NC Electric Cooperatives

Your Touchstone Energy® Cooperatives

Metering, Telemetry, and Curtailment Requirements for Distributed Energy Resources

4/29/2020

Contents

Disclaimer

The requirements set out in this standard are revised from time to time to reflect changes in technology, regulation, and business practices. As such, the requirements for a Seller's particular project will be memorialized in one of the following two ways:

(1) Where the requirements for a Seller's particular project have been identified and agreed to prior to execution of the Seller's Power Purchase Agreement (PPA), the requirements for the particular project will be incorporated into the PPA, via an exhibit to the PPA.

(2) Where the requirements for a Seller's particular project cannot be identified prior to execution of the Seller's PPA, this standard, including this disclaimer, will be attached as a placeholder exhibit to the PPA; NCEMC and Seller shall thereafter work in good faith to execute a letter agreement – in the form set out in Attachment 5 to this standard – that sets out the requirements for the particular project.

Purpose

This document provides North Carolina Electric Membership Corporation (NCEMC)'s requirements for metering, real-time telemetry data, and curtailment for Utility Distributed Energy Resources (UDER) interconnected to the system of a NCEMC Member. These requirements refer to all UDER regardless of its Qualifying Facility (QF) status and the purchaser of generation from the site. These requirements are in place to ensure the receipt of accurate and timely data for accounting and billing of resources under an executed PPA with NCEMC or NCEMC Member, and real time telemetry data integration into the NCEMC Energy Management System (EMS) and/or Distributed Energy Resources Management System (DERMS) for situational awareness, daily system operations, load modeling, reporting, and forecasting. These requirements are also intended to ensure that proper communications equipment is in place to curtail generation to preserve grid reliability.

Definitions

Interconnection Agreement - The agreement that identifies the conditions under which the Seller's generation system and equipment, will interconnect with, and operate in parallel with the NCEMC Member's electric power system.

Meter – Revenue quality metering equipment that is installed and tested in accordance with applicable American National Standards Institute (ANSI) standards and all applicable regulatory requirements to provide billing information as part of the PPA. This equipment may also be used to provide telemetry data.

Non-Utility DER – DERs that offset customer load, including residential, commercial, and industrial customers, limited to no more than 50 kW.

Point of Delivery - Point(s) on the Transmission Provider's System where capacity and energy transmitted by the Transmission Provider is delivered to the NCEMC Member.

Point of Interconnection – The point where the Seller's facilities connect with the NCEMC Member's electric power system as outlined in the applicable Interconnection Agreement.

Power Purchase Agreement (PPA) – The agreement that identifies the terms and conditions under which the Seller will sell the output of the generation system to NCEMC or an NCEMC Member.

Qualifying Facility (QF) – A generator or generation system that meets the requirements of the Public Utility Regulatory Policies Act (PURPA) for certification as a QF.

Seller – Any party that has entered into a Power Purchase Agreement with NCEMC or an NCEMC Member to sell the output of the UDER.

Utility DER – DERs that either:

- Directly connect to, or closely connected to, the distribution bus or connected to the distribution bus through a dedicated, non-load serving feeder;
- DER that offset customer load, but greater than 50 kW;
- Community DERs that do not serve any load directly but are interconnected to a single-phase or three phase distribution load serving feeder.

General Requirements

- A Meter shall be installed at the Point of Interconnection as shown in the diagrams below.
- NCEMC's purchase of energy (generation) under the PPA and the NCEMC Member's retail sales of energy (site auxiliary load) to the UDER may be metered separately.
- Locations with multiple generators operating under separate PPAs at a single Point of Interconnection will require separate metering for each PPA.

Method 1

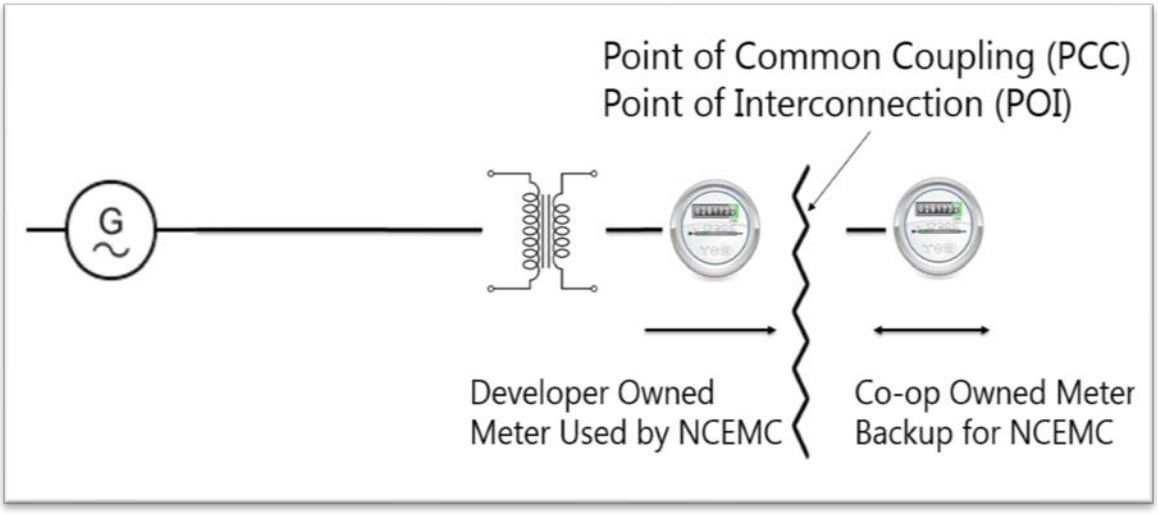


Figure 1 – Seller Owned Meter

Method 2

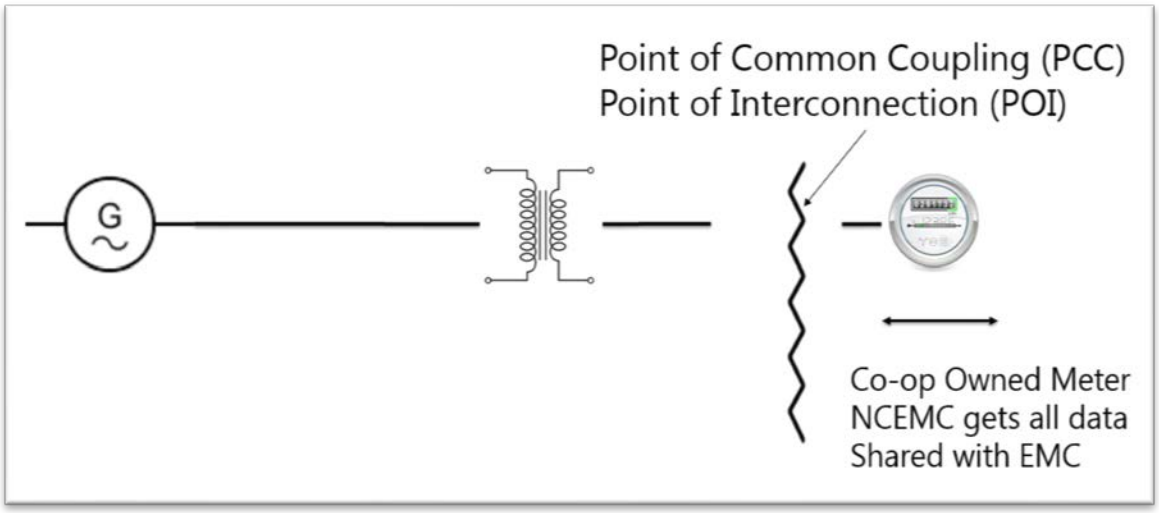


Figure 2 – Co-op Owned Single Meter Configuration

Method 3

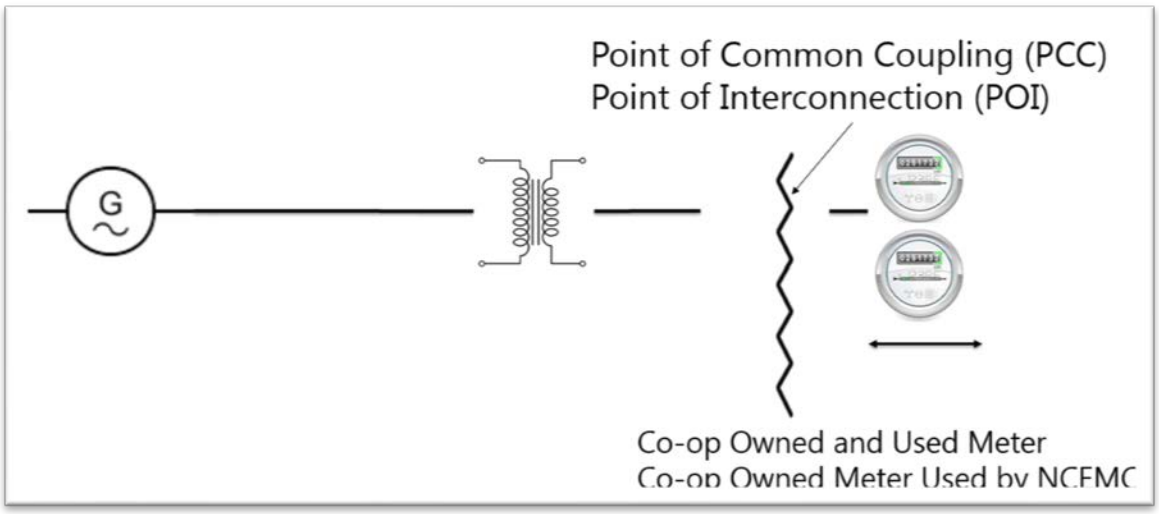


Figure 3 – Co-op Owned Dual Meter Configuration

Meters installed on the low-side of the transformer will have a compensation value programmed in the meter to account for the transformer losses. All metering PT/CTs installed shall be revenue grade with an accuracy class of 0.3% or better.

Project Specific Requirements

The following requirements assume the Seller will own, install, and maintain the Meter. The Seller may arrange for NCEMC's Member instead own, install and maintain the Meter, but in such circumstances, these requirements remain applicable.

Metering and Real-Time Telemetry Data Requirements

1. Seller will install an MV-90 compatible Meter to be used by NCEMC for accounting and billing purposes where NCEMC has the PPA. Attachment 4 contains a list of acceptable meters that is not all inclusive. To satisfy this metering requirement, NCEMC recommends the following based on the UDER size:

UDER Size	Recommended Meter	Notes
< 250 kW	• Aclara kV2C • Elster A3RAL	None
≥ 250 kW	• SEL - 735	Enables delivery of billing and real-time data from a single meter, while also meeting power quality monitoring requirements

The Meter shall be installed so that generation from the site is shown as positive kW on the real-time telemetry at the point of interconnection defined in the Interconnection Agreement between the NCEMC Member and the Seller. Any Metering PT/CTs that are installed to meter the output of the site shall be revenue grade with an accuracy class of 0.3% or better. In the case that metering equipment is installed on the low side of the step-up transformer, compensation to reflect the losses associated with the transformer shall be programmed into the meter.

2. The Generating Facility must support Modbus and DNP 3.0 protocols for the purpose of exchanging real-time telemetry (kW & kVAR) information and responding to curtailment commands. Based on the UDER size, NCEMC recommends the following methods of satisfying this requirement:

UDER Size	Telemetry Requirement		Curtailment Requirement	
	Accepted	**Preferred**	**Accepted**	**Preferred**
< 250 kW	• NCEMC Member SCADA • UDER Source (Inverter, etc.) • Seller supplied meter	• UDER Source (Inverter, etc.)	• NCEMC Member Recloser • UDER Source (Inverter, etc.)	• UDER Source (Inverter, etc.)
≥ 250 kW	• SEL – 735		• UDER Device (Inverter)	

3. Seller will make the following data available to NCEMC through a dedicated Ethernet connection:
    a. MV-90 protocol will be utilized by NCEMC for interrogation of the meter on site for billing purposes (kWh). The Meter will be programmed for Eastern Standard Time.
    b. DNP 3.0 protocol to be utilized by NCEMC for real-time data transmittal (kW & kVAR).
4. Seller will procure a Hoffman A30H2412GQRLP fiberglass cabinet ("NCEMC Communication Cabinet") and A30P24 Subpanel. The Seller may propose an alternative box to NCEMC for consideration; this box shall be similar in size, construction, material, include a subpanel, and offer ability to be secured with a padlock.
5. Seller will install the NCEMC Communication Cabinet, including a 2' x 2' ground pad[1] in front of the Cabinet connected to earth ground, either directly to a Seller owned pole located outside of the solar fence or mounted flush outside the fence around the project site in accordance with Attachment 2. The Subpanel shall be installed inside the NCEMC Communication Cabinet and grounded to the NCEMC Communication Cabinet ground.
6. Seller shall provide NCEMC unrestricted access to the NCEMC Communication Cabinet to monitor, maintain, and replace equipment in the NCEMC Communication Cabinet as necessary. Seller shall coordinate with NCEMC for final location of the NCEMC Communication Cabinet prior to installation.
7. Seller will install conduits to the NCEMC Communication Cabinet as outlined in Attachment 1:
    a. One 1-1/2" conduit from the location of Seller's station service to the NCEMC Communication Cabinet.
    b. One 2" conduit from the Meter to the NCEMC Communication.
8. Seller will provide NCEMC with a 120V power circuit via the 1-1/2" conduit, terminating at a junction box with two outlet receptacles inside the NCEMC Communication Cabinet. The junction box should be mounted near the bottom right corner attached to the Subpanel.
9. Seller will install a fiber optic cable with a minimum of six strands inside the 2" conduit from the meter to the NCEMC Communication Cabinet. Seller will install ST connectors at both ends of the fiber optic cable. NCEMC typically uses a 62.5 multimode fiber with ST connects.
10. Seller will procure two fiber converters and two Mean Well DR-45-24 power supplies in accordance with Attachment 3.
11. Seller will install one fiber converter and power supply inside the NCEMC Communication Cabinet and one fiber converter and power supply at the location where billing and real-time data is transmitted. The fiber converter at the Meter will need 120V power and need to be installed in a NEMA 4X enclosure.
12. NCEMC will procure, install and maintain communications equipment necessary to transmit and receive billing and real-time data from the site to NCEMC's office as outlined in Attachment 1.

[1] NCEMC recommends a HIDEK type 11407 grounding mats

13. Seller will complete the Metering and Real-Time Data Specification form in Attachment 6 and send it to NCEMC upon installation and programming of the Meter and real-time data equipment. Seller shall change the default password to meet National Institute of Standards and Technology (NIST) standards, due to billing system limitations the password needs to be 8 characters or less.
14. Seller is required to have a 3rd party perform and certify a calibration on the meter(s) required by the PPA and send NCEMC the calibration test report upon commissioning. Seller is required to send NCEMC datasheets showing the accuracy class of installed metering equipment. In the event that metering is done on the Seller side of the transformer, Seller shall provide NCEMC with the transformer datasheet so that the compensation for losses associated with the transformer can be verified in the meter.
15. Upon commissioning, ownership and maintenance of the NCEMC Communication Cabinet and fiber converter, and power supply inside the NCEMC Communication Cabinet will be transferred to NCEMC. All other equipment, cabling, and wiring necessary to fulfill the above requirements will be maintained in good working order and repaired or replaced as necessary by the Seller.

Transmission Provider Requirements

NCEMC's Transmission Provider may have additional requirements including but not limited to coordination of protective relay equipment, installation of a Transmission Provider owned meter or relaying components or reprogramming the Point of Delivery meter to register reverse power flow.

NCEMC may be required to enter into agreements with Duke Energy Carolinas, Duke Energy Progress, or Dominion/PJM for the purposes of installing and maintaining metering, relay protection, and other requirements to meet their Facility Interconnection Requirement (FIR) or Open Access Transmission Tariff (OATT).

Project Costs

The Seller will be responsible for any costs associated with requirements as specified in this document and or the project specific letter agreement. NCEMC's monthly administrative charge from the PPA is used to cover its ongoing costs, including maintenance of the NCEMC Communication Cabinet and communications circuit from the site to NCEMC.

Upon completion of the communications equipment installation, NCEMC will invoice the Seller for the actual cost of the labor and materials necessary to fulfill these requirements. The Seller shall reimburse NCEMC by remitting payment of the invoice in accordance to the terms outlined on the invoice.

Should NCEMC incur any costs, either as a one-time or recurring charge from its Transmission Provider as a result of its requirements, NCEMC and/or its Member will pass these charges along to the Seller. The Seller shall reimburse NCEMC by remitting payment of the invoice in accordance to the terms outlined on the invoice.

Information Timeline

Interconnection Agreement Execution

Upon execution of the Interconnection Agreement with the NCEMC Member, the Seller will furnish the following information to NCEMC:

1. Preliminary Meter information from Attachment 6 (make/model of Meter and what communication ports the meter will contain).
2. Site drawings showing location of NCEMC Communication Cabinet and Meter.
3. Site construction details such as Nameplate AC/DC capacity, Load/Capacity factor, Fixed Racking (azimuth and altitude angle), Inverter (manufacturer, model), Tracker Racking (type, make, model), Modules (# of panels, manufacturer, model, and interconnection voltage.
4. Premise info such as site GPS coordinates and 911 address.
5. Name and contact information (address, email, and phone) of a person in charge who will be NCEMC's point of contact to establish site visit or communications regarding the project.
6. Name and contact information (address, email, and phone) of the person who will be responsible for processing NCEMC's invoices.
7. Name and contact information (address, email, and phone) of a primary and back-up person who will be responsible for resolving operational and/or maintenance issues with equipment and wiring during the term of the PPA.

Upon reviewing the initial information, a site visit may be required to discuss the details of the project. This site visit may be held concurrently with the pre-construction meeting held with the NCEMC Member.

Once NCEMC has sufficient information to determine how the metering data, real-time telemetry data and curtailment signal will be transmitted to and from the associated site equipment, NCEMC will present the Seller's person in charge with a Metering, Telemetry, and Curtailment Requirements letter for review and execution. A draft Metering, Telemetry, and Curtailment Requirements letter is provided in Attachment 5.

Project Construction

Seller will keep NCEMC staff informed of the project progress and coordinate with NCEMC personnel during the installation of the Meter and real-time data equipment to ensure the timely installation of the communication equipment.

Project Commissioning

Receiving Permission To Operate (PTO) is the final step under the Interconnection Agreement with the NCEMC Member and is not the same as fulfillment of your obligations set forth in this document.

General Requirements

1. Seller installs the metering, telemetry, and curtailment equipment as required in this document.
2. NCEMC installs its communications equipment needed to satisfy requirements of this document.
3. NCEMC confirms that Seller has installed the metering and telemetry equipment per the Metering, Telemetry, and Curtailment Requirements letter and notifies the Seller of any deficiencies, if any are noted the Seller will complete any needed corrections.
4. NCEMC configures the telemetry and DERMS systems. Testing of the curtailment functionality will be verified.

Additional Requirements where NCEMC has the PPA

In addition to the General Requirements above, additional the following steps outline the process for the purposes of declaring a Commercial Operation Date (COD) to begin payment under the PPA:

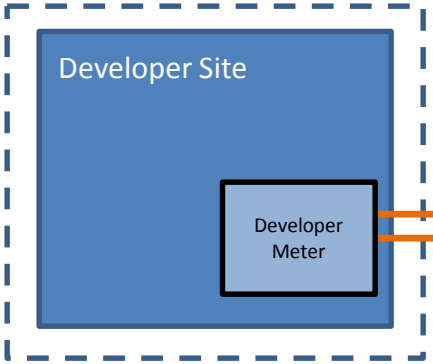
5. Seller correctly programs the meter and provides NCEMC the settings needed to communicate with the Meter. These settings will be documented in the Metering and Real-Time Data Specifications sheet – Attachment 6.
6. If the site metering equipment is installed on the low side of the step-up transformer, NCEMC will verify the meter has been properly programmed to reflect the power losses associated with the transformer.
7. NCEMC configures its billing system and verifies the meter programming based on the Metering and Real-Time Data Specifications sheet.
8. Once these steps have been completed, a COD date will be recommended for payment.
9. Seller and NCEMC or NCEMC Member execute a COD Notice for the PPA.

Revision History

Approval Date	Rev. No.	Description of Change and/or Reason
3/20/15	0	Initial document
7/13/15	1	Add Attachment 3, Telecommunication cabinet typical cost to clarify the costs of the telecommunication cabinet and associated equipment and Attachment 4, Telemetry Diagrams for typical hourly metering and real-time telemetry communication circuit requirements
4/18/16	2	Revise language based on lessons learned, requirement of real-time data, and re-ordered attachment numbers. Addition of pole mounted cabinet to Attachment 2, new Attachment 3 B&B Fiber Converters, Attachment 5 Draft Requirements, and Attachment 6 Meter and Data Specifications. Removed specific telemetry costs Attachment.
1/12/17	2	Eratta change to remove extra meter from Figure 2
7/3/17	3	Added Disclaimer Section
1/22/18	4	Changed from B&B to MOXA fiber converters. Added clarity on load meter in requirement 1, mounting of subpanel in requirement 4, and mounting of the outlet in requirement 7
6/21/2018	5	Added timeline for declaring COD. Clarified that power supply at the meter needs a 120V circuit and NEMA 4X box.
2/4/2019	6	Updated password requirements to state that password needs to be 8 characters or less to work with MV90
3/15/2019	7	Added some clarification to several bullets in the Metering and Telemetry requirements section.
4/16/2019	8	Requirements for low side metering and PT/CT accuracy class added.
5/20/19	9	Added curtailment requirement.
4/23/2020	10	Updated to include all DER per revised Board Policy 335

Attachment 1 – Communications Diagram

Data and Electrical Diagram
Meter Sends Real-Time and Billing Data



NCEMC Comm Cabinet

One, two inch conduits to be installed by the Developer between the Developer Meter and the NCEMC Communications Cabinet to be used as follows:
1) 6 strand fiber (NCEMC typically uses 62.5 multimode fiber with ST connectors):
- RX/TX Meter Register & Real-Time
- RX/TX Spare
- RX/TX Spare

2) One, 1-1/2" conduit to be installed by the Developer between the Developer power source and the NCEMC Communication Cabinet to be terminated with 120 Volt source with 2 outlet receptacle.

3) One, two inch conduit to be installed by the Developer from equipment providing real-time data (if not supplied by the meter)

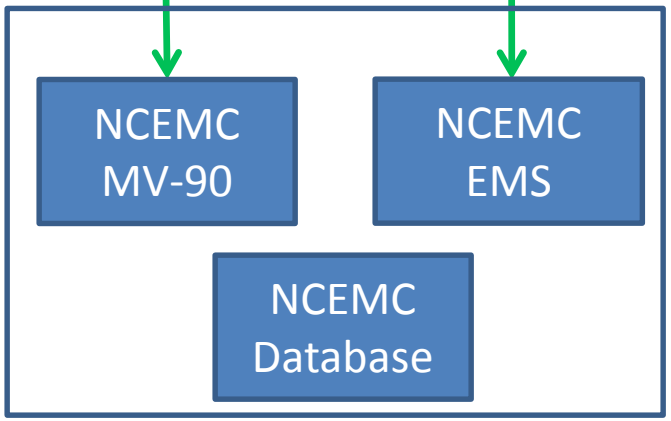
Ownership, set-up, maintenance and monitoring of the data path and associated equipment in the NCEMC Communication Cabinet at the site will be the responsibility of NCEMC. All material and labor costs will be billed to the Developer.

Metering Requirements

1) MV-90 protocol through Ethernet port for billing/register (kWh)
2) DNP 3.0 protocol through Ethernet port for Real-Time data interrogation (kW and kVAR)
3) SEL 735 metering relay preferred
4) Metering will reflect power flow at the point of interconnection as specified in the Interconnection Agreement.

Fiber Data Path

NCEMC Data Path



Optional Web Services connection for Developer

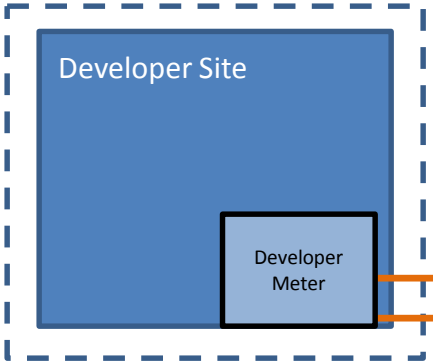
*** NCEMC Communications Cabinet will be located outside of the Solar site fence at an agreed upon location between the meter and the road access point.**

**** The Developer is responsible for installing all necessary conduit, fiber optic cable, fiber converters, and 120 volt power to the NCEMC Communications Cabinet**

***** Maintenance and repair of the meter, conduits, fiber optic cables, and any necessary equipment within the solar site fence for purposes of data communications to NCEMC are the responsibility of the Developer.**

Rev 2 4/15/2016

Data and Electrical Diagram
Real-Time and Billing Data Sent From Multiple Devices



Developer Meter/RTAC

NCEMC Comm Cabinet

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- RX/TX Meter Real-Time
- RX/TX Spare

2) One, 1-1/2" conduit to be installed by the Developer between the Developer power source and the NCEMC Communication Cabinet to be terminated with 120 Volt source with 2 outlet receptacle.

3) One, two inch conduit to be installed by the Developer from equipment providing real-time data (if not supplied by the meter)

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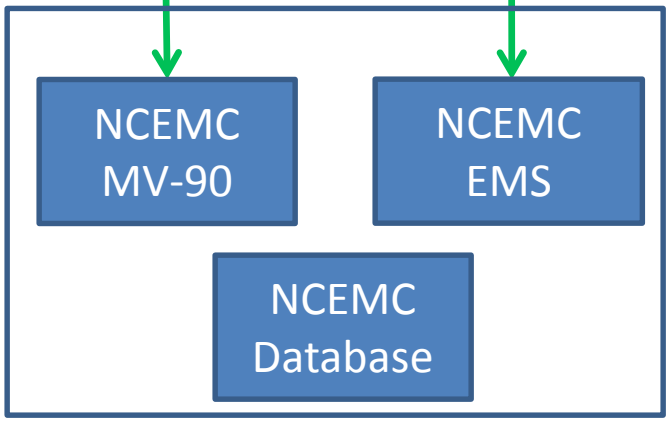
Fiber Data Path

NCEMC Data Path



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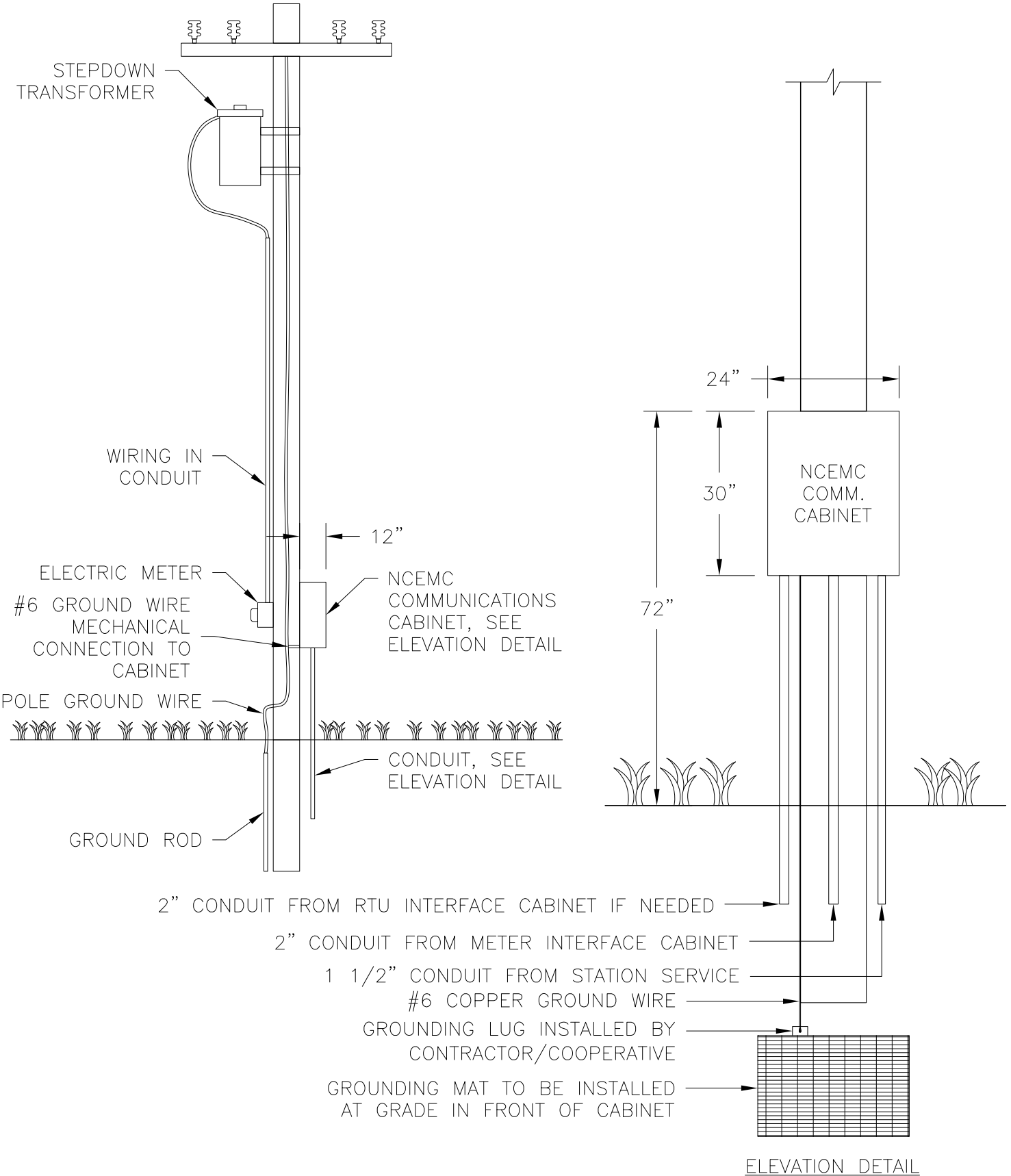
* **NCEMC Communications Cabinet will be located outside of the Solar site fence at an agreed upon location between the meter and the road access point.**

** **The Developer is responsible for installing all necessary conduit, fiber optic cable, fiber converters, and 120 volt power to the NCEMC Communications Cabinet**

*** **Maintenance and repair of the meter, conduits, fiber optic cables, and any necessary equipment within the solar site fence for purposes of data communications to NCEMC are the responsibility of the Developer.**

Rev 2 4/15/2016

Attachment 2 – NCEMC Communication Cabinet Specifications



ELEVATION DETAIL

REV.	DESCRIPTION	INIT	DATE

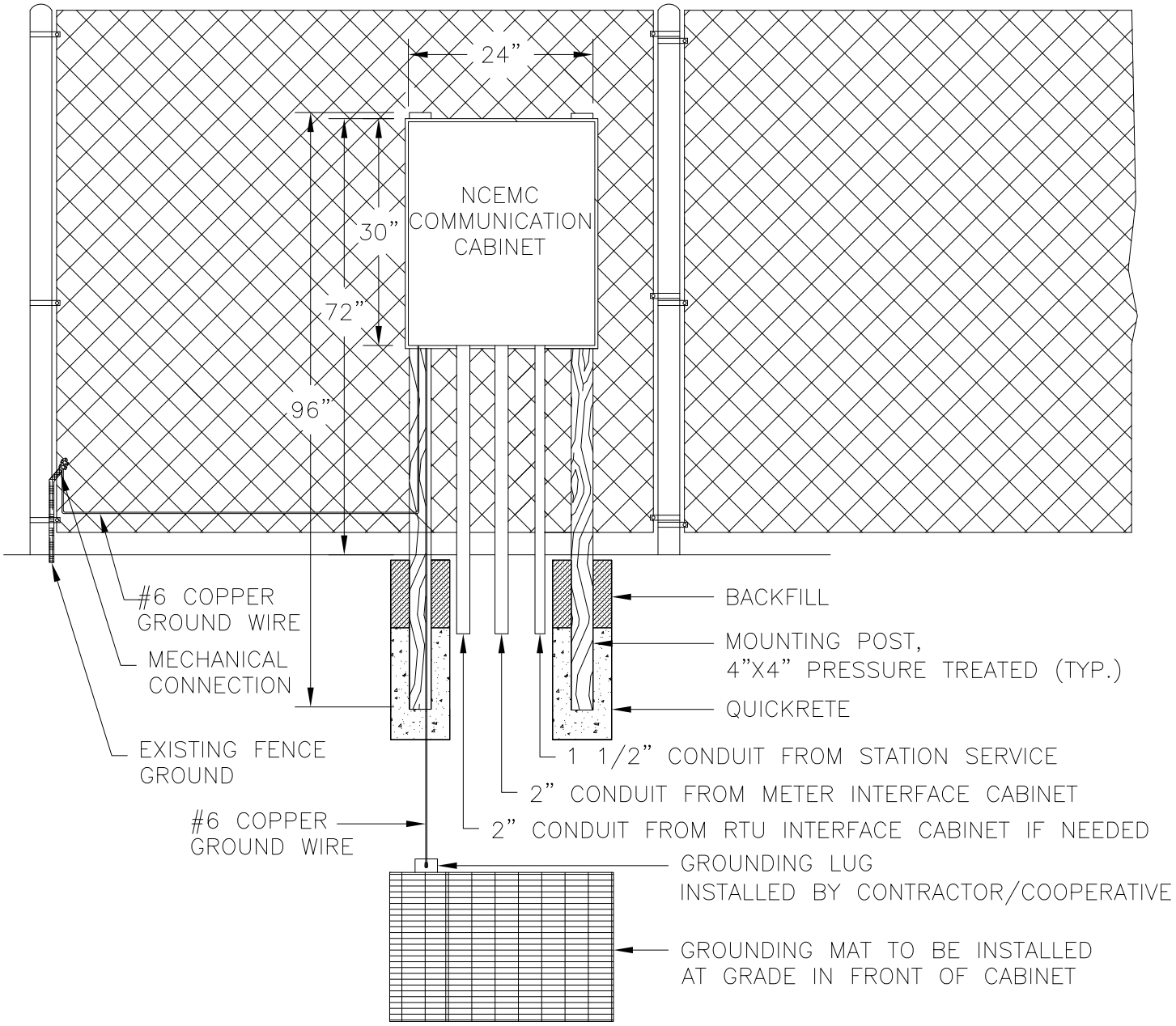
NORTH CAROLINA ELECTRIC MEMBERSHIP CORPORATION

	by	date
DESIGNED		
DRAWN	DJL	2016.04.15
CHECKED		
APPROVED		

TELEMETERING

TYPICAL NCEMC COMMUNICATION CABINET POLE MOUNT INSTALLATION

X:\Power Supply\Power Supply Common\telemetering\NC Power Telemetry Project\Engineering\Cabinet Design CAD files\Communication Cabinet Pole Mount Installation.dwg



NOTES:

1. CABINET SPECIFICATIONS MAY CHANGE FOR NCEMC OWNED METER.
2. CABINET SHALL BE MOUNTED FLUSH OUTSIDE THE FENCE AROUND SUBSTATION/SOLAR PV SITE.

REV.	DESCRIPTION	INIT	DATE

NORTH CAROLINA ELECTRIC MEMBERSHIP CORPORATION

	by	date
DESIGNED		
DRAWN	DJL	2016.04.15
CHECKED		
APPROVED		

TELEMETERING

TYPICAL NCEMC COMMUNICATION CABINET SUBSTATION INSTALLATION

X:\Power Supply\Power Supply Common\telemetering\NC Power Telemetry Project\Engineering\Cabinet Design CAD files\Communication Cabinet Substation Installation.dwg

Attachment 3 –Fiber Converter Specifications

B&B ELECTRONICS

Model FOSTC

RS-232, 422 or 485 Signals Up To 2.5 Miles with Fiber Optic Modem

Description

Fiber optic cabling has inherent resistance to EMI/RFI and transient immunity, making it ideal for industrial and utility data communication applications.

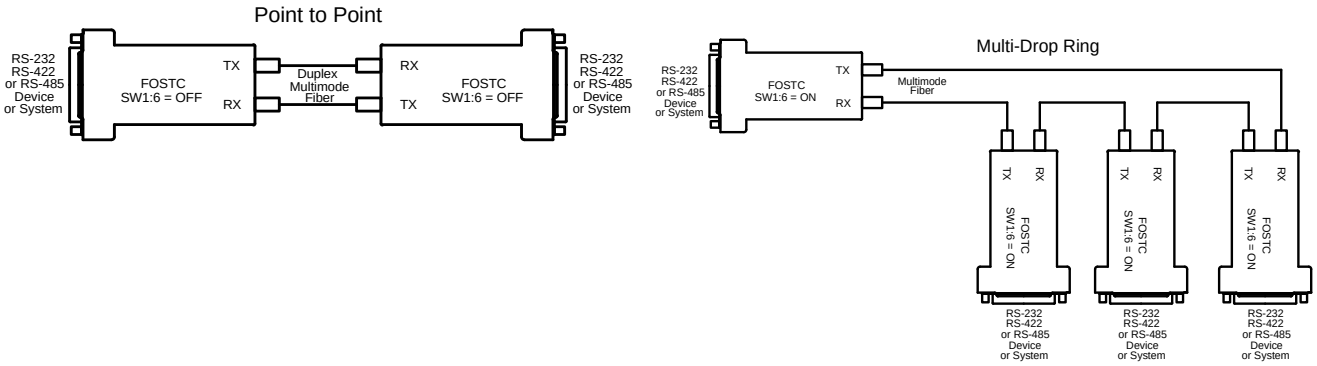
The FOSTC was designed to provide the most versatile connection possible between any asynchronous serial equipment using Fiber Optic cable. The FOSTC can be used for point-to-point communications between serial devices, or in a multi-drop fiber ring configuration, allowing multiple serial devices to communicate with each other.

It allows any two pieces of asynchronous serial equipment to communicate full or half-duplex over two fibers at typical distances up to 2.5 miles (4 km). To extend the distance of the fiber link beyond 2.5 miles, use B&B model FOSTDRP Fiber Optic Repeater.

Features/Applications

- Point-to-point or multi-drop ring configuration
- RS-232, RS-422, or RS-485 operation
- Use as a converter from RS-232 to RS-422/485
- RS-422/485 data rates up to 500 kbps
- RS-485 Automatic Send Data driver control
- Inherent EMI/RFI and transient immunity.
- Eliminate ground loops
- Extend serial signals up to 2.5 miles
- Uses popular ST type fiber connectors
- Standard DB25 female (DCE) for serial connections
- 12VDC powered (separate supply required)

Figure 1: Typical Setups



Fiber Optic Connections

The FOSTC uses a separate LED emitter and photo-detector operating at 820 nm wavelength. Connections to the emitter and detector are on ST type connectors. Almost any multimode glass fiber size can be used including 50/125 μm, 62.5/125 μm, 100/140 μm, and 200 μm. One fiber is required for each connection between a transmitter and receiver. In a point-to-point configuration, two fibers are required between the two modems, one for data in each direction. A multi-drop ring configuration requires one fiber between TX and RX around the loop. See Figure 1 for typical point-to-point and multi-drop configurations.

The most important consideration in planning the fiber optic link is the "power budget" of the fiber modem. This value represents the amount of loss in dB that can be present in the link between the two modems before the units fail to perform properly. This value includes line attenuation as well as connector loss. For the FOSTC the typical connector-

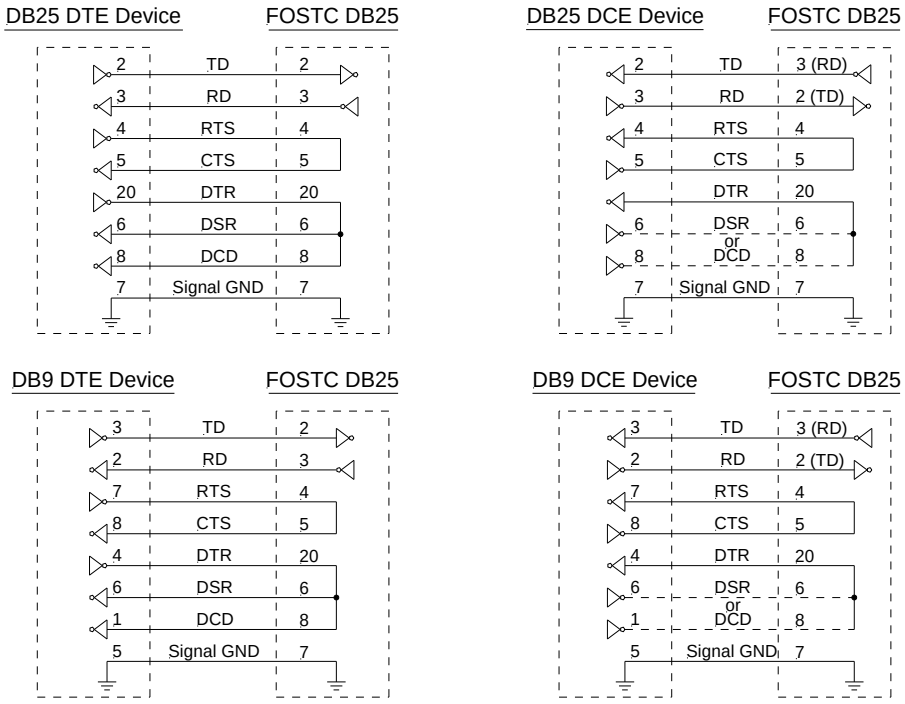
PRODUCT INFORMATION

to-connector power budget is 12.1 dB. Because 62.5/125 μm cable typically has a line attenuation of 3 dB per Km at 820 nm, the 12.1 dB power budget translates into 2.5 miles. This assumes no extra connectors or splices in the link. Each extra connection would typically add 0.5 dB of loss, reducing the possible distance by 166 m (547 ft.). The actual loss should be measured before assuming distances.

RS-232 Connections

Connection of the FOSTC is simple and straightforward. The DB25 female serial connector is used for connecting to either RS-232, RS-422 or RS-485. The RS-232 signals are pinned as a DCE device (input on Pin 2 and output on Pin 3). A straight through cable can be used from your DB25 port on any DTE device such as a PC or terminal. A standard 9 to 25-pin adapter can be used in cases where the serial port on the DTE device is a DB9. A null modem cable or adapter that swaps pins 2 and 3 is needed for connecting to modems or other DCE devices. See Figure 2 for connection diagrams to 9 pin and 25 pin DTE and DCE devices. Because RS-422 and RS-485 signals are also available on the same connector, take special care not to hook any external signals to these pins. This is not a problem for most serial devices, but a custom cable must be made that does not connect to the extra pins on the DB25 connector if your device has power or special non-standard outputs.

Figure 2: RS-232 Connection Diagrams

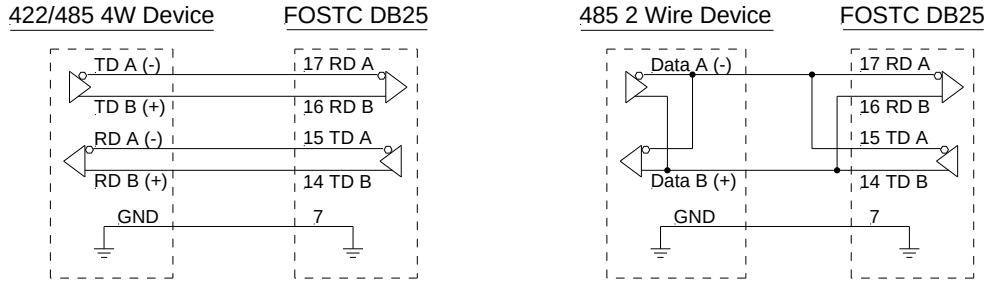


RS-422 & RS-485 Connections

The RS-422/485 driver and receiver are connected to 4 pins on the DB25 connector. Signal ground is on Pin 7. When connecting to a four-wire RS-422/485 device or system, connect the output of your device to pins 16 (B or +) and 17 (A or +). Connect the input to your device to pins 14 (B or +) and 15 (A or -). For two-wire RS-485 systems, the driver and receiver of the FOSTC must be connected together by tying pins 14 and 16 together and 15 and 17 together. This allows the FOSTC to communicate half-duplex over the same pair. Refer to Figure 3 for connection diagrams to your RS-422 or RS-485 equipment.

If termination is needed, a spot on the PCBD of the FOSTC labeled Rt allows you to solder in a termination resistor across the RD(A) and RD(B) lines. Removing R8 and R16 and replacing them with through-hole components can also change the off-state bias resistor values. Before making modifications to the FOSTC, be sure to consult B&B Electronics' free RS-422/485 Application Note or other sources of information to see if termination is necessary. The Application Note is available from our Web site, or call and we will be happy to send you one at no charge.

Figure 3: RS-422/485 Connection Diagrams



Dip-Switch Setup

The Dip-Switch (SW1) on the FOSTC defines the mode of operation when being used for RS-422 or RS-485. Positions 1 through 5 on the switch determine the timeout of the RS-485 driver. Because the driver is controlled by hardware, a specific time must be set to tell the hardware how long to wait for data on the fiber side before turning off the RS-422/485 driver. If this time is set too short, the driver could be disabled before transmission is complete, resulting in data corruption. If the time is set too long, the RS-485 device may respond before the RS-422/485 driver in the FOSTC is disabled, corrupting this response. We recommend that the timeout be set for approximately one character time or longer. The character times for several different baud rates are selectable on switch positions 1 through 5. If you need a different timeout than what is provided, R10 can be removed and replaced with a different value R9. Table 1 shows different timeout values for the switch positions as well as typical R9 replacement values.

Table 1: RS-485 Timeout Selection

Baud Rate	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	R9	Time(ms)
1200	ON	OFF	OFF	OFF	OFF	820 KΩ	8.20
2400	ON	OFF	OFF	OFF	OFF	430 KΩ	4.30
4800	OFF	OFF	OFF	OFF	ON	Not Used	2.20
9600	OFF	OFF	OFF	ON	OFF	Not Used	1.30
19.2K	OFF	OFF	ON	OFF	OFF	Not Used	0.56
38.4K	OFF	ON	OFF	OFF	OFF	Not Used	0.27
57.6K	ON	OFF	OFF	OFF	OFF	Not Used	0.22
76.8K	ON	OFF	ON	ON	OFF	Not Used	0.14
115.2K	ON	ON	ON	OFF	OFF	Not Used	0.10
153.6K	ON	OFF	OFF	OFF	OFF	6.2 KΩ	0.06
230.4K	ON	OFF	OFF	OFF	OFF	4.3 KΩ	0.04
460.8K	ON	OFF	OFF	OFF	OFF	2.2 KΩ	0.02

Position 6 of SW1 sets the unit in a “Multidrop” mode or a “Point-to-Point” mode. When the FOSTC is set in a “Multidrop” mode, data arriving on the Fiber Optic receiver is repeated back out the transmitter. When set in a “Point-to-Point” mode, data arriving at the Fiber optic receiver is not sent back out the Fiber Optic transmitter. Position 6 must be turned “On” when the FOSTC is to be used in a multi-drop ring configuration. It must be turned “Off” when the FOSTC is to be used as either end of a point-to-point communication line. See Figure 3 for typical system setups using the FOSTC in its different modes.

Positions 7 and 8 of SW1 determine when the RS-422/485 driver and receiver are enabled. Position 7 controls the driver and Position 8 controls the receiver. For RS-422 operation, set both switches to the “Off” position. For multi-drop RS-485 four-wire systems, position 7 should be “On” and position 8 should be “Off.” This allows the receiver to be enabled all of the time and eliminates some possible timing problems. For RS-485 two-wire systems, both switches should be in the “On” position. This disables the RS-422/485 receiver whenever the driver is enabled, preventing data from being echoed back to the fiber side of the FOSTC.

Table 2 illustrates the switch settings for typical setups.

Table 2: 422/485 Switch Settings

	Position 7 TX Enable	Position 8 RX Enable
RS-485 2-Wire Mode (half duplex)	ON	ON
RS-485 4-Wire Mode (full duplex)	ON	OFF
RS-422 Mode (full duplex)	OFF	OFF

Multi-Drop Operation

A multi-drop configuration is created by forming a ring of FOSTCs (see Figure 1). Whichever serial device sends data, all other devices receive it. The data is repeated around the fiber ring until it reaches the source, where it is blocked. There is no echo back to the serial side of the sending device. Each fiber transmitter must be connected to the following converter's receiver. Set SW1:6 to the "On" position on all FOSTCs in the ring. Any device can be full-duplex (RS-232, RS-422, or four-wire RS-485), or half duplex RS-485. Because all data shares the same path on the ring, only one device can send data at a time.

Interfacing to Fiber Devices from Other Manufacturers

Note: The factory default for the LED emitter is to have the light ON in the idle state. To interconnect with other devices that have the light OFF in the idle state, this unit would need to be modified. To modify the unit so that the light is OFF in the idle state, contact B&B Electronics Technical Support.

Typical Installation Configuration

Below is a University Campus setup that illustrates the basic configuration of a typical Fiber Optic Network. This scenario uses a combination of B&B Fiber devices including 3 of the FOSTCs, 2 of the fiber repeaters FOSTDRP, and one of the DIN Rail mount Fiber Converters FOSTCDR. Each of the items requires a power supply (not shown).

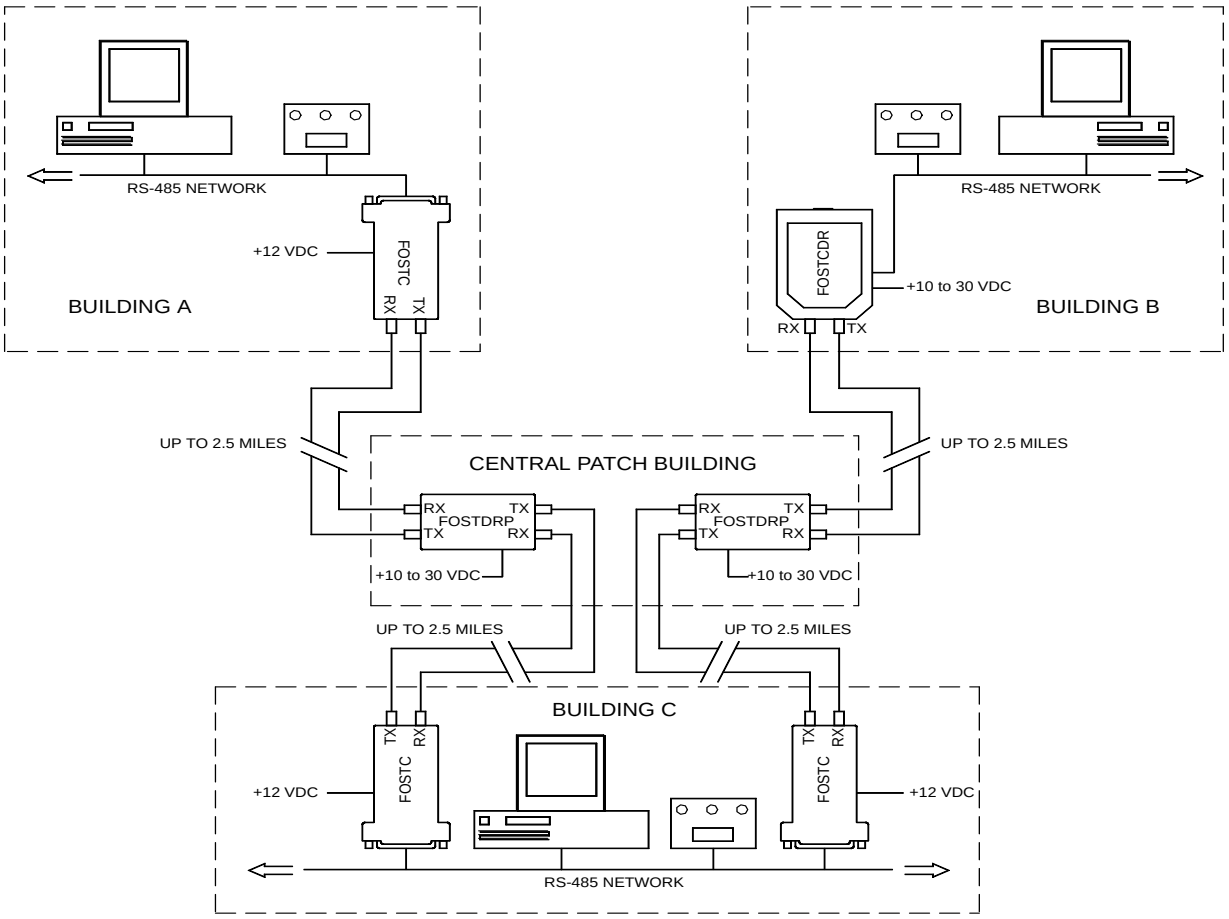


Figure 4. Typical Campus Setup

B&B ELECTRONICS

www.bb-elec.com *orders@bb-elec.com support@bb-elec.com*

International Office: 707 Dayton Road PO Box 1040 Ottawa, IL 61350 USA 815-433-5100 Fax 433-5104
European Office: Westlink Commercial Park Oranmore Co. Galway Ireland +353 91 792444 Fax +353 91 792445

B&B ELECTRONICS

PRODUCT INFORMATION

Specifications/Features

Transmission Line: Dual multimode optical cable
Point-to-Point Transmission: Asynchronous, half or full-duplex
Multi-Drop Transmission: Asynchronous, half duplex fiber ring
Interfaces: RS-232, RS-422, or RS-485
Connectors: DB25 female for serial connection, ST connectors for fiber
Dimensions: 4.3 x 2.3 x 0.95 in (11 x 5.9 x 2.5 cm)
Power Supply Connections: 2.5mm phone jack (Tip Positive) or DB25 pins 25(+) & 12(-)
Recommended Power Supply: B&B Model# 232PS3

All specifications given using 62.5/125µm glass multi-mode fiber.

Parameter	Min.	Typical	Max.	Conditions
Data Rates (RS-232 Operation)	0 bps		115.2 kbps	
Data Rates (RS-422/485 Operation)	0 bps		500 kbps	
Power Supply Voltage	10 VDC	12 VDC	14 VDC	
Power Supply Current Draw			140 mA	Full RS-485 Termination
Optic Wavelength		820 nm		
Fiber TX Launch Power	-17 dBm	-13 dBm	-10 dBm	
Minimum Required Fiber Rx Power		-25.4 dBm	-24 dBm	
Maximum Receiver Power			-10 dBm	
Coupled Power Budget		12.1 dB		
Fiber Range		2.5 Miles		
End to End Delay		2000 ns	2650 ns	Point to Point RS-232 Operation (See Notes 1 & 2)
End to End Delay		550 ns	1000 ns	Point to Point RS-422/485 Operation (See Notes 1 & 2)
End to End Skew		900 ns	1100 ns	Point to Point RS-232 Operation (See Note 3)
End to End Skew		50 ns	120 ns	Point to Point RS-422/485 Operation (See Note 3)
Maximum Total Fiber Ring Length			5 Miles	(See Note 1)
Delay between Rx & Tx on a fiber ring	52 µs			(See Note 4)

Note 1: For the total transmission time over long fibers, the time to transverse the fiber must be considered if delay is an issue. Light takes about 8.05 microseconds to travel over 1 mile of fiber.

Note 2: When operating in a ring configuration, each node in addition to the two in the point-to-point specification adds an additional 100 to 200 nanoseconds of delay.

Note 3: When operating in a ring configuration, each node in addition to the two in the point-to-point specification adds an additional 50 to 70 nanoseconds of skew.

Note 4: When operating in a ring configuration, each serial device must wait at least this minimum time between receiving data from the ring and transmitting back on to it.

Recommended Maximum FOSTCs in a Fiber Ring Topology.

Baud Rate	RS-232 Operation	RS-422/485 Operation
460.8 kbps	N/A	2
230.4 kbps	N/A	4
115.2 kbps	2	8
57.6 kbps	8	16
38.4 kbps	16	24
19.2 kbps and lower	32	32

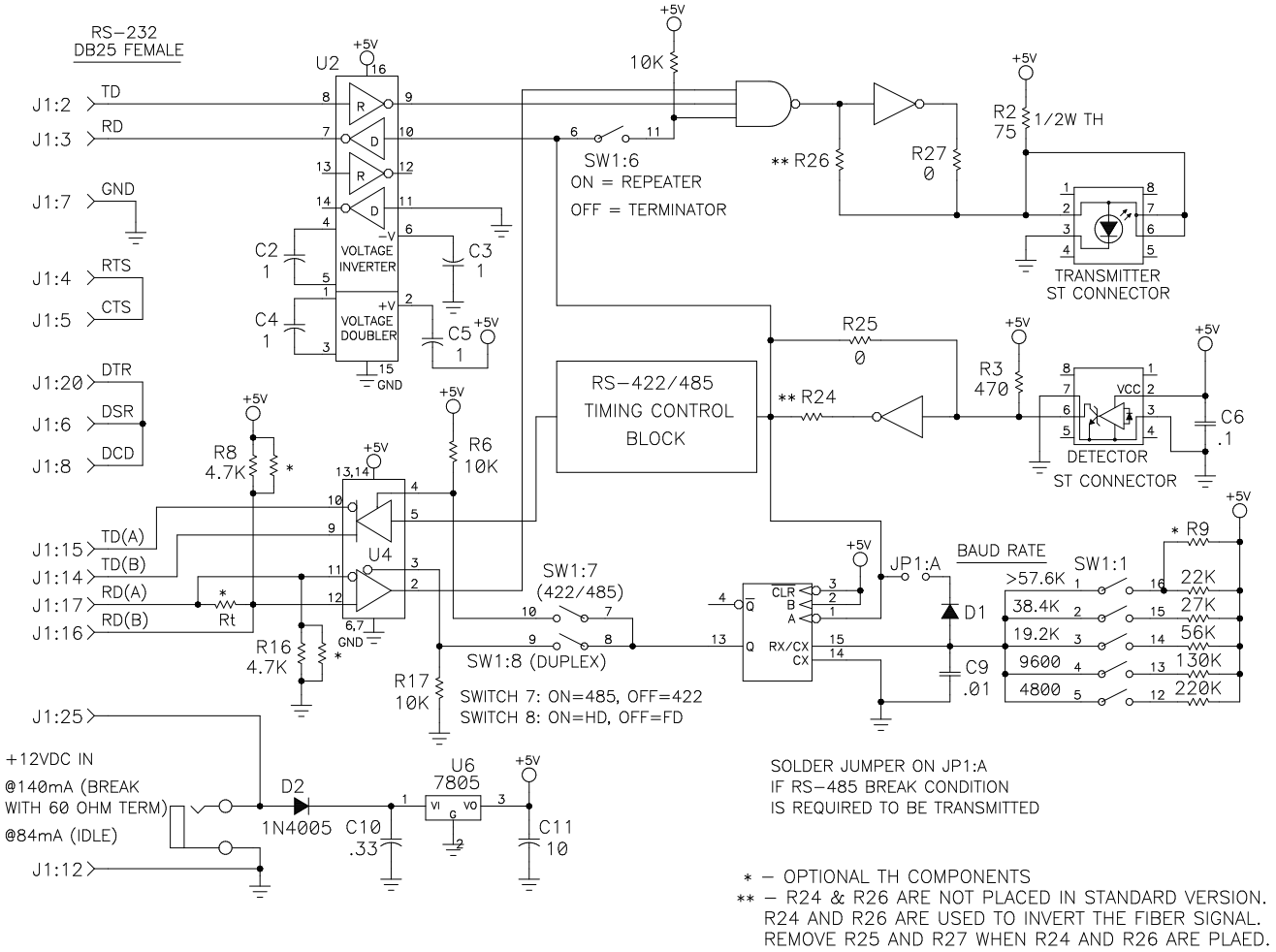
B&B ELECTRONICS

www.bb-elec.com *orders@bb-elec.com support@bb-elec.com*
International Office: 707 Dayton Road PO Box 1040 Ottawa, IL 61350 USA 815-433-5100 Fax 433-5104
European Office: Westlink Commercial Park Oranmore Co. Galway Ireland +353 91 792444 Fax +353 91 792445

B&B ELECTRONICS

PRODUCT INFORMATION

Figure 5: FOSTC Circuit Diagram



DECLARATION OF CONFORMITY

Manufacturer's Name:	B&B Electronics Manufacturing Company
Manufacturer's Address:	P.O. Box 1040 707 Dayton Road Ottawa, IL 61350 USA
Model Number:	FOSTC
Description:	High-Speed Fiber Optic Modem
Type:	Light industrial ITE equipment
Application of Council Directive:	89/336/EEC
Standards:	EN 55022 EN 61000-6-1 EN 61000 (-4-2, -4-3, -4-4, -4-5, -4-6, -4-8, -4-11)

Robert M. Paratore, Director of Engineering

CE

IMC-21A Series

Industrial 10/100BaseT(X) to 100BaseFX media converters

- Multi-mode or single-mode, with SC or ST fiber connector
- Link Fault Pass-Through (LFP)
- -40 to 75°C operating temperature range (T models)
- DIP switches to select FDX/HDX/10/100/Auto/Force

Introduction

The IMC-21A industrial media converters are entry-level 10/100BaseT(X) to 100BaseFX media converters designed to provide reliable and stable operation in harsh industrial environments. The converters can operate reliably in temperatures ranging from -40 to 75°C. The rugged hardware design ensures that your Ethernet equipment can withstand demanding industrial conditions. The IMC-21A converters are easy to mount on a DIN-Rail or in distribution boxes.

Specifications

Technology

Standards:
IEEE 802.3 for 10BaseT
IEEE 802.3u for 100BaseT(X) and 100BaseFX
IEEE 802.3x for Flow Control

Interface

RJ45 Ports: 10/100BaseT(X)
Fiber Ports: 100BaseFX (SC/ST connectors)
LED Indicators: Power, 10/100M (TP port), 100M (fiber port), FDX/COL (fiber port)
DIP Switches: TP port's 10/100M, Half/Full modes, Force/Auto modes; fiber port's Half/Full modes, Link Fault Pass-Through (LFP)

Optical Fiber

	100BaseFX	
	Multi-mode	Single-mode
Wavelength	1300 nm	1310 nm
Max. TX	-14 dBm	0 dBm
Min. TX	-20 dBm	-5 dBm
RX Sensitivity	-32 dBm	-34 dBm
Link Budget	12 dB	29 dB
Typical Distance	5 km [a] 4 km [b]	40 km [c]
Saturation	-6 dBm	-3 dBm

a. 50/125 µm, 800 MHz*km fiber optic cable
b. 62.5/125 µm, 500 MHz*km fiber optic cable
c. 9/125 µm, 3.5 PS/(nm*km) fiber optic cable

Physical Characteristics

Housing: Metal, IP30 protection
Dimensions: 30 x 125 x 79 mm (1.19 x 4.92 x 3.11 in)
Weight: 170 g
Installation: DIN-Rail mounting

Environmental Limits

Operating Temperature:
Standard Models: -10 to 60°C (14 to 140°F)
Wide Temp. Models: -40 to 75°C (-40 to 167°F)
Storage Temperature: -40 to 75°C (-40 to 167°F)
Ambient Relative Humidity: 5 to 95% (non-condensing)

Power Requirements

Input Voltage: 12 to 48 VDC
Input Current:
265 mA @ 12 VDC,
135 mA @ 24 VDC,
75 mA @ 48 VDC
Connection: Removable 3-contact terminal block
Overload Current Protection: 1.1 A
Reverse Polarity Protection: Present

Standards and Certifications

Safety: UL 60950-1
EMC: CE, FCC
EMI: FCC Part 15 Subpart B Class A, EN 55022 Class A
EMS:
EN 61000-4-2 (ESD) Level 3,
EN 61000-4-3 (RS) Level 2,
EN 61000-4-4 (EFT) Level 2,
EN 61000-4-5 (Surge) Level 2,
EN 61000-4-6 (CS) Level 2
Shock: IEC 60068-2-27
Freefall: IEC 60068-2-32
Vibration: IEC 60068-2-6
Green Product: RoHS, CRoHS, WEEE

MTBF (mean time between failures)

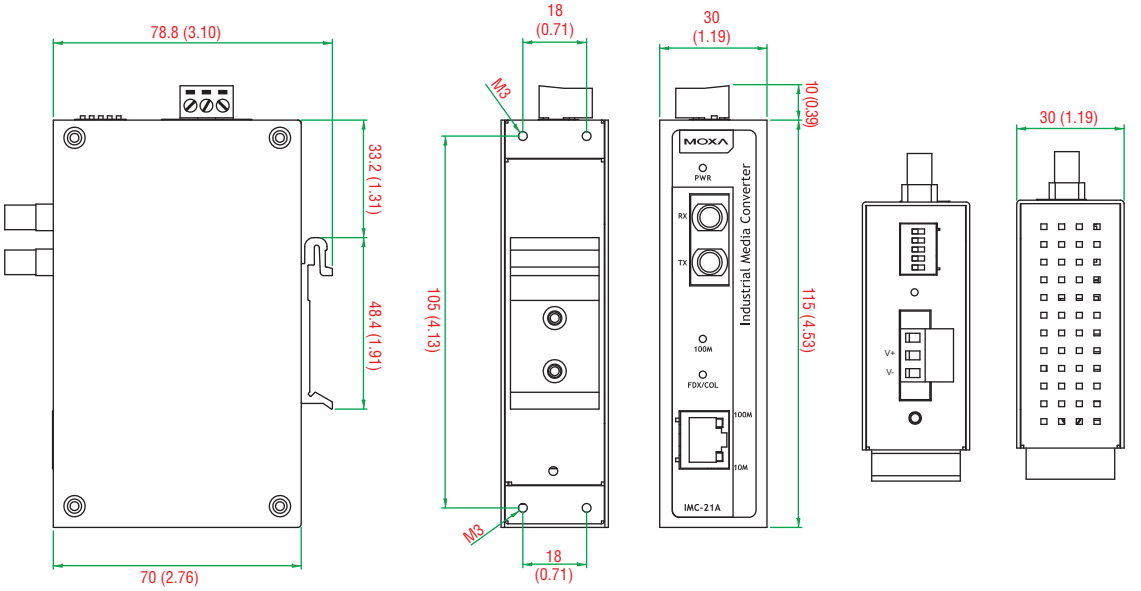
Time: 353,000 hrs
Database: MIL-HDBK-217F, GB 25°C

Warranty

Warranty Period: 5 years
Details: See www.moxa.com/warranty

Dimensions

Unit: mm (inch)



Side View | Front View | Rear View | Top View | Bottom View

Ordering Information

Available Models

IMC-21A-M-SC: Industrial 10/100BaseT(X) to 100BaseFX media converter, multi mode, SC connector, -10 to 60°C operating temperature
IMC-21A-M-ST: Industrial 10/100BaseT(X) to 100BaseFX media converter, multi mode, ST connector, -10 to 60°C operating temperature
IMC-21A-S-SC: Industrial 10/100BaseT(X) to 100BaseFX media converter, single mode, SC connector, -10 to 60°C operating temperature
IMC-21A-M-SC-T: Industrial 10/100BaseT(X) to 100BaseFX media converter, multi mode, SC connector, -40 to 75°C operating temperature
IMC-21A-M-ST-T: Industrial 10/100BaseT(X) to 100BaseFX media converter, multi mode, ST connector, -40 to 75°C operating temperature
IMC-21A-S-SC-T: Industrial 10/100BaseT(X) to 100BaseFX media converter, single mode, SC connector, -40 to 75°C operating temperature

Package Checklist

- 1 IMC-21A media converter
- Quick installation guide (printed)
- Warranty card

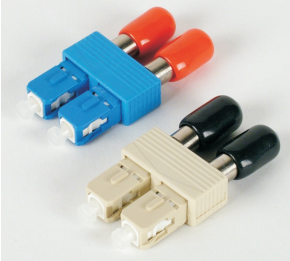
Optional Accessories (can be purchased separately)

SC to ST Connectors: See Appendix A

Fiber Accessories

Fiber Optic Adaptors

SC male to ST female duplex adaptors



These SC male to ST female duplex adaptors are provided as an optional accessory to give users of Moxa industrial Ethernet switches more fiber optic connection options. Simply plug the adaptors directly into the SC connector of any Moxa industrial Ethernet switch to convert the original SC connector into an ST connector. This allows you to use an ST connector with any MOXA industrial Ethernet switch, but without the need for an extra patchcord.

ADP-SCm-STf-S

SC male to ST female duplex adaptor for single-mode fiber

Specifications

Single-mode: 9/125 µm
Ferrules and Sleeves: Zirconia Ceramic
Body Color: Blue
Insertion Loss: 0.5/1.1 (TYP/MAX)
SC-side Connector: SC male
ST-side Connector: ST female

ADP-SCm-STf-M

SC male to ST female duplex adaptor for multi-mode fiber

Specifications

Multi-mode: 62.5/125 µm
Ferrules and Sleeves: Zirconia Ceramic
Body Color: Gray
Insertion Loss: 0.1/0.3 (TYP/MAX)
SC-side Connector: SC male
ST-side Connector: ST female

Attachment 4 – MV-90 Supported Meters

MV-90 xi & MVLT xi
Devices Supported List
05-Sep-2019

Vendor	Devices	TIM	Type	Probe Support	Decode Support
American Innovations	EMM 330	EMM	Electric		
Ametek	EXJ register w/ JEM1	EXJ	Electric	Yes	
Ametek	JEM10	JM10	Electric	Yes	
Ametek	JEM10 for Saudi Arabia	J10D	Electric		
Ametek	JEM2 with ASCII protocol	JE2A	Electric	Yes	
Ametek	JEM2 with Binary protocol	JE2B	Electric	Yes	
Ametek	JEMSTAR and Ci20 meter	JMST	Electric	Yes	Yes
Ametek	JEMStar II	JST2	Electric	Yes	Yes
Ametek	JR1	JR1	Electric		
Ametek	JR1 w/ RTS -CTS Flow Control (NIPCO)	JR1F	Electric		
AMPY (Email Metering)	A-11L Meter	A11L	Electric	Yes	
AMPY (Email Metering)	EM3300 Meter	EM33	Electric	Yes	No
AMPY (Email Metering)	Email Model A11 Meter	EA11	Electric	No	No
AMPY (Email Metering)	Email P1 Meter	EMP1	Electric	Yes	Yes
AMPY (Email Metering)	Email P1 Single Phase Meter	EMAL	Electric	No	No
AMPY (Email Metering)	Q3, Q4 Meter	EMQ4	Electric	Yes	Yes
Aptech	403 load control firmware, E-ICT WebRTU	ATC4	Electric	Yes	
Aptech	804 recorder (PSI Sentry 100 clones)	ATC1	Electric	Yes	
Aptech	804 test mode firmware	ATC3	Electric	Yes	
Aptech	804 timed relay control	ATC2	Electric	Yes	
Austin International	Sentry 200 Sentry 300 EG	PSI2	Electric		
Austin International	Vision 20 Meter	VS20	Electric	Yes	Yes
Bristol Babcock	Total Flow	BBTF	Gas		
CEWE	Prometer 2243	CEWE	Electric	Yes	Yes
CEWE	Prometer R and W	CPM2	Electric	Yes	Yes
Daniels	Solarflow Plus 2470, 2480	SOLF	Gas	Yes	
DataWatt	Datawatt D15	D15	Electric		
DataWatt	Datawatt D17	DWAT	Electric	Yes	
DataWatt	MidiElcor	ELCR	Gas		
Domestic Automation	LINC	LINC	Electric	Yes	
Dresser ROOTS	Micro PTZ+ Log Meter	MPTZ	Gas	No	No
Dresser ROOTS	MicroCorrector	PTZ2	Gas		
Eagle Research	PAT2, PAT4, AE2000, AE5000, AE6000, XARTU, MPPlus	AE	Gas	Yes	
ED&A	HPC Datalogger	HPC	Electric	No	
EDMI	MK10 (Atlas Meter)	EDMX	Electric	Yes	Yes
EDMI	MK2 System 2000-01xx Energy Meter and MK3 System 2000-04xx Energy Meter	EDM	Electric	Yes	Yes
EDMI	MK6 System 2000 (Genius Energy Meter)	EDM6	Electric	Yes	Yes
Electro Industries	EIG Shark 270/250 electric meter	SK27	Electric	Yes	Yes
Electro Industries	Futura	EIF	Electric		
Electro Industries	Nexus 1250 and 1270 series meters	NEXS/NXSP	Electric	Yes	
Electro Industries	Nexus 1252/1262, 1272, 1450 and 1500 Series Meters	NEX2	Electric	Yes	Yes
Electro Industries	Shark 200	SHK2	Electric	No	Yes
Elgama Elektronika Lithuania	EPQS	EG21	Electric	Yes	Yes
Elgama Elektronika Lithuania	EPQS	EG31	Electric	Yes	Yes
Elspec	Blackbox G4410, G4420 and G4430	ELG4	Electric	No	No
Elster	A3 Alpha, A1800 IEC meter, A3 WIC (probe)	A3, A3P	Electric	Yes	Yes
Elster	A3 WIC -- MV-90 xi Remote only	A3IP	Electric	No	Yes
Elster	Alpha meter (A1), EMF-2460	ALPH	Electric	Yes	Yes
Elster	Alpha PowerPlus Meter (A2)	ALPP	Electric	Yes	Yes
Elster	EMF registers in 25xx & 26xx families	EMF	Electric	Yes	Yes
Elster	IEC Alpha Meter	ALPI	Electric	Yes	
Elster	REX Universal Meter - WIC Remote Only	REXW	Electric	No	Yes
Elster	REX Universal WIC Electric Meter	REXP	Electric	Probe Only	Yes
Elster Germany	A140, A120	A140	Electric	Yes	
Elster Germany	AEM500, A1350, A1500, A2500, and A(S)220	A500	Electric		Yes
Elster Germany	AS1440	AS14	Electric	No	Yes
Elster UK	Alpha Vision meter (A1700)	VISI	Electric	Yes	Yes
Elster UK	AS230	A230	Electric	Yes	Yes
Elster UK	Elster A1120 and the A1140 Meters	VI40	Electric	Yes	Yes
Elster UK	OPUS Family of Outstations	OPUS	Electric	Yes	
Elster UK	PPM Polyphase Programmable Meter	GECP	Electric		Yes
Elster UK	PPM Polyphase Programmable Meter Issue2	GEC2	Electric		Yes
Elster/Itron	A3 w/ 2G ICS Module	A32G	Electric	No	Yes
Elster/Itron	A3 with ICS module	A3I	Electric	No	Yes

Vendor	Devices	TIM	Type	Probe Support	Decode Support
EMH - Elektrizitätszähler GmbH & Co KG	LZQJ-XC meters dlms/ COSEM protocol	LZQ	Electric	Yes	Yes
EMH - Elektrizitätszähler GmbH & Co KG	LZQJ-XC meters VDEW w 62056-021 protocol	LZQ2	Electric	Yes	Yes
EMON (MeterSmart)	8 channel I-MON and 3 channel PRO-MON	EMON	Electric		
Energy Intellect	Energy Intellect VM Series Meter	VM	Electric	Yes	Yes
Energy Intellect	TM, TMA	TML	Electric	Yes	
Enermet	MT30E, MT40, E700, E200 and E600	ENMT	Electric	Yes	Yes
Equimeter	EC3000 Autocorrector/NexCorr	ACOR	Gas	Yes	
Equimeter	Electrocorrector P & T	EQM	Gas	Yes	
Fisher (Emerson Process Management)	FloBoss107	F107	Gas	No	No
Fisher (Emerson Process Management)	ROC 300 series, FloBoss 407 and 500 series	FROC	Gas	No	
Flonidan	UNIFLO 1200	FUNI	Gas	No	Yes
Galvanic Applied Sciences	EVC, EPR, ER, and IDR devices	GAL	Gas	No	No
GE	DR87, DR87/1, DR87/2	DR87	Electric	Yes	
GE	GE TMx and TMRx meters, L&G DCx meters (Tx8x, Tx9x)	TMR	Electric	Probe Only	Yes
GE	I210	I210	Electric	Yes	Yes
GE	kV (a.k.a. kV96) meter	KV	Electric	Yes	Yes
GE	kV2, kV2c, kV2c+, kV2ce, kV2cs, SM300	KV2	Electric	Yes	Yes
GE	Phase 3 (KRC-901, KTC-901, KM-901), EV and ES Meter platforms	PH3	Electric	Yes	Yes
GE/Itron	I210 w/ 2G ICS module	I22G	Electric	No	Yes
GE/Itron	I210 with ICS module	I21I	Electric	No	Yes
GE/Itron	KV2c with ICS module	KV2I	Electric	No	Yes
Instromet	999 and 555 Corrector	I999	Gas		
Intellimeter	Meter Data Collection System WebService	MDCS	Electric	No	No
Iskraemeco	MT372/MT375	M372	Electric	Yes	Yes
Iskraemeco	MT420/ME420	M420	Electric	Yes	
Iskraemeco	MT85x, MT830, MT 860. MT831	M851	Electric	Yes	
Iskraemeco	MT880 & MT38x	MT88	Electric	Yes	Yes
Iskraemeco	POREG2	ISK2	Electric	Yes	
Iskraemeco	POREG4	ISK4	Electric	Yes	
Itron	200 Series (MT200 & MTR200) and Centron	M200	Electric	Yes	Yes
Itron	CENTRON II	CEN2	Electric	Yes	Yes
Itron	Centron Image	CENT	Electric	Yes	Yes
Itron	CEntron Image w/ 2G ICS module	CNTI	Electric	No	Yes
Itron	Datastar Recorder, L&G DG100's	SANG	Electric	Yes	
Itron	EM211 Meter	EM21	Electric	Probe Only	Yes
Itron	Fulcrum	FULC	Electric	Yes	Yes
Itron	Indigo+ International	INDI	Electric	Yes	
Itron	Indigo+ Meter	INDP	Electric	Yes	Yes
Itron	MT100/STD101	M100	Electric	Yes	Yes
Itron	OpenWay CENTRON Cellular Meter - MV-90 xi remote only	CENI	Electric	No	Yes
Itron	OpenWay CENTRON, CENTRON Bridge, CENTRON II Cellular (probe)	OWC	Electric	Yes	Yes
Itron	PXA-5 /R	PXAR	Electric	Yes	Yes
Itron	Q1000	Q1K	Electric	Yes	Yes
Itron	Quantum	QNTM	Electric	Yes	Yes
Itron	Quantum w/ QDIF Board	QDIF	Electric	Yes	
Itron	Sentinel	STLP	Electric	Yes	Yes
Itron	Sentinel w/ 2G ICS module	STLI	Electric	No	Yes
Itron	SEVC-D	SEVC	Gas	Yes	
Itron	SL7000, ACE6000, ACE7000 & ACE8000	SL7K	Electric	Yes	Yes
Itron	Spectra A12E recorder	SPEC	Electric	Yes	
Itron	SQ400	SQ4	Electric	Yes	
Itron	TIM Itron/Actaris CORUS gas volume converter (MID)	CORS	Gas	Yes	Yes
Itron	Vectron	VTRN	Electric	Yes	Yes
Kamstrup	UNIGAS and UNILOG devices	KUNI	Gas	No	Yes
Kenda	Medo Outstation device	MED	Electric		
Kenda	Meteor Outstation device	MTR	Electric		
KIGG	KM3T, KM3D	TIM_KM3P	Electric	Yes	Yes
Landis+Gyr	Clone of PSI Sentry 100	LNG1	Electric	Yes	
Landis+Gyr	Clone of PSI Sentry 100 with timed relay	LNG2	Electric	Yes	
Landis+Gyr	CTR101 & 102 registers	CTR	Electric		
Landis+Gyr	DXR	DXR	Electric	Yes	Yes
Landis+Gyr	E650 S4X	S4X	Electric	Probe Only	Yes
Landis+Gyr	EKM 647 and ZMB T647	EKM	Electric	Probe Only	No
Landis+Gyr	EM5400 meter	EM54	Electric	Yes	Yes
Landis+Gyr	Focus AX and RX ANSI meter	FOCS	Electric	Yes	Yes
Landis+Gyr	RXR S3, AXR & RXR S4, ZMC, SSM-4, Altimus	RXR	Electric	Yes	Yes
Landis+Gyr	S4E ANSI Meter	S4E	Electric	Yes	Yes
Landis+Gyr	Sentry 100	PSI1	Electric	Yes	
Landis+Gyr	Sentry 100 w/ load control firmware	PSI4	Electric	Yes	

Vendor	Devices	TIM	Type	Probe Support	Decode Support
Landis+Gyr	Sentry 200	PSI2	Electric	Yes	
Landis+Gyr	Sentry 200 w/ test mode firmware	PSI3	Electric	Yes	
Landis+Gyr	Sentry 200/EXP & QUAD4 & alpha cust id	EXPA	Electric		
Landis+Gyr	Sentry 200/EXP recorder, Quad 4+, MAXsys 2410, 2510, and Elite	EXP	Electric	Yes	Yes
Landis+Gyr	U1200, S1200	LGUA	Electric	Probe Only	Yes
Landis+Gyr Zug	7ED62 (L+G Download Restrictions apply to SCTM devices)	7E62	Electric		Yes
Landis+Gyr Zug	EMT - 21xx & FCM3 (L+G Download Restrictions apply to SCTM devices)	FCM	Electric	Yes	
Landis+Gyr Zug	FAF -11/12/21.2/22 (L+G Download Restrictions apply to SCTM devices)	FAF	Electric	Yes	
Landis+Gyr Zug	FAG Meter (L+G Download Restrictions apply to SCTM devices)	FAG	Electric	Yes	
Landis+Gyr Zug	FBC meter (L+G Download Restrictions apply to SCTM devices)	FBC	Electric	Yes	
Landis+Gyr Zug	FCL /1 (L+G Download Restrictions apply to SCTM devices)	FCL	Electric	Yes	
Landis+Gyr Zug	FCR meter (L+G Download Restrictions apply to SCTM devices)	FCR	Electric	Yes	
Landis+Gyr Zug	METCOM3 Modem (L+G Download Restrictions apply to SCTM devices)	MET3	Electric		
Landis+Gyr Zug	ZMB/EKM through L&G METCOM2 Modem (L+G Download Restrictions apply to SCTM devices)	MET2	Electric		
Landis+Gyr Zug	ZxD, SxA (E650/S650 Series 3), ZxQ, ZxG Meters DLMS/ COSEM device	ZMD	Electric	Yes	Yes
LG Idustrial Systems	LGRW34 Meter	LGIS, LGS2	Electric	Yes	No
Mercury	EC-AT, MINI-AT, MINI-MAX, MINI-MAX-AT, MPA and ER	MERB	Gas	Yes	Yes
Metretek	Commercial Pulse Accumulator	CPA	Gas		
Metretek	SIP, IMU, and IMU2	SIP	Gas		
Metretek	SMOD (for SMOD versions before '93)	MTEK	Gas	Yes	
Metscan/Itron	CID 30	MCID	Gas		
Metscan/Itron	CMD2000	MCMD	Gas		
Metscan/Itron	RMD 4.0LP	MRMD	Gas		
MiM (Malaysian Intelligence Meters)	Smart Anti Tamper meter	MIM	Electric	Yes	Yes
Misa	Miestro-3 (dlms)	MIE3	Electric	Yes	Yes
Misa	Miestro-CT	MIES	Electric	Yes	Yes
Mitsubishi	MX2	MX2	Electric	Yes	Yes
Nilsen	EMS2600e, 26FRC	NL26	Electric	Yes	
PRI	CALMU3 LINK	LINK	Electric	Yes	
PRI	CALMU3, CALMU3+, Sprint, and Premier meters	CMU3	Electric	Yes	Yes
PRI	Premier meters supporting PACT,PAKNET,LBP,and PACT+ protocols	CMUX	Electric	Yes	Yes
Quadlogic	Quadlogic Series 5 Transmeters, MiniClosets and Transponders	QLS5	Electric		
Reynolds	323 LVC, XVC Volume Corrector	RLVC	Gas		
Reynolds	In-line 841, 881r	INLI	Gas	Yes	
Reynolds	Recor 843 using Meter number for ID	RECM	Gas	Yes	
Reynolds	Recor 843 using serial number for ID	RECR	Gas	Yes	
Reynolds	Reynolds RVC /HVC Series Volume Correctors	RRVC	Gas	No	No
Robinton/ Aptech	LPR	LPR	Electric	Yes	
SATEC	BFM 136/036	B136	Electric	No	Yes
SATEC	EM133	E133	Electric	Yes	Yes
SATEC	EM920	EM92	Electric	Yes	Yes
SATEC	PM172E	SATC	Electric	No	Yes
SATEC	PM174/PM175/PM180	P174	Electric		Yes
Schneider Electric (Power Measurements/Square-D)	ION 7300,7330,7350,7400,7500,7550,7600,7650,7700,8000 series, 9000 series, PM8000 series	ION	Electric	Yes	Yes
Schweitzer Engineering Labs (SEL)	SEL-734 meter using the Modbus protocol	S734	Electric	Yes	
Schweitzer Engineering Labs (SEL)	SEL-734 meter using the SEL ASCII protocol	734A	Electric		No
Schweitzer Engineering Labs (SEL)	SEL-735 meter using the SEL ASCII protocol	735A	Electric	Yes	
Scientific Columbus	Scientific Columbus JEM-II (ASCII protocol)	JE2W	Electric	No	No
Sensus	Sensus iCON APEX	IAPX	Electric	Yes	Yes
Siemens UK	CM32 Outstation	CM32	Electric	No	No
Siemens UK	S4S register	S4S	Electric	Yes	
Siemens/Dietrich	MBUS	MBUS	Electric		
Siris	50G Gas Recorder	S50G	Gas	No	No
SmartNet	Mk2 PIM and PIM3	SMNT	Electric	Yes	Yes
Square D (Schneider Electric)	CM2350 Circuit Monitor	SQD	Electric		
Strike Technologies	ENERMAX meter	EMX	Electric		
Strike Technologies	ENERMAX+	EMXP	Electric	Yes	Yes
Teldata/ First Point	AC4, DC4, TDS-4M, TDS-2	TLDT	Gas		
Telecontrols	Optimodem	OPM	Electric		Yes
Transdata	EMS-65, EMS-80, EMS-96, EMS-99, MARK V, SSR6000 Recorder	EMS	Electric	Yes	Yes
Trilliant Networks/ Nertec Design	TL402 Telereader	TL4	Gas	No	No
Westinghouse	EWR with Bubble Memory	EWR1	Electric		
Westinghouse	SPRITE recorder	SPRI	Electric	Yes	
Zaptronix	Model ZAP03BE	IMS	Electric		
ZIV	5CT series	5CTX	Electric	Yes	Yes

Attachment 5 – Draft Metering, Telemetry, and Curtailment Requirements Letter

[Date]

[Developer Person In Charge Name]
[Developer Person in Charge Title]
[Developer]
[Developer Person In Charge Mailing Address]

RE: North Carolina Electric Membership Corporation (NCEMC) Metering, Telemetry, and Curtailment Requirements for _____ Project

Dear [Person In Charge Name]:

This letter is intended to supplement the _____ Power Purchase Agreement (PPA) executed between the buyer and [Developer Holding Company] to outline NCEMC's requirements for metering, telemetry, and curtailment. References below to the Developer refer either to [Developer] or [Developer Holding Company] or both, depending upon how Developer] and [Developer Holding Company] have allocated responsibilities.

Material Installation for Metering and Real-time Data
[Restatement of requirements and any special project requirements]

Billing
NCEMC estimates the cost for materials and labor related to fulfill its requirements above will be $_,000. NCEMC will bill the Developer for the actual cost of the labor and materials necessary to fulfill the above requirements by sending the final bill:

[Developer Billing Contact]
[Developer]
[Developer Billing Contact Address]
[Developer Billing Contact E-mail Address]
[Developer Billing Contact Phone Number(s)]

Developer agrees to reimburse NCEMC by remitting payment of the invoice in accordance to the terms outlined on the invoice.

Installation

NCEMC's contact for the installation of the communications equipment:

[NCEMC Installer]
North Carolina Electric Membership Corporation
3400 Sumner Boulevard
Raleigh, NC 27616
[NCEMC Installer E-mail Address]
[NCEMC Installer Phone Number(s)]

To ensure accurate configuration of the meter and real-time data into our SCADA the Developer will need to provide NCEMC with the information in the Metering and Real-Time Data Specifications document.

Operational Issues

Upon commissioning of the project during the PPA term, should NCEMC need to contact the Developer regarding but not limited to operational issues with equipment and wiring used to communicate to the Meter, the following is the Developer's contact:

[Developer Operational Contact]
[Developer]
[Developer Operational Contact Address]
[Developer Operational Contact E-mail Address]
[Developer Operational Contact Phone Number(s)]

[Developer Operational Backup Contact]
[Developer]
[Developer Operational Backup Contact Address]
[Developer Operational Backup Contact E-mail Address]
[Developer Operational Backup Contact Phone Number(s)]

Developer agrees to make a good faith effort to resolve operational issues within three (3) business days. Should the Developer determine that additional time is needed, Developer shall contact NCEMC's billing department contact below to describe the nature of the problem and provide an estimate of when the issue will be resolved:

[NCEMC Billing Analyst]
North Carolina Electric Membership Corporation
3400 Sumner Boulevard
Raleigh, NC 27616
[NCEMC Billing Analyst E-mail Address]
[NCEMC Billing Analyst Phone Number(s)]

Timeline

Receiving permission to operate (PTO) is the final step under the Interconnection Agreement with the Cooperative but is not the same as fulfillment of obligations under the PPA. The process for the purposes beginning payment under the PPA is as follows:

[Restatement of requirements and any special project requirements for COD]

If you have any questions, please feel free to contact me at (XXX) XXX-XXXX. If these requirements are acceptable please acknowledge by signing and returning a copy of this letter to my attention.

Sincerely,

[NCEMC Staff]
[NCEMC Staff Title]

Attachments:
Communications Diagram.pdf
Communications Cabinet.pdf
Fiber Converter Specifications.pdf
Metering and Real-Time Data Specifications.pdf

cc:

Agreed to by:

Name: _____

Signature: _____

Title: _____

Company: _____

Date: _____

Project: _____ Project

Attachment 6 – Metering and Real-Time Data Specifications

_____ Project

Metering and Real-Time Data Specifications

NCEMC uses a master DNP address of 1 which cannot be changed. To ensure accurate configuration of the meter and real-time data into our SCADA the following information in Sections 1-3 are needed from the Developer. The meter shall be installed as a load meter for purposes of CT and PT wiring (positive flow is when the project is generating and negative flow is station service when not generating).

Section 1 - Billing

Meter Manufacturer and Model	
Meter Identification (MID) Using the acSELerator Quicket software navigate to > General > Identifier and Scaling > MID	
Meter Serial Number	
Meter Wiring Method (Form 5,9 or 36) Verify that the meter is wired as a Load Meter	
CT Ratio Using the acSELerator Quicket software navigate to > General > Identifier and Scaling > CTR	
PT Ratio Using the acSELerator Quicket software navigate to > General > Identifier and Scaling > PTR	
Is CT and PT Ratio set in the Meter	Yes ☐ No ☐
Full Scale Value	**Watt** | **Volt** | **Amp**
Meter Multiplier	
Pulse Multiplier	
Meter Constant	
Meter Password (Level 1 and Level 2)	Level 1: Level 2:

NCEMC requires the meter password to be changed from the default. We suggest following previous NIST standards for password complexity.

- Maximum of 8 characters (limited by firmware/software)
- Upper and lower case letters and numbers
- At least one special characters like $!# etc

Verify that Meter does not follow DST and set to Eastern Standard Time	Yes ☐ No ☐

To program the meter time and DST:

a) Time
   i. Front Panel: Navigate to Set/Show > Date/Time >
   ii. Remote: Using the acSELerator QuickSet software from the top menu: click Tools > HMI > HMI > open the HMI and connect to the meter. Select 'control window' and under the 'Target, IRIG, Date, Time' enter the current date and time. Click 'Set' and send the information to the meter.
   iii. Using the meter terminal and using the TIM command. You will have to be in Level 2 authorization to complete this command (e.g. =>> TIM HH:MM:SS)

b) DST
   i. Using the acSELerator Quicket software navigate to > Daylight Savings Time > Verify that the 'Enable Daylight Savings Time Settings' box is not checked.

Meter Channel for kW delivered to NCEMC (to be furnished by NCEMC)	Channel 1
Meter Channel for kVAR delivered to NCEMC (to be furnished by NCEMC)	Channel 3
Meter Channel for kW received to Project (to be furnished by NCEMC)	Channel 2
Meter Channel for kVAR received to Project (to be furnished by NCEMC)	Channel 4
To set the Meter Channels in the acSELerator Quicket software navigate to > Events and Logging > Load Profile > LDFUNC1. NCEMC only needs four data channels configured in the following order (these correspond with the channels above): WH_DEL,WH3_REC,QH3_DEL,QH3_REC.	
Load Profile Acquisition Rate (Intervals Per Hour)	
To set the Meter Channels in the acSELerator Quicket software navigate to > Events and Logging > Load Profile > LDAR1. Enter 15M or 60M and enter the value in the 'Load Profile Acquisition Rate' box above.	
Load Profile Maximum Duration (Days) (default 602.41)	
To set the Meter Channels in the acSELerator Quicket software navigate to > Events and Logging > Load Profile > LMDUR1. NCEMC is OK with the default value of 602.41	

Section 2 – Real-Time Data

Communication Manufacturer and Model	

Unless otherwise specified the Port 1 will be the Ethernet Port. The following settings are needed to allow NCEMC to connect to the SEL-735 meter. In the acSELerator Quicket software navigate to Communication > Ports > Port 1 (Ethernet):

a. Port Security Settings:
   i. EPORT = Y
   ii. MAXACC = 2
   iii. ETCPKA = N
   iv. ESNTP = OFF
   v. ETELNET = Y
   vi. EFTPSERV = Y
   vii. EDNP = 1
   viii. EPMIP Enable PMU Sessions = 0
b. Communications Settings:
   i. TPORT = 23
   ii. IPADDR = Set by NCEMC or Developer and entered below as 'Meter IP Address'
   iii. SUBNETM = Set by NCEMC or Developer and entered below as 'Subnet Mask'
   iv. DEFRTR = Set by NCEMC or Developer and entered below as 'Default Router Gateway'
   v. TIDLE = 15

Real-time Port Number (default 20000)	
DNP Address (to be furnished by NCEMC)	
DNP Map (default 1)	

The following settings are needed to allow NCEMC to connect to the SEL-735 meter. In the acSELerator Quicket software navigate to Communication > Ports > Port 1 (Ethernet) > DNP Session Settings. Multiple DNP sessions can be setup via the Ethernet, the session for NCEMC needs to be configured as follows:

a. DNP IP Networking:
   i. DNPMAP = Select '1' and enter the value into the 'DNP Map' box above
   ii. DNPTR = TCP
   iii. DNPIP Master IP Address = 0.0.0.0
   iv. DNPUDP = Enter 20000 and enter the value into the 'Real-time Port Number' box above
   v. REPADR = 1
b. Data Link:
   i. DNPINA = 120

Section 3

Name and contact information for NCEMC staff to contact while configuring the meter in the billing system:

Name and contact information for NCEMC staff to contact while configuring the meter in the SCADA system:

Meter IP Address:
Subnet Mask:
Default Router Gateway:

Section 4

NCEMC Staff member notes relevant to this project: