan blower
CT-FANRK-B-PLUS	Rack mountable, horizontal high velocity triple fan blower, all metal unit

Features

- Three individual fans in 1.75" of rack space (1 rack space)
- Fans draw air in through the bottom and out the front
- Low noise, High volume
- Black powder coat finish
- All three fans are tied into 1 power source, power adapter included



CT-FAN3-RK-B

Product Description

The CT-FAN3-RK-B is a rack mountable ventilation system that incorporates 3 individual fans in a single rack space (1.75") housing. A single power output is attached to all three fans to minimize the number of outlets needed. The fans draw air in from the bottom of the chassis and out through the front of the chassis.

The CT-FAN3-RK-B operates with a very low amount of noise while maintaining a high volume of air movement. Each individual fan rotates at 2300 revolutions per minute (+/- 10%) for a combined 6,900 RPM of air flow.

The CT-FAN3-RK-B is highly recommended above any chassis mounted modulator set. One CT-FAN3-RK-B should be used with each bank of modulators even when the chassis is not completely full.

Specifications

Fan number	3
Power supply	External AC to DC adapter
AC input	100-240V, 50-60Hz, 1A
DC Output	12V, 3000mA, 36W
Power cord length	6'

Speed (RPM)	2300+/-10%
Operating temperature	14°F - +176°F
Weight	5.0 Lbs.

13.25 Lbs.
19" W x 1.75" H x 5.0" D
19" W x 1.75" H x 14.0" D

Ordering Information

CT-FAN3-RK-B	Rack mountable, vertical high velocity triple fan blower
CT-FAN3-QTRK-B	Rack mountable, vertical high velocity triple fan blower, ultra-quiet model

Email: sales@cabletronix.com

Web: www.cabletronix.com

15-100W, 5-48V Output DIN Rail Mount Power Supplies

Features

- ◆ Low Cost
- ◆ Universal Input
- ◆ NEC NFPA70 Class 2⁽²⁾
- ◆ UL508 Listed
- ◆ Class 1, Division 2 (ISA 12.12)⁽³⁾
- ◆ -10 to +71°C Operation



Key Market Segments & Applications



Industrial



RoHS

Specifications		DPP15	DPP25/30	DPP50	DPP100
AC Input Voltage range	VAC	85 - 264VAC			85 - 132VAC 176 - 264VAC
Input Frequency	Hz	47 - 63Hz			
DC Input Voltage range	-	90 - 375VDC*			210 - 375VDC*
Inrush Current (115 / 230VAC)	A	<35A	35 / 45A	35 / 50A	35 / 55A
Power Factor	-	Meets EN61000-3-2 Class A			
Input Current (230VAC)	A	0.25	0.4	0.7	1.2
Leakage Current	mA	<0.75mA, 265VAC, 63Hz			
Output Voltage Accuracy	%	±1% (24V outputs preset at 24.5V)			
Line Regulation	%	< 0.5%			
Load Regulation	%	< 0.5%			
Ripple and Noise	mV	50mV			
Overcurrent Protection (Typ)	-	>110% (fold forward type)			
Overvoltage Protection	V	120 - 137.5%			
Hold Up Time (115VAC input)	ms	> 20ms			
Parallel switch	-	No			Yes
LED Indicator	-	Green LED = On			
Operating Temperature	°C	-10* to +71°C (Derate linearly 5%/°C from 61 to 71°C) * -25°C start up, DPP25-50 only			
Storage Temperature	°C	-25 to +85°C			
Operating Humidity	-	20 - 90% RH (non condensing)			
Cooling	(1) -	Convection			
Withstand Voltage	-	Input to Output 3kVAC for 1 min.			
Shock	-	Half sine wave, 4G, 22ms, 3 times per face, X, Y, Z			
Vibration	-	10-500Hz (20 min sweep) 0.002G ² /Hz, 1 Grms acceleration X, Y, Z, 1 hour			
Isolation Resistance	-	>100M at 25C & 70%RH, Output to Ground 500VDC			
Safety Agency Approvals	-	UL60950-1, UL508, NEC Class 2 ⁽²⁾ , EN60950-1, CE Mark, ISA 12.12 ⁽³⁾			
Emissions	-	EN55011, EN55022 class B Radiated & Conducted, EN61000-6-3			
Immunity	-	EN61000-6-2, EN61000-4-2 Level 4, EN61000-4-3, EN61000-4-6 Level 3, EN61000-4-4 Level 4 (I/P) Level 3 (O/P), EN61000-4-5 Level 3, EN61000-4-8, EN61000-4-11			
Weight (Typ)	g	130	260	390	390
Size (WxHxD)	in	0.9x2.95x3.81"	1.77x2.95x3.58"	2.86x2.95x3.81"	2.86x2.95x3.81"
Case material	-	Flame Retardant Polycarbonate (UL94 V-0)			
MTBF (MIL-HDBK-217F, GF25)	Hours	287,000	>288,000	269,000	239,000
Warranty	yrs	Three years			

(1) Recommend 1" clearance on all sides.

(2) See model selector. Evaluated to NEC NFPA70 Class 2 output per UL1310.

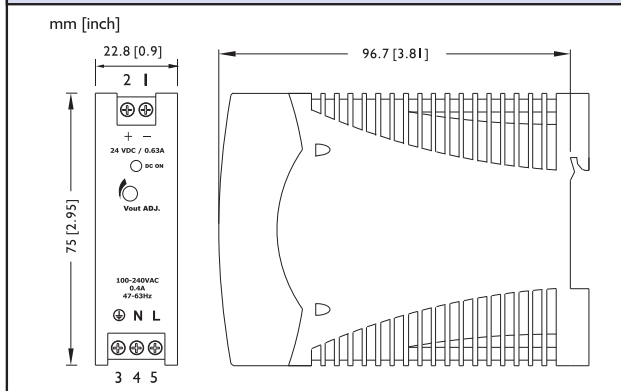
(3) See model selector.

*Safety certified for AC input only

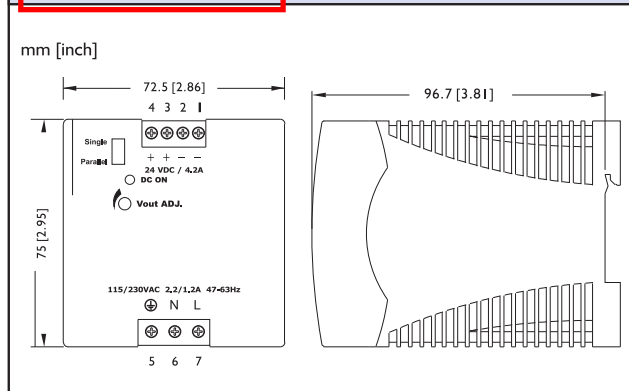
Model Selector

Model	Voltage (V)	Voltage Adjust (V)	Current (A)	Power (W)	Effic. (typ) %	UL1310 Class 2	ISA12.12 Class 1 Div 2
DPP25-5	5	5-6	5.0	25	78	-	Yes
DPP30-12	12	9.9-12.1	2.5	30	83	Yes	Yes
DPP50-15	15	11.9-15.1	3.4	50	85	Yes	Yes
DPP15-24	24	22.5-28.5	0.63	15	81	Yes	-
DPP30-24	24	22.5-28.5	1.3	30	84	Yes	Yes
DPP50-24	24	22.5-28.5	2.1	50	86	Yes	Yes
DPP100-24	24	22.5-28.5	4.2	100	87	-	-
DPP50-48	48	48-56	1.05	50	87	Yes	Yes

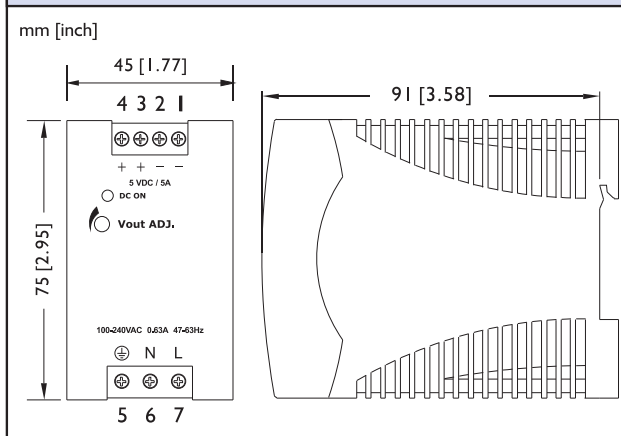
DPP15 Outline



DPP100 Outline



DPP25-DPP50 Outline



Installation:

Snap-on Mounting - snap onto DIN Rail TS35/7.5 or TS35/15. (No tools required)

Cooling - Normal Convection

Clearance - 25mm all sides

Connection - Use copper wire 0.5-2.5mm² (AWG24-12)

Other DIN Rail Products

DSP/DPP	10W to 480W power supplies
DLP	75W to 240W power supplies
DLP-PU	Redundancy Module (20A)
R Series	3A to 30A single & three phase EMI Filters

For Additional Information, please visit us.tdk-lambda.com/lp/products/dpp-series.htm



HyperLink Wireless Brand Indoor DIN 3 Rail Mount High Power 10/100/1000 Base-T Shielded CAT6 Lightning Surge Protector - Model: HGLND-CAT6-HP

Applications

- 10/100/1000 Base-T Ethernet equipment
- Intra-building cable runs
- IP, network or web cameras
- VoIP telephone
- Wireless access points, servers and routers

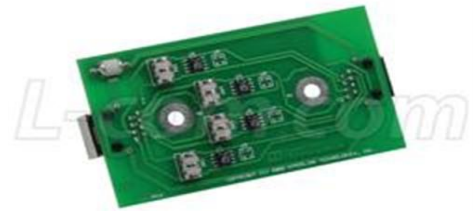
Features

- DIN 3 rail mountable
- CAT5, CAT5e and CAT6 compatibility
- GR-1089 Intra-Building rated
- Three stage protection & failsafe architecture
- Supports PoE mode B for power



Description

The HGLND-CAT6-HP DIN mountable Lightning Protector provides superior lightning and surge protection for indoor 10/100/1000 Base-T Ethernet networks. The unit has low line to line and line to ground capacitance to minimize distortion of high-speed signals. The design provides protection for both common and differential mode surges. The HGLND-CAT6-HP has been designed to meet the GR-1089 Intra-Building surge protection requirements for 10/100/1000 Base-T Ethernet lines. In addition, the unit is compatible with 802.3af Power-over-Ethernet (PoE) devices. This device supports PoE mode A and B for power. The HGLND-CAT6-HP isolates the cable shield from the metal enclosure and the safety ground. This minimizes the chance of a ground loop being introduced.



The HGLND-CAT6-HP features shielded RJ45 jacks with isolation from the metal housing and safety ground. This minimizes the chance for ground loops when using shielded cable. The unit's metal housing helps shield the effects of EMI interference and reduce signal radiation. A ground lug and terminal is provided directly on the lightning protector housing, providing superior grounding. A second ground and terminal is provided for strapping multiple units together. For maximum protection from lightning on long cable runs, two HGLND-CAT6-HP's can be used - one at each end of the cable.



This unit can be mounted to a DIN 3 rail using the DIN mounting clip located on the rear of the unit.

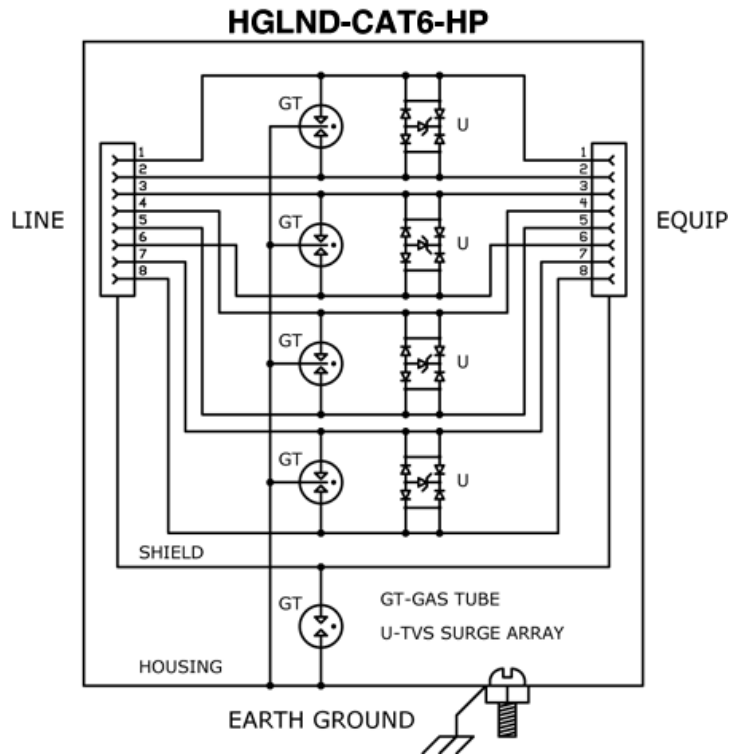
Specifications

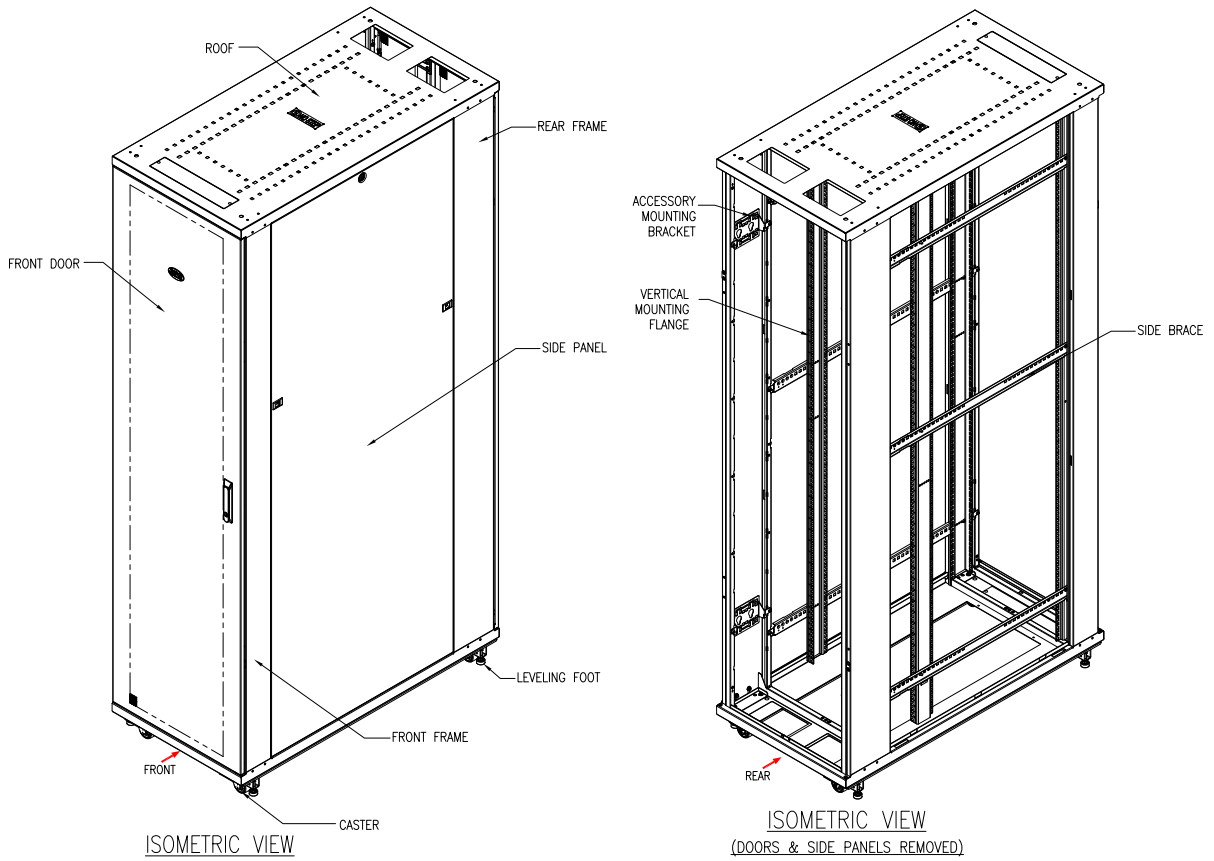
Electrical Specifications

Ethernet Connectors	(2) Shielded RJ45 Jacks
Clamping Voltage	Wire – Wire: 15 Volts Wire – Ground: 90 Volts Shield – Ground: 90 Volts
CAT6 Data Lines	Pair 1: Pins 1 and 2 Pair 2: Pins 3 and 6 Pair 3: Pins 4 and 5 Pair 4: Pins 7 and 8
PoE Mode Support	Mode A and B

Mechanical Specifications

Enclosure Material	Cast Aluminum
Ground Lugs	(2) 12 AWG Max.
DIN Mounting Clip	DIN 3 Rail
Operating Temperature	-40 C (-40 F) to +80 C (+176 F)
Weight	.40 lb. (.18 kg)
Dimensions (WxHxL)	4.5 x 2.5 x 1.5 (inches) 114.3 x 63.5 x 38.1 (mm)
RoHS Compliant	Yes





ISOMETRIC VIEW

ISOMETRIC VIEW
(DOORS & SIDE PANELS REMOVED)

NOTES:

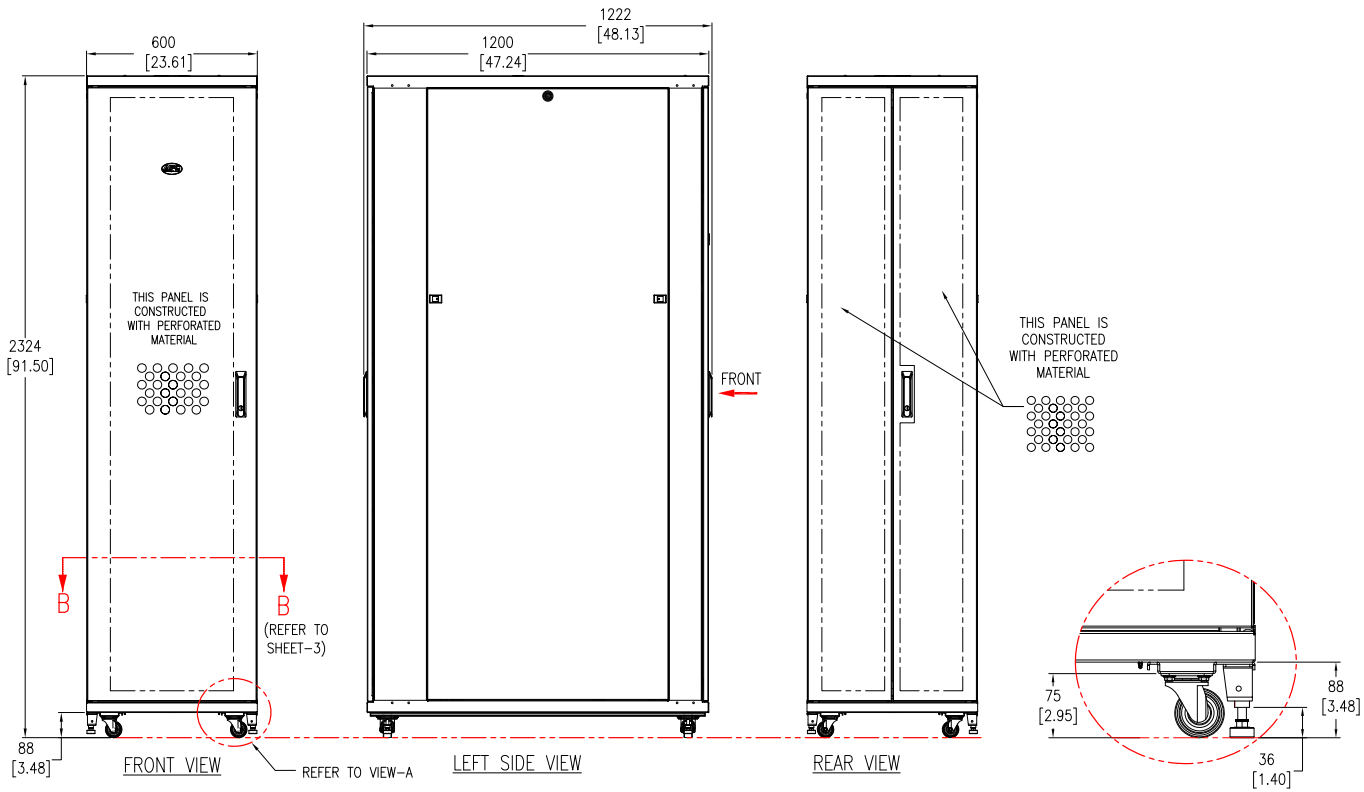
1. COMPLY WITH ALL APPLICABLE NATIONAL, STATE AND LOCAL ELECTRICAL REGULATIONS.
2. REFER TO THE PRODUCT DOCUMENTATION FOR ADDITIONAL DETAILS PRIOR TO INSTALLATION AND SITE PREPARATION WORK.

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TITLE: NetShelter SV 48U ENCLOSURE WITH SIDES 600mm WIDE x 1200mm DEEP ISOMETRIC VIEWS
PROJECT: SUBMITTAL DRAWINGS | SHEET 1 OF 5

DWG NO:	AR2507	REV:	0
DRAWN BY:	JAYAPRAKASH	DATE:	26-MAR-13
ENGINEER:	T. Xu/J. KUMMER	DATE:	01-APR-13
APPROVED BY:	SCOTT VOCCIO	DATE:	01-APR-13
		PROJECTION:	FIRST ANGLE



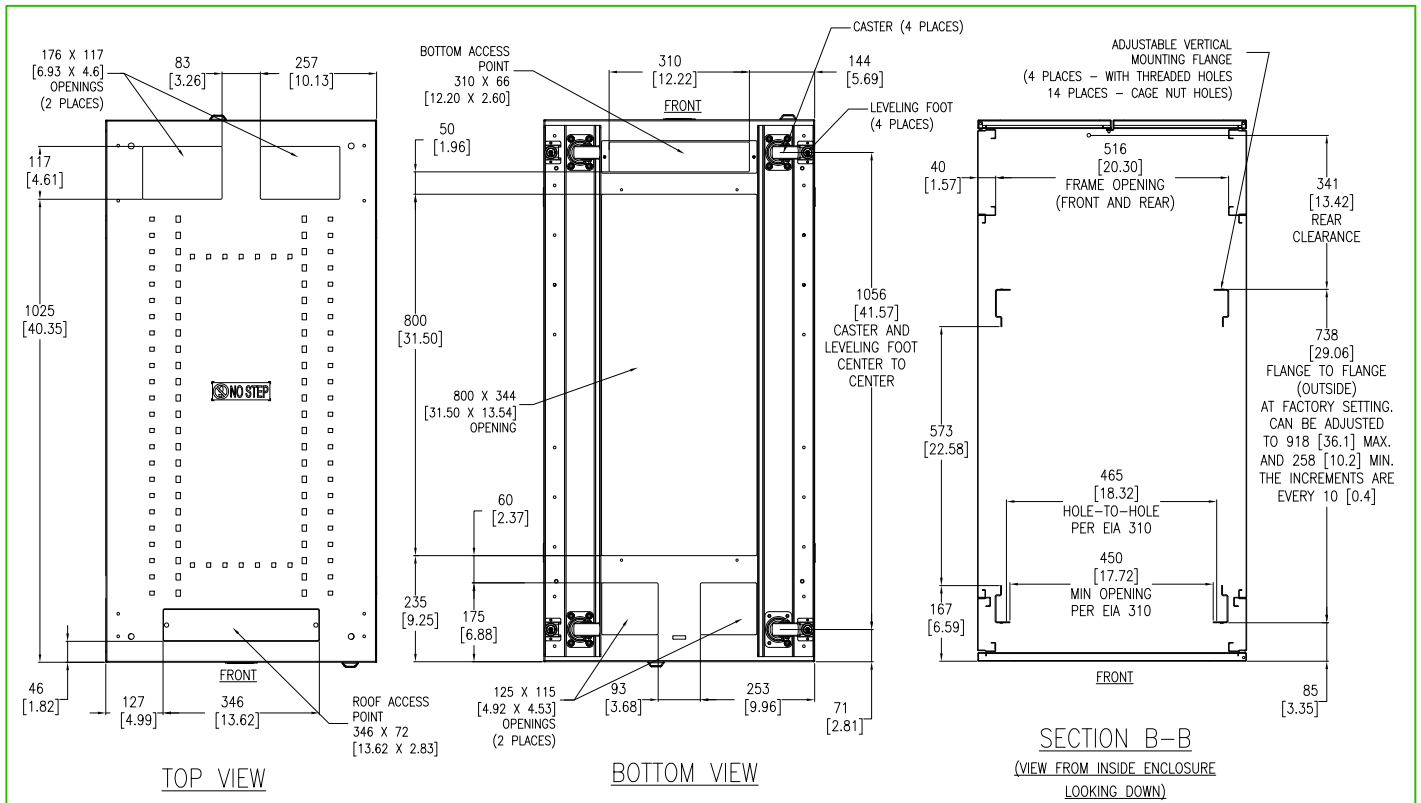
NOTES:

1. COMPLY WITH ALL APPLICABLE NATIONAL, STATE AND LOCAL ELECTRICAL REGULATIONS.
2. REFER TO THE PRODUCT DOCUMENTATION FOR ADDITIONAL DETAILS PRIOR TO INSTALLATION AND SITE PREPARATION WORK.
3. ALL DIMENSIONS ARE IN MILLIMETERS [INCHES].
4. NET WEIGHT OF ENCLOSURE IS 131.2 Kg [288.64 lb].
5. CABLE ENTRY IS TOP OR BOTTOM OF ENCLOSURE.
6. FRONT AND REAR SERVICE ACCESS REQUIRED.
7. AIR FLOW AND SERVICE REQUIREMENTS, AS WELL AS MINIMUM CLEARANCE TO FIRE SUPPRESSION SYSTEMS SHOULD BE CONSIDERED WHEN LOCATING THE ENCLOSURE.

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TITLE:	NetShelter SV 48U ENCLOSURE WITH SIDES 600mm WIDE x 1200mm DEEP GENERAL ARRANGEMENT	DWG NO:	AR2507	REV:	0
DRAWN BY:	JAYAPRAKASH	DATE:	26-MAR-13	PROJECTION:	FIRST ANGLE
ENGINEER:	T Xu/J KUMMER	DATE:	01-APR-13		
PROJECT:	SUBMITTAL DRAWINGS SHEET 2 OF 5	APPROVED BY:	SCOTT VOCCO	DATE:	01-APR-13

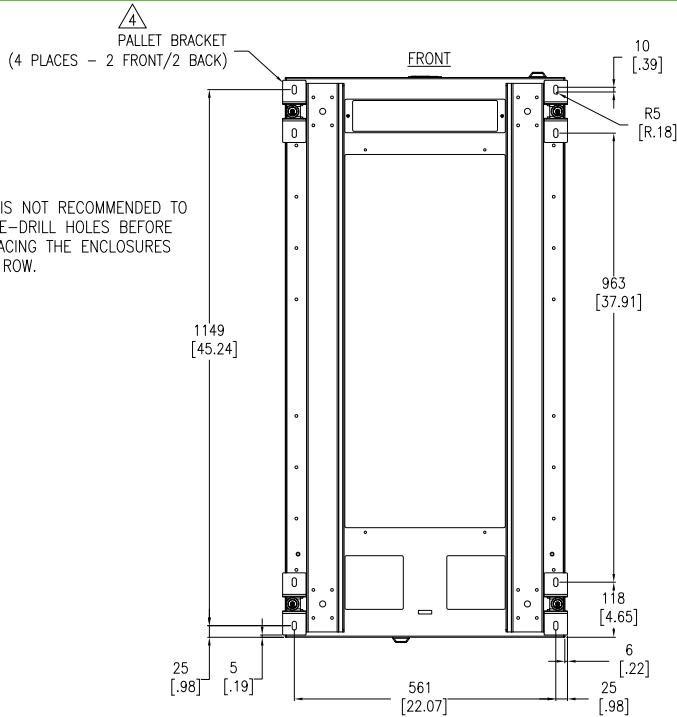


- NOTES:**
1. COMPLY WITH ALL APPLICABLE NATIONAL, STATE AND LOCAL ELECTRICAL REGULATIONS.
 2. REFER TO THE PRODUCT DOCUMENTATION FOR ADDITIONAL DETAILS PRIOR TO INSTALLATION AND SITE PREPARATION WORK.
 3. ALL DIMENSIONS ARE IN MILLIMETERS [INCHES].

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TITLE: NetShelter SV 48U ENCLOSURE WITH SIDES 600mm WIDE x 1200mm DEEP TOP, BOTTOM AND SECTION VIEWS	DWG NO: AR2507	REV: 0
PROJECT: SUBMITTAL DRAWINGS SHEET 3 OF 5	DRAWN BY: JAYAPYAKASH	26-MAR-13
	ENGINEER: T Xy/JI KUMMER	01-APR-13
	APPROVED BY: SCOTT VOCCIO	01-APR-13
		FIRST ANGLE PROJECTION



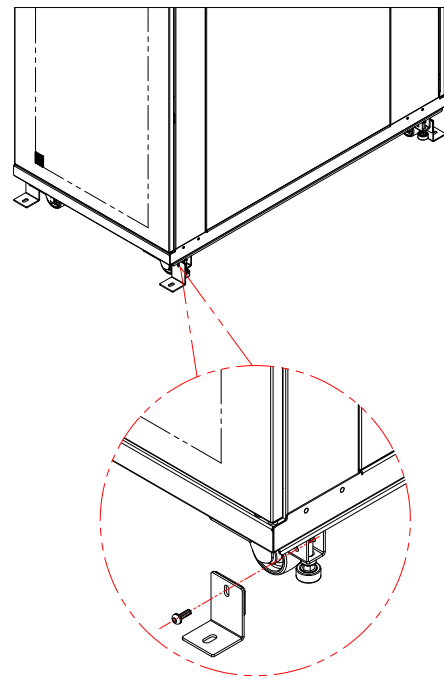
BOTTOM VIEW
WITH PALLET BRACKETS FOR ANCHORING
(CASTERS NOT SHOWN FOR CLARITY)

IT IS NOT RECOMMENDED TO PRE-DRILL HOLES BEFORE PLACING THE ENCLOSURES IN ROW.

NOTES:

1. COMPLY WITH ALL APPLICABLE NATIONAL, STATE AND LOCAL ELECTRICAL REGULATIONS.
2. REFER TO THE PRODUCT DOCUMENTATION FOR ADDITIONAL DETAILS PRIOR TO INSTALLATION AND SITE PREPARATION WORK.
3. ALL DIMENSIONS ARE IN MILLIMETERS [INCHES].
- △4. PALLET/ANCHORING BRACKETS ARE PROVIDED WITH THE ENCLOSURE AND ARE SECURED TO THE ENCLOSURE AND PALLET FOR SHIPMENT. RETAIN THE PALLET BRACKETS FROM SHIPMENT. THESE BRACKETS ARE USED TO ANCHOR THE ENCLOSURE ONCE INSTALLED. PALLET/ANCHORING BRACKETS CAN BE INSTALLED EITHER INSIDE OR OUTSIDE THE NetShelter WITH TWO AT FRONT AND TWO IN BACK.

STABILIZING THE ENCLOSURE:
TO PREVENT THE ENCLOSURE FROM MOVING FROM ITS FINAL LOCATION (IF NOT JOINED WITH ANOTHER COMPONENT, USE PALLET/ANCHORING BRACKET) ATTACH THE PALLET/ANCHORING BRACKETS TO THE ENCLOSURE AS SHOWN. USE CODE COMPLIANT FASTENERS TO SECURE THE ENCLOSURE TO THE FLOOR.



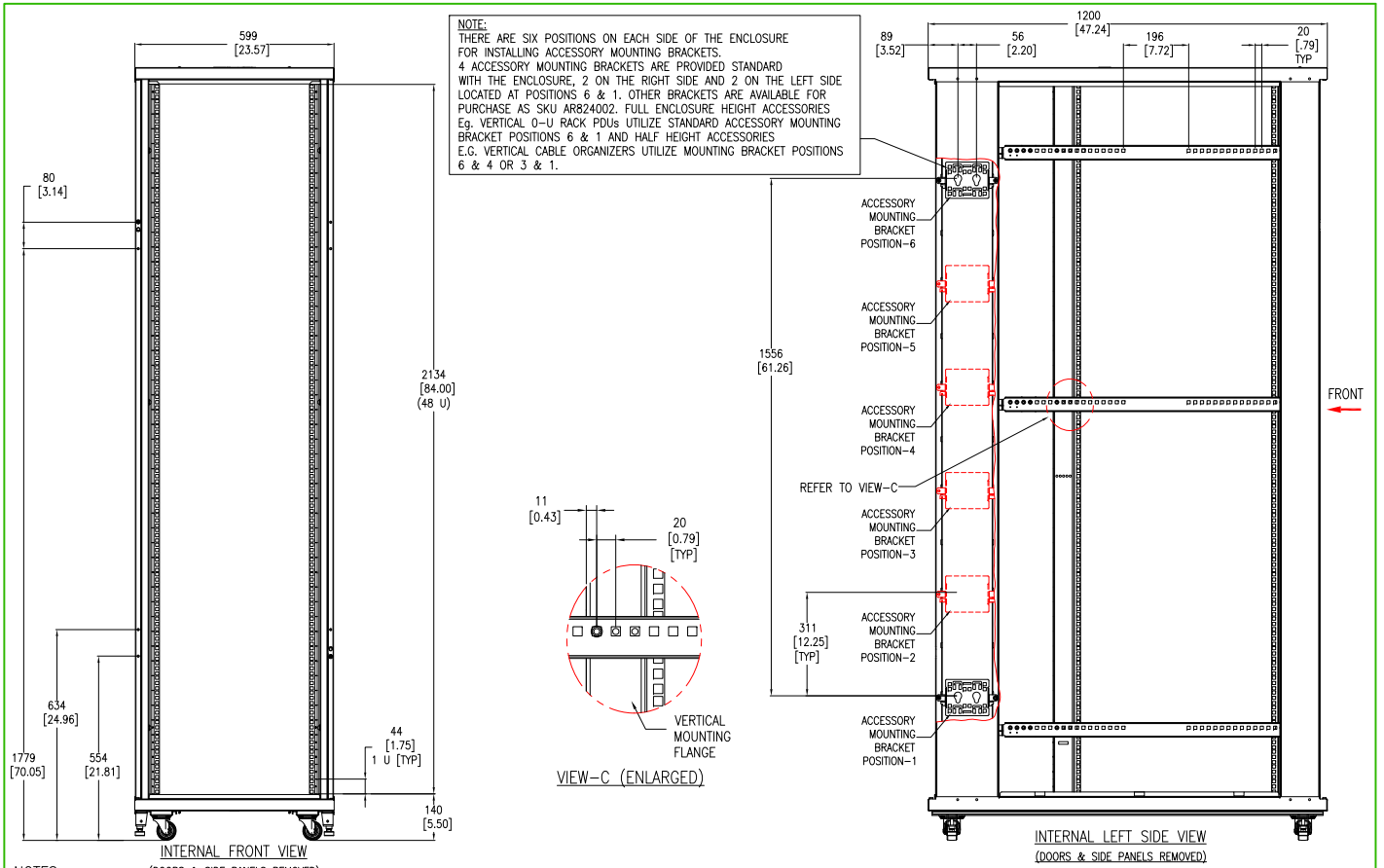
(4 PLACES - 2-FRONT/2-BACK)
ENLARGED VIEW

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TITLE: NetShelter SV 48U ENCLOSURE WITH SIDES 600mm WIDEx1200mm DEEP ANCHORING DETAILS
PROJECT: SUBMITTAL DRAWINGS | SHEET 4 OF 5

DWG NO:	AR2507	REV:	0
DRAWN BY:	JAYAPRAKASH	DATE:	26-MAR-13
ENGINEER:	T. XU/J. KUMMER	DATE:	01-APR-13
APPROVED BY:	SCOTT VOCCIO	DATE:	01-APR-13
		PROJECTION:	FIRST ANGLE



NOTES:

1. COMPLY WITH ALL APPLICABLE NATIONAL, STATE AND LOCAL ELECTRICAL REGULATIONS.
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3. ALL DIMENSIONS ARE IN MILLIMETERS [INCHES].

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TITLE: NetShelter SV 48U ENCLOSURE WITH SIDES 600mm WIDE x 1200mm DEEP INTERNAL VIEWS
 PROJECT: SUBMITTAL DRAWINGS | SHEET 5 OF 5

DWG NO: AR2507	REV: 0
DRAWN BY: JAYAPRAKASH	26-MAR-13
ENGINEER: T XU/J KUMMER	01-APR-13
APPROVED BY: SCOTT VOCCIO	01-APR-13
	FIRST ANGLE PROJECTION

ER1-17

1U 17" Rackmount LCD with Notebook Keyboard, Touch Pad and Optional KVM



Generation 4

General Information

Form Factor	: 1U Rackmount
Mounting Type	: 4 Post/Cabinet (2 Post Available)
Number of Drawers	: 1
LCD Access	: Clamshell Style
Model Version	: Generation 4 (Gen4)
Pointing Device	: Touch Pad (Track Ball Available)
Color	: Black (Custom Available)
Hardware Supported	: Multi-Platform
Regulatory Approval	: CE, FCC, RoHS, UL
Warranty	: 2 Years (Extended Available)

LCD

Display Size	: 17" Diagonal
Ratio	: 4:3
LCD Manufacturer	: Samsung
LCD Type	: Grade A Industrial TFT LCD Panel
Backlighting	: Cold Cathode Fluorescent Lamp (CCFL)
Resolution	: 1280x1024
Display Color	: 16.7M
Brightness	: 250 cd/m ²
Contrast Ratio	: 1000:1 typical
Viewing Angle	: 160° / 160°
Active Area	: 338 x 270 mm
Signal Input	: VGA; Optional HDMI, DVI-D, BNC, S-Video
Touch-Screen	: Optional e-Resistive or Capacitive
MTBF	: 50,000 hours

KVM

Number of Ports	: 8 (Std/Cat 6) / 12 (DVI-D) / 16 (Std/Cat 6) / 32 (Cat 6)
Maximum Cascade	: 8 Levels (64-256 Servers) Std & Cat 6 Only
Dongles Options	: PS/2+VGA, USB+VGA, USB+DVI-D

Remote IP Option

Number of IP Ports	: 1 (Models Ending in: IP / M3X-IP / M4X-IP) : 2 (Models Ending in: M4X-2IP)
User Management	: 15-User Login; 1-4 Active Users Possible
Security	: SSL v3, RSA, AES, HTTP/HTTPS, CSR
IP Access	: 1 x RJ45 Ethernet, 1 x DB9 Serial, 1 x USB

Multi-User Option

Remote Boxes	: 1 (Models: 2X / M2X / M3X-IP / M4X-2IP) : 2 (Models: M3X / M4X-IP) : 3 (Model: M4X)
Keyboard/Mouse	: 2 x USB-Type Connectors
Remote I/O	: RJ45 via Cat 5/Cat 5e/Cat 6 up to 330ft

Power Adapter

SINGLE CONSOLE	
Input	: 100-240VAC~1.0A Max 50/60Hz
Output	: 12V~2.5A
Consumption	: Max 30 Watts

NON-MATRIX KVM (All Single-Active User KVM Models)

Input	: 100-240VAC~1.5A Max 50/60Hz
Output	: 12V~4.0A
Consumption	: Max 48 Watts

MATRIX KVM (All Multi-Active User KVM Models)

Input	: 100-240VAC~1.3A Max 50/60Hz
Output	: 12V~7.0A
Consumption	: Max 84 Watts

Internal/External	: Internal IEC-Type C13
Optional DC	: 12V / 24V / 48V DC Input Available

Environmental

Temperature	: 0 to 50 Degree Celsius (Operation) : -5 to 60 Degree Celsius (Storage)
Relative Humidity	: 5~90%, Non-Condensing
Shock	: 10G Acceleration (11ms Dur, Half Sine)
Vibration	: 5~500Hz 1G RMS Random Vibration

Mounting Depth

w/ VGA, DVI-D	: 1.6" to 5.5" (2 Post, 12" Brackets)
w/ VGA, DVI-D	: 16.4" to 26" (4 Post, 12" Brackets)
w/ VGA, DVI-D	: 18.9" to 29.5" (4 Post, 16" Brackets)
w/ BNC or DC	: 21" to 32" (4 Post, 16" Brackets)
w/ KVM	: 23.5" to 34.5" (4 Post, 16" Brackets)
w/ Touch-Screen	: 21.5" to 35.5" (4 Post, NBK Brackets)

Dimensions & Weight

w/ VGA, DVI-D	: 17.4"W x 1.73"(1U) H x 18.1"D; 26 lbs.
w/ VGA, DVI-D	: 17.4"W x 1.73"(1U) H x 18.1"D; 26 lbs.
w/ VGA, DVI-D	: 17.4"W x 1.73"(1U) H x 18.1"D; 26 lbs.
w/ BNC or DC	: 17.4"W x 1.73"(1U) H x 20.9"D; 27 lbs.
w/ KVM	: 17.4"W x 1.73"(1U) H x 22.8"D; 28 lbs.
w/ Touch-Screen	: 17.4"W x 2.65" (1.5U) H x 25.6" D; 34 lbs.



Eclipse Rackmount, Inc.

(888) ECL-RACK (325-7225) | (415) 895-1570 Direct | (415) 727-4000 FAX

N-Female to N-Female Bulkhead 0-3 GHz Coaxial Lightning Protector Model: AL-NFNFB

Applications

- Outdoor coaxial installations
- Protection of wireless devices
- Communication towers
- IEEE 802.11b/g wireless LAN applications

Features

- Reliable performance from DC ~ 3 GHz
- Bi-directional protection
- Protector will pass DC
- Replaceable gas tube element
- Available in 90V, 230V, 350V and 600V models



Description

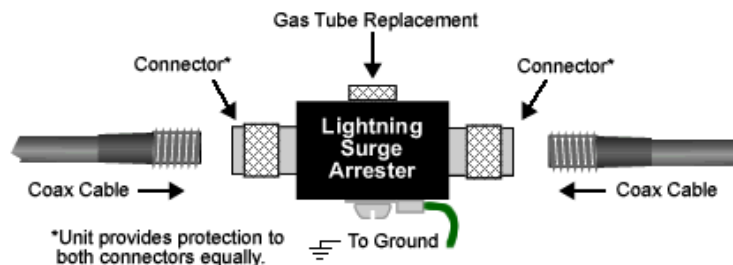
The AL-NFNFB is a gas discharge tube suppressor featuring wide-band operation up to 3 GHz. This unit features an N-Female to N-Female Bulkhead connector with a rubber "O"-ring seal for mounting through an enclosure wall or with the included aluminum mounting bracket.

Due to its low cost and superior RF performance, this unit is ideal for IEEE 802.11b and 802.11g Wireless LAN applications, as well as ISM, MMDS, Cellular, and PCS applications. Since this protector will pass DC, it is suitable for applications where DC is carried through the coax cable, such as remote amplifiers and LNAs.

Both connector ports of this unit are equally protected. This provides protection no matter which way it is installed. Either port can face the antenna and either port can face the equipment.

The unit's replaceable gas tube element, multi-strike capability, and fast response time make it suitable for a wide range of applications. A ground lug and terminal are supplied directly on the lightning protector housing, which provides superior grounding.

Replacement gas tube elements are available on the L-com web site.



Specifications

Electrical Specifications

Models	AL-NFNFB-9	AL-NFNFB-2	AL-NFNFB-3	AL-NFNFB-6
Frequency Range	0 – 3 GHz			
VSWR	1: 1.3 Max. (0 – 3 GHz)			
Insertion Loss	0.4 dB Max. (0 – 3 GHz)			
Impedance	50 Ohm			
Gas Tube Element: DC Breakdown Voltage Indicated	90V 20%	230V 20%	350V 20%	600V 20%
Gas Tube Impulse Breakdown Voltage	1000V 20%			
Gas Tube Insulation Resistance	10,000 MΩ			
Maximum Withstand Current	5 KA			

RF Power Rating

Models	Voltage Rating	DC ~ 30 MHz		30 ~ 500 MHz		500 MHz ~ 3 GHz	
		PEP ¹	CW ²	PEP ¹	CW ²	PEP ¹	CW ²
AL-NFNFB-9	90 Volt	110W	55W	65W	32W	20W	10W
AL-NFNFB-2	230 Volt	280W	140W	110W	55W	40W	20W
AL-NFNFB-3	350 Volt	650W	325W	260W	130W	100W	50W
AL-NFNFB-6	600 Volt	2KW	1KW	800W	400W	320W	160W

Notes:
 1 - Peak Envelope Power (PEP): The average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle at the crest of the modulation envelope taken under normal operating conditions.
 2 - Continuous Wave (CW): A wave of constant amplitude and constant frequency.

Mechanical Specifications – All Models

Connectors	N-Female to N-Female Bulkhead
Connector Body Material	Nickel Plated Brass
Body Material	Aluminum
Pin Material	Gold Plated Brass
O-Ring Material	Rubber
Bracket Material	Aluminum
Ground Lug	10 AWG Max.
Dimensions (L x H x W)	3.2 x 1.6 x 0.8 in. (82 x 40 x 20mm)
Max. Panel Thickness (Bulkhead Connector)	0.31 in. (7.93mm)
Weight	3.17 oz (89.8g)
RoHS Compliant	Yes

iBoot-PDU Series

Reboots the failed system to get you back online fast!

Easiest Way to Minimize Downtime

Minimize downtime to keep your critical systems running and your customers happy. iBoot-PDU provides automatic and web controlled power switching to quickly get you back online fast.

The iBoot-PDU series is designed to provide power distribution and remote power control. Each iBoot-PDU allows four or eight outlets to be independently switched on and off for reboot, energy management and security.

Control one or many iBoots with a single sign-on using the free iBoot Cloud Service. Just log in and you are instantly in control of as many locations as necessary.

Top Features:

Simple Web Browser Operation

Just point your browser, login and you are one click away from bringing that failed system back to life

All setup functions are easy to configure from the browser

Free Cloud Service

Manage an unlimited number of iBoots from a single login

Eliminate port forwarding and dynamic DNS issues

More secure with outbound connections only

Manage Multiple Locations / Outlets







One iBoot-PDU can be linked to and manage additional PDU's

Outlets can be grouped together to be managed simultaneously

Simple Web Browser Interface


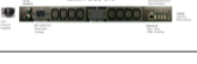

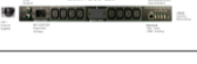
One master unit can be connected to 15 expansion units, managing 128 outlets from a single web page interface

North American Versions

Model SKU	Rear Panel click thumbnail	Power Inlet Total Capacity	Power Outlets
iBoot-PDU4-N15 1530041		1 x NEMA 5-15P 15 Amps	4 x NEMA 5-15R
iBoot-PDU4-N20 1530043		1 x NEMA 5-20P 20 Amps	4 x NEMA 5-15R
iBoot-PDU8-N15 1530081		1 x NEMA 5-15P 15 Amps	8 x NEMA 5-15R
iBoot-PDU8-2N15 1530083		2 x NEMA 5-15P 30 Amps	8 x NEMA 5-15R
iBoot-PDU8-N20 1530085		1 x NEMA 5-20P 20 Amps	8 x NEMA 5-15R
iBoot-PDU8-2N20 1530087		2 x NEMA 5-20P 40 Amps	8 x NEMA 5-15R

Model Information: www.dataprobe.com/iboot-pdu-models/

International Versions

Model SKU	Rear Panel click thumbnail	Power Inlet Total Capacity	Power Outlets
iBoot-PDU4-C10 1530045		1 x IEC C14 10 Amps	4 x IEC C13
iBoot-PDU4-C20 1530047		1 x IEC C20 20 Amps	4 x IEC C13
iBoot-PDU8-C10 1530089		1 x IEC C14 10 Amps	8 x IEC C13
iBoot-PDU8-2C10 1530091		2 x IEC C14 20 Amp	8 x IEC C13
iBoot-PDU8-C20 1530093		1 x IEC C20 20 Amp	8 x IEC C13
iBoot-PDU8-2C20 1530095		2 x IEC C20 40 Amps	8 x IEC C13

Additional Features

Independently Controllable Outlets

Designed to provide power distribution and remote power control. Each iBoot-PDU allows four or eight outlets to be independently switched on and off for reboot, energy management and security.

Dual Power inputs for Redundant Power Feed

Models with dual inputs (-2N15, -2N20, -2C10, -2C20) have two inlets (mains). Each main feeds four outlets Inlet A supports outlets 1-4 and Inlet B feeds 5-8. Dual power inlet models can be used to support higher current devices, as each inlet can carry its rated load, doubling the amperage of a single inlet device.

Telnet/Serial CLI Control

Telnet and serial access use the same Command Line Interface (CLI) structure and syntax to completely configure the iBoot-PDU, or multiple iBoot-PDUs in a cluster configuration.

Multiple iBoot-PDU Cluster Configuration

Additional iBoot-PDUs can be managed from a single unit. One master iBoot-PDU provides the communication to the users and continuously receives status information from the rest of the iBoot-PDUs in the cluster. Groups can be created across multiple PDUs and controlled simultaneously.

Network Management

Setup and Control functions can be linked to any SNMP v2c or v3 compatible manager. The iBoot-PDU MIB is downloadable from the website. Can report to a syslog server.

Specifications

Subject to Change Without Notice

Network: 10/100 Ethernet | Web, Telnet, SNMP, SMTP | Port assignable for Web and Telnet
SSL Security on Web Control

USB Ports: 4 x USB A ports for accessories, modem, temperature probe, etc.
1 x USB B port for serial port and external battery

Landline Modem Option: External 56 Kbps V.92 Global Compliance, Data or Tone Dial (DTMF) Control

AC Input:

N15 Models	NEMA 5-15 Linecord 115VAC 15 Amps combined total switched per Linecord Supplied with NEMA 5-15 Linecord, attached
N20 Models	NEMA 5-20 Linecord 115VAC 20 Amps combined total switched per Linecord Supplied with NEMA 5-20 Linecord, attached
C10 Models	IEC320 C14 Receptacle 100-240VAC 10 Amps total at 240VAC Max per Linecord Supplied with IEC320 C13 to CEE7 (SHUCO) Linecord
C20 Models	IEC320 C20 Receptacle 100-240VAC 20 Amps total at 240VAC Max per Linecord Supplied with IEC320 C19 to CEE7 (SHUCO) Linecord

Switched Outlet:

N15 Models	8 x NEMA 5-15 Receptacle, 12 Amps Max per Receptacle, 15 Amps Max Total per Linecord
N20 Models	8 x NEMA 5-15 Receptacle, 12 Amps Max per Receptacle, 20 Amps Max Total per Linecord
C10 Models	8 x IEC 320-C13 10 Amps Max per Receptacle, 10 Amps Max Total per Linecord
C20 Models	8 x IEC320-C13 10 Amps Max per Receptacle, 20 Amps Max Total per Linecord

For More Information

www.dataprobe.com/iboot-pdu/

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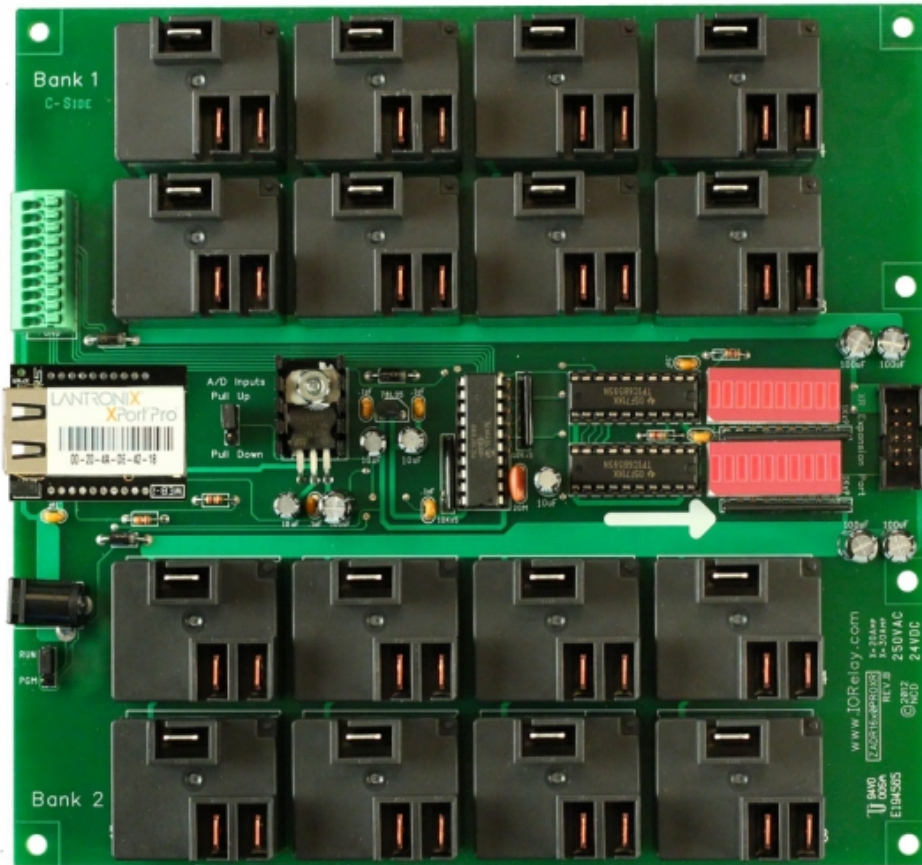


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