EX-i Series GigE 5/6 GHz

Dual-Band 5.8 & 6 GHz Gigabit Ethernet/TDM Microwave Radio System

The dual-band EX-i Series GigE long-haul microwave radios are carrier-class, high capacity, high power systems that can operate in either the Lower 6 GHz band or in the license-exempt 5.8 GHz band, providing an exceptional degree of deployment flexibility. These fully software configurable systems feature 3xGbE, 4-16xT1/E1 and 1xDS3 interfaces in a single, low profile unit. The dual-band systems offer native support for any combination of TDM and Ethernet traffic, making them ideal candidates for the rapid deployment of reliable, efficient transport of high capacity voice and packet traffic for any application, including mobile backhaul for HSPA and LTE networks.

Field-installable diplexers for single unit sparing and rapid band transition. The dual-band EX-i GigE Series systems feature compact field-installable diplexer modules that can be swapped in minutes and that enable the use of a single band-independent spare. In one common scenario, systems are installed using 5.8 GHz diplexers on 6 GHz Lower band transmission infrastructure to commission the link. Once licenses have been coordinated, the link can be migrated to the 6 GHz lower band for long-term operation.

Ultra-high system gain for greater range and smaller antennas. The dual-band EX-i Series GigE systems feature transmit power as high as +33 dBm, delivering best-in-class range of more than 40 miles at maximum capacity and providing network operators with the option of reducing recurring lease costs through use of smaller antennas.

Semi-protected 1.5+0 operation for cost effective hardware redundancy. Exalt's unique 1.5+0 configuration maximizes equipment reliability without the expense of traditional 1+1. A single terminal provides transmit fail-safe switching and redundant receivers, ensuring that the loss of either component will not lead to the loss of the link. The second receiver can also be used for optional space diversity operation without the need for second radio unit.

All-native transport for uncompromised TDM and packet performance. Like all Exalt radio systems, the EX-i Series GigE dual-band radios deliver true carrier-class capability with native TDM and native Ethernet. That means rock-solid TDM performance regardless of IP traffic behavior and a future-proof migration path from TDM backhaul to the packet backhaul required of LTE, WiMAX and other all-IP private and access networks.

Ethernet capacity aggregation for expandable long-haul capacity. The dual-band EX-i Series GigE systems include Exalt's unique Layer 1 / Layer 2 Ethernet capacity aggregation, a feature that allows traffic from up to four links of any combination of frequencies to be aggregated over a single GbE port while simultaneously providing load balancing across all links.

Adaptive modulation (ACM) for higher throughput, lower site lease costs. The EX-i Series GigE dual-band systems offer configurable adaptive modulation operating across any range between QPSK to 256QAM. Network planners can design links for 99.9% or 99.99% operation at 256QAM with the security of knowing that the system will back off to a lower throughput level and 99.999% availability when conditions necessitate. Through use of adaptive modulation, network planners can also increase the distance between sites or reduce antenna sizes to minimize capital and ongoing operating costs.

Layer 2 switching for data networking flexibility. Featuring powerful Layer 2 switching functionality, the dual-band EX-i Series GigE systems support 802.1q VLAN and 802.1p QoS along with Ethernet rate limiting and jumbo packet support suitable for transporting MPLS traffic.

High security for user data protection. The EX-i Series GigE systems allow network managers to support the most stringent security requirements, with optional FIPS 197-compliant AES 128-bit and 256-bit encryption for data traffic protection and support for both encrypted SNMP v3 and SSL/SSH to ensure the integrity of management traffic.

Built-in spectrum analysis for troubleshooting and ease of deployment. To better address potential interference in the 5.8 GHz band, the dual-band EX-i Series GigE systems include a spectrum analyzer that allows a technician to scan the spectrum and assess the likelihood of interference prior to deployment. Proper selection of diplexer then allows the radio to be tuned to the clearest part of the band.

Specifications		5.8 GHz	6 GHz Lower
Maximum Capacity	TDM	1xDS3 + 16xT1/E1	
	Ethernet (Full-Duplex)	187 Mbps	187 Mbps
Frequency (GHz)		5.725–5.850	5.925–6.425

Specifications — EX-i Series GigE 5/6 GHz

System		
Indoor Unit (IDU) Models[1]	1xDS3 + 16xT1/E1 + 3xGbE	
IDU Model Types	Non-protected 1+0 terminal Semi-protected 1.5+0 terminal	
Power Control Step Size	0.5 dB	
Maximum RSL QPSK–64QAM	-30 dBm error-free	
128–256QAM	-32 dBm error-free	
Error Floor	10^{-12}	
Power Control Range	20 dB	
ATPC	Yes	
Adaptive Modulation	QPSK–256QAM; Selectable, fully configurable with prioritization	
TDM Latency	250µs typical	
Ethernet Latency	40–125µs (<100µs typical) at full throughput (GigE) with AES encryption enabled	
Data Security	NIST FIPS 197-compliant 128-bit AES and 256-bit AES[2]	
Link Security	96-bit security key	
Transmit Protection (1.5+0 terminal only, 256QAM)	5.8 GHz Transmit fail-safe switching to +24.5 dBm	6 GHz Transmit fail-safe switching to +26 dBm
Receive Protection[2] **(1.5+0 terminal only)**	Dual receiver configurations XPIC or space diversity via second diplexer Receiver protection via single diplexer and receiver protection kit	
Path Protection (1.5+0 terminal only)	Space diversity with errorless switching Space diversity with linear combining (3 dB system gain improvement)	
Interference Cancellation	Spatial or polarization (XPIC) interference cancellation (1.5+0 terminal only)	
5 GHz to 6 GHz Migration	5.8 GHz to 6 GHz Lower with external, field installable diplexer change and license key upgrade	
Equipment Configurations	1+0, 1+1 1.5+0, 1.5+0 SD 1.5+0 with Rx protection 1.5+1, 1.5+1 SD 1.5+1.5, 1.5+1.5 SD, 1.5+1.5 XPIC	
T1/E1 Cross-connect	Built-in, software controlled T1/E1 port cross-connection between endpoints	
T1/E1 Prioritization	User configurable	
Spectrum Analyzer[3]	Embedded	
Installation and Management Manual	Embedded in radio, accessible via HTTP GUI	
Management	In-band and out-of-band management	
Security	SSL[3]/SSH and secure, encrypted SNMPv3	
Web GUI	HTTP, HTTPS[3] (Internet Explorer, Firefox, Safari, Chrome)	
CLI	Telnet, SSH via Ethernet	
SNMP	v1, v2c, and secure v3	
MIB	MIB I, MIB II, Exalt MIB	
XML	XML configuration file	
Compliance		
	SNMP v1, v2c, v3 FCC Part 101; IC SRSP-305.9 Part 15.247, IC RSS-210 UL 60950-1 IEEE 1613	

Physical			
IDU Dimensions (H x W x D)	2RU 3.5 x 17 x 16.5 in / 9 x 43.2 x 42 cm including external diplexer		
IDU Weight	17 lbs / 8 kg		
Full Specification Temperature	0 to +50 ºC / 32 to +122 ºF		
Operating Temperature	-25 to +50 ºC / -13 to +122 ºF		
Altitude	15,000 ft / 4.6 km		
Humidity	95% non-condensing		
Interfaces			
Antenna	SMA Female, impedance 50 ohm		
RF Diplexers	Field-installable. Single reversible diplexer for high or low band operation.		
5.8 GHz	T/R 62 MHz Band 1 ID#141 5726-5756 MHz / ID#142 5788-5818 MHz Band 2 ID#143 5741-5771 MHz / ID#144 5803-5833 MHz Band 3 ID#145 5757-5787 MHz / ID#146 5819-5849 MHz		
6 GHz	T/R 252.04MHz Band 1 ID#101 5925-6032 MHz / ID#102 6177-6284 MHz Band 2 ID#103 5997-6104 MHz / ID#104 6249-6356 MHz Band 3 ID#105 6069-6176 MHz / ID#106 6321-6428 MHz		
TDM (Native)	DS3	T1	E1
Connector	2 x BNC Female (1xDS3)	RJ48C/RJ45 Female (16)	
Impedance	75 ohms, unbalanced	100 ohms, balanced	120 ohms, balanced
Line Code	B3ZS	AMI, B8ZS, selectable per channel	HDB3
Clocking Speed	44.736 MHz	1.544 MHz	2.048 MHz
Compliance	ANSI T1.102-1993; GR-499-CORE	ANSI T1.102-1987; GR-499-CORE	CEPT-1; G.703; ITU-T-G.703; G.823
Loopback Modes	Remote Internal; Remote External; Local Line		
Ethernet (native)	RJ45 Female (x2), auto-MDIX	SFP (x1)	
Interface Speed	10/100/1000BaseT	1000BaseT/X	
Duplex	Half, Full, Auto	Full	
Compliance	802.3	802.3	
Maximum Packet Size	9728 bytes	9728 bytes	
VLAN	802.1q, transparent, trunk, and management only; over 4,000 VLAN IDs		
QoS[3]	8 priority levels, 8 queues 802.1p, 802.1q (VLAN ID), Source MAC address, Destination MAC address		
Ethernet Rate Limiting	Configurable per port via software		
Protection Port	1x RJ48C/RJ45, proprietary control		
Console (Serial)	9-pin Sub-D (F)		
Speed	9600 bps		
Compliance	EIA-574 (RS-232)		
Alarm	9-pin Sub-D (F) Inputs (2) TTL/Closure Outputs (2) Relay (Form C)		
DC Power	Dual 3-pin barrier strip for power source redundancy		
Input Voltage	±20–60 VDC		
Consumption	<160 W (48 V, <4 A, 24 V,<8 A) 30/33 dBm operation		
Emission Designators			
	5 MHz	5M00W7D	
	10 MHz	10M0W7D	
	20 MHz	20M0W7D	
	30 MHz	30M0W7D	
Warranty	Two years[4]		

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Specifications EX-i Series GigE 5/6 GHz

Frequency Bands		5 GHz	6 GHz Lower
Frequency Range (GHz)		5.725–5.850	5.925–6.425
TR Spacing (MHz)		62	252.04
Channel Bandwidth (MHz)	QPSK-256QAM	5, 10, 30	5, 10, 30
Output Power (dBm)		30	30 / 33[2]

Throughput (Mbps full-duplex) (Max system layer 1/Max Ethernet layer 2)[5]

	QPSK	16QAM	32QAM	64QAM	128QAM	256QAM
5 MHz	8 / 6	17 / 14	23 / 19	28 / 23	33 / 26	38 / 30
10 MHz	17 / 14	35 / 29	48 / 38	57 / 46	66 / 53	76 / 61
20 MHz	37 / 30	77 / 61	97 / 78	116 / 92	133 / 107	152 / 123
30 MHz	55 / 45	113 / 92	142 / 116	172 / 138	201 / 162	229 / 185

Receiver threshold (5/6 GHz in dBm) (guaranteed over temperature BER 10^{-6})[6]

		Single Receiver	SD with Linear Combining
QPSK	5 MHz	-90 / -91.5	-93 / -94.5
	10 MHz	-87 / -88.5	-90 / -91.5
	30 MHz	-82.5 / -84	-85.5 / -87
16 QAM	5 MHz	-83.5 / -85	-86.5 / -88
	10 MHz	-80.5 / -82	-83.5 / -85
	30 MHz	-76 / -77.5	-79 / -80.5
32 QAM	5 MHz	-80.5 / -82	-83.5 / -85
	10 MHz	-77.5 / -79	-80.5 / -82
	30 MHz	-73 / -74.5	-76 / -77.5
64 QAM	5 MHz	-77.5 / -79	-80.5 / -82
	10 MHz	-74.5 / -76	-77.5 / -79
	30 MHz	-70 / -71.5	-73 / -74.5
128 QAM	5 MHz	-74.5 / -76	-77.5 / -79
	10 MHz	-72 / -73.5	-75 / -76.5
	30 MHz	-67 / -68.5	-70 / -71.5
256 QAM	5 MHz	-71 / -72.5	-74 / -75.5
	10 MHz	-68.5 / -70	-71.5 / -73
	30 MHz	-63.5 / -65	-66.5 / -68

Maximum System Capacity (TDM:DS3+T1 or E1)

QPSK / 16QAM	5 MHz	0xDS3 + 3xT1 or 2xE1 / 0xDS3 + 8xT1 or 5xE1
	10 MHz	0xDS3 + 8xT1 or 5xE1 / 0xDS3 + 16xT1 or 14xE1
	30 MHz	0xDS3 + 16xT1 or 16xE1 / 1xDS3 + 16xT1 or 16xE1
32QAM / 64QAM	5 MHz	0xDS3 + 11xT1 or 8xE1 / 0xDS3 + 14xT1 or 11xE1
	10 MHz	0xDS3 + 16xT1 or 16xE1 / 1xDS3 + 1xT1 or 0xE1
	30 MHz	1xDS3 + 16xT1 or 16xE1 /1xDS3 + 16xT1/E1
128QAM / 256QAM	5 MHz	0xDS3 + 16xT1 or 13xE1 / 0xDS3 + 16xT1 or 14xE1
	10 MHz	1xDS3 + 6xT1 or 4xE1 / 1xDS3 + 11xT1 or 8xE1
	30 MHz	1xDS3 + 16xT1 or 16xE1 / 1xDS3 + 16xT1 or 16xE1

1. Consult your Exalt sales representative for availability of specific models and configurations, including models with 4xDS3 and 1xOC3 interfaces not shown. Please refer to the Exalt EX-i Series GigE data sheet for additional 6 and 11 GHz models.
2. Software license key option.
3. Software upgrade required.
4. Terms and conditions apply. Consult your Exalt sales representative for details.
5. Maximum Layer 1 throughput as measured with 64-byte packets and maximum Layer 2 Ethernet measured with 1522-byte packets. In both cases throughput includes source address, destination address and CRC overhead.
6. ±1 dBm over temperature.

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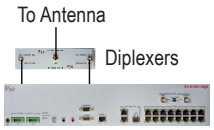
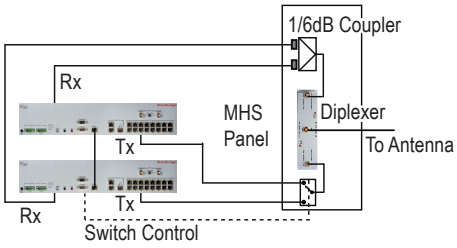
EX-i Series GigE 5/6 GHz Terminal Configurations



Non-protected 1+0 or Semi-protected 1.5+0

- Quick and simple installation
- Unique sparing with field installable diplexers
- 2RU design

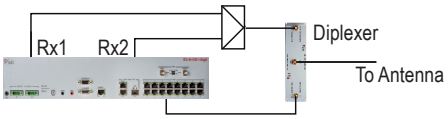


Protected 1+1

- Low loss design 1 RU protection panel
- Full equipment protection
- Single diplexer configuration
- Unique sparing with field installable diplexers
- 5RU design

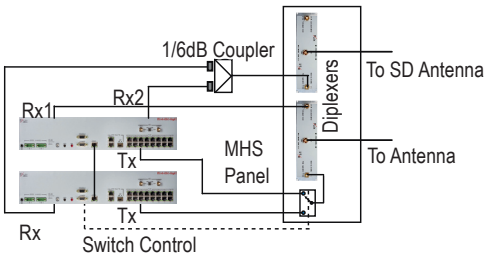
Semi-protected 1.5+0 with Space Diversity

- Built-in transmit protection
- Built-in dual receiver for SD
- Unique sparing with field installable diplexers
- 2RU design



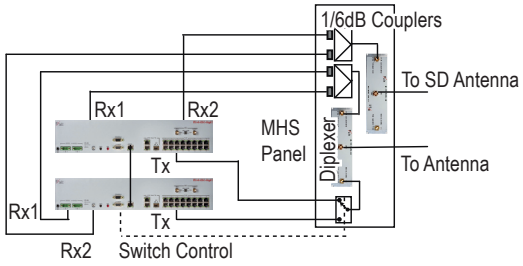
Semi-protected 1.5+0 with Receiver Protection

- Built-in transmit protection
- Receiver protection using built-in dual receiver
- Single diplexer configuration
- Unique sparing with field installable diplexers
- 2RU design



Protected 1.5+1 with Space Diversity

- Built-in transmit protection on primary terminal
- Built-in dual receiver on primary terminal for SD
- Low loss design 1RU protection panel
- 1xDS3, 16xT1/E1 and GigE protection
- 5 RU design



Protected 1.5+1.5, 1.5+1.5 XPIC and 1.5+1.5 SD

- Built-in transmit protection per terminal
- Built-in dual receiver per terminal
- Fully redundant SD protection configuration
- Low loss design 1RU protection panel
- Non-protected or protected space-diversity
- 1-4xDS3, 16xT1/E1 and GigE protection
- 5RU protection design
- 4RU XPIC design

Diagrams are for illustration purposes only. Not all configurations are available for all terminal types. Consult your Exalt sales representative for detailed bills of material for the desired configuration.

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