YELLOW FINCH

REMOTE TERMINAL UNIT (RTU)



Technical Manual

PHOENIXZ

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REVISION HISTORY

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1. Introduction

The Yellow Finch Remote Terminal Unit (RTU) is a surface-located control and communication unit designed for operation as part of the Yellow Finch Gas Monitoring Network.



The RTU performs the following primary functions:

- Supplies optical power to underground Gas Monitoring Stations (GMS)
- Interrogates Gas Monitoring Stations (GMS)
- Receives and decodes optical telemetry signals
- Converts sensor data into Ethernet-compatible digital data
- Hosts the Yellow Finch monitoring interface
- Records and logs environmental and alarm data

The RTU is installed in a safe area outside hazardous underground environments.

2. System Overview

The Yellow Finch system consists of:

- Remote Terminal Unit (RTU)
- Up to 8 Gas Monitoring Stations (GMS)
- Optical fibre communication network
- Monitoring software interface
- SCADA / industrial network connection

The RTU serves as the central processing and communication hub of the network.

3. RTU Function within Yellow Finch Network

The RTU performs centralized monitoring and communication functions for all connected GMS units.

Functions include:

- Optical power generation
- Optical interrogation, signal generation
- Optical signal reception

- FSK signal decoding
- Data logging
- Alarm management
- Ethernet communication
- User interface hosting

The RTU communicates with GMS units using dedicated optical fibre links.

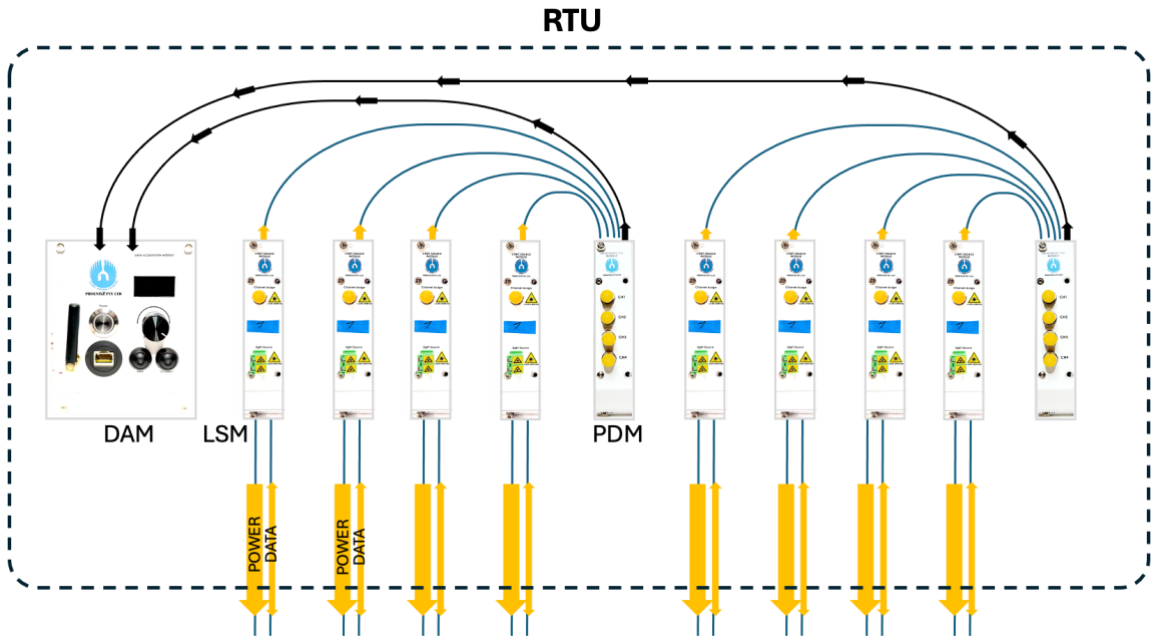
4. RTU Main Functions

The RTU provides:

Function	Description
Optical Power Delivery	Supplies optical power to GMS
Optical Interrogation	Interrogates Gas Monitoring Stations (GMSs)
Optical Signal Detection	Receives reflected optical telemetry
FSK Decoding	Decodes Frequency Shift Keyed signals
Data Processing	Converts sensor outputs into engineering values
Ethernet Interface	Provides network access
Data Logging	Stores historical data
Alarm Handling	Generates warnings and trip conditions

5. System Architecture

The RTU is a modular system consisting of a chassis, Data Acquisition Module (DAM), Light Source Module (LSM), and Photodetector Module (PDM).



Architecture of RTU

The RTU contains the following subsystems:

- Optical power source, located within the Light Source Module (LSM)
- Optical interrogation source, located within the Light Source Module (LSM)
- Optical receivers, located within the Photodetector Module (PDM)
- Signal conditioning electronics, located within the Photodetector Module (PDM)
- FSK decoding electronics, located within the Photodetector Module (PDM)

- Embedded processing unit, located within the Data Acquisition Module (DAM)
- Ethernet interface, located within the Data Acquisition Module (DAM)
- Data storage system, located within the Data Acquisition Module (DAM)
- Power supply system

The RTU communicates independently with each connected Gas Monitoring Station (GMS).

Maximum network capacity: Up to 8 GMS units.

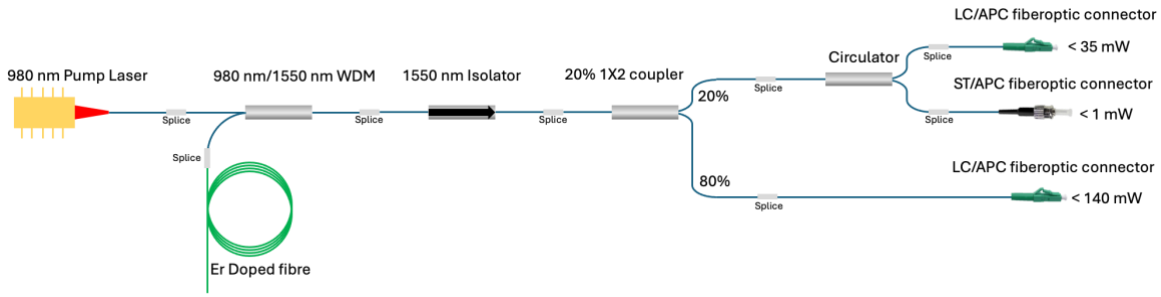
6. Light Source Module (LSM)

The Light Source Module (LSM) is a subsystem of the Yellow Finch RTU responsible for generating optical power and optical interrogation signals used for operation of the GMSs.






LSM Front LSM Back LSM side



Fibre-optic circuitry of LSM

The LSM provides controlled optical output delivered through single-mode optical fibre to connected GMS units as well as passes modulated with data optical received from GMSs to PDM for demodulation.

Main Functions

The LSM performs the following functions:

- Generation of optical power for remote powering of GMS units
- Generation of optical interrogation signals
- Stable optical output control
- Current limiting and optical power protection
- Overcurrent protection

- Distribution of optical signals to connected GMS units
- Optical Output to GMS and from GMS to PDM for demodulation

The LSM delivers optical radiation through enclosed fibre-optic interfaces only.

Parameter	Specification
Optical wavelength	1510 nm – 1570 nm
Maximum optical output power	140 mW, CW per channel
Fibre type	SMF-28 single-mode fibre
Connector type	LC/APC to GMS
	ST/APC to PDM

The optical output power is electronically limited and continuously monitored by the RTU.

Internal Construction

The LSM contains:

- Fibre-coupled optical source
- Laser driver electronics
- Optical power control circuitry
- Current limiting circuitry
- Thermal management system
- Optical connectors and fibre-optic circuitry

Optical Safety

The LSM operates as an enclosed fibre-coupled optical system.
Safety features include:

- Current-limited optical outputs
- Fibre-coupled enclosed optical interfaces
- LC/APC connectors with protective covers/shutters
- No accessible free-space optical beam is present during normal operation.
- The RTU enclosure is rated IP54.
- Overcurrent protection

The LSM is intended for operation only with connected optical fibre cables.

Communication with DAM

The LSM interfaces directly with the DAM embedded controller.

Functions monitored by the RTU include:

- Optical output power
- Laser drive current
- Module operating status
- Optical channel activity

Installation

The LSM is installed internally within the RTU enclosure and is not user serviceable.

Servicing or replacement shall only be performed by authorized personnel.

Conditions of Use

The LSM shall only be operated inside the RTU enclosure.

Optical outputs shall remain connected during normal operation.

The module shall not be modified.

Electrical power shall be disconnected before servicing.

Applicable Standards

The LSM is intended for assessment in accordance with:

- IEC 60825-1
- IEC 60825-2
- IEC 60079-28

WARNING:

Invisible optical radiation may be present at optical connectors when the system is energized.

Do not inspect optical outputs using optical instruments unless electrical power has been disconnected and the optical source verified de-energized.

7. Photodetector Module (PDM)

The Photodetector Module (PDM) is a subsystem of the Yellow Finch RTU responsible for receiving, detecting, conditioning, and decoding optical telemetry signals transmitted from connected Gas Monitoring Stations (GMS).



PDM Front PDM Back PDM Side

The PDM converts reflected optical signals from GMSs received through the optical fibre network into electrical signals suitable for digital processing by the Data Acquisition Module (DAM).

Main Functions

The PDM performs the following functions:

- Optical signal reception
- Optical-to-electrical signal conversion
- Signal amplification
- Signal filtering
- Signal conditioning
- FSK signal decoding
- Communication status monitoring

Optical Signal Reception

The PDM receives optical telemetry signals reflected from PhoenixZ optical transducers installed inside each GMS.

The received optical signals contain Frequency Shift Keying (FSK) encoded sensor and system data.

The optical interfaces operate through:

- SMF-28 single-mode optical fibre
- ST/APC optical connectors
- Enclosed fibre-coupled optical interfaces

Internal Construction

The PDM contains:

- Optical photodetectors
- Optical receiver circuitry
- Transimpedance amplifiers
- Signal conditioning electronics
- Filtering circuitry
- FSK decoding electronics
- Communication interface circuitry

Signal Processing

The PDM processes weak optical telemetry signals received from connected GMS units.

Signal processing functions include:

- Optical signal detection
- Signal amplification
- Noise reduction filtering
- Signal normalization
- FSK demodulation
- Data extraction

The processed signals are transmitted internally to the Data Acquisition Module (DAM) for further processing and Ethernet communication.

Gain Control

The PDM supports adjustable photodetector gain to compensate for:

- Fibre attenuation

- Optical connector losses
- Variable optical signal levels
- Long fibre installations

The RTU supports:

- Automatic Gain Control (recommended)
- Manual Gain Adjustment

Gain adjustment can be performed through the Yellow Finch Software Interface.

Communication Monitoring

The PDM continuously monitors:

- Optical signal presence
- Signal amplitude
- Communication stability
- Signal saturation conditions
- Low signal conditions

Diagnostic information is transmitted to the RTU monitoring software.

Optical Safety

The PDM operates exclusively with enclosed fibre-coupled optical interfaces.

No accessible free-space optical radiation is present during normal operation.

The PDM is intended for operation only with connected optical fibre cables.

Installation

The PDM is installed internally within the RTU enclosure and is not user serviceable.

Servicing or replacement shall only be performed by authorized personnel.

Conditions of Use

The PDM shall only be operated within the RTU enclosure.

Optical fibre connections shall remain connected during normal operation.

The module shall not be modified.

Electrical power shall be disconnected before servicing.

Applicable Standards

The PDM is intended for assessment in accordance with:

- IEC 60079-0
- IEC 60079-11
- IEC 60079-28
- IEC 60825-1
- IEC 60825-2

WARNING:

Do not inspect optical fibre connectors or optical interfaces while the RTU is energized.

8. Data Acquisition Module (DAM)



The Data Acquisition Module (DAM) is a subsystem of the Yellow Finch RTU responsible for processing, storing, managing, and transmitting data received from connected Gas Monitoring Stations (GMS).

The DAM receives decoded sensor and system data from the Photodetector Module (PDM) and performs centralized data processing and communication functions.

Main Functions

The DAM performs the following functions:

- Acquisition of sensor and system data
- Real-time data processing
- Communication management
- Ethernet data transmission
- Data logging and storage
- Alarm management
- Hosting of the monitoring interface
- System diagnostics and status monitoring

Internal Construction

The DAM contains:

- Embedded processing unit
- Data acquisition electronics
- Ethernet communication interface
- Internal communication interfaces
- Data logging and storage system
- System monitoring circuitry
- Micro-SD storage interface
- Data Processing

The DAM processes measurement and system information received from connected GMS units, including:

- CH_4 concentration
- CO_2 concentration
- CO concentration
- O_2 concentration
- Temperature
- Barometric pressure
- Optical power converter voltage
- Battery voltage
- Alarm conditions

- Communication status

The processed data is converted into engineering values and transmitted to the RTU monitoring interface and external systems.

Communication Functions

The DAM manages communication between:

- Photodetector Module (PDM)
- Light Source Module (LSM)
- RTU monitoring interface
- External Ethernet networks
- SCADA and industrial monitoring systems

Supported communication interfaces include:

- Ethernet TCP/IP
- Internal serial communication interfaces
- Data Logging

The DAM continuously records:

- Sensor measurements
- Alarm events
- Calibration events
- System diagnostics
- Communication status
- Data is stored locally on a Micro-SD card and can be exported in CSV format.

Alarm Handling

The DAM manages warning and trip conditions generated by connected GMS units.

Alarm functions include:

- Alarm event recording
- Timestamp generation
- Interface alarm indication
- Transmission of alarm data to external systems
- User Interface Support

The DAM hosts and supports the Yellow Finch Software Interface, including:

- Dashboard display
- Real-time graphing
- Historical data visualization
- Data export
- System diagnostics
- Gain control configuration
- Installation

The DAM is installed internally within the RTU enclosure and is not user serviceable.

Servicing or replacement shall only be performed by authorized personnel.

Conditions of Use

The DAM shall only be operated within the RTU enclosure.

The module shall not be modified.

Electrical power shall be disconnected before servicing.

Applicable Standards

The DAM is intended for assessment in accordance with:

- IEC 60079-0
- IEC 60079-11
- IEC 60079-28

WARNING:

The DAM contains electronic circuitry sensitive to electrostatic discharge (ESD). Appropriate ESD handling procedures shall be followed during servicing.

9. Communication with GMS Units

Each GMS communicates with the RTU using two optical fibre cores:

Fibre Core	**Function**
Fibre 1	Optical power delivery
Fibre 2	Bidirectional optical telemetry
Communication protocol	Frequency Shift Keying (FSK)
Sampling rate	Configurable, MIN - 1 sec

10. Optical Interfaces

RTU optical interfaces:

Parameter	**Specification**
Connector type	LC/APC and ST/APC
Wavelength	1510 nm – 1570 nm
Fibre type	SMF-28 single-mode fibre
Number of channels	Up to 8 GMS links
Optical output	Current-limited
	includes protective safety shutters

11. Optical Safety

The RTU contains fibre-coupled optical sources (LSMs) used for:

- Optical power delivery to Gas Monitoring Stations (GMS)
- Optical interrogation of PhoenixZ optical transducers placed inside GMSs
- Optical telemetry communication

The optical system operates exclusively through enclosed optical fibre interfaces and is intended for operation only with connected fibre optic cables.

Maximum optical output power: 140 mW continuous wave (CW) optical power per channel

The optical outputs are:

- Current limited
- Fibre coupled
- Enclosed during normal operation
- Accessible only through optical fibre connectors

The RTU includes the following optical safety features:

- Controlled optical output power
- Connector-based optical containment
- Protective connector covers/shutters
- Surface safe-area installation only
- No accessible free-space optical beam during normal operation

The RTU is intended for installation in a non-hazardous safe area only.

Applicable standards for assessment include:

- IEC 60825-1 — Safety of laser products
- IEC 60825-2 — Safety of optical fibre communication systems
- IEC 60079-28 — Protection of equipment and transmission systems using optical radiation

WARNING:

- Do not stare into optical connectors or fibre ends when the system is energized.
- Do not inspect optical outputs using microscopes, magnifiers, or other optical instruments unless the optical source has been isolated and verified de-energized.
- Disconnect electrical power before servicing the RTU or optical interfaces.

12. Ethernet and Network Interface

The RTU provides Ethernet connectivity for:

- Local monitoring
- SCADA integration
- Remote access
- Data export

Supported interfaces:

- Ethernet LAN
- Local Wi-Fi router connection (optional)

The RTU hosts a web-based monitoring interface accessible through a web browser.

13. Internal Data Processing

The RTU processes:

- Gas concentration measurements
- Environmental measurements
- Alarm conditions
- Calibration events
- Communication status

Processed data includes:

- CH_4
- CO_2
- CO
- O_2
- Temperature
- Pressure
- Optical power converter voltage
- Battery voltage

14. Data Logging

The RTU continuously records system data.

Logged parameters include:

- Sensor readings
- Alarm events
- Calibration events
- System diagnostics
- Communication status

Storage medium:

- Micro-SD card
- Export format:
- CSV (Excel compatible)

15. User Interface and Access

The RTU hosts the Yellow Finch Software Interface.

Functions include:

- Dashboard overview
- Real-time graphing
- Historical data review
- Alarm visualization
- Data export
- Photodetector gain adjustment

Access methods:

- Ethernet
- Wi-Fi network

Browser-based interface: No additional software installation required

16. Alarm Handling

The RTU supports three alarm states:

State	**Behaviour**
Normal	Normal display
Warning	Sensor value highlighted

Trip	Full alarm condition

Alarm thresholds are configurable during calibration.

The RTU records all alarm events with timestamps.

17. SCADA Integration

The RTU supports integration with industrial monitoring systems.
Supported outputs: Ethernet TCP/IP

Compatible systems:

- SCADA
- Industrial control systems
- Monitoring software platforms

The RTU acts as the network gateway between the optical sensing network and external industrial systems.

18. Power Supply

The RTU operates from external electrical power in a safe-area installation.
Internal subsystems include:

- Optical power drivers
- Signal acquisition electronics
- Embedded processor
- Ethernet interface
- Data logging system

The RTU is not installed in hazardous underground areas.

The RTU enclosure is earth bonded.

All optical interfaces are galvanically isolated from underground GMS units.

Electrical Specifications:

Parameter	**Value**
Input voltage	240 VAC
Frequency	50 Hz
Maximum power consumption	400 W
Internal DC rails	12 V, 5 V, 3.3 V
Fuse type	3 A slow-blow

19. Environmental Specifications

Parameter	**Value**
Installation location	Safe area
Operating temperature	4°C – 60°C
Enclosure type	Industrial enclosure
Cooling	Passive / forced air depending on configuration
Protection	IP54

20. Mechanical Construction

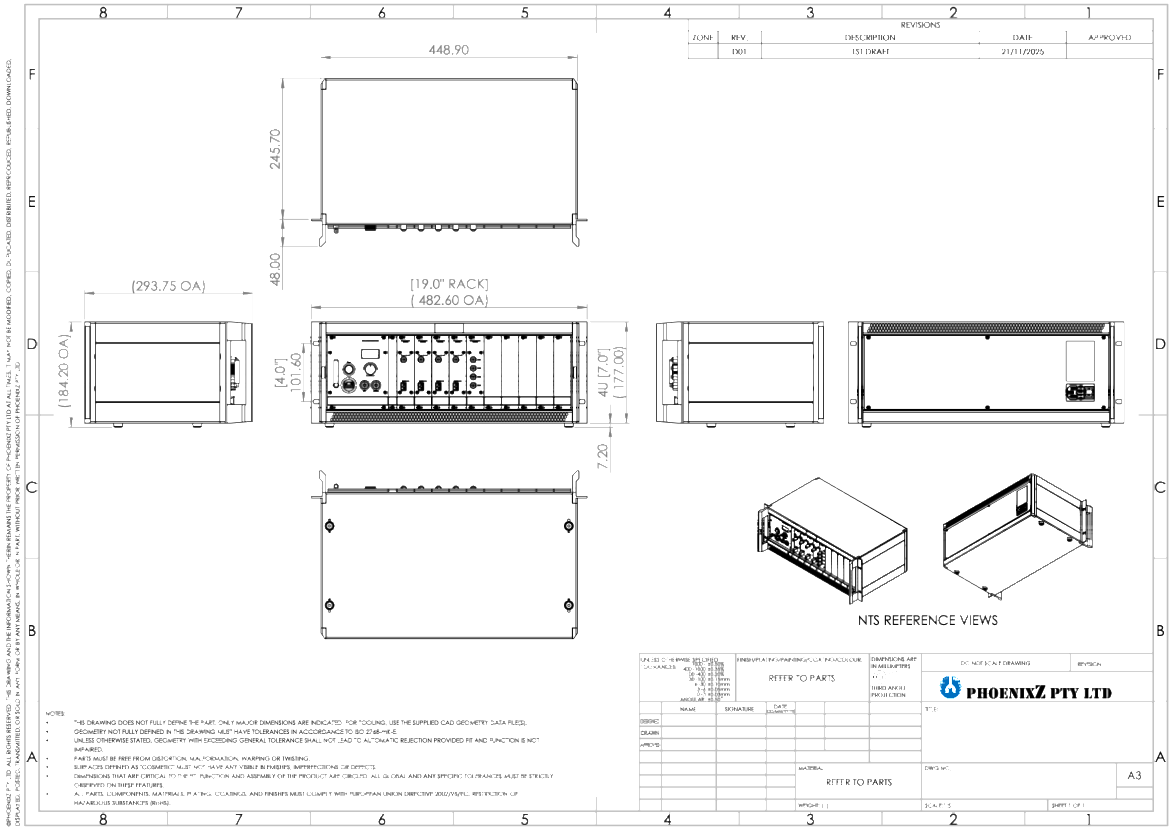
The RTU enclosure contains:

- Optical interfaces
- Embedded electronics
- Power supply
- Signal processing hardware
- Data acquisition hardware

Features:

- Portable enclosure
- Ruggedized construction
- Industrial connectors
- Fibre management system

Parameter	Value
Dimensions	293.7 mm x 448.9 mm x 177 mm
Weight	10 kg



21. Safety Features

Key safety principles:

- No electrical power distribution underground
- Optical power delivery only
- Surface-located electrical infrastructure
- Current-limited optical outputs

- Isolated communication interfaces

The RTU is designed to operate outside hazardous areas.

22. Special Conditions of Use

The RTU is intended for installation and operation in a non-hazardous safe area only.

The RTU shall only be operated with:

- Approved optical fibre connections
- LC/APC and ST/APC optical connectors
- SMF-28 single-mode optical fibre or equivalent

The RTU optical interfaces shall remain connected during normal operation.

Optical connectors and fibre ends shall not be inspected using optical instruments while the system is energized.

The RTU shall be installed in accordance with:

- Manufacturer instructions
- Applicable electrical regulations
- Site safety procedures

The enclosure shall remain closed during normal operation.

Servicing shall only be performed by authorized personnel.

Electrical power shall be disconnected before opening the enclosure or servicing optical interfaces.

Damaged optical fibre cables or connectors shall be replaced before operation.

The RTU shall not be modified without approval from PhoenixZ Pty Ltd.

23. Installation

Installation procedure:

- Mount RTU in safe area
- Connect power supply
- Connect Ethernet network
- Connect optical fibres to GMS units
- Verify optical connections
- Power ON system
- Access monitoring interface

24. Startup Procedure

Startup sequence:

- Apply power to RTU
- RTU initializes optical channels
- GMS units automatically detected
- Dashboard displays active stations
- Real-time monitoring begins

The number of dashboard panels equals the number of active GMS units.

25. Maintenance

Recommended maintenance:

- Optical connector inspection
- Fibre cleaning
- SD card inspection
- Network verification
- Software updates
- Functional verification testing

26. Troubleshooting

Problem	Possible Cause	Solution
No GMS detected	Fibre disconnected	Check optical fibre
No sensor data	Communication issue	Verify GMS link
Signal saturation	Excessive optical signal	Adjust gain
Weak signal	Fibre loss	Increase gain
No historical data	SD card issue	Check storage system
No network access	Ethernet issue	Verify network settings

27. Storage and Transport

When transporting or storing the RTU:

- Protect optical connectors
- Avoid mechanical shock
- Store in dry environment
- Disconnect external power
- Use protective transport case

28. Product Labels

The RTU includes:

- Product identification label at the back of RTU
- Serial number label combined with Product identification label
- Optical warning labels next to the optical outputs of the LSM
- Power input label



Product identification label
Serial number label
Electrical input label



Laser warning label