

# Gemini 3 Modular Remote Terminal Unit



Gemini 3 is a flexible Remote Terminal Unit (RTU) platform for advanced feeder automation on electrical distribution networks.

- Flexible solutions for improved network utilisation and optimisation of existing assets
- Fast response for improved network efficiency
- Reliable and safe operations for improved system reliability
- Data monitoring and logging providing enhanced network information

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# Introduction to Gemini 3

Gemini 3 is the next generation of Lucy Electric's highly successful Gemini remote terminal unit, which forms a key part of our cutting-edge range of automation solutions.

A flexible Remote Terminal Unit (RTU) platform for advanced feeder automation on electrical distribution networks, the Gemini 3 incorporates a range of new features allowing customers to build in flexibility and scalability to their network automation.

Designed for easy upgrades, its innovative design means the unit can be accessed remotely during support activities, improving its flexibility and usability, and its modular design allows individual modules to be replaced or upgraded without recalibration.

Designed for high temperature operation, it features serial and TCP/IP communications, a split gland plate for easy fitting of umbilical cables and platform-independent, configuration software.



**Improving Quality of Service through distribution network automation.**

## Flexible solutions

Whilst Gemini 3 has specific configurations for interfacing to ground mounted and overhead switches from a range of manufacturers, its modular design allows increases and changes of functionality. This enables utilities to build flexibility into their automation designs supporting future upgrades for anticipated and unforeseen future network needs.

The compact design Gemini 3 will support integration with existing and new installations of ring main units (RMUs) allowing utilities to make targeted investments improving network utilisation and lowering the cost of ownership. Gemini 3 supports the non-intrusive retrofit of automation and control functionality to a common range of secondary distribution switchgear, as well as supporting 'automation ready' RMUs.

## Fast response

Utilities will be able to utilise their assets more optimally through monitoring and providing fast network reconfiguration, making full use of the automation schemes and remote control facilities offered in Gemini 3. As part of a Distribution Management System solution, Gemini 3 will also help minimise unplanned outages through supporting self-healing strategies.

The Gemini 3 Configuration Tool supports remote (TCP/IP) access using a secure protocol. This provides significant flexibility and cost savings preventing unnecessary journeys to remote and inaccessible sites should the network configuration change.

## Reliable and safe operations

Intelligent management of an integral uninterruptable power supply ensures a reliable means of operating during unscheduled power outages and black start conditions. Secure multi-stage switching sequences ensure safe operations of switchgear. This is a patented application (patent number GB2534376) used in the secure control of switchgear.

## Data monitoring and logging

The application of Gemini 3 provides accurate measurements allowing operators to monitor the loading of their network in real-time and to analyse historical data to help improve operational efficiency. Inbuilt three phase and earth fault detection provides the selectivity to restore the maximum network following a power system fault reducing customer outage times and ensuring that the performance of the network meets the demands of the customers.

## Smart grid ready

Standard library functions are available (e.g. Automatic change-over, automatic isolation). Additional customised schemes available include self-healing network applications.

# Gemini 3 overview

The Gemini 3 comprises a backplane housing individual modules which provide the specific functionality, a power supply unit, a rechargeable battery, human to machine interface and a communications device. This assembly is housed in stainless steel or painted mild steel cabinets to which switchgear looms are connected for interfacing with the primary plant.

## Features:

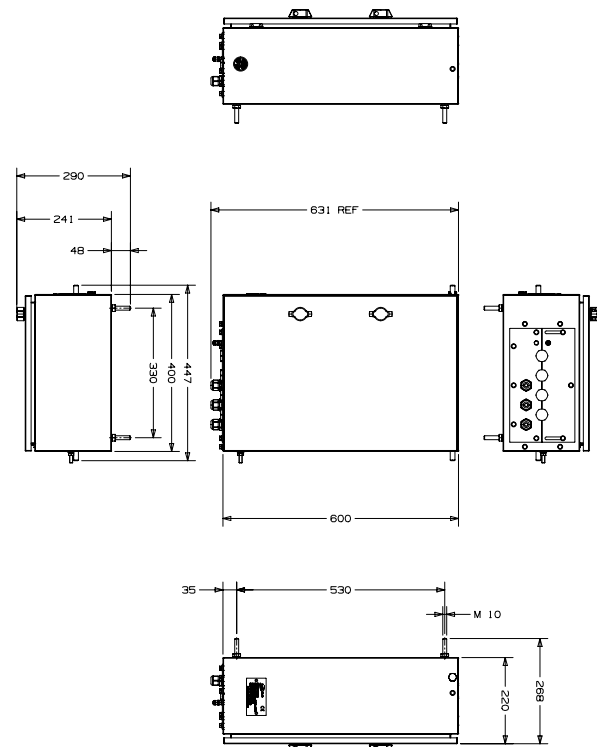
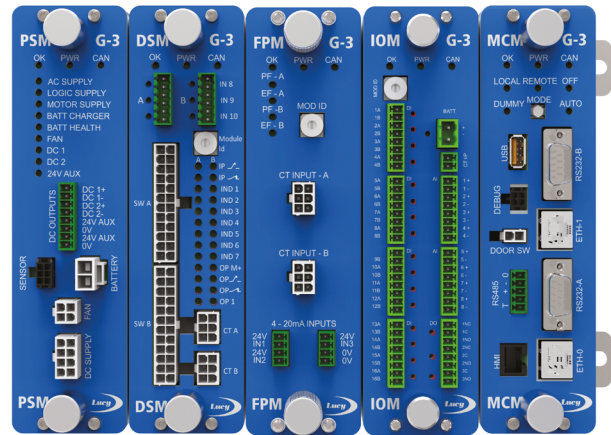
- 32-bit low power consumption microprocessors on all modules, providing local processing and efficient data handling
  - Future proof control of overhead and groundmount switchgear
    - Safe control of multiple switches (patent number GB2534376)
    - Safe control of switchgear from different manufacturers
    - Non-intrusive retrofit solution of automation and control functionality to a range of RMUs
    - Firmware upgrades
    - Upgradeability by adding additional modules
    - Smart battery charger
    - Battery test function
  - Flexible connectivity
    - Flexible inputs and outputs
- Direct connection of switchgear via split gland plate for cost effective customisation
  - Plug and socket arrangement for customer specific schemes (option)
  - External or internal fault passage detection
  - Provision for mounting 3<sup>rd</sup> party modem
  - Automation schemes include
    - Automatic sectionalising
    - Automatic change-over
    - Parasitic load tripping for meshed LV networks
  - Rugged modular design
    - Hardened modular design for harsh environments
    - Backplane arrangement for housing modules
    - HMI on separate communications bus to Gemini 3 modules
    - Ventilation/drainage provision
  - Power Supply Unit AC
    - Switch Selectable 115 or 230V AC
    - Loss of voltage indication
  - Power Supply Unit DC
    - 24 V DC



# Gemini 3 Modules

The Gemini 3 modular design provides a secure operation with built-in diagnostics, continuous status monitoring and indication. The individual modules are rugged, making the device field serviceable, ensuring future proofing of the installation. The modules currently available in Gemini 3 are:

- Master Control Module (MCM) – This contains the main processor and supervises all modules and handles the protocol communications. The MCM also integrates external field devices such as power quality meters so they are presented to the control room as coming from the Gemini 3.
- Dual Switch Module (DSM) – This provides the inputs and outputs to perform secure interlocked open/close or trip/close control of two MV ring switches. Additional features available in the DSM Plus module.
- Power Supply Module (PSM) – This module works with the switch control modules to provide secure switching operations. The PSM generates regulated power to all other modules and external communication equipment. The PSM also provides an intelligent battery charging and monitoring function to maintain a secure supply, in addition to a battery test function. A PSM Lite version is also available designed to receive 24 V DC nominal from a maintained supply. This affords system integrators added value to local solutions.
- Input Output Module (IOM) – This is a general purpose module providing digital and analogue inputs and relay outputs. It can be used as additional I/O to a multi-switch control RTU or in a monitoring-only RTU.
- Fault Passage Module (FPM) – This is a dual fault passage indicator module which detects and alarms for overcurrent and earth faults. This module also provides 3 phase line current measurement for two circuits.
- Human to Machine Interface (HMI) – This is an optional module that allows local control and monitoring without the need for a computer. It allows local controls to be issued by an authorised Engineer (security enabled) or just provide data to be viewed locally.



# Specifications

## Electromagnetic compatibility (EMC) tests

Test	Standard	Level/ class
Radiated Disturbance	EN55011:2009 + A1:2010 + EN55022:2010	Class A
Conducted Disturbance	EN55016-1-2:2014 + A1:2005 + A2:2006	Class A
Radiated radio frequency electromagnetic field immunity	EN61000-4-3:2006 + A1:2008 + A2:2010	Level 3
Electrostatic discharge immunity	EN61000-4-2:2009	Level 3
Power frequency magnetic field immunity	EN61000-4-8:2010	Level 4
Power frequency immunity	EN60255-26:2013	-
Conducted disturbance induced by rf fields immunity	EN61000-4-6:2009	Level 3
Fast transient immunity	EN61000-4-4:2014	Level 4
Damped oscillatory wave immunity	EN61000-4-18:2007	Level 3
Surge immunity	EN61000-4-5:2006	Level 4
AC and DC voltage dips & interruption immunity	EN61000-4-11:2004	-
Conducted, common mode disturbance	EN61000-4-16:1998 + A1:2004 + A2:2011	Level 4
Pulse magnetic field immunity	EN61000-4-9:1994 +A1:2001	Level 5
Damped oscillatory magnetic field immunity	EN61000-4-10:1994 + A1:2001	Level 5
Ring wave immunity	EN61000-4-12:2006	-
Burst immunity	EN60255-22-1:2005	-
Damped oscillatory wave	EN61000-4-18:2007 + A1:2010	-

## Electrical tests

Test	Standard	Description
Dielectric Voltage Strength	EN60255-27:2014 Section 10.6.4.3	Power Port 1 minute @2kV CT Input 1 minute @2.5kV
Impulse Voltage Strength	EN60255-27:2014 Section 10.6.4.2	1 second @5kV
Electrical Safety	EN61010-2-010:2014	-

## Environmental tests

Test	Standard	Description
Temperature Cold Heat Storage	EN60068-2-1:2007	-25°C, 96 hours
Temperature Cold Heat Operating	EN60068-2-1:2007	-25°C, 96 hours
Temperature Dry Heat Storage	EN60068-2-2:2007	+70°C, 96 hours
Temperature Dry Heat Operating	EN60068-2-2:2007	+55°C, 96 hours
Damp heat, steady state	EN60068-2-78:2002	+40°C, 93%, 56 days
Damp Heat, Cyclic	EN60068-2-30:2005	+55°C, 95%, six 12 hour cycles
Change of temperature	EN60068-2-14:2009	+70°C, -25°C, seven 2 hour cycles
Composite Temperature/Humidity Cyclic Test	EN60068-2-38:2009	+65°C, -10°C, 93%, ten 24 hour cycles
Degree of protection provided by enclosure (IP code)	EN60529:1992 + A2:2013	IP55 Category 2 IP65 Category 1 (available)
Solar Radiation	EN60068-2-5:2011	Five 24 hour cycles

## Mechanical

Title	Standard No.	Description / Class
Vibration	EN60255-21-1:1996	Response Class 2, Endurance Class 1
Shock	EN60255-21-2:1996	Response Class 2, Endurance Class 2
Bump	EN60255-21-2:1996	Class 1
Seismic	EN60255-21-3:1995	Class 1



# Master Control Module (MCM)

The MCM contains the main processor providing central control for the Gemini 3. It supervises all modules and handles the protocol communications.

## Features:

- 32-bit low power consumption microprocessor
- Built-in diagnostics, including temperature monitoring and hardware watch-dog.
- Real time clock
  - Accuracy, 170ms / day
  - Synchronisation available via SCADA protocol
  - NTP synchronisation available via IP and/or GPS
- Communications ports
  - Dual isolated Ethernet ports, for TCP / IP and VPN connections
  - Dual isolated RS232 ports, for serial data transmission
  - Isolated RS485 port, for serial data transmission
- Communications protocols
  - DNP 3.0 TCP / IP or serial
  - IEC 60870-5-101
  - IEC 60870-5-104
  - Modbus TCP or RTU
- Data integration
  - Integration of external field devices, for example providing 3 phase power and energy measurements
  - Protocol conversion
- IEC 61499 programmable logic
  - Event driven
  - Hierarchical
  - Distributed processing
  - Standard library functions available
  - IEC 61131-3 supported
  - Dynamic dead-band to avoid unnecessary alarms configured in SCADA
- Supervisory selection and indication (off / local / remote)
- Multiple level alarms
- Event recording
  - 7000 events in low power non-volatile memory, 1ms resolution
  - Optional flash SD card (for memory extension)
  - Events can be exported using the Gemini 3 Configuration Tool
- Port for optional HMI
- Dummy control indicator
- LED status indicators
- Maintenance free – no backup battery
- Security compliance
  - Stateful packet inspection firewall
  - VPN
  - Service and port restriction
  - Multi-layered access controls
  - Role based authentication and authorisation

We are continually reviewing product security and keep a close watch on new threats and attack vectors. As appropriate Lucy Electric will respond to identified risks and enhance the security of our products.





# Dual Switch Control Module (DSM)

The DSM performs secure control of two ring switches by providing monitored current to trigger actuator (servo motor) control inputs.

## Features:

- 32-bit low power consumption microprocessor
- Built-in diagnostics, including temperature monitoring and hardware watch-dog
- For use with ground mount switchgear, providing dual switch control
- Switched actuator supply
- 6 x relay outputs (2 x switch open / close + 2 spare)
  - Secure multi-stage switching sequence
  - Safety interlocks in hardware and software (patent number GB2534376)
  - Anti-pumping function
  - Open / close control software configurable as pull-up, pull down or volt-free
  - Continuous current measurement limit to protect the motor
  - Configurable current timeout to protect motor
- 2 x 1A CT inputs for measuring AC current
- 24 x optically isolated digital inputs (from volt free contacts)
  - 20 x Digital Inputs (10 per switch), including 6 user wireable inputs for general purpose signals
  - 2 x Switchgear status – open / close (1 pair per switch)
- Flexible controls
  - Configurable inputs, inverting, etc. for different switchgear manufacturers
- LED status display – open / close LED colours can be reversed (green / red or red / green)

## Options:

- DSM Plus
  - 2 x 1 A/5 A CT inputs
  - 2 x 4-20 mA inputs



# Power Supply Module (PSM)

## Power supply Battery management

The PSM works in conjunction with the switch control modules to provide secure switchgear controls. It generates regulated and protected power supplies providing temperature compensated smart battery charging and a battery test function.

### Features:

- 32-bit low power consumption microprocessor
- Built-in diagnostics, including temperature monitoring and hardware watch-dog
- Intelligent charger for sealed lead acid (SLA) & high temperature Nickel Metal Hydride (NiMH) batteries to maximise service life
  - Optimal battery charging
  - Battery deep-discharge protection
- Intelligent battery tests
  - Passive resistive load
  - Active load (option)
- Short circuit and over-current protection on all supplies (motor, logic, isolated communications, 24V auxiliary)
- Switched motor supply (from batteries) with current monitoring
- Switched logic supply with current monitoring
- Option for dual communications supplies
  - 12V 30W communications supply (isolated) option
  - 12V 50W communications supply (isolated) option
  - 24V 9W communications supply (non-isolated) option
  - Power cycle supplies if communications with SCADA is unreliable
- Isolation transformer for protection against over-voltages (external to PSM)
- Optional temperature / humidity sensor inside control cabinet



- Battery management functionality

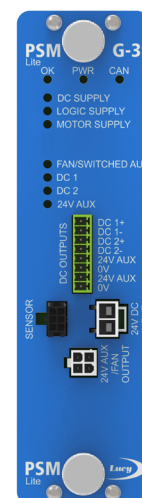
# PSM Lite

## Power supply

The PSM Lite works in conjunction with the switch control modules to provide secure switchgear controls. It generates regulated and protected power supplies for the RTU electronics and manages the 24V DC supply to control the switchgear.

### Features:

- 32-bit low power consumption microprocessor
- Built-in diagnostics, including temperature monitoring and hardware watch-dog
- Short circuit and over-current protection on all supplies (motor, logic, optional isolated communications, 24V auxiliary)
- Switched motor supply with current monitoring for switchgear control
- Switched logic supply with current monitoring for Gemini 3 modules
- Switched 24V AUX supply (for DC fan or other equipment)
- Interface for temperature / humidity sensor inside control cabinet
- Optional communications supplies
  - 12V 30W communications supply (isolated) option
  - 12V 50W communications supply (isolated) option
  - 24V 9W communications supply (non-isolated) option
  - Power cycle supplies if communications with SCADA is unreliable



# Input Output Module (IOM)

The IOM is a general purpose I/O module with digital inputs, analogue inputs and relay outputs. It can be used as additional I/O to a multi-switch control RTU or in a monitoring only RTU requiring only the Master Control Module (MCM).

## Features:

- 32-bit low power consumption microprocessor
- Built-in diagnostics, including temperature monitoring and hardware watch-dog.
- 16 x optically isolated digital inputs (voltage free operation)
- 8 x 12-bit isolated analogue inputs which can be configured as 0-10VDC or 4-20mA
- 1 x 1A CT input for measuring AC current
- 3 x volt free relay outputs (2 x NC/NO and 1 x NO)
- LED status indicators



# Fault Passage Module (FPM)

The FPM fault detection module is a dual fault passage indicator unit which measures and analyses the current waveforms to detect and alarm for three phase over current and earth faults. It additionally provides 2 x 4-20mA user configurable inputs for external sensors.

## Features:

- 32-bit low power consumption microprocessor
- Built-in diagnostics, including temperature monitoring and hardware watch-dog
- For use with overhead line and ground mount switchgear
- 2 x 3 phase 1 A CT input
- Fault detection (phase & earth)
- 3 phase current measurement
- LED status indicators
- 2 x 4-20mA sensor inputs (e.g. external sensors for transformer temperature monitoring)



# Human to Machine Interface (HMI)

HMI module enables local control and monitoring without the need for a computer to be connected. The HMI can be used to issue local commands (with appropriate security access enabled) or to view data only. An LCD screen displays site information and can be customised by the user, such as designation of signals.

## Features:

- Customisable 4 x 20 character LCD screen displays site information, including currents, voltages and plant status.
- The HMI can be attached permanently or plugged in only at the time of use. One HMI can be used on all Gemini 3 installations.
- Runs on a separate communications bus to the main Gemini 3 modules, ensuring it will not impact on their operations
- The HMI can be used to control the operating modes of Gemini 3: local, remote and off.
- Local switch control (with security access levels)
- Replaces traditional panel switches



# Gemini 3 Configuration Tool

The Gemini 3 Configuration Tool is a user friendly configuration and analysis tool which provides a powerful interface for managing the Gemini 3 installations throughout their life cycle.

## Features:

- On-line and off-line configuration
- Local and remote TCP/IP connection
- Easy commissioning
- Secure remote maintenance
- Real-time monitoring of I/O, analogue values, virtual points, events and alarms
- Multiple access levels – administrator, engineer, operator
- Operates on any platform ( MAC, Windows, Linux)
- Configuration Wizard
  - Basic configuration generated automatically
  - Configuration of Gemini 3 modules
- Mapping virtual and pseudo points to the selected protocols
- Mapping inputs to switch control operations
- Mapping I/O, alarms and virtual channels to SCADA / communications protocols
- External field devices
  - Integration of external field devices into Gemini 3
  - Mapping of external field devices to SCADA protocol, presented as part of the Gemini 3 RTU
- Monitoring digital inputs, digital outputs, analogue inputs, events, alarms, virtual points and pseudo points.
- Self-generating configuration documentation
- Export configuration in HTML / XML



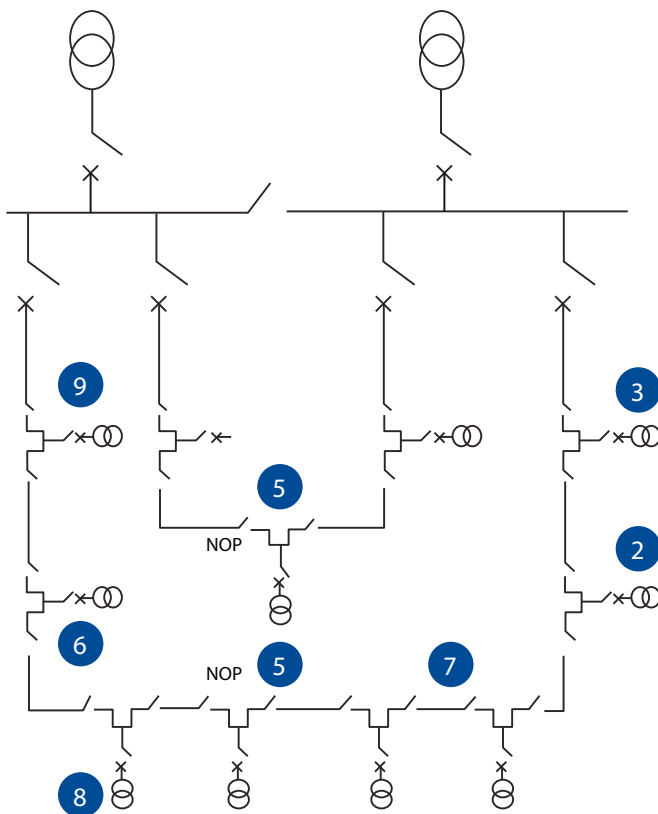


# Applications

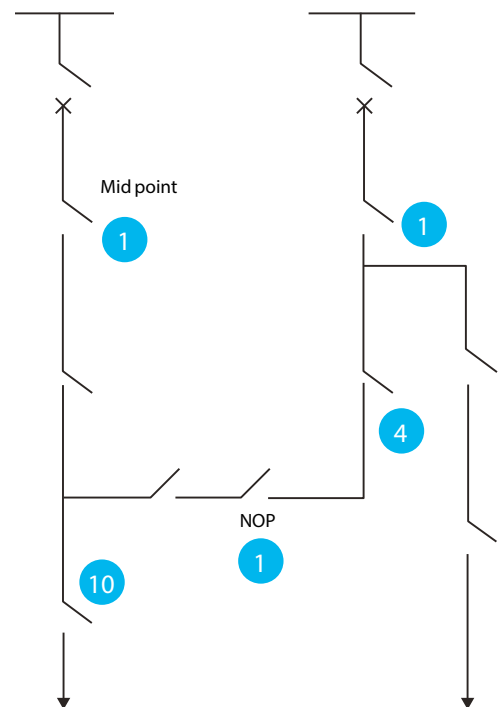
The Gemini 3 platform provides the flexibility for monitoring, control, fault detection and automation of ring main units and overhead switches for both urban and rural networks. Inbuilt functionality provides the necessary automation schemes and remote control of strategic and mid-point switches and the flexibility to operate multiple switchboards from different manufacturers.

- 1 Remote control of strategic or mid-point switches
- 2 Connection of Microgrids
- 3 Connection of PV
- 4 Auto-sectionalising
- 5 Change over schemes
- 6 Transformer monitoring
- 7 Control of multiple switchboards
- 8 Package substations
- 9 LV monitoring
- 10 Recloser interface

Urban / industrial underground cable



Rural overhead line



**Accessories:**

- Power meter
- RMU simulator
- Transformer temperature monitor

#### Disclaimer

Lucy Electric has a policy of continuous research and development and accordingly reserves the right to change the design and specification of its products without prior notice.

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