



**Datasheet**

# IP-50S

February 2020 | Rev. A



**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, 2+0 (non-XPIC)

Ability to upgrade existing links for additional capacity with a single cable via Layer 1 Link Aggregation

### Radio Features

Protection: 1+1 HSB

High spectral utilization: BPSK to 4096 QAM w/ACM

Channel bandwidth: 14 to 224 MHz

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

## Ethernet

### Ethernet Interfaces

Port 1:

- Electric: 10/100/1000Base-T RJ-45
- Management
- Ceragon-approved PoE

Port 2:

- SFP cage which supports – Regular and CSFP standards
  - Regular SFP provides Eth2
  - CSFP (Dual BiDir SFP) provides Eth2 and Eth3

Port 3:

- SFP+ cage supporting a 10G single ETH interface.

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

### Ethernet Features

MTU – 9612 Bytes

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

4K VLANs

VLAN add/remove

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 (eEEEC) 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)

## Standards

### MEF

Carrier Ethernet 2.0 (CE 2.0)

### Supported Ethernet Standards

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

Optical 10Gbase-X (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 802.3ad)

Auto MDI/MDIX for 1000baseT

RFC 1349: IPv4 TOS

RFC 2474: IPv4 DSCP

RFC 2460: IPv6 Traffic Classes

### Security

Radio Encryption – AES 256

Secured protocols:

- HTTPS
- SNMPv3
- SSH
- SFTP

RADIUS authentication and authorization

TACACS+ AAA



## Standards Compliance

Radio Spectral Efficiency: EN 302 217-2  
 EMC: EN 301 489-1, EN 301 489-4, Class A (Europe)  
 FCC 47 CFR, part 15, subpart B, class A (US)  
 ICES-003, Class A (Canada)  
 TEC/SD/DD/EMC-221/05/OCT-16, Class A (India)  
 Safety: EN 60950-1, EN 62368-1, IEC 62368-1, UL 62368-1,  
 CAN/CSA C22.2 NO 62368-1  
 Storage: ETSI EN 300 019-1-1 Class 1.2  
 Transportation: ETSI EN 300 019-1-2 Class 2.3

## Technical Specifications

### Mechanical Specifications

Dimensions (Direct Mount HW) –  
 217mm(H), 210mm(W), 85mm(D), 4kg  
 8.54(H), 8.27”(W), 3.35”(D), 8.82 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

DC Input range: -40.5 to -60 VDC

### Power Consumption Specifications

- Active:
  - 11GHz: 45W
  - 13GHz-15GHz: 35W
  - 18GHz-23GHz: 31W
- Standby (muted): 15W

## Product Images



## Radio Specifications

**Note:** For details about supported scripts, frequencies, and channels, refer to the Release Notes for the relevant CeraOS version.

### Capacity – ETSI Channels

	Capacity (Mbps)	Capacity De-Dup	Capacity (Mbps)	Capacity De-Dup	Capacity (Mbps)	Capacity De-Dup
Modulation	14 MHz		28 MHz		40 MHz	
BPSK	6-8	7-25	18-22	19-68	26-31	27-97
QPSK	17-20	17-63	40-49	42-152	55-67	58-209
8 QAM	26-32	28-100	59-72	62-225	83-102	87-317
16 QAM	38-46	39-143	84-103	89-321	114-140	120-435
32 QAM	50-62	53-192	112-137	118-426	152-185	159-577
64 QAM	63-77	66-238	139-170	146-527	187-228	196-710
128 QAM	76-93	80-290	167-205	176-637	227-277	238-862
256 QAM	87-107	92-333	193-236	203-734	244-298	256-927
512 QAM	97-119	102-369	206-251	216-782	267-327	281-1016
1024 QAM Strong	103-126	108-391	225-274	236-854	303-371	319-1026
1024 QAM Light	109-133	115-415	238-291	250-906	323-394	339-1026
2048 QAM	–	–	260-318	273-989	349-427	367-1026
4096 QAM	–	–	277-339	291-1026	369-451	388-1026
	56 MHz		80 MHz		112 MHz	
BPSK	40-49	42-153	55-67	57-208	80-97	84-303
QPSK	84-103	88-320	111-136	117-424	163-200	172-622
8 QAM	124-151	130-471	159-195	167-606	244-299	256-929
16 QAM	173-212	182-658	228-279	240-869	333-407	350-1026
32 QAM	229-280	240-870	301-367	316-1026	439-536	461-1026
64 QAM	281-344	296-1026	369-451	387-1026	539-659	566-1026
128 QAM	341-416	358-1026	436-533	458-1026	652-797	685-1026
256 QAM	394-481	414-1026	502-614	528-1026	746-912	784-1026
512 QAM	424-518	445-1026	552-675	580-1026	810-990	851-1026
1024 QAM Strong	461-564	484-1026	601-735	631-1026	879-1037	923-1026
1024 QAM Light	490-599	515-1026	638-780	670-1026	933-1037	980-1026
2048 QAM	531-649	558-1026	676-826	710-1026	1002-1037	1002-1026
4096 QAM	547-668	574-1026	–	–	–	–



## Capacity – ANSI Channels

	Capacity (Mbps)	Capacity De-Dup	Capacity (Mbps)	Capacity De-Dup	Capacity (Mbps)	Capacity De-Dup
	20 MHz		25 MHz		30 MHz	
BPSK	11-13	11-40	14-17	15-54	18-22	19-68
QPSK	25-30	26-94	33-40	34-124	40-49	42-152
8 QAM	39-47	41-148	50-61	53-191	59-72	62-225
16 QAM	54-66	57-206	69-85	73-264	84-103	89-321
32 QAM	72-88	76-275	93-113	97-352	112-137	118-426
64 QAM	90-109	94-340	114-140	120-435	139-170	146-527
128 QAM	109-133	114-413	138-169	145-526	167-205	176-637
256 QAM	124-151	130-470	158-193	166-601	193-236	203-734
512 QAM	135-165	142-515	175-214	184-665	206-251	216-782
1024 QAM Strong	144-176	151-548	186-227	195-708	225-274	236-854
1024 QAM Light	153-187	161-583	198-242	208-752	238-291	250-906
2048 QAM	–	–	212-260	223-808	260-318	273-989
4096 QAM	–	–	230-281	242-875	277-339	291-1026
	40MHz		50 MHz		60 MHz	
BPSK	26-31	27-97	33-40	35-126	40-49	42-153
QPSK	55-67	58-209	68-83	71-257	84-103	88-320
8 QAM	83-102	87-317	106-130	111-403	124-151	130-471
16 QAM	114-140	120-435	145-177	152-552	173-212	182-658
32 QAM	152-185	159-577	183-224	192-696	229-280	240-870
64 QAM	187-228	196-710	237-290	249-901	281-344	296-1026
128 QAM	227-277	238-862	277-339	291-1026	341-416	358-1026
256 QAM	244-298	256-927	329-402	345-1026	394-481	414-1026
512 QAM	267-327	281-1016	357-437	375-1026	424-518	445-1026
1024 QAM Strong	303-371	319-1026	389-475	408-1026	461-564	484-1026
1024 QAM Light	323-394	339-1026	413-505	434-1026	490-599	515-1026
2048 QAM	349-427	367-1026	446-545	468-1026	531-649	558-1026
4096 QAM	369-451	388-1026	463-565	486-1026	547-668	574-1026
	80MHz					
BPSK	55-67	57-208				
QPSK	111-136	117-424				
8 QAM	159-195	167-606				
16 QAM	228-279	240-869				
32 QAM	301-367	316-1026				
64 QAM	369-451	387-1026				
128 QAM	436-533	458-1026				
256 QAM	502-614	528-1026				
512 QAM	552-675	580-1026				
1024 QAM Strong	601-735	631-1026				
1024 QAM Light	638-780	670-1026				
2048 QAM	676-826	710-1026				



## Transmit Power

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

## Receiver Threshold (RSL)

### 14 MHz (ETSI)

Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38	42
BPSK	-91.5	-91.0	-90.5	-91.5	-90.5	-89.5	-91	-90.0	-89.5	-89.5	-89.5	-89.0	-89.0	-88.5
QPSK	-90.5	-90.0	-89.5	-90.5	-89.5	-88.5	-90	-89.0	-88.5	-88.5	-88.5	-88.0	-88.0	-87.5
8 PSK	-84.5	-84.0	-83.5	-85.5	-83.5	-82.5	-84	-83.0	-82.5	-82.5	-82.5	-82.0	-82.0	-81.5
16 QAM	-83.5	-83.0	-82.5	-83.5	-82.5	-81.5	-83	-82.0	-81.5	-81.5	-81.5	-81.0	-81.0	-80.5
32 QAM	-80.5	-79.5	-79.5	-80.5	-79.0	-78.5	-79.5	-79.0	-78.5	-78.5	-78.0	-78.0	-77.5	-77.0
64 QAM	-77.5	-76.5	-76.5	-77.0	-76.0	-75.5	-76.5	-76.0	-75.5	-75.5	-75.0	-75.0	-74.5	-74.0
128 QAM	-74.0	-73.5	-73.0	-74.0	-73.0	-72.0	-73.5	-72.5	-72.0	-72.0	-72.0	-71.5	-71.5	-71.0
256 QAM	-71.5	-70.5	-70.5	-71.0	-70.0	-69.5	-70.5	-69.5	-69.0	-69.5	-69.0	-69.0	-68.5	-68.0
512 QAM	-68.5	-68.0	-67.5	-68.5	-67.5	-66.5	-68.0	-67.0	-66.5	-66.5	-66.5	-66.0	-66.0	-65.5
1024 QAM Strong	-65.5	-65.0	-64.5	-65.5	-64.5	-63.5	-65.0	-64.0	-63.5	-63.5	-63.5	-63.0	-63.0	-62.5
1024 QAM Light	-65.0	-64.0	-64.0	-64.5	-63.5	-63.0	-64.0	-63.5	-63.0	-63.0	-62.5	-62.5	-62.0	-61.5

### 20 MHz (ANSI)

Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38
BPSK	-91.5	-91.5	-91.0	-92.0	-91.0	-90.0	-91.5	-90.5	-87.0	-90.0	-90.0	-89.5	-89.0
QPSK	-88.5	-88.5	-88.5	-89.5	-88.0	-87.5	-88.5	-88.0	-84.0	-87.5	-87.0	-87.0	-86.5
8 PSK	-83.5	-83.5	-83.0	-84.0	-83.0	-82.0	-83.5	-82.5	-79.0	-82.0	-82.0	-81.5	-81.0
16 QAM	-82.0	-82.0	-81.5	-82.5	-81.5	-80.5	-82.0	-81.0	-77.5	-80.5	-80.5	-80.0	-79.5
32 QAM	-78.0	-78.0	-78.0	-79.0	-77.5	-77.0	-78.0	-77.5	-73.5	-77.0	-76.5	-76.5	-76.0
64 QAM	-75.5	-75.5	-75.0	-76.0	-75.0	-74.0	-75.5	-74.5	-71.0	-74.0	-74.0	-73.5	-73.0
128 QAM	-72.5	-72.5	-72.0	-73.0	-71.5	-71.0	-72.5	-71.5	-68.0	-71.0	-71.0	-70.5	-70.0
256 QAM	-69.0	-69.0	-69.0	-70.0	-68.5	-68.0	-69.0	-68.5	-64.5	-68.0	-67.5	-67.5	-67.0
512 QAM	-67.0	-67.0	-66.5	-67.5	-66.0	-65.5	-67.0	-66.0	-62.5	-65.5	-65.5	-65.0	-64.5
1024 QAM Strong	-64.0	-64.0	-64.0	-65.0	-63.5	-63.0	-64.0	-63.5	-59.5	-63.0	-62.5	-62.5	-62.0
1024 QAM Light	-63.0	-63.0	-63.0	-64.0	-62.5	-62.0	-63.0	-62.5	-58.5	-62.0	-61.5	-61.5	-61.0



### 25 MHz (ANSI)

Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38
BPSK	-88.5	-87.5	-87.5	-88.0	-87.0	-86.5	-87.5	-86.5	-83.0	-86.5	-86.0	-86.0	-85.0
QPSK	-87.5	-86.5	-86.5	-87	-86.0	-85.5	-86.5	-85.5	-82.0	-85.5	-85.0	-85.0	-84.0
8 PSK	-82.5	-82.0	-81.5	-82.5	-81.5	-80.5	-82.0	-81.0	-77.5	-80.5	-80.5	-80.0	-79.5
16 QAM	-80.5	-80.0	-79.5	-80.5	-79.5	-78.5	-80.0	-79.0	-75.5	-78.5	-78.5	-78.0	-77.5
32 QAM	-77.5	-77.0	-76.5	-77.5	-76.0	-75.5	-77.0	-76.0	-72.5	-75.5	-75.5	-75.0	-74.5
64 QAM	-74.5	-74.0	-73.5	-74.5	-73.5	-72.5	-74.0	-73.0	-69.5	-72.5	-72.5	-72.0	-71.5
128 QAM	-71.5	-71.0	-70.5	-71.5	-70.5	-69.5	-71.0	-70.0	-66.5	-69.5	-69.5	-69.0	-68.5
256 QAM	-68.5	-67.5	-67.5	-68.5	-67.0	-66.5	-67.5	-67.0	-63.0	-66.5	-66.0	-66.0	-65.5
512 QAM	-66.0	-65.0	-65.0	-66.0	-64.5	-64.0	-65.0	-64.5	-60.5	-64.0	-63.5	-63.5	-63.0
1024 QAM Strong	-63.0	-62.5	-62.0	-63.0	-61.5	-61.0	-62.5	-61.5	-58.0	-61.0	-61.0	-60.5	-60.0
1024 QAM Light	-62.5	-61.5	-61.5	-62.5	-61.0	-60.5	-61.5	-61.0	-57.0	-60.5	-60.0	-60.0	-59.5
2048 QAM	-58.5	-58.0	-57.5	-58.5	-57.0	-56.5	-58.0	-57.0	-53.5	-56.5	-56.5	-56.0	-55.5
4096 QAM	-55.5	-55.0	-54.5	-55.5	-54.0	-53.5	-55.0	-	-	-	-	-	-

### 28MHz (ETSI)

Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38	42
BPSK	-88.5	-88.0	-87.5	-88.5	-87.5	-86.5	-88.0	-87.0	-86.5	-86.5	-86.5	-86.0	-86.0	-85.5
QPSK	-87.5	-87.0	-86.5	-87.5	-86.5	-85.5	-87.0	-86.0	-85.5	-85.5	-85.5	-85.0	-85.0	-84.5
8 PSK	-83.0	-82.5	-82.0	-83.0	-82.0	-81.0	-82.5	-81.5	-81.0	-81.0	-81.0	-80.5	-80.5	-80.0
16 QAM	-81.0	-80.5	-80.0	-81.0	-79.5	-79.0	-80.5	-79.5	-79.0	-79	-79.0	-78.5	-78.0	-78.0
32 QAM	-77.5	-77.0	-76.5	-77.5	-76.0	-75.5	-77.0	-76.0	-75.5	-75.5	-75.5	-75.0	-74.5	-74.5
64 QAM	-74.5	-74.0	-73.5	-74.5	-73.0	-72.5	-74.0	-73.0	-72.5	-72.5	-72.5	-72.0	-71.5	-71.5
128 QAM	-71.5	-70.5	-70.5	-71.0	-70.0	-69.5	-70.5	-69.5	-69.0	-69.5	-69.0	-69.0	-68.5	-68.0
256 QAM	-68.5	-67.5	-67.5	-68.0	-67.0	-66.5	-67.5	-66.5	-66.0	-66.5	-66.0	-66.0	-65.5	-65.0
512 QAM	-66.0	-65.0	-65.0	-66.0	-64.5	-64.0	-65.0	-64.5	-64.0	-64.0	-63.5	-63.5	-63.0	-62.5
1024 QAM Strong	-63.0	-62.5	-62.0	-63.0	-61.5	-61.0	-62.5	-61.5	-61.0	-61.0	-61.0	-60.5	-60.0	-60.0
1024 QAM Light	-62.0	-61.5	-61.0	-62.0	-60.5	-60.0	-61.5	-60.5	-60.0	-60.0	-60.0	-59.5	-59.0	-59.0
2048 QAM	-58.5	-58.0	-57.5	-58.5	-57.0	-56.5	-58.0	-57.0	-56.5	-56.5	-56.5	-56.0	-55.5	-55.5
4096 QAM	-55.5	-55.0	-54.5	-55.5	-54.0	-53.5	-55.0	-	-	-	-	-	-	-

### 30 MHz (ANSI)

Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38
BPSK	-88.5	-88.0	-87.5	-88.5	-87.0	-86.5	-88.0	-87.0	-83.5	-86.5	-86.5	-86.5	-86.0
QPSK	-87.5	-87.0	-86.5	-87.5	-86.0	-85.5	-87.0	-86.0	-82.5	-85.5	-85.5	-85.5	-85.0
8 PSK	-82.5	-81.5	-81.5	-82.5	-81.0	-80.5	-81.5	-81.0	-77.0	-80.5	-80.0	-80.0	-79.5
16 QAM	-81.0	-80.0	-80.0	-80.5	-79.5	-79.0	-80.0	-79.0	-75.5	-79.0	-78.5	-78.5	-78.0
32 QAM	-77.0	-76.5	-76.0	-77.0	-76.0	-75.0	-76.5	-75.5	-72.0	-75.0	-75.0	-75.0	-74.5
64 QAM	-74.5	-73.5	-73.5	-74.0	-73.0	-72.5	-73.5	-72.5	-69.0	-72.5	-72.0	-72.0	-71.5
128 QAM	-71.0	-70.5	-70.0	-71.0	-70.0	-69.0	-70.5	-69.5	-66.0	-69.0	-69.0	-69.0	-68.5
256 QAM	-68.0	-67.5	-67.0	-68.0	-67.0	-66.0	-67.5	-66.5	-63.0	-66.0	-66.0	-66.0	-65.5
512 QAM	-66.0	-65.5	-65.0	-66.0	-64.5	-64.0	-65.5	-64.5	-61.0	-64.0	-64.0	-64.0	-63.5
1024 QAM Strong	-63.0	-62.0	-62.0	-62.5	-61.5	-61.0	-62.0	-61.0	-57.5	-61.0	-60.5	-60.5	-60.0
1024 QAM Light	-62.0	-61.0	-61.0	-62.0	-60.5	-60.0	-61.0	-60.5	-56.5	-60.0	-59.5	-59.5	-59.0
2048 QAM	-58.0	-57.5	-57.0	-58.0	-56.5	-56.0	-57.5	-56.5	-53.0	-56.0	-56.0	-56.0	-55.5
4096 QAM	-55.0	-54.5	-54.0	-55.0	-53.5	-53.0	-54.5	-	-	-	-	-	-



### 40 MHz (ETSI and ANSI)

Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38	42
BPSK	-87.0	-86.5	-86.0	-87.0	-86.0	-85.0	-86.5	-85.5	-85.0	-85.0	-85.0	-84.5	-84.5	-84.0
QPSK	-86.0	-85.5	-85.0	-86.0	-85.0	-84.0	-85.5	-84.5	-84.0	-84.0	-84.0	-83.5	-83.5	-83.0
8 PSK	-81.0	-80.5	-80.0	-81.0	-79.5	-79.0	-80.5	-79.5	-79.0	-79.0	-79.0	-78.5	-78.0	-78.0
16 QAM	-79.5	-79.0	-78.5	-79.5	-78.0	-77.5	-79.0	-78.0	-77.5	-77.5	-77.5	-77.0	-76.5	-76.5
32 QAM	-76.0	-75.0	-75.0	-75.5	-74.5	-74.0	-75.0	-74.0	-73.5	-74.0	-73.5	-73.5	-73.0	-72.5
64 QAM	-73.0	-72.0	-72.0	-73.0	-71.5	-71.0	-72.0	-71.5	-71.0	-71.0	-70.5	-70.5	-70.0	-69.5
128 QAM	-70.0	-69.0	-69.0	-70.0	-68.5	-68.0	-69.0	-68.5	-68.0	-68.0	-67.5	-67.5	-67.0	-66.5
256 QAM	-67.0	-66.0	-66.0	-66.5	-65.5	-65.0	-66.0	-65.0	-64.5	-65.0	-64.5	-64.5	-64.0	-63.5
512 QAM	-64.0	-63.5	-63.0	-64.0	-62.5	-62.0	-63.5	-62.5	-62.0	-62.0	-62.0	-61.5	-61.0	-61.0
1024 QAM Strong	-61.5	-61.0	-60.5	-61.5	-60.0	-59.5	-61.0	-60.0	-59.5	-59.5	-59.5	-59.0	-58.5	-58.5
1024 QAM Light	-60.5	-60.0	-59.5	-60.5	-59.5	-58.5	-60.0	-59.0	-58.5	-58.5	-58.5	-58.0	-58.0	-57.5
2048 QAM	-58.0	-57.0	-57.0	-58.0	-56.5	-56.0	-57.0	-56.5	-56.0	-56.0	-55.5	-55.5	-55.0	-54.5
4096 QAM	-55.0	-54.0	-54.0	-55.0	-53.5	-53.0	-54.0	-	-	-	-	-	-	-

### 50 MHz (ANSI)

Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38
BPSK	-86.5	-85.5	-85.5	-86.0	-85.0	-84.5	-85.5	-84.5	-81.0	-84.5	-84.0	-84.0	-83.5
QPSK	-85.5	-84.5	-84.5	-85.0	-84.0	-83.5	-84.5	-83.5	-80.0	-83.5	-83.0	-83.0	-82.5
8 PSK	-80.0	-79.5	-79.0	-80.0	-79.0	-78.0	-79.5	-78.5	-75.0	-78.0	-78.0	-78.0	-77.5
16 QAM	-78.5	-77.5	-77.5	-78.0	-77.0	-76.5	-77.5	-76.5	-73.0	-76.5	-76.0	-76.0	-75.5
32 QAM	-74.5	-74.0	-73.5	-74.5	-73.5	-72.5	-74.0	-73.0	-69.5	-72.5	-72.5	-72.5	-72v
64 QAM	-71.5	-70.5	-70.5	-71.5	-70.0	-69.5	-70.5	-70.0	-66.0	-69.5	-69.0	-69.0	-68.5
128 QAM	-68.5	-68.0	-67.5	-68.5	-67.5	-66.5	-68.0	-67.0	-63.5	-66.5	-66.5	-66.5	-66.0
256 QAM	-66.0	-65.0	-65.0	-66.0	-64.5	-64.0	-65.0	-64.5	-60.5	-64.0	-63.5	-63.5	-63.0
512 QAM	-63.5	-63.0	-62.5	-63.5	-62.0	-61.5	-63.0	-62.0	-58.5	-61.5	-61.5	-61.5	-61.0
1024 QAM Strong	-60.0	-59.5	-59.0	-60.0	-58.5	-58	-59.5	-58.5	-55.0	-58.0	-58.0	-58.0	-57.5
1024 QAM Light	-59.0	-58.0	-58.0	-59.0	-57.5	-57.0	-58.0	-57.5	-53.5	-57.0	-56.5	-56.5	-56.0
2048 QAM	-57.0	-56.0	-56.0	-56.5	-55.5	-55.0	-56.0	-55.0	-51.5	-55.0	-54.5	-54.5	-54.0
4096 QAM	-54.0	-53.0	-53.0	-53.5	-52.5	-52.0	-	-	-	-	-	-	-

### 56 MHz (ETSI)

Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38	42
BPSK	-85.5	-85.0	-84.5	-85.5	-84.0	-83.5	-85.0	-84.0	-83.5	-83.5	-83.5	-83.0	-82.5	-82.5
QPSK	-84.5	-84.0	-83.5	-84.5	-83.0	-82.5	-84.0	-83.0	-82.5	-82.5	-82.5	-82.0	-81.5	-81.5
8 PSK	-80.0	-79.0	-79.0	-79.5	-78.5	-78.0	-79.0	-78.0	-77.5	-78.0	-77.5	-77.5	-77.0	-76.5
16 QAM	-77.5	-77.0	-76.5	-77.5	-76.0	-75.5	-77.0	-76.0	-75.5	-75.5	-75.5	-75.0	-74.5	-74.5
32 QAM	-74.0	-73.0	-73.0	-73.5	-72.5	-72.0	-73.0	-72.0	-71.5	-72.0	-71.5	-71.5	-71.0	-70.5
64 QAM	-70.5	-70.0	-69.5	-70.5	-69.5	-68.5	-70.0	-69.0	-68.5	-68.5	-68.5	-68.0	-68.0	-67.5
128 QAM	-68.0	-67.0	-67.0	-67.5	-66.5	-66.0	-67.0	-66.0	-65.5	-66.0	-65.5	-65.5	-65.0	-64.5
256 QAM	-64.5	-64.0	-63.5	-64.5	-63.5	-62.5	-64.0	-63.0	-62.5	-62.5	-62.5	-62.0	-62.0	-61.5
512 QAM	-62.5	-62.0	-61.5	-62.5	-61.5	-60.5	-62.0	-61.0	-60.5	-60.5	-60.5	-60.0	-60.0	-59.5
1024 QAM Strong	-59.0	-58.5	-58.0	-59.0	-58.0	-57.0	-58.5	-57.5	-57.0	-57.0	-57.0	-56.5	-56.5	-56.0
1024 QAM Light	-58.0	-57.5	-57.0	-58.0	-57.0	-56.0	-57.5	-56.5	-56.0	-56.0	-56.0	-55.5	-55.5	-55.0
2048 QAM	-55.5	-54.5	-54.5	-55.0	-54.0	-53.5	-54.5	-53.5	-53.0	-53.5	-53.0	-53.0	-52.5	-52.0
4096 QAM	-52.5	-51.5	-51.5	-52.0	-51.0	-50.5	-	-	-	-	-	-	-	-





### 60 MHz (ANSI)

Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38
BPSK	-86.0	-85.0	-84.5	-85.5	-84.0	-83.5	-85.0	-84.0	-83.5	-83.5	-83.5	-83.0	-82.5
QPSK	-85.0	-84.0	-83.5	-84.5	-83.0	-82.5	-84.0	-83.0	-82.5	-82.5	-82.5	-82.0	-81.5
8 PSK	-80.5	-79.0	-79.0	-79.5	-78.5	-78.0	-79.0	-78.0	-77.5	-78.0	-77.5	-77.5	-77.0
16 QAM	-78.0	-77.0	-76.5	-77.5	-76.0	-75.5	-77.0	-76.0	-75.5	-75.5	-75.5	-75.0	-74.5
32 QAM	-74.5	-73.0	-73.0	-73.5	-72.5	-72.0	-73.0	-72.0	-71.5	-72.0	-71.5	-71.5	-71.0
64 QAM	-71.5	-70.0	-69.5	-70.5	-69.5	-68.5	-70.0	-69.0	-68.5	-68.5	-68.5	-68.0	-68.0
128 QAM	-69.0	-67.0	-67.0	-67.5	-66.5	-66.0	-67.0	-66.0	-65.5	-66.0	-65.5	-65.5	-65.0
256 QAM	-65.5	-64.0	-63.5	-64.5	-63.5	-62.5	-64.0	-63.0	-62.5	-62.5	-62.5	-62.0	-62.0
512 QAM	-63.5	-62.0	-61.5	-62.5	-61.5	-60.5	-62.0	-61.0	-60.5	-60.5	-60.5	-60.0	-60.0
1024 QAM Strong	-60.0	-58.5	-58.0	-59.0	-58.0	-57.0	-58.5	-57.5	-57.0	-57.0	-57.0	-56.5	-56.5
1024 QAM Light	-59.0	-57.5	-57.0	-58.0	-57.0	-56.0	-57.5	-56.5	-56.0	-56.0	-56.0	-55.5	-55.5
2048 QAM	-56.5	-54.5	-54.5	-55.0	-54.0	-53.5	-54.5	-53.5	-53.0	-53.5	-53.0	-53.0	-52.5
4096 QAM	-53.5	-51.5	-51.5	-52.0	-51.0	-50.5	-	-	-	-	-	-	-

### 80 MHz (ETSI and ANSI)

Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38	42
BPSK	-85.0	-85.0	-84.5	-85.5	-84.5	-83.5	-85.0	-84.0	-83.5	-83.5	-83.5	-83.0	-83.5	-82.5
QPSK	-82.5	-82.5	-82.5	-83.0	-82.0	-81.5	-82.5	-81.5	-81.0	-81.5	-81.0	-81.0	-81.0	-80.0
8 PSK	-79.0	-79.0	-78.5	-79.5	-78.5	-77.5	-79.0	-78.0	-77.5	-77.5	-77.5	-77.0	-77.5	-76.5
16 QAM	-76.0	-76.0	-75.5	-76.5	-75.0	-74.5	-76.0	-75.0	-74.5	-74.5	-74.5	-74.0	-74.0	-73.5
32 QAM	-72.5	-72.5	-72.0	-73.0	-71.5	-71.0	-72.5	-71.5	-71.0	-71.0	-71.0	-70.5	-70.5	-70.0
64 QAM	-69.0	-69.0	-69.0	-70.0	-68.5	-68.0	-69.0	-68.5	-68.0	-68.0	-67.5	-67.5	-67.5	-66.5
128 QAM	-66.5	-66.5	-66.0	-67.0	-66.0	-65.0	-66.5	-65.5	-65.0	-65.0	-65.0	-64.5	-65.0	-64.0
256 QAM	-63.5	-63.5	-63.0	-64.0	-63.0	-62.0	-63.5	-62.5	-62.0	-62.0	-62.0	-61.5	-62.0	-61.0
512 QAM	-61.0	-61.0	-61.0	-62.0	-60.5	-60.0	-61.0	-60.5	-60.0	-60.0	-59.5	-59.5	-59.5	-58.5
1024 QAM Strong	-58.0	-58.0	-57.5	-58.5	-57.5	-56.5	-58.0	-57.0	-56.5	-56.5	-56.5	-56.0	-56.5	-55.5
1024 QAM Light	-57.0	-57.0	-57.0	-58.0	-56.5	-56.0	-57.0	-56.5	-56.0	-56.0	-55.5	-55.5	-55.5	-54.5
2048 QAM	-54.5	-54.5	-54.5	-55.5	-54.0	-53.5	-54.5	-54.0	-53.5	-53.5	-53.0	-53.0	-	-

### 112 MHz (ETSI)

Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38	42
BPSK	-82.0	-81.5	-81.0	-82.0	-80.5	-80.0	-81.5	-80.5	-80.0	-80.0	-80.0	-79.5	-79.0	-79.0
QPSK	-81.0	-80.5	-80.0	-81.0	-79.5	-79.0	-80.5	-79.5	-79.0	-79.0	-79.0	-78.5	-78.0	-78.0
8 PSK	-76.5	-75.5	-75.5	-76.0	-75.0	-74.5	-75.5	-74.5	-74.0	-74.5	-74.0	-74.0	-73.5	-73.0
16 QAM	-74.0	-73.5	-73.0	-74.0	-72.5	-72.0	-73.5	-72.5	-72.0	-72.0	-72.0	-71.5	-71.0	-71.0
32 QAM	-70.5	-69.5	-69.5	-70.0	-69.0	-68.5	-69.5	-68.5	-68.0	-68.5	-68.0	-68.0	-67.5	-67.0
64 QAM	-67.0	-66.5	-66.0	-67.0	-66.0	-65.0	-66.5	-65.5	-65.0	-65.0	-65.0	-64.5	-64.5	-64.0
128 QAM	-64.5	-63.5	-63.5	-64.0	-63.0	-62.5	-63.5	-62.5	-62.0	-62.5	-62.0	-62.0	-61.5	-61.0
256 QAM	-61.0	-60.5	-60.0	-61.0	-60.0	-59.0	-60.5	-59.5	-59.0	-59.0	-59.0	-58.5	-58.5	-58.0
512 QAM	-59.0	-58.5	-58.0	-59.0	-58.0	-57.0	-58.5	-57.5	-57.0	-57.0	-57.0	-56.5	-56.5	-56.0
1024 QAM Strong	-55.5	-55.0	-54.5	-55.5	-54.5	-53.5	-55.0	-54.0	-53.5	-53.5	-53.5	-53.0	-53.0	-52.5
1024 QAM Light	-54.5	-54.0	-53.5	-54.5	-53.5	-52.5	-54.0	-53.0	-52.5	-52.5	-52.5	-52.0	-52.0	-51.5
2048 QAM	-52.0	-51.0	-51.0	-51.5	-50.5	-50.0	-51.0	-50.0	-49.5	-5.00	-49.5	-49.5	-	-

