

# TB7300 Base Station/Repeater B9 Specifications Manual

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# Preface

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## Scope of Manual

Welcome to the Specifications Manual for the TB7300 base station. This is a special edition covering only the B9 band of operation: Tx: 148 MHz - 174 MHz; Rx: 146 - 174 MHz. Although the product functionally supports analog and MPT operation, the TB7300 has ETSI approval only for DMR in this band. This manual provides general, performance and physical specifications for the TB7300 base station.

 For specifications for other bands, see MBD-00002-xx.

## 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 TB7300 product documentation is available on the Tait technical support website. Printed copies of the documentation are available on request.

- TB7300 Installation and Operation Manual (MBD-00001-13).
- TN9300 DMR Radio Network System Manual (MNB-00003-22).
- TN9300 DMR Radio Network Node Controller Installation Manual (MNB-00001-01).

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. Look for new or updated technical notes on the Tait technical support website.

## Publication Record

Issue	Publication Date	Description
02	December 2020	Updated compliance standard
01	September 2020	First release

# 1 Base Station Specifications

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The performance figures given in these specifications are applicable only to equipment operating as an integral part of a TB7300 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 (13.8VDC).

**Notice** 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.

# 1.1 Regulatory Information

## Test Methods

Where applicable, the test methods used to obtain these specifications are those described in the following standards:

- EN 300 086
- EN 300 113
- EN 300 219
- EN 301 489
- TIA/EIA-603/603-D

## Emission Designators

This equipment is compatible with the emissions listed in the following table.

Emission Designator	Common Name	Modulation Scheme	Operating Modes
7K60FXD	2-slot DMR	4FSK	data/control channel
7K60FXW	2-slot DMR	4FSK	digital voice/data/control channel

You can obtain further details of test methods and the conditions which apply for compliance testing in all countries from Tait.

## 1.2 Frequency Bands and Sub-bands

Many of the performance figures in this manual are applicable to all frequency bands. In some cases the figures refer to specific bands or sub-bands, and these are identified with the letters listed in the following table.

<b>Frequency Identification</b>	<b>Frequency Band and Sub-band</b>	<b>40W</b>	<b>50W</b>
B band	B9 = Tx: 148 MHz to 174 MHz, Rx: 146 MHz- 174 MHz	x	✓



## 1.3 Identifying the Base Station

You can identify the model and hardware configuration of a TB7300 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.

Product Code	Description
TB73 <u>XX</u> -XXXX-XXXX-XXXX-10	10 = single 40/50W base station/repeater
TB73 <u>XX</u> -XXXX-XXXX-XXXX-10	10 = DMR 40/50W base station/repeater 60 = P25 single 40/50W base station/repeater
TB73XX- <u>XXXX</u> -XXXX-XXXX-10	<b>Frequency Band</b> B9 = Tx: 148 MHz to 174 MHz, Rx: 146 MHz- 174 MHz
TB73XX-XX <u>X</u> -XXXX-XXXX-10	B = 40/50W
TB73XX-XXX <u>X</u> -XXXX-XXXX-10	0 = default
TB73XX-XXXX- <u>XXXX</u> -XXXX-10	0 = default
TB73XX-XXXX-XXXX- <u>X</u> XXX-10	0 = 13.8VDC (nominal) input
TB73XX-XXXX-XXXX-XX <u>XX</u> -10	0 = default
TB73XX-XXXX-XXXX-XX <u>XX</u> -10	<b>Feature License</b>
TB73XX-XXXX-XXXX-XXXX- <u>10</u>	10 = default

## 1.4 Power Supply

### DC Input

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#### Input voltage

Operating voltage	12 VDC to 16 VDC
Standard test voltage	13.8 VDC

#### Operating current

refer to [“Power and Current Consumption” on page 11](#)

---

#### Protection

Fault current (input)	15 A fuse circuit breaker or fuse in external wiring <sup>a</sup>
Wrong input voltage	electronic lock-out
Wrong input voltage polarity	shunt diode

a. Provided by user.

---

## 1.5 Power and Current Consumption

The specifications in this section are typical figures.

The transmit measurements were carried out with the base station transmitting at the stated RF output power with all front panel fans running. The standby measurements were carried out with the base station not receiving or transmitting and no front panel fans running.

### 1.5.1 13.8VDC Input

#### Transmit

	A	W
B band		
Minimum RF output power (2W)	2.9A	40W
Maximum RF output power (50W)	9.6A	133W

#### Standby

	A	W
B band	0.83A	11.5W

# 1.6 Receiver

## General

Frequency bands	
B9 band	Tx: 148 MHz to 174 MHz, Rx: 146 Mhz to 174 MHz
Type	triple conversion superheterodyne; first conversion is analog, second is hybrid, and third is digital
Frequency increments	
B band	2.5 kHz and 3.125 kHz
Switching range	
B band <sup>a</sup>	±2MHz
a. The frequency range, measured from the tuned frequency, that can be used without needing to retune the front end or recalibrate the RSSI.	
Input load impedance	50Ω nominal (VSWR <2:1)
RF input protection	no degradation after 5 minutes exposure to on-channel signals at +20dBm (2.2V)
Frequency stability	
Internal reference	±0.5ppm –30°C to +60°C (–22°F to +140°F)
External reference	±1 Hz ± multiplied accuracy of external reference
RSSI	≤–125dBm to –30dBm
IF stages - B band	
Frequencies	
Analog	16.9 MHz
Digital	16.9 MHz and 0 Hz
Analog IF bandwidth	9kHz, –3dB
Digital IF bandwidth	8.06 kHz, –3dB
Spurious Emissions	
Conducted	<–90dBm 9 kHz to 2 GHz <–70dBm 2 GHz to 12.75 GHz
Radiated	<–57dBm 30 MHz to 1 GHz <–47dBm 1GHz to 4 GHz

## Digital RF (DMR)

---

Digital unfaded sensitivity<sup>a</sup>

**Guaranteed**

<-120dBm @ 5% BER (DAQ 2.0)  
<-118.5dBm @ 2.6% BER (DAQ 3.0)  
<-118dBm @ 2% BER (DAQ 3.4)  
<-117dBm @ 1% BER (DAQ 4.0)

**Typical**

<-122dBm (0.18µV) @ 5% BER

a. Center of switching range at 25°C.

---

Digital selectivity

B band ≥82dB @ 1% BER

---

Digital spurious response attenuation ≥90dB

---

Digital intermodulation response attenuation<sup>b</sup> ≥78dB @ 1% BER unfaded

b. Up to 5dB degradation at extremes of switching range and temperature.

---

Digital blocking rejection

> 1 MHz 100dB @ 1% BER

---

Digital co-channel rejection

12dB

---

Digital blocking rejection

> 1 MHz 100dB @ 1% BER

---

Digital co-channel rejection

12dB

---

## Analog RF

---

Analogue Bandwidth

	Channel Spacing	Modulation 100% Deviation (Nominal)
Narrow Bandwidth (NB)	12.5 KHz	+/-2.5 KHz
Wideband	25 kHz	+/-5 kHz

**Notice** Quoted analog FM specs are a guide to performance and do not imply that you can legally use the product over the range of frequencies allowed by the product.

## Analog RF (Continued)

### Sensitivity<sup>a,b</sup>

De-emphasised response	
Centre of switching range	< -119 dBm (0.25 μV) at 25 °C
Edge of switching range	< -117 dBm (0.32 μV) at 25 °C

a. 12 dB SINAD.

b. Up to 2 dB degradation at extremes of temperature.

### Maximum usable sensitivity<sup>c,d</sup>

De-emphasised response	
Centre of switching range	< -116 dBm (0.35 μV) at 25 °C (narrowband) < -118 dBm (0.35 μV) at 25 °C (wideband)
Edge of switching range	< -114 dBm (0.45 μV) at 25 °C (narrowband) < -116 dBm (0.45 μV) at 25 °C (wideband)

c. Sensitivity for 20 dB SINAD, psophometrically weighted, RF source modulated at 60% deviation with 1 kHz.

d. Up to 2 dB degradation at extremes of temperature.

### FM quieting<sup>e</sup>

Narrowband	-113 dBm
------------	----------

e. 20 dB FM quieting, measured with de-emphasis on.

### Hum and Noise (Ultimate signal-to-noise ratio) (at -47 dBm)<sup>f</sup>

B band	45 dB (ANSI/TIA) (narrowband) 50 dB (CEPT - psophometric) (narrowband) 55 dB (ANSI/TIA) (wideband)
--------	--

f. Up to 5 dB degradation at extremes of switching range and temperature.

### Selectivity<sup>g</sup>

	EIA-603 <sup>h</sup>	TIA/EIA-603-D	ETSI
B band (narrowband)	85 dB	50 dB	85 dB
B band (wideband)	90 dB	87 dB	

g. Up to 5 dB degradation at extremes of switching range and temperature.

h. The EIA-603 is a single tone test method. The TIA/EIA-603-D is a two-tone test method.

Signal displacement bandwidth	≥ 1 kHz
-------------------------------	---------

Spurious response attenuation	≥ 100 dB (ANSI/TIA) ≥ 90 dB (ETSI)
-------------------------------	---------------------------------------

### Intermodulation response attenuation<sup>i</sup>

B band	80 dB (ETSI) (narrowband) 85 dB (ANSI/TIA) (wideband)
--------	--

i. Up to 5 dB degradation at extremes of switching range and temperature.

## Analog RF (Continued)

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### Blocking rejection

B band	
1–10 MHz	100dB (ETSI)
> 10 MHz	110dB (ETSI)
±1, ±2, ±5 and ±10 MHz	100dB (ANSI/TIA)

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Co-channel rejection	–8dB
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Amplitude characteristic <sup>j</sup>	≤3dB (ETSI)
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### Co-channel rejection

Narrowband	–8 dB
Wideband	–5 dB

j. RF Input Level – 107dBm to –13dBm.

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## 1.7 Transmitter

**Notice** Quoted analog FM specs are a guide to performance and do not imply that you can legally use the product over the range of frequencies allowed by the product.

### General

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#### Frequency bands

B9

Tx: 148 MHz to 174 MHz, Rx: 146 MHz to 174 MHz

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#### Modulation types

7K60FXD, 7K60FXW

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#### Frequency increments

B band

2.5 kHz and 3.125 kHz

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#### Output load impedance

50Ω nominal

---

#### Frequency stability

±0.5ppm –30°C to +60°C (–22°F to +140°F)

---

#### Output power

B band

Rated power

50W

Range of adjustment

2W to 50W in 1W steps

---

#### Output power accuracy<sup>a</sup>

±1 dB into a 50Ω load

a. Within normal operating voltages and temperatures; measured directly on PA output.

---

#### Duty cycle

100% at maximum rated output power<sup>b</sup> at +60°C (+140°F) ambient temperature

b. Measured directly on PA output.

---

#### Mismatch capability

Ruggedness

open and short circuit load at any phase angle for one hour<sup>c</sup>

Stability

5:1 load VSWR at all phase angles<sup>c</sup>

c. Under power foldback.

---

#### Protection

Temperature

shutdown if PA sensor exceeds 100°C

Supply voltage

shutdown if supply is less than 11V

VSWR

gradual power foldback as VSWR increases above acceptable operating level

---



## General (Continued)

---

Steady State (All modulation types)	<-60dBc (EN 300 113 & EN 300 086)
Transient (DMR)	<-50dBc (EN 300 113)

---

### Modulation fidelity

DMR	<2% (EN 300 113)
-----	------------------

---

### Intermodulation

DMR	-40dBc with interfering signal at -30dBc at TB7300 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.
-----	--

---

### Sideband noise<sup>d</sup>

B band	
±1.5 MHz	<-142dBc/ Hz
≥±4 MHz	<-160dBc/ Hz

d. No modulation, measured from center frequency at max power.

---

### Radiated spurious emissions

Standby	<-57dBm to 1 GHz <-47dBm 1 GHz to 4 GHz
Transmit - B band	<-36dBm 30 MHz to 1 GHz <-30dBm 1 GHz to 4 GHz

---

### Conducted spurious emissions

Standby	<-57dBm to 1 GHz <-47dBm 1 GHz to 12.75 GHz
Transmit - B band	<-36dBm 9 kHz to 1 GHz <-30dBm 1 GHz to 4 GHz

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Transient behaviour - B band	complies with EN 300 113 v2.2.1
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## Simulcast

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Launch time accuracy<sup>a</sup> ±1.5µs

Deviation accuracy 0.2dB

Frequency accuracy<sup>b</sup> <1Hz

Supported simulcast modulation schemes

DMR 4FSK

a. Launch time offset adjustable in 1µs increments

b. Launch time offset adjustable in 0.1Hz increments

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Receive voter limitations

### Maximum marshaling duration

DMR 300ms (simulcast operation)

### Maximum central voter packet arrival

#### time skew

DMR 250ms

---

## Simplex

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Coaxial relay operating time 30ms (maximum)<sup>a</sup>

Isolation (off-state) > 40 dB

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a. **Warning:** A coaxial relay that takes longer than 30ms to operate risks damage to the PA.

## 1.8 Connections

### 1.8.1 External Frequency Reference Input (BNC)

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Frequencies <sup>a</sup>	10 MHz or 12.8 MHz
a. Automatically detected by the reciter.	
Lock range	±50 Hz
Input level	500mV <sub>pp</sub> to 5V <sub>pp</sub>
Input impedance	≥1 kΩ

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### 1.8.2 Ethernet Interface (RJ45)

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

---

### 1.8.3 System Interface (DB-25)

#### External General Purpose Digital Inputs

---

Input low threshold	$V_{IL} < 0.6V$
Input high threshold	$V_{IH} > 2.2V$
Internal pull-up (5 V)	≥10 kΩ
Input source current	$I_{IL} < 1mA$ ( $V_{IL} = 0V$ )
Continuous input voltage	$ V_{IN}  < 30V$
Transient input voltage	$ V_{IN}  < 35V$ ( $t < 1s$ )

---

## 1.8.4 Channel Group Size

Input low threshold	$V_{il} < 0.6V$
Input high threshold	$V_{ih} > 1.2V$
Input termination	$470\Omega + 5\%$ (AC terminated)
Transient input voltage	$ V_{in}  < 15V$
Frequency	1 PPS (required for simulcast and voted DMR channel)
Polarity	rising edge represents timing reference
Maximum jitter	$\pm 50ns$

The table below defines vote contributors and channel group size for each channel type:

‘Channel group size’ is the number of members (transceivers or receivers) in a channel group.

‘Vote contributors’ are the number of active receivers that will contribute to the voted output.

Channel type	Vote contributors	Channel group size
DMR trunked control channel (Tier 3)	10	10
DMR trunked traffic channel (Tier 3)	10	10
DMR conventional (Tier 2)	10	10
DMR conventional fallback (Tier 2) <sup>a</sup>	10	10

a. Fallback operation in Tier 3 channel groups is not supported.

## 1.8.5 Digital Air Interface

Vocoder	AMBE+2
Digital Protocol	DMR ETSI-TS102 361 -1,-2,-3,-4

## 1.9 Miscellaneous

### 1.9.1 Channel Details

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Number of channels	1000
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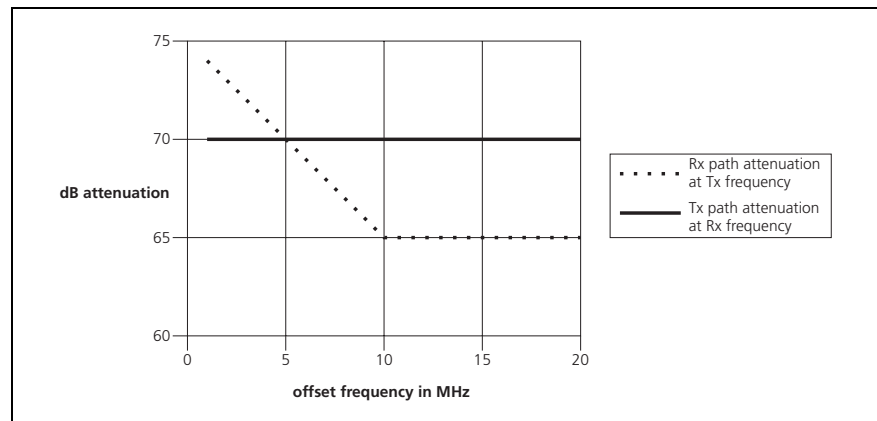
Channel change time	300ms
---------------------	-------

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### 1.9.2 Duplexer Attenuation Requirements

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.

The quoted attenuation will ensure not more than 1 dB receiver desensitization (from the specified sensitivity), and has a 5 dB margin built in.



### 1.9.3 Operating Temperature Range

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Operating temperature range	-30°C to +60°C (-22°F to +140°F) ambient temperature <sup>a</sup>
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a. Ambient temperature is defined as the temperature of the air at the intake to the cooling fans.

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## 1.9.4 Heat Load Values

These measurements were carried out with the base station transmitting at its rated output power with all front panel fans running.

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	<b>W</b>	<b>Btu/h</b>
B band	133W	454Btu/h

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## 1.9.5 Physical Details

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Cooling	forced air via front panel fan
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### Connectors

RF input	BNC female
RF output	N-type female
External reference frequency input	BNC female
1PPS input	BNC female
Ethernet	RJ45
Serial	RJ12
System inputs and outputs	DB-25
DC input	screw terminal

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### Dimensions

Height	44mm (1.73in)
Width	436mm (17.17in)
Width with 19" rack mounting bracket	483mm (19in)
Length	400mm (15.7in)

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Weight	6.7kg (14.8lb)
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## 1.9.6 Reliability

MTBF at  $\geq 50,000$  hours (estimated)

## 1.9.7 Requirements for Delay, Jitter, Loss and Duplication

Standard Requirements	Recommended	Required
Out of order C plane and U plane packets <sup>a</sup>	< 0.01%	
Packet Loss	< 0.01%	
Latency	< 40ms	< 150ms
Jitter	< 20ms	< 100ms
Skew	< 40ms recommended	< 270ms
Minimum bandwidth for user traffic (voice, control channel, packet data)	64kb/s per physical channel	
Minimum bandwidth to carry management traffic (web, logs, SNMP).	100kb/s per site	
Minimum bandwidth to meet jitter requirements on non-fragmenting link	600kb/s per site up to 5 physical channels	

a. C plane and U plane are references to telco terminology distinguishing call setup and user traffic.

## 2 Compliance Standards

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The TB7300 base station has been tested and approved to appropriate national and international compliance standards. These standards are listed on the following page.

You can obtain further details of test methods and the conditions which apply for compliance testing in all countries from Tait.

**Notice** 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.



**RF and EMC  
Compliances**

The following table shows which variants of the TB7300 have been tested and approved to the listed standards.

A check indicates the compliance has been received, a date indicates when the compliance is expected to be received, and a blank cell indicates there are currently no plans to apply for this compliance.

		B9 Band
		50W
<b>DMR</b>	EN 300 113 (ETSI)	✓
	AS/NZS 4768	✓
<b>EMC</b>	EN 301 489-1, EN 301 489-5 (ETSI)	✓

**Safety and  
Environmental  
Compliances**

The TB7300 base station has been tested and approved to the following standard: EN 62368-1 (ETSI)

	Testing Method	Testing Standard
Environmental	Shock	MIL-STD-810G:2008