



Datasheet

IP-50C

Rev C.05 | April 2021



Note: For feature availability, check the Release Notes for the CeraOS version you are using.

Radio

Supported Frequency Range

6-42 GHz

Radio Configurations

1+0 up to 4+0 Single/Dual Polarization, 1+1/2+2 HSB, 1+1/2+2 HSB-SD, 2+0 XPIC, 2x2+0 East/West Single/Dual Polarization

Radio Features

Enhanced Multi-Carrier ABC (up to 2+0)

Protection: 1+1 HSB/2+2 HSB, 1+1 HSB-SD*

High spectral utilization: BPSK to 4096 QAM w/ACM

Channel bandwidth: 14 to 224 MHz†

XPIC

2x2/4x4 LoS MIMO*

Advanced Frequency Reuse (AFR)*

Advanced Space Diversity (ASD)*

Dualband (with IP-50C, IP-20S, IP-20C, third-party MW radio)*

Multiband (with IP-20E or IP-50E)*

Ethernet

Ethernet Interfaces

Port 1:

- DC Port

Port 2:

- RJ-45 - Electric MultiRate 1/2.5/10 Gbps traffic interface/PoE port

Port 3:

- SFP – 1/2.5G traffic interface and Dualband port

Port 4:

- SFP – 1/10GE traffic interface/MIMO extension port (SFP+)

Port 5:

- SFP – 1/10GE traffic interface (SFP+)

Port 6:

- RJ-45 – Management/Protection interface - 100 Base-T

Notes: SFP and SFP+ devices must be of industrial grade (-40°C to +85°C, -40°F to +185°F).

For information on supported interface usage and speed per CeraOS release, refer to the Release Notes or Technical Description for the release.

* Planned for future release.

Ethernet Features

MTU – 9612 Bytes

Up to 1024 Ethernet services, plus one pre-defined management service

MAC address learning with 64K MAC addresses

Quality of Service:

- Multiple Classification criteria (VLAN ID, P-bits, IPv4 DSCP, IPv6 TC, MPLS EXP)
 - 8 CoS queues per port
 - Deep buffering (configurable up to 64 Mbit per queue)
 - WRED
 - P-bit marking/remarking
- VLAN add/remove
- MSTP, ERP (ITU-T G.8032)
- Y.1731 Ethernet OAM
- Y.1731 Ethernet Bandwidth Notification (ETH-BN)

Management Protocols

SNMP

REST

SDN Support:

- NETCONF/YANG

Synchronization Protocols

Enhanced Ethernet Equipment Clock (eEEC) Specification (G.8262.1)

PTP Telecom Boundary Clock (T-BC) and Time Slave Clock (T-TSC) Specification (G.8273.2)

PTP Telecom Transparent Clock (T-TC) Specification (G.8273.3)

Enhanced SyncE Network Limits (G.8261, clause 9.2.1)

Enhanced PTP Network Limits (G.8271.1)

Ethernet Synchronization Messaging Channel (ESMC) (G.8264, clause 11)

PTP Telecom Profile for Time (Full Timing Support) (G.8275.1)

Precision Time Protocol (version 2, IEEE1588-2008)

† 224 MHz is planned for future release.



Standards

MEF

Carrier Ethernet 2.0 (CE 2.0)

Supported Ethernet Standards

10/100/1000base-T/X (IEEE 802.3)

10GBase-LR (IEEE 802.3)

Ethernet VLANs (IEEE 802.3ac)

Virtual LAN (VLAN, IEEE 802.1Q)

Class of service (IEEE 802.1p)

Provider bridges (QinQ – IEEE 802.1ad)

Link aggregation (IEEE 802.1AX)

Auto MDI/MDIX for 1000baseT

RFC 1349: IPv4 TOS

RFC 2474: IPv4 DSCP

RFC 2460: IPv6 Traffic Classes

Security

Secured protocols:

- HTTPS
- SNMPv3
- SSH
- SFTP

RADIUS authentication and authorization

TACACS+ Authentication, Authorization, and Accounting (session-based)

Standards Compliance

Radio Spectral Efficiency: EN 302 217-2-2

EMC: EN 301 489-1, EN 301 489-4, Class B (Europe), FCC 47 CFR, part 15, class B (US), ICES-003, Class B (Canada), TEC/EMI/TEL-001/01, Class B (India)

Surge: EN61000-4-5, Class 4 (for PWR and ETH1/PoE ports)

Safety: EN 60950-1, IEC 60950-1, UL 60950-1, CSA-C22.2 No.60950-1, EN 60950-22, UL 60950-22, CSA C22.2.60950-22

Storage: ETSI EN 300 019-1-1 Class 1.2

Transportation: ETSI EN 300 019-1-2 Class 2.

Technical Specifications

Mechanical Specifications

Dimensions (Direct Mount HW) –
322mm(H), 227/270mm(W), 86mm(D), 6kg
12.67”(H), 8.93”/10.62”(W), 3.38”(D), 13.2 lbs.

Pole Diameter Range (for Remote Mount Installation)
8.89cm – 11.43cm; 3.5” – 4.5”

Environmental Specifications

-33°C to +55°C (-45°C to +60°C extended)
-27°F to +131°F (-49°F to +140°F extended)

Power Input Specifications

Standard Input: -48 VDC

DC Input range: -40.5 to -60 VDC

Power Consumption Specifications

2+0 Operation:

- 6-11 GHz: 73W
- 13-42 GHz: 63W

1+0 Operation (one carrier muted):

- 6-11 GHz: 63W
- 13-42 GHz: 55W

Both carriers muted:

- 6-11 GHz: 38W
- 13-42 GHz: 40W

PoE Injector Mechanical Specifications

Dimensions – 134mm(H), 190mm(W), 62mm(D), 1 kg

PoE Injector Environmental Specifications

-33°C to +55°C (-45°C to +60°C extended)

PoE Injector Power Input Specifications

Standard Input: -48 or +24 VDC (Optional)

DC Input range: $\pm(18/40.5$ to 60) VDC (+18VDC extended range is supported as part of the nominal +24VDC support)

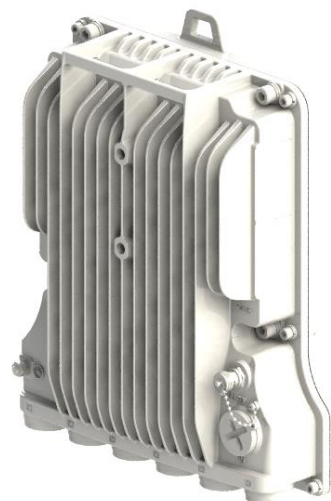
PoE Injector Interfaces

GbE Data Port supporting 10/100/1000Base-T

Power-Over-Ethernet (PoE) Port

DC Power Port –40V to -60V (a PoE supporting two redundant DC feeds each supporting $\pm(18-60)$ V is available)

Product Image



Radio Specifications

Capacity [Mbps]

| Modulation | 14 MHz | 20 MHz | 25 MHz | 28/30 MHz | 40 MHz |
|-----------------|---------|-----------|---------|-----------|-----------|
| BPSK | – | 10-13 | 14-17 | 18-22 | 25-31 |
| QPSK | 16-20 | 25-30 | 32-40 | 40-48 | 54-67 |
| 8 QAM | 26-32 | 39-47 | 50-61 | 59-72 | 83-101 |
| 16 QAM | 37-46 | 54-66 | 69-84 | 84-102 | 113-139 |
| 32 QAM | 50-61 | 72-88 | 92-112 | 111-136 | 150-184 |
| 64 QAM | 62-76 | 89-109 | 113-139 | 138-168 | 185-227 |
| 128 QAM | 76-93 | 108-132 | 137-168 | 166-203 | 225-275 |
| 256 QAM | 87-106 | 123-150 | 157-192 | 192-234 | 242-296 |
| 512 QAM | 96-118 | 134-164 | 174-212 | 204-249 | 265-324 |
| 1024 QAM Strong | 102-125 | 143-175 | 185-226 | 223-272 | 301-368 |
| 1024 QAM Light | 108-132 | 152-186 | 196-240 | 236-289 | 320-391 |
| 2048 QAM | 113-138 | 162-198 | 211-258 | 258-315 | 346-423 |
| 4096 QAM | – | – | 228-279 | 275-336 | 366-448 |
| | 50 MHz | 56/60 MHz | 80 MHz | 112 MHz | 224 MHz |
| BPSK | 33-40 | 40-49 | 54-66 | 79-97 | 162-198 |
| QPSK | 67-82 | 83-102 | 111-135 | 162-198 | 328-401 |
| 8 QAM | 105-129 | 123-150 | 158-193 | 242-296 | 489-597 |
| 16 QAM | 144-176 | 172-210 | 227-277 | 330-404 | 665-812 |
| 32 QAM | 181-222 | 227-277 | 298-365 | 435-532 | 875-1069 |
| 64 QAM | 235-287 | 279-341 | 366-447 | 535-654 | 1111-1358 |
| 128 QAM | 275-336 | 338-413 | 433-529 | 647-791 | 1298-1587 |
| 256 QAM | 326-399 | 391-478 | 498-609 | 740-905 | 1484-1815 |
| 512 QAM | 354-433 | 420-514 | 548-670 | 804-983 | 1678-2051 |
| 1024 QAM Strong | 386-472 | 457-559 | 596-729 | 872-1066 | 1860-2274 |
| 1024 QAM Light | 410-501 | 486-594 | 633-774 | 926-1132 | – |
| 2048 QAM | 442-541 | 527-644 | 670-820 | 999-1221 | – |
| 4096 QAM | 459-561 | 542-663 | 708-865 | 1034-1264 | – |

Transmit Power [dBm]

Notes: The values listed in this section are typical. Actual values may differ in either direction by up to 1 dB.

| Modulation | Frequency (GHz) | 6 | 7 | 8 | 10-11 | 13 | 15 | 18 | 23 | 26 | 28 | 32 | 38 | 42 |
|-------------|-----------------|----|----|----|-------|----|----|----|----|----|----|----|----|----|
| BPSK – QPSK | | 28 | 28 | 28 | 28 | 26 | 25 | 24 | 24 | 23 | 22 | 18 | 22 | 15 |
| 8 QAM | | 28 | 28 | 28 | 28 | 26 | 25 | 24 | 24 | 23 | 22 | 18 | 22 | 15 |
| 16 QAM | | 28 | 27 | 27 | 28 | 24 | 24 | 24 | 24 | 23 | 21 | 17 | 21 | 15 |
| 32 QAM | | 28 | 27 | 26 | 28 | 24 | 24 | 24 | 24 | 23 | 21 | 16 | 21 | 14 |
| 64 QAM | | 28 | 26 | 26 | 27 | 24 | 24 | 23 | 24 | 23 | 20 | 16 | 20 | 13 |
| 128 QAM | | 27 | 26 | 26 | 26 | 24 | 24 | 23 | 24 | 23 | 20 | 16 | 20 | 13 |
| 256 QAM | | 27 | 26 | 26 | 26 | 24 | 23 | 23 | 23 | 21 | 19 | 14 | 19 | 13 |
| 512 QAM | | 27 | 25 | 24 | 26 | 23 | 22 | 22 | 22 | 21 | 19 | 14 | 19 | 11 |
| 1024 QAM | | 26 | 24 | 24 | 25 | 22 | 21 | 21 | 21 | 20 | 18 | 13 | 18 | 11 |
| 2048 QAM | | 25 | 23 | 22 | 24 | 21 | 21 | 20 | 20 | 18 | 18 | 12 | 18 | 10 |
| 4096 QAM | | 24 | 21 | 20 | 22 | 20 | 20 | 19 | 19 | 17 | 17 | 11 | | |



Receive Level Threshold [dBm@10E-6]

| 14 MHz | GHz | 6 | 7-8 | 10 | 11 | 13 | 15 | 18 | 23 | 24 | 26 | 28-31 | 32 | 36 | 38 | 42 |
|-----------------|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| BPSK | | -94.0 | -94.0 | -93.5 | -93.5 | -93.5 | -93.5 | -93.0 | -92.5 | -92.5 | -93.0 | -93.0 | -93.0 | -91.5 | -91.5 | -90.5 |
| QPSK | | -91.0 | -91.0 | -90.5 | -90.5 | -90.5 | -90.5 | -90.0 | -90.0 | -89.5 | -90.0 | -90.0 | -90.0 | -88.5 | -88.5 | -87.5 |
| 8 PSK | | -87.0 | -87.0 | -86.5 | -87.0 | -87.0 | -86.5 | -86.0 | -86.0 | -85.5 | -86.0 | -86.0 | -86.0 | -84.5 | -84.5 | -83.5 |
| 16 QAM | | -84.0 | -84.0 | -83.5 | -83.5 | -83.5 | -83.5 | -83.0 | -83.0 | -82.5 | -83.0 | -83.0 | -83.0 | -81.5 | -81.5 | -80.5 |
| 32 QAM | | -80.5 | -80.5 | -80.0 | -80.5 | -80.5 | -80.0 | -79.5 | -79.5 | -79.0 | -79.5 | -79.5 | -79.5 | -78.5 | -78.5 | -77.5 |
| 64 QAM | | -77.5 | -77.5 | -77.0 | -77.0 | -77.0 | -77.0 | -76.5 | -76.5 | -76.0 | -76.5 | -76.5 | -76.5 | -75.0 | -75.0 | -74.0 |
| 128 QAM | | -74.5 | -74.5 | -74.0 | -74.0 | -74.0 | -74.0 | -73.5 | -73.0 | -73.0 | -73.5 | -73.5 | -73.5 | -72.0 | -72.0 | -71.0 |
| 256 QAM | | -71.0 | -71.0 | -70.5 | -70.5 | -70.5 | -70.5 | -70.0 | -70.0 | -69.5 | -70.0 | -70.0 | -70.0 | -68.5 | -68.5 | -67.5 |
| 512 QAM | | -68.0 | -68.0 | -67.5 | -68.0 | -68.0 | -67.5 | -67.0 | -67.0 | -66.5 | -67.0 | -67.0 | -67.0 | -65.5 | -65.5 | -64.5 |
| 1024 QAM Strong | | -64.5 | -64.5 | -64.0 | -64.5 | -64.5 | -64.0 | -63.5 | -63.5 | -63.0 | -63.5 | -63.5 | -63.5 | -62.0 | -62.0 | -61.0 |
| 1024 QAM Light | | -63.5 | -63.5 | -63.0 | -63.5 | -63.5 | -63.0 | -62.5 | -62.5 | -62.0 | -62.5 | -62.5 | -62.5 | -61.5 | -61.5 | -60.5 |
| 2048 QAM | | -60.5 | -60.5 | -60.0 | -60.0 | -60.0 | -60.0 | -59.5 | -59.5 | -59.0 | -59.5 | -59.5 | -59.5 | -58.0 | -58.0 | -57.0 |
| 20 MHz | | | | | | | | | | | | | | | | |
| BPSK | | -92.4 | -92.4 | -91.9 | -92.2 | -92.0 | -92.0 | -91.5 | -91.5 | -91.0 | -91.5 | -91.5 | -91.5 | -90.0 | -90.0 | |
| QPSK | | -89.5 | -89.5 | -89.0 | -89.3 | -89.5 | -89.0 | -88.5 | -88.5 | -88.0 | -88.5 | -88.5 | -88.5 | -87.0 | -87.0 | |
| 8 PSK | | -85.5 | -85.5 | -85.0 | -85.3 | -85.5 | -85.0 | -84.5 | -84.5 | -84.0 | -84.5 | -84.5 | -84.5 | -83.0 | -83.0 | |
| 16 QAM | | -82.6 | -82.6 | -82.1 | -82.4 | -82.5 | -82.0 | -81.5 | -81.5 | -81.0 | -81.5 | -81.5 | -81.5 | -80.5 | -80.5 | |
| 32 QAM | | -79.2 | -79.2 | -78.7 | -79.0 | -79.0 | -79.0 | -78.5 | -78.0 | -77.5 | -78.0 | -78.0 | -78.0 | -77.0 | -77.0 | |
| 64 QAM | | -76.0 | -76.0 | -75.5 | -75.8 | -76.0 | -75.5 | -75.0 | -75.0 | -74.5 | -75.0 | -75.0 | -75.0 | -73.5 | -73.5 | |
| 128 QAM | | -73.0 | -73.0 | -72.5 | -72.8 | -73.0 | -72.5 | -72.0 | -72.0 | -71.5 | -72.0 | -72.0 | -72.0 | -70.5 | -70.5 | |
| 256 QAM | | -69.9 | -69.9 | -69.4 | -69.7 | -69.5 | -69.5 | -69.0 | -69.0 | -68.5 | -69.0 | -69.0 | -69.0 | -67.5 | -67.5 | |
| 512 QAM | | -67.1 | -67.1 | -66.6 | -66.9 | -67.0 | -66.5 | -66.0 | -66.0 | -65.5 | -66.0 | -66.0 | -66.0 | -65.0 | -65.0 | |
| 1024 QAM Strong | | -64.2 | -64.2 | -63.7 | -64.0 | -64.0 | -64.0 | -63.5 | -63.0 | -62.5 | -63.0 | -63.0 | -63.0 | -62.0 | -62.0 | |
| 1024 QAM Light | | -63.5 | -63.5 | -63.0 | -63.3 | -63.5 | -63.0 | -62.5 | -62.5 | -62.0 | -62.5 | -62.5 | -62.5 | -61.0 | -61.0 | |
| 2048 QAM | | -61.0 | -61.0 | -60.5 | -60.8 | -61.0 | -60.5 | -60.0 | -60.0 | -59.5 | -60.0 | -60.0 | -60.0 | -58.5 | -58.5 | |
| 25 MHz | | | | | | | | | | | | | | | | |
| BPSK | | -91.4 | -91.4 | -90.9 | -91.2 | -91.0 | -91.0 | -90.5 | -90.5 | -90.0 | -90.5 | -90.5 | -90.5 | -89.0 | -89.0 | |
| QPSK | | -88.4 | -88.4 | -87.9 | -88.2 | -88.0 | -88.0 | -87.5 | -87.5 | -87.0 | -87.5 | -87.5 | -87.5 | -86.0 | -86.0 | |
| 8 PSK | | -84.4 | -84.4 | -83.9 | -84.2 | -84.0 | -84.0 | -83.5 | -83.5 | -83.0 | -83.5 | -83.5 | -83.5 | -82.0 | -82.0 | |
| 16 QAM | | -81.5 | -81.5 | -81.0 | -81.3 | -81.5 | -81.0 | -80.5 | -80.5 | -80.0 | -80.5 | -80.5 | -80.5 | -79.0 | -79.0 | |
| 32 QAM | | -78.2 | -78.2 | -77.7 | -78.0 | -78.0 | -78.0 | -77.5 | -77.0 | -76.5 | -77.0 | -77.0 | -77.0 | -76.0 | -76.0 | |
| 64 QAM | | -75.1 | -75.1 | -74.6 | -74.9 | -75.0 | -74.5 | -74.0 | -74.0 | -73.5 | -74.0 | -74.0 | -74.0 | -73.0 | -73.0 | |
| 128 QAM | | -72.0 | -72.0 | -71.5 | -71.8 | -72.0 | -71.5 | -71.0 | -71.0 | -70.5 | -71.0 | -71.0 | -71.0 | -69.5 | -69.5 | |
| 256 QAM | | -68.9 | -68.9 | -68.4 | -68.7 | -68.5 | -68.5 | -68.0 | -68.0 | -67.5 | -68.0 | -68.0 | -68.0 | -66.5 | -66.5 | |
| 512 QAM | | -66.0 | -66.0 | -65.5 | -65.8 | -66.0 | -65.5 | -65.0 | -65.0 | -64.5 | -65.0 | -65.0 | -65.0 | -63.5 | -63.5 | |
| 1024 QAM Strong | | -63.1 | -63.1 | -62.6 | -62.9 | -63.0 | -62.5 | -62.0 | -62.0 | -61.5 | -62.0 | -62.0 | -62.0 | -61.0 | -61.0 | |
| 1024 QAM Light | | -62.2 | -62.2 | -61.7 | -62.0 | -62.0 | -62.0 | -61.5 | -61.0 | -60.5 | -61.0 | -61.0 | -61.0 | -60.0 | -60.0 | |
| 2048 QAM | | -60.1 | -60.1 | -59.6 | -59.9 | -60.0 | -59.5 | -59.0 | -59.0 | -58.5 | -59.0 | -59.0 | -59.0 | -58.0 | -58.0 | |
| 4096 QAM | | -56.0 | -56.0 | -55.5 | -55.8 | -56.0 | -55.5 | -55.0 | -55.0 | -54.5 | -55.0 | | | | | |



| 28 MHz | Freq | 6 | 7-8 | 10 | 11 | 13 | 15 | 18 | 23 | 24 | 26 | 28-31 | 32 | 36 | 38 | 42 |
|-----------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| BPSK | | -90.8 | -90.8 | -90.3 | -90.6 | -90.5 | -90.5 | -90.0 | -89.5 | -89.5 | -90.0 | -90.0 | -90.0 | -88.5 | -88.5 | -87.5 |
| QPSK | | -87.8 | -87.8 | -87.3 | -87.6 | -87.5 | -87.5 | -87.0 | -86.5 | -86.5 | -87.0 | -87.0 | -87.0 | -85.5 | -85.5 | -84.5 |
| 8 PSK | | -83.9 | -83.9 | -83.4 | -83.7 | -83.5 | -83.5 | -83.0 | -83.0 | -82.5 | -83.0 | -83.0 | -83.0 | -81.5 | -81.5 | -80.5 |
| 16 QAM | | -80.9 | -80.9 | -80.4 | -80.7 | -80.5 | -80.5 | -80.0 | -80.0 | -79.5 | -80.0 | -80.0 | -80.0 | -78.5 | -78.5 | -77.5 |
| 32 QAM | | -77.6 | -77.6 | -77.1 | -77.4 | -77.5 | -77.0 | -76.5 | -76.5 | -76.0 | -76.5 | -76.5 | -76.5 | -75.5 | -75.5 | -74.5 |
| 64 QAM | | -74.6 | -74.6 | -74.1 | -74.4 | -74.5 | -74.0 | -73.5 | -73.5 | -73.0 | -73.5 | -73.5 | -73.5 | -72.5 | -72.5 | -71.5 |
| 128 QAM | | -71.5 | -71.5 | -71.0 | -71.3 | -71.5 | -71.0 | -70.5 | -70.5 | -70.0 | -70.5 | -70.5 | -70.5 | -69.0 | -69.0 | -68.0 |
| 256 QAM | | -68.4 | -68.4 | -67.9 | -68.2 | -68.0 | -68.0 | -67.5 | -67.5 | -67.0 | -67.5 | -67.5 | -67.5 | -66.0 | -66.0 | -65.0 |
| 512 QAM | | -65.6 | -65.6 | -65.1 | -65.4 | -65.5 | -65.0 | -64.5 | -64.5 | -64.0 | -64.5 | -64.5 | -64.5 | -63.5 | -63.5 | -62.5 |
| 1024 QAM Strong | | -62.7 | -62.7 | -62.2 | -62.5 | -62.5 | -62.5 | -62.0 | -61.5 | -61.0 | -61.5 | -61.5 | -61.5 | -60.5 | -60.5 | -59.5 |
| 1024 QAM Light | | -62.0 | -62.0 | -61.5 | -61.8 | -62.0 | -61.5 | -61.0 | -61.0 | -60.5 | -61.0 | -61.0 | -61.0 | -59.5 | -59.5 | -58.5 |
| 2048 QAM | | -59.5 | -59.5 | -59.0 | -59.3 | -59.5 | -59.0 | -58.5 | -58.5 | -58.0 | -58.5 | -58.5 | -58.5 | -57.0 | -57.0 | -56.0 |
| 4096 QAM | | -55.5 | -55.5 | -55.0 | -55.3 | -55.5 | -55.0 | -54.5 | -54.5 | -54.0 | -54.5 | | | | | |
| 30 MHz | | | | | | | | | | | | | | | | |
| BPSK | | -90.7 | -90.7 | -90.2 | -90.5 | -90.5 | -90.5 | -90.0 | -89.5 | -89.0 | -89.5 | -89.5 | -89.5 | -88.5 | -88.5 | |
| QPSK | | -87.7 | -87.7 | -87.2 | -87.5 | -87.5 | -87.5 | -87.0 | -86.5 | -86.0 | -86.5 | -86.5 | -86.5 | -85.5 | -85.5 | |
| 8 PSK | | -83.7 | -83.7 | -83.2 | -83.5 | -83.5 | -83.5 | -83.0 | -82.5 | -82.0 | -82.5 | -82.5 | -82.5 | -81.5 | -81.5 | |
| 16 QAM | | -80.7 | -80.7 | -80.2 | -80.5 | -80.5 | -80.5 | -80.0 | -79.5 | -79.0 | -79.5 | -79.5 | -79.5 | -78.5 | -78.5 | |
| 32 QAM | | -77.4 | -77.4 | -76.9 | -77.2 | -77.0 | -77.0 | -76.5 | -76.5 | -76.0 | -76.5 | -76.5 | -76.5 | -75.0 | -75.0 | |
| 64 QAM | | -74.3 | -74.3 | -73.8 | -74.1 | -74.0 | -74.0 | -73.5 | -73.0 | -73.0 | -73.5 | -73.5 | -73.5 | -72.0 | -72.0 | |
| 128 QAM | | -71.3 | -71.3 | -70.8 | -71.1 | -71.0 | -71.0 | -70.5 | -70.0 | -70.0 | -70.5 | -70.5 | -70.5 | -69.0 | -69.0 | |
| 256 QAM | | -68.1 | -68.1 | -67.6 | -67.9 | -68.0 | -67.5 | -67.0 | -67.0 | -66.5 | -67.0 | -67.0 | -67.0 | -66.0 | -66.0 | |
| 512 QAM | | -65.8 | -65.8 | -65.3 | -65.6 | -65.5 | -65.5 | -65.0 | -64.5 | -64.5 | -65.0 | -65.0 | -65.0 | -63.5 | -63.5 | |
| 1024 QAM Strong | | -62.5 | -62.5 | -62.0 | -62.3 | -62.5 | -62.0 | -61.5 | -61.5 | -61.0 | -61.5 | -61.5 | -61.5 | -60.0 | -60.0 | |
| 1024 QAM Light | | -61.7 | -61.7 | -61.2 | -61.5 | -61.5 | -61.5 | -61.0 | -60.5 | -60.0 | -60.5 | -60.5 | -60.5 | -59.5 | -59.5 | |
| 2048 QAM | | -59.2 | -59.2 | -58.7 | -59.0 | -59.0 | -59.0 | -58.5 | -58.0 | -57.5 | -58.0 | -58.0 | -58.0 | -57.0 | -57.0 | |
| 4096 QAM | | -55.5 | -55.5 | -55.0 | -55.3 | -55.5 | -55.0 | -54.5 | -54.5 | -54.0 | -54.5 | | | | | |
| 40 MHz | | | | | | | | | | | | | | | | |
| BPSK | | -89.6 | -89.6 | -89.1 | -89.4 | -89.5 | -89.0 | -88.5 | -88.5 | -88.0 | -88.5 | -88.5 | -88.5 | -87.5 | -87.5 | -86.5 |
| QPSK | | -86.4 | -86.4 | -85.9 | -86.2 | -86.0 | -86.0 | -85.5 | -85.5 | -85.0 | -85.5 | -85.5 | -85.5 | -84.0 | -84.0 | -83.0 |
| 8 PSK | | -82.4 | -82.4 | -81.9 | -82.2 | -82.0 | -82.0 | -81.5 | -81.5 | -81.0 | -81.5 | -81.5 | -81.5 | -80.0 | -80.0 | -79.0 |
| 16 QAM | | -79.5 | -79.5 | -79.0 | -79.3 | -79.5 | -79.0 | -78.5 | -78.5 | -78.0 | -78.5 | -78.5 | -78.5 | -77.0 | -77.0 | -76.0 |
| 32 QAM | | -76.1 | -76.1 | -75.6 | -75.9 | -76.0 | -75.5 | -75.0 | -75.0 | -74.5 | -75.0 | -75.0 | -75.0 | -74.0 | -74.0 | -73.0 |
| 64 QAM | | -73.0 | -73.0 | -72.5 | -72.8 | -73.0 | -72.5 | -72.0 | -72.0 | -71.5 | -72.0 | -72.0 | -72.0 | -70.5 | -70.5 | -69.5 |
| 128 QAM | | -70.0 | -70.0 | -69.5 | -69.8 | -70.0 | -69.5 | -69.0 | -69.0 | -68.5 | -69.0 | -69.0 | -69.0 | -67.5 | -67.5 | -66.5 |
| 256 QAM | | -67.7 | -67.7 | -67.2 | -67.5 | -67.5 | -67.5 | -67.0 | -66.5 | -66.0 | -66.5 | -66.5 | -66.5 | -65.5 | -65.5 | -64.5 |
| 512 QAM | | -64.9 | -64.9 | -64.4 | -64.7 | -64.5 | -64.5 | -64.0 | -64.0 | -63.5 | -64.0 | -64.0 | -64.0 | -62.5 | -62.5 | -61.5 |
| 1024 QAM Strong | | -61.4 | -61.4 | -60.9 | -61.2 | -61.0 | -61.0 | -60.5 | -60.5 | -60.0 | -60.5 | -60.5 | -60.5 | -59.0 | -59.0 | -58.0 |
| 1024 QAM Light | | -60.7 | -60.7 | -60.2 | -60.5 | -60.5 | -60.5 | -60.0 | -59.5 | -59.0 | -59.5 | -59.5 | -59.5 | -58.5 | -58.5 | -57.5 |
| 2048 QAM | | -58.4 | -58.4 | -57.9 | -58.2 | -58.0 | -58.0 | -57.5 | -57.5 | -57.0 | -57.5 | -57.5 | -57.5 | -56.0 | -56.0 | -55.0 |
| 4096 QAM | | -55.3 | -55.3 | -54.8 | -55.1 | -55.0 | -55.0 | -54.5 | -54.0 | -54.0 | -54.5 | | | | | |



| 50 MHz | Freq | 6 | 7-8 | 10 | 11 | 13 | 15 | 18 | 23 | 24 | 26 | 28-31 | 32 | 36 | 38 | 42 |
|-----------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| BPSK | | -88.5 | -88.5 | -88.0 | -88.3 | -88.5 | -88.0 | -87.5 | -87.5 | -87.0 | -87.5 | -87.5 | -87.5 | -86.0 | -86.0 | |
| QPSK | | -85.6 | -85.6 | -85.1 | -85.4 | -85.5 | -85.0 | -84.5 | -84.5 | -84.0 | -84.5 | -84.5 | -84.5 | -83.5 | -83.5 | |
| 8 PSK | | -81.3 | -81.3 | -80.8 | -81.1 | -81.0 | -81.0 | -80.5 | -80.0 | -80.0 | -80.5 | -80.5 | -80.5 | -79.0 | -79.0 | |
| 16 QAM | | -78.4 | -78.4 | -77.9 | -78.2 | -78.0 | -78.0 | -77.5 | -77.5 | -77.0 | -77.5 | -77.5 | -77.5 | -76.0 | -76.0 | |
| 32 QAM | | -75.4 | -75.4 | -74.9 | -75.2 | -75.0 | -75.0 | -74.5 | -74.5 | -74.0 | -74.5 | -74.5 | -74.5 | -73.0 | -73.0 | |
| 64 QAM | | -72.0 | -72.0 | -71.5 | -71.8 | -72.0 | -71.5 | -71.0 | -71.0 | -70.5 | -71.0 | -71.0 | -71.0 | -69.5 | -69.5 | |
| 128 QAM | | -69.5 | -69.5 | -69.0 | -69.3 | -69.5 | -69.0 | -68.5 | -68.5 | -68.0 | -68.5 | -68.5 | -68.5 | -67.0 | -67.0 | |
| 256 QAM | | -65.9 | -65.9 | -65.4 | -65.7 | -65.5 | -65.5 | -65.0 | -65.0 | -64.5 | -65.0 | -65.0 | -65.0 | -63.5 | -63.5 | |
| 512 QAM | | -63.4 | -63.4 | -62.9 | -63.2 | -63.0 | -63.0 | -62.5 | -62.5 | -62.0 | -62.5 | -62.5 | -62.5 | -61.0 | -61.0 | |
| 1024 QAM Strong | | -60.0 | -60.0 | -59.5 | -59.8 | -60.0 | -59.5 | -59.0 | -59.0 | -58.5 | -59.0 | -59.0 | -59.0 | -57.5 | -57.5 | |
| 1024 QAM Light | | -59.2 | -59.2 | -58.7 | -59.0 | -59.0 | -59.0 | -58.5 | -58.0 | -57.5 | -58.0 | -58.0 | -58.0 | -57.0 | -57.0 | |
| 2048 QAM | | -56.9 | -56.9 | -56.4 | -56.7 | -56.5 | -56.5 | -56.0 | -56.0 | -55.5 | -56.0 | -56.0 | -56.0 | -54.5 | -54.5 | |
| 4096 QAM | | -53.4 | -53.4 | -52.9 | -53.2 | -53.0 | -53.0 | -52.5 | -52.5 | -52.0 | -52.5 | | | | | |
| 56 MHz | | | | | | | | | | | | | | | | |
| BPSK | | -88.0 | -88.0 | -87.5 | -87.8 | -88.0 | -87.5 | -87.0 | -87.0 | -86.5 | -87.0 | -87.0 | -87.0 | -85.5 | -85.5 | -84.5 |
| QPSK | | -84.8 | -84.8 | -84.3 | -84.6 | -84.5 | -84.5 | -84.0 | -83.5 | -83.5 | -84.0 | -84.0 | -84.0 | -82.5 | -82.5 | -81.5 |
| 8 PSK | | -80.7 | -80.7 | -80.2 | -80.5 | -80.5 | -80.5 | -80.0 | -79.5 | -79.0 | -79.5 | -79.5 | -79.5 | -78.5 | -78.5 | -77.5 |
| 16 QAM | | -77.8 | -77.8 | -77.3 | -77.6 | -77.5 | -77.5 | -77.0 | -76.5 | -76.5 | -77.0 | -77.0 | -77.0 | -75.5 | -75.5 | -74.5 |
| 32 QAM | | -74.5 | -74.5 | -74.0 | -74.3 | -74.5 | -74.0 | -73.5 | -73.5 | -73.0 | -73.5 | -73.5 | -73.5 | -72.0 | -72.0 | -71.0 |
| 64 QAM | | -71.5 | -71.5 | -71.0 | -71.3 | -71.5 | -71.0 | -70.5 | -70.5 | -70.0 | -70.5 | -70.5 | -70.5 | -69.0 | -69.0 | -68.0 |
| 128 QAM | | -68.6 | -68.6 | -68.1 | -68.4 | -68.5 | -68.0 | -67.5 | -67.5 | -67.0 | -67.5 | -67.5 | -67.5 | -66.5 | -66.5 | -65.5 |
| 256 QAM | | -65.4 | -65.4 | -64.9 | -65.2 | -65.0 | -65.0 | -64.5 | -64.5 | -64.0 | -64.5 | -64.5 | -64.5 | -63.0 | -63.0 | -62.0 |
| 512 QAM | | -62.8 | -62.8 | -62.3 | -62.6 | -62.5 | -62.5 | -62.0 | -61.5 | -61.5 | -62.0 | -62.0 | -62.0 | -60.5 | -60.5 | -59.5 |
| 1024 QAM Strong | | -59.5 | -59.5 | -59.0 | -59.3 | -59.5 | -59.0 | -58.5 | -58.5 | -58.0 | -58.5 | -58.5 | -58.5 | -57.0 | -57.0 | -56.0 |
| 1024 QAM Light | | -58.6 | -58.6 | -58.1 | -58.4 | -58.5 | -58.0 | -57.5 | -57.5 | -57.0 | -57.5 | -57.5 | -57.5 | -56.5 | -56.5 | -55.5 |
| 2048 QAM | | -56.8 | -56.8 | -56.3 | -56.6 | -56.5 | -56.5 | -56.0 | -55.5 | -55.5 | -56.0 | -56.0 | -56.0 | -54.5 | -54.5 | -53.5 |
| 4096 QAM | | -52.9 | -52.9 | -52.4 | -52.7 | -52.5 | -52.5 | -52.0 | -52.0 | -51.5 | -52.0 | | | | | |
| 60 MHz | | | | | | | | | | | | | | | | |
| BPSK | | -87.8 | -87.8 | -87.3 | -87.6 | -87.5 | -87.5 | -87.0 | -86.5 | -86.5 | -87.0 | -87.0 | -87.0 | -85.5 | -85.5 | |
| QPSK | | -84.6 | -84.6 | -84.1 | -84.4 | -84.5 | -84.0 | -83.5 | -83.5 | -83.0 | -83.5 | -83.5 | -83.5 | -82.5 | -82.5 | |
| 8 PSK | | -80.8 | -80.8 | -80.3 | -80.6 | -80.5 | -80.5 | -80.0 | -79.5 | -79.5 | -80.0 | -80.0 | -80.0 | -78.5 | -78.5 | |
| 16 QAM | | -77.6 | -77.6 | -77.1 | -77.4 | -77.5 | -77.0 | -76.5 | -76.5 | -76.0 | -76.5 | -76.5 | -76.5 | -75.5 | -75.5 | |
| 32 QAM | | -74.3 | -74.3 | -73.8 | -74.1 | -74.0 | -74.0 | -73.5 | -73.0 | -73.0 | -73.5 | -73.5 | -73.5 | -72.0 | -72.0 | |
| 64 QAM | | -71.2 | -71.2 | -70.7 | -71.0 | -71.0 | -71.0 | -70.5 | -70.0 | -69.5 | -70.0 | -70.0 | -70.0 | -69.0 | -69.0 | |
| 128 QAM | | -68.4 | -68.4 | -67.9 | -68.2 | -68.0 | -68.0 | -67.5 | -67.5 | -67.0 | -67.5 | -67.5 | -67.5 | -66.0 | -66.0 | |
| 256 QAM | | -65.2 | -65.2 | -64.7 | -65.0 | -65.0 | -65.0 | -64.5 | -64.0 | -63.5 | -64.0 | -64.0 | -64.0 | -63.0 | -63.0 | |
| 512 QAM | | -62.7 | -62.7 | -62.2 | -62.5 | -62.5 | -62.5 | -62.0 | -61.5 | -61.0 | -61.5 | -61.5 | -61.5 | -60.5 | -60.5 | |
| 1024 QAM Strong | | -59.4 | -59.4 | -58.9 | -59.2 | -59.0 | -59.0 | -58.5 | -58.5 | -58.0 | -58.5 | -58.5 | -58.5 | -57.0 | -57.0 | |
| 1024 QAM Light | | -58.6 | -58.6 | -58.1 | -58.4 | -58.5 | -58.0 | -57.5 | -57.5 | -57.0 | -57.5 | -57.5 | -57.5 | -56.5 | -56.5 | |
| 2048 QAM | | -56.3 | -56.3 | -55.8 | -56.1 | -56.0 | -56.0 | -55.5 | -55.0 | -55.0 | -55.5 | -55.5 | -55.5 | -54.0 | -54.0 | |
| 4096 QAM | | -52.5 | -52.5 | -52.0 | -52.3 | -52.5 | -52.0 | -51.5 | -51.5 | -51.0 | -51.5 | | | | | |



| 80 MHz | Freq | 6 | 7-8 | 10 | 11 | 13 | 15 | 18 | 23 | 24 | 26 | 28-31 | 32 | 36 | 38 | 42 |
|-----------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| BPSK | | -85.9 | -85.9 | -85.4 | -85.7 | -85.5 | -85.5 | -85.0 | -85.0 | -84.5 | -85.0 | -85.0 | -85.0 | -83.5 | -83.5 | -82.5 |
| QPSK | | -83.6 | -83.6 | -83.1 | -83.4 | -83.5 | -83.0 | -82.5 | -82.5 | -82.0 | -82.5 | -82.5 | -82.5 | -81.5 | -81.5 | -80.5 |
| 8 PSK | | -79.9 | -79.9 | -79.4 | -79.7 | -79.5 | -79.5 | -79.0 | -79.0 | -78.5 | -79.0 | -79.0 | -79.0 | -77.5 | -77.5 | -76.5 |
| 16 QAM | | -76.9 | -76.9 | -76.4 | -76.7 | -76.5 | -76.5 | -76.0 | -76.0 | -75.5 | -76.0 | -76.0 | -76.0 | -74.5 | -74.5 | -73.5 |
| 32 QAM | | -73.5 | -73.5 | -73.0 | -73.3 | -73.5 | -73.0 | -72.5 | -72.5 | -72.0 | -72.5 | -72.5 | -72.5 | -71.0 | -71.0 | -70.0 |
| 64 QAM | | -70.6 | -70.6 | -70.1 | -70.4 | -70.5 | -70.0 | -69.5 | -69.5 | -69.0 | -69.5 | -69.5 | -69.5 | -68.5 | -68.5 | -67.5 |
| 128 QAM | | -67.6 | -67.6 | -67.1 | -67.4 | -67.5 | -67.0 | -66.5 | -66.5 | -66.0 | -66.5 | -66.5 | -66.5 | -65.5 | -65.5 | -64.5 |
| 256 QAM | | -64.9 | -64.9 | -64.4 | -64.7 | -64.5 | -64.5 | -64.0 | -64.0 | -63.5 | -64.0 | -64.0 | -64.0 | -62.5 | -62.5 | -61.5 |
| 512 QAM | | -62.2 | -62.2 | -61.7 | -62.0 | -62.0 | -62.0 | -61.5 | -61.0 | -60.5 | -61.0 | -61.0 | -61.0 | -60.0 | -60.0 | -59.0 |
| 1024 QAM Strong | | -59.0 | -59.0 | -58.5 | -58.8 | -59.0 | -58.5 | -58.0 | -58.0 | -57.5 | -58.0 | -58.0 | -58.0 | -56.5 | -56.5 | -55.5 |
| 1024 QAM Light | | -58.6 | -58.6 | -58.1 | -58.4 | -58.5 | -58.0 | -57.5 | -57.5 | -57.0 | -57.5 | -57.5 | -57.5 | -56.5 | -56.5 | -55.5 |
| 2048 QAM | | -55.7 | -55.7 | -55.2 | -55.5 | -55.5 | -55.5 | -55.0 | -54.5 | -54.0 | -54.5 | -54.5 | -54.5 | -53.5 | -53.5 | -52.5 |
| 4096 QAM | | -52.1 | -52.1 | -51.6 | -51.9 | -52.0 | -51.5 | -51.0 | -51.0 | -50.5 | -51.0 | -51.0 | -51.0 | | | |
| 112 MHz | Frequency (GHz) | | | | | | | | | | | | | | | |
| BPSK | | -84.3 | -84.3 | -83.8 | -84.1 | -84.0 | -84.0 | -83.5 | -83.0 | -83.0 | -83.5 | -83.5 | -83.5 | -82.0 | -82.0 | -81.0 |
| QPSK | | -81.9 | -81.9 | -81.4 | -81.7 | -81.5 | -81.5 | -81.0 | -81.0 | -80.5 | -81.0 | -81.0 | -81.0 | -79.5 | -79.5 | -78.5 |
| 8 PSK | | -77.9 | -77.9 | -77.4 | -77.7 | -77.5 | -77.5 | -77.0 | -77.0 | -76.5 | -77.0 | -77.0 | -77.0 | -75.5 | -75.5 | -74.5 |
| 16 QAM | | -75.0 | -75.0 | -74.5 | -74.8 | -75.0 | -74.5 | -74.0 | -74.0 | -73.5 | -74.0 | -74.0 | -74.0 | -72.5 | -72.5 | -71.5 |
| 32 QAM | | -71.6 | -71.6 | -71.1 | -71.4 | -71.5 | -71.0 | -70.5 | -70.5 | -70.0 | -70.5 | -70.5 | -70.5 | -69.5 | -69.5 | -68.5 |
| 64 QAM | | -68.6 | -68.6 | -68.1 | -68.4 | -68.5 | -68.0 | -67.5 | -67.5 | -67.0 | -67.5 | -67.5 | -67.5 | -66.5 | -66.5 | -65.5 |
| 128 QAM | | -65.7 | -65.7 | -65.2 | -65.5 | -65.5 | -65.5 | -65.0 | -64.5 | -64.0 | -64.5 | -64.5 | -64.5 | -63.5 | -63.5 | -62.5 |
| 256 QAM | | -62.7 | -62.7 | -62.2 | -62.5 | -62.5 | -62.5 | -62.0 | -61.5 | -61.0 | -61.5 | -61.5 | -61.5 | -60.5 | -60.5 | -59.5 |
| 512 QAM | | -60.3 | -60.3 | -59.8 | -60.1 | -60.0 | -60.0 | -59.5 | -59.0 | -59.0 | -59.5 | -59.5 | -59.5 | -58.0 | -58.0 | -57.0 |
| 1024 QAM Strong | | -57.3 | -57.3 | -56.8 | -57.1 | -57.0 | -57.0 | -56.5 | -56.0 | -56.0 | -56.5 | -56.5 | -56.5 | -55.0 | -55.0 | -54.0 |
| 1024 QAM Light | | -56.6 | -56.6 | -56.1 | -56.4 | -56.5 | -56.0 | -55.5 | -55.5 | -55.0 | -55.5 | -55.5 | -55.5 | -54.5 | -54.5 | -53.5 |
| 2048 QAM | | -54.0 | -54.0 | -53.5 | -53.8 | -54.0 | -53.5 | -53.0 | -53.0 | -52.5 | -53.0 | -53.0 | -53.0 | -51.5 | -51.5 | -50.5 |
| 4096 QAM | | -51.3 | -51.3 | -50.8 | -51.1 | -51.0 | -51.0 | -50.5 | -50.0 | -50.0 | -50.5 | -50.5 | -50.5 | | | |
| 224 MHz† | Frequency (GHz) | | | | | | | | | | | | | | | |
| BPSK | | -82.1 | -82.1 | -81.6 | -81.9 | -82.0 | -81.5 | -81.0 | -81.0 | -80.5 | -81.0 | -81.0 | -81.0 | -80.0 | -80.0 | -79.0 |
| QPSK | | -79.0 | -79.0 | -78.5 | -78.8 | -79.0 | -78.5 | -78.0 | -78.0 | -77.5 | -78.0 | -78.0 | -78.0 | -76.5 | -76.5 | -75.5 |
| 8 PSK | | -75.2 | -75.2 | -74.7 | -75.0 | -75.0 | -75.0 | -74.5 | -74.0 | -73.5 | -74.0 | -74.0 | -74.0 | -73.0 | -73.0 | -72.0 |
| 16 QAM | | -72.2 | -72.2 | -71.7 | -72.0 | -72.0 | -72.0 | -71.5 | -71.0 | -70.5 | -71.0 | -71.0 | -71.0 | -70.0 | -70.0 | -69.0 |
| 32 QAM | | -68.6 | -68.6 | -68.1 | -68.4 | -68.5 | -68.0 | -67.5 | -67.5 | -67.0 | -67.5 | -67.5 | -67.5 | -66.5 | -66.5 | -65.5 |
| 64 QAM | | -65.3 | -65.3 | -64.8 | -65.1 | -65.0 | -65.0 | -64.5 | -64.0 | -64.0 | -64.5 | -64.5 | -64.5 | -63.0 | -63.0 | -62.0 |
| 128 QAM | | -62.7 | -62.7 | -62.2 | -62.5 | -62.5 | -62.5 | -62.0 | -61.5 | -61.0 | -61.5 | -61.5 | -61.5 | -60.5 | -60.5 | -59.5 |
| 256 QAM | | -59.7 | -59.7 | -59.2 | -59.5 | -59.5 | -59.5 | -59.0 | -58.5 | -58.0 | -58.5 | -58.5 | -58.5 | -57.5 | -57.5 | -56.5 |
| 512 QAM | | -56.8 | -56.8 | -56.3 | -56.6 | -56.5 | -56.5 | -56.0 | -55.5 | -55.5 | -56.0 | -56.0 | -56.0 | -54.5 | -54.5 | -53.5 |
| 1024 QAM Strong | | -53.7 | -53.7 | -53.2 | -53.5 | -53.5 | -53.5 | -53.0 | -52.5 | -52.0 | -52.5 | -52.5 | -52.5 | -51.5 | -51.5 | -50.5 |
| 2048 QAM | | -50.5 | -50.5 | -50.0 | -50.3 | -50.5 | -50.0 | -49.5 | | | | | | | | |

