OMU I

Optical Master Unit Mark I

User Manual – A1829300UM Rev. 3.1

The most important thing we build is trust

THIS DOCUMENT IS VALID FOR ALL OMU MARK I MODELS

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About This Manual

This Product Manual provides the following information:

- Description of the unit
- Procedures for setup, configuration and checking the proper operation of the unit
- Maintenance and troubleshooting procedures

For whom it is intended

This Product Manual is intended for experienced technicians and engineers. It is assumed that the customers installing, operating, and maintaining Cobham Wireless Repeaters are familiar with the basic functionality of Repeaters.

Notice

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Safety Instructions and Warnings

Throughout this manual, important safety warnings and admonishments are included to warn of possible hazards to persons or equipment. A safety warning identifies a possible hazard and then describes what may happen if the hazard is not avoided. The safety warnings – in the form of Dangers, Warnings and Cautions must be followed at all times. These warnings are flagged by the use of a warning icon, usually the triangular alert icon seen below. The exclamation point within the triangular alert icon is intended to warn the operator or service personnel of operation and maintenance from factors relating to the product and its operating environment, which could pose a safety hazard.

General Safety Warnings Concerning Use of This System

Always observe standard safety precautions during installation, operation and maintenance of this product.

System Maintenance

- In the event of a failure Cobham Wireless's support service should be contacted for advice on a possible module replacement or other action to be taken.
- If a shipment of a unit back to Cobham Wireless is made within the period of guarantee the original packing must be used.
- The system normally operates without any operator intervention or maintenance. If in the unlikely event of any unit failure, the faulty repeater should be replaced. A failed unit can be removed and replaced with a spare while the rest of the system (other repeaters) is still operating. However, the power supply of the failed repeater should be isolated from the power before anything is replaced.
- Component Replacement - None of the modules in the repeater can be replaced without removing the repeater from its mounting and opening the cover of the repeater.

Product Disposal

CAUTION!! Product Disposal - Disposal of this product must be handled according to all national laws and regulations. For detailed information regarding materials, please refer to Cobham Wireless.

General Safety Warnings Concerning Use of System

Caution labels!	Throughout this manual, there are "Caution" warnings. "Caution" calls attention to a procedure or practice, which, if ignored, may result in injury or damage to the system, system component or even the user. Do not perform any procedure preceded by a "Caution" until the described conditions are fully understood and met.
Danger: Electrical Shock	To prevent electrical shock when installing or modifying the system power wiring, disconnect the wiring at the power source before working with un insulated wires or terminals.
Caution: Safety to personnel	o Before installing or replacing any of the equipment, the entire manual should be read and understood. o The user needs to supply the appropriate AC or DC power to the repeater. Incorrect power settings can damage the repeater and may cause injury to the user. o Please be aware that the equipment may, during certain conditions become very warm and can cause minor injuries if handled without any protection, such as gloves.
Caution: Safety to equipment	o When installing, replacing or using this product, observe all safety precautions during handling and operation. Failure to comply with the following general safety precautions and with specific precautions described elsewhere in this manual violates the safety standards of the design, manufacture, and intended use of this product. o Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. o Cobham Wireless assumes no liability for the customer's failure to comply with these precautions. This entire manual should be read and understood before operating or maintaining the repeater.
Warning: Restricted Access Location	Access to the unit installation location is restricted to SERVICE PERSONNEL who have been instructed on the restrictions and the required precautions to be taken.
Attention: Electrostatic Sensitivity	o Observe electrostatic precautionary procedures. o ESD = Electrostatic Discharge Sensitive Device. o Static electricity can be conducted to the semiconductor chip from the centre pin of the RF input connector, and through the AC connector pins. When unpacking and otherwise handling the repeater, follow ESD precautionary procedures including use of grounded wrist straps, grounded workbench surfaces, and grounded floor mats.
Caution: Class 1 Laser	The repeaters described in this manual are equipped with class 1 lasers which have been tested to meet IEC / EN 60825-1:2014 standards. **CAUTION!** - Un-terminated optical receptacles may emit laser radiation. Exercise caution as follows: o Use of controls or adjustments or performances of procedures other than those specified herein may result in hazardous radiation exposure. o Do not stare into beam or view with optical instruments. Optical transmitters in the fiber optic converter can send out high energy invisible laser radiation. There is a risk for permanent damage to the eye. o Always use protective cover on all cables and connectors which are not connected. o Never look directly into a fiber cable or a connector. o Consider that a fiber can carry transmission in both directions. o During handling of laser cables or connections, ensure that the source is switched off. o Regard all open connectors with respect and direct them in a safe direction and never towards a reflecting surface. Reflected laser radiation should be regarded as equally hazardous as direct radiation.

Table of Contents

1 INTRODUCTION

The Cobham Wireless OMU is a scalable, RF to optic signal conversion unit. The unit is installed near the Base Station and is used in combination with fibre fed repeaters to provide wireless coverage for remote sites located at a distance of up to 20 km (12.42 miles) from the Base Station.

The OMU taps the signal directly off a base station via a coupler and performs the RF to optic conversion of the base station signal for transmission to the fibre connected repeaters. (In the uplink, the procedure is reversed).

The OMU can either be installed at the BS or connected directly to a repeater. In that case the signal is tapped from the repeater's service antenna.

An OMU can be equipped to be used for frequency ranges from 88 MHz to 2170 MHz.

A single OMU unit supports up to 6 fibre optic converters, where each converter provides the signal conversion for one Repeater. The system can be expanded to support up to 24 Repeaters.

The figure below illustrates an OMU system with six F/O converters and two power supplies.

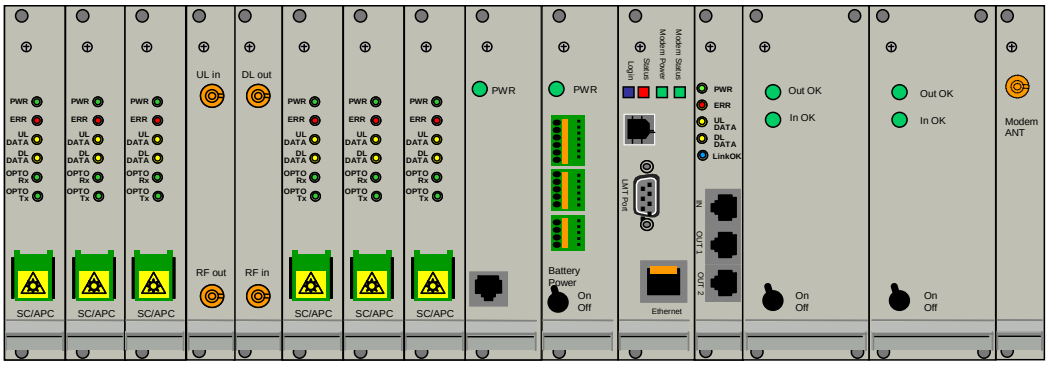


Figure 1-1. Example of OMU System

1.1 Features

- Frequency ranges from 88 MHz to 2 170 MHz.
- WDM technology (Wavelength Division Multiplexing) – single fibre connection to each Repeater
- Each OMU supports up to 6 Repeaters
- Scalability – up to four OMUs can be cascaded for support of up to 24 Repeaters
- Multi-sectors support - OMU I can support up to six sectors (model specific)
- Single-source management – cascaded OMUs can be controlled via the "Master" OMU
- Two independent power supplies (in the unit) – can be used to either:
  - allow for flexibility in power supply source selection according to the type of voltage available on site: 115 – 230 VAC 50/60 Hz and 24 – 48 VDC
  - provide power supply redundancy by installing two power supplies of the same type
- Flexible RF signal source – RF signal can be acquired either from the BS or from the Repeater's Service antenna
- Easily replaceable modules
- Simple, local setup via RS232 connection
- Remote management via Ethernet connection or via modem
- Various types of modems are supported: for example GSM, GSM-R, HSDPA/UMTS, TETRA, GPRS and PSTN.
- Single modem (installed at the Master OMU) is required for management of cascaded OMUs
- Modem can be integrated (part of the Control module) or connected separately

1.2 Models and Ordering Information

OMU is available in a range of models corresponding to repeater products

1.3 OMU Installation Configurations

The OMU can be installed in several configurations:

- Basic configuration of a single OMU installed at the BTS
- Expanding the system by either:
  - Linking several OMUs (up to four)
  - Using laser systems with three or four colours.

1.3.1 Single OMU Topology

The following figure illustrates the connections for a single OMU installed at the BTS. The OMU supports up to six Repeaters, where each repeater is connected via optic fibre to an RF/Optic converter module on the OMU. Each OMU supports up to six RF/Optic converters – for connections to up to six Repeaters.

In the downlink the radio signal is tapped from a BTS using a coupler installed in series with the BTS's antenna cable. The Fibre Optic Converter in the OMU converts the RF signal to an optical signal and sends it to the repeater over a fibre.

In the uplink the Fibre Optic Converter receives the optical RF signal from the repeater, converts it to electrical RF signal and sends it to the BTS. The signal is transferred to the antenna cable using a coupler.

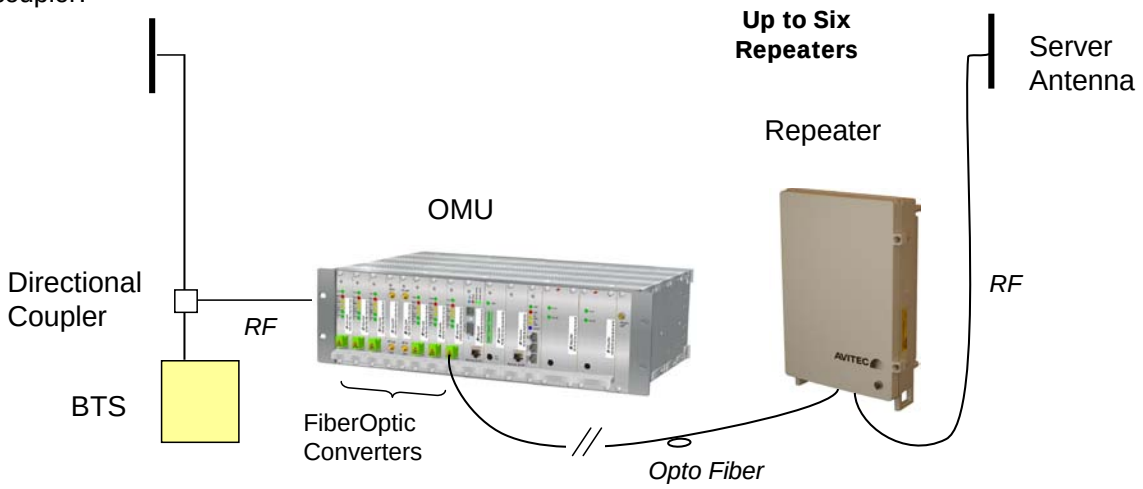


Figure 1-2. Example of Single OMU Topology

1.3.2 Cascading OMUs

Up to four OMUs can be cascaded and operate up to 24 repeaters as one system: one Master OMU and three Slave OMUs.

This type of topology requires only one Control module and one modem (at the Master OMU). All OMUs and hosted Repeaters are managed as a single system via the Master OMU.

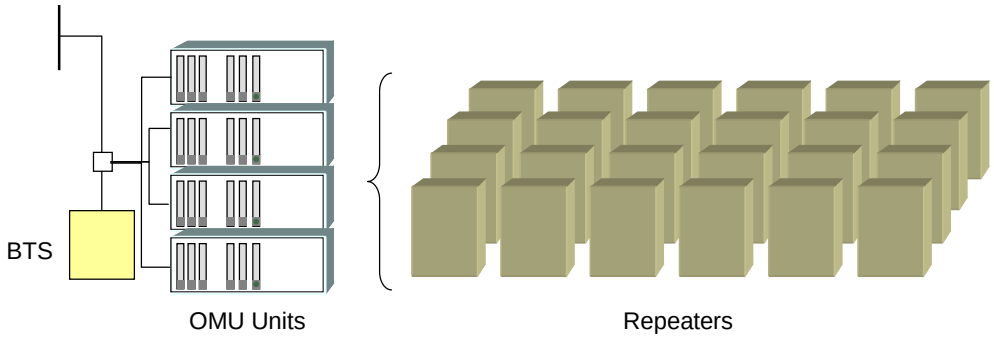


Figure 1-3. Four OMUs cascaded in one system

1.3.3 Expansion using Multi-color Laser System

The number of Repeaters supported by each OMU can be expanded using multi-coloured laser systems.

A laser system with two colours can operate one repeater for each fibre optic converter in an OMU-Repeater system – one color is used for the uplink and one for the downlink. A laser system with three or more colours can operate two or more repeaters per fibre optic converter. One color is used for the downlink which is the same for all repeaters, and in the uplink each repeater has its own color.
The connection from one repeater to the next is done via so called add-drop couplers.

The difference in distance between the repeaters and the OMU can be compensated for automatically.

Two repeaters are connected to the same converter in the OMU via the same fibre but the wavelength for the uplink differs between the units. Slave 1: 1550 ± 3 nm, Slave 2: 1510 ± 3 nm. The downlink signal is the same for both repeaters.

Figure 1-4. Dual-colour Fibre Connections to Two Repeaters

1.4 OMU Modules

The OMU is a rack type casing designed for a 19" sub-rack. The chassis supports up to six F/O to RF converters, in addition to Control, Power, Modem and additional required interface units.
Each of the modules is described in detail in the following sections.

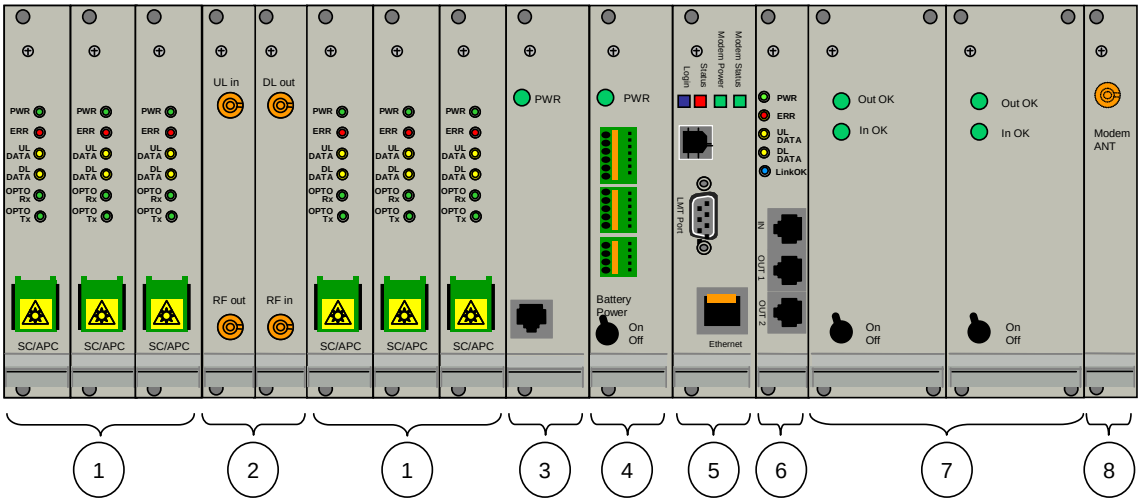


Figure 1-5. OMU Front Panel Interfaces

An OMU unit can contain the following modules:

Label	Unit	Description	Allocated Slots
1.	Fibre Optic Converter	Up to 6 WDM optic converters	1, 2, 3 and 6, 7, 8
2.	UL Combiner and DL Splitter	Combine and distribute the RF signals between the OMU's RF port and the Fibre Optic Converters.	4 and 5 respectively
3.	Modem	Optional. This unit is used for modems that are not mounted on the Control Module.	9
4.	External Alarm and Battery Module.	Supports 4 dry-contact alarms, 1 relay, and a battery (can be turned off) that enables the modem to transmit am alarm in case of loss of input power.	10
5.	Control Module	Relevant only for Master OMU	9 or 11 – without an integrated wireless modem (mounted on the control module). 11 only – if the module includes a wireless modem (to be near modem antenna module – slot 14).
6.	Rack communication board	Provides communications link between the Control Module and the Fiber Optic Converters. Also used when cascading OMUs.	12
7.	Power Supply modules (A	PS B is optional for redundancy	13

Label	Unit	Description	Allocated Slots
	and B)		
8.	Modem Antenna connections	This module is optional. This is used for OMUs with wireless modems installed that need a separate antenna. This module can also be equipped with two connectors.	14

1.4.1 WDM Fibre Optic Converter

Caution!
Un-terminated optical receptacles may emit laser radiation.
Do not stare into beam or view with optical instruments.

These modules perform the following functions:

- Provides RF to optical signal conversion in both directions.
- Downlink and uplink optical signals are combined using WDM – only one fibre is required.
- Each WDM Fibre Optic Converter in the OMU works in parallel with a corresponding unit in the repeater which is linked via the fibre (SC/APC port).
- A pilot tone can be sent between the Fiber Optic Converters in the OMU and the repeater to define the loss in the fibre. Based on this information the repeater automatically adjusts the attenuation to compensate for the fibre loss.
- On the Fibre Optic Converter module there are six LED indicators; one for power status, one for error, two for the data communication and two for the RF signals.

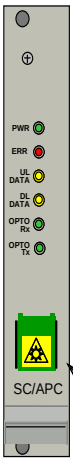


Figure 1-6.WDM Fibre Optic Converter

1.4.2 UL Combiner and DL Splitter

These modules perform the following functions:

- Combine and distribute the RF signals between the OMU's RF port and the Fiber Optic
- Contain attenuators used to set the master signal levels in the downlink and uplink.

Note: By default, the module ports are interconnected *UL In to RF out) to allow RF connections at the rear of the unit. However, these may be reconnected to allow RF connections at the front of the unit.

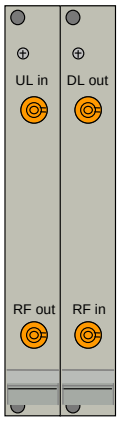


Figure 1-7. UL Combiner/DL Splitter

1.4.3 6-Way UL/DL RF Simplex Interface Cards

Optional cards used to implement multi-sectors:

- The cards are supplied in pairs (UL and DL)
- Provide the interface between up to six (UL/DL) RF sources (from Cobham Wireless Point-of-Interface system) to up to six OMU I Optic Converter Modules.
- Each DL/UL connector corresponds to a specific optic module (1st pair to Optic module in slot 1, 2nd pair to optic module in slot 2, etc.).
- Allows for Front Panel connection to RF sources
- See section 3.12.3 for more information.

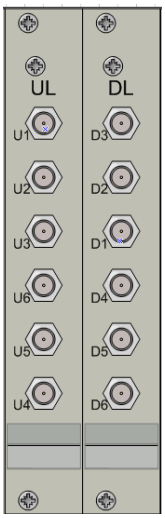


Figure 1-8. 6-Way UL/DL RF Interface Card

1.4.4 Control Module

The control module performs the following functions:

- Supports RS232 port for local connection
- Supports an Ethernet port for Ethernet connection
- For units with a modem - SIM card tray
- Manages and controls the OMU and transmits alarms to the control center
- RS232 port for local setup
- Includes a Real Time Clock (RTC) with a dedicated backup battery.

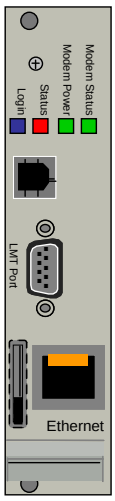


Figure 1-9. Control Module

1.4.5 External Alarm and Battery Module

The external alarm and battery module performs the following functions:

- Contains the rechargeable battery pack – allows the modem to transmit an alarm in case input power loss is detected. Switch for ON/OFF.
- Supports connections for four external alarms and one alarm relay
- The relay can be configured to trigger on any number of internal and external alarms. The maximum current through the relay is 100mA.

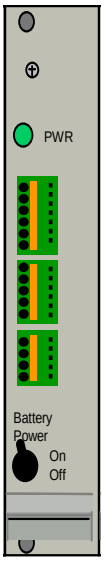


Figure 1-10. External Alarm and Battery Module

1.4.6 Modem Unit

Optional – if a modem is not available on the Control unit. For example, PSTN modems or wireless modems with a form factor that prevents it from being integrated with the Control Module.

This module performs the following functions:

- Provides modem functionality if the required modem is not available on the Control Module.
- The access to a PSTN modem is via an RJ11 connector on the font of the module.

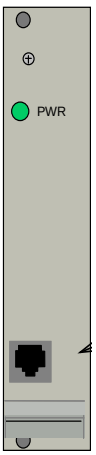


Figure 1-11. Modem Unit

1.4.7 Modem Antenna

This module performs the following functions:

- Relevant only if a wireless modem is installed in the OMU
- Provides the connection to an external (modem) antenna

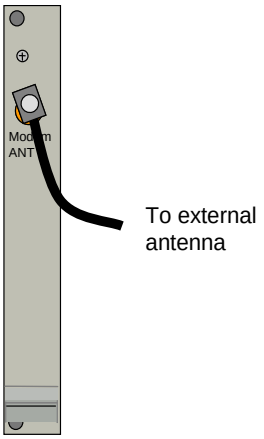


Figure 1-12.Modem Antenna

1.4.8 Rack Communication Board

This module performs the following functions:

- Provides communications link between the Control Module and the Fiber Optic Converters within the rack.
- Provides communication between cascaded OMUs.
- LEDs indicate communication status between Control Module and F/O converters.

Figure 1-13. Rack Communication Board

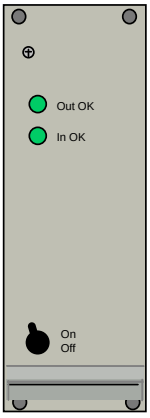
1.4.9 Power Supplies

This module performs the following functions:

- Two independent power supply modules with ON/OFF switches:

  115 - 230VAC 50/60 Hz and 24 - 48VDC.
- LEDs indicating normal levels of input and output voltages
- Each Power Supply can be switched off using the ON/OFF switches on the front panel.

  ATTENTION! *The power source is connected at the REAR of the unit. Even when the power supplies are switched off the OMU still has live power from the power input on the rear.*



1.5 Rear Panel

Note: The rear-panel layout can vary depending on the configuration.

The rear panel provides the following functions:

- Power - Plinths for **power connections** – requires opening the rear panel.
- GND - screw for earthing
- RF input - N-connector for RF input. There is one connector if the Rx/Tx input is combined and two connections if the Rx and Tx are to be fed separately.

To gain access to the plinths for power connections, duplex filter (for some models), optional attenuators and optional coupler the back panel needs to be opened. It is fastened with 4 screws.

The images to the right show the closed panel (top) and open panel (bottom) required for input power connections.

Figure 1-14. OMU with one RF In/Out

Figure 1-15. Inside of Back Lid

NOTE: Includes two plinths for power connections, a duplex filter and one RF in/out

2 INSTALLATION

2.1 Unpacking

1. Unpack the OMU.
2. Inspect the shipped material before unpacking the equipment.
3. Document any visual damage and report according to routines.
4. The OMU package contents includes the following items:
   - Checklist with delivered items
   - OMU
   - CD containing RMC and User's Manual
   - Any other specifically ordered item

2.2 Mounting in Rack

The OMU is designed to be mounted in a 19" sub rack.

Above the OMU a fibre guide unit can be mounted to support the fibres as they are run from the front of the OMU to the back side of the rack. This unit is 1 HU.

2.3 Grounding

Connect the ground connection while considering the following:

- Ensure that good grounding protection measures are taken to create a reliable OMU site. Make sure to use adequately dimensioned grounding cables.
- The antenna cabling should be connected to ground every 10m by a reliable grounding kit.
- Make sure the grounding product used is suitable for the kind and size of cable being used.
- Connect the OMU ground bolt to the same ground.

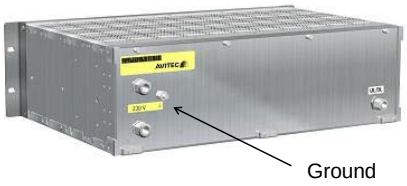
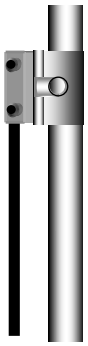


Figure 2-1. Ground Connector on OMU



2.4 Connections

2.4.1 Single Sector RF Connections

NOTE: For multi-sector configuration using 6-way RF Interface cards, refer to section 3.12.3.

The modules can to be configured in two ways as shown in the illustration below.

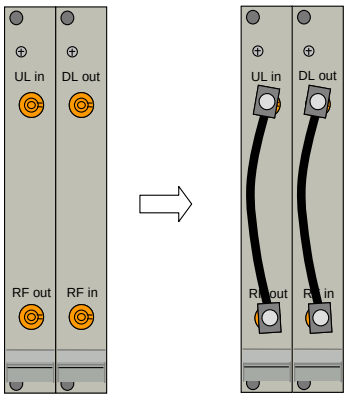
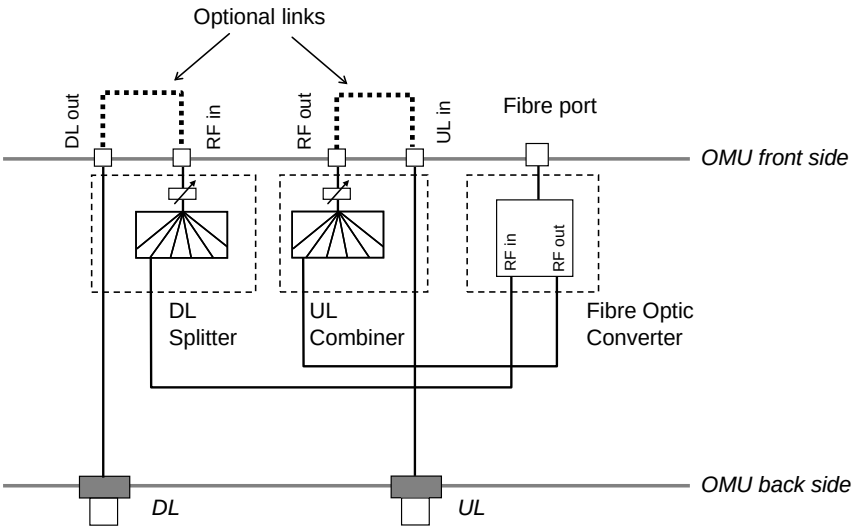


Figure 2-2. Single Sector Configuration

- In Alternative 1 the connectors on each module are linked and the input to the OMU is made via the N-connectors on the back of the OMU. See also illustration below.
- In Alternative 2 the input to the OMU is made via the QMA connectors marked RF in/RF out.



NOTE: In the illustration above only one Fibre Optic Converter is shown. The other converters are connected in a corresponding way.

2.4.2 Configuration at Delivery is Alternative 1.

Connect the OMU to the BTS or to the repeater.

Attach the coupler

The connector for the uplink and the downlink connector are N-type and placed on the OMU **rear panel**.

The OMU is connected to the BTS (or the repeater) via a directional coupler (illustrated below).

The coupler is connected in series with the BTS antenna.

2.4.3 Fibre Optic Connections

Connect the fibres

The fibre connectors on the Fibre Optic Converters are SC/APC type.

ATTENTION!
Angled connectors, APC, need to be used throughout the whole link between the OMU and the repeater. The angle needs to be 8 degrees.
Also the ODF connections need to be APC type. The fibre must be monomode type.

The fibre from each Fibre Optic Converter is connected to an ODF (Optical Distribution Frame) unit. The ODF is a cross connection for fibre cabling. At the site of the repeater, there is also an ODF for further connection to the repeater.

Note! Be careful with the fibres. They cannot be bent too sharply. Make sure there is enough room to safely close the door of the sub rack. Clean the fibres before they are connected. See instruction below.

This product is equipped with Class 1 lasers, as per definition in EN 60825-1.

CAUTION!
Un-terminated optical receptacles may emit laser radiation.
Do not stare into beam or view with optical instruments.

2.4.3.1 Cleaning Optical Connectors

An unclean optical connector is often to may cause for reduced system performance. A bit of dust or oil from a finger can easily interfere with, or block light.

See Appendix B: F/O Cleaning Procedure for detailed cleaning procedures for optical equipment.

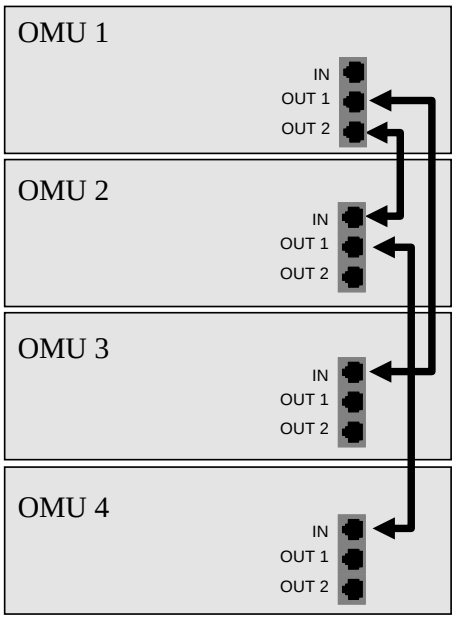
When disconnected, cap the SC/APC connector to keep it clean and prevent scratching the tip of the ferrule.

2.4.4 Connections for Cascaded OMU Units

Cascade connection of OMUs

If several OMUs are to be cascaded, the links between the OMUs are managed via the Rack Communication Boards in each unit.

The connections are made via straight Ethernet cables with RJ45 connectors. These cables can be provided by Axell Wireless in configurations where they are needed.

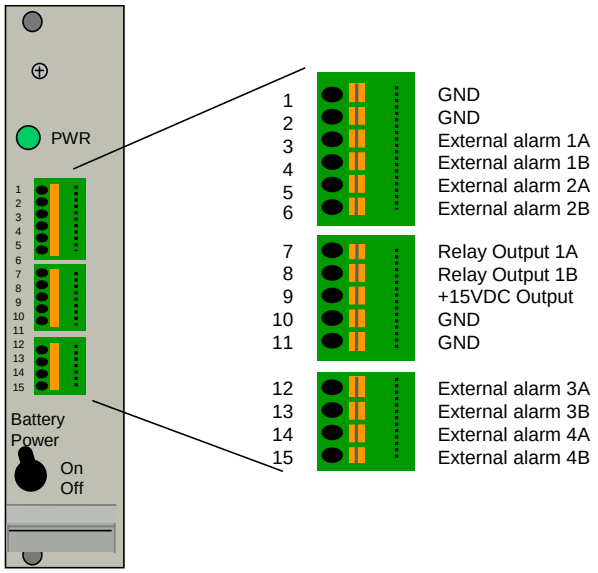


Link pattern for cascaded OMUs. OMU 1 and OMU 3 is on "bus "0 and OMU 2 and OMU 4 in on" bus 1".

2.4.5 External Alarm and Relay Connections

Four external alarm sources can be connected to the External Alarm and Battery Module via the patch panels. These sources must generate a voltage between 12 and 24VDC. The presence or absence of this voltage will trigger the alarm depending on how the alarm thresholds have been configured. The module can also supply +15V to external alarm sources. The maximum allowed load on this supply is 100mA.

The relay can be configured to trigger on any number of internal and external alarms. The maximum current through the relay is 100mA.



External Alarm and Battery Module with pin out for external alarms and relay

The panels can be used for wires of up to 0.5mm^2. To connect a wire, press the yellow lever with a pen or other pointy item, insert the wire and release the lever.

Connect external alarms

Four external alarm sources can be connected to the External Alarm and Battery Module via the patch panels. These sources must generate a voltage between 12 and 24 VDC. The presence or absence of this voltage will trigger the alarm depending on how the alarm thresholds have been configured. The module can also supply +15V to the external alarm sources. The maximum allowed load on this supply is 100mA.

The External Alarm and Battery Module contains a relay that can be connected to an external device to indicate an alarm. The relay can be configured to trigger on any number of internal and external alarms. The maximum current that can be run through the relay is 100mA.

The external alarm wires are linked to the module via patch panels. These panels can be released from the module for easier access at installation. The panels can be used for wires of up to 0.5 mm^2. To connect a wire, press the yellow lever with a pen or other pointy item, insert the wire and release the lever.

2.4.6 Modem Connections

Connect the modem	If the OMU is equipped with a wireless modem an antenna for the modem is necessary. This can be realized either via a separate antenna or via a coupler on the RF in/out port in the OMU. The coupler can only be used if the OMU runs on the same frequencies as the modem and the Rx/Tx is combined (there is a duplex filter). The separate antenna is plugged in to the Antenna connector on the far right end of the OMU. The connector is SMA. If the OMU is equipped with a PSTN modem the connector is placed in the Modem Unit. The connector is RJ11 The Ethernet connection is placed on the Control Module. The connector is RJ45.

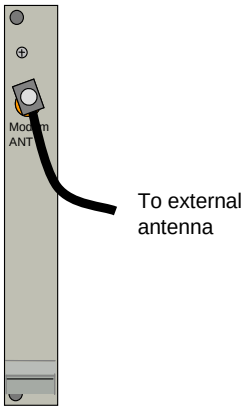
Either a separate antenna is connected to the modem antenna port, or the connection is be made via a coupler connected to the RF input to the OMU. The latter alternative can only be used if the OMU runs on the same frequency as the wireless modem and is equipped with a duplex filter.

2.4.6.1 OMUs without Duplex Filter

OMUs that are not equipped with a duplex filter and use a wireless modem has a modem antenna port to the rightmost side of the rack.

An external antenna can be connected to the "Modem Ant" port.

The connector is SMA type.



2.4.6.2 OMU with Duplex Filter

OMUs that are equipped with duplex filters and a wireless modem are of two kinds:

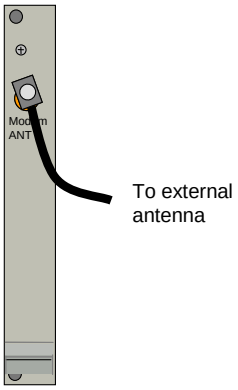
Alternative 1

Alternative 2

The OMU and the wireless modem operate on different bands (for example an OMU for TETRA with a GSM modem)

In this case the OMU will have one port where an external antenna can be connected.

The connector is SMA type.

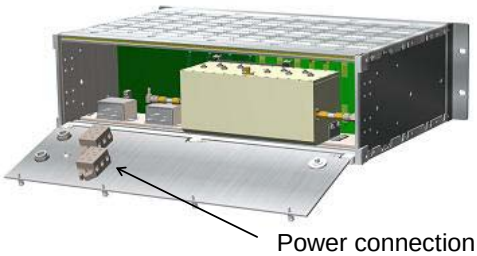


2.5 Connecting Power and Power-up

CAUTION!
Make sure the antenna cables or 50 ohm terminations are connected to the OMU's antenna connectors before the OMU is switched on.

Supply Power to the OMU

The power feed to the OMU is attached via plinths found on the inside of the back cover.



There are two plinths on the inside of the back panel. If two modules with the same power feed are installed these plinths should be interconnected.

Each OMU unit can be equipped with one or two power supplies. Either two of the same type or two of different voltage.

There are power supplies for 115 - 230VAC 50/60 Hz and 24 – 48 VDC. .

NOTE: Be careful to get the polarity right.

Each Power Supply can be switched off using the switches on the front panel.

CAUTION!
Even if the power supplies are switched off the OMU still has live power from the power input on the back.

Check Control Module LEDs

Refer to 4.1.2

2.6 OMU Module Configuration Examples

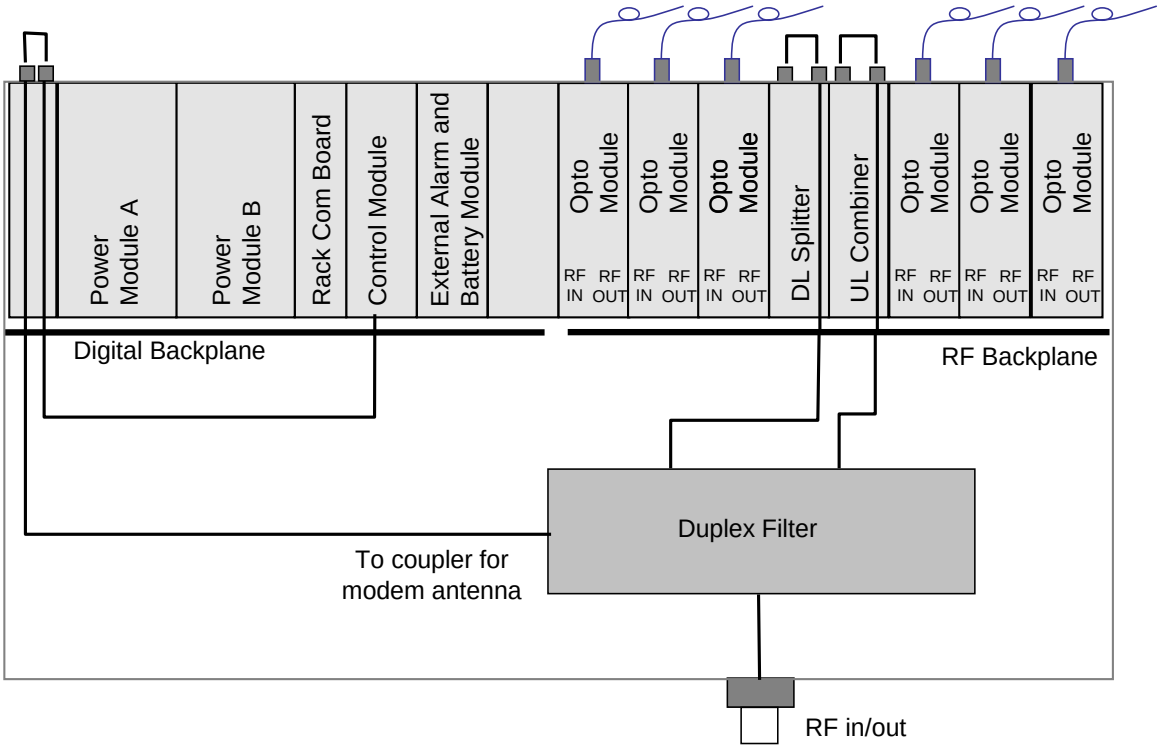
An OMU can be configured in many different ways. These are two examples.

Example 1

In this example the OMU is fed from the back so the links on the UL Combiner and the DL Splitter units are mounted.

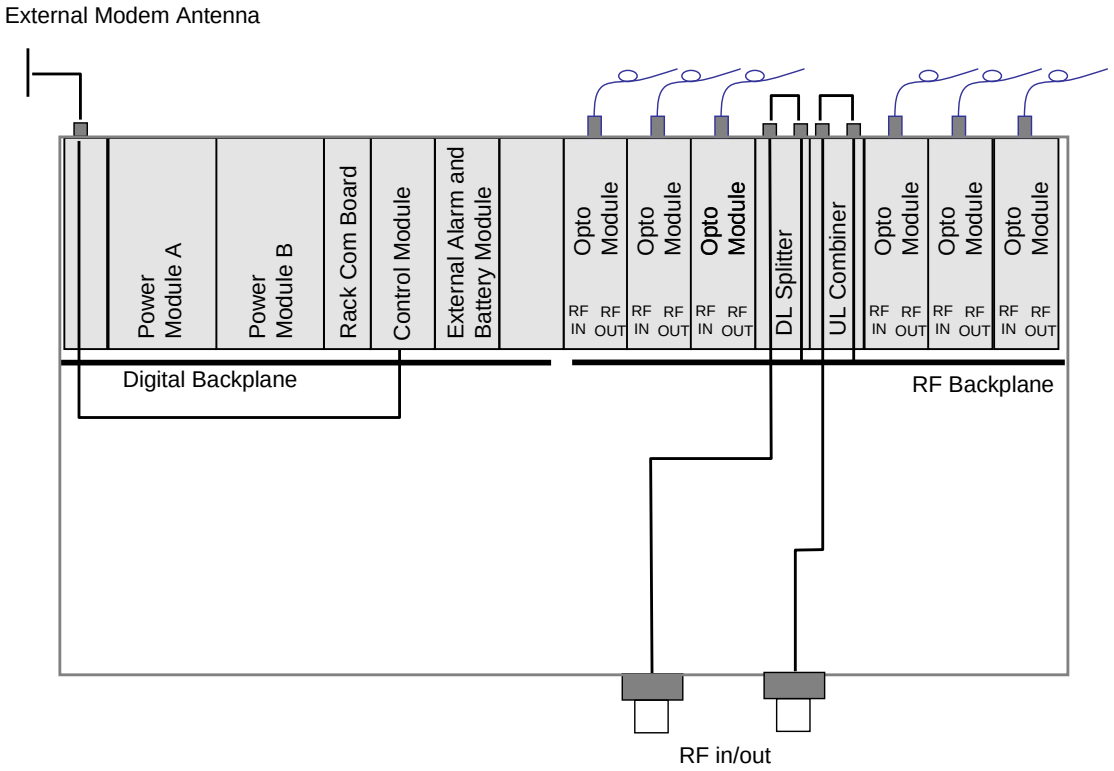
There is a duplex filter and therefore a combined RF in/out.

The wireless modem, which is placed on the Control Module, is connected to the coupler in the filter via the Modem Antenna Connection Module.



Example 2

In the example below there are separate inputs for Rx and Tx and no duplex filter. An external modem antenna is connected and linked to the modem on the Control Module.



3 SETUP

3.1 Initiate Local Communication

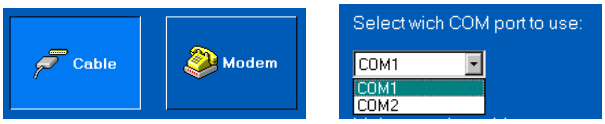
3.1.1 RMC Communication

Connect to the LMT port

Connect the computer to the LMT port on the Control Module via a DB9 male connector with serial RS232 interface.

The communication parameters are set automatically by the RMC

Select "Cable" connection and communication port



Enter user name and password

Several users at a time can be logged on, for instance one locally via the RS232 interface and one remotely via modem or Ethernet.

There is one default user name and password defined for the OMU.

User Name	Password
avitec	AvitecPasswd

NOTE: Both the user name and the password are case sensitive.

NOTE: Do not use the number pad when entering numbers.

3.2 Configure the OMU

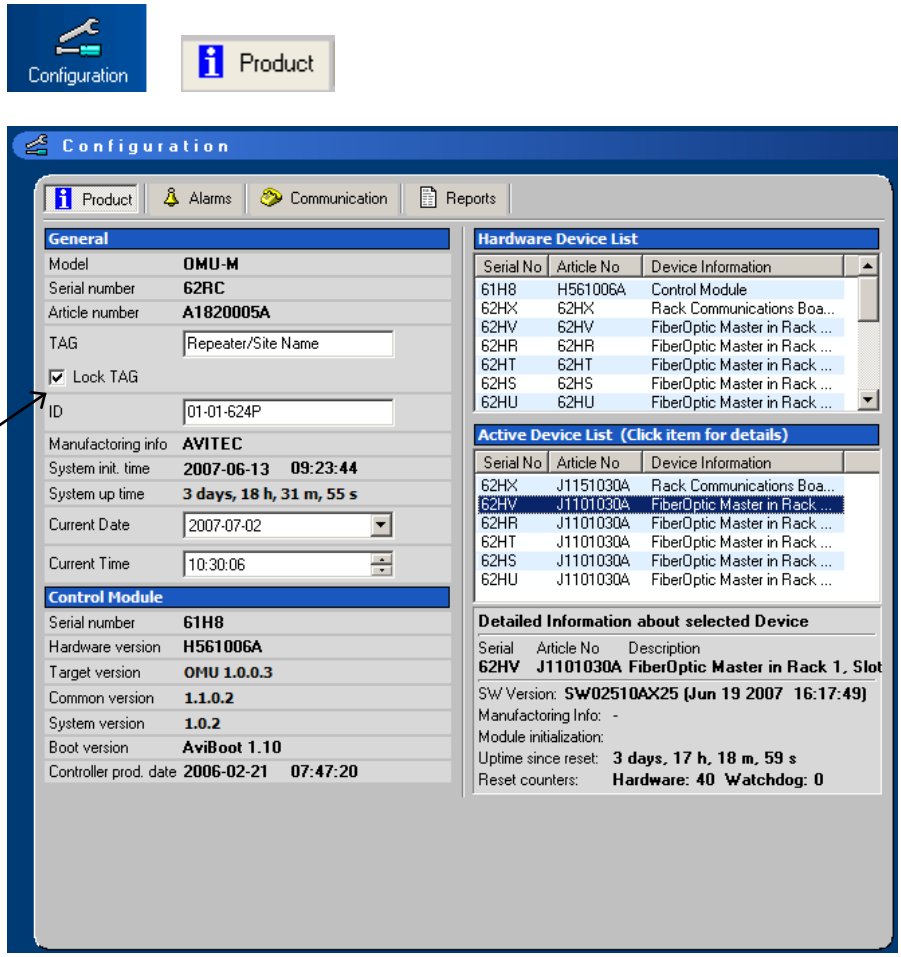
3.2.1 Set OMU Name (TAG)

The TAG can be chosen freely to give the OMU a name that is linked to the location, the site name, etc. The TAG may contain up to 30 characters including spaces.

Select "Configuration" and "Product"

Insert the OMU's name (TAG) in this box.

NOTE: The ID should not be assigned from here. The AEM will do this automatically when the repeater is integrated in the system.



3.3 Fiber Loss Compensation and Master Attenuation

The OMU has a master attenuation that can be set in downlink (DL) and uplink (UL) separately. This attenuation is useful for balancing of the whole system. See section 3.8 Balance the System for more information about this feature.

Each fibre optic link in the system will induce a loss. This loss will also differ in magnitude from one link to another since the distances between each repeater and the OMU is different. The Cobham Wireless OMU-repeater system can automatically calculate this loss, compensate for the loss in each link and by that also balance the system.

This is accomplished by using a pilot tone of a well defined level which is sent from the master node to the slave and vice versa. The received level of the pilot tone is measured and the loss is calculated. The Fiber Optic Converter is automatically adjusted to compensate for the loss. The adjustment is made towards a target value which means that the system will be balanced, i.e. all

fibres will appear to have the same loss. The maximum compensation is 10dB which equals an unbroken fibre distance of 20 km. For each connection in the link (for instance at the ODF) approximately 0.5 dB of loss will have to be added.

The loss compensation function is activated as the system is set up. Please see section 3.7. Each time the system has been changed or fibres have been exchanged or moved for some reason, it is recommended to re-activate this function.

Note: If the OMU is connected to repeaters of an earlier release that has a fibre optic convert of the type in the photograph, the Fiber optic loss cannot be measured with this command.

3.4 External Alarms

Four external alarm sources can be connected to the External Alarm and Battery Module. These can be for instance fire alarms or external door sensors.

The alarm sources must generate a voltage between 12 and 24 VDC. The presence or absence of voltage will trigger the alarm depending on how alarm thresholds have been configured in the controller software. Each alarm can also be given a unique name.

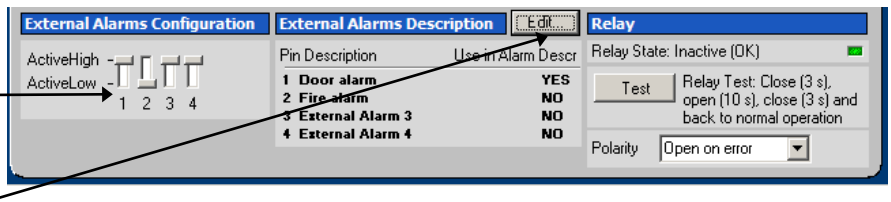
The external alarms can be set as "active high" or "active low".

As for all alarm sources a delay can be set that defines how many seconds an alarm should be in error state before an alarm is generated

To define names and polarity of the external alarms use the lower part of the Alarm Configuration screen.

Set the dip-switches to configure the external alarms

Give the alarms unique names



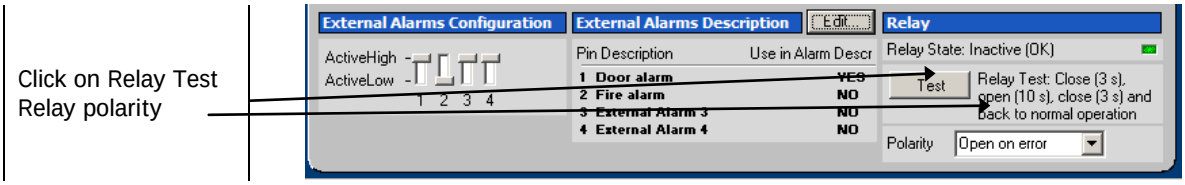
3.5 Relay

The External Alarm and Battery Module contains a relay output. The relay can be used to indicate a summary status of the repeater. Each alarm source can be configured to be affecting the relay or not.

NOTE: The relay status is never affected by the login / logout alarm parameters.

For installation testing purposes, it is possible to test the open / close function of the relay. This test procedure closes the relay for 3 seconds, then opens it for 10 seconds, and finally closes it for 3 seconds before going back to original state.

The relay can be set to close or open to indicate an alarm. This can be changed by changing the polarity.



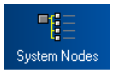
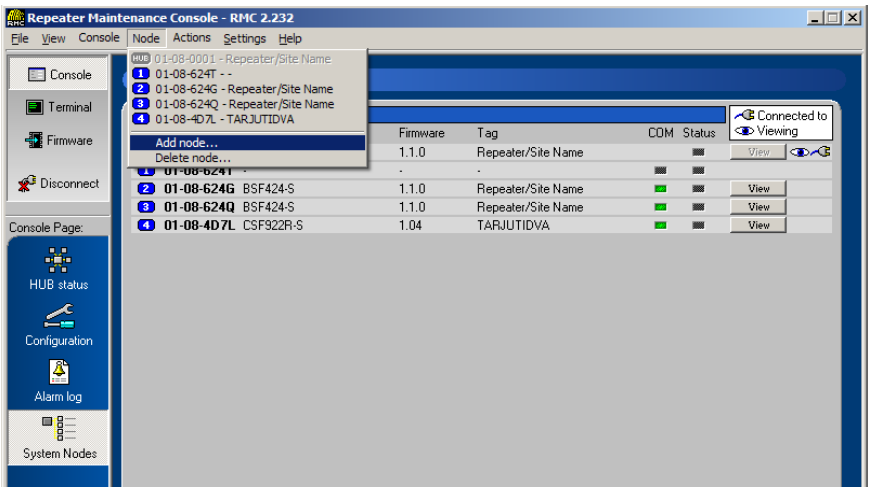
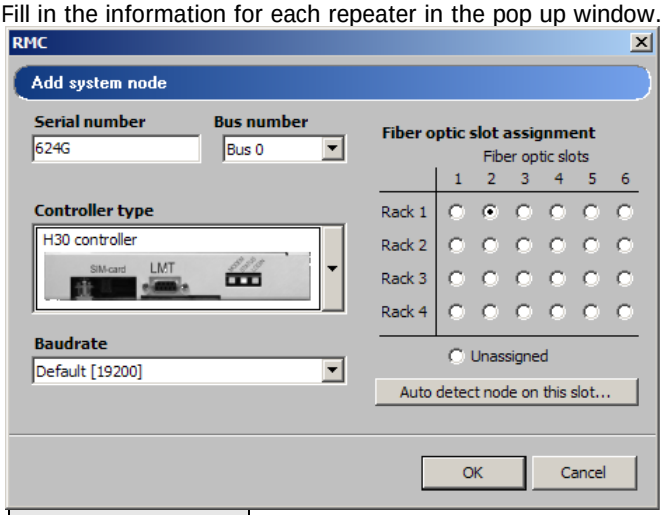
3.6 Integration into AEM

When the OMU has been installed at site and the remote communication has been enabled the OMU can be integrated to the Element Manager. This is done by the operator of the AEM. After entering the telephone number to the OMU, the AEM dials up the OMU, downloads all the OMU parameters and statuses into a database. When all parameters have been downloaded, the AEM configures the OMU with the telephone number where alarms and reports should be sent, and optionally with a secondary telephone number where the OMU can dial in case connection to primary number fails.

When heartbeat reports and alarms are sent from the OMU to the AEM also the latest information about the status and RF-configuration is included. This means that the AEM operator always has information about the current status in the AEM database (and do not need to call the repeater to find this out).

NOTE: Once the OMU is integrated to the AEM, all changes to the OMU should preferably be done from the Element Manager in order to ensure that the database always contains correct information.

3.7 Set Up OMU-Repeater System

Install the repeaters	Install the fibre fed repeaters. See the User's Manual for the repeaters.
Install the fibres to the repeaters	Make sure the fibre link between the OMU and all of the repeaters are working. Make sure all connectors in the link have APC type connectors.
Add all nodes to the OMU-Repeater System.	Select "System Nodes"  Chose "Add node…" from the "Node" drop down menu.  Fill in the information for each repeater in the pop up window. 

Serial number	The serial number consists of 4 letter and/or digits. It is printed on the yellow label on the repeater
Bus number	When OMUs are cascaded they run on different buses. OMU 1 and OMU 3 is on "bus "0 and OMU 2 and OMU 4 in on" bus 1"..
Controller type	Select the correct repeater controller based on the illustrations

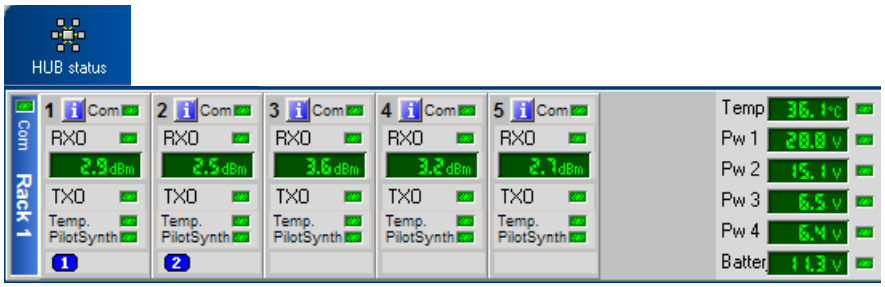
Baud rate	The default value changes when the controller type is selected. (Other values are also available for specific situations not described in this manual.)
Slot Assignment	Click the button that corresponds to the fibre optic converter the repeater is connected to.
	NOTE: To confirm an installation or to check the present configuration select a fibre optic converter and click the button [Auto detect node on this slot...]. If a repeater is installed in this position the repeater serial number will be presented.

Check the LEDs on the Fiber Optic Converters

The Fiber Optic Converter contains two optical alarm sources. These are alarms for transmitted and received optical signal level.

Select HUB Status

Check the levels of the received optical signals via the RMC



3.8 Balance the System

To estimate the signal levels in the system, a link budget should be prepared before the system is made operational. This section provides background on calculating the required attenuation values along the link and describes how to set the attenuation value in the management application.

3.8.1 Downlink Path

The following two diagrams illustrate the attenuation levels for two types of installations:

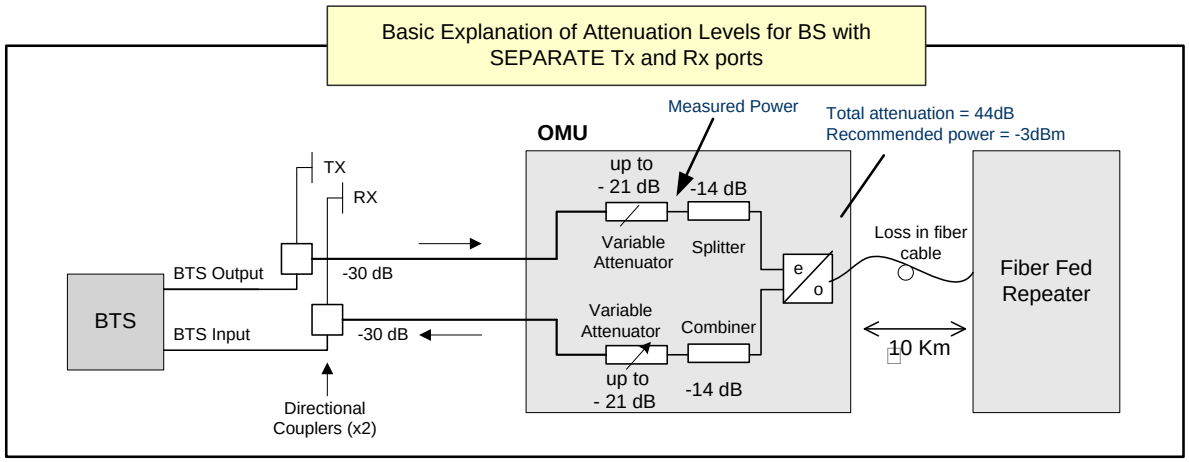
- BS with separate Tx and Rx ports – for a total attenuation of 44dB (attenuator set to 0)
- BS with a common Tx and Rx port – for a total attenuation of 45dB (attenuator set to 0)

Also note the following:

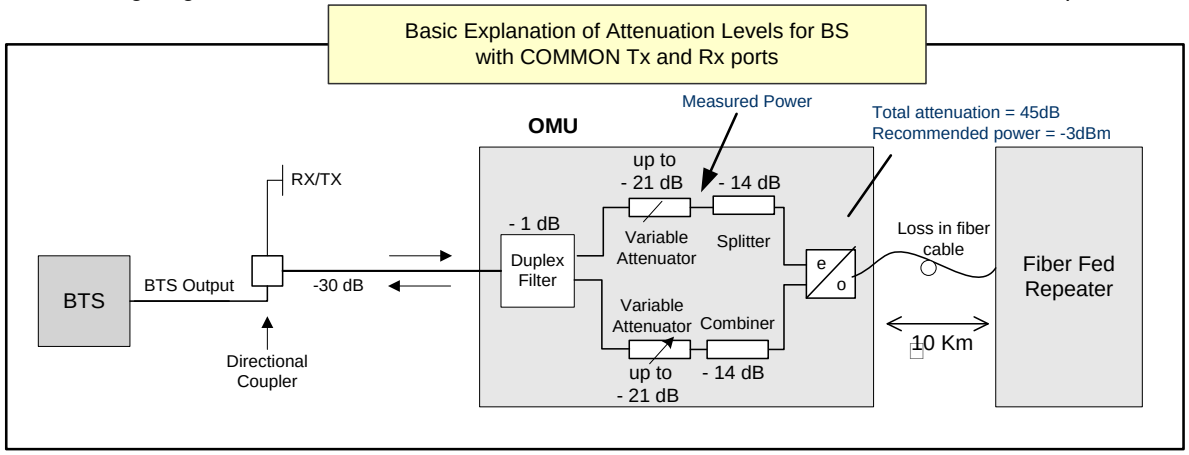
- Any additional required attenuation (up to -21dB) is implemented via the Variable Attenuator.
- The input level to the laser should be ≤-3dBm composite power

NOTE: As the composite power in a multicarrier TETRA/TDMA/W-CDMA/LTE system is traffic dependent, the maximum laser input power must be calculated for the traffic scenario that will require highest composite power. After the downlink attenuation been set, the gain of the connected repeaters should be adjusted individually in accordance to the relevant section in the manual for each repeater connected to the OMU.

The following diagram illustrates the attenuation levels for an installation with separate Tx and Rx ports.



The following diagram illustrates the attenuation levels for an installation with a common Tx and Rx port.

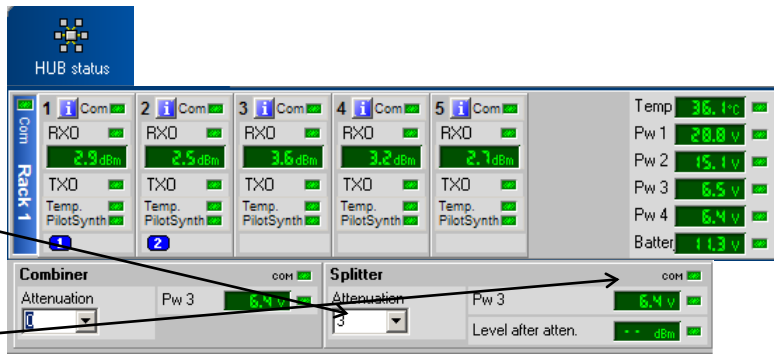


To set the attenuation

Select "HUB Status"

Set the attenuation in the downlink in this box.

The signal level after attenuation can be monitored in the RMC



3.8.2 Fiber Loss Compensation

Activate the fibre loss compensation in both the downlink (from the OMU) and in the uplink (from the repeaters) paths. See 3.9 Initiate Fibre Loss Compensation.

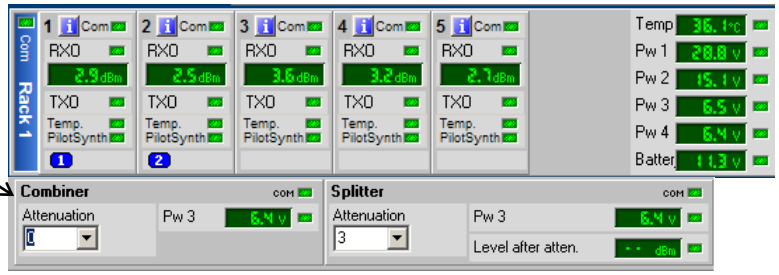
3.8.3 Uplink Path

The uplink gain setting of the OMU and connected repeaters affects the sensitivity in the connected BTS sector and the connected repeater cells. The recommended method for setting up the system below will give good noise performance in simple systems with a relative low number (less than six) of connected repeaters per BTS sector.
For more complex systems, with many repeaters connected to the same BTS sector using multi-drop, a more detailed system analysis is required to set up the system in an optimum way.

- Set the uplink attenuation in the OMU equal to the downlink attenuation.
- Set the uplink gain of each connected repeater equal to the downlink gain of the repeater (by setting the attenuation value in the RMC for both links equal).

Select "HUB Status"

Seet the attenuation in the uplink in this box.



3.8.4 Noise Considerations

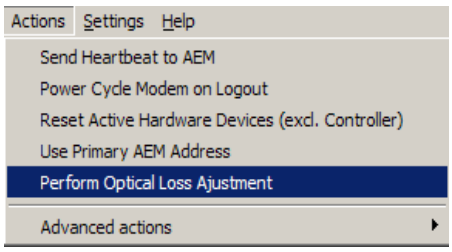
To reduce the noise degradation of the base station, it is recommended to reduce repeater uplink gain only. The repeater cells will in this case not be perfectly balanced, i.e. downlink can take higher path loss than uplink. In typical systems where you want to cover for example a road tunnel by tapping off a BTS nearby this small imbalance is less of a problem.

3.9 Initiate Fibre Loss Compensation

See section 3.3 Fiber Loss Compensation for information about this feature.

Start with the OMU

Choose "Actions/Perform Optical Loss Adjustment" from the drop down menu.



Go through all racks and all fibre optic converters one by one and initiate the compensation process

First choose the rack and then the fibre optic converter.

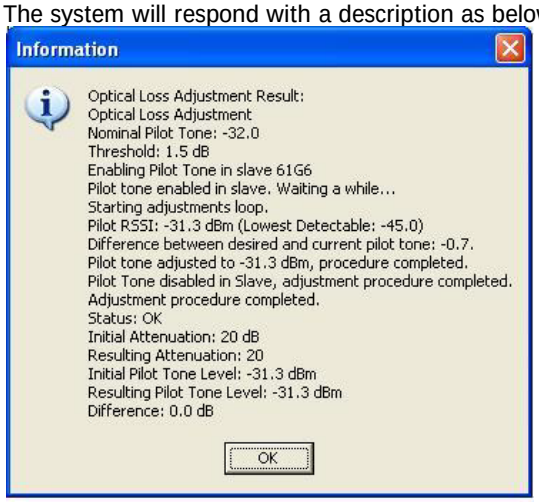
In an OMU that contains only one sub rack – this rack is called "Rack 1"

Additional sub-racks/slave OMUs that are linked to the master OMU are named "Rack 2, 3 and 4".

Each fibre optic converter is numbered from left to right in each sub-rack.

For each rack/fibre optic converter please wait for the system to respond.

The system will respond with a description as below.



In the response above the Status is "OK" (6 lines from the bottom).

If the system responds with an error message the fibre link need to be checked. If there is nothing wrong with the link it is possible that the fibre loss is too big for the system to be able to compensate for it.

Go through all racks and all fibre optic converters one by one and initiate the compensation process.

NOTE: Earlier repeater versions

If the OMU is connected to repeaters of an earlier release, which has a fibre optic converter of the type in the photograph, these commands will not work.

Instead a default value needs to be defined by using the command OLC.

Please see OMU Command and Attributes for more detailed information regarding this command.

The OLC value should be set to 6dB. This value ensures that the amplification value on the link will be 0dB at 0dB optical loss.

Example

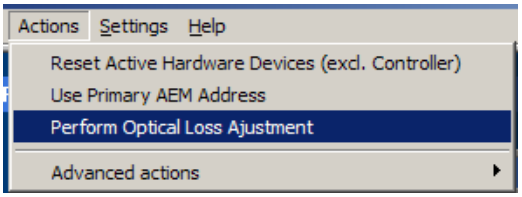
SET OLC 1:2 6

Adjusts the attenuation in the fibre optic converter unit in rack 1, slot 2 to 6 dB.

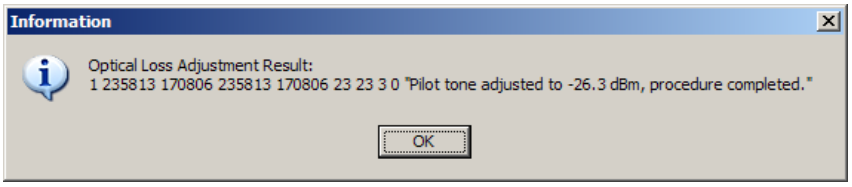
Go through all racks and slots that are connected to a repeater of this kind and send this command.

Continue with the repeaters

Choose "Actions/Perform Optical Loss Adjustment" from the drop down menu.



The system will respond with a description as below.



This command does not exist in repeaters with the earlier type of fibre optic converters, equivalent to the note above regarding OLC. For these repeaters disregard this step.

3.10 Set up Remote Communication

The OMU can be configured with a wireless modem, a PSTN modem or an Ethernet link for the remote communication.

3.10.1 Communication via Modem

The Control Module is responsible for enabling the power to the modem, unlocking the SIM-card, using the configured PIN-code and making sure the modem is logged in to the network correctly. Depending on network configuration and modem usage, the modem might require different modem initialization strings to work properly. This modem initialization string is set and verified during repeater setup.

3.10.1.1 Modem Initialization

After a power failure, or upon user request, the Control Module performs a full initialization of the modem. This consists of three steps:

- If the SIM-card in the modem has the PIN code enabled, the Control Module unlocks the PIN code. In case wrong PIN-code is configured, the Control Module will not try to unlock the SIM again until the PIN-code is changed. This avoids the SIM card being locked by a Control Module repeatedly trying to unlock the SIM with the wrong PIN code.
- Once the SIM is unlocked, the Control Module waits for the SIM to log in to the network. Depending on signal quality and network configuration this might take a while. The Control Module will wait a configurable number of seconds (default 50 seconds) for the modem to login to the network. In case no network is found, a modem power cycle will be initiated.
- When the modem is successfully logged in to the network, the Control Module configures the modem with the modem initialization string as configured when setting up the remote configuration. The modem initialization string is a network dependent string. The default string is suitable for most networks, but some networks might require some tweaking of this string.

3.10.1.2 Monitoring Modem Connection

The Control Module constantly monitors the status of the modem connection to ensure that it is working properly, and that the modem is logged in to the network.

In case the modem is not registered to the network, or the Control Module cannot properly communicate with the modem, a power cycling of the modem is initiated, after which the modem will reinitialized.

3.10.1.3 Scheduled Modem Power Cycling

In addition to polling the modem to ensure the repeater online status, the Control Module can be configured to perform an automatic power cycling on a scheduled time of the day. Power cycling the modem ensures the latest network configuration for the modem, such as the HLR Update Interval etc.

NOTE: By default, the scheduled modem power cycling is disabled.

3.10.2 Communication via Wireless Modem

There are two different ways of communication for a wireless (GSM) modem:

- Using data call / modem connection. *This requires the SIM-card in the modem to be configured with data service.*
- Using SMS to configure the repeater with simple text messages. SMS functionality is not implemented in this SW release.

The Element Manager always uses data call communication with the repeater, why all repeaters being controlled by the AEM must have data service enabled on the SIM card.

Configuring the repeater to send alarms and reports via SMS it is still possible to establish data calls to the repeater, as long as the SIM card is data service enabled.

3.10.2.1 Modem Configuration, not using GPRS

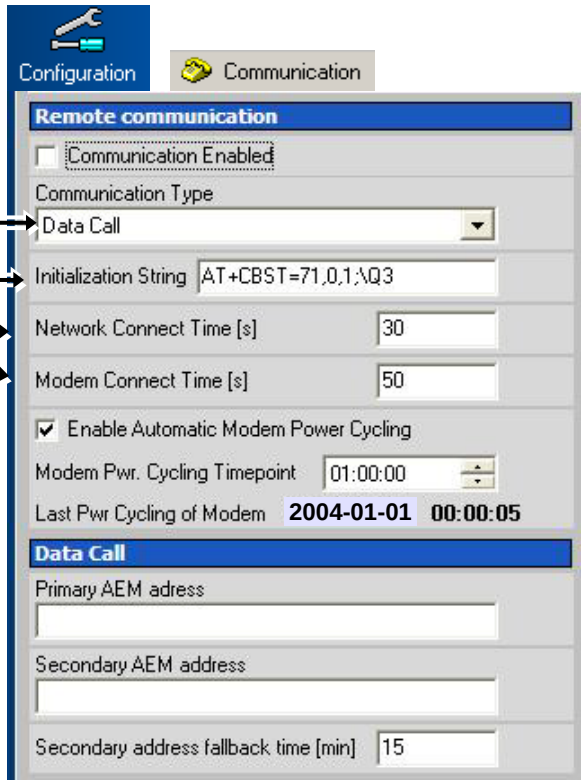
Select "Configuration" and "Communication"

Select Data Call

Initialization string

Connect times

AEM addressed are set via the AEM



- Select Data Call
- Set the modem initialization string. This string differs between networks. Primary recommendation is AT+CBST=71,0,1;\Q3. If remote communication cannot be established try 7,0,1 or 0,0,1 or 7,0,3. For more information please refer to the section on Troubleshooting Remote Communication.
- Tick "Enable Automatic Modem Power Cycling" for the modem to be power cycled once every 24 hours. Set the time at which the modem should be tested. This function ensures that the repeater always is logged in to the network.

3.10.2.2 Modem Configuration, using GPRS

Select "Configuration" and "Communication"

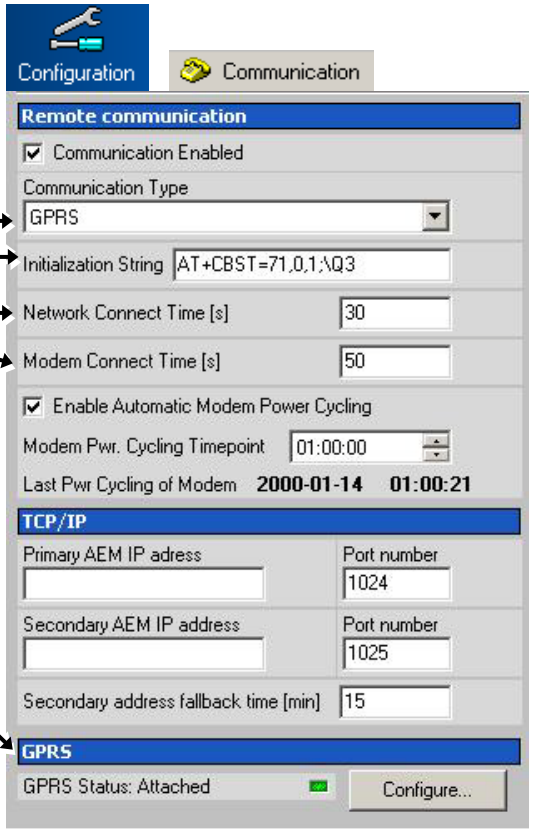
Select GPRS

Initialization string

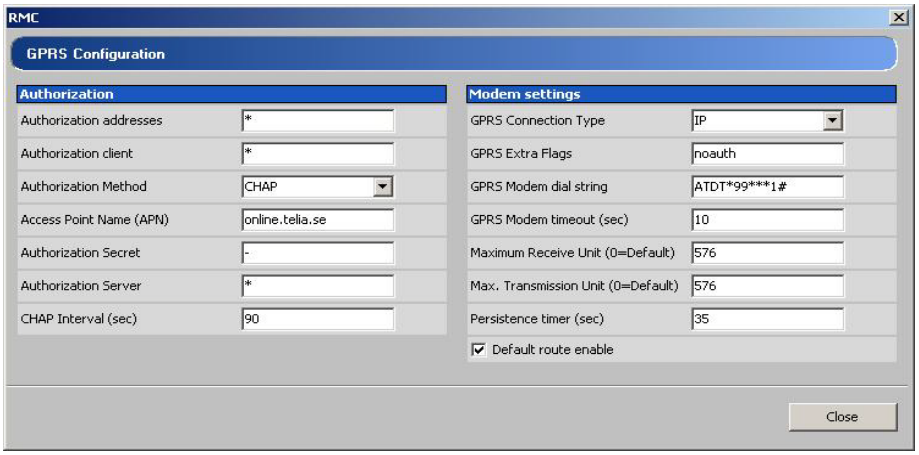
Connect times

AEM addressed are set via the AEM

Configure GPRS



- Select GPRS
- Set the modem initialization string. This string differs between networks. Primary recommendation is AT+CBST=71,0,1;\Q3
- Click "Enable Automatic Modem Power Cycling" for the modem to be power cycled once every 24 hours. Set the time at which the modem should be tested. This function ensures that the repeater always is logged in to the network.
- Click on Configure...



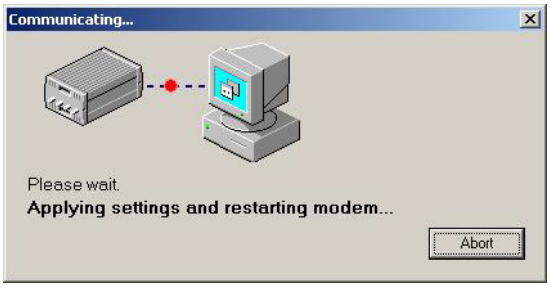
Each parameter is described in *Common Commands and Attributes*, section 14 GPRS Configurations.

Set the Access Point Name. It needs to be defined by the telecom operator

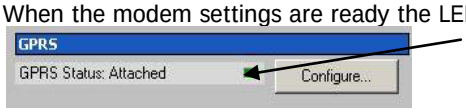
Set Maximum Receive Unit and maximum Transmission Unit. These differ depending on access type: 576 for GSM, 1476 for EDGE and 1500 for WCDMA.

Click on Close, and then on "Yes".

Wait for the modem to restart. This can take a few minutes.



When the modem settings are ready the LED turn green.



3.10.2.3 AEM Addresses

The Control Module can be configured with two different addresses (telephone numbers) to which alarms and reports are delivered. In case the repeater cannot deliver alarms and reports to the primary address, the next call will be made to the secondary address.

A fallback functionality is available, which means that the Control Module falls back to the primary address after a configurable number of minutes. If this interval is set to 0, the fallback will not be performed. A user can always force the Control Module to fall back to the primary address.

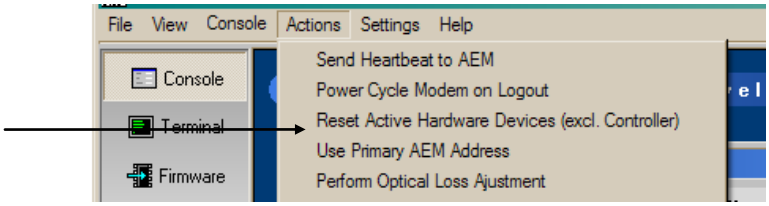
NOTE: When the repeater is integrated to the Axell Element Manager system, these addresses are set by the AEM, why they need not be configured during site installation.

3.10.2.4 Modem Verification

When the remote configuration has been set up the communication can be verified using the modem feature of the RMC and dialling the data number. The remote communication is verified as soon as a successful remote login to the repeater has been performed.

However, as a first step, it is recommended to verify that the modem is initialized correctly. After configuring the modem using the RMC, make sure to initiate a power cycling of the modem. This is done from the RMC menu.

Click on the drop-down menu Actions, choose Power Cycle Modem on Logout



An immediate power cycling is initiated after which the modem is initialized and registered onto the network. The modem is now ready for remote access.

Ensure a successful configuration by observing the modem LED as described below.

For GSM modem LED descriptions, refer to 04.1.

Verify the remote communication either by having someone attempting to integrate the repeater from the Axell Element Manager, or by dialing the repeater using the Repeater Maintenance Console.

NOTE: It is very important to dial the data number of the SIM. In case the voice number is dialled, the call is answered, but almost immediately the call will be hung up.

3.10.2.5 SIM-card Using Single Numbering Scheme

If the network is configured using Single Numbering Scheme (SNS), some special considerations apply.

The repeaters are by default configured so that networks using SNS always will have calls routed to the data service in the modem. When dialling from within the network to a repeater having an SNS-configured SIM will operate normally, since the call originator informs the system that the bearer is of type DATA. However, when dialling from outside the network trying to connect to the repeater can be difficult. Depending on the interface to the roaming network or to the PSTN network if an analogue modem is used, the bearer type can default to voice. If the bearer is set to voice, the data service cannot be converted to DATA, and a call setup cannot be completed.

NOTE: This is not a repeater related problem; the solution is to verify how the external network interfaces handles the VOICE vs. DATA bearer type.

3.10.3 Communication via PSTN (Fixed) Modem

Also for PSTN modems data call shall be used.

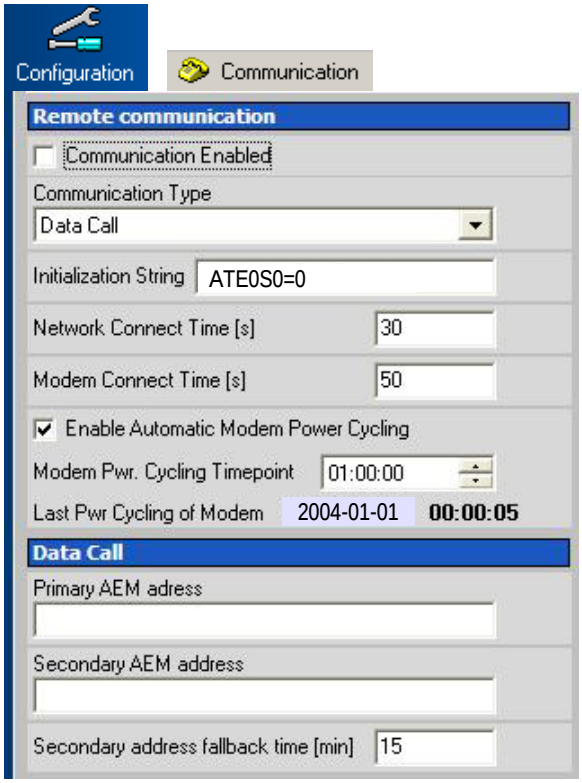
Select "Configuration" and "Communication"

Select Data Call

Initialization string

Connect times

AEM addressed are set via the AEM



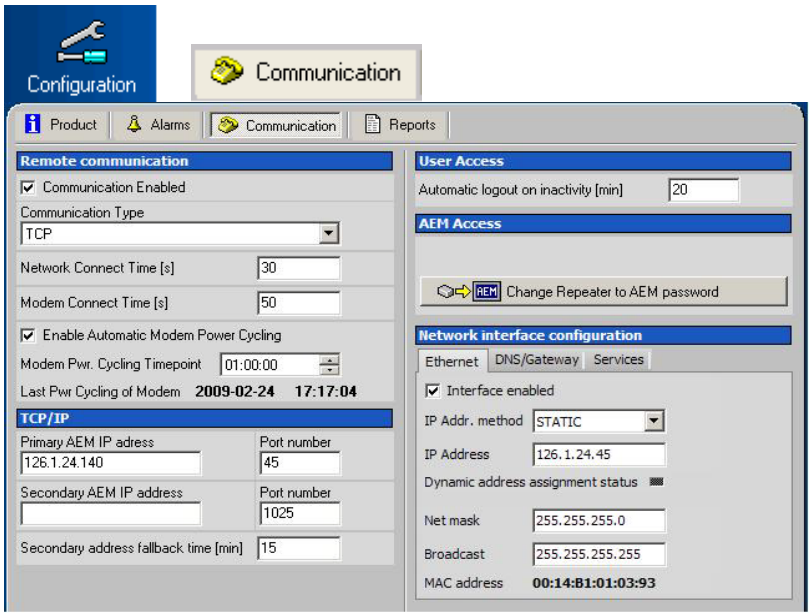
Tick "Enable Automatic Modem Power Cycling" for the modem to be power cycled once every 24 hours. Set the time at which the modem should be tested. This function ensures that the repeater always is logged in to the network.

3.10.4 Communication via TCP/IP and Ethernet

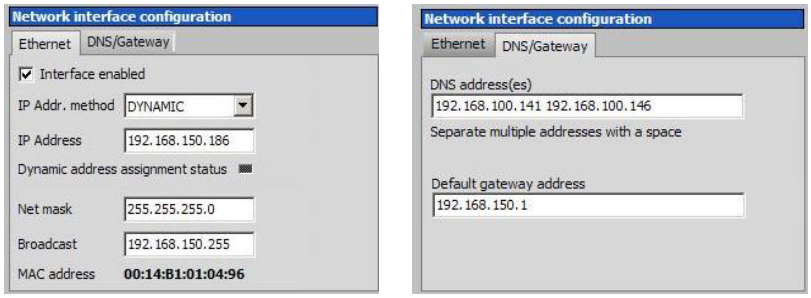
A TCP/IP communication is run over a company's network. Therefore each company needs to define the details regarding the configuration, IP addresses, etc. For more information please refer to *Common Commands and Attributes*, section 13 Network Configurations.

Select "Configuration" and "Communication"

Set IP address and other relevant information here →

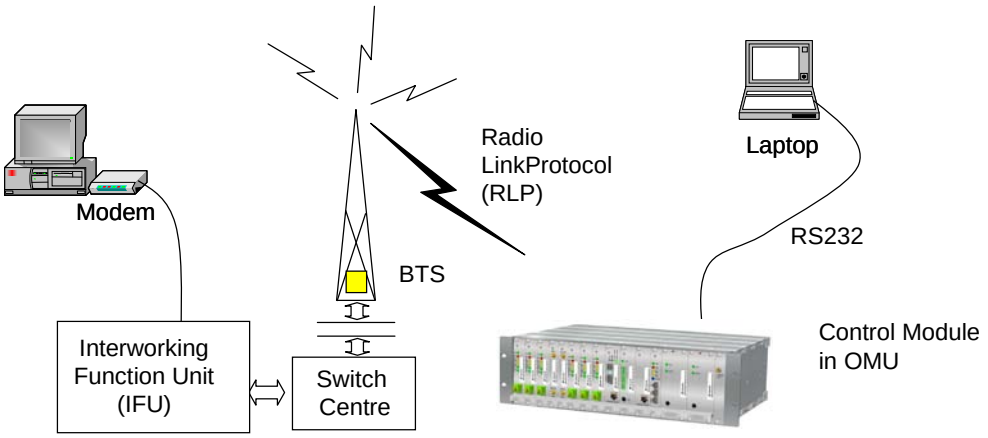


In these screens the Ethernet and/or DNS Gateway parameters can be set



3.10.5 Troubleshooting Remote Communication

Since many networks have their own "personality", performing first time configuration of the remote communication sometimes requires tweaking of the modem parameters.
This section describes some trouble shooting techniques if configuring the OMU for remote access fails.



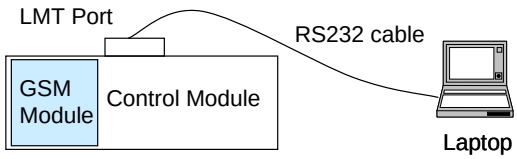
This illustration is a simplified schematic of the remote communication between a GSM module in an OMU and an analogue modem. The analogue modem in the computer communicates with the Interworking Function Unit (IFU), which is the GSM network analogue network interface. The call is routed via the switch centre over the air interface to the data call number in the SIM-card of the GSM module.

The Control Module is responsible for establishing connections with the Axell Element Manager, and to answer incoming calls to the OMU.

As described in previous sections, the Control Module only accepts one login at a time, either via Local Maintenance port (LMT) or modem connection. Hence, when verifying the remote access of the OMU, it is important to log out from the OMU locally before trying to access the OMU remotely.

3.10.5.1 Direct Modem Access

To allow for advanced trouble shooting of the communications, it is possible to access the modem directly via the Control Module from a laptop computer.



Log in to the OMU, either with RMC, or with a terminal emulation program, such as HyperTerminal™. When the login is completed, select Terminal Mode, this will give access to the OMU command prompt in the same way as with HyperTerminal.

When the OMU prompt is accessible, type in the command

`ACCESS MODEM <Enter>.`

When typing ACCESS MODEM, the controller will send all the characters that are typed directly out to the modem port. All characters replied back from the modem will go directly to the LMT port and back to the computer.

To abort an ACCESS MODEM session, press three '-' in a row (all three within one second) to come back to the OMU command prompt.

NOTE: When accessing the modem port the modem might be configured with "echo off", meaning that the characters entered will not be echoed back to the screen. In order to enable "echo", press Enter.

Type

`ATE1 <enter>`

(invisible)

The modem replies with

`OK`

indicating that the echo is enabled. All characters entered will now be echoed back to the terminal program.

Below is a list of handy modem commands for trouble shooting via Direct Modem Access. Please refer to the modem manual for details on the commands below.

Command	Description
ATE1	Enables the echo between the modem and the Control Module.
ATDT<Telephone Number>	Causes the modem to dial <Telephone Number>. This can be used to verify that the modem correctly can dial a remote modem.
ATA	Answer incoming call
ATH	Hang up call. Note, if being online to the remote peer, you need to go to

	command mode to hang up the call. This is done by waiting at least one second since last entered character, then press +++ (three plus signs), all within one second. After one second, the modem will reply OK, meaning that command mode is entered.
ATM0	Disables the loudspeaker in the modem
ATM1	Enables the loudspeaker in the modem
AT&W	Saves the current modem configuration into NVRAM. This means that this configuration will be used directly after modem power up
AT&F	Loads the modem factory configuration
ATZ	Resets the modem, and loads the default settings as saved with command AT&W

3.10.5.2 Trace Modem

For troubleshooting purposes it is possible to trace the actual progress of initializing the modem. This trace is useful when having problems with the modem initialization.

Go to Terminal Mode and type

```
TRACE MODEM
```

To end session type CTRL-Z

3.10.5.3 Manually Answering Incoming Calls

It is possible to manually answer incoming calls without involving the OMU software at all, to verify that the remote access and the network itself works as intended. In order to verify the remote communication, make sure to have someone stand by to dial up the OMU with a terminal emulation program, for example HyperTerminal™.

Go in to Direct Modem Access as described earlier. When in direct access mode, ask the person standing by to dial up the OMU.

As soon as a call is received, the text

```
RING
```

will repeatedly be displayed on the screen.

Type

```
ATA <enter>
```

This will inform the modem to answer (ATtention Answer).

When the connection is established, a connect message will be displayed including the connection speed. Sometimes the information comes together with some miscellaneous information, such as error correction protocols etc.

NOTE: Make sure the remote peer dials the Data Call number

If the voice number is dialled instead of the data number, or if the modem contains an illegal modem initialization string, the message

```
OK
```

or

```
NO CARRIER
```

will be displayed almost immediately.

Try to change the modem initialization string. The modem initialization string mainly used to configure the remote communication is AT+CBST.

Successful modem initialization strings used by Axell Wireless includes (most common first):

```
AT+CBST=71,0,1;\Q3
AT+CBST=7,0,1;\Q3
AT+CBST=0,0,1;\Q3
AT+CBST=0,0,1;\Q3
AT+CBST=7,0,3;\Q3
```

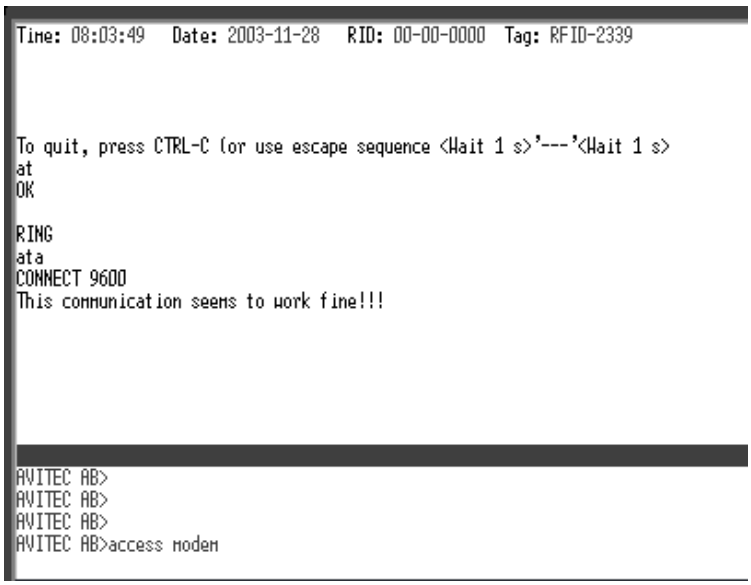
Once the modem initialization string is entered, try again to dial up the OMU. For details on the different modem initialization strings, please refer to the modem's user guide.

If the setup is successful, the connect message will be brought up;

```
CONNECT 9600
```

This means that an online connection is established to the remote peer. From now on, all characters typed on the keyboard will end up on the remote peer's screen. Similarly, all characters typed by the remote peer will be displayed on the screen.

In the example, the incoming call was successfully answered, and the remote user entered the text message.



In order to come back to modem command mode, press +++ (three pluses) rapidly (within one second).

Receiving

```
OK
```

means that the modem is back in command mode.

Type

```
ATH <enter>
```

This terminates the connection to the remote peer. The message

```
NO CARRIER
```

will be displayed.

3.10.5.4 Common Problems

Problem 1

When enabling the remote access for the OMU, the modem fails to log in to the network.

Solution

Signal strength from the donor site is too low. The signal strength can be read directly from the modem. Go in to Direct Modem Access as described earlier. Use the command AT+CSQ (documented below) to read out the signal strength.

In order to have good signal quality, Axell Wireless recommends that the signal strength should be better than -95 dBm. If signal strength is lower, try to adjust the antennas to get a better signal strength from the donor.

6.1 Signal Quality +CSQ

6.1.1 Description :

This command is used to know the *received signal strength indication* (<rssi>) and the *channel bit error rate* (<ber>) with or without any SIM card inserted.

6.1.2 Syntax :

Command syntax : AT+CSQ

Command	Possible responses
AT+CSQ	+CSQ: <rssi>,<ber> OK *Note : <rssi> and <ber> as defined below*

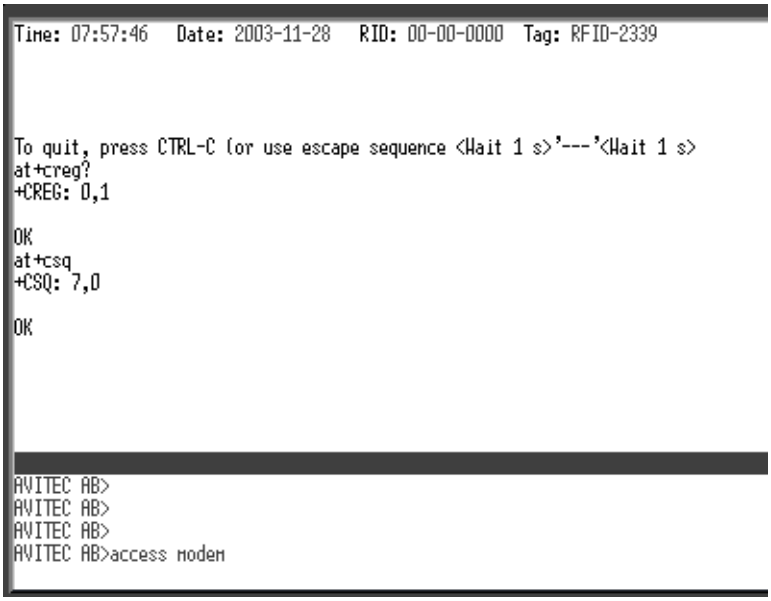
6.1.3 Defined values :

<rssi> :	0	: -113 dBm or less
	1	: -111 dBm
	2...30	: -109 to -53 dBm
	31	: -51dBm or greater
	99	: not known or not detectable
<ber> :	0...7	: as RXQUAL values in the table GSM 05.08
	99	: not known or not detectable

Documentation of +CSQ command from a modem's manual.

Figure 3-1

In the example the reply to AT+CSQ is 0,7 meaning 7*2 dB above -113 dBm; the modem detects a signal level of -99 dBm.



Problem 2a

OMU is configured properly, and answers the incoming call, but when trying to dial the OMU using an analogue mode, no modem handshaking is heard from the dialling modem.

Problem 2b

When dialling the OMU, the OMU answers the incoming call, but no connection is established, and after a while the OMU disconnects the call.

Solution

The most common cause is that the number called is the voice number of the SIM, not the data number. Therefore, make sure to dial the data number.
If data call is used, the problem probably is an illegal modem initialization string.
In order to change the modem string, go to the OMU command prompt. Try changing the modem initialization string and log out to let the controller reinitialize the modem.
If problem remains, try a few different modem initialization strings. Axell Wireless has been successful with the following modem initialization strings:

```
AT+CBST=71,0,1;\Q3
AT+CBST=7,0,1;\Q3
AT+CBST=0,0,1;\Q3
AT+CBST=0,0,1;\Q3
AT+CBST=7,0,3;\Q3
```

Please refer to the modem manual for detailed description of the modem initialization strings.

Problem 3

It is possible to call the OMU from another GSM mobile, but not from an analogue modem.

Solution

This problem is most likely related to the modem configuration and/or the configuration of the IFU unit. Try to decrease the communications speed and make sure that the modem error correction is supported by the IFU. Verify the IFU configuration to see if there are any known problems with the modem connections.

Problem 4

When dialling the OMU, or when the OMU is dialling the Element Manager, the connection is terminated before the handshaking is completed.

Solution

When an OMU is answering an incoming modem call, or calling up the OMC to deliver an alarm or a report, the OMU will wait a configurable number of seconds for the call to be established. If no communication is established within this time, the call will be hung up. If this interval is set too low, the handshaking is terminated too fast. In the RMC, verify the Modem Connect Time to see that it is set to at least 30 seconds.

3.11 Integrate into the AEM

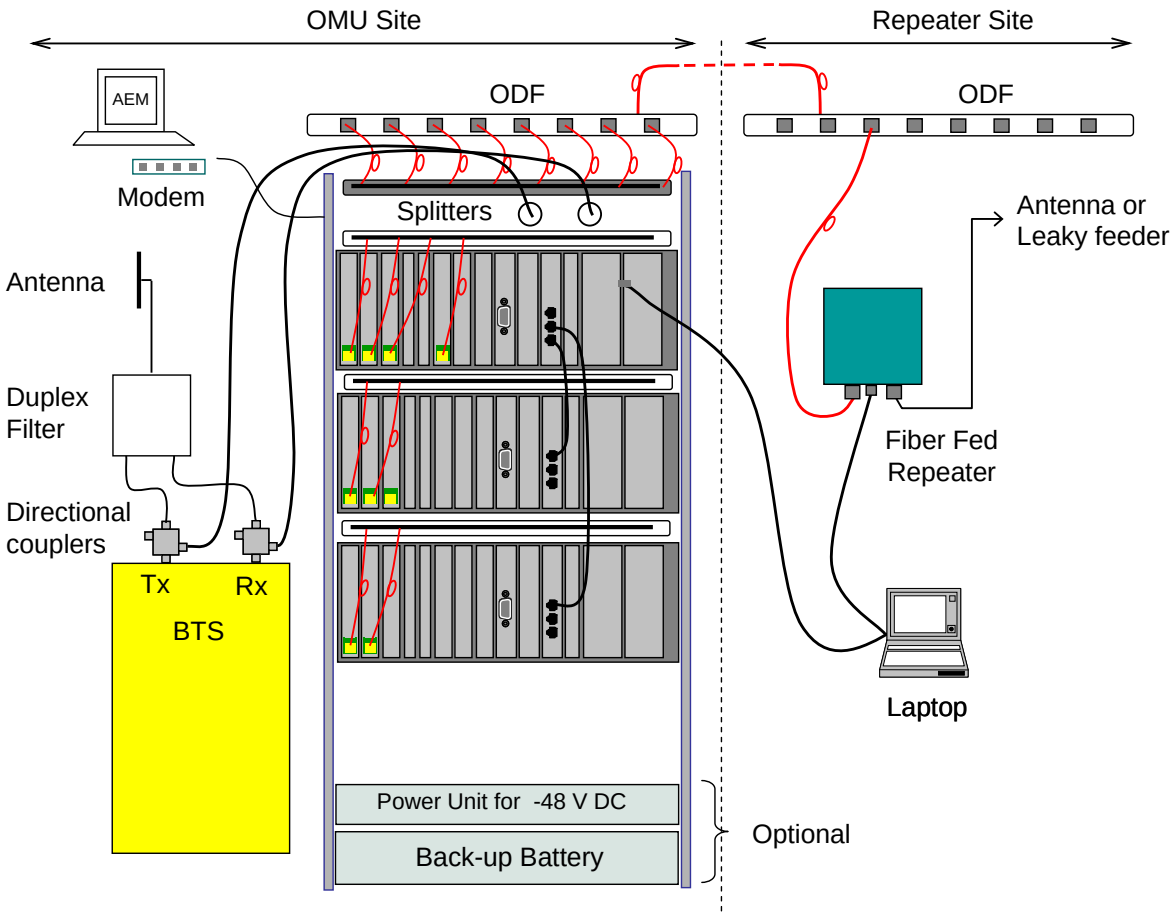
When the OMU has been installed at site and the remote communication has been enabled, the OMU can be integrated to the Axell Element Manager. This is done by the operator of the AEM. After entering the telephone number to the OMU, the AEM dials up the OMU, downloads all the OMU parameters and statuses into a database. When all parameters have been downloaded, the AEM configures the OMU with the telephone number where alarms and reports should be sent, and optionally with a secondary telephone number where the repeater can dial in case connection to the primary number fails.

When heartbeat reports and alarms are sent from the OMU to the AEM also the latest information about the status and RF-configuration is included. This means that the AEM operator always has information about the current status in the AEM database (and do not need to call the repeater to find this out).

Note! Once the OMU is integrated to the AEM, all changes to the OMU should preferably be done from the Axell Element Manager in order to ensure that the database always contains correct information.

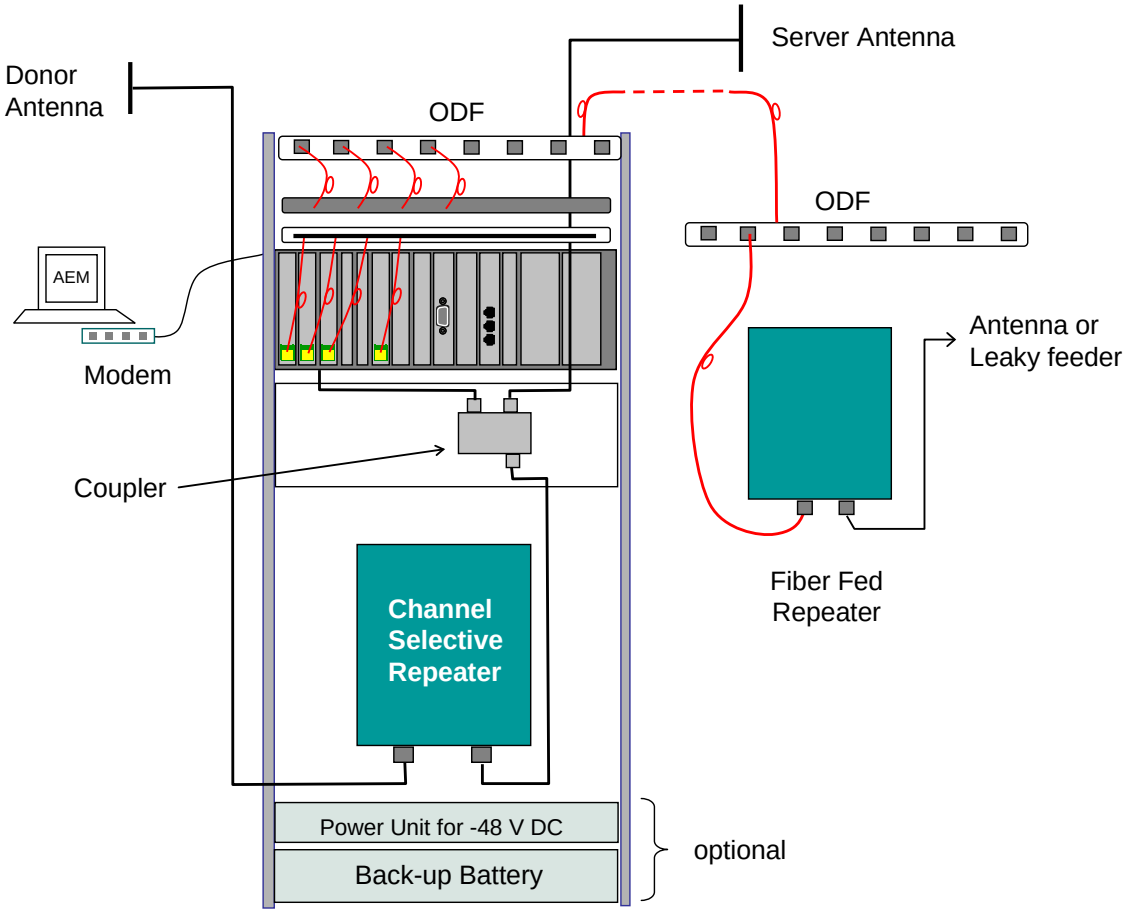
3.12 Installation Examples

3.12.1 OMU Signal Tapped at BTS



3. An example of a site installation where the FR signal to the OMU is tapped off a BTS

3.12.2 OMU Signal Source provided by Repeater



3. Example of a site installation where the FR signal to the OMU is tapped off a repeater

3.12.3 Multi-Sector Configurations - Up to Six Sectors

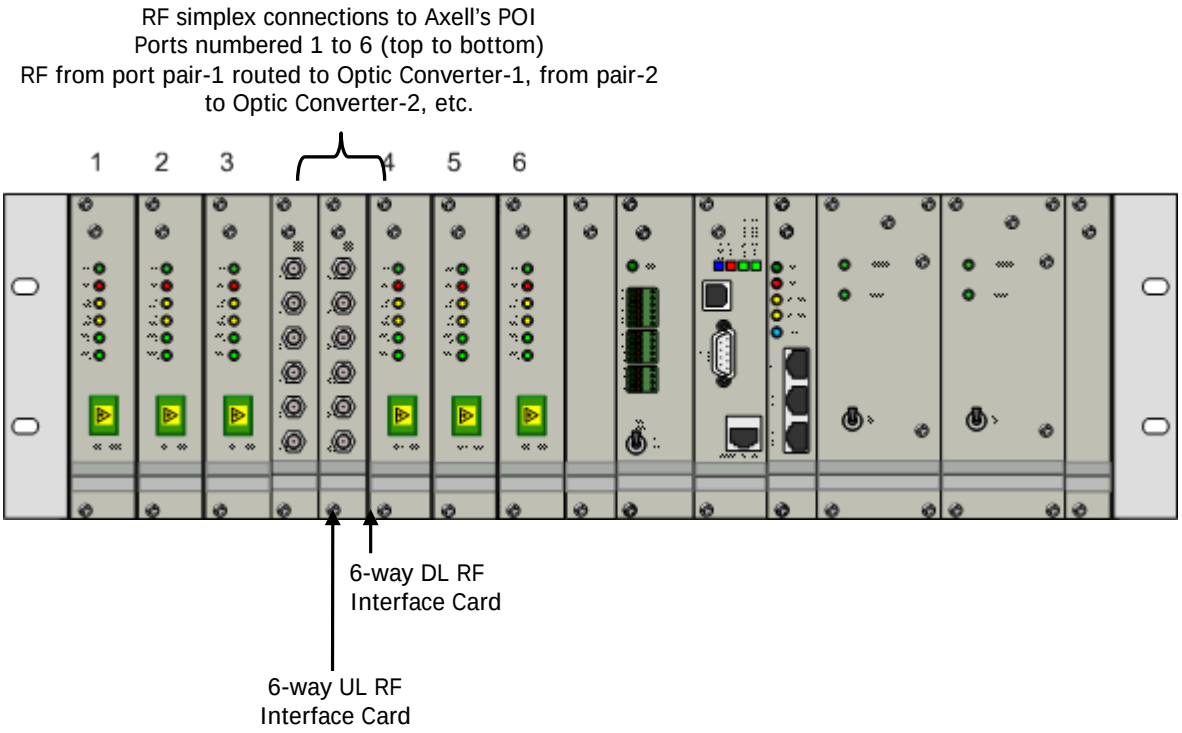
In this configuration, OMU I can support up to six sectors.

Requirements:

- OMU I physical configuration must include a pair (UL/DL) of (factory installed) 6-way RF Interface cards.
- Axell's Point-of-Interface system – provides the RF signal interfaces between the signal sources (BTS/BDA, et.) and the 6-way RF Interface cards.

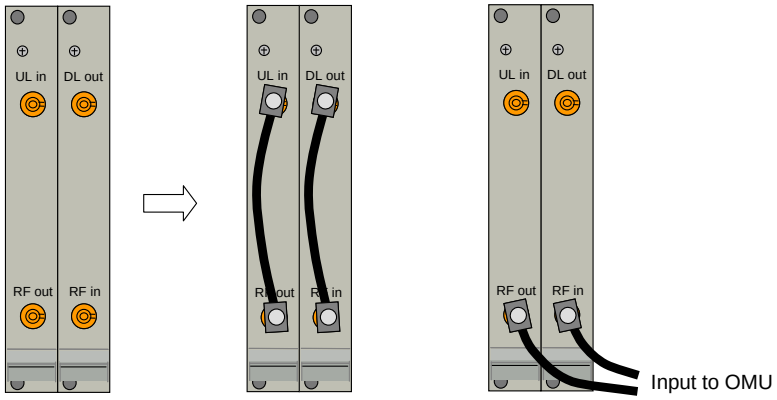
To implement the multi-sector configuration

- Connect each pair of 6-way RF Interface Card ports to a RF interface output on the POI.
- The RF signal is routed to the corresponding Optical Conversion unit, where the 6-way RF Interface Card ports are numbered 1 to 6 (from top to bottom).

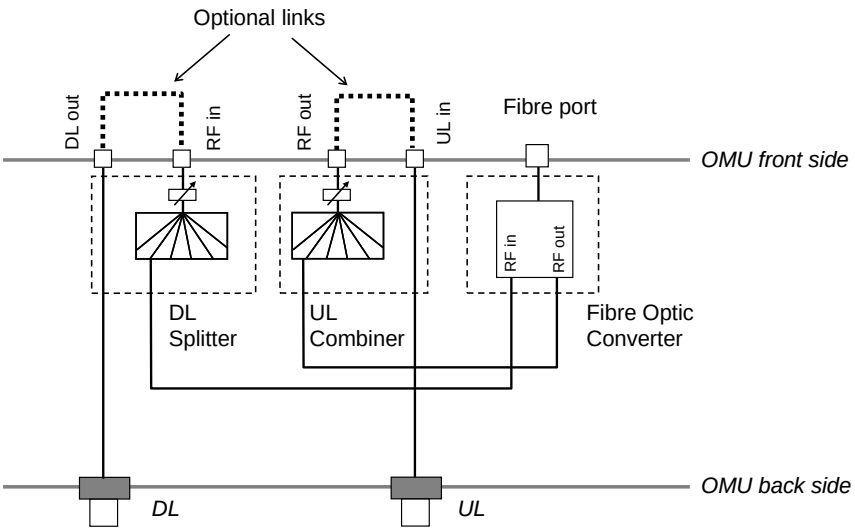


3.12.4 Changing UL Combiner and DL Splitter Connections

Via these modules the RF in/out can be connected on the front of the OMU instead of the back, if needed. The connectors are QMA type. The modules can to be configured in two ways as shown in the illustration below.



In Alternative 2 the input to the OMU is made via the QMA connectors marked RF in/RF out.



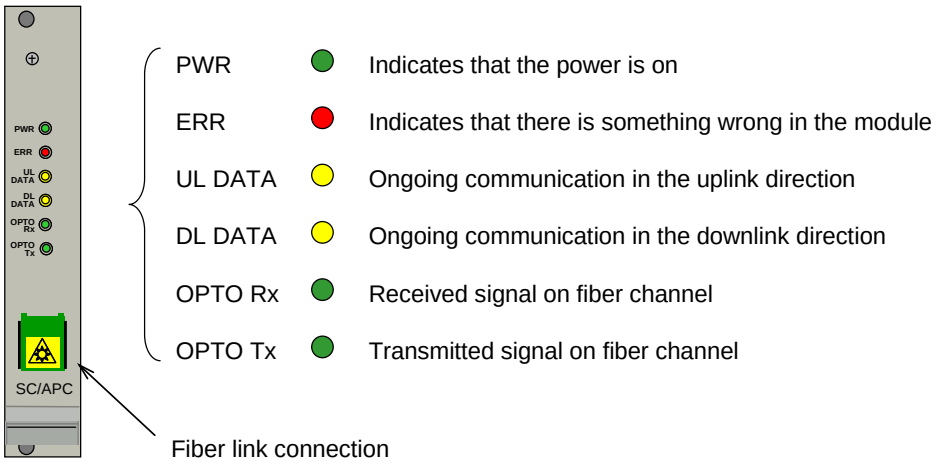
NOTE: In the illustration above only one Fiber Optic Converter is shown. The other converters are connected accordingly. The configuration at delivery is Alternative 1.

4 TROUBLESHOOTING

4.1 Module LEDs

4.1.1 WDM Module LEDs

On the Fiber Optic Converter module there are six LED indicators; one for power status, one for error, two for the data communication and two for the RF signals.

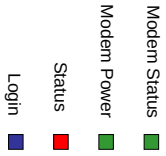


LED 1, Power, Green	
On	Unit is powered on
Off	Unit has no power
LED 2, Error, Red	
On	Error detected
Off	No error
LED 3, UL Data, Yellow	
On	Communication via the opto module is ongoing in the uplink direction
Off	No communication
LED 4, DL Data, Yellow	
On	Communication via the opto module is ongoing in the downlink direction
Off	No communication
LED 5, Opto Rx, Green	
On	Input opto level OK
Off	Input opto level below threshold
LED 6, Opto Tx, Green	
On	Output opto level OK
Off	Output opto level below threshold

4.1.2 Control Module LEDs

The Control Module has four LEDs which give information regarding the status of the OMU.

If the OMU is configured for Ethernet communication the two LEDs Modem Power and Modem Status do not fill any function and can be disregarded.



Blue LED - Login		
	Quick flash	Control Module switched on, someone logged in locally and/or remotely
	Off (except for a quick flash every 10th second)	Control Module switched on, no one logged in
	Off (permanent)	Control Module switched OFF

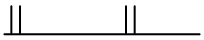
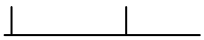
Red LED - Status		
	Quick flash	Control Module switched on, one or more errors/alarms detected
	Off (except for a quick flash every 10th second)	Control Module switched on, status OK
	Off (permanent)	Control Module switched off

Green LED – Modem Power		
	On	Modem Power is on
	Off	Modem Power is off

Green LED – Modem Status		
	On	Depending on type of call: Voice call: Connected to remote party Data call: Connected to remote party or exchange of parameters while setting up or disconnecting a call
	Flashing (irregular)	Indicates GPSR data transfer. When a GPRS transfer is in progress the LED goes on within 1 second after data packets were exchanged. Flash duration in approximately 0.5s.
	75ms on/75ms off/75ms on/3s off	One or more GPRS contexts activated
	75ms on/3s off	Logged to network (monitoring control channels and user interactions). No call in progress
	600ms on/600ms off	No SIM card inserted, or no PIN entered, or network search in progress, or ongoing user authentications, or network login in progress
	Off	Modem is off

4.1.3 GSM Modem Behaviour

Note! This LED behaviour is valid only for GSM modems. Other modem types will be added in later editions.

Green LED – Modem Status		
	On	Depending on type of call: Voice call: Connected to remote party Data call: Connected to remote party or exchange of parameters while setting up or disconnecting a call
	Flashing  (irregular)	Indicates GPSR data transfer. When a GPRS transfer is in progress the LED goes on within 1 second after data packets were exchanged. Flash duration in approximately 0.5s.
	75ms on/75ms off/75ms on/3s off 	One or more GPRS contexts activated
	75ms on/3s off 	Logged to network (monitoring control channels and user interactions). No call in progress
	600ms on/600ms off 	No SIM card inserted, or no PIN entered, or network search in progress, or ongoing user authentications, or network login in progress
	Off	Modem is off

Verify the remote communication either by having someone attempting to integrate the repeater from the Axell Element Manager, or by dialling the repeater using the Repeater Maintenance Console.

NOTE: It is very important to dial the data number of the SIM. In case the voice number is dialled, the call is answered, but almost immediately the call will be hung up.

5 MAINTENANCE

5.1 General

The system normally operates without any operator intervention or maintenance.

Should the system malfunction, the condition of the antenna systems as well as the continuity of the cabling should be checked before replacing any of the OMU units.

In the unlikely event of a unit failure, the field replaceable components (antenna unit, cables, etc.) should be checked and replaced if faulty and the system restored.

A failed unit can be removed and replaced with a spare while the rest of the system (other OMUs) is still in operation.

This product is equipped with Class 1 lasers, as per definition in EN 60825-1.

CAUTION!
Un-terminated optical receptacles may emit laser radiation. Do not stare into beam or view with optical instruments.

NOTE: The power supply of the failed OMU should be isolated from AC mains and DC power before any module is replaced.

5.2 Preventive Maintenance

The OMU does not require any preventative maintenance apart from changing the battery every three years.

CAUION!
- Risk of explosion if battery is replaced by an incorrect type.
- Dispose of used batteries according to local laws and instructions.

5.3 Product Disposal

Disposal of this product must be handled according to all national laws and regulations.

Appendix A: Specifications

RF Parameters	
Frequency Bands	68-500 / 380 – 2200 MHz (*)
Gain Flatness	Typical 2dB (p-p)
Nominal RF input power	+10dBm composite power
Absolute maximum RF input power	+23dBm composite power
Number of optical modules	1-6
Laser class	Class 1
Optical Modules Electrical Specifications	
Optical Wavelength:	
Master	1310 ± 10 nm or 1330 ± 10 nm
Slave	1510 ± 3 nm or 1530 ± 3 nm or 1550 ± 3 nm or 1570 ± 3 nm or 1590 ± 3 nm
Optical Output Power	
Master/Slave	+5 ± 2dBm
Maximum Optical Input Power	+5 ± 2dBm
Output Power (Tx) max	+7 dBm
Operating Temperature	+5 ~ +45°C
Automatic fibre optic loss compensation	Yes
Power Requirements	
Power Requirements	230/115VAC, 50/60Hz 24/- 48VDC
Power Consumption	Typical 50 W (fully equipped)
External Electrical Interfaces	
Local Maintenance Terminal	RS232
RF Ports	N-type Connector Female
Optical Ports	SC/APC
AC/DC Mains Input	Plinth
External alarms	Plinth
Modem connector	RJ45 or RJ11
Modem antenna connector	SMA
Ethernet connector	RJ45
Mechanical Specifications	
Dimensions (w x h x d)	17.5 x 5.2 x 11.4 in (444 x 132.5 x 291 mm) 19" rack
Weight	15 kg (fully equipped)
IP rating	IP20
Reliability Specifications	
Lifetime (MTBF)	>70,000 Hrs

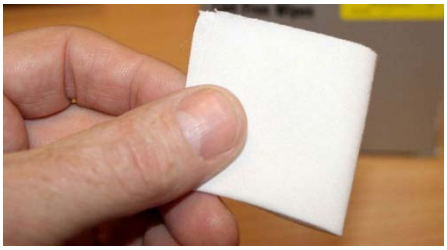
Specifications are subject to change without notice

(*) Support up to 2700MHz is available as an option.

Appendix B: F/O Cleaning Procedure

NOTE: The process is demonstrated on an OMU F/O module and is similar to all F/O equipment supplied by Axell.

Tools:

Tool Description	Illustration
Fibrescope connected to a PC running the appropriate viewing software. It is highly recommended that some form of fibre viewing equipment such as a Fibrescope is used to ensure that all fibre connections are clean before termination; failure to do so could result in poor system performance	
Lint-free swabs (box), Axell P/N 99-000127	
Lint-free wipes (pack) Axell P/N 99-000125	
Fujikura "One Click" cleaner, Axell P/N 98-900004.	
99% isopropyl alcohol (can), Axell P/N 99-000126	
Cletop type S Cassette Cleaner, Axell P/N 98-900001	

Dry Cleaning

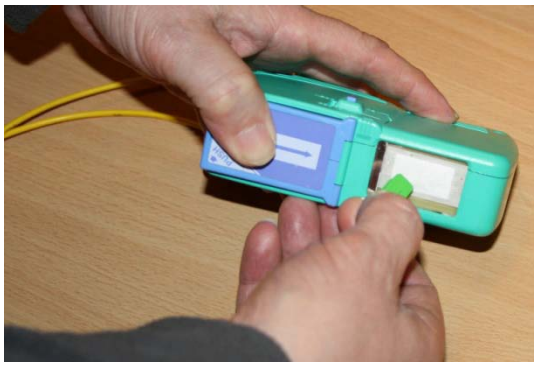
ATTENTION!

Invisible laser radiation might be emitted from disconnected fibres or connectors. Do not stare into beams or view directly with optical instruments.

1. Before cleaning the optical connectors on the OMU it is advisable to clean the connector of the mating cable being attached to the optical port.

   An unclean optical connector is often the cause for reduced system performance. A bit of dust or oil from a finger can easily interfere with, or block light. Fortunately, it is very easy to clean the connector. Be sure to use the correct procedure for the given connector. When disconnected, cap the SC/APC connector to keep it clean and prevent scratching the tip of the ferrule.

   Use a product specially designed for the purpose, such as the Cletop type S Cassette Cleaner.

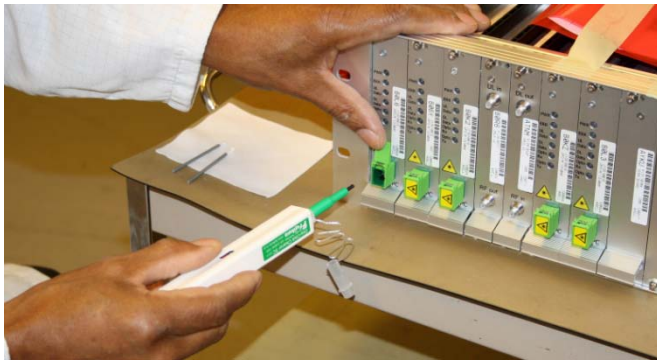


2. Begin by dry cleaning the F/O bulkhead connector (shown below is the Fujikura One-Click in use).

IMPORTANT

Always make sure there is a way of inspecting the connector after cleaning. Cleaning can actually leave the end-face in a worse condition, since alcohol residue is one of the most difficult contaminants to remove.

3. Remove the protective cap from the cleaning-head end of the "One Click" cleaner, lift the protective end-cap on the fibre connector and offer-up the end to the fibre connector



4. With the cleaning-head end fully engaged in the connector, push until an audible "click" is heard

5. Without fully withdrawing the cleaning head end push it in again twice more, each time until an audible "click" is heard.
6. Withdraw the "One Click" cleaner and replace the protective end cap.
7. Inspect the fibre connector using a Fibrescope. On the PC monitor, verify that there is no contamination present on the connector end-face.
8. If the connector is dirty, clean it with a wet cleaning technique followed immediately by dry cleaning. This is to remove any remaining residue from the wet clean (the following steps demonstrate a wet cleaning technique).

Wet Cleaning

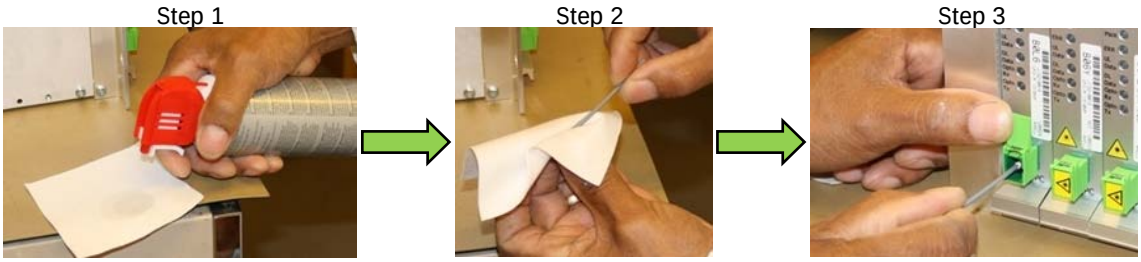
ATTENTION! Invisible laser radiation might be emitted from disconnected fibers or connectors. Do not stare into beams or view directly with optical instruments.

1. Lightly moisten a new lint-free wipe with 99% isopropyl alcohol. (Step 1 below).

   Tip: Have a dry lint-free swab available for immediately drying after performing the wet-cleaning.

2. Lightly press and turn a clean lint-free swab in the moistened area of the wipe to moisten the swab. It is important that the swab is not too wet. (Step 2 below).

3. Insert the moistened lint-free swab into the bulkhead adapter. Lightly press and rotate several times in the same direction. (Step 3 below).



Wet-Cleaning Technique

4. Immediately use a dry lint-free swab to clear any remaining alcohol residue.

   NOTE: Do **not** re-use any of the wipes and/or swabs. Dispose of them properly.

5. Follow steps 3 to 6 of Dry Cleaning above
6. Re-inspect the fibre using the Fibrescope. On the PC monitor, verify that there is no contamination present on the connector end-face.
7. If the fibre is still dirty, go back to step 1 (Wet Cleaning) and repeat the entire process.

NOTE: The entire wet/dry cleaning cycle should only be used twice, if the fibre is still dirty after two cycles of wet/dry cleaning seek advice from the Cobham Wireless Support Desk.

Appendix C: EU Declaration of Conformity

EU DECLARATION OF CONFORMITY

Declaration **RED_OMU_09_02_OMU1**

We Cobham Wireless, Asheridge Road, Chesham, Bucks HP5 2QD, UK, declare under our own responsibility that the OMU (Optical Master Unit) complies with the following directives,

- 2011/65/EU European RoHS 2 directive.
- 2014/53/EU Radio Equipment Directive (RED)

and the following associated standards

RED Article 3.1(a) Health & safety	EN 60950-1:2006+A2:2013 EN 50385:2002
RED Article 3.1(b) EMC (where relevant to the EMC standards supported by the OMU)	EN 301 489-1 V2.2.0 EN 301 489-5 V2.2.0 EN 301 489-50 V2.2.0

Date: 29, 06, 2017

Brian Barton
Operations Support Director

Cobham Wireless

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