Gemini 3
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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www.lucyelectric.com

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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.

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.

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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 a stainless steel cabinet 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
  - 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

- 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
- 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
- Power Supply Unit
  - Switch Selectable 115 or 230V AC

Gemini 3 modules

HMI

Rechargeable battery

Power supply

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.

- **Switch Control Module (SCM)** – This provides the inputs and outputs to perform secure interlocked control of a single air break switch.

- **Single Switch Module (SSM)** – This provides the inputs and outputs to perform secure interlocked control of a single gas enclosed switch.

- **Dual Switch Module (DSM)** – This provides the inputs and outputs to perform secure interlocked control of two MV ring switches.

- **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.

- **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.
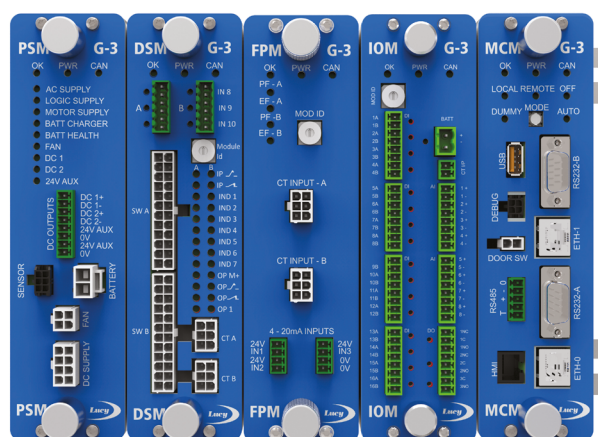
Specifications

EMC / Electrical tests

Title	Standard No.	Description / Level
Radiated Emission (below 1GHz)	CISPR 11	–
Conducted Emission	CISPR 22	–
Radiated radiofrequency electromagnetic field	IEC 61000-4-3	Level 3
Electrostatic discharge	IEC 61000-4-2	Level 4
Power frequency magnetic field	IEC 61000-4-8	Level 5
Conducted disturbance induced by rf fields	IEC 61000-4-6	Level 3
Fast transients	IEC 61000-4-4	Level 4
Slow damped oscillatory waves	IEC 61000-4-18	Level 3
Surge	IEC 61000-4-5	Level 4
AC and DC voltage dips & interruptions	IEC 61000-4-11	–
AC and DC voltage interruptions	IEC 61000-4-11	–
Slow damped oscillatory waves	IEC 61000-4-18	–
Surge	IEC 61000-4-5	Level 4
Surge	IEC 61000-4-5	Level 4
Power Frequency	IEC 61000-4-16	Level 4
Pulse magnetic field immunity test	IEC 61000-4-9 +A1	Level 5
Damped oscillatory magnetic field immunity test	IEC 61000-4-10	Level 5
Dielectric	BS EN 60255-27:2014 Section 10.6.4.3	No flashover
Impulse Voltage	BS EN 60255-27:2014 Section 10.6.4.2	No disruptive discharge

Environmental

Title	Standard No.	Description / Level
Temperature Cold Heat Storage	BS EN 60068-2-1:2007	60255-1 - 6.12.3.4
Temperature Cold Heat Operating	BS EN 60068-2-1:2007	60255-1 - 6.12.3.2
Temperature Dry Heat Storage	BS EN 60068-2-2:2007	60255-1 - 6.12.3.3
Temperature Dry Heat Operating	BS EN 60068-2-2:2007	60255-1 - 6.12.3.1
Test Cab: Damp heat, steady state	BS EN 60068-2-78:2002	60255-1 - 6.12.3.6
Damp Heat, Cyclic	BS EN 60068-2-30:2005	60255-1 - 6.12.3.7
Degrees of protection provided by enclosures (IP code)	BS EN 60529:1992 + A2:2013	IP55
Solar Radiation	BS 7527-2.4:1991	–
Test N: Change of temperature	BS EN 60068-2-14	60255-1 - 6.12.3.5

Mechanical

Title	Standard No.	Description / Level
Vibration	BS EN 60068-2-6 BS EN 60255-21-1:1996	Response Class 2, Endurance Class 1
Shock	BS EN 60068-2-27 BS EN 60255-21-2:1996	Response Class 2, Endurance Class 1
Bump	BS EN 60255-21-2:1996	Class 1
Seismic	BS EN 60255-21-3:1995	Class 1
Test N: Change of temperature	BS EN 60068-2-14	60255-1 - 6.12.3.5

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.

- Security enabled (firewall, SSL)

- Real time clock
    - Accuracy, 170mS / day
    - NTP synchronisation available via SCADA protocol

- 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

- Programmability
    - Control logic function blocks
    - 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

- HMI port (optional)

- Dummy control indicator

- LED status indicators

- Maintenance free – no backup battery

Single Switch Module (SSM)

The SSM performs secure control of a single gas enclosed pole mounted switch by providing monitored current to trigger the actuator (servo motor) control input.

Features:

- 32-bit low power consumption microprocessor

- Built-in diagnostics, including temperature monitoring and hardware watch-dog

- For use with ground mount switchgear, providing efficiencies with a dual switch control

- Switched actuator supply

- 3 x relay outputs (switch open / close + spare)

    – Secure multi-stage switching sequence

    – Safety interlocks in hardware and software (Patent Pending)

    – 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

- CT input for measuring AC current

- 11 x optically isolated digital inputs (from volt free contacts)

    – 10 x Digital Inputs (10 per switch), including 6 user wireable inputs for general purpose signals

    – 1 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)

Switch Control Module (SCM)

The SCM provides a secure control of a single switch by supplying a monitored current to actuator (servo motor) control inputs or supply monitored motor current (from the battery) directly in either polarity to a servo motor armature enabling control of different manufacturer's switchgear from the same RTU.

Features:

- 32-bit low power consumption microprocessor

- Built-in diagnostics, including temperature monitoring and hardware watch-dog

- For use with overhead air break switch disconnectors

- High current switched actuator supply to drive air break switch servo motor

- Relay outputs

  – Secure multi-stage switching sequence

  – Safety interlocks in hardware and software (Patent Pending)

  – Open / close control

  – Continuous current measurement limit to protect the motor

  – Configurable current timeout to protect motor

- 8 x optically isolated digital inputs (from volt free contacts)

  – Actuator disabled indicator

  – Switchgear status (open / close)

  – 3 x spare inputs

- 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)

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 efficiencies with a 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 Pending)

  – 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 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)

Power Supply Module (PSM)

The PSM works in conjunction with the switch control modules to provide secure switchgear controls. It generates regulated and protected power supplies, all of which are under the control of the Master Control Module (MCM) and provides temperature compensated smart battery charging.

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 (e.g. for radio repeater sites)
  - 12V 30W 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)

- Temperature / humidity sensor inside control cabinet

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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 factory configured as 0-10VDC, 0-5VDC, 0-20mA or 4-20mA (various combinations possible)

- 1 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 3 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 CT inputs

• Fault detection (phase & earth)

• 3 phase current measurement

• LED status indicators

• 3 x 4-20mA sensor inputs (e.g. external sensors for transformer temperature monitoring)

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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

- Downloadable from a Gemini 3, ensuring correct version for software configuration

- Real-time monitoring of I / O, analogue values, virtual points, events and alarms

- Multiple access levels – administrator, engineer, operator

- Operates on any platform (MAC, PC, 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

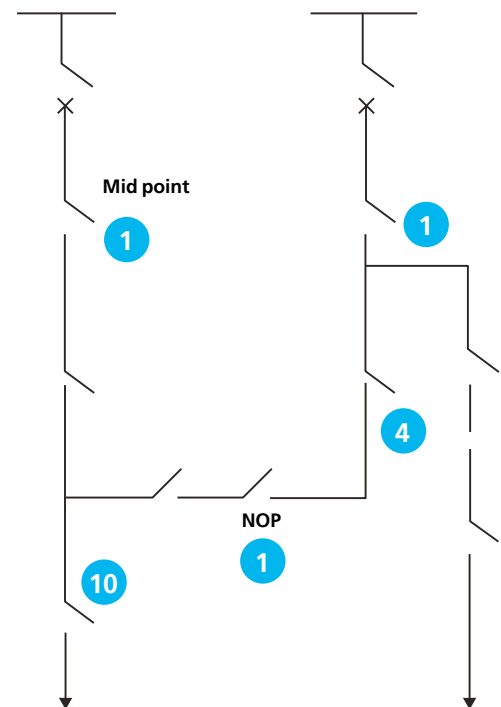- Export configuration in HTML / XML

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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 controller

Urban / industrial underground cable
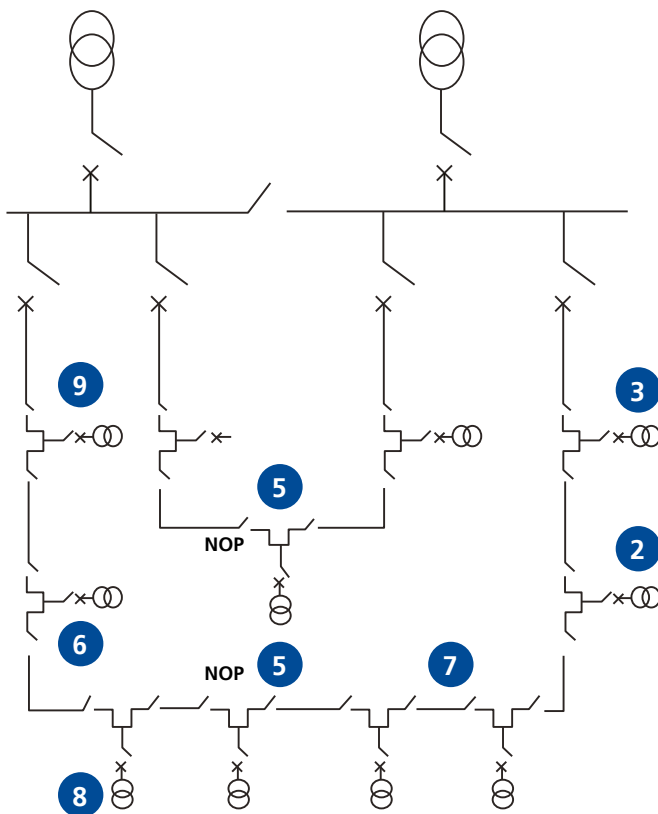
Rural overhead line

Accessories:

- Power meter
- RMU simulator
- Transformer temperature monitor

CAUTION
DO NOT FIT WIRES
UNDER CLAMP

RTU POWER

ON
OFF

F2 (INPUT)
T3.15A250V ~

F1 (AUXILIARY)
T1A250V ~

CAUTION
DO NOT CONNECT
EARTH INSIDE RTU

F3
(BATTERY)

DSM   G-3
CAN

AC SUPPLY
LOGIC SUPPLY
MOTOR SUPPLY
BATT CHARGER
BATT HEALTH
FAN
DC 1
DC 2 AUX

DC 1+
DC 1-
DC 2+
DC 2-
24V AUX
0V
24V AUX
0V

DSM   G-3
OK PWR CAN

CT INPUT - A

CT INPUT - B

FPM   G-3
OK PWR CAN
PF-A
EF-A
PF-B
EF-B
MOD ID

DSM   G-3
OK PWR CAN

MCM   G-3
OK   PWR   CAN
LOCAL REMOTE
OFF
DUMMY   MODE

USB

RS232-B

ETH-1

ETH-0

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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