YELLOW FINCH

GAS MONITORING STATION (GMS)



Technical Manual

PHOENIXZ

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1. Introduction

The **Gas Monitoring Station (GMS)** is an intrinsically safe environmental monitoring device designed for use in **underground mining environments**.

The GMS is a sensing node within the **PhoenixZ's Yellow Finch Gas Monitoring Network**. The system continuously measures atmospheric conditions underground and transmits the data optically to a **Remote Terminal Unit (RTU)** located in a safe area.

The GMS operates using **optical power delivered via fibre optic cable**, eliminating electrical power distribution in hazardous areas.

2. System Overview

The Yellow Finch system consists of the following components:

- **Remote Terminal Unit (RTU)**
- **Up to 8 Gas Monitoring Stations**
- **Ruggedised optical fibre network**

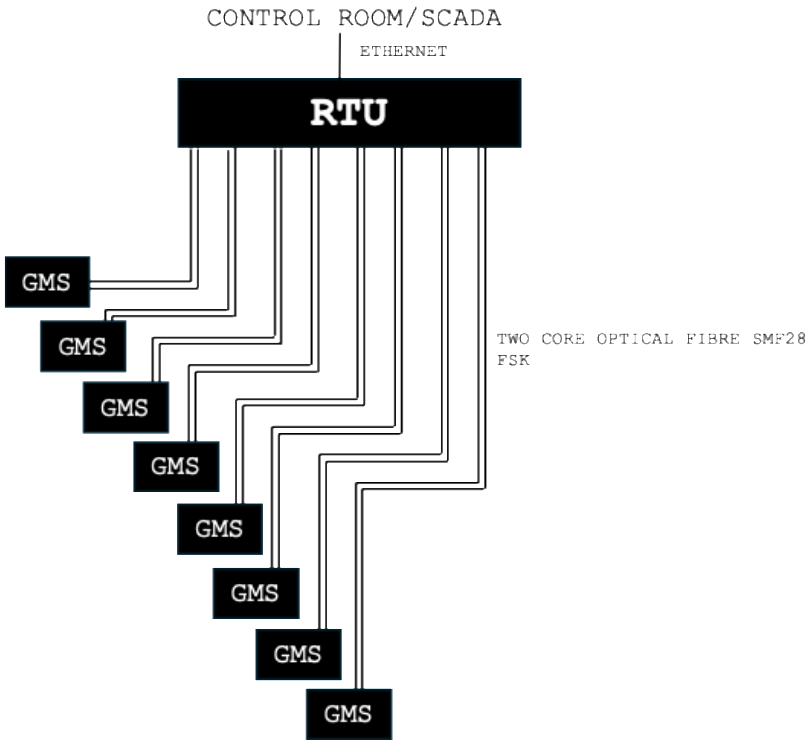


Primary system functions:

• Continuous gas monitoring
• Optical telemetry
• Intrinsically safe operation
• Real-time monitoring and alarms

3. Yellow Finch Network Architecture

Diagram — System Layout



Maximum stations per RTU: **8 Gas Monitoring Stations**

4. Gas Monitoring Station Overview

Each GMS is an intrinsically safe sensing device designed to measure:

Parameter	Measurement
Methane	CH_4
Carbon dioxide	CO_2
Carbon monoxide	CO
Oxygen	O_2
Temperature	Ambient
Barometric pressure	Ambient

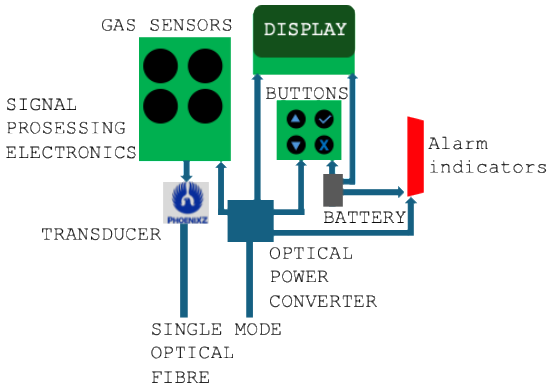


Weight: **1.5 kg**

5. System Components

Each GMS consists of:

- Optical power converter
- Battery
- Gas sensors
- Signal processing electronics
- PhoenixZ optical transducer
- LCD display
- Control buttons
- Alarm indicators



6. Optical Power Delivery and Optical Data Transmission

Optical power is supplied from the RTU to the GMS via **single-mode fibre**.
Maximum optical input power: **149 mW continuous wave optical power.**
The optical energy is converted inside the GMS into electrical power. The electrical power delivered to the GMS is sufficient to power the sensors and signal processing electronics but might not be sufficient to power the LC Display, control buttons and alarm indicators. When those components are initiated additional power is borrowed from an intrinsically safe rated battery.

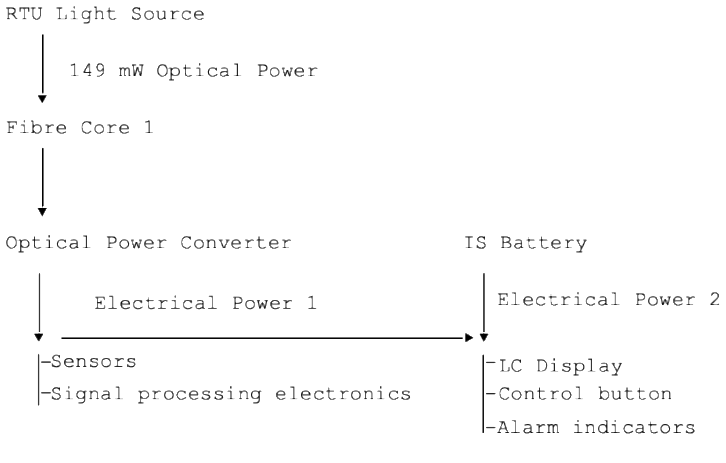


Diagram — Optical Power System

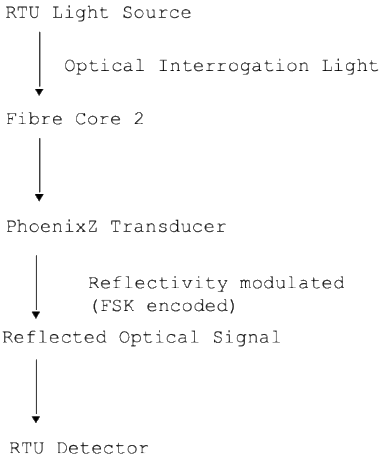


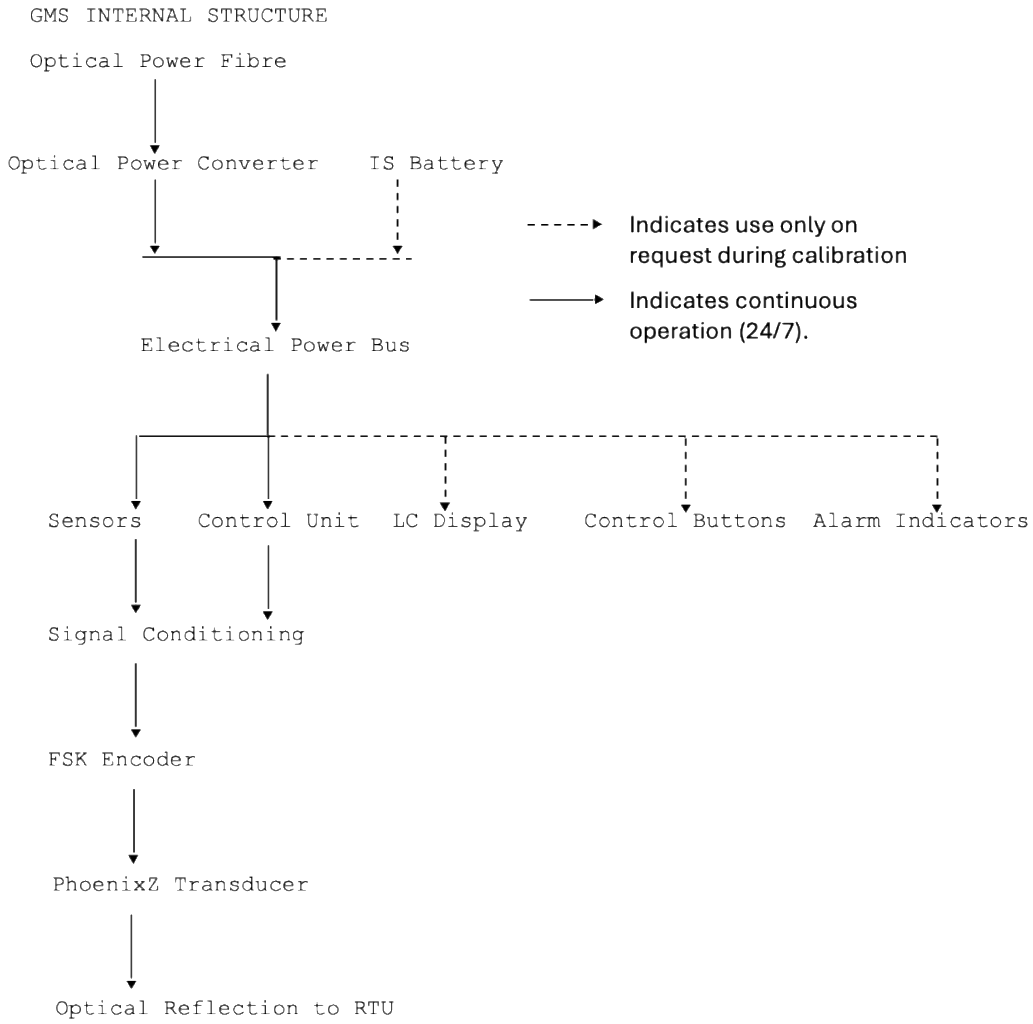
Diagram — Optical Data Transmission

Optical Data Transmission: The second fibre core provides **bidirectional optical telemetry**.

Signal flow:

1. RTU sends interrogation light
2. Electronics encode sensor outputs using **FSK**
3. PhoenixZ transducer modulates reflectivity
4. Modulated light returns to RTU

7. Internal System Architecture



8.Sensors and Measurement Ranges

Sensor	Range
CH_4	0–5 % v/v
CO_2	0–1.5 % v/v
CO	0–500 ppm
O_2	0–25 %

Environmental sensors:

- Temperature
- Barometric pressure

9. Sensor Response Times

Gas	Response Time
CH_4	T90 = 30 s

Gas	Response Time
CO_2	T90 = 30 s
CO	T90 = 15 s
O_2	T90 = 15 s

10. Environmental Specifications

Parameter	Value
Operating temperature	4°C – 60°C
Enclosure rating	IP54
Environment	Underground mining

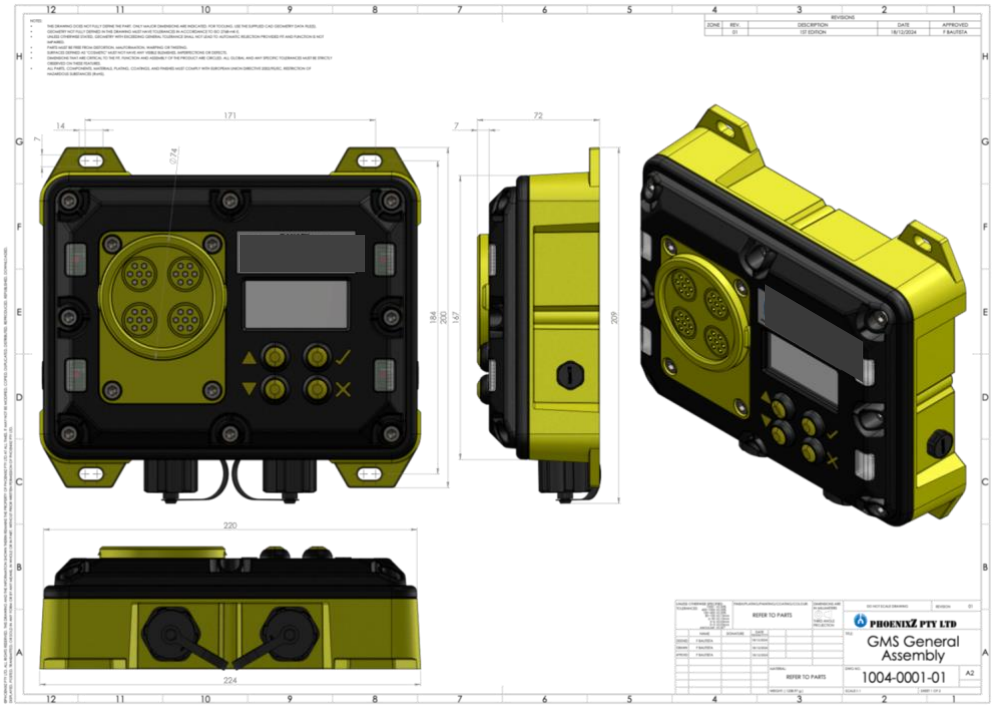
11. Mechanical Construction

The GMS enclosure is designed for rugged underground conditions.

Features:

- Impact resistant housing
- Sealed electronics compartment
- Sensor chamber
- Optical feedthrough ports

Weight: **1.5 kg**



12. Optical Interface

The GMS contains **two fibre optic inlets**.

Current configuration:

Port	Status
Primary fibre inlet	Active
Secondary fibre inlet	Reserved

Connectors: **LC/APC**

Fibre type: **Ruggedised SMF-28 single-mode fibre**

13. Electrical and Optical Power Conversion

Optical energy delivered via the fibre optic cable is converted into electrical energy using a **high-efficiency optical-to-electrical power converter**. Additional power may be drawn from the **intrinsically safe (IS) certified battery** when required. This supplementary power is used only during the **calibration process**, when the **LCD display and control buttons** are active or alarmed.

During normal operation, when only the **gas sensors, environmental sensors, and signal-processing electronics** are engaged, the system operates exclusively using the power delivered through the fibre optic cable in the form of light.

Power is distributed internally to:

- Sensors
- Electronics
- Display system
- Control buttons
- LED alarm lights

14. Signal Processing

Sensor outputs are processed using signal conditioning electronics.

Processing includes:

- Amplification
- Filtering
- Encoding

The encoded signal is transmitted using **Frequency Shift Keying (FSK)**.

15. User Interface

The GMS contains:

- LCD display
- Four control buttons
- Four alarm LEDs



Display size: **60 mm × 28 mm**

16. Control Buttons

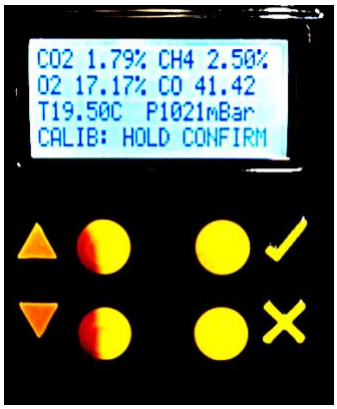
Button	Function
UP	Navigate menu
DOWN	Navigate menu
OK	Confirm
CANCEL	Exit

17. Display Activation

To activate the display: Press and hold **OK button for 5 seconds**.

Displayed information:

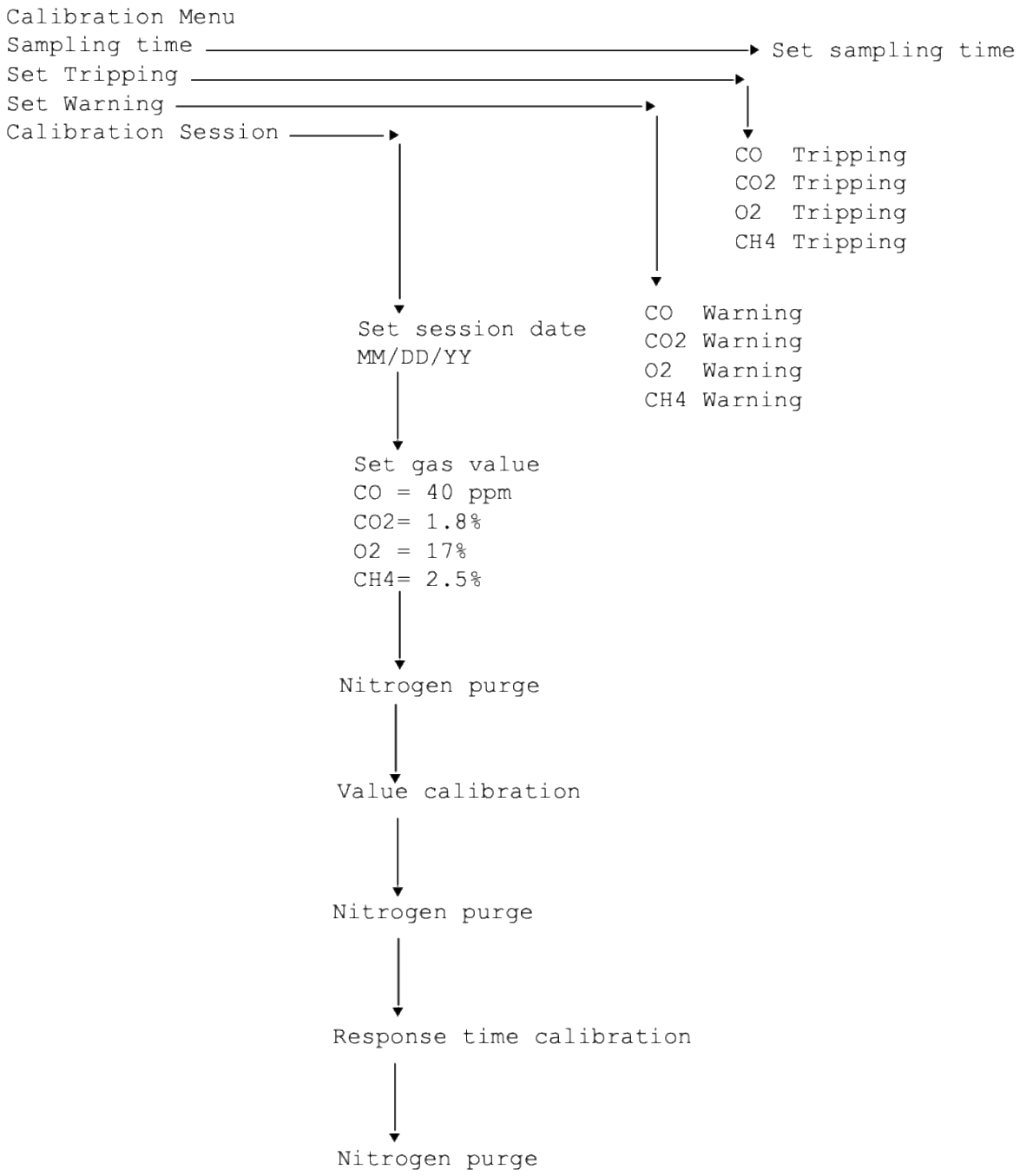
- Sensor readings
- Calibration menu
- System status



18. Calibration System Overview

Calibration ensures measurement accuracy. Calibration interval is determined by: **Mine operator or regulatory requirements.**

This chart shows the **calibration sequence**. The operator can choose to adjust the **sampling rate**, **warning limits**, and **trip limits**, or proceed directly to the **calibration procedure**.



19. Calibration Procedure

Step 1 — Enter calibration mode
Hold **OK button for 5 seconds**





Step 2 — Configure parameters using **UP** and **DOWN** arrows

• Sampling time

• Alarm System
  -Tripping levels
  -Warning levels

Step 3 — Save each value by pressing the **OK** button

20. Sampling Time



The frequency with which the GMS sends data to the RTU is referred to as the sampling time. The minimum sampling time is 1 second.

The sampling time can be adjusted via the GMS. Increasing the sampling time reduces the overall power consumption of the GMS.

To change the sampling time, press OK when the arrow indicates Sampling Time. Adjust the value using the OK button.

21. Alarm System



The GMS contains **four red LEDs**.

When gas concentration exceeds **warning threshold**:

• LEDs flash
• Interface indicator turns red
• Station frame in monitoring software turns red

Alarm levels are **user configurable** using the GMS interface.

22. Calibration Session



Using the **UP** and **DOWN** arrows, the technician navigates to Calibration Session and presses the **OK** button. This action initiates the calibration procedure and the screen request entry of date **MM/DD/YY**

23. Date Entry

The technician enters the current date using the **UP** and **DOWN** arrows, confirming each value with the **OK** button. Once the date entry is complete, the screen transitions to the Calibration Gas Configuration menu.





24. Calibration Gas Configuration

The technician enters the expected gas concentrations by using the **UP** and **DOWN** arrows and saving each value using the **OK** button.

Typical calibration mixture (CGA: C-10, Part #: G103DS4GASSPO1N by SkillPro Pty Ltd):

Gas	Value
CO	40 ppm
CO_2	1.8 %
CH_4	2.5 %
O_2	17 %





Once the entry of the expected gas values is complete, the menu automatically transitions to the Nitrogen Purge state.

25. Nitrogen Purge (Sensor zeroing pre sensor value calibration)

This step prepares all the sensors for calibration and ensures that all sensor readings are zeroed except for Oxygen which is set to 20%





Procedure:

1. Connect nitrogen cylinder: CGA: C-10, Part #: G103DSZERO by SkillPro Pty Ltd
2. Attach purge funnel
3. Press **OK** button

System performs automatic purge.

Once the Nitrogen Purge is complete, the menu automatically transitions to the Sensor Value Calibration.

26. Sensor Value Calibration





The system prompts to perform sensor calibration and connect cylinder containing mixed gases for calibration: CGA: C-10, Part #: G103DS4GASSPO1N by SkillPro Pty Ltd.

During calibration the system compares output of each sensor with expected previously entered gas values

Time Response	Sensor Output Validation	
Sensor	**Expected Value**	**Measured Value**
CO	40 ppm	40 ppm
CH_4	2.5 %	2.5 %
CO_2	1.8 %	1.8 %
O_2	17 %	17 %

Once the sensor outputs have been verified and calibrated, the menu automatically transitions to the Nitrogen Purge state to prepare (Zero) the sensors for time-response verification.

27. Nitrogen Purge (Sensor zeroing pre time response calibration)





This step prepares all the sensors for time response, measurement calibration and ensures that all sensor readings are zeroed except for Oxygen which is set to 20% before response time measurement.

Procedure:

1. Connect nitrogen cylinder: CGA: C-10, Part #: G103DSZERO by SkillPro Pty Ltd
2. Attach purge funnel
3. Press **OK** button

System performs automatic purge.

Once the Nitrogen Purge is complete, the menu automatically transitions to the Sensor time response calibration.

28. Sensor Response Time Measurement



The system prompts to perform sensor calibration and connect cylinder containing mixed gases for calibration: CGA: C-10, Part #: G103DS4GASSPO1N by SkillPro Pty Ltd.

During calibration the system measures response times T90 and T10 for sensors to reach measured values.

Time Response		Sensor Output Validation	
Sensor	**Parameter**	**Time (sec)**	**Measured Value**
CO	T90	60	40 ppm
CH_4	T90	30	2.5 %
CO_2	T90	60	1.8 %
O_2	T10	60	17 %

29. Nitrogen Purge (Sensor zeroing pre-deployment)

This step prepares all the sensors for deployment in the field; all sensor readings are zeroed except for Oxygen which is set to 20% before starting measurements of actual values in the field.



Procedure:

1. Connect nitrogen cylinder: CGA: C-10, Part #: G103DSZERO by SkillPro Pty Ltd
2. Attach purge funnel
3. Press **OK** button

System performs automatic purge.

Once the Nitrogen Purge is complete, the menu and display automatically switches off indicating that GMS is ready and starts monitoring environmental conditions.

30. Communication with RTU

The RTU performs the following functions:

• Generates optical signals used to supply power to the GMS and to interrogate the reflectivity of the PhoenixZ transducer (output DATA is encoded in the signal reflected by the transducer).
• Optical signal detection
• FSK decoding
• Data conversion
• Ethernet translation

31. Network Capacity

Maximum stations per RTU: **8 GMS units**

32. Safety

The system is designed for **intrinsically safe operation**.

Key safety features:

• No electrical power lines underground
• Optical power delivery
• Passive optical telemetry

33. Maintenance

Recommended maintenance:

• Sensor calibration
• Optical connector inspection
• Sensor replacement if required
• Sensor filter replacement if required

34. Storage and Handling

When storing the device:

• To place the GMS into **storage mode**, switch the **ON/OFF switch**, located behind the sensor cover, to the **OFF** position.
To access the switch:

1. Unscrew the **four screws** securing the sensor cover.
2. Carefully lift and remove the sensor cover.
3. Move the **ON/OFF switch** to the **OFF** position.
4. Reinstall the sensor cover.
5. Secure the cover by tightening the **four screws**.

• Protect optical connectors
• Avoid mechanical shock
• Store in dry environment

35. Troubleshooting

Problem	Possible Cause	Solution
No display	No optical power	Check fibre
No sensor reading	Sensor fault	Recalibrate
No RTU communication	Fibre break	Inspect cable