

LTE Radio Access, Rel. RL50, Operating Documentation, Issue 02

Flexi Multiradio BTS Radio Module and Remote Radio Head Description

DN0951745

Issue 03

Approval Date 2013-12-13



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Summary of changes

Changes between document issues are cumulative. Therefore, the latest document issue contains all changes made to previous issues.

Changes between issues 02 (2013-11-28) and 03 (2013-12-13)

- Power requirements section has been updated.
- Appendix C: Avoiding Passive Intermodulation during RF Module and RRH operation has been added
- Reference to the *Flexi Multiradio BTS RF Sharing Released Configurations; DN09123381; Issue 11; GSM EDGE BSS Rel. RG20(BSS), RG30(BSS); WCDMA RAN Rel. RU30, RU40; LTE RAN Rel. RL30, RL40, RL50 Operating Documentation* has been added

Changes between issues 01 (2012-10-28) and 02 (2013-11-28)

- Issue numbering has been changed to reflect all Radio Access Technologies (RAT).
- Information on FRGT capabilities for RU40 SW release have been introduced.
- RF Module frequency range and bandwidth section has been updated.
- RRH front panel description section has been updated

Changes between issues 01 (2012-12-29) and 01A (2013-10-28)

Information on multi-technology content has been added or updated across the document.

1 RSS-310 compliance

This equipment complies with RSS-310 of Industry Canada. Operation is subject to the condition that this device does not cause harmful interference.

2 EU RoHS statement

This equipment complies with the European Union RoHS Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment. The directive applies to the use of lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE) in electrical and electronic equipment.

3 CE marking

Declaration of Conformity with Regard to the EU Directive 1999/5/EC (R&TTE Directive)

Hereby, NSN declares that this equipment is in compliance with the essential requirements and other relevant provisions of Directive: 1999/5/EC. TEST

Figure 1 List of countries respecting EU Directive 1999/5/EC

CE ⓘ R&TTE Directive 1995/5/EC							
AT	✓	FR	✓	LV	✓	LI	✓
BE	✓	DE	✓	LT	✓	RO	✓
BG	✓	GB	✓	LU	✓	SK	✓
CY	✓	GR	✓	MT	✓	SI	✓
CZ	✓	HU	✓	NL	✓	ES	✓
DK	✓	IS	✓	NO	✓	SE	✓
EE	✓	IE	✓	PL	✓	CH	✓
FI	✓	IT	✓	PT	✓	TR	✓

This declaration is only valid for configurations (combinations of software, firmware, and hardware) provided and/or supported by NSN.

4 FCC Part 15 compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manuals, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

5 Overview



This document is common for all Radio Access Technologies (RAT). You may find here information about solutions that are not available or supported in a specific SW release or RAT. For features supported in your SW release, see respective feature documentation chapter in the system library.



For information on supported configuration in your SW release, see:
Flexi Multiradio BTS RF Sharing Released Configurations; DN09123381; Issue 11; GSM EDGE BSS Rel. RG20(BSS), RG30(BSS); WCDMA RAN Rel. RU30, RU40; LTE RAN Rel. RL30, RL40, RL50 Operating Documentation document.

5.1 Overview of Flexi Multiradio BTS RF Module

The Flexi Multiradio Radio Frequency Module or RF Module, is a three sector, multi-standard radio transceiver module. The module consists of independent branches, capable of transmitting and receiving signals of multiple radio technologies concurrently:

- Up to six GSM carriers with 400 KHz minimum carrier separation
- Up to four WCDMA carriers with 3.8 MHz minimum carrier separation
- LTE signal with 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, and 20 MHz carrier bandwidth
- Multi RAT operation with combination of GSM, WCDMA, and LTE



In this document the following naming convention of RF Modules has been adopted:

Table 1 RF Module naming convention

RF Module variant	RF Module variant names
2x30 W RF Module	FRMA FRMD
2x45 W RF Module	FRIE
3x60 W RF Module	FXCA FXDA FXDJ FXEA FXFA/B FRGP_A FRGP_B FRHA FRIE FRMA FRMD
3x80 W RF Module	FXCB FXDB FXEB FXFC FRGT FRGS
6x40 W RF Module	FRPA FRPB FRHC FRHF FRMC



The following 3x80 W RF Module variants do not support the legacy Siemens MHA/TMA using Motorola protocol: FXCB/FXDB/FXEB/FXFC. Maximum Inrush current supported is 1Amp.

RF Module is a 3U high module with an integrated, replaceable fan assembly for module cooling. The supported functions are:

- Chaining up to three RF Modules with OBSAI RP3_01
- 2-way receive diversity in the receiver chains
- Integrated antenna line supervision
- MHA
- Remote Electrical Tilt (RET)

The RF Module can be installed inside or outside on a stack, pole, or wall. Pole mounting kits supported by the RF Modules are Flexi Pole Mounting Kit (FPKA/C) and Pole Mounting Kit (VMPB). For wall installations, the RF Module is mounted directly to the wall.

5.1.1 RF Module frequency range and bandwidth

The Flexi Multiradio RF Module variants and their frequency range and bandwidths are listed below:

Table 2 RF Module frequency range and bandwidth

RF Module variant	TX frequency range [MHz]	RX frequency range [MHz]	DL instantaneous bandwidth [MHz]	UL instantaneous bandwidth [MHz]	DL filter bandwidth [MHz]	UL filter bandwidth [MHz]
RFM 3x60W 850MHz FXCA	880-915	806-849	15	15	15	15
RFM 6x40W 700MHz FRPA	703-738	758-793	35	35	35	35
RFM 6x40W 700MHz FRPB	718-748	773-803	30	30	30	30
RFM 3x60W 800MHz FRMA	832-862	791-821	20	20	30	30
RFM 3x60W 800MHz FRMD	832-847	791-806	15	15	15	15
RFM 6x40W 800MHz FRMC	842-862	801-821	20	20	20	20
RFM 3x80W 850MHz FXCB ¹⁾	869-894	824-849	35	25	25	25
RFM 3x60W 900 MHz FXDA	925-960	880-915	20	20	20	20
RFM 3x80W 900 MHz FXDB ¹⁾	925-960	880-915	35	35	35	35
RFM 3x60W 900 MHz FXDJ	935-960	890-915	12.5	12.5	12.5	12.5
RFM 3x60W 2100/1700 MHz FRIE	1710-1770	2110-2170	20	20	45	45
RFM 3x60W 1800 MHz FXEA	1805-1880	1710-1785	25	30	30	30

¹⁾ 60 W in RU30 and 80 W in RU40.

Table 2 RF Module frequency range and bandwidth (Cont.)

RF Module variant	TX frequency range [MHz]	RX frequency range [MHz]	DL instantaneous bandwidth [MHz]	UL instantaneous bandwidth [MHz]	DL filter bandwidth [MHz]	UL filter bandwidth [MHz]
RFM 3x80W 1800 MHz FXEB ¹⁾	1805-1880	1710-1785	35	60	75	75
RFM 3x80W 1900 MHz FXFC ¹⁾	1930-1990	1850-1915	35	60	65	65
RFM 3x60W 1900 MHz FXFA/B	1930-1990	1850-1910	20	20	20	20
RFM 3x60W 2100 MHz FRG-P_A/FRGP_B	1920-1980	2110-2170	20	20	20	20
RFM 3x80W 2100 MHz FRGT ¹⁾²⁾	1920-1980	2110-2170	60	60	60	60
RFM 3x80W 2100 MHz FRGS ²⁾	1920-1980	2110-2170	40	40	40	40
RFM 6x40W 2600 MHz FRHC	2500-2555	2620-2675	40	40	55	55
RFM 6x40W 2600 MHz FRHF	2520-2570	2640-2690	40	40	50	50
RFM 3x60W 2600 MHz FRHA	2620-2690	2500-2570	20	20	70	70

Table 3 RF Module FRGT and FRGS output power in RU40

RF Module variant	DL bandwidth [MHz]	Output power [W]
FRGT, FRGS	0 - 20	80
FRGS	20 - 40	70 ³⁾
FRGT	20 - 45	70 ³⁾
FRGT	45 - 60	60

²⁾ In RU40 output power depends on DL bandwidth, see [Table 3: RF Module FRGT and FRGS output power in RU40](#).

³⁾ BTS can be commissioned as 80W (e.g. 4x20W per pipe) and RFM internal power control limits the total power to 70W when needed.

5.1.2 RF Module isometric view

Figure 2 Isometric view of RF Module FXDx, FXEx, FXFx, FXCx

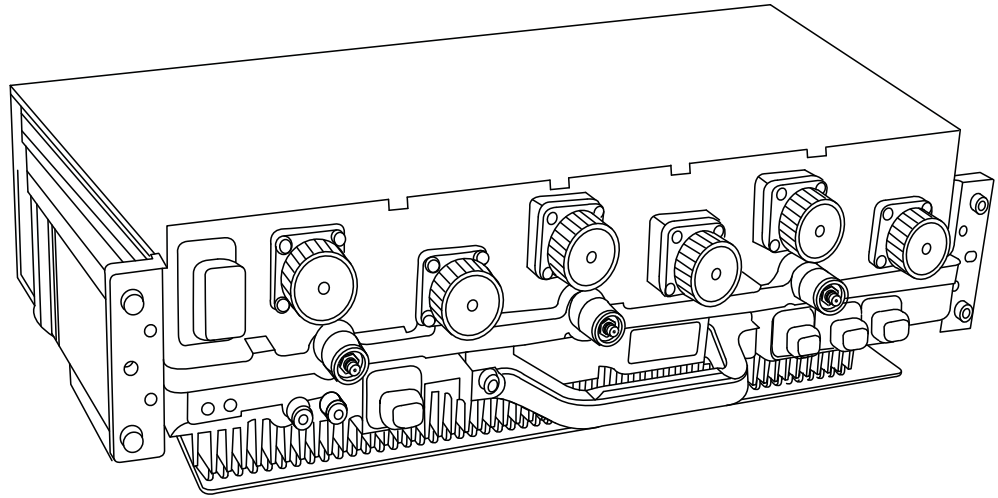
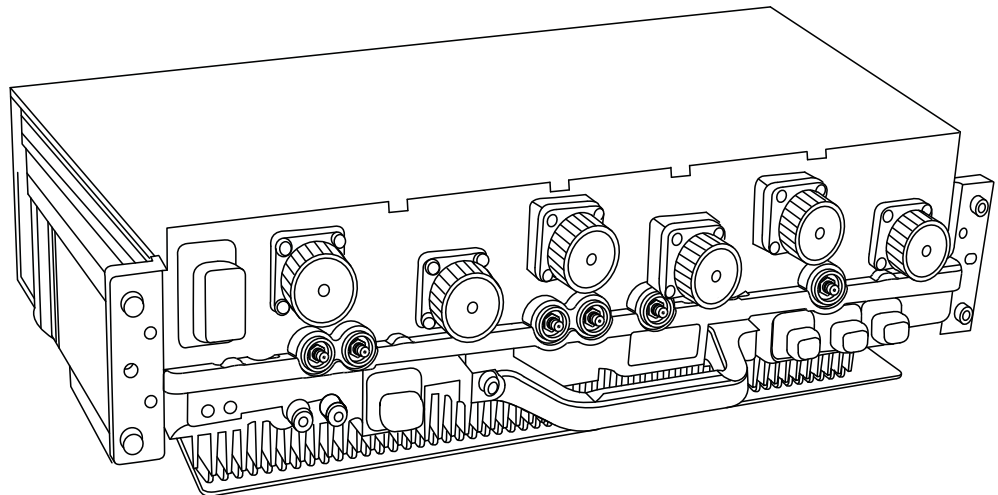


Figure 3 Isometric view of RF Module FXFA and FXCA



The FXFx and FXCx variants have extra QMA connectors for E911 positioning systems.

Figure 4 Isometric view of 3x80 W RF Module FXxx

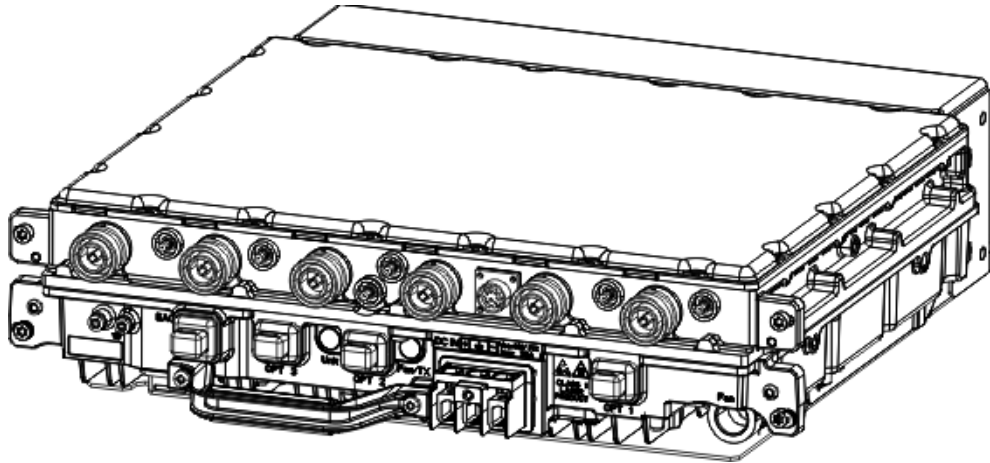


Figure 5 Isometric view of RF Module FRGP

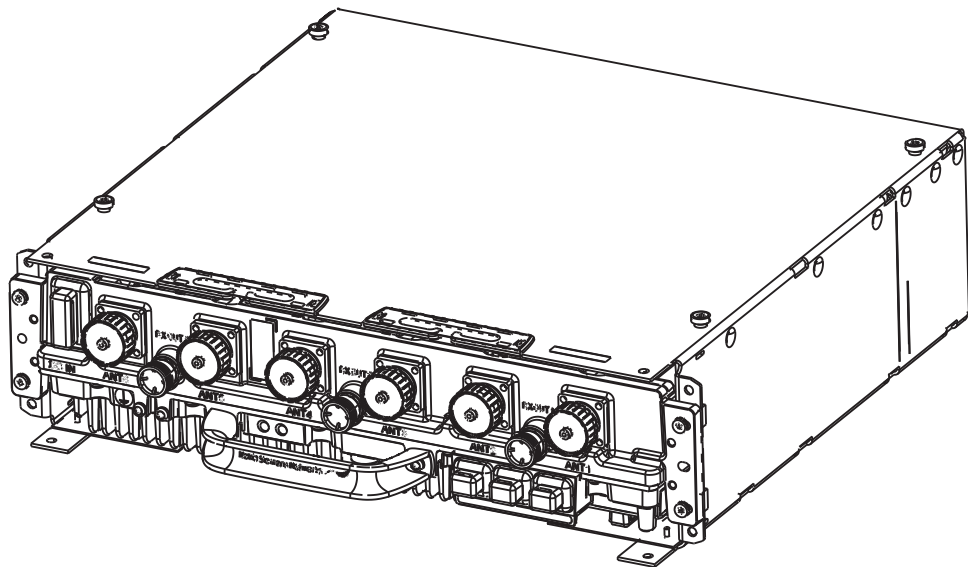


Figure 6 Isometric view of RF Module FRGT/FRGS

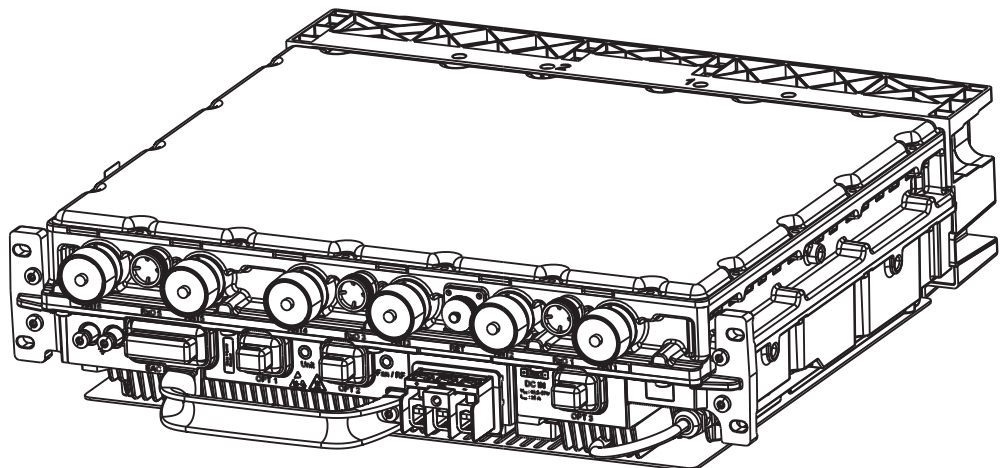
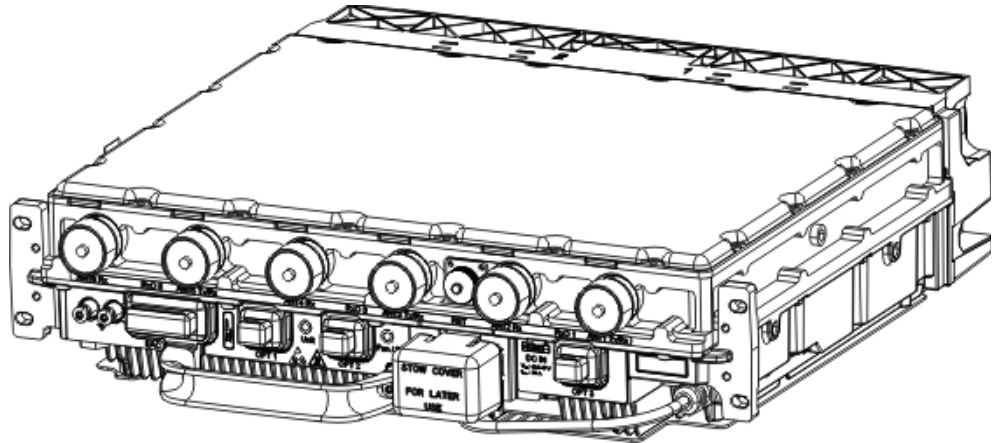


Figure 7 Isometric view of 6x40 W RF Module



5.2 Overview of Flexi Multiradio BTS RRH

The Flexi Multiradio Radio Remote Radio Head or RRH, is a one sector, multi-standard radio transceiver module. Each branch consists of a transmitter and receiver chain. It is intended for outdoor mounting and optimized for feederless applications.



In this document the following naming convention has been adopted:

Table 4 RRH naming convention

RF Module variant	RF Module variant list
2x40 W RRH	FHCA FHDA FHEA FRGQ FRHB FRMB
2x60 W RRH	FHEB FHDB
4x30 W RRH	FRIG FRHD FRHE



The following 2x60 W RRH variants do not support the legacy Siemens MHA/TMA: FHDB, FHEB. Dual MHA which operates in ASIG mode. Current Mode is not supported.

The module consists of two or four independent branches, capable of transmitting and receiving signals of multiple radio technologies concurrently:

- Up to six GSM carriers with 400 KHz minimum carrier separation
- Up to four WCDMA carriers with 3.8 MHz minimum carrier separation

- Multi-carrier LTE signal with 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, and 20 MHz carrier bandwidth
- Multi RAT operation with a combination of GSM, WCDMA, and LTE

The supported functions are:

- Chaining up to three RF Modules with OBSAI RP3-01
- Integrated antenna line supervision
- MHA and RET support
- Digital and control circuitry, optical interface, DC power input, and other necessary functionalities
- Integrated DC line OVP, Class II rated to 5kA pulse
- Input DC voltage monitoring

The RRH is installed on a pole or wall. Pole mounting kits supported by the RRHs are Flexi Pole Mounting Kit (FPKA/C) and Pole Mounting Kit (VMPB). For wall installations, the RRH is mounted directly to the wall. The RRH has no cooling fans, and relies on convection cooling. To ensure proper cooling, RRH should always be mounted in a vertical orientation with connectors on the bottom side.

5.2.1 RRH frequency range and bandwidth

The he Flexi Multiradio BTS RRH variants and their frequency range and bandwidths are listed below.

Table 5 RRH frequency range and bandwidth

RF Module variant	TX frequency range [MHz]	RX frequency range [MHz]	DL instantaneous bandwidth [MHz]	UL instantaneous bandwidth [MHz]	DL filter bandwidth [MHz]	UL filter bandwidth [MHz]
RRH 2x40W 730 MHz FRLB	729-745	699-715	16	16	16	16
RRH 2x40W 800 MHz EU FRMB	791-821	832-862	20	20	30	30
RRH 2x40W 850 MHz FHCA	869-894	824-849	15	15	25	25
RRH 2x40W 900 MHz FHDA	925-960	880-915	25 ⁴⁾ 30.2 ⁵⁾	35	35	35
RRH 2x60W 900 MHz FHDB	925-960	880-915	35	35	35	35
RRH 2x40W 1800 MHz FHEA	1805-1880	1710-1785	23 ⁴⁾ 25 ⁵⁾	40	75	75
RRH 2x60W 1800 MHz FHEB	1805-1880	1710-1785	35/40 ⁶⁾ 40 ⁷⁾	60	75	75

4) A.10x version
 5) A.20x version
 6) relevant for WCDMA/LTE when shared with GSM
 7) relevant for WCDMA and LTE

Table 5 RRH frequency range and bandwidth (Cont.)

RF Module variant	TX frequency range [MHz]	RX frequency range [MHz]	DL instantaneous bandwidth [MHz]	UL instantaneous bandwidth [MHz]	DL filter bandwidth [MHz]	UL filter bandwidth [MHz]
RRH 2x60W/4x30W 1700 MHz/2100 MHz FRIG	2110-2155	1710-1755	45	45	45	45
RRH 2x40W 2100 FRGQ	2110-2170	1920-1980	20	60	60	60
RRH 4x30W 2600 MHz FRHE	2620-2675	2500-2555	40	40	55	55
RRH 4x30W 2600 MHz FRHD	2640-2690	2520-2570	40	40	50	50
RRH 2x40W 2600 FRHB	2620-2690	2500-2570	20	20	70	70

5.2.2 RRH isometric view

Figure 8 Isometric view of the 2x40 W RRH

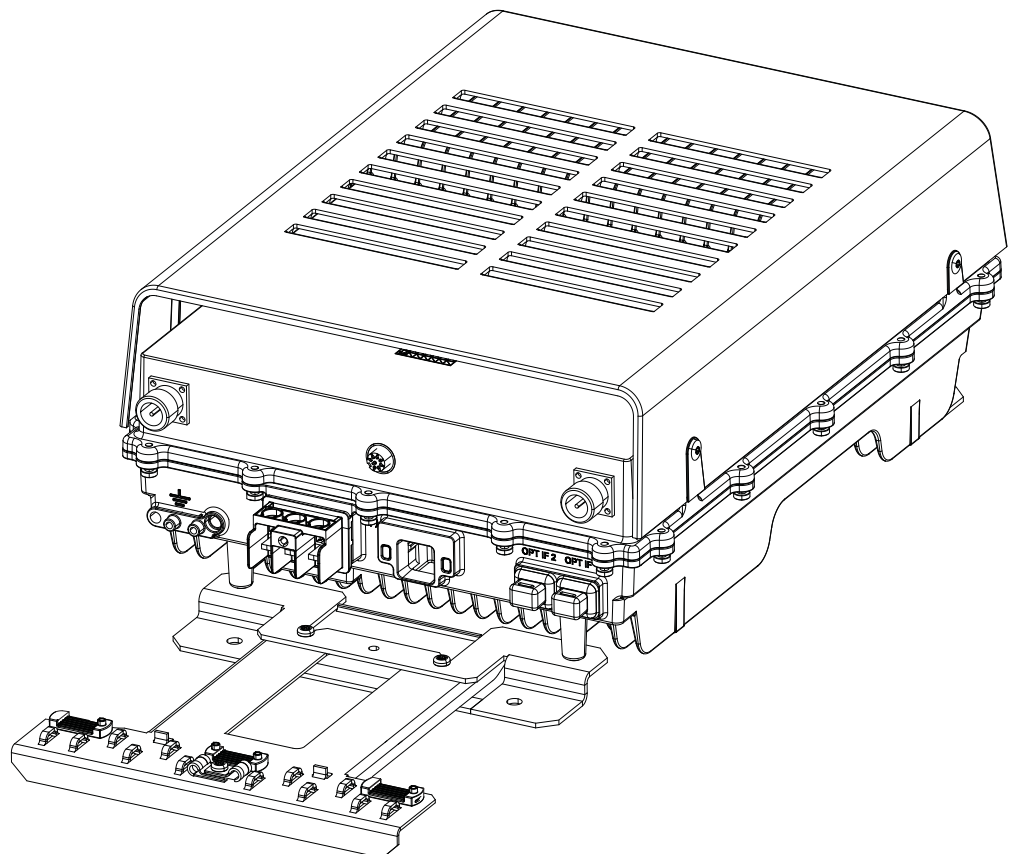


Figure 9 Isometric view of the Remote Radio Head (FRGQ)

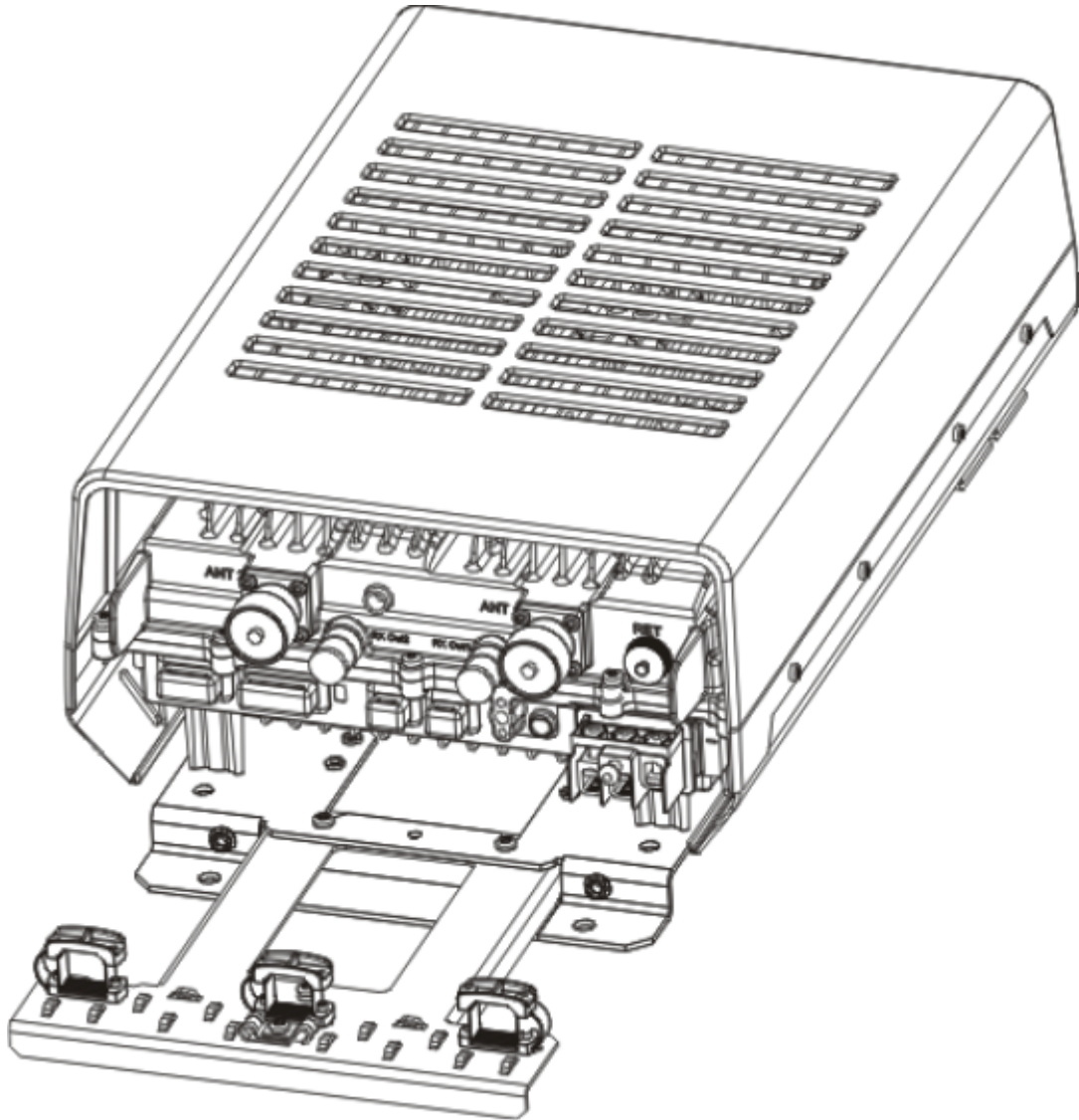


Figure 10 Isometric view of the Remote Radio Head (FRLB)

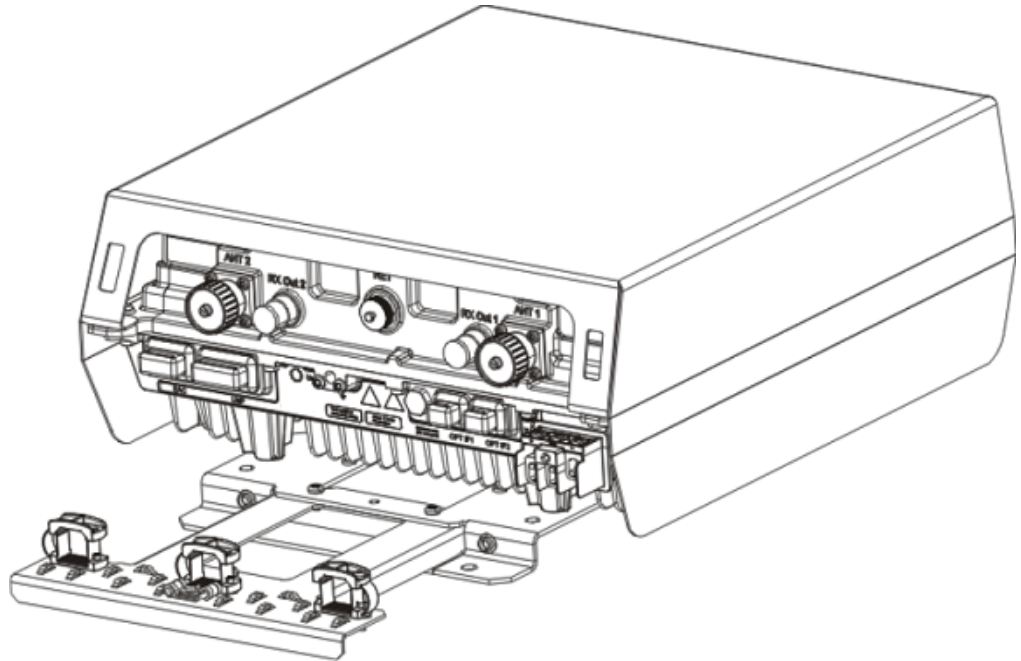


Figure 11 Isometric view of the Remote Radio Head (FHCA)

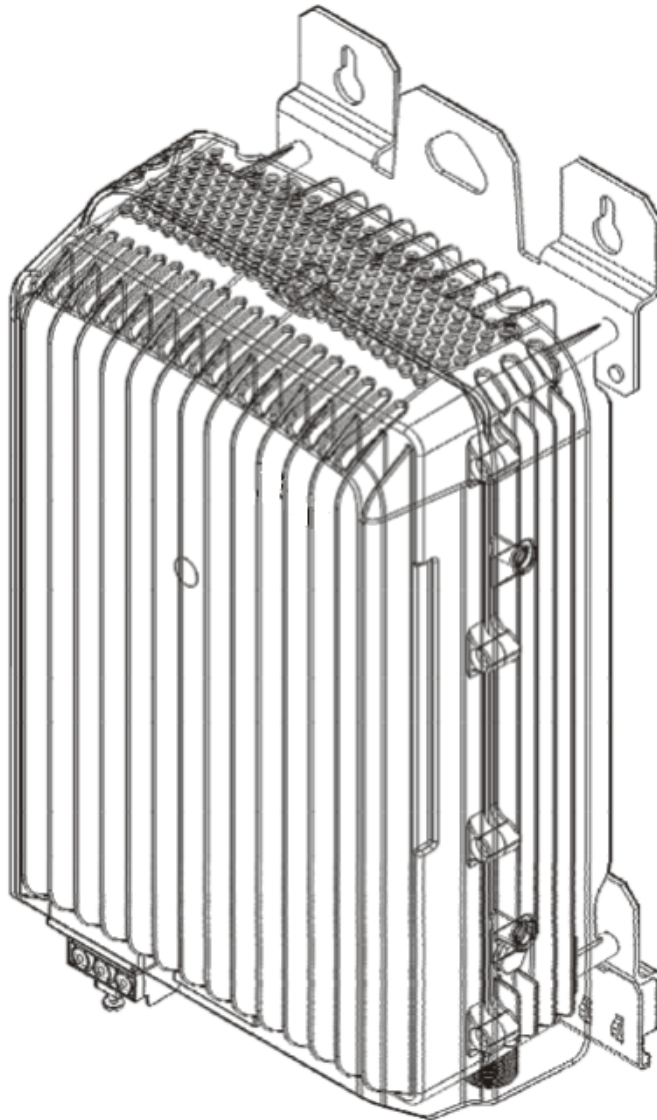
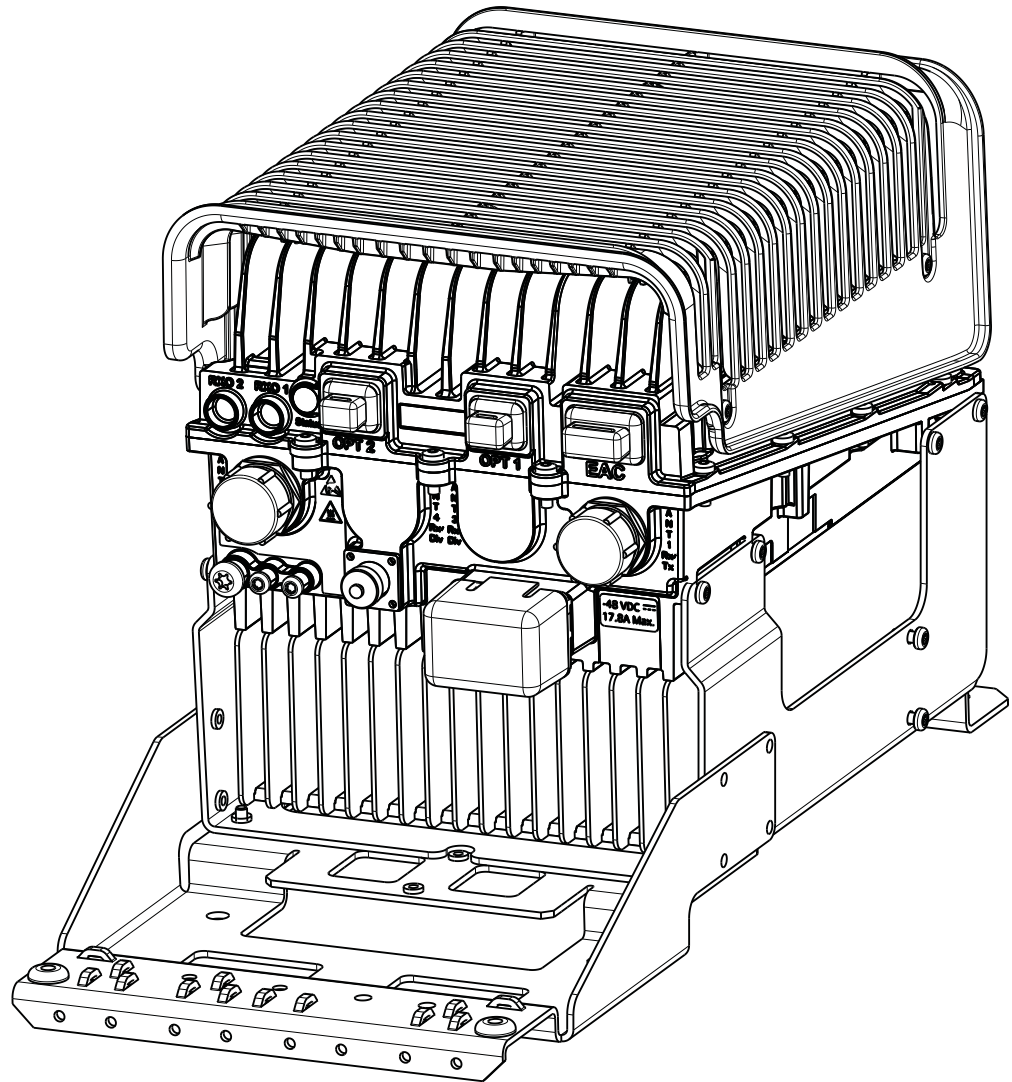
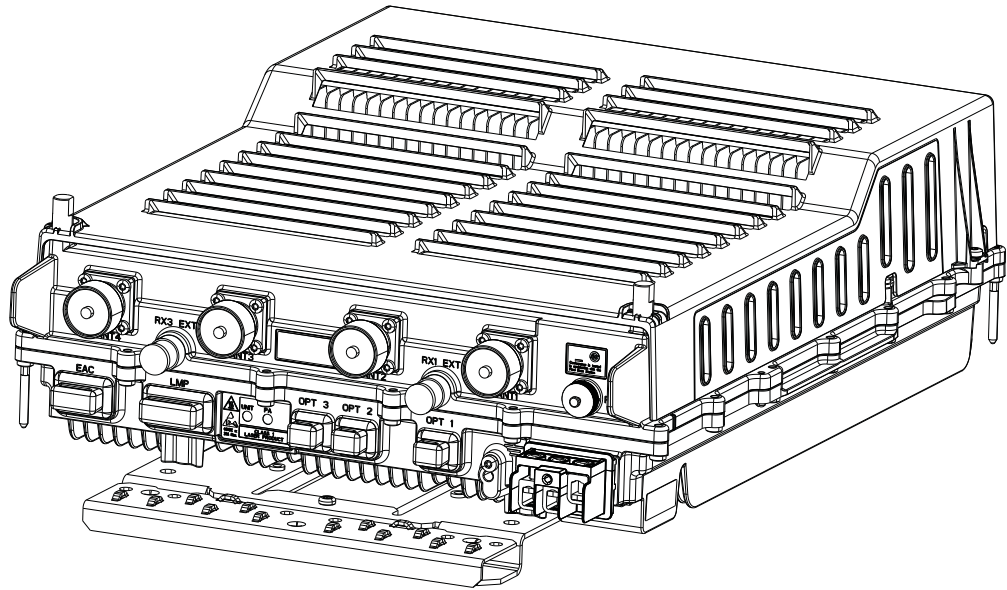


Figure 12 Isometric view of the 2x60 W RRH



The DC Input connector and protective cap is not shown in the above figure for 2x60 W RRH.

Figure 13 Isometric view of the 4x30 W RRH



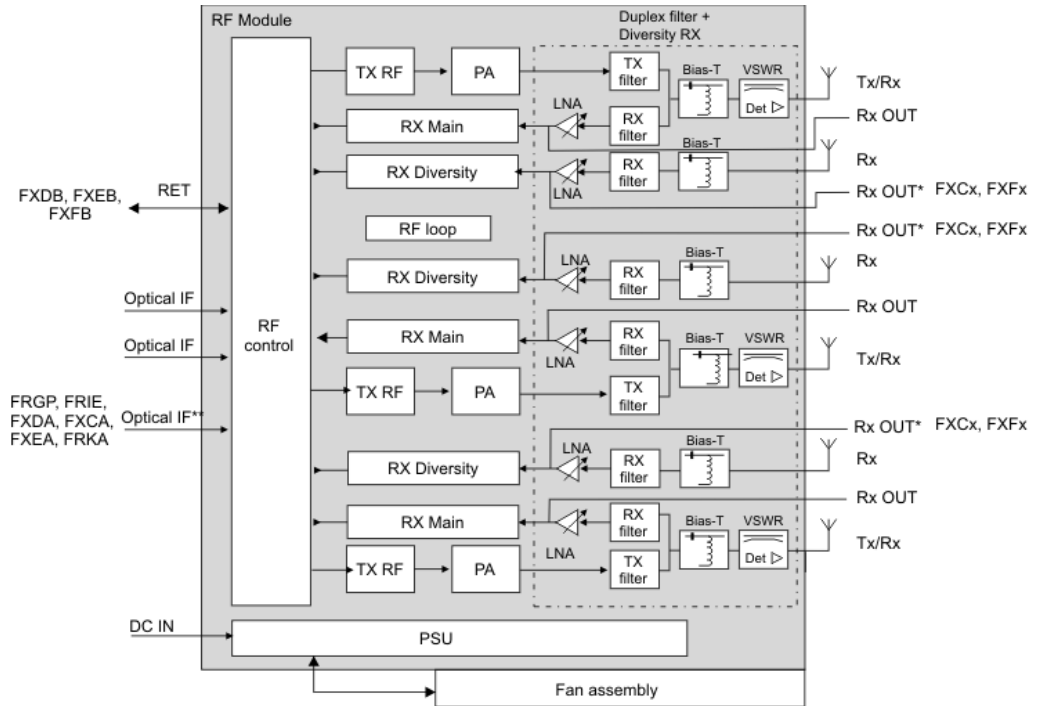
6 RF Module and RRH main blocks

6.1 RF Module main blocks

The RF Module includes the following functional blocks:

- RF Baseband (RF BB)
 - RF control
 - Provides three optical interfaces with the System Module or other RF modules (OBSAI RP3_01)
 - Provides the external alarm interface
 - Most of the module internal connections are made through this block
 - Processes signals and module control functionalities
 - Transmitter
 - Direct conversion from TX interface to TX RF
 - Digital power control
 - TX Double Power and IDD support
 - Predistortion transmitter
 - Receiver
 - Dual down conversion from RX RF to RX baseband signal
 - Diversity reception
- Power Amplifier (PA)
 - Amplifies signal coming from RF BB TX output and feeds it to TX input of the filters
- RF Front end
 - Includes three duplexers and three diversity RX filters with LNAs and RF test loops
 - Processes air interface RF signals for selected channels
 - Provides connection for Flexi Antenna Line to Flexi Multiradio Base Station
 - Supports usage of NSN Masthead Amplifier (MHA) units
 - Provides the supply voltage to the Flexi Antenna Line units via main antenna branch
 - Provides the supply voltage for dual MHA unit via diversity antenna branches or two single MHAs via both antenna lines
 - Contains integrated bias-Ts with over-current and undercurrent alarm detection/protection
- Power supply unit (PSU)
 - Contains power input and distribution of internal supply voltages
- Fan assembly
 - Consists of three separate fans and a fan plate which mechanically mounts to the fan shroud

Figure 14 Functional blocks of the 3-sector RF Module



6.2 RRH Module main blocks

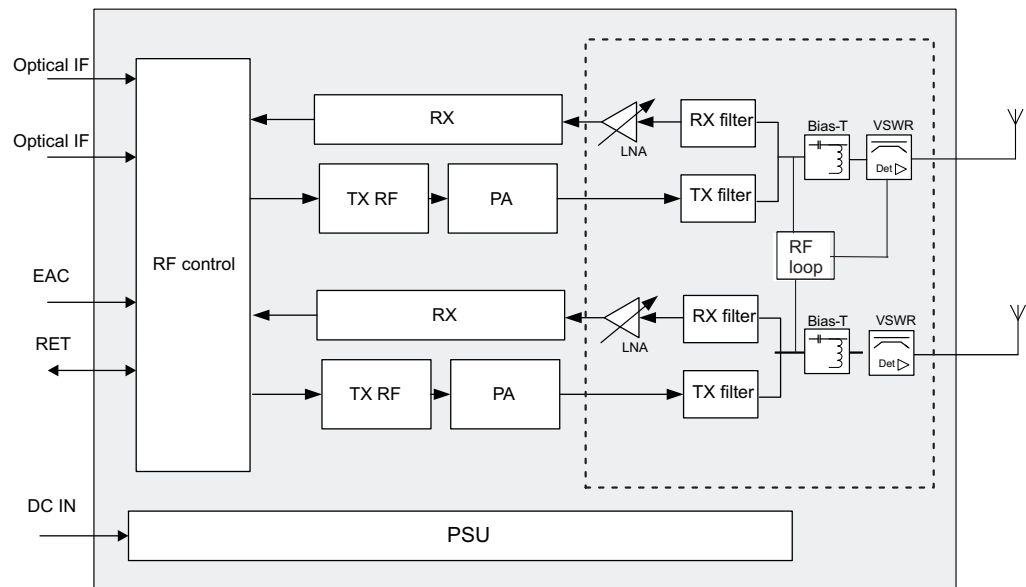
The RRH includes the following functional blocks:

- RF control block
 - There are interfaces from the RF control block towards the System Module through optical connection. Most unit internal connections are made from the RF control block. Signal processing and unit control functionalities are located in this block
- TX block
 - Analogue RF parts are located in the TX block
- RF Front end
 - Includes an RX filter with LNAs
 - Processes air interface RF signals for selected channels
 - Provides connection for Flexi Antenna Line to Flexi Multiradio Base Station
 - Supports usage of NSN Masthead Amplifier (MHA) units
 - Provides the supply voltage to the Flexi Antenna Line units via main antenna branch
 - Contains integrated bias-Ts with over-current and undercurrent alarm detection/protection
- PA block
 - The power amplifier block amplifies TX block output signal to a specified output power level
- RX block

- The RX block includes two 2-carrier receivers
- Antenna filter block
 - Antenna filtering for TX and RX signals is done in the Antenna filter block

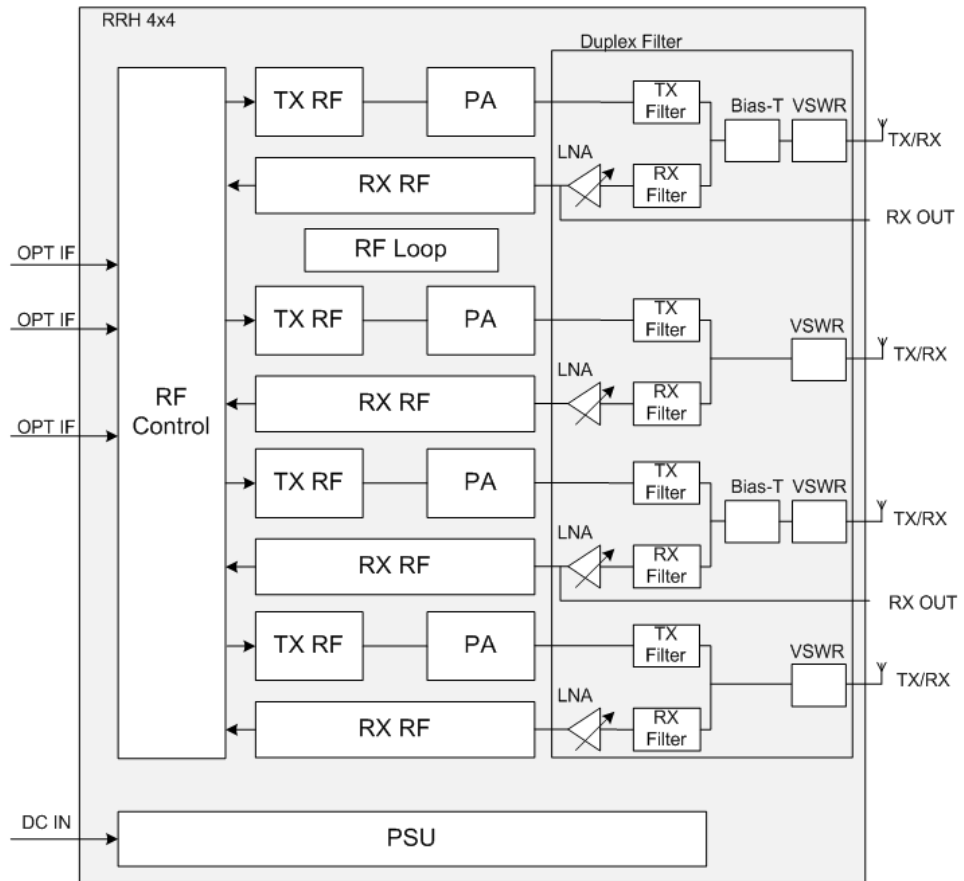
See the following figure for the functional blocks of the 2 TX RRH.

Figure 15 Functional blocks of the 2TX RRH



2x60 W RRH have the same functional blocks as 2x40 W RRH except that 2x60 W RRH has bias T only on Branch 1 (with ANT1) to support dual MHAs.

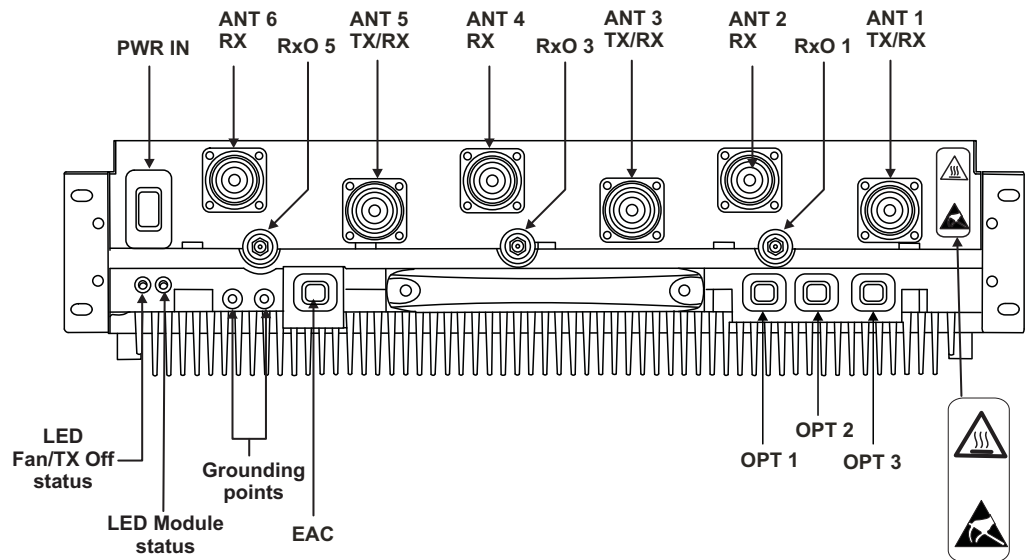
Figure 16 Functional blocks of the 4TX RRH.



7 RF Module and RRH interfaces

7.1 Front panel views of RF Module

Figure 17 FXDA, FXEA, and FXDJ front panel view



Some older modules use ANT 1 RxOut, ANT 3 RxOut, ANT 5 RxOut instead of Rx O1, Rx O3, and Rx O5.

Figure 18 FXFx and FXCA front panel view

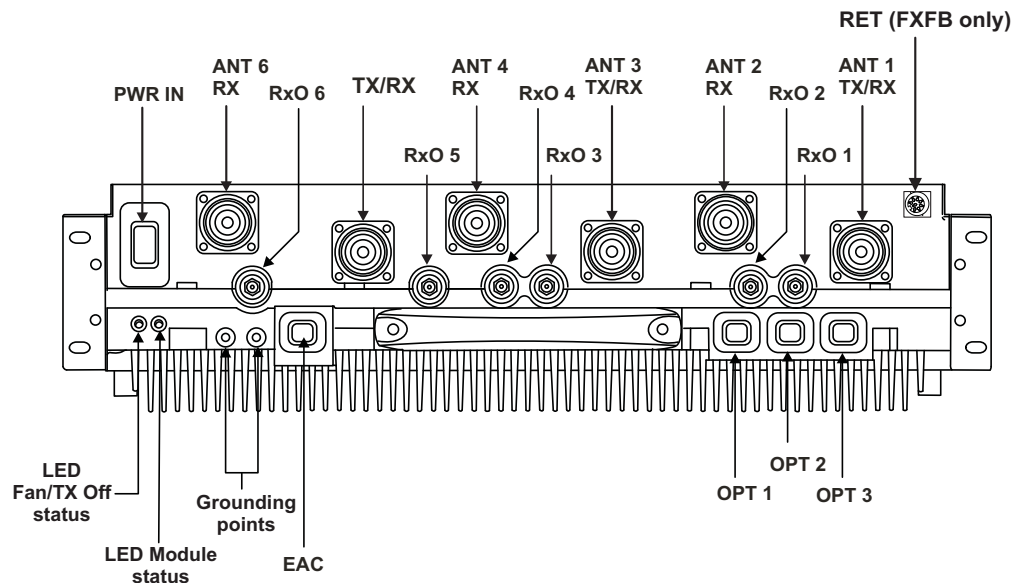


Figure 19 FXDB and FXEB front panel view

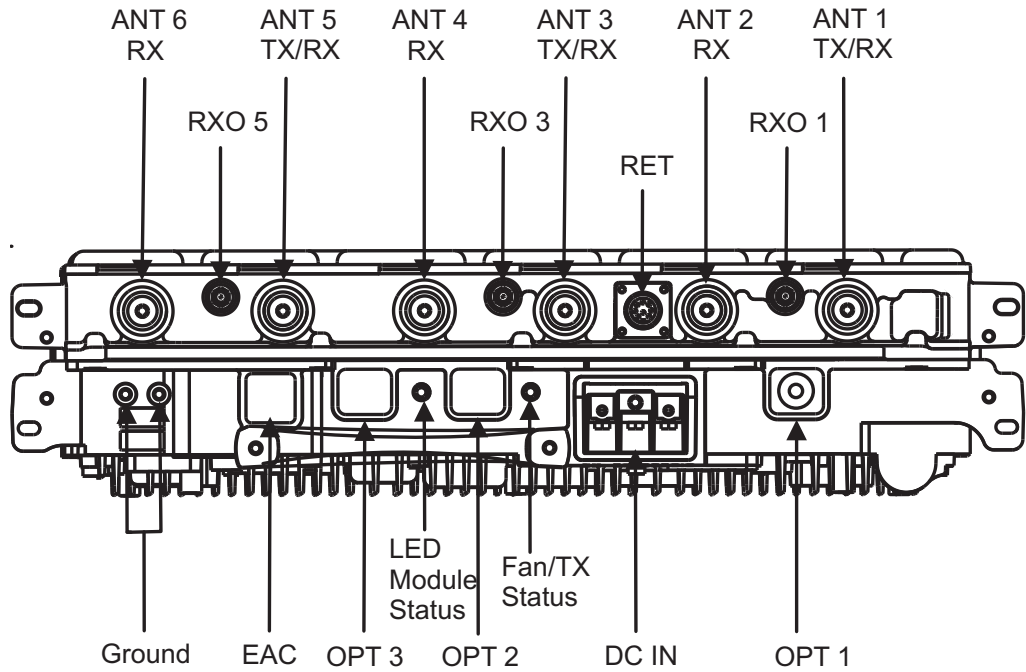


Figure 20 FXCB and FXFC front panel view

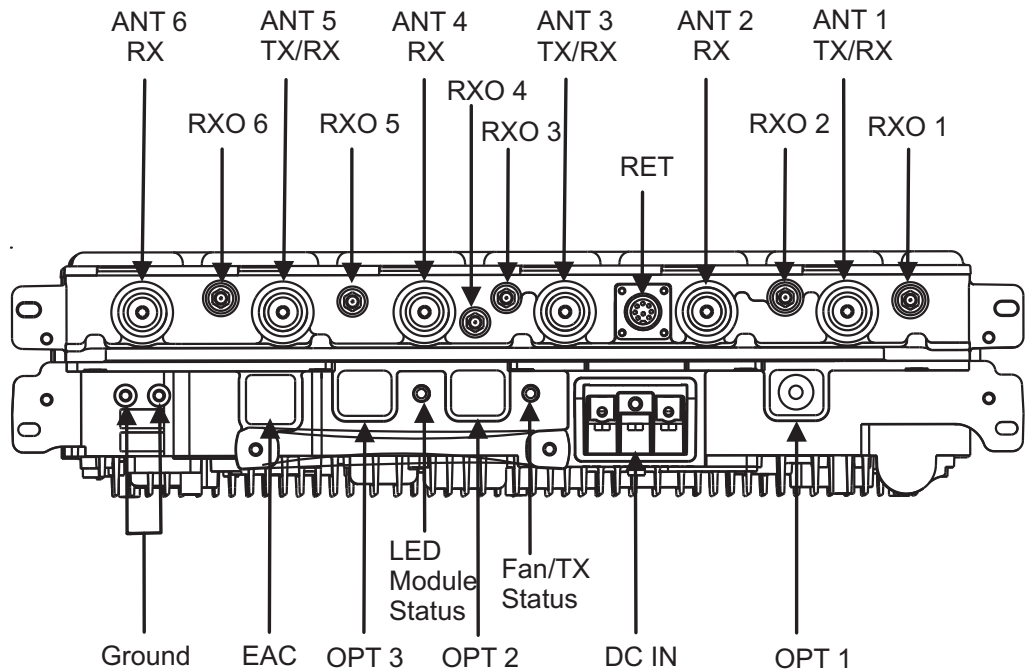


Figure 21 FRGP_A/B, FRGT front panel view

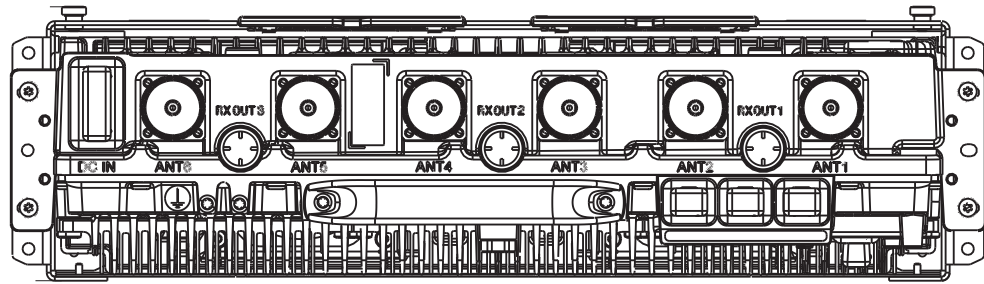
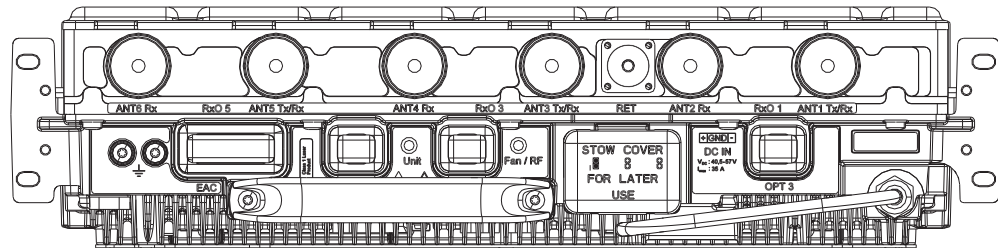


Figure 22 6x40W RF Module front panel view



7.2 RF Module front panel description

i In FxFx and FXCx, RxO 2, RxO 4, and RxO 6 are for E911 positioning systems and are associated with RX diversity.

The connectors on the front panel of the RF Module, their type, and purpose are listed in the [Table 6: RF Module external interfaces](#).

Table 6 RF Module external interfaces

	PWR IN	ANT	RxO	RET	EAC	OPT
RFM 3x60W 850MHz FXCA	2-pin multi-beam XL female	6x 7/16 female	3x QMA(fe-male)	-	RJ45 female shielded	3Gb SFP
RFM 6x40W 700MHz FRPA	Screw-interterminal	6x 7/16 female	-	-	MDR36	3Gb or 6Gb SFP
RFM 6x40 W 700MHz FRPB	Screw-interterminal	6x 7/16 female	-	8-pin circular	MDR36	3Gb or 6Gb SFP
RFM 3x60W 800MHz FRMA	2-pin multi-beam XL female	6x 7/16 female	3x QMA(fe-male)	-	RJ45 female shielded	3Gb SFP
RFM 3x60W 800MHz FRMD	2-pin multi-beam XL female	6x 7/16 female	3x QMA(fe-male)	-	RJ45 female shielded	3Gb SFP
RFM 3x60W 800MHz FRMC	Screw-interterminal	6x 7/16 female	6x QMA(fe-male)	-	RJ45 female shielded	3Gb or 6Gb SFP

Table 6 RF Module external interfaces (Cont.)

	PWR IN	ANT	RxO	RET	EAC	OPT
RFM 3x80W 850MHz FXCB	Screw- interterminal	6x 7/16 female	6x QMA(fe- male)	8-pin circular	RJ45 female shielded	3Gb or 6Gb SFP
RFM 3x60W 900MHz FXDA	2-pin multi- beam XL fe- male	6x 7/16 female	3x QMA(fe- male)	-	RJ45 female shielded	3Gb SFP
RFM 3x80W 900MHz FXDB	Screw- interterminal	6x 7/16 female	3x QMA(fe- male)	-	RJ45 female shielded	3Gb or 6Gb SFP
RFM 3x60W 900MHz FXDJ	2-pin multi- beam XL fe- male	6x 7/16 female	3x QMA(fe- male)	-	RJ45 female shielded	3Gb SFP
RFM 3x60W 2100/1700MHzFR IE	2-pin multi- beam XL fe- male	6x 7/16 female	3x QMA(fe- male)	-	RJ45 female shielded	3Gb SFP
RFM 3x60W 1800MHz FXEA	2-pin multi- beam XL fe- male	6x 7/16 female	3x QMA(fe- male)	-	RJ45 female shielded	3Gb SFP
RFM 3x80W 1800MHz FXEB	Screw- interterminal	6x 7/16 female	3x QMA(fe- male)	8-pin circular	RJ45 female shielded	3Gb or 6Gb SFP
RFM 3x60W 2100MHz FRG- P_A/FRGP_B	2-pin multi- beam XL fe- male	6x 7/16 female	QMA(female)	-	RJ45 female shielded	3Gb SFP
RFM 3x80W 2100MHz FRGT	Screw- interterminal	6x 7/16 female	-	8-pin circular	RJ45 female shielded	3Gb or 6Gb SFP
RFM 3x80W 2100MHz FRGS	Screw- interterminal	6x 7/16 female	-	8-pin circular	RJ45 female shielded	3Gb or 6Gb SFP
RFM 3x80W 1800MHz FXFC	Screw- interterminal	6x 7/16 female	6x QMA(fe- male)	8-pin circular	RJ45 female shielded	3Gb or 6Gb SFP
RFM 3x60W 1900MHz FXFA/B	2-pin multi- beam XL fe- male	6x 7/16 female	6x QMA(fe- male)	8-pin circular	MDR36	3Gb SFP
RFM 6x40W 2600MHz FRHC	Screw- interterminal	6x 7/16 female	-	-	MDR36	3Gb or 6Gb SFP
RFM 6x40W 2600MHz FRHF	Screw- interterminal	6x 7/16 female	-	-	MDR36	3Gb or 6Gb SFP
RFM 3x60W 2600MHz FRHA	2-pin multi- beam XL fe- male	6x 7/16 female	6x QMA(fe- male)	-	RJ45 female shielded	3Gb SFP

! *NOTICE:* Risk of damage to equipment. Incorrect cables and seals may not provide secured environmental protection. Use only tested IP65 class cables with seals provided by NSN.

7.3 Front panel views of RRH

Figure 23 2x40 W RRH front panel connectors

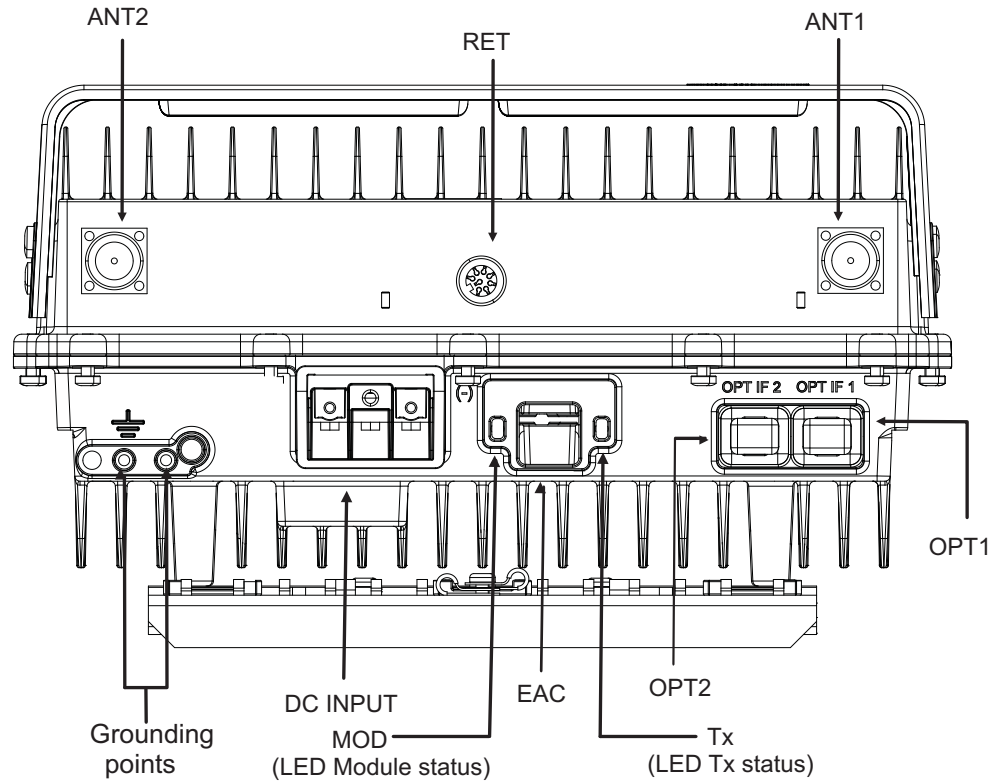


Figure 24 2x60 W RRH front panel connectors

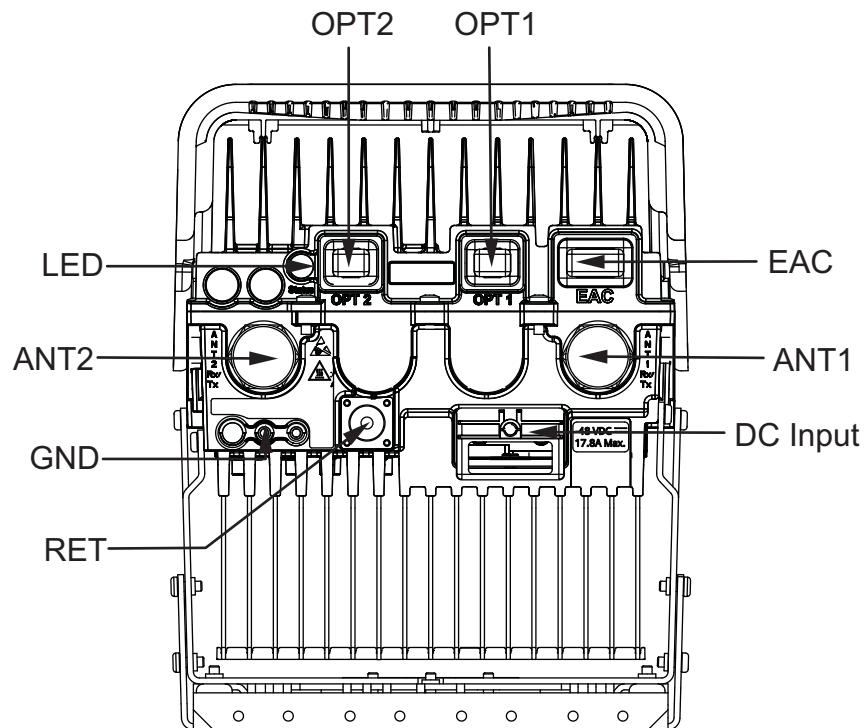
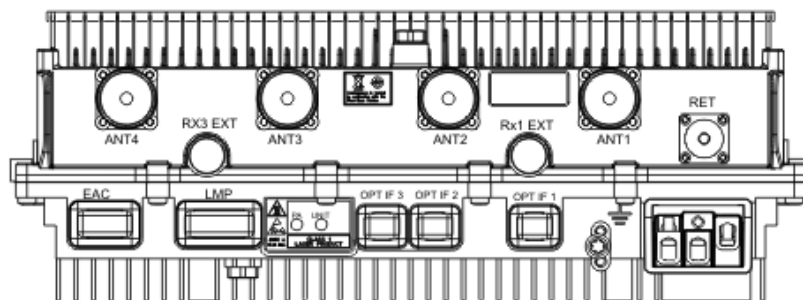


Figure 25 4x30 W RRH front panel connectors



7.4 RRH front panel description

The connectors on the front panel of the , their type, and purpose are listed in the [Table 7: RRH external interfaces](#).

Table 7 RRH external interfaces

Variant	PWR IN	ANT	Rx EXT	RET	EAC	OPT	LMP
RRH 2x40W730 MHz FRLB	3-pole screw terminal	2x 7/16 female	2x QMA, female	8-pin circular	D-sub MDR14	SFP	2x15 pin header
RRH 2x40W800 MHz FRMB	3-pole screw terminal	2x 7/16 female	2x SMA, female	8-pin circular	D-sub MDR14	SFP	2x15 pin header

Table 7 RRH external interfaces (Cont.)

Variant	PWR IN	ANT	Rx EXT	RET	EAC	OPT	LMP
RRH 2x40W 850MHz FHCA	3-pole screw terminal	2x 7/16 fe- male	-	8-pin circu- lar	RJ45 fe- male shielded	SFP	-
RRH 2x40W 850MHz FHCB	3-pole screw terminal	2x 7/16 fe- male	-	8-pin circu- lar	RJ45 fe- male shielded	SFP	-
RRH 2x40W 900MHz FHDA	3-pole screw terminal	2x 7/16 fe- male	-	8-pin circu- lar	RJ45 fe- male shielded	SFP	-
RRH 2x60W 900MHz FHDB	3-pole screw terminal	2x 7/16 fe- male	-	8-pin circu- lar	D-sub MDR14	SFP	-
RRH 2x40W 1800MHz FHEA	3-pole screw terminal	2x 7/16 fe- male	-	8-pin circu- lar	RJ45 fe- male shielded	SFP	-
RRH 2x60W 1800MHz FHEB	3-pole screw terminal	2x 7/16 fe- male	-	8-pin circu- lar	D-sub MDR14	SFP	-
RRH 4x30W 2600MHz FRHD	3-pole screw terminal	4x 7/16 fe- male	2x QMA, fe- male	8-pin circu- lar	D-sub MDR14	SFP	2x15 pin header
RRH 4x30W 2600MHz FRHE	3-pole screw terminal	4x 7/16 fe- male	2x QMA, fe- male	8-pin circu- lar	D-sub MDR14	SFP	2x15 pin header
RRH 2x60W/4x30W 1700MHz/2100 MHz FRIG	3-pole screw terminal	4x 7/16 type, female	2x QMA, fe- male	8-pin circu- lar	D-sub MDR14	SFP	2x15 pin header



NOTICE: Risk of damage to equipment. Incorrect cables and seals may not provide secured environmental protection. Use only tested IP65 class cables with seals.

8 Power requirements and output power

8.1 RF Module power requirements and output power

DC cable requirements for 60 W RF Modules

48 VDC power can be fed to the RF Module directly from the System Module or from an external power source. In both cases, the internal power cable with boot included in the RF Module delivery must be connected to the RF Module to provide IP65 protection.

- If the cable path between the System module and RF Module is less than 2 m then the internal power cable included in the RF Module delivery is connected directly to the System module and RF Module. The optional 4 m (13.1 ft) power cable FPTA 472246A can also be used between the System Module and RF Module.
- If the cable path between the System Module and RF Module exceeds 4 m (13.1 ft), then a pair of FSEC/FSESs (Flexi System External OVP) must be installed between the System module and RF Module. For details, see Creating Flexi Multiradio BTS Site Configurations in respective system documentation.
- For all RF Modules with or only modules with the 3-terminal DC connector if 48 VDC power is supplied to the RF module from an external power source, then an FSEC/FSES must be installed between the external power source and the RF module. The internal power cable included in the RF module delivery must be connected from the RF module to the FSEC/FSES.

DC cable requirements for 80 W RF Modules

The DC cable is not included in the 80 W RF Module delivery. 48 VDC power can be fed from a System Module or directly from an external power source.

The following table defines DC cables to be used if power is fed from a System Module using FPF1/FPFD:

Table 8 DC Cable Requirements for 80 W RF Modules

Variant	Total Configured output power ⁸⁾	RET/MHA	Minimum DC voltage	Power Cable ⁹⁾
1900/1800	<= 180 W	Any	Any	Single
1900/1800	> 180 W	Yes	< 46.5	Dual
1900/1800	> 180 W	Yes	>= 46.5	Single
1900/1800	> 180 W	No	< 41.5	Dual
1900/1800	> 180 W	No	>= 41.5	Single
850/900	<= 180 W	Any	Any	Single
850/900	> 180 W	Yes	< 40	Dual

⁸⁾ Total configured output power is the total power for all three branches. For example, a 2+2+2 @ 40 W is equal to 240 W.

⁹⁾ The following power cables are available: FPCA 472806A (Dual, 2 m, 6.6 ft), FPCB 472817A (Single, 2 m, 6.6 ft), FPCC 472823A (Single, 2 m, 6.6 ft), FPTA 472246A (Single, 4 m, 13.1 ft). The dual power cable requires two available PWR outputs on the System Module or PDU (excluding PWR AUX). It is recommended to use the next available connectors in sequence. The FPCC and FPTA require removing the connector from one end. Consider future expansion when choosing single or dual power cables.

Table 8 DC Cable Requirements for 80 W RF Modules (Cont.)

Variant	Total Configured output power ⁸⁾	RET/MHA	Minimum DC voltage	Power Cable ⁹⁾
850/900	> 180 W	Yes	< 46.5	Single
850/900	> 180 W	Yes	>= 46.5	Single
850/900	> 180 W	No	< 41.5	Single
850/900	> 180 W	No	>= 41.5	Single

DC cable requirements for 6TX 40W RF Modules

The DC cable is not included in the 6TX 40 W RF Module delivery. 48 VDC power can be fed from an external power source.

- If 6TX 40 W RFM is used with FSME or FPFC/FPFD (30 A PDU), then the rules in [DC cable requirements for 6TX 40W FRMC, FRPA, FRPB Modules](#) and [DC cable requirements for 6TX 40W FRHC, FRHF Modules](#) apply:

Table 9 DC cable requirements for 6TX 40W FRMC, FRPA, FRPB Modules

Total Configured output power	RET/MHA	Minimum DC Voltage voltage (at FRM input)	Power Cable
<= 180 W	No	Any	Single
<= 180 W	Yes	Any	Single
> 180 W	Yes	<44.3	Dual
> 180 W	Yes	>44.3	Single
> 180 W	No	<41.3	Dual
> 180 W	No	>41.3	Single

Table 10 DC cable requirements for 6TX 40W FRHC, FRHF Modules

Total Configured output power	RET/MHA	Minimum DC Voltage voltage (at FRM input)	Power Cable
<= 180 W	No	Any	Single
<= 180 W	Yes	Any	Single

⁸⁾ Total configured output power is the total power for all three branches. For example, a 2+2+2 @ 40 W is equal to 240 W.
⁹⁾ The following power cables are available: FPCA 472806A (Dual, 2 m, 6.6 ft), FPCB 472817A (Single, 2 m, 6.6 ft), FPCC 472823A (Single, 2 m, 6.6 ft), FPTA 472246A (Single, 4 m, 13.1 ft). The dual power cable requires two available PWR outputs on the System Module or PDU (excluding PWR AUX). It is recommended to use the next available connectors in sequence. The FPCC and FPTA require removing the connector from one end. Consider future expansion when choosing single or dual power cables.

Table 10 DC cable requirements for 6TX 40W FRHC, FRHF Modules (Cont.)

Total Configured output power	RET/MHA	Minimum DC Voltage voltage (at FRM input)	Power Cable
> 180 W	Yes	<48.2	Dual
> 180 W	Yes	>48.2	Single
> 180 W	No	<45.2	Dual
> 180 W	No	>45.2	Single

Requirements if power is supplied from an external source

The following requirements apply if power is fed from an external power source:

- The allowed diameter of shielded or jacketed cables is 6-25 mm (0.24-1 in.).
- The allowed cross section of individual DC wires is 6-25 mm² (10-4 AWG) at the DC terminal. It is recommended that 25 mm² (4 AWG) wires are capped to avoid loose strands. If thicker DC wires are required, then an FSEC/FSES or other IP65 DC distribution box is required to reduce the cable thickness at the module.
- Recommended DC cable lengths, thicknesses, and type are provided in the section Feederless site and Distributed site solution requirements.
- The DC connector has three screw terminals. The outer terminals are for (+) and (-) wires. The middle terminal is for grounding the shielded DC cable braid.

Requirements if power is supplied from an external source

The following requirements apply if power is fed from an external power source:

- The allowed diameter of shielded or jacketed cables is 6-25 mm (0.24-1 in.).
- The allowed cross section of individual DC wires is 6-25 mm² (10-4 AWG) at the DC terminal. It is recommended that 25 mm² (4 AWG) wires are capped to avoid loose strands. If thicker DC wires are required, then an FSEC/FSES or other IP65 DC distribution box is required to reduce the cable thickness at the module.
- Recommended DC cable lengths, thicknesses, and type are provided in the section Feederless site and Distributed site solution requirements.
- The DC connector has three screw terminals. The outer terminals are for (+) and (-) wires. The middle terminal is for grounding the shielded DC cable braid.

RF Module input voltage range

Table 11 RF Module input voltage range

Property	Value
Nominal system voltage	48 V DC
Input voltage range	40.5 - 57 V DC

RF Module output power

Basic typical conditions:

- room temperature 23°C

- no MHA power feeding included
- no antenna tilting power feeding included

The tolerance of the power consumption estimate +/-10%.

Table 12 RF Module frequency range and bandwidth

RF Module variant	Maximum number of pipes	RF output power per sector [W]	Est. power consumption [W] at 48 VDC input in 23 °C	
			50% RF load	100% RF load
RFM 3x60W 850MHz FXCA	3	60	545	794
		40	468	644
		20	393	494
RFM 6x40W 700MHz FRPA/B	3	40	753	1046
		30	626	849
		20	472	620
		8	380	441
RFM 3x60W 800MHz FRMA	3	60	669	943
		40	510	673
		20	374	450
RFM 3x60W 800MHz FRMD	3	60	621	826
		40	486	616
		20	369	435
RFM 3x60W 800MHz FRMC ¹⁰⁾	3	40	621	826
		30	486	616
		20	369	435
RFM 3x80W 850MHz FXCB	3	80	649	1021
		60	572	860
		40	490	698
		20	406	532
RFM 3x60W 900MHz FXDA	3	60	567	822
		40	492	674

¹⁰⁾ data for two pipes

Table 12 RF Module frequency range and bandwidth (Cont.)

RF Module variant	Maximum number of pipes	RF output power per sector [W]	Est. power consumption [W] at 48 VDC input in 23 °C	
			50% RF load	100% RF load
		20	420	526
RFM 3x80W 900MHz FXDB	3	80	626	955
		60	562	818
		40	488	680
		20	409	528
RFM 3x60W 900MHz FXDJ	3	60	567	822
		40	492	674
		20	420	526
RFM 3x60W 2100/1700 MHz FRIE	3	60	465	610
		40	420	535
		20	345	420
RFM 3x60W 1800MHz FXEA	3	60	588	891
		40	512	736
		20	428	568
RFM 3x80W 1800MHz FXEB	3	80	708	1069
		60	613	878
		40	520	701
		20	425	519
RFM 3x60W 2100MHz FRGP_A FRGP_B	3	60	584	804
		40	490	647
		20	393	476
RFM 3x80W 2100MHz FRGT/S	3	80	560	884
		60	522	729
		40	407	544
		20	316	386

Table 12 RF Module frequency range and bandwidth (Cont.)

RF Module variant	Maximum number of pipes	RF output power per sector [W]	Est. power consumption [W] at 48 VDC input in 23 °C	
			50% RF load	100% RF load
RFM 3x80W 1800MHz FXFC	3	80	755	1021
		60	662	934
		40	556	733
		20	451	550
RFM 3x60W 1800MHz FXFA	3	60	709	977
		40	612	776
		20	508	599
RFM 3x60W 1900MHz FXFB	3	60	639	948
		40	549	777
		20	456	589
RFM 6x40W 2600 MHz FRHC	6	60	839	1148
		40	700	946
		20	508	672
RFM 6x40W 2600 MHz FRHF	6	60	839	1148
		40	700	946
		20	508	672
RFM 3x60W 2600 MHz FRHA ¹¹⁾	6	60	806	1130
		40	622	825
		20	462	580

8.2 RRH Module power requirements

RRH Module input voltage range

¹¹⁾ data for three pipes

Table 13 RRH Module input voltage range

Property	Value
Input voltage range	36 - 57 V DC ¹²⁾

RRH output power

Basic typical conditions:

- room temperature 23°C
- no MHA power feeding included
- no antenna tilting power feeding included

The tolerance of the power consumption estimate +/-10%.

Power consumption of the FRHB, RFHE RRH will be provided in further deliveries.

Table 14 RRH frequency range and bandwidth

Configuration	Maximum number of pipes	RF output power per sector [W]	Est. power consumption [W] at 48 VDC input in 23 °C	
			50% RF load	100% RF load
RRH 2x40W 850MHz FHCA	2	40	260	350
		20	200	240
RRH 2x40W 900MHz FHDA	2	40	232	325
		20	188	239
RRH 2x60W 900MHz FHDB	2	60	313	472
		40	270	378
		20	228	303
RRH 2x40W 1800MHz FHEA	2	40	267	393
		30	260	373
		20	256	356
RRH 2x60W 1800MHz FHEB	2	60	437	500
		40	371	416
		20	297	325

¹²⁾ The minimum startup voltage is 40.5 V DC

Table 14 RRH frequency range and bandwidth (Cont.)

Configuration	Maximum number of pipes	RF output power per sector [W]	Est. power consumption [W] at 48 VDC input in 23 °C	
			50% RF load	100% RF load
RRH 2x60W/4x30W 1700 MHz/2100 MHz FRIG	4	30	479	673
		20	417	533
		10	355	415
RRH 2x40W 2100 MHz FRGQ	3	40	292	382
		30	265	334
		20	212	259
RRH 4x30W 2600 MHz FRHD	4	30	496	688
		20	428	562
		10	355	429

9 RF Module and RRH Module dimensions and weight

Radio Frequency Module Dimensions and weight

The dimensions of the Radio Frequency Module are presented in the table below.

Table 15 Radio Module dimensions and weight

Property	Value
Width ¹³⁾	447/492 mm (17.6/19.4 in.)
Height	133 mm/ 3U (5.2 in.)
Depth ¹⁴⁾	422/560 mm (16.6/22.1 in.)
Weight	25 kg (55.1 lbs)

RRH Module dimensions and weight

The dimensions of the Remote Radio Head Module are presented in tables below.

Table 16 RRH dimensions and weights

Variant	Width	Height	Depth	Weight
RRH 2x40W 730 MHz FRLB	400 mm (15.75 in.)	400 mm (15.75 in.)	150 mm (5.90 in.)	27 kg ¹⁵⁾ (59.52 lbs)
RRH 2x40W 800 MHz EU FRMB	326 mm (12.83 in.)	514 mm (20.27 in.)	148mm (5.83 in.)	17.3 kg ¹⁾ (38.14 lbs)
RRH 2x40W 850MHz FHCA	358 mm (14.1 in.)	579 mm (22.7 in.) ¹⁶⁾	215 mm (8.4 in.)	20 kg 44 lbs
		733 mm (28.8 in.) ¹⁷⁾		
RRH 2x40W 900MHz FHDA	358 mm (14.1 in.)	579 mm (22.7 in.) ²⁾	215 mm (8.4 in.)	20 kg 44 lbs

¹³⁾ Width of the casing without front covers/with front covers

¹⁴⁾ Depth of the casing without front covers/with front covers

¹⁵⁾ without solar shield and mounting shroud

¹⁶⁾ as delivered, cable tie point recessed

¹⁷⁾ as installed, cable tie point released due to brackets and solar shields

Table 16 RRH dimensions and weights (Cont.)

Variant	Width	Height	Depth	Weight
		733 mm (28.8 in.) ³⁾		
RRH 2x60W 900MHz FHDB	260 mm (10.2 in.)	335.2 (13.2 in.) ²⁾	324 mm (12.8 in.)	17.3 kg (38.1 lbs)
		571 mm (22.5 in.) ¹⁸⁾		
		621 mm (24.4 in.) ¹⁹⁾		
RRH 2x40W 1800MHz FHEA	358 mm 14.1 in.	579 mm (22.7 in.) ²⁾	215 mm (8.4 in.)	20 kg 44 lbs
		733 mm (28.8 in.) ³⁾		
RRH 2x60W 1800MHz FHEB	260 mm (10.2 in.)	335.2 (13.2 in.) ²⁾	324 mm (12.8 in.)	17.3 kg (38.1 lbs)
		571 mm (22.5 in.) ⁴⁾		
		621 mm (24.4 in.) ⁵⁾		
RRH 2x60W/4x30W 1700MHz/2100 MHz FRIG	400 mm (15.74 in.)	459.5 mm (18.09 in.)	133.4 / 162.3 mm (5.25 / 6.38 in.)	23.7 kg (52.24 lbs)
RRH 2x40W 2100 FRGQ	324 mm (12.8 in.)	486 mm (19.1 in.)	155 mm (6.1 in.)	17 kg (37.47 lbs)
RRH 4x30W 2600MHz FRHE	400 mm (15.7 in.)	578 mm (22.7 in.)	201.5 mm (7.9 in.)	max. 28.5 kg (62.8 lbs)
RRH 4x30W 2600MHz FRHD	400 mm (15.7 in.)	578 mm (22.7 in.)	201.5 mm (7.9 in.)	max. 28.5 kg (62.8 lbs)
RRH 2x40W 2600 FRHB	326 mm (12.83 in.)	514 mm (20.27 in.)	148 mm(5.83 in.)	17.3 kg ¹⁾ (38.14 lbs)

18) with lower mounting bracket in the "FMFA" position

19) with lower mounting bracket in the "ALT" position

10 RF Module and RRH Module LED indications

The Flexi Multiradio RF Module and Flexi RRH Module have two tricolor LEDs on the front panel to indicate the operational status of the module and all fault conditions during operation. A blinking red LED does not always require removing the module.

The Flexi Multiradio RF Module LEDs are:

- Module Status - indicates the status of the RF Module core functional block
- Fan/TX Status - indicates the fan and TX status

The Flexi Multiradio RRH Module LEDs are:

- Module Status - indicates the status of the RRH Module core functional block
- TX Status - indicates the TX status of the RRH Module



A Red, blinking LED does not necessarily mean hardware failure. Always perform troubleshooting before replacing the module.

You can identify faulty Flexi Multiradio BTS modules with respective Flexi BTS Site Manager. In the Alarms window of respective Flexi BTS Site Manager, you can see the object that the alarm refers to in the Object column. It is not always the alarming module that is faulty, it may also be the connected cable or the interworking module that causes the alarm.

At the site, you can easily locate the alarming module by checking the color of the LED. See the LED status indications tables for information of LED status.

Table 17 RF/RRH Module unit status LED indications

Color	Indication
Red, blinking	Operation degraded: Major alarm on the RF Module
Red, stable	Faulty: Critical alarm on the RF Module
Yellow, blinking	Software download in progress or Configuration in progress: RF resources are being set-up, but not yet activated
Yellow, stable	Until software download begins or The carriers are blocked from BTS or There is no connection to any System Module
Green, blinking	Software downloading and updating
Green, stable	Software configuration is complete or Supervisory: RF resources activated and transmission is possible or Working normally, no alarm on the RF Module
Stable Red for less than 5 seconds and changes to Stable Yellow	Switched ON, but the next conditions are not reached yet
Stable Red for less than 5 seconds	The module is in the process of resetting
Periodic Red and Green	Antenna line device faulty/degraded (RF Module only)

Table 17 RF/RRH Module unit status LED indications (Cont.)

Color	Indication
Blinking Colors (Red, Yellow, and Green), each color stable for 500 ms	Module highlighting ²⁰⁾

Table 18 RF Module fan/TX status LED indications

Color	Indication
Yellow, stable	O&M control is missing
Red, stable	All fans are faulty
Green, stable	All fans are working
Yellow	First fan is not working ²¹⁾
Color set according to fan status, stable	RF transmission is ON
Color set according to fan status, blinking	RF transmission is OFF

The RRHs do not have fans, therefore, there is no Fan LED.

Table 19 2x40 W RRH TX Status LED

Color	Indication
Yellow, Stable	O&M control missing
Green, Stable	Transmission ON
Green, Blinking	Transmission OFF



2x60 W RRH does not have a TX status LED and the BTS Manager reports its status by indicating LED state only.

²⁰⁾ Flexi BTS SM functionality that can help identifying faulty module.

²¹⁾ counting from the left-hand side of the RF Module back view.

11 RF Module and Remote Radio Head temperature range

For RF Module and RRH temperature ranges, see [Table 20: RF Module temperature range](#) and [Table 21: RRH temperature range](#).

Table 20 RF Module temperature range

Property	Temperature
Maximum operational outdoor temperature	+55°C (131°F) ²²⁾
Minimum operational temperature	-35°C (-31°F) ²³⁾

Table 21 RRH temperature range

Property	Temperature
Maximum operational outdoor temperature (in the shade)	+55°C (131°F) ²⁴⁾
Maximum operational outdoor temperature (in the sun) ²⁵⁾	+50°C (122°F) ¹⁾
Maximum indoor temperature	+45°C (129.2°F) ²⁶⁾
Minimum operational temperature	-40°C (-40°F) ²⁷⁾

22) At constant high ambient temperature maximum output power might be limited.
 23) Including cold start.
 24) At constant high ambient temperature maximum output power might be limited.
 25) According to GR-487-Core specification.
 26) This is valid for fanless products.
 27) Including cold start.

12 Appendix B: Compliance with EMC, RF, and safety

In Europe, this means compliance with Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.

In other market areas additional compliance is fulfilled according to relevant authority requirements.

EMC emission

- ETSI EN 301 489-1: Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements.
- ETSI EN 301 489-8: Part 8: Specific conditions for GSM base stations.
- EN55022: "Limits and methods of measurement of radio disturbance characteristics of information technology equipment".

EMC immunity

- ETSI EN 301 489-1: "Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services - Part 1: Common technical requirements".
- ETSI EN 301 489-8: Part 8: Specific conditions for GSM base stations.
- IEC 1000-4-9: Pulse magnetic field immunity test.
- IEC 1000-4-8: "Electromagnetic Compatibility (EMC) Part 4. Testing and measurement techniques Section 8: Power frequency magnetic field immunity test, Basic EMC Publication".

RF

- **GSM:** ETSI EN 301 502: Harmonized EN for Global System for Mobile communications (GSM) - Base Station and Repeater equipment covering essential requirements under article 3.2 of the R&TTE directive.
- **WCDMA:** ETSI EN 301 908-3: IMT cellular networks; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive; Part 3: CDMA Direct Spread (UTRA FDD) Base Stations (BS).
- **LTE:** ETSI EN 301 908-14: IMT cellular networks; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive; Part 14: Evolved Universal Terrestrial Radio Access (E-UTRA) Base Stations (BS)

Safety

- IEC 60950-1/ EN 60950-1: "Safety of Information Technology equipment including electrical business equipment".
- IEC 60950-22/ EN 60950-22: "Information technology equipment - Safety - Part 22: Equipment to be installed outdoors"
- EN 50383: Basic standard for the calculation and measurement of the electromagnetic field strength and SAR related to human exposure from radio base stations and fixed terminal stations for wireless telecommunications system (110 MHz - 40 GHz).
- EN 50384: Product standard to demonstrate the compliance of radio base stations and fixed terminal stations for wireless telecommunications systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz - 40 GHz) - Occupational.

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- EN 50385: Product standard to demonstrate the compliances of radio base stations and fixed terminal stations for wireless telecommunications systems with the basic restrictions or the reference levels related to human exposure to radio frequency electromagnetic fields (110 MHz - 40 GHz) - General public.
 - UL 60950-1: Safety of Information Technology Equipment.
 - CSA C22.2 No. 60950-00: Safety of Information Technology Equipment.

13 Appendix C: Avoiding Passive Intermodulation during RF Module and RRH operation

In wideband frequencies when several transmitting and receiving signals are sharing same hardware there could be noted effect called Passive Intermodulation (PIM) Interference. Using RF Modules might cause a potential risk of generating third-order intermodulation that results in distortions in own receiver (RX) channel. Antenna Line Devices (ALD) have important role in preventing Passive Intermodulation generation, even if used RF Module and RRH performance at the antenna connector complies with 3GPP requirements. Poor PIM performance of ALD might degrade significantly the reference sensitivity.

The risk might be high in the following cases:

- Maximum bandwidth (BW) used for the carriers is more than 0.5 x duplex separation of the band
- Carriers in configuration are wideband in nature (for example WCDMA or LTE), or combination of wideband and narrow band carriers (for example RF sharing GSM-WCDMA or GSM-LTE).
- Antenna line PIM performance is poor, or not on the required level for the configuration.

Table 22 Typical reference sensitivity degradation with different Antenna line PIM performance. shows example of the degradation levels

PIM performance	Typical degradation	Note
-140 dBc @ 2x43 dBm	~10 dB	High degradation, carrier configuration unusable in many cases
-153 dBc @ 2x43 dBm	~2 dB	Modest degradation, tolerable in many cases
-161 dBc @ 2x43 dBm	~0.2 dB	Minimal degradation, however, difficult to reach on the typical site environment.

When using wideband carrier configurations where PIM products fall into own receiver band, it is recommended that antenna line PIM performance is at least -153 dBc measured with 2 x 43dB test signals.

However, this kind of performance might be very difficult to achieve and maintain over time in outdoor environment due to mechanisms behind the PIM including corrosion, oxidation, material imperfections, and defects in workmanship. Some of these parameters might change, and can degrade performance during operation. Taking that into consideration, it is highly recommended not to use carrier configurations which are generating intermodulation results in landing in own receiver channels.