

Time Synchronization Equipment



The Time Synchronization Equipment receives the date and time from the Global Positioning System (GPS) and distributes a time strobe pulse to sync pulsed stations.

OVERVIEW

The Global Positioning System (GPS) is the source of the time and time strobe pulse. A Master TimeKeeper (MTK) workstation maintains the time source and distributes an accurate time strobe pulse to control stations on the application network. The MTK workstation, using the Foxboro Evo™ Control Network (the control network), informs the distributed control and other stations what the time will be when the station receives the next time strobe. The hardware modules can be used in a nonredundant or redundant time strobe network.

The hardware modules are:

- ▶ GPS Antenna/Receiver
- ▶ Time Strobe Generator (PCI card)
- ▶ MTK modem
- ▶ Time Strobe Converter (TSC) (with single-mode or multi-mode fiber optic cable inputs)
- ▶ GPS Fiber Optic Isolator (optional)
- ▶ Time Strobe extender (optional - with single-mode or multi-mode fiber optic cable outputs).

FEATURES

Key features of the Time Synchronization Equipment are:

- ▶ Synchronizes Master TimeKeeper (MTK) workstation to Global Positioning System (GPS) time
- ▶ MTK sends “time at the next pulse” message via the control network every minute
- ▶ Time strobe network distributes the time strobe pulse to control processors and other communications modules
- ▶ Field Control Processors (FCP280 and FCP270) and Z-module Control Processors (ZCP270) receive the time strobe and “time at the next pulse” message
- ▶ Fieldbus Communications Module (FCM100Et) receives current time of day message from the ZCP270 and time strobe from a Time Strobe Converter, and then calculates the time at next time strobe
- ▶ Synchronizes concurrent events for every Transient Data Recorder and Analysis (TDR/TDA) and Sequence of Events (SOE) Fieldbus Module (FBM) to within a 1-3 ms time difference depending on your configuration. Refer to the section on “Timestamp Accuracy and Precision of SOE Data” in *Time Synchronization User's Guide* (B0700AQ).
- ▶ Selected control stations can be synchronized in a Foxboro Evo system
- ▶ Time strobe network can be installed as a single or redundant network.

GPS ANTENNA/RECEIVER

The source of the time strobe signal are GPS satellites from which the GPS antenna/receiver (Figure 1) obtains the time information.



Figure 1. GPS Antenna/Receiver

The GPS receiver uses an omni-directional antenna to obtain synchronized pulses from multiple satellites to determine time and position. The GPS receiver decodes the time signals simultaneously from up to 8 GPS satellites (minimum of 4 satellites). The GPS antenna/receiver are housed in a single unit and have to be mounted outdoors with an unobstructed view of the sky.

TIME STROBE GENERATOR

The Time Strobe Generator is a PCI card (Figure 2) that resides in the MTK workstation. It receives the antenna system's output, provides time data to the workstation and passes a time strobe to the MTK modem. Time is obtained and distributed in Coordinated Universal Time (UTC) format. Therefore, the same time (and date) is received in every part of the control network, regardless of the local time zone.

The PCI card (Time Strobe Generator) can maintain the stream of time strobe signals even if it does not receive signals from the GPS antenna system. It reverts to a highly accurate (2×10^{-7}) internal clock if the GPS signals are not available.



Figure 2. Time Strobe Generator (PCI Card)

MASTER TIMEKEEPER MODEM

The Time Strobe Generator generates and transmits a periodic time pulse using RS-422 signal levels. The Master TimeKeeper Modem (MTK modem) passes the signals between the GPS antenna and the Time Strobe Generator (PCI card). The time strobe pulse is converted to fiber optic signals via the MTK modem. Time Strobe signals are connected to the Time Strobe Converter located in an enclosure or to the optional Time Strobe extender for transmission throughout the plant locations.

Fiber optic cable is used for the transmission of the time strobe signals from the MTK modem to the Time Strobe Converter (TSC) modules or Time Strobe extenders, or between TSC modules.

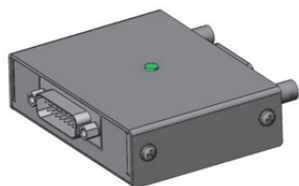


Figure 3. Master TimeKeeper Modem

TIME STROBE CONVERTER

The Time Strobe Converter (TSC) provides the conversion of the accurate time strobe pulse from a Master TimeKeeper station to the controller stations. The TSC module transforms the time strobe signal from a fiber optic cable to eight RS-422 differential output signals.

The TSC module (Figure 4) can be mounted on a DIN rail or tray within an enclosure containing the controller stations. A non-redundant MTK system can have a single TSC module to provide time strobe signals for up to eight control stations/baseplates within a single enclosure.

Two types of TSCs are available. One accepts multi-mode fiber optic (MMF) inputs for connections from the MTK modem or an MMF-compatible extender, with cable lengths of up to 2 km (6562 ft) per segment. The second type accepts single-mode fiber optic (SMF) inputs for connections from a SMF-compatible extender, with cable lengths of up to 10 km (6.2 mi) per segment. The latter is optimal for an expansive plant, where time is needed to be distributed to small clusters apart from the central control room.

Both types of TSCs also provide a multi-mode fiber optic (MMF) output for continuation of the time strobe signal, if needed, to the next MMF-compatible TSC module or MMF-compatible Time Strobe extender.

Up to fifty (50) TSCs can be interconnected using the same power supply connections. However, additional TSCs can be linked together to communicate with one another.

Time strobes can be selectively connected to any FCP280, FCP270, FCM100Et, or ZCP270 in the system. TDR/TDA and SOE FBMs receiving concurrent time messages from an FCP280, FCP270, or FCM100Et are synchronized to within a 1-3 ms time difference depending on your configuration. For more information, refer to the section on "Timestamp Accuracy and Precision of SOE Data" in *Time Synchronization User's Guide* (B0700AQ).

NOTE

AC signals coming into SOE points cannot be synchronized to 1 millisecond in the same manner as DC based points can. The AC SOE points will have a delay of ~8-20 milli-

second due to the 50 or 60 Hz AC wave form. If 1 millisecond synchronization is vital when time synchronization is needed, avoid the use of AC inputs. For more information on collecting SOE data from ac signals, refer to the section on “Timestamp Accuracy and Precision of SOE Data” in *Time Synchronization User's Guide* (B0700AQ).

In a system with ZCP270s, both the ZCP270 and its associated FCM100Es have to receive a time strobe signal.

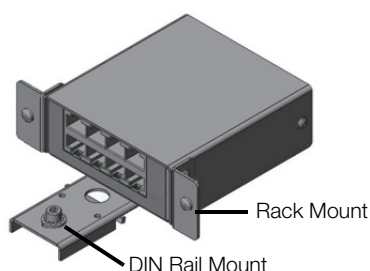


Figure 4. Time Strobe Converter (TSC)

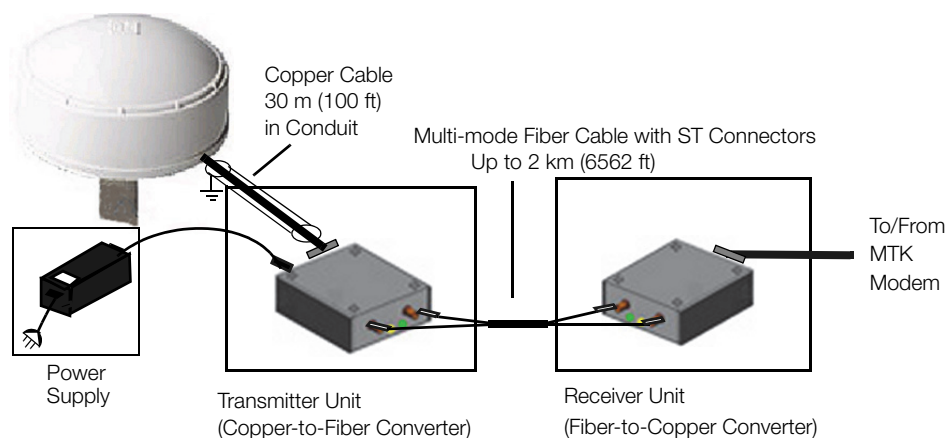


Figure 5. GPS Fiber Optic Isolator (Optional)

GPS FIBER OPTIC ISOLATOR (OPTIONAL)

Fiber optic transmission extends the distance of the MTK host computer to the GPS antenna (see Figure 5) up to 2 km (6562 ft). This hardware provides electrical isolation in addition to extending the cabling distance. A Transmitter Unit (copper-to-fiber converter) and a Receiver Unit (fiber-to-copper converter), at the MTK host computer end, converts the signals to its native electrical signals. A 12 V dc source of power is provided by the Power Supply to the GPS antenna. The optional GPS Fiber Optic Isolator modules are shelf- or enclosure-mounted. When using the GPS Fiber Optic Isolator, the cable from the antenna/receiver has to be run in grounded conduit.

TIME STROBE EXTENDER (OPTIONAL)



Figure 6. MMF Time Strobe Extender (Optional)

Two types of optional 7-port Time Strobe extenders (Figure 6) are available for distributing the time strobe signal. The MMF-compatible extender receives the GPS time pulse from the MTK modem or other TSCs or from other MMF extenders, and distributes it to enclosures containing MMF-compatible TSCs, or to other MMF-compatible extenders.

The SMF-compatible extender receives the GPS time pulse from the MTK modem or from MMF extenders and distributes it to up to six SMF-compatible TSCs. This extender has one MMF-compatible input port and six SMF-compatible output ports.

Depending on the choice of extender, the Time Strobe extenders use either single-mode or multi-mode fiber optic output cables to send their long distance transmission to the enclosures in various plant locations, which house the controller stations. MMF cable supports lengths of up to 2 km (6562 ft) per segment, while SMF cable supports lengths of up to 10 km (6.2 mi) per segment.

One Time Strobe extender can distribute the time strobe signal to up to six TSCs. The Time Strobe extenders can be daisy-chained allowing distribution of the time strobe throughout the entire plant.

REDUNDANT TIME SYNCHRONIZATION SYSTEMS

In redundant Time Synchronization systems (see Figure 7), two Master TimeKeeper workstations are needed, primary and backup (optional redundant MTK functionality), each providing their time strobe signals to the controller modules. Two GPS antenna/receivers, Time Strobe Generator PCI cards, MTK modems, and TSC modules are used for connecting controller stations to primary and backup MTK stations. In a redundant time strobe distribution system, any module can be removed without affecting the other path of the time strobe signal to the controller stations. Each module can be withdrawn/replaced while the remainder of the system is under power.

FOR MORE INFORMATION

For additional information describing the Time Synchronization system, refer to the *Time Synchronization Overview Product Specification* (PSS 31H-1TIME).

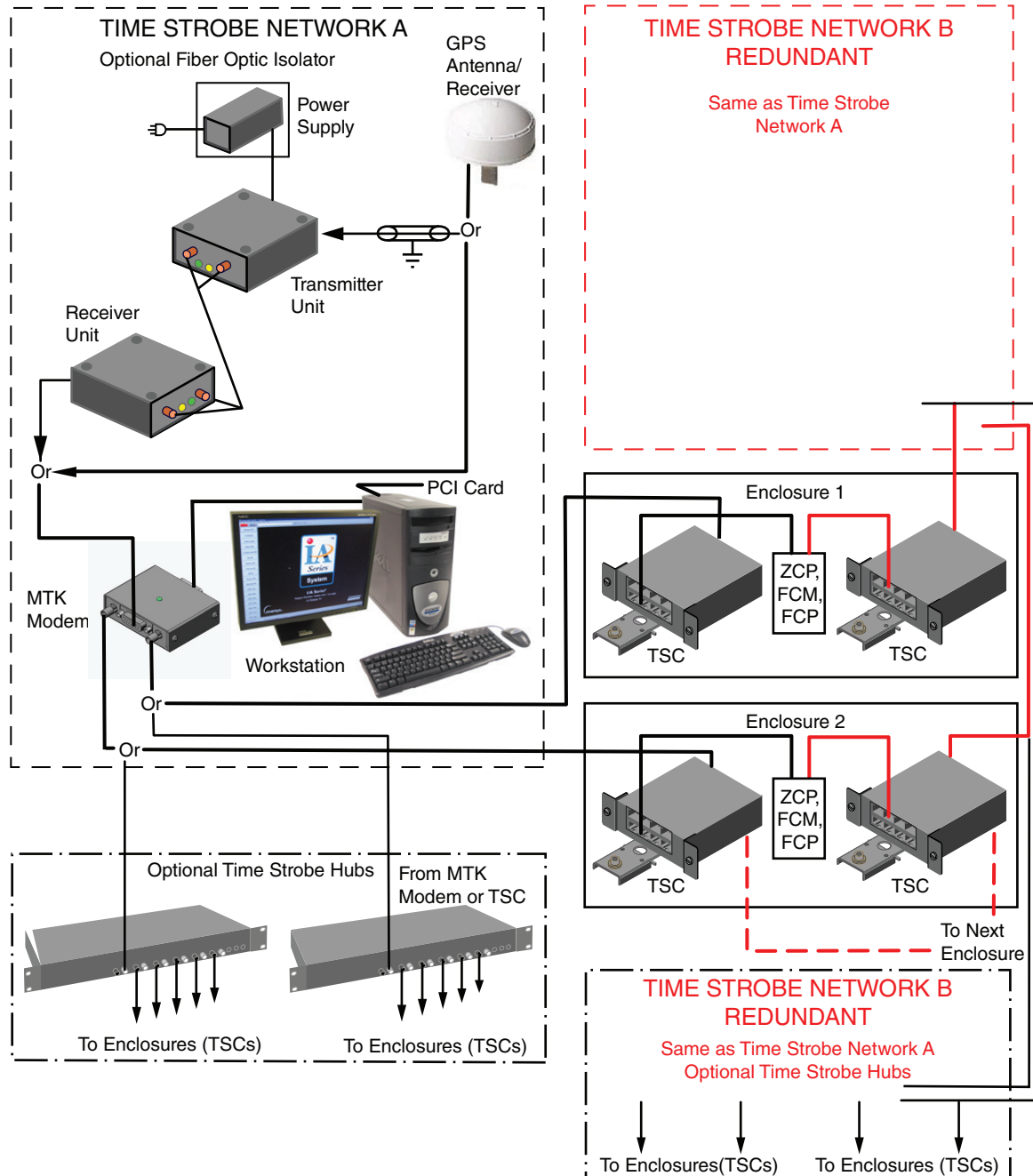


Figure 7. Time Strobe Network Equipment (Redundant)

GPS ANTENNA/RECEIVER

FUNCTIONAL SPECIFICATIONS

Number of Satellites

Up to 8

Acquisition Time (cold start)

5 minutes typical, 15 minutes maximum

Re-acquisition Time

Less than 1 minute at the same physical location unless the antenna is powered down for longer than 14 days. After 14 days, it behaves as a cold start.

Frequency

1575 MHz (receive only)

Sync to UTC

Within ± 1.0 μ s maximum (antenna in stationary position).

IRIG-B Output

CODE FORMAT

IRIG-B (B122)

AMPLITUDE (MARK)

2.6 V p-p (type)

MODULATION RATIO

3:1

OUTPUT IMPEDANCE

600 ohms

Time Output

OUTPUT

RS-422 strobe compatible

WAVE SHAPE

Pulse

PULSE WIDTH

1 ms (also, see Note in "MASTER TIMEKEEPER MODEM" on page 3)

PULSE POLARITY

Negative

SQUARE WAVE

45 to 55%

TIMING

Falling edge on-time pulse

RANGE

65.53 s to 2 ms (500 Hz to 0.0152543 Hz)

POWER-ON DEFAULT RATE

1 pps

Power Requirements

INPUT VOLTAGE RANGE

12 V dc +5%, -10%

ENVIRONMENTAL SPECIFICATIONS

Operating Conditions

TEMPERATURE

-30 to +70°C (-22 to +158°F)

Storage Conditions

TEMPERATURE

-55 to +100°C (-67 to +212°F)

Altitude

0 m to +18000 m (0 to 59,005 ft)

Salt Fog

MIL-STD-202F, Method 101D, Condition B

Water Resistant

Submersion to 1 m (39 in)

GPS ANTENNA/RECEIVER (CONTINUED)

PHYSICAL SPECIFICATIONS

Mounting (Pole Mount)

1.00 in I.D., 14 turns/inch straight thread (not tapered)

Dimensions - Nominal

DIAMETER

147 mm (5.8 in)

HEIGHT

100 mm (3.9 in)

Weight - Approximate

475 g (16.5 oz)

Antenna Cable

TYPE

Copper

LENGTH

30.5 m ± 0.2m (100 ft ± 8 in)

CABLE SIZE

9mm (0.35 in) O.D.

CABLE TO OPTIONAL TRANSMITTER UNIT

Cable from antenna has to be installed in grounded conduit when a Fiber Optic Isolator is used

CONNECTOR SIZE

Antenna End

12-pin round connector, 20 mm (0.79 in) O.D. to antenna

MTK Modem or Optional Transmitter Unit End

DB-15 connector, 46 mm (1.80 in) O.D.

TIME STROBE CONVERTER (TSC)

FUNCTIONAL SPECIFICATIONS

Outputs

ELECTRICAL SIGNAL CHARACTERISTICS

RS-422

NUMBER

8

PROTECTION

Surge protected

Inputs

MULTI-MODE FIBER COMPATIBLE TSC (FROM MTK, MMF-COMPATIBLE EXTENDER OR ANOTHER TSC)

One 62.5/125 micron, simplex multi-mode Fiber
Optic input

SINGLE-MODE FIBER COMPATIBLE TSC (FROM SMF-COMPATIBLE EXTENDER)

One 9/125 micron, simplex single-mode Fiber
Optic input

Output Ports

One 62.5/125 micron, simplex multi-mode Fiber
Optic output

Propagation Delay

TSC

1 μ s per TSC

FIBER CABLE

5 μ s per km

Power Requirements

INPUT VOLTAGE RANGE

21 to 42 V dc

INPUT POWER TERMINAL BLOCKS

2: one for power input, one for power output to
next TSC within same enclosure

CONSUMPTION

3.3 W at 24 V dc with each of the 8 outputs used
4.1 W at 39 V dc with each of the 8 outputs used

ENVIRONMENTAL SPECIFICATIONS

Operating Conditions

TEMPERATURE

0 to +60°C (32 to +140°F)

RELATIVE HUMIDITY

5 to 95% (noncondensing)

Storage Conditions

TEMPERATURE

-40 to +70°C (-40 to +158°F)

RELATIVE HUMIDITY

5 to 95% (non condensing)

Vibration

5.0 m/s² (0.5 g) from 5 to 200 Hz

Contamination

Class G1 (Mild) as defined in ISA Standard S71.04

TIME STROBE CONVERTER (TSC) (CONTINUED)
PHYSICAL SPECIFICATIONS

Mounting

DIN RAIL

Accommodates multiple DIN styles including 32 mm (1.26 in) and 35 mm (1.38 in)

RACK

19 in rack on a special designed shelf

Dimensions - Nominal

HEIGHT

38 mm (1.5 in)

WIDTH

102 mm (4.0 in)

DEPTH

89 mm (3.5 in)

Weight - Approximate

681 g (1.5 lb)

Indicator

Green is power. Yellow is dual purpose; yellow on is link and yellow flashing is time pulse signal output.

Cables

TYPE

Fiber Optic Cable

Multi-Mode Fiber Compatible TSC

One 62.5/125 micron, simplex multi-mode
Fiber Optic input and output

Single-Mode Fiber Compatible TSC

One 9/125 micron, simplex single-mode
Fiber Optic input

One 62.5/125 micron, simplex multi-mode
Fiber Optic output

Copper Cable

Cat 5 STP cable

CABLE LENGTHS

Input and Output Fiber Cables

Multi-Mode Fiber Optic Cable

3 m to 2 km (10 to 6562 ft)

Greater than 50 m (160 ft); customer
supplied

Single-Mode Fiber Optic Cable

3 m to 10 km (6.2 mi)

Customer-supplied

To Controller/Baseplates (Copper Cables)

0.5 m (1.6 ft) to 3 m (10 ft) within same
enclosure

CONNECTORS

Fiber Optic Input /Output Connectors (2)

One input and one output connector, ST
Type

Copper Strobe Output Connectors (8)

RJ-45

MTK MODEM

FUNCTIONAL SPECIFICATIONS

Input Electrical Signal Characteristics

RS-422

Outputs (to TSC or Extender)

2 outputs for two physical directions of time strobe pulse

Propagation Delay

100 ns

Power Requirements

INPUT VOLTAGE RANGE (FROM WORKSTATION)

12 V dc +5%, -10%

OUTPUT VOLTAGE RANGE (TO ANTENNA)

12 V dc +5%, -10%

CONSUMPTION

1 W

ENVIRONMENTAL SPECIFICATIONS

Operating Conditions

TEMPERATURE

0 to +50°C (-4 to +122°F)

RELATIVE HUMIDITY

5 to 95% (noncondensing)

Storage Conditions

TEMPERATURE

-40 to +70°C (-40 to +158°F)

Storage Conditions (Continued)

RELATIVE HUMIDITY

5 to 95% (noncondensing)

Vibration

5.0 m/s² (0.5 g) from 5 to 200 Hz

Contamination

Class G1 (Mild) as defined in ISA Standard S71.04

PHYSICAL SPECIFICATIONS

Mounting

Free Standing; Shelf or desktop (customer supplied)

Dimensions - Nominal

HEIGHT

26 mm (1.0 in)

WIDTH

64 mm (2.5 in)

DEPTH

58 mm (2.25 in)

Weight - Approximate

Less than 454 g (1 lb)

Connectors

ANTENNA OR FIBER -TO-COPPER RECEIVER TO MTK MODEM

DB-15, male

FIBER OPTIC OUTPUT CONNECTORS (2)

ST Type

Indicator

Dual purpose; yellow on is link and yellow flashing is time pulse signal.

Cables

MTK TO PCI BOARD IN WORKSTATION

Length

0.3 m (1 ft)

Type

15-pin (DB-15) Male Connector

MTK OUTPUTS (2)

Length

3 m to 2 km (10 to 6562 ft)

Type

Single multi-mode fiber, 62.5/125 micron

GPS FIBER OPTIC ISOLATOR (OPTIONAL)

FUNCTIONAL SPECIFICATIONS

Transmitter Unit

INPUT VOLTAGE (FROM POWER SUPPLY)

12 V dc, 600 mA

OUTPUT VOLTAGE (TO ANTENNA)

12 V dc, 600 mA

INPUT THROUGH DB-15 CONNECTOR (FROM ANTENNA)

RS-422 GPS Data and RS-422 1PPS

FIBER OPTIC OUTPUT CONNECTORS (2)

ST Type

MULTIMODE CABLE

Attenuation

Less than 3.85 db/km at 860 nm

Propagation Delay

5 microseconds/km

Receiver Unit

INPUT VOLTAGE RANGE

12 V dc +5%, -10% (from DB-15 connector, which connects to MTK modem)

PROPAGATION DELAY

Total propagation delay is 80 ns plus 6 ns per meter of fiber optic cable

OUTPUT THROUGH DB-15 CONNECTOR

RS-422 GPS Data and RS-422 1PPS

FIBER OPTIC INPUT CONNECTORS (2)

ST Type

Power Supply (for Transmitter Unit)**INPUT VOLTAGE RANGE**

94 to 264 V ac, 50 Hz to 60 Hz

OUTPUT VOLTAGE RANGE

12 V dc, 600 mA

ENVIRONMENTAL SPECIFICATIONS

Operating Conditions

TEMPERATURE

0 to +50°C (-4 to +122°F)

RELATIVE HUMIDITY

5 to 95% (noncondensing)

Storage Conditions

TEMPERATURE

-40 to +70°C (-40 to +158°F)

RELATIVE HUMIDITY

5 to 95% (noncondensing)

Vibration

5.0 m/s² (0.5 g) from 5 to 200 Hz

Contamination

Class G1 (Mild) as defined in ISA Standard S71.04.

Location

Indoors

GPS FIBER OPTIC ISOLATOR (OPTIONAL) (CONTINUED)

PHYSICAL SPECIFICATIONS

Transmitter Unit (Copper-to-Fiber Converter)

INDOOR MOUNTING

Free Standing: Shelf or enclosure (customer supplied)

WEIGHT - APPROXIMATE

460 g (1 lb)

DIMENSIONS - NOMINAL

Height

34 mm (1.3 in)

Width

89 mm (3.5 in)

Depth

115 mm (4.5 in)

CABLE

Length

Up to 2 km (6562 ft) fiber optic cable

Connectors

Input from Antenna

DB-15 Connector (Cable from antenna has to be installed in grounded conduit when a GPS Fiber Optic Isolator is used)

Fiber Optic Output Connectors (2)

ST Type (1PPS and GPS Data)

INDICATORS (2)

Power (green) and Link Monitor/Activity (yellow)

Receiver Unit (Fiber-to-Copper Converter)

INDOOR MOUNTING

Free Standing: Shelf or enclosure (customer supplied)

WEIGHT - APPROXIMATE

460 g (1 lb)

Receiver Unit (Fiber-to-Copper Converter) (Continued)

DIMENSIONS - NOMINAL

Height

26 mm (1.0 in)

Width

89 mm (3.5 in)

Depth

115 mm (4.5 in)

CABLE

Connectors

Output Connector to MTK modem

DB-15 Connector

Fiber Optic Input Connectors (2)

ST Type (1PPS and GPS Data)

Length of Cable to MTK modem

3 m (10 ft)

INDICATORS (2)

Power (green) and Link Monitor/Activity (yellow)

Power Supply (for Transmitter Unit)

INDOOR MOUNTING

Free Standing: Shelf or enclosure (customer supplied)

WEIGHT - APPROXIMATE

460 g (1 lb)

DIMENSIONS - NOMINAL

Height

38 mm (1.5 in)

Width

51 mm (2.0 in)

Depth

102 mm (4.0 in)

CABLE

Length to Power Outlet

2 m (6 ft)

Length from Supply to Transmitter Unit

2 m (6 ft)

7-PORT TIME STROBE EXTENDER (OPTIONAL)

FUNCTIONAL SPECIFICATIONS

Standards Supported

ISO 8802/3, IEEE 802.3, Ethernet 10Base-FL

Power

AC INPUT POWER

100 V ac to 240 V ac

POWER CONSUMPTION

50 to 60 Hz - 8 VA

FUSE

1 A

ENVIRONMENTAL SPECIFICATIONS

Operating Conditions

TEMPERATURE

0 to +50°C (-4 to +122°F)

RELATIVE HUMIDITY

0 to 95% (non condensing)

Storage Conditions

TEMPERATURE

-40 to +70°C (-40 to +158°F)

RELATIVE HUMIDITY

0 to 95% (non condensing)

Vibration

5.0 m/s² (0.5 g) from 5 to 200 Hz

Contamination

Class G1 (Mild) as defined in ISA Standard S71.04.

PHYSICAL SPECIFICATIONS MOUNTING

Free Standing, 19-inch rack, or wall mount

MASS - APPROXIMATE

2.7 kg (6 lb)

DIMENSIONS - NOMINAL

Height

44 mm (1.75 in) or 1U

Width

425 mm (16.8 in)

Depth

190 mm (7.5 in)

CABLE

Length

Multi-Mode Fiber Optic Cable

Up to 2 km (10 to 6562 ft)

Single-Mode Fiber Optic Cable

Up to 10 km (6.2 mi)

Connectors

Fiber Optic Input/Output Connectors - ST

Bayonet Type

INDICATORS

Power OK (green), Power Unavailability (red),

TS Pulse Tx (yellow), Link (yellow)

PART NUMBERS

MMF EXTENDER RH100AM

SMF EXTENDER RH100AN

REGULATORY COMPLIANCE

Regulatory Compliance

ELECTROMAGNETIC COMPATIBILITY (EMC)

European EMC Directive 2014/30/EU

Meets: EN61326-1:2013 Class A Emissions
and Industrial Immunity Levels

ROHS COMPLIANCE

Complies with European RoHS Directive
2011/65/EU.

PRODUCT SAFETY

*Time Strobe Converter, Time Strobe Modem,
and Time Strobe Extender*

North America:

Underwriters Laboratories (UL) listed
for U.S. and Canada for use in Ordinary
Locations

Time Strobe Converter is additionally UL/UL-
C listed as suitable for use in UL/UL-C listed
Class I, Groups A-D; Division 2; temperature
code T4 enclosure based systems when
connected to specified Foxboro Evo
processor modules as described in the
*Standard and Compact 200 Series
Subsystem User's Guide* (B0400FA).

Communications circuits also meet the
requirements for Class 2 as defined in
Article 725 of the National Electrical Code
(NFPA No.70) and Section 16 of the
Canadian Electrical Code (CSA C22.1).
Conditions for use are as specified in the
*Standard and Compact 200 Series
Subsystem User's Guide* (B0400FA).

Time Strobe Converter, Time Strobe Modem,
and Time Strobe Extender are compliant
with the European Low Voltage Directive
2014/35/EU.

Time Strobe Converter is additionally
compliant with the Explosive Atmospheres
(ATEX) Directive 2014/34/EU and are
DEMKO certified as Ex nA IIC T4 for use in
certified Zone 2 enclosure when connected
to specified Foxboro Evo processor modules
as described in the *Standard and Compact
200 Series Subsystem User's Guide*
(B0400FA).



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