CERAGON

Datasheet

IP-50C

November 2021 | Rev F

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

Note: HSB configurations are hardware-ready and planned for future release.

Radio Features

4+0 Layer 1 Link Bonding

Link Bonding with IP-20C and IP-20C-HP

Link Bonding with IP-20N or IP-20A

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)*

Multiband with Layer 1 Link Bonding (with 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.

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)

* Planned for future release.

† 224 MHz is only supported with certain hardware versions. For details, ask your Ceragon representative..

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: FCC Part 101, EN 302 217-2

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: ±(18/40.5 to 60) VDC (+18VDC extended range is supported as part of the nominal +24VDC support)

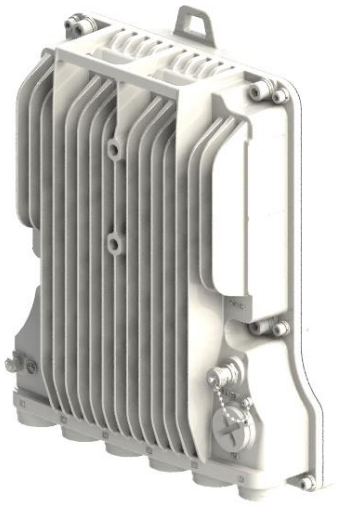
PoE Injector Interfaces

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 ±(18-60)V is available)

Product Image



Radio Specifications

Capacity [Mbps]

Modulation	14 MHz	20 MHz	25 MHz	28/30 MHz	40 MHz	50 MHz
BPSK	–	10-13	14-17	18-22	25-31	33-40
QPSK	16-20	25-30	32-40	40-48	54-67	67-82
8 QAM	26-32	39-47	50-61	59-72	83-101	105-129
16 QAM	37-46	54-66	69-84	84-102	113-139	144-176
32 QAM	50-61	72-88	92-112	111-136	150-184	181-222
64 QAM	62-76	89-109	113-139	138-168	185-227	235-287
128 QAM	76-93	108-132	137-168	166-203	225-275	275-336
256 QAM	87-106	123-150	157-192	192-234	242-296	326-399
512 QAM	96-118	134-164	174-212	204-249	265-324	354-433
1024 QAM Strong	102-125	143-175	185-226	223-272	301-368	386-472
1024 QAM Light	108-132	152-186	196-240	236-289	320-391	410-501
2048 QAM	113-138	162-198	211-258	258-315	346-423	442-541
4096 QAM	–	–	228-279	275-336	366-448	459-561

	56/60 MHz	80 MHz	112 MHz	160 MHz	224 MHz
BPSK	40-49	54-66	79-97	112-137	162-198
QPSK	83-102	111-135	162-198	228-279	328-401
8 QAM	123-150	158-193	242-296	340-416	489-597
16 QAM	172-210	227-277	330-404	463-566	665-812
32 QAM	227-277	298-365	435-532	610-745	875-1069
64 QAM	279-341	366-447	535-654	776-948	1111-1358
128 QAM	338-413	433-529	647-791	905-1107	1298-1587
256 QAM	391-478	498-609	740-905	1035-1266	1484-1815
512 QAM	420-514	548-670	804-983	1171-1431	1678-2051
1024 QAM Strong	457-559	596-729	872-1066	1301-1590	1860-2274
1024 QAM Light	486-594	633-774	926-1132	1301-1590	–
2048 QAM	527-644	670-820	999-1221	1431-1749	2009-2456
4096 QAM	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	22	22	22	22	15
8 QAM		28	28	28	28	26	25	24	24	22	22	22	22	15
16 QAM		28	27	27	28	24	24	24	24	21	21	21	21	15
32 QAM		28	27	26	28	24	24	24	24	21	21	21	21	14
64 QAM		28	26	26	27	24	24	23	24	20	20	20	20	13
128 QAM		27	26	26	26	24	24	23	24	19	20	20	20	13
256 QAM		27	26	26	26	24	23	23	23	18	19	19	19	13
512 QAM		27	25	24	26	23	22	22	22	18	19	19	19	11
1024 QAM		26	24	24	25	22	21	21	21	17	18	18	18	11
2048 QAM		25	23	22	24	21	21	20	20	16	18	18	18	10
4096 QAM		24	21	20	22	20	20	19	19	15	17	17		

Receive Level Threshold [dBm@10E-6]

Note: 160 MHz and 224 MHz channels are not supported with 6 GHz. For 7-8 GHz, support for 160 MHz and 224 MHz channels may be offered in future releases.

14 MHz GHz	6	7	8	10-11	13	15	18	23	24	26	28-31	32	36	38	42
BPSK	-93.4	-92.9	-92.8	-92.3	-92.3	-92.0	-93.3	-91.8	-90.8	-91.3	-91.3	-91.1	-91.1	-91.3	-90.3
QPSK	-90.5	-90.0	-89.9	-89.4	-89.4	-89.1	-90.4	-88.9	-87.9	-88.4	-88.4	-88.2	-88.2	-88.4	-87.4
8 PSK	-86.6	-86.1	-86.0	-85.5	-85.5	-85.2	-86.5	-85.0	-84.0	-84.5	-84.5	-84.3	-84.3	-84.5	-83.5
16 QAM	-83.5	-83.0	-82.9	-82.4	-82.4	-82.1	-83.4	-81.9	-80.9	-81.4	-81.4	-81.2	-81.2	-81.4	-80.4
32 QAM	-80.2	-79.7	-79.6	-79.1	-79.1	-78.8	-80.1	-78.6	-77.6	-78.1	-78.1	-77.9	-77.9	-78.1	-77.1
64 QAM	-77.0	-76.5	-76.4	-75.9	-75.9	-75.6	-76.9	-75.4	-74.4	-74.9	-74.9	-74.7	-74.7	-74.9	-73.9
128 QAM	-73.9	-73.4	-73.3	-72.8	-72.8	-72.5	-73.8	-72.3	-71.3	-71.8	-71.8	-71.6	-71.6	-71.8	-70.8
256 QAM	-70.5	-70.0	-69.9	-69.4	-69.4	-69.1	-70.4	-68.9	-67.9	-68.4	-68.4	-68.2	-68.2	-68.4	-67.4
512 QAM	-67.6	-67.1	-67.0	-66.5	-66.5	-66.2	-67.5	-66.0	-65.0	-65.5	-65.5	-65.3	-65.3	-65.5	-64.5
1024 QAM Strong	-64.1	-63.6	-63.5	-63.0	-63.0	-62.7	-64.0	-62.5	-61.5	-62.0	-62.0	-61.8	-61.8	-62.0	-61.0
1024 QAM Light	-63.2	-62.7	-62.6	-62.1	-62.1	-61.8	-63.1	-61.6	-60.6	-61.1	-61.1	-60.9	-60.9	-61.1	-60.1
2048 QAM	-60.0	-59.5	-59.4	-58.9	-58.9	-58.6	-59.9	-58.4	-57.4	-57.9	-57.9	-57.7	-57.7	-57.9	-57.0
20 MHz															
BPSK	-91.9	-91.4	-91.3	-90.8	-90.8	-90.5	-91.9	-90.4	-89.3	-89.8	-89.8	-89.6	-89.6	-89.9	
QPSK	-89.0	-88.5	-88.4	-87.9	-87.9	-87.6	-89.0	-87.5	-86.4	-86.9	-86.9	-86.7	-86.7	-87.0	
8 PSK	-85.0	-84.5	-84.4	-83.9	-83.9	-83.6	-85.0	-83.5	-82.4	-82.9	-82.9	-82.7	-82.7	-83.0	
16 QAM	-82.1	-81.6	-81.5	-81.0	-81.0	-80.7	-82.1	-80.6	-79.5	-80.0	-80.0	-79.8	-79.8	-80.1	
32 QAM	-78.7	-78.2	-78.1	-77.6	-77.6	-77.3	-78.7	-77.2	-76.1	-76.6	-76.6	-76.4	-76.4	-76.7	
64 QAM	-75.5	-75.0	-74.9	-74.4	-74.4	-74.1	-75.5	-74.0	-72.9	-73.4	-73.4	-73.2	-73.2	-73.5	
128 QAM	-72.5	-72.0	-71.9	-71.4	-71.4	-71.1	-72.5	-71.0	-69.9	-70.4	-70.4	-70.2	-70.2	-70.5	
256 QAM	-69.4	-68.9	-68.8	-68.3	-68.3	-68.0	-69.4	-67.9	-66.8	-67.3	-67.3	-67.1	-67.1	-67.4	
512 QAM	-66.6	-66.1	-66.0	-65.5	-65.5	-65.2	-66.6	-65.1	-64.0	-64.5	-64.5	-64.3	-64.3	-64.6	
1024 QAM Strong	-63.7	-63.2	-63.1	-62.6	-62.6	-62.3	-63.7	-62.2	-61.1	-61.6	-61.6	-61.4	-61.4	-61.7	
1024 QAM Light	-63.0	-62.5	-62.4	-61.9	-61.9	-61.6	-63.0	-61.5	-60.4	-60.9	-60.9	-60.7	-60.7	-61.0	
2048 QAM	-60.5	-60.0	-59.9	-59.4	-59.4	-59.1	-60.5	-59.0	-57.9	-58.4	-58.4	-58.2	-58.2	-58.5	
25 MHz															
BPSK	-90.9	-90.4	-90.3	-89.8	-89.8	-89.5	-90.9	-89.4	-88.3	-88.8	-88.8	-88.6	-88.6	-88.9	
QPSK	-87.9	-87.4	-87.3	-86.8	-86.8	-86.5	-87.9	-86.4	-85.3	-85.8	-85.8	-85.6	-85.6	-85.9	
8 PSK	-83.9	-83.4	-83.3	-82.8	-82.8	-82.5	-83.9	-82.4	-81.3	-81.8	-81.8	-81.6	-81.6	-81.9	
16 QAM	-81.0	-80.5	-80.4	-79.9	-79.9	-79.6	-81.0	-79.5	-78.4	-78.9	-78.9	-78.7	-78.7	-79.0	
32 QAM	-77.7	-77.2	-77.1	-76.6	-76.6	-76.3	-77.7	-76.2	-75.1	-75.6	-75.6	-75.4	-75.4	-75.7	
64 QAM	-74.6	-74.1	-74.0	-73.5	-73.5	-73.2	-74.6	-73.1	-72.0	-72.5	-72.5	-72.3	-72.3	-72.6	
128 QAM	-71.5	-71.0	-70.9	-70.4	-70.4	-70.1	-71.5	-70.0	-68.9	-69.4	-69.4	-69.2	-69.2	-69.5	
256 QAM	-68.4	-67.9	-67.8	-67.3	-67.3	-67.0	-68.4	-66.9	-65.8	-66.3	-66.3	-66.1	-66.1	-66.4	
512 QAM	-65.5	-65.0	-64.9	-64.4	-64.4	-64.1	-65.5	-64.0	-62.9	-63.4	-63.4	-63.2	-63.2	-63.5	
1024 QAM Strong	-62.6	-62.1	-62.0	-61.5	-61.5	-61.2	-62.6	-61.1	-60.0	-60.5	-60.5	-60.3	-60.3	-60.6	
1024 QAM Light	-61.7	-61.2	-61.1	-60.6	-60.6	-60.3	-61.7	-60.2	-59.1	-59.6	-59.6	-59.4	-59.4	-59.7	
2048 QAM	-59.6	-59.1	-59.0	-58.5	-58.5	-58.2	-59.6	-58.1	-57.0	-57.5	-57.5	-57.3	-57.3	-57.6	
4096 QAM	-55.5	-55.0	-54.9	-54.4	-54.4	-54.1	-55.5	-54.0	-52.9	-53.4					

28 MHz	Freq	6	7	8	10-11	13	15	18	23	24	26	28-31	32	36	38	42
BPSK		-90.4	-89.9	-89.8	-89.3	-89.3	-88.9	-90.3	-88.8	-87.8	-88.3	-88.3	-88.1	-88.1	-88.3	-87.3
QPSK		-87.4	-86.9	-86.8	-86.3	-86.3	-85.9	-87.3	-85.8	-84.8	-85.3	-85.3	-85.1	-85.1	-85.3	-84.3
8 PSK		-83.5	-83.0	-82.9	-82.4	-82.4	-82.0	-83.4	-81.9	-80.9	-81.4	-81.4	-81.2	-81.2	-81.4	-80.4
16 QAM		-80.5	-80.0	-79.9	-79.4	-79.4	-79.0	-80.4	-78.9	-77.9	-78.4	-78.4	-78.2	-78.2	-78.4	-77.4
32 QAM		-77.2	-76.7	-76.6	-76.1	-76.1	-75.7	-77.1	-75.6	-74.6	-75.1	-75.1	-74.9	-74.9	-75.1	-74.1
64 QAM		-74.2	-73.7	-73.6	-73.1	-73.1	-72.7	-74.1	-72.6	-71.6	-72.1	-72.1	-71.9	-71.9	-72.1	-71.1
128 QAM		-71.1	-70.6	-70.5	-70.0	-70.0	-69.6	-71.0	-69.5	-68.5	-69.0	-69.0	-68.8	-68.8	-69.0	-68.0
256 QAM		-68.0	-67.5	-67.4	-66.9	-66.9	-66.5	-67.9	-66.4	-65.4	-65.9	-65.9	-65.7	-65.7	-65.9	-64.9
512 QAM		-65.2	-64.7	-64.6	-64.1	-64.1	-63.7	-65.1	-63.6	-62.6	-63.1	-63.1	-62.9	-62.9	-63.1	-62.1
1024 QAM Strong		-62.3	-61.8	-61.7	-61.2	-61.2	-60.8	-62.2	-60.7	-59.7	-60.2	-60.2	-60.0	-60.0	-60.2	-59.2
1024 QAM Light		-61.6	-61.1	-61.0	-60.5	-60.5	-60.1	-61.5	-60.0	-59.0	-59.5	-59.5	-59.3	-59.3	-59.5	-58.5
2048 QAM		-59.1	-58.6	-58.5	-58.0	-58.0	-57.6	-59.0	-57.5	-56.5	-57.0	-57.0	-56.8	-56.8	-57.0	-56.0
4096 QAM		-55.1	-54.6	-54.5	-54.0	-54.0	-53.6	-55.0	-53.5	-52.5	-53.0	-	-	-	-	-
30 MHz																
BPSK		-90.2	-89.7	-89.6	-89.1	-89.1	-88.8	-90.2	-88.7	-87.6	-88.1	-88.1	-87.9	-87.9	-88.2	
QPSK		-87.2	-86.7	-86.6	-86.1	-86.1	-85.8	-87.2	-85.7	-84.6	-85.1	-85.1	-84.9	-84.9	-85.2	
8 PSK		-83.2	-82.7	-82.6	-82.1	-82.1	-81.8	-83.2	-81.7	-80.6	-81.1	-81.1	-80.9	-80.9	-81.2	
16 QAM		-80.2	-79.7	-79.6	-79.1	-79.1	-78.8	-80.2	-78.7	-77.6	-78.1	-78.1	-77.9	-77.9	-78.2	
32 QAM		-76.9	-76.4	-76.3	-75.8	-75.8	-75.5	-76.9	-75.4	-74.3	-74.8	-74.8	-74.6	-74.6	-74.9	
64 QAM		-73.8	-73.3	-73.2	-72.7	-72.7	-72.4	-73.8	-72.3	-71.2	-71.7	-71.7	-71.5	-71.5	-71.8	
128 QAM		-70.8	-70.3	-70.2	-69.7	-69.7	-69.4	-70.8	-69.3	-68.2	-68.7	-68.7	-68.5	-68.5	-68.8	
256 QAM		-67.6	-67.1	-67.0	-66.5	-66.5	-66.2	-67.6	-66.1	-65.0	-65.5	-65.5	-65.3	-65.3	-65.6	
512 QAM		-65.3	-64.8	-64.7	-64.2	-64.2	-63.9	-65.3	-63.8	-62.7	-63.2	-63.2	-63.0	-63.0	-63.3	
1024 QAM Strong		-62.0	-61.5	-61.4	-60.9	-60.9	-60.6	-62.0	-60.5	-59.4	-59.9	-59.9	-59.7	-59.7	-60.0	
1024 QAM Light		-61.2	-60.7	-60.6	-60.1	-60.1	-59.8	-61.2	-59.7	-58.6	-59.1	-59.1	-58.9	-58.9	-59.2	
2048 QAM		-58.7	-58.2	-58.1	-57.6	-57.6	-57.3	-58.7	-57.2	-56.1	-56.6	-56.6	-56.4	-56.4	-56.7	
4096 QAM		-55.0	-54.5	-54.4	-53.9	-53.9	-53.6	-55.0	-53.5	-52.4	-52.9	-	-	-	-	
40 MHz																
BPSK		-89.2	-88.7	-88.6	-88.1	-88.1	-87.7	-89.1	-87.6	-86.6	-87.1	-87.1	-86.9	-86.9	-87.1	-86.1
QPSK		-86.0	-85.5	-85.4	-84.9	-84.9	-84.5	-85.9	-84.4	-83.4	-83.9	-83.9	-83.7	-83.7	-83.9	-82.9
8 PSK		-82.0	-81.5	-81.4	-80.9	-80.9	-80.5	-81.9	-80.4	-79.4	-79.9	-79.9	-79.7	-79.7	-79.9	-78.9
16 QAM		-79.1	-78.6	-78.5	-78.0	-78.0	-77.6	-79.0	-77.5	-76.5	-77.0	-77.0	-76.8	-76.8	-77.0	-76.0
32 QAM		-75.7	-75.2	-75.1	-74.6	-74.6	-74.2	-75.6	-74.1	-73.1	-73.6	-73.6	-73.4	-73.4	-73.6	-72.6
64 QAM		-72.6	-72.1	-72.0	-71.5	-71.5	-71.1	-72.5	-71.0	-70.0	-70.5	-70.5	-70.3	-70.3	-70.5	-69.5
128 QAM		-69.6	-69.1	-69.0	-68.5	-68.5	-68.1	-69.5	-68.0	-67.0	-67.5	-67.5	-67.3	-67.3	-67.5	-66.5
256 QAM		-67.3	-66.8	-66.7	-66.2	-66.2	-65.8	-67.2	-65.7	-64.7	-65.2	-65.2	-65.0	-65.0	-65.2	-64.2
512 QAM		-64.5	-64.0	-63.9	-63.4	-63.4	-63.0	-64.4	-62.9	-61.9	-62.4	-62.4	-62.2	-62.2	-62.4	-61.4
1024 QAM Strong		-61.0	-60.5	-60.4	-59.9	-59.9	-59.5	-60.9	-59.4	-58.4	-58.9	-58.9	-58.7	-58.7	-58.9	-57.9
1024 QAM Light		-60.3	-59.8	-59.7	-59.2	-59.2	-58.8	-60.2	-58.7	-57.7	-58.2	-58.2	-58.0	-58.0	-58.2	-57.2
2048 QAM		-58.0	-57.5	-57.4	-56.9	-56.9	-56.5	-57.9	-56.4	-55.4	-55.9	-55.9	-55.7	-55.7	-55.9	-54.9
4096 QAM		-54.9	-54.4	-54.3	-53.8	-53.8	-53.4	-54.8	-53.3	-52.3	-52.8	-	-	-	-	-

50 MHz	Freq	6	7	8	10-11	13	15	18	23	24	26	28-31	32	36	38	42
BPSK		-88.1	-87.5	-87.5	-87.0	-87.0	-86.6	-88.0	-86.5	-85.4	-85.9	-86.0	-85.7	-85.7	-86.0	
QPSK		-85.2	-84.6	-84.6	-84.1	-84.1	-83.7	-85.1	-83.6	-82.5	-83.0	-83.1	-82.8	-82.8	-83.1	
8 PSK		-80.9	-80.3	-80.3	-79.8	-79.8	-79.4	-80.8	-79.3	-78.2	-78.7	-78.8	-78.5	-78.5	-78.8	
16 QAM		-78.0	-77.4	-77.4	-76.9	-76.9	-76.5	-77.9	-76.4	-75.3	-75.8	-75.9	-75.6	-75.6	-75.9	
32 QAM		-75.0	-74.4	-74.4	-73.9	-73.9	-73.5	-74.9	-73.4	-72.3	-72.8	-72.9	-72.6	-72.6	-72.9	
64 QAM		-71.6	-71.0	-71.0	-70.5	-70.5	-70.1	-71.5	-70.0	-68.9	-69.4	-69.5	-69.2	-69.2	-69.5	
128 QAM		-69.1	-68.5	-68.5	-68.0	-68.0	-67.6	-69.0	-67.5	-66.4	-66.9	-67.0	-66.7	-66.7	-67.0	
256 QAM		-65.5	-64.9	-64.9	-64.4	-64.4	-64.0	-65.4	-63.9	-62.8	-63.3	-63.4	-63.1	-63.1	-63.4	
512 QAM		-63.0	-62.4	-62.4	-61.9	-61.9	-61.5	-62.9	-61.4	-60.3	-60.8	-60.9	-60.6	-60.6	-60.9	
1024 QAM Strong		-59.6	-59.0	-59.0	-58.5	-58.5	-58.1	-59.5	-58.0	-56.9	-57.4	-57.5	-57.2	-57.2	-57.5	
1024 QAM Light		-58.8	-58.2	-58.2	-57.7	-57.7	-57.3	-58.7	-57.2	-56.1	-56.6	-56.7	-56.4	-56.4	-56.7	
2048 QAM		-56.5	-55.9	-55.9	-55.4	-55.4	-55.0	-56.4	-54.9	-53.8	-54.3	-54.4	-54.1	-54.1	-54.4	
4096 QAM		-53.0	-52.4	-52.4	-51.9	-51.9	-51.5	-52.9	-51.4	-50.3	-50.8	-	-	-	-	
56 MHz																
BPSK		-87.6	-87.0	-87.0	-86.5	-86.5	-86.1	-87.5	-86.0	-84.9	-85.4	-85.5	-85.2	-85.2	-85.5	-84.5
QPSK		-84.4	-83.8	-83.8	-83.3	-83.3	-82.9	-84.3	-82.8	-81.7	-82.2	-82.3	-82.0	-82.0	-82.3	-81.3
8 PSK		-80.3	-79.7	-79.7	-79.2	-79.2	-78.8	-80.2	-78.7	-77.6	-78.1	-78.2	-77.9	-77.9	-78.2	-77.2
16 QAM		-77.4	-76.8	-76.8	-76.3	-76.3	-75.9	-77.3	-75.8	-74.7	-75.2	-75.3	-75.0	-75.0	-75.3	-74.3
32 QAM		-74.1	-73.5	-73.5	-73.0	-73.0	-72.6	-74.0	-72.5	-71.4	-71.9	-72.0	-71.7	-71.7	-72.0	-71.0
64 QAM		-71.1	-70.5	-70.5	-70.0	-70.0	-69.6	-71.0	-69.5	-68.4	-68.9	-69.0	-68.7	-68.7	-69.0	-68.0
128 QAM		-68.2	-67.6	-67.6	-67.1	-67.1	-66.7	-68.1	-66.6	-65.5	-66.0	-66.1	-65.8	-65.8	-66.1	-65.1
256 QAM		-65.0	-64.4	-64.4	-63.9	-63.9	-63.5	-64.9	-63.4	-62.3	-62.8	-62.9	-62.6	-62.6	-62.9	-61.9
512 QAM		-62.4	-61.8	-61.8	-61.3	-61.3	-60.9	-62.3	-60.8	-59.7	-60.2	-60.3	-60.0	-60.0	-60.3	-59.3
1024 QAM Strong		-59.1	-58.5	-58.5	-58.0	-58.0	-57.6	-59.0	-57.5	-56.4	-56.9	-57.0	-56.7	-56.7	-57.0	-56.0
1024 QAM Light		-58.2	-57.6	-57.6	-57.1	-57.1	-56.7	-58.1	-56.6	-55.5	-56.0	-56.1	-55.8	-55.8	-56.1	-55.1
2048 QAM		-56.4	-55.8	-55.8	-55.3	-55.3	-54.9	-56.3	-54.8	-53.7	-54.2	-54.3	-54.0	-54.0	-54.3	-53.3
4096 QAM		-52.5	-51.9	-51.9	-51.4	-51.4	-51.0	-52.4	-50.9	-49.8	-50.3	-	-	-	-	-
60 MHz																
BPSK		-87.3	-86.8	-86.8	-86.2	-86.3	-85.9	-87.3	-85.8	-84.7	-85.2	-85.2	-85.0	-85.0	-85.3	
QPSK		-84.1	-83.6	-83.6	-83.0	-83.1	-82.7	-84.1	-82.6	-81.5	-82.0	-82.0	-81.8	-81.8	-82.1	
8 PSK		-80.3	-79.8	-79.8	-79.2	-79.3	-78.9	-80.3	-78.8	-77.7	-78.2	-78.2	-78.0	-78.0	-78.3	
16 QAM		-77.1	-76.6	-76.6	-76.0	-76.1	-75.7	-77.1	-75.6	-74.5	-75.0	-75.0	-74.8	-74.8	-75.1	
32 QAM		-73.8	-73.3	-73.3	-72.7	-72.8	-72.4	-73.8	-72.3	-71.2	-71.7	-71.7	-71.5	-71.5	-71.8	
64 QAM		-70.7	-70.2	-70.2	-69.6	-69.7	-69.3	-70.7	-69.2	-68.1	-68.6	-68.6	-68.4	-68.4	-68.7	
128 QAM		-67.9	-67.4	-67.4	-66.8	-66.9	-66.5	-67.9	-66.4	-65.3	-65.8	-65.8	-65.6	-65.6	-65.9	
256 QAM		-64.7	-64.2	-64.2	-63.6	-63.7	-63.3	-64.7	-63.2	-62.1	-62.6	-62.6	-62.4	-62.4	-62.7	
512 QAM		-62.2	-61.7	-61.7	-61.1	-61.2	-60.8	-62.2	-60.7	-59.6	-60.1	-60.1	-59.9	-59.9	-60.2	
1024 QAM Strong		-58.9	-58.4	-58.4	-57.8	-57.9	-57.5	-58.9	-57.4	-56.3	-56.8	-56.8	-56.6	-56.6	-56.9	
1024 QAM Light		-58.1	-57.6	-57.6	-57.0	-57.1	-56.7	-58.1	-56.6	-55.5	-56.0	-56.0	-55.8	-55.8	-56.1	
2048 QAM		-55.8	-55.3	-55.3	-54.7	-54.8	-54.4	-55.8	-54.3	-53.2	-53.7	-53.7	-53.5	-53.5	-53.8	
4096 QAM		-52.0	-51.5	-51.5	-50.9	-51.0	-50.6	-52.0	-50.5	-49.4	-49.9	-	-	-	-	

80 MHz	Freq	6	7	8	10-11	13	15	18	23	24	26	28-31	32	36	38	42
BPSK		-85.4	-84.9	-84.8	-84.3	-84.3	-84.0	-85.4	-83.8	-82.8	-83.3	-83.3	-83.1	-83.1	-83.4	-82.4
QPSK		-83.1	-82.6	-82.5	-82.0	-82.0	-81.7	-83.1	-81.5	-80.5	-81.0	-81.0	-80.8	-80.8	-81.1	-80.1
8 PSK		-79.4	-78.9	-78.8	-78.3	-78.3	-78.0	-79.4	-77.8	-76.8	-77.3	-77.3	-77.1	-77.1	-77.4	-76.4
16 QAM		-76.4	-75.9	-75.8	-75.3	-75.3	-75.0	-76.4	-74.8	-73.8	-74.3	-74.3	-74.1	-74.1	-74.4	-73.4
32 QAM		-73.0	-72.5	-72.4	-71.9	-71.9	-71.6	-73.0	-71.4	-70.4	-70.9	-70.9	-70.7	-70.7	-71.0	-70.0
64 QAM		-70.1	-69.6	-69.5	-69.0	-69.0	-68.7	-70.1	-68.5	-67.5	-68.0	-68.0	-67.8	-67.8	-68.1	-67.1
128 QAM		-67.1	-66.6	-66.5	-66.0	-66.0	-65.7	-67.1	-65.5	-64.5	-65.0	-65.0	-64.8	-64.8	-65.1	-64.1
256 QAM		-64.4	-63.9	-63.8	-63.3	-63.3	-63.0	-64.4	-62.8	-61.8	-62.3	-62.3	-62.1	-62.1	-62.4	-61.4
512 QAM		-61.7	-61.2	-61.1	-60.6	-60.6	-60.3	-61.7	-60.1	-59.1	-59.6	-59.6	-59.4	-59.4	-59.7	-58.7
1024 QAM Strong		-58.5	-58.0	-57.9	-57.4	-57.4	-57.1	-58.5	-56.9	-55.9	-56.4	-56.4	-56.2	-56.2	-56.5	-55.5
1024 QAM Light		-58.1	-57.6	-57.5	-57.0	-57.0	-56.7	-58.1	-56.5	-55.5	-56.0	-56.0	-55.8	-55.8	-56.1	-55.1
2048 QAM		-55.2	-54.7	-54.6	-54.1	-54.1	-53.8	-55.2	-53.6	-52.6	-53.1	-53.1	-52.9	-52.9	-53.2	-52.2
4096 QAM		-51.6	-51.1	-51.0	-50.5	-50.5	-50.2	-51.6	-50.0	-49.0	-49.5	-49.5	-49.3	-49.3	-	-
112 MHz																
BPSK		-83.8	-83.3	-83.3	-82.8	-82.8	-82.4	-83.8	-82.3	-81.2	-81.7	-81.7	-81.5	-81.5	-81.8	-80.8
QPSK		-81.4	-80.9	-80.9	-80.4	-80.4	-80.0	-81.4	-79.9	-78.8	-79.3	-79.3	-79.1	-79.1	-79.4	-78.4
8 PSK		-77.4	-76.9	-76.9	-76.4	-76.4	-76.0	-77.4	-75.9	-74.8	-75.3	-75.3	-75.1	-75.1	-75.4	-74.4
16 QAM		-74.5	-74.0	-74.0	-73.5	-73.5	-73.1	-74.5	-73.0	-71.9	-72.4	-72.4	-72.2	-72.2	-72.5	-71.5
32 QAM		-71.1	-70.6	-70.6	-70.1	-70.1	-69.7	-71.1	-69.6	-68.5	-69.0	-69.0	-68.8	-68.8	-69.1	-68.1
64 QAM		-68.1	-67.6	-67.6	-67.1	-67.1	-66.7	-68.1	-66.6	-65.5	-66.0	-66.0	-65.8	-65.8	-66.1	-65.1
128 QAM		-65.2	-64.7	-64.7	-64.2	-64.2	-63.8	-65.2	-63.7	-62.6	-63.1	-63.1	-62.9	-62.9	-63.2	-62.2
256 QAM		-62.2	-61.7	-61.7	-61.2	-61.2	-60.8	-62.2	-60.7	-59.6	-60.1	-60.1	-59.9	-59.9	-60.2	-59.2
512 QAM		-59.8	-59.3	-59.3	-58.8	-58.8	-58.4	-59.8	-58.3	-57.2	-57.7	-57.7	-57.5	-57.5	-57.8	-56.8
1024 QAM Strong		-56.8	-56.3	-56.3	-55.8	-55.8	-55.4	-56.8	-55.3	-54.2	-54.7	-54.7	-54.5	-54.5	-54.8	-53.8
1024 QAM Light		-56.1	-55.6	-55.6	-55.1	-55.1	-54.7	-56.1	-54.6	-53.5	-54.0	-54.0	-53.8	-53.8	-54.1	-53.1
2048 QAM		-53.5	-53.0	-53.0	-52.5	-52.5	-52.1	-53.5	-52.0	-50.9	-51.4	-51.4	-51.2	-51.2	-51.5	-50.5
4096 QAM		-50.8	-50.3	-50.3	-49.8	-49.8	-49.4	-50.8								
160 MHz																
BPSK			-82.7	-82.6	-82.1	-82.1	-81.8	-83.2	-81.6	-80.6	-81.1	-81.1	-80.9	-80.9	-81.2	-80.2
QPSK			-79.6	-79.5	-79.0	-79.0	-78.7	-80.1	-78.5	-77.5	-78.0	-78.0	-77.8	-77.8	-78.1	-77.1
8 PSK			-75.8	-75.7	-75.2	-75.2	-74.9	-76.3	-74.7	-73.7	-74.2	-74.2	-74.0	-74.0	-74.3	-73.3
16 QAM			-72.8	-72.7	-72.2	-72.2	-71.9	-73.3	-71.7	-70.7	-71.2	-71.2	-71.0	-71.0	-71.3	-70.3
32 QAM			-69.2	-69.1	-68.6	-68.6	-68.3	-69.7	-68.1	-67.1	-67.6	-67.6	-67.4	-67.4	-67.7	-66.7
64 QAM			-65.9	-65.8	-65.3	-65.3	-65.0	-66.4	-64.8	-63.8	-64.3	-64.3	-64.1	-64.1	-64.4	-63.4
128 QAM			-63.3	-63.2	-62.7	-62.7	-62.4	-63.8	-62.2	-61.2	-61.7	-61.7	-61.5	-61.5	-61.8	-60.8
256 QAM			-60.4	-60.3	-59.8	-59.8	-59.5	-60.9	-59.3	-58.3	-58.8	-58.8	-58.6	-58.6	-58.9	-57.9
512 QAM			-57.4	-57.3	-56.8	-56.8	-56.5	-57.9	-56.3	-55.3	-55.8	-55.8	-55.6	-55.6	-55.9	-54.9
1024 QAM			-54.3	-54.2	-53.7	-53.7	-53.4	-54.8	-53.2	-52.2	-52.7	-52.7	-52.5	-52.5	-52.8	-51.8
2048 QAM			-50.8	-50.7	-50.2	-50.2	-49.9	-51.3	-49.7	-48.7	-49.2	-49.2	-49.0	-49.0	-49.3	-48.3

224 MHz	Freq	6	7	8	10-11	13	15	18	23	24	26	28-31	32	36	38	42
BPSK			-81.1	-81.1	-80.5	-80.6	-80.2	-81.6	-80.1	-79.0	-79.5	-79.5	-79.3	-79.3	-79.6	-78.6
QPSK			-78.0	-78.0	-77.4	-77.5	-77.1	-78.5	-77.0	-75.9	-76.4	-76.4	-76.2	-76.2	-76.5	-75.5
8 PSK			-74.2	-74.2	-73.6	-73.7	-73.3	-74.7	-73.2	-72.1	-72.6	-72.6	-72.4	-72.4	-72.7	-71.7
16 QAM			-71.2	-71.2	-70.6	-70.7	-70.3	-71.7	-70.2	-69.1	-69.6	-69.6	-69.4	-69.4	-69.7	-68.7
32 QAM			-67.6	-67.6	-67.0	-67.1	-66.7	-68.1	-66.6	-65.5	-66.0	-66.0	-65.8	-65.8	-66.1	-65.1
64 QAM			-64.3	-64.3	-63.7	-63.8	-63.4	-64.8	-63.3	-62.2	-62.7	-62.7	-62.5	-62.5	-62.8	-61.8
128 QAM			-61.7	-61.7	-61.1	-61.2	-60.8	-62.2	-60.7	-59.6	-60.1	-60.1	-59.9	-59.9	-60.2	-59.2
256 QAM			-58.7	-58.7	-58.1	-58.2	-57.8	-59.2	-57.7	-56.6	-57.1	-57.1	-56.9	-56.9	-57.2	-56.2
512 QAM			-55.8	-55.8	-55.2	-55.3	-54.9	-56.3	-54.8	-53.7	-54.2	-54.2	-54.0	-54.0	-54.3	-53.3
1024 QAM			-52.7	-52.7	-52.1	-52.2	-51.8	-53.2	-51.7	-50.6	-51.1	-51.1	-50.9	-50.9	-51.2	-50.2
2048 QAM			-49.5	-49.5	-48.9	-49.0	-48.6	-50.0	-48.5	-47.4	-47.9	-47.9	-47.7	-47.7	-48.0	-47.0