TB9100 Base Station/Repeater
P25 CG Console Gateway
P25 TAG Trunked Analog Gateway

Specifications Manual

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Contents

Preface

Scope of Manual

Welcome to the Specifications Manual for the TB9100 base station, P25 CG console gateway, and P25 TAG trunked analog gateway. This manual provides general, performance and physical specifications for the TB9100 5 W, 50 W and 100 W base stations, the P25 CG console gateway, and P25 TAG trunked analog gateway.

The console gateway is different from the TB9100 base station, in that the purpose of the console gateway is primarily to provide an encryption/decryption point at the analog line. The console gateway's analog line connects to the dispatch system, and its digital channel group interface connects to the Tait P25 network. It has no RF functionality as the receiver is disabled.

The primary purpose of the trunked analog gateway is also to provide an encryption/decryption point at the analog line. The trunked analog gateway's analog line connects to the dispatch system, and its Ethernet interface connects (via a CSSI interface) to an RFSS controller in a Tait P25 Trunked Network. It has no RF functionality as the receiver is disabled.

Throughout the manual, specifications will apply to TB9100 base stations and gateways, unless otherwise indicated.

The 100W PA is not available in all markets. A lower power level is also available if required. Consult your regional Tait office for more information.

Document Conventions

Within this manual, four types of alerts may be given to the reader. The following paragraphs illustrate each type of alert and its associated symbol.

Warning **This alert is used when there is a hazardous situation which, if not avoided, could result in death or serious injury.**

Caution This alert is used when there is a hazardous situation which, if not avoided, could result in minor or moderate injury.

Notice This alert is used to highlight information that is required to ensure procedures are performed correctly. Incorrectly performed procedures could result in equipment damage or malfunction.

This icon is used to draw your attention to information that may improve your understanding of the equipment or procedure.

Associated Documentation

The current set of TB9100 product documentation is provided in PDF format on the product CD. Updates are made available on the Tait support web. Print copies of the documentation are available on request.

- TB9100 Installation and Operation Manual (MBA-00002-**xx**).
- TB9100 Customer Service Software User's Manual (MBA-00003-**xx**) and online Help.
- TB9100 Calibration Software User's Manual (MBA-00004-**xx**) and online Help.
- TB9100 Service Manual (MBA-00039-**xx**).
- TBA0STU/TBA0STP Calibration and Test Unit Operation Manual (MBA-00013-**xx**).
- TaitNet P25 Conventional Networks System Manual (MBA-00032-**xx**).
- TaitNet P25 Trunked Networks System Manual (MBA-00045-**xx**).
- TN9400 P25 Trunked Network System Manual (MNC-00001-**xx**).

The characters **xx** represent the issue number of the documentation.

Technical notes are published from time to time to describe applications for Tait products, to provide technical details not included in manuals, and to offer solutions for any problems that arise. The product CD includes technical notes that were available at the time of release. Look for new or updated technical notes on Tait's technical support website.

Publication Record

Issue	Publication Date	Description
1	May 2005	First release
2	August 2005	Updated specifications: ■ 12V PA specifications added to manual ■ Power consumption figures updated in "System Specifications" ■ Duplexer Attenuation Requirements added ■ MTBF ■ Digital Faded Sensitivity ■ Conducted Spurious Emissions ■ Analog Modulation Distortion ■ Audio Input Distortion ■ Audio Output Distortion ■ Inrush Current ■ Input Voltage ■ Input Current
3	November 2005	Updated specifications: ■ Reciter operating voltage ■ Reciter connectors ■ Digital sensitivity ■ Inputs available ■ 12V PA operating voltage
4	May 2006	Updates: ■ K Band added ■ Recommended torque settings added ■ Transmit power and consumption figures for 50W base station 12V PA ■ Channel Change Time ■ Switching Range ■ Flat Response ■ Group Delay ■ Tone Detect Response Time ■ Flat Response ■ Group Delay ■ RF Input Range

Issue	Publication Date	Description
5	August 2006	Updates: ■ P25 Console Gateway specifications added ■ H4 Sub-band added ■ FM Quieting added ■ Digital Selectivity changed to Digital Adjacent Channel Rejection ■ Digital Signal Displacement Bandwith added ■ Digital Spurious Response Attenuation added ■ Digital Intermodulation Response Attenuation added ■ Digital Blocking Rejection added ■ Digital Co-channel Rejection added ■ Fixed Station Interface added ■ Modulation Emission Spectrum
6	March 2007	Additions: ■ RSSI Output Configured as a Digital Output Updates: ■ MTBF ■ Operating Voltage ■ Digital Sensitivity ■ Transmitter Intermodulation ■ Startup Voltages for Battery Protection (Fail-safe) Limits
7	October 2007	Updates for version 3.1 release. Additions: ■ Channel Group Limitations ■ 1 PPS specifications ■ Simulcast specifications Updates: ■ Analog Intermodulation Response Attenuation ■ Adjacent Channel Power
8	March 2008	Update for version 3.20 release. Addition: ■ Signal Delay Spread Capability on page 34
9	January 2009	Updates for version 3.3 release. Additions: ■ P25 TAG trunked analog gateway ■ Dual base station power consumption ■ BTU load values ■ Frequency response graphs Updates: ■ PMU DC startup voltages

Issue	Publication Date	Description
10	June 2009	Updates for version 3.35 release. Additions: ■ Specifications for L band Updates: ■ Module weights ■ Reciter wide bandwidth hum and noise ■ 12V PA startup voltage
11	September 2010	Updates for release of versions 3.54 & 3.60. Additions: ■ Receiver bulk delay ■ Reciter current on 12VDC ■ External reference frequency stability Updates: ■ Compliance specifications ■ MTBF ■ PMU AC voltage extremes
12	July 2011	Updates for version 3.7 release. ■ Current consumption for 100W & dual 50W base stations ■ Compliance specifications
13	August 2012	Updates for version 3.9 release. Information added on compliance standards.
14	November 2012	■ Information added on FCC narrowbanding regulations ■ 1PPS specifications updated to remove duplication
15	October 2013	■ Power and current consumption figures for 5W PAs updated ■ Torque setting for SMA connectors reduced ■ Compliance specifications updated

1 System Specifications

This chapter provides specifications pertaining to the TB9100 base station, P25 CG console gateway, and P25 TAG trunked analog gateway. You will find the specifications for individual modules in separate chapters in this manual.

The software release notes list known issues or limitations of the base station that may vary from the specifications published in this document. Please refer to the current software release notes for any variations to the specifications in this document.

Unless stated otherwise, the performance figures given in the power and current consumption specifications are typical figures based on using the equipment listed in the tables below.

AC and 12VDC Test Equipment

Module	Description
Reciter	mid-band UHF (H2 band) reciter; the test frequency was 475MHz
PA	5W, 50W or 100W PA, as stated in the appropriate specifications
PMU	AC and DC PMU (12V DC module) fitted with a standby power supply card and an auxiliary power supply board

24VDC and 48VDC Test Equipment

Module	Description
Reciter	mid-band UHF (H2 band) reciter; the test frequency was 460.5MHz
PA	5W, 50W or 100W PA, as stated in the appropriate specifications
PMU - 24VDC tests	AC and DC PMU (24V DC module) fitted with a standby power supply card and an auxiliary power supply board
PMU - 48VDC tests	AC and DC PMU (48V DC module) fitted with a standby power supply card and an auxiliary power supply board

AC measurements were made using a Voltech PM100 power analyzer. High power DC measurements were made using an HP 6032A DC power supply.

For AC power measurements the voltage, current drawn, volt.amp product, and true power are given. True power is equal to the volt.amp product multiplied by the power factor.

1.1 TB9100 Base Station AC Input

Transmit Power and Current Consumption - 240VAC Input

	A	VA	W
5W base station			
Minimum RF Output Power (1W)	490mA	118VA	40W
50% RF Output Power (2.5W)	500mA	120VA	45W
Maximum RF Output Power (5W)	510mA	122VA	50W
50W base station			
Minimum RF Output Power (5W)	550mA	133VA	66W
50% RF Output Power (25W)	650mA	155VA	102W
Maximum RF Output Power (50W)	740mA	177VA	132W
100W base station			
Minimum RF Output Power (10W)	640mA	154VA	100W
50% RF Output Power (50W)	870mA	209VA	171W
Maximum RF Output Power (100W)	1.4A	330VA	303W

Transmit Power and Current Consumption - 110VAC Input

	A	VA	W
5W base station			
Minimum RF Output Power (1W)	420mA	46VA	40W
50% RF Output Power (2.5W)	465mA	51VA	45W
Maximum RF Output Power (5W)	500mA	55VA	50W
50W base station			
Minimum RF Output Power (5W)	650mA	72VA	67W
50% RF Output Power (25W)	990mA	109VA	105W
Maximum RF Output Power (50W)	1.3A	138VA	136W
100W base station			
Minimum RF Output Power (10W)	960mA	106VA	103W
50% RF Output Power (50W)	1.6A	178VA	176W
Maximum RF Output Power (100W)	3.0A	325VA	323W

Transmit Power and Current Consumption - AC Input Voltage Extremes

	A	VA	W
5W base station (at 5W RF output power)			
88VAC	600mA	53VA	50W
264VAC	545mA	144VA	50W
50W base station (at 50W RF output power)			
88VAC	1.6A	139VA	138W
264VAC	730mA	194VA	131W
100W base station (100W RF output power)			
88VAC	3.8A	335VA	330W
264VAC	1.3A	342VA	300W

1.2 TB9100 Base Station 12.5VDC Input

Transmit Power and Current Consumption - 12.5VDC Input

	PMU		12V PA	
	A	**W**	**A**	**W**
5W base station				
Minimum RF Output Power (1W)	2.3A	29W	1.44A	18W
50% RF Output Power (2.5W)	2.7A	34W	1.84A	23W
Maximum RF Output Power (5W)	3.0A	38W	2.16A	27W
50W base station				
Minimum RF Output Power (5W)	4.6A	58W	3.8A	41W
50% RF Output Power (25W)	7.6A	95W	6.7A	76W
Maximum RF Output Power (50W)	10.0A	125W	9.2A	107W
100W base station*				
Minimum RF Output Power (10W)	9.0A	113W	-	-
50% RF Output Power (50W)	16.5A	206W	-	-
Maximum RF Output Power (100W)	25.0A	313W	-	-

*At 850MHz.

Transmit Power and Current Consumption - DC Input Voltage Extremes

	PMU		12V PA	
	A	**W**	**A**	**W**
5W base station (at 5W RF output power)				
10.5VDC	3.6A	38W	2.5A	26W
15.5VDC	2.4A	38W	1.75A	27W
50W base station (at 50W RF output power)				
10.5VDC	11.7A	123W	10.5A	110W
15.5VDC	8.3A	128W	6.8A	105W
100W base station (at 100W RF output power)*				
10.5VDC	28.0A	294W	-	-
15.5VDC	20.0A	300W	-	-

*At 850MHz.

Receive Power and Current Consumption

The specifications in this section refer to a base station operating in receive mode with an input voltage of 12.5VDC.

	PMU		12V PA	
	A	**W**	**A**	**W**
Full Speaker Audio	1.34A	16.7W	0.99A	12.38W
Gate Open, Speaker Off	1.15A	14.4W	0.81A	10.13W

1.3 TB9100 Base Station 24VDC Input

Transmit Power and Current Consumption - 24VDC Input

	A	W
5W base station		
Minimum RF Output Power (1W)	1.2A	29W
50% RF Output Power (2.5W)	1.4A	34W
Maximum RF Output Power (5W)	1.6A	38W
50W base station		
Minimum RF Output Power (5W)	2.5A	60W
50% RF Output Power (25W)	4.1A	98W
Maximum RF Output Power (50W)	5.4A	130W
100W base station		
Minimum RF Output Power (10W)	4.0A	96W
50% RF Output Power (50W)	7.4A	178W
Maximum RF Output Power (100W)	13.0A	312W

Transmit Power and Current Consumption - DC Input Voltage Extremes

	A	W
5W base station (at 5W RF output power)		
21.0VDC	1.8A	38W
35.6VDC	1.1A	38W
50W base station (at 50W RF output power)		
21.0VDC	6.1A	128W
35.6VDC	3.8A	135W
100W base station (at 100W RF output power)		
21.0VDC	15.0A	315W
35.6VDC	8.8A	313W

Receive Power and Current Consumption

The specifications in this section refer to a base station operating in receive mode with an input voltage of 24VDC.

	A	W
Full Speaker Audio	720mA	17.28W
Gate Open, Speaker Off	630mA	15.12W

1.4 TB9100 Base Station 48VDC Input

Transmit Power and Current Consumption - 48VDC Input

	A	W
5W base station		
Minimum RF Output Power (1W)	550mA	26W
50% RF Output Power (2.5W)	650mA	31W
Maximum RF Output Power (5W)	750mA	36W
50W base station		
Minimum RF Output Power (5W)	1.2A	58W
50% RF Output Power (25W)	2.0A	96W
Maximum RF Output Power (50W)	2.6A	125W
100W base station		
Minimum RF Output Power (10W)	1.9A	91W
50% RF Output Power (50W)	3.6A	173W
Maximum RF Output Power (100W)	6.5A	312W

Transmit Power and Current Consumption - DC Input Voltage Extremes

	A	W
5W base station (at 5W RF output power)		
42.0VDC	860mA	36W
69.2VDC	560mA	36W
50W base station (at 50W RF output power)		
42.0VDC	2.9A	122W
69.2VDC	1.8A	128W
100W base station (at 100W RF output power)		
42.0VDC	7.5A	315W
69.2VDC	4.5A	311W

Receive Power and Current Consumption

The specifications in this section refer to a base station operating in receive mode with an input voltage of 48VDC.

	A	W
Full Speaker Audio	350mA	16.8W
Gate Open, Speaker Off	300mA	14.4W

1.5 Dual Base Station Power and Current Consumption

The performance figures given in the DC specifications are typical figures based on using the equipment listed below.

- Base station 1: H4 band reciter with H0 band PA (UHF).
- Base station 2: B3 band reciter with B1 band PA (VHF).
- PMU: 12V, 24V or 48V model as appropriate.

13.8VDC Input

	A	W
Both Base Stations Idle*	1.9A	26W
*Neither base station is transmitting or receiving.		
Both Base Stations Transmitting		
Minimum RF Output Power (5W)	8.4A	116W
50% RF Output Power (25W)	15A	207W
Maximum RF Output Power (50W)	21.6A	298W

24VDC Input

	A	W
Both Base Stations Idle*	1.1A	26W
*Neither base station is transmitting or receiving.		
Both Base Stations Transmitting		
Minimum RF Output Power (5W)	4.5A	108W
50% RF Output Power (25W)	8A	192W
Maximum RF Output Power (50W)	12.4A	298W

48VDC Input

	A	W
Both Base Stations Idle*	0.5A	24W
*Neither base station is transmitting or receiving.		
Both Base Stations Transmitting		
Minimum RF Output Power (5W)	2.2A	106W
50% RF Output Power (25W)	3.9A	187W
Maximum RF Output Power (50W)	6.2A	298W

1.6 P25 CG Console Gateway Power Consumption

Console Gateway Power Consumption with PMU - 12.5V Supply

	A	W
Nominal Operation	1.28A	16W

Power Consumption for Console Gateway alone - 28VDC Input

	A	W
Nominal Operation	0.31A	8.7W

1.7 P25 TAG Trunked Analog Gateway Power Consumption

Trunked Analog Gateway Power Consumption with PMU - 12.5V Supply

	A	W
Nominal Operation	1.28A	16W

Power Consumption for Trunked Analog Gateway alone - 28VDC Input

	A	W
Nominal Operation	0.31A	8.7W

1.8 BTU Load Values

	W	BTU/h
Base Station*		
5W	45W	154BTU/h
50W	86W	292BTU/h
100W	225W	768BTU/h

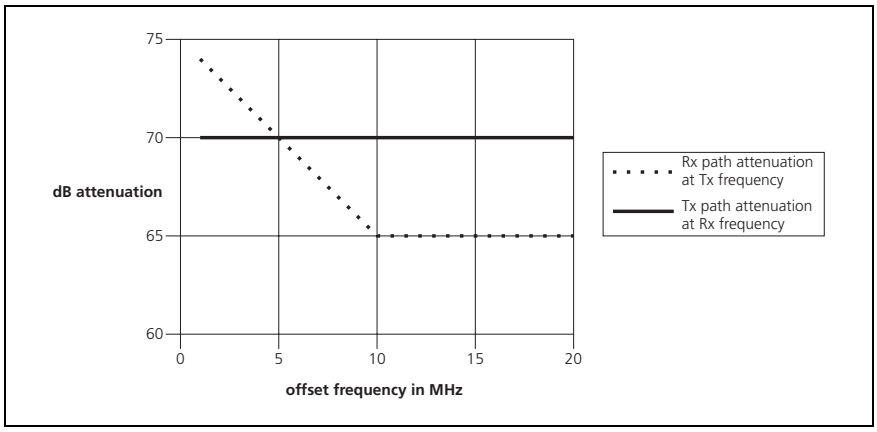
*Transmitting at rated output power.

1.9 TB9100 Base Station Duplexer Attenuation Requirements

These requirements are specifically for the base station, not for the console gateway or trunked analog gateway.

The following graph shows the attenuation requirements for duplexers used with the base station. The dotted plot represents the attenuation required in the Rx path at the Tx frequency, while the continuous plot shows the attenuation required in the Tx path at the Rx frequency.

A 100W transmitter is assumed. The quoted attenuation will ensure not more than 1dB receiver desensitization, and has a 5dB margin built in.



1.10 Channel Group Limitations

For a discussion of the significance of these limitations, see the System Manual.

Maximum Number of Members	14
Maximum Preamble Length	300 ms
Maximum Marshalling Duration	150 ms (simulcast operation)
Maximum Central Voter Speech Packet Arrival Time Skew	100 ms

1.11 Miscellaneous

Dimensions and Weight

Dimensions	
Height	176.8 mm (7 in)
Width	482.6 mm (19 in)
Length	
Subrack Only	385 mm (15.2 in)
Including Front Panel	410 mm (16.1 in)
Weight*	
5/50 W Base Station System	21.5 kg (47.4 lb)
100 W Base Station System	22.8 kg (50.3 lb)

*with AC and DC PMU

Reliability

MTBF	≥80,000 hours (estimated)

2 Reciter Specifications

This chapter provides specifications pertaining to the receiver and exciter circuitry within the reciter module. However, the transmitter RF specifications which pertain to the combination of exciter and power amplifier are given in "Transmitter RF Section" on page 55. RF specifications do not apply to the P25 CG console gateway or P25 TAG trunked analog gateway.

The performance figures given in these specifications are applicable only to equipment operating as an integral part of a TB9100 base station, P25 CG console gateway, and P25 TAG trunked analog gateway. These performance figures are minimum figures, unless otherwise indicated (e.g. "typical"), for equipment tuned with the maximum switching range and operating at standard room temperature (+22°C to +28°C [+71.6°F to +82.4°F]) and standard test voltage (28VDC).

Where applicable, the test methods used to obtain these figures are those described in the ANSI/TIA-603-B-2002, TIA 102_CAAA_A and ETSI-EN specifications. This equipment is compatible with 11K0F3E, 16K0F3E, 6K60F2D, 9K60F2D, 8K10F1E, 10K0F1E, 8K10F1D, 10K0F1D, 8K10F7E, 10K0F7E, 8K10F7D and 10K0F7D emissions. You can obtain further details of test methods and the conditions which apply for compliance testing in all countries from Tait.

The software release notes list known issues or limitations of the base station that may vary from the specifications published in this document. Please refer to the current software release notes for any variations to the specifications in this document.

Analog Bandwidth

The terms "wide bandwidth", "mid bandwidth" and "narrow bandwidth" used in this and following sections are defined in the following table.

	Channel Spacing	Modulation 100% Deviation (Nominal)	Receiver IF Bandwidth
Narrow Bandwidth (NB)	12.5kHz	±2.5kHz	7.5kHz
Mid Bandwidth[a] (MB)	20kHz	±4kHz	12kHz
Wide Bandwidth (WB)	25kHz	±5.0kHz	15.0kHz

a. Mid bandwidth is available only in H band reciters (380MHz to 520MHz).

Sensitivity and distortion figures are stated for standard operating conditions which includes audio de-emphasis. Note that the sensitivity, distortion and signal-to-noise figures will be degraded when flat audio is selected.

FCC Narrowbanding Regulations

The following information applies to all base stations, not just to those sold in countries where FCC regulations apply.

From 1 January 2013 it is an FCC requirement that land mobile radio systems must not operate channels with a bandwidth greater than 12.5kHz in the 150–174MHz and 421–470MHz frequency bands. From this date all base stations will be supplied with firmware that requires a software feature license to operate a mid-bandwidth or wide bandwidth channel in these frequency bands.

The TBAS083 20/25kHz Unrestricted Wideband feature license is available to any customer who is not subject to the relevant FCC regulations, or who has an FCC waiver. Note that this feature license is also required to operate a mid-bandwidth or wide bandwidth channel on the spot frequencies which are exempt from the FCC requirement. To obtain the feature license, or for more information about it, contact your regional Tait office.

Identifying the Base Station Reciter

You can identify the model and hardware configuration of a base station reciter by referring to the product code printed on a label on the rear panel. The meaning of each character in the product code is explained in the table below.

This explanation of reciter product codes is not intended to suggest that any combination of features is necessarily available in any one reciter. Consult your regional Tait office for more information regarding the availability of specific models and options.

Product Code	Description
TBA**X**XXX-XXXX	4 = reciter 5 = receive only
TBAX**X**XX-XXXX	0 = default
TBAXX**XX**-XXXX	**Frequency Band and Sub-band** B2 = 136MHz to 156MHz B3 = 148MHz to 174MHz H1 = 400MHz to 440 MHz H2 = 440MHz to 480MHz H3 = 470MHz to 520MHz H4 = 380MHz to 420MHz K4 = 762MHz to 870MHz[a] L1 = 852MHz to 854MHz and 928MHz to 930MHz[b]
TBAXXXX-**XXXX**	**Network Board** PA00 = P25 network board without encryption (conventional) PB00 = P25 network board (trunked) PAC0 = P25 network board with encryption PAC1 = P25 CG console gateway module without RF PBC1 = P25 TAG trunked analog gateway module without RF

a. The actual frequency coverage in this band is:
Transmit: 762MHz to 776MHz and 850MHz to 870MHz
Receive: 792MHz to 824MHz

b. L1-band reciters currently only have compliance for sale in Australia, and are unavailable in other markets.

Identifying the Gateway

You can identify the model and hardware configuration of a console gateway or trunked analog gateway by referring to the product code printed on a label on the rear panel. The meaning of each character in the product code is explained in the table below.

This explanation of gateway product codes is not intended to suggest that any combination of features is necessarily available. Consult your regional Tait office for more information regarding the availability of specific models and options.

Product Code	Description
TBA**XX**XXXX	GW = gateway
TBAGW**X**XXX	**PMU type** 0 = no PMU (DC only, external power supply required) A = AC PMU, 12VDC auxiliary power supply B = AC PMU, 24VDC auxiliary power supply C = 12VDC PMU, 12VDC auxiliary power supply D = 12VDC PMU, 24VDC auxiliary power supply E = 24VDC PMU, 12VDC auxiliary power supply F = 24VDC PMU, 24VDC auxiliary power supply G = 48VDC PMU, 12VDC auxiliary power supply H = 48VDC PMU, 24VDC auxiliary power supply J = AC and 12VDC PMU, 12VDC auxiliary power supply K = AC and 12VDC PMU, 24VDC auxiliary power supply L = AC and 24VDC PMU, 12VDC auxiliary power supply M = AC and 24VDC PMU, 24VDC auxiliary power supply N = AC and 48VDC PMU, 12VDC auxiliary power supply P = AC and 48VDC PMU, 24VDC auxiliary power supply
TBAGWX**X**XX	**Number of channels** 1 to 5 with PMU 1 to 7 without PMU
TBAGWXX**X**X	0 = default
TBAGWXXX**X**	0 = console gateway 1 = trunked analog gateway

2.1 General

Number of Channels	255
Channel Change Time	300ms
Supply Voltage	
Operating Voltage	10.8VDC to 32VDC (non-operating survival voltage ≤ 36VDC)
Standard Test Voltage	28VDC
Polarity	negative earth
Polarity Protection	Zener diode and thermal resistor
Supply Current*	
12VDC	<580mA
28VDC	<330mA
*receiver and exciter operating	
Operating Temperature Range	-30°C to +60°C (-22°F to +140°F) ambient temperature* *ambient temperature is defined as the temperature of the air immediately in front of the control panel
Cooling	forced air via reciter fan
Connectors	
RF Input	BNC female or TNC female
RF Output	SMA female
Recommended SMA Torque	0.6N·m (5lbf·in)
Control and Alarm	16-way IDC male
External Reference Frequency Input	BNC female
28VDC Input	4-way Micro-Fit 3.0 (Molex) male
Ethernet	RJ45
Audio	Keyed RJ45
Serial	9-way D-range
Dimensions	
Height	143.6mm (5.7in)
Width	54.6mm (2.1in)
Length	333.3mm (13.1in)
Weight	2.4kg (5.3lb)

2.2 Receiver RF Section

The specifications in Section 2.2 apply to the TB9100 base station.

Receiver RF Section - General

Frequency Bands	
B Band	136 MHz to 174 MHz
H Band	380 MHz to 520 MHz
K Band	792 MHz to 824 MHz
L Band	852 MHz to 854 MHz and 928 MHz to 930 MHz
Frequency Sub-bands	
B2	136 MHz to 156 MHz
B3	148 MHz to 174 MHz
H1	400 MHz to 440 MHz
H2	440 MHz to 480 MHz
H3	470 MHz to 520 MHz
H4	380 MHz to 420 MHz
K4	792 MHz to 824 MHz
L1	852 MHz to 854 MHz and 928 MHz to 930 MHz
Type	triple conversion superheterodyne; first conversion is analog, second is hybrid, and third is digital
Frequency Increments	
Synthesizer	
B Band	3.125 kHz and 2.5 kHz
H, K and L Bands	5 kHz and 6.25 kHz
Fine Tuning*	125 Hz steps
*receiver selectivity may be slightly degraded if fine tuning is used	
Switching Range	> 2% of the center frequency* *for example: B band 3MHz @ 150MHz H Band 10MHz @ 500MHz K Band 18MHz between 792MHz and 824MHz L Band 852 MHz to 854 MHz and 928 MHz to 930 MHz
Input Load Impedance	50Ω nominal (VSWR < 2:1)
RF Input Protection	no degradation after 5 minutes exposure to on-channel signals at +20 dBm (2.2 V)

Receiver RF Section - General (Continued)

Frequency Stability	
Internal Reference	±0.5ppm –30°C to +60°C (–22°F to +140°F)
External Reference	
B and H Bands	±1Hz ± multiplied accuracy of external reference
K and L Bands	±2Hz ± multiplied accuracy of external reference
RSSI	-120dBm to -60dBm
IF Stages - B Band	
Frequencies	
Analog	16.9MHz
Digital	16.9MHz and 0Hz
Analog IF Bandwidths	
Narrow Bandwidth	9kHz, -3dB
Wide Bandwidth	20kHz, -3dB
Digital IF Bandwidths	
Narrow Bandwidth	8.8kHz, -3dB
Wide Bandwidth	14.0kHz, -3dB
IF Stages - H, K and L Bands	
Frequencies	
Analog	70.1MHz
Digital	9.9MHz and 0Hz
Analog IF Bandwidth	20kHz, -4dB
Digital IF Bandwidths	
Narrow Bandwidth	8.8kHz, -3dB
Mid Bandwidth	12.0kHz, -3dB
Wide Bandwidth	14.0kHz, -3dB
Offset Selectivity*	> 20dB
*K band wide bandwidth only	
Amplitude Characteristic*	≤ 3dB (ETSI)
*RF Input Level -107dBm to -13dBm	
Spurious Emissions	
Conducted	< -90dBm 9 kHz to 1GHz
	< -70dBm 1GHz to 4GHz
Radiated	< -57dBm 30 MHz to 1GHz
	< -47dBm 1GHz to 4GHz

Receiver RF Section - Analog

Analog Sensitivity*	
De-emphasized Response	
Center of Switching Range	< -119 dBm (0.25 µV) at 25°C**
Edge of Switching Range	< -117 dBm (0.32 µV) at 25°C**
Flat Response	
Center of Switching Range	< -117.5 dBm (0.30 µV) at 25°C**
Edge of Switching Range	< -115.5 dBm (0.38 µV) at 25°C**
*12 dB SINAD	**up to 2 dB degradation at extremes of temperature

Maximum Usable Analog Sensitivity*	
De-emphasized Response	
Center of Switching Range	< -116 dBm (0.35 µV) at 25°C (NB)** < -118 dBm (0.28 µV) at 25°C (WB)**
Edge of Switching Range	< -114 dBm (0.45 µV) at 25°C (NB)** < -116 dBm (0.35 µV) at 25°C (WB)**
Flat Response	
Center of Switching Range	< -112 dBm (0.56 µV) at 25°C (NB)** < -116 dBm (0.35 µV) at 25°C (WB)**
Edge of Switching Range	< -110 dBm (0.71 µV) at 25°C (NB)** < -114 dBm (0.45 µV) at 25°C (WB)**
*sensitivity for 20 dB SINAD, psophometrically weighted, RF source modulated at 60% deviation with 1 kHz	**up to 2 dB degradation at extremes of temperature

Analog Selectivity	EIA-603	TIA/EIA-603-B	ETSI
B Band			
Narrow Bandwidth	85 dB*	50 dB*	85 dB*
Wide Bandwidth	90 dB*	87 dB*	—
H Band			
Narrow Bandwidth	85 dB*	46 dB*	85 dB*
Mid Bandwidth	—	—	85 dB*
Wide Bandwidth	90 dB*	82 dB*	—
K and L Bands			
Narrow Bandwidth	79 dB*	45 dB*	—
Wide Bandwidth	84 dB*	75 dB*	—

*up to 5 dB degradation at extremes of switching range and temperature

Analog Signal Displacement Bandwidth	> 40% of the rated system deviation
Analog Spurious Response Attenuation	≥ 100 dB (ANSI/TIA)* ≥ 90 dB (ETSI) *AGC switched off in H band reciter

Receiver RF Section - Analog (Continued)

Analog Ultimate Signal-to-Noise Ratio*

B and H Bands	
Narrow Bandwidth	45 dB (ANSI/TIA)**
	50 dB (CEPT - psophometric)**
Mid Bandwidth+	50 dB (ANSI/TIA)**
Wide Bandwidth	55 dB (ANSI/TIA)**
K and L Bands	
Narrow Bandwidth	43 dB (ANSI/TIA)**
Wide Bandwidth	47 dB (ANSI/TIA)**

*at –47 dBm

+H band only

**up to 5 dB degradation at extremes of switching range and temperature

Analog Intermodulation Response Attenuation

B Band	
Narrow Bandwidth	78 dB (ETSI)*
Wide Bandwidth	85 dB (ANSI/TIA)*
H Band	
Narrow Bandwidth	80 dB (ETSI)*
Mid Bandwidth	80 dB (ETSI)*
Wide Bandwidth	85 dB (ANSI/TIA)*
K and L Bands	
Narrow Bandwidth	80 dB (ANSI/TIA)*
Wide Bandwidth	85 dB (ANSI/TIA)*

*up to 5 dB degradation at extremes of switching range and temperature

Analog Blocking Rejection

B and H Bands	
1 to 10 MHz	100 dB (ETSI)
>10 MHz	110 dB (ETSI)
±1, ±2, ±5 and ±10 MHz	100 dB (ANSI/TIA)*
K and L Bands	
1 to 10 MHz	100 dB (ANSI/TIA)
>10 MHz	110 dB (ANSI/TIA)
±1, ±2, ±5 and ±10 MHz	100 dB (ANSI/TIA)

*AGC switched off in H band reciter

Analog Co-channel Rejection

Narrow Bandwidth	–8 dB
Mid Bandwidth*	–8 dB
Wide Bandwidth	–5 dB

*H band only

20 dB FM quieting (measured with de-emphasis on)	-113 dBm for NBFM -117 dBm for WBFM

Receiver RF Section - Digital

Digital Sensitivity	TIA 102A_CAAA at 25°C:
Center of switching range	< -120.5dBm @ 5% BER -119dBm @ 2.6% BER (DAQ 3.0) -118.5dBm @ 2.0% BER (DAQ 3.4) -117.5dBm @ 1.0% BER (DAQ 4.0)
Digital Faded Sensitivity	TIA 102A_CAAA: -115dBm @ 5% BER -114dBm @ 2.6% BER (DAQ 3.0) -113.5dBm @ 2.0% BER (DAQ 3.4) -112.5dBm @ 1.0% BER (DAQ 4.0)
Digital Adjacent Channel Rejection	60dB TIA 102A + ETSI 300 -113 (across all bands)
Digital Signal Displacement Bandwidth	T1A 102_CAAA
Digital Spurious Response Attenuation	≥ 95dB TIA 102
Digital Intermodulation Response Attenuation	
B and H Bands	
Narrow Bandwidth	80dB (TIA 102)*
Mid Bandwidth**	80dB (TIA 102)*
Wide Bandwidth	80dB (TIA 102A)*
K and L Bands	
Narrow Bandwidth	75dB (TIA 102)*
Wide Bandwidth	75dB (TIA 102)*
**H band only	*up to 5dB degradation at extremes of switching range and temperature
Digital Blocking Rejection	
B and H Bands	
1 to 10MHz	95dB (TIA 102)
>10MHz	95dB (TIA 102)
±1, ±2, ±5 and ±10MHz	95dB (TIA 102)*
K and L Bands	
1 to 10MHz	95dB (TIA 102)
>10MHz	95dB (TIA 102)
±1, ±2, ±5 and ±10MHz	95dB (TIA 102)
	*AGC switched off in H band reciter
Digital Co-channel Rejection	-7dB (TIA 102A_CAAA)
Signal Delay Spread Capability	50μs (TIA 102)

2.3 Receiver Audio Section

The specifications in Section 2.3 apply to the TB9100 base station.

Receiver Audio Section - General

Outputs Available	speaker output via control panel balanced line outputs via network board Ethernet
Frequency Response	flat or de-emphasized (750 µs)
De-emphasized Response	
Bandwidth	300 Hz to 2.55 kHz (NB) 300 Hz to 3.4 kHz (MB)* 300 Hz to 3.4 kHz (WB)
Response	within +1, -3 dB of a -6 dB/octave de-emphasis curve (ref. 1 kHz) *H band only
Flat Response	
Bandwidth	67 Hz to 2.55 kHz (NB) 67 Hz to 3.4 kHz (MB)* 67 Hz to 3.4 kHz (WB)
Response	within +1, -3 dB of output level at 1 kHz *H band only
Bulk Delay*	264 ms
*from antenna to audio output	
Group Delay	
Receiver	≤ 40 µs pp 300 Hz to 3.4 kHz
Talk Through Repeater	≤ 40 µs pp 300 Hz to 3.4 kHz
Full Flat Audio Path	≤ 40 µs pp 300 Hz to 3.4 kHz
Speaker Output (via Control Panel)	
Power	0.5 W maximum
Speaker Impedance	16 Ω nominal
Distortion*	≤ 3% at 1 kHz, 0.35 W, 16 Ω
*at -70 dBm RF signal level, de-emphasis selected	

Receiver Audio Section - CTCSS

High Pass (Subaudible) Filter

Bandwidth	300 Hz to 2.55 kHz (NB) 300 Hz to 3.4 kHz (MB)* 300 Hz to 3.4 kHz (WB)
Response	within +1, -3 dB of level at 1 kHz
Hum and Noise**	30 dB minimum at 250.3 Hz 35 dB typical (67 Hz to 240 Hz)

**1 kHz at 60% system deviation, CTCSS at 10% system deviation

*H band only

Tone Detect

Tone Squelch Opening	better than 6 dB SINAD 3 dB SINAD at 250.3 Hz (typical) 4 dB SINAD at 100 Hz (typical)
Tone Detect Bandwidth	±2 Hz accept (typical) ±3 Hz reject (typical)
Response Time	≤ 120 ms open and close (typical)

Receiver Audio Section - Analog Gating Operation

Systems Available	SINAD gating (noise mute) RSSI gating (carrier mute)

SINAD Gating

Opening Level	8 dB to 20 dB SINAD
Accuracy	±3 dB
RF Hysteresis*	1.5 dB to 6 dB
Opening Time	≤ 20 ms
Closing Time	50 ±10 ms

*programmable

RSSI Gating

Opening Level	-117 dBm to -70 dBm
Accuracy	±3 dB
Hysteresis*	2 dB to 10 dB
Opening Time	≤ 5 ms
Closing Time	50 ±10 ms

*programmable

Receiver Audio Section - Digital Gating Operation

Digital Gating	Set by digital sensitivity (see "Digital Sensitivity" on page 34).

2.4 Exciter RF Section

The specifications in Section 2.4 apply to the TB9100 base station.

Frequency Bands	
B Band	136 MHz to 174 MHz
H Band	380 MHz to 520 MHz
K Band	762 MHz to 776 Mhz and 850 MHz to 870 MHz
L Band	852 MHz to 854 MHz and 928 MHz to 930 MHz
Frequency Sub-bands	
B2	136 MHz to 156 MHz
B3	148 MHz to 174 MHz
H1	400 MHz to 440 MHz
H2	440 MHz to 480 MHz
H3	470 MHz to 520 MHz
H4	380 MHz to 420 MHz
K4	762 MHz to 776 Mhz and 850 MHz to 870 MHz
L1	852 MHz to 854 MHz and 928 MHz to 930 MHz
Modulation Types	11K0F3E, 16K0F3E, 6K60F2D, 9K60F2D, 8K10F1E, 10K0F1E, 8K10F1D, 10K0F1D, 8K10F7E, 10K0F7E, 8K10F7D and 10K0F7D
Frequency Increments	
Synthesizer	
B Band	3.125 kHz and 2.5 kHz
H, K and L Bands	5 kHz and 6.25 kHz
Fine Tuning	125 Hz steps
Switching Range	
B Band	8 MHz
H Band	10 MHz
K Band	762 MHz to 776 Mhz and 850 MHz to 870 MHz
L Band	852 MHz to 854 MHz and 928 MHz to 930 MHz
Output Load Impedance	50 Ω nominal (VSWR <2:1)
Frequency Stability*	±0.5 ppm -30°C to +60°C (-22°F to +140°F)

*For K4 band (762 MHz to 776 MHZ) - the internal frequency reference accuracy is inadequate, and an external reference (e.g. Tait T801-02) must be used. The stability of this reference should be better than 50 parts per billion. See "External Reference Input" on page 40.

Power Output	+11 dBm ± 2 dB

2.5 Exciter Audio Section

The specifications in Section 2.5 apply to the TB9100 base station.

Exciter Audio Section - Inputs

Inputs Available	microphone input via control panel balanced line inputs via network board Ethernet RF-received audio (internal)
Microphone Input	
Input Level Range*	80 dB SPL to 115 dB SPL
Impedance	600 Ω
Compressor	
Attack Time	10 ms
Decay Time	800 ms
Dynamic Range	35 dB
Distortion	≤ 3%
*60% modulation at 1 kHz	

Exciter Audio Section - Analog Modulation Characteristics

Frequency Response*	flat or pre-emphasized**
*below limiting	**microphone input via control panel, balanced line inputs via network board
Line and Microphone Inputs	
Pre-emphasized Response	
Bandwidth	300 Hz to 2.55 kHz (NB) 300 Hz to 3 kHz (MB)* 300 Hz to 3 kHz (WB)
Below Limiting	within +1, -3 dB of a 6 dB/octave pre-emphasis curve (ref. 1 kHz)
Flat Response	
Bandwidth	67 Hz to 2.55 kHz (NB) 67 Hz to 3 kHz (MB)* 67 Hz to 3 kHz (WB)
Response	within +1, -3 dB of output level at 1 kHz *H band only
Above Limiting Response	within +1, -2 dB of a flat response (ref. 1 kHz)
Distortion	< 3% typical

Exciter Audio Section - Analog Modulation Characteristics (Continued)

Hum and Noise	
Narrow Bandwidth	-50 dB typical (ETSI)*
Mid Bandwidth**	-50 dB typical (ETSI)*
Wide Bandwidth	-51.5 dB typical, 300 Hz to 3 kHz (ANSI/TIA)*
**H band only	*up to 5 dB degradation at extremes of switching range and temperature
Bulk Delay	These specifications will vary according to the system configuration. If this information is required, please contact Technical Support (refer to "Contact Information" on page 2).
Group Delay	
Transmitter	≤ 40 µs pp 300 Hz to 3.4 kHz
Talk Through Repeater Full Flat	≤ 40 µs pp 300 Hz to 3.4 kHz

Exciter Audio Section - Digital Modulation Characteristics

Modulation Fidelity	< 3% TIA 102A

Exciter Audio Section - CTCSS

Standard Tones	all 37 ANSI/TIA group A, B and C tones plus 13 commonly used tones
Frequency Error*	0.08% maximum
*from ANSI/TIA tones	
Generated Tone Distortion	1.2% maximum
Generated Tone Flatness	flat across 67 Hz to 250.3 Hz to within 1 dB
Modulation Level	adjustable
Modulated Distortion	< 5%

2.6 External Reference Input

Frequencies*	10MHz or 12.8MHz
*One frequency must be specified by the CSS.	
Lock Range	±50Hz
Input Level	300mVpp to 5Vpp
Input Impedance	≥ 1kΩ

2.7 Ethernet Interface (RJ45)

Transceiver	10/100 Base-Tx/Rx
IEEE-spec	IEEE802.3 and 802.3u

2.8 Audio Line Connector (RJ45) (Keyed)

Audio Input

Input Impedance	600 Ω nominal
Return Loss	> 20dB (450 to 3400Hz) > 16dB (300 to 450Hz)
Longitudinal Conversion Loss	> 40dB (300 to 600Hz) > 46dB (600 to 3400Hz)
Input Level Range	-20dBm to 0dBm nominal (300 to 3400Hz) -20dBm to -14dBm nominal (67 to 300Hz)
Input Level Accuracy	±0.5dB (1kHz, -20dBm to 0dBm)
Input Gain Steps	0.1dB nominal
Frequency Response	+0.5/-2.0dB rel. 1kHz (300 to 3000Hz) +0.5/-3.0dB rel. 1kHz (67 to 300Hz, 3000 to 3400Hz)
Audio Distortion	< 3% typical* * provided reciter power supply > 12V (base station with PMU or 12V PA will normally guarantee reciter voltage supply > 12V)

Audio Output

Output Impedance	600 Ω
Return Loss	> 16dB (450 to 3400Hz) > 12dB (300 to 450Hz)
Output Level Range	-20dBm to +6dBm nominal (300 to 3400Hz) -20dBm to -14dBm nominal (67 to 300Hz)
Output Level Accuracy	±0.5dB (1kHz, -20dBm to -6dBm output)
Output Level Steps	0.1dB nominal
Input Gain Steps	0.1dB nominal
Frequency Response	+0.5/-2.0dB rel. 1kHz (300 to 3000Hz, 0dBm output) +0.5/-3.0dB rel. 1kHz (67 to 300Hz, -14dBm output) +0.5/-3.0dB rel. 1kHz (3000 to 3400Hz, 0dBm output)
Audio Distortion	< 3% typical* * provided reciter power supply > 12V (base station with PMU or 12V PA will normally guarantee reciter voltage supply > 12V)
Out-of-band Noise	< -36dBm (4.3 to 5kHz, 300Hz BW) < -46dBm (5 to 7kHz, 300Hz BW) < -41dBm (7 to 200kHz, 1kHz BW) < -45dBm (200kHz to 2MHz, 10kHz BW)

Tone Signaling (Tone Remote)

Keytone Accept Limit	±16Hz at 2175Hz, speech at -10dBm, keytone at -30dBm
Keytone Reject Limit	±32Hz at 2175Hz
Talkoff (maximum difference between speech and keytone)	> 27 dB
Keytone Sensitivity	> -50dBm (keytone is typically -20dBm down on mean speech level)

Keytone Frequencies (Hz)

2100	2175	2300	2325	2500	2600	2800	2970	3000

Function Tone Frequencies

Hz	550	650	750	850	950	1050	1150	1250	1350	1450	1550	1650	1750	1850	1950	2050
Event	00	11	22	33	44	55	66	77	88	99	AA	BB	CC	DD	EE	FF

Guard Tone Notch

Notch Filter Bandwidth at -40dB	±10Hz
Notch Filter Bandwidth at -3dB	±28Hz

Center Freq	-3dB, cf-28	-40dB, cf-10	-40dB, cf+10	-3dB, cf+28
2100	2072	2090	2110	2128
2175	2147	2165	2185	2203
2300	2272	2290	2310	2328
2325	2297	2315	2335	2353
2500	2472	2490	2510	2528
2600	2572	2590	2610	2628
2800	2772	2790	2810	2828
2970	2942	2960	2980	2998
3000	2972	2990	3010	3028

MDC1200

Tx Level	-10dBm to -30dBm
Rx Level	+3 to -30dBm
Baud Rate	1200 baud
Frequencies	1200Hz, 1800Hz

E&M Signaling Interface[a]

E Line:	
Input On State Control Current	$\|I_{ON}\|$ < 6mA (input is polarity insensitive)
Input Off State Control Current	$\|I_{OFF}\|$ > 100µA
Input On State Control Voltage	$\|V_{ON}\|$ < 10V
Maximum Input Control Voltage	$\|V_{MAX}\|$ > 60V (internally current limited)
Input Response Time	t < 1ms (not including software response time)
M Line:	
Output Switching Voltage	$\|V_{SW}\|$ > 60V (output is polarity insensitive)
Output On Resistance	R_{ON} < 40 Ω ($\|I_{OUT}\|$ = 100mA)
Switched Output Load Current	$\|I_{OUT}\|$ > 100 mA
Output Off State Leakage Current	$\|I_{LKG}\|$ < 10µA ($\|V\|$ < 60V)
Output Response Time	t < 5ms (not including software response time)

a. The specifications show either minimum values (>) or maximum values (<).

2.9 Digital Interface 9 Way ‘D’ Connector

Asynchronous Serial Port

Port Type	DCE (only TxD and RxD lines supported)
Signal Levels	RS-232 compatible
Format	8 bit ASCII, 1 stop bit, no parity
Baud Rate	9600 to 115,200 bps (default setting 57k6 bps)

Analog RSSI Interface

Not available in all software versions. These specifications apply to the TB9100 base station.

Output Impedance	100 Ohms
Output Level Range	0.5 to 4.5V
Accuracy	±3dB
Response Time	<= 5ms
Rf Input Range	-130dBm to -60dBm

RSSI Output Configured as a Digital Output

Not available in all software versions. These specifications apply to the TB9100 base station.

Output Low Voltage	$V_{OL} \leq 0.5V$ (I_{OL} = 500µA) $V_{OL} \leq 0.8V$ (I_{OL} = 2mA)
Output High Voltage	$V_{OH} \geq 3.5V$ [TTL and 5V CMOS compatible] (I_{OH} = -100µA)

External General Purpose Digital Inputs

Input Low Threshold	$V_{IL} \geq 0.8V$
Input High Threshold	$V_{IH} \leq 2.0V$
Input Source Current	$I_{IL} > -1mA$ ($V_{IL} = 0V$)
Continuous Input Voltage	$\|V_{IN}\| \leq 30V$
Transient Input Voltage	$\|V_{IN}\| \leq 50V$ ($t \leq 1s$)

External Auxiliary Digital Outputs (includes Antenna Relay)

Output Low Voltage	$V_{OL} \leq 0.6V$ ($I_{OL} = 250mA$)
Output High Voltage	$V_{OH} \geq 3.5V$ [TTL and 5V CMOS compatible] ($I_{OH} = -100\mu A$)
Maximum Off-state Voltage	$-0.3V \leq V_{OH} \leq 30V$ (transients outside this range may be clamped)
Off-state Leakage Current	$I_{OH} \leq 6mA$ ($V_{OH} = 30V$, pulled up through an external load)

2.10 1 PPS Specifications

Frequency	1 PPS (required for Simulcast)
Polarity	Rising edge represents timing reference
Maximum Low Level Voltage	0.7V
Minimum High Level Voltage	2.6V
Impedance	High
Supported High Level Pulse Duration	30µs to 995ms
Transient Input Voltage	$\|V_{IN}\| \leq 50V$

2.11 Trunked Analog Gateway User Feedback Tones

The trunked analog gateway provides the dispatcher with the following tones to indicate call status.

	Frequency	**Duration**
Call Queued	500Hz	500ms with a gap of 250ms (repeating)
Go Ahead	900Hz	25ms with a gap of 25ms (3 beeps)
Call Deny	500Hz	500ms (1 beep)
Incoming Individual Call	1000Hz and 800Hz (dual tone)	1600ms with a gap of 800ms (repeating)
Line Level of User Feedback Tones		
Default	–13dBm0	
Range of Adjustment	–7dBm0 to –30dBm0	

2.12 Compliance Standards

Where applicable, this equipment has been tested and approved to the following standards.

RF	EN 300 086-2 EN 300 113-2 AS/NZS 4295 CFR Title 47 Parts 15, 22, 74, 80, 90 and 95a RSS-119 TIA 603 TIA 102_CAAB
EMC	ETSI EN 301 489-5 CFR Title 47 Part 15
EMC Regulatory Compliance in Australia 	This product meets all ACMA regulatory requirements for electromagnetic compatibility (EMC). For more information about EMC compliance, visit the ACMA website at www.acma.gov.au.
Safety	EN 60950-1
Environmental	
Low Pressure (Altitude)[a]	MIL-STD-810F 500.4 Proc 2
Humidity	IEC60068-2-30
Vibration	MIL-STD-810F 514.5 Proc 1
Shock	MIL-STD-810F 516.5 Proc 1
Leased line approvals	Europe CE Canada CS-03 Australia AS/ACIFS043 New Zealand PTC 100
Fixed Station Interface (analog and digital)	TIA 102-BAHA

a. 15000 ft (4572 m).

3 Power Amplifier and Transmitter Specifications

This chapter provides specifications pertaining to the power amplifier as a separate module. It also includes a number of transmitter RF specifications which pertain to the combination of power amplifier and exciter.

The specifications in this chapter apply only to the TB9100 base station.

The performance figures given in these specifications are applicable only to equipment operating as an integral part of a TB9100 base station. These performance figures are minimum figures, unless otherwise indicated, for equipment operating at standard room temperature (+22°C to +28°C [+71.6°F to +82.4°F]) and standard test voltage (28VDC).

Where applicable, the test methods used to obtain these figures are those described in the ANSI/TIA-603-B-2002, TIA 102_CAAA_A and ETSI-EN specifications. This equipment is compatible with 11K0F3E, 16K0F3E, 6K60F2D, 9K60F2D, 8K10F1E, 10K0F1E, 8K10F1D, 10K0F1D, 8K10F7E, 10K0F7E, 8K10F7D and 10K0F7D emissions. You can obtain further details of test methods and the conditions which apply for compliance testing in all countries from Tait.

The software release notes list known issues or limitations of the base station that may vary from the specifications published in this document. Please refer to the current software release notes for any variations to the specifications in this document.

Bandwidth

The terms “narrow bandwidth”, “mid bandwidth” and “wide bandwidth” used in this chapter are defined in the following table.

	Channel Spacing	Modulation 100% Deviation	Receiver IF Bandwidth
Narrow Bandwidth	12.5kHz	±2.5kHz	7.5kHz
Mid Bandwidth[a]	20kHz	±4kHz	12kHz
Wide Bandwidth	25kHz	±5kHz	15kHz

a. Mid bandwidth is available only in H band transmitters (380MHz to 520MHz).

FCC Narrowbanding Regulations

The following information applies to all base stations, not just to those sold in countries where FCC regulations apply.

From 1 January 2013 it is an FCC requirement that land mobile radio systems must not operate channels with a bandwidth greater than 12.5kHz in the 150–174MHz and 421–470MHz frequency bands. From this date all base stations will be supplied with firmware that requires a software feature license to operate a mid-bandwidth or wide bandwidth channel in these frequency bands.

The TBAS083 20/25kHz Unrestricted Wideband feature license is available to any customer who is not subject to the relevant FCC regulations, or who has an FCC waiver. Note that this feature license is also required to operate a mid-bandwidth or wide bandwidth channel on the spot frequencies which are exempt from the FCC requirement. To obtain the feature license, or for more information about it, contact your regional Tait office.

Identifying the PA

You can identify the model and hardware configuration of a PA by referring to the product code printed on labels on the heatsink and rear of the cover. The meaning of each character in the product code is explained in the table below.

This explanation of PA product codes is not intended to suggest that any combination of features is necessarily available in any one PA. Consult your regional Tait office for more information regarding the availability of specific models and options.

Product Code	Description
TBA**X**XXX-XXXX	7 = 5W 8 = 50W 9 = 100W
TBAX**X**XX-XXXX	0 = default 1 = 12V PA
TBAXX**XX**-XXXX	**Frequency Band and Sub-band** B1 = 136MHz to 174MHz H0 = 380MHz to 520MHz[a] K2 = 760MHz to 870MHz[b] L0 = 850MHz to 960MHz[c]
TBAXXXX-**X**XXX	0 = default
TBAXXXX-X**X**XX	0 = default
TBAXXXX-XX**X**X	0 = default
TBAXXXX-XXX**X**	0 = default

a. Only PAs with hardware version 00.02 and later can operate from 380MHz to 520MHz. PAs with hardware version 00.01 and earlier can only operate from 400MHz to 520MHz.

b. The actual frequency coverage in this band when used with a K-band TB9100 reciter is 762MHz to 776MHz and 850MHZ to 870MHz.

c. The actual frequency coverage in this band when used with an L-band TB9100 reciter is 852MHz to 854MHz and 928MHz to 930MHz. Only 5W L1-band PAs are available. They currently only have compliance for sale in Australia, and are unavailable in other markets.

General

Supply Voltage - 12V PA

Operating Voltage	10.5VDC ±0.25V to 16.8VDC*
Standard Test Voltage	12.5VDC
Minimum Startup Voltage	10.8VDC ±0.25V*
Polarity	negative earth only
Protection	
Wrong Input Voltage	electronic lock-out
Wrong Input Voltage Polarity	shunt diode**

Supply Voltage - 28V PA

Operating Voltage	26.5VDC to 29.5VDC
Standard Test Voltage	28VDC
Polarity	negative earth only
Polarity Protection	shunt diode

*These limits are set in hardware at the factory, and cannot be adjusted in normal operation by the user. However, the startup voltage can be increased to 12VDC ±0.25V by carrying out the hardware modifications described in TN-1305 ("Changing the Startup Voltage of a 12V PA").

**Circuit breaker or fuse in external wiring provided by user.

Supply Current - 12V PA*	Maximum	Typical
Standby	200mA	165mA
Transmit**		
5W PA @ 5W	1.5A	1.2A
50W PA @ 50W	10.2A	9.2A

Supply Current - 28V PA	Maximum	Typical
Standby	50mA	42mA
Transmit - B and H Bands**		
5W PA @ 5W	600mA	530mA
50W PA @ 50W	5A	4.2A
100W PA @ 100W	10A	8.3A
Transmit - K and L Bands**		
5W PA @ 5W	600mA	530mA
50W PA @ 50W***	5A	4.2A
100W PA @ 100W***	11A	8.5A

*measured at 12.5VDC input

**into a 50Ω load

***not available in L band

Operating Temperature Range	–30°C to +60°C (–22°F to +140°F) ambient temperature* *ambient temperature is defined as the temperature of the air at the intake to the cooling fan
Cooling	forced air over heatsink via fan mounted in subrack

General (Continued)

Connectors - 12V PA	
12VDC Input	Phoenix MSTBA2.5HC/2-G-5.08 male*
12VDC Output	4-way Micro-Fit 3.0 (Molex) female
RF Input	SMA female
RF Output	N-type female
Recommended SMA Torque	0.6N·m (5lbf·in)
Control and Alarm	16-way IDC male
	*this is the connector fitted to the PA; the matching connector for the DC input leads is the Phoenix MVSTBR2.5HC/2-ST/5.08 female
Connectors - 28V PA	
28VDC Input	Phoenix MVSTBR2.5HC/2-ST/5.08 female*
RF Input	SMA female
RF Output	N-type female
Control and Alarm	16-way IDC male
	*recommended screw torque 0.5N·m or 4.5lbf·in
Dimensions	
Height	86mm (3.4in)
Length	350mm (13.8in)
Width	
5W and 50W PAs	144mm (5.7in)
100W PA	177mm (7in)
Weight	
5 and 50W PAs	4.6kg (10.1lb)
100W PA	5.9kg (13.0lb)

Power Amplifier RF Section

Frequency Bands	Frequency	5W	50W	100W
B Band	136MHz to 174MHz	✓	✓	✓
H Band	380MHz to 520MHz*	✓	✓	✓
K Band	760MHz to 870MHz**	✓	✓	✓
L Band	850MHz to 960MHz**	✓	—	—

*Only PAs with hardware version 00.02 and later can operate from 380MHz to 520MHz. PAs with hardware version 00.01 and earlier can only operate from 400MHz to 520MHz.

**Refer to "Identifying the PA" on page 51 for the actual frequency coverage in this band when used with a TB9100 reciter.

Input Power	+11dBm ±2dB

Power Amplifier RF Section (Continued)

Output Power	
5W PA	
Rated Power	5W
Range of Adjustment	1W to 5W in 1W steps
50W PA	
Rated Power	50W
Range of Adjustment	5W to 50W in 1W steps
100W PA (28V PA only)	
Rated Power	100W
Range of Adjustment	10W to 100W in 1W steps
Output Power Accuracy*	±0.5dB into a 50Ω load
*within normal operating voltages and temperatures; measured directly on PA output	
Duty Cycle	100% at maximum rated output power* at +60°C (+140°F) ambient temperature *measured directly on PA output
Input Load Impedance	50Ω nominal (VSWR ≤1.8:1)
Output Load Impedance	50Ω nominal
Mismatch Capability	
Ruggedness	open and short circuit load at any phase angle for one hour*
Stability	5:1 load VSWR at all phase angles* *under power foldback
Protection	
Temperature	power foldback to 10% if RF power devices exceed safe operating conditions
Current	power foldback and shutdown if RF power devices exceed safe operating currents
Supply Voltage	power foldback to 10% when supply voltage is 24V to 26V and 30V to 32V; shutdown when supply voltage is < 24V and >32V
VSWR	power foldback to 10% at VSWR extremes; continuous analog power foldback to maintain 100% duty cycle into mismatched loads

Transmitter RF Section

The specifications in this section pertain only to the combination of a 5W, 50W or 100W power amplifier with a TB9100 reciter.

Adjacent Channel Power

Values when tested for TIA compliance (ETSI compliance in brackets, if different:

	UHF/VHF Steady Condition (TIA and ETSI)	UHF/VHF Transient Condition (ETSI only)	800/900MHz (TIA only)
Narrow Bandwidth	< -60dBc	< -50dBc	< -65dBc
Mid and Wide Bandwidth	< -70dBc	< -60dBc	< -75dBc
APCO C4FM*	< -67dBc (ETSI: -60)	< -50dBc	< -67dBc
TSM*	< -64dBc (ETSI: -60)	< 60dBc	< -64dBc
Wide Pulse**	< -70dBc	< -70dBc	< -70dBc

*Tested as for narrow band FM

**Tested as for wide band FM

Values for AS 4295 compliance are the same as for ETSI compliance. ETSI compliance has not been sought for 800MHz and 900MHz base stations.

Modulation Emission Spectrum

TIA 102_CAAB paragraphs 3.2.5.1 and 3.2.5.2

Sideband Noise*

B and H Bands	
±25kHz	< -137dBc/Hz
±1MHz	< -147dBc/Hz
±10MHz	< -147dBc/Hz at 5W < -157dBc/Hz at 50W < -160dBc/Hz at 100W
K and L Bands	
±25kHz	< -130dBc/Hz
±10MHz	< -160dBc/Hz at 5W < -156dBc/Hz at 100W

*no modulation, measured from center frequency

Hum and Noise

Narrow Bandwidth	-50dB (300Hz to 3kHz [ANSI/TIA])
Mid Bandwidth*	-54dB (300Hz to 3kHz [ANSI/TIA])
Wide Bandwidth	-55dB (300Hz to 3kHz [ANSI/TIA])

*H band only

Intermodulation

–40dBc with interfering signal at –30dBc at TB9100 base station RF output. For Europe, 70dB ratio is achieved using an external Circulator/Isolator with a minimum isolation of 30dB and less than 0.5dB insertion loss.

Transmitter RF Section (Continued)

Radiated Spurious Emissions	
Transmit - B and H Bands	< -36 dBm 30 MHz to 1 GHz < -30 dBm 1 GHz to 4 GHz
Transmit - K Band	<–20 dBm to 9 GHz
Transmit - L Band	<–20 dBm to 10 GHz
Standby	< -57 dBm to 1 GHz < -47 dBm 1 GHz to 4 GHz
Conducted Spurious Emissions	
Transmit - B and H Bands	< -36 dBm 9 kHz to 1 GHz < -30 dBm 1 GHz to 4 GHz
Transmit - K Band	< -20 dBm to 9 GHz
Transmit - L Band	<–30 dBm to 12.75 GHz
Standby	< -57 dBm to 1 GHz < -47 dBm 1 GHz to 12.75 GHz
Transient Behaviour - B and H Bands	complies with EN 300 113-1 v1.6.2 and EN 300 113-2 v1.4.2
Transmit Key Time*	
Key Up	
5 W PA	≤ 2.5 ms
50 and 100 W PAs	≤ 2 ms
Key Up Debounce Timer	20 ms
Key Down	
5 W PA	≤ 2.5 ms
50 and 100 W PAs	≤ 2 ms
Key Down Debounce Timer	20 ms
*with VCO in lock	
Continuous Repetitive Key Rate	24 Hz maximum
Lock Time	≤ 20 ms

Transmitter RF Section - Simulcast

Launch Time Accuracy*	± 1.5 microseconds
*Launch time offset adjustable in 1 microsecond increments.	
Deviation Accuracy	0.2 db (digital P25 only) 0.5 db (if simulcast is not enabled)
Frequency Accuracy	< 1 Hz (VHF and UHF) 2 Hz (800 MHz)

Transmitter RF Section - Simulcast (Continued)

Supported Simulcast Modulation Schemes	C4FM TSM* Wide pulse * TSM (Tait simulcast modulation) is a proprietary Tait Modulation Scheme that is designed to improve the delay spread capability of compatible receiving terminals.

Control and Monitoring

Control Inputs and Outputs	I^2C data, clock and ground PA key line input fan control output

Compliance Standards

Where applicable, this equipment has been tested and approved to the following standards.

RF	EN 300 086-2 EN 300 113-2 AS/NZS 4295 CFR Title 47 Parts 15, 22, 74, 80, 90 and 95a RSS-119 TIA 603 HKTA 1002* TS LMR* TIA 102_CAAB *H band only
EMC	ETSI EN 301 489-5 CFR Title 47 Part 15
EMC Regulatory Compliance in Australia N46	This product meets all ACMA regulatory requirements for electromagnetic compatibility (EMC). For more information about EMC compliance, visit the ACMA website at www.acma.gov.au.
Safety	EN 60950-1
Environmental	
Low Pressure (Altitude)[a]	MIL-STD-810F 500.4 Proc 2
Humidity	IEC60068-2-30
Vibration	MIL-STD-810F 514.5 Proc 1
Shock	MIL-STD-810F 516.5 Proc 1

a. 15000 ft (4572 m).

4 Power Management Unit Specifications

This chapter provides specifications pertaining to the power management unit (PMU) as a separate module.

The performance figures given in these specifications are applicable only to equipment operating as an integral part of a TB9100 base station, P25 CG console gateway, and P25 TAG trunked analog gateway. These performance figures are minimum figures, unless otherwise indicated, for equipment operating at standard room temperature (+22°C to +28°C [+71.6°F to +82.4°F]) and standard test voltages as follows:

- AC module - 230VAC
- 12V DC module - 12VDC
- 24V DC module - 24VDC
- 48V DC module - 48VDC.

Where applicable, the test methods used to obtain these figures are those described in the ETSI-EN specifications. You can obtain further details of test methods and the conditions which apply for compliance testing in all countries from Tait.

The software release notes list known issues or limitations of the base station that may vary from the specifications published in this document. Please refer to the current software release notes for any variations to the specifications in this document.

Identifying the PMU

You can identify the model and hardware configuration of a PMU by referring to the product code printed on a label on the rear panel. The meaning of each character in the product code is explained in the table below.

This explanation of PMU product codes is not intended to suggest that any combination of features is necessarily available in any one PMU. Consult your regional Tait office for more information regarding the availability of specific models and options.

Product Code	Description
TBA**X**XXX-XXXX	3 = PMU
TBA3**X**XX-XXXX	0 = default
TBA3X**X**X-XXXX	0 = AC module not fitted A = AC module fitted
TBA3XX**X**-XXXX	0 = DC module not fitted 1 = 12V DC module fitted 2 = 24V DC module fitted 4 = 48V DC module fitted
TBA3XXX-**X**XXX	0 = standby power supply card not fitted 1 = 12VDC standby power supply card fitted 2 = 24VDC standby power supply card fitted 4 = 48VDC standby power supply card fitted
TBA3XXX-X**X**XX	0 = auxiliary power supply board not fitted 1 = 12VDC auxiliary power supply board fitted 2 = 24VDC auxiliary power supply board fitted 4 = 48VDC auxiliary power supply board fitted
TBA3XXX-XX**X**X	0 = default
TBA3XXX-XXX**X**	0 = default

General

Operating Temperature Range	-30°C to +60°C (-22°F to +140°F) ambient temperature* *ambient temperature is defined as the temperature of the air at the intake to the cooling fan
Cooling	forced air over heatsink via fan mounted in subrack
Front Panel LED Indicators	
Green - Steady	PMU operating correctly
Green - Flashing	PMU not operating, bootloader in progress
Red - Flashing	one or more alarm conditions present
Parameters Monitored by PMU Microprocessor	mains input good signal DC input voltage PA output current and voltage heatsink temperatures of AC and DC modules
Dimensions	
Height	143.5mm (5.6in)
Width	121.4mm (4.8in)
Length	
AC PMU	324mm (12.8in)
DC PMU	337mm (13.3in)
AC and DC PMU	337mm (13.3in)
Weight	
AC PMU	4.8kg (10.6lb)
DC PMU	5.1kg (11.2lb)
AC and DC PMU	7.0kg (15.4lb)

Input - AC Module

Input

Voltage	88VAC to 264VAC
Frequency	45Hz to 65Hz
Power Factor	> 0.95
Total Harmonic Distortion (THD)	< 8%
Inrush Current	
230VAC	< 30A @ < 4ms
115VAC	< 15A @ < 4ms
Leakage Current	< 3.5mA/240VAC

Protection

Fault Current (Input)	10A fuse
Transient Suppression	275V MOV (line-to-line)
Overvoltage Inhibit (Self Recovering)	275VAC ±10V
Undervoltage Signal	83VAC ±5V

General

Efficiency at Rated Output*	86%
Input-to-chassis Isolation	1500VAC, 50Hz, 1 minute
Input-to-output Isolation	3000VAC, 50Hz, 1 minute
Output-to-chassis Isolation	500VAC, 50Hz, 1 minute

*at 220VAC

Input - DC Module

Input Voltage	**12V PMU**	**24V PMU**	**48V PMU**
User-programmable Alarms*			
Low Battery Voltage	10V to 14V	20V to 28V	40V to 56V
High Battery Voltage	14V to 17.5V	28V to 35V	56V to 70V
User-programmable Limits+			
Startup Voltage (after shutdown)	10.9V to 15V ±0.3V	21.8V to 30V ±0.5V	43.6V to 60V ±1V
Shutdown Voltage	10V to 13.5V ±0.3V	20V to 27V ±0.5V	40V to 54V ±1V
Battery Protection (Fail-safe) Limits**			
Startup Voltage	10.8V ±0.2V	21.6V ±0.5V	43.2V ±1V
Undervoltage Shutdown	9.5V ±0.3V	19V ±0.5V	38V ±1V
Overvoltage Shutdown	18.1V ±0.3V	36.2V ±0.5V	72.4V ±1V
Overvoltage Shutdown Reset	17.1V ±0.3V	34.2V ±0.5V	68.4V ±1V

*User-programmable alarms can be set for low or high battery voltage, using the CSS software. The alarms will be triggered when the set voltage levels are reached. These limits are subject to the tolerances of the battery protection circuitry, as stated in "Battery Protection (Fail-safe) Limits" above.

+The user-programmable startup and shutdown limits allow for adjustable startup and shutdown voltages. Using the CSS software, these limits can be adjusted for different numbers of battery cells, or for the particular requirements of the base station operation. Once the limits are reached, the PMU will shutdown. These limits are subject to the tolerances of the battery protection circuitry.

** The battery protection limits are set in hardware at the factory and cannot be adjusted by the user. These limits will not be reached under normal operation conditions, but are provided as "fail-safe" measures to protect the battery from deep discharge.

Input Current	**12V**	**24V**	**48V**
0V to Battery Protection Startup Voltage*	2mA maximum	2mA maximum	1.2mA maximum
Battery Protection Startup Voltage to User-programmed Startup Voltage**	40mA (typical) at 10.8V	30.1mA (typical) at 21.6V	13.2mA (typical) at 43.2V
Operating Current	refer to "System Specifications" on page 11		

*When the input voltage drops below the battery protection undervoltage shutdown limit, and until the voltage rises above the battery protection startup voltage.

**At initial power-up; or, after battery protection has occurred, when the input voltage rises above the battery protection startup voltage (PMU now under control of its microcontroller), but is still below the user-programmed startup voltage

Protection	
Fault Current (Input)	circuit breaker or fuse in external wiring*
Wrong Input Voltage	electronic lock-out
Wrong Input Voltage Polarity	shunt diode
	*provided by user

General	
Efficiency at Rated Output	
12VDC	82%
24VDC	85%
48VDC	90%
Input-to-output Isolation	1000VAC, 50Hz, 1 minute

Output - AC and DC Modules

High Current Output for PA

Voltage	28V
Current	14A maximum
Regulation	±0.5%
Ripple and Noise*	50mV pp
Ripple and Noise rms	10mV rms
Transient Response on 28V Loadstep**	2% overshoot and recover within 0.6ms

*100MHz bandwidth
**10% to 100% loadstep

Protection - PA Output

Overload	electronic current limit above 16A
Short Circuit	hiccup mode, self-resetting
Overvoltage	
AC Module	electronic shutdown latch (33.5V)
DC Module	electronic hysteric control (33.5V)

Protection - Reciter Output

Short Circuit	2.5A self-resetting fuse

Standby Output - DC Module

Low Current Output for Reciter

Voltage	28.9V
Current	0.3A maximum
Regulation	±2.5%
Ripple and Noise*	50mV pp
Ripple and Noise rms	10mV rms

*100MHz bandwidth

Protection

Overload/Short Circuit	electronic current limit

General

Efficiency at Rated Output	86%
Input-to-output Isolation	1000VAC, 50Hz, 1 minute
Control	shutdown signal (isolated)

Auxiliary Power Supply

DC Input Voltage	28V ±15%		
DC Output	**12V**	**24V**	**48V**
Voltage	13.65V	27.3V	54.6V
Current	3A maximum	1.5A maximum	750mA maximum
Regulation	±2%	±2%	±2%
Ripple and Noise*	50mV pp	50mV pp	50mV pp
Ripple and Noise rms	10mV rms	10mV rms	10mV rms
Zero Load Ripple	100mVpp	100mVpp	100mVpp
*100MHz bandwidth			
Protection	**12V**	**24V**	**48V**
Overload/Short Circuit	electronic current limit	electronic current limit	electronic current limit
Overvoltage	16V Zener diode	32V Zener diode	62V Zener diode
General			
Efficiency at Rated Output	88%		
Input-to-output Isolation	1000VAC, 50Hz, 1 minute		
Output-to-chassis Isolation	500VAC, 50Hz, 1 minute		

Connections

The following specifications refer to the external wiring and connectors which are connected to the PMU. They do not refer to the wiring and connectors built into the PMU itself.

AC Input

Connector Type	IEC female
Current Rating	8A

DC Input - 12VDC*

Connector Type	M6 screw into threaded fitting on bus bar
Recommended Screw Torque	2-2.5N·m (18-20lbf·in)
Connector Current Rating	50A
Flexible Wire Size	2AWG**
Flexible Wire Cross Section	35mm^2**

DC Input - 24VDC*

Connector Type	M6 screw into threaded fitting on bus bar
Recommended Screw Torque	2-2.5N·m (18-20lbf·in)
Connector Current Rating	25A
Flexible Wire Size	5AWG**
Flexible Wire Cross Section	16mm^2**

DC Input - 48VDC*

Connector Type	M6 screw into threaded fitting on bus bar
Recommended Screw Torque	2-2.5N·m (18-20lbf·in)
Connector Current Rating	12A
Flexible Wire Size	8AWG**
Flexible Wire Cross Section	8mm^2**

*battery

** for a length of 1.5m to 2m (5ft to 6.5ft) (typical); the DC input leads should be of a suitable gauge to ensure less than 0.2V drop at maximum load over the required length of lead

DC Output - 28V High Current for PA

Connector Type	Phoenix MVSTBR2.5HC/2-ST/5.08 female
Recommended Screw Torque	0.5N·m (4.5lbf·in)
Connector Current Rating	16A
Flexible Wire Size	11AWG

DC Output - 28V Low Current for Reciter

Connector Type	2 x 4-way Molex 43025-0800/crimp socket 43030-0001 female
Connector Current Rating	3A
Flexible Wire Size	20AWG

Connections (Continued)

DC Output - Low Current
(from optional auxiliary power supply)

Connector Type	Phoenix MVSTBR2.5HC/2-ST/5.08 female
Connector Current Rating	3A to 16A
Flexible Wire Size	20AWG to 11AWG

Compliance Standards

Where applicable, this equipment has been tested and approved to the following standards.

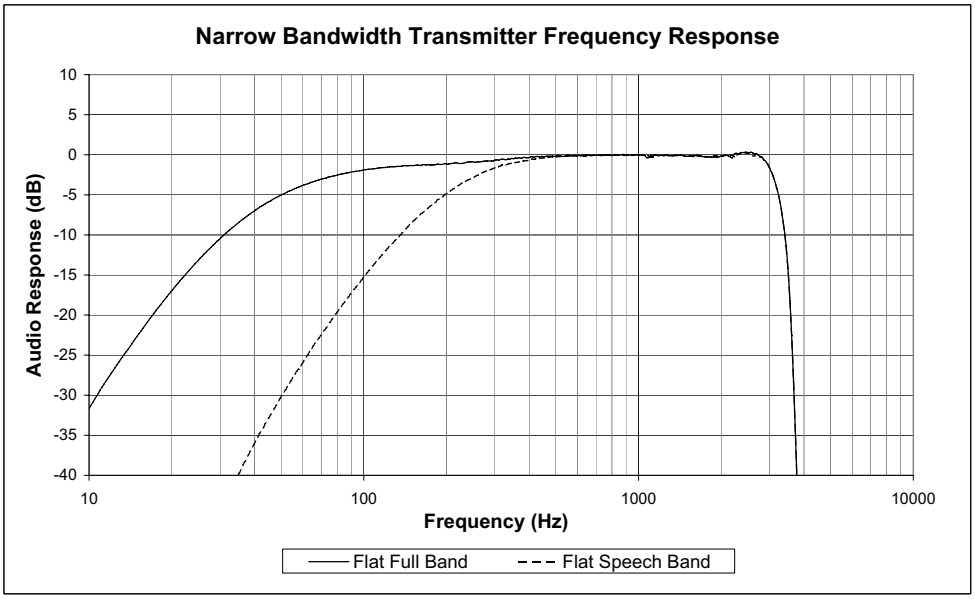
Safety	EN 60950-1 UL E223047 AS/NZS 60950-1:2011 Q090114
EMC	ETSI EN 301 489-5 CFR Title 47 Part 15
EMC Regulatory Compliance in Australia N46	This product meets all ACMA regulatory requirements for electromagnetic compatibility (EMC). For more information about EMC compliance, visit the ACMA website at www.acma.gov.au.
Environmental	
Low Pressure (Altitude)[a]	MIL-STD-810F 500.4 Proc 2
Humidity	IEC60068-2-30
Vibration	MIL-STD-810F 514.5 Proc 1
Shock	MIL-STD-810F 516.5 Proc 1

a. 15000ft (4572m).

A Frequency Response Diagrams

This appendix shows the transmitter and receiver audio frequency response diagrams for the analog line.

Figure A.1 Transmitter audio frequency response – narrow bandwidth



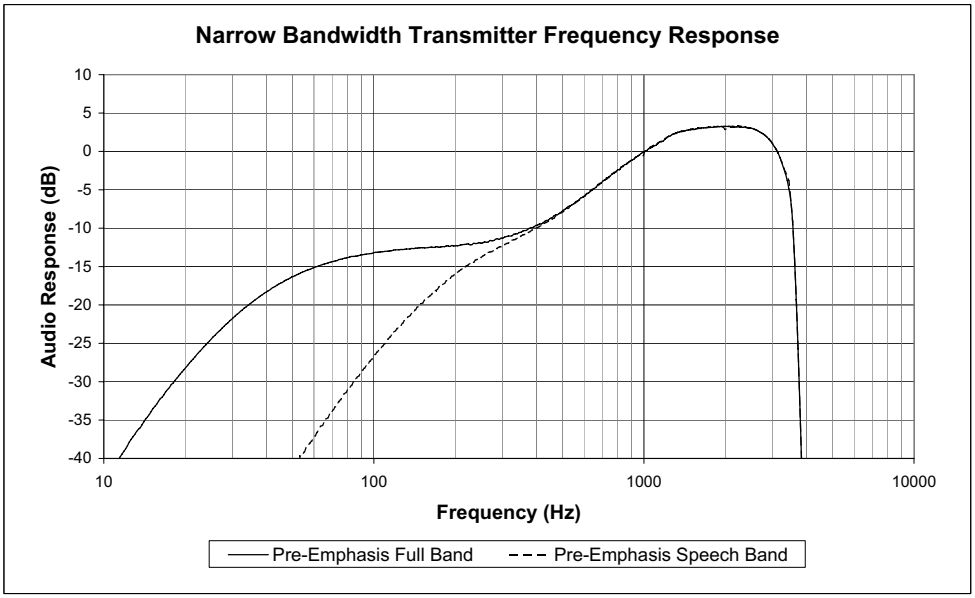
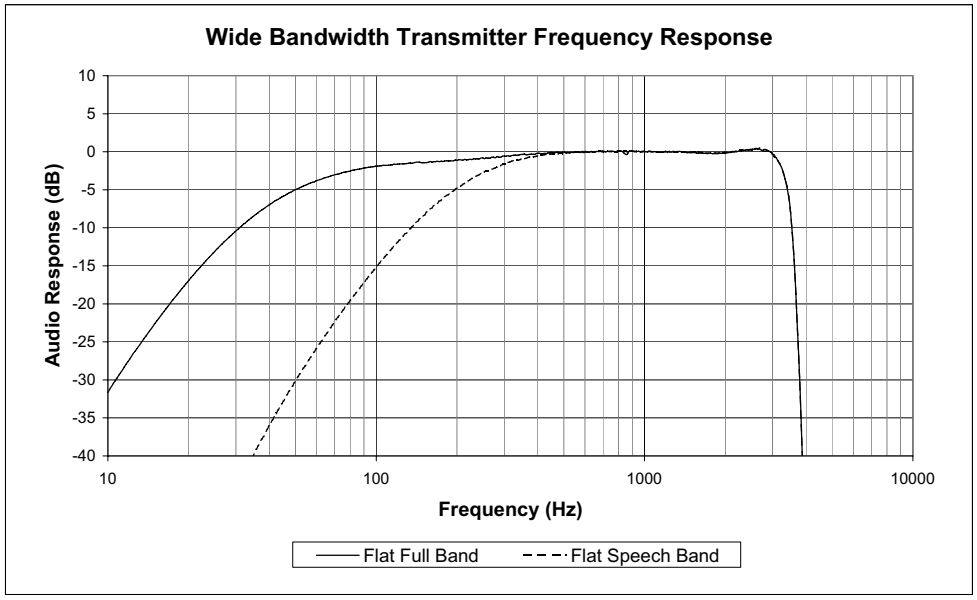


Figure A.2 Transmitter audio frequency response – wide bandwidth



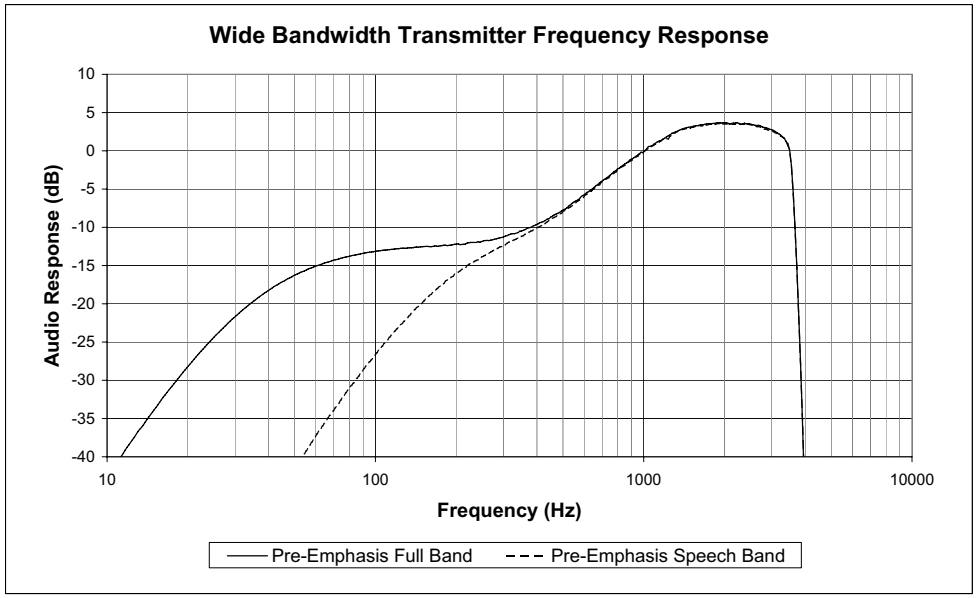
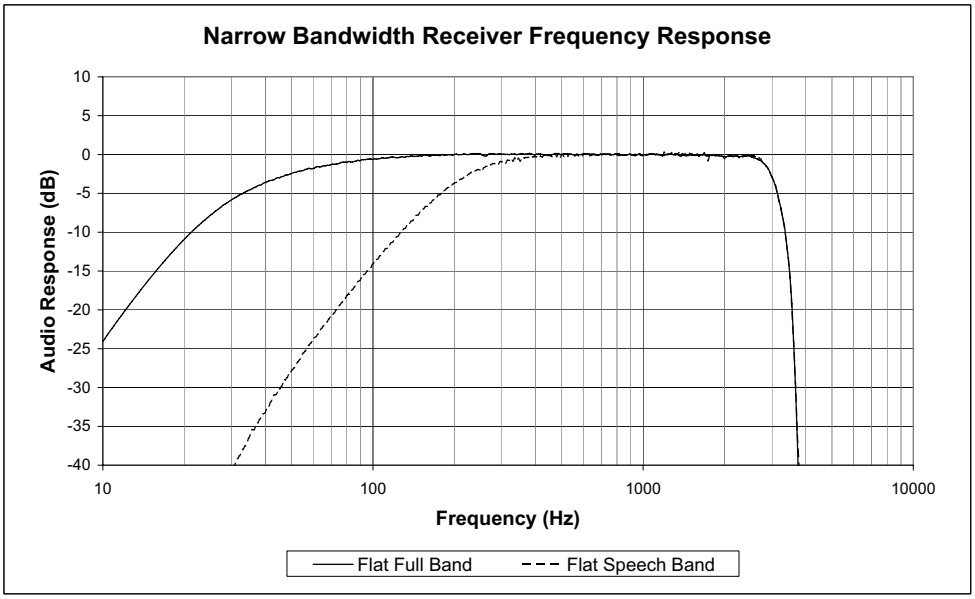


Figure A.3 Receiver audio frequency response – narrow bandwidth



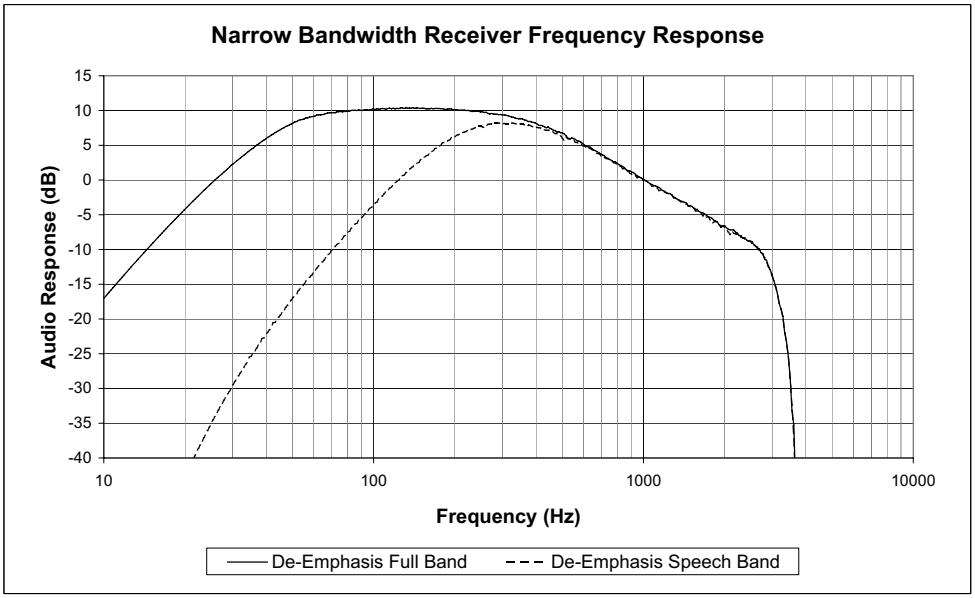


Figure A.4 Receiver audio frequency response – wide bandwidth