

All health and safety procedures and recommendations must be followed as detailed in the Horizon Quantum User Manual.

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Mechanical

Modem (IDU)	4.3 cm x 32 cm x 22 cm; 2.4 kg	1.7 in x 12.75 in x 8.6 in; 5.3 lbs.
Radio (without antenna)	20 cm x 20 cm x 9 cm; 3.2 kg	7.8 in x 7.8 in x 3.6 in; 7 lbs.
Antenna Wind Loading	110 kph (70 mph) Operational	200 kph (125 mph) Survival
Antenna Mount Adjustment	+/- 45° Az; +/- 22° El	
Radio Operating Temperature		
Quantum	Standard Power + Solar Shield	-40°C to + 60°C (-40°F to +140° F)
DUO	High Power + Standard Power	-40°C to + 45°C (-40°F to +113° F)
	Standard Power + Solar Shield	-40°C to + 60°C (-40°F to +140° F)
IDU Operating Temperature		0°C to + 50°C ( 0°F to +122° F)
ODU Humidity		100 % Condensing
IDU Humidity		95% Non-Condensing
Altitude		4500 m (14,760 ft)
NEB-3 Compliant		Yes
Power Input		-36 VDC to -60 VDC
Optional Adapter		110/240 VAC
Power Consumption:		
Single Channel, Single Radio		< 105 Watts
Dual Channel, Single Radio		< 126 Watts
Dual Channel, Dual Radio		< 172 Watts

Power

Horizon Quantum requires a 48VDC power supply.

A 100-240VAC / 47-63 Hz to 48VDC power supply is available as an option from DragonWave.

Customers may use their own +/-48VDC supplies.

Mounting Structures

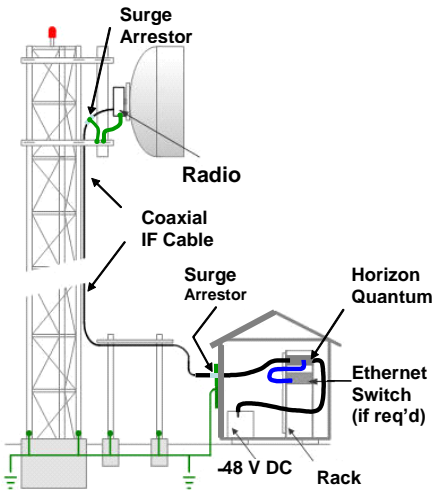
Minimum 2 3/8" OD thick-wall (Sched. 80):  
galvanized mast for 30 and 60 cm antennas

Minimum 3" OD thick-wall (Sched. 80)  
galvanized mast for 90 and 120 cm antennas

Minimum 4" OD thick-wall (Sched. 80)  
galvanized mast for 180 cm and larger antennas

Twist and Sway

Maximum allowed twist of structure or mount should be ½ of the antenna beamwidth. Generally < 1° degree for 30 and 60 cm antennas, and <½° degree for 120 cm and larger antennas. Maximum allowed sway should be no more than 1/10th of beam size at target.



Features

Capacity w/Accelerator	Variable from 10 to 2000 Mbps full duplex CIR
	2.5x capacity up to 4 Gbps with DPRM
Base Capacity	Variable from 10 to 800 Mbps full duplex CIR
	2x capacity up to 1.6 Gbps with DPRM
Interface	6X1000/100/10 BaseT + 2 SFP Ports
Latency GigE	< 200µs, Typical 120µs GigE
Packet Size	64 to 9600 Bytes
Flow Control	Yes
Prioritization	8 levels served by 4 queues, based on 802.1p/q, MPLS, DSCP ToS Bits
Modulation Shifting	Yes, Hitless
Loopback	Yes, IF [Network], Modem [Network]
XPIC	Yes, enables Co-Channel Cross Polarization
Synchronization	SynchE ready

System Capacity

Horizon Quantum throughput can reach 1.6 Gbps (over the air bandwidth), depending upon hardware and configuration:

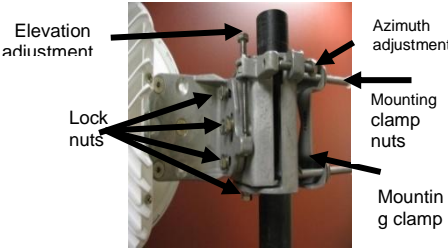
- One IF connector: (includes IF combiner)
  - 400 Mbps using 1 radio channel
  - 800 Mbps using 2 radio channels
- Two IF connectors (no IF combiner)
  - 400 Mbps using 1 radio channel and 1 radio
  - 800 Mbps using 1 radio channel on each of 2 radios (2 channels total)
- Two radio channels on each of two Horizon Quantum units results in 1600 Mbps, when using aggregation protocols or technology.

**Note:** Horizon Quantum has a compression ratio of up to 2.5:1 across a link. Therefore, with compressible data, Horizon Quantum throughput can reach 4 Gbps, depending upon hardware and configuration.

Antenna Alignment

Perform rough alignment by eye, aligning the center line of the mounting bracket to the far end.

Tighten down the mounting bracket. Loosen the Lock Nuts for only one alignment direction at a time. (ex. If performing azimuth alignment, loosen only the Azimuth Lock Nuts.) This prevents unexpected movements of the antenna. During both azimuth and elevation adjustments it should be possible to identify the main lobe, along with one or more side lobes per side. Perform a check for the side lobes (by panning) to ensure the main lobe has been identified and aligned to.



Enable Alignment:

**-set alignment [on | off] [wireless\_port1 | wireless\_port2] -tsecs**  
sets the antenna alignment mode On or Off for -t seconds (default is 7200 = 2 Hours).

Loosen the antenna mount fine azimuth and elevation adjustment lock nuts.

Connect a voltmeter to the field strength monitoring port (BNC) and adjust the fine azimuth and elevation adjustments for a maximum signal.

Identify all side lobes plus the main lobe. Ensure that you are aimed at the main signal lobe.

**The final received signal strength (RSL) should be within ±3 dB of the link budget figure.**

Once alignment is achieved, tighten the lock nuts on the adjustment mechanisms.

Alignment Adjustment Sensitivity

When performing fine alignment adjustments it is important to **rotate the adjustment nuts 1/10th of a turn at a time between taking RSL readings.**

The beam width of a Horizon Compact system is no greater than 2 degrees. **One complete turn of a fine adjustment nut moves the system through more than 1 degree.** One complete turn can, therefore, move right through the peak signal position.

Available Configurations

Single modem/Single radio                      Dual modem/Dual Radio  
Dual modem/Single radio                      Modem redundancy

**Note:** 2 radio licenses are required for 2 channels or 2 radio configurations.  
Adjacent channel configurations are supported.

Network Management (NMS)

Alarm Management	SNMP Traps, Enterprise MIB
NMS Compatibility	Any SNMP based network manager, SNMP v1, v2 and v3
Security	3 Level Authentication, SSH, HTTPS
EMS	Embedded web server, CLI (telnet/serial), SSL HTTP, SSH, Radius

Cables and Installation

IF cables from Horizon Quantum modem to radio are 50 Ohm coaxial. Times Microwave LMR-400/600/900 (and equivalents) can be ordered from DWI or vendors in 30, 60 and 90 meter lengths. Grounding cables for radio chassis and DWI supplied surge arrestors: 6 AWG stranded bare copper

Maximum Allowable Loss

Quantum IDU Configuration	Transmit Cable Loss Budget (dB)	Receive Cable Loss Budget (dB)
Single Modem with Combiner	14	23
Dual Modem with Combiner	14	20
Dual Modem no combiner	18	24

Transmit IF Frequency (Tx IF) = 400-700 MHz      Receive IF Frequency (Rx IF) = 1600-1900 MHz

DragonWave has determined that the DWI supplied patch cables (one 6' and one 15') plus two surge arrestors add approximately 1.1 dB of extra loss @ 700 MHz, and 2.0 dB of extra loss @ 2000 MHz

Cable Type (Times Microwave)	Outer Diameter	Single Modem, Single IF (23dB)	Dual Modem, Single IF (20dB) (with combiner)	Dual Modem, Dual IF (24dB) (no combiner)
LMR-400	3/8"	351'	301'	367'
LMR-600	9/16"	539'	462'	564'
LMR-900	7/8"	797'	683'	835'

Configuration

- Logging In – Serial Port, Telnet, Web Interface**
- Default IP address: 192.168.10.100      Default subnet is: 255.255.0.0**
- Super User Default Username: **energetic**, default password: **wireless**
- Serial port speed: 19200 baud, 8 data bits, no stop bits, 1 parity, no flow control (19200 N81)
- Default management is via Ethernet Port 3 (out of band)
- Configure your pc with an IP address in the same subnet.

Command Line Interface (CLI) Overview: Serial Port or Telnet to system IP address

- CLI uses GET and SET commands or config wizards with interactive question/answer.
- Full context sensitive help is available for all CLI commands. Type '?' followed by a partial command.
  - For example **'? statistics'** will provide all commands with the word *'statistics'*.
- Pressing the TAB key after entering a partial command will complete the command if unique.
- Up and down (↑ and ↓) arrow keys will recall previous CLI entries.
- Unrecognized CLI commands will receive a NAK response.
- Issue **'save mib'** command to save the new settings to flash memory. Some changes require the system to be reset to implement the new settings. (**'reset system'** CLI command)

Web Interface (GUI) (must be enabled)

Enter the target system's IP address into web browser (Example: <http://192.168.10.100>)

Firmware Upgrades

**Note:** You must commit the software bank prior to loading any software.

**-commit**  
**-copy ftp:[filename]** filename must remain unchanged [in a proper format]  
ie, frequencyFileHzQtm\_1.00.00.txt

**Warning:** Your software bank [active or not] contains your mib (configuration). Failure to commit prior to swapping banks may result in an older or unknown configuration being applied to your system.

Configuration Steps

Radio Band & System Mode is applied to both modems

Each modem supports its own frequency/channel and Tx Power (dual radio only)

**NOTE:** Switch ports must be properly configured in order to pass VLAN tagged traffic.  
By default all ports are considered access Ports and will only allow untagged or VLAN ID 1. (see configuration Step 10)

- Configure the system capacity (Web: Basic Configuration page)
  - get system capacity**
  - set system capacity <index>** (setting single/dual modem or radio, or redundancy)

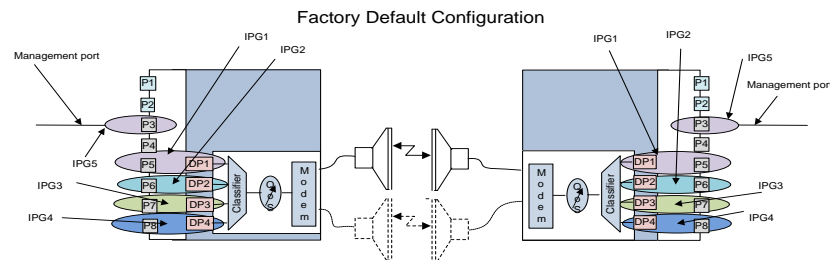


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**Note:** For system capacities with 'Dual Wireless Ports'; a license key is required.  
To check if the unit is shipped with the license key, '**get licensed feature groups**'.  
See Index 5.

If the unit is not licensed for 'Dual Wireless Ports':  
Please contact [support@dragonwaveinc.com](mailto:support@dragonwaveinc.com) or +1 (613) 271-7010.

- Configure the Radio Band. (Web: Basic and Port Configuration page)  
**-set radio band <radio band>**  
**Example: set radio band fcc11\_a\_30** (11GHz B1 30MHz Channels – DUO/AP Radio)  
**Example: set radio band fcc23\_2\_50\_R5** (23GHz B2 50MHz Channels – Quantum Radio)
- Configure the System Mode. (Web: Basic Configuration page)  
**-set system mode <system mode>** (used for setting speed and modulation)  
**Example: set system mode hz30\_212\_256qam** (212 Mbps at 256QAM modulation)
- Configure the frequency bank. (Web: Basic Configuration page)  
**-set frequency bank <txhigh/txlow>**
- Review available frequency pairs and indexes. (Web: Basic Configuration page)  
**-get frequency bank**
- Program transmit and receive frequency by index. (Web: Basic Configuration page)  
**-set programmed frequency <index>**  
**-set programmed frequency <index> wireless\_port2** (for dual modem)
- Configure the IP address, subnet mask and default gateway. (Web: Basic Configuration page)  
**Note:** Selecting yes after either of these commands will apply the settings immediately.  
**-set ip address <xxx.xxx.xxx.xxx>**  
**-set subnet mask <xxx.xxx.xxx.xxx>**  
**-set default gateway <xxx.xxx.xxx.xxx>**  
**Note:** The user can select any user ports (P1 to P8) and data paths (DP1 to DP4) to manage the system.
- Configure the network management interface. (Web: Basic Configuration page)  
**set network management interface** (interactive wizard)  
By default the management interface is p3.  
**Note:** By assigning the management ports as the ports belonging to an IPG the management traffic can be isolated from other user traffic. (Out Of Band Management)
- Configure Isolated Port Groups.  
IPGs are used to interconnect multiple isolated networks by creating multiple switching domains.  
**-set ipg config <group name><enable|disable><port list>**  
**Example:**  
**In Band: -set ipg config ipg5 enable p3,dp1**  
(enable ipg5 to correspond with port3 and dp1)  
**Out of Band: -set ipg config ipg5 enable p3**  
(enable ipg5 to correspond with port3)  
ipg = isolated port group (1-5) dp = data path (1-4).



**Note:** It is suggested both link ends are configured the same.  
To default IPGs back to default each IPG must be reprogrammed.  
**-set ipg config ipg5 enable p3**  
**-set ipg config ipg1 enable p5, dp1**  
**-set ipg config ipg2 enable p6, dp2**  
**-set ipg config ipg3 enable p7, dp3**  
**-set ipg config ipg4 enable p8, dp4**

- Switch Port VLAN Configuration – Use this command to define Ethernet ports as either Trunk or Access.  
A **Trunk** port will accept any packet with a VLAN identifier within a specified and configurable range of values from 1 to 4094. Trunk ports will drop untagged packets, or those that are outside of their configured VLAN, or trunk range.  
An **Access** port may only accept untagged packets, and those with the configured access VLAN identifier. Packets leaving an access port will be untagged.  
**-set vlan config** (interactive wizard)
- Save configuration and reset the system to implement the changes. (Web: Save and Reset)  
**-save mib**  
**-reset system**
- Reconnect to system and set transmit power. (Web: Basic Configuration page)  
**-set transmit power <x>**  
**-set transmit power <x> wireless\_port2** (for dual radio only)
- Save the transmit power changes to flash memory. (Web: Save Settings and Reset System)  
**-save mib**

## Firmware Upgrades

**Note:** You must commit the software bank prior to loading any software.  
**-commit**  
**-copy ftp:[filename]** filename must remain unchanged [in a proper format]  
ie, frequencyFileQTM.txt  
**Warning:** Your software bank [active or not] contains your mib (configuration). Failure to commit prior to swapping banks may result in an older or unknown configuration being applied to your system.

**Advanced Configuration Parameters** (see Horizon Quantum user manuals)

Radius Server User Authentication	Threshold Alarms
VLAN Tagging	Rapid Link Shutdown (RLS)
802.1P Priority Tagging	Timing Protocol (SNTP)
Horizon Throughput Speed	Radio Redundancy
Adaptive Transmit Power Control (ATPC)	Hitless Automatic Adaptive Modulation (HAAM)
Bandwidth Acceleration	On Board Network Switch
Bandwidth Throughput Management	Horizon Quantum Redundancy
Ethernet Connectivity Fault Management	
Horizon Quantum Authentication (applies to single radio/ single modem configuration)	

## Bandwidth Doubling

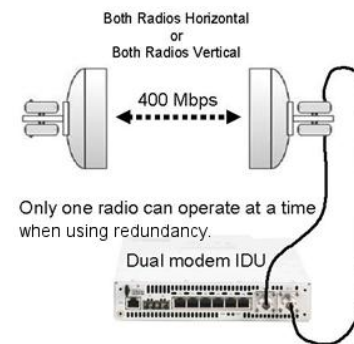
The Dual Polarity Radio Mount (DPRM) allows two Horizon Quantum units to mount onto a single antenna, providing bandwidth doubling capabilities. One Horizon Quantum is horizontally polarized and the second is vertically polarized.  
For bandwidth doubling, each Horizon Quantum is fed up to 800 Mbps (2 modem cards) X compression ratio (2.5 for example) = 2 Gbps from the network switch, enabling the wireless link to carry up to 4 Gbps, full duplex, of user traffic.

## Redundancy

Redundancy capability is achieved with Horizon Quantum Dual Modem variant connected to two radios. This functionality is intended for use with a PSRM (coupler) connecting two radios to a single antenna with common polarization. Alternatively, it could be used with two radios connected to two antennas with common polarization. This functionality will not work for links which are cross-polarized.  
Configure the system capacity (Web: Basic Configuration page)  
**-set system capacity 4** (Configure the redundancy)  
**-set redundancy installation rdrm\_single\_modem**  
(where only one radio is transmitting)  
**-set switching algorithm < manual/algorithm based>**

- for algorithm based method, switching will occur automatically when a detectable problem occurs if the mate has no detectable problems.
- for manual, no switching will occur except when we initiate a **switch radio (web/cli)**

**-set redundancy primary wireless port <wireless\_port1 / wireless-port2>**  
(Web: Radio Redundancy Configuration page)



## Indications of a Properly Operating Link

**- get alarms** No alarms  
**- get modem statistics and get modem statistics wireless\_port2**  
RSL within ±3 dB of link budget figure Eb/No ≥ 21 dB  
Signal to Noise Ratio (SNR) ≥29 dB Equalizer Stress typically 20-100 , but < 150

**- get traffic statistics** RX Block Errors (WP1/WP2) not increasing.  
**- get health** All sections operational

## Troubleshooting: 1<sup>st</sup> step: run Merlin diagnostics

**Alarms:** Check alarms. No alarms should be present.  
Modem Receiver Loss of Signal = no signal being received from the far end.  
Radio Mismatch = incorrect radio band/type configured,  
TxH / TxL reversed, or SP/HP system mode incorrect  
Ethernet Link Down = no connectivity on Ethernet link  
Modem Hardware Fault = replace Horizon Quantum IDU unit  
Radio Power Amp = replace Quantum/DUO radio unit  
Synthesizer Unlock = replace Quantum/DUO radio unit if alarm is persistent.

### RSL Issues:

**Mismatched RSL between endpoints**

- one endpoint at target RSL, other endpoint low RSL: use RF loopback feature to determine if Transmitter at one end, or Receiver at other end is at fault.

**Low RSL both endpoints**

- Verify clear LOS exists / Verify alignment / Verify Transmit power at both ends
- Link fade? Polarization is the same at both ends?

### Poor RF Signal Quality:

- See parameters in "Indications of a Properly Operating Link"

### Packet Loss, Poor Throughput, Loss of IP Connectivity:

- check RF signal quality
- check for mismatched modulation between endpoints
- check Ethernet switch traffic statistics at both ends of the link
- verify Ethernet speed and duplex settings
- check integrity of Ethernet cables
- check COS/QOS settings

### IP Address Recovery, Super User Name Reset & Serial Number Retrieval

- PC connection to Horizon Ethernet cable using DragonWave Merlin application software
- Contact DragonWave Technical Support

## Channel BW, Modulation, RF Sensitivity and Throughput

Typical Guaranteed values. (23GHz, 18GHz, 11GHz) See individual product sheets.

Channel Bandwidth	Modulation Schemes	Rx Sensitivity	Single Channel/Dual Channel		
			Base Throughput	Throughput with Accelerator	Tx Power
56 MHz	QPSK / 32QAM / 256QAM	-80/-70/-59	65/216/385 130/432/770	Up to 150/550/1000 Up to 300/1100/2000	27/21/19.5 23/17/15.5
50 MHZ	QPSK / 64QAM / 256QAM	-81/-68/-59	67/215/364 134/430/728	Up to 150/550/1000 Up to 300/1100/2000	27/22.5/19.5 23/18.5/15.5
40 MHz	QPSK / 64QAM / 256QAM	-81/-69/-60	57/181/277 114/362/554	Up to 140/450/700 Up to 280/900/1400	27/20.5/19.5 23/16.5/15.5
30 MHZ	32QAM / 128QAM / 256QAM	-75/-65/-62	107/165/212 214/330/424	Up to 250/400/550 Up to 500/800/1100	23/20/19.5 19/16/15.5
28 MHZ	QPSK / 32QAM / 256QAM	-84/-75/-64	48/100/190 96/200/380	Up to 120/250/500 Up to 240/500/1000	23.5/21/19.5 19.5/17/15.5
14 MHz	QPSK / 32QAM / 256QAM	-87/-80/-68	23/47/95 46/94/190	Up to 60/120/250 Up to 120/240/500	23.5/23/19.5 19.5/19/15.5
7 MHz	QPSK / 64QAM / 128QAM	-88/-78/-74	11/33/39 22/66/78	Up to 30/80/100 Up to 60/160/200	27/20.5/20 23/16.5/16