# EX-s Series GigE FCC

## Split-Mount, Carrier-Class, Upgradeable Licensed-Band Systems for Medium and High Capacity TDM and Ethernet Backhaul Applications

The EX-s Series GigE split-mount microwave radios are carrier-class, point-to-point systems for the entire 6 to 40 GHz licensed spectrum. Featuring native TDM and native Gigabit Ethernet transport with up to 370 Mbps full-duplex capacity per radio carrier, EX-s Series GigE systems are available with software configurable PDH or SDH/SONET interfaces up to 2xOC-3 and up to 4x10/100/1000 BaseT ports available in the same 1RU IDU. The EX-s Series GigE systems are designed to support any mix of TDM and IP/Ethernet traffic, allowing risk-free network migration for both private and operator networks, including 3G to LTE evolution.

**The Native Difference.** The EX-s GigE systems deliver true carrier-class capability, made possible by running TDM and Ethernet natively. That means rock-solid TDM performance regardless of IP traffic behavior. It also means that when T1/E1 ports are added, TDM throughput is traded bit-for-bit for Ethernet throughput and vice versa, so there's never a question about available user throughput for either transport.

**Adaptive Modulation.** Exalt's adaptive modulation technology is both errorless and jitterless and allows links to simultaneously support different availability levels for TDM and Ethernet. This optimizes range and performance for the most sensitive TDM traffic while ensuring high performance for inherently resilient Ethernet traffic. Links can be engineered for longer distances and Ethernet transport will respond elastically to changing link conditions without affecting TDM availability.

**Capacity Aggregation.** The EX-s GigE radios can aggregate capacity across multiple licensed and license-exempt microwave links to deliver a single, high speed connection of up to 1 Gbps full-duplex across a single Gigabit Ethernet interface.

**Advanced Data Networking.** The EX-s GigE radios offer a rich set of advanced data networking features, including a built-in Gigabit Ethernet layer 2 switch with 802.1q VLAN (single and double tag) up to 4094 VLAN IDs, plus multi-level QoS featuring 8 priority levels and 8 individual queues. Traffic can be prioritized based on 802.1p tags, VLAN ID, MAC source address or MAC destination address as required.

**High Security.** The EX-s 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 encrypted SNMP v3 to ensure management security.

| **Primary Specifications** | | 6 GHz Lower | 6 GHz Upper | 11 GHz | 15 GHz | 18 GHz | 23 GHz | 28 GHz | 38 GHz |
|---|---|---|---|---|---|---|---|---|---|
| Maximum Capacity | TDM | 1xDS3, 4xDS3, 1-2xOC3, 16xT1/E1, 8xT1/E1, and 4xT1/E1 in various configurations | | | | | | | |
| | Ethernet | 187 Mbps | 187 Mbps | 252 Mbps | 371 Mbps | 315 Mbps | 315 Mbps | 365 Mbps | 315 Mbps |
| Frequency (GHz) | | 5.925–6.425 | 6.525–6.875 | 10.700–11.700 | 14.500–15.350 | 17.700–19.700 | 21.200–23.610 | 27.500–28.350 | 38.600–40.000 |

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| System | |
|---|---|
| **IDU Models**[1] | |
| **1000F/E** | 4xGbE (-48 VDC) |
| **8-1000F/E** | 8xT1/E1 + 4xGbE (-48 VDC) |
| **DS3/8-1000F/E** | 1xDS3 + 8xT1/E1 + 4xGbE (-48 VDC) |
| **DS3/16-1000F/E** | 1xDS3 + 16xT1/E1 + 4xGbE (±20 to 60 VDC) |
| **4DS3/4-1000F/E** | 4xDS3 + 4xT1/E1 + 4xGbE (±20 to 60 VDC) |
| **2OC3/4-1000F/E** | 2xOC3 + 4xT1/E1 + 4xGbE (±20 to 60 VDC) |
| **Power Control Step Size** | 0.5 dB |
| **Maximum RSL** | |
| **QPSK-256QAM** | -25 dBm error-free |
| **Error Floor** | $10^{-12}$ |
| **Power Control Range** | 20 dB |
| **ATPC**[2] | Yes |
| **Adaptive Modulation** | QPSK–256QAM; Selectable, errorless and jitterless; fully configurable with prioritization |
| **TDM Latency** | 250µs typical |
| **Ethernet Latency** | 40–125µs (<100µs typical) at full throughput (GigE) with AES encryption enabled |
| **Link Encryption** | Optional NIST FIPS 197-compliant 128-bit AES and 256-bit AES[3] |
| **Link Security** | 96-bit security key |
| **Path Protection** | Space diversity with errorless switching<br>Frequency diversity |
| **Equipment Configurations** | 1+0, 1+1, 1+1 SD, 1+1 SD/FD<br>N+0 |
| **Capacity Aggregation** | N+0 link aggregation |
| **T1/E1 Cross-connect** | Built-in, software controlled T1/E1 port cross-connection between endpoints |
| **T1/E1 Prioritization** | User configurable |
| **Installation and Management Manual** | Embedded in radio, accessible via HTTP GUI |
| **Management** | In-band and out-of-band management |
| **Security** | SSL/SSH and secure, encrypted SNMP v3 |
| **Web GUI** | Embedded web server GUI (Internet Explorer, Firefox) |
| **CLI** | 10/100/1000BaseT or serial craft port |
| **SNMP** | v1, v2c, and secure v3 |
| **MIB** | MIB I, MIB II, Exalt MIB |
| **XML** | XML configuration file |
| **Compliance** | |
| **RF** | FCC Part 101;<br>IC SRSP-305.9, 310.7, 314.5, 317.8, SP 23/38 GHz; NTIA |
| **EMI** | FCC Part 15; CISPR 22 |
| **Environmental** | ETS-300-019-2-4 class 4<br>ETS-300-019-2-1<br>ETS-300-019-2-2 |
| **Safety** | IEC 60950-1, EN 60950-1, UL 60950-1 |

| Physical | |
|---|---|
| **IDU Dimensions (H x W x D)** | 1 RU<br>1.7 x 17 x 11 in / 4.3 x 43.2 x 28 cm |
| **ODU Dimensions (H x W x D)** | 10.9 x 9.4 x 3.6 in / 27.7 x 23.9 x 9 cm |
| **IDU Weight** | 9 lbs / 4 kg |
| **ODU Weight** | ≤9.5 lbs / 4.3 kg |
| **Full Specification Temperature** | IDU: -5 to +50 ºC / 23 to +122 ºF<br>ODU: -33 to +50 ºC / -27 to + 122 ºF |
| **Operating Temperature** | IDU: -10 to +55 ºC / 14 to +131 ºF<br>ODU: -40 to +55 ºC / -40 to +131 ºF |
| **Altitude** | 15,000 ft / 4.6 km |
| **Humidity** | IDU: 95% non-condensing<br>ODU: 100% non-condensing |

| Interfaces | | | | |
|---|---|---|---|---|
| **IDU to ODU** | N-type Female, impedance 50 ohm | | | |
| **TDM (Native)** | OC3 | DS3 | T1 | E1 |
| **Connector** | SFP, Single Mode LC Transceiver | 2x BNC Female; Native | RJ48C/RJ45 Female (x16) | RJ48C/RJ45 Female (x16) |
| **Impedance** | - | 75 ohms, unbalanced | 100 ohms, balanced | 120 ohms, balanced |
| **Line Code** | Binary Scrambled NRZ; CMI | B3ZS | AMI, B8ZS, selectable per channel | HDB3 |
| **Clocking Speed** | 155.52 MHz | 44.736 MHz | 1.544 MHz | 2.048 MHz |
| **Compliance** | ITU-T G.957; G.703; GR-253-CORE | ANSI T1.102-1993; GR-499-CORE | ANSI T1.102-1987; ITU-T; G.823; GR-499-CORE | CEPT-1; G.703; ITU-T-G.703 |
| **RxTx** | 1310nm single mode (2km, 15 km) Rx: -31 to -8 dBm Tx: -15 to -8 dBm | - | - | - |
| | 850nm multi-mode Rx: -30 to -14 dBm Tx: -19 to -14 dBm | - | - | - |
| **Loopback Mode** | Remote Internal; Remote External; Local Line | | | |

| | | |
|---|---|---|
| **Ethernet (Native)** | RJ45 Female (x2), auto-MDIX | SFP (x2) |
| **Interface Speed** | 10/100/1000BaseT | 1000BaseT/X |
| **Duplex** | Half, Full, Auto | Full, Auto |
| **Compliance** | 802.3 | 802.3 |
| **Maximum Packet Size** | 9728 bytes | 9728 bytes |
| **VLAN** | 802.1q, transparent, trunk, and management only[2]; over 4,000 VLAN IDs | |
| **QoS** | 8 priority levels, 8 queues<br>802.1p, 802.1q (VLAN ID), Source MAC Address, Destination MAC Address | |
| **Ethernet Rate Limiting** | Configurable per port via software | |
| **1+1 Protection Port** | 1x RJ48C/RJ45 Female, proprietary control | |
| **Expansion Port** | 1x RJ48C/RJ45 Female, proprietary control | |
| **Console (Serial)** | 9-pin Sub-D (F) | |
| **Speed** | 9600 bps | |
| **Compliance** | EIA-574 (RS-232) | |
| **Alarm** | 9-pin Sub-D (F)<br>Inputs (2) TTL/Closure<br>Outputs (2) Relay (Form C) | |
| **DC Power** | 3-pin (±20 to 60 VDC) or 2-pin (-48 VDC) barrier strip | |
| **Input Voltage** | -48 VDC or ±20 to 60 VDC (based on model) | |
| **Consumption** | <115W (48 V : <2.5 A, 24 V : <5 A) | |
| **AC Power Adapter (optional accessory)** | EIC-to-NEMA 5–15 | |
| **Input** | 100–240 VAC, 2.5 A | |
| **Output** | 48 VDC, 3 A, 150 W | |
| **Warranty** | Two years[4] | |

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| Frequency Bands | 6 GHz Lower | 6 GHz Upper | 11 GHz | 15 GHz | 18 GHz | 23 GHz | 28 GHz | 38 GHz |
|---|---|---|---|---|---|---|---|---|
| Frequency Range (GHz) | 5.925–6.425 | 6.425–6.815 | 10.700–11.700 | 14.500–15.350 | 17.700–19.700 | 21.200–23.610 | 27.500–28.350 | 38.595–40.100 |
| TR Spacing (MHz) | 252.04 | 160 | 490, 500 | 640, 728 | 1560 | 1200 | 450 | 700 |
| Channel Bandwidth (MHz) | 5,10, 20, 30 | 5, 10, 30 | 5, 10, 30, 40 | 5, 10, 20, 30, 40, 50, 56[5] | 5,10, 20, 30, 40, 50 | 5,10, 20, 30, 40, 50 | 5, 10, 20, 30, 40, 50, 56[5] | 20, 30, 40, 50 |
| Antenna interface | Non-standard | Non-standard | WR-75 | WR-42 | WR-42 | WR-42 | WR-28 | 0.219" dia |
| Output Power (dBm)[6] | | | Stnd/Power Upgrade[7] | | | | | |
| QPSK | 30.0 | | - | 24.5 | 22.5 | 22.5 | 25.0 | 23.0 |
| 16QAM | 30.0 | | 24.5 / 28.0 | 20.5 | 19.0 | 19.0 | 22.0 | 20.0 |
| 32QAM | 30.0 | | 20.5 / 28.0 | 20.0 | 19.0 | 19.0 | 22.0 | 20.0 |
| 64QAM | 28.0 | | 18.0 / 27.0 | 18.5 | 17.0 | 16.0 | 19.0 | 17.0 |
| 128QAM | 27.0 | | 18.0 / 26.0 | 18.0 | 17.0 | 16.0 | 19.0 | 17.0 |
| 256QAM | 27.0 | | 16.0 / 25.0 | 16.5 | 15.0 | 14.0 | 17.0 | 15.0 |
| Receiver Threshold (dBm) (guaranteed over temperature BER $10^{-6}$)[6] | | | - | | | | | |
| QPSK 5 MHz | -89 | -89 | -89 | -89 | - | - | - | - |
| 10 MHz | -86 | -86 | -86 | -87 | -87 | -86 | - | - |
| 20 MHz | - | - | - | -84 | -84 | -83 | -83 | -81 |
| 30 MHz | -83 | -83 | -83 | -82 | -82 | -81 | -81 | -79 |
| 40 MHz | - | - | - | -81 | -81 | -80 | -80 | -80 |
| 50 MHz | - | - | - | -80 | -80 | -79 | -79 | -79 |
| 56 MHz | - | - | - | -80 | - | - | -77 | - |
| 16QAM 5 MHz | -82 | -82 | - | - | - | - | - | - |
| 10 MHz | -81 | -81 | - | -81 | -81 | -80 | -80 | -80 |
| 20 MHz | - | - | - | -78 | -78 | -77 | -77 | -75 |
| 30 MHz | -76 | -76 | -78 | -76 | -76 | -75 | -75 | -73 |
| 40 MHz | - | - | -77 | -75 | -75 | -74 | -74 | -74 |
| 50 MHz | - | - | - | -74 | -74 | -73 | -73 | -73 |
| 56 MHz | - | - | - | -73 | - | - | -71 | - |
| 32QAM 5 MHz | -78 | -78 | -82 | - | - | - | - | - |
| 10 MHz | -78 | -78 | -79 | -78 | -78 | -77 | -77 | -77 |
| 20 MHz | - | - | - | -75 | -75 | -74 | -74 | -72 |
| 30 MHz | -73 | -73 | -74 | -73 | -73 | -72 | -72 | -70 |
| 40 MHz | - | - | -73 | -72 | -72 | -71 | -71 | -71 |
| 50 MHz | - | - | - | -71 | -71 | -70 | -70 | -70 |
| 56 MHz | - | - | - | -70 | - | - | -68 | - |
| 64QAM 5 MHz | -78 | -78 | -80 | -78 | -78 | -77 | -77 | - |
| 10 MHz | -75 | -75 | -77 | -75 | -75 | -74 | -74 | -74 |
| 20 MHz | - | - | - | -72 | -72 | -71 | -71 | -69 |
| 30 MHz | -70 | -70 | -72 | -70 | -70 | -69 | -69 | -67 |
| 40 MHz | - | - | -71 | -69 | -69 | -68 | -68 | -68 |
| 50 MHz | - | - | - | -68 | -68 | -67 | -67 | -67 |
| 56 MHz | - | - | - | -67 | - | - | -65 | - |
| 128QAM 5 MHz | -75 | -75 | -76 | -75 | -75 | -74 | -74 | - |
| 10 MHz | -72 | -72 | -73 | -72 | -72 | -71 | -71 | -71 |
| 20 MHz | - | - | - | -69 | -69 | -68 | -68 | -66 |
| 30 MHz | -67 | -67 | -68 | -67 | -67 | -66 | -66 | -64 |
| 40 MHz | - | - | -67 | -66 | -66 | -65 | -65 | -65 |
| 50 MHz | - | - | - | -65 | -65 | -64 | -64 | -64 |
| 56 MHz | - | - | - | -64 | - | - | -62 | - |
| 256QAM 5 MHz | -71 | -71 | - | - | - | - | - | - |
| 10 MHz | -68 | -68 | - | -68 | -68 | -67 | -67 | -67 |
| 20 MHz | - | - | - | -65 | -65 | -64 | -64 | -64 |
| 30 MHz | -62 | -62 | -65 | -63 | -63 | -62 | -62 | -62 |
| 40 MHz | - | - | -64 | -62 | -62 | -61 | -61 | -61 |
| 50 MHz | - | - | - | -61 | -61 | -60 | -60 | -60 |
| 56 MHz | - | - | - | -61 | - | - | -58 | - |
| Emission Designators | | | | | | | | |
| 5 MHz | 5M00W7D | 5M00W7D | 5M00W7D | 5M00W7D | 5M00W7D | 5M00W7D | 5M00W7D | - |
| 10 MHz | 10M0W7D | 10M0W7D | 10M0W7D | 10M0W7D | 10M0W7D | 10M0W7D | 10M0W7D | - |
| 20 MHz | - | - | - | 20M0W7D | 20M0W7D | 20M0W7D | 20M0W7D | 20M0W7D |
| 30 MHz | 30M0W7D | 30M0W7D | 30M0W7D | 30M0W7D | 30M0W7D | 30M0W7D | 30M0W7D | 30M0W7D |
| 40 MHz | - | - | 40M0W7D | 40M0W7D | 40M0W7D | 40M0W7D | 40M0W7D | 40M0W7D |
| 50 MHz | - | - | - | 50M0W7D | 50M0W7D | 50M0W7D | 50M0W7D | 50M0W7D |
| 56 MHz | - | - | - | 56M0W7D | - | - | 56M0W7D | |

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## Specifications EX-s Series GigE FCC

| Throughput (Mbps full-duplex) (Max system layer 1/Max Ethernet layer 2)[8] | | | | | | |
|---|---|---|---|---|---|---|
| | QPSK | 16QAM | 32QAM | 64QAM | 128QAM | 256QAM |
| **5 MHz** | 15 / 11 | 28 / 21 | 36 / 27 | 43 / 32 | 49 / 37 | 58 / 43 |
| **10 MHz** | 19 / 15 | 38 / 30 | 47 / 38 | 57 / 46 | 66 / 53 | 76 / 61 |
| **20 MHz** | 38 / 30 | 76 / 61 | 95 / 76 | 114 / 92 | 133 / 107 | 152 / 123 |
| **30 MHz** | 57 / 46 | 114 / 92 | 143 / 115 | 172 / 139 | 201 / 162 | 229 / 185 |
| **40 MHz** | 76 / 61 | 153 / 124 | 192 / 155 | 230 / 186 | 269 / 217 | 307 / 249 |
| **50 MHz** | 96 / 77 | 192 / 155 | 241 / 195 | 289 / 234 | 337 / 273 | 385 / 312 |
| **56 MHz[5]** | 106 / 86 | 214 / 174 | 284 / 231 | 342 / 278 | 399 / 324 | 457 / 371 |

| Dispersive Fade Margin[9] (dB) | | | | | | |
|---|---|---|---|---|---|---|
| | 256 QAM | 128 QAM | 64 QAM | 32 QAM | 16 QAM | QPSK |
| **10 MHz** | 62 | 65 | 68 | 71 | 74 | 80 |
| **20 MHz** | 55 | 58 | 62 | 65 | 67 | 73 |
| **30 MHz** | 50 | 53 | 57 | 60 | 63 | 69 |
| **40 MHz** | 48 | 51 | 54 | 57 | 60 | 66 |
| **50 MHz** | 46 | 49 | 52 | 55 | 57 | 64 |

1 Consult your Exalt sales representative for availability.
2 Software upgrade required. Consult your Exalt sales representative for availability.
3 Software license key option.
4 Terms and conditions apply. Consult your Exalt sales representative for more information.
5 Requires 1000E IDU version supporting 7, 14, 28 and 56 MHz channels.
6 ±1 dB over temperature.
7 Power upgrade is a license key option to improve system gain when required. Power upgrade specification is preliminary.
8 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.
9 Bellcore BER $10^{-3}$.

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