

<div><div><div>KeyStone</div><div>Semiconductor</div></div><div>成一電子體股份有限公司</div><div>KeyStone Semiconductor Corp.</div></div>	<div>Product Specification</div>	Doc. No.:	Version: A
		Model No.: T4B	
<div>T4B DAB / DAB+ / FM /RDS module specification</div> <div>Key Features :</div> <div><ul style="list-style-type: none">• ETSI EN 300 401 compliant receiver• DAB/DAB+ sensitivity to -99dBm (typical)• FM sensitivity to -106dBm (typical)• DAB Color Slide show support (Data service option)• DMB video service support (Data service option)• TPEG/TMC support for GPS applications (Data service option)• Decodes audio services up to 384kbps without external RAM• FM with RDS/RBDS decoder• Combined antenna input for FM / Band3• Integrated stereo audio DAC• Stereo Line-in• Digital audio output – I2S and SPDIF• Digital audio Input – I2S• UART and I²C Serial control interface• ADC Keypad• Real time clock accurate 50ppm• Configurable general purpose I/O• Ultra low-power• RoHS compliant</div>			
Approved by	Verified by	Made by	Date of modification:
		Ken.Chung	Date of establishment
			September 29 2017

Revision History

Rev.	Revise page	Revise Contents	Date	Ref. No.	Reviser
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1. General description

The T4B is the latest in a new generation of digital audio module to use the new RF Front-end and Oceanus baseband. T4B is designed to enable dual or tri-band DAB/DAB+/DMB-Radio/FM receivers of various types to be produced at lower cost and lower power consumption. The module would operate in master mode stand alone or accept commands by an external microcontroller. And provide DMB-R, DMB-Video, color slide show, and TPEG or TMC bit stream to external host through SPI or UART (Data Service Option).

The module includes all the interfaces necessary so that manufacturers need only add power supply, display, keypad, audio amplifier and speakers to provide a fully functional DAB/DAB+/DAB- Radio /FM/RDS radio.

2. Application

- Portable radio
- Clock radio
- Kitchen radio
- Boombox
- Hi-Fi radio
- Digital frame
- Car-radio
- Mini-CD system
- DVD player
- Multimedia System
- iPhone/iPod Docking System
- Personal Navigation Device

3. Introduction

3.1. Block Diagram

The main components of the T4B Module are shown in the diagram as Fig 1. These are the RF front-end, baseband processor (build in with Audio DAC).

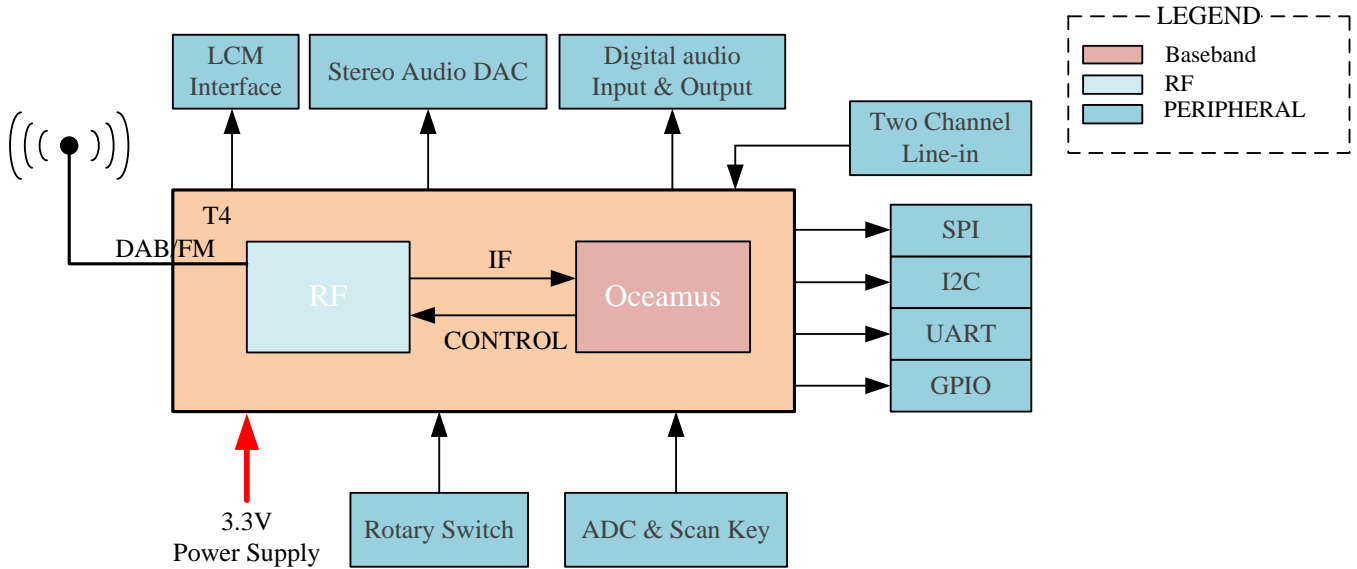


Figure 1 : Module Block Diagram

T4B dimension is 40 x 60 mm, and Hardware interface includes stereo audio DAC / Line In / LCD control / ADC and Scan key Keypad / GPIO / I2C / I2S / SPI / UART.

3.2. Master & Slave mode Application

Figure 2&3 show a master and slave mode application block diagram of the T4B.

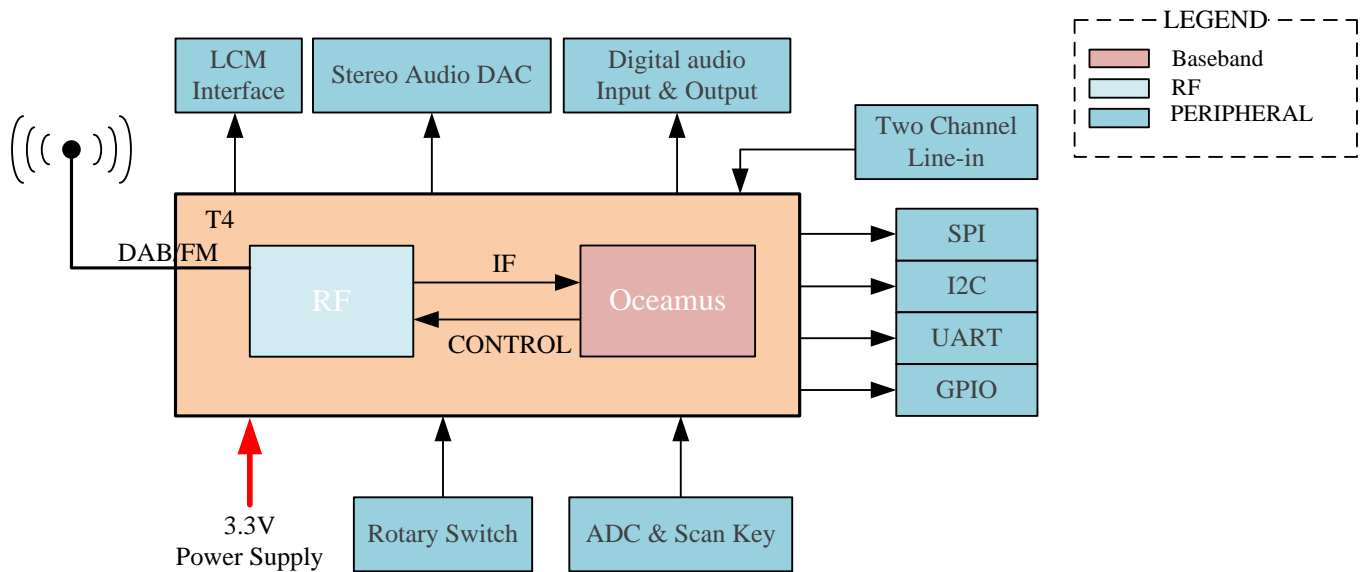


Figure 2 : Block diagram of master mode application

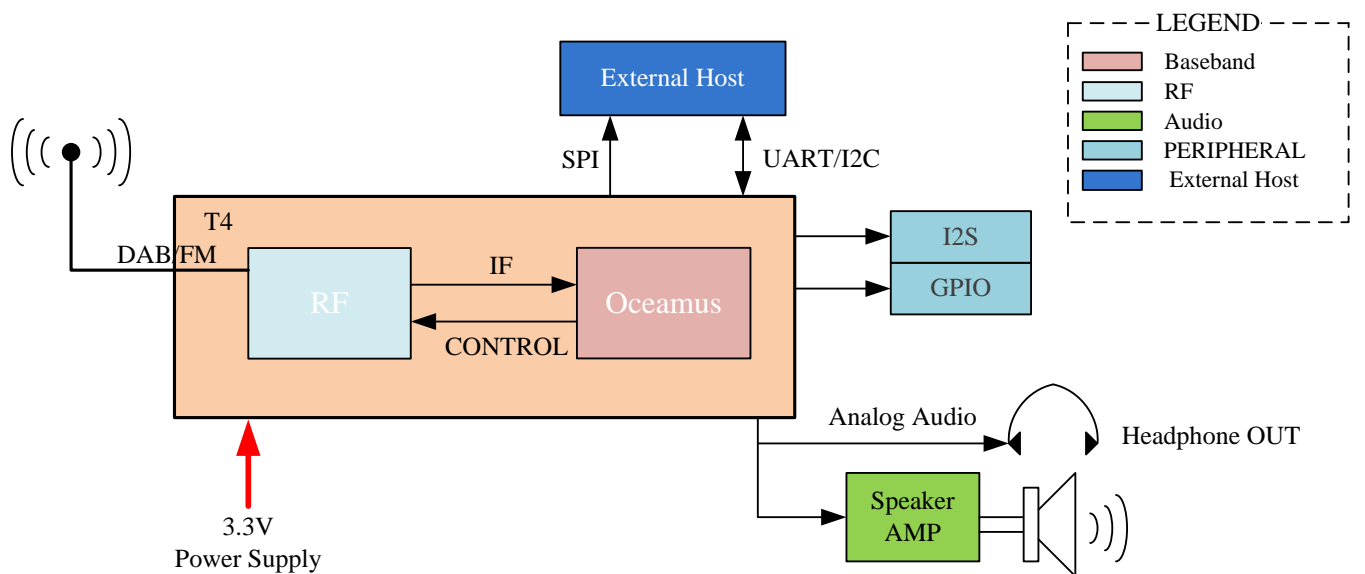


Figure 3 : Block diagram of slave mode application

4. Software

Software is configured to customer requirements and is pre-installed in the T4B Software builds

are available for the module to meet customer's application.

5. Data Service (Option)

5.1. DAB Slide Show Support

Slideshow adds synchronized visual content (slides) to radio broadcasts on DAB or DAB+.

It could support simple profile slide show for HOST to display on TFT screen.

- Image Format :

PNG or JPEG format with 50kB in file size (51200 bytes).

Resolution of 320 × 240 pixels at a color/ grey scale depth of 8 bits per pixel

(¼-VGA).

5.2. DMB video service profiles Support

It could support DMB video service with provide DMB Video/Audio data stream for HOST to decode and display on the TFT screen.

- Video format :

ITU-T Recommendation H.264 | MPEG-4 AVC.

Simple profile, resolution up to 352x288 @30 frame/sec

- Audio format :

Profile I---audio object: MPEG-4 ER-BSAC.

Profile II ---MPEG-4 HE AAC V2

- Data transmitting interface: SPI with clock rate more than 1MHz

- Communication interface with HOST: UART / I2C / SPI

5.3. TPEG/TMC Support

TPEG/TMC are encoded in raw data formats. The raw data formats of TPEG have been defined in ISO/TS 18234-1 to -6, in general, it will be defined by UML model.

TMC data stream is defined by ETSI TS 102 368.

- TPEG Data transmitting interface: SPI with clock rate more than 1MHz

- TMC Data transmitting interface: UART

- Communication interface with Host: UART

5.4. Module Part Number (Support Data Service Function)

Commercial	T4B-6D60CDB-1.0	0 to 70	Band III, FM	with slide show & Support TFT LCD
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Industry	T4B-6D60VDB-1.0	-40 to 85	Band III, FM	with slide show & Support TFT LCD
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6. Mechanical Specification

6.1. Mechanical drawing

Top View & Side View

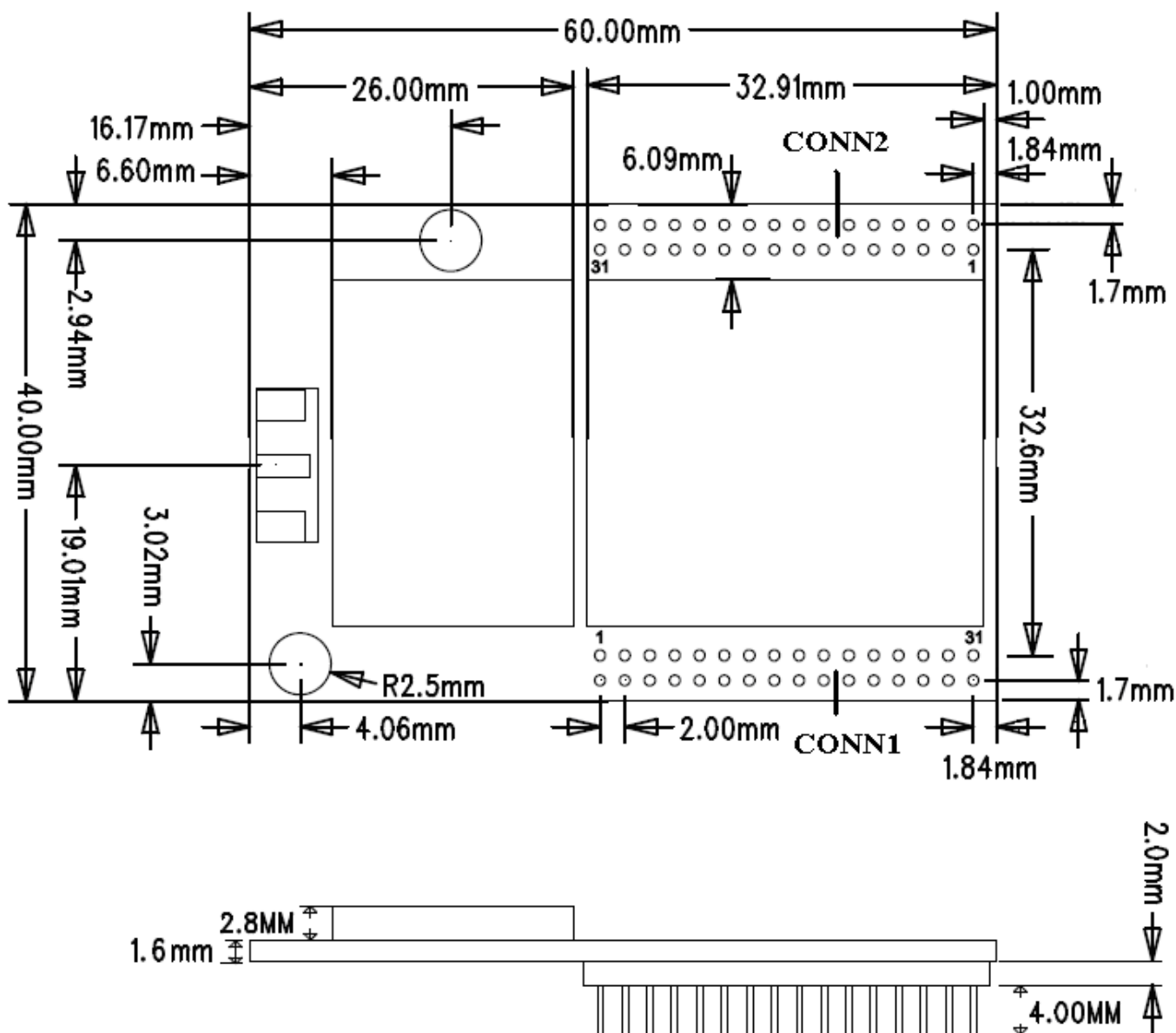


Figure 4 : T4B module mechanical drawing.

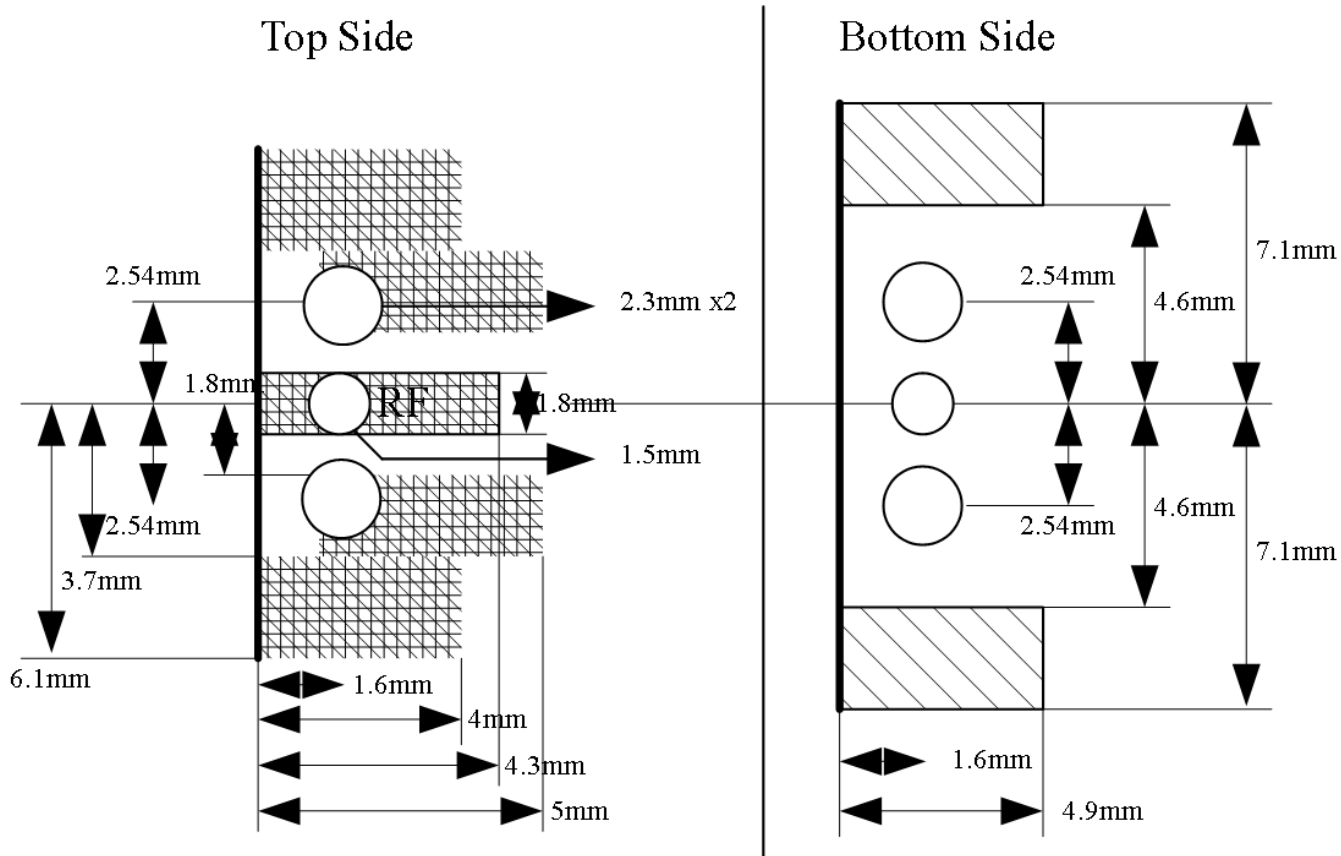
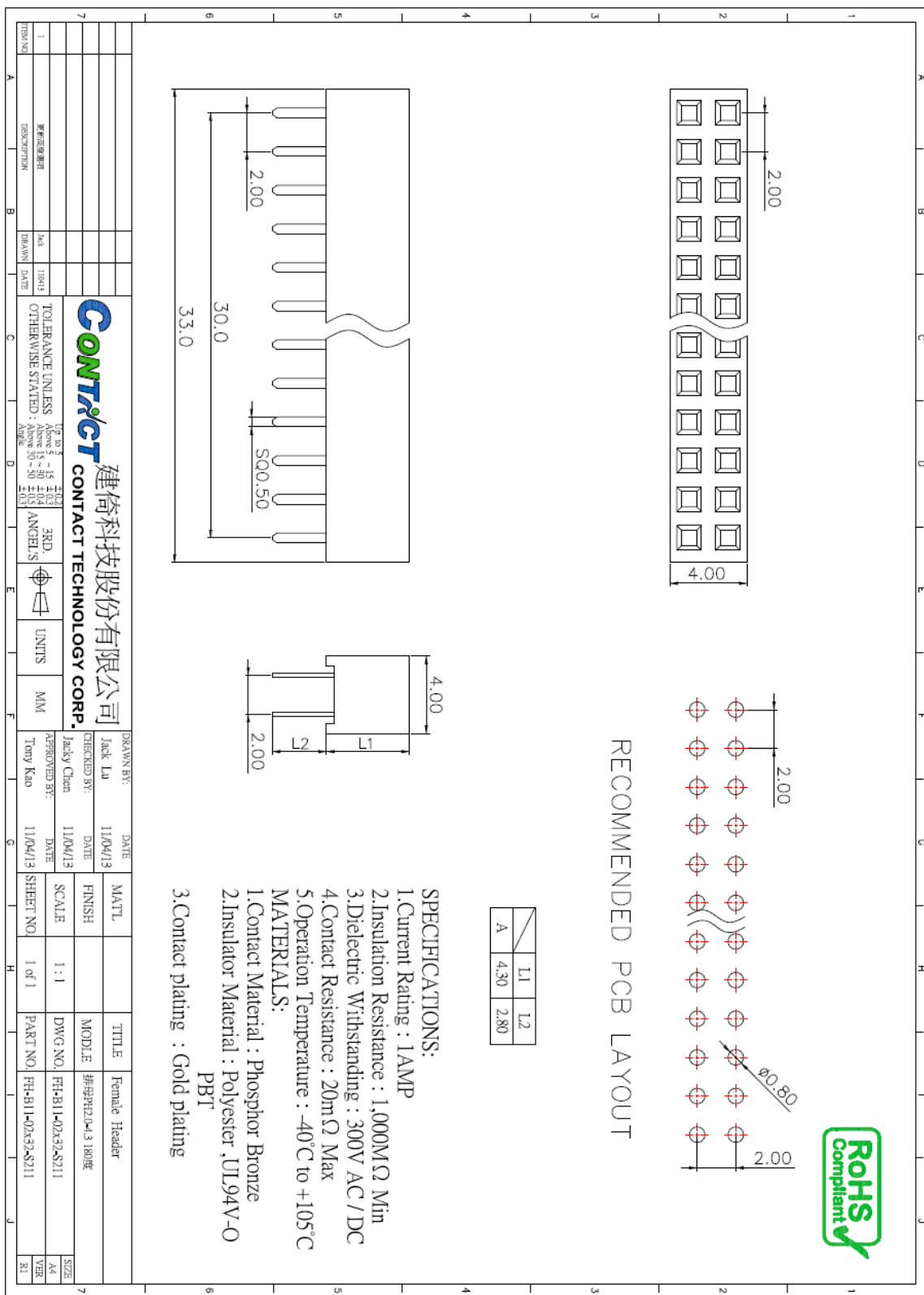


Figure 5 : BANDIII/FM Footprint.

6.3. Module mating connector

Recommend part numbers FH-B11-02x32-S211



Pin No.	Pin name	Pin Description			POR	Note
		TYPICAL	ALTERNATIVE	GPIO		
1	VDD33	+3.3V Power supply				
2	GPIO_7	GPIO_7	GPIO_7	GPIO_7	INPUT	*NOTE1 & *NOTE2
3	GPIO_6	GPIO_6	GPIO_6	GPIO_6	INPUT	*NOTE1 & *NOTE2
4	GND	GND				
5	VRTC	RTC Battery Power Input				Voltage Range 2.45~3.63V
6	PWR15_EN	Enable external POWER IC pin			Open Drain	Need pull up resistor.
7	POWER_ON	Power UP System Function			INPUT	User power on: Pull Low
8	IR	IR Receiver	GPIO_9	GPIO_9	Out_Low	*NOTE1
9	GPIO_10	GPIO_10	GPIO_10	GPIO_10	INPUT	*NOTE1
10	RES_OUT	When System Reset Output Function			Open Drain	When System Reset Output Low signal, Need pull up resistor.
11	RESET	System Reset			INPUT	
12	GND	GND				
13	NMI	NMI	GPIO_8	GPIO_8	INPUT	*NOTE1
14	GPIO_11	GPIO_11	GPIO_11	GPIO_11	INPUT	*NOTE1
15	UIP_TXD0	UIP_TXD0				For FW update.
16	UIP_RXD0	UIP_RXD0				
17	I2C_SDA	I2C_DATA	GPIO_46	GPIO_46	INPUT	*NOTE1
18	I2C_SCL	I2C_CLK	GPIO_12	GPIO_12	INPUT	*NOTE1
19	UIP_TXD1	Rotary Wheel B1	GPIO_14	GPIO_14	INPUT	*NOTE1
20	GND	GND				
21	LCD_CTRL3/ SPI_DO	LCD_CTRL3	GPIO_47	GPIO_47	Out_Low	*NOTE1
22	UIP_RXD1	Rotary Wheel A1	GPIO_16	GPIO_16	INPUT	*NOTE1
23	LCD_CTRL2/ SPI_CLK	LCD_CTRL2	GPIO_48	GPIO_48	INPUT	*NOTE1
24	PE5	GPIO_18	GPIO_18	GPIO_18	INPUT	*NOTE1
25	LCD_CTRL1/ SPI_CS	LCD_CTRL1	GPIO_49	GPIO_49	INPUT	*NOTE1
26	PE6	GPIO_20	GPIO_20	GPIO_20	INPUT	*NOTE1

27	LCD_CTRL0/ SPI_DI	LCD_CTRL0	GPIO_50	GPIO_50	INPUT	*NOTE1
28	LCD_CTRL4/ SPDIF	LCD_CTRL4	GPIO_22	GPIO_22	INPUT	*NOTE1
29	LCD_D0	LCD_D0	GPIO_25	GPIO_25	INPUT	*NOTE1
30	LCD_D1	LCD_D1	GPIO_27	GPIO_27	INPUT	*NOTE1
31	GND	GND				
32	GND	GND				
CONN2						
1	LCD_D2	LCD_D2	GPIO_33	GPIO_33	INPUT	*NOTE1
2	LCD_D3	LCD_D3	GPIO_34	GPIO_34		*NOTE1
3	LCD_D4/SCAN_KEYO0	LCD_D4/SCAN_KEYO0	GPIO_36	GPIO_36		*NOTE1
4	LCD_D5/SCAN_KEYO1	LCD_D5/SCAN_KEYO1	GPIO_51	GPIO_51		*NOTE1
5	LCD_D6/SCAN_KEYO2	LCD_D6/SCAN_KEYO2	GPIO_52	GPIO_52		*NOTE1
6	LCD_D7/SCAN_KEYO3	LCD_D7/SCAN_KEYO3	GPIO_41	GPIO_41		*NOTE1
7	GND	GND				
8	GND	GND				
9	SCAN_KEYIN0	SCAN_KEYIN0	GPIO_43	GPIO_43	INPUT	*NOTE1
10	SCAN_KEYIN1	SCAN_KEYIN1	GPIO_55	GPIO_55	Out_Low	*NOTE1
11	SCAN_KEYIN2	SCAN_KEYIN2	GPIO_54	GPIO_54	INPUT	*NOTE1
12	SCAN_KEYIN3	SCAN_KEYIN3	GPIO_53	GPIO_53	INPUT	*NOTE1
13	ROT_B0	Rotary Wheel B0	GPIO_62	GPIO_62	INPUT	*NOTE1
14	ROT_A0	Rotary Wheel A0	GPIO_63	GPIO_63	INPUT	*NOTE1
15	N.C	N.C				
16	GND	GND				
17	BDTIN	Battery Detect Input				Analog input, Battery Range (0 to 4.5V), Recommend connect 3.3V when not use for battery detect.

18	GND	GND				
19	ADKIN	Key detector ADC analog input				
20	GND	GND				
21	ROUT	Stereo audio output-Right				Output Impedance is 32 Ω
22	GND	GND				
23	LOUT	Stereo audio output-Left				Output Impedance is 32 Ω
24	GND	GND				
25	LI_RIN2	Analog Input 2 For R Channel LINPGA				Audio Frequency 20~20KHz Input Impedance is 10K Ω Audio Gain -60dB~20dB
26	LI_RIN	Analog Input 1 For R Channel LINPGA				
27	LI_LIN2	Analog Input 2 For L Channel LINPGA				
28	LI_LIN	Analog Input 1 For L Channel LINPGA				
29	GND	GND				
30	GND	GND				
31	VDD1V2(Reserved)	+1.2V Power supply				
32	ANT_V(Reserved)	Antenna Power Supply 3.3V、5V or 12V。				

*NOTE1 : Multifunction GPIO(I2C、SPI、SCANKEY、IR、NMI...) *NOTE2 : When IC power on & Reset, initial state internal pull High.

6.5. Weight of module

14g \pm 10%

7. Hardware interface

7.1. RF Input

The module has two RF inputs, one can support both Band 2(FM) and Band 3(DAB).

The RF input is ESD sensitive. Please reserve the ESD protection circuit or component at RF input.

T4B module build-in antenna matching circuit and ESD protection circuit. System designer only need to do is connecting antenna by RF cable directly. We already consider several common antennas (Rod antenna, Pig Tail, T type antenna). Please refer antenna selection guide for detail.

Please notice. Optimize reception performance with adequate Antenna.

Adequate antenna define was :

1. Antenna type requirement as selection guide.
2. Antenna length requirement as selection guide.

T4B module can't customize matching with any other antenna.

The RF Input is standard 50 Ohm input impedance at vehicle grade module.

7.2. Analogue audio output

Stereo analog audio outputs are provided by T4B on-chip audio DAC. It's line out type audio output and directly support headphone 32 ohm load, the output impedance is 32 Ω .

When audio output is directly drive 32 ohm headphone then output level will reduce 6dB.

Audio output, need at external ac coupling capacitor (10uF for Line out, 100uF for Headphone)

7.3. Stereo Line-in

The module provides two stereo inputs port. It also has the selectable input gain.

Audio gain

range -60~20dB(63 level).

7.4. Serial port

Serial port pins (UART_RXD, UART_TXD) runs RS232 protocol, and can interface to external host or PC. Software control is required on this serial port.

7.5. I2C interface

I2C interfaces can be used to communicate with I2C LCM, EPROM or other I2C devices.

7.6. Power and ground

The module requires a $3.3\text{ V} \pm 10\%$ for the RF circuits and other baseband devices as minimum requirement. The module Internal DC-DC 1.2V, supply for the digital baseband. Noise and spurs associated with these power supplies should be kept as low as possible to ensure high receiving sensitivity performance. All power supply voltage ripple should be under **10mVpp** for best performance.

GND is the lowest potential of the module, and it should connect to true ground by a plane as close as possible.

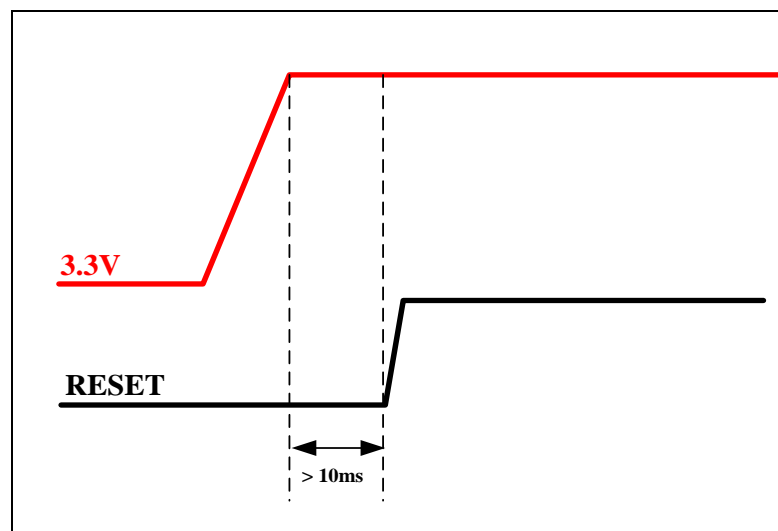


Figure 8 : Power on sequence

7.7. LCM

The module provides three series LCM control interfaces:

a) **Character LCM Control Interface**

It offers a wide range of character LCM control interfaces to fit for customer's applications. It provides three data-bus modes: 1-bit mode, 4-bit mode and 8-bit mode. The firmware now supports all these three data-bus modes and is able to control the standard 2x16 and 4x16 LCM with or without customized icons.

The following lists the LCM controllers that have been tested and qualified for used with module.

- Sitronix ST7032 (2x16 Characters)
- Sitronix ST7070 (4x16 Characters)
- Samsung KS0066 (2x16 Characters)
- SunPlus SPLC780C (2x16 Characters)

b) **Serial Control Interface**

It also supports I2C and SPI Character LCM such as Sitronix ST7032i (I2C), Philips PCF2116 (I2C) and Samsung KS0074 (SPI).

c) **Parallel Control Interface**

There are two popular parallel control interfaces used especially in the graphic LCM: Motorola 6800-series and Intel 8080-series parallel interface. The following lists the LCM controllers that have been tested and qualified for used with module.

- Sitronix ST7565R (65 x 132 Dot Matrix LCD Controller)
- Solomon Systech SSD1303 (OLED driver/controller IC)
- Novatek NT7501
- PTC PT6866 (OLED driver/controller IC)
- ILITEK ILI9341 (TFT-LCD single chip driver/controller IC)

LCD interface contains 8 data pins (LCD_D[0:7]) and 4 control pins (LCD_CTRL[0:3]) to drive typical 2x16 LCD display or OLED display.

LCD_CTRL3 is configured to control the backlight of the LCD panel.

LCD_D[0:3] can be configured as GPIO if 8-bit data mode is not needed.

In order to prevent the LCD interface interference, a serial resistor under 2kohm should be placed on each LCD output lines as close to module as possible.

7.8. Keyboard

a) Scan key operation

SCAN_IN[0:3] and SCAN_OUT[0:3] forms a 4x4 key matrix consist of 16 key pads. A key is detected when it shorts (pressed) the intersection of any SCAN_IN and SCAN_OUT lines. In order to prevent scan key interference, a serial resistor 3.3Kohm with shunt 560pF capacitor should be placed on each scan key output pins as close to module as possible.

b) ADC key operation

The module provides 6-bit ADC. To ensure the best ADC accuracy, the full range of the converter should be used.

7.9. GPIO

Every digital pin of the module has a main function plus a GPIO function. If an application does not use the main function of a pin, then it can be reconfigured to input, output or bi-directional function through software configuration.

All GPIO pins are Schmitt-trigger input mode as reset default value, and FW can configure each GPIO to its main function.

7.10. Roll switch

Two sets of Roll Switch inputs are provided. Roll Switch used 2-pin phase-encoder to determine the direction and counts of rotation.

7.11. IR receiver

The Module provides one IR receiver if required.

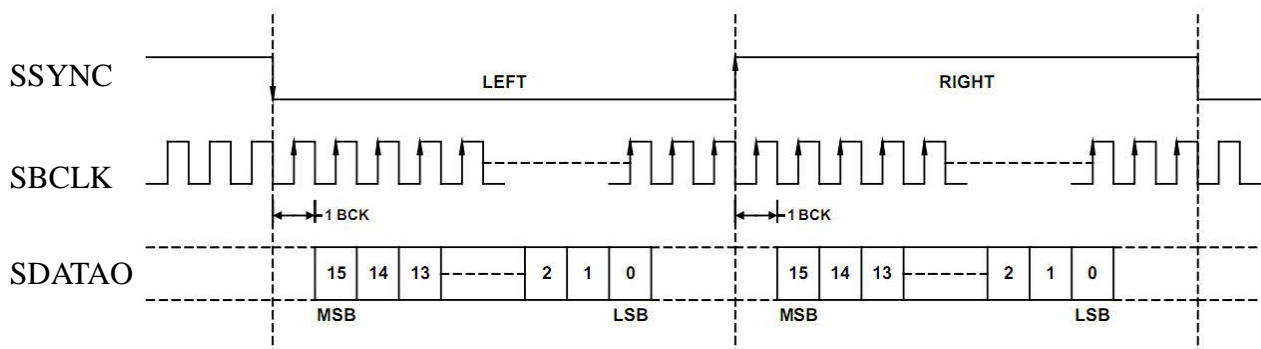
7.12. SPI interface

LCD_CTRL [0:3] can be configured as SPI interface if LCD_CTRL [0:3] are not used. SPI interface is the default data transmitting path for Host to decode DMB video stream. It supports both master and slave SPI application.

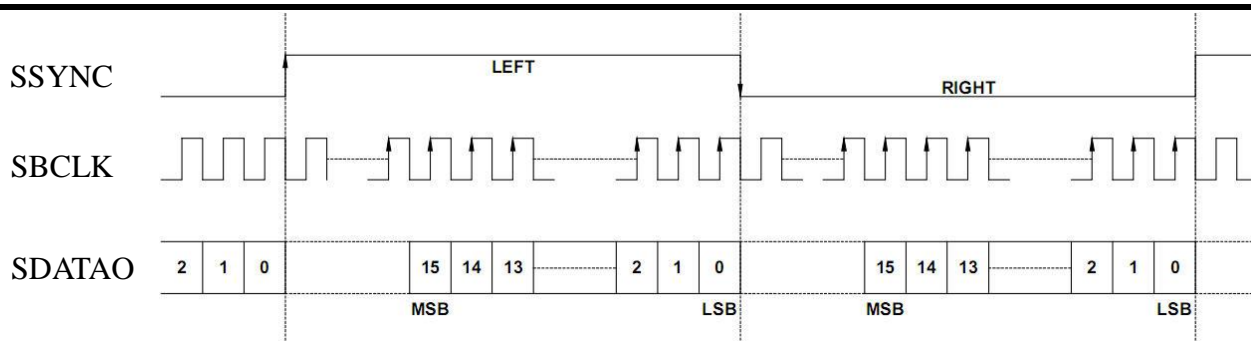
7.13. I2S interface

It support I2S output and input for optional and two formats are supported: 32-bit I2S format and 32-bit Right justified format.

I2S format:



Right justified format:



7.14. H/W reset

The external H/W reset control is required. Either controlled by external MCU in slave mode or use T4B module internal power on reset sequence are recommended. Before power off DAB module at slave mode. Reset signal should be active before power down 100ms.

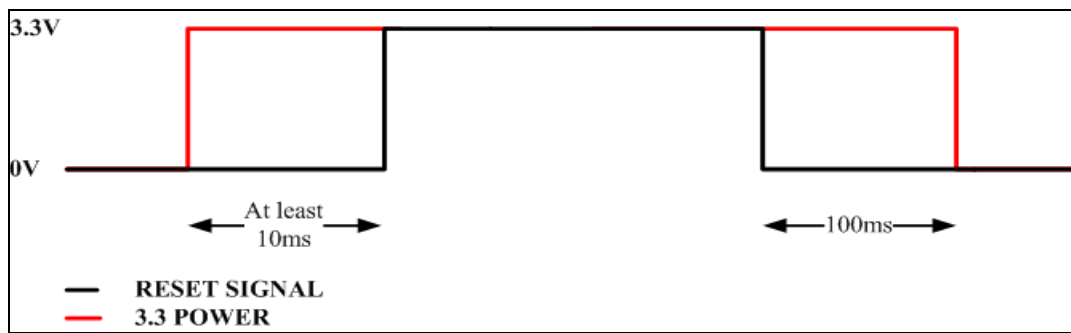


Figure 9 : Power On/Off reset timing

7.15. Power level detection

Internal already have a 3.3V power level detector, do not need another power level detector at 3.3V.

8. Technical Specification

No.	Item	Conditions
-----	------	------------

8-1	RF/IF Description (1) Input frequency range (2) Antenna impedance (3) IF frequency	FM : 76~108MHz Band-3 : 174~240MHz Commercial grade: It is smart match, Please to reference antenna type requirement as selection guide Vehicle grade: 50Ω FM : 512Khz(2.048MHz) DAB : 1.536Mhz
8-2	Signal format	FM : BS5942-2 / BS 60315-4 DAB : ETSI EN 300 401(V2.1.1), Modes I support.
8-3	Analogue audio output	Stereo audio output
8-4	Analogue audio input	Stereo Line-in
8-5	Power supply voltage CONN1-Pin1	+3.3V±10%
8-6	Environmental specification	
8-6-1	Temperature for <u>commercial grade</u> Operating Storage	0 ~ +70 ° C -20 ~ +70 ° C
8-6-2	Temperature for <u>industry grade</u> Operating Storage	-40 ~ +85 ° C -40 ~ +85 ° C
8-6-3	Humidity Operating Storage	Less than 80% RH(at 40 ° C) Less than 95% RH(at 40 ° C)

9. DC Electrical Characteristics

Test for electrical specifications shall be performed at following condition unless otherwise

specified.

No.	Item	Conditions	
9-1	Ambient Condition Temperature	25 ° C	
9-2	Power Supply +3.3V (Pin 1)	3.3 V DC , ripple \leq 10mVpp	
9-3	Operation Current Consumption (mA)	Typ.	Max.
	DAB Mode +3.3V	46 ^{*1}	51
	DAB+ Mode +3.3V	44 ^{*1}	53
	FM Mode +3.3V		66
	Standby Current (mA)^{*2} +3.3V		6

*1: With power cycling on, at strong input signal condition, audio load 1K.

*2: All function disable, include mono LCM display function.

10. Absolute Maximum Ratings

No	Item	Max.	Unit
10-1	VDD33 Power Supply	3.6	V
10-2	Digital & Analog IO Pad Input Voltage	-0.3 to VDD33+0.3	

11. DC Operating Condition

No	Item	Specification			
		Min.	Typ.	Max.	Unit
11	+3.3 Power Supply	+3.0	+3.3	+3.6	V

12. AC Electrical Specifications

TA = 25°C, 3.3 V DC , ripple \leq 10mVpp ,unless otherwise noted

12.1. DAB Band-III Performance(Commercial grade)

No	Item	Specification				Condition
		Min.	Typ.	Max.	Unit	
12-1-1	Sensitivity	-98	-99	-100	dBm	
12-1-2	RF input large signal		0	10	dBm	
12-1-3	Adjacent channel selectivity		38	40	dB	N \pm 1
12-1-4	Far off selectivity		50	55	dB	N \pm 5MHz
12-1-5	Audio Output Loading Resistance	16	32		Ω	
12-1-6	Audio output voltage(32 Ω Load)		410	435	mV _{rms}	*NOTE2
12-1-7	Audio output voltage(1K Ω Load)		850	865	mV _{rms}	*NOTE1
12-1-8	THD+N		0.03		%	
12-1-9	SNR		72	77	dB	*NOTE1
12-1-10	Stereo separation		80	88	dB	*NOTE1
12-1-11	Audio 3dB cutoff frequency				Hz	
	Low		30			
	Higher		20000			

*NOTE1: 1Khz/UEP3/MODE1/256K or 192K sample rate, headroom=0db, audio full scale, Audio output load=1K

*NOTE2: 1Khz/UEP3/MODE1/256K or 192k sample rate, headroom=0db, audio full scale, Audio output load=32 Ω

12.2. FM Performance(Commercial grade)

No	Item	Specification				Condition
		Min.	Typ.	Max.	Unit	
12-2-1	Sensitivity @ (S+N)/N=30dB		-106	-107	dBm	*NOTE1
12-2-2	RDS Sensitivity		-94	-95	dBm	*NOTE2
12-2-3	RF input large signal		0	10	dBm	
12-2-5	Adjacent channel		36	38	dB	*NOTE1
12-2-4	Far off selectivity		50	53	dB	*NOTE1
12-2-6	Audio Output Loading Resistance	16	32		Ω	
12-2-7	Audio output voltage(32 Ω Load)		280	310	mV _{rms}	*NOTE8
12-2-8	Audio output voltage(1K Ω Load)		570	610	mV _{rms}	*NOTE8

12-2-9	THD+N		0.03	0.05	%	*NOTE3
12-2-10	Mono SNR		68	72	dB	*NOTE4
12-2-11	Stereo SNR		53	57	dB	*NOTE5
12-2-12	Stereo separation		42	55	dB	*NOTE6
12-2-13	Audio 3dB cutoff frequency				Hz	
	Low		30			*NOTE7
	High		14000			

All test base on de-emphasis=50us, 1kohm ohm load. Audio analyzer with 20Khz bandwidth LPF.

Signal Generator is R&S EFT100 or Agilent N5182A

*NOTE1: Mono audio, $\Delta F=22.5\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$

*NOTE2: Stereo audio, $\Delta F=75\text{KHz}$, $\Delta\text{pilot}=6.75\text{KHz}$. $\Delta\text{RDS}=2\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$. FM frequency=98Mhz. Radio text and program service receive time under 15 sec. Which ΔF = Frequency deviation, Δpilot = Pilot deviation, ΔRDS =RDS deviation.

*NOTE3: RF=60dBuV/emf. Mono audio, $\Delta F=75\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$.

*NOTE4: RF=60dBuV/emf. Mono audio, $\Delta F=75\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$.

*NOTE5: RF=60dBuV/emf. Stereo audio, $\Delta F=75\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$.

*NOTE6: RF=60dBuV/emf. Stereo audio, $\Delta F=75\text{KHz}$, $\text{pilot}=6.75\text{KHz}$.

*NOTE7: RF=60dBuV/emf. Mono audio, $\Delta F=22.5\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$, $\text{Pre_emphasis}=50\mu\text{S}$.

*NOTE8: RF=60dBuV/emf. Mono audio, $\Delta F=75\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$. Headroom=0db.

12.3. DAB Band-III Performance(Vehicle grade)

No	Item	Specification				Condition
		Min.	Typ.	Max.	Unit	
12-3-1	Sensitivity	-99	-100	-101	dBm	
12-3-2	RF input large signal		0	10	dBm	
12-3-3	Adjacent channel selectivity		38	40	dB	$N\pm 1$
12-3-4	Far off selectivity		50	55	dB	$N \pm 5\text{MHz}$
12-3-5	Audio Output Loading Resistance	16	32		Ω	
12-3-6	Audio output voltage(32 Ω Load)		410	435	mV _{rms}	*NOTE2
12-3-7	Audio output voltage(1K Ω Load)		850	865	mV _{rms}	*NOTE1
12-3-8	THD+N		0.03		%	
12-3-9	SNR		72	77	dB	*NOTE1

12-3-10	Stereo separation		80	88	dB	*NOTE1
12-3-11	Audio 3dB cutoff frequency				Hz	
	Low		30			
	Higher		20000			

*NOTE1: 1Khz/UEP3/MODE1/256K or 192K sample rate, headroom=0db, audio full scale, Audio output load=1K

*NOTE2: 1Khz/UEP3/MODE1/256K or 192k sample rate, headroom=0db, audio full scale, Audio output load=32Ω

12.4. FM Performance(Vehicle grade)

No	Item	Specification				Condition
		Min.	Typ.	Max.	Unit	
12-4-1	Sensitivity @ (S+N)/N=30dB		-107	-109	dBm	*NOTE1
12-4-2	RDS Sensitivity		-95	-96	dBm	*NOTE2
12-4-3	RF input large signal		0	10	dBm	
12-4-5	Adjacent channel		36	38	dB	*NOTE1
12-4-4	Far off selectivity		50	53	dB	*NOTE1
12-4-6	Audio Output Loading Resistance	16	32		Ω	
12-4-7	Audio output voltage(32Ω Load)		280	310	mV _{rms}	*NOTE8
12-4-8	Audio output voltage(1KΩ Load)		570	610	mV _{rms}	*NOTE8
12-4-9	THD+N		0.03	0.05	%	*NOTE3
12-4-10	Mono SNR		68	72	dB	*NOTE4
12-4-11	Stereo SNR		53	57	dB	*NOTE5
12-4-12	Stereo separation		42	55	dB	*NOTE6
12-4-13	Audio 3dB cutoff frequency				Hz	*NOTE7
	Low		30			
	High		14000			

All test base on de-emphasis=50us, 1kohm ohm load. Audio analyzer with 20Khz bandwidth LPF.

Signal Generator is R&S EFT100 or Agilent N5182A

*NOTE1: Mono audio, $\Delta F=22.5\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$

*NOTE2: Stereo audio, $\Delta F=75\text{KHz}$, $\Delta\text{pilot}=6.75\text{KHz}$, $\Delta\text{RDS}=2\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$, FM frequency=98Mhz. Radio text and program service receive time under 15 sec. Which ΔF = Frequency deviation, Δpilot = Pilot deviation, ΔRDS =RDS deviation.

*NOTE3: RF=60dBuV/emf. Mono audio, $\Delta F=75\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$.

*NOTE4: RF=60dBuV/emf. Mono audio, $\Delta F=75\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$.

*NOTE5: RF=60dBuV/emf. Stereo audio, $\Delta F=75\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$.

*NOTE6: RF=60dBuV/emf. Stereo audio, $\Delta F=75\text{KHz}$, $\text{pilot}=6.75\text{KHz}$.

*NOTE7: RF=60dBuV/emf. Mono audio, $\Delta F=22.5\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$, $\text{Pre_emphasis}=50\mu\text{S}$.

*NOTE8: RF=60dBuV/emf. Mono audio, $\Delta F=75\text{KHz}$, $F_{\text{mod}}=1\text{KHz}$. Headroom=0db.

12.5. Stereo Line-in

$T_A = 25^\circ\text{C}$, 3.3 V DC , ripple $\leq 10\text{mVpp}$, 1KHz sine wave input ,unless otherwise noted

No	Item	Specification				Condition
		Min.	Typ.	Max.	Unit	
12-5-1	Input full-scale			1	V_{rms}	
12-5-2	Bandwidth	20		20K	Hz	
12-5-3	SNR		77		dB	*NOTE1
12-5-4	THD+N		0.015		%	*NOTE1
12-5-5	Audio output voltage(1K Ω Load)		900	920	mVrms	*NOTE2
12-5-6	Line in to audio out separation		80		dB	*NOTE3
12-5-7	Minimum input impedance		10K		Ω	Audio Gain=20dB

Audio Gain Range= -60dB~20dB, The path has a fixed attenuation.

*NOTE1: $f_{\text{in}}=1\text{KHz}$, A-weighted, $\text{THD+N} < 0.015\%$, $800\text{mV}_{\text{rms}}$ input, Audio Gain=-0.1dB.

*NOTE2: $f_{\text{in}}=1\text{KHz}$, A-weighted, $\text{THD+N} < 0.015\%$, 125mVrms input, Audio Gain=20dB.

*NOTE3: $f_{\text{in}}=1\text{KHz}$, A-weighted, $\text{THD+N} < 0.015\%$, 800mVrms input, Audio Gain=-0.1dB, Power Spectral Density=Enable. (1K tone signal generator is ONKYO SE-U33GXV Audio analyzer)

13. Compliance standards

13-1 Electromagnetic compatibility(EMC)

T4B module is tested to comply with the following standard:

BS EN 55022:2010

BS EN 55013:2013

The electromagnetic compatibility of a particular product is highly dependent on the usage environment and how the module is installed within final product. Care should be taken to integrate the module with due regard to the effects of conducted and radiated signals.

13-2 Electrostatic discharge (ESD) protection

T4B module is an ESD-sensitive device and is tested to IEC 61000-4-2 standard.

Special precautions should be taken during manufacturing and testing process.

14. Ordering Information

14.1. Orderable Part Number

Grade	Part Number	Temp (°C)	Band	Note
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Commercial	T4B-6620CDB-1.0	0 to 70	Band III, FM	
Commercial	T4B-6D60CDB-1.0	0 to 70	Band III, FM	with slide show & Support TFT LCD
Industry	T4B-6620VDB-1.0	-40 to 85	Band III, FM	
Industry	T4B-6D60VDB-1.0	-40 to 85	Band III, FM	with slide show & Support TFT LCD