ECLIPSE™

Power Quality User's Manual

Power Monitors, Inc.

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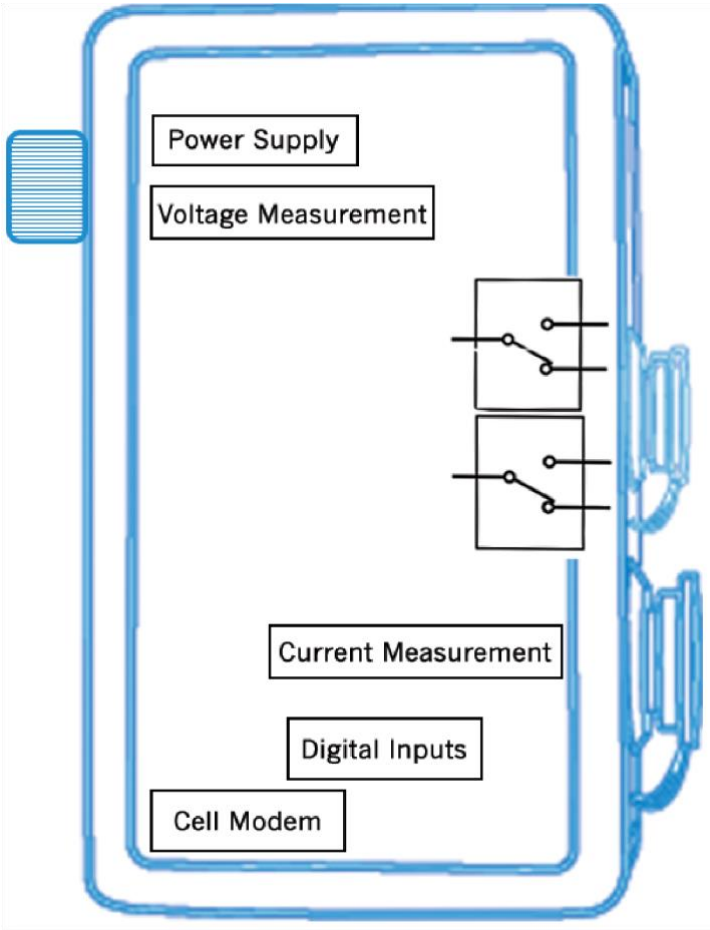
Introduction

The Eclipse is a self-contained device that allows a utility to monitor and control distributed generation or other systems via SCADA. Fully configured, the Eclipse includes 3 phase voltage, current, and power monitoring, along with digital inputs and two independent Form C relays. The embedded LTE cell modem, power supply, and NEMA 4X weatherproof housing allows for fast and easy installation.



Voltage Inputs

The Eclipse AC voltage inputs are located on the SOOW rubber cable (600V oil, water, and weather resistant, or SJOOW for 300V rated), terminated with alligator clips. These clips may be removed, and ring terminals or other connections made to the 18 AWG wires in the cable. The cable includes 4 wires – one for each AC phase, and neutral. These inputs are rated for 0-300VAC, CAT IV locations. No external fusing is needed.
The Eclipse is powered from the channel one input. AC voltage of at least 60 Volts is needed to power the Eclipse. Unused voltage inputs may be left unconnected or tied to the common input.

Boot Color	Function
Black	Power and channel 1 input
Red	Channel 2 input
Green	Channel 3 input
White	Power and measurement common input

Typically, the black, red, and blue boots are connected to phases A, B, and C, and the white boot connected to neutral. With a delta hookup, connect the white boot to one corner of the delta (not the same corner as channel 1).

Current Inputs

The Eclipse uses PMI's standard TLAR or Flex CT sets. Connect the CT set to the CT INPUT port on the Eclipse. The current range may be adjusted via commands from Canvass, through DNP3, or with the DMU software. The individual CT elements each display an arrow – this arrow should point away from the utility, towards the load (or distributed generation).

Digital Inputs

The Eclipse includes two digital voltage inputs. These may be used to detect the presence of AC or DC voltage. The detection is a binary measurement - voltage above a threshold is a logical “present” or “true”; voltage below the threshold is “absent” or “false.” It’s not possible to read the underlying analog voltage value or alter the threshold. AC voltage is rectified before sensing. The inputs are high impedance (over 1 Mohm). Both digital inputs share the same common voltage reference input. This reference input is electrically isolated from all other ports on the Eclipse, including the 3-phase voltage front-end and the relay outputs.

The digital inputs have a threshold of roughly 60VAC or 85VDC, and a max working voltage of 150VAC. The Eclipse is also available with a threshold at 6V, for use with 12VDC logic outputs. The digital inputs are typically used to monitor status signals from an inverter or control system, or the raw 120VAC output from an inverter. These signals are readable as DNP binary inputs, through the DMU, and through the Canvass interface. Response time is 1 second.

Relay Outputs

The Eclipse includes two internal Form C relays. Each relay has a normally open and normally closed contact. The relay common is shared between both relays. These relays are independently operable through DNP only. The relay contacts are rated for 6A, 120VAC , but are only wired for 4A maximum.. They are typically used to energize contactors, breaker shunt trip coils, or act as dry contacts as part of a larger control system. The relay common is isolated from the digital input common and the voltage inputs. The relays default to “de-energized” during Eclipse power up, meaning their N.O. contacts are open, and their N.C. contacts are closed All 4 relay contacts have 300VAC 110J rated MOV overvoltage protection included across each. The relays may only be energized through SCADA DNP commands - the Eclipse does not autonomously control the relays. Upon loss of power, the relays are de-energized - the built-in supercapacitor does not provide power to keep the relays energized.

The relays are dry contacts. If needed for control purposes, a wetting voltage must be supplied from an external source (e.g. a 120V branch circuit, or low voltage signaling source).

Cell Modem

The Eclipse includes an internal LTE cell modem. The LTE SIM card is also located inside the Eclipse. The SIM card is not user accessible. A new Eclipse includes a blank, unprovisioned SIM card for activation on the Verizon cell network. Upon power up, the Eclipse modem automatically connects to the cell network within 2 minutes. The modem uses Verizon LTE bands 4 and 13 (2100 and 850 MHz, respectively).

Antenna

The base Eclipse includes an internal LTE cell antenna - no external connection is required. An optional external antenna option is available. With this option, the internal antenna is not used - instead, a standard SMA RF connector is provided on the Eclipse housing, for use with the included external antenna. An antenna kit is also available which includes low-loss RF coax, to allow remote antenna placement. This may be useful if the Eclipse is mounted inside a metal enclosure such as a panel or switchgear.

Supercapacitor Ride-through

The Eclipse includes an internal supercapacitor to provide ride-through power during an outage. This capacitor provides roughly one minute of power, and is intended to allow the Eclipse to send outage notifications to SCADA or Canvass. The relays are not energized during the ride-through period. The supercapacitor requires at least 30 minutes to fully.

Mounting

The Eclipse housing is NEMA 4X rated, suitable for permanent outdoor use. An optional magnetic mounting bracket is also available. The mounting bracket also includes holes for permanent screw attachment to a base plate or other surface. If the Eclipse is mounted inside another metal enclosure, an external cell antenna should be considered.

Digital I/O Cable

The two relay outputs and digital inputs are exposed with 8 connector cable which attaches to the Eclipse via a weatherproof connector. The other end of the cable is unterminated, with bare wires. The standard cable is 7 feet long; other lengths are available. The wire gauge in the cable is 22 AWG for all signals. The connector pinout is as follows:

Pin	Wire Color	Function
1	Brown	Relay Common
2	Red	K2 Normally Open
3	Orange	K1 Normally Open
4	Yellow	K2 Normally Closed
5	Green	K1 Normally Closed
6	Blue	Digital Input 1
7	Violet	Digital Input 2
8	Black	Digital Input Common

Operation

Typical Uses

The Eclipse is most commonly used for electric utility monitoring control of distributed generation through a SCADA system, ADMS, DERMS, or an automation controller such as an SEL RTAC. The Eclipse DNP interface and cell modem allow for remote communication to any compatible system. Some common scenarios:

1. Eclipsed used to disable PV inverter: The Eclipse relay output is wired in series with the PV inverter Remote Power Off (RPO) or Emergency stop (E-Stop) circuit. The N.O or N.C. relay connection is used depending on the desired start-up default and outage state. SCADA commands. If the Eclipse relay opens the RPO or E-Stop circuit, the inverter is shut down. Eclipse digital inputs may be used to monitor the inverter status to confirm disconnect or loss of output.
2. Eclipse used to trip PV inverter breaker the Eclipse relay N.O. output is wired in series with an AC voltage source and a circuit breaker shunt-trip coil. The shunt-trip coil is attached to the breaker which connects the PV inverter output to the main bus. If the Eclipse is commanded to energize the relay, the shunt trip coil trips the circuit breaker, disconnecting the inverter output from the network. As long as the Eclipse relay is energized, the shunt-trip coil continues to hold the breaker open, preventing local manual closing. When the utility releases the hold, the breaker may be manually closed to reconnect the inverter output. Eclipse digital inputs may be used to monitor the inverter status to confirm disconnect or loss of output.
3. Eclipse used to remote start diesel generation: the Eclipse relay N.O. output is connected to diesel or propane generation remotely during periods of peak demand. The relay output is connected to the starter

circuit of the generator. Eclipse digital inputs may be used to monitor the generator status to confirm start, etc.

With each of these scenarios, optional 3 phase voltage and current monitoring provide analog RMS voltage and current, and real/reactive/apparent power measurements with one second resolution. This allows for monitoring of generation output along with control.

Communications/Networking

All communication with the Eclipse is through the LTE modem interface; there is no local wired communication port (e.g. no USB or serial port). An Eclipse with cell service will get an IP address from the cell network. Depending on the service type, this address may be in the utility private network, PMI private network, or public network. In any case, the service should be for a static IP address, allowing mobile-terminated connections, using a machine to machine telemetry data plan (no voice or SMS messaging). A typical data plan for the Eclipse may range from 1MB/ month to 25MB/month, depending on SCADA activity and poll cycle.

The Eclipse supports three connection types through the cell interface: DNP, Canvass, and DMU. The DNP interface is used with a utility SCADA system, ADMS/DERMS, RTAC, or another DNP-compatible package. Full relay control is available with the DNP protocol. Canvass is PMI's cloud-based system for monitoring 3 phase voltage/current/ power, and relay/digital input status. Relay operation is not available through the Canvass interface to ensure cybersecurity over control functions. The DMU is standalone software package used for Eclipse management and may be used for spot check of live readings, device configuration, pushing firmware updates, and other maintenance tasks.

SCADA DNP Interface

The Eclipse is a DNP3 outstation, or slave. A SCADA master may poll the Eclipse to read analog or binary inputs, including relay status and voltage thresholds (analog outputs). DNP commands are used to energize or de-energize the Eclipse relays. The Eclipse also supports unsolicited response by exception, allowing autonomous reporting of exceedance conditions.

The DNP interface may be used with UDP or TCP packets. UDP is recommended for cell networks. The Eclipse slave address, default DNP port, etc. are configured with the DMU.

Canvass Interface

Canvass is PMI's cloud-based storage and analytics package. When enabled, the Eclipse sends continuous 1 second voltage/current/power data to Canvass for permanent storage. This high-resolution data allows for close monitoring of voltage in the presence of local generation. Canvass also includes a sophisticated email/SMS notification system, sending alerts as needed based on voltage or power changes. Relay and digital input status may be read using Canvass. A single Eclipse may be present in multiple Canvass accounts - one common scenario is a utility with many devices in one master Canvass account, while key customers have access to a small Canvass account showing only the device on their system.

An Eclipse may be used with Canvass and SCADA/DNP simultaneously. Tunneling may be required to allow the Eclipse to access private, secure networks for both protocols.

DMU Interface

The DMU is a small PC application for Eclipse management. If the Eclipse is networked in a utility's private network, the DMU must be executed on a PC with access to that network. The DMU is used for maintenance and status purposes, and may be used to download logs, push firmware updates, etc. on one or more devices.

Specifications

RELAY OUTPUTS	
Output Type:	Dry Contact Form C (1 normally open, 1 normally closed)
Number of Outputs:	2 Independent Relays
Max Switching Voltage:	120V
Max Switching Current:	4 amps
DIGITAL INPUTS	
Input Type:	High Impedance
Number of Inputs:	2
Min Sense Voltage:	60V
Nominal Sense Voltage:	120V
Max Sense Voltage:	150V
VOLTAGE	
Input Range:	70-300 V RMS
Measurement Channel:	3
Accuracy:	0.50%
Resolution:	0.1V
CURRENT	
Measured:	20, 200 A w/ TLARs
Quantities:	100, 1000, 5000 A w/ FCTs
Accuracy:	1%
Measurement Channel:	3
POWER	
Accuracy:	1%
Measurement Channel:	3
COMMUNICATION	
Standard:	Embedded Cell Modem
ENVIRONMENTAL	
Temperature Range:	-22° F to 130° F
PHYSICAL DIMENSIONS	
Size:	5.06" L X 3.35" W X 1.84" H
Weight:	Less than 1 lb.
Case:	NEMA 4X