

**SP14T Antenna Switch Module for 12TRx/2Tx with 4bit parallel I/F**

# CXM3614ER

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**Description**

The CXM3614ER is a SP14T antenna switch module for GSM / UMTS / CDMA / LTE multi-mode handset.

The CXM3614ER has a built-in dual low pass filter and a +1.8V CMOS compatible decoder.

The Sony GaAs junction gate pHEMT (JPHEMT) MMIC process is used for low insertion loss and high linearity. The device has low BOM with no DC blocking Capacitor.

(Applications: GSM/UMTS/CDMA/LTE multi-mode handset)

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**Features**

- Low Insertion Loss: 0.50dB (Typ.) TRx (Cellular Band)  
0.70dB (Typ.) TRx (IMT Tx Band)
- High Linearity: IIP3 = 68dBm
- Low Voltage Operation: Vdd=2.5V
- No DC Blocking Capacitors
- Small Package Size: VQFN-26P (2.8mm x 3.2mm x 0.775mm Max.)
- Lead-Free and RoHS Compliant

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**Structure**

GaAs Junction Gate pHEMT (JPHEMT) MMIC Switch, CMOS Decoder

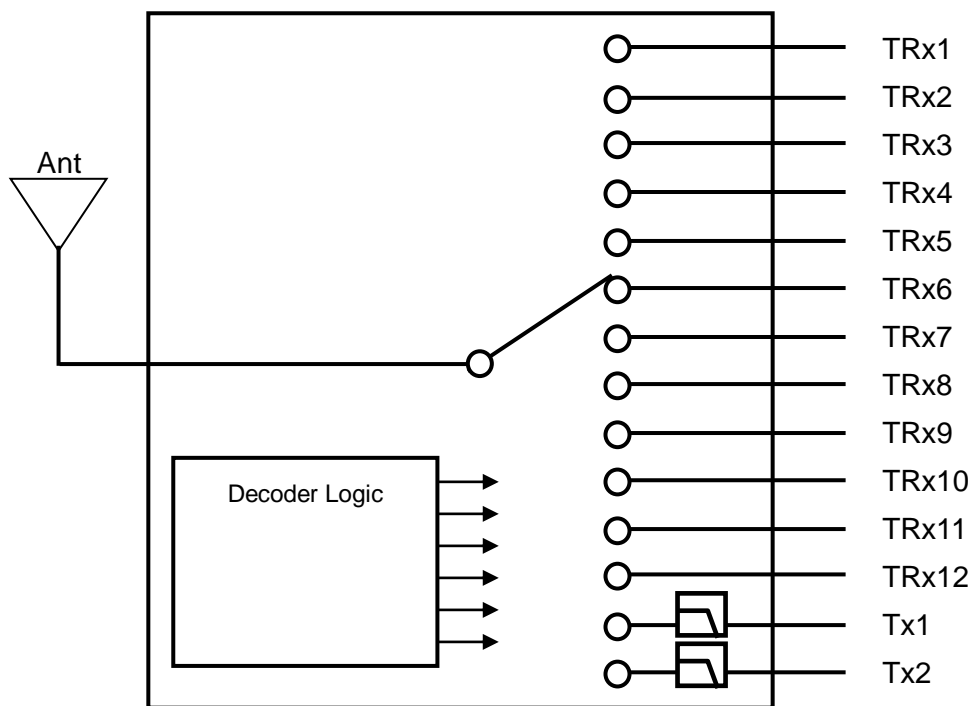
This IC is ESD sensitive device. Special handling precautions are required.

Sony reserves the right to change products and specifications without prior notice.

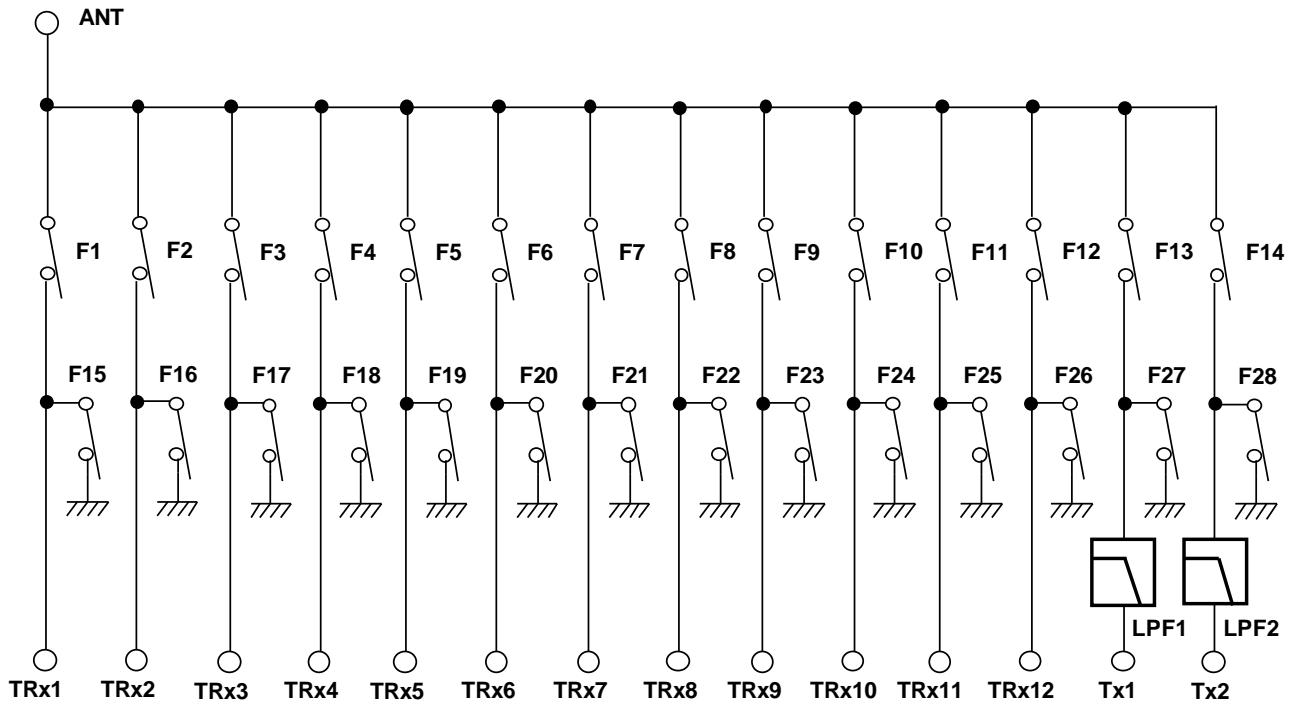
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Application circuits shown, if any, are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits

Block Diagram of SP14T Antenna Switch Module



Block Diagram of SP14T(12TRx/2Tx)

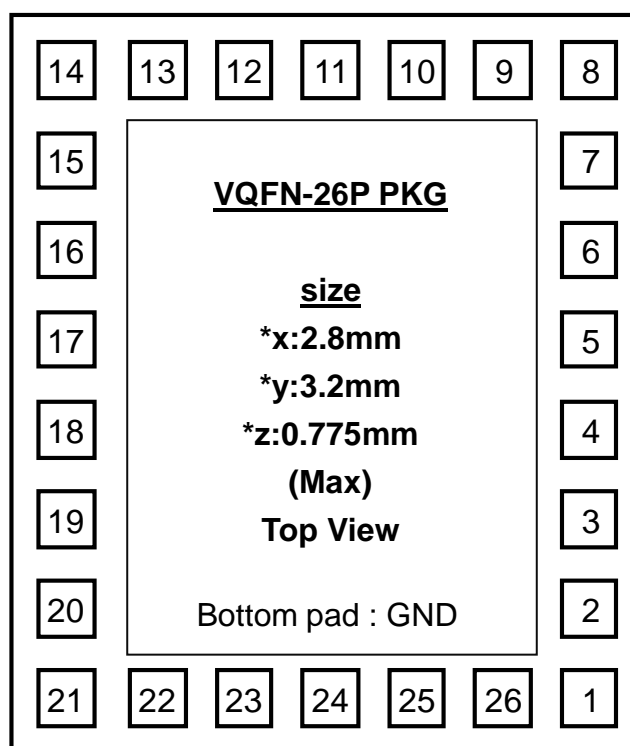


Truth Table

State	Active Path	CTL State				SW State(*1)																													
		CTLA	CTLB	CTLC	CTLD	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25	F26	F27	F28		
1	TRx1	H	L	H	L	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	
2	TRx2	H	H	H	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L	H	L	H	H	H	H	H	H	H	H	H	H	H	H	H	
3	TRx3	H	L	H	H	L	L	H	L	L	L	L	L	L	L	L	L	L	L	H	H	L	H	H	H	H	H	H	H	H	H	H	H	H	
4	TRx4	H	H	H	H	L	L	L	H	L	L	L	L	L	L	L	L	L	L	H	H	H	L	H	H	H	H	H	H	H	H	H	H	H	
5	TRx5	H	L	L	H	L	L	L	L	H	L	L	L	L	L	L	L	L	L	H	H	H	H	L	H	H	H	H	H	H	H	H	H	H	
6	TRx6	H	H	L	H	L	L	L	L	L	H	L	L	L	L	L	L	L	L	H	H	H	H	H	L	H	H	H	H	H	H	H	H	H	
7	TRx7	L	L	L	H	L	L	L	L	L	L	H	L	L	L	L	L	L	L	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H	
8	TRx8	L	L	H	H	L	L	L	L	L	L	L	H	L	L	L	L	L	L	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H	
9	TRx9	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H	
10	TRx10	L	L	H	L	L	L	L	L	L	L	L	L	H	L	L	L	L	L	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H	
11	TRx11	L	H	H	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H	
12	TRx12	L	H	L	L	L	L	L	L	L	L	L	L	L	H	L	L	L	L	H	H	H	H	H	H	L	H	H	H	H	H	H	H	H	
13	Tx1	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	L	H	H	H	H	H	H	H	H	H	H	H	L	H	H	
14	Tx2	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	L	H

\*1)State "L" means a switch "OFF", state "H" means a switch "ON".

## Pin Configuration



Pin	Name	Pin	Name
1	GND	14	TRx12
2	ANT	15	TRx11
3	GND	16	TRx10
4	TRx5	17	TRx1
5	TRx6	18	TRx2
6	TRx7	19	TRx3
7	TRx8	20	TRx4
8	TRx9	21	GND
9	GND	22	VDD
10	Tx2	23	CTLD
11	GND	24	CTLG
12	Tx1	25	CTLB
13	GND	26	CTLA

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**DC Bias Conditions**

Parameter	Min.	Typ.	Max.	Unit
$V_{DD}$	2.5	2.8	3.3	V
Vctl(H)	1.35	1.8	3.1	V
Vctl(L)	0	-	0.25	V

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**Absolute Maximum Ratings**

Item	Symbol/conditions	Minimum	Maximum	Unit	Notes
Supply voltage	$V_{DD}$	-	4	V	Ta=25°C
Control voltage	Vctl	-	4	V	Ta=25°C
Input power	Tx1	-	36	dBm	Duty=12.5 to 50% Ta=25°C
	Tx2	-	34	dBm	
	TRx	-	32	dBm	Ta=25°C
Operating temperature	Topr	-35	90	°C	
Storage temperature	Tstg	-65	150	°C	

Electrical Characteristics

V<sub>DD</sub> =2.5V, Ta=25°C

Item	Symbol	Path	Condition	Min.	Typ.	Max.	Unit
Insertion Loss	IL	Ant - TRx1	*1, *2	-	0.42	0.52	dB
			*3	-	0.57	0.72	
			*4	-	0.60	0.75	
			*5	-	0.72	0.92	
			*6	-	0.85	1.05	
		Ant - TRx2	*1, *2	-	0.49	0.59	
			*3	-	0.66	0.81	
			*4	-	0.69	0.84	
			*5	-	0.81	1.01	
			*6	-	0.95	1.15	
		Ant - TRx3	*1, *2	-	0.50	0.60	
			*3	-	0.65	0.80	
			*4	-	0.69	0.84	
			*5	-	0.81	1.01	
		Ant - TRx4	*6	-	0.96	1.16	
			*1, *2	-	0.46	0.56	
			*3	-	0.59	0.74	
			*4	-	0.63	0.78	
		Ant - TRx5	*5	-	0.76	0.96	
			*6	-	0.91	1.11	
			*1, *2	-	0.45	0.55	
			*3	-	0.76	0.91	
		Ant - TRx6	*4	-	0.85	1.00	
			*5	-	1.07	1.27	
			*6	-	1.39	1.59	
			*1, *2	-	0.50	0.60	
		Ant - TRx7	*3	-	0.77	0.92	
			*4	-	0.83	0.98	
			*5	-	1.01	1.21	
			*6	-	1.25	1.45	
		Ant - TRx8	*1, *2	-	0.50	0.60	
			*3	-	0.66	0.81	
			*4	-	0.70	0.85	
			*5	-	0.83	1.03	
		Ant - TRx9	*6	-	0.99	1.19	
			*1, *2	-	0.49	0.59	
			*3	-	0.63	0.78	
			*4	-	0.65	0.80	
		Ant - TRx10	*5	-	0.76	0.96	
			*6	-	0.89	1.09	
			*1, *2	-	0.49	0.59	
			*3	-	0.58	0.73	
		Ant - TRx11	*4	-	0.61	0.76	
			*5	-	0.73	0.93	
			*6	-	0.86	1.06	
			*1, *2	-	0.59	0.69	
		Ant - TRx12	*3	-	0.82	0.97	
			*4	-	0.89	1.04	
			*5	-	1.05	1.25	
			*6	-	1.26	1.46	
		Ant - Tx1	*1, *2	-	0.57	0.67	
			*3	-	0.76	0.91	
			*4	-	0.84	0.99	
			*5	-	1.03	1.23	
		Ant - Tx2	*6	-	1.27	1.47	
			*1, *2	-	0.55	0.65	
			*3	-	0.79	0.94	
			*4	-	0.83	0.98	

V<sub>DD</sub> =2.5V, Ta=25°C

Item	Symbol	Path	Condition	Min.	Typ.	Max.	Unit
VSWR	VSWR	All ports in Active Paths	600M to 2170MHz	-	-	1.8	-
Harmonics	2fo	Ant-TRx1,2,3,4,5,6,7,8,9	*2, *3	-	-72	-60	dBm
	3fo			-	-74	-60	
	2fo	Ant-TRx10,11,12	*2, *3	-	-58	-46	
	3fo			-	-73	-60	
	2fo	Ant-Tx1	*7	-	-42	-36	
	3fo			-	-47	-36	
2fo	Ant-Tx2	*8	-	-44	-36		
3fo			-	-50	-36		
Attenuation	ATT	Tx1-Ant	1648M to 1805MHz	25	-	-	dB
			1805M to 1830MHz	30	-	-	
			2472M to 2745MHz	25	-	-	
		Tx2-Ant	3296M to 12750MHz	15	-	-	
			3420M to 3820MHz	25	-	-	
			5130M to 5730MHz	20	-	-	
Inter modulation product power in Rx band	IMD2	Ant-TRx1,2,3,4,5,6,7,8,9,10,11,12	*11,*12,*13,*16,*17,*20,*21	-	-	-105	dBm
	IMD3	10,11,12	*11,*14,*15,*18,*19,*22,*23	-	-	-105	
Input IP3	IIP3	Ant-TRx1,2,3,4,5,6,7,8,9,10,11,12	*11,24,25	-	68	-	
Switching Time	T <sub>s</sub>		50%ctl to 90%RF	-	3	5	μs
Supply Current	I <sub>DD</sub>	Active mode	V <sub>dd</sub> =2.5V	-	0.22	0.4	mA
Control Current	I <sub>ctl</sub>		V <sub>ctl</sub> =1.8V	-	5	20	uA

Isolation

V<sub>DD</sub> =2.5V, Ta=25°C

Active Port	frequency (MHz)	Isolation(min, dB)													
		Tx1	Tx2	TRx1	TRx2	TRx3	TRx4	TRx5	TRx6	TRx7	TRx8	TRx9	TRx10	TRx11	TRx12
Tx1	824 to 915	25	25	40	40	40	40	38	40	40	40	40	40	40	35
Tx2	1710 to 1910	25		40	40	40	40	29	36	39	40	40	40	40	35
TRx1	452 to 960	30	34		33	35	40	37	40	40	40	40	32	40	40
	1710 to 2170				22	27	34	28	36	40	40	40	22	28	31
	2300 to 2690				18	24	29	26	33	36	36	34	18	23	25
TRx2	452 to 960	35	34	31		30	40	37	40	40	40	40	40	40	40
	1710 to 2170			22		20	30	28	36	40	40	40	29	32	34
	2300 to 2690			17		17	25	26	33	36	36	34	24	27	27
TRx3	452 to 960	35	35	40	29		33	37	40	40	40	40	40	40	40
	1710 to 2170			27	20		23	28	36	40	40	40	33	35	35
	2300 to 2690			22	15		19	26	33	36	36	35	27	29	28
TRx4	452 to 960	37	33	40	40	30		38	40	40	40	40	40	40	40
	1710 to 2170			32	28	21		29	38	40	40	40	36	38	38
	2300 to 2690			27	23	17		25	31	35	35	34	31	31	30
TRx5	452 to 960	38	40	40	40	40	40		31	40	40	40	40	40	40
	1710 to 2170			40	40	40	40		20	30	34	37	40	40	37
	2300 to 2690			35	35	35	33		17	25	29	30	36	34	29
TRx6	452 to 960	37	39	40	40	40	40	30		35	40	40	40	40	40
	1710 to 2170			40	40	40	40	23		28	30	33	40	40	37
	2300 to 2690			35	36	36	33	18		19	25	27	36	34	29
TRx7	452 to 960	35	34	40	40	40	40	40	31		33	40	40	40	40
	1710 to 2170			40	40	40	40	32	23		23	28	40	40	37
	2300 to 2690			36	37	37	37	25	19		19	23	36	34	29
TRx8	452 to 960	33	28	40	40	40	40	39	40	31		32	40	40	40
	1710 to 2170			40	40	40	40	31	30	22		21	40	40	36
	2300 to 2690			36	37	37	37	26	25	18		18	36	33	29
TRx9	452 to 960	31	24	40	40	40	40	39	40	40	30		40	40	40
	1710 to 2170			40	40	40	40	30	33	27	20		40	39	34
	2300 to 2690			35	37	37	37	26	27	23	17		35	33	28
TRx10	452 to 960	26	29	31	40	40	40	37	40	40	40	40		29	40
	1710 to 2170			21	29	33	38	28	37	40	40	40		19	26
	2300 to 2690			17	24	28	31	26	32	35	33	32		16	20
TRx11	452 to 960	23	28	40	40	40	40	37	40	40	40	40	29		33
	1710 to 2170			26	32	35	39	28	37	40	40	39	18		21
	2300 to 2690			22	26	29	31	25	32	38	33	31	15		16
TRx12	452 to 960	18	28	40	40	40	40	37	40	40	40	40	40	31	
	1710 to 2170			29	33	35	38	28	37	40	40	37	25	20	
	2300 to 2690			24	27	29	31	26	32	33	33	30	21	16	

Electrical Characteristics are measured with all RF ports terminated in 50 ohms.

- \*1 Pin = 25dBm, 704 to 787 MHz (Band 13, Band 17)
- \*2 Pin = 26dBm, 824 to 960 MHz (Band 5, Band 8)
- \*3 Pin = 26dBm, 1710 to 1990 MHz (Band 1 Tx, Band 2, Band 3, Band 4 Tx)
- \*4 Pin = 10dBm, 2110 to 2170 MHz (Band 1 Rx, Band 4 Rx)
- \*5 Pin = 26dBm, 2300 to 2400 MHz (Band 40)
- \*6 Pin = 26dBm, 2500 to 2690 MHz (Band 7)
- \*7 Pin = 35dBm, 824 to 915 MHz (GSM 850/900 Tx)
- \*8 Pin = 32dBm, 1710 to 1910 MHz (GSM 1800/1900 Tx)
- \*9 Pin = 10dBm, 869 to 960 MHz (GSM 850/900 Rx)
- \*10 Pn = 10dBm, 1805 to 1990 MHz (GSM 1800/1900 Rx)
- \*11 Measured with the recommended circuit

**IMD Condition**

Band	fRx on TRx	fTx +20 dBm on TRx	fBlocker -15 dBm on Ant		IMD Condition
Band I	2140 MHz	1950 MHz	IMD2 (fRx-fTx)	190 MHz	*12
			IMD2 (fRx-fTx)	4090 MHz	*13
			IMD3 (2fTx-fRx)	1760 MHz	*14
			IMD3 (2fTx-fRx)	6040 MHz	*15
Band II	1960 MHz	1880 MHz	IMD2 (fRx-fTx)	80 MHz	*16
			IMD2 (fRx-fTx)	3840 MHz	*17
			IMD3 (2fTx-fRx)	1800 MHz	*18
			IMD3 (2fTx-fRx)	5720 MHz	*19
Band V	880 MHz	835 MHz	IMD2 (fRx-fTx)	45 MHz	*20
			IMD2 (fRx-fTx)	1715 MHz	*21
			IMD3 (2fTx-fRx)	790 MHz	*22
			IMD3 (2fTx-fRx)	2550 MHz	*23

**IIP3 Condition**

Band	f1	f2	IIP3 Condition
	+27 dBm on TRx	+27 dBm on TRx	$IIP3 = (3 \times P_{out} - IM3)/2$
Band I	1950 MHz	1951 MHz	*24
Band V	835 MHz	836 MHz	*25



**Triple Beat Ratio**

V<sub>DD</sub> = 2.5 V, Ta = 25 °C

Item	Symbol	Path	Condition				Min.	Typ.	Max.	Unit
Triple Beat Ratio	TBR		Tx1 at TRx <sup>*1</sup> 21.5 dBm	Tx2 at TRx <sup>*1</sup> 21.5 dBm	Jammer at Ant -30 dBm	Triple Beat Product at TRx <sup>*1</sup>				dBc
		Ant-TRx1, 2, 3, 4, 5, 6, 7, 8, 9,10,11,12	835.5MHz	836.5MHz	881.5MHz	881.5 ± 1MHz	81	-	-	
			1880MHz	1881MHz	1960MHz	1960 ± 1MHz	81	-	-	

\*1 Electrical characteristics are measured with all RF ports terminated in 50 Ω.  
Measured with the recommended circuit

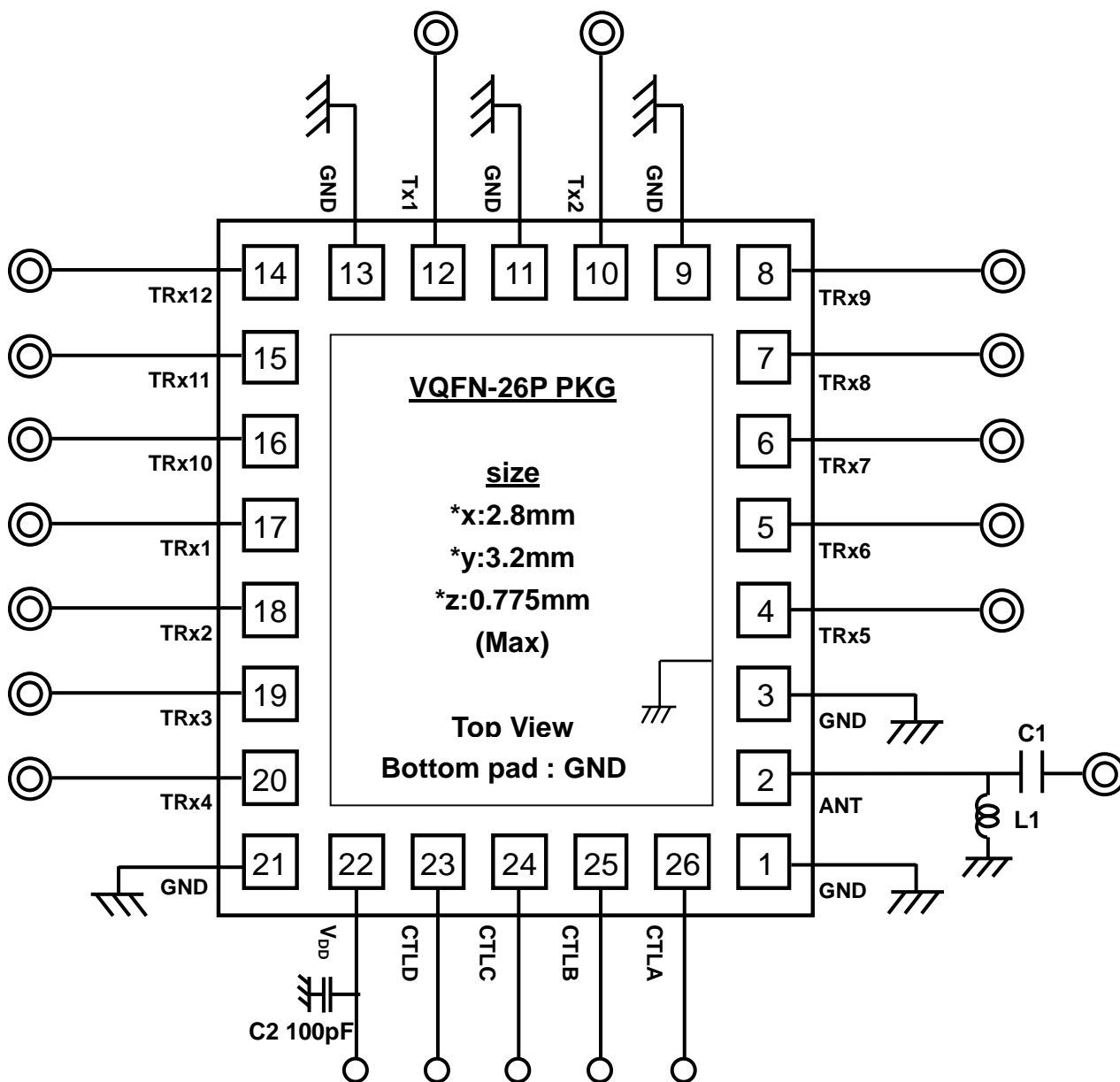
**IIP2**

V<sub>DD</sub> = 2.5 V, Ta = 25 °C

Item	Symbol	Path	Condition			Min.	Typ.	Max.	Unit
Input IP2	IIP2		Tx at TRx <sup>*1</sup> 24 dBm	Jammer at Ant -20 dBm	IM2 Product at TRx <sup>*1</sup>				dBm
		Ant-TRx1, 2, 3, 4, 5, 6, 7, 8, 9,10,11,12	836.61MHz	1718.22MHz	881.61MHz	113.5	—	—	
			836.61MHz	45MHz	881.61MHz	95.5	—	—	
			1885MHz	3850MHz	1965MHz	95.5	—	—	
			1885MHz	80MHz	1965MHz	95.5	—	—	
			1732.5MHz	3865MHz	2132.5MHz	95.5	—	—	
			1732.5MHz	400MHz	2132.5MHz	95.5	—	—	

\*1 Electrical characteristics are measured with all RF ports terminated in 50 Ω.  
Measured with the recommended circuit

Recommended Circuit






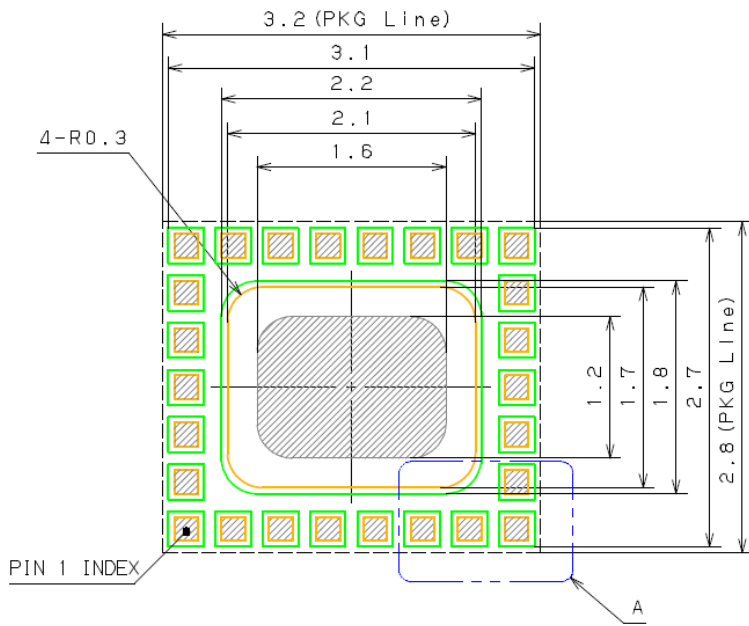
- \*1: No DC blocking capacitors are required on all RF ports.
- \*2: DC levels of all RF ports are GND.
- \*3: L1(22nH) and C1(22pF) are recommended on Ant port for ESD protection.
- \*4: C2 Capacitor (100pF) is recommended.

**Recommended Land Pattern**

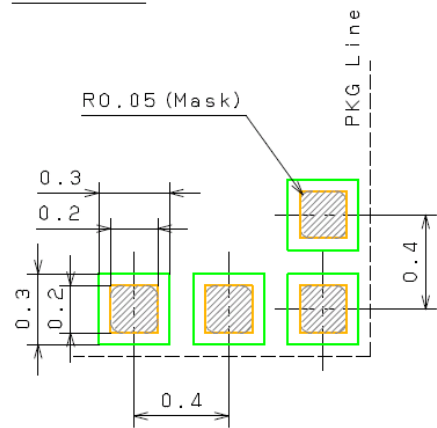
VQFN-26P-02 Macro drawing (Reference)

- PKG : 3.2mm×2.8mm      \*Metal mask thickness : 110μm
- Pin pitch : 0.4mm

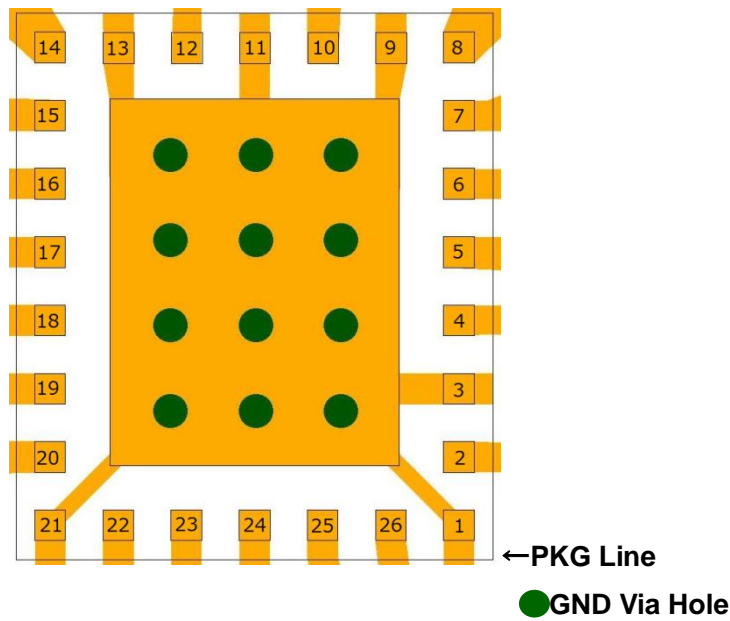
-  : Land
-  : Mask (Open area)
-  : Resist (Open area)



Detail A

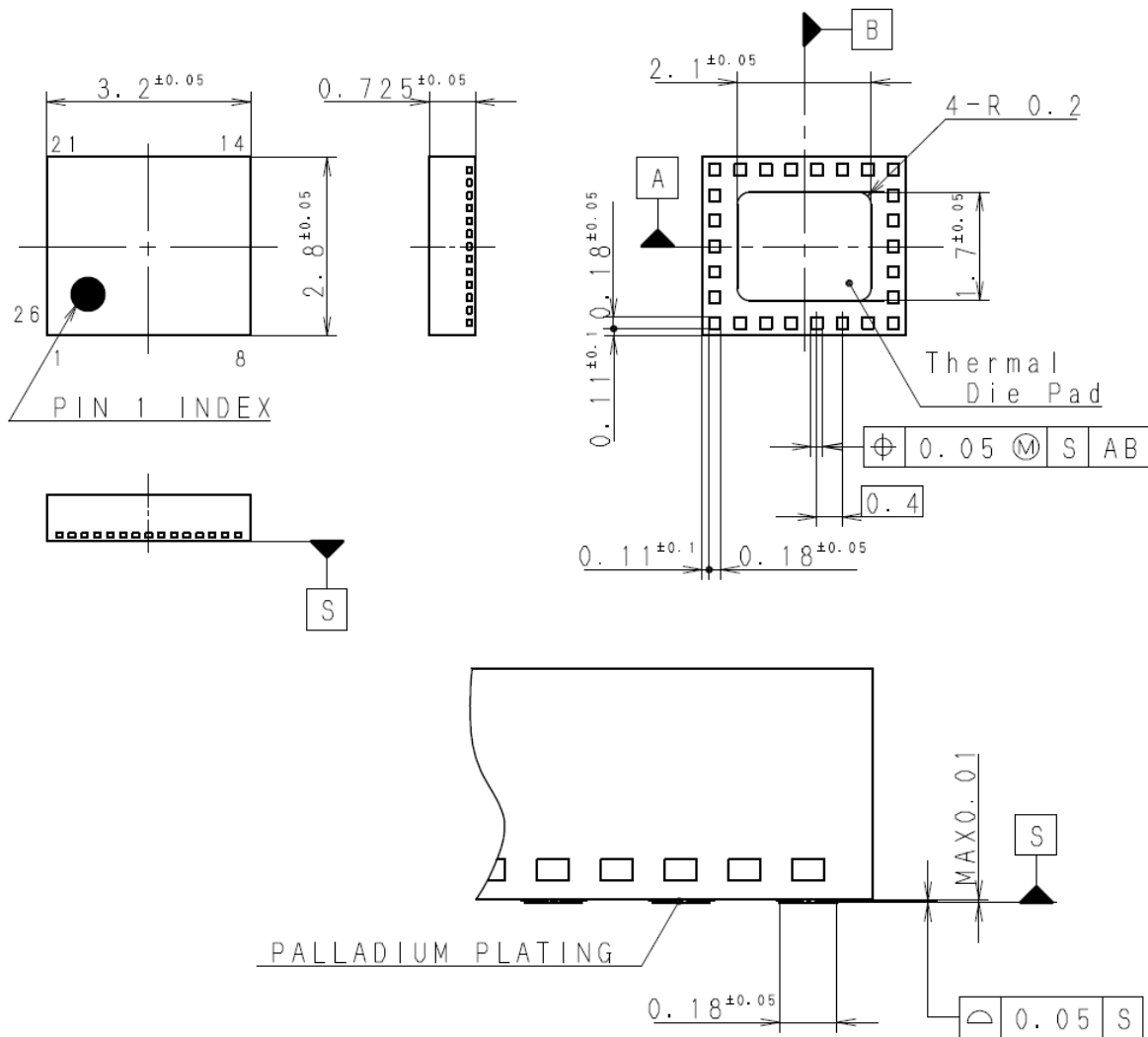


**PWB(Printed Wiring Board) GND Design for VQFN-26P (Image)**



Package Outline

26PIN VQFN (PLASTIC)



TERMINAL SECTION

PACKAGE STRUCTURE

SONY CODE	VQFN-26P-02
JEITA CODE	_____
JEDEC CODE	_____

PACKAGE MATERIAL	EPOXY RESIN
TERMINAL TREATMENT	PALLADIUM PLATING
TERMINAL MATERIAL	COPPER ALLOY
PACKAGE MASS	0.020g

PART No.	AP-4000-26013S	Rev. 0
ISSUED /	13.01.08	REVISED
PRODUCTION LINE	COMPILING DIV. SONY SEMICONDUCTOR	
REMARKS	PKG CODE:ER-26-A1	

**Tape and Reel Size**

1 2 mm WIDTH EMBOSSED TAPING

PACKAGE CODE	EMBOSSED TAPING CODE
VQFN-26P-02	R026QNR3-12-N-1

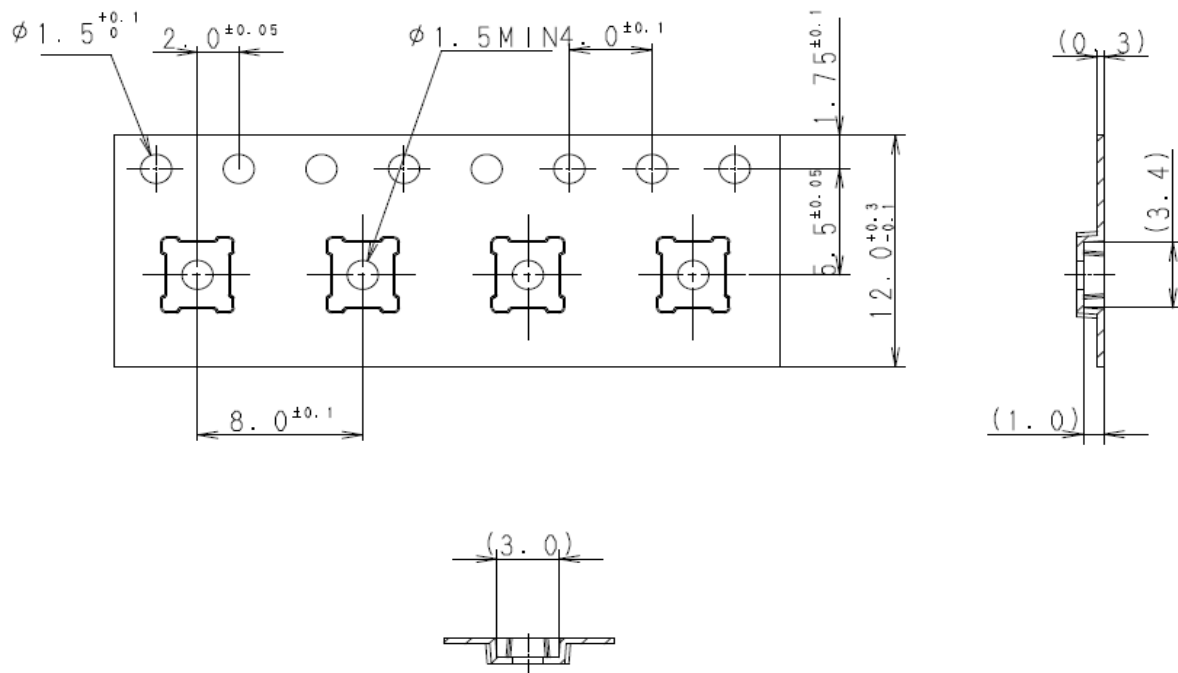
**1. SCOPE**

THIS SPECIFICATION DESCRIBES THE EMBOSSED TAPING FOR SMD (SURFACE MOUNTED DEVICE) IC'S. FOR SHIPMENT. THIS SPECIFICATION IS BASED ON THE STIPULATIONS OF JAPAN ELECTRONICS AND INFORMATION TECHNOLOGY INDUSTRIES ASSOCIATION (JEITA), JIS C0806-3, AND ELECTRONIC INDUSTRIES ASSOCIATION EIA-481.

**2. PRODUCT INDICATION**

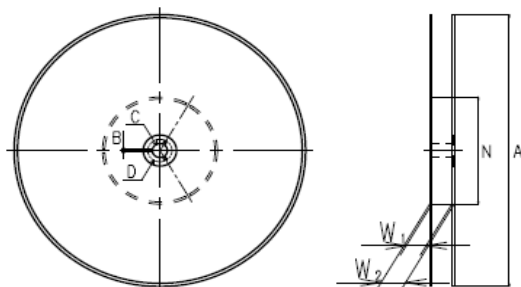


**3. TAPING SPECIFICATIONS**



NOTE) 1. THE R MEASUREMENT WITHOUT INDICATION IS ASSUMED TO BE 0.3 mm MAX.      GENERAL TOLERANCE:  $\pm 0.2$   
 2. THE FEED HOLE CUMULATIVE PITCH ERROR IS ASSUMED AT  $\pm 0.2$  mm/10 PITCH.      UNIT: mm

**4. REEL DIMENSIONS**  
 $\phi 330$  mm PLASTIC REEL



UNIT: mm

SYMBOL	A	N	C	D
DIMENSION	$\phi 330 \pm 2$	$\phi 100 \pm 1$	$\phi 13 \pm 0.2$	$\phi 21 \pm 0.8$
SYMBOL	B	W <sub>1</sub>	W <sub>2</sub>	
DIMENSION	$2 \pm 0.5$	$13.4 \pm 1$	$17.4 \pm 1$	

MATERIAL: POLYSTYRENE CONTAINING CARBON (ANTISTATIC)

\*INTRODUCTION OF REUSE REEL

(REEL THAT IS USED AGAIN AFTER COLLECTION)

WE USE THE REUSE REEL OF JEITA SPECIFICATION.

Revision History

Status	Revised Date	Revised Contents	Comment
0.1		-----	Initial Datasheet
0.2	Sep. 7,2012	Updates ABS Max. Ratings table, Electrical characteristics table Add footer on P1, add GND symbol at package back side	
0.3	Oct. 3, 2012	Fixed IL item Moved Isolation table, changed Harmonics limit, changed package outline figure	Typo
0.4	Oct.23, 2012	Fix pin configuration tabl Changed IL table by port, Add VSWR, change Harmonics limits	Typo
0.5	Dec.26, 2012	Change Attenuation limit(ANT-TX1 high freq), Add revision history	
0.6	Feb. 25,2013	Change Bias condition Vctl(L) Change Attenuation (ANT-TX1 freq) (ANT-TX2 limit 5GHz) Change IL(TRx12, TX2) Change Isolation table Add Harmonics,IMD,IP3 path condition Delete "Target Specification of" at TBR, IIP2 specification and change tables. Change IIP2 Jammer condition. Add PWB GND Design for VQFN-26P figure Change Package Outline, Tape and Reel Size figures	Typo             Typo