



**Datasheet**

# FibeAir IP-20F

Rev. A.20 | May 2020  
ETSI Version

## High-availability, split-mount multicore aggregation node

FibeAir 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.

FibeAir 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<sup>†</sup>, 2+2 HSB<sup>†</sup>

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

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

† Planned for future release.

1+1 / 1:1 path protection

## Management Protocols

SNMP

REST

SDN Support:

- NETCONF/YANG

## Synchronization

### Synchronization Distribution

Sync Distribution over any Ethernet traffic interface

Dedicated In/Out synch interface (E1<sup>+</sup>/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<sup>†</sup>

### IEEE-1588

Optimized Transport for reduced PDV

IEEE-1588 TC<sup>†</sup>

IEEE-1588 BC<sup>†</sup>

## 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 302 217-2-2

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 (-15°C to +60°C extended);

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) – 130W

RFU-E – 43W

RFU-S – 43W

Product Images

IDU



Radio Units

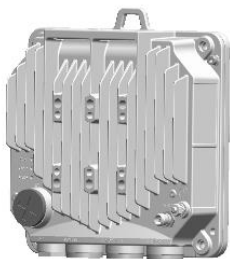
*RFU-D*



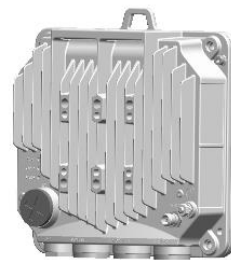
*RFU-D-HP*



*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 |
|-------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| <b>Modulation</b> | <b>14 MHz</b>   |                 |                 | <b>28 MHz</b>   |                 |                 | <b>40 MHz</b>   |                 |                 |
| BPSK              | 6-8             | 7-25            | 4               | 18-22           | 19-68           | 9               | 26-31           | 27-97           | 12              |
| QPSK              | 17-20           | 17-63           | 8               | 40-49           | 42-152          | 18              | 55-67           | 58-209          | 24              |
| 8 QAM             | 26-32           | 28-100          | 12              | 59-72           | 62-225          | 26              | 83-102          | 87-317          | 36              |
| 16 QAM            | 38-46           | 39-143          | 17              | 84-103          | 89-321          | 37              | 114-140         | 120-435         | 50              |
| 32 QAM            | 50-62           | 53-192          | 23              | 112-137         | 118-426         | 49              | 152-185         | 159-577         | 65              |
| 64 QAM            | 63-77           | 66-238          | 28              | 139-170         | 146-527         | 60              | 187-228         | 196-710         | 80              |
| 128 QAM           | 76-93           | 80-290          | 33              | 167-205         | 176-637         | 72              | 227-277         | 238-862         | 97              |
| 256 QAM           | 87-107          | 92-333          | 38              | 193-236         | 203-734         | 83              | 244-298         | 256-927         | 104             |
| 512 QAM           | 97-119          | 102-369         | 42              | 206-251         | 216-782         | 88              | 267-327         | 281-1016        | 114             |
| 1024 QAM Strong   | 103-126         | 108-391         | 45              | 225-274         | 236-854         | 96              | 303-371         | 319-1026        | 130             |
| 1024 QAM Light    | 109-133         | 115-415         | 47              | 238-291         | 250-906         | 102             | 323-394         | 339-1026        | 138             |
| 2048 QAM          | –               | –               | –               | 260-318         | 273-989         | 111             | 349-427         | 367-1026        | 149             |
| 4096 QAM          | –               | –               | –               | 277-339         | 291-1026        | 118             | 369-451         | 388-1026        | 156             |
|                   | <b>56 MHz</b>   |                 |                 | <b>80 MHz</b>   |                 |                 | <b>112 MHz</b>  |                 |                 |
| BPSK              | 40-49           | 42-153          | 18              | 55-67           | 57-208          | 24              | 80-97           | 84-303          | 35              |
| QPSK              | 84-103          | 88-320          | 37              | 111-136         | 117-424         | 48              | 163-200         | 172-622         | 70              |
| 8 QAM             | 124-151         | 130-471         | 54              | 159-195         | 167-606         | 69              | 244-299         | 256-929         | 104             |
| 16 QAM            | 173-212         | 182-658         | 74              | 228-279         | 240-869         | 98              | 333-407         | 350-1026        | 142             |
| 32 QAM            | 229-280         | 240-870         | 98              | 301-367         | 316-1026        | 128             | 439-536         | 461-1026        | 187             |
| 64 QAM            | 281-344         | 296-1026        | 120             | 369-451         | 387-1026        | 157             | 539-659         | 566-1026        | 229             |
| 128 QAM           | 341-416         | 358-1026        | 145             | 436-533         | 458-1026        | 186             | 652-797         | 685-1026        | 277             |
| 256 QAM           | 394-481         | 414-1026        | 168             | 502-614         | 528-1026        | 214             | 746-912         | 784-1026        | 317             |
| 512 QAM           | 424-518         | 445-1026        | 180             | 552-675         | 580-1026        | 235             | 810-990         | 851-1026        | 344             |
| 1024 QAM Strong   | 461-564         | 484-1026        | 196             | 601-735         | 631-1026        | 255             | 879-1037        | 923-1026        | 373             |
| 1024 QAM Light    | 490-599         | 515-1026        | 208             | 638-780         | 670-1026        | 271             | 933-1037        | 980-1026        | 396             |
| 2048 QAM          | 531-649         | 558-1026        | 226             | 676-826         | 710-1026        | 287             | 1002-1037       | 1002-1026       | 427             |
| 4096 QAM          | 547-668         | 574-1026        | 232             | –               | –               | –               | –               | –               | –               |

## 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 |
|-------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| <b>Modulation</b> | <b>14 MHz</b>   |                 |                 | <b>28 MHz</b>   |                 |                 |
| 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              |
| <b>Modulation</b> | <b>62.5 MHz</b> |                 |                 | <b>125 MHz</b>  |                 |                 |
| 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             | -               | -               | -               |
| <b>Modulation</b> | <b>250 MHz</b>  |                 |                 | <b>500 MHz</b>  |                 |                 |
| 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 | 20 | 21 | 18    | 22 | 15 |
| 8 QAM       |                 | 28 | 28 | 28 | 28 | 24 | 24 | 22 | 20 | 21 | 18    | 22 | 15 |
| 16 QAM      |                 | 28 | 27 | 27 | 28 | 23 | 24 | 22 | 20 | 20 | 17    | 21 | 15 |
| 32 QAM      |                 | 28 | 27 | 26 | 28 | 23 | 24 | 22 | 20 | 19 | 16    | 21 | 14 |
| 64 QAM      |                 | 28 | 26 | 26 | 27 | 23 | 24 | 22 | 20 | 19 | 16    | 20 | 13 |
| 128 QAM     |                 | 27 | 26 | 26 | 26 | 22 | 24 | 22 | 20 | 19 | 16    | 20 | 13 |
| 256 QAM     |                 | 27 | 26 | 26 | 26 | 21 | 22 | 20 | 20 | 17 | 14    | 19 | 13 |
| 512 QAM     |                 | 27 | 25 | 24 | 26 | 21 | 22 | 20 | 20 | 17 | 14    | 19 | 11 |
| 1024 QAM    |                 | 25 | 24 | 24 | 25 | 20 | 20 | 20 | 18 | 16 | 13    | 18 | 11 |
| 2048 QAM    |                 | 25 | 23 | 22 | 24 | 20 | 20 | 18 | 17 | 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 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 | –  | –  | –     | –  |

## 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

| 14 MHz          | 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 |
| <b>28 MHz</b>   |                 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 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 | -     | -     | -     | -     | -     | -     | -     |
| <b>40 MHz</b>   |                 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 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 | -     | -     | -     | -     | -     | -     | -     |

| 56 MHz          | 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 | -     | -     | -     | -     | -     | -     | -     | -     |
| <b>80 MHz</b>   |                 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 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 | -     | -     |
| <b>112 MHz</b>  |                 |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 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 | -49.5 | -49.5 | -49.5 | -     | -     |

## RFU-D-HP

|                 | 28 MHz |       |       |       |       | 40 MHz |       |       |       |       | 56 MHz |       |       |       |       |
|-----------------|--------|-------|-------|-------|-------|--------|-------|-------|-------|-------|--------|-------|-------|-------|-------|
| Frequency (GHz) | 4-5    | 6     | 7     | 8     | 11    | 4-5    | 6     | 7     | 8     | 11    | 4-5    | 6     | 7     | 8     | 11    |
| BPSK            | -91.9  | -91.6 | -91.8 | -91.2 | -91.3 | -90.6  | -90.3 | -90.5 | -89.9 | -90.0 | -89.1  | -88.8 | -89.0 | -88.4 | -88.5 |
| QPSK            | -88.9  | -88.6 | -88.8 | -88.2 | -88.3 | -87.4  | -87.1 | -87.3 | -86.7 | -86.8 | -85.9  | -85.6 | -85.8 | -85.2 | -85.3 |
| 8 PSK           | -85.0  | -84.7 | -84.9 | -84.3 | -84.4 | -83.4  | -83.1 | -83.3 | -82.7 | -82.8 | -81.8  | -81.5 | -81.7 | -81.1 | -81.2 |
| 16 QAM          | -82.0  | -81.7 | -81.9 | -81.3 | -81.4 | -80.5  | -80.2 | -80.4 | -79.8 | -79.9 | -78.9  | -78.6 | -78.8 | -78.2 | -78.3 |
| 32 QAM          | -78.7  | -78.4 | -78.6 | -78.0 | -78.1 | -77.1  | -76.8 | -77.0 | -76.4 | -76.5 | -75.6  | -75.3 | -75.5 | -74.9 | -75   |
| 64 QAM          | -75.7  | -75.4 | -75.6 | -75.0 | -75.1 | -74.0  | -73.7 | -73.9 | -73.3 | -73.4 | -72.6  | -72.3 | -72.5 | -71.9 | -72.0 |
| 128 QAM         | -72.6  | -72.3 | -72.5 | -71.9 | -72.0 | -71.0  | -70.7 | -70.9 | -70.3 | -70.4 | -69.7  | -69.4 | -69.6 | -69.0 | -69.1 |
| 256 QAM         | -69.5  | -69.2 | -69.4 | -68.8 | -68.9 | -68.7  | -68.4 | -68.6 | -68.0 | -68.1 | -66.5  | -66.2 | -66.4 | -65.8 | -65.9 |
| 512 QAM         | -66.7  | -66.4 | -66.6 | -66.0 | -66.1 | -65.9  | -65.6 | -65.8 | -65.2 | -65.3 | -63.9  | -63.6 | -63.8 | -63.2 | -63.3 |
| 1024 QAM Strong | -63.8  | -63.5 | -63.7 | -63.1 | -63.2 | -62.4  | -62.1 | -62.3 | -61.7 | -61.8 | -60.6  | -60.3 | -60.5 | -59.9 | -60.0 |
| 1024 QAM Light  | -63.1  | -62.8 | -63.0 | -62.4 | -62.5 | -61.7  | -61.4 | -61.6 | -61.0 | -61.1 | -59.7  | -59.4 | -59.6 | -59.0 | -59.1 |
| 2048 QAM        | -60.6  | -60.3 | -60.5 | -59.9 | -60.0 | -59.4  | -59.1 | -59.3 | -58.7 | -58.8 | -57.9  | -57.6 | -57.8 | -57.2 | -57.3 |
| 4096 QAM        | -56.6  | -56.3 | -56.5 | -55.9 | -56.0 | -56.3  | -56.0 | -56.2 | -55.6 | -55.7 | -54.0  | -53.7 | -53.9 | -53.3 | -53.4 |

|                 | 80 MHz |       |       |       |       | 112 MHz |       |       |       |       |
|-----------------|--------|-------|-------|-------|-------|---------|-------|-------|-------|-------|
| Frequency (GHz) | 4-5    | 6     | 7     | 8     | 11    | 4-5     | 6     | 7     | 8     | 11    |
| BPSK            | -86.8  | -86.5 | -86.7 | -86.1 | -86.2 | -85.4   | -85.1 | -85.3 | -84.7 | -84.8 |
| QPSK            | -84.5  | -84.2 | -84.4 | -83.8 | -83.9 | -83.0   | -82.7 | -82.9 | -82.3 | -82.4 |
| 8 PSK           | -80.8  | -80.5 | -80.7 | -80.1 | -80.2 | -79.0   | -78.7 | -78.9 | -78.3 | -78.4 |
| 16 QAM          | -77.8  | -77.5 | -77.7 | -77.1 | -77.2 | -76.1   | -75.8 | -76.0 | -75.4 | -75.5 |
| 32 QAM          | -74.4  | -74.1 | -74.3 | -73.7 | -73.8 | -72.7   | -72.4 | -72.6 | -72.0 | -72.1 |
| 64 QAM          | -71.5  | -71.2 | -71.4 | -70.8 | -70.9 | -69.7   | -69.4 | -69.6 | -69.0 | -69.1 |
| 128 QAM         | -68.5  | -68.2 | -68.4 | -67.8 | -67.9 | -66.8   | -66.5 | -66.7 | -66.1 | -66.2 |
| 256 QAM         | -65.8  | -65.5 | -65.7 | -65.1 | -65.2 | -63.8   | -63.5 | -63.7 | -63.1 | -63.2 |
| 512 QAM         | -63.1  | -62.8 | -63.0 | -62.4 | -62.5 | -61.4   | -61.1 | -61.3 | -60.7 | -60.8 |
| 1024 QAM Strong | -59.9  | -59.6 | -59.8 | -59.2 | -59.3 | -58.4   | -58.1 | -58.3 | -57.7 | -57.8 |
| 1024 QAM Light  | -59.5  | -59.2 | -59.4 | -58.8 | -58.9 | -57.7   | -57.4 | -57.6 | -57.0 | -57.1 |
| 2048 QAM        | -56.6  | -56.3 | -56.5 | -55.9 | -56.0 | -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.