

**BM23SPKA1NB9**

**Bluetooth 4.1 Digital Audio Interface Module**

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## Product Description

The ISSC BM23SPKA1NB9 is a highly integrated Bluetooth 4.1 digital audio output module, designed for high data rate, short-range wireless communication in the 2.4 GHz ISM band. With the build-in ISSC Bluetooth stack, profile and digital audio interface, the ISSC BM23SPKA1NB9 can combine the external DSP and codec to provide high performance Bluetooth audio.

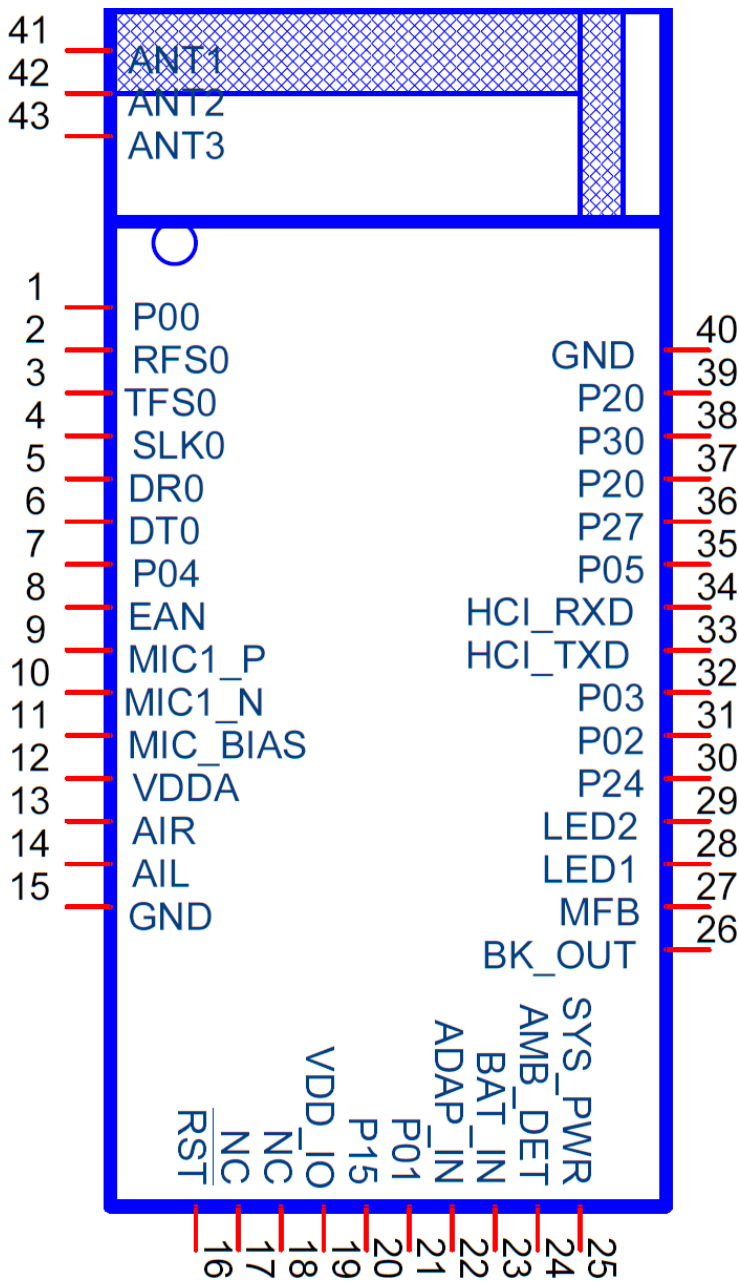
## Features

- Main Chip: ISSC IS2023S(ROM version)
- Bluetooth 4.1 EDR compliant
- Max. +4dBm Class 2 output power
- Receiver Sensitivity: GFSK typical -90dBm,  $\pi/4$  PSK typical -91dBm, 8DPSK typical -84dBm
- Piconet and Scatter net support
- CVSD, A-law,  $\mu$ -law, mSBC CODEC algorithms for voice applications
- SBC/AAC decode for Bluetooth audio streaming
- Microphone input and audio line-in support
- Built-in four language voice prompt (Chinese/English/Spanish/French)
- Support PCM and I2S digital audio interface
- Built-in 350mAH Li-ion battery charger
- HSP, HFP, A2DP, AVRCP,SPP profiles supported
- 3.3V operating voltage
- Built-in program ROM and 64Kb EEPROM
- 43 pins for SMT module Size: 15mmx29mm<sup>2</sup>
- Built-in PCB Antenna
- RoHS compliant
- FCC certification

**Module Pin Out Diagram**

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## Pin Definition for ROM module

Pin No.	I/O	Name	Description
1	I/O	P00	GPIO, default pull-low input. UART_TX_IND: BT Module use to inform MCU
2	I/O	RFS0	Receive frame synchronization
3	I/O	TFS0	Transmit frame synchronization
4	I/O	SLK0	Serial clock
5	I	DR0	Serial data receive
6	O	DT0	Serial data transmit
7	I/O	P04	GPIO, default pull-high input
8	I	EAN	Embedded ROM/External Flash enable High: ROM mode; Low: External Flash mode
9	AI	MIC1_P	Mic 1 mono differential analog positive input
10	AI	MIC1_N	Mic 1 mono differential analog negative input
11	AP	MIC_BIAS	Power output, microphone biasing voltage
12	AP	VDDA	Power output, reserve for external cap to fine tune audio frequency response, no need to add power to this pin
13	AI	AIR	Stereo analog line in, R-channel
14	AI	AIL	Stereo analog line in, L-channel
15	P	GND	Ground
16	I/O	RST_N	System Reset Pin, Low: reset
17	--	NC	--
18	--	NC	--
19	P	VDDIO	Power output, VDDIO pin, no need to add power to this pin
20	I/O	P15	GPIO, default pull-high input
21	I/O	P01	GPIO, default pull-high input
22	P	ADAP_IN	Power adaptor input
23	P	BAT_IN	Battery input
24	P	AMB_DET	ADC analog input 1

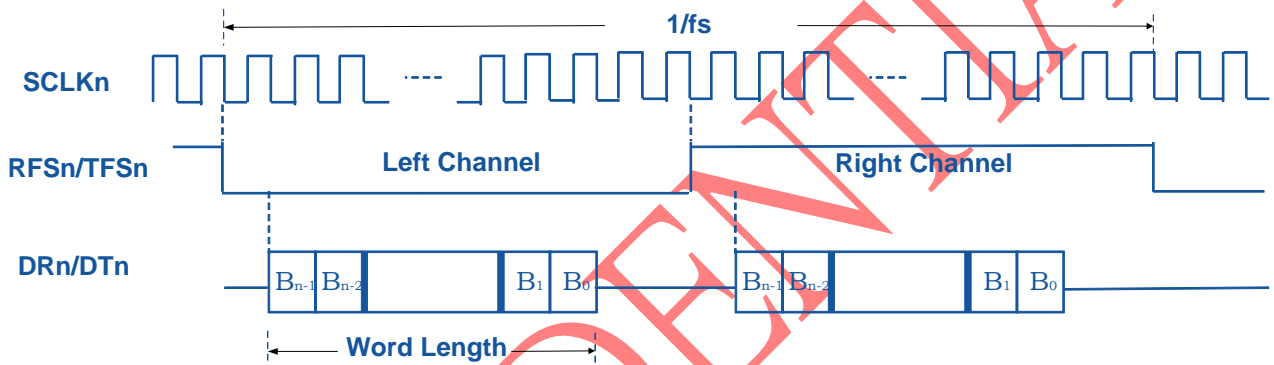
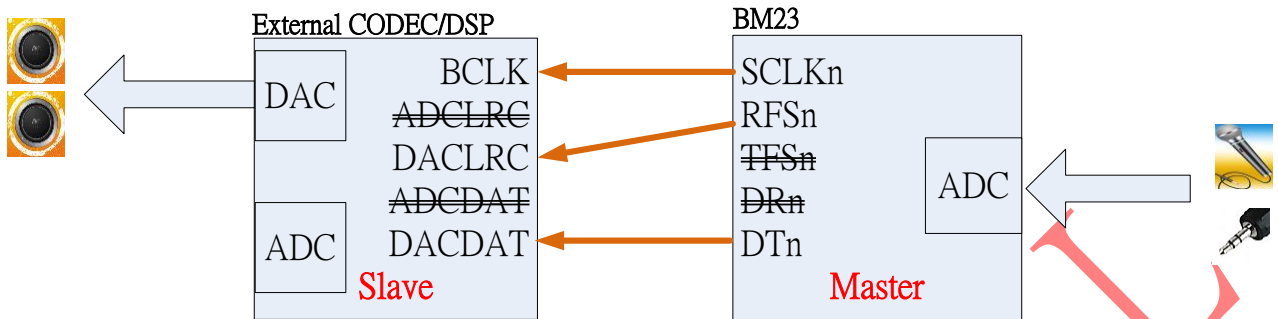
25	P	SYS_PWR	System Power Output BAT mode: 3.3~4.2V Adapter mode: 4.0V
26	P	BK_OUT	Power output, 1v8 pin, no need to add power to this pin
27	P	MFB	1. Power key when in off mode 2. UART_RX_IND: MCU use to wakeup BT
28	P	LED1	LED Driver 1, 4mA max
29	P	LED2	LED Driver 2, 4mA max
30	I/O	P24	GPIO, default input with internal pull high System Configuration: (with the combination of P20 and EAN) Low: boot Mode when P20=low, EAN=high
31	I/O	P02	GPIO, default pull-high input
32	I/O	P03	GPIO, default pull-high input
33	O	HCI_TXD	HCI TX data, output pin, BT to send data
34	I	HCI_RXD	HCI RX data, input pin, BT to receive data
35	I/O	P05	GPIO, default pull-high input
36	I/O	P27	GPIO, default pull-high input
37	I/O	P20	GPIO, default pull-high input
38	I/O	P30	GPIO, default pull-high input
39	I/O	P20	GPIO, default pull-high input System Configuration, H: Application L: Baseband(IBDK Mode)
40	P	GND	Ground.
41	A	ANT1	Antenna enhancement .
42	A	ANT2	Antenna enhancement .
43	A	ANT3	Antenna enhancement .

**Digital Audio Interface**

- Support I2S and PCM interface
- Sampling Rate : 8K, 44.1K, 48K
- Word Length: 16 bits, 24 bits
- 4 application modes

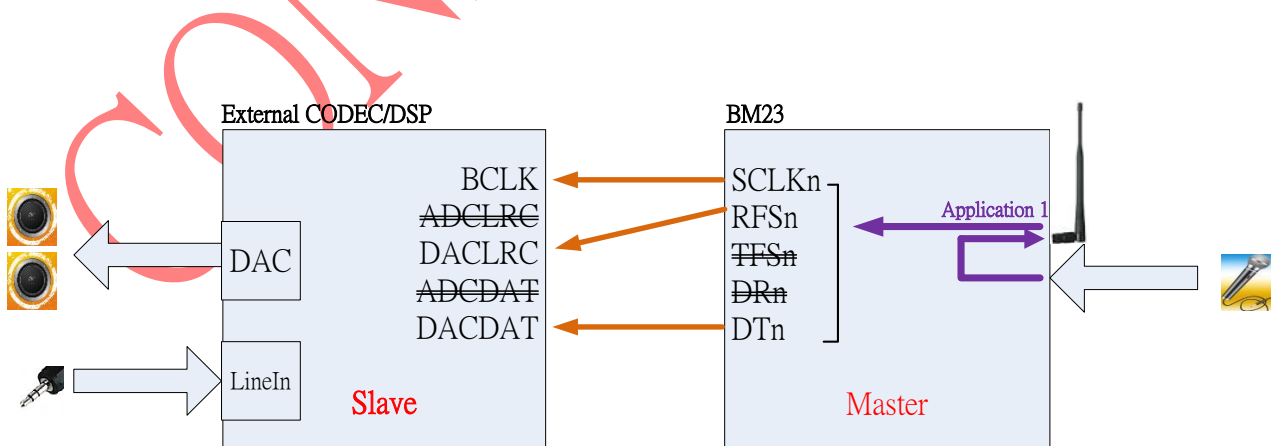
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**Mode 1: I2S Master**



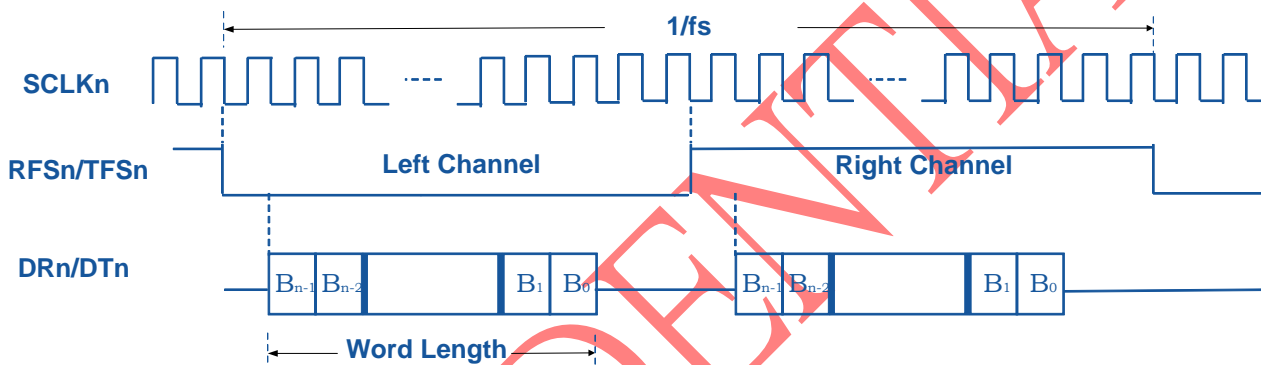
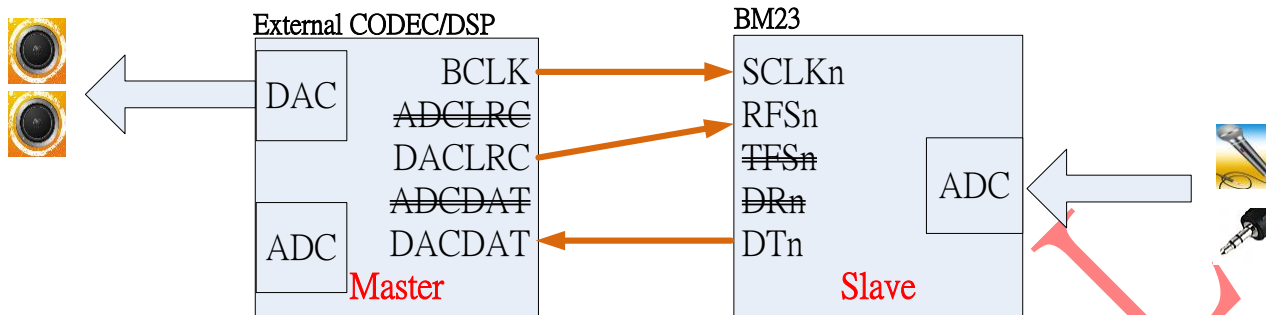
Or

- Solutions with mic and line-in analog input with I2S audio output
- Mic for Bluetooth SCO link
- Line-in for external audio playback (for high SNR requirement)



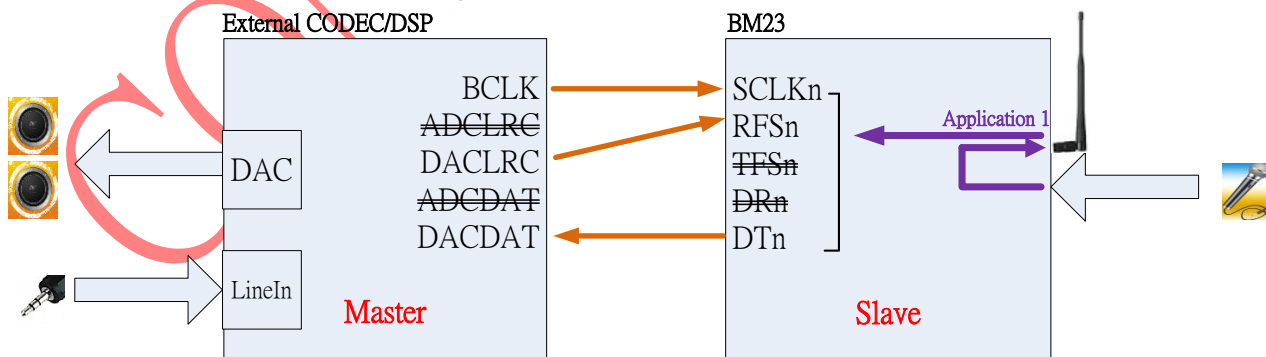


**Mode 2: I2S Slave**

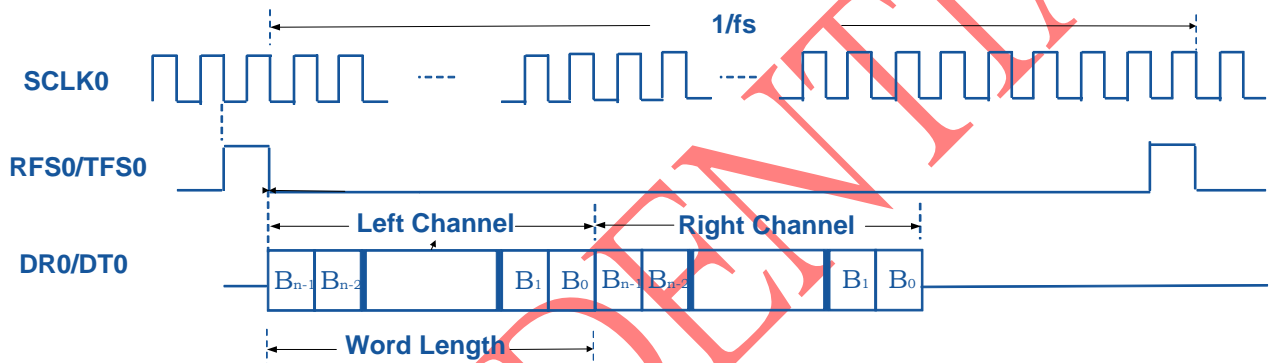
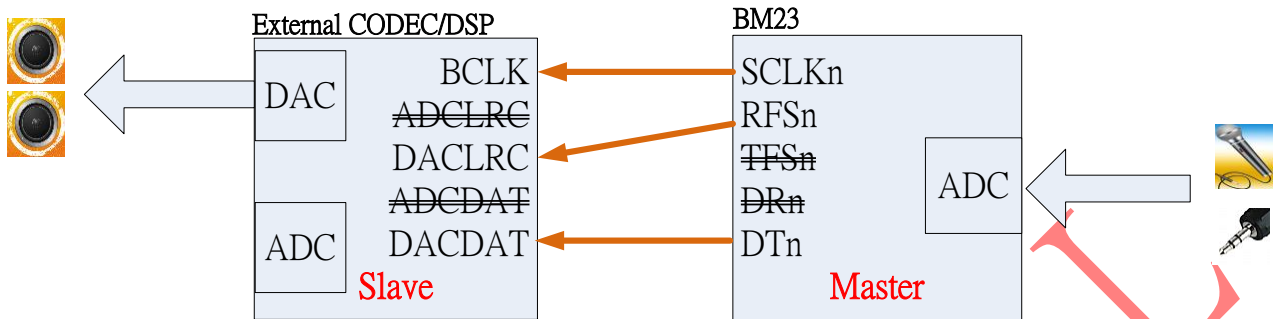


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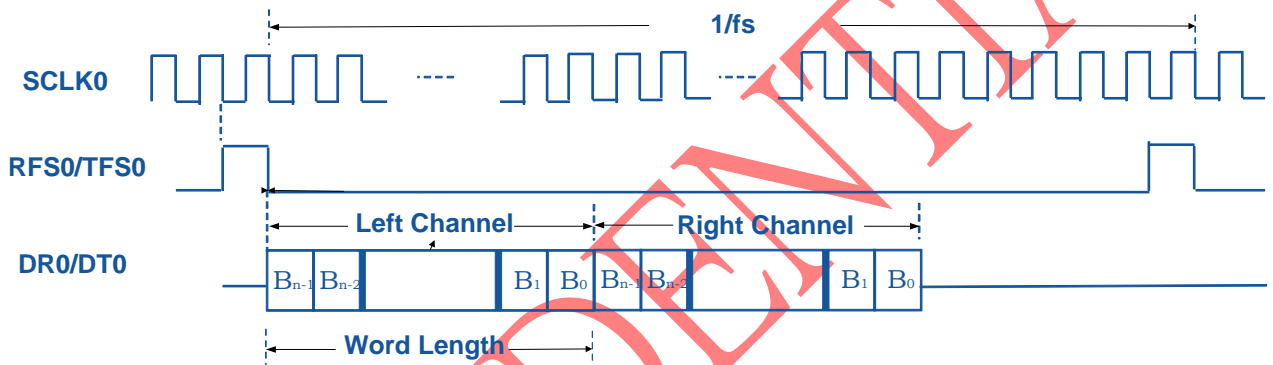
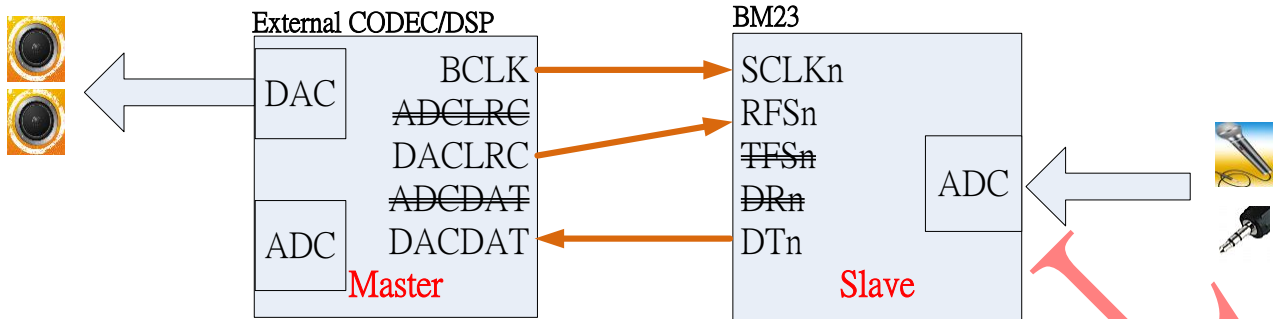
- Solutions with mic and line-in analog input with I2S audio output
- Mic for Bluetooth SCO link
- Line-in for external audio playback (for high SNR requirement)



**Mode 3: PCM master**

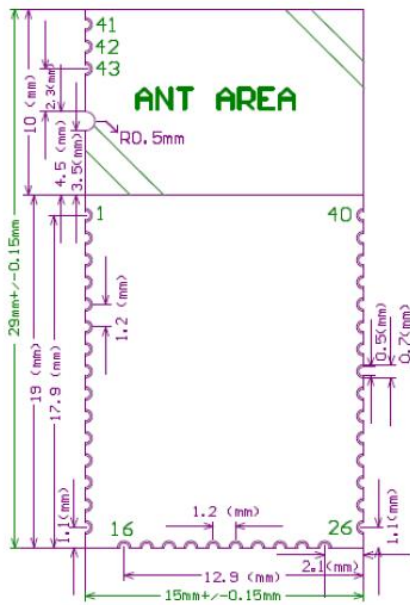


**Mode 4: PCM slave**

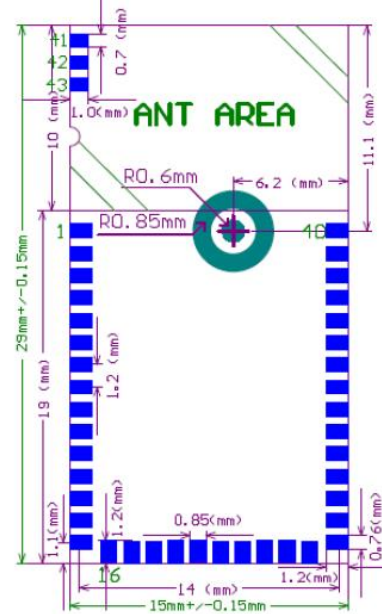


**Outline Dimension (Module Foot print)**

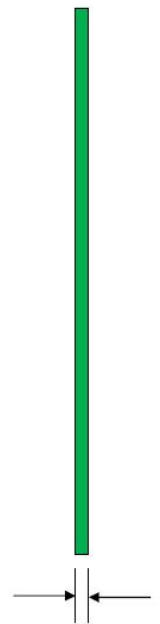
**Dimension(TOP)**



**Dimension(BOT)**



ISSC BM2023



0.6mm ± 0.06mm  
PCB Thickness

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## Electrical Characteristics

**Table 1: Absolute Maximum Voltages**

Rating		Min	Max
Storage Temperature		-40°C	+85°C
ESD: Human Body Mode		±2KV	
ESD: Machine Mode		±200V	
ESD: Charge Device Mode		±400V	
Core supply voltage	VDD_CORE, AVDD_PLL	1.14V	1.26V
RF supply voltage	VCC_RF	1.28V	
SAR supply voltage	AVDD_SAR	1.62V	1.98V
Codec supply voltage	VDD_AUDIO	2.7V	3.0V
I/O voltage	VDD_IO		3.6V
Supply voltage	BK_VDD		4.3V
	3V1_VIN		4.3V
	BAT_IN	3.0	4.3V
	ADAP_IN	4.5	7.0V
	LED		5.1V
	Power switch		7.0V

**Table 2: Recommended operate condition**

Rating		Min	Typ	Max
Storage Temperature		-10°C	+25°C	+60°C
Core supply voltage	VDD_CORE, AVDD_PLL	1.14V	1.2V	1.26V
RF supply voltage	VCC_RF		1.28V	
SAR supply voltage	AVDD_SAR	1.62V	1.8V	1.98V
Codec supply voltage	VDD_AUDIO	2.7V		3.0V
I/O voltage	VDD_IO	2.7V	3.0V	3.3V
Supply voltage	BK_VDD	3V		4.3V
	3V1_VIN	3V		4.3V
	BAT_IN	3V		4.3V

	ADAP_IN	4.5V		7.0V
	LED		4.3V	
	Power switch	1.8V		7.0V

**Table 3: BUCK switching regulator**

Normal Operation		Min	Typ	Max	Unit
Operation Temperature		-40		85	°C
Input Voltage ( $V_{IN}$ )		3.0	3.8	4.5	V
Output Voltage ( $V_{OUT}$ ) ( $I_{LOAD}=70mA$ , $V_{IN}=4V$ )		1.7	1.80	2.05	V
Output Voltage Accuracy			±5		%
Output Voltage Adjustable Step			50		mV/Step
Output Adjustment Range		-0.1		+0.25	V
Output Ripple			10	15	mV <sub>RMS</sub>
Average Load Current ( $I_{LOAD}$ )		120			mA
Settling Time (start-up time)	EN or $V_{IN}$ to $V_{OUT}$		1.2	2	ms
Conversion efficiency @BAT=3.8V	$I_{LOAD} = 50mA$		88		%
	$I_{LOAD} \geq 10mA$ (PWM)		70		
	$I_{LOAD} \geq 10mA$ (PFM)		80		
	$I_{LOAD} \geq 250 \mu A$ (PFM)		65	70	
Switching Frequency			800		KHz
PWM/PFM Switching Point			by F/W		mA
Start-up Current Limit		0	50	210	mA
Start-up Inrush Current	$I_{LOAD} = 10mA$			400	mA
Quiescent Current	PWM			1000	$\mu A$
	PFM		30	40	
Output Current (Peak)		200			mA
Load Regulation ( $I_{LOAD} = 10 \sim 100mA$ )			1		mV/mA
Line Regulation ( $3.2V < V_{IN} < 4.2V$ )			0.03		%/V

			(30)		(mV/V)
EN threshold	Logic Low Voltage ( $V_{IL}$ )			0.4	V
	Logic High Voltage ( $V_{IH}$ )	1.62			V
EN current				10	nA
Shutdown Current *1				<1	$\mu$ A

**Table 4: Low Drop Regulation**

Normal Operation		Min	Typ	Max	Unit
Operation Temperature		-40		85	°C
Input Voltage ( $V_{IN}$ )		3.0		4.5	V
Output Voltage ( $V_{OUT}$ ) (1) $V_{OUT\_CODEC}$ (2) $V_{OUT\_IO}$	$V_{OUT} = 2.9V$ (2.4~3.4V)		2.9		V
	$V_{OUT} = 1.8V$ (1.3~2.3V)		1.8		
Accuracy ( $V_{IN}=3.7V$ , $I_{LOAD}=100mA$ , 27°C)			$\pm 5$		%
Output Voltage Adjustable Step		67	100		mV/Step
Output Adjustment Range			$\pm 0.5$		V
Start-up Inrush Current	$I_{LOAD}=10mA$		200	400	mA
Settling Time (start-up time)	EN or $V_{IN}$ to $V_{OUT}$		250	500	$\mu$ s
Output Current (Average)	$V_{OUT}$			100	mA
Output Current (Peak)	$V_{OUT}$			150	mA
Drop-Out Voltage ( $I_{LOAD} = \text{maximum output current}$ )				300	mV
Quiescent Current (excluding load, $I_{LOAD} < 1mA$ )			45		$\mu$ A
Quiescent Current (excluding load, $I_{LOAD} < 100 \mu A$ )				N/A	$\mu$ A
Load Regulation ( $I_{load} = 0mA$ to $100mA$ ), $\Delta V_{OUT}$				40 (0.4)	mV (mV/mA)

Note: $0.4(\text{mV}/\text{mA}) * (100\text{mA}-0\text{mA})=40\text{mV}$					
Line Regulation ( $V_{\text{OUT}}+0.3\text{V}<V_{\text{IN}}<4.5\text{V}$ )			7	10	mV/V
EN threshold	Logic Low Voltage ( $V_{\text{IL}}$ )			0.4	V
	Logic High Voltage ( $V_{\text{IH}}$ )	1.62			V
EN current				10	nA
Shutdown Current (*1)				<1	$\mu\text{A}$

**Table 5: Battery Charger**

Charging Mode (BAT_IN rising to 4.2V)		Min	Typ	Max	Unit
Operation Temperature		-40		85	°C
Input Voltage ( $V_{\text{IN}}$ ) Note: It needs more time to get battery fully charged when $V_{\text{IN}}=4.5\text{V}$		4.5	5.0	7.0	V
Supply current to charger only			3	4.5	mA
Battery trickle charge current (BAT_IN < trickle charge voltage threshold)			0.1C		mA
Maximum Battery Fast Charge Current Note: ENX2=0	Headroom > 0.7V (ADAP_IN=5V)	170	200	240	mA
	Headroom = 0.3V (ADAP_IN=4.5V)	160	180	240	mA
Maximum Battery Fast Charge Current Note: ENX2=1	Headroom > 0.7V (ADAP_IN=5V)	330	370	420	mA
	Headroom = 0.3V (ADAP_IN=4.5V)	180	220	270	mA
Minimum Step			1		mA
Trickle Charge Voltage Threshold			3		V
Float Voltage		4.158	4.2	4.242	V
Battery Charge Termination Current, % of Fast Charge Current			10		%
<b>Standby Mode (BAT_IN falling from 4.2V)</b>					
Supply current to charger only			2	4	mA



Battery Current		-1		$\mu A$
Battery Recharge Current Note: C $\rightarrow$ Battery Capacity (*1)		0.25C		mA

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**Table 6: Audio codec ADC**

	Conditions		Min	Typ	Max	Unit
Temperature			-40	25	85	°C
Resolution					16	Bits
Input sample rate, $F_{\text{sample}}$	8KHz for MIC 44.1KHz for Line-in		8		44.1	KHz
Signal to Noise Ratio (SNR @MIC or Line-in mode)	$f_{\text{in}}=1\text{KHz}$ B/W=20~20KHz A-weighted THD+N < 1% 150mVpp input	8KHz		90		dB
		44.1KHz		90		
Digital Gain			-54		4.85	dB
Digital Gain Resolution				2~6		dB
MIC Boost Gain				20		
Analog Gain					60	dB
Analog Gain Resolution				2.0		dB
Input full-scale at maximum gain (differential)				4		mV rms
Input full-scale at minimum gain (differential)				800		mV rms
3dB bandwidth				20		KHz
Microphone mode input impedance	Input impedance			6	10	K $\Omega$
	Input capacitance				20	pF
THD+N (microphone input) @30mVrms input				0.02		%
THD+N (line input)				0.04		%
ADC channels				2		
Analog supply voltage			2.6	2.8	3.0	V
Digital supply voltage			1.08	1.2	1.32	V

**Table 7: Transmitter section for BDR (25°C)**

		Min	Typ	Max	Bluetooth specification	Unit
Maximum RF transmit power			4.0	5.0	-6 to 4	dBm
RF power variation over temperature range with compensation enabled			±1.0			dB
RF power variation over temperature range with compensation disabled			±2.0			dB
RF power control range			18		≥16	dB
RF power range control resolution			±0.5			dB
20dB bandwidth for modulated carrier			925		≤1000	KHz
ACP	F = F <sub>0</sub> ±2MHz		-42	-40	≤-20	dBm
	F = F <sub>0</sub> ±3MHz		-49	-48	≤-40	dBm
	Note: F <sub>0</sub> =2441MHz F = F <sub>0</sub> ±>3MHz		-57	-53	≤-40	dBm
Δf <sub>1avg</sub> maximum modulation		145		175	140<Δf <sub>1avg</sub> <175	KHz
Δf <sub>2max</sub> maximum modulation		120	135	140	≥115	KHz
Δf <sub>2avg</sub> /Δf <sub>1avg</sub>		0.9	0.95		≥0.80	
ICFT		4.5	8	10.5	±75	KHz
Drift rate		3.3	5	7.0	≤20	KHz/50 us
Drift (single slot packet)			12		≤40	KHz
2 <sup>nd</sup> harmonic content			-42		≤-30	dBm
3 <sup>rd</sup> harmonic content			-45		≤-30	dBm

**Table 8 Transmitter section for EDR (25°C)**

		Min	Typ	Max	Bluetooth specification	Unit
Relative transmit power			-1.2		-4 to 1	dB
$\pi/4$ DQPSK max carrier frequency stability	$ \omega_o $ freq. error		2.5	5	$\leq 10$ for all blocks	KHz
	$ \omega_i $ initial freq. error		2.5	5	$\leq 75$ for all blocks	KHz
	$ \omega_o + \omega_i $ block freq. error		5	10	$\leq 75$ for all blocks	KHz
8DPSK max carrier frequency stability	$ \omega_o $ freq. error		2.5	5	$\leq 10$ for all blocks	KHz
	$ \omega_i $ initial freq. error		2.5	5	$\leq 75$ for all blocks	KHz
	$ \omega_o + \omega_i $ block freq. error		5	10	$\leq 75$ for all blocks	KHz
$\pi/4$ DQPSK modulation accuracy	RMS DEVM		7	12.2	$\leq 20$	%
	99% DEVM		PASS		$\leq 30$	%
	Peak DEVM			25	$\leq 35$	%
8DQPSK modulation accuracy	RMS DEVM		7		$\leq 13$	%
	99% DEVM		PASS		$\leq 20$	%
	Peak DEVM			20	$\leq 25$	%
In-band spurious emissions  Note: $F_0=2441$ MHz	$F > F_0+3$ MHz		<-52		$\leq -40$	dBm
	$F < F_0-3$ MHz		<-53		$\leq -40$	dBm
	$F = F_0-3$ MHz		-46		$\leq -40$	dBm
	$F = F_0-2$ MHz		-34		$\leq -20$	dBm
	$F = F_0-1$ MHz		-34		$\leq -26$	dBm
	$F = F_0+1$ MHz		-37		$\leq -26$	dBm
	$F = F_0+2$ MHz		-34		$\leq -20$	dBm

	$F = F_0 + 3\text{MHz}$		-46		$\leq -40$	dBm
EDR differential phase encoding			100		$\geq 99$	%

**Table 9 Receiver section for BDR (25°C)**

	Frequency (GHz)	Min	Typ	Max	Bluetooth specification	Unit
Sensitivity at 0.1% BER for all basic rate packet types	2.402		-90		$\leq -70$	dBm
	2.441		-90			
	2.480		-90			
Maximum received signal at 0.1% BER			0		$\geq -20$	dBm
Continuous power required to block Bluetooth reception (for input power of -67dBm with 0.1% BER) measured at the unbalanced port of the balun	0.030–2.000		-7		-10	dBm
	2.000-2.400		-10		-27	
	2.500-3.000		-11		-27	
	3.000-12.75		-7		-10	
C/I co-channel			6		$\leq 11$	dB
Adjacent channel selectivity C/I  Note: $F_0 = 2441\text{MHz}$	$F = F_0 + 1\text{MHz}$		-6		$\leq 0$	dB
	$F = F_0 - 1\text{MHz}$		-6.5		$\leq 0$	dB
	$F = F_0 + 2\text{MHz}$		-36		$\leq -30$	dB
	$F = F_0 - 2\text{MHz}$		-28		$\leq -9$	dB
	$F = F_0 - 3\text{MHz}$		-31		$\leq -20$	dB
	$F = F_0 + 5\text{MHz}$		-48		$\leq -40$	dB
	$F = F_{\text{image}}$		-28		$\leq -9$	dB
Maximum level of intermodulation			-37		$\geq -39$	dBm

interferers					
Spurious output level		N/A			dBm/Hz

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**Table 10: Receiver section for EDR (25°C)**

	Frequency (GHz)	Modulation	Min	Typ	Max	Bluetooth specification	Unit	
Sensitivity at 0.01% BER	2.402	$\pi/4$ DQPSK		-91		$\leq -70$	dBm	
	2.441	$\pi/4$ DQPSK		-91				
	2.480	$\pi/4$ DQPSK		-91				
		2.402	8DPSK		-85		$\leq -70$	dBm
		2.441	8DPSK		-84			
		2.480	8DPSK		-85			
Maximum received signal at 0.1% BER		$\pi/4$ DQPSK		-10		$\geq -20$	dBm	
		8DPSK		-10		$\geq -20$		
C/I co-channel at 0.1% BER		$\pi/4$ DQPSK		10		$\leq 13$	dB	
		8DPSK		16		$\leq 21$	dB	
Adjacent channel selectivity C/I	F = F <sub>0</sub> +1MHz	$\pi/4$ DQPSK		-11		$\leq 0$	dB	
		8DPSK		-5		$\leq 5$	dB	
	F = F <sub>0</sub> -1MHz	$\pi/4$ DQPSK		-8		$\leq 0$	dB	
		8DPSK		-4		$\leq 5$	dB	
	F = F <sub>0</sub> +2MHz	$\pi/4$ DQPSK		-38.5		$\leq -30$	dB	
		8DPSK		-33.5		$\leq -25$	dB	
	Note: F <sub>0</sub> =2441MHz	F = F <sub>0</sub> -2MHz	$\pi/4$ DQPSK		-29		$\leq -7$	dB
			8DPSK		-25		$\leq 0$	dB
	F = F <sub>0</sub> -3MHz	$\pi/4$ DQPSK		-32.5		$\leq -20$	dB	
		8DPSK		-27		$\leq -13$	dB	
	F = F <sub>0</sub> +5MHz	$\pi/4$		-49.5		$\leq -40$	dB	

		DQPSK					
		8DPSK		-43.5		≤-33	dB
	F = F <sub>image</sub>	$\pi/4$ DQPSK		-29		≤-7	dB
		8DPSK		-25		≤0	dB

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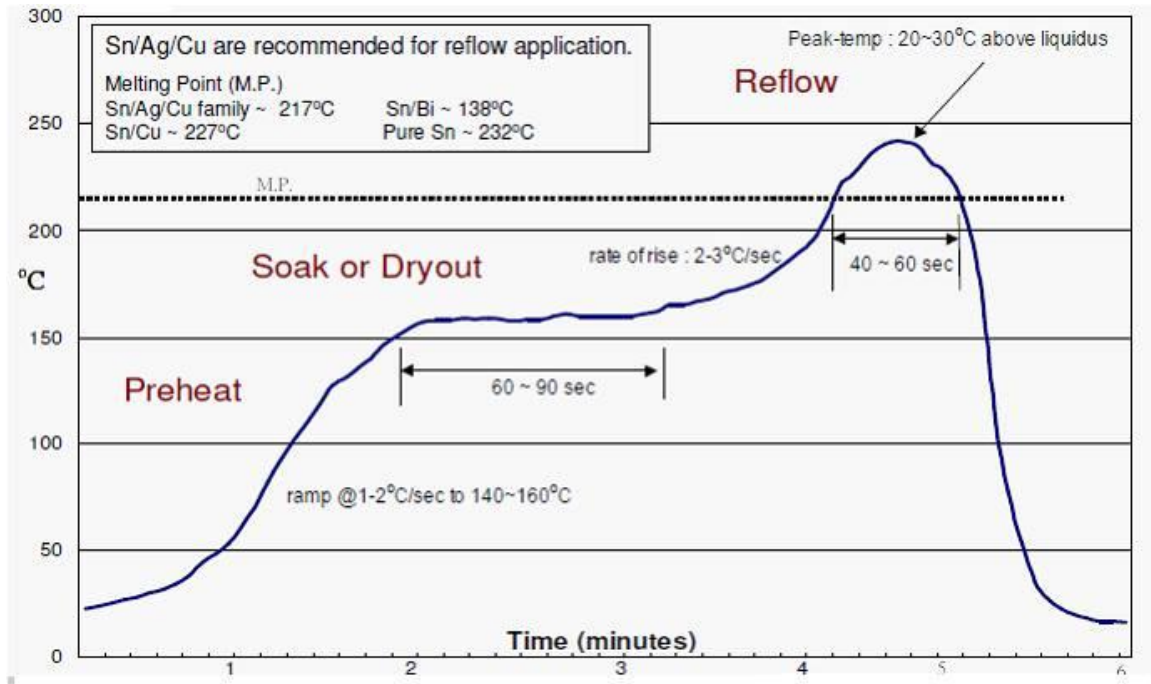
## FCC Label Instructions

The outside of final products that contains this module device must display a label referring to the enclosed module. This exterior label can use wording such as the following: “**Contains Transmitter Module FCC ID: A8TBM23SPKXYC2A**” or “**Contains FCC ID: A8TBM23SPKXYC2A.**” Any similar wording that expresses the same meaning may be used.

If the final product is to be sold in Canada, then this exterior label should use wording such as the following: “Contains Transmitter Module IC: 12246A-BM23SPKXYC2”

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**Reflow profile**



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QR code label information

Label Size:  $15 \pm 1.5$  \*  $6 \pm 1.5$  mm

Device Name: BM23SPKA1NB9

MAC ID: xxxxxxxxxx

Customer ID Name: Cxxxxx

Date Code: 13xx

Module Weight

(Test condition: module with QR label)

TBD

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### Storage standard

1. Calculated shelf life in sealed bag: 12 months at < 40 °C and <90% relative humidity (RH)
2. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be Mounted within 168 hours of factory conditions <30°C/60% RH

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**Ordering Information**

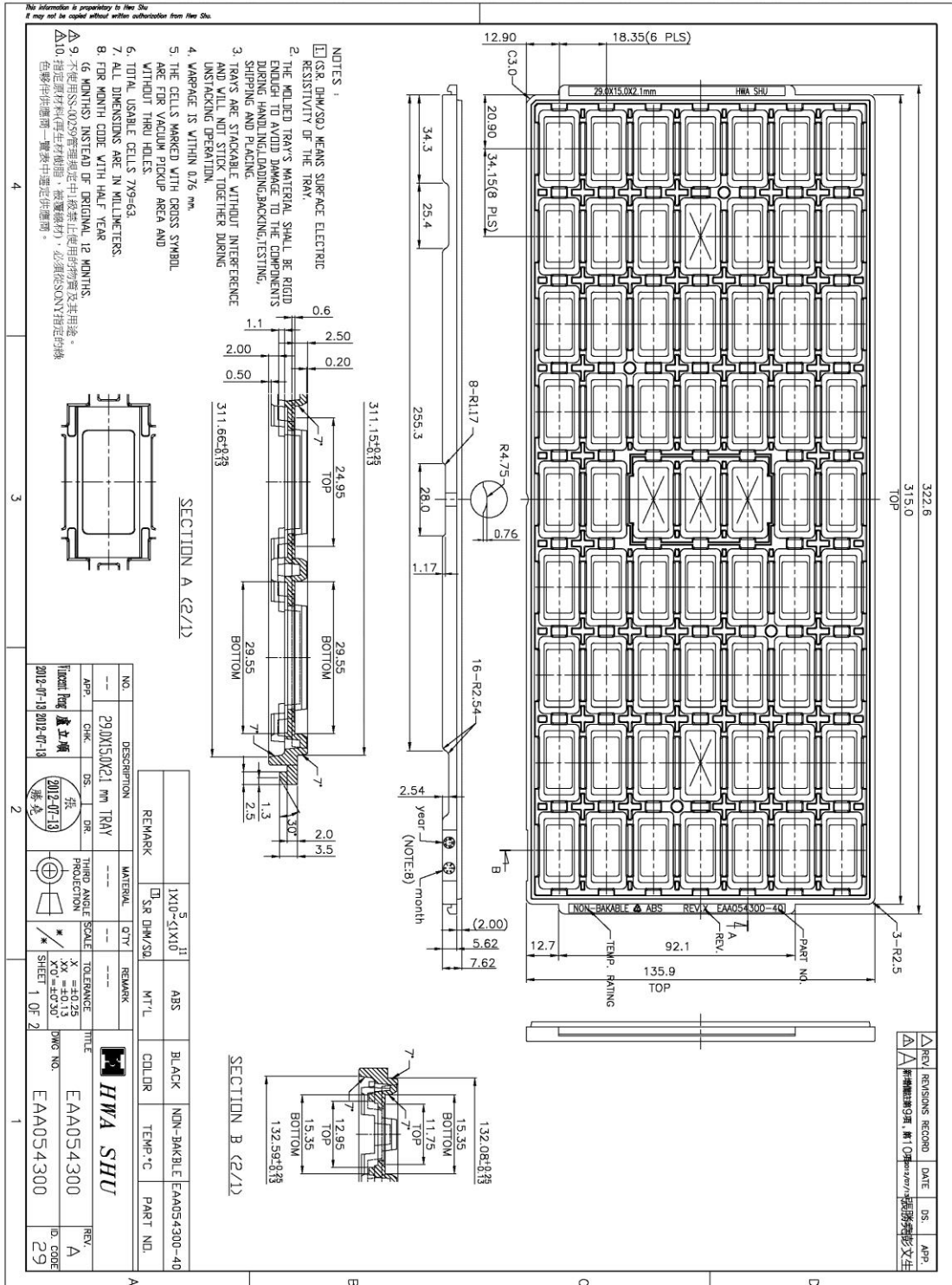
Device	Module		Order Number
	Size	Shipment Method	
<b>BM23SPKA1NB9</b> Bluetooth 4.1 digital audio Module	29*15 mm <sup>2</sup>	Tray	

**Note:**

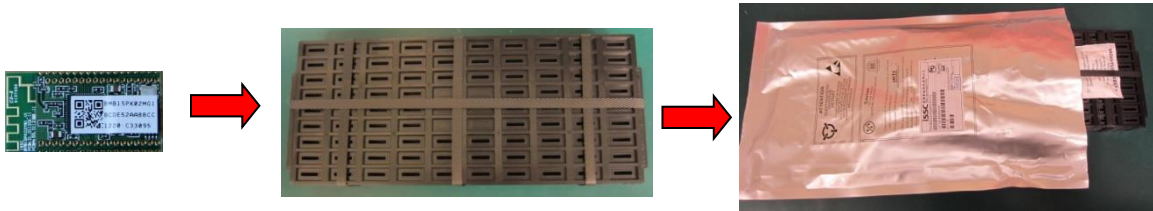
Minimum Order Quantity is 630pcs Tray.

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**Packing Information**  
Tray Dimensions



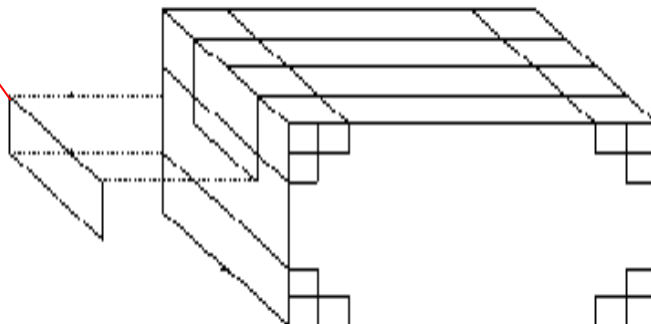
Packing Method



Inner box: Q'ty (630 Pcs)  
Dimensions: 36\*16\*9.5 cm



Bar Code Label  
P/N: Device name  
C/N: Customer name  
Lot No: Lot ID  
Q'ty: Box or Carton Module's Q'ty



Carton: Q'ty (3780 Pcs)  
Dimensions: 38\*35\*30 cm