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**Nokia UltraSite EDGE BTS, Rel. CX5, Product
Documentation, v.1**

UltraSite EDGE BTS Unit Descriptions



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Contents

	Contents	3
1	Summary of changes in UltraSite EDGE BTS Unit Descriptions	9
2	Base Operations and Interfaces (BOIx) unit	11
2.1	Technical description of the Base Operations (BOIx) and Interfaces unit	11
2.1.1	Function	11
2.1.2	Operation	13
2.1.3	Main blocks	14
2.2	Interfaces of the Base Operations and Interfaces (BOIx) unit	15
2.3	Base Operations and Interfaces (BOIx) unit LEDs	16
2.4	Dimensions and weight of Base Operations and Interfaces	17
2.5	Electrical properties for Base Operations and Interfaces	17
3	Bias Tee (BPxx) unit	19
3.1	Technical description of Bias Tee (BPxx) unit	19
3.2	Interfaces of the Bias Tee (BPxx) unit	23
3.2.1	Without VSWR (WBNB, 800/900/1800/1900)	23
3.2.2	With VSWR (WBVC, 800/900; WBVB, 1800/1900)	24
3.2.3	Bias Tee Interface Module unit	26
3.3	Bias Tee (BPxx) unit alternatives	27
3.4	Electrical specifications for Bias Tee (BPxx) unit	27
3.5	Mechanical specifications for Bias Tee (BPxx) unit	28
3.6	Environmental specifications for Bias Tee (BPxx) unit	29
3.7	Mean Time Between Failure (MTBF) specifications for Bias Tee (BPxx) unit	29
3.8	Electromagnetic Compatibility (EMC) of Bias Tee (BPxx) unit	29
4	Dual Band Diplex Filter (DU2A) unit	31
4.1	Technical description of Dual Band Diplex Filter (DU2A) unit	31
4.1.1	Function	31
4.1.2	Operation	32
4.1.3	Main blocks	32
4.2	Interfaces of the Dual Band Diplex Filter (DU2A) unit	33
4.3	Dimensions and weight of Dual Band Diplex Filter (DU2A) unit	34
4.4	Insertion and return loss of Dual Band Diplex Filter (DU2A) unit	34
4.5	Power requirements for Dual Band Diplex Filter (DU2A) unit	34
5	Dual Variable Gain Duplex Filter (DVxx) unit	35
5.1	Technical description of Dual Variable Gain Duplex Filter (DVxx) unit	35
5.1.1	Function	35
5.1.2	Operation	37
5.1.3	Main blocks	37
5.1.4	I2C-data bus	38
5.2	Interfaces of the Dual Variable Gain Duplex Filter (DVxx) unit	39
5.3	Dual Variable Gain Duplex Filter (DVxx) unit alternatives	41
5.4	Dual Variable Gain Duplex Filter (DVxx) unit LEDs	41

5.5	Dimensions and weight of Dual Variable Gain Duplex Filter (DVxx) unit	42
5.6	Power requirements for Dual Variable Gain Duplex Filter (DVxx) unit	42
5.7	RF properties for Dual Variable Gain Duplex Filter (DVxx) unit	43
6	Power Supply (PWSx) unit	49
6.1	Technical description of Power Supply (PWSx) unit	49
6.1.1	Function	49
6.1.2	Power supply redundancy	50
6.1.3	Operation	51
6.1.3.1	Operating switch	51
6.1.3.2	Thermal protection	51
6.1.3.3	PWSA	51
6.1.3.4	PWSB	52
6.1.3.5	PWSC	53
6.1.3.6	Overvoltage protection	55
6.1.4	Main blocks	55
6.1.4.1	Power input block	55
6.1.4.2	Power switcher block	55
6.1.4.3	Control block	56
6.2	Interfaces of the Power Supply (PWSx) unit	56
6.3	Power Supply (PWSx) unit alternatives	60
6.4	Power Supply (PWSx) unit LEDs	61
6.5	Dimensions and weight of Power Supply (PWSx) units	62
6.6	Power requirements for Power Supply (PWSx) units	62
7	Receiver Multicoupler (M2xA or M6xA) unit	65
7.1	Technical description of Receiver Multicoupler (MxxA) unit	65
7.1.1	Function	65
7.1.2	Operation	66
7.1.3	MAIN blocks	69
7.2	Interfaces of the Receiver Multicoupler (M2xA and M6xA) unit	71
7.2.1	M2xA interfaces	71
7.2.2	M6xA interfaces	71
7.3	Receiver Multicoupler (M2xA or M6xA) unit alternatives	72
7.4	Dimensions and weight of Receiver Multicoupler (M2xA or M6xA) unit	72
7.5	Insertion and return loss of Receiver Multicoupler (M2xA or M6xA) unit	73
8	Remote Tune Combiner (RTxx) unit	75
8.1	Technical description of Remote Tune Combiner (RTxx) unit	75
8.1.1	Function	75
8.1.2	Operation	77
8.1.2.1	Overvoltage protection	78
8.1.3	Main modules	78
8.1.3.1	Selector	80
8.1.3.2	Combiner	81
8.1.3.3	Filter	83
8.1.3.4	Controller	86
8.2	Interfaces of the Remote Tune Combiner (RTxx) unit	87
8.3	Remote Tune Combiner (RTxx) unit alternatives	89
8.4	Remote Tune Combiner (RTxx) unit LEDs	90
8.5	Dimensions and weight of Remote Tune Combiner (RTxx) unit	90

8.6	Electrical properties for Remote Tune Combiner (RTxx) unit	91
8.7	RF properties for Remote Tune Combiner (RTxx) unit	91
8.8	Insertion loss (TX) of Remote Tune Combiner (RTxx) unit	93
9	Temperature Control System (TCS)	97
9.1	Technical description of Temperature Control System (TCS)	97
9.1.1	Operation	97
9.1.1.1	Unit cooling fans	97
9.1.1.2	Cabinet cooling fan	101
9.1.1.3	HETA	105
9.1.1.4	Fan control during startup	107
9.1.2	Fan control during reset	107
9.1.3	Main blocks	108
9.2	Interfaces of the Temperature Control System	109
9.2.1	Fans	109
9.2.2	HETA	110
9.3	Dimensions and weight of Temperature Control System (TCS)	111
9.4	Electrical properties for Temperature Control System (TCS)	112
10	Transceiver Baseband (BB2x) unit	115
10.1	Technical description of Transceiver Baseband (BB2x) unit	115
10.1.1	Function	115
10.1.2	Operation	116
10.1.2.1	Downlink signal processing	117
10.1.2.2	Uplink Signal Processing	117
10.1.2.3	Downlink signal processing	117
10.1.3	Main blocks	118
10.2	Interfaces of the Transceiver Baseband (BB2x) unit	121
10.2.1	BB2A interfaces	121
10.2.2	BB2E and BB2F interfaces	121
10.3	Transceiver Baseband (BB2x) unit alternatives	121
10.4	Transceiver Baseband (BB2x) unit LEDs	122
10.5	Dimensions and weight of Transceiver Baseband (BB2x) unit	122
10.6	Power requirements for Transceiver Baseband (BB2x) unit	123
11	Transceiver (TSxx) unit	125
11.1	Technical description of Transceiver (TSxB) unit	125
11.1.1	TRX module	127
11.1.2	Power Amplifier module	129
11.2	Interfaces of the Transceiver (TSxB) unit	130
11.2.1	Front interfaces	130
11.2.2	Back interfaces	130
11.2.2.1	X6 connector	131
11.2.2.2	X7 connector	131
11.2.2.3	X100 connector	132
11.3	Transceiver (TSxx) unit alternatives	139
11.4	Transceiver (TSxB) unit LEDs	140
11.5	Dimensions and weight for Transceiver (TSxx) unit	140
11.6	Electrical properties for Transceiver (TSxx) unit	141
11.7	RF properties for Transceiver (TSxx) unit	142

- 12 Wideband Combiner (WCxA) unit 143**
 - 12.1 Technical description of Wideband Combiner (WCxA) unit **143**
 - 12.1.1 Function **143**
 - 12.1.2 Operation **143**
 - 12.1.3 Main blocks **144**
 - 12.2 Interfaces of the Wideband Combiner (WCxA) unit **146**
 - 12.3 Wideband Combiner (WCxA) unit alternatives **146**
 - 12.4 Dimensions and weight of Wideband Combiner (WCxA) unit **146**
 - 12.5 RF properties for Wideband Combiner (WCxA) unit **147**

- 13 Triple Wideband Combiner (WCxT) unit 149**
 - 13.1 Technical description of Triple Wideband Combiner (WCxT) unit **149**
 - 13.1.1 Function **149**
 - 13.1.2 Operation **150**
 - 13.1.3 Main blocks **150**
 - 13.2 Interfaces of the Triple Wideband Combiner (WCxT) unit **153**
 - 13.3 Triple Wideband Combiner (WCxT) unit alternatives **153**
 - 13.4 Dimensions and weight of Triple Wideband Combiner (WCxT) unit **153**
 - 13.5 RF properties for Triple Wideband Combiner (WCxT) unit **154**

- 14 Transmission (VXxx) unit 155**
 - 14.1 Technical description of transmission interfaces **155**
 - 14.2 Technical description of transmission interface measurements **155**
 - 14.3 Transmission (VXxx) unit alternatives **156**
 - 14.4 BTS transmission capacity signal types **157**
 - 14.5 Transmission unit LEDs **158**

- 15 FC E1/T1 159**
 - 15.1 Technical description of FC E1/T1 transmission unit **159**
 - 15.2 Interfaces of FC E1/T1 Transmission (VXxx) units **160**
 - 15.3 Dimensions and weight of FC E1/T1 Transmission (VXxx) units **161**
 - 15.4 International standards; FC E1/T1 transmission (VXxx) units **162**
 - 15.5 Electrical properties for FC E1/T1 Transmission (VXxx) units **164**

- 16 FXC E1 and FXC E1/T1 167**
 - 16.1 Technical description of the FXC E1 and FXC E1/T1 transmission units **167**
 - 16.1.1 FXC E1 **167**
 - 16.1.2 FXC E1/T1 **168**
 - 16.2 Interfaces of the FXC E1 transmission unit **171**
 - 16.3 Interfaces of the FXC E1/T1 transmission unit **171**
 - 16.4 Dimensions and weight of FXC E1 and E1/T1 transmission units **172**
 - 16.5 Power requirements for FXC E1 and FXC E1/T1 transmission units **173**
 - 16.6 International standards; FXC E1 and FXC E1/T1 transmission units **173**

- 17 FXC RRI 175**
 - 17.1 Technical description of the FXC RRI transmission unit **175**
 - 17.2 Interfaces of the FXC RRI transmission unit **178**
 - 17.3 Dimensions and weight of the FXC RRI transmission unit **178**
 - 17.4 Power requirements for the FXC RRI transmission unit **179**
 - 17.5 International standards; FXC RRI transmission units **179**

17.6	Flexbus cable requirements for the FXC RRI transmission unit	179
17.7	Flexbus DC LEDs on the FXC RRI transmission unit	180
18	FXC STM-1 and FXC Bridge	181
18.1	Technical description of the FXC STM-1 and FXC Bridge transmission units	181
18.1.1	Main features of FXC STM-1 and FXC Bridge	182
18.1.2	Main blocks of the FXC STM-1 and FXC Bridge units	183
18.1.3	FXC STM-1	186
18.1.4	FXC Bridge	188
18.1.5	FXC Bridge D-bus implementation	190
18.2	Interfaces of the FXC STM-1 and FXC Bridge transmission units	191
18.3	Dimensions and weight of FXC STM-1 and FXC Bridge transmission units	192
18.4	Power requirements for FXC STM-1 and FXC Bridge transmission units	192
18.5	International standards; FXC STM-1 and FXC Bridge transmission units	193
19	Technical description of optional DC filter module	195
19.1	Technical description of the -48 VDC filter module	195
19.2	Interfaces of the -48 VDC filter module	197
19.2.1	Input terminals	197
19.2.2	Output terminals	197
19.3	Electrical properties for -48 VDC filter module	198
	Related Topics	201

1

Summary of changes in UltraSite EDGE BTS Unit Descriptions

The following changes have taken place in the *UltraSite EDGE BTS Unit Descriptions* document:

- The following sections have been removed from the document:
 - *Overview of GSM/EDGE unit technical descriptions*
 - *Description of hot insertion*
 - *Technical data for unit cable kits*

These sections can be found in the *UltraSite EDGE BTS Product Description* document

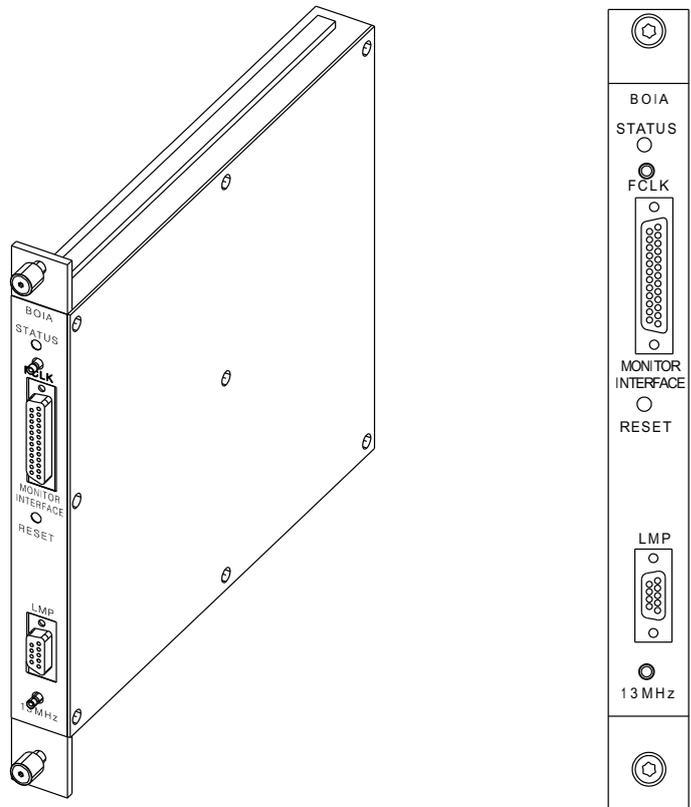
2 Base Operations and Interfaces (BOIx) unit

2.1 Technical description of the Base Operations (BOIx) and Interfaces unit

2.1.1 Function

The Base Operations and Interfaces (BOIx) unit is EDGE compatible and handles the control functions that are common among all other units in the BTS. The unit manages the following functions:

- BTS initialisation and self-testing
- configuration
- Operations and Maintenance (O&M) signalling
- software downloads
- main clock functions
- timing functions
- collection and management of external and internal alarms
- delivery of messages to the Base Station Controller (BSC) through the Transmission (VXxx) unit
- cabinet control
- boundary scan for unit-level testing
- flash programming in the production line



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Figure 1. BOIx unit

When the BOIx unit is installed in an outdoor cabinet, it requires a rubber cover for environmental protection.



DN03418265

Figure 2. BOIx cover

2.1.2 Operation

The BSC or Nokia BTS Manager downloads software to the Flash memory of the BOIx unit. The BOIx unit downloads BTS software and configuration data to other units in the BTS. The LED on the BOIx unit indicates the status of the board. The BOIx unit receives alarm notifications from other active units and saves configuration information in non-volatile memory. The unit also controls the uplink and downlink cross-connection between the Transceiver Baseband (BB2x) unit and the Transceiver (TSxx) unit. The BOIx unit detects unit alarms and performs recovery actions. In certain situations, the unit resets itself. The BOIx unit generates an accurate reference clock signal for the TSxx unit, BB2x unit, and Remote Tune Combiner (RTxx) unit. The BTS can synchronize its frame clock and number with a member of the Nokia Talk family (with Talk as the clock master) or to another BTS. The following features are standard with the BOIx unit:

- self-testing
- Local Management Port (LMP) - interface that allows the user to communicate with the main processor and control the BTS through Nokia BTS Manager
- BTS software download - from the BSC (through the Abis interface) or Nokia BTS Manager
- EMI/EMC shielding - for internal electrical components

- High-accuracy reference clock - for timing generation; clock can be adjusted according to the Abis reference
- Overvoltage protection for electrostatic discharge - the front panel of the BOIx unit is grounded and the power supply lines are protected against damage from accidental cross-connection

2.1.3 Main blocks

The BOIx unit consists of the following functional blocks:

- Unit Controller (UC)
- Master Clock Generator (MCLG)
- D-bus
- Field Programmable Gate Array (FPGA)

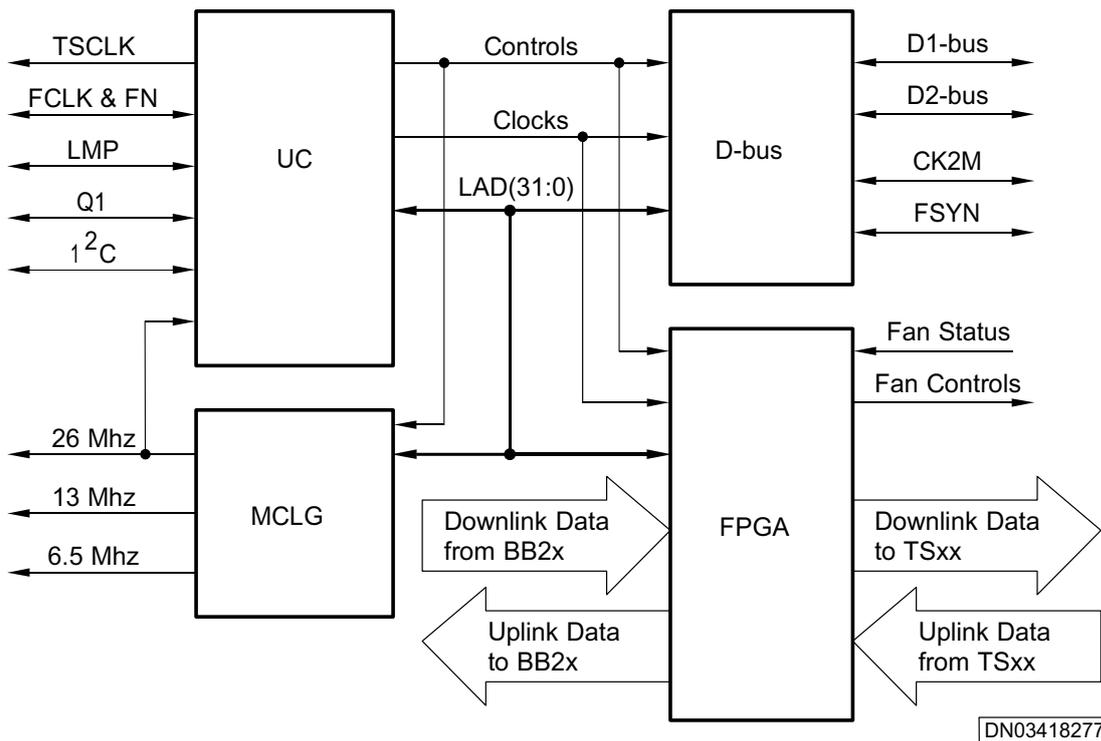


Figure 3. BOIx main blocks

2.2 Interfaces of the Base Operations and Interfaces (BOIx) unit

Interfaces

Table 1. Connectors

Interface	Reference designator	Connector type
Backplane	X2	10-pin power connector (female)
Front-mounted LMP	X3	D-9 (female)
Front-mounted 13 MHz clock for test equipment	X4	SMB
Front-mounted Frame Clock (FCLK) for test equipment	X5	SMB
Front-mounted Monitor interface for R&D and production	X6	D-25 (female)
Backplane	X7 – X11	30-pin signal connector (female)
Backplane	X12 – X15	30-pin signal connector (female)

Pin configurations

Table 2. LMP pin configurations

Pin	Signal
1	not used
2	LMP_IN
3	LMP_OUT
4	spare
5	GND
6	spare
7	spare
8	spare
9	V3P (Reserved for future use)

Table 3. Monitor interface pin configurations

Pin	Signal
1	MCK2M
2	GND
3	MFSYN
4	MD2_DD
5	V5P
6	BIST_OUT
7	BIST_IN
8	ECOI2CC
9	ECOI2CD
10	MON_EN
11	GND
12	MQ1_DD
13	MQ1_DU
14	TD2_DU
15	MD11_DD
16	MD11_DU
17	MD2_DU
18	DI0 (Reserved for future use)
19	DI1 (Reserved for future use)
20	DI2 (Reserved for future use)
21	DI3 (Reserved for future use)
22	DI4 (Reserved for future use)
23	COI2CC
24	COI2CD
25	GND

2.3 Base Operations and Interfaces (BOIx) unit LEDs

The front panel of the Base Operations and Interfaces (BOIx) unit has one LED (diffused/high-efficiency type) that indicates the operational status of the unit.

Table 4. LED indications

LED colour	Steady	Flashing
RED	Unit faulty	Not available
YELLOW	No LAPD connection or loss of clock synchronisation (slave)	Configuring
GREEN	Unit is on and operating	Software downloading

2.4 Dimensions and weight of Base Operations and Interfaces

Table 5. Dimensions and weight

Property	Value (metric)	Value (imperial)
Height	280.8 mm	11.1 in
Width	30 mm	1.2 in
Depth	259 mm	10.2 in
Weight	1.64 kg	3.6 lb

2.5 Electrical properties for Base Operations and Interfaces

Table 6. Electrical properties

Output number	V3	V5P	V9P	V9N
Nominal voltage	+3.4 V	+5.1 V	9.1 V	-9.1 V
Maximum supply voltage from backplane	+3.47 V	+5.2 V	+9.28 V	-9.28 V
Minimum supply voltage from backplane	+3.16 V	+4.74 V	+8.46 V	-8.46 V
Typical current	1.0 A	0.5 A	0.10 A	0.005 A
Maximum current	1.4 A	1.0 A	0.4 A	0.04 A

3

Bias Tee (BPxx) unit

3.1 Technical description of Bias Tee (BPxx) unit

Function

A Bias Tee is required to transfer DC voltage onto the antenna line for use by the Masthead Amplifier (MHA) that is also connected to the antenna line. The BTS TX power is fed through the Bias Tee. For this reason, the Bias Tee provides RF isolation toward the DC voltage supply and DC isolation toward the BTS.

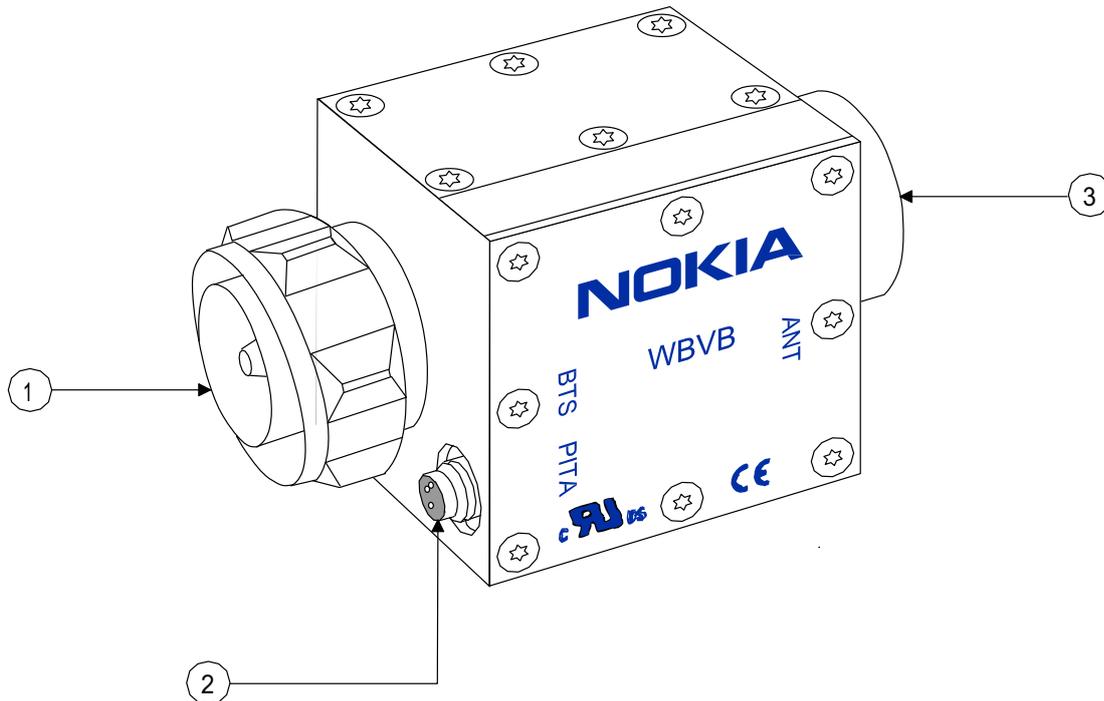
There are two types of Bias Tees:

- WBVx - Bias Tee with Voltage Standing Wave Ratio (VSWR) antenna monitoring checks the condition of the antenna line and gives an alarm if the VSWR value exceeds the limit. The BPxV can be used with or without the MNxx unit.
- WBNB - Bias Tee without VSWR antenna monitoring is used solely with the MNxx unit.

Connection of the Bias Tee is at the BTS, directly to the BTS antenna connectors. An antenna box assembly (to enable Bias Tee mounting) is fitted to the top of the BTS. Two assemblies exist: one is for an indoor BTS and one is for an outdoor BTS. Fitted below the top of the BTS is a Bias Tee/BTS interface module that provides the DC connectivity and the alarm connectivity between the Bias Tee and the BTS.

Note

The alarm connectivity is applicable only for VSWR Bias Tees.



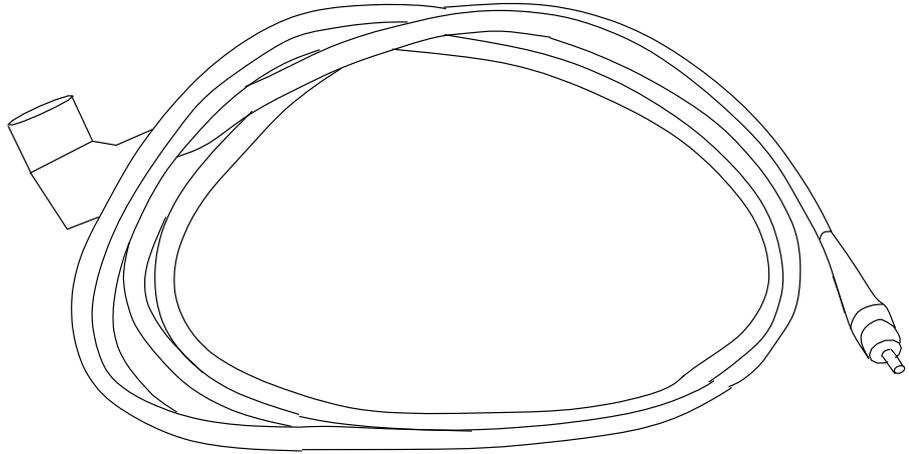
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1	BTS connector
2	4-pole connector
3	Jumper Cable Connector (towards Antenna)

Figure 4. Bias Tee

The VSWR alarm function indicates that the antenna, MHA, feeders, or jumpers have developed problems that impair their functioning. The alarm is instrumented to sense statistically significant faults.

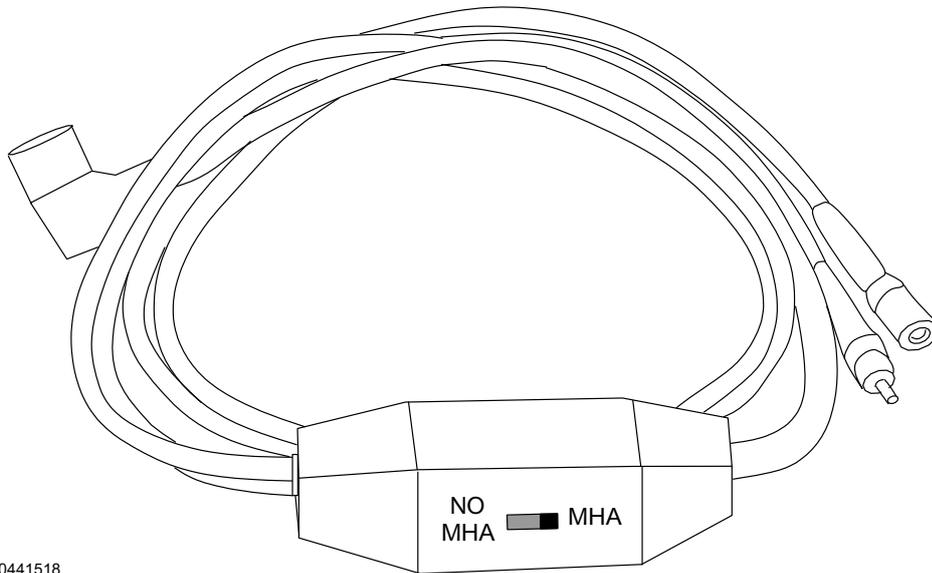
The non-VSWR Bias tee has a cable without the MHA/NO MHA switch, and comes with an angle Binder connector, which makes installation easier, at the Bias Tee end, and one SMB connector at the BTS end.



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Figure 5. Connector without MHA/NO MHA switch

The VSWR Bias tee has a cable featuring an angle Binder connector at the Bias Tee end, two SMB connectors at the BTS end, and an MHA/NO MHA switch. The switch has two positions: MHA and NO MHA. In MHA position both the VSWR circuit and the MHA are powered. In NO MHA position only the VSWR alarm circuit is powered.



DN0441518

Figure 6. Cable with the MHA/NO MHA switch

A VSWR Bias Tee (used for each feeder cable) is fitted to the top of the BTS. The Bias Tee can be used either with, or without a corresponding MHA unit. This type of Bias Tee includes the VSWR measurement option to be used together with the BTS.



Note

In all cases the first action is setting the switch cable to NO MHA position.



Caution

If the switch is not set to NO MHA, and is in the MHA position, the connector makes it possible to feed the VSWR circuit into the Bias Tee without sending a DC voltage into the center pin of the RF cable. It is possible that power is applied in to a short circuit which will damage the Bias Tee.

VSWR Bias Tee units are used for the low-band of either GSM/EDGE 800/900 or GSM/EDGE 1800/1900.

Note

A VSWR Bias Tee (WBVC/WBVB) cannot be installed following a Dual Band Diplex Filter (DU2A) unit. The alarm results and RF power from such installations are not reliable.

Main blocks

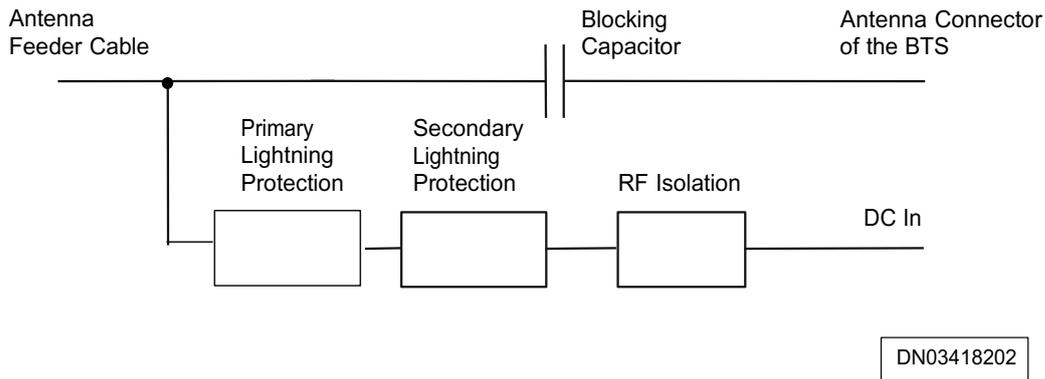


Figure 7. Bias Tee block diagram

3.2 Interfaces of the Bias Tee (BPxx) unit

3.2.1 Without VSWR (WBNB, 800/900/1800/1900)

Table 7. Connectors

Interface	Connector type
TX/RX	7-16 coaxial socket (male)
RF output	7-16 coaxial socket (female)
DC input (PWS/BOI)	m8 4-pole connector

Table 8. RF interface details

Parameter	Details
Frequency range	824 MHz to 960 MHz and 1710 MHz to 1990 MHz
Return loss	18 dB minimum
Insertion loss	0.3 dB maximum
Rated operating power	RMS 240W (1440W peak)
Inter-modulation	GSM 05.05; GSM 11.21
Spurious emission	GSM 05.05; GSM 11.21

Table 9. DC interface details

Parameter	Details
Supply voltage DC	+7.5 V to +14.4 V
DC current	1000 mA maximum
DC voltage drop	1 V maximum at 900 mA load

3.2.2 With VSWR (WBVC, 800/900; WBVB, 1800/1900)

Interface	Connector type
TX/RX	7-16 coaxial socket (male)
RF output	7-16 coaxial socket (female)
DC input (PWS/BOI)	m8 4-pole connector
Alarm	m8 4-pole connector

Table 10. RF interface details

Parameter	Details
Frequency range	824 MHz to 960 MHz or 1710 MHz to 1990 MHz
Return loss	20 dB minimum
Insertion loss	0.3 dB maximum
Rated operating power	RMS 240W (1440W peak)
Inter-modulation	GSM 05.05; GSM 11.21
Spurious emission	GSM 05.05; GSM 11.21
VSWR alarm indication	<ol style="list-style-type: none"> 1. Return loss < 7 +/-2 dB and RF power level > +27.5 dBm 2. RF power level < -35 dBm (indicating missing RF power)

Table 11. DC interface details

Parameter	Details
Supply voltage DC	+7.5 V to +14.4 V
DC current	1000 mA maximum
DC voltage drop	1 V maximum at 900 mA load

3.2.3 Bias Tee Interface Module unit

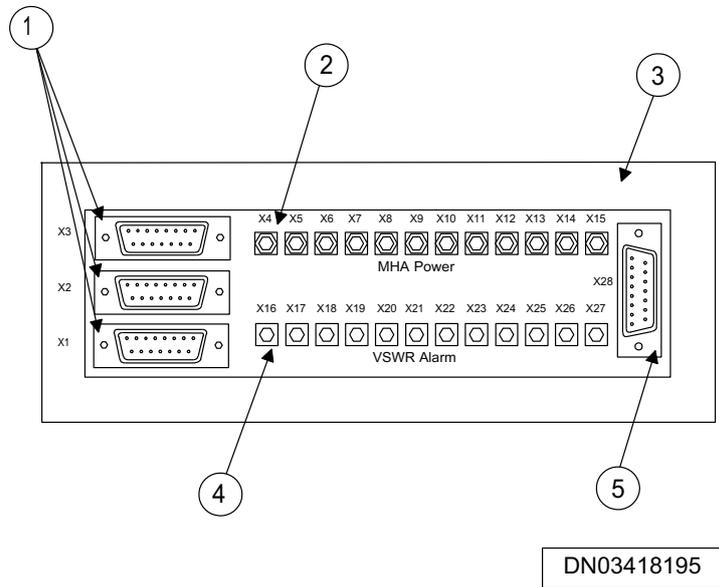


Figure 8. Bias Tee Interface Module

1	DC Power Input Connectors from BTS ('D' type, 15-pin Male)
2	MHA DC Power Connector (SMB Female x 12)
3	Bias Tee Interface Module
4	VSWR Alarm Connector (SMB Male x 12)
5	VSWR Alarm Connector ('D' type, 15-pin Female)

Interface	Reference designator	Connector type	Quantity
DC Power Input	X1 - X3	D-15 (male)	3
MHA DC Power (12V DC)	X4 - X15	SMB (female)	12
VSWR Alarm	X16 - X27	SMB (male)	12
VSWR Alarm	X28	D-15 (female)	1

3.3 Bias Tee (BPxx) unit alternatives

Unit	Frequency band
WBNB	GSM EDGE 800, 900, 1800, 1900
WBVC	GSM EDGE 800, 900 with VSWR
WBVB	GSM EDGE 1800, 1900 with VSWR
WBSB	GSM EDGE 1800, 1900 with VSWR, Sniffer

3.4 Electrical specifications for Bias Tee (BPxx) unit

Table 12. RF Interface Details

Parameter	Details	
	without VSWR	with VSWR
Frequency range	824 MHz to 960 MHz and 1710 MHz to 1990 MHz	824 MHz to 960 MHz and 1710 MHz to 1990 MHz
Return loss	18 dB minimum	20 dB minimum
Insertion loss	0.3 dB maximum	0.3 dB maximum
Rated operating power	RMS 240W (1440W peak)	RMS 240W (1440W peak)
Inter-modulation	GSM 05.05; GSM 11.21	GSM 05.05; GSM 11.21
Spurious emission	GSM 05.05; GSM 11.21	GSM 05.05; GSM 11.21
VSWR alarm indication	N/A	<ol style="list-style-type: none"> 1. Return loss < 7 +/-2 dB and RF power level > +27.5 dBm 2. RF power level < -35 dBm (indicating missing RF power)

Table 13. DC Interface Details

Parameter	Details	
	without VSWR	with VSWR
Supply voltage DC	+7.5 V to +14.4 V	+7.5 V to +14.4 V
DC current	1000 mA maximum	1000 mA maximum
DC voltage drop	1 V maximum at 900 mA load	1 V maximum at 900 mA load

Table 14. Lightning Protection Details

Parameter	Details	
	without VSWR	with VSWR
Meeting standard	IEC 801-5 and IEC 1312	IEC 801-5 and IEC 1312
Over current pulse between centre conductor and shield of ANT port	3 kA, 10/350 us pulse	3 kA, 10/350 us pulse
Over current pulse between shield of BTS port and shield of MHA port	20 kA, 10/350 us pulse	20 kA, 10/350 us pulse

3.5 Mechanical specifications for Bias Tee (BPxx) unit

Table 15. Mechanical details

Parameter	Details	
	without VSWR	with VSWR
Size: W x L x D (mm)	48 mm x 54 mm x 48 mm	95 mm x 80 mm x 52 mm
Weight, including connectors	0.4 kg	0.4 kg
BTS connector	Type 7-16 male	Type 7-16 male
Antenna connector	Type 7-16 female	Type 7-16 female
DC supply connector	m8 4-pole connector	m8 4-pole connector
Alarm connector	Not available	m8 4-pole connector

3.6 Environmental specifications for Bias Tee (BPxx) unit

Table 16. Environmental specifications

Temperature range; operation	-40° C to +65° C
Temperature range; storage and transportation	-40° C to +70° C
Meeting standard; operation	ETS 300 019-1-3, class 4.1E
Meeting standard; transportation	ETS 300 019-1-2, class 2.3
Meeting standard storage	ETS 300 019-1-1, class 1.3E
Enclosure Protection	IP65

3.7 Mean Time Between Failure (MTBF) specifications for Bias Tee (BPxx) unit

Table 17. MTBF Details

Bias Tee	>1 000 000 hours at +30° C
Bias Tee with VSWR	>1 000 000 hours at +30° C

3.8 Electromagnetic Compatibility (EMC) of Bias Tee (BPxx) unit

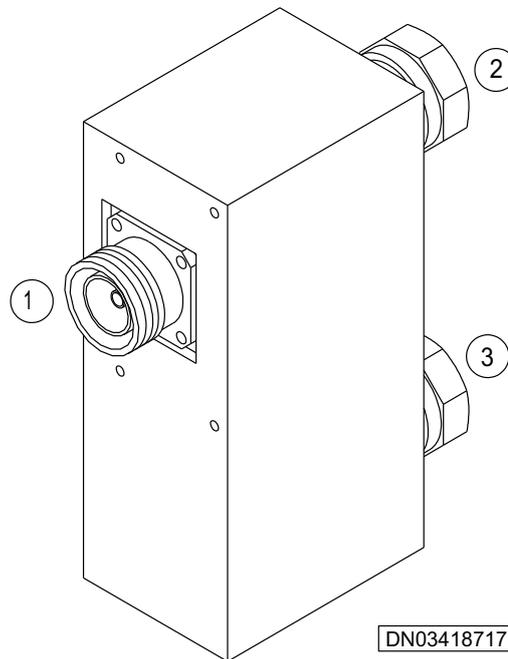
The Bias Tee meets the requirements stated in ETSI 300 342-2. The equipment complies with the European EMC directives 89/336/EEC for both spurious emissions and immunity.

4 Dual Band Diplex Filter (DU2A) unit

4.1 Technical description of Dual Band Diplex Filter (DU2A) unit

4.1.1 Function

The Dual Band Diplex Filter Unit (DU2A) either combines signals of different frequencies onto one antenna, or splits an antenna signal into different frequencies. It handles TX and RX signals from the GSM/EDGE 800/900 bands and the GSM/EDGE 1800/1900 bands.



1	Dual band antenna
---	-------------------

2	RX/TX GSM 1800/1900 band
3	RX/TX GSM 800/900 band

Figure 9. DU2A unit

Lightning protection

The centre pin of the DU2A unit antenna port is DC grounded. This connection prevents a charge buildup on the antenna and protects th DU2A unit against lightning.

4.1.2 Operation

The DU2A unit operates on the following frequency bands:

- GSM/EDGE 800/900 band – 824 to 960 MHz
- GSM/EDGE 1800/1900 band – 1710 to 1990 MHz

The normal operating temperatures for the DU2A unit are -10° C to 65° C (14° F to 149° F). However, the unit can operate in temperatures as low as -33° C (-27.4° F) with degraded RF performance.

4.1.3 Main blocks

The main blocks of the DU2A unit are the following passive filter sections:

- GSM/EDGE 800/900 RX/TX filter
- GSM/EDGE 1800/1900 RX/TX filter

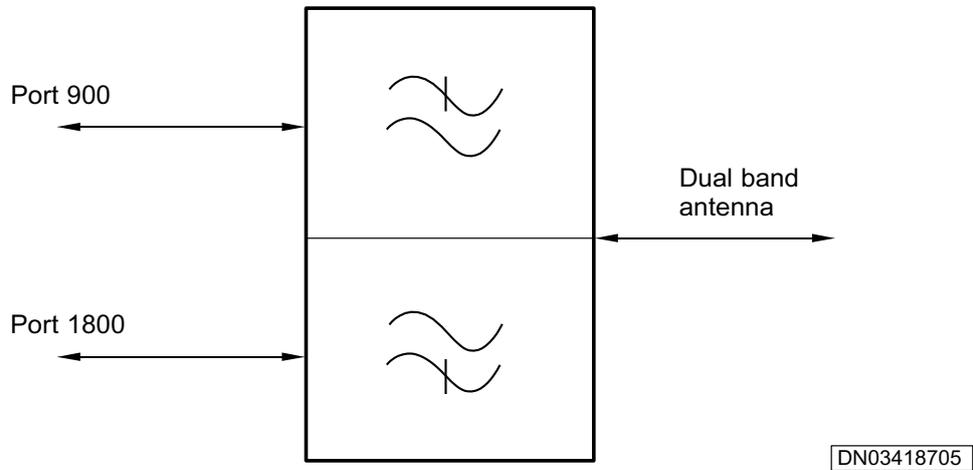


Figure 10. DU2A main blocks



Note

Port 900 is dedicated to the 800/900 bands.

Port 1800 is dedicated to the 1800/1900 bands.

4.2 Interfaces of the Dual Band Diplex Filter (DU2A) unit

Table 18. RF connectors

Interface	Connector type
Antenna	7/16, flange jack
900	7/16, flange plug, 800/900-band input/output
1800	7/16, flange plug, 1800/1900-band input/output

4.3 Dimensions and weight of Dual Band Diplex Filter (DU2A) unit

Table 19. Dimensions and weight

Property	Value (metric)	Value (imperial)
Height	150 mm	5.91 in.
Width	55 mm	2.17 in.
Depth	75 mm	2.95 in.
Weight	2.0 kg	4.42 lb

4.4 Insertion and return loss of Dual Band Diplex Filter (DU2A) unit

Table 20. Unit insertion and return loss

Frequency band	Frequency range	Insertion loss	Return loss
GSM/EDGE 800/900	824 MHz to 960 MHz	0.4 dB (maximum)	20 dB (minimum)
GSM/EDGE 1800/1900	1710 MHz to 1990 MHz	0.4 dB (maximum)	20 dB (minimum)

4.5 Power requirements for Dual Band Diplex Filter (DU2A) unit

Table 21. Maximum RF input power

Property	Value
CW power/carrier	46 dBm (40 W)
Peak	61.6 dBm (1440 W)
Duration of peak	20 μ s
Period between peaks	550 μ s

5

Dual Variable Gain Duplex Filter (DVxx) unit

5.1 Technical description of Dual Variable Gain Duplex Filter (DVxx) unit

5.1.1 Function

The Dual Variable Gain Duplex Filter (DVxx) unit performs the following primary functions:

- combines transmitted and received signals into one antenna
- amplifies received signals with a variable-gain Low Noise Amplifier (LNA)

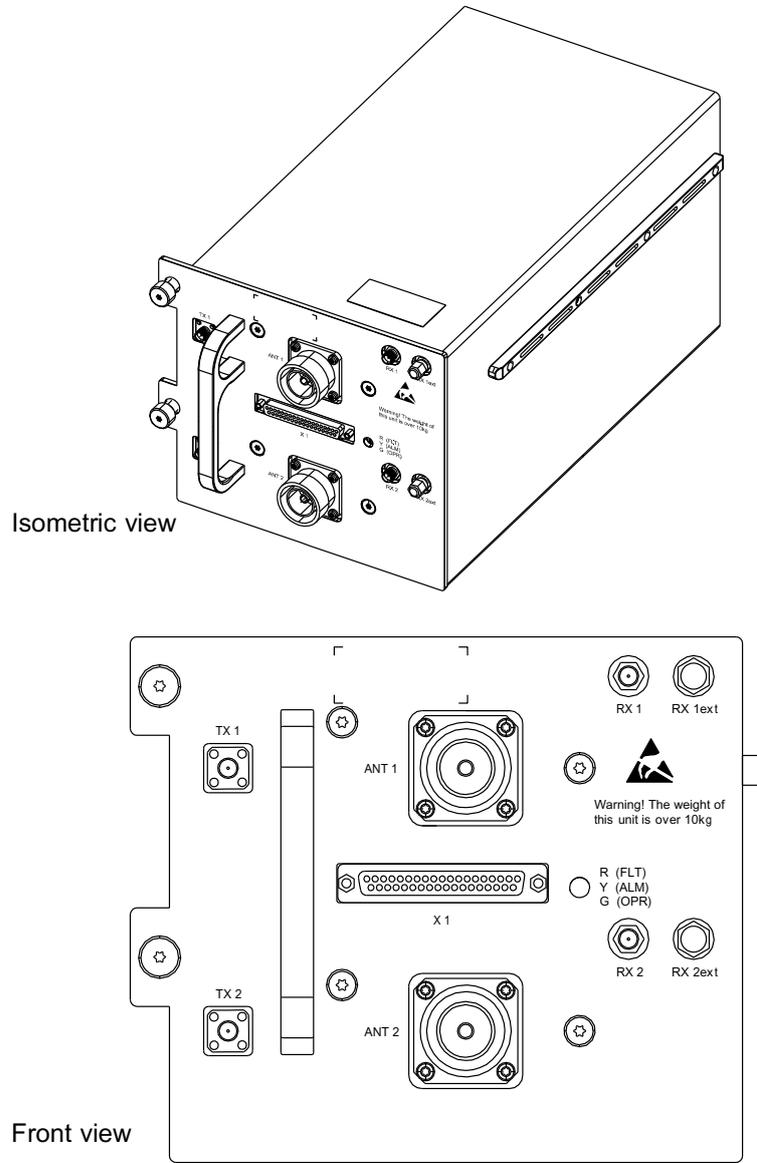


Figure 11. DVxx unit (with terminations on RX 1ext and RX 2ext connectors)

5.1.2 Operation

The normal operating temperature for the DVxx unit is -10° C to 65° C (14° F to 149° F). However, the unit can operate in temperatures as low as -33° C (-27.4° F), though with degraded RF performance.

The DVxx alternatives are provided to increase TX/RX separation and to achieve better performance. Full-band options are also available.

Lightning protection

The centre pin of the antenna port on the DVxx unit is DC grounded. This connection prevents a charge buildup on the antenna and protects the unit against lightning.

LNA alarms

Each LNA in the DVxx unit has two alarms (LNA_MINOR and LNA_MAJOR) representing minor and major failures. The LNA_MINOR alarm is activated when a single amplifier in any balanced amplifier stage fails. The LNA_MAJOR alarm is activated when two or more single amplifiers in any balanced amplifier structure fail. LNA_MINOR and LNA_MAJOR alarms are transmitted to the BTS through the I2C-bus. These alarms are also available on four separate pins of the X1 connector on the DVxx unit.

5.1.3 Main blocks

The DVxx unit includes two identical duplex filter sections. Each section comprises a duplexer, a variable-gain LNA, and an I²C-bus I/O buffer block. Each LNA defaults into the high-gain state at startup and can be switched by the operator to the low-gain state through the I²C-bus using the Site Manager. The operator can also adjust the gain of the low gain path.

The DVxx unit includes an I²C EEPROM that stores the serial number, information about the insertion loss variation of TX filters and other data.

The I²C-bus also carries alarm signals to indicate fault conditions for each LNA branch. The signals are relayed to the Base Operations and Interfaces (BOIx) unit, which generates the alarms and sends them on to the user interface.

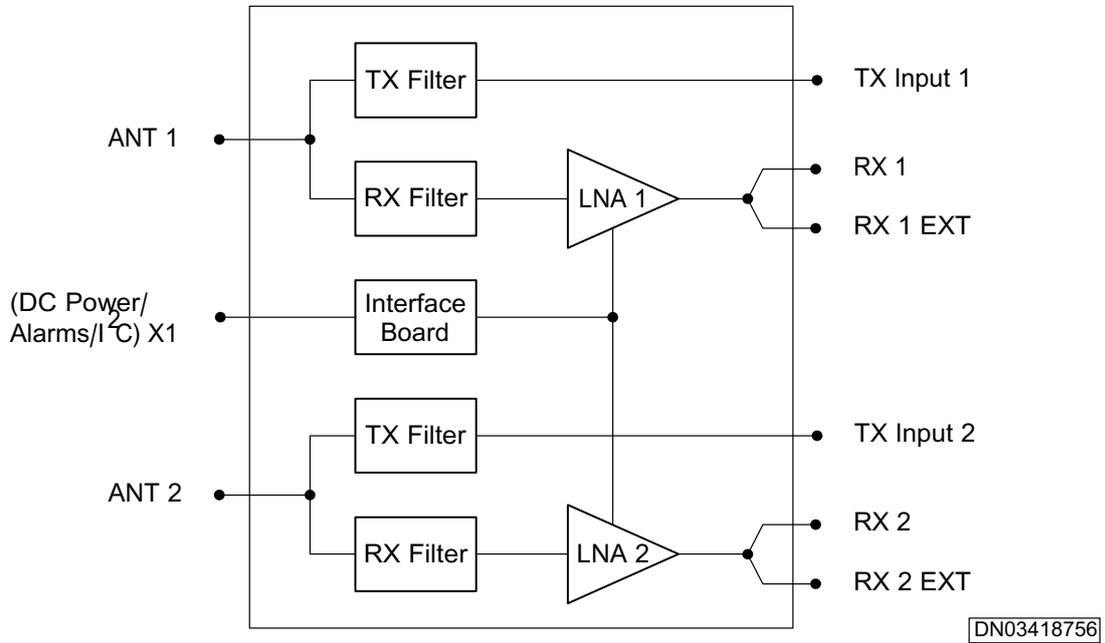


Figure 12. DVxx main blocks

5.1.4 I²C-data bus

Functions

The I²C-data bus is a bi-directional, two-wire serial bus that performs the following functions:

- auto detection of the unit
- version and serial number management
- alarm collection
- data storage to the I²C EEPROM
- control of the high-gain and low-gain state of the LNAs
- low-gain LNA adjustment

Signals

The I²C-data bus is a multipoint bus. Several devices can connect to it through two bus lines:

- serial data line – RFUI2CD
- serial clock line – RFUI2CC

Signals are 5 V Transistor-to-Transistor Logic (TTL) levels with a transfer rate of 100 kbit/s in standard mode.

Circuits

The DVxx unit includes three separate integrated circuits for the I²C-data bus:

- two I/O devices
- one EEPROM

5.2 Interfaces of the Dual Variable Gain Duplex Filter (DVxx) unit

Table 22. Connectors

Interface	Ref Designator	Connector Type
RF	TX 1, TX 2, RX 1, RX 1ext, RX 2, RX 2ext	SMA (female)
RF	ANT 1, ANT 2	7/16 (female)
DC power, I ² C-data bus, and alarms	X1	D-37 (male)

Table 23. X1 connector pin configurations

Pin	Description	Purpose
1	Reserved	Reserved
2	Reserved	Reserved
3	Reserved	Reserved
4	Reserved	Reserved
5	Reserved	Reserved

Table 23. X1 connector pin configurations (cont.)

Pin	Description	Purpose
6	Reserved	Reserved
7	Reserved	Reserved
8	Reserved	Reserved
9	RFUI2CC	I ² C-data bus clock
10	GND	I ² C Ground
11	RFUI2CD	I ² C-data bus data
12	GND	I ² C Ground
13	UA1	Module addressing
14	UA2	Module addressing
15	LNA 1 Minor	LNA 1 Minor alarm output
16	LNA 1 Major	LNA 1 Major alarm output
17	LNA 2 Minor	LNA 2 Minor alarm output
18	LNA 2 Major	LNA 2 Major alarm output
19	Reserved	Reserved
20	Reserved	Reserved
21	GND	Ground
22	V9P	DC Input
23	GND	Ground
24	V9P	DC Input
25	GND	Ground
26	V9P	DC Input
27	GND	Ground
28	V9N	DC Input
29	GND	Ground
30	V5P	DC Input
31	GND	Ground
32	V5P	DC Input
33	GND	Ground
34	Reserved	Reserved
35	GND	Ground
36	Reserved	Reserved
37	Reserved	Reserved

5.3 Dual Variable Gain Duplex Filter (DVxx) unit alternatives



Note

The GSM 800 DVTC has been removed from the product portfolio. Take this into consideration when carrying out maintenance activities, and supplying replacement units.

Table 24. Unit alternatives

Unit	Frequency Band
DVTB	full band for GSM EDGE 800
DVTD	full band for co-siting GSM EDGE 800 and SMR ^a
DVGA	full band for GSM EDGE 900
DVHA	customer specific for GSM EDGE 900 ^a
DVJA	customer specific for GSM EDGE 900 ^a
DVDA	A band for GSM EDGE 1800
DVDB	B band for GSM EDGE 1800
DVDC	full band for GSM EDGE 1800
DVPA	full band for GSM EDGE 1900

^aTo distinguish between DVHA and DVJA, see *Technical data for the Dual Variable Gain Duplex Filter unit*.

5.4 Dual Variable Gain Duplex Filter (DVxx) unit LEDs

The front panel on the Dual Variable Gain Duplex Filter (DVxx) unit has one tri-colour LED (diffused/high efficiency type). The LED indicates the operating condition of both LNAs, in either high-gain or low-gain state.

Table 25. LED indications

LED colour	Steady
RED	Unit LNA module major fault, no RX gain available
YELLOW	Unit LNA module minor fault, partial RX gain available
GREEN	LNA is on and operating

5.5 Dimensions and weight of Dual Variable Gain Duplex Filter (DVxx) unit



Note

GSM 800 DVTC has been removed from the product portfolio. Take this into consideration when carrying out maintenance activities, and supplying replacement units.

Table 26. Maximum dimensions and weight

Property	Value (metric)	Value (imperial)
Height	160 mm	6.3 in.
Width	188 mm	7.4 in.
Depth	337 mm	13.3 in.
Weight	13 kg	28.7 lb

5.6 Power requirements for Dual Variable Gain Duplex Filter (DVxx) unit

Table 27. Maximum input power

Input power	+9V	-9V	+5V
Voltage tolerance	±3%	±3%	±3%

Table 27. Maximum input power (cont.)

Input power	+9V	-9V	+5V
Current draw	2400 mA	200 mA	400 mA
Ripple 0 to 150 kHz (maximum)	50 mVpp	50 mVpp	50 mVpp
Ripple 150 kHz (maximum)	100 mVpp	100 mVpp	100 mVpp

5.7 RF properties for Dual Variable Gain Duplex Filter (DVxx) unit

Table 28. Operating frequency ranges

Version	TX band	RX band	Duplex separation	Duplex filter bandwidth
DVTD (full band co-sited)	869 to 894 MHz	824 to 849 MHz	45 MHz	25 MHz
DVTB	869 to 894 MHz	824 to 849 MHz	45 MHz	25 MHz
DVGA	925-960 MHz	880 to 915 MHz	45 MHz	35 MHz
DVHA	942.5 to 960 MHz	897.5 to 915 MHz	45 MHz	17.5 MHz
DVJA	935 to 960 MHz	890 to 915 MHz	45 MHz	25 MHz
DVDA	1805 to 1850 MHz	1710 to 1755 MHz	95 MHz	45 MHz
DVDB	1835 to 1880 MHz	1740 to 1785 MHz	95 MHz	45 MHz
DVDC	1805 to 1880 MHz	1710 to 1785 MHz	95 MHz	75 MHz
DVPA	1930 to 1990 MHz	1850 to 1910 MHz	80 MHz	60 MHz

Table 29. TX insertion loss

Version	TX to antenna	Maximum
DVTB	869 to 894 MHz	1.1 dB
DVTD (full band co-sited) DVTD provides >20dB rejection at SMR 900 RX frequency 896 to 901 MHz to reduce TX spurious	869 to 871.5 MHz	1.65dB
	871.5 to 891.5	1.1 dB
	891.5 to 894	1.65 dB
DVGA	925 to 960 MHz	1.2 dB
DVHA	942.5 to 960 MHz	1.2 dB
DVJA	935 to 960 MHz	1.2 dB
DVDA	1805 to 1850 MHz	0.8 dB
DVDB	1835 to 1880 MHz	0.8 dB
DVDC	1805 to 1880 MHz	1.2 dB
DVPA	1930 to 1990 MHz	1.1 dB

Table 30. RX High-gain values

Version	Temperature	Value
DVTD (full band co-sited) DVTD provides >40dB rejection at SMR 800 TX frequency 851 to 869 MHz to protect LNA	20° C to 30° C	(824 to 847) 28.4 dB ±1.1 dB/28.4 dB ±1.6 dB
	-10° C to 65° C	(847 to 849) 28.4 dB +1.1 to - 3.3 dB/28.4 dB +1.6 to -3.8 dB
DVGA	20° C to 30° C	28.4 dB ±1.1 dB 28.4 dB ±1.6 dB
DVHA	-10° C to 65° C	
DVJA		
DVTB		
DVDA	20° C to 30° C	29.4 dB ±1.1 dB
DVDB	-10° C to 65° C	29.4 dB ±1.6 dB
DVPA		
DVDC	20° C to 30° C	28.4 dB ±1.6 dB
	-10° C to 65° C	28.4 dB ±2.1 dB



Note

20° C to 30° C is equal to 68° F to 86° F. -10° C to 65° C is equal to 14° F to 149° F.

Table 31. RX Low-gain values

Version	Temperature	Maximum	Minimum
DVTD (full band co-sited)	20° C to 30° C	(824 to 847) 3.4 dB ±1.4 dB/3.4 dB ± 1.9	(824 to 847) -3.6 dB + 1.4 dB/ -3.6 dB ± 1.9 dB
	-10° C to 65° C	(847 to 849) 3.4 dB + 1.4 to -3.6 dB/3.4 dB + 1.9 to -4.1 dB	(847 to 849) -3.6 dB + 1.4 dB to -3.6 dB/-3.6 dB + 1.9 dB to -4.1 dB
DVTB	20° C to 30° C	3.4 dB ±1.4 dB	-3.6 dB ±1.4 dB
DVGA	-10° C to 65° C	3.4 dB ±1.9 dB	-3.6 dB ±1.9 dB
DVHA			
DVJA			
DVDA	20° C to 30° C	6.4 dB ± 1.4 dB	-3.6 dB ± 1.4 dB
DVDB	-10° C to 65° C	6.4 dB ± 1.9 dB	-3.6 dB ± 1.9 dB
DVDC	20° C to 30° C	6.4 dB ±1.9 dB	-3.6 dB ± 1.9 dB
	-10° C to 65° C	6.4 dB ± 2.4 dB	-3.6 dB ± 2.4 dB
DVPA	20° C to 30° C	6.4 dB ±1.4 dB	-3.6 dB ±1.4 dB
	-10° C to 65° C	6.4 dB ± 1.9 dB	-3.6 dB ±1.9 dB



Note

The step size for adjustment is 0.5 dB ±0.8 dB.

Table 32. Isolation parameters (high-gain state)

Version	Band	Minimum
DVTB	824 to 849 MHz	60 dB
DVTD (full band co-sited)	869 to 894 MHz	89 dB

Table 32. Isolation parameters (high-gain state) (cont.)

Version	Band	Minimum
DVGA	880 to 915 MHz	60 dB
	915 to 925 MHz	31 dB
	925 to 960 MHz	88 dB
DVHA	897.5 to 915 MHz	60 dB
	915 to 942.5 MHz	31 dB
	942.5 to 960 MHz	88 dB
DVJA	890 to 915 MHz	60 dB
	915 to 935 MHz	31 dB
	935 to 960 MHz	88 dB
DVDA	1710 to 1755 MHz	47 dB
	1755 to 1805 MHz	35 dB
	1805 to 1850 MHz	85 dB
DVDB	1740 to 1785 MHz	47 dB
	1785 to 1835 MHz	35 dB
	1835 to 1880 MHz	85 dB
DVDC	1710 to 1785 MHz	47 dB
	1785 to 1805 MHz	35 dB
	1805 to 1880 MHz	85 dB
DVPA	1850 to 1910 MHz	47 dB
	1910 to 1930 MHz	27 dB
	1930 to 1990 MHz	85 dB

Table 33. Isolation parameters (low-gain state)

Version	Band	Minimum
DVTB	824 to 849 MHz	85 dB
DVTD (full band co-sited)	869 to 894 MHz	102 dB
DVGA	880 to 915 MHz	85 dB
	915 to 925 MHz	56 dB
	925 to 960 MHz	100 dB
DVHA	897.5 to 915 MHz	85 dB
	915 to 942.5 MHz	56 dB
	942.5 to 960 MHz	100 dB

Table 33. Isolation parameters (low-gain state) (cont.)

Version	Band	Minimum
DVJA	890 to 915 MHz	85 dB
	915 to 935 MHz	56 dB
	935 to 960 MHz	100 dB
DVDA	1710 to 1755 MHz	70 dB
	1755 to 1805 MHz	58 dB
	1805 to 1850 MHz	95 dB
DVDB	1740 to 1785 MHz	70 dB
	1785 to 1835 MHz	58 dB
	1835 to 1880 MHz	95 dB
DVDC	1710 to 1785 MHz	70 dB
	1785 to 1805 MHz	45 dB
	1805 to 1880 MHz	95 dB
DVPA	1850 to 1910 MHz	70 dB
	1910 to 1930 MHz	50 dB
	1930 to 1990 MHz	95 dB

Table 34. Return loss

Port/band	Minimum
TX 1 / TX 2	18 dB (1.29:1)
RX port / RX band (high-gain and low-gain)	16 dB (1.38:1)
ANT port/TX band	18 db (1:29:1)
ANT port / RX band (high-gain)	16 dB (1.38:1)
ANT port / RX band (low-gain)	13 dB (1.58:1)

Table 35. Maximum RF input power

Property	Value
rms	51 dBm (125 W)
Peak (20 ms peak, 550 ms between peaks)	55 dBm (316.2 W)
Peak voltage	130 V

Table 36. Maximum RX band input power

Property	Value
RX (high gain)	16 dBm minimum
RX (low gain with maximum gain)	23 dBm minimum

6 Power Supply (PWSx) unit

6.1 Technical description of Power Supply (PWSx) unit

6.1.1 Function

The Power Supply (PWSx) unit converts input AC or DC voltage to the DC voltages required for BTS. The PWSx unit distributes the appropriate voltages through the backplane to the units - except for the optional Heater unit (HETA), which receives its voltages from the AC mains through the AC filter unit. The PWSx unit also supplies power for the MNxx unit.

The BTS can hold one or two AC Power Supply units (PWSA - +230 VAC), three DC Power Supply units (PWSB - -48 VDC), or one or two DC Power Supply units per cabinet (PWSC - +24 VDC). The PWSA and PWSC support full redundancy for as many as six TSxx units. The PWSB supports full redundancy for as many as 12 TSxx units.

The PWSx performs the following functions:

- sends an input alarm to the Base Operations and Interfaces (BOIx) unit when the input voltage is out of range.
- sends an output alarm to the BOIx unit when any output voltages fall below specified limits.
- turns off any output voltages and sends an output alarm to the BOIx unit when any output voltages exceed the specified overvoltage protection limit.
- turns off any output voltages and sends an output alarm to the BOIx unit when the temperature exceeds the specified limit.
- turns off any output voltages and sends an output alarm to the BOIx unit when the input voltage falls outside the specified protection limits.

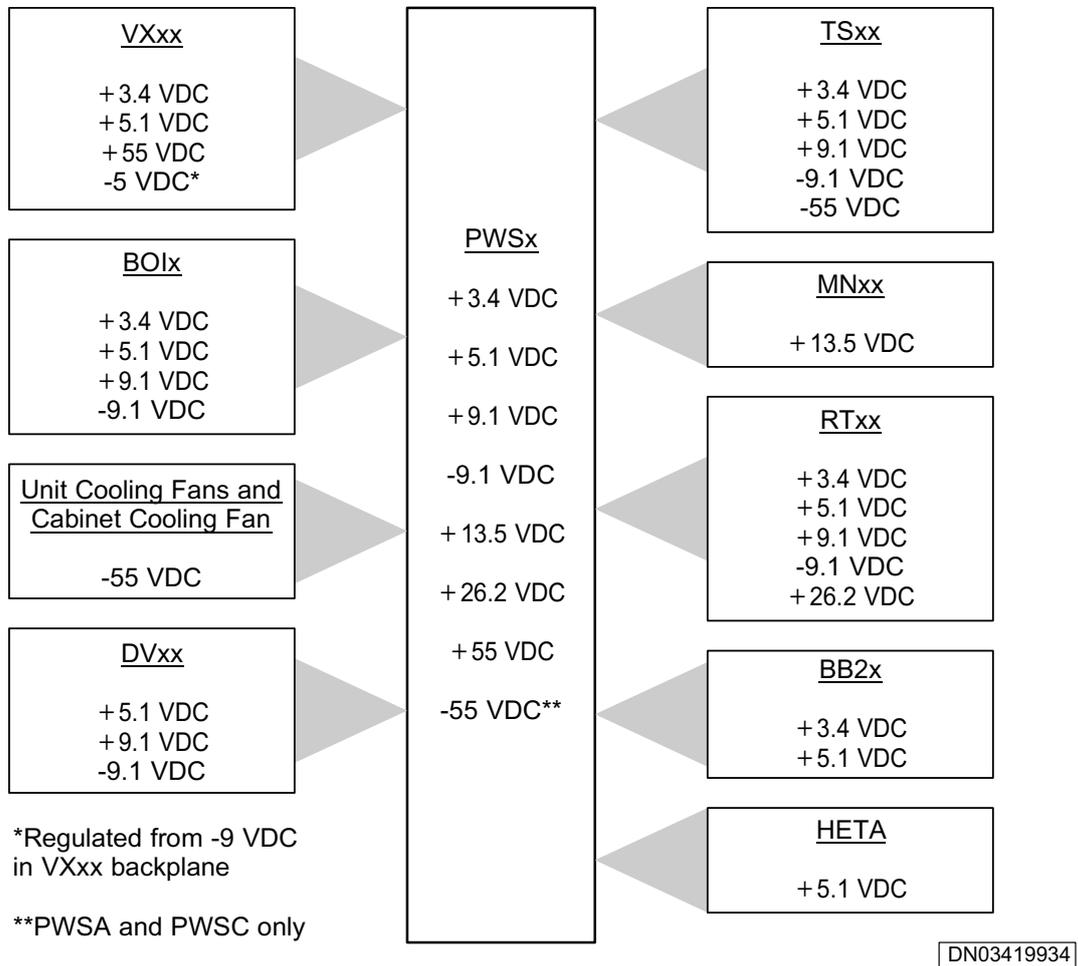


Figure 13. PWSx voltages distributed to units

6.1.2 Power supply redundancy

Power supply redundancy is the capability of maintaining full system operation in the event of a single power supply unit failure. Redundancy in BTS depends on the system configuration and the PWSx units installed.

**Note**

Full redundancy assumes the maximum number of PWSx units are installed.

Table 37. Power supply redundancy

PWSx unit	TSxx units ≤ 6	TSxx units > 6
PWSA	Fully redundant ¹	Not redundant
PWSB	Fully redundant ¹	Fully redundant ¹
PWSC	Fully redundant ¹	Not redundant

¹Dependent on TSxx slot population configuration.

6.1.3 Operation

6.1.3.1 Operating switch

The operating switch on the front panel of the PWSx unit has two positions: ON and STAND BY.

6.1.3.2 Thermal protection

The PWSx unit is protected against damage from overtemperature conditions. If the unit temperature exceeds the specified limit, the PWSx unit turns off any output voltages and sends an output alarm to the BOIx unit. It automatically resets when the temperature drops by 15° C (59° F) and is then within acceptable operating range, or if the input power is cycled. Using the switch will not reset an overtemperature fault.

6.1.3.3 PWSA

The PWSA unit uses an input voltage of 230 VAC to apply power factor correction and produces the following regulated output voltages for other BTS units:

- +3.4 VDC
- +5.1 VDC
- ±9.1 VDC

- +13.5 VDC
- +26.2 VDC
- ±55 VDC

The -55 VDC output and return are isolated, and the common DC return line is grounded.

If mains power loss occurs, it halts the PWSA output operation for at least 20 milliseconds.

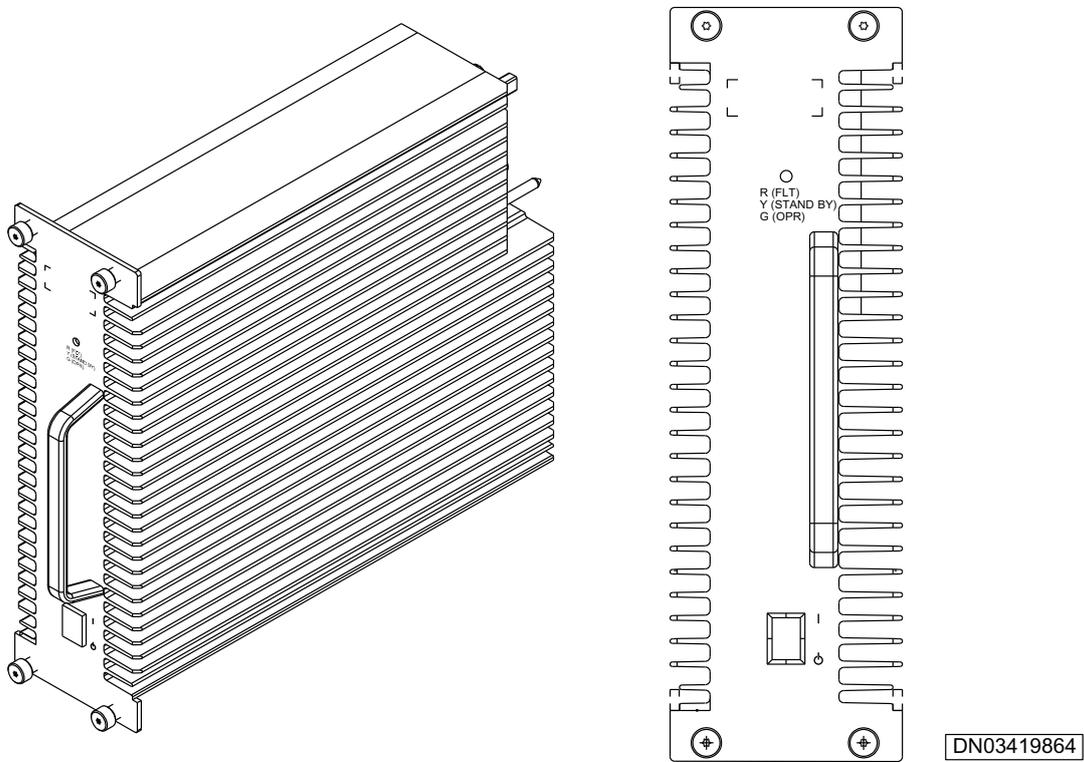


Figure 14. PWSA unit (230 VAC)

6.1.3.4 PWSB

The PWSB unit uses a floating input voltage of -48 VDC and produces the following regulated output voltages for other BTS units:

- +3.4 VDC
- +5.1 VDC
- ±9.1 VDC
- +13.5 VDC
- +26.2 VDC
- +55 VDC

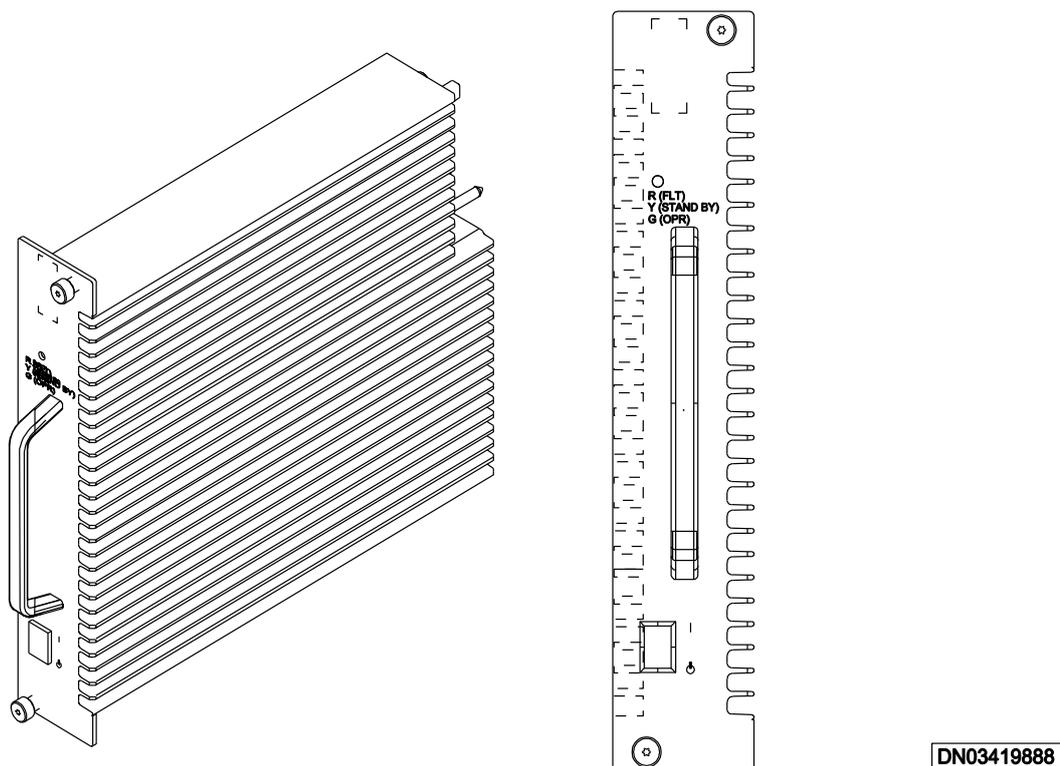


Figure 15. PWSB unit (-48 VDC)

6.1.3.5 PWSC

The PWSC unit uses a floating input voltage of +24 VDC and produces the following regulated output voltages for other BTS units:

- +3.4 VDC
- +5.1 VDC

- ±9.1 VDC
- +13.5 VDC
- +26.2 VDC
- ±55 VDC

The -55 VDC output and return are isolated, and the common DC return line is grounded.



Note

The location of the handle, LED, and switch varies with the version of the unit.

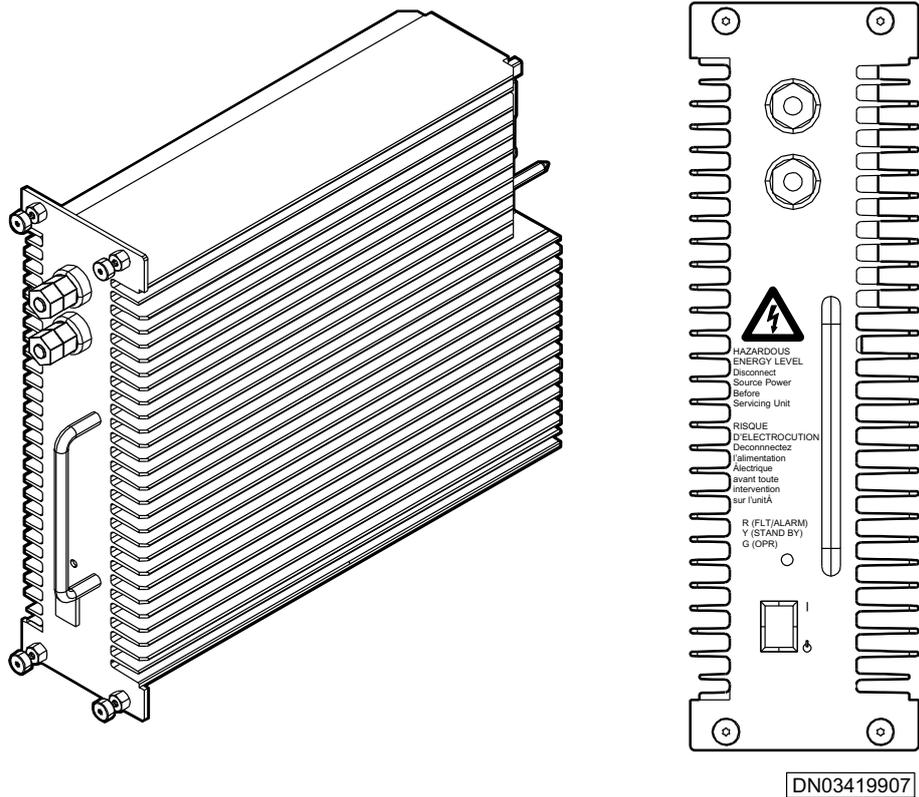


Figure 16. PWSC unit (+24 VDC)

6.1.3.6 Overvoltage protection

The power output on the TWSx unit is protected against overvoltage. Cycling the power or using the switch resets the overvoltage protection logic.

6.1.4 Main blocks

6.1.4.1 Power input block

PWSA

The power input block on the PWSA unit includes the following components:

- input circuit (mains filter, inrush current limiter, and rectifier)
- Power Factor Correction (PFC) preregulator

The input voltage is applied to the input circuit. The PFC preregulator converts the input voltage to a stabilised intermediate voltage for the power switcher block, improving the power factor.

PWSB and PWSC

The power input block on the PWSB and PWSC units includes the following components:

- input circuit
- step-up converter

The input circuit filters the input voltage and limits the inrush current. The stepup converter converts the filtered input voltage to a stabilised intermediate voltage for the power switcher block.

6.1.4.2 Power switcher block

The power switcher block includes switched-mode circuits that convert the intermediate voltage to the output voltage.

6.1.4.3 Control block

The control block includes the input and output control circuits that monitor and control the PWSx unit operation. The control block handles the following functions:

- overvoltage and undervoltage protection
- overcurrent protection
- temperature protection
- unit synchronisation
- front-panel LED control
- I²C data received from the BOIx unit

If the BTS includes a Masthead Amplifier (MNxx) unit, the control block also:

- monitors and controls the output voltage to the MNxx unit
- reports the current consumption of the MNxx unit through the I²C-bus, if requested

6.2 Interfaces of the Power Supply (PWSx) unit

The power connector on the back of the Power Supply (PWSx) unit consists of the following interfaces and connections:

- I2C-bus (between the BOIx and PWSx units) for alarms, remote-control signals, temperature, and measurement of the MNxx unit current
- remote-control interface from the optional Heater (HETA) unit for cold starts
- power and control-signal input and output



Note

The PWSC power input is located on the front panel of the unit.

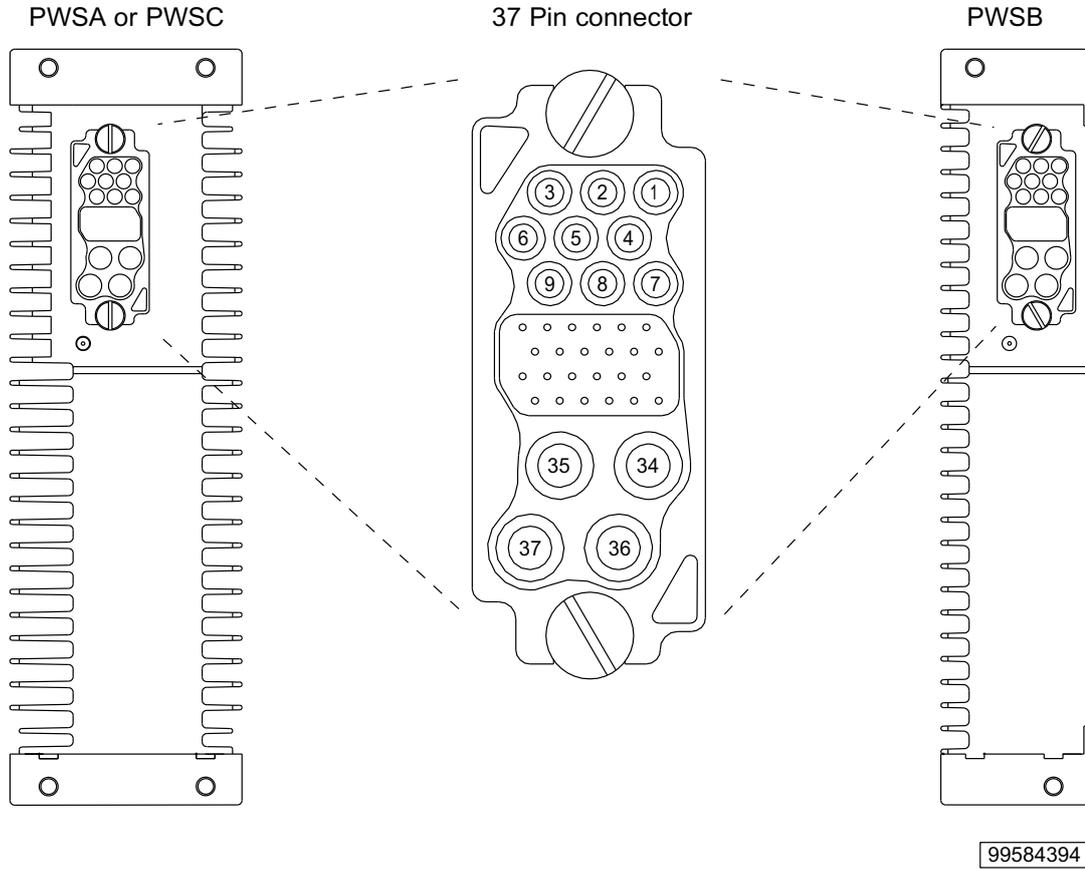


Figure 17. PWSx power connector



Note

Pins 10 through 33 are identified in the same descending right-to-left order as those identified by number in PWSx power connector.

Table 38. PWSx pin configurations

Pin	Name	Description
1	GNDIN	Earth/Safety Ground

Table 38. PWSx pin configurations (cont.)

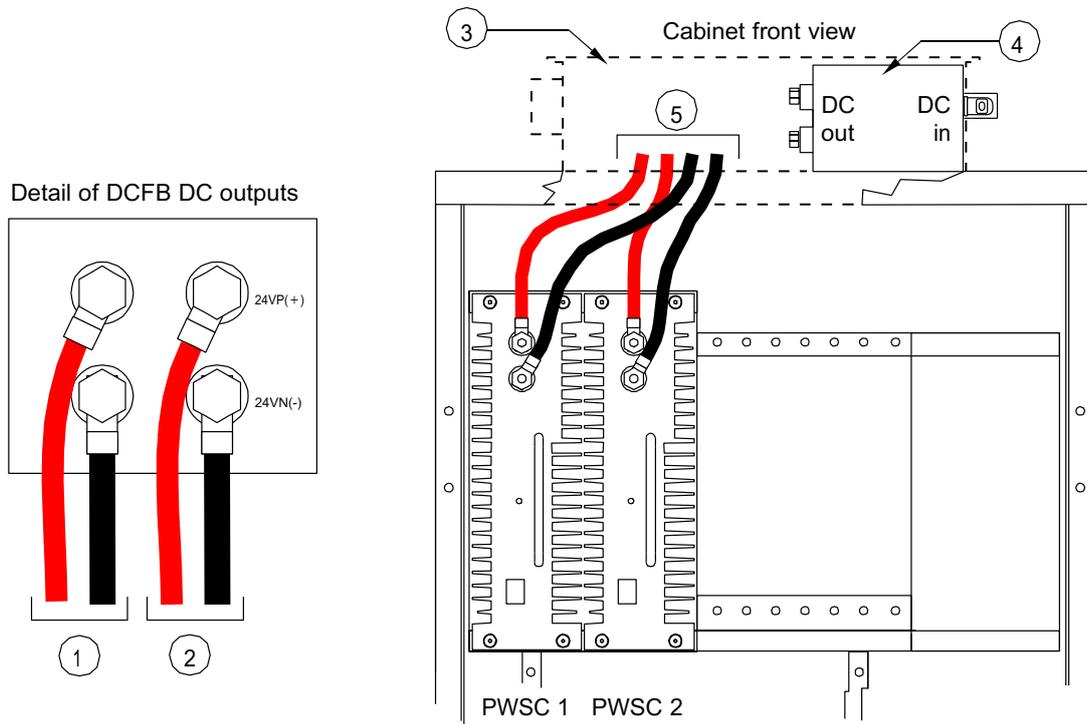
Pin	Name	Description
2	Earth/Safety Ground	AC Power Conductor 1 (PWSA only)
3	ACIN2	AC Power Conductor 2 (PWSA only)
4	V55P	+55 VDC VXR
5	V9P	+9 VDC
6	V9P	+9 VDC
7	V5P	+5 VDC
8	V3P	+3 VDC
9	V3P	+3 VDC
10	MHA01B	Masthead Amplifier
11	MHA02B	Masthead Amplifier
12	MHA03B	Masthead Amplifier
13	MHA04B	Masthead Amplifier
14	MHA05B	Masthead Amplifier
15	MHA06B	Masthead Amplifier
16	MHA07B	Masthead Amplifier
17	MHA08B	Masthead Amplifier
18	MHA09B	Masthead Amplifier
19	MHA10B	Masthead Amplifier
20	MHA11B	Masthead Amplifier
21	MHA12B	Masthead Amplifier
22	COI2CD	I2C Serial Clock
23	CO12CC	I2C Serial Clock
24	UA1	I2C Unit Address bit 0
25	UA2	I2C Unit Address bit 1
26	RLC	Remote latch clear
27	L5V	+5 VDC Logic signal
28	UI1	PWSx Unit 2 installed
29	UI2	PWSx Unit 3 installed
30	PWR_AL	Input Power Low Alarm (PWSA only)
31	RCTL	Remote Control Signal

Table 38. PWSx pin configurations (cont.)

Pin	Name	Description
32	V9N	-9 VDC
33	V26P	+26 VDC
34	V48RTN	DC Power - (output on PWSA and PWSC, input on PWSB)
35	V48N	DC Power - (output on PWSA and PWSC, input on PWSB)
36	CGND	Common Ground
37	CGND	Common Ground

The input power terminals for the PWSC are located on the front unit. These terminals connect the PWSC unit to the DCFB unit. The input power terminals are M8-threaded studs, or alternately, M8-threaded inserts. The appropriate mounting hardware (hex-nuts or hex-head bolts and washers) are included with the unit. Do not exceed the following torque limits:

- Hex-nuts – 10 Nm
- Hex-bolts – 10 Nm



DN03418647

1	PWSC 1
2	PWSC 2
3	Antenna box
4	DCFb
5	To DCFb/DC out

Figure 18. PWSC input power terminals

6.3 Power Supply (PWSx) unit alternatives



Note

Full redundancy assumes the maximum number of PWSx units are installed.

Table 39. Unit alternatives

PWSx unit	TSxx units ≤ 6	TSxx units > 6
PWSA	Fully redundant ¹	Not redundant
PWSB	Fully redundant ¹	Fully redundant ¹
PWSC	Fully redundant ¹	Not redundant

¹Dependent on TSxx slot population configuration.

6.4 Power Supply (PWSx) unit LEDs

A tri-colour LED indicator on the front panel of the Power Supply (PWSx) unit displays operating conditions. The operating switch has two positions (ON and STAND BY).

Table 40. LED indications

LED colour	Steady
RED	<ul style="list-style-type: none"> Unit faulty, major alarm, or short circuit in one of the BTS units Output voltage is off because of a detected PWSx over temperature Input voltage out of range
YELLOW	<ul style="list-style-type: none"> Output voltage off, power supply unit switch in ON position, BTS in cold-start mode Power shutdown signal sent from the BSC, NMS/2000 or NetAct Input voltage OK, switch on the power supply unit in STAND BY position
GREEN	Unit is on and operating

6.5 Dimensions and weight of Power Supply (PWSx) units

Table 41. Dimensions and weight

Property	PWSA	PWSB	PWSC
Height	300 mm 11.8 in.	300 mm 11.8 in.	300 mm 11.8 in.
Width	99 mm 3.9 in.	63 mm 2.5 in.	99 mm 3.9 in.
Depth	350 mm 13.8 in.	350 mm 13.8 in.	350 mm 13.8 in.
Weight	11 kg 24 lb	7 kg 15.4 lb	11 kg 24 lb

6.6 Power requirements for Power Supply (PWSx) units

Table 42. Input voltage

Unit	Value	Notes
PWSA	230 VAC (184 to 276 VAC)	The unit accepts both 50Hz and 60 Hz input.
The unit accepts both 50 Hz and 60 Hz input.	-48 VDC (-36 to -60 VDC)	The unit has reverse polarity protection. If input voltage reverse polarity occurs, the internal fuse opens.
PWSC	+24 VDC (+20 to +32 VDC)	The unit has reverse polarity protection. If input voltage reverse polarity occurs, the internal fuse opens.

Table 43. Maximum continuous output power rating

Unit	Value
PWSA	2250 W
PWSB	600 W
PWSC	2500 W

7

Receiver Multicoupler (M2xA or M6xA) unit

7.1 Technical description of Receiver Multicoupler (MxxA) unit

7.1.1 Function

The multicoupler units split Received (RX) and Diversity-Received (DRX) signals and distribute them to the Transceiver (TSxx) units.

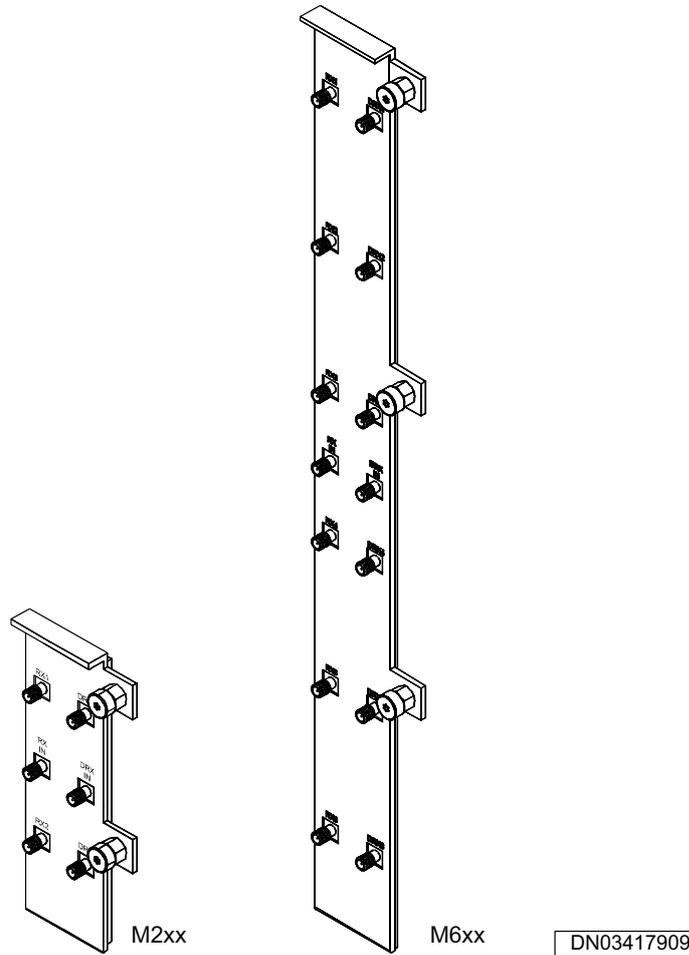


Figure 19. 2-way (M2xA) and 6-way (M6xA) Receiver Multicoupler units

7.1.2 Operation

M2xA

The M2xA unit receives signals from the DVxx unit or the RTxx unit. The M2xA unit divides the signals into two outputs for the RX path and two outputs for the DRX path. The outputs feed the receivers of two TSxx units, and a BTS can accommodate a maximum of six M2xA units. The unit is used in most wideband combining or combining by-pass configurations.

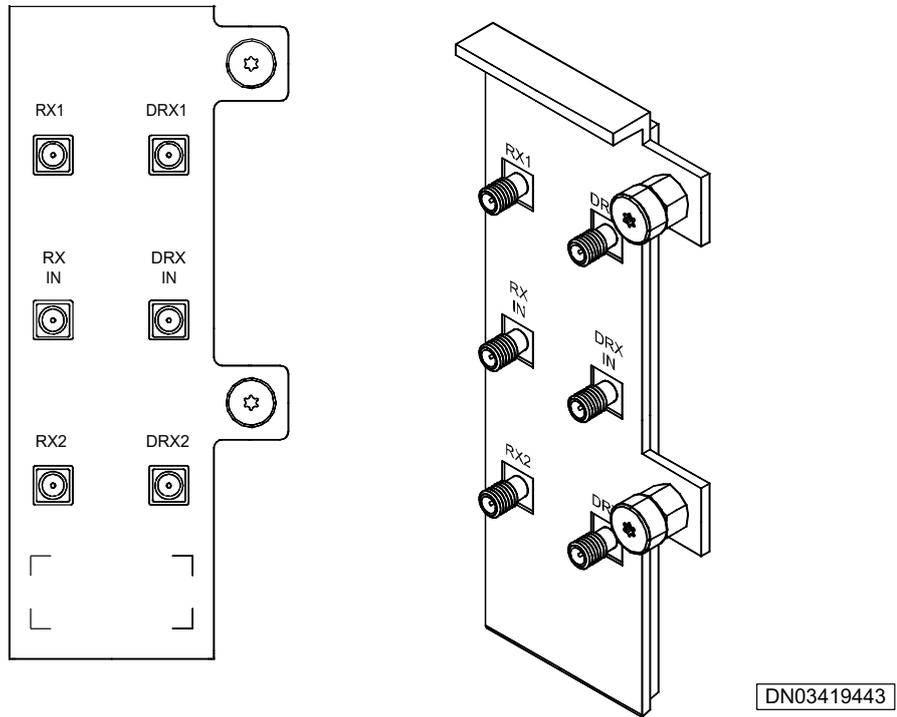


Figure 20. M2xA unit

M6xA

The M6xA unit receives signals from the DVxx unit or the RTxx unit. The M6xA unit divides the signals into six outputs for the RX path and six outputs for the DRX path. The outputs feed the receivers of six TSxx units, and a BTS can accommodate a maximum of two M6xA units. The unit is used most in conjunction with Remote Tune Combining.

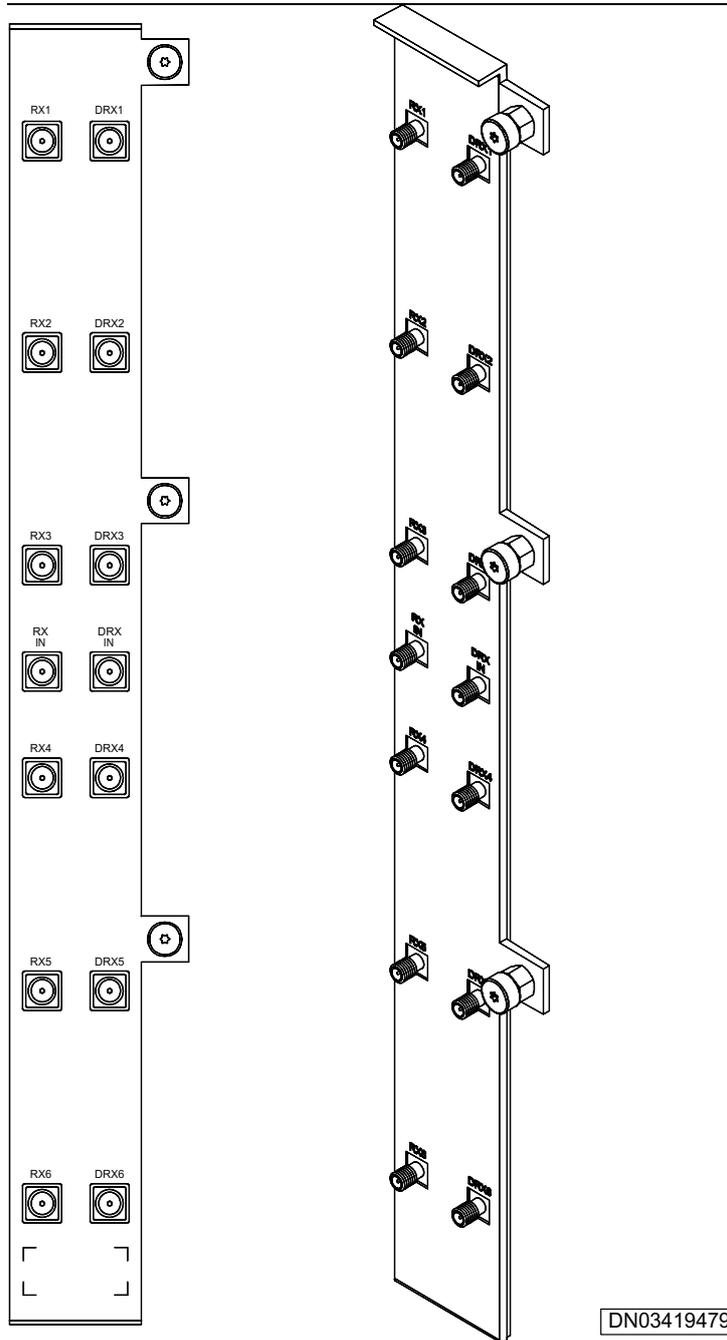


Figure 21. M6xA unit

7.1.3 MAIN blocks

M2xA blocks

The blocks of the M2xA unit provide the following outputs:

- Two RX – RX 1 and RX 2
- Two DRX – DRX 1 and DRX 2



Note

An unused RX output on the M2xA unit requires 50 Ω termination.

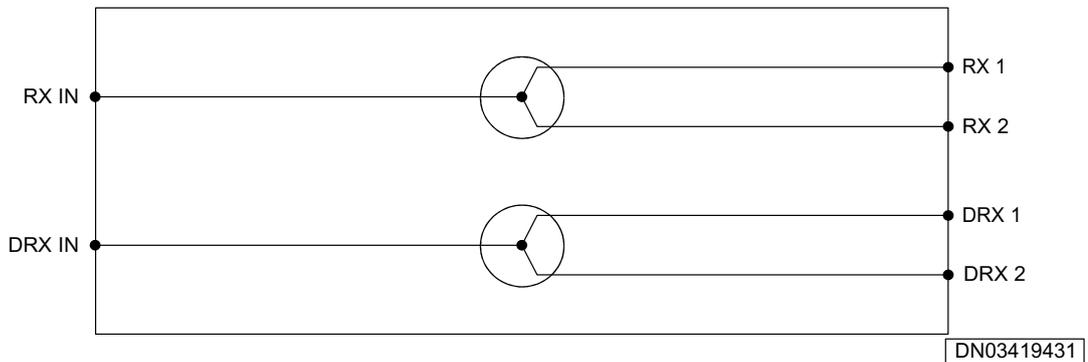


Figure 22. M2xA main blocks

M6xA blocks

The blocks of the M6xA unit provide the following outputs:

- Six RX – RX 1 to RX 6
- Six DRX – DRX 1 to DRX 6



Note

An unused RX output on the M6xA unit requires 50 Ω termination.

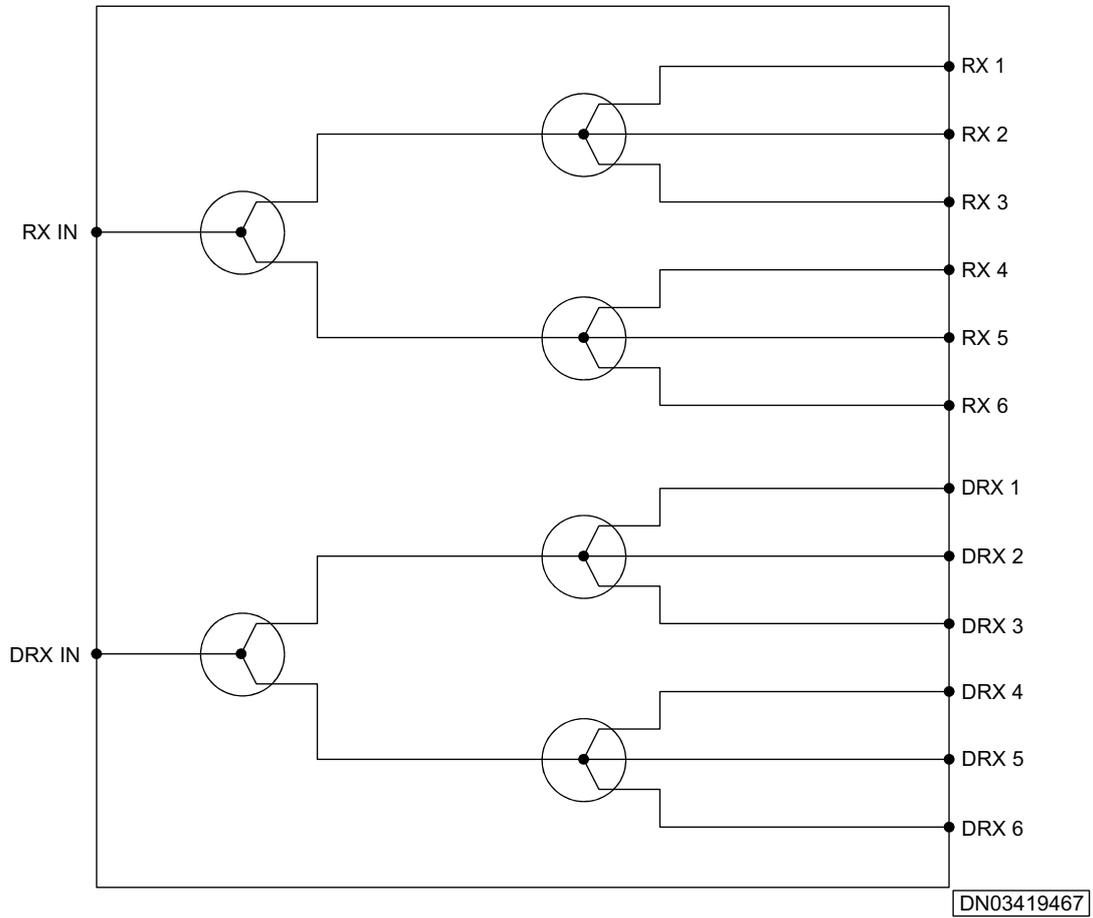


Figure 23. M6xA main blocks

7.2 Interfaces of the Receiver Multicoupler (M2xA and M6xA) unit

7.2.1 M2xA interfaces

Table 44. Connectors

Interface	Purpose	Connector type	Quantity
RX IN	Input from DVxx unit or RTxx unit	SMA (female)	1
DRX IN	Input from DVxx unit or RTxx unit	SMA (female)	1
RX 1 and RX 2	Outputs to main RX of TSxx unit	SMA (female)	2
DRX 1 and DRX 2	Outputs to diversity RX of TSxx unit	SMA (female)	2

7.2.2 M6xA interfaces

Table 45. Connectors

Interface	Purpose	Connector type	Quantity
RX IN	Input from DVxx unit or RTxx unit	SMA (female)	1
DRX IN	Input from DVxx unit or RTxx unit	SMA (female)	1
RX 1 and RX 6	Outputs to main RX of TSxx unit	SMA (female)	6
DRX 1 and DRX 6	Outputs to diversity RX of TSxx unit	SMA (female)	6

7.3 Receiver Multicoupler (M2xA or M6xA) unit alternatives



Note

The M2xA and M6xA units split Received (RX) and Diversity-Received (DRX) signals and distribute them to the Transceiver (TSxx) units. Two versions are available for different frequency bands.

Table 46. Unit alternatives

GSM/EDGE 800 and 900 bands.	GSM/EDGE 1800 and 1900 bands.
M2LA	M2HA
M6LA	M6HA

7.4 Dimensions and weight of Receiver Multicoupler (M2xA or M6xA) unit

Table 47. Dimensions and weight

Property	M2xA	M6xA
Height	160 mm 6.3 in.	490 mm 19.3 in.
Width	50 mm 2 in.	50 mm 2 in.
Depth	21.5 mm 0.85 in.	21.2 mm 0.83 in.
Weight	0.14 kg 0.3 lb	0.48 kg 1.05 lb

7.5 Insertion and return loss of Receiver Multicoupler (M2xA or M6xA) unit

Table 48. Insertion loss and return loss

Frequency band	Frequency range	Insertion loss	Return loss
GSM/EDGE 800/900	824MHz to 915 MHz	8.7 ± 0.8 dB	14.6 dB minimum
GSM/EDGE 1800/1900	1710 MHz to 1910 MHz	8.3 ± 0.8 dB	14.6 dB minimum

8

Remote Tune Combiner (RTxx) unit

8.1 Technical description of Remote Tune Combiner (RTxx) unit

8.1.1 Function

The Remote Tune Combiner (RTxx) unit is EDGE compatible and performs the following primary functions:

- combines up to six Transceiver (TSxx) units into a single BTS antenna
- provides duplex filtering to connect transmitted and received signals into one antenna
- provides RX filtering and amplification for the main and diversity branches

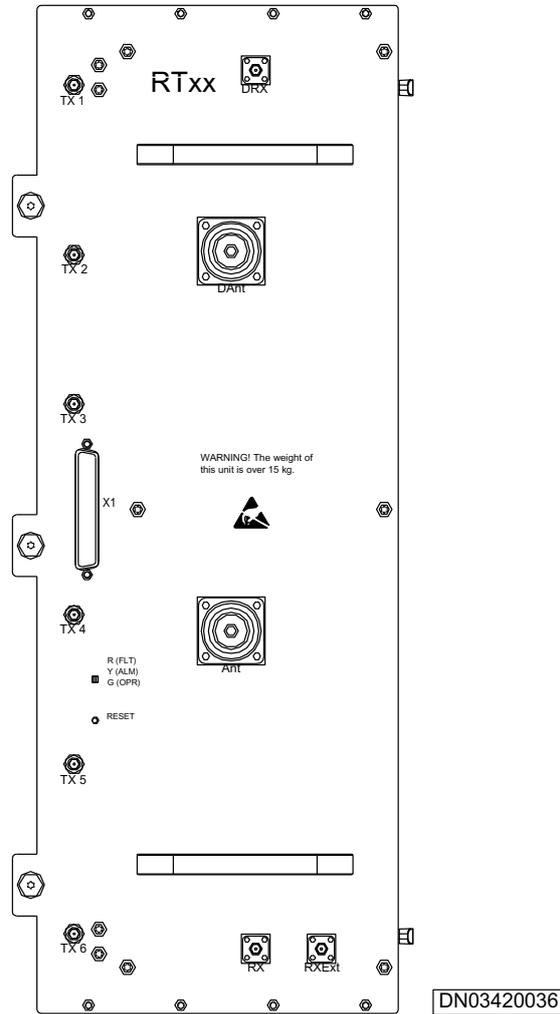


Figure 24. RTxx unit

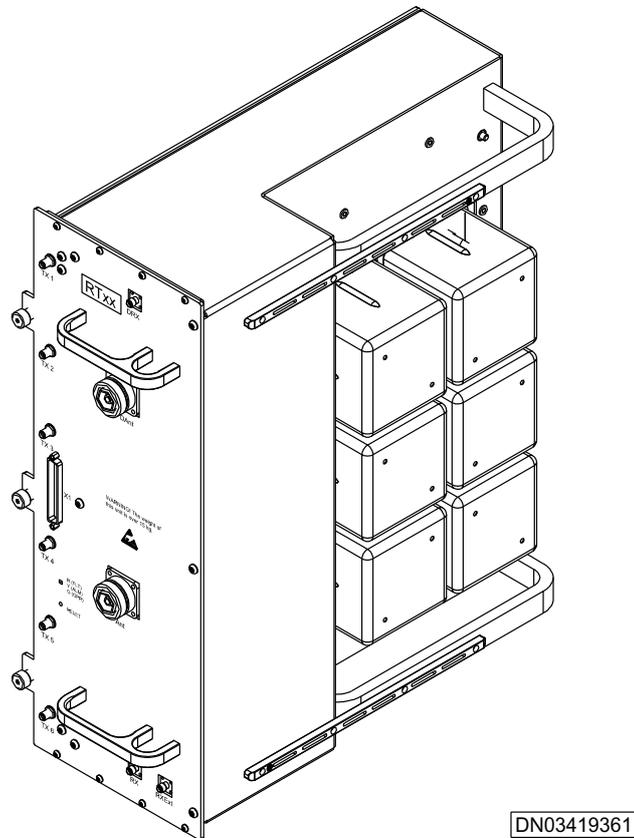


Figure 25. Isometric view of the RTxx unit

8.1.2 Operation

During BTS set-up, the BOIx unit commands the TSxx unit to send a dummy burst, modulated RF carrier signal at the frequency to which the combiner filter will be tuned. The BOIx unit sends a configuration message to the RTxx unit, and the RTxx unit starts to tune the combiner filters.

The power of the RF carrier signal forwarded to the combiner filter and reflected from it is measured. The signals are compared, and the centre frequency of the combiner filter is adjusted so that the reflecting power level from the filter is as low as possible.

Tuning is performed for each combiner filter. Tuning is then repeated, starting with the first combiner filter. The second tuning corrects the mutual effect of the combiner filters. The RTxx unit is ready for use.

The RTxx unit checks the condition of the combiner filters regularly and fine tunes the filters only if the forwarding power exists. The software of the RTxx is downloaded from the BOIx unit through the D2-bus. The software is first loaded to the DRAM of the controller. If the software is correct, it is loaded to Flash memory and is ready for use. The operational temperature range for the RTxx unit is -10° C to +65° C (+14° F to 149° F).

8.1.2.1 Overvoltage protection

The RTxx unit checks the condition of the combiner filters regularly and fine tunes the filters only if the forwarding power exists. The software of the RTxx is downloaded from the BOIx unit through the D2-bus. The software is first loaded to the DRAM of the controller. If the software is correct, it is loaded to Flash memory and is ready for use. The operational temperature range for the RTxx unit is -10° C to +65° C (+14° F to 149° F).

8.1.3 Main modules

The RTxx unit consists of the following main modules:

- selector
- combiner
- filter
- controller

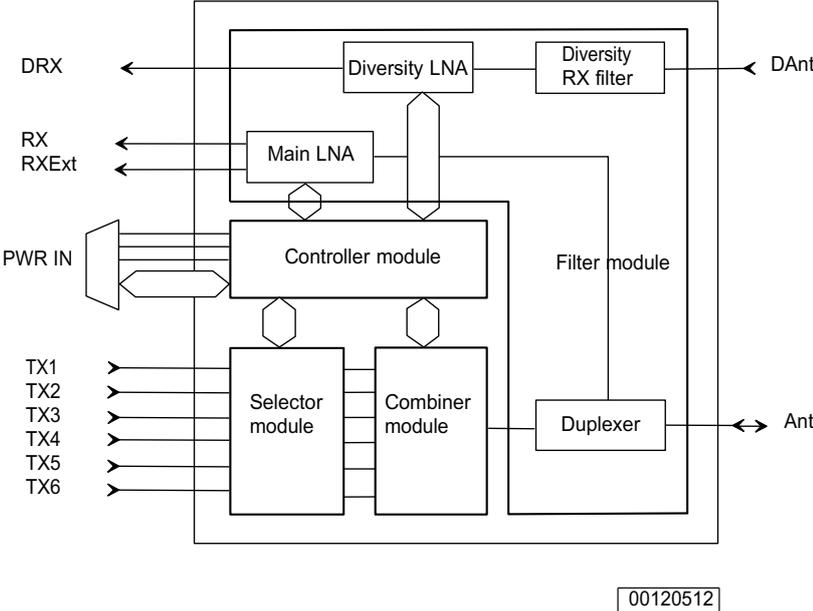


Figure 26. RTxx main modules

8.1.3.1 Selector

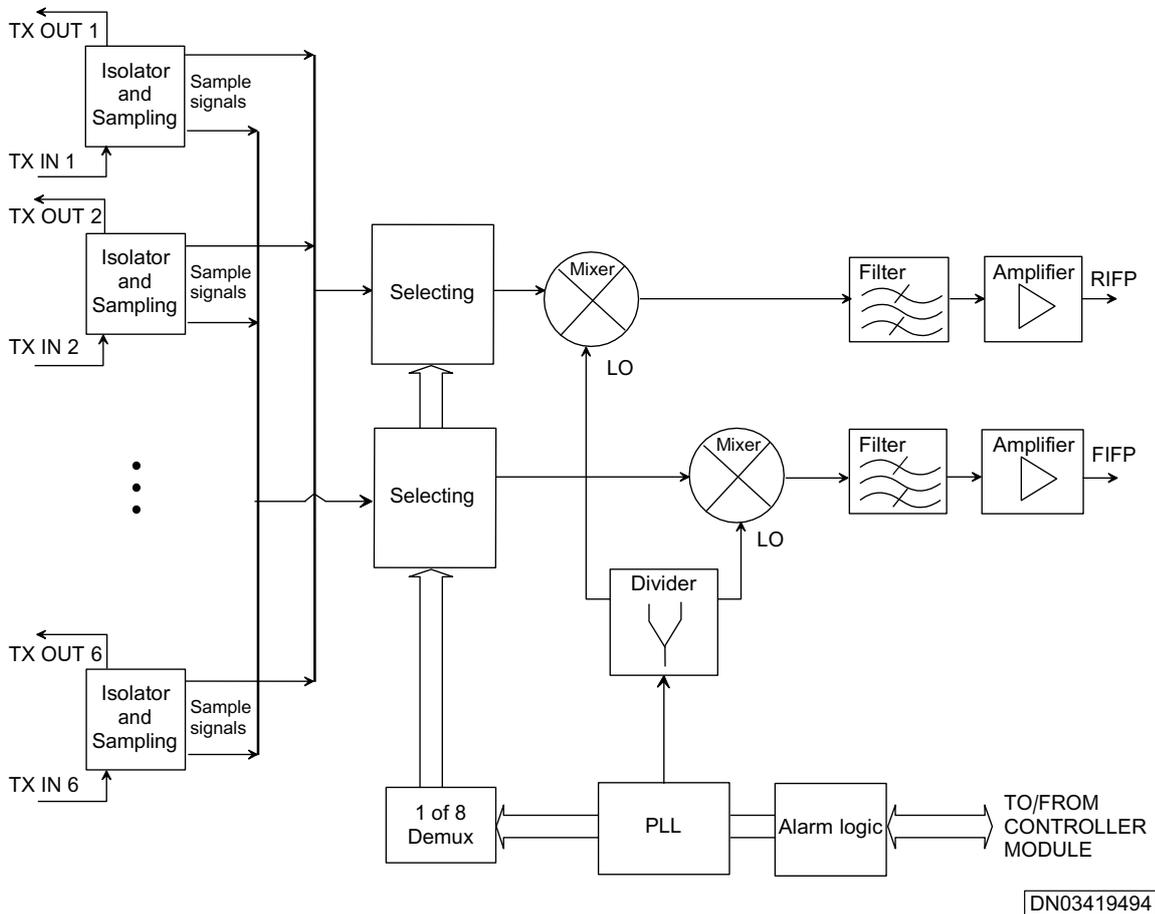


Figure 27. Main functional blocks of the selector module

The selector module provides the controller module with power samples that are proportional to the reflecting and forwarding power.

The TX signals go first to the selector module. The selector module then creates a sample of every forwarding power signal. After this sampling, the selector module directs the TX signals to the combiner module.

The selector module also creates samples of every reflected TX signal that comes from the combiner module. After this sampling, reflected power is directed to the high-power terminator.

The RTxx unit requires Forwarded Intermediate Frequency Power (FIFP) and Reflected Intermediate Frequency Power (RIFP) signals for tuning. The selector module mixes Local Oscillator (LO) and sample signals to create FIFP and RIFP signals and directs these signals to the controller module.

LO signal is generated in the PLL block of the selector module. The selector module also prevents reflected power flow toward the TSxx unit.

8.1.3.2 Combiner

The main function of the combiner module is to merge the modulated TX signals from the TSxx units through the following components:

- narrow bandpass filters
- single coaxial line using the summing network

The combiner module also provides RF isolation between the TSxx units.

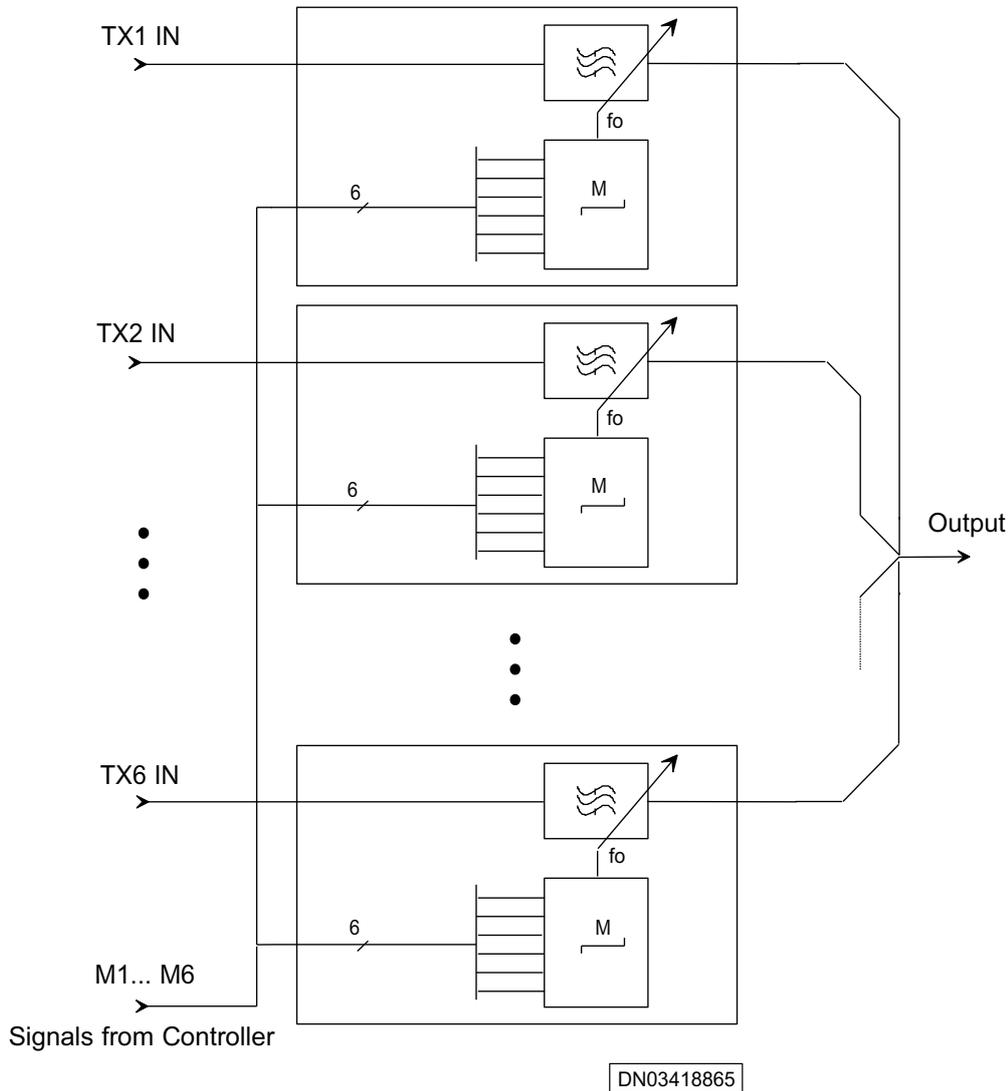


Figure 28. Functional blocks of combiner module

The carriers from the selector module are connected to the combiner filters. These filters are individually tuned to the carrier frequencies. The stepper motors, which receive control signals (M) from the controller, tune the centre frequencies of the combiner filters.

The combiner filters have narrow bandwidth and low insertion loss. The narrow bandwidth of the filters provides frequency-dependent attenuation between the filter input and output. This makes it possible to combine the outputs with a reasonably low insertion loss. Together with the filter module, the combiner filters provide the high attenuation required in the RX band.

The outputs of the combiner filters are connected to a single coaxial line using the summing network.

8.1.3.3 Filter

The main function of the filter module is to connect the TX branch and the main RX branch to the same BTS antenna with minimum insertion loss and high stopband attenuation, which in turn eliminates the need for a separate duplexer unit. Another important function of the filter module is to connect the RX diversity branch to the BTS diversity antenna.

The filter module includes two LNAs with adaptive gain state feature: high gain and low gain. The controller software adjusts the low-gain state, whereas the high-gain state remains constant.

The filter module has two functional blocks: main and diversity. The main block consists of a duplexer and adaptive LNA with two outputs. The diversity block consists of an RX diversity filter and adaptive LNA with one output. Gain of the LNAs can be switched between the high-gain or low-gain state by the controller module. If a Masthead Amplifier (MHA) is used, the LNAs must be set to the low-gain state.

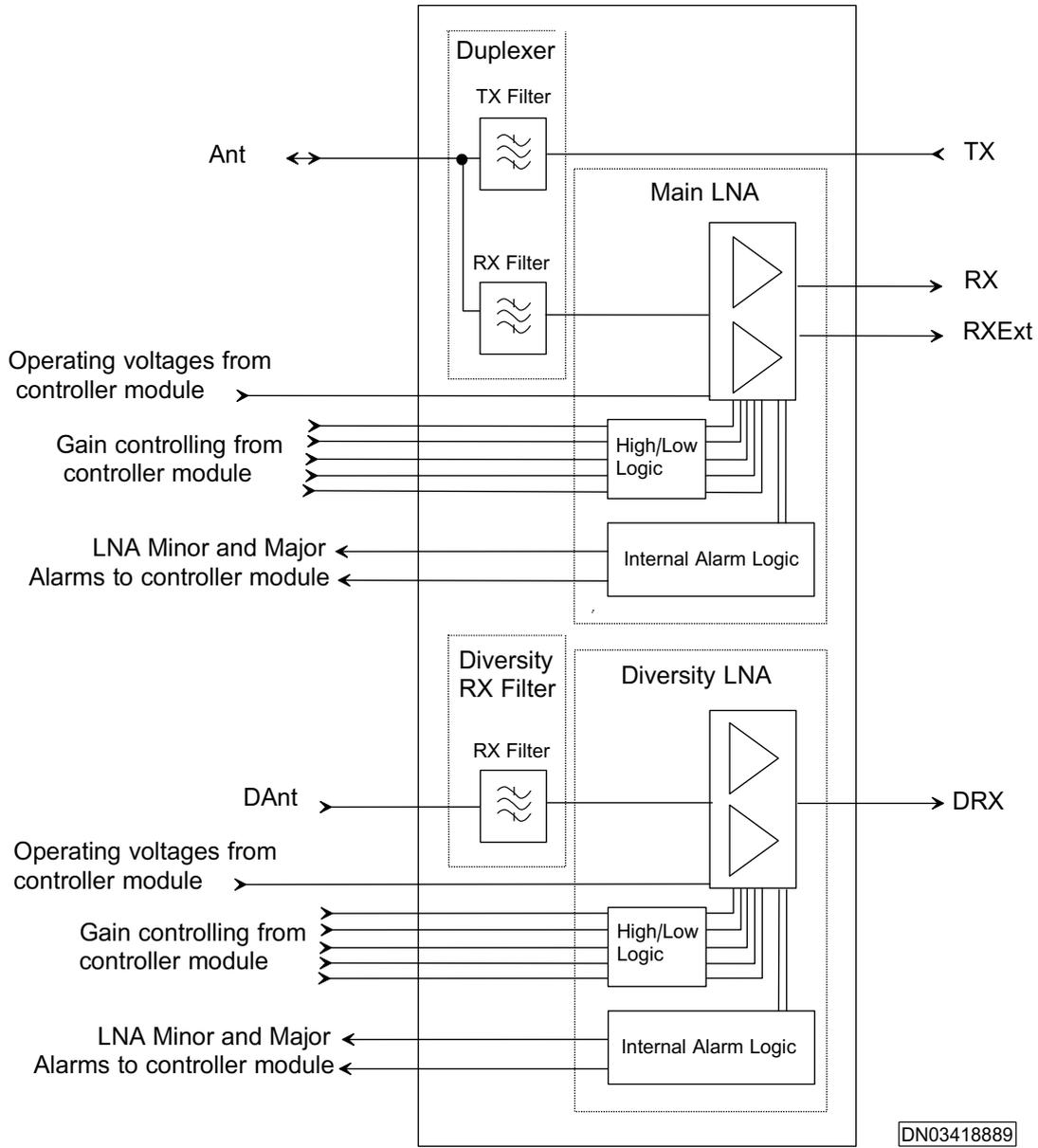


Figure 29. Functional blocks of filter module

Duplex filter

The combined TX carriers from the combiner module are connected to the BTS antenna through the TX bandpass filter. The passband of the filter covers the whole TX band with minimum insertion loss. The filter provides the high stopband attenuation that is required to limit the level of spurious frequencies and intermodulation products in the RX band.

The main RX signal from the BTS antenna is connected to the RX bandpass filter. The filter and adaptive LNA provide an amplified RX signal to the Receiver Multicoupler unit. The passband of the filter covers the whole RX band, and the stopband of the filter effectively rejects the spurious frequencies from the antenna and TX branch.

RX diversity filter

The diversity RX signal from the BTS antenna is connected to the RX diversity bandpass filter. The filter and adaptive LNA provide an amplified RX signal to the Receiver Multicoupler unit. The passband of the filter covers the whole RX band, and the stopband of the filter effectively rejects the spurious frequencies from the antenna.

8.1.3.4 Controller

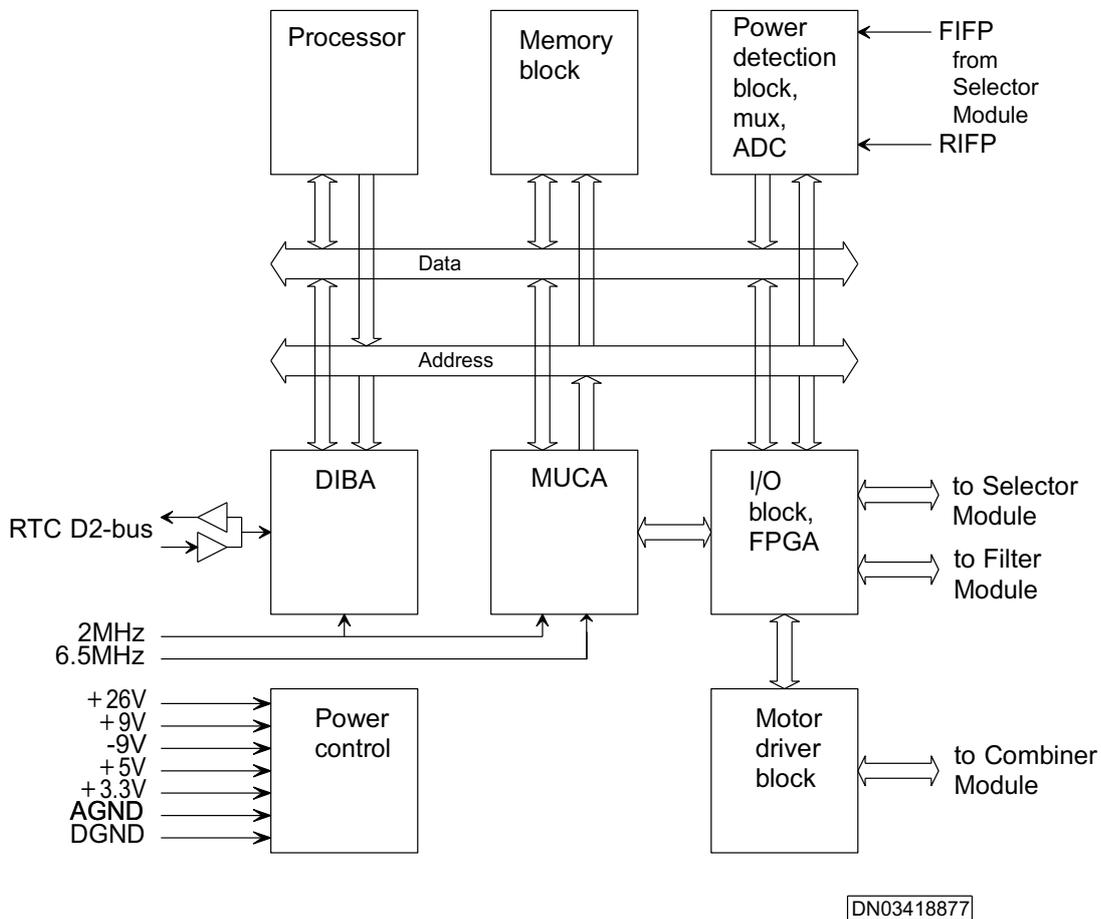


Figure 30. Functional blocks of controller module

The main purpose of the controller module is to control and monitor the function of the RTxx unit. It also handles communication between the RTxx and BOIx units through the RTC D2-bus. The RTxx unit sends status information to the BOIx unit. The BOIx updates the controller software when necessary.

The controller module also tunes the cavities of the RTxx unit to the desired frequencies. The selector module gathers samples from the forwarded and reflected power, and the power detection block on the controller module collects the samples. The UC (Unit Controller) processes the sample information to form the correct commands for the motor drivers. The UC sends the commands to the motor controller block that drives the stepper motors, so that the cavities are tuned to the correct frequencies.

The controller module manages the alarms from the filter and selector modules and the controller module itself. The controller module also monitors the temperature of the RTxx unit.

The controller module receives and manages the 3.3 V operating voltages from the RFU backplane through the flexible cable and supplies operating voltages to the connected modules.

8.2 Interfaces of the Remote Tune Combiner (RTxx) unit

Table 49. Connectors

Interface	Purpose	Connector type
Ant	Combined TX signals from the RTxx to the BTS and main RX signals from the BTS to the TSxx	7/16 (female)
DAnt	Diversity RX signal from the diversity antenna	7/16 (female)
DRX	Output to the Receiver Multicoupler	SMA connector (female)
RX	Output to the Receiver Multicoupler	RX
RXExt	Output to the Receiver Multicoupler	SMA connector female)
TX1 to TX6	RTxx input connector for TSxx transmitters	SMA connector female)
X1	D-37, D-sub (male)	D-37, D-sub (male)

Table 50. Pin configurations

Pin configurations	Signal	Used by
1	RTxx	RTxx
2	D2DUN	RTxx
3	D2DDP	RTxx
4	D2DDN	RTxx
5	CK2MP	RTxx

Table 50. Pin configurations (cont.)

Pin configurations	Signal	Used by
6	CK2MN	RTxx
7	CK6M5P	RTxx
8	CK6M5N	RTxx
9		DVxx
10	GND	RTxx
11		DVxx
12	GND	RTxx
13		DVxx
14		DVxx
15	RXD	R&D testing
16	GND	R&D testing
17	TXD	R&D testing
18	GND	R&D testing
19	RTCUA	RTxx
20	V26P	RTxx
21	GND	RTxx
22	V9P	RTxx
23	GND	RTxx
24	V9P	RTxx
25	GND	RTxx
26	V9P	RTxx
27	GND	RTxx
28	V9P	RTxx
29	GND	RTxx
30	V5P	RTxx
31	GND	RTxx
32	V5P	RTxx
33	GND	RTxx
34	V5P	RTxx
35	GND	RTxx
36	V3P	RTxx
37	GND	RTxx

Table 51. Signal descriptions

Signal	Level	Description
CK2MN	LVDS	D2-bus 2MHz clock, negative
CK2MP	LVDS	D2-bus 2MHz clock, positive
CK6M5N	LVDS	6.5 MHz Reference Clock for selector module, negative slope
CK6M5P	LVDS	6.5 MHz Reference Clock for selector module, positive slope
D2DDN	LVDS	D2 downlink data, negative
D2 downlink data, negative	LVDS	D2 downlink data, positive
D2DUN	LVDS	D2 uplink data, negative
D2 uplink data, negative	LVDS	D2 uplink data, positive
GND	0 V	Ground
RTCUA	LVTTTL	RTxx unit address bit
RXD	RS-232	R and D testing
TXD	RS-232	R and D testing
V3P	+3.3 VDC	Digital supply voltage
V5P	+5 VDC	Digital supply voltage
V9N	-9 VDC	Digital supply voltage
V9P	+9 VDC	Digital supply voltage
V26P	+26 VDC	Digital supply voltage

8.3 Remote Tune Combiner (RTxx) unit alternatives

Table 52. Unit alternatives

Unit	Frequency Band
RTGA	full band for GSM/EDGE 900
RTHA	H sub-band for GSM/EDGE 900
RTJA	J sub-band for GSM/EDGE 900

Table 52. Unit alternatives (cont.)

Unit	Frequency Band
RTDA	A band for GSM/EDGE 1800
RTDB	B band for GSM/EDGE 1800
RTDC	full band for GSM/EDGE 1800
RTPA	full band for GSM/EDGE 1900

8.4 Remote Tune Combiner (RTxx) unit LEDs

A tri-colour LED on the front of the Remote Tune Combiner (RTxx) unit indicates operating conditions.

Table 53. LED indications

LED colour	Steady	Flashing
RED	Fault or alarm, all six cavities faulty	One or more faulty cavities
YELLOW	Power is on, and unit is waiting	Configuring ongoing
GREEN	Unit is on and operating	Software downloading

8.5 Dimensions and weight of Remote Tune Combiner (RTxx) unit

Table 54. Dimensions and weight

Property	Value (metric)	Value (imperial)
Height	490 mm	19.29 in.
Width	195 mm	7.68 in.
Depth	432 mm	17.01 in.
Weight	20 kg maximum	44.09 lb maximum

8.6 Electrical properties for Remote Tune Combiner (RTxx) unit

Table 55. Electrical properties

Nominal supply voltage	Nominal current consumption
+3.3 V	650 mA
+5.0 V	500 mA
+9.0 V	2800 mA
-9.0 V	450 mA
+26.0 V	1000 mA

8.7 RF properties for Remote Tune Combiner (RTxx) unit

Table 56. GSM/EDGE 900

	GSM/EDGE 900	GSM/EDGE 900H	GSM/EDGE 900J
TX frequency range	925 - 960 MHz	942.5 - 960 MHz	935 - 960 MHz
RX frequency range	880 - 915 MHz	897.5 - 915 MHz	890 - 915 MHz
Carrier frequency spacing	600 kHz minimum	600 kHz minimum	600 kHz minimum
Insertion loss (TX)	4.0 dB maximum	4.0 dB maximum	4.0 dB maximum
TX power in the input	55.0 W maximum	55.0 W maximum	55.0 W maximum
Number of TX carriers combined into one antenna	1 - 6 TX	1 - 6 TX	1 - 6 TX
Return loss at TX input port	15.6 dB minimum	15.6 dB minimum	15.6 dB minimum
Return loss at Ant port/TX band	8.0 dB	8.0 dB	8.0 dB
Gain (RX)	+28.4 dB / high gain +3.4 dB / low gain, maximum gain -3.6 dB / low gain, minimum gain	+28.4 dB / high gain +3.4 dB / low gain, maximum gain -3.6 dB / low gain, minimum gain	+28.4 dB / high gain +3.4 dB / low gain, maximum gain -3.6 dB / low gain, minimum gain
Return loss at DAnt port on RX band, high gain	16 dB minimum	16 dB minimum	16 dB minimum

Table 56. GSM/EDGE 900 (cont.)

	GSM/EDGE 900	GSM/EDGE 900H	GSM/EDGE 900J
Return loss at DAnt port on RX band, low gain	13 dB minimum	13 dB minimum	13 dB minimum
Return loss at RX output ports	16 dB minimum	16 dB minimum	16 dB minimum
Tuning time	62 s	62 s	62 s

Table 57. GSM/EDGE 1800

	GSM/EDGE 1800A	GSM/EDGE 1800B	GSM/EDGE 1800C
TX frequency range	1805 - 1850 MHz	1835 - 1880 MHz	1805 - 1880 MHz
RX frequency range	1710 - 1755 MHz	1740 - 1785 MHz	1710 - 1785 MHz
Carrier frequency spacing	800 kHz minimum	800 kHz minimum	800 kHz minimum
Insertion loss (TX)	3.6 dB maximum	3.6 dB maximum	4.0 dB maximum
TX power in the input	55.0 W maximum	55.0 W maximum	55.0 W maximum
Number of TX carriers combined into one antenna	1 - 6 TX	1 - 6 TX	1 - 6 TX
Return loss at TX input port	15.6 dB minimum	15.6 dB minimum	15.6 dB minimum
Return loss at Ant port/TX band	9.0 dB	9.0 dB	7.0 dB
Gain (RX)	+29.4 dB / high gain +6.4 dB / low gain, maximum gain -3.6 dB / low gain, minimum gain	+29.4 dB / high gain +6.4 dB / low gain, maximum gain -3.6 dB / low gain, minimum gain	+28.4 dB / high gain +6.4 dB / low gain, maximum gain -3.6 dB / low gain, minimum gain
Return loss at DAnt port on RX band, high gain	16 dB minimum	16 dB minimum	16 dB minimum
Return loss at DAnt port on RX band, low gain	13 dB minimum	13 dB minimum	13 dB minimum
Return loss at RX output ports	16 dB minimum	16 dB minimum	16 dB minimum
Tuning time	62 s	62 s	62 s

Table 58. GSM/EDGE 1900

	GSM/EDGE 1900
TX frequency range	1930 - 1990 MHz
RX frequency range	1850 - 1910 MHz
Carrier frequency spacing	800 kHz minimum
Insertion loss (TX)	3.9 dB maximum
TX power in the input	55.0 W maximum
Number of TX carriers combined into one antenna	1-6 TX
Return loss at TX input port	15.6 dB minimum
Return loss at Ant port/TX band	7.0 dB
Gain (RX)	+29.4 dB / high gain +6.4 dB / low gain, maximum gain -3.6 dB / low gain, minimum gain
Return loss at DAnt port on RX band, high gain	16 dB minimum
Return loss at DAnt port on RX band, low gain	13 dB minimum
Return loss at RX output ports	16 dB minimum
Tuning time	62 s

8.8 Insertion loss (TX) of Remote Tune Combiner (RTxx) unit

Table 59. Insertion loss for GSM/EDGE 900 RTGA, RTHA, and RTJA

Number of cavities	Minimum spacing (600 kHz)	Extended spacing (600 kHz + 400 kHz)
1	1.76	1.76
2	2.04	1.81
3	2.21	1.88
4	2.26	1.89
5	2.34	1.93

Table 59. Insertion loss for GSM/EDGE 900 RTGA, RTHA, and RTJA (cont.)

Number of cavities	Minimum spacing (600 kHz)	Extended spacing (600 kHz + 400 kHz)
6	2.36	1.93

Table 60. Insertion loss for GSM/EDGE 1800 RTDA

Number of cavities	Minimum spacing (800 kHz)	Extended spacing (800 kHz + 400 kHz)
1	1.91	1.91
2	2.11	2.01
3	2.26	2.07
4	2.31	2.07
5	2.38	2.11
6	2.41	2.12

Table 61. Insertion loss for GSM/EDGE 1800 RTDB

Number of cavities	Minimum spacing (800 kHz)	Extended spacing (800 kHz + 400 kHz)
1	1.98	1.98
2	2.16	2.04
3	2.31	2.12
4	2.36	2.14
5	2.43	2.16
6	2.45	2.18

Table 62. Insertion loss for GSM/EDGE 1800 RTDC

Number of cavities	Minimum spacing (800 kHz)	Extended spacing (800 kHz + 400 kHz)
1	2.12	2.12
2	2.39	2.22
3	2.55	2.30
4	2.62	2.32
5	2.68	2.39
6	2.72	2.40

Table 63. Insertion loss for GSM/EDGE 1900 RTPA

Number of cavities	Minimum spacing (800 kHz)	Extended spacing (800 kHz + 400 kHz)
1	2.22	2.22
2	2.43	2.31
3	2.58	2.39
4	2.63	2.40
5	2.68	2.43
6	2.72	2.45

9 Temperature Control System (TCS)

9.1 Technical description of Temperature Control System (TCS)

This section describes the operation and functional blocks of the Temperature Control System (TCS). The TCS includes the following hardware elements:

- Unit cooling fans - included in the cabinet core mechanics (Indoor and Outdoor BTS)
- Cabinet cooling fan - included in the Outdoor BTS
- HETA (BTS cabinet heater) unit - optional in the Outdoor BTS. AC filter unit and associated AC cabling must be installed if optional HETA unit is used.

The main purpose of the TCS is to monitor and control the internal temperature of the BTS cabinet. The TCS uses integrated control software in the Base Operations and Interfaces (BOIx) unit and unit temperature sensors to monitor the temperature. Using these measurements, the TCS adjusts the speed of the fans and turns the HETA on or off, if installed. The alarm-handling software in the BOIx unit also uses these measurements to generate temperature alarms.

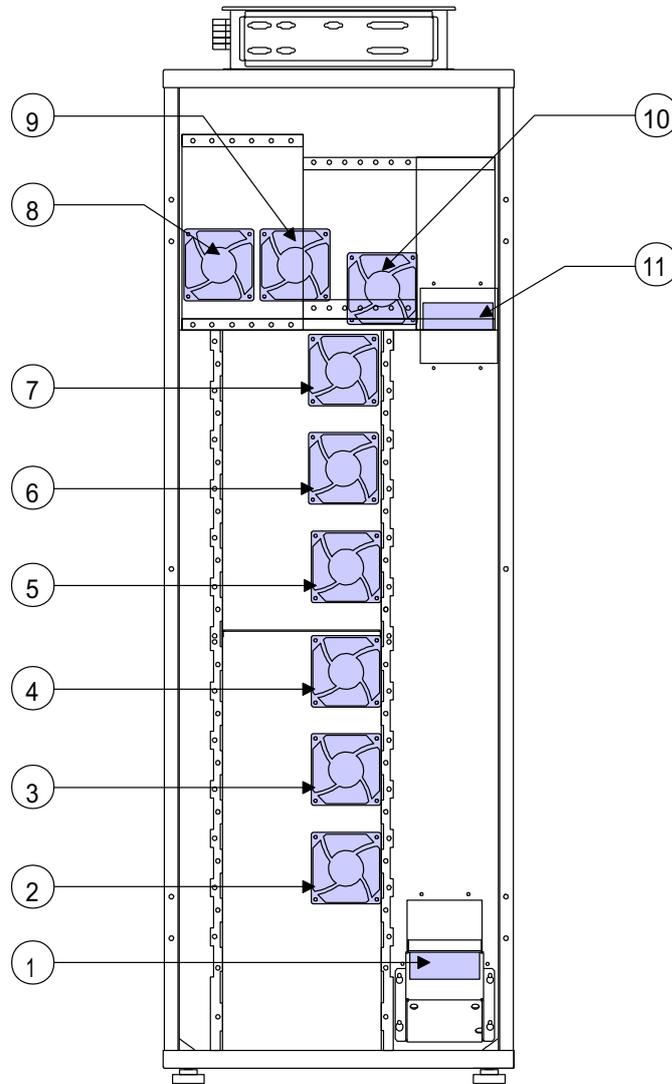
The TCS also monitors the rotation speed of the unit cooling fans and the cabinet cooling fan.

9.1.1 Operation

9.1.1.1 Unit cooling fans

The unit cooling fans cool the various units inside the BTS cabinet. The fans have reverse polarity, blocked rotor protection and automatic restart capability. Their normal operating temperature is from -33° C to 70° C (-27.4° F to 158° F).

The TCS software in the BOIx unit controls and monitors fan function and speed. If fan speed degrades significantly, the reduced fan speed alarm notifies the operator before failure occurs. When failure occurs, the fan broken alarm is sent. Each fan's airflow varies according to the temperatures of the individual units in the fan's general area.

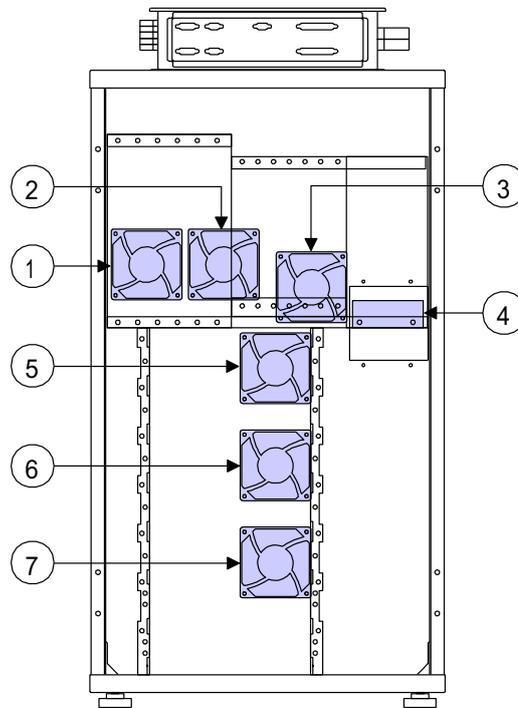


UltraSite cabinet core

DN03419607

Figure 31. Names and locations of unit cooling fans

1	RF Filter fan 2, horizontal mount
2	TSxx fan 6
3	TSxx fan 5
4	TSxx fan 4
5	TSxx fan 3
6	TSxx fan 2
7	TSxx fan 1
8	Power fan, 1
9	Power fan, 2
10	Common units fan
11	RF Filter fan 1, horizontal mount



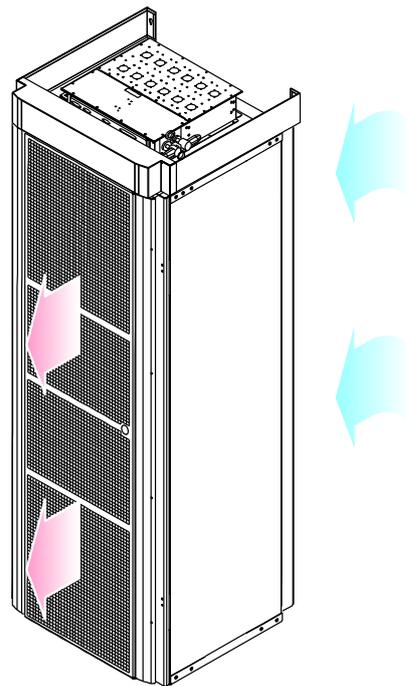
UltraSite MIDI cabinet core

DN05129831

1	Power fan, 1
2	Power fan, 2
3	Common units fan

4	RF Filter fan 1, horizontal mount
5	TSxx fan 1
6	TSxx fan 2
7	TSxx fan 3

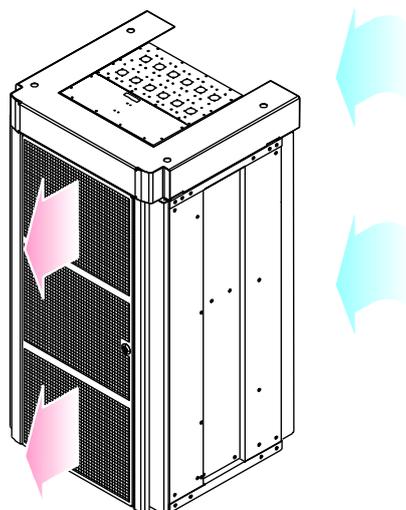
Figure 32. Names and locations of unit cooling fans - Midi



UltraSite Cabinet

DN03418008

Figure 33. Airflow of unit cooling fans - IDCx



UltraSite Midi Cabinet

DN05129879

Figure 34. Airflow of unit cooling fans - Midi

9.1.1.2 Cabinet cooling fan

The cabinet cooling fan is included in the Outdoor Application Kit (OAK_x). This fan draws cool air in and exhausts warm air from the BTS cabinet. The normal operating temperature of the fan is from -33°C to 70°C (-27.4°F to 158°F).

The TCS software in the BOI_x unit controls the functions and speed of the cabinet cooling fan. The airflow varies according to the temperature inside the cabinet.

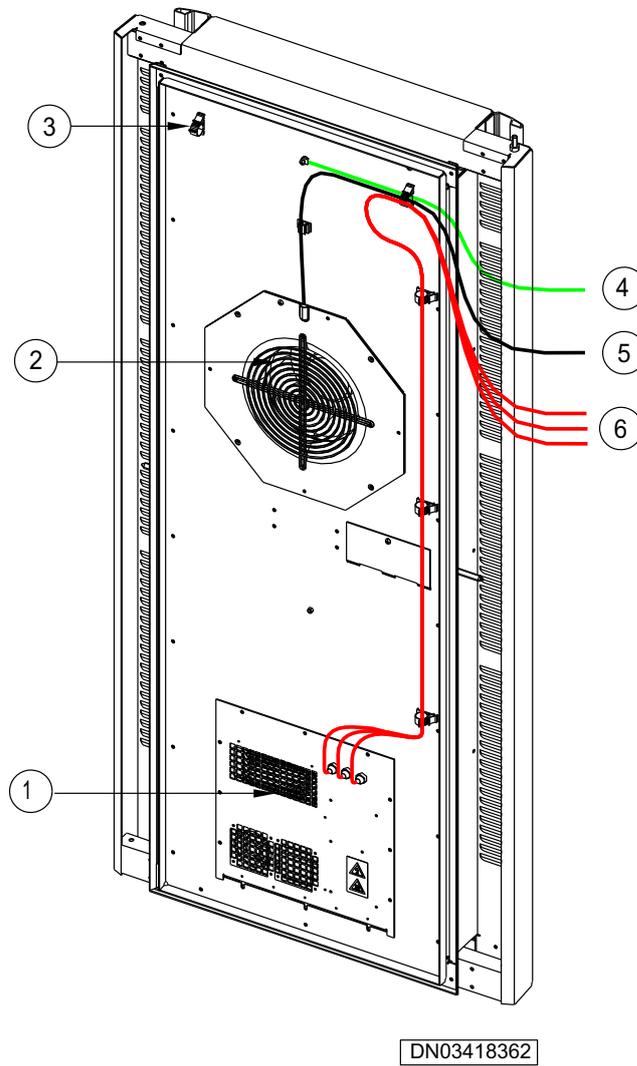


Figure 35. Cabinet cooling fan and optional HETA in OAKA cabinet door

1	Optional heater unit
2	Cabinet fan (CAFA)
3	Cable clamp, six places
4	Door ground strap
5	Wiring to CAFA power and control
6	Wiring to HETA power and control

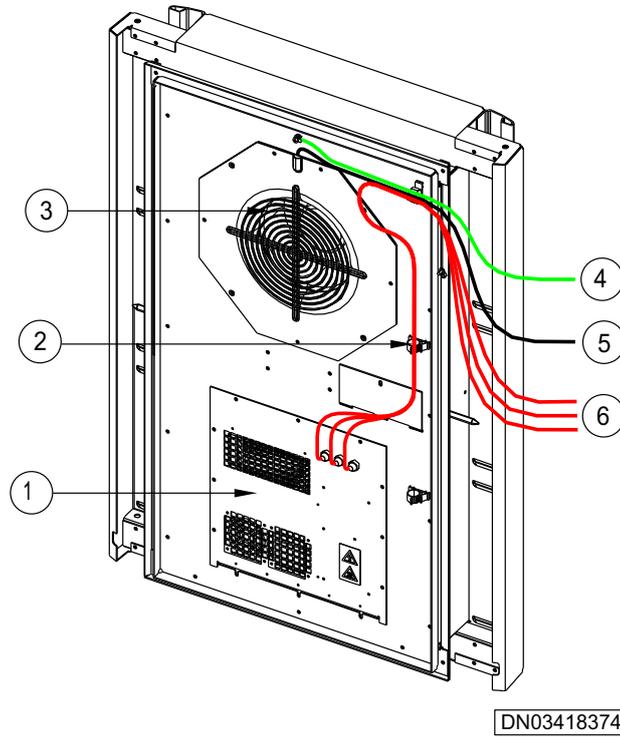
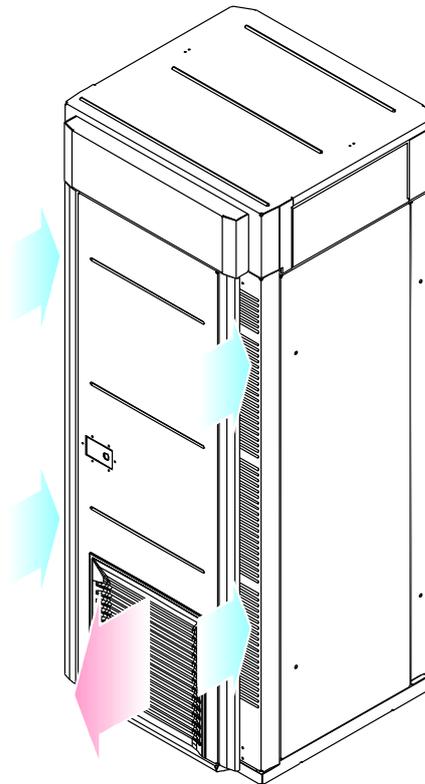


Figure 36. Cabinet cooling fan and optional HETA in OAKC cabinet door

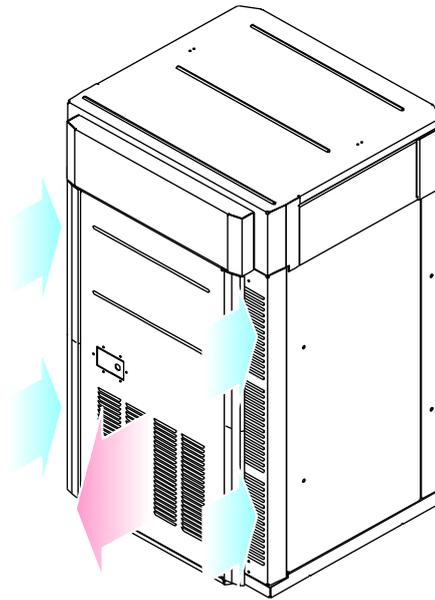
1	Optional heater unit
2	Cable clamp, three places
3	Cabinet fan (CAFA)
4	Door ground strap
5	Wiring to CAFA power and control
6	Wiring to HETA power and control



UltraSite Cabinet

DN03417999

Figure 37. Airflow of cabinet and unit cooling fans - OAKA



UltraSite Midi Cabinet

DN05129882

Figure 38. Airflow of cabinet and unit cooling fans - OAKC

9.1.1.3 HETA

The HETA is available as an option for the OAKx only. The HETA is required for BTS operation at ambient temperatures below -10°C (14°F). Its minimum operating temperature is -33°C (-27.4°F).



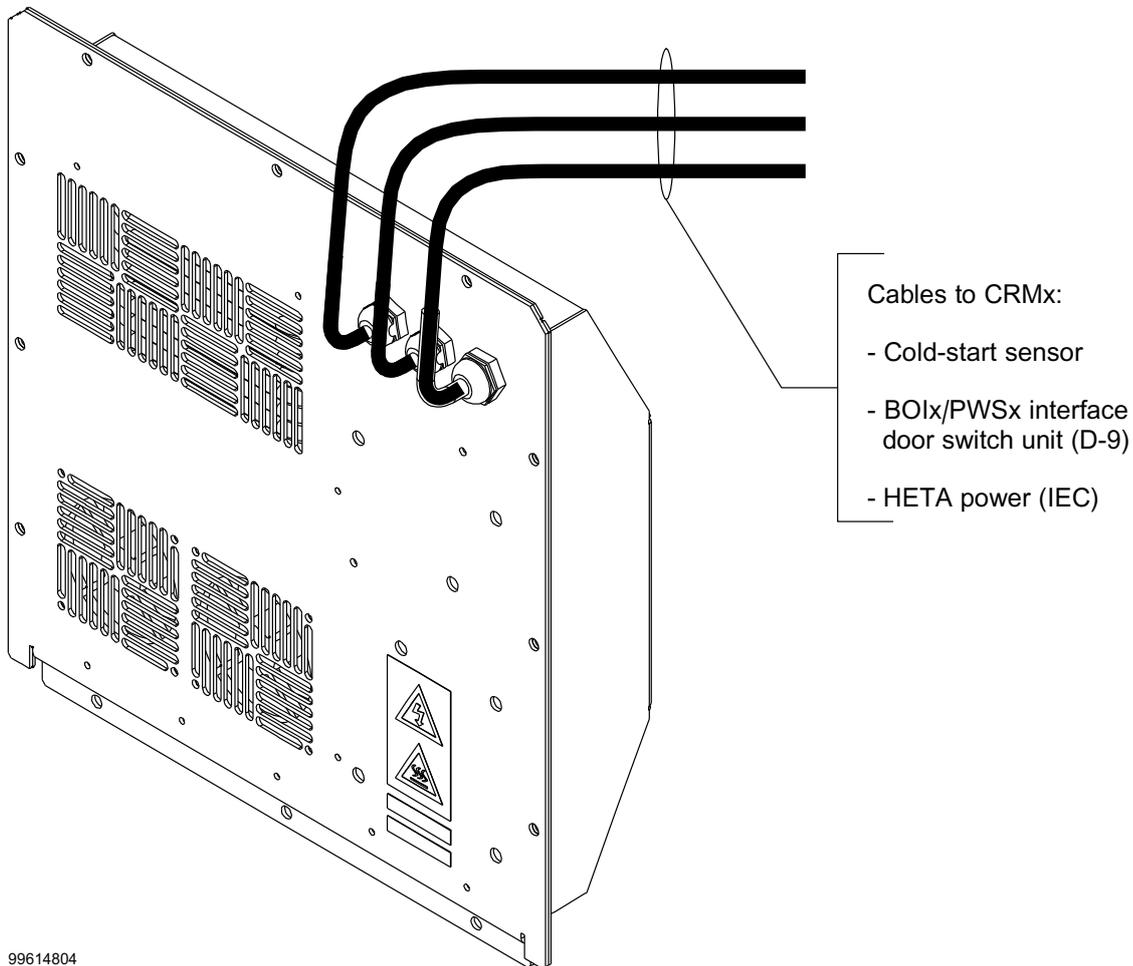
Note

The HETA unit needs AC filter unit and associated AC cabling to operate. If installed to a BTS working of DC, that cabinet would also need AC power cables as well as DC.

The HETA is installed in the cabinet door and has the following functions:

- raise the internal BTS temperature when it falls below -5°C (23°F) during normal operation
- protect the BTS during cold-start operation

The HETA reports its status and potential alarms to the BOIx unit, which detects the HETA during the auto-detection procedure. The HETA interfaces with the BOIx and power supply (PWSx) units through the common backplane.



99614804

Figure 39. Optional HETA

Normal operation

During normal BTS operation (ambient temperature from -33° C to 50° C, or - 27.4° F to 122° F), the BOIx unit controls the HETA according to the temperatures of the individual units. If any unit temperature falls below -5° C (23° F), the BOIx unit enables the HETA. After the HETA raises the unit's temperature above 5° C (41° F), the BOIx unit disables the HETA.

Cold-start operation

The cold-start controller circuit on the HETA protects the BTS during startup when the cabinet temperature falls below -10°C (14°F). The controller circuit has a sensor that measures the temperature inside the cabinet. When the temperature at startup is below -10°C (14°F), the cold-start controller prevents the enabling of the PWSx unit outputs and enables the HETA, which is used to raise the cabinet temperature to the minimum operating level within four hours. When the cabinet temperature reaches -5°C (23°F), the cold-start controller enables the PWSx unit outputs. Once the BTS is online, the TCS software assumes responsibility for the cabinet temperature.

9.1.1.4 Fan control during startup

When the BTS is powered on (before the TCS software has started), the FPGA Field Programmable Gate Array (FPGA) software in the BOIx unit uses a default speed to control the cabinet and unit fans directly connected to the BOIx unit. The TSxx microcontroller software controls the TSxx fans at a default speed.



Note

The TSxx unit fan speeds can vary, because the Pulse Width Modulation (PWM) signals received from the two TSxx that control each fan may be out of phase (until TCS software takes over).

The TCS software starts and takes control of the fan speeds when the BOIx unit reaches a *Supervisory* state, which requires an Abis or BTS Manager connection.

9.1.2 Fan control during reset

During an Operation and Maintenance Unit (OMU) reset, the unit fans directly connected to the BOIx unit rotate at the default speed. The TSxx unit fans maintain their speed until the BOIx unit software starts, because the TSxx hardware and software are not reset.

During a site reset, the unit fans directly connected to the BOIx and TSxx unit fans rotate at the default speed until the BTS software starts.

9.1.3 Main blocks

Unit cooling fans

The manufacturers of the unit cooling fans supply the fan components. Each fan includes a PWM input for control and a tachometer output for monitoring speed.

Cabinet cooling fan

The manufacturers of the cabinet cooling fan supply the fan components. The fan includes a PWM input for control and a tachometer output for monitoring speed.

HETA

The HETA includes the following functional blocks:

- heating element
- relay
- fan
- temperature sensor and cable
- cold-start controller circuit
- internal power supply for the cold-start controller circuit, with a power board and a cable for connection to the AC filter module
- interface with the BOIx and PWSx units, consisting of an interface circuit and cable

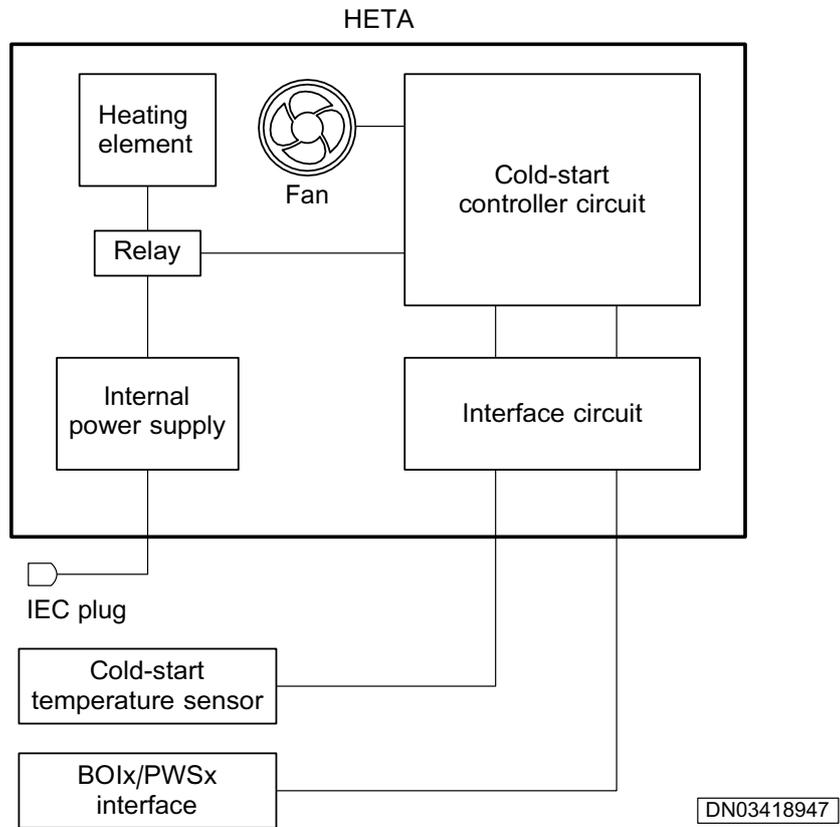


Figure 40. HETA functional blocks

9.2 Interfaces of the Temperature Control System

9.2.1 Fans

Unit cooling fans

The unit cooling fans have the following interfaces:

- fan control
- fan status
- 48 VDC power

Cabinet cooling fan

The cabinet cooling fan has the following interfaces:

- fan control
- fan status
- 48 VDC power

Table 64. Interface wires and pin configurations

Pin	Wire
1	V48RTN (+ pole of input voltage)
3	3 V48N (- pole of input voltage)
6	FANST (RPM info)
8	FANCTRL (PWM)

9.2.2 HETA

The HETA has the following interfaces:

- AC power
- control and status
- cold-start sensor

AC power interface

The AC power cable has an IEC male latching/locking connector. The secondary side of the AC/DC converter is grounded to the HETA case.

Control and status interface

The HETA interfaces with the BOIx and PWSx units through the common backplane. This interface routes control and status signals to and from the appropriate units. The HETA control cable runs from the HETA to the common backplane. The connector type is D-9 male.

Table 65. Pin configurations

Pin	Signal		Pin	Signal
1	Pin		2	GND
3	V5P		4	NA
5	V5P		6	HETA_CTRL
7	HETA_AD		8	RCTL
9	GND			

9.3 Dimensions and weight of Temperature Control System (TCS)

Table 66. Dimensions and weight of unit cooling fans

Property	Value (metric)	Value (imperial)
Height ¹	119 mm or 127 mm	4.7 in. or 5.0 in.
Width ¹	119 mm or 127 mm	4.7 in. or 5.0 in.
Depth	38 mm	1.5 in.
Weight ¹	0.36 kg or 0.38 kg	0.79 lb or 0.84 lb

¹Differing values represent different manufacturers.

Table 67. Dimensions and weight of cabinet cooling fan

Property	Value (metric)	Value (imperial)
Height	280 mm	10.92 in.
Width	280 mm	10.92 in.
Depth	125 mm	4.88 in.
Weight	2.6 kg	5.75 lb

Table 68. Dimensions and weight of cabinet heater (HETA)

Property	Value (metric)	Value (imperial)
Height	365 mm	14.37 in.
Width	340 mm	13.39 in.
Depth	88.5 mm	3.48 in.
Weight	3.0 kg	6.6 lb

9.4 Electrical properties for Temperature Control System (TCS)

Table 69. Electrical properties for unit cooling fans

Property	Value
Input voltage	36 to 60 VDC ¹
Nominal voltage	54 VDC
Nominal running current	< 0.25 A
Maximum peak current	≤ 0.75 A ²

¹Fans are not damaged if the voltage level is from 0 to 36 VDC.

²Duration is no more than three seconds.

Table 70. Electrical properties for cabinet cooling fan

Property	Value
Input voltage	36 to 60 VDC ¹
Nominal voltage	54 VDC
Nominal running current	< 3.0 A
Maximum peak current	≤ 4.5 A ²

¹The fan is not damaged if the voltage level is from 0 to 36 VDC.

²Duration is no more than three seconds.

Table 71. Electrical properties for cabinet heater (HETA)

Property	Value
Input voltage	166 to 276 VAC
Nominal voltage	208 to 230 VAC
Power rating	1500 W \pm 5% (230 VAC)
Noise	50 dB maximum
Protection	IP 54 - One T16A fuse, located after the power filter module, protects against over-current

**Note**

The power for the HETA comes from the AC mains through the ACFU power filter module. An AC/DC converter inside the HETA supplies power for the cold-start control logic and for the fans.

10 Transceiver Baseband (BB2x) unit

10.1 Technical description of Transceiver Baseband (BB2x) unit

10.1.1 Function

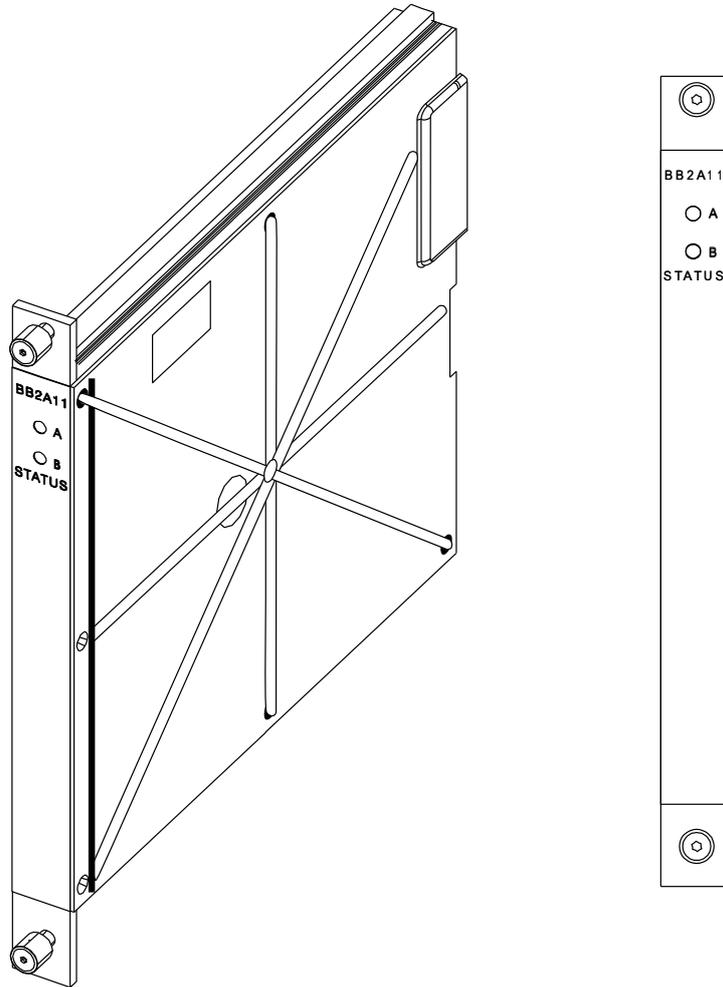
The Transceiver Baseband (BB2x) unit is a digital signal processing board, consisting of two independent baseband modules. Each module functions independently for its own TSxx unit. The BB2x unit also controls frequency hopping.

Externally, all the units are alike except for the model number on the face of each. Internally, the major difference is the additional EDGE capability provided by the BB2E and BB2F units. BB2A units can only be used with GSM (TSxA) transceiver units. The BB2E and BB2F may be used with or can replace the BB2A and supports GSM (TSxA) and GSM/EDGE (TSxB) transceiver units. EDGE operation is only possible when BB2E or BB2F units are used in conjunction with TSxB transceiver units.

The front panel of the BB2x unit is grounded to handle electrostatic discharges.

The BB2x units of the Base Station have the following main functions:

- Process digital speech and data channels signals
- Manage all speech function signalling
- Uses software downloaded from the Base Operations and Interfaces (BOIx) unit
- Sets internal timing according to clock references from the BOIx unit
- Supports synthesised radio frequency (RF) and baseband (BB) frequency hopping



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Figure 41. BB2x unit

10.1.2 Operation

The BB2x units are functionally located between the Abis interface and the BTS RF modules. The BB2x processes uplink and downlink information from/to the TSxx. The uplink is from the mobile station (MS) to the Base Transceiver Station (BTS) with the downlink in the reverse direction.

The BB2x units communicate with the following units:

- Base Operations and Interfaces (BOIx)
- Transceiver (TSxx)
- Transmission (DTRUx)

These units send and/or receive signals through the uplink and downlink paths.

10.1.2.1 Downlink signal processing

BB2x unit

In the downlink path, the BSC sends a signal through the Abis interface to the DTRUx unit, which passes the signal to the BB2x unit. The BB2x unit encodes the signal and reformats it as a GSM/EDGE TDMA burst. The BB2x unit then sends the signal to the TSxx unit.

The TSxx unit modulates and amplifies the signal and sends it to the RF filter units. From those units, the signal goes to the antenna, which passes the signal over the Air interface to the Mobile Station (MS).

10.1.2.2 Uplink Signal Processing

BB2A

In the uplink path, the TSxx unit samples the signal and sends the information, plus High-Level Data Link Coded (HDLC) status and alarm messages, to the BB2A. The BB2x unit then sends the processed signal to the DTRUx unit, which passes the signal through the Abis interface to the Base Station Controller (BSC). The BB2A combines normal (NRX) and diversity (DRX) data on to the NRX line.

BB2E and BB2F

Uplink signal processing includes basic BB2A unit capabilities plus normal (NRX) and diversity (DRX) branch uplink interfaces in EDGE mode. While in EDGE mode, the BB2E and BB2F units use NRX for main RX data and the DRX line for diversity RX data.

10.1.2.3 Downlink signal processing

BB2x unit

In the downlink path, the BSC sends a signal through the Abis interface to the DTRUx unit, which passes the signal to the BB2x unit. The BB2x unit encodes the signal and reformats it as a GSM/EDGE TDMA burst. The BB2x unit then sends the signal to the TSxx unit.

The TSxx unit modulates and amplifies the signal and sends it to the RF filter units. From those units, the signal goes to the antenna, which passes the signal over the Air interface to the Mobile Station (MS).

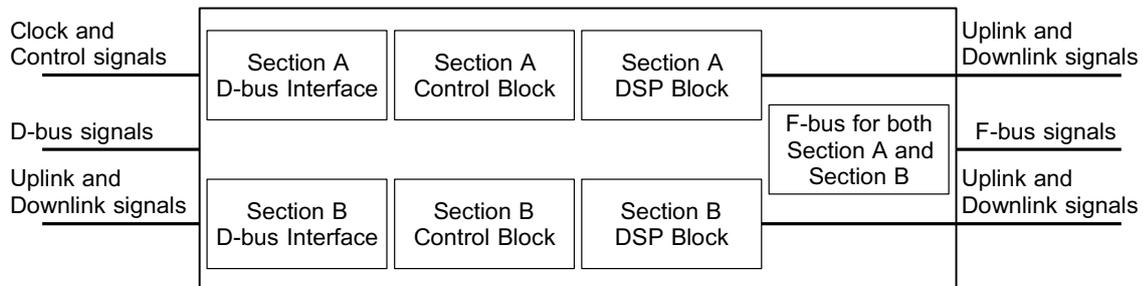
10.1.3 Main blocks

The BB2x units are self-contained and consist of two separate baseband sections. Each section is further divided into five functional blocks.

The BB2x unit has two independent baseband sections. Each section communicates with the TRX module of one TSxx unit. Typically, one BB2x unit processes signals to/from two TSxx units, each with eight receive/transmit logical channels. The channel usage varies according to configuration.

Each BB section consists of the following functional blocks:

- Uplink/Downlink interface
- D-bus interface
- Control block
- Digital Signal Processor (DSP) block
- F-bus interface



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Figure 42. BB2x main blocks

Uplink/downlink interface

The uplink/downlink interface consists of communication pathways between the BTS and MS. Baseband data is converted for transmission and during reception. The interface also handles synthesiser control, clock distribution from the baseband section, alarm functions, and TRX loop control.

BB2x downlink

In the downlink direction (BTS to MS), the BB2x unit sends transmission, initialisation, and synthesiser-control data (to TSxx) through a serial point-to-point line using HDLC protocol.

BB2x uplink

In the uplink direction (MS to BTS), the BB2x unit receives the following data:

- I (In Phase) and Q (Quadrature) components of the normal and diversity branch data samples
- RF alarms and status information through a serial point-to-point line

D-bus interface

The D-bus interface synchronises the signals transmitted and received through the D-bus. The D-bus interface also synchronises data between the D-bus and Unit Controller (UC) processor and between the D-bus and Channel Digital Signal Processor (CHDSP).

The D-bus consists of the following buses:

- D1-bus, which transfers traffic and signalling data among the BB2x, DTRUx, and BOIx units
- D2-bus, which transfers internal O and M communications (including software downloads) among the BOIx, BB2x, and Remote Tune Combiner (RTxx) units

Control block

The Control block handles the following functions:

- clock generation and synchronisation
- DSP interrupt signals
- alarm management

The Control block contains the UC processor, which runs the BTS software.

Digital Signal Processor

Each DSP block has an Equaliser DSP (EQDSP) and a Channel DSP (CHDSP).

Equaliser DSP

The EQDSP handles the following functions:

- sample reception from RF
- bit detection
- channel equalisation
- demodulation

Channel DSP

The CHDSP handles the following functions:

- sample transmission to RF
- channel decoding and encoding
- ciphering and deciphering
- demodulation

F-bus interface

The frequency-hopping bus (F-bus) between the BB2x units is used for baseband hopping (moving TX and RX bursts between the BB2x units).

Frequency-hopping is only allowed between sets of the same hopping group configurations in GMSK mode. For example, TSxA and TSxB units cannot be used in the same hopping group, but can be used in different hopping groups on the same bus.

When a mixture of BB2As and BB2Es are used in the BTS, baseband hopping is only allowed between sets of the same hopping group configurations in GMSK mode. For example, TSxA and TSxB units cannot be used in the same hopping group, but they can be used in different hopping groups on the same bus.

When a mixture of (BB2As and/or BB2Es) and BB2Fs are used in the Base Station Cabinet, baseband hopping can be configured with both TSxAs and TSxBs in the same baseband hopping group when the BB2F drives the TSxB.

10.2 Interfaces of the Transceiver Baseband (BB2x) unit

The Transceiver Baseband (BB2x) unit has connectors for power and interface-signal inputs and outputs.

10.2.1 BB2A interfaces

Table 72. Connectors

Interface	Purpose	Type
X0210 X0220 X0230 X0240	Four connectors stacked to form one 120-pin female connector	30-pin (female)
X0204	One piece connector used in place of four piece stacked connector	120-pin (female)
X1	Power connector	10-pin (female)

10.2.2 BB2E and BB2F interfaces

Table 73. Connectors

Interface	Purpose	Type
X0204	One piece connector used in place of four piece stacked connector	120-pin (female)
X0202	Power connector	10-pin (female)

10.3 Transceiver Baseband (BB2x) unit alternatives

Table 74. Unit alternatives

Unit	Coding scheme
BB2A	GMSK only

Table 74. Unit alternatives (cont.)

Unit	Coding scheme
BB2E	GMSK/EDGE
BB2F	GMSK/EDGE

10.4 Transceiver Baseband (BB2x) unit LEDs

The Transceiver Baseband (BB2x) unit has two tri-colour LEDs (A and B) on the front panel. Each LED indicates the operating condition of one baseband section. The upper LED indicates the status of the first baseband section and the lower LED indicates that of the second.

Table 75. LED indications

LED colour	Steady	Flashing
RED	Fault or alarm	TRX test running
YELLOW	No Abis LAPD link	Configuring
GREEN	Unit is on and operating	Software downloading

10.5 Dimensions and weight of Transceiver Baseband (BB2x) unit

Table 76. Dimensions and weight

Property	Value (metric)	Value (imperial)
Height	280.8 mm	11.1 in.
Width	25 mm	1 in.
Depth	266 mm	10.5 in.
Weight	1.5 kg	3.3 lb
BB2F weight	0.85 kg	1.87 lb

10.6 Power requirements for Transceiver Baseband (BB2x) unit

Table 77. Power requirements

Power requirement	V3P	V5P	Noise
Nominal voltage	+3.4 V	+5.1 V	<100 mVpp
Maximum supply voltage from backplane	+3.47 V	+5.2 V	<100 mVpp
Minimum supply voltage from backplane	+3.16 V	+4.74 V	<100 mVpp
Average current:			
BB2A	2.4 A	2 mA	NA
BB2E	3.5 A	30 mA	NA
BB2F	3.2 A	30 mA	NA
Maximum Current:			
BB2A	3.8 A	0.1 A	NA
BB2E	5 A	0.1 A	NA
BB2F	5 A	0.1 A	NA

11 Transceiver (TSxx) unit

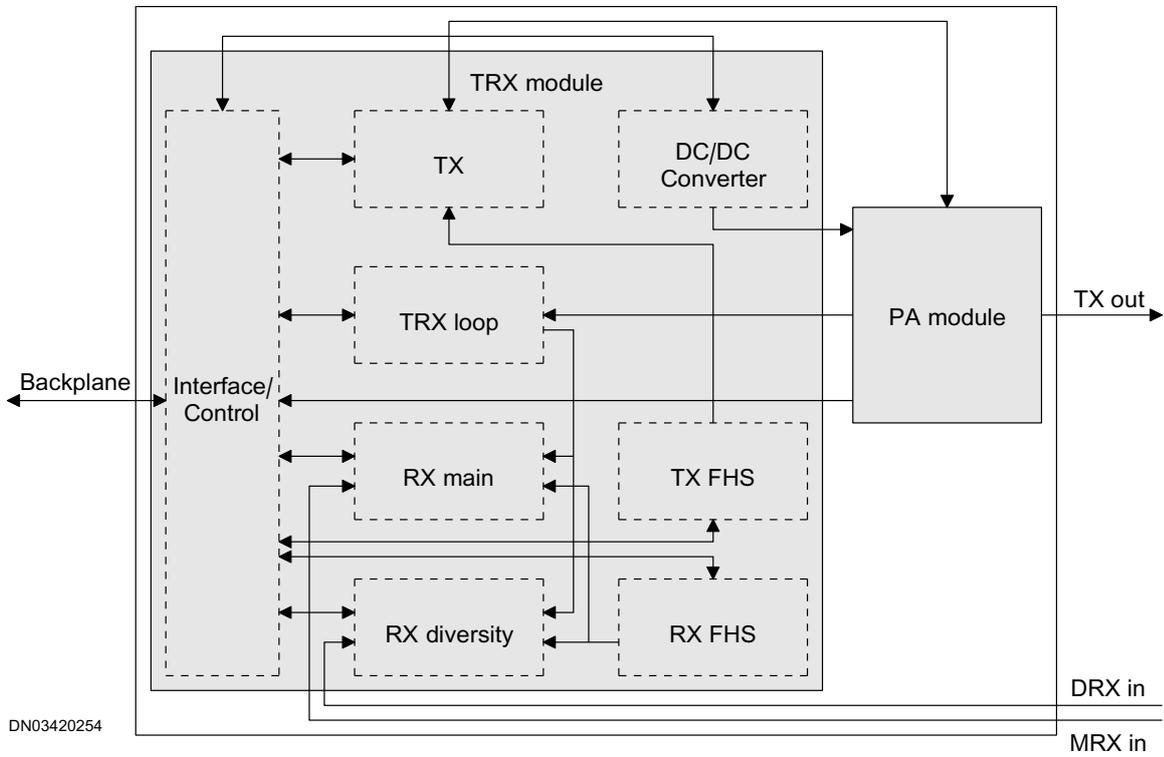
11.1 Technical description of Transceiver (TSxB) unit

The Transceiver (TSxB) unit performs RF modulation/demodulation and amplification for one RF carrier. The TSxB handles uplink signals from the Mobile Station (MS) to the BTS and downlink signals from the BTS to the MS. The TSxB unit provides both GSM and EDGE functionality.

Overvoltage protection

The power supply lines for the TSxB unit are protected with fuses and provide reverse voltage protection on the -48 VDC lines.

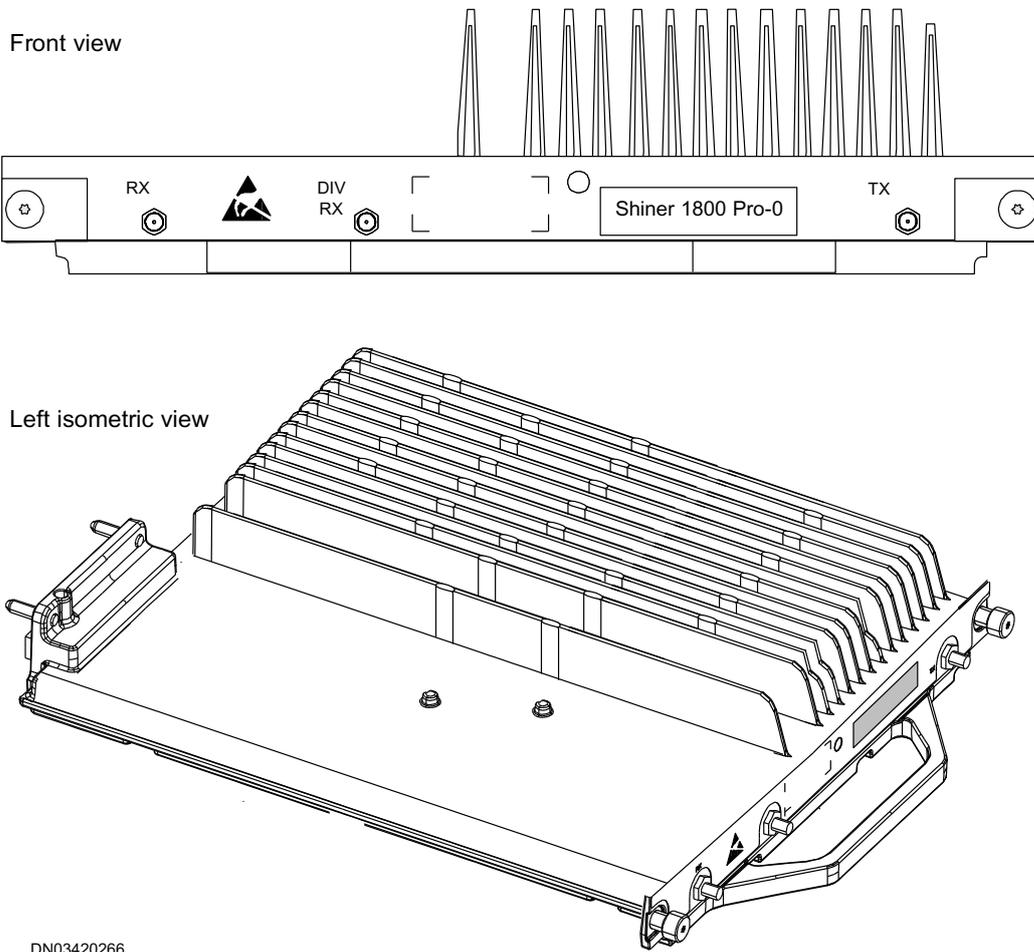
TSxA and TSxB modules



DN03420254

Figure 43. TSxB main modules

For frequency bands available in TSxB, see *Transceiver Baseband (BB2x) unit alternatives*.



DN03420266

Figure 44. TSxB units

11.1.1 TRX module

The TRX module provides the main RF functions for EDGE BTS. The TRX module has the following functional sections:

- Interface/Control
- Transmitter (TX)
- Main Receiver (MRx)
- Diversity Receiver (DRx)

- RX and TX Frequency Hopping Synthesizer (FHS)
- DC/DC Converter
- TRX loop

These functional sections communicate with the Transceiver Baseband (BB2x) and Base Operations and Interfaces (BOIx) units through the backplane. The functional sections process the following signals:

- data signals between the TSxB and BB2x units
- initialisation and control signals from the BB2x unit to the TSxB unit
- status and alarm signals from the TSxB unit to the BB2x unit

The TRX module includes two Application Specific Integrated Circuits (ASICs). The ASICs interface to the BB2x through the backplane and provide control and reference signals to, and alarms from, the analogue functions. One of the ASICs incorporates Direct Digital Synthesis (DDS), generating a GMSK/8-PSK signal for the transmitter.

Interface/Control section

The Interface/Control section converts the baseband (BB) data stream to GMSK/8-PSK modulation for the Transmitter section. It also converts the analogue RX signal from the main and diversity branches to the baseband data stream. The Interface/Control section controls all synthesizers and the TRX loop. It also handles clock distribution from the BB2x unit as well as alarm functions.

Transmitter (TX)

The intermediate frequency (IF) sections in the transmitter provide amplification and filtering prior to the signal being raised to the RF carrier frequency. Thereafter, the RF section amplifies the signal to the desired output signal amplitude. Filters are used to achieve spectral purity. The RF output signal is sampled and detected for output power control.

The TSxB unit supports 16 power levels for GMSK and 10 power levels for 8-PSK. The power steps are 2 dB, with a maximum range of 30 dB. Power levels from 0 to 7 are static.

Receiver (MRx/DRx)

The RF section of the receiver converts the carrier frequency signal to the IF frequency.

The IF sections of the receiver perform channel filtering to prevent interfering frequencies from distorting the signal. The IF sections also provide automatic gain control.

TRX loop

The TRX loop supports self-testing of the TSxB unit. The tests are carried out by converting the frequency of the TX signal to the RX band. The signal is coupled from the TX output, and a low-level signal is routed back through the RX path. The signal is routed to main and diverse Rx branches.

Frequency Hopping Synthesizer

The Frequency Hopping Synthesizer (FHS) module consists of separate synthesizer blocks; the RX block and the TX block.

- The RX block serves as the first local oscillator in the receiver.
- The TX block serves as the second local oscillator in the transmitter.

Both the RX and the TX blocks have two Phased-Locked Loop (PLL) circuits. Each circuit includes a PLL, an amplification chain, and a switching network. The output buffer is common for both circuits. Each circuit has appropriate voltage supply regulation. Both blocks work according to the Ping-Pong principle; the output frequency is taken alternately from the two PLLs.

Frequency-hopping is only allowed between sets of the same hopping group configurations in GMSK mode. Frequency-hopping in EDGE mode is only allowed between matching BB2E/TSxB equipped hopping groups.

DC/DC Converter

The DC/DC converter consists of a discrete, regulated power supply, input and output filters, and connectors. This component converts the -48 VDC supply voltage to 28 VDC, as required by the PA module and driver.

11.1.2 Power Amplifier module

The Power Amplifier (PA) module amplifies the GMSK/8-PSK modulated signal from the TRX module to the appropriate level and provides a detected sample of the RF output for the Power Control function on the TRX module.

11.2 Interfaces of the Transceiver (TSxB) unit

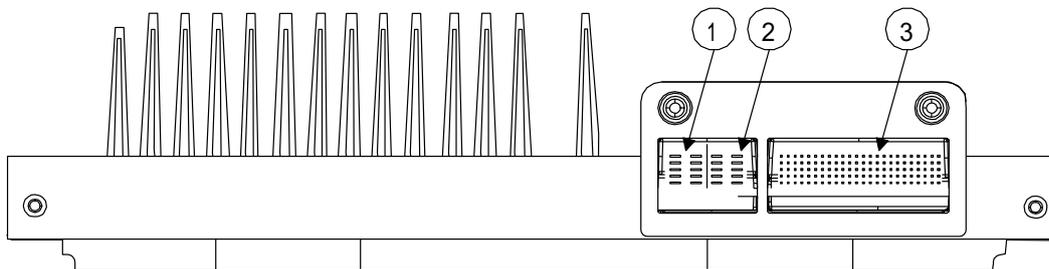
11.2.1 Front interfaces

Table 78. Connectors

Connector	Description	Type
RX	Receiver, main branch	SMA
DIV RX	Receiver, diversity branch	SMA
TX	Transmitter	SMA

11.2.2 Back interfaces

The Transceiver (TSxB) unit has three connectors on the back of the TRX unit: X6, X7, and X100.



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1	X7
2	X6
3	X100

Figure 45. TSxB back connectors

11.2.2.1 X6 connector

Table 79. X6 interface signals

Signal	Description	Pin count	Level	I/O
V48RTN	Power supply return	18	N/A	N/A
FANST	Fan status +	3	PWM	I
Not connected		9	N/A	N/A

Table 80. X6 pin configurations

Pin	Signal	Pin	Signal	Pin	Signal
A1	V48RTN	A3	V48RTN	A5	Not connected
B1	V48RTN	B3	V48RTN	B5	Not connected
C1	V48RTN	C3	V48RTN	C5	Not connected
D1	V48RTN	D3	V48RTN	D5	V48RTN
E1	V48RTN	E3	V48RTN	E5	FANST
A2	V48RTN	A4	Not connected	A6	Not connected
B2	V48RTN	B4	Not connected	B6	Not connected
C2	V48RTN	C4	Not connected	C6	Not connected
D2	V48RTN	D4	V48RTN	D6	V48RTN
E2	V48RTN	E4	FANST	E6	FANST

11.2.2.2 X7 connector

Table 81. X7 interface signals

Signal	Description	Pin count	Level	I/O
V48N	-48 VDC supply	18	N/A	N/A
FANCTRL	Fan control +	3	PWM	O
Not connected		9	N/A	N/A

Table 82. X7 pin configuration

Pin	Signal	Pin	Signal	Pin	Signal
A1	V48N	A3	V48N	A5	V48N
B1	Not connected	B3	Not connected	B5	V48N
C1	Not connected	C3	Not connected	C5	V48N
D1	Not connected	D3	Not connected	D5	V48N
E1	FANCTRL	E3	FANCTRL	E5	V48N
A2	V48N	A4	V48N	A6	V48N
B2	Not connected	B4	V48N	B6	V48N
C2	Not connected	C4	V48N	C6	V48N
D2	Not connected	D4	V48N	D6	V48N
E2	FANCTRL	E4	V48N	E6	V48N

11.2.2.3 X100 connector

The TSxB unit uses four side by side connectors in place of the single X100 connector. The stacked connector pins carry identical signals. The four connectors and their pin designations are described in the following table.

Table 83. X100 four-connector pin definition

Connector pins	TSxB
A1-E6	X97
A7-E12	X98
A13-E18	X99
A19-E24	X100

Table 84. X100 interface signals

Signal	Description	Pin count	Level	I/O
DLP, DLN	Downlink bus, differential	2	LVDS	I
CK6M5P, CK6M5N	6.5 MHz clock signal, differential	2	RS-485	I
TSCLKP, TSCLKN	Time slot clock, differential	2	RS-485	I
V3P	3.3 V supply voltage, digital	2		I
GND	Ground	73		
TI2CD	I ² C serial data – internal to TSxB, BTxx	1	TTL	I/O
TI2CC	I ² C serial clock – internal to TSxB, BTxx	1	TTL	I
RFUI2CD	I ² C serial data to DVxx	1	TTL	I/O
RFUI2CC	I ² C serial clock to DVxx	1	TTL	I
EXT_IN2	External input 2, 6.8 k Ω pull up to 3.3 V	1	LVTTTL	I
CLK_DIS	Disable clock signals of boundary-scan components, active low	1	LVTTTL	I
RF_RESET	Hardware reset of TSxB, active low (not used)	1	LVTTTL	I
RF_TMS	Mode select, boundary scan	1	LVTTTL	I
RF_TCK	Clock, boundary scan	1	LVTTTL	I
RF_TDI	Data in, boundary scan	1	LVTTTL	I
RF_TDO	Data out, boundary scan	1	LVTTTL	O

Table 84. X100 interface signals (cont.)

Signal	Description	Pin count	Level	I/O
RF_TRST	Boundary-scan reset, active low	1	LVTTTL	I
ADCSYNC_OUT	ADC_SYNC to output	1	TTL	O
V5P	+5 V DC power, digital	3		I
V9P	+9 V DC power, analogue	4		I
V9N	-9 V DC power, analogue	2		I
BI2CC (not connected)	I ² C serial clock	1		N/A
BI2CD (not connected)	I ² C serial data	1		N/A
BOOSTER_REF (not connected)	ADC Sync	1		N/A
UL_NRXP, UL_NRXN	Main and diversity RX branch data, alarms, status, and control from TSx B to BB2x through BOIx, differential	2	LVDS	O
DRXP, DRXN	Diversity RX data, (EDGE support), differential	2	LVDS	O
PSEN	µcontroller Program Store Enable output	1	TTL	O
_EA	µcontroller External Access input	1	TTL	I
RXD	µcontroller Serial Input port	1	TTL	I
TXD	µcontroller Serial Output port	1	TTL	O

Table 84. X100 interface signals (cont.)

Signal	Description	Pin count	Level	I/O
ALE	µcontroller Address Latch Enable	1	TTL	O
_EW	µcontroller Enable Watchdog Timer	1	TTL	I
PSEN_PROG	µcontroller In-circuit Programming signal	1	TTL	I



Note

The Level specifications are used to determine the standard by which each interface signal is transmitted. The following abbreviations are derived from telecom standards:

- LVDS – Low Voltage Differential Signalling.
- RS-485 – Recommended Standard for a balanced interface.
- TTL – Transistor Transistor Logic.
- LVTTL – Low Voltage Transistor Transistor Logic.

Table 85. X100 pin configuration for A1-A24

Pin	Signal
A1	GND
A2	ADCSYNC_IN (not used)
A3	T12CD
A4	T12CC
A5	B12CC (not used)
A6	B12CD (not connected)
A7	RFUI2CC

Table 85. X100 pin configuration for A1-A24 (cont.)

Pin	Signal
A8	RFUI2CD
A9	TXD
A10	ALE
A11	GND
A12	GND
A13	GND
A14	GND
A15	GND
A16	GND
A17	TSCLKP
A18	GND
A19	TSCLKN
A20	GND
A21	PSEN
A22	_EA
A23	GND
A24	GND

Table 86. X100 pin configuration for B1-B24

B1	V5P
B2	GND
B3	V9P
B4	GND
B5	DRXP (EDGE support)
B6	GND
B7	DRXN
B8	GND
B9	_EW
B10	RXD
B11	GND
B12	GND

Table 86. X100 pin configuration for B1-B24 (cont.)

B13	GND
B14	ADCSYNC_OUT
B15	GND
B16	GND
B17	GND
B18	GND
B19	GND
B20	GND
B21	GND
B22	GND
B23	GND
B24	GND

Table 87. X100 pin configuration for C1-C24

C1	PSEN_POG (not used)
C2	GND
C3	GND
C4	GND
C5	GND
C6	GND
C7	V9P
C8	GND
C9	GND
C10	RF_REST
C11	RF_TDI
C12	GND
C13	GND
C14	GND
C15	GND
C16	GND
C17	DLN
C18	GND

Table 87. X100 pin configuration for C1-C24 (cont.)

C19	UL_NRXN
C20	GND
C21	GND
C22	GND
C23	GND
C24	GND

Table 88. X100 pin configuration for D1-D24

D1	V9N
D2	GND
D3	V3P
D4	GND
D5	V5P
D6	GND
D7	V9P
D8	GND
D9	GND
D10	RF_TRST
D11	RF_TCK
D12	GND
D13	GND
D14	V3P
D15	GND
D16	EXT_IN2
D17	GND
D18	CLK_DIS
D19	GND
D20	GND
D21	CK6M5N
D22	GND
D23	CK6M5P
D24	GND

Table 89. X100 pin configuration for E1-E24

E1	V9N
E2	GND
E3	V3P
E4	GND
E5	V5P
E6	GND
E7	V9P
E8	GND
E9	GND
E10	RF_TDO
E11	RF_TMS
E12	GND
E13	GND
E14	GND
E15	GND
E16	GND
E17	DLP
E18	GND
E19	UL_NRXP
E20	GND
E21	GND
E22	GND
E23	GND
E24	GND

11.3 Transceiver (TSxx) unit alternatives



Note

GSM 1900 TRX (TSPA) has been removed from the product portfolio. Take this into consideration when carrying out maintenance activities, and replacing units.

Table 90. Frequency band alternatives in the TSxx unit

Frequency band	TSxA	TSxB
GSM 900	TSGA	N/A
GSM 1800	TSDA	N/A
GSM/EDGE 800	N/A	TSTB
GSM/EDGE 900	N/A	TSGB
GSM/EDGE 1800	N/A	TSDB
GSM/EDGE 1900	N/A	TSPB

11.4 Transceiver (TSxB) unit LEDs

The Transceiver (TSxB) unit has one tri-colour LED on the front panel that indicates its operating conditions.

Table 91. LED indications

LED colour	Steady	Flashing
Red	Fault or alarm	TRX test
Yellow	Unit is on; transmitter off (no calls at any time slot)	N/A
Green	Unit is on and transmitting (call and/or BCCH)	N/A

11.5 Dimensions and weight for Transceiver (TSxx) unit

Table 92. Nominal dimensions and weight

Property	Value (metric)	Value (imperial)
Height	80 mm	3.2 in.
Width	300 mm	11.9 in.
Depth	400 mm	15.9 in.
Weight	6.2 kg	13.6 lb

11.6 Electrical properties for Transceiver (TSxx) unit

Table 93. Input voltage supply requirements

Voltage	-48 V	+9 V	+5 V	+3.3 V	-9 V
Tolerance	± 12 V	± 3%	± 3%	± 3%	± 3%
Maximum ripple < 150 kHz	In accordance with ETS 300-132-2 and ETS 300-342-2.	30 mVpp	30 mVpp	30 mVpp	30 mVpp
Maximum ripple > 150 kHz	In accordance with ETS 300-132-2 and ETS 300-342-2.	100 mVpp	100 mVpp	100 mVpp	100 mVpp

Table 94. Current consumption

Voltage	-48 V	+9 V	+5 V	_3.3 V	-9 V
TSDA	4.5 to 7.6 A	2100 mA	710 mA	670 mA	260 mA
TSGA	2.2 to 3.7 A	1510 mA	630 mA	650 mA	295 mA
TSxB	4.4 to 7.4 A (265W)	2100 mA	710 mA	710 mA	420 mA

The DC/DC power supply module converts the -48 VDC input voltage to the output voltage required by the PA module.

Table 95. Output voltage requirements

Requirement	Value
Output voltage	26.2 VDC
Output maximum current	8.7 A
Efficiency at maximum current	> 85%
Tolerance	± 1.5%
Maximum ripple at < 150 kHz	20 mVpp
Maximum ripple at > 150 kHz	80 mVpp

11.7 RF properties for Transceiver (TSxx) unit

Table 96. TX output power

Property	GMSK (TSxx)		8PSK (TSxB)	
	Nominal output power (maximum power level)	TSTx (800)	47 dBm	TSTx (800)
	TSGx (900)	47 dBm	TSGx (900)	45 dBm
	TSDx (1800)	47 dBm	TSDx (1800)	45 dBm
	TSPx (1900)	47 dBm	TSPx (1900)	45 dBm
Output power variation (maximum power level)	± 0.5 dB (normal conditions)			
Output power variation (power levels 1 through 15)	± 3.0 dB (normal conditions)			

Table 97. RX sensitivity

Version	GMSK (TSxx)	8PSK (TSxB)
TSTx (800)	< -99.0 dBm	< -94.3 dBm
TSGx (900)	< -99.0 dBm	< -94.3 dBm
TSDx (1800)	< -97.8 dBm	< -92.6 dBm
TSPx (1900)	< -97.8 dBm	< -92.6 dBm

12 Wideband Combiner (WCxA) unit

12.1 Technical description of Wideband Combiner (WCxA) unit

12.1.1 Function

The Wideband Combiner (WCxA) unit(s) can combine transmit (TX) signals from two or four Transceiver (TSxx) units; then feeds the combined signal to the antenna through the TX port of the Dual Variable Gain Duplex Filter (DVxx) unit.

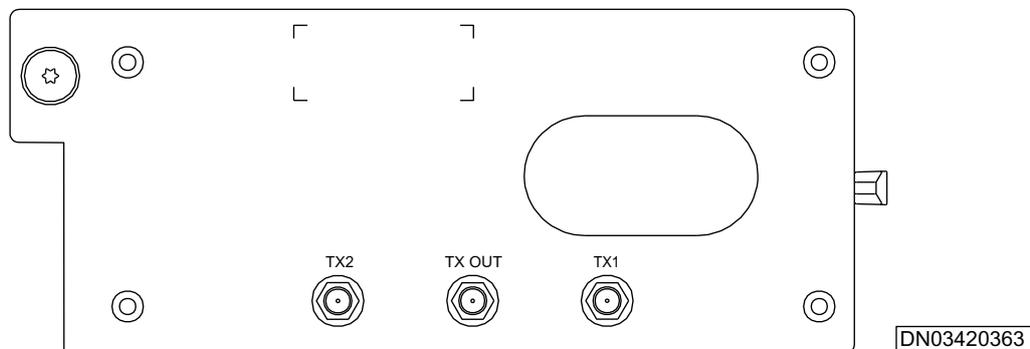


Figure 46. WCxA front panel

12.1.2 Operation

The BTS supports two Wideband Combining options:

- 2-way Wideband Combining
- 4-way Wideband Combining

With 2-way Wideband Combining, the WCxA unit combines the transmit (TX) signals from two Transceiver (TSxx) units and feeds the combined signal to the antenna through the TX port of the Dual Variable Gain Duplex Filter (DVxx) unit.

With 4-way Wideband Combining, the TX signals from four TSxx units are combined using three WCxA units in the following manner. The first WCxA unit combines the TX signals from two of the four TSxx units. The second WCxA unit combines the TX signals from the other two TSxx units. The third WCxA unit combines the two combined signals; then feeds the combined signal to the antenna through the TX port of the DVxx unit.

The normal range for operational temperatures is -10° C to 65° C (14° F to 149° F). However, the WCxA unit can operate in temperatures as low as -33° C (-27.4° F) with degraded RF performance.

12.1.3 Main blocks

The WCxA unit contains the following components:

- one 2-way combiner
- two isolators
- one 50 Ω termination
- one heatsink for thermal dissipation

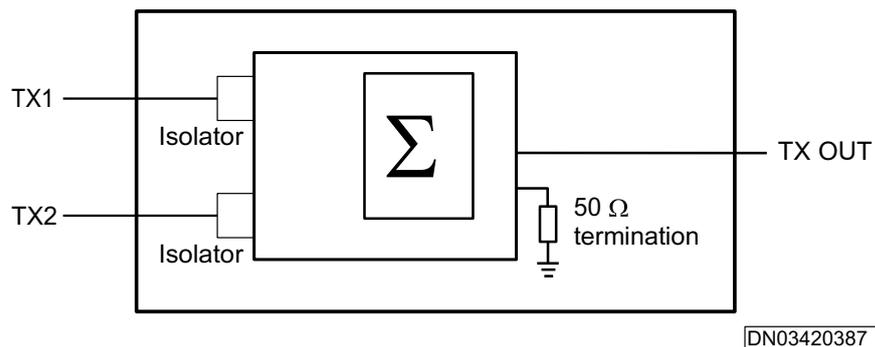


Figure 47. WCxA main blocks

The heatsink fins on the WCxA unit extend past the DVxx unit where most of the cooling occurs. Two unit cooling fans create an upward airflow through the fins at a velocity of approximately 1.1 m/s.

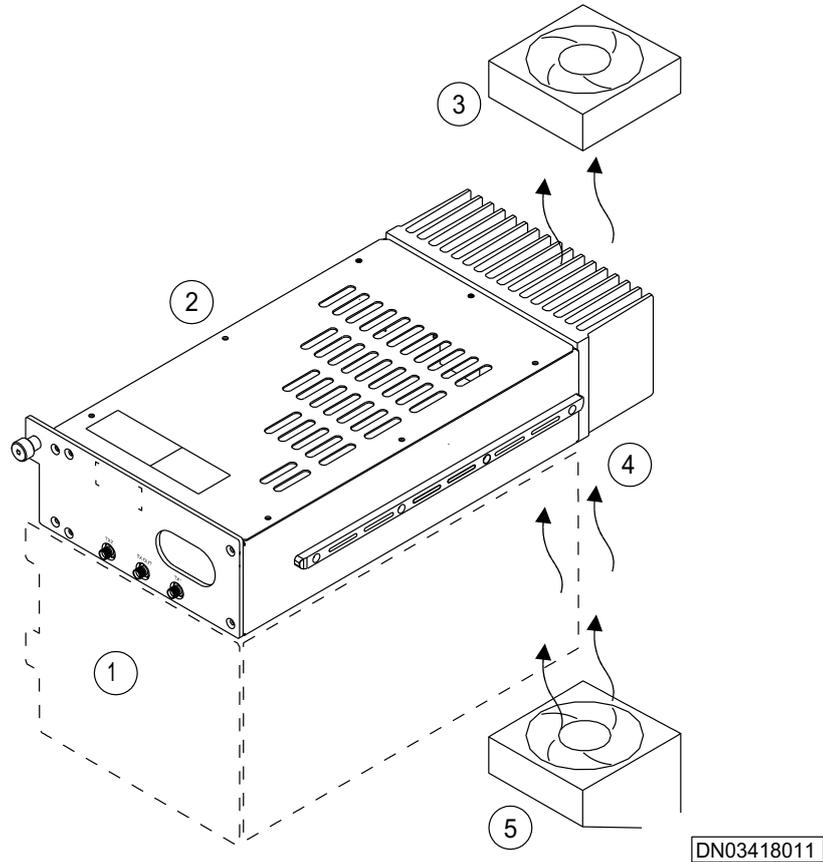


Figure 48. Airflow through WCxA heatsink fins

1	Duplexer unit
2	Wideband Combiner
3	Top RF filter unit cooling fan
4	Airflow
5	Bottom RF filter unit cooling fan

12.2 Interfaces of the Wideband Combiner (WCxA) unit

Table 98. Connectors

Interface	Purpose	Connector type
TX1	Receives input signal from TX connector on TSxx unit	SMA (female)
TX2	Receives input signal from TX connector on TSxx unit	SMA (female)
TX OUT	TX output	SMA (female)

12.3 Wideband Combiner (WCxA) unit alternatives

Table 99. Unit alternatives

Unit	Frequency band
WCGA	GSM/EDGE 800, 900
WCDA	GSM/EDGE 1800
WCPA	GSM/EDGE 1900

12.4 Dimensions and weight of Wideband Combiner (WCxA) unit

Table 100. Maximum dimensions and weight

Property	Value (metric)	Value (imperial)
Height	75 mm	3.0 in.
Width	188 mm	7.4 in.
Depth	295 mm	11.6 in.
Weight	3.5 kg	7.7 lb

12.5 RF properties for Wideband Combiner (WCxA) unit

Table 101. Operating frequency range

Version	Frequency range
WCGA (GSM/EDGE 800/900)	869 to 960 MHz
WCDA (GSM/EDGE 1800)	1805 to 1880 MHz
WCPA (GSM/EDGE 1900)	1930 to 1990 MHz

Table 102. Maximum insertion loss

Property	Insertion loss	Return loss (input/output)
TX 1 to TX OUT	-3.5 dB maximum	-20 dB maximum
TX 2 to TX OUT	-3.5 dB maximum	-20 dB maximum

Table 103. Maximum RF input power

Property	Value
rms	48 dBm (63 W)
Peak (20 μ sec peak, 550 μ sec between peaks)	52 dBm (158.5 W)
Peak voltage	90 V

Impedance

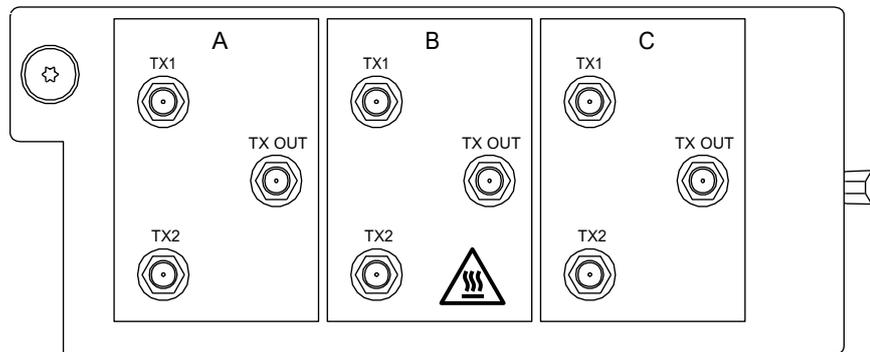
The nominal input and output impedance of the WCxA unit is 50 Ω .

13 Triple Wideband Combiner (WCxT) unit

13.1 Technical description of Triple Wideband Combiner (WCxT) unit

13.1.1 Function

The WCxT unit has three independent combiner blocks (A, B, or C) that can combine signals from two or four Transceiver (TSxx) units. The combined signal is then fed to the antenna through the TX port of the Dual Variable Gain Duplex Filter (DVxx) unit.



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Figure 49. WCxT front panel



Warning

The unit can be hot in faulty conditions.

13.1.2 Operation

The BTS supports two Wideband Combining options:

- 2-way Wideband Combining
- 4-way Wideband Combining

With 2-way Wideband Combining, the WCxT unit uses one block (A, B, or C) to combine the transmit (TX) signals from two Transceiver (TSxx) units and feeds the combined signal to the antenna through the TX port of the Dual Variable Gain Duplex Filter (DVxx) unit.

With 4-way Wideband Combining, the WCxT unit uses all three blocks (A, B, and C) to combine the TX signals from four TSxx units in the following manner. The first block combines the TX signals from two of the four TSxx units. The second block combines the TX signals from the other two TSxx units. The third block combines the two combined signals and feeds the combined signal to the antenna through the TX port of the DVxx unit.

The normal range for operational temperatures is -10° C to 65° C (14° F to 149° F). However, the WCxT unit can operate in temperatures as low as -33° C (-27.4° F) with degraded RF performance.

13.1.3 Main blocks

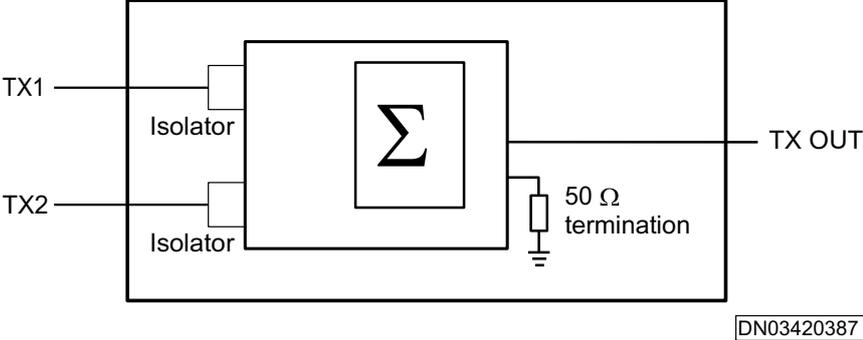
Each combiner block of the WCxT unit contains the following components:

- one 2-way combiner
- two isolators
- one 50 Ω termination



Note

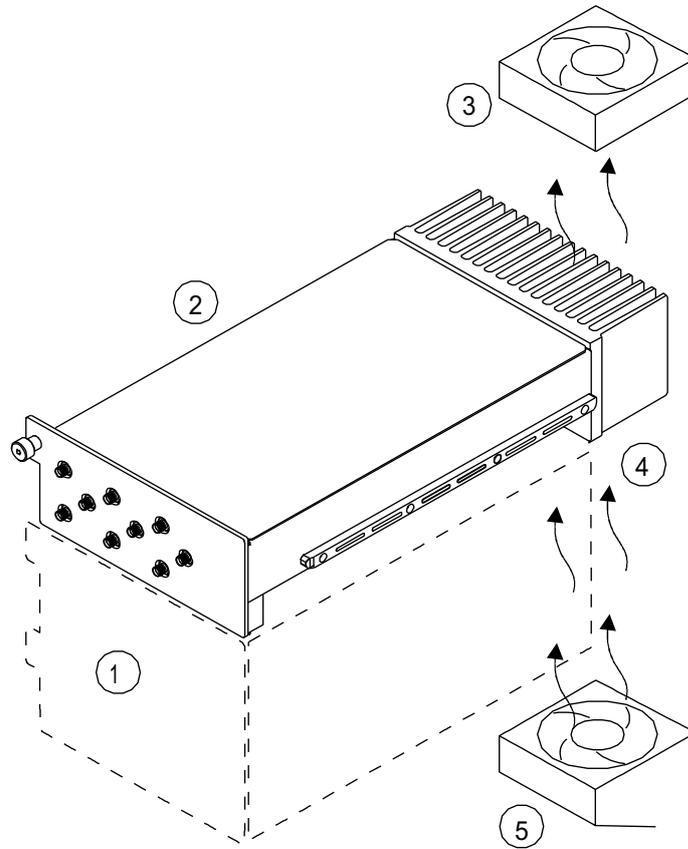
All three blocks use one heat sink for thermal dissipation.



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Figure 50. WCxT block (A, B, or C)

The heatsink fins on the WCxT unit extend past the DVxx unit where most of the cooling occurs. Two unit cooling fans create an upward airflow through the fins at a velocity of approximately 1.1 m/s.



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Figure 51. Airflow through WCxT heatsink fins

1	Duplexer unit
2	Wideband Combiner
3	Top RF filter unit cooling fan
4	Airflow
5	Bottom RF filter unit cooling fan

13.2 Interfaces of the Triple Wideband Combiner (WCxT) unit

Table 104. Connectors (Blocks A, B, and C)

Interface	Purpose	Connector type
TX1	Receives input signal from TX connector on TSxx unit	SMA (female)
TX2	Receives input signal from TX connector on TSxx unit	SMA (female)
TX OUT	TX output	SMA (female)

13.3 Triple Wideband Combiner (WCxT) unit alternatives

Table 105. Unit alternatives

Unit	Frequency band
WCGT	GSM/EDGE 800/900
WCDT	GSM/EDGE 1800
WCPT	GSM/EDGE 1900

13.4 Dimensions and weight of Triple Wideband Combiner (WCxT) unit

Table 106. Maximum dimensions and weight

Property	Value (metric)	Value (imperial)
Height	77 mm	3.0 in.
Width	188 mm	7.4 in.
Depth	393 mm	15.5 in.
Weight	3.5 kg	7.7 lb

13.5 RF properties for Triple Wideband Combiner (WCxT) unit

Table 107. Operating frequency range

Version	Frequency range
WCGT (GSM/EDGE 800/900)	869 to 960 MHz
WCDT (GSM/EDGE 1800)	1805 to 1880 MHz
WCPT (GSM/EDGE 1900)	1930 to 1990 MHz

Table 108. Maximum insertion loss

Property	Insertion loss	Return loss (input/output)
TX 1 to TX OUT	-3.5 dB maximum	-20 dB maximum
TX 2 to TX OUT	-3.5 dB maximum	-20 dB maximum

Table 109. Maximum RF input power

Property	Value
rms	48 dBm (63 W)
Peak (20 µsec peak, 550 µsec between peaks)	52 dBm (158.5 W)
Peak voltage	90 V

Impedance

The nominal input and output impedance of the WCxT unit is 50 Ω.

14 Transmission (VXxx) unit

14.1 Technical description of transmission interfaces

The transmission interfaces of the transmission node are implemented using FXC transmission units. Nokia MetroHub can host up to five FXC transmission units and Nokia UltraSite EDGE can host up to four FXC transmission units, and it is possible to cross-connect between any of these units regardless of the physical interface type. A scalable number of transmission interfaces allow the operator to expand the capacity of the network as needed.

The transmission units are connected to each other via the backplane using the non-blocking cross-connection bus with 8 kbit/s granularity. The available interface variants for the PDH transmission units are Flexbus, E1 and T1. The FXC STM-1 transmission unit has two long-haul optical STM-1 interfaces. In addition, the FXC Bridge unit has a test interface. The units do not have separate Q1 management interfaces. Instead, they are managed locally via the local management port (LMP) of the Nokia BTS or Nokia MetroHub, or remotely via the Nokia Q1 bus.

14.2 Technical description of transmission interface measurements

All FXC E1/T1 interfaces (platform interfaces if FXC RRI is used) have statistical error counters (ITU-T G.826) that count errors from incoming signals. For FXC STM-1 and FXC Bridge the performance data is collected according to ITU-T G.828. The statistical error counters start at start up and continue until the counters are reset. Flexbus interfaces have bit error ratio measurement from incoming Flexbus signals. This bit error ratio is equivalent to the bit error ratio in 2M signals passing through the Flexbus. Nokia FlexiHopper (Plus) radios have bit error ratio measurement for the air interface before the error correcting algorithm.

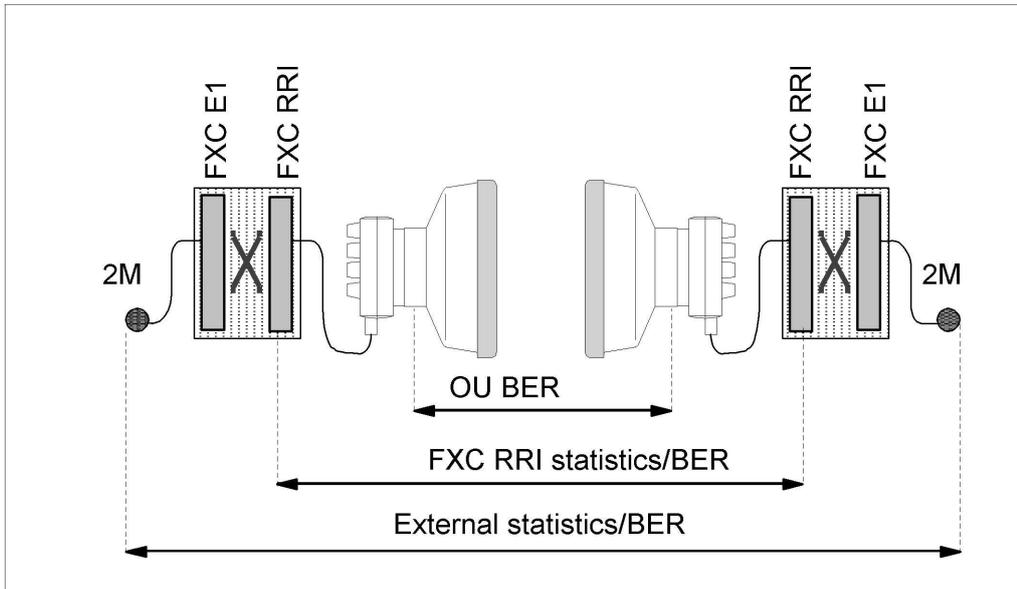


Figure 52. BER and statistics measurement points at unit level

14.3 Transmission (VXxx) unit alternatives

Table 110. Alternatives

Unit	Interface	Usage
FXC RRI	Two Flexbus interfaces	Radio-link to FlexiHopper Microwave Radio or Metro Hopper Radio
FXC STM-1/FXC Bridge	Two STM-1 interfaces	STM-1 optical fibre
FXC E1	Four Abis line interfaces	Wireline for E1 use
FXC E1/T1	Four Abis line interfaces	Wireline for E1 or T1 use
FC E1/T1	One Abis line interface	Wireline for E1 or T1 (co-siting with Talk-family)

14.4 BTS transmission capacity signal types

Table 111. Signal types

Signal Type	Description
EDAP	<p>Edge Dynamic Abis Pool (EDAP) buses can be used to optimise the creation of cross-connections in a loop network by automatically allocating D-buses and creating the required cross-connections.</p> <p>Traffic Manager's EDAP support includes:</p> <ul style="list-style-type: none"> • adding new EDAPs • adding a TRX to or removing a TRX from an existing EDAP • modifying the size of the existing EDAPs • removing EDAPs
OMUSIG	<p>The BTS can have one OMUSIG which allocates 2, 4 or 8 bits in one time slot, depending on the link speed used (16, 32 or 64 kbit/s).</p>
TCH	<p>The BTS must be allocated at least as many TCHs as there are TRXs installed in it (1 to 12). Each TCH allocates 2 contiguous time slots (16 bits) for a single TRX. Each time slot is marked with the TRX number. The TCHs are numbered from 1 to 12 in the order in which they are defined.</p>
TRXSIG	<p>The BTS must be allocated at least as many TRXSIGs as there are TRXs installed in it (1 - 12). Each TRXSIG can allocate 2, 4 or 8 bits in one time slot depending on the link speed used (16, 32 or 64 kbit/s). The TRXSIGs are numbered from 1 to 12 in order of which they are entered.</p>
TRXSIG on TCHs	<p>The TRXSIG can be reserved on a traffic channel (TCH) but then up to 4 radio time slots (8 bits) are lost. The signal type must always start from the first bit of the channel.</p>

14.5 Transmission unit LEDs

Indicator	Static	Slow flashing	Fast flashing
GREEN	Power is on and the operation is error free.	Upon master's command ¹ ; no alarms active.	Software is downloading to the unit.
YELLOW	A major or minor alarm is active.	Upon master's command; major or minor alarm(s) active.	Software is downloading to the unit.
RED	A critical alarm is active.	Upon master's command; critical alarms active.	Software is downloading to the unit.

¹When the Q1 master unit sends the functional entity indication command.

15 FC E1/T1

15.1 Technical description of FC E1/T1 transmission unit

Features

The main features of the FC E1/T1 transmission unit are:

- one Abis line interface to the 2 Mbit/s (E1) or 1.5 Mbit/s (T1) transmission line
- operation as the termination point in a chain or star configuration
- balanced interface that can be configured to E1 or T1 mode
- interface statistics gathered in compliance with ITU-T G.826 and ANSI T1.403 Recommendations
- handling of timeslot 0 at 2 Mbit/s interfaces. The 2 Mbit/s E1 frame/multiframe structure complies with ITU-T G.704/706 Recommendations
- transmitting and receiving functions at the 2 Mbit/s interfaces (HDB3 line coding, clock recovery, AIS detection etc.) and at the 1.5 Mbit/s interfaces (B8ZS line coding, clock recovery, AIS detection etc.)
- easy management of settings and transmission configurations both remotely and locally, using the Nokia Q1 management protocol. The management is carried out using a Nokia NMS-compatible node manager software.
- multiple Q1 management connections can be simultaneously active



Note

To meet the BTS Air interface accuracy requirement ± 0.05 ppm (set by ETSI), the Abis interface must meet the long-term accuracy of ± 0.015 ppm. This kind of accuracy is attained if the network master clock (PRC) fulfills the ITU-T recommendation G.811 and the synchronisation of the network is correct. The maximum jitter/wander of the Abis interface is specified in the ITU-T recommendation G.823.

MAIN blocks

FC E1/T1 units are encased plug-in units constructed on a printed circuit board. The unit connects to other units in the base station cabinet via its backplane connectors, so it does not require any additional cabling except the line interface cables.

The state of the incoming line signal is monitored in the transmission unit. If the line signal switches into an error state, the unit indicates the fault.

15.2 Interfaces of FC E1/T1 Transmission (VXxx) units

Table 112. E1 equipment interface of FC E1/T1 transmission unit

Property	Value
Bit rate	2048 kbit/s ± 50 ppm ⁴
Line code	HDB3
Transmitter characteristics	75 Ω
Receiver parameters:	
Attenuation at 1 MHz	< 20 dB
Impedance	75 Ω
Jitter and wander	ITU-T G.823

⁴This is the equipment requirement. The BSS system requirement for Nokia BTS is ± 0.015 ppm which is needed in order to fulfil the ETSI requirement for the Air interface. (The signal used for synchronisation of the transmission part is used as a BTS clock reference source.)

Table 113. T1 equipment interface of FC E1/T1 transmission unit

Property	Value
Bit rate	1544 kbit/s \pm 32 ppm ⁵
Line code	AMI or B8ZS
Transmitter characteristics	ANSI T1.403 (DS-1) or ANSI T1.102 (DSX-1)
Receiver parameters:	
Attenuation at 772 kHz	< 26 dB
Impedance	100 Ω
Jitter and wander	ITU-T G.824

⁵This is the equipment requirement. The BSS system requirement for Nokia BTS is \pm 0.015 ppm which is needed in order to fulfil the ETSI requirement for the Air interface. (The signal used for synchronisation of the transmission part is used as a BTS clock reference source.)

15.3 Dimensions and weight of FC E1/T1 Transmission (VXxx) units

Table 114. Dimensions and weight of FC E1/T1 transmission unit

Property	Value (metric)	Value (imperial)
Height	254 mm	10 in.
Width	30 mm	1.18 in.
Depth	220 mm	8.7 in.
Weight	1.35 kg	3 lb.

15.4 International standards; FC E1/T1 transmission (VXxx) units

Table 115. International standards for FC E1/T1 transmission unit

Standard	Note
2048 kbit/s E1 interface:	
ITU-T G.703 (1991)	Physical/electrical characteristics of hierarchical digital interfaces
ITU-T G.704 (10/94)	Synchronous frame structures used at primary and secondary hierarchical levels.
ITU-T G.706 (1991)	Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in Recommendation G.704.
ITU-T G.823 (03/93)	The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy.
ITU-T G.826 (08/96)	Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate.
1544 kbit/s T1 interface:	
ITU-T G.824 (03/93)	The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy
ANSI T1.403 (1995) and T1.102 (1993)	Digital interface characteristics Functional Interface Characteristics PCM Coding Law Primary PCM Multiplexer Performance parameters
BELCORE GR-1089	Electromagnetic compatibility and electrical safety - generic criteria for network telecommunications equipment
FCC Part 68.308	Signal power limitations

Table 116. International standards for FXC STM-1 and FXC Bridge transmission units

Standard	Note
ITU-T G.828 (March 2000)	Error performance parameters and objectives for international, constant bit rate synchronous digital paths.
ITU-T G.829 (December 2002)	Digital networks - Quality and availability targets - Error performance events for SDH multiplex and regenerator sections.
ITU-T G.957	Digital sections and digital line systems - Optical interfaces of equipments and systems relating to the synchronous digital hierarchy.
ETS 300147 (September 2001)	ETSI Transmission and Multiplexing; Synchronous Digital Hierarchy - Multiplexing Structure.
EN 300417-1-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 1: Generic processes and performance.
EN 300417-2-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 2: SDH and PDH physical layer functions.
EN 300417-3-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 3: STM-N MS and RS section layer functions.
EN 300417-4-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 4: SDH path layer functions.
EN 300417-5-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 5: PDH layer functions.
EN 300417-6-1 (May 1999)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 6: Synchronisation layer functions.
EN 300417-7-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 7: Equipment Management and Auxiliary Layer Functions.

Table 116. International standards for FXC STM-1 and FXC Bridge transmission units (cont.)

Standard	Note
EN 300462-1 (June 1998)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 1: Definition and terminology for synchronisation networks.
EN 300462-2 (June 2002)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 2: Synchronisation Network Architecture.
EN 300462-3 (June 1998)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 3: The control of jitter and wander within synchronisation networks.
EN 300462-4 (June 1998)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 4: Timing characteristic of slave clocks suitable for synchronisation supply to SDH and PDH equipment.
EN 300462-5 (June 1998)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 5: Timing characteristics of slave clocks suitable for operation in SDH equipment.
EN 300462-6 (June 1998)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 6: Timing characteristics of primary clocks.
TS 101009 (V1.1.1. (November 1997))	ETSI Transmission and Multiplexing; SDH Network protection schemes types and characteristics.
TS 101010 (V1.1.1. (November 1997))	ETSI Transmission and Multiplexing; SDH Network protection schemes.

15.5 Electrical properties for FC E1/T1 Transmission (VXxx) units

Table 117. Electrical data for FC E1/T1 transmission unit

Property	Value
DC supply voltage	Powered by BTS

Table 117. Electrical data for FC E1/T1 transmission unit (cont.)

Property	Value
Power consumption	< 6 W

16 FXC E1 and FXC E1/T1

16.1 Technical description of the FXC E1 and FXC E1/T1 transmission units

In mobile networks, it has to be possible to route the traffic in many different ways. FXC E1 and FXC E1/T1 offer great flexibility in this regard. FXC E1 and FXC E1/T1 transmission units provide the transmission functionality, including cross-connections, for various Nokia transmission solutions. The units can be applied as a single-unit transmission equipment or a multi-unit cross-connect node. Using these interfaces the operator defines the traffic routes using the cross-connection functions available in the network elements.

16.1.1 FXC E1

The FXC E1 transmission unit has four pairs of unbalanced 75 ohm connectors (type BT-43). Each pair forms a transmission interface. The Tx and Rx line interface connectors are separate; the upper connector is always the Tx connector and the lower the Rx connector. Each FXC E1 interface provides a 2 Mbit/s connection. With this interface, the signals can travel up to 1 km over a coaxial cable.

The 75 ohm Tx and Rx connectors are connected to each other with a grounding bridge. If the grounding bridge is removed, the grounding of the Rx connectors' outer conductor changes from direct grounding to capacitive grounding.

The unit has a tri-colour status LED, which can emit green, yellow and red.

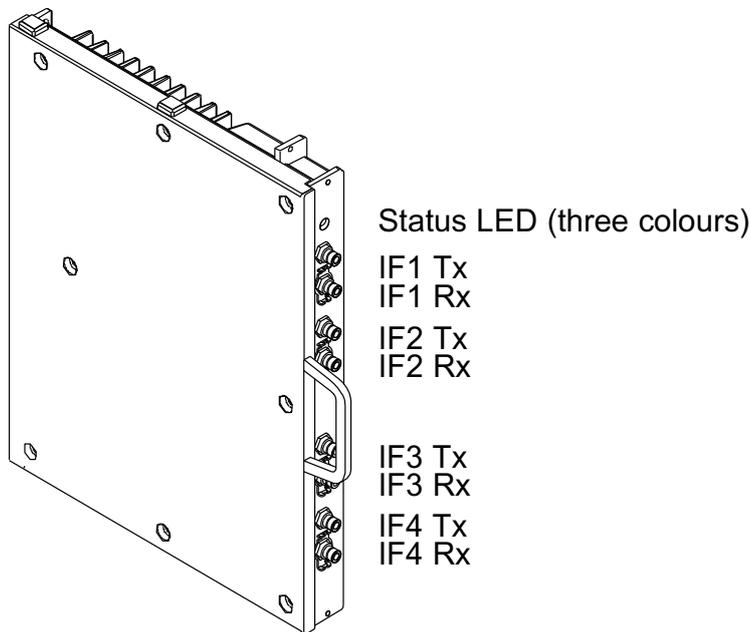


Figure 53. Unbalanced FXC E1

Additional synchronisation interface in FXC E1

The Rx-connector of line interface 4 can be used as a synchronisation interface for an externally provided 2048 kHz clock signal. Software settings determine whether this interface is used or not.

16.1.2 FXC E1/T1

The FXC E1/T1 transmission unit has four balanced TQ connectors (Tx and Rx in the same connector). Each line interface can be independently configured as a 120 ohm E1 interface or a 100 ohm T1 interface. This makes it possible to use it as an E1/T1 converter. The E1 interface offers a maximum capacity of 2 Mbits/s whereas the T1 interface offers 1.5 Mbit/s. With either one of these interfaces, the signals can travel up to 1 km over a shielded telecommunications cable.

The unit has a tri-colour status LED which can emit green, yellow and red.

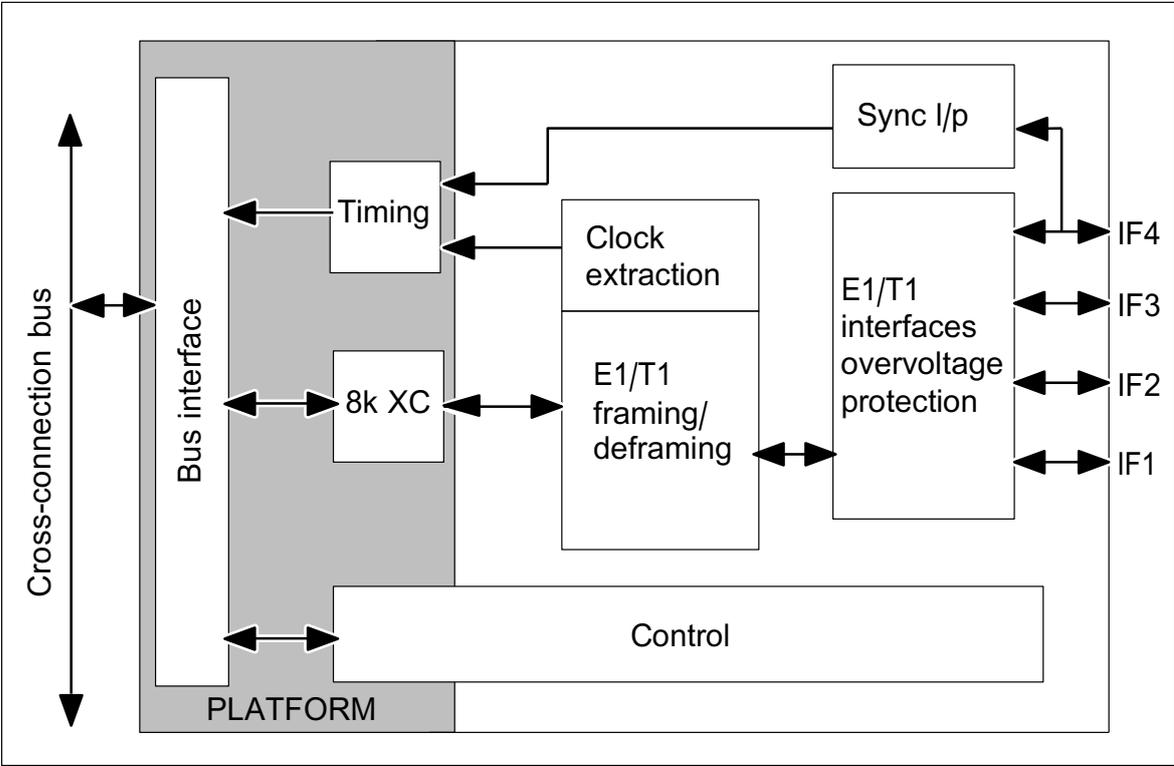


Figure 54. FXC E1 and FXC E1/T1 block diagram

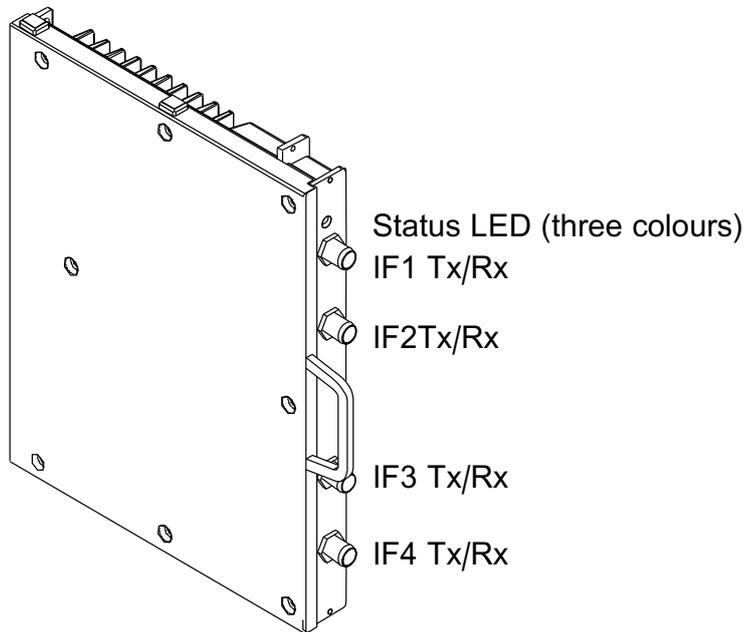


Figure 55. Balanced FXC E1/T1

There are four common TQ connectors for T1 (100 ohm) and E1 (120 ohm). The line interface connectors offer both the Tx and Rx direction.

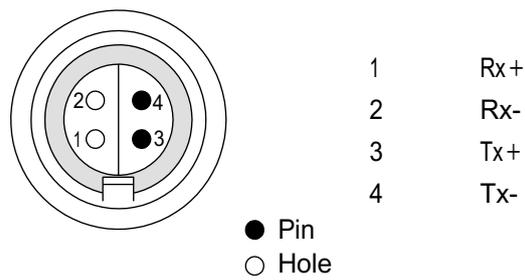


Figure 56. TQ connector

Additional synchronisation interface in FXC E1/T1

The Rx-connector of line interface 4 can be used as a synchronisation interface for an externally provided 2048 kHz clock signal. Software settings determine whether this interface is used or not.

16.2 Interfaces of the FXC E1 transmission unit

Table 118. E1 equipment interface

Bit rate	2048 kbit/s ± 50 ppm
Line code	HDB3
Impedance	75 Ω
Connector type	BT43 female
Transmitter characteristics:	ITU-T G.703
- Nominal peak voltage of mark (pulse)	2.37 V
- Peak voltage of a space (no pulse)	0 ± 0.237 V
- Attenuation at 1 MHz	< 6 dB
Receiver characteristics:	ITU-T G.703
- Line attenuation at 1 MHz	< 20 dB
Jitter and wander	ITU-T G.823
E1 equipment synchronisation input (IF4 Rx):	
- Frequency	2048 kHz/s ± 50 ppm
- Sensitivity	1.5-3.0 Vpp

16.3 Interfaces of the FXC E1/T1 transmission unit

Table 119. E1 equipment interface

Bit rate	2048 kbit/s ± 50 ppm
Line code	HDB3
Impedance	120 Ω
Connector type	E1: BT43 female T1: TQ

Table 119. E1 equipment interface (cont.)

Transmitter characteristics:	ITU-T G.703
- Nominal peak voltage of mark (pulse)	3 V
- Peak voltage of a space (no pulse)	0 ± 0.3 V
- Attenuation at 1 MHz	< 6 dB
Receiver characteristics:	ITU-T G.703
- Line attenuation at 1 MHz	< 20 dB
Jitter and wander	ITU-T G.823
E1 equipment synchronisation input (IF4 Rx)	
- Frequency	2048 kHz/s ± 50 ppm
- Sensitivity	2-3.8 Vpp

Table 120. T1 equipment interface

Bit rate	1544 kbit/s ± 32 ppm
Line code	AMI or B8ZS
Impedance	100 Ω
Transmitter characteristics	ANSI T1.403 (DS-1) or ANSI T1.102 (DSX-1)
Jitter and wander	ITU-T G.824

16.4 Dimensions and weight of FXC E1 and E1/T1 transmission units

Table 121. FXC E1 and FXC E1/T1 dimensions and weight

Height	254 mm (10 in.)
Width	30 mm (1.18 in.)
Depth	220 mm (8.7 in.)

Table 121. FXC E1 and FXC E1/T1 dimensions and weight (cont.)

Weight	1.35 kg (3 lb.)
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16.5 Power requirements for FXC E1 and FXC E1/T1 transmission units

Table 122. Power supply and power consumption

DC supply voltage	Powered by Nokia MetroHub or BTS
Power consumption	< 6 W

16.6 International standards; FXC E1 and FXC E1/T1 transmission units

Table 123. International recommendations

2048 kbit/s E1 interface	
ITU-T G.703 (1991)	Physical/electrical characteristics of hierarchical digital interfaces
ITU-T G.704 (10/94)	Synchronous frame structures used at primary and secondary hierarchical levels
ITU-T G.706 (1991)	Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in Recommendation G.704
ITU-T G.823 (03/93)	The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy
ITU-T G.826 (08/96)	Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate
1544 kbit/s T1 interface	
ITU-T G.824 (03/93)	The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy

Table 123. International recommendations (cont.)

ANSI T1.403 (1995) and T1.102 (1993)	Digital interface characteristics Functional Interface Characteristics PCM Coding Law Primary PCM Multiplexer Performance parameters
BELCORE GR-1089	Electromagnetic compatibility and electrical safety - generic criteria for network telecommunications equipment.
FCC Part 68.308	Signal power limitations

17 FXC RRI

17.1 Technical description of the FXC RRI transmission unit

The FXC RRI transmission unit has two Flexbus interfaces, which allow the operator to connect the unit to any radio unit with a Flexbus interface. This requires a Flexbus cable. For example, it is possible to connect FXC RRI to:

- Nokia MetroHopper radio with 4 x 2 Mbit/s capacity
- Nokia FlexiHopper (Plus) radio with 2 x 2, 4 x 2, 8 x 2 or 16 x 2 Mbit/s capacity

FXC RRI contains two Flexbus interfaces, FB1 and FB2, located on the front panel and a cross-connection bus interface on the backplane. FXC RRI does not have a separate management connector, as it is managed via the local management port (LMP) of the base station or the transmission node, or via Nokia Q1 bus.

FXC RRI has separate short circuit protection for each of the Flexbus interfaces. This ensures that a short circuit in one Flexbus interface does not affect the other in MetroHub.

If a Flexbus interface is connected to an outdoor unit, the power feed (55 V_{DC}) to the outdoor unit is done through the interface.

Currently FXC RRI supports three operating modes:

- single use
- hot standby
- hot standby + space diversity

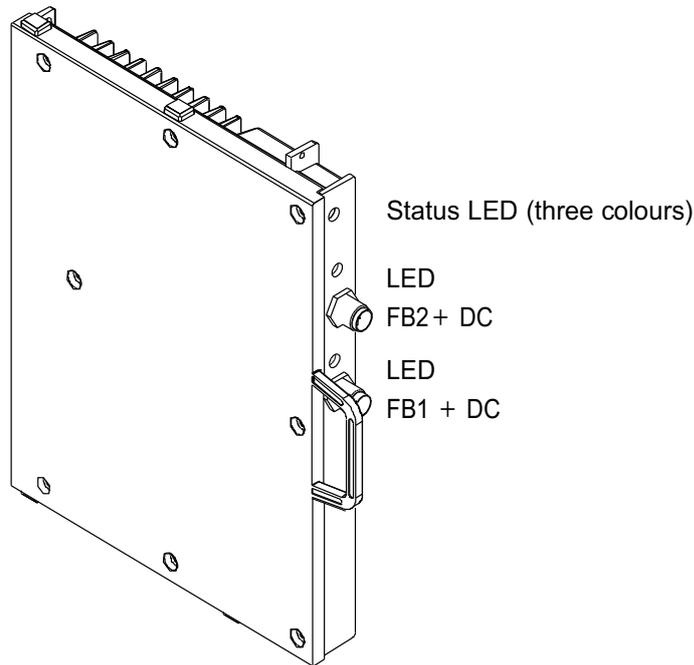


Figure 57. FXC RRI transmission unit

The FXC RRI offers a bypass cross-connection feature, which can be used to bypass traffic through the unit transparently without terminating the signal. From the performance management point of view, a link can be extended to include several nodes, while the performance data is gathered for the whole extended link. It is possible to make bypass cross-connections even if all the platform interfaces of the FXC RRI unit are in use. In other words, the bypass cross-connection does not reserve any capacity from the cross-connection bus.

The platform interfaces of each indoor unit have a maximum capacity of 16 x 2 Mbit/s. This traffic can either be dropped to the cross-connection bus or bypassed from one interface to another in the same FXC RRI in a separate 2 Mbit/s cross-connection field. If the total Flexbus interface traffic in one FXC RRI exceeds 16 x 2 Mbit/s, the surplus traffic has to be bypassed. In such a scenario, time slot 0 is not regenerated.

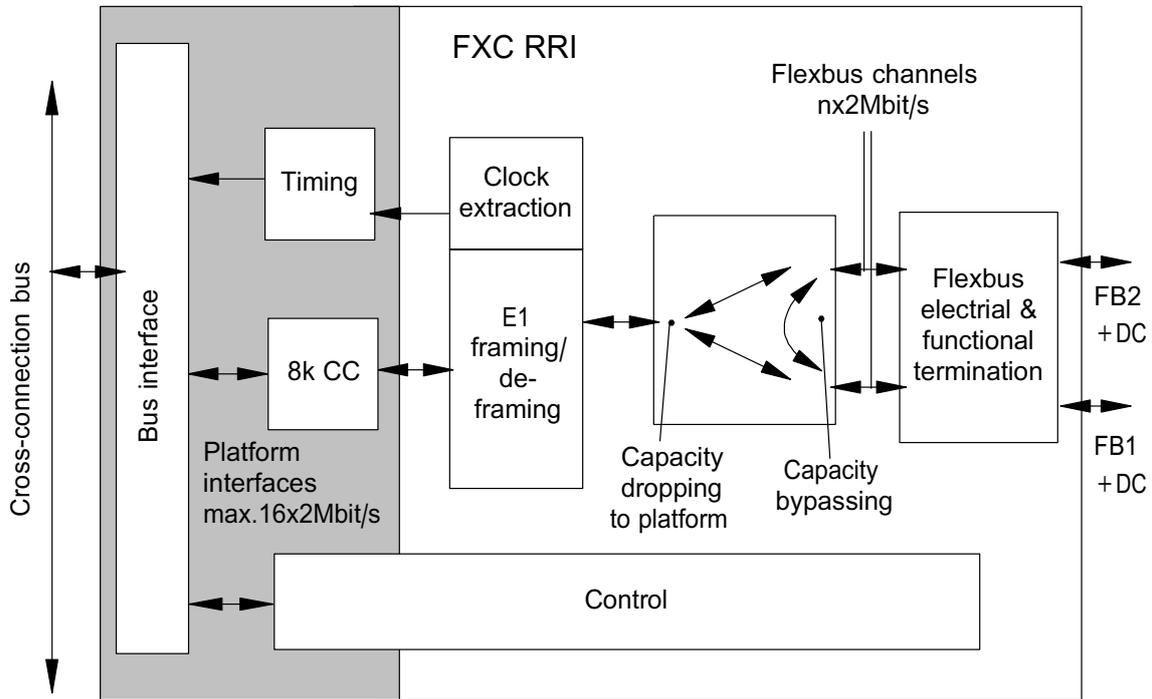


Figure 58. FXC RRI block diagram

A connection made between a Flexbus channel and a platform interface is a blocking connection. This means that the whole 2 Mbit/s frame is reserved for the connection even if only part of it, for example, one time slot, is used.

The operator defines the traffic routes in the network elements by using the cross-connection functions available in the network elements. Thus, routing traffic means managing the cross-connections in the network elements.

The cross-connection function of the FXC RRI transmission unit allows the traffic to be groomed. This ensures that the transmission paths are fully utilised, thereby reducing transmission costs.

The amount of 2M capacity add/drop towards the D-bus of a Nokia BTS is configurable, allowing you to utilise the available capacity to its maximum.



Note

FXC RRI platform interface 15 is always connected to the D-bus, because at least 1*2M capacity is always needed for the Nokia BTS. Only FXC RRI platforms 13 and 16 are configurable.

D11, D12, and D13 are only configurable via the RRI manager in a configuration with an RRI connected to a FlexiHopper (Plus).

17.2 Interfaces of the FXC RRI transmission unit

Table 124. FXC RRI interfaces

Flexbus interfaces 1 (FB1) and 2 (FB2)	TNC connector 50 Ω Up to 16 x 2 Mbit/s signals Embedded power supply voltage 55 V _{DC} for radio outdoor units
Jitter and wander	ITU-T G.823
Bidirectional data	37 Mbit/s, NRZ code, 1.4V pulse amplitude

17.3 Dimensions and weight of the FXC RRI transmission unit

Table 125. FXC RRI dimensions and weight

Height	254 mm (10 in.)
Width	30 mm (1.18 in.)
Depth	220 mm (8.7 in.)
Weight	1.35 kg (3 lb.)

17.4 Power requirements for the FXC RRI transmission unit

Table 126. Power supply and power consumption

DC supply voltage	Powered by Nokia MetroHub or BTS
Power consumption	< 8 W (For OU power consumption, see the radio documentation)

17.5 International standards; FXC RRI transmission units

Table 127. International recommendations

Flexbus interface	
ITU-T G.704 (10/94)	Synchronous frame structures used at primary and secondary hierarchical levels.
ITU-T G.706 (1991)	Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in Recommendation G.704
ITU-T G.823 (03/93)	The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy.
ITU-T G.826 (08/96)	Error performance parameters and objectives for international, constant bit rate digital paths at or above primary rate.
ITU-T G.921	Digital sections based on the 2048 kbit/s hierarchy

17.6 Flexbus cable requirements for the FXC RRI transmission unit

Table 128. Flexbus cable requirements

Cable type	Coaxial cable, double shielded or semi-rigid
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Table 128. Flexbus cable requirements (cont.)

Recommended cable types	RG-223, max. length 140 m RG-214, max. length 300 m
Characteristic impedance	50 ± 2 Ω
DC resistance	< 4.6 Ω (sum of inner and outer conductor)
Data attenuation	< 9.0 dB at 19 MHz
Flexbus signals	- DC power supply - Bidirectional data (37 Mbit/s, NRZ code, 1.4V pulse amplitude)
 Note Over-voltage protection and cable equalizer are integral parts of the Flexbus interface. Primary over-voltage protection is a 90 V gas-arrester. External gas-arresters can be used as well.	

Table 129. Recommended cable type

RG-223	Maximum length 140 m (459 ft.)
RG-214	Maximum length 300 m (984 ft.)

17.7 Flexbus DC LEDs on the FXC RRI transmission unit

LED	Situation
No light	No power feed or Tx signal.
Flashing GREEN	DC power feed to the outdoor unit is active, Tx signal is not active.
Steady GREEN	DC power feed to the outdoor unit and Tx signal is active.

18 FXC STM-1 and FXC Bridge

18.1 Technical description of the FXC STM-1 and FXC Bridge transmission units

The FXC STM-1 and FXC Bridge transmission units enable cross-connections between PDH (plesiochronous digital hierarchy) and SDH (synchronous digital hierarchy) transmission rates. The units work together to form a complete SDH STM-1 terminal multiplexer (TM) or add-drop multiplexer (ADM) node inside Nokia base stations or Nokia MetroHub transmission nodes. FXC STM-1 performs the main SDH functions, whereas FXC Bridge forms a bridge for the signals between the SDH part and the PDH cross-connect part of the node. The two units are always used together.

The units both have a tri-colour status LED, which can emit green, yellow and red. In addition, the FXC Bridge unit has a test interface.

The FXC STM units do not have separate Q1 management interfaces. Instead, they are managed locally via the local management port (LMP) of Nokia BTS or Nokia MetroHub, or remotely via the Nokia Q1 bus.

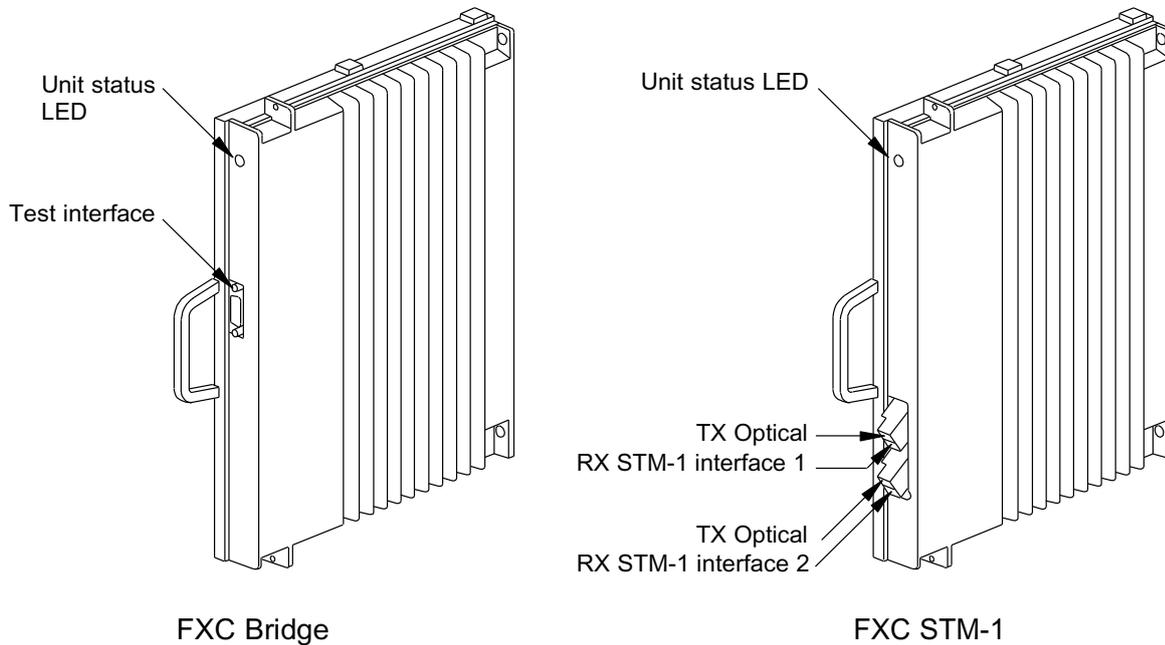


Figure 59. FXC Bridge and FXC STM units

18.1.1 Main features of FXC STM-1 and FXC Bridge

The main features of the FXC STM-1 and FXC Bridge units provide support for:

- automatic laser shutdown (ALS).
- both SDH STM-1 TM and STM-1 ADM node types.
- fully non-blocking cross-connections on TU-12 level between both STM-1 aggregate interfaces and the add/drop traffic
- SDH S12 SNC/I+ (Inherently monitored subnetwork connection protection), that is, protection on the VC-12 level.
- up to 20 x TU-12 (2M) drop capacity from SDH.
- grooming via PDH cross-connections for the add/drop traffic with the following granularity: 8k, 16k, 32k, 64k, Nx64k.
- interface statistics collection in compliance with ITU-T G.826.

- easy management of settings and transmission configuration (locally and remotely) with the Nokia Q1 management protocol. Management is carried out with a Nokia NetAct compatible node manager.
- remote and local software download.

18.1.2 Main blocks of the FXC STM-1 and FXC Bridge units

The FXC STM-1 and FXC Bridge units are encased plug-in units constructed on a printed circuit board. The units connect to other units in their environment via their backplane connectors. Thus, they do not require any cabling besides the STM-1 interface cabling.

The two figures below show the backplane structures of a Nokia BTS and MetroHub.

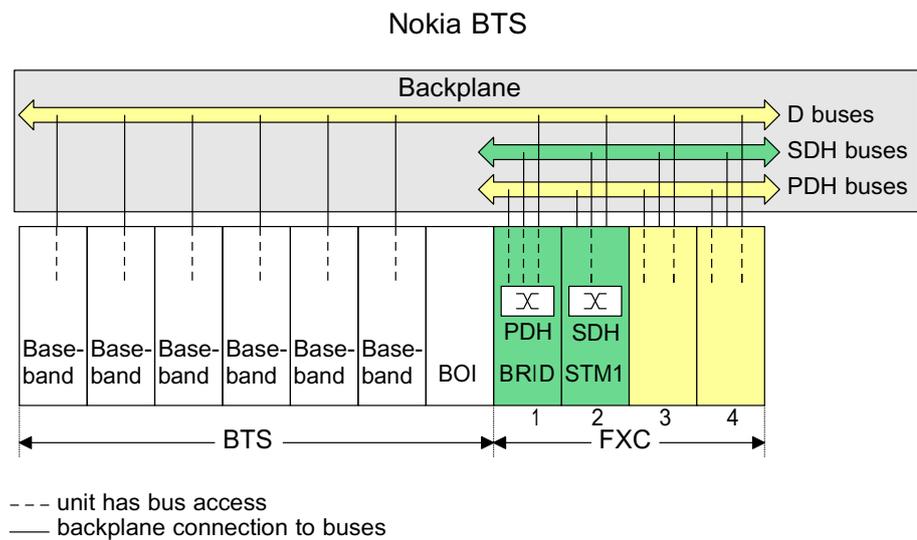


Figure 60. Nokia BTS backplane structure

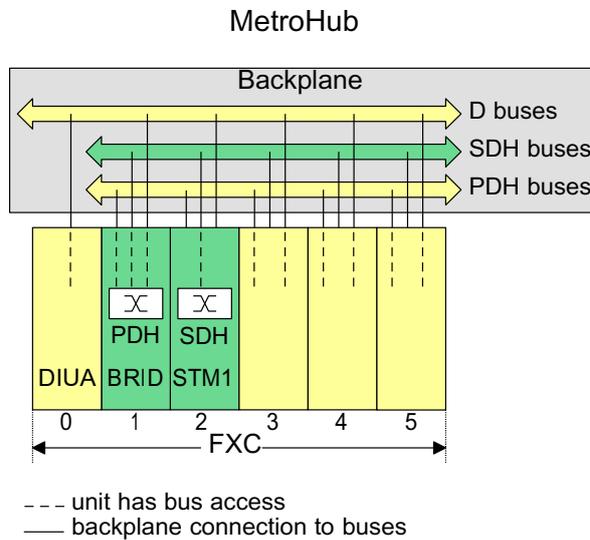


Figure 61. Nokia MetroHub backplane structure

SDH buses

The SDH buses are used for communication between the FXC STM-1 and FXC Bridge units. Main information/signals transferred via the SDH buses are:

- add/drop payload (via tributary bus)
- SDH byte information (time-division multiplexing (TDM) bus)
- SDH timing and synchronisation signals
- communication between units.



Note

Note The FXC (PDH) units do not access the SDH buses.

PDH buses

The PDH buses are used for communication between the FXC (PDH) units, including the FXC Bridge unit. Main information/signals transferred via the PDH buses are:

- Q1 communication buses
- PDH timing and synchronisation signals
- communication between units
- node control buses (for example temperature and fan control, and external alarm inputs/outputs).

D-buses

D-buses are three PDH buses, each supporting 2M. They are used for transferring the PDH add/drop and Q1 management traffic between the local BTS baseband units, and the FXC (PDH)/FXC Bridge transmission units. No external cabling is needed for this purpose.

18.1.3 FXC STM-1

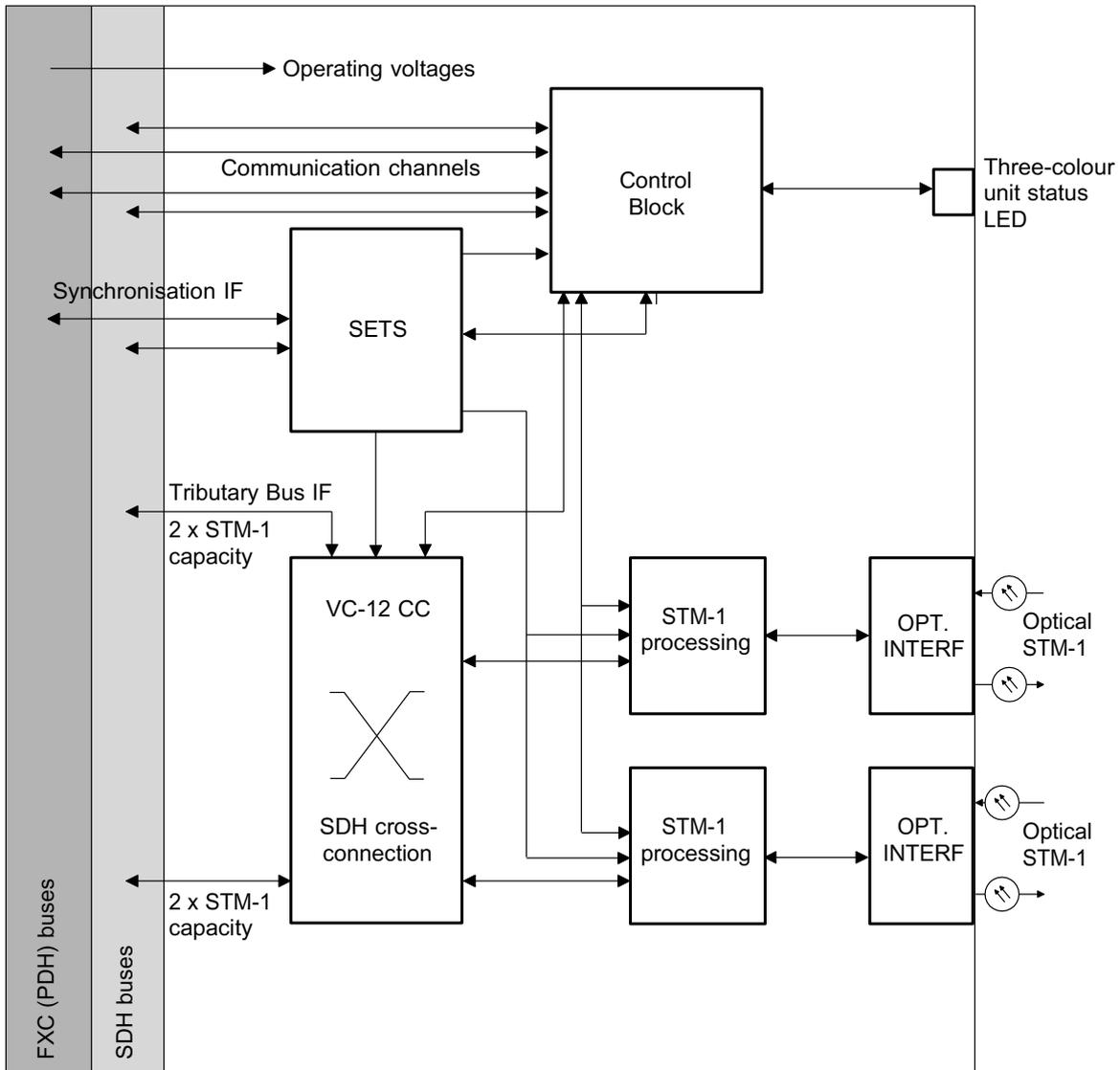


Figure 62. FXC STM block diagram

Optical interfaces

FXC STM-1 has two L-1.1 long-haul optical interfaces, which perform the following functions:

- optical to electrical signal conversion
- electrical to optical signal conversion
- clock and data recovery and serial to parallel conversion for the Rx signal
- data and transmit clock generation and parallel to serial conversion for the Tx signal
- optical output power measurement.

STM-1 processing block

The two STM-1 processing blocks perform the following functions:

- termination of the STM-1 signal between the optical section and the VC-12 path layer.
- adaptation from incoming clock rate (from optical interface) to SDH node clock rate through a TU pointer buffer.
- two aggregate bus input and output interfaces towards the VC-12 cross-connection block for transferring an AU-4 signal including 63 x TU-12 with STM-1 data rate.
- two serial data communication channel interfaces for transferring management traffic.

SDH cross-connection block

The SDH cross-connection block performs the following functions:

- cross-connections on the TU-12 level.
- generation of clock and frame synchronising signals for the buses.

SETS block

The SETS (synchronous equipment timing source) block:

- includes the SDH node clock.
- provides a 19.44 MHz synchronisation signal to synchronise the SDH functionality of the FXC STM transmission units.
- provides 2.048 MHz and 4.096 MHz synchronisation signals as reference for the PDH node clock.
- provides a 32.768 kHz clock signal for the real-time clock of the unit.

Control block

The control block in FXC STM-1 contains:

- a three-colour unit status LED.
- unit control and supervision functionality
- the real time clock (RTC)
- unit temperature measurement functionality
- data interfaces for local unit control
- serial communication channel interfaces for the transfer of management and software download information between different FXC transmission units and/or local STM-1 interfaces.

18.1.4 FXC Bridge**PDH control block**

The PDH control block in FXC Bridge contains:

- a three-colour unit status LED
- control functions for the PDH part of the unit system internal communication channels via the backplane
- user management channels (Q1 and LMP) via the backplane
- unit temperature supervision functionality
- cabinet management functionality (in Nokia MetroHub)

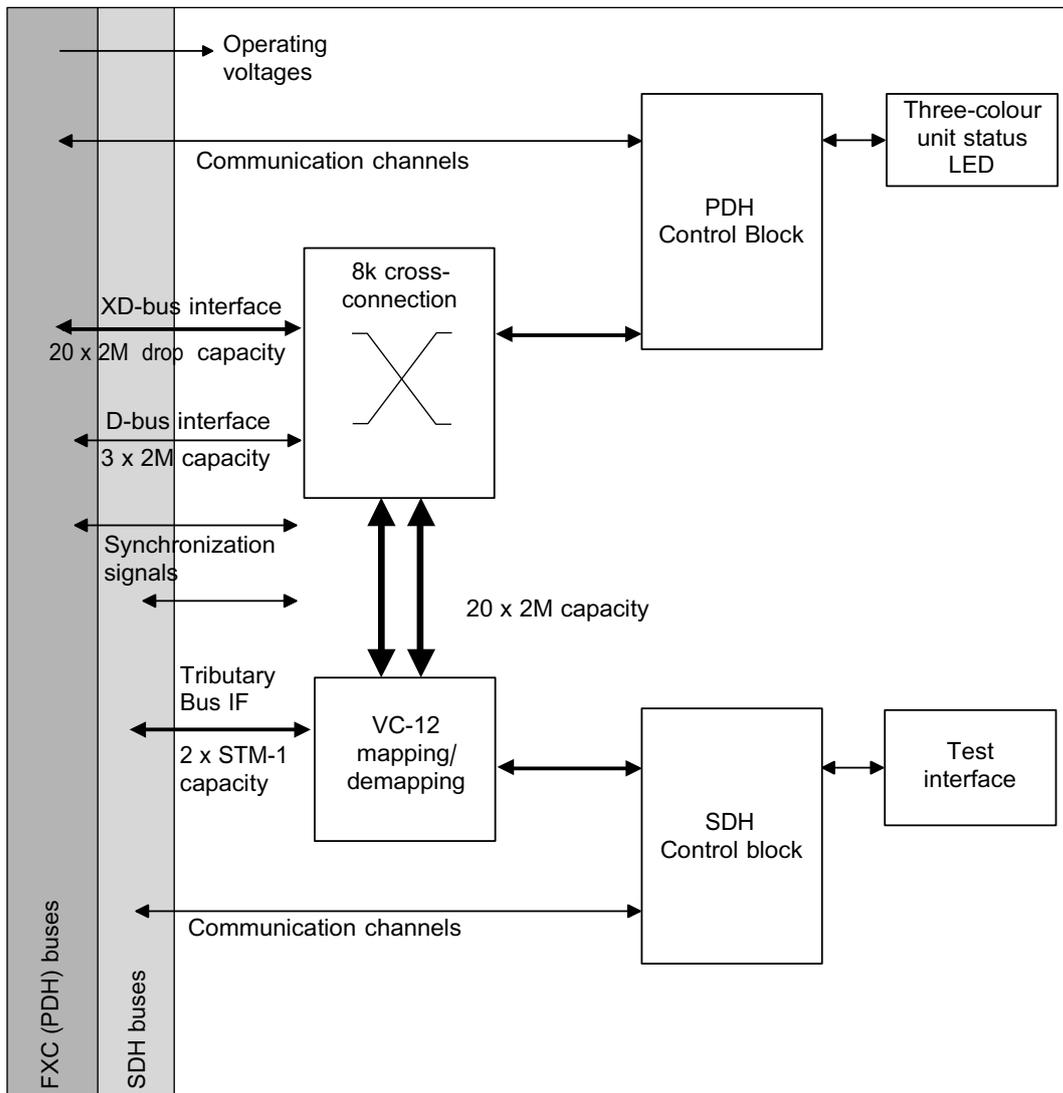


Figure 63. FXC Bridge block diagram

8k cross-connection block

The 8k cross-connection block has:

- 24 x 2 Mbit/s cross-connection capability at 8 kbit/s granularity.
- a connection to the cross-connection bus (XD-bus) on the backplane (56 x 2M capacity).

- 3 x 2 Mbit/s fixed D-bus connections towards the base station or hub.
- elastic buffers for incoming signal to align the 2M frames so that the PDH data can be cross-connected on the sub-2M level.

SDH control block

The SDH control block in FXC Bridge contains:

- the control functions for the SDH part of the unit.
- system internal communication channels via the backplane.
- user management channels (Q1 and LMP) via the backplane.

VC-12 mapping/demapping block

The VC-12 mapping/demapping block performs the following functions:

- in SDH to PDH direction: terminates up to 20 TU-12 level signals, extracts the 2 Mbit/s signals, and forwards them to the 8k cross-connection block.
- in PDH to SDH direction: maps the transmitted 2 Mbit/s signals to VC-12 containers and generates the TU-12 signals towards the FXC STM-1 unit. Asynchronous and byte synchronous 2048 Kbit/s mapping modes are supported.
- connects to the SDH tributary add/drop bus on the backplane.

Synchronisation block

The synchronisation block:

- connects to the backplane synchronisation signals.
- in node control functionality:
 - synchronises the PDH cross-connection system to the SDH node clock.
 - provides the PDH node clock master functionality.

18.1.5 FXC Bridge D-bus implementation

FXC Bridge supports up to three D-buses for connecting PDH add/drop and Q1 management traffic between the BTS and the FXC (PDH)/FXC Bridge transmission units.

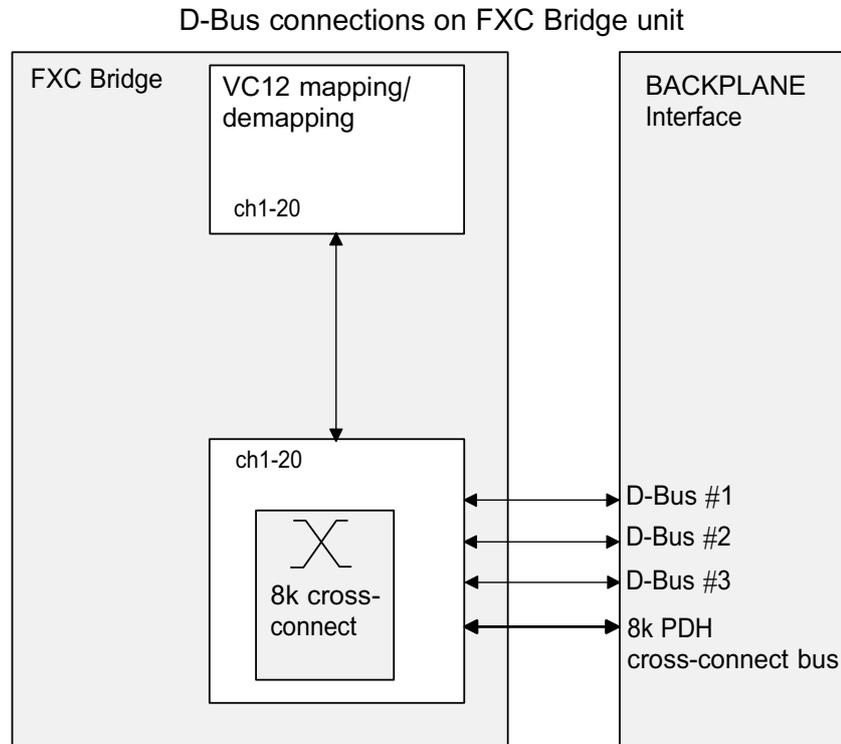


Figure 64. FXC Bridge D-bus implementation

18.2 Interfaces of the FXC STM-1 and FXC Bridge transmission units

Table 130. FXC STM-1 front panel interfaces

Optical STM-1 interfaces 1 and 2	LC Duplex (ITU-T G.957; L-1.1 long-haul, 1310 nm)
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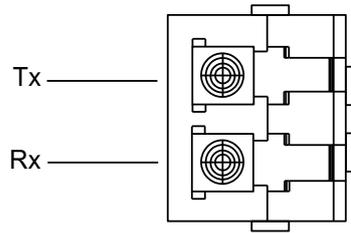


Figure 65. FXC STM-1 connector

Table 131. FXC Bridge front panel interfaces

Test interface	Connector type: SUB-D9 male (used only for Nokia testing purposes)
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18.3 Dimensions and weight of FXC STM-1 and FXC Bridge transmission units

Table 132. FXC STM-1 and FXC Bridge dimensions and weight

Height	254 mm (10 in.)
Width	28 mm (1.1 in.)
Depth	187 mm (7.4 in.)
Weight	1.35 kg (3 lb.)

18.4 Power requirements for FXC STM-1 and FXC Bridge transmission units

Table 133. Power supply and power consumption

DC supply voltage	Powered by Nokia MetroHub or BTS
Power consumption	< 11 W

18.5 International standards; FXC STM-1 and FXC Bridge transmission units

ITU-T G.828 (March 2000)	Error performance parameters and objectives for international, constant bit rate synchronous digital paths.
ITU-T G.829 (December 2002)	Digital networks - Quality and availability targets - Error performance events for SDH multiplex and regenerator sections.
ITU-T G.957	Digital sections and digital line systems - Optical interfaces of equipments and systems relating to the synchronous digital hierarchy.
ETS 300147 (September 2001)	ETSI Transmission and Multiplexing; Synchronous Digital Hierarchy - Multiplexing Structure.
EN 300417-1-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 1: Generic processes and performance.
EN 300417-2-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 2: SDH and PDH physical layer functions.
EN 300417-3-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 3: STM-N MS and RS section layer functions.
EN 300417-4-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 4: SDH path layer functions.
EN 300417-5-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 5: PDH layer functions.
EN 300417-6-1 (May 1999)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 6: Synchronisation layer functions.
EN 300417-7-1 (October 2001)	ETSI Transmission and Multiplexing; Generic functional requirements for SDH equipment; Part 7: Equipment Management and Auxiliary Layer Functions.

EN 300462-1 (June 1998)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 1: Definition and terminology for synchronisation networks.
EN 300462-2 (June 2002)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 2: Synchronisation Network Architecture.
EN 300462-3 (June 1998)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 3: The control of jitter and wander within synchronisation networks.
EN 300462-4 (June 1998)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 4: Timing characteristic of slave clocks suitable for synchronisation supply to SDH and PDH equipment.
EN 300462-5 (June 1998)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 5: Timing characteristics of slave clocks suitable for operation in SDH equipment.
EN 300462-6 (June 1998)	ETSI Transmission and Multiplexing; Generic requirements for synchronisation networks; Part 6: Timing characteristics of primary clocks.
TS 101009 (V1.1.1. (November 1997))	ETSI Transmission and Multiplexing; SDH Network protection schemes types and characteristics.
TS 101010 (V1.1.1. (November 1997))	ETSI Transmission and Multiplexing; SDH Network protection schemes.

19

Technical description of optional DC filter module

19.1 Technical description of the -48 VDC filter module

The optional -48 VDC Filter module is required when installing -48 VDC power.



The -48 VDC filter module is pre-installed in the cabinet.

Function

The DC filter is used for attenuating conducted and radiated emission between the BTS and the external 48VDC power supply network. The DC filter is designed to ensure adequate protection against user contact with any part at hazardous voltage or energy levels.

Operation

The operating temperature of the DC filter is between -33 and +65 °C.

DC filter components

The filter components are mounted inside an enclosed box (the housing), which has threaded studs (terminals) for the input and also for the output interface. The DC filter components conform to the environmental requirements. The component life is consistent with the system life.

DC filter conformity with standards

The DC filter unit, when assembled into its specified position is in conformity with the relevant parts of the following standards:

- IEC 801-2 / IEC 1000-4-2 Electrostatic discharge requirements. Discharge of the 15 KV static charge.
- IEC 801-3 / IEC 1000-4-3 Electromagnetic compatibility for industrial-process measurement and control equipment.
- IEC 801-4 / IEC 1000-4-4 Electrical fast transients/burst requirements. (5/50 ns 2kV in AC-branch and 5/50 ns 1kV in DC-branch)
- IEC 801-5 / IEC 1000-4-5 Surge immunity requirements. 1.2/50 μ s and 2 kV
- IEC 801-6 / IEC 100-4-6 Immunity to conducted disturbance, inducted by radio frequency fields above 9 kHz.
- EN 55022 class B Limits and methods of measurement of radio interference Characteristics of information technology equipment.
- ETSI GSM 11.20, Clause 2.1.6.6 Spurious emission [This standard is a system-level standard the BTS has to meet, this filter shall facilitate and enhance the system level performance.]
- GR-1089-CORE Issue 2, with revision 1, Feb 1999 class B limits. Electromagnetic Compatibility and Electrical Safety – Generic Criteria for Network Telecommunications Equipment. Bellcore.

DC filter conformity with safety requirements

The filter and its components comply with the relevant parts of the following safety requirements standards:

- EN 60950, IEC950, UL1950 [The Standard for Safety of Information Technology Equipment, Including Electrical Business Equipment, UL 1950, Third Edition]
- UL 1283 Electromagnetic Interference Filters
- IEC 939-1 Complete filter units for radio interference suppression. Part 1: Generic specification
- IEC 939-2 Complete filter units for radio interference suppression. Part 2: Sectional specification. Selection of methods of test and general requirements
- EN 133200 Sectional Specification: Passive filter units for electromagnetic interference suppression (filters for which safety test are required)
- UL 50, Eleventh Edition, Revised August 19, 1997: “Enclosures for Electrical Equipment”

- GR-63-CORE Issue 1 [18], General Requirements for Electronic Equipment Cabinets, Physical Protection, "Indoor"
- GR-487-CORE Issue 2 [19], General Requirements for Electronic Equipment Cabinets, Physical Protection, "Outdoor"

19.2 Interfaces of the -48 VDC filter module

The DC filter components are mounted inside an enclosed box that has threaded studs for the input interface, and also threaded studs for the output interface.

19.2.1 Input terminals

The DC filter has two pieces of brass M10 studs functioning as input terminals. Each input terminal has installation hardware installed consisting of two nuts and two split washers. The installation hardware is the same material as the input terminal.

The input terminals are clearly marked to show the correct DC polarity:

- V48N
- V48RTN

19.2.2 Output terminals

The DC filter has two pieces of brass M10 studs functioning as output terminals. Each input terminal has installation hardware installed consisting of two nuts and two split washers. The installation hardware is the same material as the output terminal.

To show the connection the output terminals have coloured rings:

- blue for V48N
- black for V48RTN

19.3 Electrical properties for -48 VDC filter module

The optional -48 VDC Filter module is required when installing -48 VDC power. The DC filter is used for attenuating conducted and radiated emission between the BTS and the external 48 DC power supply network. The DC filter is designed to ensure adequate protection against user contact with any part at hazardous voltage or energy levels.



Note

The -48 VDC filter module is pre-installed in the cabinet.

The operating temperature of the DC filter module is between -33 and +65 °C. The following electrical specifications apply across the entire operating temperature range:

- Rated voltage:
60 VDC
Operating voltage V48N (-) and V48RTN (+).
- Rated current:
140 ADC
The current flow is bi-directional. The current can flow from the input threaded studs to the output threaded studs, and from the output threaded studs to the input threaded studs.
- Leakage current:
Less than 1mA
- DC resistance:
5 mΩ/line maximum
- Insulation resistance:
500 MΩ minimum (100VDC. +/- to chassis/PE)
- Dielectric Strength:
The electric strength tests have been performed on every single filter.

Between + and -	707VDC	2s.
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+,- to chassis	707VDC	2s.
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Related Topics

Technical description of the Base Operations (BOIx) and Interfaces unit

Instructions

Installing the BOIx unit

Replacing the BOIx unit

Reference

BOIx unit technical data

BOIx unit LEDs

BOIx unit interfaces

Technical description of Bias Tee (BPxx) unit

Instructions

Installing the Bias Tee (BPxx) unit

Replacing the Bias Tee (BPxx) unit

Reference

Bias Tee (BPxx) unit technical data

Bias Tee unit alternatives

Bias Tee (BPxx) unit Interfaces

Technical description of Dual Band Diplex Filter (DU2A) unit

Instructions

Installing the DU2A unit

Replacing the DU2A unit

Reference

DU2A unit technical data

DU2A unit interfaces

Technical description of Dual Variable Gain Duplex Filter (DVxx) unit

Instructions

Installing the DVxx unit

Replacing the DVxx unit

References

DVxx unit technical data

DVxx unit alternatives

DVxx unit LEDs

DVxx unit interfaces

Technical description of Power Supply (PWSx) unit

Instructions

Installing the PWSx unit

Replacing the PWSx unit

Reference

PWSx unit technical data

PSWx unit alternatives

PWSx unit LEDs

PWSx unit interfaces

Technical description of Receiver Multicoupler (MxxA) unit

Instructions

Installing the M2xA or M6xA unit

Replacing the M2xA or M6xA unit

Reference

M2xA or M6xA unit technical data

M2xA or M6xA unit alternatives

M2xA or M6xA unit interfaces

Technical description of Remote Tune Combiner (RTxx) unit

Instructions

Installing the RTxx unit

Replacing the RTxx unit

Reference

RTxx unit technical data

RTxx unit alternatives

RTxx unit interfaces

RTxx unit LEDs

Technical description of Temperature Control System (TCS)

Reference

Technical data for the Temperature Control System (TCS)

Interfaces of the Temperature Control System (TCS)

Technical description of Transceiver Baseband (BB2x) unit

Instructions

Installing the BB2x unit

Replacing the BB2x unit

Reference

BB2x unit technical data

BB2x unit alternatives

BB2x unit LEDs

BB2x unit interfaces

Technical description of Transceiver (TSxB) unit

Instructions

Installing a Transceiver (TSxx) unit

Replacing a Transceiver (TSxx) unit

Reference

Technical data for the Transceiver (TSxx) unit

Interfaces of the Transceiver (TSxx) unit

Transceiver (TSxx) unit LEDs

Transceiver (TSxx) unit alternatives

Technical description of Wideband Combiner (WCxA) unit

Instructions

Installing the WCxA unit

Replacing the WCxA unit

Reference

WCxA unit technical data

WCxA unit alternatives

WCxA unit interfaces

Technical description of transmission interfaces

Reference

Interfaces of the FXC E1 transmission unit

Interfaces of the FXC E1/T1 transmission unit

Interfaces of the FXC RRI transmission unit

Interfaces of the FXC STM-1 and FXC Bridge transmission units

Technical description of FC E1/T1 transmission unit

Instructions

Installing the VXxx unit

Reference

VXxx unit technical data

VXxx unit alternatives

VXxx unit LEDs

Technical description of the FXC E1 and FXC E1/T1 transmission units

Instructions

Connecting cables to the FXC E1 transmission unit

Connecting cables to the FXC E1/T1 transmission unit

Reference

Transmission unit LEDs

Dimensions and weight of the FXC E1 and E1/T1 transmission units

Interfaces of the FXC E1 transmission unit

Interfaces of the FXC E1/T1 transmission unit

Power requirements for the FXC E1 and FXC E1/T1 transmission units

Technical description of the FXC RRI transmission unit

Instructions

Connecting the Flexbus cable to the FXC RRI transmission unit

Reference

Transmission unit LEDs

Flexbus DC LEDs on the FXC RRI transmission unit

Dimensions and weight of the FXC RRI transmission unit

Interfaces of the FXC RRI transmission unit

Flexbus cable requirements for the FXC RRI transmission unit

Power requirements for the FXC RRI transmission unit

International standards; FXC RRI transmission units

Technical description of the FXC STM-1 and FXC Bridge transmission units

Instructions

Connecting cables to the FXC STM-1 transmission unit

Reference

Dimensions and weight of FXC STM-1 and FXC Bridge transmission units

Power requirements for FXC STM-1 and FXC Bridge transmission units

International standards; FXC STM and FXC Bridge transmission units

Technical description of the -48 VDC filter module

Instructions

Installing a -48 VDC filter module in UltraSite EDGE BTS

Removing a -48 VDC filter module from UltraSite EDGE BTS