

Technical Description

The Equipment Under Test (EUT) is a Bluetooth Music Receiver. It can pair with a Bluetooth device as the audio source. The demodulated audio signal is then drive an external active speaker via phone jack output. The Bluetooth module in the EUT is operating in the frequency range from 2402MHz to 2480MHz (79 channels with 1MHz channel spacing). The EUT is powered by 5V DC from an AC/DC adaptor. The adaptor accepts 100-240VAC 50/60Hz.

The EUT is using non-Adaptive Frequency Hopping as declared by applicant

2.4GHz Bluetooth Module:

Modulation Type: GFSK

Antenna Type: Integral, Internal (PCB Trace)

Frequency Range: 2402MHz - 2480MHz, 1MHz channel spacing, 79 channels

Nominal field strength is 100.3dB μ V/m @ 3m

Production Tolerance of field strength is +/- 2.5dB

Antenna gain is +1.76dBi

The functions of main ICs are mentioned below.

1. BlueTooth module BM81SPK02 (BT1):

- 1) U1 (IS1681S) acts as the 2.4GHz radio core of Bluetooth module (BT1) (BM81SPK02NB2), which is integrating with audio CODEC.
- 2) 16MHz crystal (X1) provides clock for Bluetooth RF IC IS1681S (U1).
- 3) U2 (24C32) is serial EEPROM for parameter backup of U1 (IS1681S).

2. Power Supply portion:

- 1) U3 (ME6211) is LDO providing 3.3VDC for the system.

Channel Frequency Table of Bluetooth Module

CH. NO.	FRE.	Hex Value		CH. NO.	FRE.	Hex Value		CH. NO	FRE.	Hex Value		CH. NO	FRE.	Hex Value
CH0	2402MHz	0		CH26	2428MHz	1A		CH52	2454MHz	34		CH78	2480MHz	4E
CH1	2403MHz	1		CH27	2429MHz	1B		CH53	2455MHz	35				
CH2	2404MHz	2		CH28	2430MHz	1C		CH54	2456MHz	36				
CH3	2405MHz	3		CH29	2431MHz	1D		CH55	2457MHz	37				
CH4	2406MHz	4		CH30	2432MHz	1E		CH56	2458MHz	38				
CH5	2407MHz	5		CH31	2433MHz	1F		CH57	2459MHz	39				
CH6	2408MHz	6		CH32	2434MHz	20		CH58	2460MHz	3A				
CH7	2409MHz	7		CH33	2435MHz	21		CH59	2461MHz	3B				
CH8	2410MHz	8		CH34	2436MHz	22		CH60	2462MHz	3C				
CH9	2411MHz	9		CH35	2437MHz	23		CH61	2463MHz	3D				
CH10	2412MHz	A		CH36	2438MHz	24		CH62	2464MHz	3E				
CH11	2413MHz	B		CH37	2439MHz	25		CH63	2465MHz	3F				
CH12	2414MHz	C		CH38	2440MHz	26		CH64	2466MHz	40				
CH13	2415MHz	D		CH39	2441MHz	27		CH65	2467MHz	41				
CH14	2416MHz	E		CH40	2442MHz	28		CH66	2468MHz	42				
CH15	2417MHz	F		CH41	2443MHz	29		CH67	2469MHz	43				
CH16	2418MHz	10		CH42	2444MHz	2A		CH68	2470MHz	44				
CH17	2419MHz	11		CH43	2445MHz	2B		CH69	2471MHz	45				
CH18	2420MHz	12		CH44	2446MHz	2C		CH70	2472MHz	46				
CH19	2421MHz	13		CH45	2447MHz	2D		CH71	2473MHz	47				
CH20	2422MHz	14		CH46	2448MHz	2E		CH72	2474MHz	48				
CH21	2423MHz	15		CH47	2449MHz	2F		CH73	2475MHz	49				
CH22	2424MHz	16		CH48	2450MHz	30		CH74	2476MHz	4A				
CH23	2425MHz	17		CH49	2451MHz	31		CH75	2477MHz	4B				
CH24	2426MHz	18		CH50	2452MHz	32		CH76	2478MHz	4C				
CH25	2427MHz	19		CH51	2453MHz	33		CH77	2479MHz	4D				

BM81SPK02

Bluetooth 3.0 EDR Wireless Speaker Module

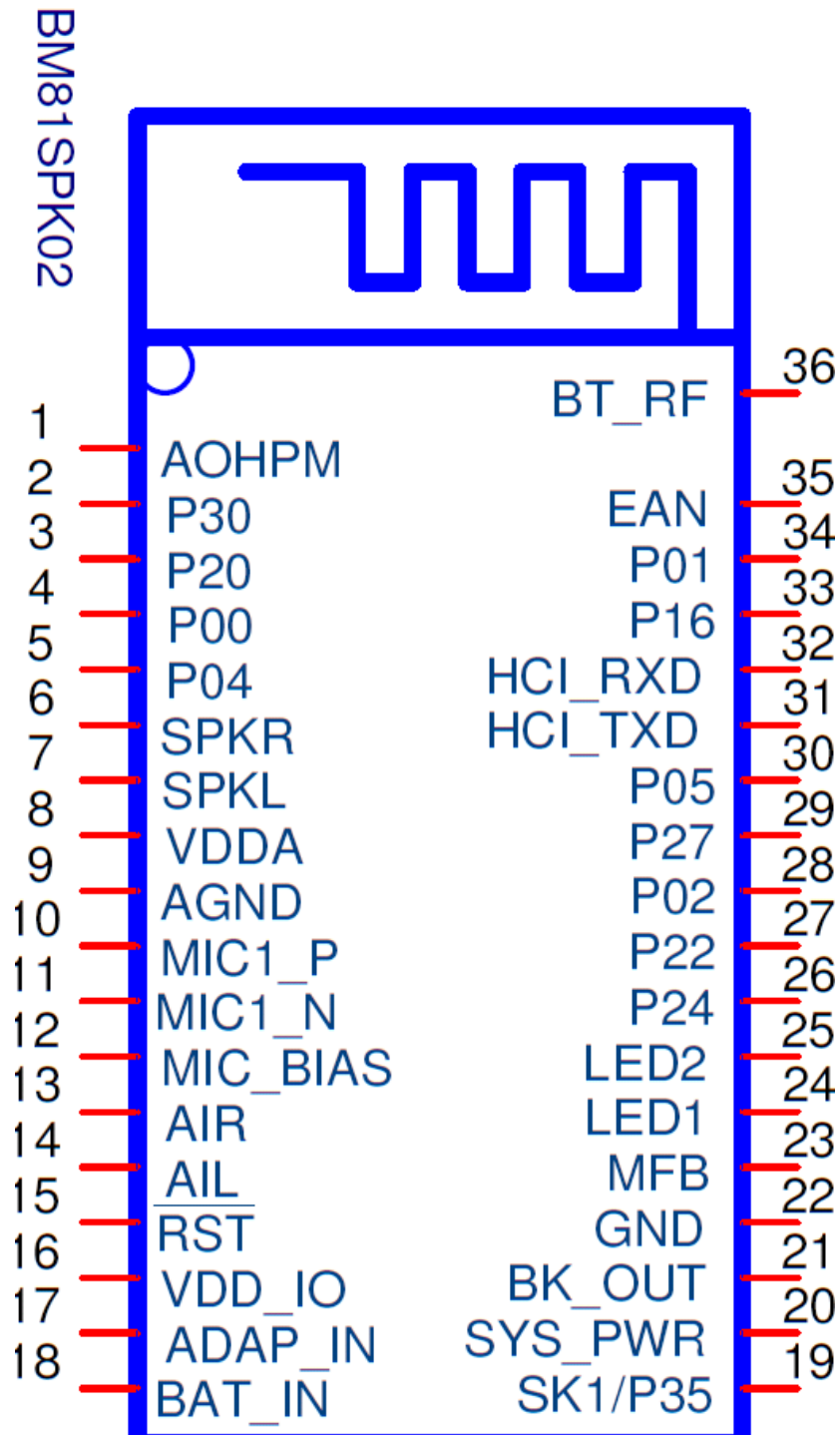
Product Description

The ISSC BM81SPK02 is a highly integrated Bluetooth 3.0 EDR stereo module, designed for high data rate, short-range wireless communication in the 2.4 GHz ISM band. With the ISSC Bluetooth stack and profile, the ISSC BM81SPK02 provides a low power and ultra-low cost Bluetooth 3.0+EDR solution for wireless voice/audio applications.

Features

- Main Chip: ISSC IS1681S
- Bluetooth 3.0 EDR compliant
- Max. +4dBm Class 2 output power
- Receiver Sensitivity: GFSK typical -90dBm, $\pi/4$ PSK typical -91dBm, 8DPSK typical -83dBm
- Piconet and Scatter net support
- HCI UART interface
- CVSD, A-law, μ -law CODEC algorithms for voice applications
- SBC decode for Bluetooth audio streaming
- Build-in High performance stereo audio codec
- Microphone input and audio line-in support
- Build-in audio mux/gain control for line-in audio signal
- Cap-less/single end headphone driver
- Audio DAC: 94dB SNR
- Build in Max. 300mAH Li-ion battery charger
- HSP, HFP, A2DP, AVRCP profile support
- 3.3V operating voltage
- ROM version: 32Kb EEPROM
- 35 pins for DIP module, 36pins for SMT module (with additional 36th pin antenna port for external antenna option)
- Size: 15mm x29mm
- Build-in PCB Antenna
- RoHS compliant

Device Pinout Diagram



Pin Definition

Pin No.	I/O	Name	Description
1	AP	AOHPM	Headphone common mode output/sense input. Cap-less application only.
2	P	P30	GPIO, default pull-high input Line-in detection, 1: no line-in detected; 0: line-in detected
3	I/O	P20	GPIO, default pull-high input System Configuration, H: Application L: Baseband(IBDK Mode)
4	I/O	P00	GPIO, default pull-low input. Slide Switch Detector
5	I/O	P04	GPIO, default pull-high input Audio AMP Enable
6	AO	SPKR	R-channel analog headphone output, for cap-less and single-ended applications both
7	AO	SPKL	L-channel analog headphone output, for cap-less and single-ended application both
8	AP	VDDA	Reserve for external cap to fine tune audio frequency response
9	AP	AGND	Audio ground
10	AI	MIC1_P	Mic 1 mono differential analog positive input
11	AI	MIC1_N	Mic 1 mono differential analog negative input
12	AP	MIC_BIAS	Microphone biasing voltage
13	AI	AIR	Stereo analog line in, R-channel
14	AI	AIL	Stereo analog line in, L-channel
15	I/O	RST_N	System Reset Pin
16	P	VDDIO	VDDIO pin, for calibration only Do not add external power to this pin
17	P	ADAP_IN	Power adaptor input
18	P	BAT_IN	Battery input
19	I/O	SK1/P35	Default SAR input for battery detection This pin can be re-defined as GPIO P35
20	P	SYS_PW	System Power Output
21	P	BK_OUT	Buck feedback sense pin

22	P	GND	Digital ground
23	P	MFB	Multi-Function Push Button key Combined Play/Pause key when A2DP enabled.
24	P	LED1	LED Driver 1
25	P	LED2	LED Driver 2
26	I/O	P24	GPIO, default pull-high input System Configuration, H: Boot Mode
27	I/O	P22	GPIO, default pull-low input. External LDO enable
28	I/O	P02	GPIO, default pull-high input PLAY/PAUSE button
29	I/O	P27	GPIO, default pull-high input Foward button
30	I/O	P05	GPIO, default pull-high input REW button
31	O	HCI_TXD	HCI TX data
32	I	HXI_RXD	HCI RX data
33	I/O	P16	GPIO, default pull-high input Volumn down button
34	I/O	P01	GPIO, default pull-high input Volumn up button
35	I	EAN	Embedded ROM/External Flash enable H: Embedded; L: External Flash
36	AIO	BT_RF	NC for on board PCB antenna Antenna matching if an external antenna is used

Electrical Characteristics

Absolute Maximum Ratings

Rating		Min	Max	Max
Operation Temperature		-40°C	+85°C	°C
Core supply voltage	VDD_CORE, VCC_RF, AVDD_SAR, AVDD_PLL	1.7V	1.98V	V
Codec supply voltage	VDD_AUDIO		3	V
I/O voltage	VDD_IO		3.3	V
Supply voltage	BK_VDD		4.3	V
	3V1_VIN		5	V
	BAT_IN		4.3	V
	ADAP_IN		5	V
	LED[1:0]		5	V
	Power switch		5	V

Recommended Operate Condition

Symbol	Parameter	Min	Typical	Max	Unit
V _{DD18}	Digital core supply voltage				
	SAR ADC supply voltage	1.8	1.85	1.95	V
	CODEC supply voltage				
V _{DDIO}	I/O supply voltage	2.8	3	3.3	V
T _{OPERATION}	Operating temperature range	-20	+25	+70	°C
T _{stg}	Storage temperature	-40		+125	°C
V _{LDO}	LDO supply voltage	1.8		3.3	V
V _{BAT_IN}	Input voltage for SAR ADC	0.9		3.3	V

Radio Characteristics: Transmitter section for BDR

VCC_RF = 1.85V Temperature = 25°C		Min	Typ	Max	Bluetooth specification	Unit
Maximum RF transmit power			3	4.0	-6 to 4	dBm
RF power variation over temperature range with compensation enabled			±2			dB
RF power control range			20		≥16	dB
RF power range control resolution			0.5			dB
20dB bandwidth for modulated carrier			900		≤1000	KHz
ACP Note: F ₀ =2441MHz	F = F ₀ ±2MHz		-28		≤-20	dBm
	F = F ₀ ±3MHz		-46		≤-40	dBm
	F = F ₀ ±>3MHz		-54		≤-40	dBm
Δf _{1avg} maximum modulation		150		165	140<Δf _{1avg} <175	KHz
Δf _{2max} maximum modulation		140		150	≥115	KHz
Δf _{2avg} /Δf _{1avg}		0.95	1		≥0.80	
ICFT (abs)		0	5	10	75	KHz
Drift rate (abs)		2		7	≤20	KHz/50μs
Drift (single slot packet, abs)			12		≤25	KHz
2 nd harmonic content @ Tx= 4dBm			-53		≤-47	dBm
3 rd harmonic content @ Tx= 4dBm			-55		≤-47	dBm

Receiver section for BDR

Temperature = 25°C	Frequency (GHz)	Min	Typ	Max	Bluetooth specification	Unit
Sensitivity at 0.1% BER for all basic rate packet types	2.402		-90		≤-70	dBm
	2.441		-90			
	2.480		-90			
Maximum received signal at 0.1% BER			-10		≥-20	dBm
C/I co-channel			5		≤11	dB
Adjacent channel selectivity C/I Note: F ₀ =2441MHz	F = F ₀ +1MHz		-7		≤0	dB
	F = F ₀ -1MHz		-7		≤0	dB
	F = F ₀ +2MHz		-36		≤-30	dB
	F = F ₀ -2MHz		-22		≤-9	dB
	F = F ₀ -3MHz		-24		≤-20	dB
	F = F ₀ +5MHz		-50		≤-40	dB
	F = F _{image}		-22		≤-9	dB
Maximum level of intermodulation interferers			-38		≥-39	dB

Transmitter Section for EDR

Temperature = 25°C		Min	Typ	Max	Bluetooth specification	Unit
Relative transmit power			-1.6		-4 to 1	dB
π/4 DQPSK max carrier frequency stability	$ \omega_o $ freq. error		5		≤10 for all blocks	KHz
	$ \omega_i $ initial freq. error		10		≤75 for all blocks	KHz
	$ \omega_o+\omega_i $ block freq. error		10		≤75 for all blocks	KHz
8DPSK max carrier frequency stability	$ \omega_o $ freq. error		5		≤10 for all blocks	KHz
	$ \omega_i $ initial freq. error		10		≤75 for all blocks	KHz
	$ \omega_o+\omega_i $ block freq. error		10		≤75 for all blocks	KHz
π/4 DQPSK modulation accuracy @ Tx= 2dBm	RMS DEVM		7		≤20	%
	99% DEVM		Pass		≤30	%
	Peak DEVM			25	≤35	%
8DQPSK modulation accuracy @ Tx= 2dBm	RMS DEVM		7		≤13	%
	99% DEVM		Pass		≤20	%
	Peak DEVM			20	≤25	%

In-band spurious emissions Note: $F_0=2441\text{MHz}$	$F > F_0+3\text{MHz}$		<-54		≤ -40	dBm
	$F = F_0-3\text{MHz}$		-46		≤ -40	dBm
	$F = F_0-2\text{MHz}$		-28		≤ -20	dBm
	$F = F_0-1\text{MHz}$		-30		≤ -26	dBm
	$F = F_0+1\text{MHz}$		-30		≤ -26	dBm
	$F = F_0+2\text{MHz}$		-28		≤ -20	dBm
	$F = F_0+3\text{MHz}$		-46		≤ -40	dBm
EDR differential phase encoding			100		≥ 99	%

Receiver Section for EDR

Temperature = 25°C	Frequency (GHz)	Modulation	Min	Typ	Max	Bluetooth specification	Unit	
Sensitivity at 0.01% BER	2.402	$\pi/4$ DQPSK		-91		≤ -70	dBm	
	2.441	$\pi/4$ DQPSK		-91				
	2.480	$\pi/4$ DQPSK		-91				
	2.402	8DPSK		-83		≤ -70	dBm	
	2.441	8DPSK		-83				
	2.480	8DPSK		-83				
Maximum received signal at 0.1% BER		$\pi/4$ DQPSK		-10		≥ -20	dBm	
		8DPSK		-10		≥ -20		
C/I co-channel at 0.1% BER		$\pi/4$ DQPSK		4		≤ 13	dB	
		8DPSK		5		≤ 21	dB	
Adjacent channel selectivity C/I	F = F ₀ +1MHz	$\pi/4$ DQPSK		-14		≤ 0	dB	
		8DPSK		-8		≤ 5	dB	
	F = F ₀ -1MHz	$\pi/4$ DQPSK		-13		≤ 0	dB	
		8DPSK		-8		≤ 5	dB	
	Note: F ₀ =2441MHz	F = F ₀ +2MHz	$\pi/4$ DQPSK		-38		≤ -30	dB
			8DPSK		-34		≤ -25	dB
F = F ₀ -2MHz	$\pi/4$ DQPSK		-21		≤ -7	dB		
	8DPSK		-21		≤ 0	dB		

	$F = F_0 - 3\text{MHz}$	$\pi/4$ DQPSK		-27		≤ -20	dB
		8DPSK		-20		≤ -13	dB
	$F = F_0 + 5\text{MHz}$	$\pi/4$ DQPSK		-52		≤ -40	dB
		8DPSK		-45		≤ -33	dB
	$F = F_{\text{image}}$	$\pi/4$ DQPSK		-21		≤ -7	dB
		8DPSK		-21		≤ 0	dB

Audio Codec: ADC (MIC PATH/Line-in path)

Test Condition:						
T= 25°C, V _{DD} =2.8V, 1KHz sine wave input, Bandwidth = 20~20KHz						
Parameter	Condition		Min.	Typ.	Max.	Unit
Input full-scale	Full scale (line-in)				2.2	Vpp
Resolution				16		bits
Input Sampling Rate			8		48	kHz
SNR	f _{in} =1KHz B/W=20~20KHz A-weighted THD+N < 1% 150mVpp input	8KHz		85		dB
		16KHz		85		
		32KHz		85		
		44.1KHz		85		
		48KHz		85		
SNR	A-weighted 1KHz@full scale, Microphone boost enable			75		dB
THD+N (Mic input) @30mVrms input				0.04		%
THD+N (line input)				0.01		%
Mic Boost Gain				20		dB
Digital Gain			-54		4.85	dB
Analog Gain					26	dB
Digital Gain Step				6		dB
Analog Gain Step				1.7		dB
Input impedance (microphone mode)	Input impedance			6	10	KΩ
	Input capacitance				20	pF
Analog supply voltage (AVDD)			1.8	2.8	3.0	V

Audio Codec: DAC (SPEAKER path)

Test Condition: T= 25°C, V _{DD} =2.8V, 1KHz sine wave input, Bandwidth= 20~20KHz						
Parameter	Condition		Min.	Typ.	Max.	Unit
Output Level	Full scale			2.1		Vpp
Resolution			16			bits
Output Sampling Rate			8		48	KHz
SNR	f _{in} =1KHz B/W=20~20KHz A-weighted THD+N < 0.01% 0dBFS signal Load=100KΩ	8KHz		94		dB
		16KHz		94		dB
		32KHz		94		dB
		44.1KHz		94		dB
		48KHz		94		dB
Max Output Power	R _L =16Ohm			35		mW
	R _L =32Ohm			17		mW
THD+N	16Ohm load				0.05	%
	100KΩ load				0.01	%
Digital Gain			-54		4.85	dB
Digital Gain Resolution				6		dB
Analog Gain			-28		3	dB
Analog Gain step				1		dB
Output resistance	R _L		8	16		Ohm
Output capacitance	C _p				500	pF
Crosstalk between channels	L vs. R, measured at -10dBFS@1KHz input			-90	-80	dB
Analog supply voltage (AVDD)			1.8	2.8	3.0	V

Battery Charger

Charging Mode (BAT_IN rising to 4.2V)		Min	Typ	Max	Unit
Operation Temperature		-10		55	°C
Input Voltage (Vin) Note: It needs more time to get battery fully charged when Vin=4.5V		4.5		6	V
Battery trickle charge current (BAT_IN < trickle charge voltage threshold)			0.1C		mA
Trickle charge voltage threshold			3		V
Maximum battery charge current	Headroom > 0.7V		200		mA
	Headroom = 0.3V		150		mA
Minimum battery charge current	Headroom > 0.7V		1		mA
	Headroom = 0.3V		1		mA
Battery charge termination current, % of fast charge current			10		%
Battery recharge hysteresis (Note1)			100		mV
Battery recharge current (Note2) Note: C → Battery capacity			0.25C		mA

Note1 : When charging complete and the adapter is still in, the battery voltage will slowly drop down.

When the voltage drop is larger than 100mV from the full voltage, the re-charging cycle will start.

Note2 : If the battery voltage during plug in is larger than 4V, the charging current will be limited to 0.25C to avoid the battery voltage overshoot.

Clock

Parameters	MIN	TYP	MAX	Unit
Crystal Frequency		16		MHz
Frequency Tolerance		±20		ppm
Operating Temperature	-20		70	°C
Trimming Capacitance		6.4		pF
Trimming Step Size		0.2		pF

Digital GPIO

Parameters	MIN	TYP	MAX	Unit
Input Voltage	2.7	3	3.6	V
V _{IH} (Input High Voltage)	2.0		V _{dd}	V
V _{IL} (Input Low Voltage)	0		0.8	V
Input Reference Resistor				
R _{PU} (Pull-Up Resistor)		50K		Ohm
R _{PD} (Pull-Down Resistor)		50K		Ohm
Output Voltage				
V _{OH} (Output High Voltage)	2.4		V _{dd}	V
V _{OL} (Output Low Voltage)	0		0.4	V

Current Consumption ROM mode

Test Condition: T= 25°C, BAT_IN=4.0V, with flash code				
Normal Operation	Min	Typ	Max	Unit
Off mode	2		10	uA
Standby mode		0.6		mA
Link mode		0.6		mA
SCO link		13.7		mA
A2DP link		15.3		mA

Current Consumption Flash mode

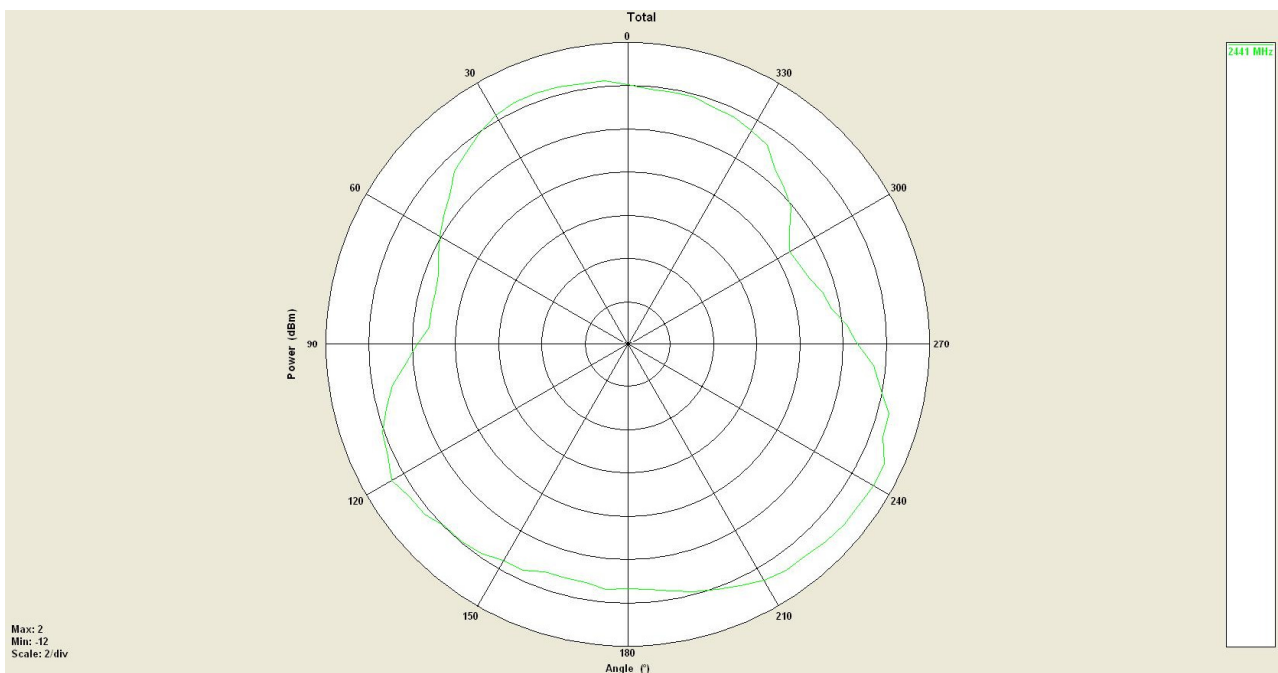
(special code, the number depends on the FW code)

Test Condition: T= 25°C, BAT_IN=4.0V, with flash code, codec without loading				
Normal Operation	Min	Typ	Max	Unit
Off mode	2		10	uA
Standby mode		1.4		mA
Link mode		1.4		mA
SCO link		22.8		mA
A2DP link		24.6		mA

Antenna performance

Parameters	MIN	TYP	MAX	Unit
Antenna gain		1.76		dBi
Efficiency	51.5		59.7	%

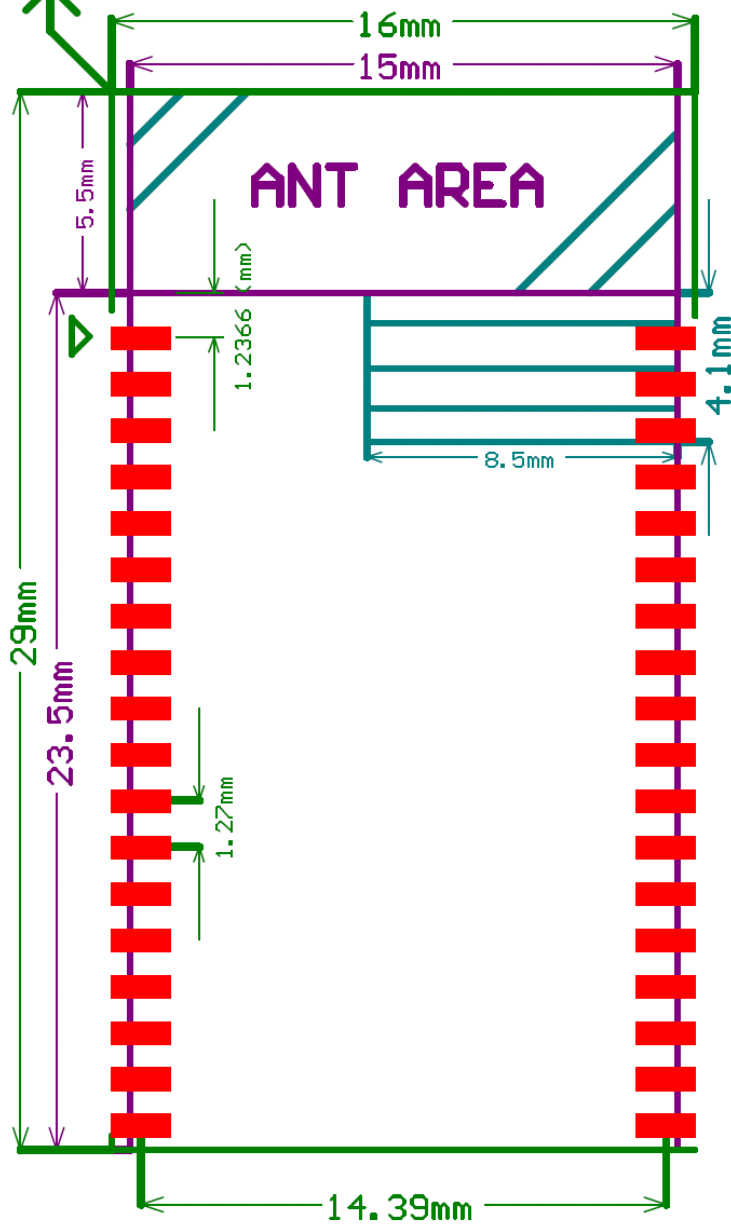
2441MHz



Outline Dimension (Module Foot print)

BM81 Module Footprint

$\langle 0, 0 \rangle$



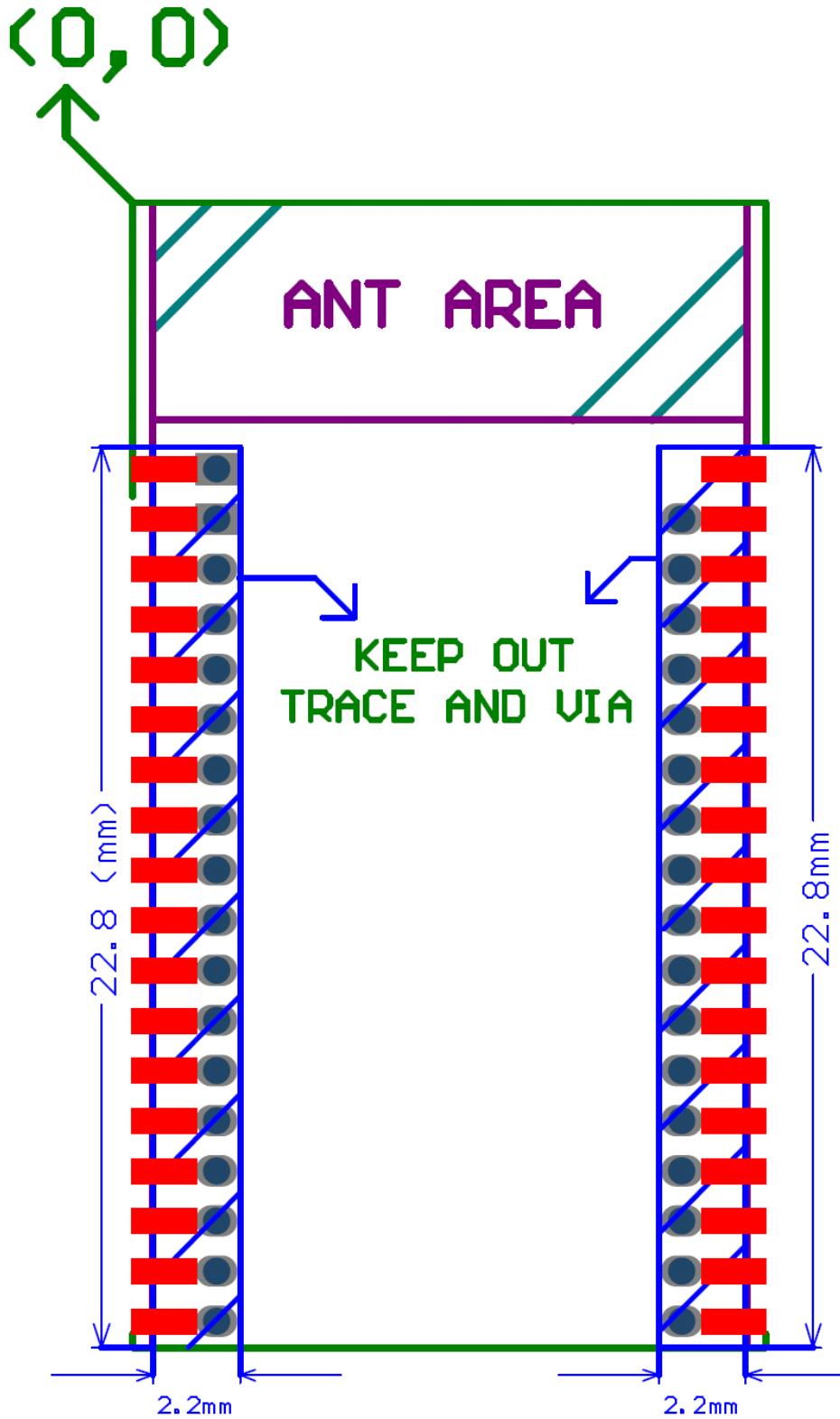
RF TP AREA
KEEP OUT

Pad Size

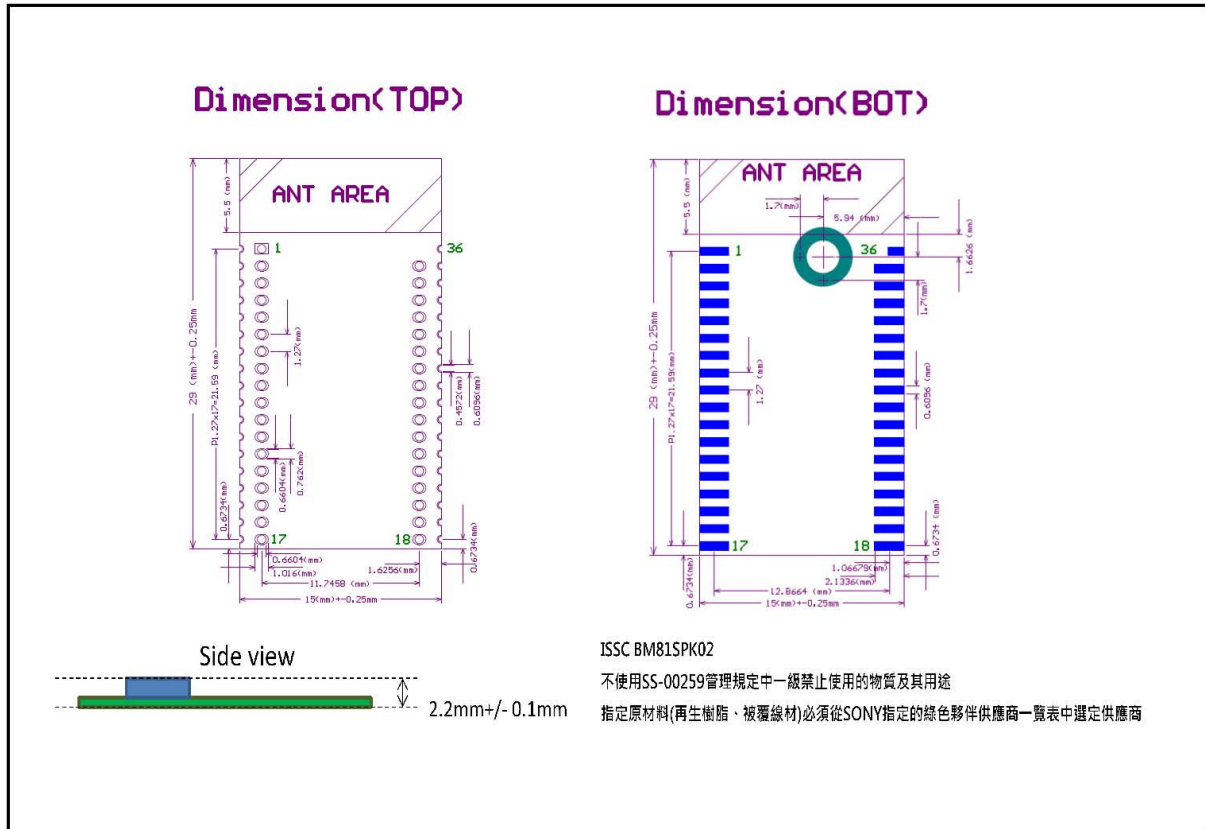


L: 1.61mm / W: 0.6096mm

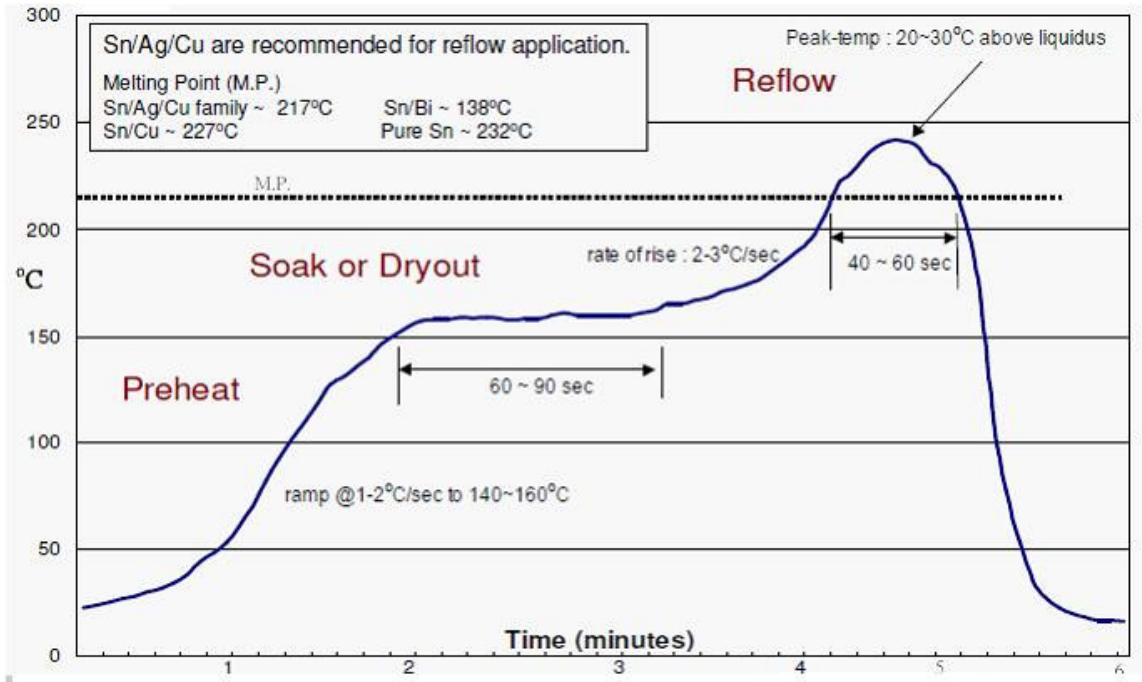
BM81SPK02 Trace + Via



Outline Dimensions



Reflow profile



QR code label information

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



Device Name: BM81SPK02MG1

MAC ID: 8CDE52AABBCC

SONY Code Name: C33039

Date Code: 1220

Module Weight

(Test condition: module with QR label)

$1.15\text{g} \pm 10\%$

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

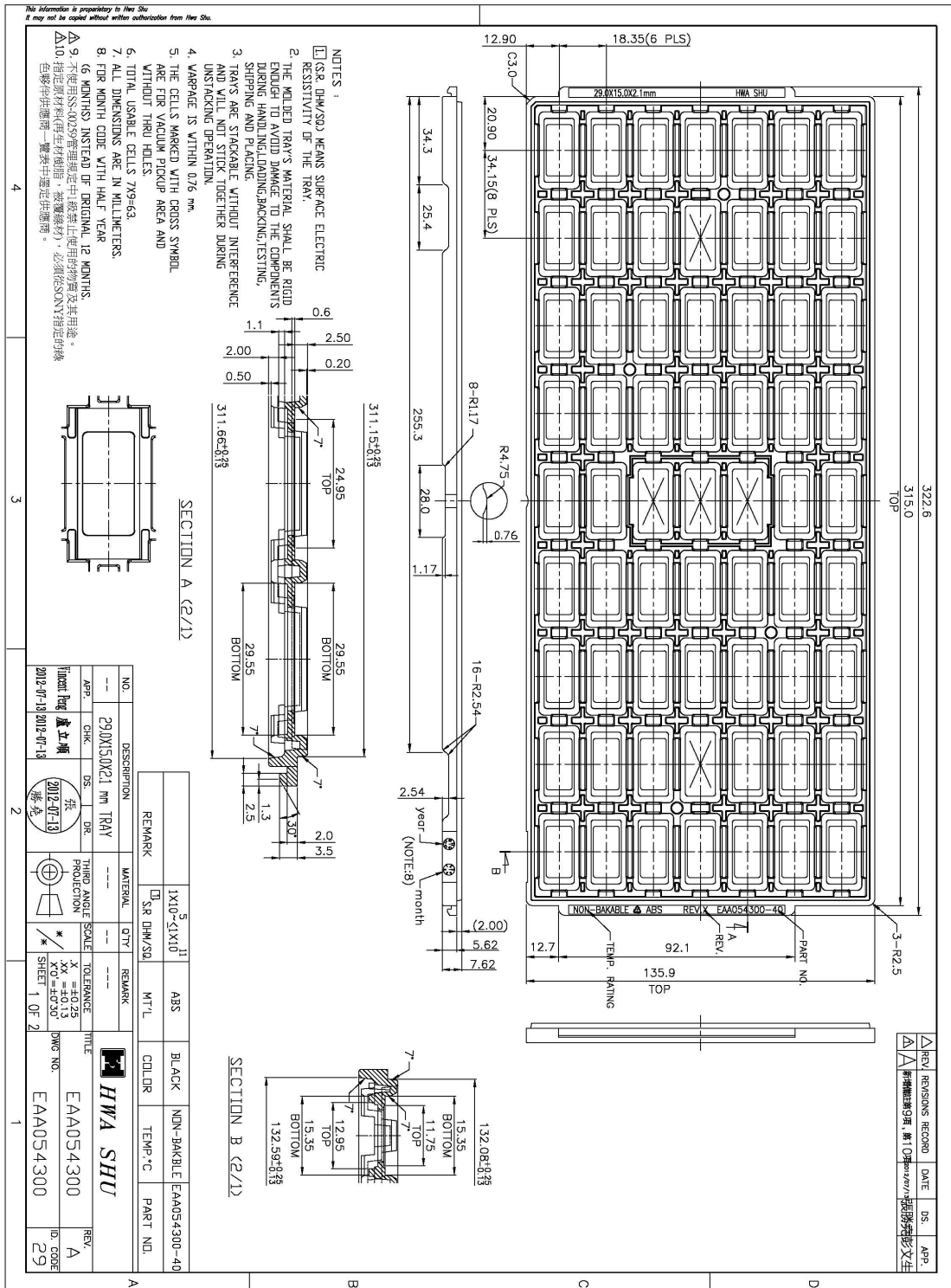
Ordering Information

Device	Module		Order Number
	Size	Shipment Method	
BM81SPK02MG1 Bluetooth 3.0 EDR Wireless Speaker Module	29*15 mm	Tray	

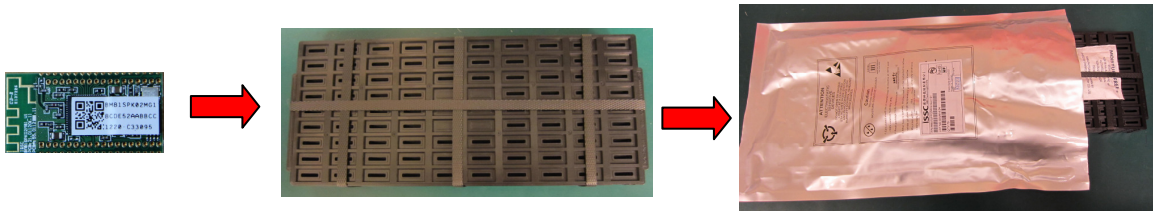
Note:

Minimum Order Quantity is 630pcs Tray.

Packing Information
Tray Dimensions



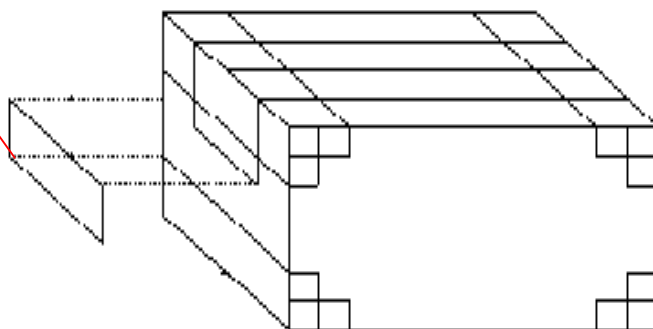
Packing Method



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



Bar Code Label
P/N: SONY device name
Lot No: Lot ID
Q'ty: box or Carton Module's Q'ty



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

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