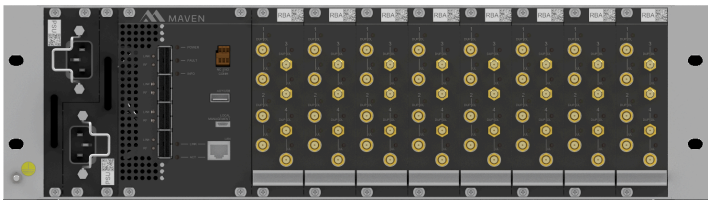
Maven Wireless Nebula DAS

Installation User Manual

Document version: 1.4



Revision history

Date	Rev	Description	Signed
2022-02-16	A2	Initial version	BRPA
2023-11-20	A3	Update on DC connection for Orion	BRPA
2024-03-04	A4	Add compliance statements, US Format	GG

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Warranty

Standard product warranty is 12 months or as otherwise agreed.

All outdoor antennas must be installed with lightning protection. Damage to modules, as a result of lightning is not covered by the warranty.

Antennas must be connected before switching on AC or DC power. Energizing the equipment prior to the connection of the antenna cable(s) is regarded as faulty installation procedure and therefore not covered by the Maven Wireless warranty.

Unauthorized changes to equipment

Any changes or modifications not expressly approved by Maven Wireless (who are responsible for compliance) could void the user's authority to operate the equipment.
The equipment must be installed and operated in accordance with any license required from the radio authorities in the country concerned. In most cases a failure to obtain or the contravention of a license is a criminal offense. It is the user's responsibility to ensure any required licenses are obtained, that system installations are commissioned in accordance with their terms and that no changes can later be made which contravene them.

Standards and approvals

- The Maven DAS complies with the following standards
- EMC Directive 2004/108/EC
- Low Voltage Directive 73/23/EEC
- RED directive 2014/53/EU
- EN 50121-4 (to special order)
- UL 62368-1, CSA C22.2, NEMA 4X
- FCC 15B, ICES-003; FCC 22, 24, 27, 90; ISED RSS 130, 132, 133, 192

General Safety Warnings and Compliance

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

Safety to Personnel

Before installing, replacing or modifying any of the equipment, the entire manual should be read and understood. The user needs to supply the appropriate AC or DC power to the equipment. Incorrect power setting can damage the equipment and may cause injury to the user.
Be aware that the equipment can in certain conditions become very warm and can cause minor injuries if handled without protection such as gloves.

Electrical Shock

To prevent electrical shock when installing, modifying or replacing the system power wiring, disconnect the wiring at the power source before working with uninsulated wires or terminals.

Non Ionising Radiation

The Remote Unit outputs Radio Frequencies at high power. The connected antenna system must be engineered to comply with the requirements of 1999/519/EC: Council Recommendation of the limitation of exposure of the general public to electromagnetic fields 0Hz to 300GHz. Otherwise, in cases where the general public is not admitted to the coverage area, such other occupational limits may be applicable.

Maven Wireless customers must adhere to the standards when designing and commissioning DAS systems by ensuring that the combination of output power, splitting losses, antenna gains and separation distances to accessible areas yield field strengths below safe levels.

Note that in some instances it will be necessary to shut down Remote Units in order for work to be performed on or near system antennas. Adequate warning notices should be posted to ensure every installation is safe.

ISED non-interference disclaimer

This device contains licensed transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licensed RSS(s). Operation is subject to the following two conditions:
(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.
This device complies with the Canadian ICES-003 Class A specifications. CAN ICES-003(A) / NMB-003 (A).

L'émetteur/récepteur autorisée contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio autorisée. L'exploitation est autorisée aux deux conditions suivantes :
(1) L'appareil ne doit pas produire de brouillage;
(2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.
Cet appareil numérique de la Canadian ICES-003. Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

RF Exposure Statement
This equipment complies with ISED RSS-102 radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm (7.9 inches) between the radiator and any part of your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet équipement est conforme aux limites d'exposition aux radiations ISED CNR-102 établies pour un environnement non contrôlé. Une distance de séparation d'au moins 20 cm doivent être maintenue entre l'antenne de cet appareil et toutes les personnes. Lanceurs ou ne peuvent pas coexister cette antenne ou capteurs avec d'autres.

FCC Compliance Statement
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation. Please note that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Strato, Cirrus and Cumulus Unit Weight
The unit weighs 25kg. It can be lifted by one man but due care with handling is required. Personnel should have received suitable training and be provided with adequate PPE, at a minimum safety shoes, preferably a lifting belt.

Optical Hazards
Master and Remote units are linked together by commercially available optical transceivers to the SFP+ or QSFP+standards. Usually these are optical hazard Class 1 and require no optical hazard markings or special precautions. For this reason no warning labels are applied to the Maven Master or Remote Units.

The instructions accompanying the optical transceivers themselves will describe the optical hazard class and any necessary hazard mitigation measures. These must be followed for the type in question. Laser warning labels must be applied immediately adjacent to the optical transceivers if the type in use is of a higher hazard class.

For use only by Trained Personnel
The devices should be installed and energized only by trained personnel who are familiar with the type of equipment and the associated hazards.

The high power remote unit has an access cover protected by keys. The keys should only be issued to suitably trained persons. There are no user serviceable parts inside and maintenance must be carried out by trained staff in workshop conditions. Apart from the access cover, the devices must not be opened on site.

Login details of user accounts must be controlled so that only competent persons possess the privilege to adjust frequency bands and operating levels.

Use in accordance with this manual
The protection provided by the equipment may be impaired if installed and used in a manner not specified by the manufacturer. Follow all guidance contained in this manual.

Electrical & Environmental Ratings

Orion Master Unit

Voltage Rating	115-230V AC +/-10% **or** 48V DC, 42.3-60V -15% / +20%
AC Frequency	50/60 Hz
Current	1.3-0.65 A rms AC **or** 3.0-2.1 A DC
Temperature	+5 to +45 ℃
Relative Humidity	5 to 85 % Non Condensing
Indoor/Outdoor Use	Indoor
Environment	Weather Protected, Temperature Controlled, EN300-019-1-3, Class 3.1
Operational Spacing	None Specified, air flow must not be impeded front or back
Dimensions	130 x 436 x 309 mm in standard 19” rack format
Weight	< 8kg in max configuration

Stratus/Cumulus Remote Unit and Cirrus Off-Air Master Unit

Voltage Rating	115-230V AC , 48V DC
AC Frequency	50/60 Hz
Current	5.2-2.6 A rms AC
Temperature	-25 to +55 ℃
Relative Humidity	10 to 100 % Non Condensing
Indoor/Outdoor Use	Indoor/Outdoor
Environment	Weather Protected, Not Temperature Controlled - EN 300-019-1-3, Class3.3
Operational Spacing	Horizontal side by side - 300 mm Horizontal front to back - 300 mm Vertical top to bottom - 500 mm
Dimensions	670 x 383 x 270 mm
Weight	25 kg

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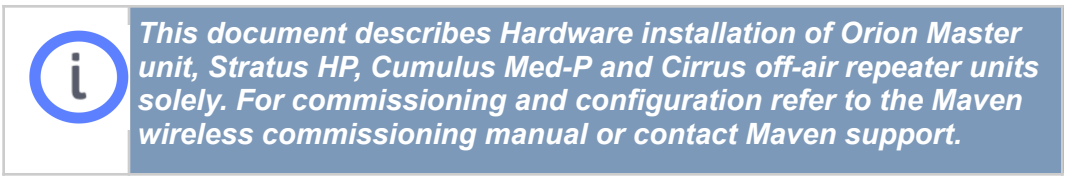

This document describes Hardware installation of Orion Master unit, Stratus HP, Cumulus Med-P and Cirrus off-air repeater units solely. For commissioning and configuration refer to the Maven wireless commissioning manual or contact Maven support.

General description of Maven Digital DAS

Maven DAS components and operating principle

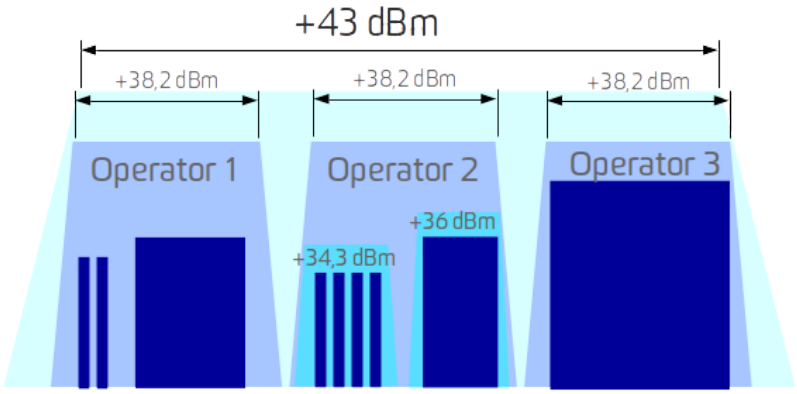
The Maven digital DAS consists of:

- One or more Orion master units and / or Cirrus off air master units, which connect to operators' base stations and convert downlink RF signals to digital signals, and digital signals to RF in the uplink. Orion master units connect physically to the base stations using RF cables (with couplers / attenuators if needed), while Cirrus off-air masters connect over the air via a donor antenna directed toward a base station site.
- One or more Stratus or Cumulus remote units, which recreate the downlink signals for transmission over the antennas in the coverage area, and which convert uplink signals from mobile terminals into digital signals to send back to the base stations.
- Digital fiber-optic interconnections between the units, using industry-standard digital fiber interfaces (QSFP+ / SFP+) which can be selected for a range of distances from 0-3 m multimode up to 40+ km over single mode fiber.

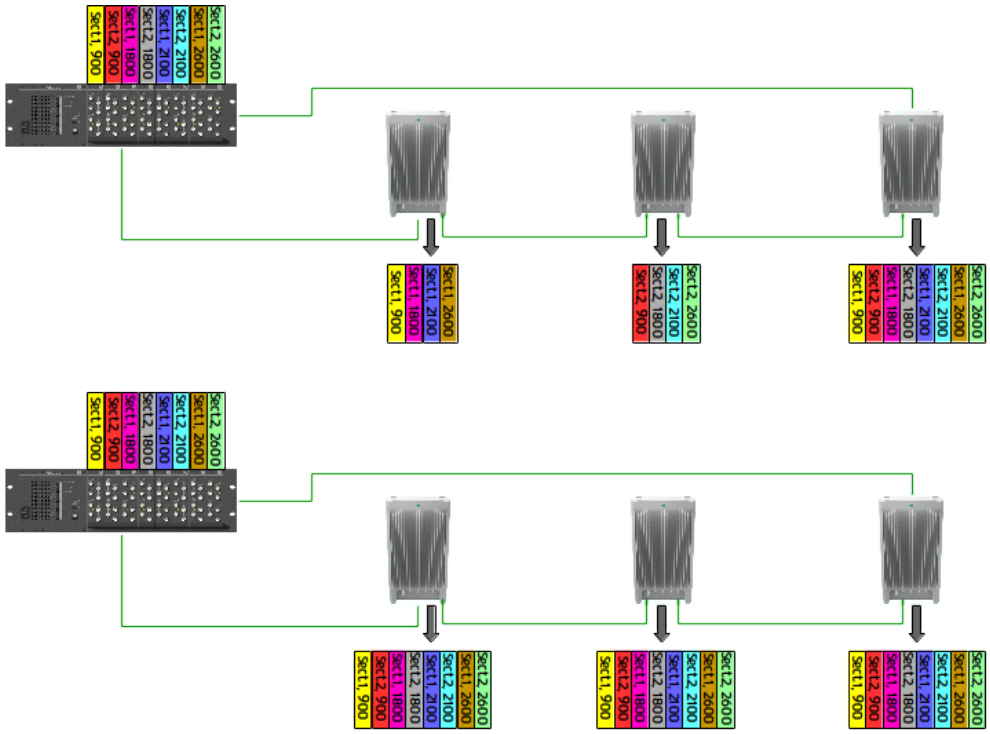
Filtering in Maven DAS is software-defined: each operator specifies in the management GUI which frequency ranges they are using for their signals, which are then known to the system as a named "sector input". These sector inputs are filtered into separate bidirectional (DL / UL) digital data streams that are distributed over the digital fiber network. Each operator can then decide:

- What sector inputs should be enabled at which remote units: this allows each operator to for example define their own sectorization.
- What downlink and uplink gain should be provided for each sector input to and from each remote. This allows each operator to balance the power budget for each signal type.
- What share of the maximum output power at each remote is allocated to each operator, and for each operator how they allocate that power to sector inputs of different technologies.

The separation of sector inputs by digital filtering allows the downlink signals from several operators to be combined into a single Orion band module with different power levels, while still allowing each operator to define their own coverage parameters without being affected by changes in the other operator signals.



Separate sector inputs routed to Stratus with different power levels per technology and operator



Software-defined control of sectorization

Coverage parameters can be changed at any time via the management GUI, allowing signals to be added or removed, power levels to be changed or sectorization adjusted remotely. The figure shows a number of sector inputs for one operator: in the first example, capacity is concentrated on one remote, while in the second example capacity is distributed evenly. These changes can be made independently for each operator, with the separate frequency ranges for several operators sharing each band module.

Migration from analog DAS

Maven digital DAS offers a flexibility in system design which does not exist with analog DAS. In an analog DAS, all signals in all frequency bands are combined into a single analog signal which is used to modulate the laser in the optical transceiver. This combined signal is carried by the fiber and converted back to an analog signal at the detector at the destination. There is no choice in which signals are carried: the entire frequency range connected at one end is hard-wired to appear at the other end, and there is no selectivity to prevent unwanted signals from interfering.To make system signal selective,additional IF pass bands and SAW filters are needed. Also, relative signal levels are fixed for each operator input in proportion to the combiner attenuations, with no scope to set different levels for different carriers. Except for the input attenuators in the head end or POI.

In an analog DAS, the fiber transmission forms part of the analog signal path: this means that distortion from non-linearity and noise in the fiber transmission appears directly in the RF signal. Also, the loss through the fiber appears directly as loss in the RF signal level, and while analog DAS units typically compensate for this to some extent it is still usually required to perform

manual trimming of signal levels. Also, with longer fibers the noise increases, which may require compromises in for example reaching the desired uplink gain and noise level simultaneously.

In the Maven digital DAS, each operator input signal is digitized into sector inputs covering specific frequency ranges. This means that sectorization and distribution of signals is independent of the physical fiber connections. With digital fiber interconnections, there is effectively no contribution from the fiber distribution to the signal quality: the digital signal entering the fiber is transmitted perfectly to the far end. Unit gains are factory calibrated, and end-to-end gain is independent of the fiber length. Also, the digital distribution automatically provides redundancy to maintain coverage in the event of a fiber interruption, as long as an alternative path exists through the fiber network.

analog DAS is sensitive to reflections and discontinuities in the optical signal path at connectors, which appear as distortion in the signal. As a result, analog DAS requires APC-style angled connectors. In contrast, digital links in Maven DAS can use datacom standard LC/UPC connectors.

analog DAS

- Combined input signals transmitted over fiber between fixed source and destination.
- No selectivity against unwanted uplink signals.
- Noise, distortion and gain are affected by fiber transmission.
- Sensitive to reflections at connectors, need special APC optical connectors.
- Delay balancing via physical spools of fiber

Maven digital DAS

- Input signals split into individual sector inputs which can be separately controlled.
- Flexible signal distribution and topology.
- Unwanted uplink signals filtered out.
- Perfect transmission of signals over fiber.
- Factory-calibrated end-to-end gain.
- Datacom standard LC connectors.
- Automatic delay management and balancing via signal processing.

Fiber Topologies

QSFP+ and SFP+ digital fiber connections

Maven digital DAS uses two types of digital fiber connector modules: QSFP+ and SFP+.

The main digital backbone connections use QSFP+ modules which integrate 4 lanes of 10 Gbit/s to give a total link capacity of 40 Gbit/s. These are available in 3 main connector variants:

- Quad lane WDM with duplex LC connector. The data for the 4 lanes are sent using different wavelengths over a common fiber, with separate fiber strands for transmit and receive directions. This gives a total aggregate capacity of 40 Gbit/s in each direction, which corresponds to a maximum RF signal bandwidth of approximately 1200 MHz. These are available for maximum fiber reaches from 100 m to 40 km, with the shorter reaches using a multi-mode fiber pair and longer reaches requiring single-mode fiber.

- Four separate lanes with MTP/MPO connector. Each of the 4 lanes is available as a separate transmit / receive pair which can be broken out into 4 separate links, for example terminating at 4 separate LC connectors. Each lane carries 10 Gbit/s, corresponding to a maximum RF bandwidth of approximately 300 MHz. These are available in reaches from 100 m to 10 km, again using multimode or single mode fiber depending on reach.
- Active Optical Cables (AOC) with integrated fiber. These provide QSFP+ 40 Gbit/s capacity or 10 Gbit/s SFP+ capacity and are a convenient way for short connections between units, with the pre-formed fiber interfaces avoiding any risk of contamination of fiber terminations.

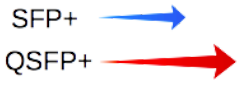
SFP+ connections carry a single lane of 10 Gbit/s (300 MHz maximum RF BW) and are primarily intended for local interconnection. They may however also be used as an alternative to QSFP+ where bandwidth requirements are lower and if a larger fan-out is required: 4 x SFP+ duplex LC connectors can be connected to a single QSFP+ MTP/MPO module using 4 fiber pairs. Also, SFP+ modules are available in a wider range of variants (including DWDM and BiDi) and may be useful in special situations where fiber availability is extremely limited.

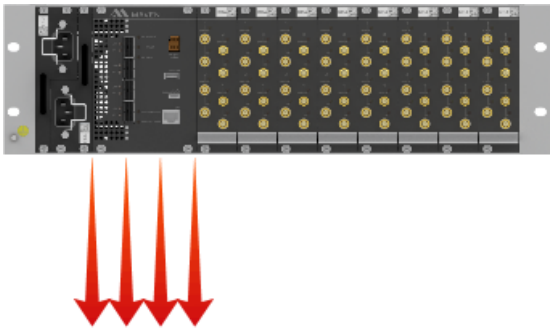
SFP+ modules are also available in 3 main connection variants:

- Duplex LC connector. The data for the lane is carried over separate fiber strands for transmit and receive directions. The supported reaches and fiber types are the same as for the corresponding QSFP+ module. In addition, DWDM modules allow the use of external optical multiplexers to combine a large number of wavelengths over a single fiber pair, useful for example where capacity is limited between a remote site and the coverage area.
- BiDi module with simplex LC connector. These modules use CWDM to multiplex transmit and receive signals over a single fiber strand. The modules are typically available in reaches up to 10 km. Care must be taken to install the modules in matching pairs, with TX and RX at opposite ends of the fiber using the same wavelength.
- Active Optical Cables (AOC) with integrated fiber. These are the 10 Gbit/s equivalent of the QSFP+ patch connectors.

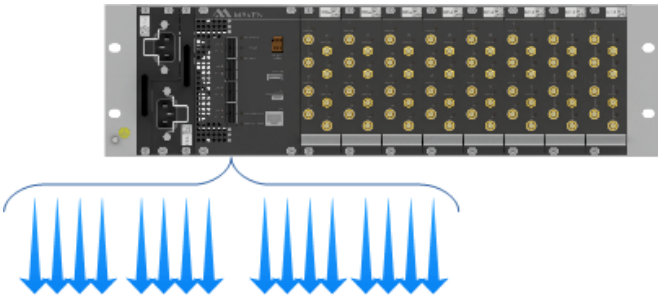
Orion digital fiber connection options

The Orion head end unit has 4 connector slots for QSFP+ digital fiber connector modules. These are typically connected using quad lane 40 Gbit/s configurations, giving 4 links with the full 1200 MHz RF bandwidth per link. However, if more fan-out is required, each module can be replaced with an MTP/MPO breakout module to give a maximum of 16 links at 10 Gbit/s / 300 MHz each.

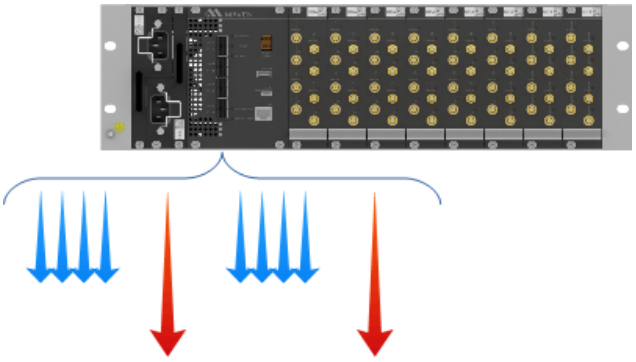




Option 1: Using 1 up to 4 QSFP+ fiber modules



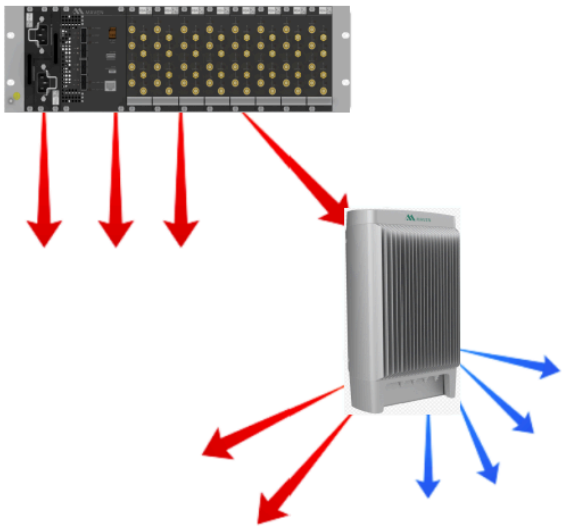
Option 2: Using QSFP+ breakout modules



Option 3: Mixing option 1 & 2 above

Stratus, Cumulus and Cirrus digital fiber connections

The remote units and the Cirrus off-air master have 3 connector slots for QSFP+ digital fiber connector modules and 4 connector slots for SFP+ digital fiber connector modules. The QSFP+ connection ports are typically used for the core front-haul fiber network, and the SFP+ connectors are typically used for local connections at the remote location. A common use of these local connections is to provide additional bands and MIMO paths by connecting extra units.



QSFP+ and SFP+ fan-out in the Stratus remote unit

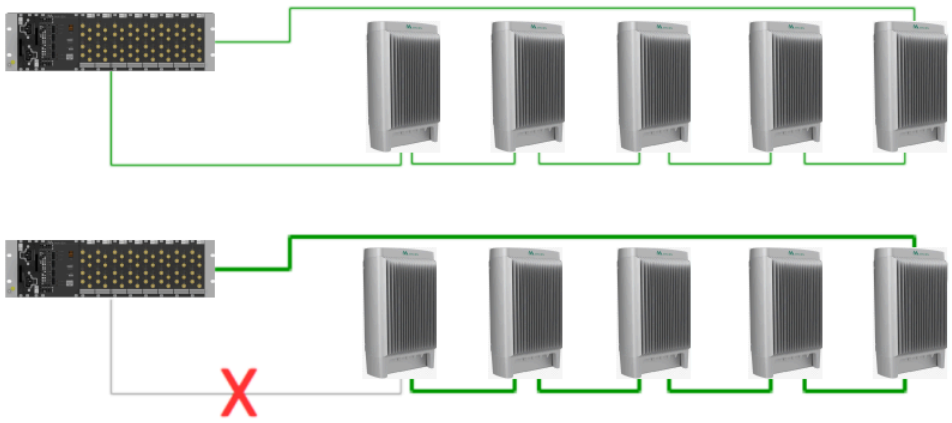
Topologies and redundancy

The QSFP+ and SFP+ connectors can be used to interconnect the units in the Maven digital DAS in any desired topology. The system automatically registers unit interconnections and topology and, as long as a physical path exists with enough transmission capacity, arranges the distribution of the digitized sector inputs so that they are routed where they are required. Orion / Cirrus master units and remote units can be located wherever is most convenient in the system.

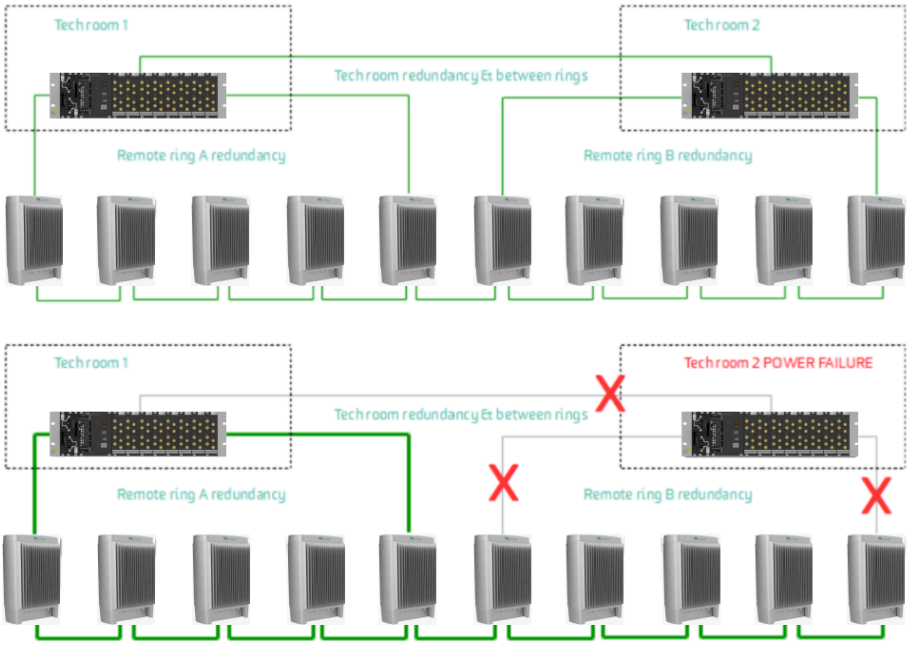
Some commonly used topologies are:

- **Star topology -** many remotes are connected to a central master unit. This is the typical arrangement used with analog DAS.
- **Chain topology** - where units are connected in series. This arrangement is particularly useful along tunnels or railway tracks.
- **Ring topology** - an extension of chain topology where the last unit in the chain is connected back to the start, as shown in the first example. Interruption of a single connection does not affect coverage; the alternative path around the ring is automatically used.
- **Tree topology** - each unit has several connectors, 4 QSFP+ connectors on an Orion and 3 QSFP+ connectors on a remote or Cirrus. This means that units can be connected in a fan-out tree, with the number of connections increasing at each step through the tree.
- **Mesh topology** - a mesh is a general pattern where additional connections are made beyond the minimum needed to provide routing. This provides a number of alternative redundant paths. The additional paths can be selected to maintain RF distribution in the event of more serious events. The second example shows such a configuration, with two Orion master nodes in separate equipment rooms (for example, a system fed from two sites for redundancy purposes). The remotes are connected in two rings, with mesh cross-connections between the rings and between the equipment rooms. Even if power is lost at one of the equipment rooms, coverage can still be provided from the other equipment rooms.

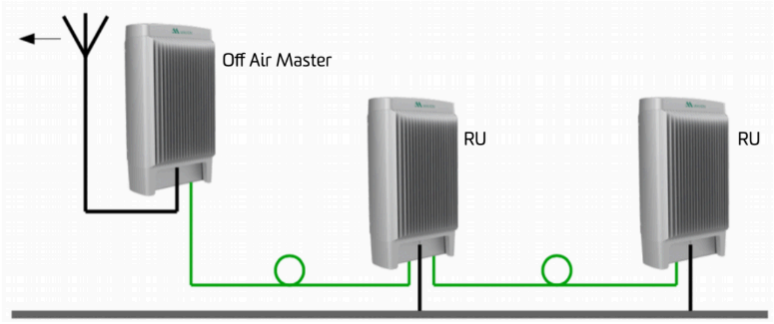
It is recommended to keep the number of interconnection hops between a master unit and the most distant remote to fewer than 10. The fan-out capabilities mean that the number of remotes which can be reached within this limit is larger than would be needed in any practical system.



Ring connection topology providing redundancy on broken link or unit power failure



Redundant mesh connections provide continued service even with more serious disruption



Cirrus Off Air master and remote units.

Optical Transceiver Selection

The choice of Optical Transceivers is dictated by the capacity and reach required by each optical link.

Only Optical Transceivers recommended by Maven should be used. Please discuss the system requirements before purchasing them.

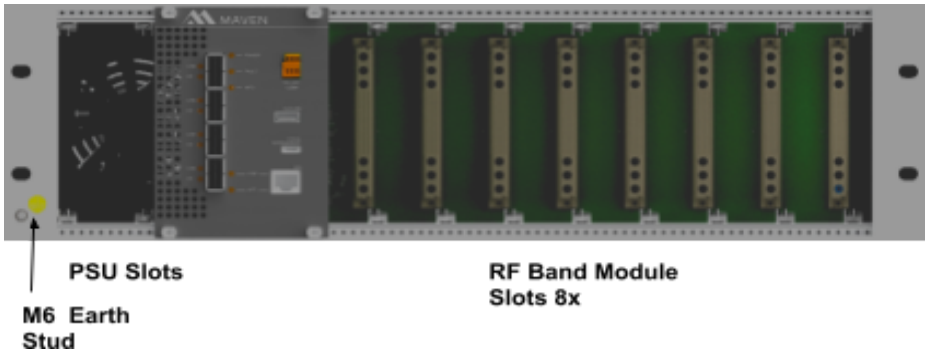
The calculation of link capacity for particular system topologies and frequency capacities is beyond the scope of this manual but assistance is available with system design via the Support and Technical Assistance details listed in the Contact Information section.

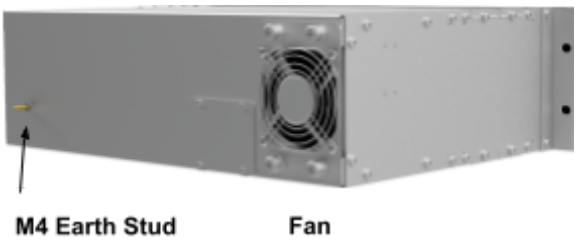
Overview of Orion Master Unit

The Orion Master unit is constructed in a 3U high 19” rack chassis.

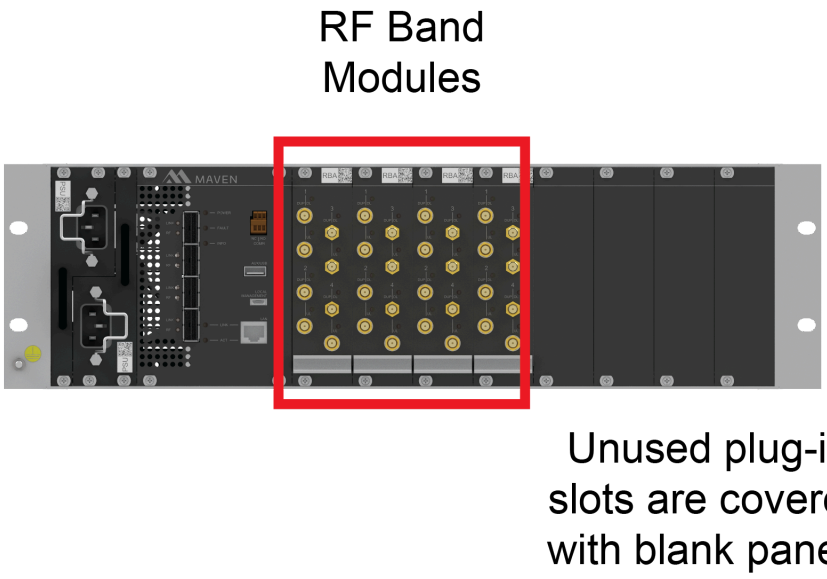
The Power supplies are located at the left hand end of the chassis and the Master Node Digital Unit is located immediately adjacent to it.

The PSUs and Digital Unit form a semi-sealed air compartment which is cooled by a temperature controlled fan drawing air through the compartment and exhausting through the rear chassis panel. A proportion of the air passed by the fan is also drawn from the grille on the right hand side panel. This air flows over the RF Band Modules to cool them.





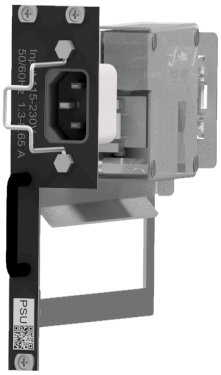
Unused band module slots are covered with plates fitted to preserve the air flow in the Master unit.



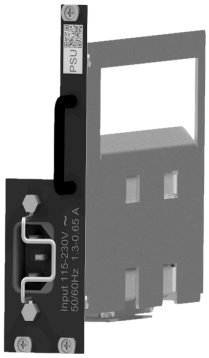
Orion Master Unit Modules

AC Power Supply 110V / 230V - PSU00008

The AC PSU modules occupy the two left hand slots of the Master Unit.
Two PSUs are used for redundancy, each generating a 12V supply, however a single PSU and blanking plate may be fitted instead if redundancy is not required.
The DC output of each PSU feeds a diode combiner on the Master Unit backplane to share the load and prevent back feeding should the output of one PSU fail. Replacement of a failed unit is possible without interruption of service. The two PSUs are identical but they are mounted with opposite orientation.



PSU1 (Left Slot orientation)



PSU2 (Right Slot orientation)

The AC Power Cable connects to a single C14 IEC Inlet Connector combined with a Mains Filter. The AC filter output is by crimped, insulated Spade Terminal sockets (not shown in diagram).

An insulated cover prevents finger contact with Live Parts of the PSU. The cover is open ended to permit cooling air to flow from front to back drawn by the negative pressure created by the fan at the rear of the chassis.

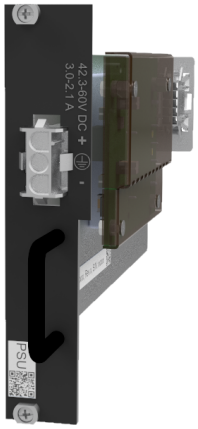
> *The mains safety Earth is connected to the PSU chassis plate and via the rear connector, to the main rack chassis. A secondary Earth connection should be made to one of the Earthing Studs provided on front and rear of the rack to maintain a safety Earth in the event that the PSUs or their supply leads are removed.*

DC Power Supply 48V - PSU00009 & PSU00011

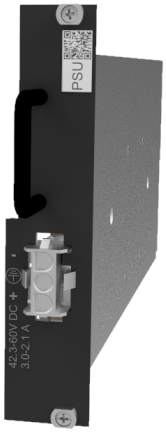
The DC PSU modules occupy the two left hand slots of the Master Unit.

> *As the form factors differ between AC & DC units, the two types cannot be mixed in the same Master Unit.*

Mounted to the chassis plate is a 12V DC/DC converter. It is mounted on a PCB which contains fuses, polarity protection and EMC filtering. The DC output of each PSU feeds a diode combiner on the Master Unit backplane to share the load and prevent back feeding should the output of one PSU fail.
Replacement of a failed unit is possible without interruption of service. The two PSUs are identical but they are mounted with opposite orientation.
PSU00011 includes an additional surge protection board MSC00002 which makes the Orion comply with EN 50121-4 for electromagnetic compatibility in railway applications.



PSU1 (Left Slot orientation)



PSU2 (Right Slot orientation)

The 48V input is a two wire galvanically isolated DC circuit so that it can be used in both +Ve (positive ground) and -Ve (negative ground) Earth installations.

The center pin of the input connector is an Earth wire connected to the PSU chassis plate and via the rear connector to the main rack chassis. A secondary Earth connection should be made to one of the Earthing Studs provided on front and rear of the rack to maintain a Protection Earth (PE) in the event that the PSUs or their supply leads are removed.

> ⚠ *The Voltage Rating shown on the front panel, 42.3-60V includes tolerances of -15% and +20% therefore 36-72V, is the absolute limit. Do not exceed this rating or shutdown/damage may occur. It is chosen to match the working range of a 48V Battery Supply.*

An insulated cover prevents finger contact with Live Parts of the PCB

Master Node Digital Unit

The master node digital unit is responsible for all signal processing between the digital fiber optic links and the Inputs and Outputs of the associated Radio Band Modules (maximum of 8 Band Modules). It also contains clock generation and conditioning circuitry which distributes precise frequency clocks with minimal phase noise to all modules.

Master node connections and slots

The Master digital unit has the following connectors/slots located on the front panel:

4 x QSFP+ fiber Optic Module Slots

1 x 3Pin External alarm relay connector. Isolated change over contacts indicate summary alarm status.

1 x USB 2.0 Type A Jack - AUX USB, provided for connection of USB device (prepared for future use)

1 x USB 2.0, micro, 5-pin Jack - LOCAL MANAGEMENT, connect a laptop or other compatible device to control via a web browser.

1 x RJ45 Ethernet connector - unit can be connected to a LAN for remote access

LED descriptions

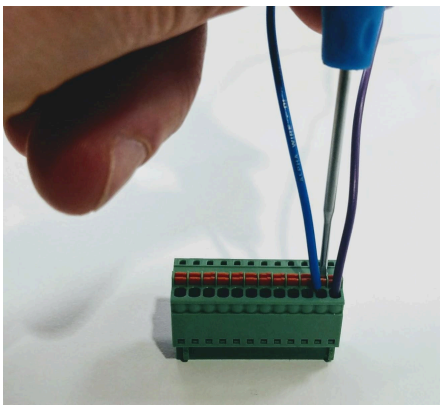
The front panel contains a number of LED indicators:

LED Text	Colour	Indication
LINK	Green	This is lit if there is a link established to the remote peer and that communication is operational over this fiber connection. Should QSFP+ Breakout be used it indicates a link established on one or more of the links.
RF	Yellow	Indicating if there is one or more RF streams running over this Should QSFP+ Breakout be used it indicates RF streams over one or more of the links. If an optical module is plugged out while this is lit it means that one or more of the remote sites will have RF affected.
POWER	Green	Constantly lit except short blink to indicate that the unit is powered up and software is operational.
FAULT	Red	This blinks if there is one or more errors in this unit. Short blink on regular intervals to indicate that LED is working.
INFO	Yellow	Prepared for future use.
LINK/LAN	Green	Indicates that there is an Ethernet connection over the LAN cable.
ACT	Yellow	Activity LED when traffic is present over the Ethernet connection.

Master External alarm relay connection

The External alarm connector is a cage type with clamping spring terminals on a 0.1” Pitch in an Orange Insulating body. The acceptable range of wire gauge is 20-28 AWG. Stranded wire is recommended.
The wire gauge and insulation should be chosen to match the Voltage/Current requirements of the External alarm circuit. The cage spring of each terminal is released by the adjacent actuating lever. It is helpful to have a fine bladed screwdriver to depress the lever for wire insertion or removal.

The connector itself can be unplugged from the unit, allowing it to do all the connections externally and then plug the connector back into the unit once all cabling is done.



External alarm input contains a series resistor of 2.2 kOhm internally to limit the current through the photodiode. For maximum ratings of the inputs, see next section.

Contact Ratings

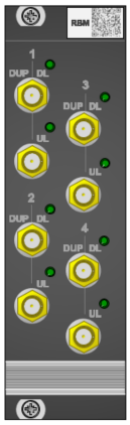
Parameter	Value
Max Switching Voltage	100 V AC/DC
Rated Current	1 A DC, 0.3 A AC
Max Switched Power	30 W, 30 VA (resistive load)
Minimum Switching Voltage	100 uV
Contact Resistance	< 100 mOhm

Contact Pinout

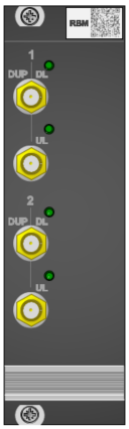
Pin	Usage
NC	External Alarm Relay Normally Closed Connected to Common when Alarm is BAD or Power OFF
C	External Alarm Relay Common
NO	External Alarm Relay Normally Open Connected to Common when Alarm is GOOD

Master Band Modules

The hot swappable master band modules provide interface between RF input / output and the digital unit. Band Module variants are available for the 700, 800, 900, 1800, 2100 and 2600 MHz cellular bands.
For a UHF Orion MRN00002 (e.g. for TETRA operation) there are UHF band modules available which may be fitted in slots 1 and 3. Slots 5-8 are used for cellular bands, and slots 2 and 4 are unavailable for use. An alarm is generated if a module is fitted in an invalid slot.



4 x BTS, Quad port Band Module



2 x BTS, Dual port Band Module

1 x BTS, Single port Band Module

Quad port modules support 4x BTS interfaces with either Duplex or separated DL and UL connections (configurable through the GUI) using two or four connectors.
Dual port modules likewise support 2x BTS connections.

Each Input/Output port is protected by a power attenuator. The Maximum RF level that can be applied at any front panel port in normal operation is +30dBm.

It is good practice to limit the total input from all sources to a maximum of +30 dBm. External attenuator values should be chosen so that heat dissipation occurs there rather than inside the band modules.

Each DL Input path is equipped with an RMS power detector covering the range -15 to +45 dBm. The detector measures the applied signal level allowing alarms to be generated for loss of power or for overdrive conditions.

A digital stepped attenuator follows the detector in each DL input path allowing equalization of different input levels before these paths are combined for processing. A similar set of digital stepped attenuators are provided in each UL path of the module. These provide individual control of level for each BTS UL Output.
When applying DL input powers greater than 0 dBm, the attenuator for the corresponding port should be adjusted accordingly in the System Elements page of the GUI.

Example:
If a DL input power of 10 dBm is applied, then attenuation of 10 dB should be selected.

Failure to set the DL attenuation in these cases may lead to an automatic level control alarm from the Orion where the gain is reduced before the digital link. Typically the UL attenuation should be set to match the DL attenuation.

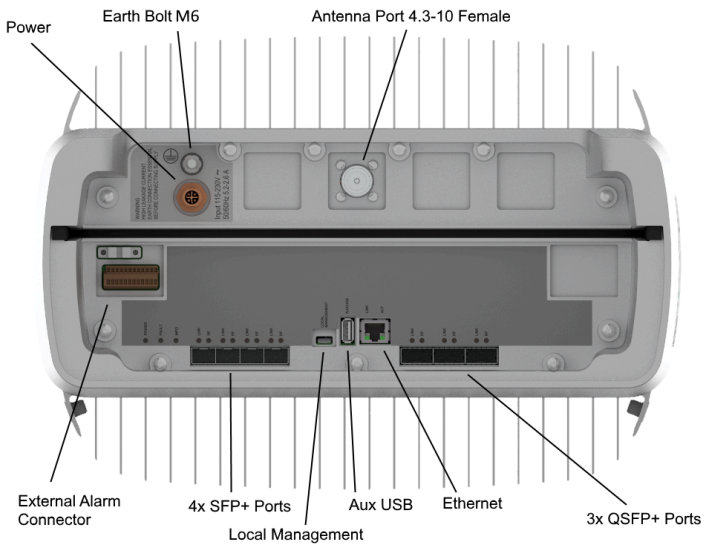
Adjacent to each BTS socket is a LED Indicator. In normal operation these are green when the path is configured and operating within the expected signal levels. In duplex configuration only the LED adjacent to the Duplex / DL port will be lit. In simplex configuration the LED below, adjacent to the UL output port, will also be lit. A four second flashing routine acts as a lamp test to show that the board is alive. A fault condition on the port is shown when the adjacent LED is

Red. If a fault is detected in the band module configuration (for example, a band module inserted into an invalid slot in a UHF Orion) then all the band module LEDS are illuminated Red.

Overview of the Stratus/Cumulus Remote and Cirrus Off-Air Master Unit

The Stratus remote unit is a high power remote (+43 dBm/Band), Cumulus remote unit is a medium power remote (+30 dBm/Band), Cirrus Off-air is a master unit constructed in a lightweight alloy chassis.
In most variants a single antenna port with 4.3-10 Female connector is fitted. All bands are combined to a single antenna port with very high rejection between bands. The unit is specifically designed for very low Passive Intermodulation (PIM).
The unit can also be provided with additional antenna connectors for specific requirements such as MIMO or separated band outputs.

Connectors and LEDs of Stratus and Cumulus Remote and Cirrus off-air Master



Connections and slots

The unit has the following connectors/slots presented on the bottom panel:

4 x	SFP+ fiber Optic Module Slots - low capacity links e.g. to nearby units
3 x	QSFP+ fiber Optic Module Slots - high capacity links e.g. to master units or a fiber ring.
1 x	12-pin External alarm connector - see later section

1 x USB 2.0 Type A Jack - AUX USB, provided for connection of USB device (prepared for future use)

1 x USB 2.0, micro, 5-pin Jack - LOCAL MANAGEMENT, connect a laptop or other compatible device to control via a web browser.

1 x RJ45 Ethernet connector - unit can be connected to a LAN for remote access

LED descriptions

The Remote Unit contains a number of different LEDs to give the user at site a clear indication of the status of the unit:

LED Text	Colour	Indication
LINK	Green	This is lit if there is a link established to the remote peer and that communication is operational over this fiber connection. Should QSFP+ Breakout be used it indicates a link has been established on one or more of the lanes.
RF	Yellow	Indicating if there is one or more RF streams running over this Should QSFP+ Breakout be used it indicates RF streams over one or more of the links. If the optical module is pulled out while this is lit it means that one or more of the remote sites will have RF affected.
POWER	Green	Constantly lit except short flash to indicate that the unit is powered up and software is operational.
FAULT	Red	This is flashing regularly if there are one or more errors in this unit. Short flash on regular intervals to indicate that the LED is working.
INFO	Yellow	Prepared for future use.
LINK/LAN	Green	Indicates that there is an Ethernet connection over the LAN cable.
ACT	Yellow	Activity LED when traffic is present over the Ethernet connection.

Access cover

The access cover covers the Opto Transceiver, LAN, USB and External Alarm Connections
To remove the access cover open the sealing lid covering the lock and unlock using the key provided. Slide the access cover down the slot to remove.