



GE Digital Energy
Multilin

MX350 Automatic Transfer Control System

Low voltage power transfer control



Instruction manual

MX350 revision: 1.2x

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GE Multilin MX350 Automatic Transfer Control System instruction manual for revision 1.2x.

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Table of Contents

1. INTRODUCTION	Overview 1 - 1
	Cautions and warnings..... 1 - 1
	Description of the Automatic Transfer Controller system..... 1 - 2
	ATS types 1 - 5
	Specifications 1 - 6
	Timing specifications 1 - 6
	Protection specifications..... 1 - 6
	User interface specifications..... 1 - 7
	Metering and monitoring specifications..... 1 - 7
	Inputs specifications 1 - 7
	Outputs specifications 1 - 8
	Power supply specifications..... 1 - 8
	Communications specifications 1 - 9
	Testing and certification..... 1 - 9
	Physical specifications 1 - 10
	Environmental specifications..... 1 - 10
	Order codes for MX350 1 - 11
	Example of an MX350 order code 1 - 11
<hr/>	
2. INSTALLATION	Mechanical installation 2 - 1
	Dimensions 2 - 1
	Product identification 2 - 2
	Mounting 2 - 2
	Module withdrawal and insertion 2 - 4
	Module and terminal identification 2 - 6
	Electrical installation 2 - 7
	Power supply module..... 2 - 8
	CPU module..... 2 - 9
	Input/Output modules..... 2 - 10
	Dielectric strength testing 2 - 14
<hr/>	
3. INTERFACING WITH THE MX350 AT CONTROLLER	Graphical control panel 3 - 1
	Introduction to the graphical control panel..... 3 - 1
	MX350 graphical display pages..... 3 - 6
	MX350 programming techniques..... 3 - 13
	EnerVista™ MX350 Setup Software 3 - 17
	Software requirements..... 3 - 17
	Troubleshooting the USB driver..... 3 - 17
	Installing the EnerVista™ MX350 Setup software 3 - 20
	Connecting EnerVista MX350 Setup to the relay 3 - 20
	Working with setpoints and setpoint files..... 3 - 23
	Upgrading relay firmware 3 - 29
	Power analysis 3 - 30
	Waveform capture..... 3 - 30
	Data logger..... 3 - 34
<hr/>	
4. ACTUAL VALUES	Actual values overview 4 - 1

Metering	4 - 2
Current metering.....	4 - 2
Voltage metering.....	4 - 2
Power metering	4 - 3
PQ metering.....	4 - 3
Status	4 - 4
Status messages.....	4 - 4
Input and output status	4 - 4
System Page.....	4 - 5
Flex Page.....	4 - 5

5. SETPOINTS

Understanding setpoints	5 - 1
Setpoint text abbreviations	5 - 2
Configuration setpoints	5 - 3
ATS setpoints.....	5 - 3
ATS types.....	5 - 4
Chicago Transfer Alarm Panel (CTAP) option	5 - 7
Common ATS setpoints.....	5 - 8
Current and voltage transformers.....	5 - 9
Inputs.....	5 - 10
Outputs.....	5 - 10
Communications setpoints.....	5 - 10
System.....	5 - 12
Events	5 - 13
Zenith.....	5 - 13
Operation setpoints	5 - 14
Timers.....	5 - 15
Control	5 - 16
General.....	5 - 16
Interlock.....	5 - 18
Alarms	5 - 19
Security	5 - 20

6. EXERCISER

Information	6 - 1
Setup.....	6 - 2
Test.....	6 - 2

7. DIAGNOSTICS

Events	7 - 1
Statistical information	7 - 3
Phasors	7 - 4
Product information	7 - 5
Reports	7 - 6
Waveform	7 - 7
Datalog	7 - 8

8. FLEXLOGIC™

FlexLogic™ overview	8 - 1
Introduction to FlexLogic™.....	8 - 1

9. COMMUNICATIONS

Communications interfaces	9 - 1
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MX350 Automatic Transfer Control System

Chapter 1: Introduction

Overview

The MX350 is a modular control and monitoring system designed specifically for low-voltage transfer switch application. The MX350 provides the following key benefits.

- Flexible control and communication options to suit any low-voltage transfer switch application.
- Small footprint.
- Modular design reduces the number of spare components for maintenance and testing.
- Integrated pushbuttons and LED indicators reduce external components and wiring.
- DIN rail and Panel Mounting.
- Multiple communication protocols allows simple integration into monitoring and control systems.
- Graphical control panel interface provides local control and access to system information.
- Automation FlexLogic™ with interlocking and programmable logic control.

Cautions and warnings

Before attempting to install or use this device, it is imperative that all caution and danger indicators in this manual are reviewed to help prevent personal injury, equipment damage, or downtime. The following icons are used to indicate notes, cautions, and dangers.

Figure 1: Note icons used in the documentation



The standard **note** icon emphasizes a specific point or indicates minor problems that may occur if instructions are not properly followed.

The **caution** icon indicates that possible damage to equipment or data may occur if instructions are not properly followed.

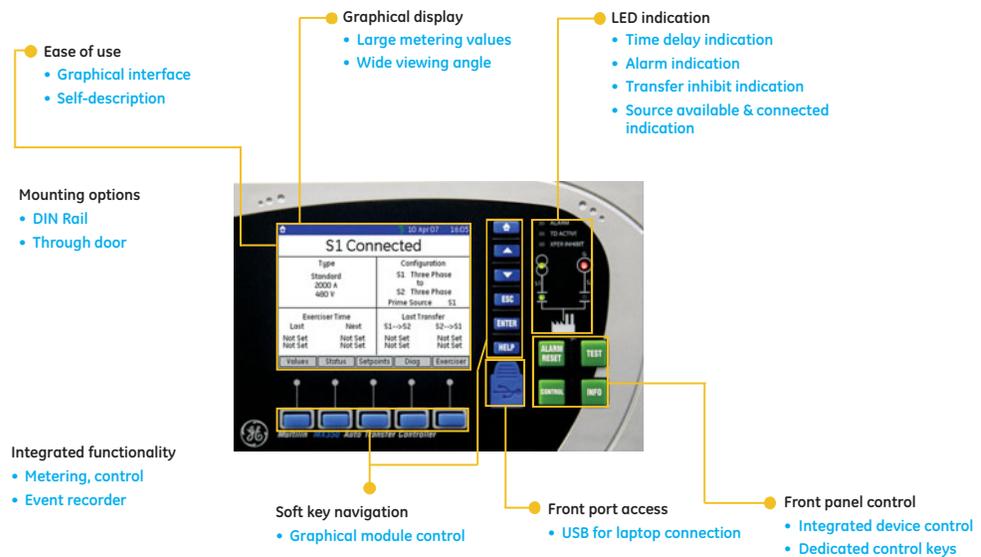
The **danger** icon provides users with a warning about the possibility of serious or fatal injury to themselves or others.

Description of the Automatic Transfer Controller system

The MX350 is equipped with a graphical control panel:

- Includes a 89 mm (3.5-inch) 320 by 240 pixel backlit colour LCD screen, 15 pushbuttons, and 7 LED indicators, which provide access to actual values, fault and alarm lists, event records, and setting configuration. A USB port is provided for laptop computer connection.

Figure 2: MX350 feature overview



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The MX350 includes the following input/output capabilities:

- 5 to 25 contact outputs
- 5 to 32 contact inputs

The following option packages are available:

Option A:

- Full function ATS control with full sensing and control capabilities, depending on order option.
- Expanded diagnostics, high-speed 256-event capture, 365-day exerciser, EnerVista launchpad, USB interface for uploading and downloading setup parameters
- 4 programmable inputs and 4 outputs assignable to additional ATS features
- Full complement of programmable ATS control switches (AUTO/MAN, Preferred Source selector, Commit/No Commit Xfer, Transition Mode Select (for Closed Transition switch models).

Option B:

Option Package A plus:

- 10 customer programmable digital and 10 analog alarms

- 20 channel data logger, customer configurable sample period from 1 cycle to 60 minutes
- Waveform capture, 10 channels, up to 256 cycles each 16 samples/sec
- Auto Load Shed with voltage, frequency and kW triggers

Option C:

Option Package B plus:

- 4 additional inputs and outputs (total 8 in, 8 out)

Option D:

Option Package C plus:

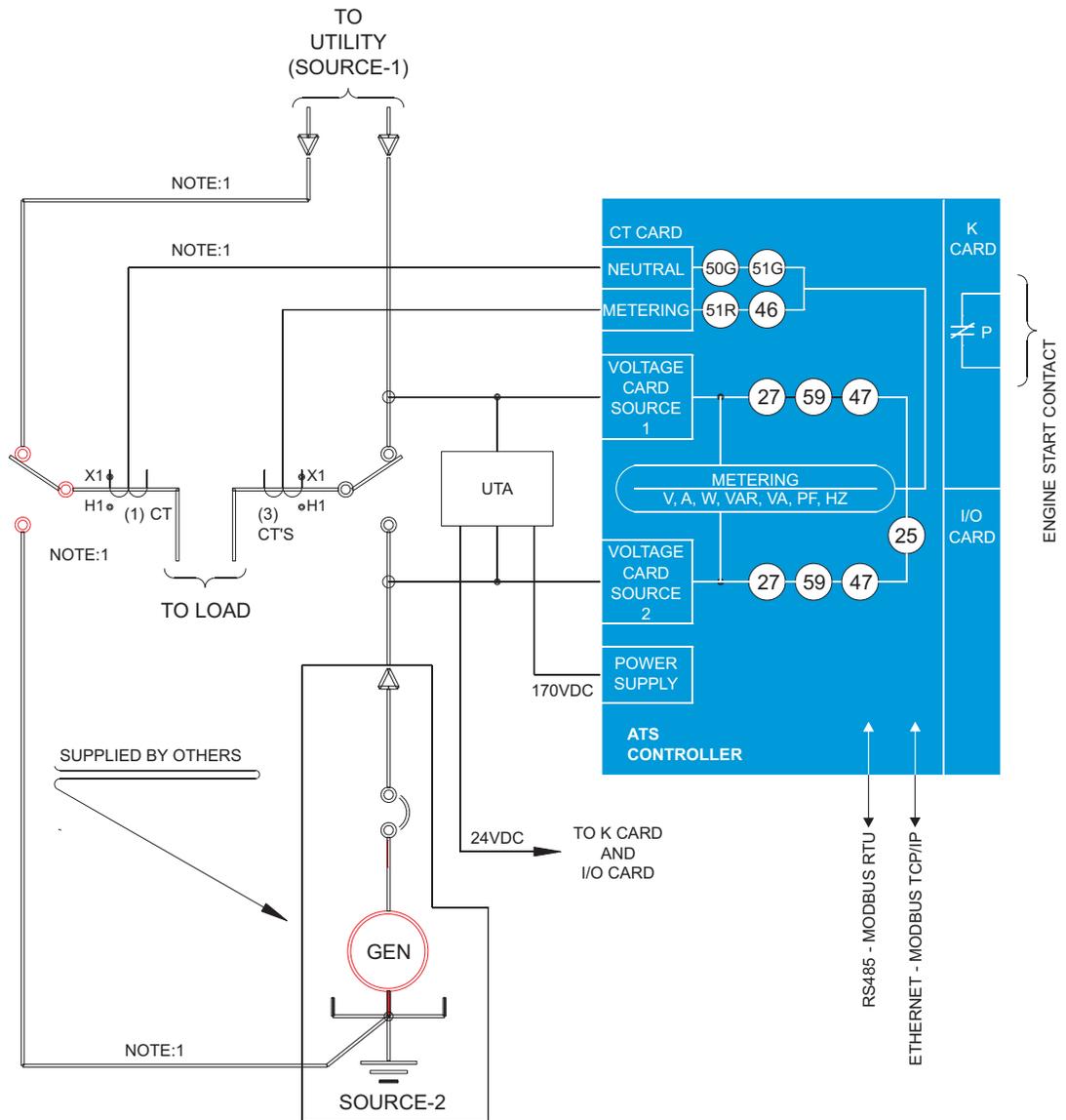
- 4 additional inputs and outputs (total - 12 in, 12 out)
- FlexLogic for user-customized control logic

Option M:

- Configuration for Manual operation only (non-Automatic)

A single-line diagram for the MX350 is shown below.

Figure 3: Single line diagram



NOTE:1- FOURTH POLE/NEUTRAL POLE IS AN OPTIONAL FEATURE.

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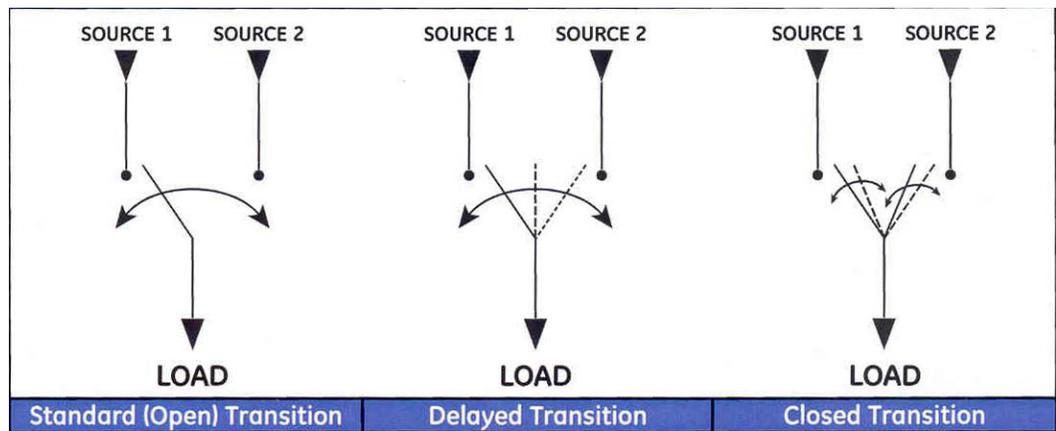
Table 1: MX350 protection functions

ANSI device	Description
25	Synch check
27	Undervoltage
46	Current balance
47	Voltage phase reversal
50G (option)	Ground instantaneous overcurrent
51G (option)	Ground time overcurrent
51 (option)	Overcurrent
59	Overvoltage

ATS types

Automatic Transfer switch types to be controlled by the Controller are Standard (Open) Transition, Delayed Transition, and Closed Transition. The figure below shows the one-line diagram for all three types.

Figure 4: Automatic transfer switch types



In addition, the MX350 can control the Bypass/Isolation type version of the three basic ATS types.

Specifications



Specifications are subject to change without notice.

Timing specifications

GENERAL TIMING ACCURACY

Accuracy:..... ±500 ms

Protection specifications

OVERVOLTAGE

Pickup level:..... 1.05 to 1.10 × VT in steps of 0.01 (programmable)

Dropout: 1.03 to 1.08 × VT in steps of 0.01 (programmable)

Time delay: No programmable time delay

UNDERVOLTAGE

Pickup level:..... 0.75 to 0.99 × VT in steps of 0.01 (programmable)

Dropout: 0.85 to 1.00 × VT in steps of 0.01 (programmable)

Time delay: No programmable time delay

OVERFREQUENCY

Pickup level:..... 50.1 to 63.0 Hz in steps of 0.1 (programmable)

Dropout: 50.0 to 62.9 Hz in steps of 0.1 (programmable)

Time delay: No programmable time delay

Accuracy:..... ±0.05 Hz

UNDERFREQUENCY

Pickup level:..... 45.0 to 59.9 Hz in steps of 0.1 (programmable)

Dropout: 45.1 to 60.0 Hz in steps of 0.1 (programmable)

Time delay: No programmable time delay

Accuracy:..... ±0.05 Hz

POWER FACTOR

Pickup level:..... 0.99 lag to 0.99 lead in steps of 0.01 (programmable)

Dropout: pickup + hysteresis

Time delay: 0 to 65535 seconds in steps of 1

Accuracy:..... ±0.05

VOLTAGE IMBALANCE

Pickup level:..... 0.05 to 0.20 in steps of 0.01 (programmable)

Dropout: 0.03 to 0.18 in steps of 0.01 (programmable)

Time delay: 1 to 60 seconds in steps of 1

CURRENT IMBALANCE

Range: 4 to 40% in steps of 1

Pickup level:..... 0.04 to 0.40 in steps of 0.01 (programmable)

Time delay: 1 to 60 seconds in steps of 1 s

Timing accuracy: ±500 ms

Elements: alarm

Accuracy:..... ±2%

CALCULATION METHOD
$(I_M - I_{AV} / I_{AV}) \times 100\%$
Where:
I_{AV} = average phase current
I_M = current in a phase with maximum deviation from I_{AV}

THD ALARM (CURRENT/VOLTAGE)

Pickup level: 0.1% to 100.0% in steps of 0.1% (programmable)

Time delay: 0 to 65535 seconds in steps of 1

OVERCURRENT (PER PHASE/NEUTRAL)

Pickup level: 0.01 to 2.00 × Nominal Current in steps of 0.01% (programmable)

Time delay: 0 to 65535 seconds in steps of 1

User interface specifications

GRAPHICAL CONTROL PANEL

Size: height 102mm, width 153mm, depth 35mm

LCD: 89 mm (3.5-inch) colour, 320 by 240 pixels

LED indicators: 7 LEDs

Pushbuttons: Alarm Reset, Test, Ctrl, Info, plus 11 LCD screen display control keys

Ports: USB 2.0 type Mini-B for laptop computer connection

Metering and monitoring specifications

EVENT RECORDER

Capacity: 256 events

Data storage: non-volatile memory

FREQUENCY METERING

Range: 40.00 to 70.00 Hz in steps of 0.01

Accuracy: ±0.05 Hz

POWER METERING

Real power range: -2000.0 to 2000.0 kW in steps of 0.1

Apparent power range: 0.0 to 2500.0 kVA in steps of 0.1

Accuracy: ±2.0% of full scale with 5 A CT

POWER FACTOR METERING

Range: -0.99 to +0.99 in steps of 0.01

Accuracy: ±0.05

Inputs specifications

CONTROL VOLTAGE INPUT

Input range: 60 V to 300 V AC

Nominal frequency: 50 or 60 Hz

DIGITAL INPUTS

Nominal input voltage: 24 V DC

Recognition time: 2 cycles

Continuous current draw: 4 mA

Type: opto-isolated inputs

External switch: wet contact

Communications specifications

ETHERNET (COPPER)

Modes:.....10/100 MB (auto-detect)
 Connector:.....RJ-45
 SNTP clock synchronization error:.....<200 ms (typical)
 Protocol:.....Modbus TCP

RS485 PORT

Port:.....opto-isolated
 Baud rates:.....up to 115 kbps
 Protocol:.....Modbus RTU, half-duplex
 Maximum distance:.....1200 m
 Isolation:.....2 kV

USB PORT

Standard specification:.....Compliant with both USB 2.0 and USB 1.1
 Data transfer rate:.....USB device emulating serial communications port at
 115 kbps
 Connector:.....USB2.0 Mini-B

Testing and certification

TESTING AND CERTIFICATION

Test	Reference Standard	Test Level
Dielectric Voltage Withstand:	EN60255-5	2.0 KV
Impulse Voltage Withstand:	EN60255-5	5 KV
Insulation Resistance:	EN60255-5	500 V DC > 100 Mohm
Damped Oscillatory:	IEC61000-4-18/IEC60255-22-1	2.5 KV CM, 1 KV DM
Electrostatic Discharge:	EN61000-4-2/IEC60255-22-2	Level 4
RF Immunity:	EN61000-4-3/IEC60255-22-3	Level 3
Fast Transient Disturbance:	EN61000-4-4/IEC60255-22-4	Level 4
Surge Immunity:	EN61000-4-5/IEC60255-22-5	Level 3 & 4
Conducted RF Immunity:	EN61000-4-6/IEC60255-22-6	Level 3
Power magnetic Immunity:	IEC61000-4-8	Level 4
Voltage Dip & Interruption:	IEC61000-4-11	0,40,70% dips 250/300cycle interrupts
Radiated & Conducted Emissions:	CISPR11 /CISPR22/ IEC60255-25	Class A
Ingress Protection:	IEC60529	IP20 (base unit) IP54 (Control Panel)
Environmental (Cold):	IEC60068-2-1	-20°C 16 hrs
Environmental (Dry heat):	IEC60068-2-2	85°C 16hrs
Relative Humidity Cyclic:	IEC60068-2-30	6-day variant 2
Fast Transient Disturbance:	IEEE C37.90.1	4 KV CM & DM
SWC Damped Oscillatory:	IEEE C37.90.1	2.5 KV CM
Electrostatic Discharge:	IEEE C37.90.3	8 KV CD, 15 KV AD

APPROVALS

	Applicable Council Directive	According to
CE compliance:	Low voltage directive EMC Directive	EN60255-5, EN60947-1, EN60947-6-1 EN61000-6-2/ EN61000-6-4
ISO:	Manufactured under a registered quality program	ISO9001

Physical specifications

DIMENSIONS

Size:	Base: 62 mm [2.44"] (W) × 90 mm [3.54"] (H) × 113 mm [4.45"] (D) (+ terminals 10mm [0.39"])
	Expansion: 62 mm [2.44"] (W) × 90 mm [3.54"] (H) × 113 mm [4.45"] (D)
	GCP: 153 mm [6.02"] (W) × 102 mm [4.02"] (H) × 35 mm [1.38"] (D)
Weight (Base):.....	0.75 kg [1.65 lb]

Environmental specifications

ENVIRONMENTAL SPECIFICATIONS

Ambient temperatures:

Storage/shipping:	- 40°C to 90°C *
Operating:	-20°C to 60°C * (Base Unit and Basic Control Panel) -20°C to 50°C * (Graphical Control Panel)

* 1" around Base Unit

Humidity:	Operating up to 95% (non condensing) @ 55°C (As per IEC60068-2-30 Variant 2, 6days)
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Altitude:	2000 m (max)
Overvoltage Category:	II
Ingress Protection:	IP20 (Base Unit), IP54 (Control Panel)

Order codes for MX350

The information to specify an MX350 relay is provided in the following order code figure.

Figure 5: MX350 order codes

MX350 - *		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Interface	MX350																			MX350 Automatic Transfer Control System
Control panel	G																			Graphical control panel with USB
Language	E																			English (Standard)
	C																			Chinese
Power supply	H																			High (60 to 300 V AC; 84 to 250 V DC)
Communications	X																			No Base Unit Communications
	S																			Adds RS485 Serial Modbus RTU
	E																			Adds 10/100 Ethernet Modbus TCP
Firmware Options	S																			Standard ATS Functions
	1																			Adds Control Switches
	2																			Adds 16 Digital & 16 Analog Customer Config. Alarms
	3																			Adds Data Logger and Waveform Capture
Hardware Options	4																			Adds FlexLogic™
	B	B	X	K	X	X	X	X	X											Two Source ATS Basic
			A																	CT Card for Metering Options
					L	L	L	L	L											Additional 24 V DC I/O - 5 Outputs, 7 Inputs per Card

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Example of an MX350 order code

MX350-GEHE3BBAKLL: MX350 with graphical control panel incl. USB port, English language display, high voltage control power supply (84 to 250 VDC or 60 to 300VAC), RS-485 Modbus RTU port and 10/100 Modbus TCP/IP Ethernet port), data logger and waveform capture, source 1 voltage sensing, source 2 voltage sensing, load current sensing, P relay function, and two input/output cards.



MX350 Automatic Transfer Control System

Chapter 2: Installation

Mechanical installation

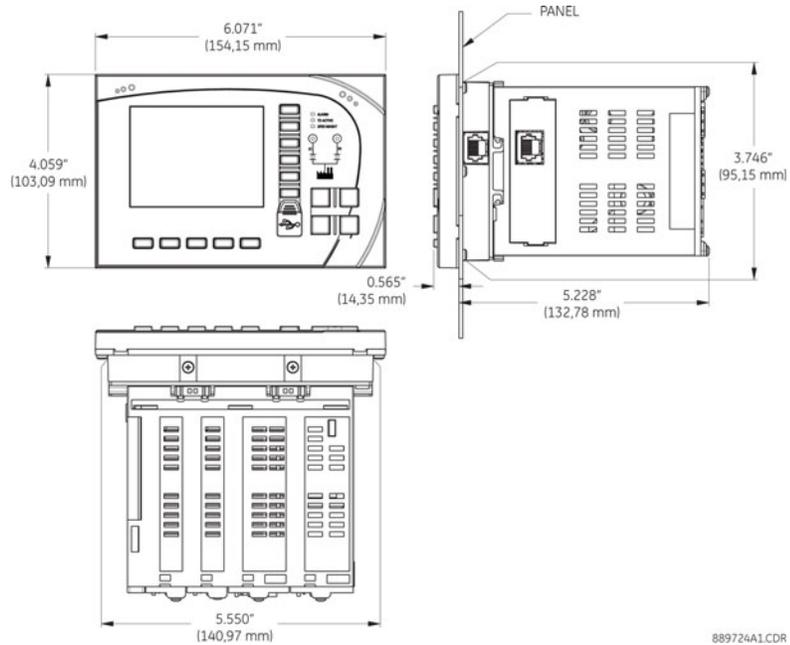
This section describes the mechanical installation of the MX350 system, including dimensions for mounting and information on module withdrawal and insertion.

Dimensions

The MX350 is packaged in a modular arrangement.

The dimensions of the MX350 are shown below. Additional dimensions for mounting and panel cutouts are shown in the following sections.

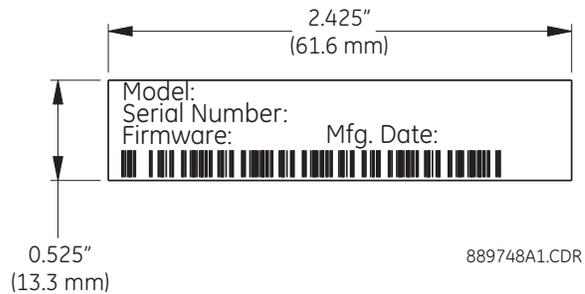
Figure 1: MX350 dimensions



Product identification

The product identification label is located on the side panel of the MX350. This label indicates the product model, serial number, firmware revision, and date of manufacture.

Figure 2: MX350 label

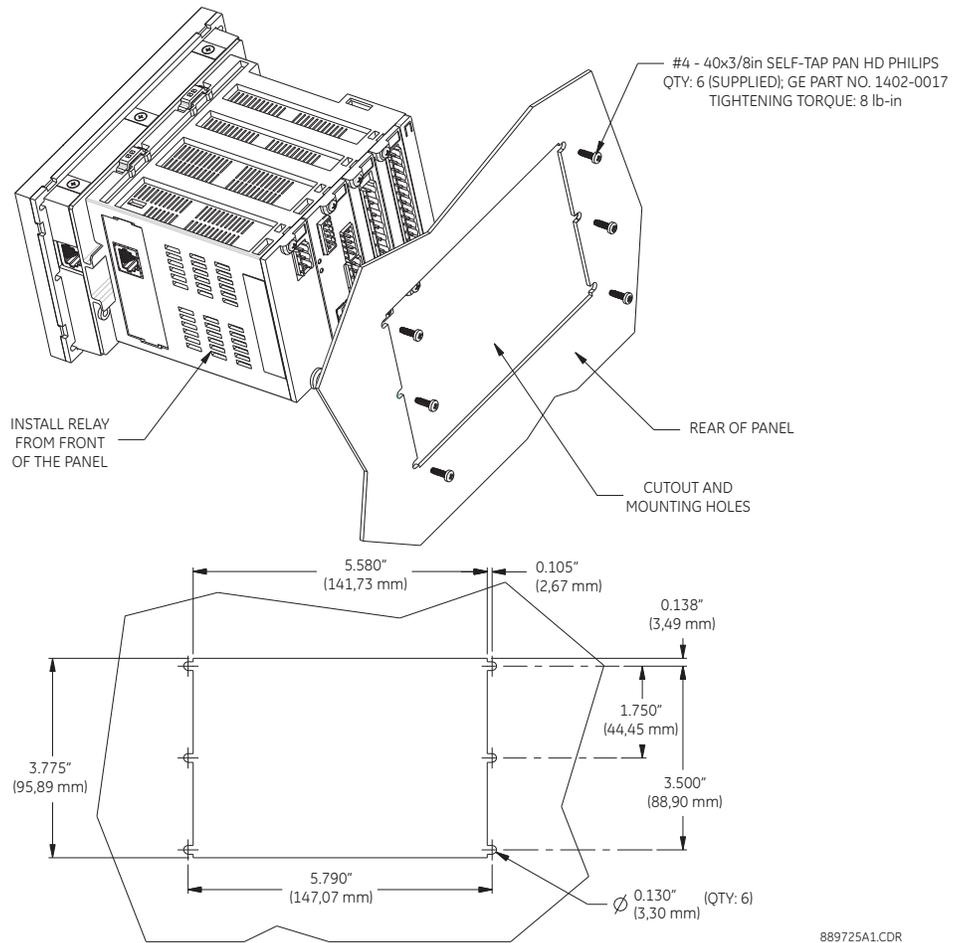


Mounting

The MX350 can be mounted three ways: standard panel mount, DIN rail mount, and screw mount for high vibration environments.

The standard panel mount and cutout dimensions are illustrated below.

Figure 3: Panel mounting and cutout dimensions

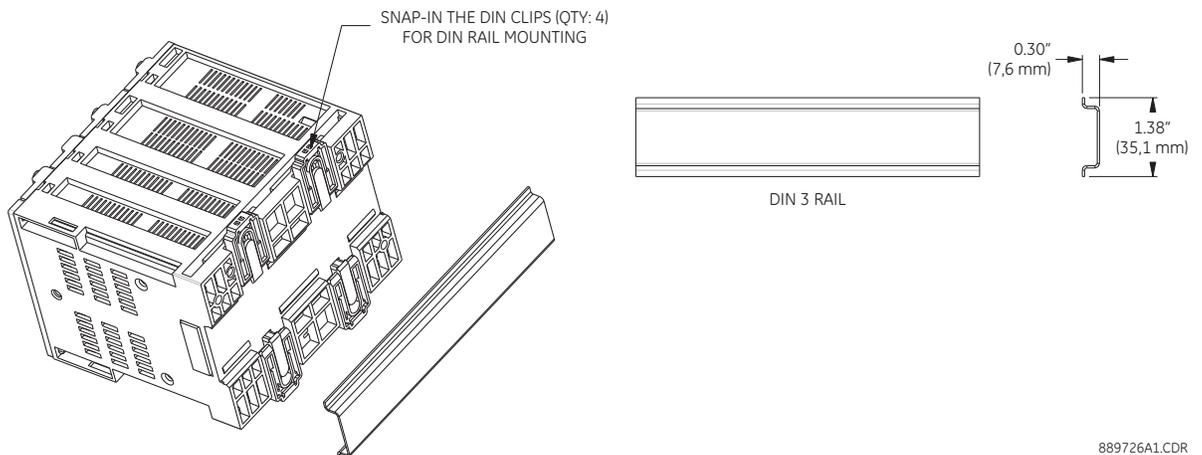


The DIN rail mounting is illustrated below. The DIN rail conforms to EN 50022.



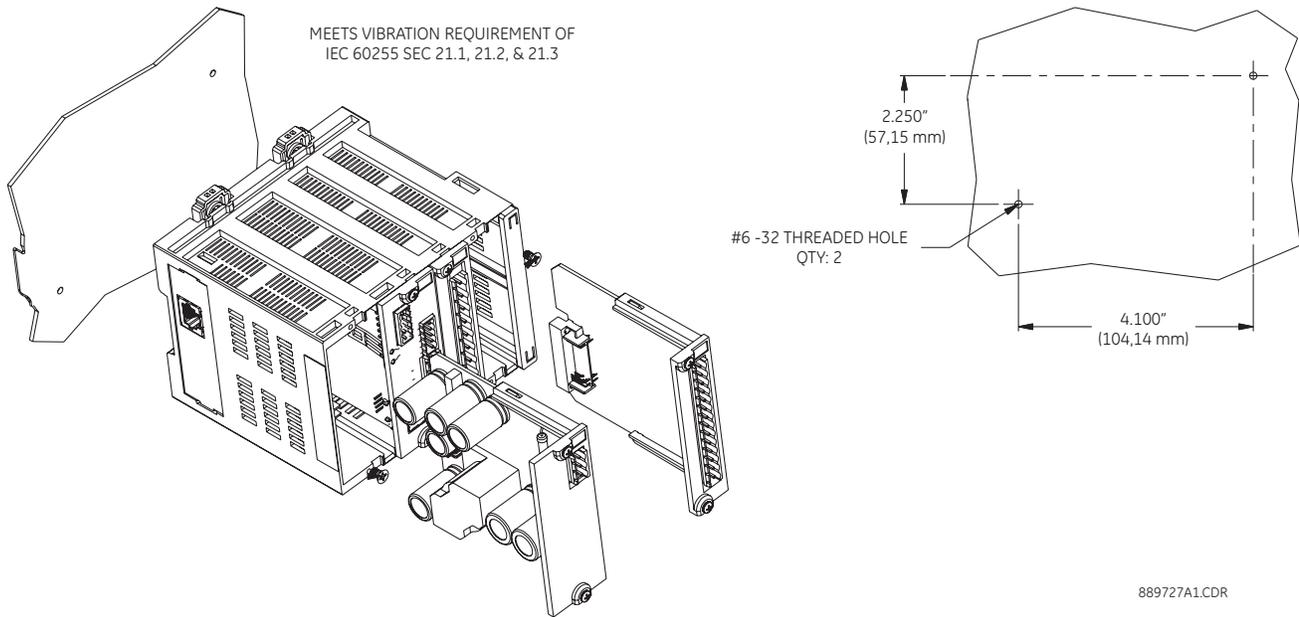
To avoid the potential for personal injury due to fire hazards, ensure the unit is mounted in a safe location and/or within an appropriate enclosure.

Figure 4: DIN rail mounting



The screw mount for high vibration environments is illustrated below.

Figure 5: Screw mounting



Module withdrawal and insertion



Module withdrawal and insertion may only be performed when control power has been removed from the unit. Inserting an incorrect module type into a slot may result in personal injury, damage to the unit or connected equipment, or undesired operation!

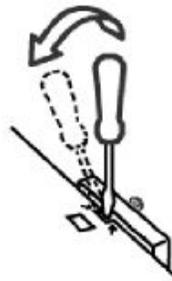


Proper electrostatic discharge protection (for example, a static strap) must be used when coming into contact with modules while they are removed from the MX350.

The MX350 is a modular protection system. This allows for easy withdrawal and insertion of modules for fast replacement. Modules must only be replaced in their original factory configured slots.

Use the following procedure to withdraw a module.

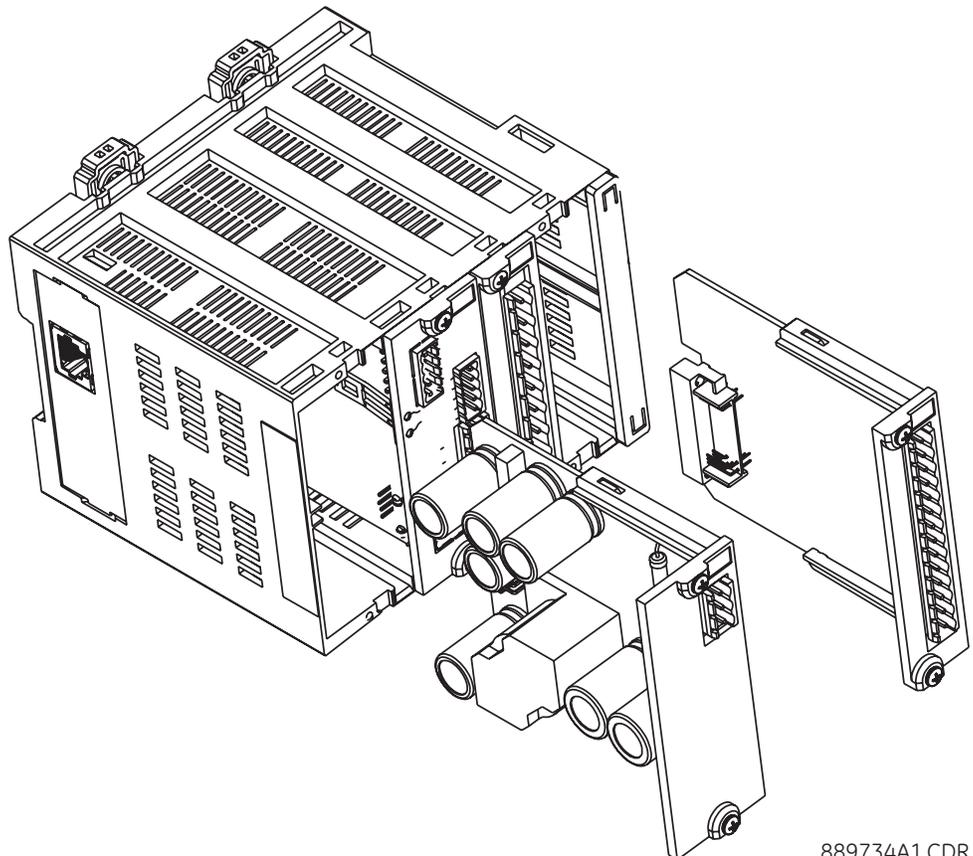
1. Ensure that control power has been removed from the MX350.
2. Record the slot location of the module to ensure that the same or replacement module is inserted into the correct slot.
3. Remove the two captive screws at the top and bottom of the module.
4. Slide a flat-blade screwdriver into the opening above the module marked by the two arrows on top of the MX350 case.
5. Press down on the screwdriver and pivot towards the unit to unlatch the module from the MX350 case.

Figure 6: Removing a module from the MX350

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Use the following procedure to insert a module.

1. Ensure that control power has been removed from the MX350.
2. Ensure that the module is being inserted into the correct slot.
3. Align the module card edges with the slot track as shown in the diagram below.
4. Gently slide the modules into the slot until the modules latch into the opening marked by the two arrows on top of the MX350 case.
5. Attach the two captive screws to anchor the module to the case (use a tightening torque of 3.5 lb.-in.).

Figure 7: Inserting modules into the MX350

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Module and terminal identification

The MX350 input/output and metering modules are labeled with the “IO_” prefix followed by a one-character identifier as follows.

Table 1: Input/output and metering module nomenclature

Module	Description
IO_A	CT module
IO_B	VT module
IO_K	4 inputs, 4 outputs, plus relay for engine control
IO_L	7 inputs, 5 outputs

The MX350 terminals are labeled with a two-character identifier. The first character identifies the module slot position and the second character identifies the terminals within the module. For example, the first terminal in a module in slot F is identified as “F1”.



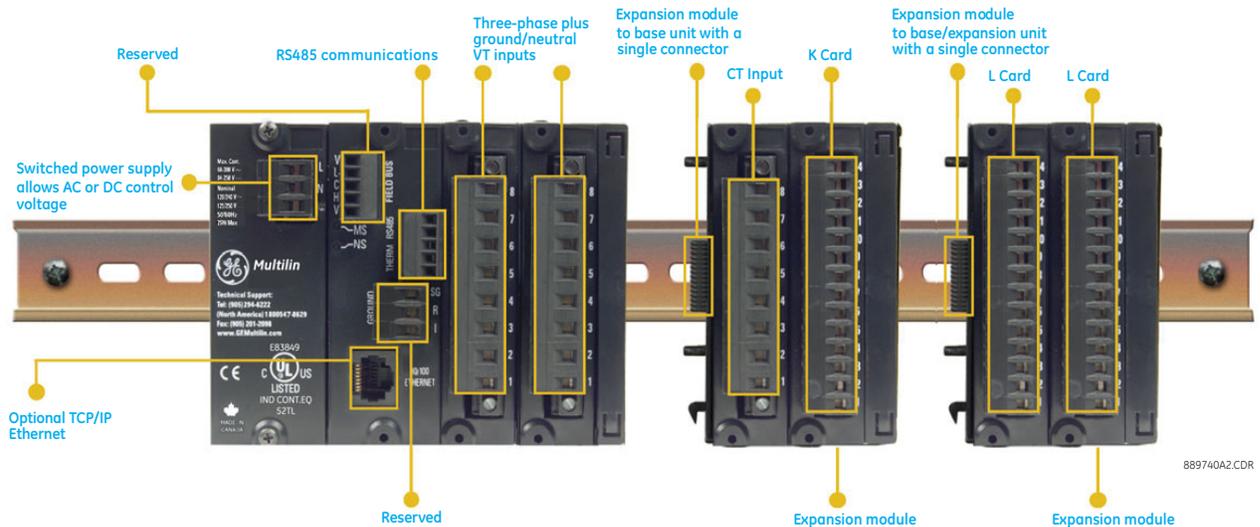
NOTE

Do not confuse the slot designation with the module ordering designation. That is, terminal “F1” does not imply an IO_F module. Rather, it indicates the first terminal of whatever module is in slot F, which can only be an IO_K module.

Electrical installation

This section describes the electrical installation of the MX350 system. An overview of the MX350 terminal connections is shown below.

Figure 8: MX350 terminal connection overview



The MX350 can contain up to ten modules. The first four modules (slots A through D) reside in the base unit while all subsequent modules (slots E and J) reside in expansion units. Each expansion unit can contain up to two modules. Slots A through G make up the basic MX350. The next three modules (slots H through J) are optional I/O modules.

Table 2: Module slot position

Slot	Module types
A	Power supply module
B	CPU module with communications
C	IO_B module
D	IO_B module
E	IO_A module (optional)
F	IO_K module
G	IO_L module
H	IO_L module (optional)
I	IO_L module (optional)

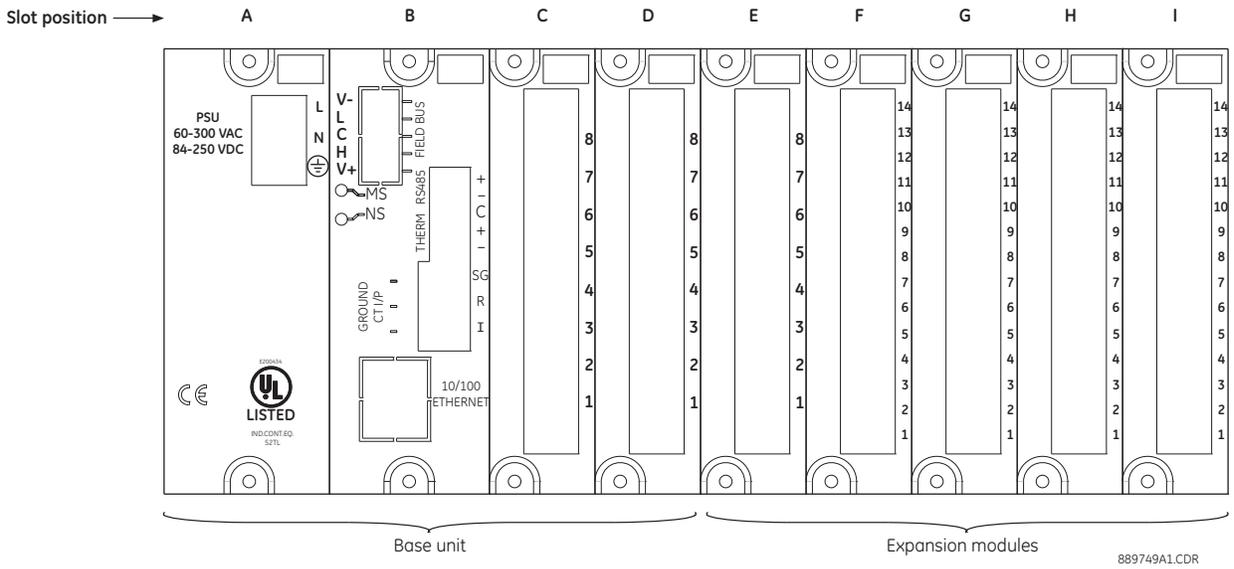
The following figure shows a typical module arrangement for an expanded unit.



Use gauge size appropriate for the voltage and current draw of the device.

The MX350 is not to be used in any way other than described in this manual.

Figure 9: Typical module arrangement



Power supply module

The power supply module in slot A supplies control power to the MX350 system. A supply voltage between 60 to 300 V AC or 84 to 250 V DC is required to power the MX350



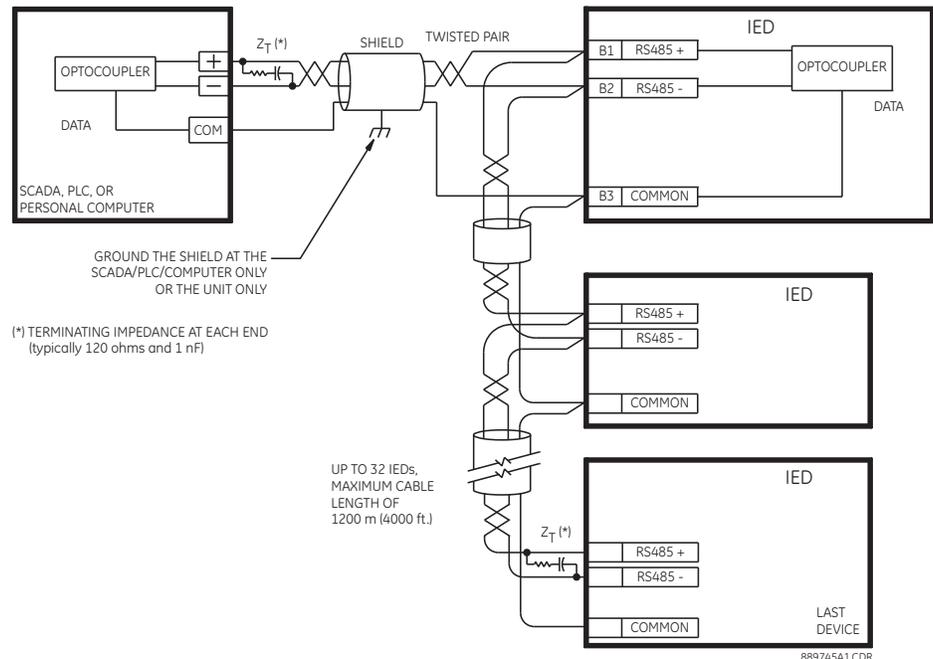
Check the voltage rating of the unit before applying control power! Control power outside of the operating range of the power supply will damage the MX350.

CPU module

The main CPU module and optional communications board is contained in slot B. The main CPU module provides a Modbus RTU RS485 port. The optional communications board provides an Ethernet port.

RS485 connections

Figure 10: Typical RS485 connection



One two-wire RS485 port is provided. Up to 32 MX350 IEDs can be daisy-chained together on a communication channel without exceeding the driver capability. For larger systems, additional serial channels must be added. Commercially available repeaters can also be used to add more than 32 relays on a single channel. Suitable cable should have a characteristic impedance of 120 ohms (for example, Belden #9841) and total wire length should not exceed 1200 meters (4000 ft.). Commercially available repeaters will allow for transmission distances greater than 1200 meters.

Voltage differences between remote ends of the communication link are not uncommon. For this reason, surge protection devices are internally installed across all RS485 terminals. Internally, an isolated power supply with an optocoupled data interface is used to prevent noise coupling.



To ensure that all devices in a daisy-chain are at the same potential, it is imperative that the common terminals of each RS485 port are tied together and grounded only once, at the master or at the MX350. Failure to do so may result in intermittent or failed communications.

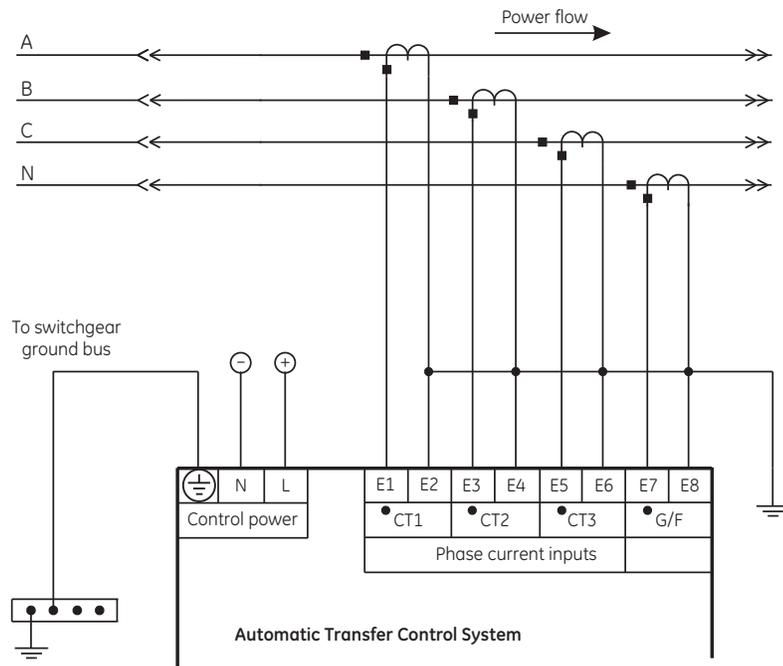
The source computer/PLC/SCADA system should have similar transient protection devices installed, either internally or externally. Ground the shield at one point only, as shown in the figure above, to avoid ground loops.

Correct polarity is also essential. The MX350 IEDs must be wired with all the positive (+) terminals connected together and all the negative (-) terminals connected together. Each relay must be daisy-chained to the next one. Avoid star or stub connected configurations. The last device at each end of the daisy-chain should be terminated with a 120 ohm ¼ watt resistor in series with a 1 nF capacitor across the positive and negative terminals. Observing these guidelines will ensure a reliable communication system immune to system transients.

Input/Output modules

Phase current inputs (IO_A module)

Figure 11: Typical phase current input connections



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The MX350 has three channels for phase current inputs, plus an additional channel input for ground/neutral current, each with an isolating transformer. The phase CTs should be chosen so the nominal current is not less than 50% of the rated phase CT primary. Ideally, the phase CT primary should be chosen such that the nominal current is 100% of the phase CT primary or slightly less, never more. This will ensure maximum accuracy for the current measurements. The maximum phase CT primary current is 4000 A.

The MX350 measures up to 1.5 times the phase current nominal rating. CTs with 1 A or 5 A secondaries must be used if the FLA is greater than 5 A. The chosen CTs must be capable of driving the MX350 phase CT burden.



Polarity of the phase CTs is critical for negative-sequence unbalance calculation, power measurement, and residual ground current detection (if used).

Phase voltage inputs (IO_B module)

The MX350 has three channels for AC voltage inputs. There are no internal fuses or ground connections on the voltage inputs. Polarity is critical for correct power measurement and voltage phase reversal operation.

Figure 12: Wye voltage connection

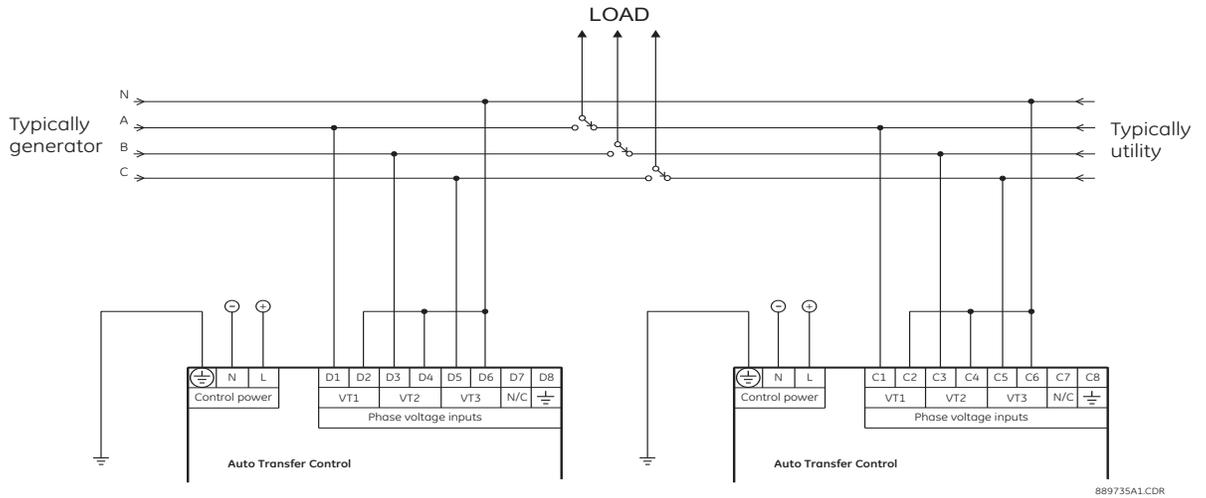
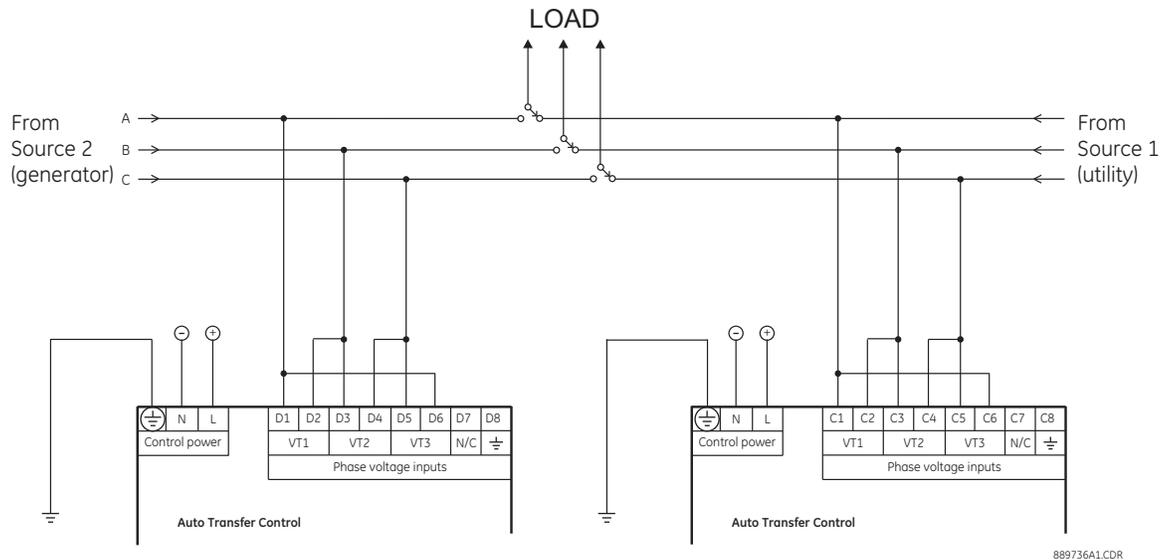


Figure 13: Delta voltage connection

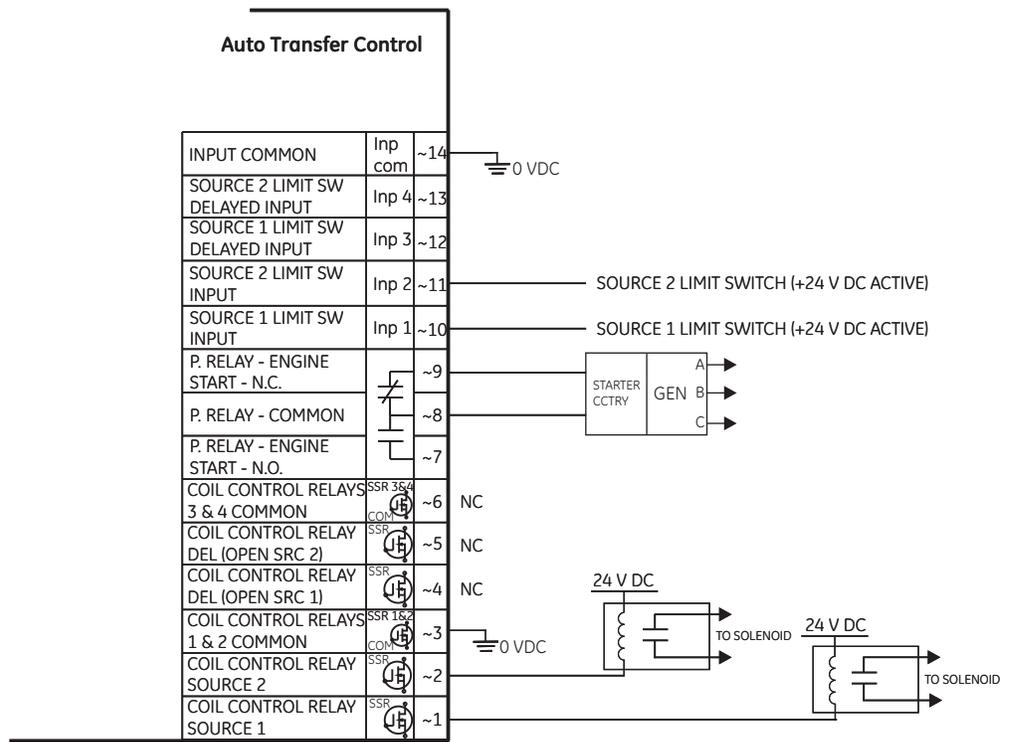


Type IO_K module connections

The IO_K module handles the automatic delayed start of the engine in case there is a total power outage, i.e. Source 1 power fails and the MX350 is not powered by an auxiliary power source. The terminal assignments are as follows:

Terminal	Type	Function	Type
F1	Output	S1 Sol Relay	N.O.
F2	Output	S2 Sol Relay	N.O.
F3	N/A	Common F1, F2	N/A
F4	Output	S1 Del Sol Relay	N.O.
F5	Output	S2 Del Sol Relay	N.O.
F6	N/A	Common F4, F5	N/A
F7	Output	Engine Start Signal (P Relay)	N.O.
F8	N/A	Engine Start Signal, Common	N/A
F9	Output	Engine Start Signal (P Relay)	N.C.
F10	Input	SN Limit Switch	pos.
F11	Input	SE Limit Switch	pos.
F12	Input	SNO Limit Switch	pos.
F13	Input	SEO Limit Switch	pos.
F14	N/A	Input Common	N/A

Figure 14: IO_K module connections - standard ATS



Type IO_L module connections

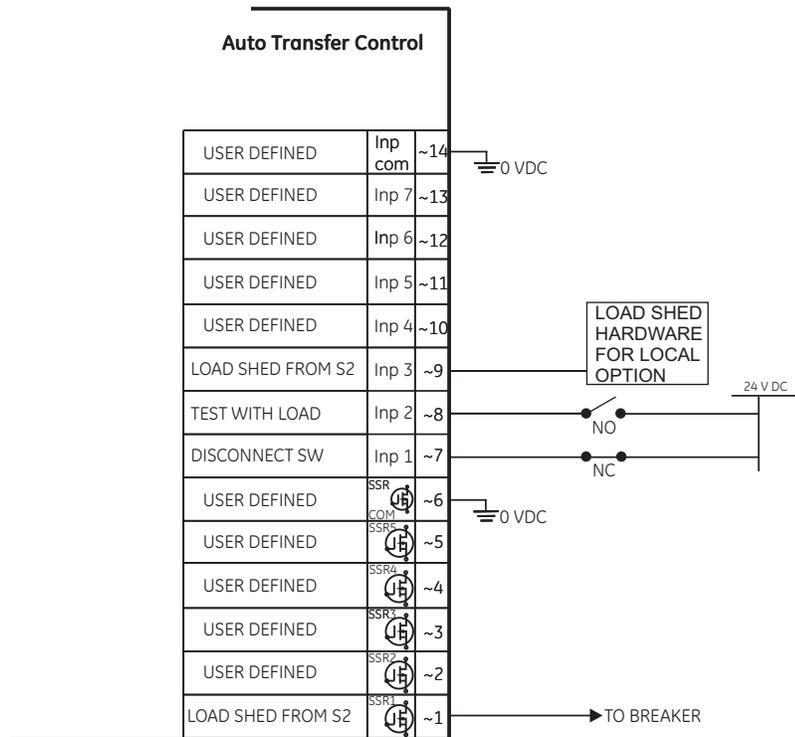
IO_L modules provide all user configurable I/O. Additionally, some of the I/O points on the first L module in slot G are used for some factory configured I/O. The terminal configuration is as follows:

Terminal	Terminal	Terminal	Type	Function
G1	H1	J1	Output	Output 1
G2	H2	J2	Output	Output 2
G3	H3	J3	Output	Output 3
G4	H4	J4	Output	Output 4
G5	H5	J5	Output	Output 5
G6	H6	J6	Common	Common, Outputs 1 to 5
G7	H7	J7	Input	Input 1
G8	H8	J8	Input	Input 2
G9	H9	J9	Input	Input 3
G10	H10	J10	Input	Input 4
G11	H11	J11	Input	Input 5
G12	H12	J12	Input	Input 6
G13	H13	J13	Input	Input 7
G14	H14	J14 </td <td>Common</td> <td>Common, Inputs 1 to 7</td>	Common	Common, Inputs 1 to 7



Terminals G7 and G8 are always used as DS and Q2, respectively. Depending on the type of switch and the features ordered, Terminals G1 through G5 as well as G9 through G13 may not be available for customer configuration.

Figure 15: IO_L module - standard ATS



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MX350 Automatic Transfer Control System

Chapter 3: Interfacing with the MX350 AT Controller

There are four methods of interfacing with the MX350 ATS Controller.

- Interfacing via the graphical control panel.
- Interfacing via remote inputs.
- Interfacing via communicated inputs.
- Interfacing via the EnerVista™ MX350 Setup software.

This section provides an overview of the interfacing methods available with the MX350. For additional details on interface parameters (for example, settings, actual values, etc.), refer to the individual chapters.

Graphical control panel

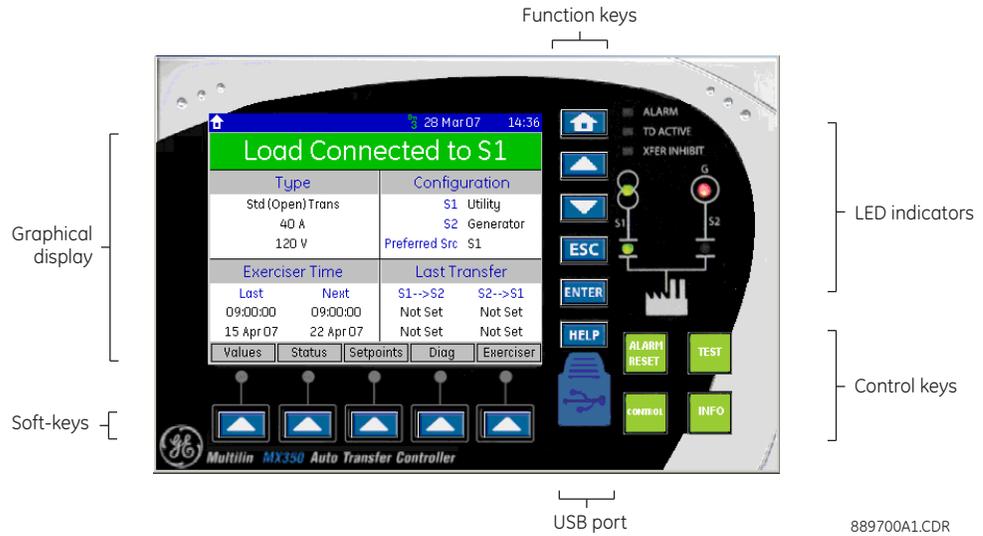
The MX350 graphical control panel provides the operator with rapid access to relevant information and controls using intuitive sequences. It also provides all available information and setting control, again with intuitive sequences.

Introduction to the graphical control panel

The central feature of the graphical control panel is a 89 mm (3.5-inch) 320 by 240 pixel backlit color LCD screen. The panel also contains keys (pushbuttons) that control the display and perform commands. In addition, the interface contains ALARM RESET, TEST, CONTROL, and INFO direct acting control pushbuttons.

The display also contains several LED indicators that provide a summary of the machine status. Details are displayed on the screen when the user navigates to the appropriate page.

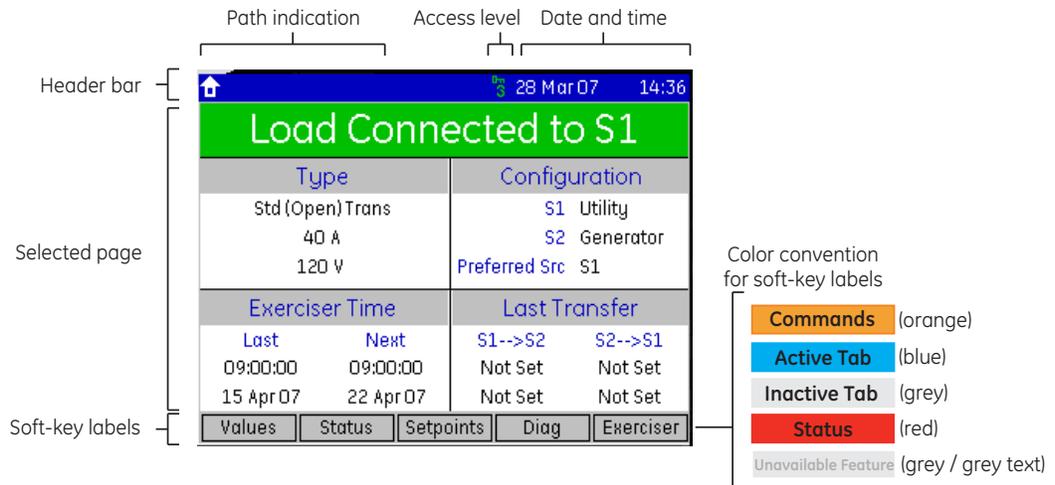
Figure 1: MX350 front panel with example default display



Graphical display

Each display page consists of the three components shown below.

Figure 2: Graphical display overview



The header bar (white text on a blue background) displays the hierarchical path name, the date and time in 24-hour format, and the current password access level. The hierarchical path is always displayed on the left top side of the graphical display. The present time is displayed on the right top side.

The soft-key labels are indicated on the bottom line. The soft-keys are used for navigation, performing functions, and for acknowledgement.

- Navigation: soft-keys can be used to traverse across and down the hierarchy of pages.
- Functional: soft-keys can be used to perform page-specific functions.
- Acknowledgement: soft keys can be used to acknowledge popup windows.

Soft-keys labels change to show relevant selections for the displayed screen. The color of each soft-key label indicates its functionality. Soft-keys are highlighted for the displayed page, unauthorized keys are “greyed-out”, and unused keys are not displayed.

The remainder of the screen shows the selected page. Pages are organized in a hierarchical or tree-based menu structure. To improve readability, some pages are labeled with rectangular outlines or colored backgrounds. Some pages contain too many fields to display at once. These pages display arrows bars at the right edge to indicate that the page continues below the screen. When recalled, scrolled pages are re-positioned at the top of the page.

Fields display actual value or setting information, and have behaviours that allow help display, editing, and control.

Each Actual Value analog field displayed on the home page has an associated alarm limit and changes color to orange when that limit is exceeded. Fields with an associated trip limit change their color to red when that limit has tripped. Fields that are disabled or unavailable are greyed-out.

Keypad

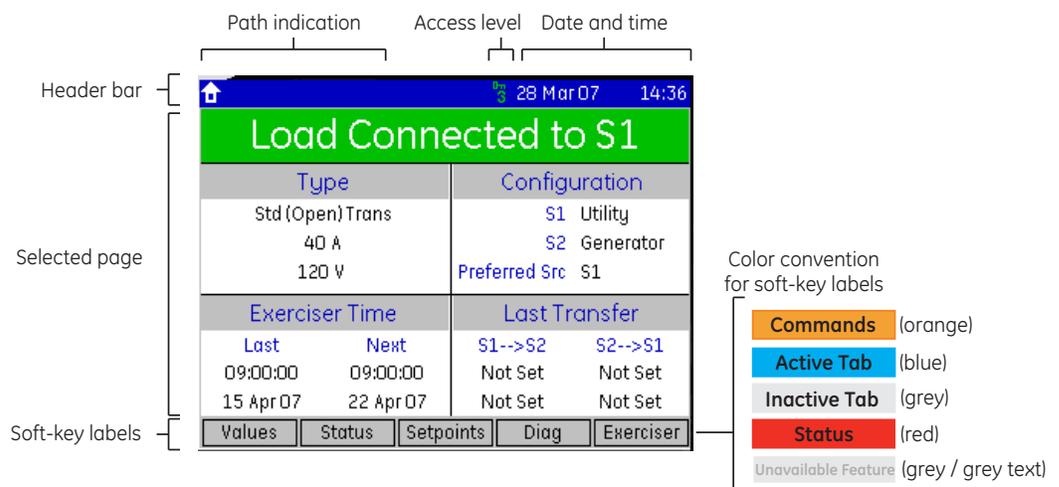
The function keys perform the labeled functionality. The summary of function key operation is shown below.

Table 1: Summary of function key operations

Key	Operation
HOME	Single press recalls the home page; double press recalls the default display
UP	Scroll up page, select field, tab to next field, increment value
DOWN	Scroll down page, select field, tab to previous field, decrement value
ESC	Single press closes pop-up, cancels editing, deselects field, moves to previous page; sustained press logs out (cancels security passcode entry)
ENTER	Single press freezes scrolling and selects field, edits selected field, saves edited value; double press sets the selected field/page as default; sustained press logs in (enter security passcode)
HELP	Displays context sensitive help and Modbus address

The HOME key always recalls the root or home page. The home page allows access to all sub-pages and also contains a status and process values summary. Double pressing the HOME key recalls the default display. Like a screen-saver, the default display appears after a period of inactivity and displays user-selected information. A typical display is shown below, indicating that the system load is connected to the utility.

Figure 3: Typical default display (actual size)



The UP and DOWN keys function in different ways depending on their context.

- Where a scroll bar is displayed, the UP and DOWN keys scroll the page up and down.

- Where there is no scroll bar or it is greyed-out, the first press of the UP and DOWN keys selects the first field. Subsequent presses tab up and down through the fields, scrolling as required.
- When a field is open for editing, the UP and DOWN keys increment/decrement the value of that field.

The ENTER key functions in different ways depending on its context.

- If there are no selected fields, the ENTER key will freeze any scroll bars and select the first field on the display.
- If a field is selected, pressing ENTER will attempt to open it for editing.
- If a field is opened for editing, pressing enter will exit the edit sequence.
- Double pressing the ENTER key at any time selects the displayed page as the default display.
- A sustained press on ENTER prompts the security passcode and displays a dialog box that allows passcode entry.

For example, pressing and holding the ENTER key, or attempting a control where a password is required, displays the following page.

Figure 4: Passcode entry dialog box



The ESC key functions in different ways depending on its context.

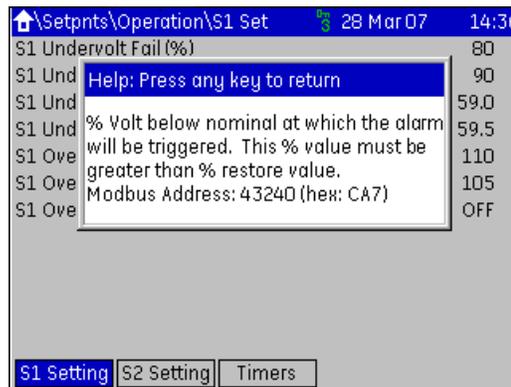
- If a pop-up dialog box is displayed, the ESC key closes it.
- If an edit sequence is in progress, the ESC key cancels the edit.
- If a field is selected, the ESC key de-selects it.
- In all other instances, the ESC key moves back one page in the menu structure.
- A sustained press on the ESC key clears the security passcode and prompts for confirmation.

The HELP key functions in different ways depending on its context.

- If a field is selected, the HELP key displays a help window for the field.
- If a help window is displayed, the HELP key closes it.

Help windows are also closed when any other key is pressed. A typical help window is shown below.

Figure 5: Typical MX350 help window



Pressing an invalid key displays a message explaining the problem and recommending a solution. Where the keypress is invalid because a security passcode is required, the dialog window will be a passcode entry window.

Control keys

The MX350 has four large direct control keys: ALARM RESET, TEST, CONTROL, and INFO.

- ALARM RESET: allows the user to silence any audible alarm.
- TEST: takes the user directly to the System Test Screen.
- CONTROL: takes the user directly to the Control Screen that allows the user to select certain modes of operation.
- INFO: takes the user directly to the Event Report screen.

LED indicators

The control panel LEDs summarize the status of the transfer switch:.

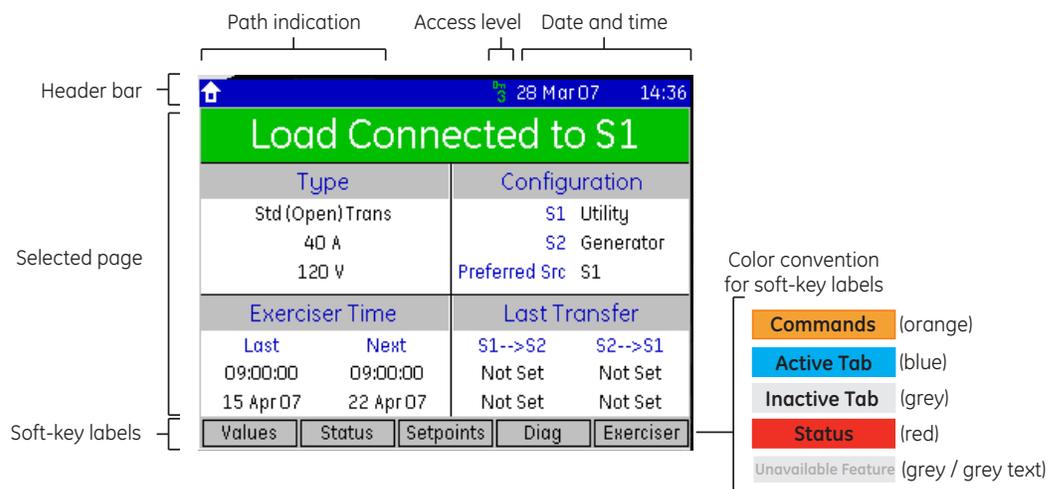
- ALARM: indicates that there is a problem with the ATS, or that a user configurable alarm condition is active, or that the ATS is not in AUTO mode.
- TD ACTIVE: indicates that the controller is timing before taking the next control action.
- XFER INHIBIT: indicates that the controller will not automatically transfer to the other source and that operator intervention is required.
- S1 (Source-1, typically utility power) Available LED: indicates that S1 is present and within user defined limits.
- S2 (Source-2, typically generator power) Available LED: indicates that S2 is present and within user defined limits.
- S1 (Utility) Status LED: indicates that the load is connected to S1 power.
- S2 (Generator) Status LED: indicates that the load is connected to S2 power.

Home display page

The home page represents the root of the entire menu structure. An overview of the system status is displayed which indicates the following items:

- Load connected to Source 1 or Source 2
- Type of ATS being controlled
- Amperage rating of ATS
- Voltage rating of ATS
- Source 1 type
- Source 2 type
- Preferred source selection
- Information on the System Exerciser
- Information regarding the last load transfer.

Figure 7: Typical MX350 home display



The **Values**, **Status**, **Setpoints**, **Diag**, and **Exerciser** soft-keys are displayed on the home page. The **Status** soft-key will be highlighted if any alarm condition is present. Pressing any of the soft-keys displays the first sub-page in the hierarchy. Pressing the ESC key within any of these sub-pages returns directly to the home page.

Default display

The default display is automatically shown when no control key has been pressed for five minutes. It can also be recalled at any time by double-clicking the **HOME** key.

The default display can be set to the home page, any actual values page, or any status page. A page can be set to be the default display by navigating to that page and double-pressing the **ENTER** key. The default display setting is saved in non-volatile memory.

If a page is set as the default display, the soft-keys will be those of the selected page.

Actual values pages

The actual values pages are divided into five sections.

- Summary (overview of primary actual values)
- Amps (metered current values)
- Volts (metered voltage values)
- Power (metered power values)
- PQ (metered power quality values)

The actual values summary page displays a summary of the analog actual values. The current, voltage, power, and PQ actual values pages are accessible from the summary page through the corresponding soft-keys at the bottom of the screen.

Some typical actual values screens are shown below.

Figure 8: Typical actual values summary page

S1		S2		Power	
415	Vab	0	Vab	0.5	kW
415	Vbc	0	Vbc	0.0	kVA
415	Vca	0	Vca	0.3	kvar
60.10	Hz	0.00	Hz	0.80	lag

Figure 9: Typical actual values current page

Ia	0.8	A
Ib	0.8	A
Ic	0.8	A
Iavg	0.8	A
In	0.0	A

Figure 10: Typical actual values voltage page

S1		S2	
415	Vab	0	Vab
415	Vbc	0	Vbc
415	Vca	0	Vca
60.10	Hz	0.00	Hz

Status pages

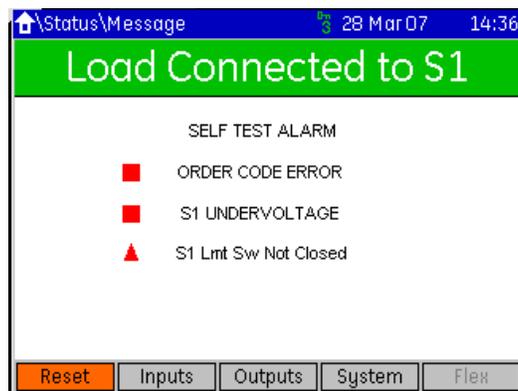
The status pages provide the user with up-to-date information on the current status of the ATS that the MX350 is controlling.

Status pages are divided into five sections.

- Message (displays all locked out conditions plus conditions such as alarms, internal faults, control status, etc.).
- Inputs (displays the present state of assigned contact inputs).
- Outputs (displays the present state of assigned contact outputs).
- System (displays the present state of the communications interface).

- Flex (displays the present state of the FlexLogic™ engine and number of lines used.)
- A typical display is shown below:

Figure 11: Typical status message page



Message types are classified by color and associated icon type, as follows::

- Red Triangle = Alarm
- Orange Square = Status
- Black Text = Information Message

Message can have an associated countdown timer, if applicable.

When the controller is first powered up, the status page will display any parameters that must be entered for proper operation of the associated ATS.

Inhibits

These include Transfer Inhibits like Q3 or Q7.

Faults / Alarms

These trigger depending on the respective protection setpoints. A typical example would be "S1 Failure."

Information Messages

Information can be one of two types:

- information only
- information with navigation (marked on the Status page with an **Enter** symbol on the right)

By pressing the **Enter** key when an information message with navigation is highlighted, the Graphical Control Panel will take the user directly to the respective page.

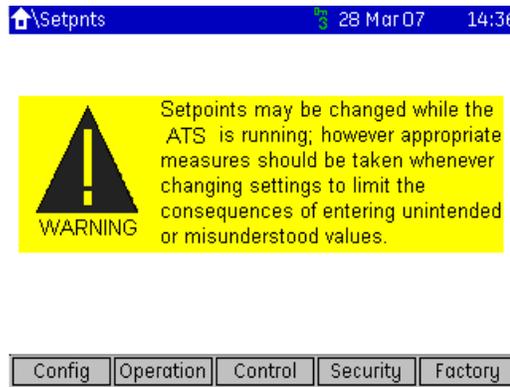
Setpoints pages

The Setpoints pages are divided into five sections.

- Config (contains basic configuration setpoints)
- Operation (contains range limits for both power sources and timer values for transfer operations)
- Control (contains basic control function setup, also accessible via the green CONTROL key)
- Security (contains the password security setpoints)
- Factory (for access by GE only)

The **Home > Setpoints** page displays a warning message concerning unexpected performance if setpoints are improperly changed. It is recommended that all relay outputs capable of causing damage or harm be blocked before a setpoints change is made and it is clear the relay is performing as intended with the new setpoints.

Figure 12: setpoints home page

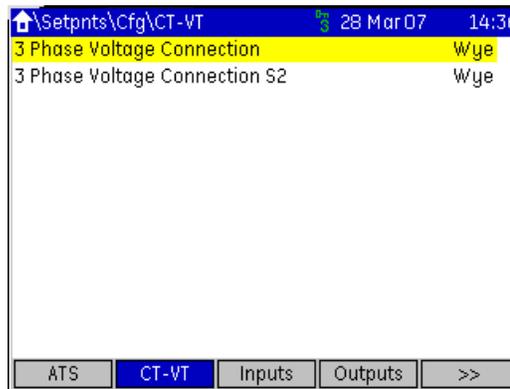


To streamline the setpoint entry process, the graphical control panel will not display setpoints that are not relevant at the specific instance. For instance, if a process interlock function is disabled, the six setpoints associated with that interlock function will not be displayed. If all ten process interlock functions are disabled, the MX350 will display only 10 successive "Disabled" list items. If one of the interlock functions were then enabled, then room is made on the display for the six setpoints which are now functional.

The setpoint pages are in a common format of up to twelve lines. Each line has a column that displays the setpoint name and unit, and another column displaying the value entered.

The Home > Setpoints > Config > CT-VT page is shown below.

Figure 13: Typical setpoints page



Diagnosics pages

The diagnostic pages are divided into five sections.

- Events (event recorder data for up to 256 events)
- Stats (statistical data on the last transfer event)
- Phasors (metered phasor data)
- About (product information)

Typical diagnostic pages for Events, Stats, Phasors, and Product Information are shown below.

Figure 14: Typical Events page

Diag\Events			28 Mar 07	14:36
Total Number of Events Since Last Clear			10	
#	Date/Time	Cause		
0	Not Set/Not Set	No Event/Fault To Date		
3	14JAN09:49:28:562	P Relay Status		
2	14JAN09:49:23:341	S1 Connected		
1	14JAN09:49:23:135	S2 Disconnected		
0	Not Set/Not Set	No Event/Fault To Date		
0	Not Set/Not Set	No Event/Fault To Date		
0	Not Set/Not Set	No Event/Fault To Date		
0	Not Set/Not Set	No Event/Fault To Date		
0	Not Set/Not Set	No Event/Fault To Date		
0	Not Set/Not Set	No Event/Fault To Date		
0	Not Set/Not Set	No Event/Fault To Date		
Clear			Stats	Phasors
			About	>>

Figure 15: Typical Stats page

Diag/Stats		28 Mar 07	14:36
Last Primary Source Fail Date		23 Mar 2007	
Last Primary Source Fail Time		03:43:12:433	
Last Transfer Reason		Outage	
Last Transfer to S2 Date		Not Set	
Last Transfer to S2 Time		Not Set	
Last Transfer to S1 Date		Not Set	
Last Transfer to S1 Time		Not Set	
Days Powered Up (days)		23	
Total Time On S1 (hrs)		4354	
Total Time On S2 (hrs)		27	
Total Primary Source Failures		0	
Total Time Load w/o Power (s)		0 ↓	
Events		Clear	Phasors
		About	>>

Figure 16: Typical Phasors page

Diag/Phasors				28 Mar 07	14:36
3Ph	3.0	S2 In Sync w/ S1		3Ph	
S1	V	S2	V		
Va	240 0	Va	0 0		
Vb	240 120	Vb	0 0		
Vc	240 240	Vc	0 0		
Freq	60.10	Freq	0.00		
Events		Stats	Phasors	About	>>



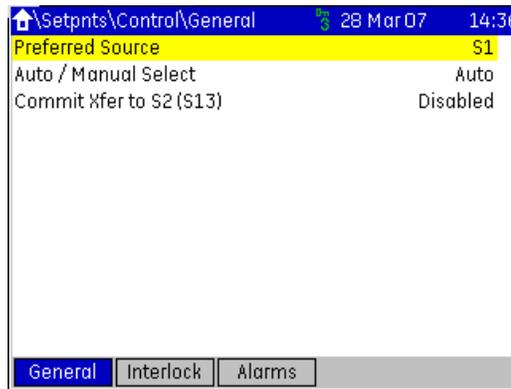
NOTE

Voltage metering displayed on this page is L-N for a 3-phase system. L-L values are shown on the Voltage Metering page. See the *Voltage Metering* section in the Actual Values chapter of this manual.

Control page

This page is used to view the active control modes. For example, selection of primary source, automatic vs manual initialization of transfer, etc.

Figure 17: Typical control page display



Refer to the *Control* chapter for details on control page functionality.

Popup windows

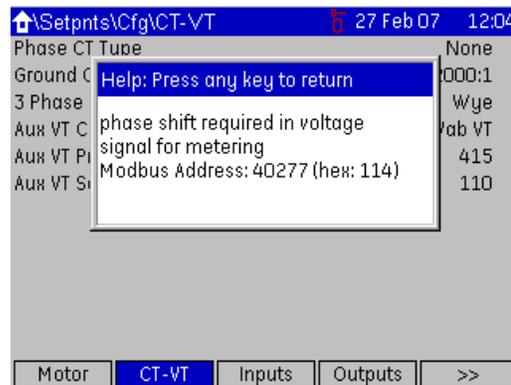
There are three types of popup windows:

- Setpoint editor popup windows.
- Help popup windows.
- Invalid operation popup windows.

Refer to the *Setpoints* chapter for details on setpoint editor popup windows.

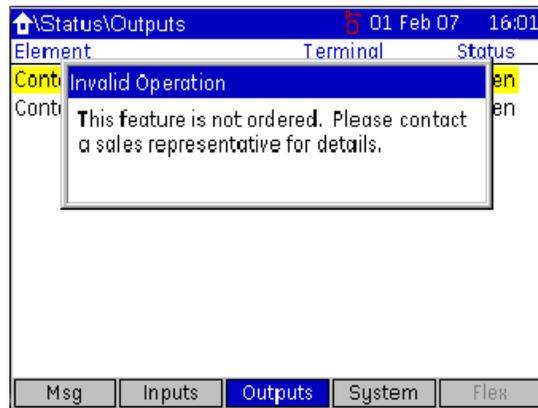
Help popup windows are initiated by pressing the **HELP** key. This will display help text for the active setpoint field.

Figure 18: Typical help popup window



Invalid operation popups explain the problem and provide direction on how to rectify it. This may also include invalid features or uninstalled options. Where a keypress is illegal because a security passcode is required, the popup is a passcode entry dialog box.

Figure 19: Typical invalid operation popup window



Help and illegal action popup windows remain open until they are acknowledged by clicking any soft or hard key, or until a pre-determined period of inactivity has passed.

MX350 programming techniques

To streamline the setting entry process, the graphical control panel omits non-functional settings from the display.



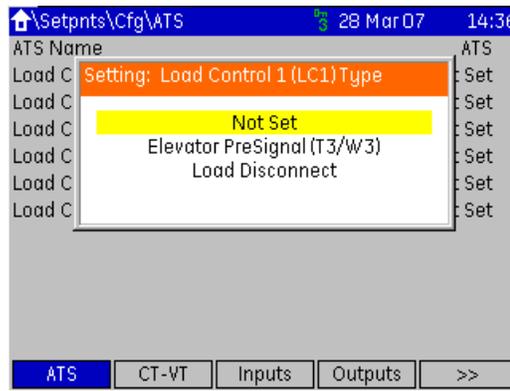
Settings may be changed while the Automatic Transfer switch panel associated with the Controller is energized. However, appropriate measures must be taken to limit the consequences of entering unintended or misunderstood setting values. Consequences of inappropriate settings to the specific application at hand include loss of protection, loss of control, and undesired starting or stopping.

Enumeration setpoints

Enumeration settings select from a limited set of values (for example, enabled or disabled). The following procedure describes how to edit an enumeration setting.

1. Use the soft-keys to select the relevant setting page.
2. Use the **UP** and **DOWN** keys to select the relevant setting field.
3. Press the **ENTER** key. A popup window will appear with a list of available values.
4. Use the **UP** and **DOWN** keys to select from the available values. If there are more than seven available values, then an arrow indicator will appear on the lower right of the popup to indicate additional selections.
5. Press the **ENTER** key when complete to exit the edit sequence. The selection will be automatically saved.
6. Press **Esc** to cancel the edit and leave the setpoint unchanged.

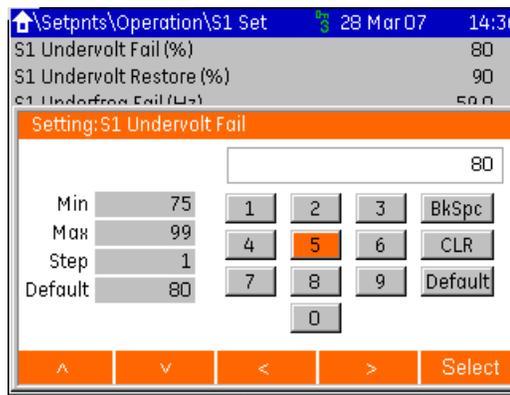
Figure 20: Enumeration setpoint editing



Numeric setpoints

Numeric setpoints accept a numerical value within a specific range. The numeric setpoint editor is a numeric input panel, with the current value shown on the number display. The minimum, maximum, step, and default values are shown on the left of the keypad, and the label of the setpoint being edited is displayed on the menu bar of the setpoint editor.

Figure 21: Numeric setpoint editor window



The navigational soft keys change the numeric key in focus, which is highlighted in orange. There are also five functional soft-buttons in the popup window.

- BkSpC: This key performs the backspace function, clearing the last digit or decimal from the display.
- CLR: This key clears the field's value from the display
- Default: This key returns the setpoint value to its default value.
- OFF: This key disables the setpoint and is visible only for setpoints that can be disabled.

In order to activate the functions offered by these buttons, the user has to highlight the appropriate button and press "Select".

The **UP** and **DOWN** front panel keys can also be used to increment and decrement the setpoint by its step value. Clicking the **ENTER** key verifies the displayed value. If the setpoint value is valid, it is stored as the new setpoint value and the editor is closed. Otherwise, an error statement is displayed and the **Default** soft-button is brought to focus. Clicking **HOME** before the value is stored cancels the edit sequence and recalls the home page.

The following procedure describes how to edit a numeric setting.

1. Use the navigation keys to select the relevant setting page.
2. Use the navigation keys to select the relevant setting field.

3. Press the **ENTER** key to open the numeric setpoint editor.
4. Use the navigational soft-keys to highlight the first digit of the new setpoint value.
5. Press the **SELECT** soft-key to select the highlighted digit.
6. Use the navigational soft-keys to highlight the next digit, then press **SELECT**.
7. When the new value has been fully entered, press the **ENTER** key to store the value and close the window.

Alphanumeric setpoints

Alphanumeric setpoints accept any alphanumeric value of a specified size and are generally used for labeling and identification purposes. When an alphanumeric setpoint is selected, the MX350 displays an alphanumeric setpoint editor window.

Figure 22: Alphanumeric setpoint editor



A flashing underline marks the current character. The “<” and “>” soft-keys shift the cursor left and right. When the cursor is at the extreme right hand side of the field and the field has not reached its maximum length of string input, the “>” key shifts the cursor to the right and sets the selected character to the space character. Up to 20 characters can be stored for alphanumeric setpoints. A long click of the “<” and “>” soft keys move the cursor to the first or last character in the string.

The up and down soft-keys increment and decrement the selected character through the character set. A long click of the up or down soft-keys sets the selected character to “a” and “Z”, respectively. The shift soft-key toggles the case of the character set. Pressing **ENTER** stores the selected value, while pressing **ESC** cancels the editing sequence and closes the popup editor.

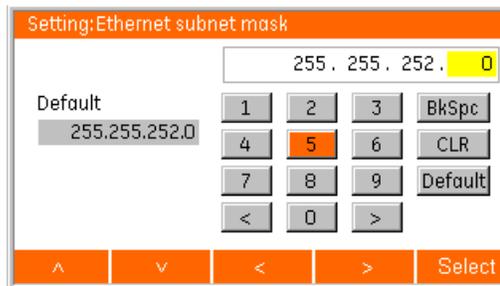
The following procedure describes how to edit an alphanumeric setting.

1. Use the soft-keys to select the relevant setting page.
2. Use the **ARROW** soft-keys to select the relevant alphanumeric setpoint field.
3. Press the **ENTER** key to open the alphanumeric setpoint editor.
4. The first character of the alphanumeric setting value will be marked with a flashing cursor (underline).
5. Use the **UP**, **DOWN**, **LEFT**, **RIGHT**, **SHIFT**, and **SPACE** soft-keys to change the indicated character.
6. Use the **LEFT** and **RIGHT ARROW** soft-keys to select and change more characters.
7. Press the **ENTER** key when complete to exit the edit sequence. The changes are automatically saved.

Date, time, and IP entry

The entry process for date, time, and IP setpoints follows the same convention as numeric setpoints, where the day, month, year, hour, minute, second, and each octet of the IP address are entered as separate fields. Input verification is performed for all fields of the setpoint when the **ENTER** key is pressed. As these are standard formats, the minimum, maximum and step value displays are removed. For date and time setpoints, a format string of DD/MM/YYYY or HH:MM:SS is included as a part of the setpoint label for reference when entering a new value.

Figure 23: IP address setpoint editor



Security access

There are three levels of security access allowing write access to setpoints, lockout reset, and firmware download. When there are no pop-ups present, a sustained press on the **ESC** key clears the security passcode. When operations are performed that require a higher level of security, a passcode entry dialog box automatically opens (for example, in entering factory page at read only security access).

Figure 24: Password entry dialog box



The encrypted key information appears only when the current security access level is 0.

EnerVista™ MX350 Setup Software

Although settings can be entered manually using the control panel keys, a PC can be used to download values through the communications port. The EnerVista™ MX350 Setup software is available from GE Multilin to make this as convenient as possible. With EnerVista™ MX350 Setup running, it is possible to:

- Program and modify settings
- Load and save setting files to and from a disk
- Read actual values
- Monitor status
- Read pre-trip data and event records
- Get help on any topic
- Upgrade the MX350 firmware

The EnerVista™ MX350 Setup software allows immediate access to all MX350 features with easy to use pull down menus in the familiar Windows environment. This section provides the necessary information to install EnerVista™ MX350 Setup upgrade the relay firmware, and write and edit setting files.

The EnerVista™ MX350 Setup software can run without a MX350 connected to the computer. In this case, settings may be saved to a file for future use. If an MX350 is connected to a PC and communications are enabled, the MX350 can be programmed from the setting screens. In addition, measured values, status and trip messages can be displayed with the actual value screens.

Software requirements

The following requirements must be met for the EnerVista™ MX350 Setup software.

- Microsoft Windows™ XP / 2000 is installed and running properly.
- At least 20 MB of hard disk space is available.
- At least 128 MB of RAM is installed.

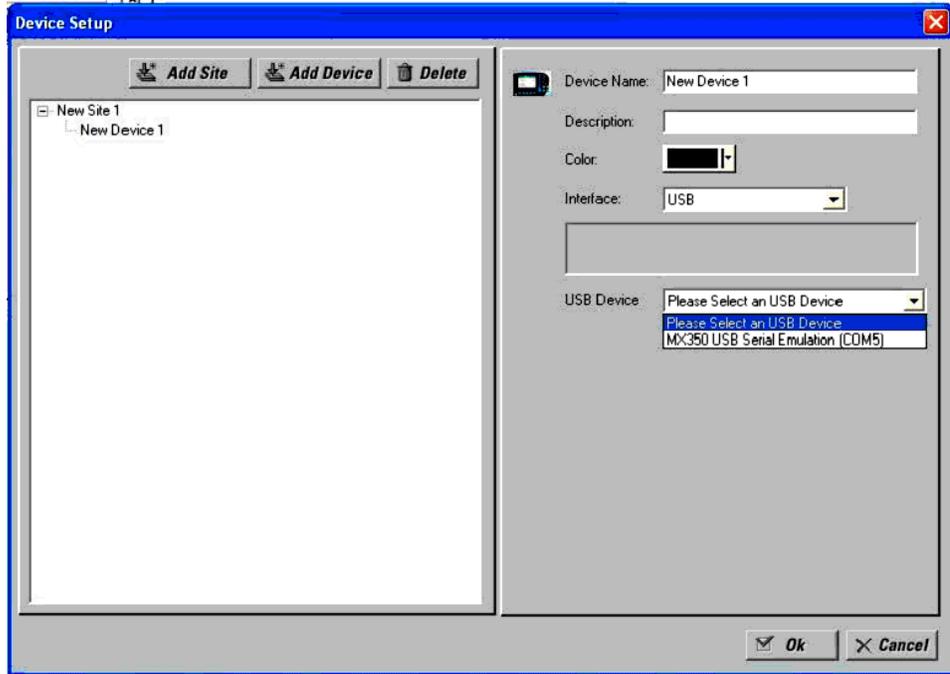
The EnerVista™ MX350 Setup software can be installed from either the GE EnerVista CD or the GE Multilin website at <http://www.GEmultilin.com>.

Troubleshooting the USB driver

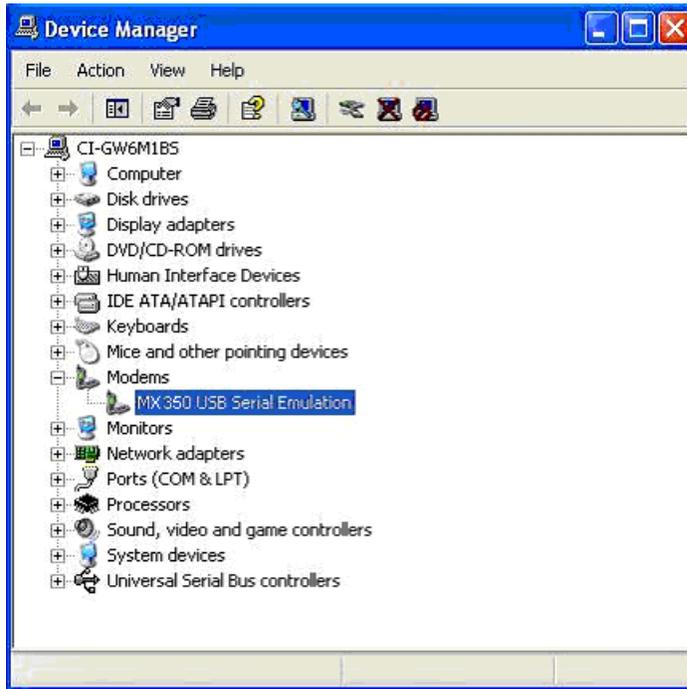
When the Setup Software is installed on the Windows 2000 or XP operating system, and the device is power recycled while the native USB port is still connected to the PC, the USB driver in the PC Program may get lost and the setup software may fail to recognize the USB device. If this happens, the 'MX350 USB Serial Emulation (COM #)' will be missing in the Setup Software's Device Setup window. To overcome the problem:

1. Remove the USB cable from the native port of the device.
2. Wait for 20 Seconds and connect the cable back to the native port of the device.

3. Check the Setup Software for the availability of the USB Device on the Device setup Window. It will automatically reappear on the 'USB Device' list as 'MX350 USB Serial Emulation (COM #)' as shown in the image below.



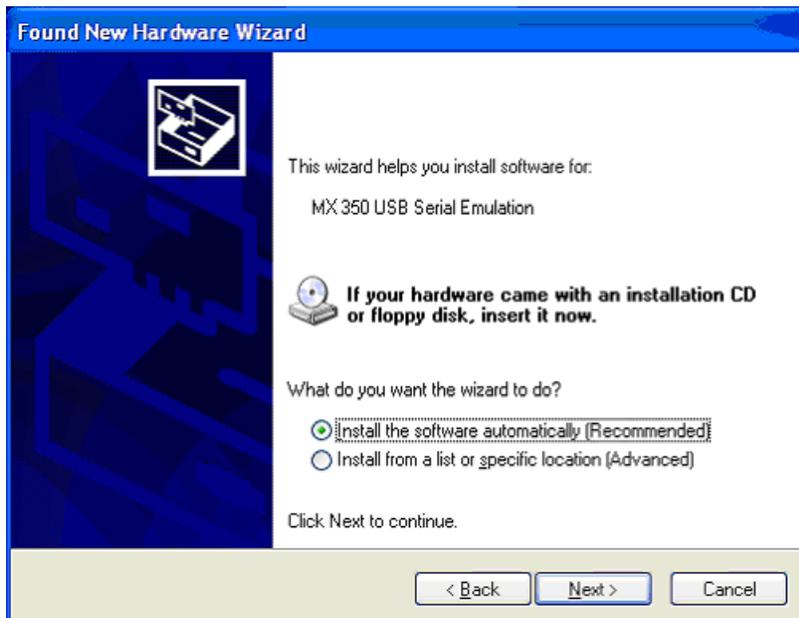
4. If the USB Device is not recognized automatically in the Setup Software, repeat the same procedure 2 or 3 times until the PC Program recognizes the USB device (and 'MX350 USB Serial Emulation (COM #)' reappears in dropdown of 'USB Device' list).
5. If problem still persists, uninstall the USB driver from Computer's 'Device Manager' under tree-branch **modems** from the Installation folder. To uninstall it, right click on **MX350 USB Serial Emulation** and select **Uninstall**.



- After the uninstall, remove the USB cable from the Device's native USB port, wait for at least 10 Seconds and reconnect it.
- Now the 'Found New Hardware Wizard' will open, select **No, not this time** and press the **Next** button.



- Select **Install the software automatically (Recommended)** and press the **Next** button.



9. Press **Continue Anyway**.



10. At the end press **Finish**.
 11. Check in the Setup Software for the availability of the USB Device on the Device setup Window. Now the device will reappear on the 'USB Device' list.
- For the current version, the USB driver can not be installed on Windows Vista Operating System and communication to the Device via the Native USB port is not supported.

Installing the EnerVista™ MX350 Setup software

After ensuring the minimum PC requirements indicated earlier, use the following procedure to install the EnerVista™ MX350 Setup software from the enclosed GE EnerVista CD.

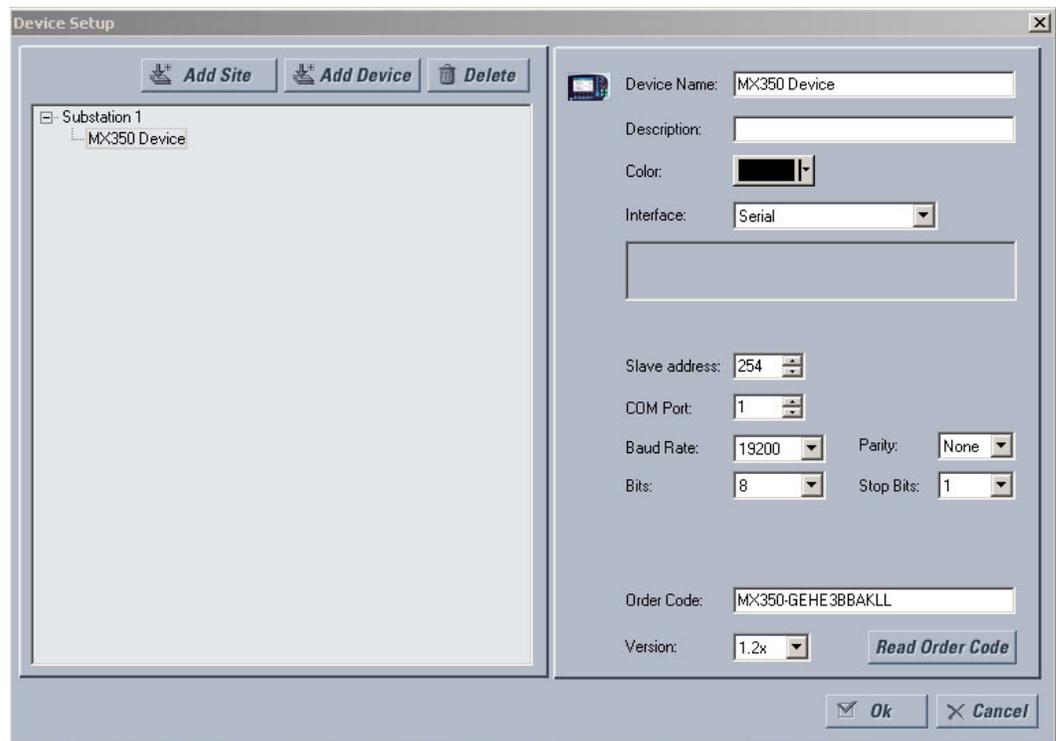
1. From the CD, run the MX350Setup.exe file on your computer.
2. Follow the installation instructions to install the EnerVista software on the local PC.
3. When installation is complete, start the EnerVista™ MX350 Setup application.

Connecting EnerVista MX350 Setup to the relay

Configuring serial communications

Before starting, verify that the cable is properly connected to either the USB port on the front panel of the device (for USB communications) or to the Serial port on the rear of the device. This example demonstrates a Serial connection.

1. Install and start the latest version of the software (available from the GE EnerVista CD). See the previous section for the installation procedure.
2. Click on the **Device Setup** button to open the Device Setup window and click the **Add Site** button to define a new site.
3. Enter the desired site name in the "Site Name" field. If desired, a short description of the site can also be entered. In this example, we will use "Substation 1" as the site name.
4. The new site will appear in the upper-left list in the window.
5. Click the **Add Device** button to define the new device.
6. Enter the desired name in the "Device Name" field and a description (optional) of the device.
7. Select "Serial Device" from the Interface drop-down list.



8. Select the relay as the USB device.
9. Click the **Read Order Code** button to connect to the device and upload the order code.
10. Click **OK** when the relay order code has been received. The new device will be added to the Site List window (or Online window) located in the top left corner of the main window.

The Site Device has now been configured for USB communications. Proceed to *Connecting to the Relay* below, to begin communications.

Using the Quick Connect feature

The **Quick Connect** button can be used to establish a fast connection through the front panel USB port of a relay. The following window will appear when the **QuickConnect** button is pressed:



As indicated by the window, the "Quick Connect" feature can quickly connect the software to a front port if the USB is selected in the interface drop-down list. Select "Relay" and press the **Connect** button.

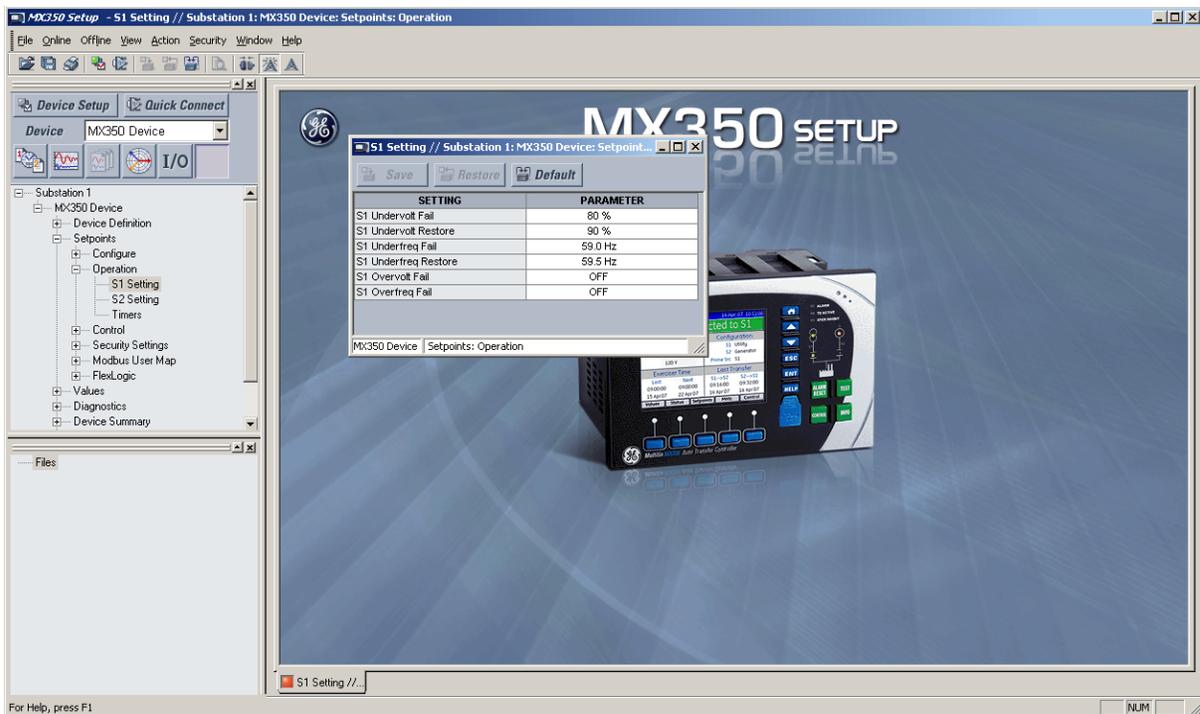
When connected, a new Site called "Quick Connect" will appear in the Site List window.

The Site Device has now been configured via the Quick Connect feature for either USB or Serial communications. Proceed to *Connecting to the Relay* below, to begin communications.

Connecting to the relay

Now that the communications parameters have been properly configured, the user can easily communicate with the relay.

1. Expand the Site list by double clicking on the site name or clicking on the «+» box to list the available devices for the given site.
2. Desired device trees can be expanded by clicking the «+» box. The following list of headers is shown for each device:
 - Device Definition
 - Setpoints
 - Values
 - Diagnostics
 - Device Summary
 - Status
 - Exerciser
 - Maintenance.
3. Expand any list item and double click on any item contained in the expanded list to open that item, as shown below:



4. The window related to that item will open with a corresponding status indicator tab on the lower left of the EnerVista SR3 Setup window.
5. If the status indicator is red, verify that the serial or USB cable is properly connected to the relay, and that the relay has been properly configured for communications (steps described earlier).

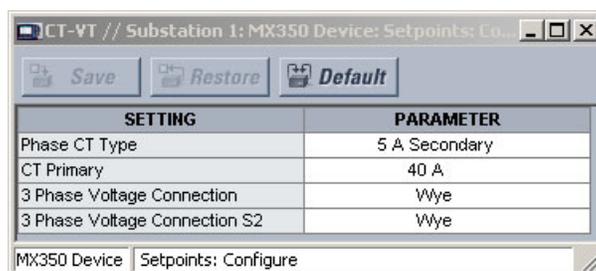
The "item" settings can now be edited, printed, or changed. Other windows can be displayed and edited in a similar manner. These windows can be arranged, and resized at will.

Working with setpoints and setpoint files

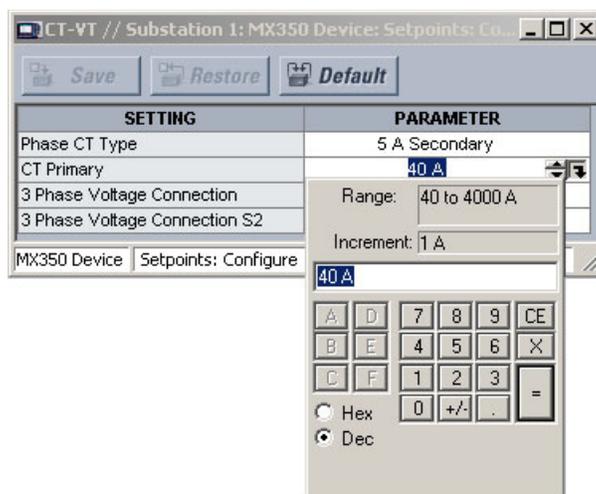
Engaging a device The software may be used in on-line mode (relay connected) to directly communicate with a relay. Communicating relays are organized and grouped by communication interfaces and into sites. Sites may contain any number of relays selected from the product series.

Entering setpoints The System Setup page will be used as an example to illustrate the entering of setpoints. In this example, we will be changing the current sensing setpoints.

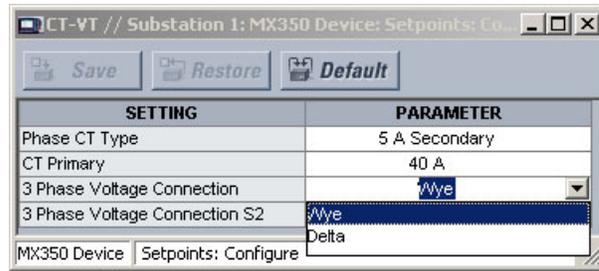
1. Establish communications with the relay.
2. Select the **Setpoint > Configure > CT-VT** menu item.
3. Select the CT Primary setpoint by clicking anywhere in the parameter box. This will display three arrows: two to increment/decrement the value and another to launch the numerical keypad.



4. Clicking the arrow at the end of the box displays a numerical keypad interface that allows the user to enter a value within the setpoint range displayed near the top of the keypad: Click = to exit from the keypad and keep the new value. Click on X to exit from the keypad and retain the old value.



5. For setpoints requiring non-numerical pre-set values (e.g. **CT Primary** below), clicking anywhere within the setpoint value box displays a drop-down selection menu arrow. Select the desired value from this list.



- For setpoints requiring an alphanumeric text string (e.g. "relay name"), the value may be entered directly within the setpoint value box.
- In the **Setpoint > Config > CT-VT** dialog box, click on **Save** to save the values into the . Click **YES** to accept any changes and exit the window. Click **Restore** to retain previous values. Click **Default** to restore Default values.

File support

Opening any file will automatically launch the application or provide focus to the already opened application. If the file is a Settings file (has a 'SR3' extension) which had been removed from the Settings List tree menu, it will be added back to the Settings List tree. New files will be automatically added to the tree.

Using setpoints files

The software interface supports three ways of handling changes to relay settings:

- In off-line mode (relay disconnected) to create or edit relay settings files for later download to communicating relays.
- Directly modifying relay settings while connected to a communicating relay, then saving the settings when complete.
- Creating/editing settings files while connected to a communicating relay, then saving them to the relay when complete.

Settings files are organized on the basis of file names assigned by the user. A Settings file contains data pertaining to the following types of relay settings:

- Configure
- Operation
- Control
- Security Settings
- Modbus User Map
- FlexLogic

Factory default values are supplied and can be restored after any changes.

The MX350 displays relay setpoints with the same hierarchy as the front panel display.

Downloading and saving setpoints files

Setpoints must be saved to a file on the local PC before performing any firmware upgrades. Saving Setpoints is also highly recommended before making any Setpoint changes or creating new Setpoint files.

The Setpoint files in the window are accessed in the Files Window. Use the following procedure to download and save Setpoint files to a local PC.

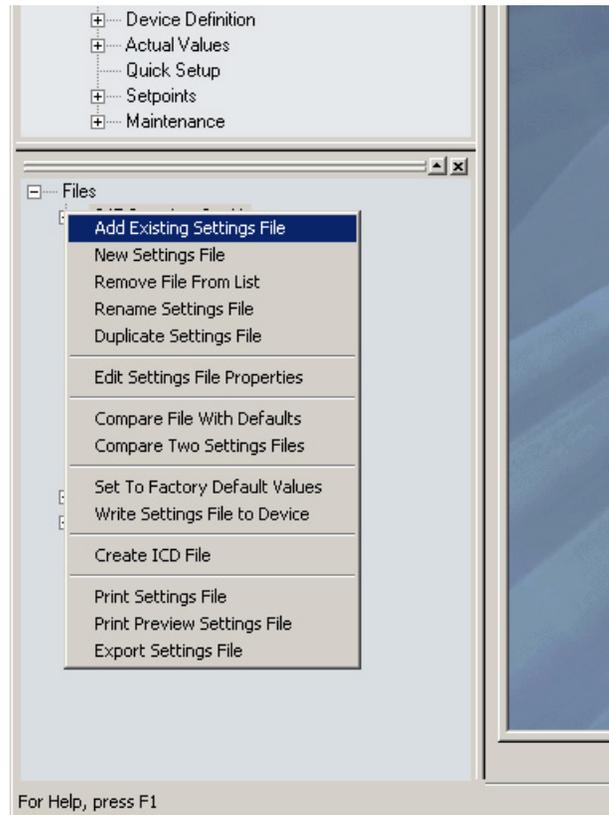
- Ensure that the site and corresponding device(s) have been properly defined and configured as shown in *Connecting to the Relay*, above.
- Select the desired device from the site list.
- Select the **Online > Read Device Settings** from Device menu item (at the top of the page), or right-click on the device and select **Read Device Settings** to obtain settings information from the device.

4. After a few seconds of data retrieval, the software will request the name and destination path of the setpoint file. The corresponding file extension will be automatically assigned. Press **Receive** to complete the process. A new entry will be added to the tree, in the File pane, showing path and file name for the setpoint file.

Adding setpoints files to the environment

The software provides the capability to review and manage a large group of setpoint files. Use the following procedure to add an existing file to the list.

1. In the files pane, right-click on **Files** and select the **Add Existing Setting File** item as shown:

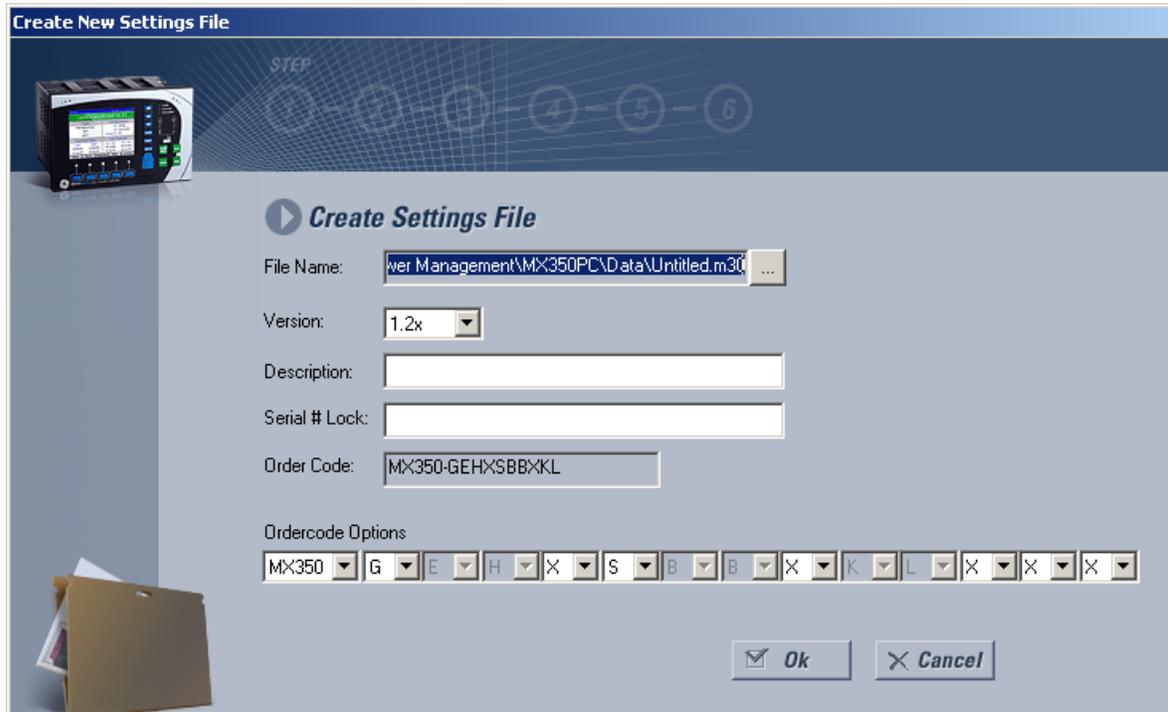


2. The Open dialog box will appear, prompting the user to select a previously saved setpoint file. As for any other MS Windows® application, browse for the file to be added then click **Open**. The new file and complete path will be added to the file list.

Creating a new setpoints file

The software allows the user to create new setpoints files independent of a connected device. These can be uploaded to a relay at a later date. The following procedure illustrates how to create new setpoints files.

1. In the File pane, right click on **File** and select the **New Setpoints File** item. The following box will appear, allowing for the configuration of the setpoints file for the correct firmware version. It is important to define the correct firmware version to ensure that setpoints not available in a particular version are not downloaded into the relay.



2. Select the Firmware Version, and Order Code options for the new setpoints file.
3. For future reference, enter some useful information in the **Description** box to facilitate the identification of the device and the purpose of the file.
4. To select a file name and path for the new file, click the button beside the File Name box.
5. Select the file name and path to store the file, or select any displayed file name to replace an existing file. All MX350 setpoints files should have the extension 'M30' (for example, 'ExerciserStatus.M30').
6. Click **OK** to complete the process. Once this step is completed, the new file, with a complete path, will be added to the EnerVista™ MX350 Setup software environment.

Upgrading setpoint files to a new revision

It is often necessary to upgrade the revision for a previously saved setpoint file after the firmware has been upgraded. This is illustrated in the following procedure:

1. Establish communications with the relay.
2. Select the **Online > Device Setup** menu item and record the Firmware Revision from the Device Setup window.
3. Load the setpoint file to be upgraded into the EnerVista SR3 Setup environment as described in the section, *Adding Setpoints Files to the Environment*.
4. In the File pane, right-click on the saved setpoint file.
5. Note the File Version of the setpoint file. If this version is different from the Firmware Revision noted in step 2, select a New File Version that matches the Firmware Revision from the pull-down menu.

6. For example, if the firmware revision is MAMO3MA120.000 (Firmware Revision 1.20) and the current setpoint file revision is 1.10, change the setpoint file revision to "1.2x".

Edit Settings File

STEP 1 - 2 - 3 - 4 - 5 - 6

File Name: ts\GE Power Management\MX350PC\Data\

Description:

Old File Version: 120 New File Version: 1.2x

Old Serial # Lock: New Serial # Lock:

Old Order Code: MX350-GEHX5BBXKL New Order Code: MX350-GEHX5BBXKL

Order Code

MX350	G	E	H	X	S	B	B	X	K	L	X	X	X
-------	---	---	---	---	---	---	---	---	---	---	---	---	---

Ok Cancel

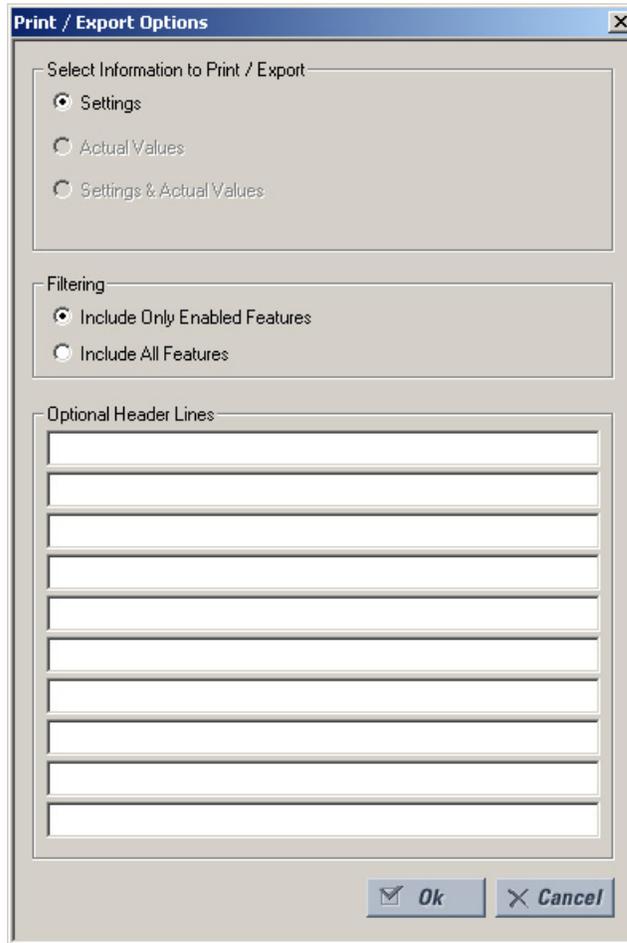
7. Enter any special comments about the setpoint file in the "Description" field.
8. Select the desired firmware version from the "New File Version" field.
9. When complete, click **OK** to convert the setpoint file to the desired revision. See *Loading Setpoints from a File* below, for instructions on loading this setpoint file into the MX350.

Printing setpoints and actual values

The software allows the user to print partial or complete lists of setpoints and actual values. Use the following procedure to print a list of setpoints:

1. Select a previously saved setpoints file in the File pane or establish communications with a device.
2. From the main window, select the **Offline > Export Settings File** menu item.

- The Print/Export Options dialog box will appear. Select **Settings** in the upper section and select either **Include All Features** (for a complete list) or **Include Only Enabled Features** (for a list of only those features which are currently used) in the filtering section and click **OK**.



- The process for **Offline > Print Preview Settings File** is identical to the steps above.
- Setpoint lists can be printed in the same manner by right clicking on the desired file (in the file list) or device (in the device list) and selecting the **Print Device Information** or **Print Settings File** options.

Printing actual values from a connected device

A complete list of Actual Values can also be printed from a connected device with the following procedure:

- Establish communications with the desired device.
- From the main window, select the **Online > Print Device Information** menu item.
- The Print/Export Options dialog box will appear. Select **Actual Values** in the upper section and select either **Include All Features** (for a complete list) or **Include Only Enabled Features** (for a list of only those features which are currently used) in the filtering section and click **OK**.

Actual Values lists can be printed in the same manner by right clicking on the desired device (in the device list) and selecting the **Print Device Information** option.

Loading setpoints from a file



An error message will occur when attempting to download a setpoint file with a revision number that does not match the relay firmware. If the firmware has been upgraded since saving the setpoint file, see *Upgrading Setpoint Files to a New Revision*, above, for instructions on changing the revision number of a setpoint file.

The following procedure illustrates how to load setpoints from a file. Before loading a setpoints file, it must first be added to the environment as described in the section, *Adding Setpoints Files to the Environment*.

1. Select the previously saved setpoints file from the File pane of the EnerVista™ MX350 Setup software main window.
2. Select the **Offline > Edit Settings File Properties** menu item and verify that the corresponding file is fully compatible with the hardware and firmware version of the target relay. If the versions are not identical, see *Upgrading Setpoint Files to a New Revision*, above, for details on changing the setpoints file version.
3. Right-click on the selected file and select the **Write Settings File to Device** item.
4. Select the target relay from the list of devices shown and click **Send**. If there is an incompatibility, an "Incompatible Device" error message will occur:

If there are no incompatibilities between the target device and the settings file, the data will be transferred to the relay. An indication of the percentage completed will be shown at the bottom of the main window.

Upgrading relay firmware

For firmware updates contact GE Zenith Service Group at 1-800-637-1738 x3.

Power analysis

Waveform capture

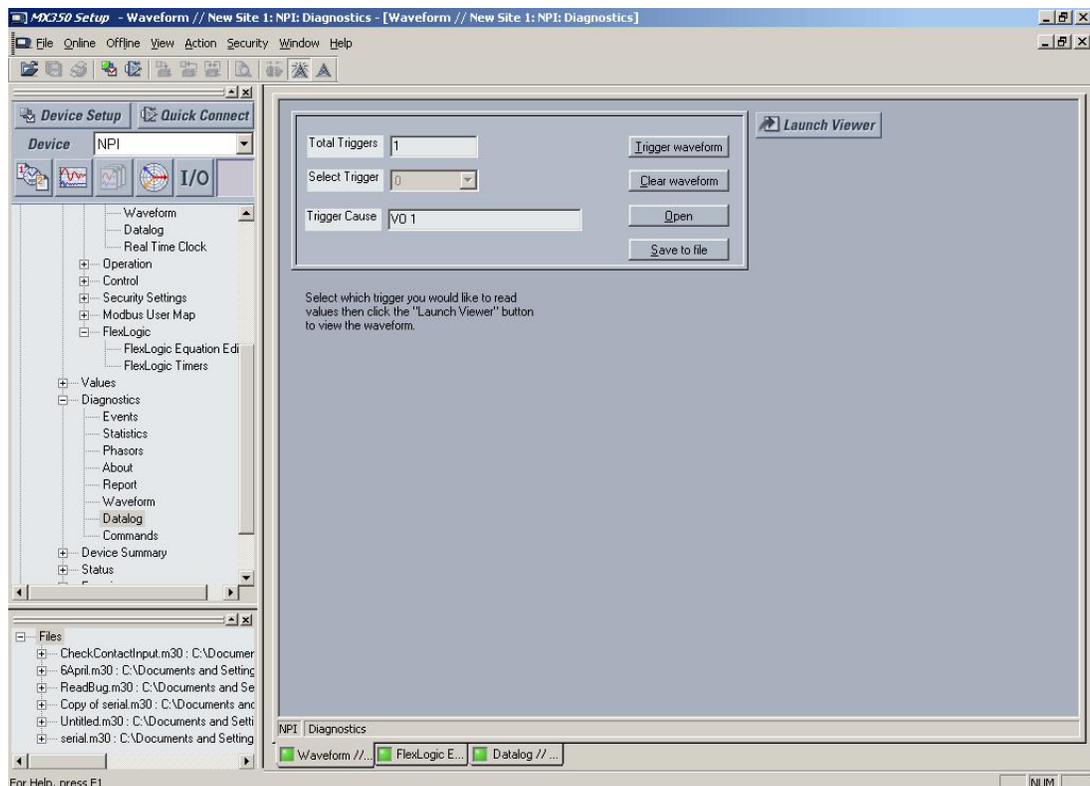
The EnerVista™ MX350 Setup software can be used to capture waveforms (or view trace memory) from the MX350 at the instance of a trip, activation of a virtual output, or other conditions. A maximum of 64 cycles (32 samples per cycle) can be captured and the trigger point can be adjusted to anywhere within the set cycles.

If the trigger mode is set to "ONE-SHOT," then the trace memory is triggered once; if it is set to "RETRIGGER," then it automatically retriggers and overwrites the previous data.

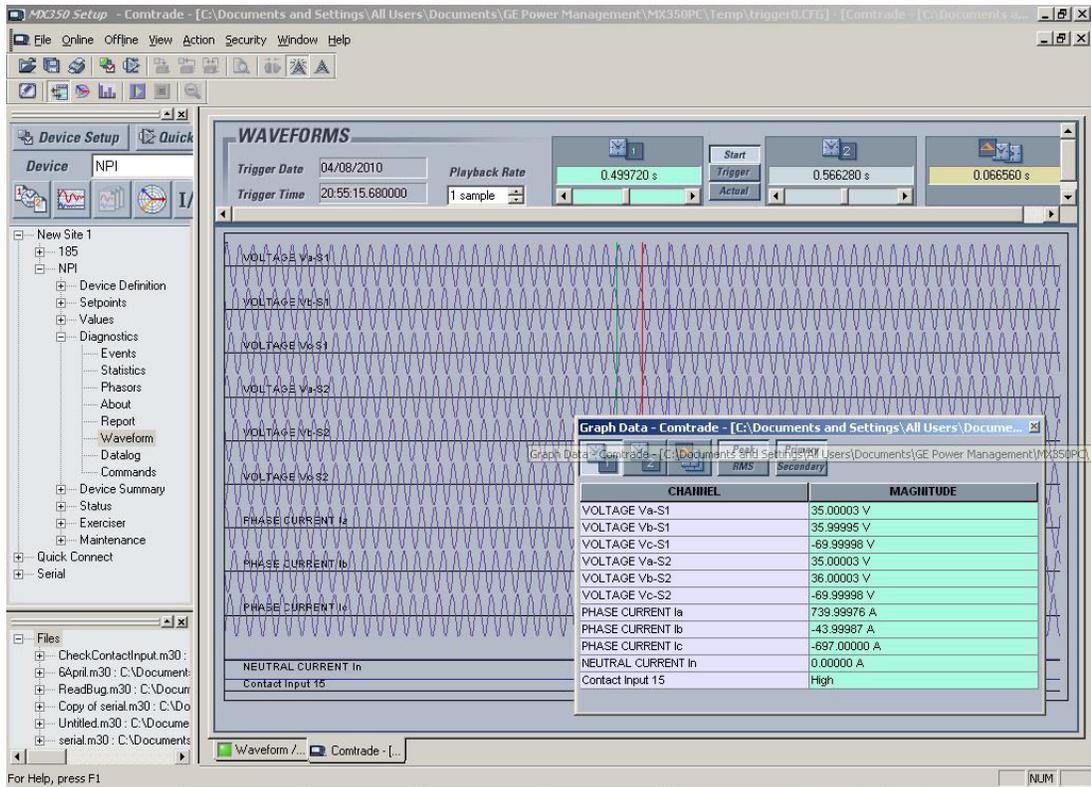
The following waveforms can be captured:

- Phase A, B, and C currents (Ia, Ib, and Ic)
- Ground/Neutral current (Ig)
- Phase A-N, B-N, and C-N voltages (Van, Vbn, and Vcn) if wye-connected. Phase A-B, B-C, and C-A voltages (Vab, Vbc, and Vca) if delta-connected.
- Digital data for output relays and contact input states.

1. With EnerVista™ MX350 Setup running and communications established, select the **Diagnostics > Waveform** menu item to open the Waveform Capture setup window.



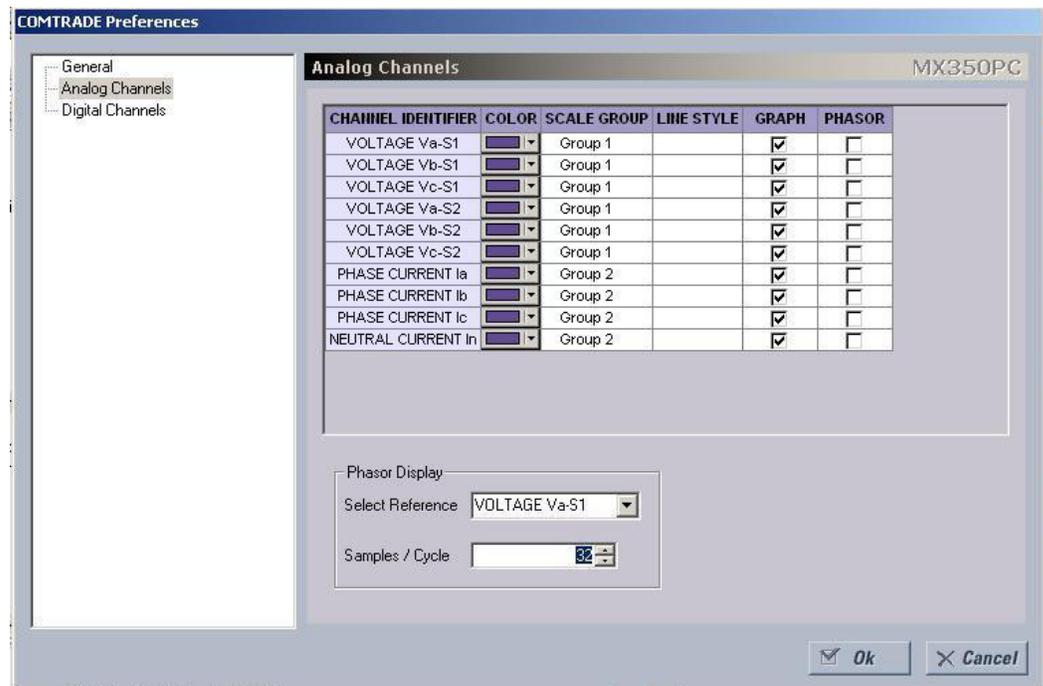
2. Click on **Trigger Waveform** to trigger a waveform capture. Waveform file numbering starts with the number zero in the MX350, so that the maximum trigger number will always be one less than the total number of triggers available.
3. Click on the **Save to File** button to save the selected waveform to the local PC. A new window will appear, requesting the file name and path. One file is saved as a COMTRADE file, with the extension "CFG." The other file is a "DAT" file, required by the COMTRADE file for proper display of waveforms



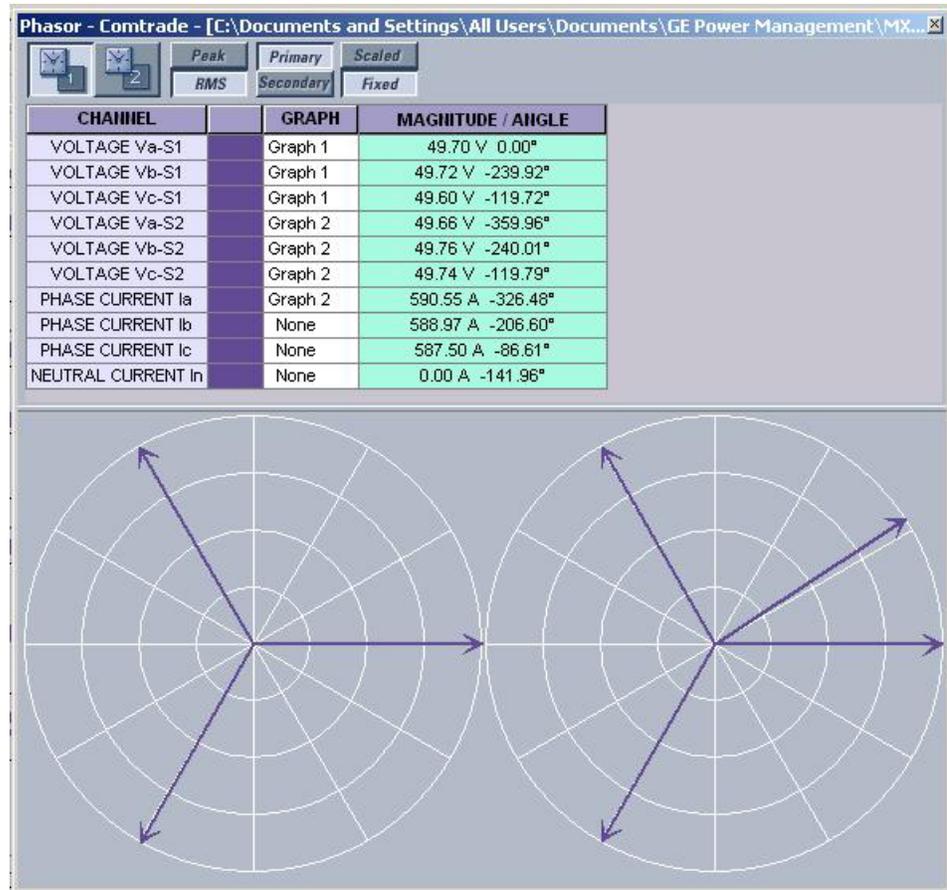
- From the window main menu bar, press the **Preference** button to open the COMTRADE Setup page, in order to change the graph attributes.



- The following window will appear:



10. Change the color of each graph as desired, and select other options as required, by checking the appropriate boxes. Click **OK** to store these graph attributes and to close the window. The Waveform Capture window will reappear with the selected graph attributes available for use.
11. To view a vector graph of the quantities contained in the waveform capture, press the **Vector Display** button to display the following window:



12. Use the graph attribute utility described in step 10, to change the vector colors.

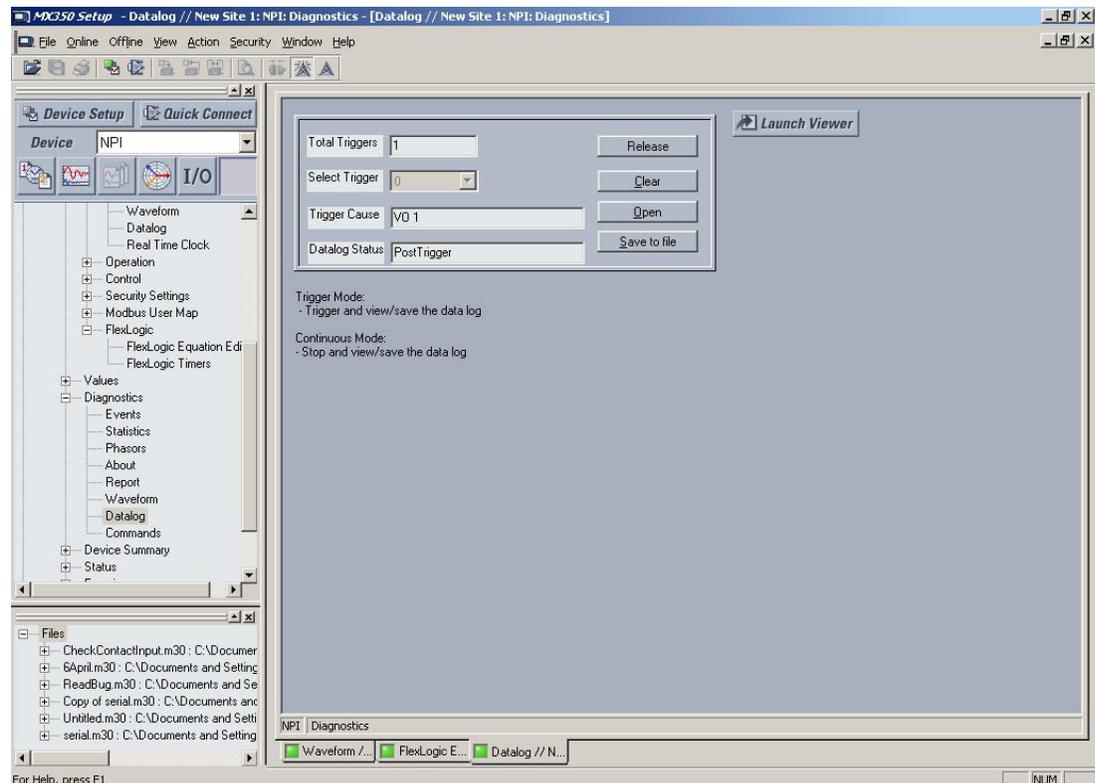
Data logger

The data logger feature is used to sample and record up to ten actual values at a selectable interval. The datalogger can be run with Continuous mode Enabled, which will continuously record samples until stopped by the user; or with Continuous mode Disabled, which will trigger the datalog once without overwriting previous data.

Setting	Parameter
Sample Rate	1 Second
Continuous Mode	Disabled
Data Log Trigger Position	25%
Data Log Trigger Source	None
Channel 1 Source	Phase A Current
Channel 2 Source	Phase B Current
Channel 3 Source	Phase C Current
Channel 4 Source	Disabled
Channel 5 Source	Disabled
Channel 6 Source	Disabled
Channel 7 Source	Disabled
Channel 8 Source	Disabled
Channel 9 Source	Disabled
Channel 10 Source	Disabled

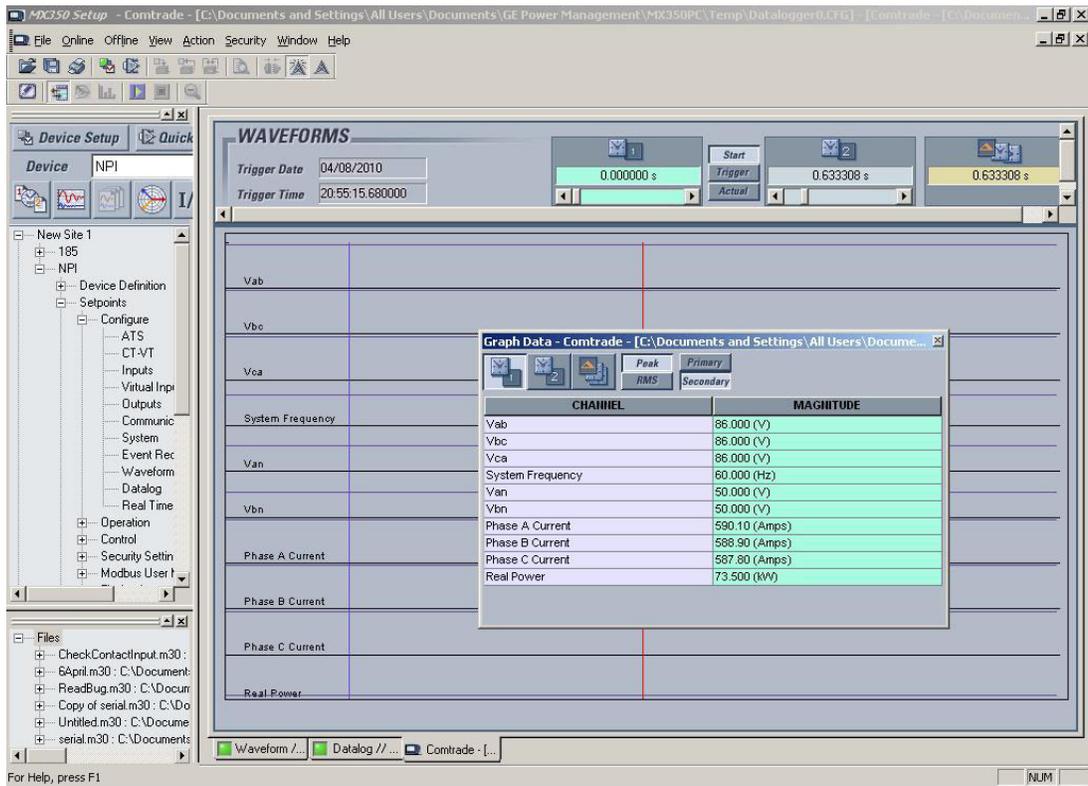
Viewing and saving of the Datalogger is performed as follows:

1. With EnerVista™ MX350 Setup running and communications established, select the **Diagnostics > Datalog** menu item to open the datalog setup window:

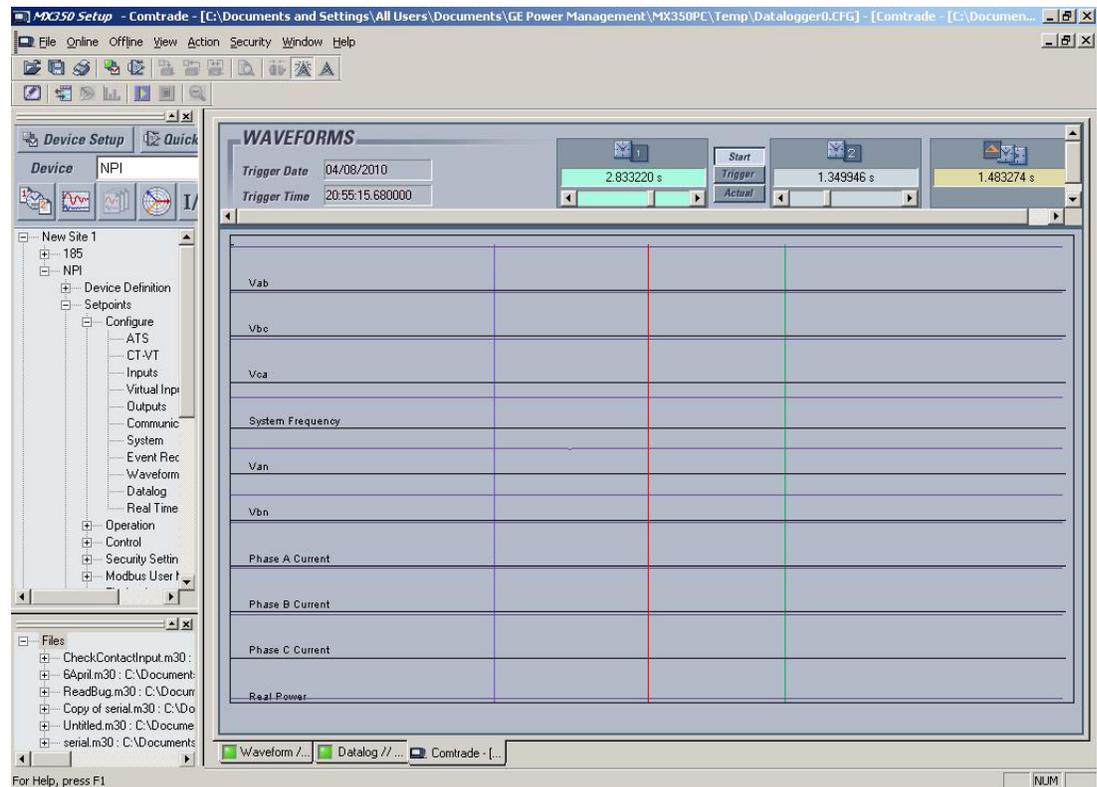


2. If Continuous mode is enabled, click on **Stop** to stop the datalog
3. Click on the **Save to File** button to save the datalog to the local PC. A new window will appear requesting for file name and path.
4. One file is saved as a COMTRADE file, with the extension 'CFG'. The other file is a DAT file, required by the COMTRADE file for proper display of data.

5. To view a previously saved COMTRADE file, click the **Open** button and select the corresponding COMTRADE file.
- 6.



7. To view the datalog, click the **Launch Viewer** button. A detailed Datalog window will appear as shown below.



8. The method of customizing the datalog view is the same as the Waveform Capture described above.
9. The datalog can be set to capture another buffer by clicking on **Run** (when Continuous mode is enabled), or by clicking on **Release** (when Continuous mode is disabled).



MX350 Automatic Transfer Control System

Chapter 4: Actual values

Actual values overview

Measured values, maintenance and fault analysis information are accessed in the actual values screens. Actual values may be accessed via one of the following methods.

- Through the graphical control panel, using the keys and display.
- With the EnerVista™ MX350 Setup software supplied with the relay.
- Through the RS485 or Ethernet ports and a PLC/SCADA system running user-written software.

Actual value messages are organized into logical groups, or pages, for easy reference.

Pressing the **Values** soft-key displays the actual values summary window. All phase voltages for both sources as well as power, apparent power, reactive power, and power factor for the load are shown in the summary window.

Figure 1: Actual values summary window

S1		S2		Power	
415	Vab	0	Vab	0.5	kW
415	Vbc	0	Vbc	0.0	kVA
415	Vca	0	Vca	0.3	kvar
60.10	Hz	0.00	Hz	0.80	lag

Summary | Amps | Volts | Power | PQ

Metering

Current metering

Select the **Values > Amps** page to display the metered current for all three phases and ground/neutral.

Figure 2: Current metering page

Values\Amps		
28 Mar07 14:36		
Ia	0.8	A
Ib	0.8	A
Ic	0.8	A
Iavg	0.8	A
In	0.0	A

Summary | Amps | Volts | Power | PQ

Voltage metering

Select the **Values > Volts** page to display the metered voltage for all three phases of both sources, as well as their respective frequencies.

Figure 3: Voltage metering page

Values\Volts	
28 Mar07 14:36	
S1	S2
415 Vab	0 Vab
415 Vbc	0 Vbc
415 Vca	0 Vca
60.10 Hz	0.00 Hz

Summary | Amps | Volts | Power | PQ



Voltage metering displayed on this page is L-L for a 3-phase system. L-N values are shown on the Phasor page. See the *Phasor* section in the Diagnostics chapter of this manual.

Power metering

Select the **Values > Power** page to display the power and energy metering values.

Figure 4: Power metering display

↑ \Values\Power		22 Mar 07	22:00
Real Power (kw)	0.5		
Apparent Power (kVA)	0.6		
Reactive Power (kvar)	0.3		
Power Factor (lead)	0.80		
MWh Consumption (Mwh)	0.080		
Mvarh Consumption (Mvarh)	0.050		

Summary Amps Volts **Power** Sensor

PQ metering

Select the **Values > PQ > Summary** page to display the metered power quality values.

Figure 5: Temperature metering page

↑ \Values\PQ\Summary		28 Mar 07	14:36
Voltage Unbalance (%Ub)	0		
Voltage Unbalance S2 (%Ub)	0		
Current Imbalance (%Ub)	0		
Avg V THD (%)	0.0		
Avg S2 V THD (%)	0.0		
Avg I THD (%)	0.0		
S1 Va THD (%)	0.0		
S1 Vb THD (%)	0.0		
S1 Vc THD (%)	0.0		
S2 Va THD (%)	0.0		
S2 Vb THD (%)	0.0		
S2 Vc THD (%)	0.0		↓

Summary V1 Harm V2 Harm I Harm

From the **Values > PQ > Summary** page the user can access detailed information screens for the voltage harmonics of Source 1, and Source 2, as well as the current harmonics of the switch load. A typical page for the voltage harmonics of Source 2 can be seen in the figure below.

Figure 6: Source 2 voltage harmonics

↑ \Values\PQ\W2 Harm\W2a		28 Mar 07	14:36
V2a 2nd Harm. Distortion (%)	0.0		
V2a 3rd Harm. Distortion (%)	0.0		
V2a 4th Harm. Distortion (%)	0.0		
V2a 5th Harm. Distortion (%)	0.0		
V2a 6th Harm. Distortion (%)	0.0		
V2a 7th Harm. Distortion (%)	0.0		
V2a 8th Harm. Distortion (%)	0.0		

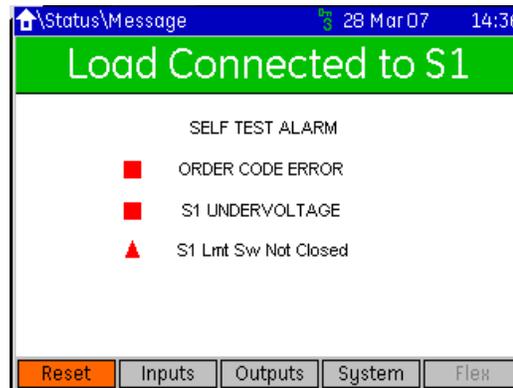
Phase A Phase B Phase C

Status

The MX350 status messages are categorized as alarm, or status messages.

Status messages

Figure 7: Typical status message display



Color indicates message type:

- Red Triangle = Alarm
- Orange Square = Status
- Black Text = Information Message

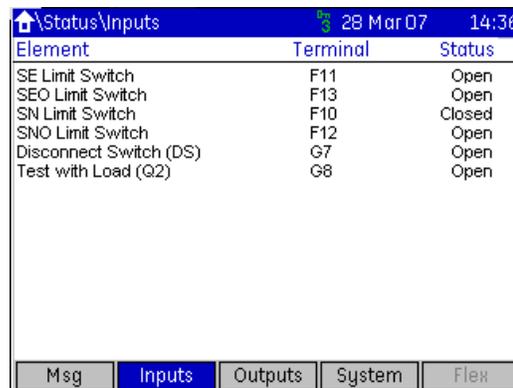
Messages can have an associated countdown timer.

Select the **Status > Msg** page to display a list of Status messages. Trips, alarms, and control messages are displayed as Status messages. The up and down keys can be used to scroll through large lists of Status messages.

Input and output status

Select the **Status > Inputs** page to display a list of the current state of each input. Similarly, selects the **Status > Outputs** page to display a list of the current state of each output.

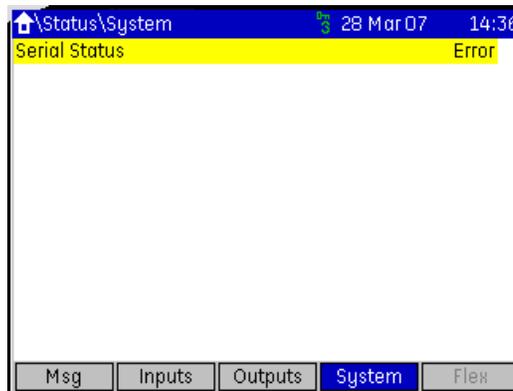
Figure 8: Typical input status message page



System Page

Shows the communication status of configuration interfaces (serial and Ethernet).

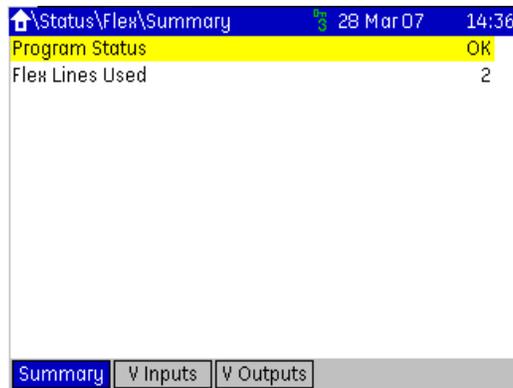
Figure 9: Typical system page



Flex Page

Shows the status of Flex engine and the number of 512 lines in use.

Figure 10: Typical flex page





MX350 Automatic Transfer Control System

Chapter 5: Setpoints



Great care has to be used when switching the standard mode of operation to “Delayed Transition”. In this mode, the controller will not synchronize the two sources. Adequate time delay for the DW and DT timers has to be selected to make sure any rotating loads have enough time to coast to a stop before selecting the Delayed Transition mode. If this is not taken into account, severe damage to rotating equipment can occur!

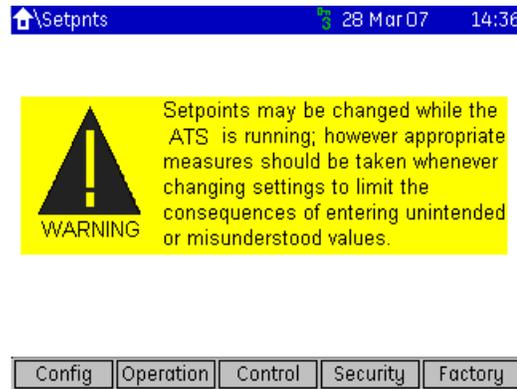
Understanding setpoints

Any of the ATS setpoints may be viewed or altered by pressing the **Setpoints** soft-key. Setpoints data is divided into four pages.

- Configuration page: Information about the ATS configuration as well as system setup, inputs, outputs, communications, CTs, and VTs, events, and data log.
- Operation page: Information about the two power sources, such as failure points for voltage and frequency, and failure time delays.
- Control page: Operator access to different modes of operation.
- Security page: Information about the security and password features.

Press the **Setpoint** soft-key to scroll through the setpoints pages. When pressed for the first time, the following screen is displayed.

Figure 1: Setpoints home page



The soft-keys on the **Home > Setpoints** page open pages two levels down, since the pages immediately below this page are blank. For example, the Config soft-key opens the **Home > Setpoints > Config > ATS** page.

The pages containing setpoint fields, except for the inputs and outputs pages, are in a common format. This is a simple tabular format with two columns: setpoint name and units, and setpoint value. Setpoints for features that are not enabled are omitted from the page.



Setpoints may be changed while the ATS is in operation; however it is not recommended to change parameters while the ATS load is fed from Source 2.

Setpoints will remain stored indefinitely in the internal non-volatile memory even when control power to the is removed. Protection parameters are based on the entered data. This data must be complete and accurate for the given system for reliable protection and operation of the ATS.

Setpoint text abbreviations

The following abbreviations are used in the setpoints pages.

- A, Amps: amperes
- AUX: auxiliary
- COM, Comms: communications
- CT: current transformer
- GND: ground
- Hz: Hertz
- MAX: maximum
- MIN: minimum
- SEC, s: seconds
- UV & U/V: undervoltage
- VT: voltage transformer
- Ctrl: control
- Hr & hr: hour
- UTC: co-ordinated universal time
- ops: operations

Configuration setpoints

The configuration setpoints contain data on ATS configuration as well as system setup, inputs, outputs, communications, CTs, and VTs. The following sub-pages are available.

- ATS (setpoints related to ATS configuration).
- CT-VT (setpoints related to CT and VT configuration).
- Inputs (setpoints related to digital input configuration)
- Outputs (setpoints related to digital output configuration)
- Comms (setpoints related to communications configuration)
- System (setpoints related to MX350 system configuration)
- Events (setpoints related to the event recorder)
- Counters (setpoints related to the digital counters)

ATS setpoints

The MX350 can control the following types of transfer switch:

1. Standard (Open) Transition (with or without bypass panel)
2. Delayed Transition (with or without bypass panel)
3. Closed Transition (with or without bypass panel)

The home screen tells the user for which application a particular MX350 is suitable. The figure below shows the home screen for a Closed Transition type controller.



It is important not to confuse the type of ATS being controlled, with the mode in which it is being operated. For example, a Closed Transition type switch can be operated in Closed Transition Mode or in Delayed Transition Mode.

Select the **Home > Setpoints > Config > ATS** page to edit the ATS data settings.

Figure 2: Closed Transition home screen

28 Mar 07 14:36				
Load Connected to S1				
Type		Configuration		
Closed Trans		S1 Utility		
40 A		S2 Generator		
120 V		Preferred Src S1		
Exerciser Time		Last Transfer		
Last	Next	S1-->S2	S2-->S1	
09:00:00	09:00:00	Not Set	Not Set	
15 Apr 07	22 Apr 07	Not Set	Not Set	
Values	Status	Setpoints	Diag	Exerciser

ATS types

The following is a brief description of how each type of switch works in a typical setup. i.e. S1 is utility power and S2 is engine generator power:

	Name on Status/Outputs Screen	Associated Function	Standard/Open Transition	Delay/Closed Transition
SCR-N	S1 Sol Relay	Connect load to S1	Yes	Yes
SCR-NO	S1 Delay Relay	Disconnect load from S1	N/A	Yes
SCR-E	S2 Sol Relay	Connect load to S2	Yes	Yes
SCR-EO	S2 Delay Relay	Disconnect load from S2	N/A	Yes

Standard transition

SOURCE 1 POWER FAILURE:

When the Source 1 voltage or frequency has fallen below the values as set up in the **Setpoints > Operations > S1 Settings** screen, the controller initiates the P timer (engine start delay timer). Upon the completion of the P time delay, an Engine Start signal is sent to Source 2, typically an engine generator set. When frequency and voltage of S2 reach the values as set up in the **Setpoints > Operations > S2 Settings** screen, the W timer (time delay to S2) begins timing. The W time delay ensures that source 2 is stable before actually transferring to this source. If desired, the operator can bypass this timer from the Status screen, or through a remote signal. After the W time delay, the MX350 energizes SCR-E to move the switch to the S2 position, transferring the load to Source 2.

SOURCE 1 POWER RESTORATION:

When Source 1 is recovering and reaches the presets as set up in the **Setpoints > Operations > S1 Settings** screen, the controller initiates a re-transfer to Source 1. In order to ensure that the utility voltage and frequency are stable before transferring back to Source 1, the delay to Source 1 (T) timer begins to time for a period of time as set up by the user, typically set to 30 minutes. If the user wishes to re-transfer before the T timer has expired, he or she can highlight the timing message on the Status screen and bypass the timer by depressing the Bypass soft key. When the T timer has timed out or the Bypass key has been depressed, the ATS will transfer the load back to Source 1.

The controller maintains the engine start signal for the time period specified as the U timer (delay to stop engine) in order to ensure proper cooling of the engine before shutting it down. If the operator desires to turn off the engine before the U timer has expired, he can highlight the timing message on the Status screen and bypass the timer by depressing the Bypass soft key. When the U timer has timed out or the Bypass key has been depressed, the engine start signal will be removed, causing the engine to shut down.

Delayed transition

SOURCE 1 POWER FAILURE:

When the Source 1 voltage or frequency has fallen below the values as set up in the **Setpoints > Operations > S1 Settings** screen, the controller initiates the P timer (engine start delay timer). Upon the completion of the P time delay, an Engine Start signal is sent to Source 2, typically an engine generator set. When frequency and voltage of S2 reach the values as set up in the **Setpoints > Operations > S2 Settings** screen, the W timer (time delay to S2) begins timing. The W time delay ensures that source 2 is stable before actually transferring to this source. If desired, the operator can bypass this timer from the Status screen or through a remote signal. After the W time delay, the MX350 energizes SCR-NO to move the switch to the open position, where the load is connected to neither source.

Once the switch is in the open position, the delay to Source 2 (DW) timer starts its timing cycle. Upon completion of the DW timer, the energizes SCR-E in order to transfer the load to source 2.

SOURCE 1 POWER RESTORATION:

When Source 1 is recovering and reaches the presets as set up in the **Setpoints > Operations > S1 Settings** screen, the controller initiates a re-transfer to Source 1. In order to ensure that the utility voltage and frequency are stable before transferring back to Source 1, the delay to Source 1 (T) timer begins to time for a period of time as set up by the user, typically set to 30 minutes. If the user wishes to re-transfer before the T timer has expired, he or she can highlight the timing message on the Status screen and bypass the timer by depressing the Bypass soft key. When the T timer has timed out or the Bypass key has been depressed, the controller will energize SCR-EO and the ATS will move to the open/neutral position.

Once the switch is in the open position, the delay to Source 1 (DT) timer starts its timing cycle. Upon completion of the DT timer, the controller energizes SCR-N in order to transfer the load back to Source 1.

The controller maintains the engine start signal for the time period specified as the U timer (delay to stop engine) in order to ensure proper cooling of the engine before shutting it down. If the operator desires to turn off the engine before the U timer has expired, he or she can highlight the timing message on the Status screen and bypass the timer by depressing the Bypass soft key. When the U timer has timed out or the Bypass key has been depressed, the engine start signal will be removed, causing the engine to shut down.

Closed transition

GE Zenith Controls Closed Transition Transfer Switches are designed to transfer a load between two available sources without interrupting power to the load, i.e. in a make-before-break type manner. The actual paralleling of the two sources typically occurs within a time period of 100 ms.

Closed Transition Transfer Switches are designed to transfer a load between two available sources without interrupting power to the load, i.e. in a make-before-break type manner. The actual paralleling of the two sources typically occurs within a time period of 100 ms. In order for the controller to consider both sources synchronized, the following criteria have to be met:

- Phase Rotation: match
- Voltage difference: < 10%
- Phase Angle difference: < 10 degrees
- Frequency difference: < 0.2 Hz

SOURCE 1 POWER FAILURE:

When the Source 1 voltage or frequency has fallen below the values as set up in the **Setpoints > Operations S1 > Settings** screen, the controller initiates the P timer (engine start delay timer). Upon the completion of the P time delay, an Engine Start signal is sent to Source 2, typically an engine generator set. When frequency and voltage of S2 reach the values as set up in the **Setpoints > Operations > S2 Settings** screen, the W timer (time delay to S2) begins timing. The W time delay ensures that source 2 is stable before actually transferring to this source. If desired, the operator can bypass this timer from the Status screen or through a remote signal. After the W time delay, the MX350 controller energizes SCR-NO to move the switch to the open position, where the load is connected to neither source.

Once the switch is in the open position, the delay to Source 2 (DW) timer starts its timing cycle. Upon completion of the DW timer, the controller energizes SCR-E in order to transfer the load to source 2.

SYSTEM TEST (S1 AVAILABLE):

When the system is performing a test, the MX350 controller sends an engine start signal to Source 2. When frequency and voltage of S2 reach the values as set up in the **Setpoints > Operations > S2 Settings** screen, the W timer (time delay to S2) begins timing. The W time delay ensures that source 2 is stable before actually transferring to this source. If desired, the operator can bypass this timer from the Status screen or through a remote signal.

Once the W timer has expired, the controller will wait until both sources are within the allowable synchronization limits and then it will energize SCR-E to connect the load with Source 2 while it is still connected to Source 1. Once both sources are connected to the load, the controller will immediately energize SCR-NO and the load will be disconnected from Source 1. The actual time during which both sources are paralleled is typically less than 100 ms.

1. The two sources don't become synchronized within 60 seconds while attempting to transfer to the other source.
2. If the ATS fails to disconnect from the source from which it is transferring away and both sources remain paralleled for more than 100ms (Open Last Closed feature is being activated).
3. The Open Last Closed feature fails and the controller issues a shunt trip command to the generator breaker.

SOURCE 1 POWER RESTORATION:

When Source 1 is recovering and reaches the presets as set up in the

Setpoints > Operations S1 > Settings screen, the controller initiates a re-transfer to Source 1. In order to ensure that the utility voltage and frequency are stable before transferring back to Source 1, the delay to Source 1 (T) timer begins to time for a period of time as set up by the user, typically set to 30 minutes. If the user wishes to re-transfer before the T timer has expired, he or she can highlight the timing message on the Status screen and bypass the timer by depressing the Bypass soft key. When the T timer has timed out or the Bypass key has been depressed, the controller will wait until both sources are within the allowable synchronization limits and then will energize SCR-N to connect the load with Source 1 while it is still connected to Source 2. Once both sources are connected to the load, the controller will immediately energize SCR-EO and the load will be disconnected from Source 2. The actual time during which both sources are paralleled is typically less than 100 ms.

The controller maintains the engine start signal for the time period specified as the U timer (delay to stop engine) in order to ensure proper cooling of the engine before shutting it down. If the operator desires to turn off the engine before the U timer has expired, he or she can highlight the timing message on the Status screen and bypass the timer by depressing the Bypass soft key. When the U timer has timed out or the Bypass key has been depressed, the engine start signal will be removed, causing the engine to shut down.

If both sources do not synchronize within 60 seconds, the alarm light will come on, the banner message will display "Sync Fail - Bypass Wait", and the status screen will display the message "Sources Out of Phase". If that is the case, the user can either continue to wait for the sources to sync at which the controller will transfer in Closed Transition mode, or he or she can highlight the message and then press the 'Bypass' button. In that case, the switch will transfer back in Delayed Transition mode, meaning the load will be out of power for the time period specified as 'Delay - Neutral to Preferred Source' or 'Delay - Neutral to Non-Preferred Source', respectively, on the Config/Operation/Timers screen.



CAUTION

The user has to make sure that the values entered for 'Delay - Neutral to Preferred Source' and/or 'Delay - Neutral to Non-Preferred Source' are sufficient to allow rotating loads to coast to a stop. Severe damage to connected rotating equipment can occur if too small of a time value is selected.



NOTE

If the ATS fails to open the source from which it is transferring away during a closed transition transfer and both sources remain paralleled for more than 100ms, an alarm message will be triggered, and the source that had just been connected to the load in parallel with the other source will attempt to open once more (a.k.a the open-last-closed feature).

If the sources remain paralleled for 500ms, another alarm message will be triggered. This alarm can be programmed to trigger a programmable output which, in turn, can be used to shunt trip, and thus disconnect, either source. If enabled and wired into the customer circuit, the shunt trip will ensure that the two sources will not remain paralleled for an extended period of time.

All Closed Transition type switches are equipped with an audible alarm (horn). This output is activated when:

1. The two sources don't become synchronized within 60 seconds while attempting to transfer to the other source.
2. If the ATS fails to disconnect from the source from which it is transferring away and both sources remain paralleled for more than 100ms (Open Last Closed feature is being activated).
3. The Open Last Closed feature fails and the controller issues a shunt trip command to the generator breaker.

In order to silence the horn, the operator must navigate to the Status screen, highlight the 'Audible Alarm' message, and then press the Horn Silence softkey . Alternatively, the user may press the ALARM RESET key located on the front panel.

Figure 3: Front Panel Alarm Reset key



The table below describes the different timers that are active during the different switch transition types.

Timer Designations						
ATS Type	P	W	DW	T	DT	U
Standard Transition	Time Delay S2 Start	Time Delay S2 Stable	→	Time Delay S1 Stable	→	S2 Stop Delay
Delay/ Open Transition	Time Delay S2 Start	Time Delay S2 Stable	ATS Open Time to S2	Time Delay S1 Stable	ATS Open Time to S1	S2 Stop Delay
Source 1 Fails	Transfer to Source 2 →		Source 1 Returns	Transfer to Source 1 →		Engine Cooldown

Chicago Transfer Alarm Panel (CTAP) option

If a switch has been ordered with the CTAP option, the Alarm light will illuminate and the horn will sound when the load is connected to the non-preferred source. In order to silence the horn, the operator must navigate to the Status screen, highlight the 'Audible Alarm' message, and then press the Horn Silence softkey . Alternatively, the user may press the ALARM RESET key (see above) located on the front panel.

Common ATS setpoints

Several setpoints are dependent on the chosen ATS type. The setpoints shown below are common for all ATS types. They are accessible as Modbus registers as well as through the Setpnt/Config/ATS screen.

ATS name

Range: Up to 20 alphanumeric characters

Default: ATS

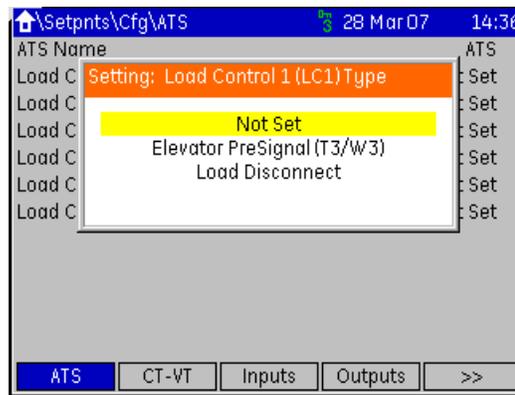
This setpoint specifies a name for the ATS. This name will appear with the actual values, sequence of events record, and other reports

Load control type (for up to 6 loads - LC1 through LC6)

Range: Not Set/Elevator Pre-Signal (T3/W3)/Load Disconnect

Default: Not Set

Load control signals are used to protect certain loads during a transfer of the switch from one active source to the other. The following picture shows the screen that is used to activate load control outputs



Elevator Pre-Signal (T3/W3) contacts open prior to transfer in either direction. The user can specify the time period during which the signal is activated. It can range from 0 seconds to 60 minutes on the Setpoints\Operation\Timers screen. Load Control outputs selected as 'Pre Elevator Signal' will only be activated when both sources are available.

Load Control outputs selected as type Load Disconnect will close a contact prior to the load transfer. The operator can specify the time period during which the signal is activated by entering the desired value as 'Pre Load Control x (LCx) Timer'. Unlike the Elevator Pre-Signal, Load Disconnect signals will stay active after the load transfer has occurred for the time specified as 'Post Load Control x (LCx) Timer'. Timer presets are selected for each load on the Setpoints\Operation\Timers screen and can range from 0 sec to 60 minutes.

When one or more Load Control outputs have been activated, the following will happen during a transfer sequence with both sources available (e.g. load test):

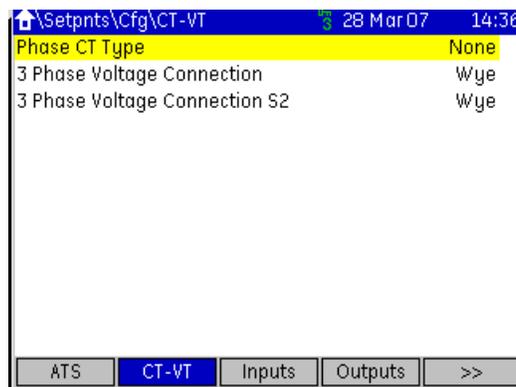
- Immediately after the W or T timer expires, the Load Control output is energized.
- If several Load Control outputs have been selected by the user, the Load Control with the longest 'Pre Load Control x (LCx) Time' is activated, followed by the one with the second longest Pre Load Control Time, etc.
- All load control pre-timers expire at the same time. When that happens, the controller transfers the ATS from S1 to S2 or S2 to S1.
- The Load control outputs selected as 'Pre Elevator Signal' are de-energized immediately after the transfer.
- Load Control outputs for each Load Control output selected as 'Load Disconnect' remain energized for the time specified as 'Post Load Control Time' for the respective load.

- The total time that a given Load control output is active, thus, is the sum of the 'Pre Load Control x (LCx) Timer' and 'the Post Load Control x (LCx) Timer'.
- Unlike the Elevator Pre-Signal, the Load Disconnect outputs will be energized, regardless whether one or two sources are available, i.e. they will be activated even during a transfer of the load due to a source failure.

Current and voltage transformers

The figure below shows the CT-VT screen that allows the user to specify the kind of CT used in conjunction with the A card in slot E of the controller (if applicable) and the type of connection for the voltage sensing for both sources.

Figure 4: Typical current and voltage transformer setpoints window



Valid selections for the CT are "None", "1A secondary", "5A secondary", or "Direct Connect". If the user enters "1A secondary" or "5A secondary", another entry field comes up to enter the primary current of the corresponding current transformer.

This screen is also used to enter the 3 Phase voltage connection type for both Source 1 and Source 2. Possible selections are Wye and Delta.



NOTE

Although it is possible to enter different connection types for both sources, both wiring schemes and selected connection type have to match. Unexpected results and possible damage to the switch can result if this is not observed.



NOTE

Only 5 A secondary connections are supported.

Inputs

The following figure shows the screen that lists all assignable inputs. The user can highlight any of these input signals and hit enter to see to which available terminal input the signal can be assigned.

Figure 5: Input configuration setpoint page

Element	Terminal
Lockout Reset	NA
Access Switch	NA
Inhibit Xfer to S2 (Q3)	NA
Inhibit Xfer to S1 (Q7)	NA
Load Shed from S2 (R15)	NA
Load Shed from S1 (R26)	NA
Engine Start (SW1)	NA
Manual Xfer S1-2, S2-1 (S12)	NA
Commit Xfer to S2 (S13)	NA
Manual Xfer S2-S1 (S5)	NA
Preferred Source Select (SW3)	NA ↓

Each function can be assigned to only one input. Once an input is assigned, its status can be monitored from the Status > Inputs screen.



Only inputs to L cards are user programmable, with the exception of the input terminals for G7 and G8. These inputs are hard coded for basic ATS functions.

Outputs

The following figure shows the screen that lists all assignable outputs. The user can highlight any of these output signals and hit enter to see to which available terminal output terminal the signal can be assigned.

Figure 6: Output configuration setpoint page

Element	Terminal
Any Alarm	NA
Current I	NA
Internal T	NA
Self Test	NA
Voltage I	NA
Low Pow	NA
S1 to S2	NA
S2 to S1	NA ↓
S1 Under	NA
S1 Overv	NA
S1 Underfrequency	NA ↓

Each function can be assigned to only one output. Once an output is assigned, its status can be monitored from the **Status > Outputs** screen .

Communications setpoints

The MX350 has one RS485 serial communication port supporting a subset of the Modbus protocol.

Select the **Home > Setpnts > Cfg > Comms** page to edit the communications setpoints.

Figure 7: Communications setpoints page

\\Setpnts\Cfg\Comms		22 Mar 07	22:51
Slave Address		254	
RS485 Baud Rate		115200 baud	
RS485 Parity		None	
NTP IP address		3.94.244.203	
Ethernet IP address		0.0.0.0	
Ethernet subnet mask		255.255.252.0	
Ethernet gateway address		0.0.0.0	
Comm Failure Mode		Serial	
Comm Failure Trip		OFF	
Comm Failure Alarm		OFF	

The following setpoints are available.

Slave Address

Range: 1 to 254 in steps of 1

Default: OFF

For RS485 communications, each MX350 IED must have a unique address from 1 to 254. Address 0 is the broadcast address detected by all IEDs in the serial link. Addresses do not have to be sequential, but no two units can have the same address or errors will occur. Generally, each unit added to the link uses the next higher address starting at 1.

RS485 Baud Rate

Range: 9600, 19200, 38400, 57600, or 115200 baud

Default: 115200 baud

This setpoint selects the baud rate for the RS485 port. The data frame is fixed at 1 start, 8 data, and 1 stop bits, while parity is optional.

NTP IP Address

This setpoint is set to the IP address of the external clock source.

Setting of the NTP IP Address will not function unless Comms Security is set to Disabled.



NOTE

Ethernet IP Address

Range: standard IP address format

Default: 0.0.0.0

This setpoint specifies the dedicated IP address provided by the network administrator.



NOTE

When changing the IP address, power to the relay must be cycled in order for the new IP address to become active.

Ethernet Subnet Mask

Range: standard IP address format

Default: 255.255.252.0

This setpoint specifies the subnet IP mask provided by the network administrator.

Ethernet Gateway Address

Range: standard IP address format

Default: 0.0.0.0

This setpoint specifies the gateway IP address provided by the network administrator.

Comms OK Evaluation

Range: Serial, Serial + Ethernet, Ethernet, All

Default: Serial

Specifies the operands for the Comms OK flag.

Comm Failure Trip

Range: Off, 5 to 25 step 5s
 Default: Off

Specifies the time without comms before a trip will be generated.

Comm Failure Alarm

Range: Off, 5 to 25 step 5s
 Default: Off

Specifies the time without comms before an alarm will be generated.

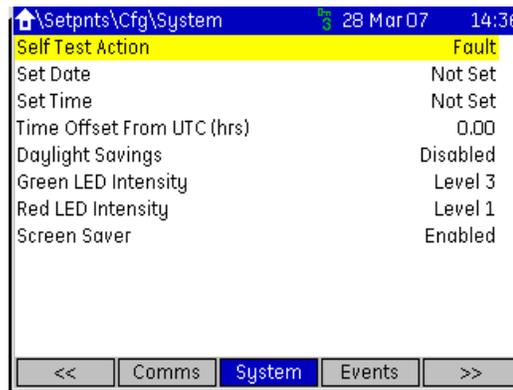
Timing delay commences **5 seconds after** failure is detected.



System

The System screen lets the user select important system parameters, such as date and time, LED light intensity, and others.

Figure 8: System screen



System trouble

For relay self-test, the MX350 runs a series of self-tests, including data and program memory integrity and program execution watchdogs. If any of these tests fail, a self-test fault or alarm is generated depending on the value of the Self Test Action setpoint. The following setpoints are available for the system trouble element.

Self-Test Action

Range: Fault, Alarm
 Default: Fault

This setpoint defines whether a self-test failure will cause a fault or an alarm.

LED indicators

These setpoints allow the user to control the display characteristics of the front panel LEDs. The following setpoints are available.

Green LED Intensity

Range: 1 to 6
 Default: 1

Selects brightness level (1 to 6) for Control Panel LEDs.

Red LED Intensity

Range: 1 to 6
 Default: 1

Selects brightness level (1 to 6) for Control Panel LEDs.

Screensaver

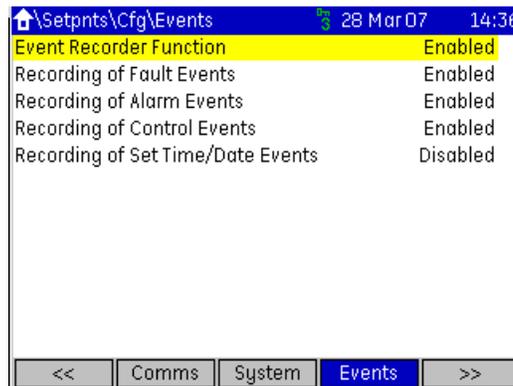
The user can select whether or not the screen save mode is enabled or disabled. When enabled, the screen will change to displaying a picture of the controller after being idle for one minute. After two minutes, the pictures will disappear and the screen will go completely dark.

The Screensaver is enabled by default. If desired, the user can disable it in order to have the screen visible at all times. GE discourages disabling the Screensaver in order to avoid the screen being burned-in with a screen image.

Events

The Events screen allows the user to enable or disable certain functions relating the recording of events as seen in the picture below.

Figure 9: Events screen



The event recorder can be enabled to record alarm, fault, and/or control events. It can also be used to record changes made to the real time clock of the controller.

Zenith

The Zenith screen gives an overview of the factory setup of the MX350 controller. Parameters on this screen are not accessible to the user. Only Zenith authorized personnel can make changes to this screen.



Unauthorized changes made to this screen can lead to damage or destruction of the ATS and can result in personal injuries or death!

Operation setpoints

Operation setpoints define the acceptable electrical and time limits for both Source 1 and Source 2. These setpoints define dropout and restore values for over and undervoltage, over and under frequency, as well as the associated time delays.

Setpnts\Operation\S2 Set		28 Mar 07	14:36
S2 Undervolt Fail (%)	80		
S2 Undervolt Restore (%)	90		
S2 Underfreq Fail (Hz)	59.0		
S2 Underfreq Restore (Hz)	59.5		
S2 Overvolt Fail (%)	110		
S2 Overvolt Restore (%)	105		
S2 Overfreq Fail (Hz)	OFF		
S2 Auto LS Underfreq Set (Hz)	59.0		
S2 Auto LS Underfreq Delay	Not Set		
S2 Auto LS Undervolt Set (%)	OFF		
S2 Auto LS Overpower Set (%)	OFF		

S1 Setting S2 Setting Timers

In addition, the screen for Source 2 (usually an engine generator set) has a setpoint for Auto Loadshed Underfrequency. If this feature is enabled, a programmed output can be used to shed part of the switch load via a downstream breaker. Also, if it is enabled the user has to setup the variables for the corresponding parameters.



NOTE

Additional customer wiring is required to use the Auto Load Shed feature.

Figure 10: User settings table

	Parameter		Units	Resolution	Factory Default	Minimum Setting	Maximum Setting	
Source 1	Under Voltage	Fail	[% of nominal]	1%	80	75	99	
	Under Voltage	Restore	[% of nominal]	1%	90	85	100	
	Under Frequency	Fail	[Hz]	0.1	54.0*	45.0	59.9	
	Under Frequency	Restore	[Hz]	0.1	57.0*	45.1	59.5	
	Over Voltage	Fail	[% of nominal]	1%	110%	105	110	
	Over Voltage	Restore	[% of nominal]	1%	105%	103	108	
	Over Frequency	Fail	[Hz]	0.1	OFF	50.1	63.0	
	Over Frequency	Restore	[Hz]	0.1	OFF	50.0	62.9	
Source 2	Under Voltage	Fail	[% of nominal]	1%	80	75	99	
	Under Voltage	Restore	[% of nominal]	1%	90	85	100	
	Under Frequency	Fail	[Hz]	0.1	54.0*	45.0	59.9	
	Under Frequency	Restore	[Hz]	0.1	57.0*	45.1	59.5	
	Over Voltage	Fail	[% of nominal]	1%	110%	105	110	
	Over Voltage	Restore	[% of nominal]	1%	105%	103	108	
	Over Frequency	Fail	[Hz]	0.1	OFF	50.1	63.0	
	Over Frequency	Restore	[Hz]	0.1	OFF	50.0	62.9	
	Under Frequency	Auto Loadshed	[Hz]	0.1	OFF	45.0	60.0	
	Under Frequency	Auto LS Delay	[m]:[s]	0:01	OFF	0:00	60:00	
	Under Voltage	Auto Loadshed	[% of nominal]	1	OFF	0	100	
	Over Power	Auto Loadshed	[% of nominal]	1	OFF	50	110	
	*setpoint for 60Hz applications; subtract 10.0 for 50Hz applications							
	Source 1, 2	Voltage Imbalance	Fail	[% of nominal]	1%	OFF	5	20
Voltage Imbalance		Restore	[% of nominal]	1%	8	3	18	

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Timers

Associated Timers	Units	Resolution	Factory Default	Minimum Setting	Maximum Setting
Delay for Generator Start (P Timer)	minmin:ss	0:01	0:03	0:00	259:00
Delay - Xfer to Nonpreferred Src (W Timer)	minmin:ss	0:01	0:03	0:00	259:00
Delay - Xfer to Preferred Src (T Timer)	minmin:ss	0:01	30:00	0:00	259:00
Delay - Neutral to Nonpreferred (DW Timer)	minmin:ss	0:01	00:05	0:00	10:00
Delay - Neutral to Preferred (DT Timer)	minmin:ss	0:01	00:05	0:00	10:00
Delay for Engine Cooldown (U Timer)	minmin:ss	0:01	05:00	0:00	60:00
Time Delay for Gen Sag	ss	1	Not Set	0	30
Delay for Voltage Imbalance Alarm	ss	1	30	1	60

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Control

General

Select the **Home > Setpoints > Control > General** page to edit the controller setpoints.

The general control screen allows the user to set up the following operating parameters:

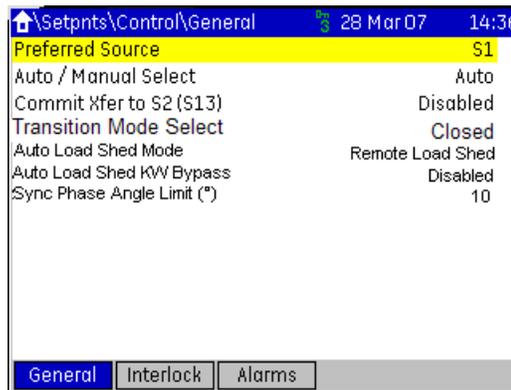
- Selection of Preferred Source: typically S1 (utility power) is the preferred power source.
- Auto/Manual: An Automatic Transfer Switch can be set up for the following types of transfers:
 - Automatic (both from S1 to S2 and from S2 to S1)
 - Manual S1 to S2, S2 to S1, also known as S12
 - Manual S2 to S1 Only, also known as S5



NOTE

These selections are not available on a switch that is designed for manual operation only!

Figure 11: General control configuration setpoints



Commit transfer to S2 (S13): If this option is enabled, then the switch will transfer to Source 2 once the W timer has begun timing, even if Source 1 returns before the transfer takes place. This feature can be used to ensure that the transfer takes place, because one brief outage may be followed by another outage. If this option is disabled, the switch will only transfer if the duration of the outage is still present when the W timer has expired. This option should be disabled, when empirical data suggests that a typical outage is an isolated event.

Preferred source

The Preferred Source is the source of power that the controller will try to connect to the load, if both sources are available. Either source 1 (generally utility power) or source 2 (generally generator power) can be selected as Preferred Source. Typically, utility power is the preferred source to power the ATS load.

Auto-Manual select



NOTE

This is not available for Manual type switches.

Three choices are presented for the Auto Manual Select:

- Automatic: In Automatic mode the MX350 will automatically control all load transfers from S1 to S2, or from S2 to S1.

- Manual S1-S2, S2-S1 (S12): In this mode, the controller will not automatically initiate a transfer of the load from one source to the other. It will always wait for an operator input before automatically transferring the load.
- Manual S2-S1 Only (S5): In this mode, the controller will automatically transfer the load from S1 to S2, e.g. when a power outage occurs. However, it will only start the re-transferring from S2 to S1 after it receives an operator input, or upon Source 2 failure.

Commit transfer to S2 (S13)

Depending on empirical data, a customer may want to assume that a brief outage is an isolated event or that it is likely to be followed by another outage.

If the former is the case, the user should set the 'Commit Transfer to S2' to OFF. This will start the generator, but the ATS will not transfer to the alternate source unless the outage is still present the generator power has reached its nominal voltage and frequency and when the 'Delay - Transfer to Nonpreferred Source' timer (W timer) has expired.

If the latter is the case, the user should set the 'Commit Transfer to S2' to ON. This will ensure that the ATS will transfer to the alternate source if the outage is still present when the generator power has reached its nominal voltage and frequency and the 'Delay - Transfer to Nonpreferred Source' timer (W timer) has started timing.

Transition mode select



Applicable only to Closed Transition types of ATS

If a power outage occurs, the MX350 controller will transfer the load to the alternate source, once that source has become available. An interruption of power cannot be avoided in this case. However, after the utility has returned and the T time has expired, another brief power interruption due to the load transfer from one source to the other may be undesirable.

If this is the case, the switch needs to be operated in Closed Transition mode. The controller will then ensure that power to the load is not interrupted during the re-transfer process.

Closed Transition may also be desirable for testing and exercising the switch so that power interruptions to the switch load can be avoided during the transfer.

Alternatively, the user can select Delayed Transition mode as the normal mode of operation.

Auto load shed

Auto load shed

Range: Enabled, Disabled

Default: Disabled

Source 2 (normally the generator source) can be protected with the Auto Load Shed feature.

By factory default this feature is disabled. If desired, it can be activated by changing the parameter 'S2 Auto Load Shed Underfrequency Set' on the **Settings > Operations > S2 Set screen** from OFF to a valid frequency set point. For example, the user could enter a value of 59.0 Hz as the trigger point for the Auto Load Shed feature.

Once a valid set point has been entered, the user will be presented with three more entry fields. For example, the parameters could be set up as follows:

S2 Auto Load Shed Underfrequency Set (Hz)	59.0
S2 Auto Load Shed Underfrequency Delay (s)	3
S2 Auto Load Shed Undervoltage Set (%)	95
S2 Auto Load Shed Overpower Set (%)	103

Once this feature is enabled, the user can assign one of the configurable outputs to be turned on when the Auto Load Shed logic in the controller senses a condition that warrants a load shed. This is done on the **setpoints > config > outputs > alarms** screen. The user can then wire this output to trip a downstream breaker.

In the example above, the Auto Load Shed output will be triggered when the frequency falls below 59.0Hz for more than 3 seconds, when the voltage drops to less than 95% of nominal, or when the power of the switch increases to 103% of nominal. If this output is used to trip a downstream load breaker, a part of the load fed by the switch can be shed in order to stabilize the generator and keep the system from failing due to overload.

If desired, the user can also bypass the load shedding due to a KW overload condition. To do so, the 'Auto Load Shed KW Bypass' parameter on the Control screen needs to be changed from 'Disabled' to 'Enabled'.

The output will remain energized until the user manually clears the Load Shed on the Status screen of the controller.

If the ATS has been ordered with the R15 option, the user will be presented with the Auto Load Shed Mode selector on the Control screen. If the mode is set to 'Remote', the logic of the controller will trip a downstream breaker as indicated above. If, however, the mode is set to 'Local', the whole switch will disconnect from the S2 power source and the complete switch load will be without power.

Auto Load Shed Mode, Auto Load Shed KW Bypass, and Auto Load Shed Reset can also be controlled by hardwired or communicated inputs.



If either the hardwired user configurable input or the selector on the control switch has been set to 'Local', the ATS will disconnect from the S2 power source when the controller detects a Auto Load Shed condition. In order to have the Auto Load Shed trip a downstream breaker, the mode selector on the Control screen has to be set to 'Remote' and the hardwired input (if configured by user) has to be OFF.



Great care has to be used by the customer to properly apply the Auto Load Shed feature in order to avoid unintentional power loss to the switch load.

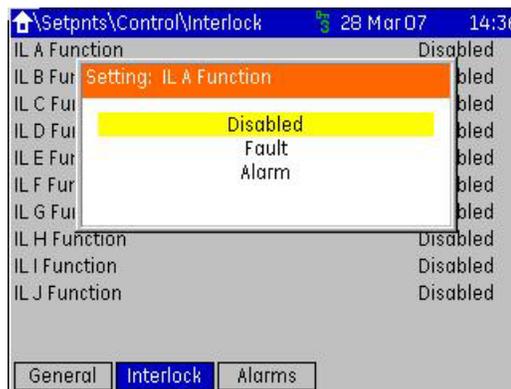
Sync phase angle limit



This is applicable only to Closed Transition type switches.

With this variable, the user can select the allowable phase angle difference between Source 1 and Source 2 for Closed Transition transfer. The default is 10°.

Interlock



The Interlock screen lets the user enable interlock functions and define their parameters. Programmable parameters for each interlock are a corresponding name, a function (fault or alarm), an associated time delay, and the definition of the interlocks healthy state. Once an interlock has been enabled on this screen, a corresponding input can be set up for this element on Setpoints\Config\Inputs screen.

The following picture shows a typical interlock setup:

Figure 12: Typical interlock setup

IL A Name	Process Interlock A
IL A Function	Alarm
IL A Override (s)	5
IL A Healthy State	Open
IL B Function	Disabled
IL C Function	Disabled
IL D Function	Disabled
IL E Function	Disabled
IL F Function	Disabled
IL G Function	Disabled
IL H Function	Disabled
IL I Function	Disabled

Alarms

Voltage THD Alarm Level (%)	OFF
Current THD Alarm Level (%)	OFF
Low PF Lag Alarm Level	OFF
Low PF Lead Alarm Level	OFF
Overpower Alarm Level (kW)	OFF
Phase A Overcurrent Level (%FLA)	OFF
Phase B Overcurrent Level (%FLA)	OFF
Phase C Overcurrent Level (%FLA)	OFF
Neutral Overcurrent Level (%FLA)	OFF
Current Imbalance Alarm Level (%)	15
Current Imbalance Alarm Delay (s)	1
Voltage Imbalance Alarm Level (%)	10

The Alarms screen lets the user enable alarm features and define the setpoints for triggering these alarms as well as associated time delays. Any configured alarm can be linked to a programmable output on the Setpoints\Config\Outputs\Alarms screen for customer use.



NOTE

When a Power Factor alarm activates, you can determine whether it is a lead or lag Power Factor alarm by going to either the **Home > Values > Summary**, or **Home > Values > Power** screen.

Security

Hardware and passcode security features are designed to restrict user access. This can deter inappropriate employee action and curtail errors. Security against hackers or others with malicious intent should be provided by other means. Security for the external hard-wired and field controls should also be externally provided as required.

Three security levels above the default level are recognized. Each security level can also be set for passcode access. The passcode is programmed as a five-digit number, using only digits 1 through 5. The security access levels are:

- Default - reset faults
- Level 1 - default privileges plus setpoint access
- Level 2 - level 1 privileges plus lockout reset and reset counters
- Level 3 - level 2 privileges plus factory page.

The system passcode can be entered at any time by a sustained press on the ENTER key. This displays a dialog box prompting for a new passcode. Alternatively, the system passcode can be entered by pressing a currently unauthorized (grayed-out) control/selection key. This will display an error message detailing the required security levels and whether access switch or passcode entry is required. If only a passcode is required to complete the control/selection, the error message displays a passcode entry dialog box.

Figure 13: Passcode entry dialog box



Passcodes are automatically canceled after five minutes of inactivity. The system passcode access can also be canceled by a sustained press on the ESC key, which clears any previously entered passcode. Communications passcode access can be cancelled by writing zero to the passcode register.

Figure 14: Security page



The following system security setpoints are programmed in the security page.

Passcode Level 1, Passcode Level 2, Passcode Level 3

Range: any five-digit number using digits 1 through 5 only or Disabled

Default value: 11111 (level 1), 22222 (level 2)

Access is granted if a passcode has been correctly entered matching the value of this setpoint.

Access Switch Level

Range: 1, 2, 3

Default value: 1

Sets the access level provided by the access switch being closed. The contact input for the access switch is configured on the contact inputs page.

Comms security

Range: Enabled, Disabled

Default: Disabled

Sets whether the security feature applies to the communications ports.

Setting of the NTD IP Address will not function unless Comms Security is set to Disabled.

**Setpoint access**

Range: Enabled, Disabled

Default: Enabled

Sets whether the setpoint access is allowed from the control panel display.



MX350 Automatic Transfer Control System

Chapter 6: Exerciser

Information

The MX350 has a built-in exerciser that can be enabled and set up from the Exerciser\Info screen. This feature allows the user to test the system periodically or to setup a schedule for operating the system periodically in order to minimize utility costs.

Figure 1: Exerciser information screen

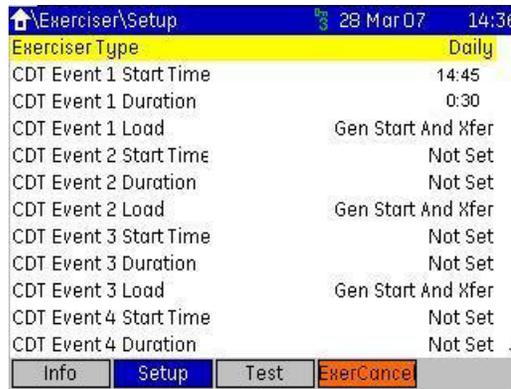


From **Exerciser > Info** screen the operator can access all required setup parameters for scheduling exercises. It also indicates as to when the last exercise took place and when the next exercise will be performed.

Setup

The **Home > Exercise > Setup** page displays the MX350 Exerciser parameters as shown below.

Figure 2: Exerciser values



Exercise type and schedule can be selected on the **Exerciser > Setup** screen as seen above. The mode of operation of the exerciser function can be selected with a time base of 1 day, 1 week, 14 days, 28 days, or 365 days. With a time base of 365 days, up to 24 events can be scheduled. With all other time bases, the number of exercise events is limited to 7.

For each exercising event, the operator enters a start time as well as a duration. The exercise duration range is 0 to 60 minutes. In addition, the operator can select the type of exercise as 'Genstart and Transfer' or as 'Genstart only'.



Do not program two or more CDT events for the same time.

When the 'Gen Start only' mode is selected, the controller will start the engine, but does not actually transfer the load. In this mode, the readiness for the engine generator set is tested. It does not test the functionality of the Automatic Transfer Switch itself.

In the 'Gen Start and Transfer' mode, the controller starts the engine and actually transfers the load to the alternative source. This mode can be used to test the integrity of the emergency power system. It can also be used to setup a schedule for times of operation when the switch load will run on an alternative power supply. This could be done, e.g., to avoid power demand charges from a utility company.

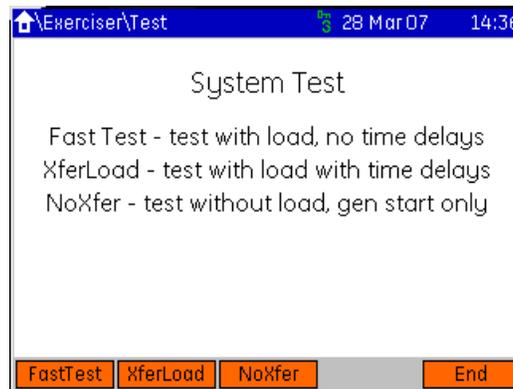
If the operator chooses to abort an ongoing test, there is a 'Test Cancel' button on the Exerciser > Info screen. This screen also contains a 'Test' button that will take the user directly to the Test screen.

Test

The **Home > Exerciser > Test** page displays the MX350 system test choices, as shown below.

From the Test screen the user can perform the same operations as performed by the exerciser. Whereas exercises are performed automatically, a Test always has to be initiated by the user.

Figure 3: System test choices



There are three types of tests: **Fast Test**, **Xfer Load**, and **No Xfer**. The screen also provides an 'End' button to abort any of the three test types.

To test the functionality of the switch the operator can use the Fast Test option. With this kind of test, the engine generator will start and the load will transfer without going through any time delays.

In order to simulate a load transfer as if an outage was occurring, the operator can select the Xfer Load test. With this test type, the engine will start up and the load will transfer according the time delay of the W timer. When the test is ended by depressing the END button, the switch will go through the U timer delay before actually transferring back to the utility.



NOTE

Once a Fast Test, or a Xfer Load command has been issued and the alternative source has reached an acceptable level of voltage and frequency, the test cannot be aborted. If the user tries to end the test at this point, the load will still be transferred to the alternative source, but the return sequence will immediately activated.

For testing the functionality of the engine generator set only, the operator can initiate a NoXfer test. In this case will engine will start up, but the load will not be transferred.



MX350 Automatic Transfer Control System

Chapter 7: Diagnostics

The diagnostics pages display typical diagnostic information, including the event recorder, learned data, phasors, system counters, and system information. In the event of a fault or alarm, the diagnostic pages are often very helpful in diagnosing the cause of the condition.

Events

The **Home > Diag > Events** page displays up to 256 events.

When this page is selected, the controller will load and format an event list of the ten most recent events from the event recorder. The most recent event is placed at the top of the list, with the oldest event at the bottom..

If a new event occurs while viewing the event page, the event list will automatically reorganize itself and place the newest event first. The addition of new events while the event list is being viewed will not reset the event screen to the top of the page unless the newest event is being viewed. If there are no events in the event recorder, then this page will be empty.

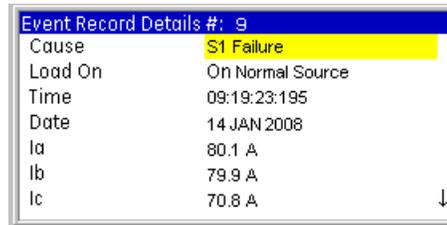
Figure 1: Typical event recorder view

Diag\Events			28 Mar 07	14:36
Total Number of Events Since Last Clear			10	
#	Date/Time	Cause		
15	14JAN/09:54:28:010	P Relay Status		
14	14JAN/09:49:23:680	S1 Connected		
13	14JAN/09:49:23:660	S2 Disconnected		
12	14JAN/09:49:23:510	S1 Solenoid Relay		
11	14JAN/09:19:23:260	S2 Connected		
10	14JAN/09:19:23:205	S1 Disconnected		
9	14JAN/09:19:23:195	S1 Failure		
8	14JAN/09:19:23:195	Engine Start		
7	14JAN/09:19:23:190	Control Power Applied		
6	14JAN/09:19:13:100	Control Power Lost		

Clear Stats Phasors About >>

Individual events are selected by using the UP and DOWN keys to highlight the event then pressing the ENTER key. This will display a pop-up window with the event details.

Figure 2: Typical event details view



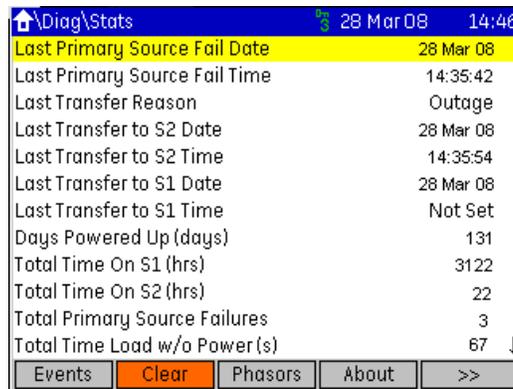
The image shows a screenshot of a software window titled "Event Record Details #: 9". The window contains a list of event parameters and their values. The "Cause" field is highlighted in yellow and shows "S1 Failure". Other fields include "Load On" (On Normal Source), "Time" (09:19:23:195), "Date" (14 JAN 2008), and three current values: "Ia" (80.1 A), "Ib" (79.9 A), and "Ic" (70.8 A). A scroll bar is visible on the right side of the window.

Event Record Details #: 9	
Cause	S1 Failure
Load On	On Normal Source
Time	09:19:23:195
Date	14 JAN 2008
Ia	80.1 A
Ib	79.9 A
Ic	70.8 A

Statistical information

The **Home > Diag > Stats** page displays date and time information as well as the reason for the last failure of the preferred source. It also contains information about how long the load has been in either source, how many transfers have occurred, and the total time the load has been without power. All this data is accumulative and can be reset by pressing the CLEAR soft key.

Figure 3: Statistical information page



The screenshot shows a window titled 'Diag\Stats' with a date and time of '28 Mar 08 14:46'. The window contains a list of statistical data points and a set of control buttons at the bottom.

Statistical Information	Value
Last Primary Source Fail Date	28 Mar 08
Last Primary Source Fail Time	14:35:42
Last Transfer Reason	Outage
Last Transfer to S2 Date	28 Mar 08
Last Transfer to S2 Time	14:35:54
Last Transfer to S1 Date	28 Mar 08
Last Transfer to S1 Time	Not Set
Days Powered Up (days)	131
Total Time On S1 (hrs)	3122
Total Time On S2 (hrs)	22
Total Primary Source Failures	3
Total Time Load w/o Power (s)	67 ↓

Buttons: Events, Clear, Phasors, About, >>

Phasors

The **Home > Diag > Phasors** page displays phase rotation, voltages and angles, frequency, and phase difference for both sources. The figure below shows a typical screen for a 240V, 3-phase system. In this example, the both sources are on an ABC rotation with an actual phase angle difference of 1.3 degrees. The frequency differential between both sources is ensuring that the phase angle will be driven towards 0 during the synchronization period. If the resulting phase angle difference becomes less than 10° (factory default), the controller will allow the switch to transfer.

This page also features a status message that will inform the operator about the lead status of one power source with respect to the other power source. When the phase angle is less than 3°, the message changes 'S2 In Sync w/ S1'.

Figure 4: Typical phasor page

S1		S2	
V	°	V	°
Va	240	0	241
Vb	241	120	240
Vc	240	240	241
Freq	60.00		60.10

Additional screen details: Home \ Diag \ Phasors, 28 Mar 07, 14:36, ABC 1.3 S2 In Sync w/ S1 ABC, Events Stats Phasors About >>



Voltage metering displayed on this page is L-N for a 3-phase system. L-L values are shown on the Voltage Metering page. See the *Voltage Metering* section in the Actual Values chapter of this manual.

Product information

The **Home > Diag > Info** page displays fixed system information, including the order code, serial number, hardware revision, software revision, modification number, boot revision, boot modification, original calibration date, and last calibration date.

Figure 5: Product information page

Diag\About		28 Mar 07	14:36
Product Device Code	MA		
Hardware Revision	A		
Firmware Version	1.00		
Platform Version	1.20		
Display Software Version	1.00		
Comm Rev	1.00		
Boot Version	1.00		
Serial Number	MAMA06000001		
Order Code	MX350-GEHE2BBAKLL		
Build Date	Jan 23 2008		
Build Time	15:57:10		
Original Calibration Date	Jan 23 2008		↓
Events Stats Phasors About >>			

Diag\About		28 Mar 07	14:36
Product Device Code	MA		
Hardware Revision	A		
Firmware Version	1.00		
Platform Version	1.20		
Display Software Version	1.00		
Comm Rev	1.00		
Boot Version	1.00		
Serial Number	MAMA06000001		
Order Code	X3000-GEHE2BBAKLL		
Build Date	Jan 23 2008		
Build Time	15:57:10		
Original Calibration Date	Jan 23 2008		↓
Events Stats Phasors About >>			

Reports

The **Home > Diag > Report** page displays additional information on the last transfer event and the load conditions at that time.

Figure 6: Typical Report page

The screenshot shows a software interface window titled '\Diag\Report' with a timestamp of '28 Mar 08 14:36'. The main content is a table of data related to the last transfer event. The first row, 'Last Transfer Reason', is highlighted in yellow and shows 'Outage'. Below this are various metrics such as 'Date Gen Start Sent', 'Time Gen Start Sent', 'Alt Source Startup Time (s)', 'Last Transfer to S2 Time', and several 'Max Alt Source' and 'Avg. Alt Source' values for voltage dips, frequency dips, current, kW, and pF. The final row is 'Time Primary Ret (or Test Reset)' with a value of '23:25:12' and a downward arrow. At the bottom of the window are four buttons: '<<', 'Report', 'Waveform', and 'Datalog'.

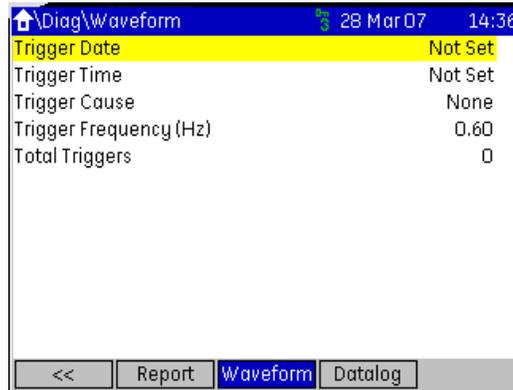
\Diag\Report 28 Mar 08 14:36	
Last Transfer Reason	Outage
Date Gen Start Sent	27 Mar 08
Time Gen Start Sent	22:17:35
Alt Source Startup Time (s)	8
Last Transfer to S2 Time	22:17:44
Max Alt Source Voltage Dips (%)	0.1
Max Alt Source Freq Dip (%)	0.1
Max Alt Source Current (A)	85
Avg. Alt Source kW (kW)	310
Avg. Alt Source pF	0.83
Max Alt Source Volt THD (%)	0.02
Time Primary Ret (or Test Reset)	23:25:12 ↓

Waveform

The **Home > Diag > Waveform** page displays information regarding the date and time of the waveform capture as well as the event that triggered it.

The setup for the wave form capture is performed on **Home > Diag > Waveform**.

Figure 7: Typical Waveform information page



The screenshot shows a software window titled '\Diag\Waveform' with a timestamp of '28 Mar 07 14:36'. The window contains a table with the following data:

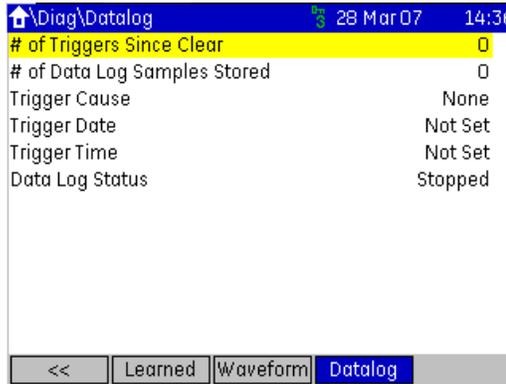
Parameter	Value
Trigger Date	Not Set
Trigger Time	Not Set
Trigger Cause	None
Trigger Frequency (Hz)	0.60
Total Triggers	0

At the bottom of the window, there are four buttons: '<<', 'Report', 'Waveform' (which is highlighted in blue), and 'Datalog'.

Datalog

The **Home > Diag > Datalog** page displays the MX350 datalog parameters. A typical datalog page is shown below.

Figure 8: Datalog values



of Triggers Since Clear

Range: 0 to 65535

Count of data log triggers since the Clear Data Logger command was sent.

of Datalog Samples Stored

Range: 0 to 256

Count of the number of samples stored in the data log for the current trigger cause.

Trigger Cause

Range: None, Command, VO1 to VO32, Any Trip Pickup, Any Trip, Any Trip Dropout, Any Alarm Pickup, Any Alarm, Any Alarm Dropout, Any Stop, Start A, Start B

Indicates the cause of the datalog trigger.

Trigger Date

Date of the current trigger.

Trigger Time

Time of the current trigger.

Datalog Status

Range: Stopped, Started, Triggered, Pretrigger, Posttrigger

Indicates the present status of the data log feature. Stopped and Started are used only in Continuous mode. Triggered, Pretrigger, and Posttrigger are used only in Trigger Mode.



MX350 Automatic Transfer Control System

Chapter 8: FlexLogic™

FlexLogic™ overview

Introduction to FlexLogic™

This chapter describes the MX350 FlexLogic™ system, defines its operators, and lists its operands.

All MX350 digital signal states are represented by FlexLogic™ operands. Each operand is in one of two states: on (asserted, logic 1, or set), or off (de-asserted, logic 0, or reset). There is a FlexLogic™ operand for each contact input, contact output, communications command, control panel command, element trip, and element alarm, as well as many others.

A list of FlexLogic™ operands and operators are sequentially processed once every 50 ms. When list processing encounters an operand, the value of that operand is placed in a first-in-first out stack. When list processing encounters a calculation operator, the number of values required for the calculation are removed from the stack, and the result of the operation is placed back on the stack. The operators are logic gates (for example, AND, OR, NOT), timers, latches, one-shots, and assignments. Assignment operators assign the value calculated by the preceding operators to a special class of operands called virtual outputs. Like any other operand, a virtual output can be used as an input to any operator – feedback to achieve seal-in is allowed. When list processing encounters an end operator, processing is stopped until the next processing cycle, at which time it restarts at the top of the list.

Each contact output has a setpoint to specify the operand that drives the output. Any operand may be selected – selection of a virtual output is the means by which FlexLogic™ directly controls external equipment such as the motor contactors.

The operators used in FlexLogic™ conform to the following rules.

- A virtual output may only be assigned once within any given ATS. An unassigned virtual output will have a value of off.
- A maximum of thirty (30) general purpose timers (timers 1 through 30) are allowed.
- Each timer may only be used once within any given ATS.
- A maximum of thirty (30) one-shots are allowed.
- 512 lines are executed during every 50 ms.

The operators available in FlexLogic™ are shown below.

Table 1: FlexLogic™ operators

Operator	Inputs	Description
<operand>	none	The output value is the value of the named <operand>.
NOT	1	The output value is “on” if and only if the input value is “off”.
OR	2 to 16	The output value is “on” if and only if any of the input values are “on”.
AND	2 to 16	The output value is “on” if and only if all of the input values are “on”.
NOR	2 to 16	The output value is “on” if and only if all of the input values are “off”.
NAND	2 to 16	The output value is “on” if and only if any of the inputs values are “off”.
XOR	2	The output value is “on” if and only if one input value is “on” and the other input value is “off”.
TIMER	1	The output value is “on” if the input value has been “on” for the set pickup time. Once the output value is “on”, it remains “on” until the input value has been “off” for the set dropout time.
LATCH	2	The output value is the state of a reset-dominant volatile bi-stable latch, where the first input value is the set input, and the second input value is the reset input.
Positive one-shot	1	The output value is “on” for one processing cycle following an off-to-on transition of the input value.
Negative one-shot	1	The output value is “on” for one processing cycle following an on-to-off transition of the input value.
Dual one-shot	1	The output value is “on” for one processing cycle following either an on-to-off or off-to-on transition of the input value.
ASSIGN <operand>	1	The input value is assigned to the named operand. There is otherwise no output value.
END	none	The first END encountered terminates the current processing cycle.

The FlexLogic™ operands available in the MX350 are listed below.

Control operands: auto/manual

- Access Switch Closed..... Asserted when the corresponding Access Switch input is active.
- Load Control 1..... Asserted when the Load Control 1 output is active.
- Load Control 2..... Asserted when the Load Control 2 output is active.
- Load Control 3..... Asserted when the Load Control 3 output is active.
- Load Control 4..... Asserted when the Load Control 4 output is active.
- Load Control 5..... Asserted when the Load Control 5 output is active.
- Load Control 6..... Asserted when the Load Control 6 output is active.
- Remote Timer Bypass..... Asserted when one or more of the corresponding Bypass Xfer Time Delay to S1 or Bypass Xfer Time Delay to S2 inputs are active, or when either one or both of the equivalent communications signals has been received.

Any Alarm

- Bypass ATS on S1..... Asserted when the corresponding AB4 input is active.
- Bypass ATS on S2..... Asserted when the corresponding AB3 input is active.
- Process Interlock A Alarm..... Asserted when customer configurable interlock A is active.
- Process Interlock B Alarm..... Asserted when customer configurable interlock B is active.
- Process Interlock C Alarm..... Asserted when customer configurable interlock C is active.
- Process Interlock D Alarm..... Asserted when customer configurable interlock D is active.
- Process Interlock E Alarm..... Asserted when customer configurable interlock E is active.

Process Interlock F Alarm Asserted when customer configurable interlock F is active.
 Process Interlock G Alarm Asserted when customer configurable interlock G is active.
 Process Interlock H Alarm Asserted when customer configurable interlock H is active.
 Process Interlock I Alarm Asserted when customer configurable interlock I is active.
 Process Interlock J Alarm Asserted when customer configurable interlock J is active.

Fixed operands

Off The operand is always off (not asserted). This may be used as a placeholder or test value.
 On The operand is always on (asserted). This may be used as a placeholder or test value.

Security operands

Level 1 Access Asserted when level 1 security rights are in effect.
 Level 2 Access Asserted when level 2 security rights are in effect.
 Level 3 Access Asserted when level 3 security rights are in effect.

System trouble operands

Self-Test Alarm Asserted when the self-test has failed and is set for alarm.

Example: Assigning an AB3 position contact to a user-configurable output.

To create an additional AB3 relay, the user can go into the FlexLogic editor of the Multilin PC Setup software.

The first entry entails selecting a Contact Input from the dropdown list as type, and then select Contact Input G10 (Cont Ip (8) G10) under 'syntax'. The second entry involves assigning this input to a virtual output. To do so, select 'Assign Virtual Output' as 'type' and select, e.g., '= Virtual Op 1 (VO1)' as 'syntax'

The picture below illustrates these assignments:

Figure 1: FlexLogic entry

FLEXLOGIC ENTRY	TYPE	SYNTAX
View Graphic	View	View
FlexLogic Entry 1	Contact Input	Cont Ip 8 (G10)
FlexLogic Entry 2	Assign Virtual Output	= Virtual Op 1 (VO1)
FlexLogic Entry 3	End of List	

This virtual output can now be assigned to a real output from the setpoints/configure/ outputs screen. For example, the picture below shows how this virtual output is assigned to Contact Output 7 on terminal G2.

Figure 2: Output assignment

SETTING	PARAMETER
Contact Output 7 (G2)	Virtual Output 1
Contact Output 8 (G3)	N/A
Contact Output 9 (G4)	N/A
Contact Output 10 (G5)	N/A



MX350 Automatic Transfer Control System

Chapter 9: Communications

Communications interfaces

The MX350 supports two communications interfaces:

- Modbus RTU via RS485
- Modbus TCP/IP via 10/100Base-T Ethernet

In addition, a USB interface is provided on the front of the interface panel. It is configured to be used in conjunction with a virtual serial port on a Windows-based PC.



NOTE

Setpoint changes related to communication parameters require a power cycle of the controller to be activated.



NOTE

For full details, please refer to the *MX350 Communications Guide* to be found at <http://www.gedigitalenergy.com/app/Resources.aspx?prod=zte&type=3>.

