

Gemini-Automated Power Distribution

Solutions for network control and monitoring



GEMINI The power to deliver

Lucy Electric – the Systems Provider

Drawing from a wealth of experience, Lucy Electric's Automation group can provide all the requisite expertise to specify and design automated Medium Voltage (MV) electrical distribution solutions that meet precise customer specifications.

Lucy Electric has consistently demonstrated its capabilities in delivering first class remote control, monitoring and automation solutions on time and within budget whilst working together with partners from a variety of sectors that include building services, consultancies and utilities.

GEMINI automated solutions provide an extra dimension to an already impressive portfolio of MV ring main units and pole mounted switchgear. The modular approach of the GEMINI technology affords an array of automation building blocks which can be tailored to offer a complete turnkey solution.

Meeting Expectations

The days when consumers were satisfied with electricity supplies prone to blackouts or interruptions are gone. Critical industries spread across the spectrum of transport infrastructure, manufacturing, healthcare, banking and data centres demand that power supplies are constant. Power outages cause unacceptable disruption and result in loss of profits.

Diligent network design can contribute to the continuity of supplies in some part, but mission critical loads are often further protected by the installation of Uninterruptible Power Supplies (UPS) and/or standby generation. The MV network feeding these Low Voltage load centres can be overlooked in the overall performance of the electrical distribution network. GEMINI products can be utilised to enhance the power availability and security in addition to enabling users to oversee their important networks.



The Possibilities

Automatic Network Reconfiguration

Automatic reconfiguration of MV networks without loss of supply under fault conditions is often only possible by installing expensive and complex circuit breaker switchboards and unit protection systems configured in a closed ring. A more viable and economic alternative can be achieved with lower cost ring main equipment in an open ring which is fully automated with motorised switching functions and Remote Terminal Units (GEMINI-RTU 2.5).

It is possible to reconfigure the MV network under fault conditions in less than 30 seconds with automation routines running independently within the GEMINI-RTUs. Lower runtime Uninterruptable Power Supplies can be deployed to fill the 30 second time gap before power restoration to any essential loads. This could also negate the requirement to install supplementary standby generation with all its associated costs. Such a scheme is illustrated in the diagram on the right.

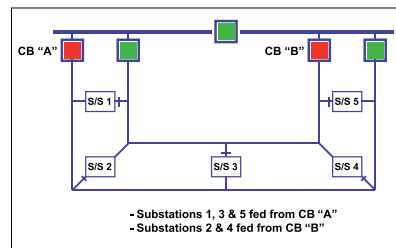
Remote Monitoring and Control

GEMINI systems are approved for use by electricity utilities worldwide and offer the customer peace of mind in the knowledge that their MV networks are continuously supervised and controlled. This enables real time diagnosis of potential problem areas whilst gathering vital information to plan for network expansion or improvement. An additional benefit to the user is the opportunity to delegate the responsibility for operating and maintaining MV networks to the Distribution Network Operators (DNO) or utility.

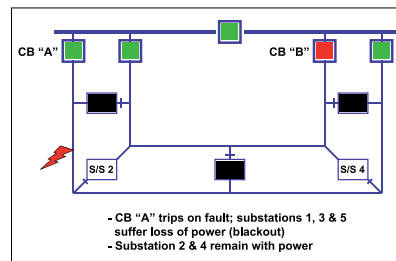
Communications

The GEMINI-RTU 2.5 and SCADA software is designed to cater for a number of de-facto standard communication protocols such as IEC 60870-5-101/104, DNP3 and Modbus; other protocols can be made available on request. The GEMINI systems are also compatible with a wide variety of wireless and cable (twisted pair or fibre optic) communication media.

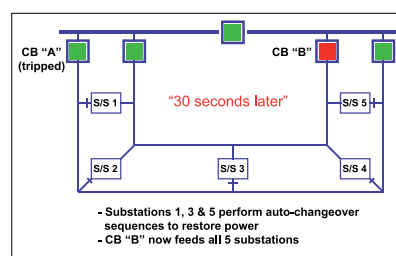
Advances in IP communication technologies enable secure Virtual Private Network (VPN) connections to be created over open Ethernet networks. Remote diagnostics or troubleshooting of distant sites is achieved through updating/upgrading of configuration files or firmware



Stage 1
System
Operating
Normally



Stage 2
Fault Condition
Occurs on Feeder 'A'



Stage 3
Automatic
Reconfiguration
of the Network

across "the air" without even having to leave the work station. It is now possible, with a suitable choice of communication modem, to design IP based communications across legacy systems such as pilot or twisted pair copper cables. This allows the retention of existing communication infrastructure whilst at the same time upgrading to the latest industrial Ethernet capability.

In order to ensure reliable and resilient communications, Lucy Electric can give unbiased advice as to the most suitable media for each particular application.

Expert Assistance at Hand

If help is required in the design or implementation of an MV network automation programme or indeed a turnkey package, Lucy Electric can offer a number of complementary services to achieve your business objectives:

- System design and integration
- On-site installation and commissioning
- Communication system infrastructure
- Technical support through a Service Level Agreement, including spares and repairs
- Comprehensive product/systems training
- Consultancy

GEMINI-SCADA 2 – The right SCADA choice

In addition to providing switching and protection solutions for electrical distribution systems, Lucy Electric offers entire electrical network remote control options via the use of GEMINI automation and monitoring products. The technology is at the cutting edge of MV switchgear design and innovation in the fields of both ground and pole-mounted switchgear. With these combined capabilities, Lucy Electric can offer its customers a truly systems-engineered approach to their turnkey MV electrical distribution requirements for the utility, industrial, commercial and infrastructure sectors.

Lucy Electric's GEMINI SCADA-2 (or G-2 SCADA) software provides a dynamic and robust medium for MV network. It allows the user to have full visual control and information accessibility to any networked system architecture which incorporates G2.5 RTUs and/or protocol capable IEDs. The GEMINI SCADA software has been developed as "application specific" for the control and monitoring of MV networks.

Other benefits include:

- Use of an "off the shelf", Windows based solution that has the ability to be tailored to suit any control room operation
- Scalable and affordable system architecture
 - Requirements can be single user 'read only' accessibility right through to multi user read/write privileges that can be securely accessed from any networked PC
- Network status and alarm handling can be interrogated via SMS messaging and mobile communication devices
- Low cost of ownership, thanks to easy configuration and upgrade paths to cater for future network expansion
- Financing options available

Core SCADA Capabilities

- Real time data collection, database management, real-time dynamic data display
- Historical collection with real-time and historical trending graphs
- Alarm, event, sequence of event management
- Secure operator supervisory control
- User-based security
- On-line configuration

Time for the right call...

To improve the real time understanding and operational capabilities of your MV distribution systems, why not give Lucy Electric a call or email your requirements to one of our specialists in the Automation team? We will be delighted to explain the options available to you.



Specification for G2-SCADA

Requirements

Microsoft Windows 2003 server,
Windows XP or later
Pentium IV; 512MB RAM
120MB disc space; CD ROM
TCP/IP LAN Interface
SVGA or higher
Mouse

Display & Graphics

Multiple monitors per workstation
Windows style navigation
Object-orientated graphics
Industry specific object libraries
Pan, zoom with automatic declutter

Summary Lists

Alarms
Events
Sequence of events
Dynamic database display
Control tag
Information tag
Manual overwrite
Disabled alarms
Operator notes

Connectivity

G2.5-RTU (Lucy Electric)
Multiple communications to RTUs, IEDs, PLCs or other I/O devices
DNP3, IEC 60870-5-101/104 – others on request
Full OPC server and client support
Serial or Ethernet communication channels
e.g. radio, GSM or GPRS

Safety Features

Select before operate control
Control timeouts; control fail alarm
Simultaneous control lock-out
Control tagging (control lock-out)
Information tagging



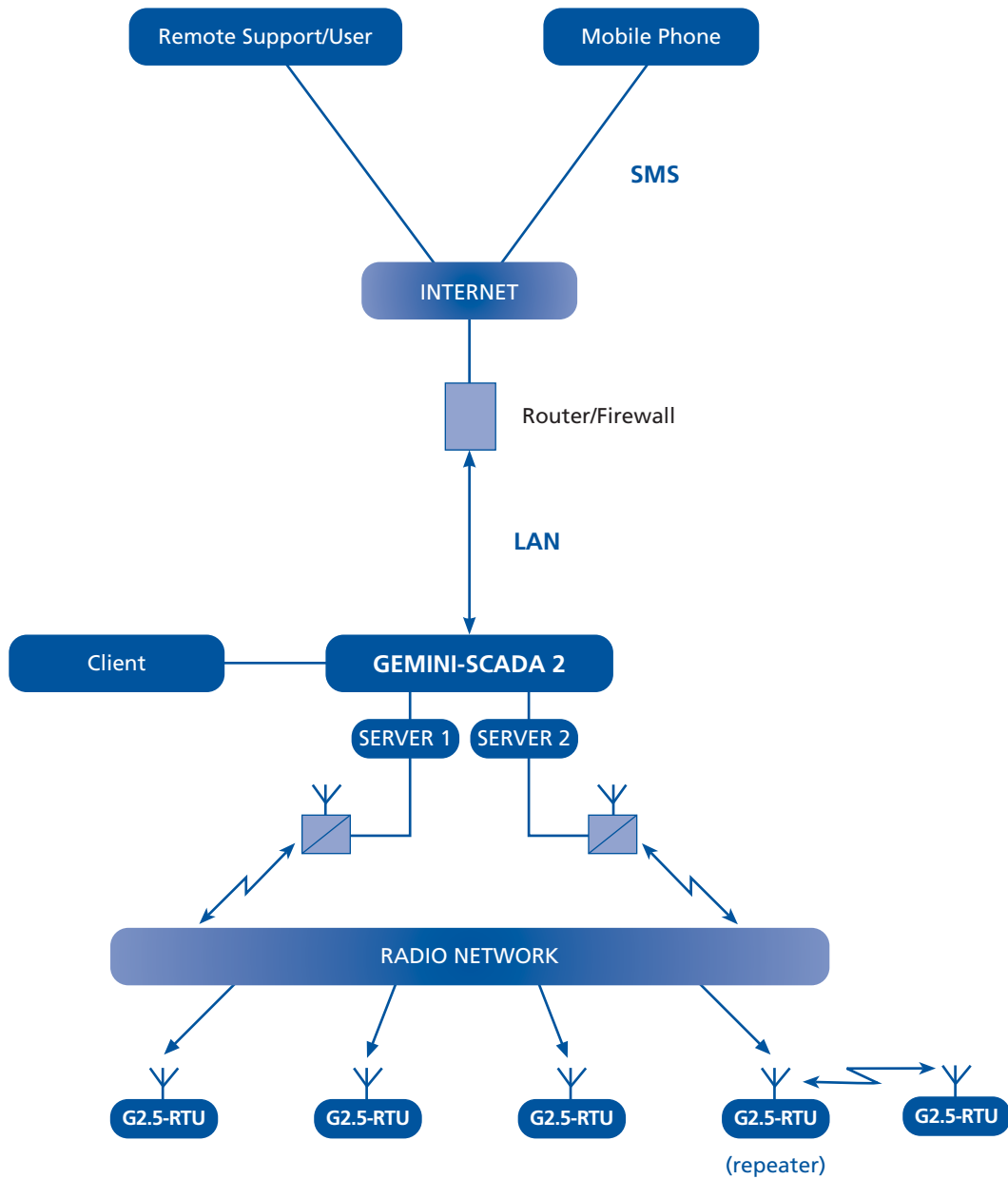
Automated Pole Mounted Load Break Switch



Automated Ground Mounted Ring Main Unit

Typical G2-SCADA System Architecture

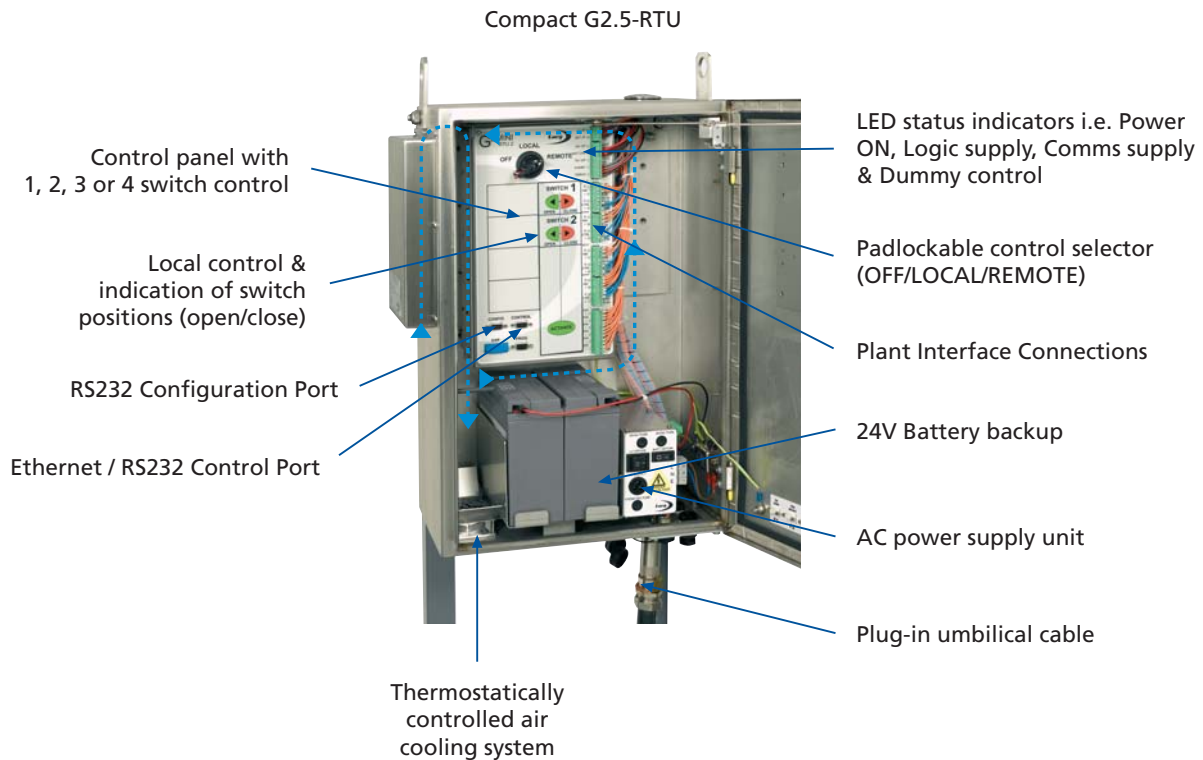
(with redundant servers/communications)



GEMINI-RTU 2.5

Lucy Electric has now introduced the second generation of the highly successful GEMINI-RTU, namely the GEMINI-RTU 2.5 abbreviated to G2.5-RTU.

This multi-purpose Remote Terminal Unit (RTU) continues to provide the telecontrol interface for the Lucy Electric range of pole and ground mounted medium voltage switchgear. Additionally, in its basic form, the G2.5-RTU can be sold as an OEM component for integration into third party MV switchgear or controllers.



Hardware Interfaces

The G2.5-RTU can support, as standard, up to 14 digital inputs (or 11 digital inputs and 3 analogue inputs) and 8 single digital outputs. All inputs and outputs are fully isolated together with the 12V, 3A d.c. dedicated supply for the communication device. For ease of maintenance and upgrading, all the connections are of a plug and socket arrangement.

Three RS232 (or two RS232 and one Ethernet) connection ports on the front panel are assigned to the configuration, re-programming and host port for the communication link. A fourth port allows the addition of further input/output modules if required.

Local electrical operation can be performed via an 'Activate' and 'Open' or 'Close' membrane push buttons (provided the padlockable control selector is set to 'Local'). For Ring Main Unit applications, the G2.5-RTU is manufactured in a one, two, three or four switch control format. Each controllable circuit has an identifiable label adjacent to the control.

All open/closed indications of the switching functions are visible on the front control panel via LED indicators and all control outputs will momentarily illuminate when active. The control panel also includes a comprehensive array of LED indications for various RTU services.

Screened and armoured connection to external plant is achieved through the plug and sockets on the RTU gland plate and these significantly reduce on-site installation time and potential errors.

Core Design

The G2.5-RTU is equipped with control electronics, communication module, battery back-up system and charger.

The control electronics system consists of two core components, namely:

- Control Logic comprises a high performance PIC based processor handling power and I/O processing.
- Communication Module performs all the protocol and communication functions (including the automation sequencing) on an ARM-based processor with a multi-tasking operating system.

All the configuration of the RTU database and communication parameters can be carried out locally or remotely using a PC running the GEMINI-RTU configurator.

Power Supplies

The RTU incorporates an auto-switching power supply unit (PSU) for accepting AC inputs of 110 or 230V. This module also comprises an AC outlet for accessories such as laptop computers or communication devices. Isolating switches for the AC and DC supplies provide independent control. Finally, the PSU is protected against under and over-voltage fluctuations from the AC input.

Battery Back-up System

Advanced battery back-up design enables the G2.5-RTU to operate under AC input failure conditions for up to 48 hours (depending on the communication device e.g. GSM/GPRS modem). A pair of long life, 12V sealed lead acid batteries support the RTU during this period and are supplied as standard. The G2.5-RTU provides a comprehensive and continuous condition monitoring facility for the battery back-up system.

For very hot conditions, a high temperature battery option (Nickel Metal Hydride) is available upon request.

All battery connections are via a simple plug and socket arrangement.

Flexible Communications

The G2.5-RTU maintains its flexibility as a device that can support a host of different communication media including radio (low/high power), RS232/RS485, packet data networks, GSM/GPRS, PSTN, Ethernet and fibre optic.

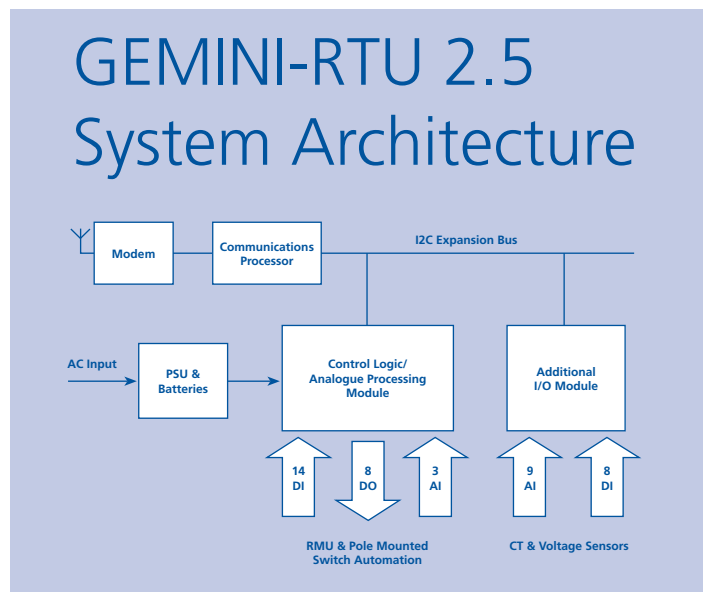
The software protocols to communicate with the host SCADA or master RTU include the de-facto worldwide standards such as DNP3 and IEC 60870-5-101/4. Other protocols are also available on request. This makes the G2.5-RTU connectivity to control systems quick and seamless.

The G2.5-RTU is equipped with a universal mounting plate for your chosen communication device.



Key features

- Local and remote operation
- DNP3 and IEC 60870-5-101/104 protocols as standard - others on request
- Flexible communications interface - radio, RS232, RS485, Paknet, GSM, GPRS, PSTN, Bluetooth, optical fibre, TCP/IP and SMS messaging
- Isolated analogue monitoring (AI)
- Isolated digital inputs (DI)
- Isolated digital control outputs (DO)
- Embedded and customised automation sequencing (e.g. Auto-changeover and Auto-sectionalising schemes)
- 24V backup battery for continued operation under power failure conditions
- Advanced monitoring (including: battery condition, temperature compensation, number of switch operations, automatic cooling system, gas pressure)
- Fully tested to Energy Networks Association Technical Standards (ENATS), EMC and Environmental standards



Optional Functions

The functionality of the G2.5-RTU can be further enhanced by the addition of the following optional modules:

- Additional Input/Output modules to expand the Digital and Analogue capability
- Fault passage modules for detecting overcurrent, earth and sensitive earth faults in ground and pole mounted switchgear
- Line current modules for measuring three phase MV line currents
- RS485 support for Modbus power meters
- Bespoke automation sequences embedded into the G2.5-RTU
- High temperature battery module

Controlled Environment

All the RTU electronics are contained within an enclosure inside the IP54 stainless steel cabinet, suitable for use in hostile environments.

A temperature controlled ventilation system forms part of the G2.5-RTU environmental monitoring to maintain stable operating conditions inside the cabinet. The overall standing load of the RTU has been significantly reduced and the G2.5-RTU is a low power consumption device. The internal working temperature of the RTU can be configured as a reportable alarm.

Excessive dust settlement is reduced inside the RTU control cabinet by incorporating a unique baffle filter system on the air intake aperture.

The G2.5-RTU has been subjected to the latest rigorous and exacting EMC and Environmental test standards to ensure a most robust and reliable operation.



Applications

The G2.5-RTU is a key component of the automated MV switchgear offered by Lucy Electric and includes the following products:

RAPIER AX-RC - Remotely controlled air break switch disconnecter up to 36kV

RAPIER GX-RC/S - Remotely controlled gas enclosed load break switch or sectionaliser up to 38kV

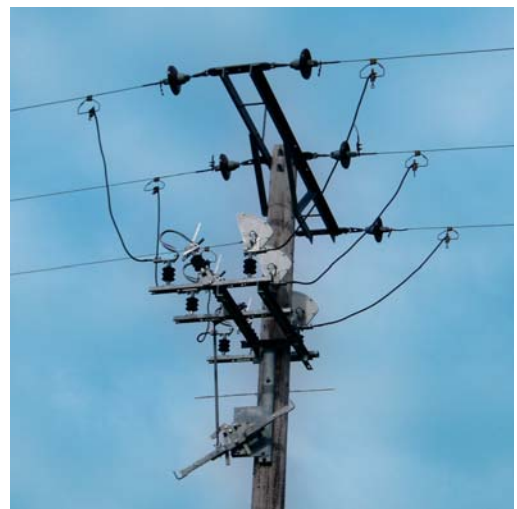
SABRE RMU Range - Automated, SF6 insulated ring main units up to 24kV

SCIMITAR SFRMU Range – Automated SF6 insulated ring main units up to 17.5kV

TRIDENT RMU range - Automated, oil-insulated ring main units up to 15.5kV

Retrofit Actuators - For legacy oil/gas-insulated ring main equipment (Lucy or third party manufacture)

OEM RTU - For integration into third party MV switchgear and controllers e.g. auto-reclosers



G2.5-RTU for ground mounted applications:

- Controls and monitoring for up to 4 motorised functions (ring switches or circuit breakers)
- Inbuilt earth and phase fault passage detection
- Supports up to 4 external fault passage indicators
- Current and voltage monitoring
- Embedded automation sequences such as Auto-changeover or Auto-sectionalising
- RTU mounting options include wall, floor or switchgear

Key benefits of remotely controlled MV switchgear

The benefits of implementing a programme of remote control and automation on secondary distribution networks are significant and include:

- Reduced time in diagnosing system faults, locating and isolating the faulty section of network
- Faster response time and network reconfiguration resulting in a reduction in customer minutes lost (CML)
- Optimisation of asset management through the implementation of customised automation schemes
- Reduced operational costs associated with routine network switching
- Increased operator safety

G2.5-RTU for pole mounted applications:

- Inbuilt low power actuator to drive air break switch disconnectors (RAPIER AX-RC)
- Supports retrofit fault passage indicator/ current sensor (RAPIER AX-RC)
- Voltage sensing (RAPIER GX-RC/S)
- Sectionaliser functionality (RAPIER GX-RC/S)
- Pole mounted RTU



Specification for GEMINI-RTU 2.5

GEMINI RTU		
General	Enclosure Degree of Protection Operating Temperature Relative Humidity Method of Mounting Dimensions	Stainless steel IP54 -25 to 60°C Up to 95% Floor, wall, pole or RMU switchgear H 600mm, W 400mm, D 210mm
RTU Hardware	Processor Module Power Supply Battery Type Battery Charger Control Electronics Inner Enclosure Ventilation	ARM9 Microprocessor 110/ 230V AC supply - over and under-voltage protection 2x12V DC, sealed lead acid or high temperature NiMH Temperature compensated, fully protected PIC based processor with expandable I ² C bus Stainless steel Microprocessor controlled, long life fan with baffle air intake filter
Inputs/ Outputs	Digital Inputs Digital Outputs Analogue Inputs Expansion I/O Module	14 isolated digital inputs - expandable 8 isolated digital outputs - expandable 3 CT analogue inputs as standard (DIs reduced to 11) 3 AIs/ 4 DIs; 7 DIs; 4 DIs/ 2 DOs
Communications	Communication Interfaces Protocols Communication Media	3 RS-232 for Control (Ethernet option), Configuration & Programming plus one Expansion Bus DNP3, IEC 60870-5-101/104 & Modbus (others on request) RS-232/ 485, UHF/ VHF radio, Packet Data, GSM/ GPRS/ EDGE, PSTN, Leased or Twisted Pair Lines, Optical Fibre, Ethernet (TCP/IP) & Bluetooth
Switchgear Interface	Controls Indications Cables	Membrane push-button for Open/ Close operations in conjunction with Activate push-button up to four switching functions (standard 1, 2, 3 or 4 switch control formats) Selector control for Off, Local or Remote modes RTU services such as DC/ AC supplies, Dummy Control and Debug LEDs Switch status LEDs for Open/ Closed positions Control Output LEDs (illuminates when active) Configurable LED indications Plug-in, multi-core umbilicals to switchgear
Software	Configuration	Windows based software for configuration of: <ul style="list-style-type: none"> • Protocol parameters including device and I/O addresses • Parameters for the communications device • Parameters for digital, analogue and counter points • Automation sequences • Power saving routines • Battery tests
Environmental Standards	Environmental (Atmospheric) Environmental (Mechanical) Electrical	EN 60068-2-1 Temperature Cold Heat EN 60068-2-2 Temperature Dry Heat HD 323.2.30 S3 Relative Humidity IEC 60255-21-1 Vibration IEC 60255-21-2 Shock IEC 60255-21-2 Bump IEC 60255-21-3 Seismic EN 50093 Voltage Dip Immunity Test IEC 60950-1 Dielectric IEC 60950-1 Impulse Voltage
EMC Standards		EN 61000-4-12 Oscillatory Waves Immunity Test EN 61000-4-2 Electrostatic Discharge Immunity Test ENV 50140 Radiated Electromagnetic Field Disturbance Test ENV 50204 Radiated Electromagnetic Fields from Digital Radio Telephones Immunity Test EN 61000-4-4 Electrical Fast Transient/ Burst Immunity Test EN 61000-4-5 Surge Immunity Test ENV 50141 Conducted Electromagnetic Field Disturbance Tests EN 61000-4-16 Power Frequency Test EN 50081-2 Conducted and Radiated Emissions Test

GEMINI Data Concentrator

Gemini Data Concentrator (GEMINI DC)

The GEMINI-DC is a standalone device acting as a SCADA front end processor and performing key functions including:

- Data capturing and monitoring
- Simple control of serial ports
- Protocol conversion
- Data concentration for transmission over Ethernet



Device Hardware

Housed in a compact enclosure, the GEMINI-DC comprises a CPU (Central Processing Unit) together with four serial ports and one 10 baseT Ethernet port. The serial channels can be configured as two RS 232/485 and two additional RS 232 only ports plus one Ethernet port. The serial communication interfaces supports speeds of up to 56k bytes.

Designed for substation applications, the GEMINI-DC operates on input power of 24 to 160V d.c. or 110/120V a.c.

When acting as a Data Concentrator, the SCADA master communicates with the GEMINI-DC as if it were a single RTU with a large database of digital and analogue data points. This database is mapped to individual GEMINI-RTU's and IED's, which communicate through the GEMINI-DC serial channels utilising radio or other communications devices.

When acting as a Protocol Converter, the GEMINI-DC can translate a number of protocols between serial/ Ethernet channels; these include the IEC 60870-5-101/104 and DNP3 communication protocols.

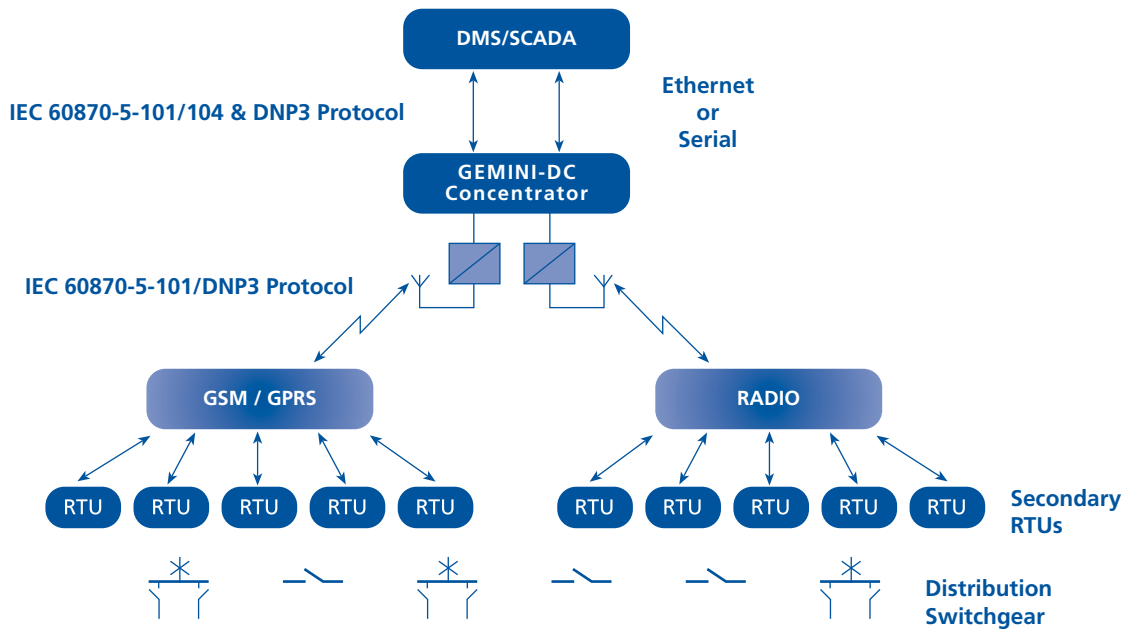
Easy to configure

Configuration of the system can be carried out centrally from the control centre using the graphic-based GEMINI Configurator Editor and application software.

Each communications port, serial or network, can be easily configured for a different protocol as well as for master or remote mode.

The software incorporates a comprehensive debug and monitoring feature which allows problems to be identified and solved quickly.





Key functions

- Protocol converter/translator: translates between legacy proprietary protocols and standard protocols
- Data concentrator: concentrates data from three slave channels, one master serial channel or four slave channels on LAN/WAN circuit
- Multi-port: allow multi-port access to single-ported device. Each host port can support a different protocol
- Network transport: add Ethernet access to a serial port. Supports DNP3 LAN/WAN, IEC 60870-5-101/104 and Modbus/TCP
- Byte transport: transport legacy bit-protocols over almost all serial communications media

Benefits

- Provides centralised and distributed processing of secondary nodes, thus preventing server overloads
- Allows multiple serial data streams to be combined into a single data hub for monitoring and control
- Minimises communication traffic with the master scada

Specification for GEMINI Data Concentrator

GEMINI-DC		
Hardware	Processor Power Temperature Watchdog Timer Activity LEDs Dimensions	AMD Elan microprocessor 24 to 160V DC or 110/120V AC 0 to 60°C Automatic restart in the event fatal hardware or software error Complete set of RS232 and Ethernet signal plus one software controlled communication LED per channel H 295mm W 530mm D 420mm
Software Configuration	Database Protocol Master/ Slave Mode RTU/ point count	Off-line creation via Windows Utility, loaded through network or configuration/maintenance port Selectable via channel Selectable by channel Capacity for over 50,000 points and large number of devices
Communications	Serial Network Maintenance	Four RS232 ports, one of which can be used for RS485 operation 10Base-T Ethernet port Separate configuration and maintenance port
Applications	Protocol Converter Multi-port Network transport Byte transport Data concentrator	Add new protocol capabilities to existing devices Allow multi-port access to single-ported device. Each host port can support a different protocol Add Ethernet access to a serial port. Supports DNP3 LAN/WAN, IEC 60870-5-101/104 and Modbus/TCP Transport legacy bit-protocols over almost all serial communication equipment Concentrate data from three slave channels, one master serial channel, or four slave channels on LAN/WAN circuit

A global network

In association with industrial partners and contractors, Lucy Electric has established a global network operating in over 50 countries. Currently its 50 agents, joint venture associates and trading partners represent Lucy Electric products all over the world from Europe, the Middle East, the Far East, Africa, Australasia, Central America, the Caribbean to South America thus strengthening the Lucy Electric presence globally.

With headquarters in Oxfordshire, UK, and a main regional office in Dubai, servicing the Middle East, the Lucy group is constantly looking to develop further partnerships.

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