



Datasheet

IP-20F

December 2021 | Rev. D
ETSI Version

High-availability, split-mount multicore aggregation node

IP-20F is a split-mount edge node that delivers multi-Gbps radio capacity to the transport network. It provides operators with the simplicity that comes with deploying a very compact, fixed configuration node, helping operators to meet their operational efficiency targets. The IP-20F's fixed configuration simplifies installation, spare part management and maintenance. What's more, its passive cooling design suits harsh environments, increases reliability and minimizes ambient noise.

IP-20F operates with a variety of high capacity, multicore, standard and high power RF units, offering high spectral efficiency across licensed and license-exempt frequency bands (4-86GHz).

Note: For exact feature availability, contact your Ceragon representative. In case of discrepancy between this Datasheet and the Technical Description for the product, the Technical Description prevails.

Radio

Supported Frequency Range

Standard Power: 6-42 GHz, 71-76 GHz, 81-86 GHz

High Power: 4-11 GHz

Supported RFUs

RFU-D – High-capacity MultiCore radio

RFU-D-HP – High-capacity, high-power MultiCore radio

RFU-E – High capacity E-band radio

RFU-S – High-capacity radio

Radio Interfaces

Two combo radio interfaces

An additional interface that can be configured as a radio interface or a 2.5/1 GbE interface*

Radio Configurations

1+0, 3 x 1+0, 2 x 2+0, 2 x 2+0 + 1+0, 1+1 HSB[†], 2+2 HSB[†]

2+0 Multi-Carrier ABC

Radio Features

Multi-Carrier Adaptive Bandwidth Control

High spectral utilization: BPSK to 4096 QAM w/ACM

Channel bandwidth:

- 4-42 GHz: up to 112 MHz
- E-Band: up to 500 MHz

XPIC

Diversity: 1+0 SD (BBC)

Field Replaceable Diplexers/ Field Replaceable Channel Filters

Ethernet

Ethernet Interfaces

Four 1 GbE combo interfaces (RJ-45/SFP)

One 2.5/1 GbE combo interface (RJ-45/SFP)*

An additional interface that can be configured as a radio interface or a 2.5/1 GbE interface*

Management Interfaces – 2 x 10/100 Base-T (RJ-45)

Ethernet Features

MTU – 9600 Bytes

Quality of Service

- Multiple Classification criteria (VLAN ID, P-bits, IPv4 DSCP, IPv6 TC, MPLS EXP)
- 8 priority queues per port
- Deep buffering (configurable up to 64 Mbit per queue)
- WRED
- P-bit marking/remarking

4K VLANs

VLAN add/remove

MSTP, ERP (ITU-T G.8032)

Frame Cut Through – controlled latency and PDV for delay sensitive applications

Header DeDuplication – Capacity boosting by eliminating inefficiency in all layers (L2, MPLS, L3, L4, Tunneling – GTP for LTE, GRE)

Y.1731 Ethernet OAM

Y.1731 Ethernet Bandwidth Notification (ETH-BN)

TDM

TDM Interfaces

16 x E1

TDM Features

XC capacity – 256 VCs

Timing options – Loop timing, system clock, recovered clock
1+1 / 1:1 path protection

* For information on interface availability, refer to the Release Notes for the CeraOS version you are using.

† Planned for future release.

Management Protocols

SNMP

REST

SDN Support:

- NETCONF/YANG

Synchronization

Synchronization Distribution

Sync Distribution over any Ethernet traffic interface

Dedicated In/Out synch interface (E1⁺/2 MHz)

SyncE (ITU-T G.8261, G.8262)

SSM/ESMC Support for ring/mesh applications (ITU-T G.8264)

SyncE Regenerator mode, providing PRC grade (ITU-T G.811) performance for smart pipe applications[†]

IEEE-1588

Optimized Transport for reduced PDV

IEEE-1588 TC

IEEE-1588 BC[†]

Standards

MEF

Carrier Ethernet 2.0 (CE 2.0)

Supported Ethernet Standards

10/100/1000base-T/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

Supported E1 Standards

ITU-T G.703, G.736, G.775, G.823, G.824, G.828, ITU-T I.432, ETSI ETS 300 147, ETS 300 417

TDM Pseudowire Standards

SAToP – RFC 4553

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

EMC: EN 301 489-4, EN 301 489-1, FCC 47 CFR, part 15, class B

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

Ingress Protection:

- RFU-D: IP67
- RFU-D-HP: IP67
- RFU-E: IP67
- RFU-S: IP67

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

Transportation: ETSI EN 300 019-1-2 Class 2.3

Technical Specifications

Mechanical Specifications

IDU – 44mm(H), 482mm(W), 165mm(D), 2.4 kg

RFU-D – 230mm(H), 233mm(W), 98mm(D), 6.5kg (includes diplexer unit)

RFU-D-HP – 319mm(H), 286mm(W), 107mm(D), 12kg (includes diplexer or OCU unit)

RFU-E – 220mm(H), 198mm(W), 75mm(D), 3kg

RFU-S – 217mm(H), 210mm(W), 85mm(D), 4kg

Environmental Specifications

IDU: -5° to +55°C

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

Power Input Specifications

IDU Standard Input: -48 VDC

IDU DC Input range: -40 to -60 VDC

Dual-feed power support

Power Consumption Specifications

IDU: 48W maximum

RFU-D (2+0) – 6-11 GHz: 65W; 13-42 GHz: 48W

RFU-D-HP (2+0) – 135W*

RFU-D-HP (1+0 SD) – 88 W*

RFU-D-HP (2+0 SD, Rx only) – 41W*

RFU-E – 43W

RFU-S – 43W

* For 80-112 MHz channels, an additional 6W can be expected.

Product Images

IDU



Radio Units

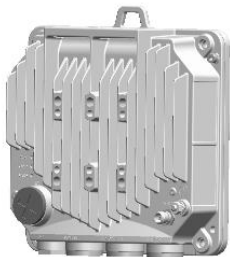
RFU-D



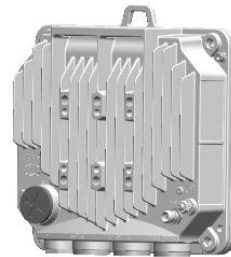
RFU-D-HP



RFU-E



RFU-S



Radio Specifications

Capacity and Maximum Number of E1s – Microwave Bands

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

	Capacity (Mbps)	Capacity De-Dup	Max. No. of E1s	Capacity (Mbps)	Capacity De-Dup	Max. No. of E1s	Capacity (Mbps)	Capacity De-Dup	Max. No. of E1s
Modulation	7 MHz			14 MHz			28 MHz		
BPSK	–	–	–	6-8	7-25	4	18-22	19-68	9
QPSK	6-7	6-22	4	17-20	17-63	8	40-49	42-152	18
8 QAM	10-12	10-37	6	26-32	28-100	12	59-72	62-225	26
16 QAM	15-19	16-58	8	38-46	39-143	17	84-103	89-321	37
32 QAM	21-26	23-82	11	50-62	53-192	23	112-137	118-426	49
64 QAM	27-33	29-103	14	63-77	66-238	28	139-170	146-527	60
128 QAM	33-40	35-126	16	76-93	80-290	33	167-205	176-637	72
256 QAM	39-47	41-148	19	87-107	92-333	38	193-236	203-734	83
512 QAM	42-51	44-158	20	97-119	102-369	42	206-251	216-782	88
1024 QAM Strong	45-55	47-170	22	103-126	108-391	45	225-274	236-854	96
1024 QAM Light	48-59	51-183	23	109-133	115-415	47	238-291	250-906	102
2048 QAM	–	–	–	–	–	–	260-318	273-989	111
4096 QAM	–	–	–	–	–	–	277-339	291-1055	118
	40 MHz			56 MHz			80 MHz		
BPSK	26-31	27-97	12	40-49	42-153	18	55-67	57-208	24
QPSK	55-67	58-209	24	84-103	88-320	37	111-136	117-424	48
8 QAM	83-102	87-317	36	124-151	130-471	54	159-195	167-606	69
16 QAM	114-140	120-435	50	173-212	182-658	74	228-279	240-869	98
32 QAM	152-185	159-577	65	229-280	240-870	98	301-367	316-1143	128
64 QAM	187-228	196-710	80	281-344	296-1071	120	369-451	387-1402	157
128 QAM	227-277	238-862	97	341-416	358-1296	145	436-533	458-1658	186
256 QAM	244-298	256-927	104	394-481	414-1498	168	502-614	528-1911	214
512 QAM	267-327	281-1016	114	424-518	445-1612	180	552-675	580-2101	235
1024 QAM Strong	303-371	319-1154	130	461-564	484-1754	196	601-735	631-2286	255
1024 QAM Light	323-394	339-1227	138	490-599	515-1864	208	638-780	670-2428	271
2048 QAM	349-427	367-1327	149	531-649	558-2020	226	676-826	710-2500	287
4096 QAM	369-451	388-1404	156	547-668	574-2079	232	–	–	–
	112 MHz								
BPSK	80-97	84-303	35						
QPSK	163-200	172-622	70						
8 QAM	244-299	256-929	104						
16 QAM	333-407	350-1266	142						
32 QAM	439-536	461-1669	187						
64 QAM	539-659	566-2051	229						
128 QAM	652-797	685-2481	277						
256 QAM	746-912	784-2500	317						
512 QAM	810-990	851-2500	344						
1024 QAM Strong	879-1075	923-2500	373						
1024 QAM Light	933-1141	980-2500	396						
2048 QAM	1007-1231	1057-2500	427						

Capacity and Maximum Number of E1s – RFU-E

	Capacity (Mbps)	Capacity De-Dup	Max. No. of E1s	Capacity (Mbps)	Capacity De-Dup	Max. No. of E1s
Modulation	14 MHz			28 MHz		
BPSK	9-11	10-36	3	20-26	21-70	8
QPSK	19-24	20-76	8	43-52	45-162	17
8 QAM	29-36	31-115	12	62-76	65-236	24
16 QAM	-	-	-	87-107	92-332	35
32 QAM	-	-	-	115-140	121-437	46
64 QAM	-	-	-	141-173	149-538	56
128 QAM	-	-	-	170-208	179-648	68
256 QAM	-	-	-	196-239	206-745	78
512 QAM	-	-	-	209-255	219-794	83
Modulation	62.5 MHz			125 MHz		
BPSK	42-51	44-160	19	90-110	94-341	41
QPSK	93-114	98-355	42	188-230	197-715	85
8 QAM	139-170	146-528	63	279-341	293-1062	127
16 QAM	188-230	198-716	85	379-463	398-1443	172
32 QAM	247-302	259-939	112	499-610	524-1898	227
64 QAM	301-368	316-1145	137	612-748	643-2329	278
128 QAM	362-442	380-1377	165	737-900	774-2500	335
256 QAM	412-504	433-1569	187	838-1025	880-2500	381
512 QAM	453-554	476-1724	206	923-1128	969-2500	420
1024 QAM	505-617	530-1920	230	-	-	-
Modulation	250 MHz			500 MHz		
BPSK	180-221	189-687	82	362-442	-	165
QPSK	377-461	396-1435	171	755-923	-	343
8 QAM	559-683	587-2128	254	1119-1368	-	509
16 QAM	759-928	797-2500	345	1520-1858	-	512
32 QAM	998-1220	1048-2500	454	1998-2442	-	512
64 QAM	1225-1497	1286-2500	512	2451-2500	-	512
128 QAM	1474-1802	1548-2500	512	-	-	-
256 QAM	1653-2021	1736-2500	512	-	-	-

Transmit Power – Microwave Bands

RFU-D

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

RFU-D-HP

Modulation	Frequency (GHz)	4	5	6	7	8	11
BPSK		35	35	38	38	37	36
QPSK – 8 QAM		35	35	37	37	37	36
16 – 32 QAM		35	35	37	37	37	35
64 QAM		34	34	36	36	35	34
128 QAM		34	34	36	35	35	33
256 QAM		33	33	35	34	33	32
512 QAM		33	33	34	33	33	32
1024 QAM		32	32	33	32	32	31
2048 QAM		31	31	33	31	31	31
4096 QAM		30	30	31	29	29	29

RFU-S

Modulation	Frequency (GHz)	6	7	8	11	13	15	18	23	26	28-38	42
BPSK - 8 QAM		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	–	–	–	–

Transmit Power – RFU-E

Modulation	Channel Bandwidth (MHz)	14	28	62.5	125	250	500
BPSK - QPSK		18	18	18	18	18	15
8 QAM		18	18	18	18	16	11
16 QAM		–	17	17	17	15	10
32 QAM		–	17	17	17	15	10
64 QAM		–	16	16	16	14	9
128 QAM		–	16	16	16	14	–
256 QAM		–	15	15	15	13	–
512 QAM		–	14	14	14	–	–
1024 QAM		–	–	13	–	–	–

Receiver Threshold (RSL) – Microwave Bands

RFU-D and RFU-S

7 MHz	Frequency (GHz)	6	7-8	10	11	13	15	18	23	24	26	28-31	32	38	42
QPSK		-92.5	-92.0	-91.5	-92.5	-91.5	-90.5	-92.0	-91.0	-90.5	-90.5	-90.5	-90.0	-90.0	-89.5
8 QAM		-89.5	-89.0	-88.5	-89.5	-88.5	-87.5	-89.0	-88.0	-87.5	-87.5	-87.5	-87.0	-87.0	-86.5
16 QAM		-86.5	-86.0	-85.5	-86.5	-85.5	-84.5	-86.0	-85.0	-84.5	-84.5	-84.5	-84.0	-84.0	-83.5
32 QAM		-83.5	-82.5	-82.5	-83.5	-82.0	-81.5	-82.5	-82.0	-81.5	-81.5	-81.0	-81.0	-80.5	-80.0
64 QAM		-80.5	-79.5	-79.5	-80.0	-79.0	-78.5	-79.5	-79.0	-78.5	-78.5	-78.0	-78.0	-77.5	-77.0
128 QAM		-77.0	-76.5	-76.0	-77.0	-76.0	-75.0	-76.5	-75.5	-75.0	-75.0	-75.0	-74.5	-74.5	-74.0
256 QAM		-74.5	-73.5	-73.5	-74.0	-73.0	-72.5	-73.5	-72.5	-72.0	-72.5	-72.0	-72.0	-71.5	-71.0
512 QAM		-71.5	-71.0	-70.5	-71.5	-70.5	-69.5	-71.0	-70.0	-69.5	-69.5	-69.5	-69.0	-69.0	-68.5
1024 QAM Strong		-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 Light		-68.0	-67.0	-67.0	-67.5	-66.5	-66.0	-67.0	-66.5	-66.0	-66.0	-65.5	-65.5	-65.0	-64.5
14 MHz															
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 QAM		-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
28 MHz															
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 QAM		-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	-	-	-	-	-	-	-

40 MHz	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 QAM		-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	-	-	-	-	-	-	-
56 MHz															
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 QAM		-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	-	-	-	-	-	-	-	-
80 MHz															
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 QAM		-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	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 QAM		-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	-49.5	-49.5	-49.5	-	-

RFU-D-HP

	7 MHz					14 MHz					28 MHz				
Frequency (GHz)	4-5	6	7	8	11	4-5	6	7	8	11	4-5	6	7	8	11
BPSK						-94.9	-94.6	-94.8	-94.2	-94.3	-91.9	-91.6	-91.8	-91.2	-91.3
QPSK	-94.0	-93.7	-93.9	-93.3	-93.4	-91.9	-91.6	-91.8	-91.2	-91.3	-88.9	-88.6	-88.8	-88.2	-88.3
8 QAM	-91.0	-90.7	-90.9	-90.3	-90.4	-88.0	-87.7	-87.9	-87.3	-87.4	-85.0	-84.7	-84.9	-84.3	-84.4
16 QAM	-88.0	-87.7	-87.9	-87.3	-87.4	-85.0	-84.7	-84.9	-84.3	-84.4	-82.0	-81.7	-81.9	-81.3	-81.4
32 QAM	-84.7	-84.4	-84.6	-84.0	-84.1	-81.7	-81.4	-81.6	-81.0	-81.1	-78.7	-78.4	-78.6	-78.0	-78.1
64 QAM	-81.7	-81.4	-81.6	-81.0	-81.1	-78.7	-78.4	-78.6	-78.0	-78.1	-75.7	-75.4	-75.6	-75.0	-75.1
128 QAM	-78.6	-78.3	-78.5	-77.9	-78.0	-75.6	-75.3	-75.5	-74.9	-75.0	-72.6	-72.3	-72.5	-71.9	-72.0
256 QAM	-75.5	-75.2	-75.4	-74.8	-74.9	-72.5	-72.2	-72.4	-71.8	-71.9	-69.5	-69.2	-69.4	-68.8	-68.9
512 QAM	-72.7	-72.4	-72.6	-72.0	-72.1	-69.7	-69.4	-69.6	-69.0	-69.1	-66.7	-66.4	-66.6	-66.0	-66.1
1024 QAM Strong	-69.8	-69.5	-69.7	-69.1	-69.2	-66.8	-66.5	-66.7	-66.1	-66.2	-63.8	-63.5	-63.7	-63.1	-63.2
1024 QAM Light	-69.1	-68.8	-69.0	-68.4	-68.5	-66.1	-65.8	-66.0	-65.4	-65.5	-63.1	-62.8	-63.0	-62.4	-62.5
2048 QAM											-60.6	-60.3	-60.5	-59.9	-60.0
4096 QAM											-56.6	-56.3	-56.5	-55.9	-56.0
	40 MHz					56 MHz					80 MHz				
Frequency (GHz)	4-5	6	7	8	11	4-5	6	7	8	11	4-5	6	7	8	11
BPSK	-90.6	-90.3	-90.5	-89.9	-90.0	-89.1	-88.8	-89.0	-88.4	-88.5	-86.8	-86.5	-86.7	-86.1	-86.2
QPSK	-87.4	-87.1	-87.3	-86.7	-86.8	-85.9	-85.6	-85.8	-85.2	-85.3	-84.5	-84.2	-84.4	-83.8	-83.9
8 QAM	-83.4	-83.1	-83.3	-82.7	-82.8	-81.8	-81.5	-81.7	-81.1	-81.2	-80.8	-80.5	-80.7	-80.1	-80.2
16 QAM	-80.5	-80.2	-80.4	-79.8	-79.9	-78.9	-78.6	-78.8	-78.2	-78.3	-77.8	-77.5	-77.7	-77.1	-77.2
32 QAM	-77.1	-76.8	-77.0	-76.4	-76.5	-75.6	-75.3	-75.5	-74.9	-75	-74.4	-74.1	-74.3	-73.7	-73.8
64 QAM	-74.0	-73.7	-73.9	-73.3	-73.4	-72.6	-72.3	-72.5	-71.9	-72.0	-71.5	-71.2	-71.4	-70.8	-70.9
128 QAM	-71.0	-70.7	-70.9	-70.3	-70.4	-69.7	-69.4	-69.6	-69.0	-69.1	-68.5	-68.2	-68.4	-67.8	-67.9
256 QAM	-68.7	-68.4	-68.6	-68.0	-68.1	-66.5	-66.2	-66.4	-65.8	-65.9	-65.8	-65.5	-65.7	-65.1	-65.2
512 QAM	-65.9	-65.6	-65.8	-65.2	-65.3	-63.9	-63.6	-63.8	-63.2	-63.3	-63.1	-62.8	-63.0	-62.4	-62.5
1024 QAM Strong	-62.4	-62.1	-62.3	-61.7	-61.8	-60.6	-60.3	-60.5	-59.9	-60.0	-59.9	-59.6	-59.8	-59.2	-59.3
1024 QAM Light	-61.7	-61.4	-61.6	-61.0	-61.1	-59.7	-59.4	-59.6	-59.0	-59.1	-59.5	-59.2	-59.4	-58.8	-58.9
2048 QAM	-59.4	-59.1	-59.3	-58.7	-58.8	-57.9	-57.6	-57.8	-57.2	-57.3	-56.6	-56.3	-56.5	-55.9	-56.0
4096 QAM	-56.3	-56.0	-56.2	-55.6	-55.7	-54.0	-53.7	-53.9	-53.3	-53.4					

	112 MHz				
Frequency (GHz)	4-5	6	7	8	11
BPSK	-85.4	-85.1	-85.3	-84.7	-84.8
QPSK	-83.0	-82.7	-82.9	-82.3	-82.4
8 QAM	-79.0	-78.7	-78.9	-78.3	-78.4
16 QAM	-76.1	-75.8	-76.0	-75.4	-75.5
32 QAM	-72.7	-72.4	-72.6	-72.0	-72.1
64 QAM	-69.7	-69.4	-69.6	-69.0	-69.1
128 QAM	-66.8	-66.5	-66.7	-66.1	-66.2
256 QAM	-63.8	-63.5	-63.7	-63.1	-63.2
512 QAM	-61.4	-61.1	-61.3	-60.7	-60.8
1024 QAM Strong	-58.4	-58.1	-58.3	-57.7	-57.8
1024 QAM Light	-57.7	-57.4	-57.6	-57.0	-57.1
2048 QAM	-55.1	-54.8	-55.0	-54.4	-54.5

Receiver Threshold (RSL) – RFU-E

Channel Bandwidth (MHz)	14	28	62.5	125	250	500
BPSK	-90.5	-87.5	-83.0	-80.0	-77.0	-74.0
QPSK	-87.2	-84.6	-79.5	-76.5	-73.5	-70.5
8 QAM	-83.1	-80.6	-75.5	-72.5	-70.0	-67.0
16 QAM	–	-77.4	-73.0	-69.5	-67.0	-64.0
32 QAM	–	-73.9	-69.0	-66.0	-63.0	-60.0
64 QAM	–	-70.8	-66.0	-63.0	-60.0	-57.0
128 QAM	–	-67.6	-63.0	-60.0	-57.0	–
256 QAM	–	-64.6	-59.5	-57.0	-54.0	–
512 QAM	–	-62.4	-57.0	-54.0	–	–
1024 QAM	–	–	-54.0	–	–	–

Note: Feature availability and specifications are subject to change without prior notification.