Distribution Feeder Protection

Multilin Digital Energy

- Comprehensive low voltage feeder management system - Integrated feeder protection and process control in a small package
- Cost effective solution - Low cost modular design
- Small footprint and compact design - With or without display, fits into standard Power Control Center buckets
- Ease of use - EnerVista™ compatible
- Remote monitoring - via serial communications, Modbus RTU
- Easy installation and integration - Door mount option
- Reduced number of devices - Replaces bi-metal overload elements, integrates timers, relays, meters, switches, indicators
- Integrated trip pushbutton
- Easy to read two line display

Economical and compact feeder protection for low voltage feeders

KEY BENEFITS

- Feeder protection and management system for low voltage distribution feeders
- Integrated process and electrical control
- Specifically designed for Power Control Centre applications

APPLICATIONS

- Protection and Control
  - Thermal overload protection
  - Current unbalance
  - Ground fault protection
  - Open contactor/Welded contactor
  - Under voltage autoreclose
  - Outputs: 2 fixed, 1 programmable and 1 emergency shutdown
  - Inputs: 6 fixed, 10 programmable

- Monitoring & Metering
  - Display phase current, ground current, current unbalance, voltage, power, energy, etc.
  - Trip record and pre-trip values
  - Maintenance information

- Communications
  - RS485 ModBus™, 1200 - 19,200 bps
  - Front Panel 11 LEDs, key pad, and 2x20 LCD display
  - Front Panel control push buttons
  - Includes EnerVista™ software

- EnerVista™ Software
  - EnerVista™ software - an industry leading suite of software tools that simplifies every aspect of working with GE Multilin devices
  - EnerVista™ Integrator providing easy integration of data in the FM2 into new or existing monitoring and control systems
Protection and Control
The FM2 is available with a variety of protection and control features. FM2 can be used for fuse contactors feeders or feeders with breakers having built in trip units.

Thermal Overload
Thermal overload trip occurs when the thermal capacity value equals 100%. Thermal capacity used is calculated from accumulated I²t value and chosen overload curves. True RMS current sensing ensures correct response to the heating effect of harmonics. One of 3 different I²t time overcurrent overload curves may be selected from standard IEC curves. After an overload trip, the thermal capacity value decreases exponentially to model the load cooling characteristic. An overload trip can be reset when the thermal capacity value decreases to 15%.

Ground Fault
Aging and thermal cycling can cause cable and equipment insulation to break down, resulting in ground faults. Ground faults can be detected by either from the residual connection of the phase CTs or from the zero sequence CT. The FM2 can trigger a trip or an alarm if the ground fault pickup level is exceeded. A time delay may be entered for time coordination of systems with several levels of ground fault detection.

Contactor/Circuit Breaker Failure
The FM2 monitors the contactor/circuit breaker while performing close and open commands. If the contactor does not change status an ‘open control circuit’ or ‘welded contactor’ alarm is triggered. If circuit breaker doesn’t change status a ‘breaker failed to close’ or ‘breaker failed to open’ alarm is generated.

Additional Alarms
The FM2 has programmable alarms to warn of a number of abnormal conditions. These include: contactor inspection, and process interlock switch open.

Undervoltage Autoreclose
The feeder can be automatically reclosed after a momentary power loss when this feature is enabled. When the control voltage drops below the dropout voltage the contactors are de-energized. The FM2 can initiate timers to reclose selected feeder upon the return of supply voltage. It has one instantaneous and two delayed reclose settings. If control voltage is restored within the programmed reclose time, the feeder will be reclosed immediately. If the control voltage takes longer to be restored, the FM2 can be programmed to attempt a reclose after a programmed time delay.

Outputs
The FM2 has two output relays (A and B). Relay A and Relay B can be controlled independently for controlling a breaker. Relay A is used as close contact and Relay B is used as a trip contact for the breaker. There is also a programmable relay available on the FM2, which can be assigned to any one of the relay functions. FM2 has an emergency shutdown (ESD) relay, which can be energized externally by applying 24VDC.

Switched Inputs
The FM2 has six fixed control inputs. These are used for close A and B, open, test status, and contactor A and B status. The FM2 also has 10 programmable switch inputs. Each input can have one of a number of interlock functions assigned to it. A function can be assigned to one interlock input.

Monitoring and Metering
The FM2 offers advanced monitoring and metering which includes:

Metering
The FM2 meters and displays:
- RMS current of each phase
- Ground fault leakage current
- Phase current imbalance (%)
- Power (kW)
- Energy (kWhr)
- Voltage

Trip Record
When the FM2 issues a trip command a record is generated which includes the cause and pre-trip current values.

Statistics and Maintenance
The FM2 records statistical data about relay and feeder operation, allowing the user to set the interval at which routine maintenance tasks should be performed. When the times are exceeded an alarm is generated. This includes:
- Contactor inspection: number of contactor/breaker operations after which contactor contacts must be inspected for wear

Functional Block Diagram

ANSI Device Numbers & Functions

<table>
<thead>
<tr>
<th>Device Number</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>49/51</td>
<td>Overload</td>
</tr>
<tr>
<td>50G</td>
<td>Welded/open contactor</td>
</tr>
<tr>
<td>79</td>
<td>Earth fault</td>
</tr>
<tr>
<td>79</td>
<td>Undervoltage autoreclose</td>
</tr>
</tbody>
</table>

*see ANSI Standard in catalog for a complete list
**User Interfaces**

The user can communicate with the FM2 through a variety of interfaces:

**Display and Control Keys**

The panel mount model has a large user OPEN key which opens Feeder contactor/breaker. The panel mount model comes with a two-line 40 character display and additional control keys. The display and keypad can be used for local programming, showing information on alarms and trips, and displaying monitoring and metering values.

**Indicator LEDs**

The panel mount FM2 has nine status LEDs and has two additional LEDs which indicate auto mode or manual control mode.

**Communications**

The FM2 uses a ModBus® RTU RS485 connection for communication. Up to 32 FM2s can be daisy-chained together on a single communication channel. The FM2 supports operation at 1200 to 19,200 bps. A RS232/485 converter module may be used to connect a personal computer to the FM2.

**Models**

**Mounting Configurations**

The FM2 can be ordered in either chassis mount or panel mount with display.

The chassis mount model comes with any of the option models. Setpoints are loaded through the RS485 port.

The panel mount with display model may be ordered with any option model. It is mounted on the front panel of the PCC with its two by 20 alphanumeric display, full keypad, and 11 status LEDs exposed to the operator for complete local viewing and setpoint programming. The setpoints can also be loaded into the relay through the RS485 communications port.

**Models**

**Model 712:**
- 120V, 50 or 60Hz AC VT input and switch input voltage rating

**Model 722:**
- 240V, 50 or 60Hz AC CT input and switch input voltage rating

**EnerVista™ Software**

A single PC setup software package is required to access, configure, and monitor the FM2 relay. The EnerVista™ FM2 Setup Software extracts the model number, version, and configuration parameters from the connected relay to display only the relevant data and options for the relay it is communicating with. This eliminates having to manually configure the relay within the software and provides a simple and easy to use operator user interface.

The FM2 relay is supplied with Windows® based EnerVista™ FM2 Setup Software. EnerVista™ software may be run on a PC with any Windows® based operating system. The program may be used locally on the RS232 front port or remotely on the RS485 port. It provides full access to the relay data with the following features:

- View relay status and actual values
- View/edit settings on-line/off-line
- View event recorder for trouble-shooting
- Configure inputs, outputs and LEDs through configurable logic
- Utilize a configurable protection curve
- Relay firmware programming for upgrades

In addition, all status information such as target messages and digital input/output states may be viewed with EnerVista™ FM2 Setup Software.
Features

**Front View**

**DISPLAY:**
2 line, 40 character illuminated display communicates all messages in simple English for easy interpretation by users unfamiliar with unit.

**RELAY INDICATORS:**
- RELAY A: Contactor A energized.
- RELAY B: Contactor B energized.
- PROG RELAY: User programmable relay 1 energized.
- ESD RELAY: ESD Relay energized.

**STATUS INDICATORS:**
- CLOSED: Contactor is energized and feeder is closed.
- OPEN: Contactor is not energized and motor is not running.
- TRIPPED: Contactor is not energized. Feeder is open. The FM2 has tripped the feeder due to a fault. Normally a cause of trip message will be displayed.
- ALARM: One or more alarm conditions are present. Normally a cause of alarm message will be displayed.
- FAULT: An internal fault or abnormal condition has been detected. The FM2 may need to be replaced or serviced.

**CONTROL KEYS:**
- AUTO: Selects operation of close via communication port.
- MANUAL: Selects manual operation of feeder using close key.
- CLOSE A: Energize contactor A.
- CLOSE B: Energize contactor B.
- OPEN: De-energize contactors.

**PROGRAM KEYS:**
- ACTUAL VALUES: Press to enter actual values mode to display actual feeder values such as current, earth leakage, voltage, power, energy.
- SETPOINTS: Press to enter setpoint mode to alter or examine setpoints.
- STORE: Save a newly entered setpoint.
- RESET: Reset the FM2 after a trip.
- MESSAGE: Move to the desired setpoint or actual value message.
- VALUE: Increment or decrement currently displayed setpoint value.

**Rear View**

**SUPPLY VOLTAGE:**
Required to power the FM2.

**COMMUNICATIONS:**
RS485 2 wire serial communication port operates at 1200 – 19,200 bps for remote commands, monitoring and setpoint store. ModBus® RTU protocol.

**SWITCH INPUTS:**
Opto-isolated 120 VAC live inputs for various interlock functions. The interlock inputs are fully programmable and can be assigned to such functions as setpoint access, plant interlock, test, and various others.

**4 RELAYS:**
- Relay A
- Relay B
- User programmable relay (PROG RELAY 1)
- Emergency Shutdown Relay (ESD)

**EARTH FAULT CT INPUT:**
5 amp or 500:0.025 earth fault input for residually connected phase CTs or separate core balance (zero sequence) CT.

**CONTROL POWER:**
120/240 VAC supply voltage selector switch and fuse access door.

**VOLTAGE INPUT:**
Phase R voltage input for voltage and power monitoring.

**PHASE CT INPUTS:**
3 isolated phase CT inputs that accept 1 amp or 5 amp CT.

**Earth safety and surge.**
Typical Wiring

![Typical Wiring Diagram]

Dimensions

![Dimensions Diagram]
FM2 Technical Specifications

**PROTECTION**

<table>
<thead>
<tr>
<th>IEC OVERLOAD CURVES</th>
<th>IEC A, IEC B, IEC C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>±2% of trip time over 10 sec</td>
</tr>
<tr>
<td>Detection level</td>
<td>±1% of primary CT amps</td>
</tr>
</tbody>
</table>

**GROUND FAULT TRIP TIME**

| Accuracy | ±0 ms, ±50 ms, 0.0 = ±50 ms |

**UNDERVOLTAGE – SUPPLY VOLTAGE**

<table>
<thead>
<tr>
<th>Undervoltage</th>
<th>65% of nominal (120 VAC or 240 VAC) immediate reclose for maximum dip time of 0.1 - 0.5 sec or OFF delay 1 reclose for maximum dip time of 1 - 60 sec/unlimited time delay 2 reclose for maximum dip time of 8 x phase CT primary amps setpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delay reclose range</td>
<td>0.2 – 300 sec</td>
</tr>
<tr>
<td>Delay restart accuracy</td>
<td>±0.2 sec</td>
</tr>
</tbody>
</table>

**FM2 TECHNICAL SPECIFICATIONS**

<table>
<thead>
<tr>
<th>DELAY RECLOSE RANGE</th>
<th>±2% of trip time over 10 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELAY RESTART ACCURACY</td>
<td>±1% of primary CT amps</td>
</tr>
</tbody>
</table>

**MONITORING**

<table>
<thead>
<tr>
<th>VOLTAGE INPUT/POWER READING</th>
<th>True RMS, sample time: 12 samples/cycle for 50Hz 10 samples/cycle for 60Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage full scale</td>
<td>1.5 x VT primary</td>
</tr>
<tr>
<td>Voltage accuracy</td>
<td>±2% of VT primary or ±2% of reading (whichever is greater)</td>
</tr>
<tr>
<td>Power accuracy</td>
<td>±5% of nominal or ±5% of reading (whichever is greater)</td>
</tr>
<tr>
<td>Power range</td>
<td>0.5 - 60.0 min/off, 0.5 - 15.0 amps, 1.5 x CT primary amps setpoint</td>
</tr>
<tr>
<td>VT burden</td>
<td>0.01 VA</td>
</tr>
</tbody>
</table>

**PHASE IMBALANCE**

<table>
<thead>
<tr>
<th>Range</th>
<th>Greater than 30% U/B trip, alarm 12%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>±2 percentage points</td>
</tr>
</tbody>
</table>
| Calculation method | \[
| Where I_N = average phase currents |
| I_L = current in a phase with maximum deviation from I_N |
| I_F = motor full load current setting |

**METERING**

<table>
<thead>
<tr>
<th>PHASE CURRENT INPUTS Conversion</th>
<th>True RMS, sample time: 12 samples/cycle for 50Hz 10 samples/cycle for 60Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>0.1 x phase CT primary amps setpoint</td>
</tr>
<tr>
<td>Full scale</td>
<td>8 x phase CT primary amps setpoint</td>
</tr>
<tr>
<td>Accuracy</td>
<td>±2% of Phase CT primary amps setpoint or ±2% of reading, whichever is greater</td>
</tr>
</tbody>
</table>

**GROUND FAULT CURRENT INPUT**

| True RMS, sample time: 12 samples/cycle for 50Hz 10 samples/cycle for 60Hz |
| Range                           | 0.1 to 1.0 x Phase CT primary amps setpoint (5 A secondary CT) 0.5 to 15.0 amps (2000:1 CT) |
| Full scale                      | 1.5 x phase CT primary amps setpoint (5 A secondary CT) 7.5 x phase CT primary amps setpoint (2000:1 CT) |
| Accuracy                        | ±2% of full scale, ±2% of total CT amps setpoint (2000:1 CT), 0.0 to 10.0 A, 0.0 to 20.0 A |

**OUTPUTS**

**RELAY CONTACTS**

<table>
<thead>
<tr>
<th>FM2 CONTACTOR A &amp; B AND ESD RELAY</th>
<th>(PF = 0.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>MAX OPERATING VOLTAGE</td>
</tr>
<tr>
<td>30 VDC</td>
<td>280 VAC, 250 VDC</td>
</tr>
<tr>
<td>125 VDC</td>
<td>250 VAC, 300 VDC</td>
</tr>
<tr>
<td>250 VDC</td>
<td>300 VAC, 500 VDC</td>
</tr>
<tr>
<td>500 VDC</td>
<td>550 VAC, 1000 VDC</td>
</tr>
</tbody>
</table>

**INPUTS**

**CT INPUTS**

<table>
<thead>
<tr>
<th>CT INPUT</th>
<th>BURDEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase CT (1 A)</td>
<td>1.0000</td>
</tr>
<tr>
<td>Phase CT (5 A)</td>
<td>25.00</td>
</tr>
<tr>
<td>Earth CT (5 A)</td>
<td>100.00</td>
</tr>
<tr>
<td>Sensitive Earth Fault CT (500.025)</td>
<td>0.0100</td>
</tr>
</tbody>
</table>

**WITHSTAND**

<table>
<thead>
<tr>
<th>1 SEC x CT</th>
<th>5 SEC x CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase CT (1 A)</td>
<td>100.00</td>
</tr>
<tr>
<td>Phase CT (5 A)</td>
<td>100.00</td>
</tr>
<tr>
<td>Earth CT (5 A)</td>
<td>100.00</td>
</tr>
</tbody>
</table>

**SOILO.025 EFFORT FAULT INPUT WITHSTAND**

<table>
<thead>
<tr>
<th>Continuous</th>
<th>Maximum 12 A for 3 cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>500.025 input can be driven by a GE Multilin 500.025 CT</td>
<td></td>
</tr>
</tbody>
</table>

**DIGITAL INPUTS**

<table>
<thead>
<tr>
<th>Inputs</th>
<th>6 fixed &amp; 10 configurable inputs, optically isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Type</td>
<td>Dry contact</td>
</tr>
</tbody>
</table>