CUBIC | Trafficware

# Model 980 ATC

## TS1/TS2 Type 2 Controller with Ethernet & USB

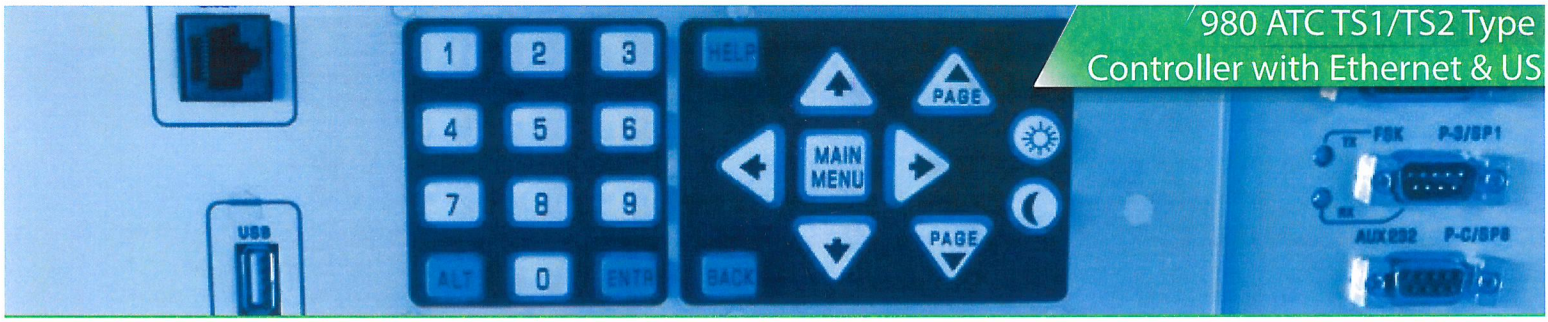

## Traffic Adaptive Controller

The Series 900 ATC Traffic Signal Controller is designed using state of the art electronics to ensure reliability, a long life, and superb performance in all signal control applications.

Design of the Series 900 ATC Controller is based on the ATC and NEMA TS2 standards and includes advanced functionality for complex phasing, detector processing, coordination, preemption, communications, adaptive timing, and systems operation as a master or a secondary controller.

The advanced LCD display and menu-driven software provide a user-friendly approach to programming and access. Built-in diagnostics permit rapid evaluation of operational status. The on-board Flash File System allows software upgrades without PROM replacements. The front panel mounted USB port facilitates the upgrade process and file access with ease and the Ethernet-enabled controller allows communication across a TCP/IP network.

522 Gillingham | Sugar Land | Texas | 77478
For more information, call 281-269-6512 or visit www.trafficware.com.




# Product Features & Specifications

| FEATURES | |
|---|---|
| Flash File System | The Series 900 Controller is easily configured to various firmware versions through the utilization of Flash File System, which eliminates the need for obsolete EPROM technology. A complete traffic controller firmware update requires only seconds. No hardware changes or EPROM replacements are required. |
| Master/Secondary | Operation in a Closed Loop System requires only one Series 900 Controller to be located at the master cabinet. Both the master and secondary functions are simultaneously provided by a single controller. |
| Display | A backlit, 8-line by 40-character LCD display provides full-menu screens for eased data entry. Optimum contrast and brightness are automatically maintained by temperature-compensating circuitry. The menu-driven format and context sensitive help screens eliminate the need for special codes or front panel identification characters. |
| Easily Serviced | The modular design of the Series 900 Controller allows quick sub-assembly level problem isolation. Printed circuit board components are clearly labeled with silk-screen. No specific tools or extender cards are needed for troubleshooting. |
| Real-Time Clock | The real-time clock maintains accurate timing by utilizing a "super capacitor" and crystal-controlled circuitry, which allows for 0.005% accuracy. |
| NTCIP Objects | The Trafficware 980 Controller incorporates the NTCIP Standard Objects and many additional objects that allow for enhancements to standard ATC operating features as well as entirely new ones. Sixteen phases, sixteen overlaps, ten compatible phases per phase, alternative programming by time-of-day, and many other features provide extreme flexibility to handle the most challenging traffic control situations. |
| Keyboard | A custom 23-key keypad containing four (4) red function keys, ten (10) white numeric keys, seven (7) cursor and menu navigation keys, and two (2) LCD contrast adjustment keys. |
| Diagnostics | Built-in diagnostics provide for improved maintenance and easier repairs. It allows operator tests on all input and output signals, RAM devices, memory, LCD, keypads, etc. |
| Communications | Four (4) EIA-232 ports and an optional FSK modem are available. These ports are keyboard programmable with selectable baud rates up to 115K with full and half duplex options. Various communication configurations allow the user multiple interfaces to other cabinet devices: conflict monitor, preemption equipment, detectors, GPS, modems, notebooks, printers, etc. An RS-485 SDLC Port is available for applications using the NEMA TS2 Port 1 interface and a USB 2.0 Full Speed interface is available for software updates and file transfer. |

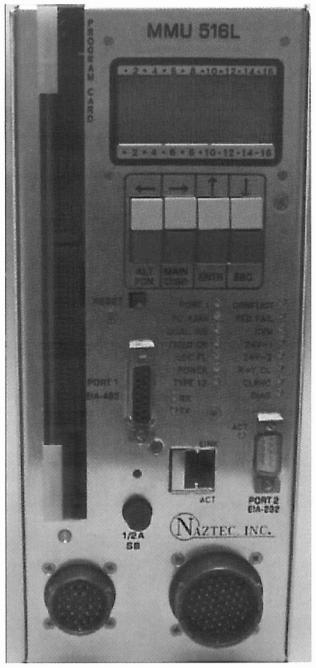
| HARDWARE SPECIFICATIONS | |
|---|---|
| Voltage | 89 to 135 VAC |
| Frequency | 60 +/- 3 Hz |
| Temperature | -30° F to 165° F |
| Humidity | 95% max, non-condensing |
| Dimensions | 10.50"H x 14.75"W x 8.38"D |

Trafficware

Engineered by Naztec

# MMU 516L-E LCD with Ethernet

## FEATURES




- Meets and exceeds all TS2 specifications
- High speed internal data transfer and communications via an SDLC port
- High speed external data transfer via an RS-232 or Ethernet port
- Full LCD Screen w/ Menu-Driven, Easy to Use Software
- LED indicator lamps for operation analysis
- Removable program card
- High performance machine tooled sockets for integrated circuit mounting

The **Trafficware Model MMU 516L-E Malfunction Management Unit** is an enhanced MMU that monitors up to 16 traffic signal indications (channels) for conflict, improper sequencing, incorrect timing, and improper signal voltage levels. The MMU 516L-E is fully compliant with NEMA Standard TS2-2003. The MMU 516L-E is also capable of operating in older TS1 type cabinets, and is compatible with 12-channel Conflict Monitor Units conforming to the NEMA Standard TS1-1989.

All connectors, indicators, and operator controls are located on the front panel of the MMU 516L-E. Channel and control input signals and relay output connections are made through two MIL-C-26482 connectors, and the SDLC Port is an A-size, 15 contact, D shell connector. The MMU 516L-E is equipped with a 10/100 Ethernet Port and a RS232 Port, which are excellent for tracking important phase output, status, and logging data back to the controller or to a PC for logging. The programming card and the AC line fuse are easily accessed from the front panel.

The MMU 516L-E provides a Reset Timeout feature to prevent a broken switch or accidental wiring fault from holding the unit in the reset state for an extended period of time. LED indicators, in addition to the TS2 specified indicators, include Dual Indication Fault, Yellow+Red Clearance Fault, Programming Card Ajar, Field Check (active channels do not match SDLC message from controller) Fault, and LEDs for two +24VDC input faults and CVM input faults. Status indicators provided include: AC Line Power, Type 12 Indicator, SDLC Transmitter Active, and SDLC Msg Received.

For added safety, the MMU516L-E performs continuous diagnostic tests during all operating modes. All memory elements, the microprocessor, operating voltages, and critical circuitry are checked.

***The MMU 516L-E is now available with the new Protected/Permission Flashing Yellow monitoring.

Trafficware

Engineered by Naztec

# MMU 516L-E LCD with Ethernet

**PROGRAMMING**

- Minimum flash; 0-16 seconds
- Short yellow per channel
- Programmable sequence monitor
- Latch selectable options

**INDICATIONS**

- Conflict LED
- Red Fail LED
- 24 V-1
- 24 V-2
- Controller Voltage Monitor
- Red+Yel Clearance
- Clearance
- Diagnostics
- Port 1 Fault, Tx, Rx
- Program Card Ajar
- Indication Fail LED
- Field Check
- Power LED
- Type 12 Mode

**ENVIRONMENTAL**

- Operating Temperature: -34° C to +74° C
- Storage Temperature: -45° C to +85° C
- Humidity: Less than 95% non-condensing to +43° C

**DIMENSIONS**

- Height: 10.5 inches
- Width: 4.5 inches
- Depth: 10.9 inches

**NEMA + FEATURES**

- Meets and exceeds TS2-2003 Specifications
- Operates in TS1 Cabinets
- EPROM Memory
- No batteries
- Menu Driven LCD Display
- Machine tooled socket I.C.'s
- Programmable Minimum Flash Time
- Latch 24 V failures
- Latch CVM Failure
- Enhanced Monitoring
- Flashing Yellow Protected/Permissive
- 10/100 Ethernet

**ELECTRICAL**

**Power**

- Line Voltage: 75 to 150 VAC, RMS
- Line Frequency: 57 to 63 Hz, 60Hz nominal
- Power: 10 watts, typical
- Fuse, Front Panel: 0.5A Slow Blow

**Monitoring Voltage**

- Pickup: 96 +/- 2.5 Volts AC, RMS
- Dropout: 91 +/- 2.5 Volts AC, RMS
- Hysteresis: 4 +/- 1.0 Volts AC, RMS

# Data Sheet

## UPStealth® Inverter/Controller Series

ZincFive

## Introduction

We now live in an Always-On ITS world and Departments of Transportation throughout U.S. and Canada have made a commitment to increasing safety with the UPStealth Uninterruptible Power Supply (UPS). UPStealth is an intelligent UPS designed by transportation experts for Intelligent Transportation System (ITS) requirements and utilizes transformational Nickel-Zinc battery chemistry to energize intersections and IT equipment when utility power is lost.

As the fastest growing UPS for ITS, UPStealth offers transportation departments the opportunity to upgrade to an easy-to-install, self-maintained solution with superior performance, environmental and safety advantages over traditional battery backup solutions.

## UPStealth Benefits

**Cabinet Optimization**
- Cabinet Space and Thermal Optimization

**Transformational Batteries**
- Superior performance, safety and environmental advantages over lead-acid

**Simple Installation & Self Maintaining**
- Innovative form factors
- No periodic maintenance

**Active Power Supervision**
- Intelligent two stage operation
- Modern power analysis

**Lower Total Cost of Ownership**


UPStealth® 170 Inverter/Controller


UPStealth® NEMA Inverter/Controller



Office 503.399.3517

# Specifications

| | |
|---|---|
| **Input Power** | |
| Input Voltage Range | 120VAC nominal<br>85-140VAC User Programmable |
| Input Current | 20A max |
| Input Frequency | 60Hz nominal<br>±10% (54-66Hz) |
| **Output** | |
| Output Voltage | 120VAC ±3% |
| Output Current | Standard Version: 8.3A Typical, 17A Surge<br>HD Version: 12.5A Typical, 25A Surge |
| Output Power (Watts) | Standard Version: 1,000 Typical<br>HD Version: 1,500 Typical |
| Output Frequency | 60Hz ±0.5Hz |
| Output Waveform | Pure Sinewave |
| UPS Efficiency | 97% |
| **Environmental** | |
| Operating Temperature Range | (-37°C to 74°C) (-34°F to 165°F) |
| **Inverter Performance** | |
| THD | Standard Version: <2%<br>HD Version: <3% |
| Overload | Standard Version: 2,000W Surge<br>HD Version: 1725W for 180 sec., 1875W for 10 sec., Surge Power 3000W for 30 cycles |
| **System Switchover** | |
| Operating Modes | Intelligent Two-Stage Operation<br>Stage One: Line Conditioner, Waveform Monitoring and Switchover to Battery Backup<br>Stage Two: Waveform Monitoring, Return to AC Power |
| Switchover Thresholds | AC Voltage: Programmable from 85-140VAC in 1V Steps<br>AC Waveform Analysis: Programmable Across 5 Sensitivity Levels<br>AC Frequency: 60Hz ±0.2Hz |
| Transfer Time from AC Power to Battery Backup | Typical <8ms |
| **Mechanical** | |
| Size | 170 Model: 3.5"H X 17"W X 13"D<br>NEMA Model: 8"H X 17"W X 9"D |
| Weight | 170 Model: 14lbs.; HD Version 17lbs.<br>NEMA Model: 15lbs.; HD Version 18lbs. |
| Battery Connection System | Single Quick Connect/Disconnect CPC-6 Barrel Connector with Multiple Conductor Cable Containing Signal and Power Pins |
| **Communications** | |
| Display | 4 Line by 20-Character LCD Display with White LED Backlight |
| Ports | Ethernet RJ45 (Utilizes NTCIP Framework and TCP/IP)<br>USB Type A connector; USB 2.0 OTG-Compliant, Full-Speed Interface |
| Dry Relay Contacts | 8 Independent Programmable Form C Relays (default state: NO)<br>125VAC, 2A rating<br>240VAC, 1A rating |
| **Indicators & Alarms** | |
| Alarm Functions | AC Power Failure<br>Cabinet Temperature<br>Daily Time Trigger<br>Flash Trigger Timed After Power Failure<br>Battery Capacity |
| Audible Indicators | System Startup Indicator<br>Cold Start Indicator (Force On Function)<br>Inverter On/Off Indicator<br>Battery Cable Attachment Error Indicator |
| **Features** | |
| Battery Management System | Digital Battery Bus<br>Compartmentalized Battery String<br>Parallel Battery Connections<br>Integrated Temperature Compensated Charging<br>Redundant Performance |
| Multiple Mounting Configurations | Rack, Shelf or Hanging |
| Ethernet SNMP Interface | SNMP Traps: Power Failure, Battery Capacity, Remaining Runtime, and Heartbeat |
| Local and Remote Control | Front Panel Keypad with 5 Pushbuttons for Local Menu-Driven Programming<br>Separate Software Application, RTi Connect, for Remote Connectivity and Control |
| Internal Battery Backed-Up Clock | Operates for Life of System |
| AC Power Event Log | Stores Previous 60 Events |

*All Specifications Valid at Operating Temperature Range *All Specifications Subject to Change

# Data Sheet

## UPStealth® Battery Panels

ZincFive

## Introduction

We now live in an Always-On ITS world and Departments of Transportation throughout U.S. and Canada have made a commitment to increasing safety with the UPStealth Uninterruptible Power Supply (UPS). UPStealth is an intelligent UPS designed by transportation experts for Intelligent Transportation System (ITS) requirements and utilizes transformational Nickel-Zinc battery chemistry to energize intersections and IT equipment when utility power is lost.

As the fastest growing UPS for ITS, UPStealth offers transportation departments the opportunity to upgrade to an easy-to-install, self-maintained solution with superior performance, environmental and safety advantages over traditional battery backup solutions.

## UPStealth Benefits

**Nickel-Zinc Battery Chemistry**

- Superior electrical performance compared to lead-acid batteries
- Half the size and weight of lead-acid batteries
- Self-maintaining; No periodic maintenance
- Faster recharge time than lead-acid batteries
- Longer storage and operational life than lead-acid batteries
- No hazardous materials; No sulfation
- Extreme operating temperature range
- No trickle charging required
- Physically safe operation
- Recyclable and environmentally friendly

UPStealth® Living-Hinge Battery Panel
Available in 300W & 500W

**Compact Form Factors**

- Ingenious flexible battery design inserts in dead space between rack and cabinet wall
- Shelf mount, hanging and stand mount
- Single quick connect/disconnect battery string cables

**Innovative Electronics Design**

- Built-in chargers and controllers
- Integrated temperature compensated charging
- Digital battery bus
- Parallel battery strings; Redundant performance


UPStealth® NEMA Battery Panel



Office 503.399.3517

# Specifications

| | |
|---|---|
| **Output** | |
| Power Output | 300W Living-Hinge Battery Panel: 300 Watts<br>500W Living-Hinge Battery Panel: 500 Watts<br>500W NEMA Battery Panel: 500 Watts |
| Voltage Output | 48VDC Nominal with Redundancy |
| **Battery Type & Panel Design** | |
| Chemistry | Nickel-Zinc, Sealed |
| Electrolyte | Starved, KOH, Aqueous<br>(no acid) |
| Configuration | Digital Battery Bus<br>Compartmentalized Battery String<br>Parallel Battery Connections<br>Redundant Performance |
| Battery Communications | Digital Battery Bus via Single Connector |
| Maximum Battery Configuration | 16 Panels With Optional Hub |
| **Mechanical** | |
| Size | 300W Living-Hinge Battery Panel: 1"H X 19"W X 19"D<br>500W Living-Hinge Battery Panel: 1"H X 19"W X 28.75"D<br>500W NEMA Battery Panel: 17"W X 3.5"H X 10.5"D |
| Weight | 300W Living-Hinge Battery Panel: 20lbs.<br>500W Living-Hinge Battery Panel: 30lbs.<br>500W NEMA Battery Panel: 28lbs. |
| Battery Connection System | Single Quick Connect/Disconnect CPC-4 Barrel Connector with Multiple Conductor Cable Containing Signal and Power Pins |
| Form Factors and Mounting | Living Hinge Models - Flexible Battery Panel Inserted in Dead Space Between Rack and Cabinet Wall<br>NEMA Models - Shelf Mount, Hanging and Stand Mount |
| **Maintenance** | |
| Maintenance | Self-Maintaining, No Periodic Maintenance |
| **Environmental** | |
| Operating Temperature Range | Discharge: (-37°C to 74°C) (-34°F to 165°F)<br>Charge: (-37°C to 50°C) (-34°F to 122°F) |
| **Charge/Discharge** | |
| Battery Charging | Built-In Chargers and Controllers<br>Integrated Temperature Compensated Charging<br>Typical 4-Hour Charge Time |
| Self-Discharge | Self-Discharge Time (From 100% to 0% charge):<br>1. At 25C or below, >1,000 days;<br>2. At 60C, >240 days<br>Capacity can be fully recovered to 100% after self-discharging |
| Battery Storage | Batteries Do Not Sulfate When Stored<br>No Trickle Charging Required |
| Battery Memory | None |
| **Indicators & Alarms** | |
| Visual | Multi-Color LED Providing Battery Panel Status and Alarms |
| Audible | Battery Cable Attachment Error Indicator |
| **Warranty** | |
| Warranty | 2 Years on Battery Panel, 5 Years on Battery Cells |

*All Specifications Valid at Operating Temperature Range
*All Specifications Subject to Change

# IPn920T

## 1W 900 MHz Wireless Ethernet/Serial/USB Gateway

*The Nano IP Turbo Series delivers a high power (1W) wireless link with speeds of up to 1.2 Mbps. The IPn920T operates in the license free 900 MHz Frequency Band, offering an off the shelf solution for reliable wireless communications. This robust and compact Ethernet Bridge and Serial Gateway provides simultaneous serial data and Ethernet communication to extend Serial & IP networks.*

- *Up to 1.2 Mbps*
- *900 MHz*
- *Up to 1 Watt*
- *RS232/485 Serial Data*
- *10/100 Ethernet Data*


## IPn920T Features

- Supports up to 1.2 Mbps
- Up to 1W transmit power (Adjustable)
- Point-to-Point, Point-to-Multipoint, Repeater, Peer-to-Peer
- Master, Remote & Repeater Modes
- 2 Series Data Ports, 1 USB Port, and 1 Ethernet Port
- Industrial Temperature (-40°C to +85°C)
- Low Power consumption
- Radius Authentication
- Full VLAN Support
- Local and remote management & diagnostics through local console, telnet, WebUI, SNMP (v1,2,3)
- Local and remote firmware updates
- Compact & Robust Design


◆ VLAN ◆ RADIUS ◆ QoS ◆ HTTPS ◆ USB ◆ Firewall

# Specifications

| | |
|---|---|
| **Frequency** | 902 - 928 MHz |
| **Spread Method** | Frequency Hopping / DTS |
| **Link Rate** | 276 kbps / 345 kbps / 1.2 Mbps (User Selectable) |
| **Error Detection** | 32 bits of CRC, ARQ |
| **Encryption** | 128-bit WEP/WPA (Canada & USA only. NOT AVAILABLE for export, see –AES option) |
| **Range** | Up to 30+ miles (50+ km) @ 1.2Mbps |
| **Sensitivity** | -97dBm @ 1.2Mbps link rate |
| **Output Power** | 100mW - 1W (20-30dBm) |
| **Serial Interface** | RS232, RS485, RS422 |
| **Serial Baud Rate** | 300bps to 921kbps |
| **USB** | USB 2.0<br>USB Console Port<br>USB to Serial Data Routing<br>USB to Ethernet Data Routing |
| **Ethernet** | 10/100 BaseT, Auto - MDI/X<br>IEEE 802.3 |
| **Network Protocols** | TCP, UDP, TCP/IP, TFTP, ARP, ICMP, DHCP, HTTP, HTTPS*, SSH*, SNMP, FTP, DNS, Serial over IP, QoS (* Only available in –AES) |
| **Operating Modes** | Point-to-Point, Point-to-Multipoint, Store & Forward Repeater, Peer-to-Peer |
| **Management** | Local Serial Port Console, Telnet, WebUI, SNMP, FTP & Wireless Upgrade, RADIUS authentication, VLAN |
| **Diagnostics** | Battery Voltage, Temperature, RSSI, and remote diagnostics |
| **Rejection** | Excellent strong signal interference & rejection characteristics |
| **Input IP3** (Antenna Connector) | +12 dBm |

| | |
|---|---|
| **Input Voltage** | 7-30VDC |
| **Power Consumption (Typical@ 12V)** | Sleep: < 1mA<br>Idle: 35mA<br>Rx: 110mA to 145mA<br>Tx: 350mA to 500mA |
| **Connectors:** | Antenna: RPSMA Female Bulkhead<br>Ethernet: RJ-45<br>Serial: 2x Female DB9<br>USB: Mini |
| **Environmental**<br>Temperature<br>Humidity | <br>-40°F to 185°F (-40°C to +85°C)<br>5-95%, non-condensing |
| **Weight** | Approx. 250 grams |
| **Dimensions** | Approx. 2.25" x 3.85" x 1.50"<br>(57mm x 98mm x 38mm) |
| **Approvals** | FCC / Industry Canada |

## Order Options

| | |
|---|---|
| **-UL** | UL HazLoc (for use in hazardous environments) |
| **-AES** | 128/256-bit AES Encryption, Secure Shell, HTTPS (Canada & USA only. NOT AVAILABLE for export) |

## Contact Information



Microhard Systems Inc.
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Calgary, AB, Canada T3K 5P3

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microhard

www.microhardcorp.com

WaveLink
Antenna Systems Inc.

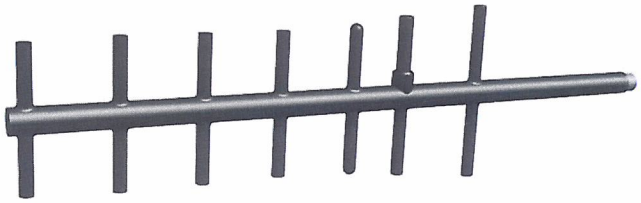
# PROFESSIONAL GRADE YAGI

## PRO890-12-EBN4

## 890-960 MHz

### ANTENNA SPECIFICATIONS

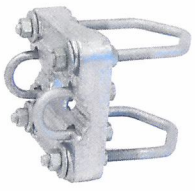
| | |
|---|---|
| Operating Frequency (VSWR ≤ 1.5) MHz | 890-960 |
| Nominal Gain (dBi) | 12 |
| Horizontal Beamwidth (Deg-3dB) | 52 |
| Vertical Beamwidth (Deg-3dB) | 42 |
| Power Rating (W) | 200 |
| Length (inches) | 23.5 |
| Width (inches) | 6.2 |
| Antenna Weight (lbs.) | 3 |
| Cross Sectional Area (Max. Ft²) | 0.26 |
| Lateral Thrust at 100mph (lbs.) | 7 |
| Rated Wind Velocity (mph) | 150 |
| Rated Wind Velocity with 1/2" radial ice (mph) | 100 |



PRO890-12-EB is manufactured with an N-Female only.

The **PRO890-12- EB** is specifically designed to meet or exceed the requirements of a high gain, broadband *Professional Grade* antenna. This antenna provides **12 dBi** gain and operates very effectively across the operating range of **890-960 MHz** with a VSWR of 1.5:1 or less. All **WaveLink** *Professional Grade* antennas are manufactured using high strength 6061 T-6 aluminum, and are fully welded to ensure optimum performance in the most severe operating conditions. The end boom N-Female connector is soldered directly to the internal feed, optimizing the operating characteristics, and is factory sealed using an epoxy resin to ensure a long-lasting watertight seal. All elements are fully welded to the boom, eliminating any potential intermod problems. The **PRO890-12 EB** is finished with black powder coat to protect against the effects of oxidation.

To view polar plots for this antenna please visit www.wavelinkantenna.com/plots



Includes mounting bracket C1001

Easily permits vertical or horizontal polarization. Mounts on 1"-2⅜" pipe.

WaveLink
Antenna Systems Inc.
Box 5458, Station A, Calgary, AB Canada, T2H 1X8
T: (403)-236-2298, F: (403)-236-2618, E: support@wavelinkantenna.com

WaveLink™
Antenna Systems Inc.

# PROFESSIONAL GRADE OMNI

## PRO902-8

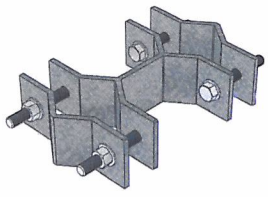
## 902-928 MHz

### ANTENNA SPECIFICATIONS

| | |
|---|---|
| Operating Frequency (VSWR ≤ 1.5) MHz | 902-928 |
| Nominal Gain (dBi) | 8.5 |
| Horizontal Beamwidth (Deg-3dB) | 360 |
| Vertical Beamwidth (Deg-3dB) | 15 |
| Power Rating (W) | 200 |
| Length (inches) | 72.5 |
| Width (inches) | 2.5 |
| Antenna Weight (lbs.) | 10 |
| Cross Sectional Area (Max. Ft²) | 1.17 |
| Lateral Thrust at 100mph (lbs.) | 29.25 |
| Rated Wind Velocity (mph) | 150 |
| Rated Wind Velocity with 1/2" radial ice (mph) | 125 |

PRO902-8 equipped with integrated N-Female connector

The **PRO902-8** is engineered to meet or exceed the requirements for a rugged, high gain outdoor omni-directional antenna. This antenna provides **8.5 dBi** gain and operates effectively across the operating range of **902- 928 MHz** with a VSWR of 1.5:1 or less. Every **WaveLink** *Professional Grade* Omni is built using a UV-resistant fiberglass radome, coupled to a machined, heavy duty aluminum base. The 6061-T6 aluminum base is anodized to protect against environmental degradation. The elongated N-Female connector is recessed within the base to minimize exposure, while the large inside diameter allows easy access for the connection. The antenna is supplied with two heavy duty mounting brackets.



Includes mounting brackets C1002 (2 included)

Phone: 1 800.805.6922 (Toll Free USA & Canada)
Visit us online at WavelinkAntenna.com

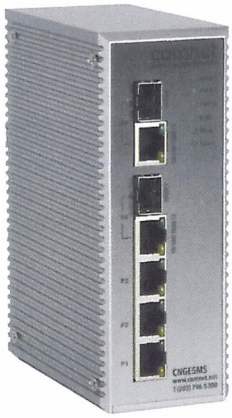
WaveLink™
Antenna Systems Inc.

comnet
Communication Networks

# Managed Ethernet Switch with (3) 10/100/1000Base-TX & (2) 10/100/1000Base-TX/100/1000Base-FX Combo Ports

CNGE5MS


INCLUDED | -40 TO 75°C | FLEXIBILITY | ALL GIGABIT | 3 + 2



The ComNet™ CNGE5MS is a hardened, industrial five port all gigabit managed Ethernet switch. It has three 10/100/1000Base-TX and two Gigabit combo ports that utilize ComNet SFP* modules for fiber and connector type and distance. The IEEE 802.3 compliant unit is a redundant switch offering multiple Ethernet redundancy protocols, C-Ring, ComRing, C-RSTP and MSTP/RSTP/STP. This redundancy feature protects your applications from network interruptions or temporary malfunctions by redirecting transmission within the network. The CNGE5MS offers centralized and convenient management through a windows-based utility called eConsole. Redundant DC power inputs provide non-stop operation in case of power supply disruption. The backup power input will take over immediately when the primary DC power input fails. The unit provides relay outputs that can be set up to indicate events and notify in case of potential problems.

## FEATURES

› 5 Gbps Ports: 3 × 10/100/1000Base-TX
2 × 10/100/1000Base-TX/
100/1000Base-FX SFP Combo Ports

› Environmentally Hardened for use in unconditioned installations

› Certified for compliance with NEMA TS1/TS2 and CALTRANS environmental specifications

› Designed for and fully compliant with the EN50155 standard for railroad applications

› Fast Redundant Ethernet Ring: C-Ring (recovery time <20ms over 250 units of connection)

› Com-Ring supports proprietary ring technology in open architecture

› STP/RSTP/MSTP supported

› Supports PTP Client (Precision Time Protocol) clock synchronization

› IGMP v2/v3 (IGMP snooping support) for filtering multicast traffic

› Port Trunking for easy of bandwidth management

› Supports LLDP Protocol

› SNMP v1/v2c/v3 support for secured network management

› RMON for traffic monitoring

› Event notification through Syslog, Email, SNMP trap, and Relay Output

› Windows utility (eConsole) supports centralized management and configurable by Web-based Telnet, and Console (CLI) configurations

› DIN-Rail and wall mounting

› Lifetime Warranty

** Small Form-Factor Pluggable Module. Sold separately.*

CNGE5MS

# Managed Ethernet Switch with (3) 10/100/1000Base-TX & (2) 10/100/1000Base-TX/100/1000Base-FX Combo Ports

## SOFTWARE SPECIFICATIONS

### Network Redundancy

ComRing, C-Ring, C-RSTP, Legacy Ring
STP, RSTP, MSTP

### Physical Ports

3 × 10/100/1000 Base-T Ports in RJ45, Auto MDI/MDIX
2 × Gigabit Combo Port with 10/100/1000Base-T(X) and 100/1000Base-X SFP port

### MAC Table

8192 MAC Addresses

### Serial Console Port

RS-232 in RJ45 connector with console cable. 9600bps, 8, N, 1

### Switch Properties

Switching Latency: 7µs
Switching Bandwidth: 10Gbps
Max. Available VLANs: 4096
IGMP Multicast Groups: 1024
Port Rate Limitng: User-defined

### Processing

Store-and-Forward

### Priority Queues

4

### Security Features

Enable/disable ports, MAC based port security
Port based network access control (802.1x)
VLAN (802.1Q ) to segregate and secure network traffic
Radius centralized password management
SNMP v1/v2c/v3 encrypted authentication and access security

### Software Features

STP/RSTP/MSTP (IEEE 802.1D/w/s)
Redundant Ring (C-Ring) with a recovery time of <20ms over 250 units
Com-Ring supporting proprietary manufacturer redundancy features
TOS/Diffserv supported
Quality of Service (802.1p) for real-time traffic
VLAN (802.1Q) with VLAN tagging and GVRP supported
IGMP v2/v3 (IGMP Snooping support) for multicast filtering
Port configuration, status, statistics, monitoring, security
PTP Client (Precision Time Protocol) clock synchronization
DHCP Server / Client support
Port Trunk support
MVR (Multicast VLAN Registration) support

### Indicating LEDs

Power Indicator, R.M. Indicator
Ring Indicator, Fault Indicator
10/100/1000Base-T(X) RJ45 Port Indicator

## HARDWARE SPECIFICATIONS

### Power

| | |
|---|---|
| Input Power | Redundant +/–12~48VDC on 7-pin terminal block<br>One 12 ~ 45VDC on power jack |
| Power Consumption | 10 Watts (Typ.) |
| Overload Current Protection | Present |
| Reverse Polarity Protection | Present on terminal block |

### Mechanical

| | |
|---|---|
| Size (W × D × H) | 2.13 × 4.18 × 5.72 in (5.42 × 10.61 × 14.54 cm) |
| Weight | 820g / 1.8lb |
| Installation | DIN Rail and Wall Mount Design |

### Environmental

| | |
|---|---|
| Storage Temperature | –40 to 85°C (–40 to 185°F) |
| Operating Temperature | –40 to 75°C (–40 to 167°F) |
| Operating Humidity | 5% to 95% Non-condensing |
| MTBF | >100,000 hours |

### Ethernet Standards

IEEE 802.3 for 10Base-T,
IEEE 802.3u for 100Base-TX and 100Base-FX
IEEE 802.3z for 1000Base-X
IEEE 802.3ab for 1000Base-T(X),
IEEE 802.3x for Flow control
IEEE 802.3ad for LACP (Link Aggregation Control Protocol)
IEEE 802.1D for STP (Spanning Tree Protocol)
IEEE 802.1p for COS (Class of Service)
IEEE 802.1Q for VLAN Tagging
IEEE 802.1w for RSTP (Rapid Spanning Tree Protocol)
IEEE 802.1s for MSTP (Multiple Spanning Tree Protocol)
IEEE 802.1x for Authentication
IEEE 802.1AB for LLDP (Link Layer Discovery Protocol)

### Regulatory Compliance

| | |
|---|---|
| EMI | FCC Part 15, CISPR (EN55022) class A, EN50155 (EN50121-3-2, EN55011, EN50121-4) |
| EMS | EN61000-4-2 (ESD), EN61000-4-3 (RS), EN61000-4-4 (EFT), EN61000-4-5 (Surge), EN61000-4-6 (CS), EN61000-4-8, EN61000-4-9, EN61000-4-11 |
| Shock | IEC60068-2-27, EN61373 |
| Free Fall | IEC60068-2-32 |
| Vibration | IEC60068-2-6, EN61373 |
| Safety | EN60950-1 |

AGENCY COMPLIANCE
PART 15 COMPLIANT · E322911 · N24621

Low Power Consumption

## ORDERING INFORMATION

| Part Number | Description | 10/100/1000TX Ports | Combo Ports |
|---|---|---|---|
| CNGE5MS | Environmentally Hardened Managed Ethernet Switch | 3 | 2 |
| Accessories | DC Plug in Power Supply, 90-264VAC, 50/60Hz (Included) for benign 0° - 50°C application<br>PS24-1A – 24VDC DIN Rail Power supply (sold separately) | | |

*In a continuing effort to improve and advance technology, product specifications are subject to change without notice.*

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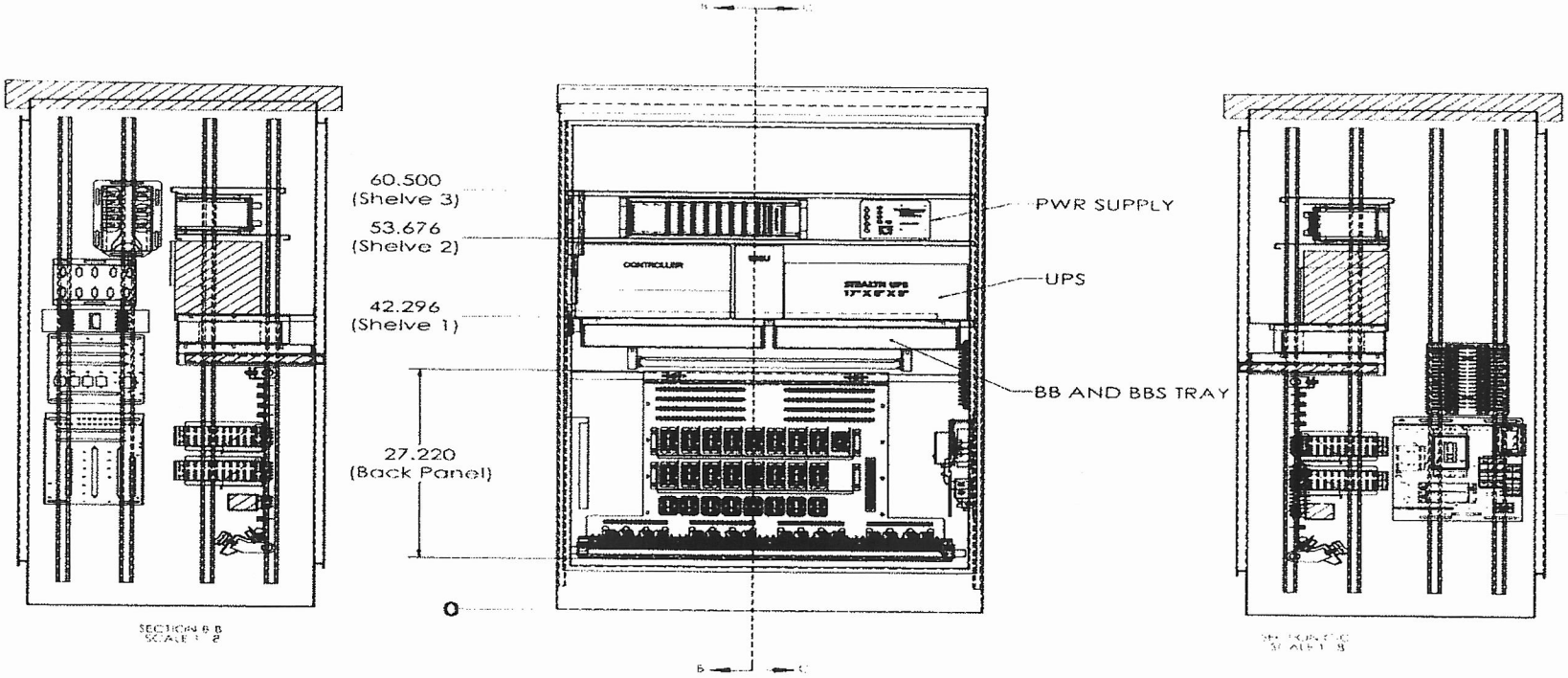
13 Jul 2015

# Knoxville TS2 Hybrid Double-Door Traffic Cabinet




- Meets NEMA standards
- 16 Channel back panel
- Base mounted
- Built-in UPStealth BBS battery trays
- Constructed of 0.125 thick aluminum
- Dual fan and thermostatic controls
- Aluminum exterior, White powdercoat
- 8 slot detector rack with preempt
- Compatible with both NEMA TS1 and TS2 (BIU)
- Plug-in MOV/CAP for reduced heat
- Trafficware "D" connector preempt panel
- Overall dimension 75"H x 40"W x 27"D
- LED interior lighting
- Auxiliary Police door w/key interior
- Document drawer
- (2) Vents with 14" x 20" x 1" filters

a. Clamp the surge voltage to a level no greater than twice the peak operating voltage of the circuit being protected.
b. Withstand a surge current of 1000A with an 8 by 20 μs waveform six times (at 1 second intervals between surges) without damage to the suppressor.
c. 10 year manufacturer's warranty minimum

5. Loop lead-in cable field wiring terminal SPD:

a. Protect the detector unit loop inputs against differential (between the loop lead) surges, and against common mode (between loop leads and ground) surges
b. Clamp the surge voltage to 25 V or less when subjected to repetitive 300A surges
c. Withstand repetitive 400A surges with an 8 by 20 μs waveform without damage
d. 10 year manufacturer's warranty minimum

All SPDs must be installed according to the SPD manufacturer's instructions and not affect the operation of equipment. SPD leads must be kept as short and straight as possible.

## CABINETS – GENERAL

### 730.26 Cabinets

Controller cabinet shall be housed in a rigid, weatherproof cabinet, constructed, finished and equipped as detailed throughout this document. All cabinets shall be wired to TS 2 Type 2 standards. Unless specifically specified differently in the plan sheets and specifications for a particular project, all of the following shall be included;

**1. Material, Workmanship, Dimensions and Layout**

a. All cabinets shall be of weather tight construction fabricated from aluminum sheet minimum 0.125 in. thickness or cast aluminum alloy minimum 0.25 in. thickness.

b. The interior of each cabinet shall be powder coated white to reduce overall cabinet temperature, reduce glare, and increase ambient light during night time troubleshooting in the cabinet.

c. All pad mounted cabinets should be 72" high X 40" wide X 26" deep unless a different size is specified in the plans. Due to many size differences between manufactures we will accept cabinet height sizes from 70" to 75".

d. All pole mounted cabinets shall be 60" high X 36" wide X 16.5" deep at a minimum, unless a different size is specified in the plans. The pole mounted cabinet will be determined on a per job basis.

e. All pole mount cabinets shall be equipped with a removable bottom panel to facilitate optional pad mounting.

f. All cabinets shall have a name plate riveted to main door 16.5"W x 4"H with two lines of one inch text that displays "CITY OF KNOXVILLE" on first line and "TRAFFIC CONTROL" on second line. Inside each letter shall be clearly identified with black paint that will bond to the surface of plate.

g. All base mounted cabinets shall have cabinet flanges welded to the cabinet base to accommodate standard Knoxville base and anchor bolt pattern. There shall be 4 anchor bolt holes that center the cabinet over anchor bolts located 30" apart center to center in width and 18" center to center front to back. Each mounting hole shall be one inch by 2 inches oblong (front to back) to accommodate anchor bolts.

h. All shelves and panels shall mount on C-Channel type rails and be fully adjustable by loosening panel bolts.

i. No less than three shelves shall be provided to support controller and auxiliary equipment. Shelves shall be a minimum of 10 inches deep. Shelves shall be the entire inside width of cabinet minus mounting rails. The shelves shall have slots aligned with the cabinet mounting rails. All shelves shall be secured with spring mounted nuts and hex head bolts. "Drop in" shelves secured with Nylon cable ties are not allowed. The front edge of the shelf shall be punched every 6 inches to accommodate tie-wrapping of cables/harnesses.

j. Cabinet Main Back panel shall have a hinged type mount at the bottom of the panel to facilitate rotating the panel forward for inspection of the rear wiring.

k. All feed through terminals shall be soldered. The use of crimp on style connectors on the rear of the panel will not be accepted.

**2. Doors**

a. Cabinets shall have a hinged front opening door which shall include substantially the full area of the front of the cabinet and be hinged on the right side facing the outside of the cabinet. There shall also be a rear door the same dimensions as the front door and hinged on the right side facing back of cabinet.

b. Both front and back doors shall be equipped with a positive hold fast device to secure the door in at least two open positions; one position at approximately 90 degrees and the other at 120 degrees or more.

c. The holdfast device shall be easily secured and released without the use of tools.

d. The top of the cabinet shall incorporate a 1-inch slope toward the rear to prevent rain accumulation.

e. Cabinets shall also be equipped with a switch compartment and the manual switches specified in this section and shall have a hinged front opening auxiliary door. Each door shall have a gasket to provide a weatherproof seal when closed.

f. All surfaces shall be free from weld flash. Welds shall be smooth, neatly formed, free from cracks, blowholes and other irregularities. All sharp edges shall be ground smooth.

g. A rain channel shall be incorporated into the design of the main door opening to prevent liquids from entering the enclosure.

h. The main door shall have No. 2 pin-tumbler cylinder lock.

i. The auxiliary front door shall have a standard police sub-treasury lock.

j. Two keys for each lock shall be provided.

**3. Ventilation.** Unless otherwise specified, ventilation shall be provided as follows:

a. All cabinets shall be ventilated through internal baffles located in the top front and rear of the cabinet.

b. Inlet ventilation openings shall be filtered on the front and rear door. Inlet ventilation openings shall be filtered using size 14" X 20" X 1" filter.

c. Cabinets shall be provided with two independently controlled "Exhaust Fans".

d. Exhaust fans shall consist of an electric fan with ball or roller bearings and a capacity of at least 100 $ft^3$ per minute.

e. The fans shall be mounted in a rain tight housing attached to the plenums inside the top front and rear of the cabinet.

f. Each fan shall be controlled by thermostats having a temperature differential between turn-on and turn-off of 15° F (0, +5° F) (8° C (0, + 3° C)), adjustable for turn-on through a minimum calibrated range of from 100° to 150° F (38 to 65° C).

4. **All cabinets.** Shall include a cabinet sliding storage drawer mounted under lower shelf in accordance with the following:

a. Approximate exterior dimensions 1.75" (H) x 16"(W) x 14"(D).

b. Telescoping drawer guides to allow full extension from beneath the shelf using ball bearings.

c. Opening storage compartment lid to access storage space for cabinet documentation and other items.

d. Supports a weight of 25 Lb. when extended.

e. Non-slip plastic laminate surface attached to the compartment lid which covers a minimum of 90% of the surface area of the drawer lid.

f. The drawer shall be installed in accordance to 5.D.

5. **Auxiliary Equipment.** Except cabinets used in special applications, all cabinets shall be fitted with the following:

a. All terminal panels shall be arranged for adequate electrical clearance.

b. One 8-position outlet strip located on the right side of the cabinet, mounted so as not to interfere with shelf space. The outlet strip should be mounted either on a 45 degree angle or a 90 degree angle so large power supplies for devices may be accommodated.

c. L.E.D type lighting mounted on the plenum, under the front of each shelf, under document drawer, and over the rear of the back-panel. All L.E.D lights shall be controlled by a door switch.

d. A form fitting enclosure with 2 cavities measuring 10" X 17" X 3"shall be mounted to the bottom shelve to secure BBS batteries, the document drawer shall attach to the bottom of the enclosure.

e. Back-panel shall include module "plug-in" type load capacitors for signal output and incorporate MOV (Metal Oxide Varistors) for surge providing capacitive loading and MOV protection. MOV protection shall be provided for each output. Capacitive loading shall be available for each output or for green and yellow outputs only. Capacitive loading shall provide an AC impedance equivalent to the DC resistance provided by a 1.5 K-ohm resistor. Modules shall be accessible from the front of the load bay and replaceable within a few seconds.

f. A main Power Distribution Assembly (PDA) on the right cabinet wall shall contain the following:

1) The top, front, and sides of the panel shall be protected by a clear plastic cover and with openings to allow access to the circuit breakers. The rear and bottom shall be open for ventilation.

2) GFI outlet in the front panel

3) A removable/serviceable multi-stage surge suppressor equivalent to Hesco HE1750

4) Circuit Breakers minimum requirements for:
   i. Main power Input to provide all power associated with normal operation. (30 Amp)
   ii. Equipment Power to provide power to all associated cabinet equipment. (10 Amp)
   iii. Service entrance Power to provide Power for the lamp and duplex receptacle. (10 Amp)
   iv. Sign Power (15 Amp) to provide power to street name signs (if required by plans)

5) Radio Interference Filter (RFI) which meets the requirements set forth in Section 5.4.2.5 of the NEMA Standards Publication No. TS 2-2003 or later revision.

6) A normally-open, 50-amp, Solid State Relay (SSR) signal contactor.

7) Bus bars:
   i. One 6-Position alloy for PDA Chassis Ground (Earth) connections.
   ii. One 6-Position alloy for PDA AC- (Neutral) connections. This Busbar shall be isolated from the panel and cabinet.

g. Bus bar panel located directly under the PDA on the right cabinet wall with:

1) Minimum of one 17 position bar for Chassis Ground (Earth)

2) Minimum of two 17 position bars for AC- Common Return (Neutral). This Busbar shall be isolated from the panel and cabinet.

h. The MMU channel inputs shall be terminated at the closest tie point to the field termination of the signal displays.

i. Where required to perform specified functions general purpose relays shall be provided.

j. Common Ground System: AC – return (Neutral) and Chassis (Earth) must be referenced to a single ground point at the electric service.

k. Logic ground may be connected to AC- or Chassis at the detector power terminal panel.

l. Provide a plug in Pedestrian Push Button Isolation device to completely isolate Pedestrian push buttons from AC-, Chassis, and Logic Ground.

m. Individual phase pedestrian test switches to be toggle type of the On-Off-Momentary type located at the top of the loop panel to place:

Up- "CALL" – locked detector call
   i. Center - "AUTO" – no call – Call provided by detectors.
   ii. Down - "TEST" – momentary detector call

n. A Police Switch Panel behind the auxiliary door to contain the following switches:

1) A Signals on/off switch.

2) An Auto/Flash switch, which shall be wired when in the Flash position, shall cause the cabinet to provide Flash Operation and Stop Time shall be applied to the controller.

3) Auto/Manual switch to activate Manual Control Enable.

4) Manual control pushbutton switch with self-coiling cord. Cord shall attach to a 2 position terminal strip via fork type connectors. Cord shall be a minimum of s6 feet.

o. A Technician Switch Panel inside the main door to contain the following switches:

1) Equipment Power On/Off switch for Controller and Monitor.

2) A Stop-Time switch to apply Stop Time to both controller rings.

3) A Signal On/Off switch which will remove the AC power applied to the signal heads for normal operation while the controller continues to operate.

4) A Signal Auto/Flash switch to enable intersection flash when in the Flash position.

5) Switch terminals on back of main cabinet door shall be insulated or shielded so that no live parts are exposed for safety.

6) All switches protected from accidental actuation by hinged clear plastic cover.

p. Leads to the auxiliary door and technician switch panel switches shall be stranded and no less than:

1) # 8 AWG for Signal On/Off Switch

2) # 18 AWG for all other AC switches.

3) # 20 AWG for all DC switches.

q. A TS2 Port-3 FSK Communications Panel shall be provided with:

1) Aluminum panel mounted on left cabinet wall.

2) Two 5-position terminal blocks for Transmit pair, receive Pair, and ground in and out of surge suppresser.
   i. EDCO PC642-008D surge suppresser or approved equivalent and base.
   ii. TS2 9-Position FSK communications harness.

r. Each cabinet shall include on the left side wall a Loop Panel which includes:

s. Terminal blocks to accommodate the termination of loop lead in wires and pedestrian push button wires.

t. EDCO surge bases and accompanying EDCO PC-642C-030 surge suppressors or equivalent to terminate incoming vehicle call input wires, pedestrian push button wires and loop lead in wires.

u. All termination and function locations shall be clearly identified with permanent style labels.

v. A ground bar of at least 17 positions at the lower edge of the panel.

w. Each cabinet shall include on the left side wall a Preemption Panel compatible with Trafficware controllers:

1) Terminal blocks to accommodate the termination of incoming preemption wires.

2) A bank of relays for conveying preemption calls to the controller.

3) All termination and function locations shall be clearly identified with permanent style labels.

x. All cabinets to include sixteen I/O load switches, one flasher, six flash transfer relays, one BIU and four detector cards (two channel variety).

y. Wiring - The cabinet shall be wired according to the following:

**6. Back-panel**

a. Shall be wired for 8 vehicle movements, 4 pedestrian phases and 4 overlaps (sixteen channels) and must be anodized black.

b. Sixteen NEMA input and output indicating load switches and bases shall be provided.

c. Shall be wired for 8 flash relay bases to allow any loadswitch (phase) outputs to flash Yellow, Red, or no-flash.

d. Cabinet Main Back Panel signal outputs shall use both color coded red, yellow and green wires and red, yellow and green labels for easy identification.

e. All pedestrian and overlap signal wires shall feed to their back-panel positions from below the terminal strips and not travel over the face of the back-panel and other signal wires.

f. Provide 4 terminal screw downs per channel, one each for red, yellow, green and flash.

g. Color coded labels shall be placed on the inside of the front cabinet door to illustrate the procedure for changing the signal output flash colors.

h. Detector rack (eight 2-Channel Slots) shall be included and shall be wired and clearly labeled:

1) Slot-1 PH-1/6

2) Slot-2 PH-2/5

3) Slot-3 PH-3/8
4) Slot-4 PH-4/7

5) Slot-5 PH-1/6

6) Slot-6 PH-2/5
7) Slot-7 Pre-3/4

8) Slot-8 Pre-1/2

**7. Individual phase vehicle detector test switches.** Shall be included and shall be toggle type of the On-Off-momentary type located at the top of the loop panel to place:

a. Up- "CALL" – locked detector call

b. Center - "AUTO" – no call – Call provided by detectors.

c. Down - "TEST" – momentary detector call

**8. Wire type:**

a. All wiring, 14 AWG and smaller, shall conform to MIL-W-16878/17, Type B/N. The wire shall have a minimum of 0.010 inches thick PVC insulation with clear nylon jacket.

b. All wiring larger than 14 AWG shall have UL listed THHN/THWN 90 degrees Celsius. 600V, 0.020 inches thick PVC insulation with clear nylon jacket.

9. **Power Supply.** The cabinet shall include a cabinet power supply meeting the requirements of NEMA specification TS2. The power supply shall be completely enclosed in an aluminum housing, shall be shelf mounted, and shall provide the following voltage and current outputs:

   a. +12 VDC +/- 1 VDC, 2.0 A

   b. +24 VDC +/- 1 VDC, 2.0 A

   c. 12 VAC, 0.25 A

   d. Outputs shall be fused with slow blow fuses of the ratings indicated.

   e. AC power input shall be protected against over current with a 2 Amp slow blow fuse.

   f. L.E.D. indicators on the front panel shall denote the presence of 12 VAC, 24 VDC and 12 VDC and the 60 Hz reference signal Test points for logic common and +24 VDC shall also be provided on the front panel.

   g. The power supply harness shall be connected to a terminal block at the top of the cabinet detector panel.

   h. The panel shall have a decal that is color coded to indicate all voltage and ground bus connections for safety reasons. A clear plastic cover shall be placed o over the terminal bloc to prevent accidental contact with line voltage terminals.

10. **Bus Interface Unit (BIU).** The cabinet shall include:

    a. A detector rack with provision for a BIU as defined in Section 8 of NEMA Standards Publication No. TS 2, 2003 or later revision.

    b. One BIU that shall be a NEMA designated BIU2 as listed in Table 8-1 of NEMA Standards Publication No. TS 2-2003 or later revision.

    c. One SDLC distribution panel with connectors for 10 SDLC cables.

    d. Three SDLC cables one each for MMU, Controller, and detector rack BIU.

    e. The cabinet assembly shall have provision for supporting detection inputs by means of NEMA TS1 interface method or by NEMA TS2 BIU method. The cabinet assembly shall be easily converted from one interface method to the other. Converting from one method to the other shall not require replacement of the detection rack. When utilizing the TS1 method, detector calls shall be routed via a modular harness from the detector rack to the back-panel assembly and the vehicle call inputs to the controller. A BIU shall not be employed. When using the TS2 BIU method, the detector rack shall use a standard BIU to route detector calls to the controller via the SDLC Port 1 bus and the modular TS1 harness shall be removed. It shall not be necessary to reconfigure numerous jumpers to make the switch from TS1 to TS2 detection.

11. **Lightning Protectors and Interference Suppressors.** Ample lightning protectors to provide effective defense against high transient voltages caused by lightning discharges or other sources shall be provided. Each controller cabinet must be furnished with the following surge protection devices:

a. Main power suppressor shall be EDCO SHP-300-10 or approved equivalent for all but flasher or remote detector cabinets and shall have the following characteristics:

1) Peak surge current: 20,000 Amperes

2) Clamp Voltage: 340 Volts

3) Response Time: Voltage NEVER exceeds 340 Volts

4) Continuous Current: 10 AMPS at 120 VOLTS AC

b. Power Protector for Controller Flasher, Flashing Beacon, and Remote Detector Cabinets:

1) Peak Current: 15,000 Amperes

2) Power Dissipation: 15 Watts

3) Peak Voltage: 650 Volts

c. Controller detector input terminals (vehicle and pedestrian) shall be terminated at a plug-in surge suppressor, EDCO PC-642C-030 or approved equivalent, and have the following characteristics:

1) Peak Surge Current: 400 Amps Differential Mode

2) Response Time: 40 Nanoseconds

3) Input Capacitance: 35 pf typical

4) Clamp Voltage: 30 Volts Max (either mode)

12. **Flash Relays, Auxiliary Relays, and Fan.** Shall be provided with a resistor/capacitor circuit to suppress generated noise.

### 730.27 Auxiliary Equipment for Traffic Signal Controllers

Furnish and install the following auxiliary equipment in each cabinet for traffic actuated controllers.

#### A. Load Switches and Flash Transfer Relays

Provide each cabinet complete, with the necessary number of NEMA load switches and Flash Transfer relays necessary to affect the specified signal sequence and phasing. Load switches shall:

1. Meet NEMA standards.
2. Have front-face mounted LED indicators to indicate the "On" condition of both the Input and Output circuits.
3. Use replaceable "cube" type circuitry or encapsulated discrete component construction. No unencapsulated discrete component constructions are acceptable.

#### B. Time Clock Switches

Where shown on the Plans, provide time clock switches of solid state circuitry, continuous duty, with a 7-day cycle clock operating from the 120-volt AC service line. Provide switching for a minimum of one independent output and ensure the time of day selection is adjustable to within 1 minute of the desired time. Provide a battery backup system that can maintain time keeping and memory a minimum of 24 hours after power interruption. Furnish an omitting device as an integral part of the time switch to allow the switching operation to be skipped for any preselected day or days of the week. The time clock shall automatically compensate for daylight savings time changes. When the time clock is supplied as an internal component of the controller,