SONY

SP10T Antenna Switch Module for GSM and UMTS/CDMA Multi Mode Handset

CXM3520BER

Description

The CXM3520BER is a SP10T antenna switch module for GSM and UMTS/CDMA multi-mode handset.
The CXM3520BER 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 (4bands) / UMTS (1band) / CDMA (3bands) multi-mode handset
- GSM (4bands) / UMTS (2bands) / CDMA (2bands) multi-mode handset, etc.

Features

- ◆ Low insertion loss (SP10T): 0.85dB (Typ.) Tx1 (GSM Low band Tx)
  0.85dB (Typ.) Tx2 (GSM High band Tx)
  0.53dB (Typ.) TRx1 (UMTS Band I)
- ◆ High attenuation: 35dB (Typ.) On Tx1 path @1648-1830MHz
  33dB (Typ.) On Tx2 path @3420-3820MHz
- ◆ Low voltage operation: V_{DD} = +2.5V
- ◆ No DC blocking capacitors
- ◆ Small package (Size): VQFN-26P (3.0mm × 3.8mm × 0.8mm Typ.)
- ◆ Lead-free and RoHS compliant

Structure

GaAs junction-gate PHEMT MMIC switch, CMOS decoder and Dual-LPF.
Sony PHEMT GaAs process is utilized for low insertion loss.

Note on Handling
GaAs MMIC's are ESD sensitive devices. Special handling precautions are required.

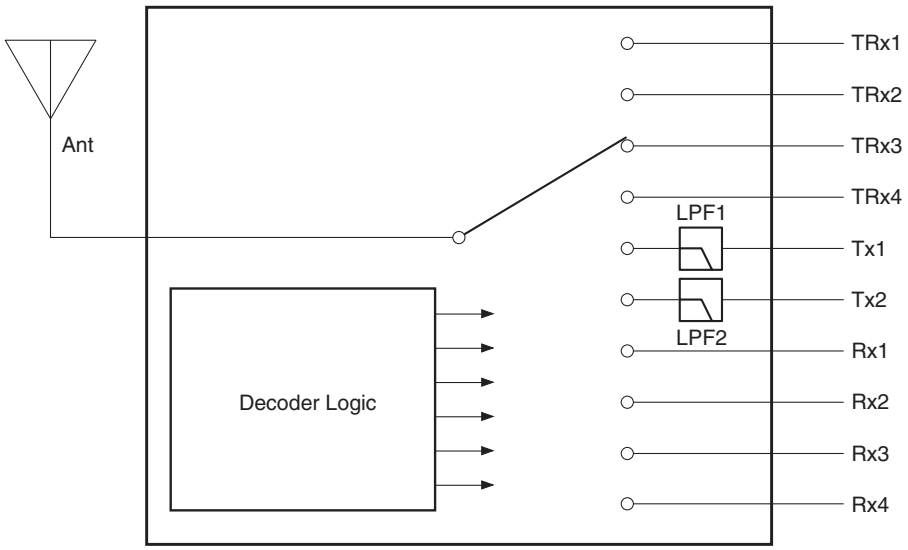
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E09218

Absolute Maximum Ratings

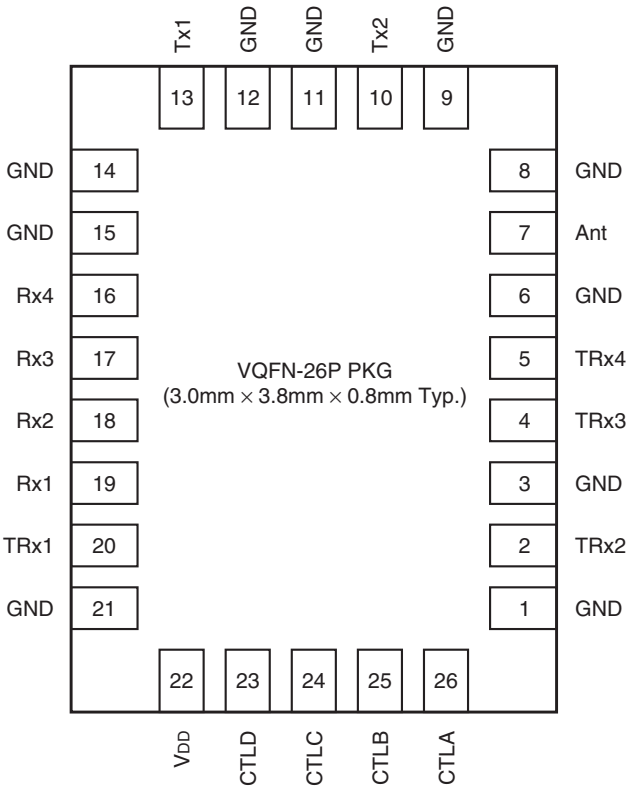
Item	Ratings
Bias voltage (V_{DD})	+4V (Ta: +25℃)
Control voltage (CTL-A/B/C/D)	+4V (Ta: +25℃)
Input power max. (Tx1)	+36dBm (Duty cycle = 12.5%) (Ta: +25℃)
Input power max. (Tx2)	+34dBm (Duty cycle = 12.5%) (Ta: +25℃)
Input power max. (TRx1, 2, 3, 4)	+32dBm (Ta: +25℃)
Input power max. (Rx1, 2, 3, 4)	+13dBm (Ta: +25℃)
Operating temperature range	–35 to +90℃
Storage temperature range	–65 to +150℃

Block Diagram



Pin Configuration

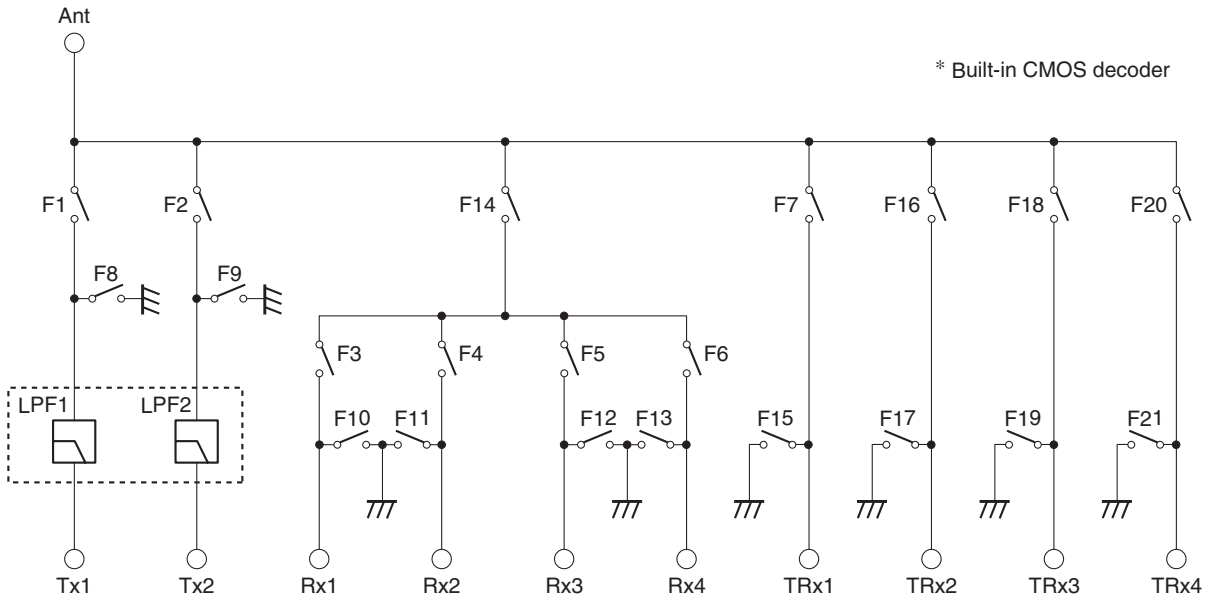
(Top View)



Pin Description

Pin No.	Symbol	Pin No.	Symbol
1	GND	14	GND
2	TRx2	15	GND
3	GND	16	Rx4
4	TRx3	17	Rx3
5	TRx4	18	Rx2
6	GND	19	Rx1
7	Ant	20	TRx1
8	GND	21	GND
9	GND	22	V_{DD}
10	TX2 (DCS/PCS)	23	CTLD
11	GND	24	CTLC
12	GND	25	CTLB
13	TX1 (GSM850/900M)	26	CTLA

Block Diagram of RF Switch



Truth Table

State	Active path	Vctl state				Switch state (*2)																				
		A	B	C	D	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21
1	Tx1	H	H	L	L	H	L	L	L	L	L	L	L	H	H	H	H	H	L	H	L	H	L	H	L	H
2	Tx2	H	L	L	L	L	H	L	L	L	L	L	H	L	H	H	H	H	L	H	L	H	L	H	L	H
3	Rx1 (*1)	L	L	L	L	L	L	H	L	L	L	L	H	H	L	H	H	H	H	H	L	H	L	H	L	H
4	Rx2 (*1)	L	L	H	L	L	L	L	H	L	L	L	H	H	H	L	H	H	H	H	L	H	L	H	L	H
5	Rx3 (*1)	L	H	H	L	L	L	L	L	H	L	L	H	H	H	H	L	H	H	H	L	H	L	H	L	H
6	Rx4 (*1)	L	H	L	L	L	L	L	L	L	H	L	H	H	H	H	H	L	H	H	L	H	L	H	L	H
7	TRx1	H	L	H	L	L	L	L	L	L	L	H	H	H	H	H	H	H	L	L	L	H	L	H	L	H
8	TRx2	H	H	H	L	L	L	L	L	L	L	L	H	H	H	H	H	H	L	H	H	L	L	H	L	H
9	TRx3	H	L	H	H	L	L	L	L	L	L	L	H	H	H	H	H	H	L	H	L	H	H	L	L	H
10	TRx4	H	H	H	H	L	L	L	L	L	L	L	H	H	H	H	H	H	L	H	L	H	L	H	H	L

*1 Each Rx path can be used over a wide frequency range from 869MHz to 1990MHz.

*2 State “L” means a switch “OFF”, state “H” means a switch “ON”.

Supply Voltage Value

(Ta = +25°C)

Item	Min.	Typ.	Max.	Unit
Bias voltage (V_{DD})	+2.5	+2.65	+3.3	V

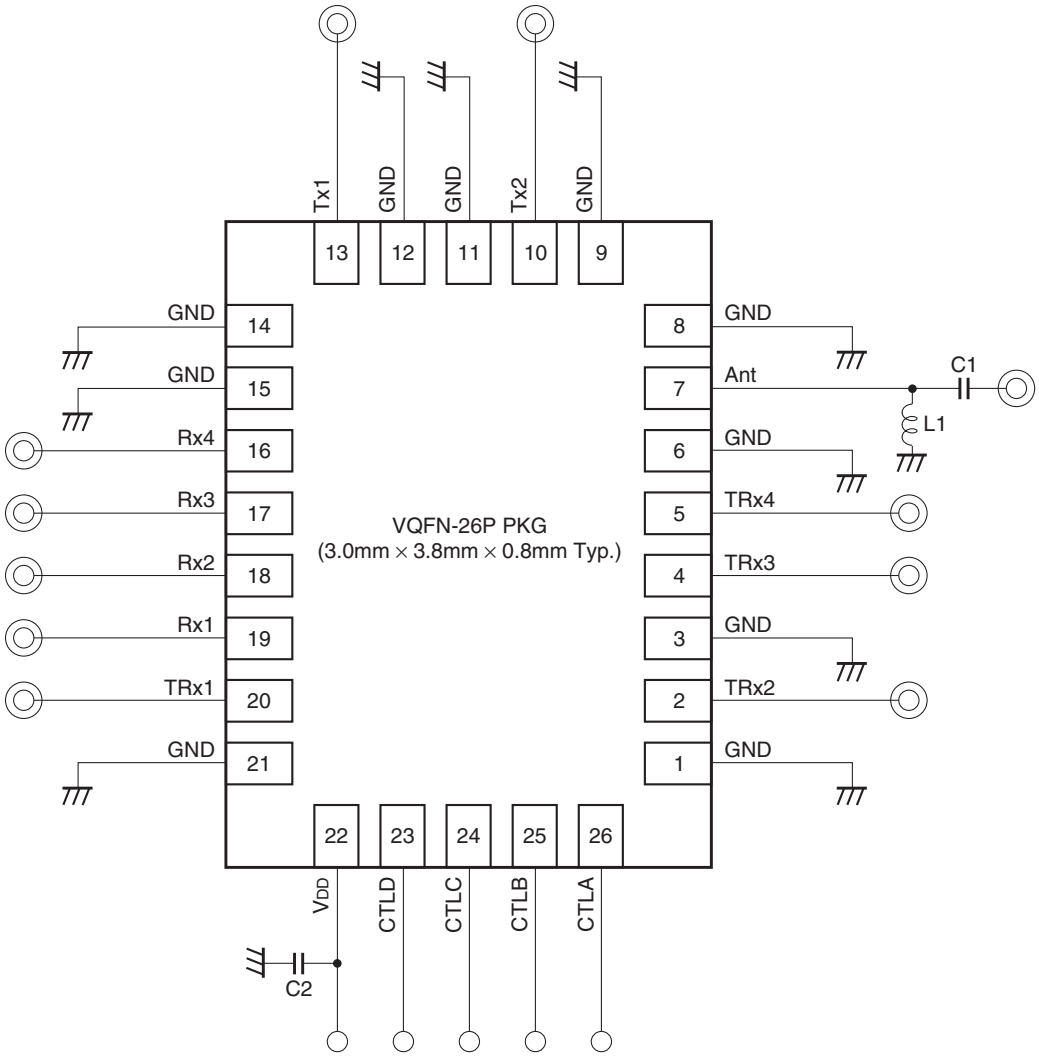
Logic Value

(Ta = +25°C)

Item	State	Min.	Typ.	Max.	Unit
Control voltage (CTL-A/B/C/D)	High	+1.35	+1.8	+3.3	V
	Low	0	—	+0.3	

Recommended Circuit

(Top View)



Note) 1. No DC blocking capacitors are required on all RF ports.
2. DC levels of all RF ports are GND.
3. L1 inductor (22nH) and C1 capacitor (12pF) are recommended on Ant port for ESD protection.
4. C2 capacitor (100pF) is recommended.

Electrical Characteristics

(V_{DD} = +2.5V, Vctl = +1.80V, Ta = +25℃)

Item	Symbol	Path	Condition	Min.	Typ.	Max.	Unit
Insertion loss	I.L	Ant-Tx1	*1	—	0.85	1.00	dB
		Ant-Tx2	*2	—	0.85	1.05	
		Ant-TRx1	*3	—	0.53	0.68	
			*4	—	0.55	0.70	
		Ant-TRx2	*5	—	0.45	0.55	
			*6	—	0.59	0.74	
		Ant-TRx3	*5	—	0.45	0.55	
			*6	—	0.61	0.76	
		Ant-TRx4	*5	—	0.37	0.47	
		Ant-Rx1	*7	—	0.70	0.80	
			*8	—	1.05	1.20	
		Ant-Rx2	*7	—	0.70	0.80	
			*8	—	1.05	1.20	
		Ant-Rx3	*7	—	0.70	0.80	
			*8	—	1.00	1.15	
		Ant-Rx4	*7	—	0.70	0.80	
			*8	—	1.00	1.15	
V.S.W.R.	V.S.W.R.	All ports in active paths	824 to 2170MHz	—	1.2	1.6	—
Switching time	Ts		90% OFF to 90% ON	—	2	5	μs

Electrical characteristics are measured with all RF ports terminated in 50Ω and recommended circuit.

*1 Frequency = 824 to 915MHz, Pin on Tx1: +34dBm C.W.
*2 Frequency = 1710 to 1910MHz, Pin on Tx2: +32dBm C.W.
*3 Frequency = 1920 to 1980MHz, Pin on TRx1: +26dBm C.W.
*4 Frequency = 2110 to 2170MHz, Pin on TRx1: +26dBm C.W.
*5 Frequency = 824 to 894MHz, Pin on TRx2 or TRx3 or TRx4: +26dBm C.W.
*6 Frequency = 1710 to 1990MHz, Pin on TRx2 or TRx3: +26dBm C.W.
*7 Frequency = 869 to 960MHz, Pin on Ant: +10dBm C.W.
*8 Frequency = 1805 to 1990MHz, Pin on Ant: +10dBm C.W.

(V_{DD} = +2.5V, Vctl = +1.80V, Ta = +25℃)

Item	Symbol	Path	Condition	Min.	Typ.	Max.	Unit
Isolation	ISO.	Active path: Tx1-Ant (State1)					dB
		Tx1-Rx1	824 to 915MHz	35	44	—	
		Tx1-Rx2		35	44	—	
		Tx1-Rx3		35	43	—	
		Tx1-Rx4		35	42	—	
		Tx1-TRx1		35	40	—	
		Tx1-TRx2		45	61	—	
		Tx1-TRx3		45	62	—	
		Tx1-TRx4		30	37	—	
		Tx1-Tx2		20	23	—	
			1648 to 1830MHz	20	23	—	
		Tx2-Ant		25	29	—	
		Active path: Tx2-Ant (State2)					
		Tx2-Rx1	1710 to 1910MHz	32	38	—	
		Tx2-Rx2		32	37	—	
		Tx2-Rx3		32	38	—	
		Tx2-Rx4		32	38	—	
		Tx2-TRx1		30	33	—	
		Tx2-TRx2		35	42	—	
		Tx2-TRx3		35	40	—	
		Tx2-TRx4		20	26	—	
		Tx2-Tx1		20	27	—	

(V_{DD} = +2.5V, Vctl = +1.80V, Ta = +25℃)

Item	Symbol	Path	Condition	Min.	Typ.	Max.	Unit
Isolation	ISO.	Active path: TRx1-Ant (State7)					dB
		TRx1-Rx1	1920 to 1980MHz	17	20	—	
		TRx1-Rx2		20	28	—	
		TRx1-Rx3		30	35	—	
		TRx1-Rx4		35	43	—	
		TRx1-Tx1		35	42	—	
		TRx1-Tx2		25	30	—	
		TRx1-TRx2		35	39	—	
		TRx1-TRx3		35	38	—	
		TRx1-TRx4		20	26	—	
		Active path: TRx2-Ant (State8)					
		TRx2-Rx1	824 to 849MHz	35	41	—	
		TRx2-Rx2		35	42	—	
		TRx2-Rx3		35	43	—	
		TRx2-Rx4		35	46	—	
		TRx2-Tx1		30	40	—	
		TRx2-Tx2		30	41	—	
		TRx2-TRx1		30	36	—	
		TRx2-TRx3		30	37	—	
		TRx2-TRx4		30	37	—	
		TRx2-Rx1	1710 to 1910MHz	25	33	—	
		TRx2-Rx2		25	34	—	
		TRx2-Rx3		30	35	—	
		TRx2-Rx4		30	38	—	
		TRx2-Tx1		30	55	—	
		TRx2-Tx2		25	32	—	
		TRx2-TRx1		25	29	—	
		TRx2-TRx3		25	31	—	
		TRx2-TRx4		20	26	—	
		Active path: TRx3-Ant (State9)					
		TRx3-Rx1	824 to 849MHz	35	41	—	
		TRx3-Rx2		35	42	—	
		TRx3-Rx3		35	43	—	
		TRx3-Rx4		35	46	—	
		TRx3-Tx1		35	40	—	
		TRx3-Tx2		35	43	—	
		TRx3-TRx1		30	37	—	
		TRx3-TRx2		30	39	—	
		TRx3-TRx4		30	34	—	
		TRx3-Rx1	1710 to 1910MHz	25	34	—	
		TRx3-Rx2		25	34	—	
		TRx3-Rx3		30	36	—	
		TRx3-Rx4		30	39	—	
		TRx3-Tx1		30	55	—	
		TRx3-Tx2		25	34	—	
		TRx3-TRx1		25	30	—	
		TRx3-TRx2		25	30	—	
		TRx3-TRx4		17	22	—	
		Active path: TRx4-Ant (State10)					
		TRx4-Rx1	824 to 849MHz	35	42	—	
		TRx4-Rx2		35	42	—	
		TRx4-Rx3		35	43	—	
		TRx4-Rx4		35	46	—	
		TRx4-Tx1		35	39	—	
		TRx4-Tx2		35	44	—	
		TRx4-TRx1		30	37	—	
		TRx4-TRx2		30	51	—	
		TRx4-TRx3		30	36	—	

(V_{DD} = +2.5V, Vctl = +1.80V, Ta = +25℃)

Item	Symbol	Path	Condition		Min.	Typ.	Max.	Unit
Inter modulation distortion level in Rx band	IMD2	TRx1-Ant	TRx: 835MHz State7	Ant: 45MHz *1	—	—	–105	dBm
				Ant: 1715MHz *2	—	—	–105	
			TRx: 1880MHz State7	Ant: 80MHz *3	—	—	–105	
				Ant: 3840MHz *4	—	—	–105	
			TRx: 1950MHz State7	Ant: 190MHz *5	—	—	–105	
				Ant: 4090MHz *6	—	—	–105	
		TRx2-Ant	TRx: 835MHz State8	Ant: 45MHz *1	—	—	–105	
				Ant: 1715MHz *2	—	—	–105	
			TRx: 1880MHz State8	Ant: 80MHz *3	—	—	–105	
				Ant: 3840MHz *4	—	—	–105	
			TRx: 1950MHz State8	Ant: 190MHz *5	—	—	–105	
				Ant: 4090MHz *6	—	—	–105	
		TRx3-Ant	TRx: 835MHz State9	Ant: 45MHz *1	—	—	–105	
				Ant: 1715MHz *2	—	—	–105	
			TRx: 1880MHz State9	Ant: 80MHz *3	—	—	–105	
				Ant: 3840MHz *4	—	—	–105	
			TRx: 1950MHz State9	Ant: 190MHz *5	—	—	–105	
				Ant: 4090MHz *6	—	—	–105	
		TRx4-Ant	TRx: 835MHz State10	Ant: 45MHz *1	—	—	–105	
				Ant: 1715MHz *2	—	—	–105	
	IMD3	TRx1-Ant	TRx: 835MHz State7	Ant: 790MHz *7	—	—	–105	
				Ant: 2550MHz *8	—	—	–105	
			TRx: 1880MHz State7	Ant: 1800MHz *9	—	—	–105	
				Ant: 5720MHz *10	—	—	–105	
			TRx: 1950MHz State7	Ant: 1760MHz *11	—	—	–105	
				Ant: 6040MHz *12	—	—	–105	
		TRx2-Ant	TRx: 835MHz State8	Ant: 790MHz *7	—	—	–105	
				Ant: 2550MHz *8	—	—	–105	
			TRx: 1880MHz State8	Ant: 1800MHz *9	—	—	–105	
				Ant: 5720MHz *10	—	—	–105	
			TRx: 1950MHz State8	Ant: 1760MHz *11	—	—	–105	
				Ant: 6040MHz *12	—	—	–105	
		TRx3-Ant	TRx: 835MHz State9	Ant: 790MHz *7	—	—	–105	
				Ant: 2550MHz *8	—	—	–105	
			TRx: 1880MHz State9	Ant: 1800MHz *9	—	—	–105	
				Ant: 5720MHz *10	—	—	–105	
			TRx: 1950MHz State9	Ant: 1760MHz *11	—	—	–105	
				Ant: 6040MHz *12	—	—	–105	
		TRx4-Ant	TRx: 835MHz State10	Ant: 790MHz *7	—	—	–105	
				Ant: 2550MHz *8	—	—	–105	

Electrical characteristics are measured with all RF ports terminated in 50Ω and recommended circuit.

*1 TRx port: +20dBm, 835MHz, Ant port: –15dBm, 45MHz
*2 TRx port: +20dBm, 835MHz, Ant port: –15dBm, 1715MHz
*3 TRx port: +20dBm, 1880MHz, Ant port: –15dBm, 80MHz
*4 TRx port: +20dBm, 1880MHz, Ant port: –15dBm, 3840MHz
*5 TRx port: +20dBm, 1950MHz, Ant port: –15dBm, 190MHz
*6 TRx port: +20dBm, 1950MHz, Ant port: –15dBm, 4090MHz
*7 TRx port: +20dBm, 835MHz, Ant port: –15dBm, 790MHz
*8 TRx port: +20dBm, 835MHz, Ant port: –15dBm, 2550MHz
*9 TRx port: +20dBm, 1880MHz, Ant port: –15dBm, 1800MHz
*10 TRx port: +20dBm, 1880MHz, Ant port: –15dBm, 5720MHz
*11 TRx port: +20dBm, 1950MHz, Ant port: –15dBm, 1760MHz
*12 TRx port: +20dBm, 1950MHz, Ant port: –15dBm, 6040MHz

(V_{DD} = +2.5V, Vctl = +1.80V, Ta = +25℃)

Item	Symbol	Path	Condition			Min.	Typ.	Max.	Unit
			Tx at TRx* 24dBm [MHz]	Jammer at Ant –20dBm [MHz]	IM2 product at TRx* [MHz]				
Input IP2	IIP2	Ant - TRx1, TRx2, TRx3, TRx4	836.61	1718.61	881.61	113.5	—	—	dBm
			836.61	45	881.61	95.5	—	—	
			1885	3850	1965	95.5	—	—	
			1885	80	1965	95.5	—	—	
			1732.5	3865	2132.5	95.5	—	—	
			1732.5	400	2132.5	95.5	—	—	

Electrical characteristics are measured with all RF ports terminated in 50Ω and recommended circuit.

(V_{DD} = +2.5V, Vctl = +1.80V, Ta = +25℃)

Item	Symbol	Path	Condition				Min.	Typ.	Max.	Unit
			Tx1 at TRx* 21.5dBm [MHz]	Tx2 at TRx* 21.5dBm [MHz]	Jammer at Ant –30dBm [MHz]	Triple beat product at TRx* [MHz]				
Triple beat ratio	TBR	Ant - TRx1, TRx2, TRx3, TRx4	835.5	836.5	881.5	881.5 ± 1	81	—	—	dBc
			1880	1881	1960	1960 ± 1	81	—	—	

Electrical characteristics are measured with all RF ports terminated in 50Ω and recommended circuit.

(V_{DD} = +2.5V, Vctl = +1.80V, Ta = +25°C)

Item	Symbol	Path		Condition		Min.	Typ.	Max.	Unit
Harmonics	Harm	Tx1-Ant *1	2nd harmonic	1648 to 1698MHz 1780 to 1830MHz	C.W. Pin = +34dBm	—	–54	–36	dBm
			3rd harmonic	2472 to 2547MHz 2670 to 2745MHz		—	–47	–36	
		Tx2-Ant *2	2nd harmonic	3420 to 3570MHz 3700 to 3820MHz	C.W. Pin = +32dBm	—	–55	–36	
			3rd harmonic	5130 to 5355MHz 5550 to 5730MHz		—	–46	–36	
		TRx1-Ant *3	2nd harmonic	3420 to 3960MHz	C.W. Pin = +26dBm	—	–61	–36	
			3rd harmonic	5130 to 5940MHz		—	–70	–36	
		TRx2-Ant *3	2nd harmonic	3420 to 3960MHz	C.W. Pin = +26dBm	—	–68	–36	
			3rd harmonic	5130 to 5940MHz		—	–69	–36	
		TRx3-Ant *3	2nd harmonic	3420 to 3960MHz	C.W. Pin = +26dBm	—	–61	–36	
			3rd harmonic	5130 to 5940MHz		—	–66	–36	
		TRx4-Ant *4	2nd harmonic	1648 to 1698MHz	C.W. Pin = +26dBm	—	–67	–36	
			3rd harmonic	2472 to 2547MHz		—	–68	–36	
Attenuation	ATT	Tx1-Ant		1648 to 1830MHz	2fo_ATT	25	33	—	dB
				2472 to 2745MHz	3fo_ATT	25	36	—	
				3296 to 3660MHz	4fo_ATT	20	24	—	
		Tx2-Ant		3420 to 3820MHz	2fo_ATT	25	34	—	
				5130 to 5730MHz	3fo_ATT	25	30	—	

Electrical characteristics are measured with all RF ports terminated in 50Ω and recommended circuit.

*1 Frequency = 824 to 915MHz, Pin on Tx1: +34dBm C.W.
*2 Frequency = 1710 to 1910MHz, Pin on Tx2: +32dBm C.W.
*3 Frequency = 1710 to 1980MHz, Pin on TRx1 or TRx2 or TRx3: +26dBm C.W.
*4 Frequency = 824 to 849MHz, Pin on TRx4: +26dBm C.W.

(Ta = +25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply current	I_{DD}	Active mode V_{DD} = 2.65V, Vctl = 1.8V	—	0.22	0.4	mA
Control current	Ictl	V_{DD} = 2.65V, Vctl = 1.8V	—	—	10	μA

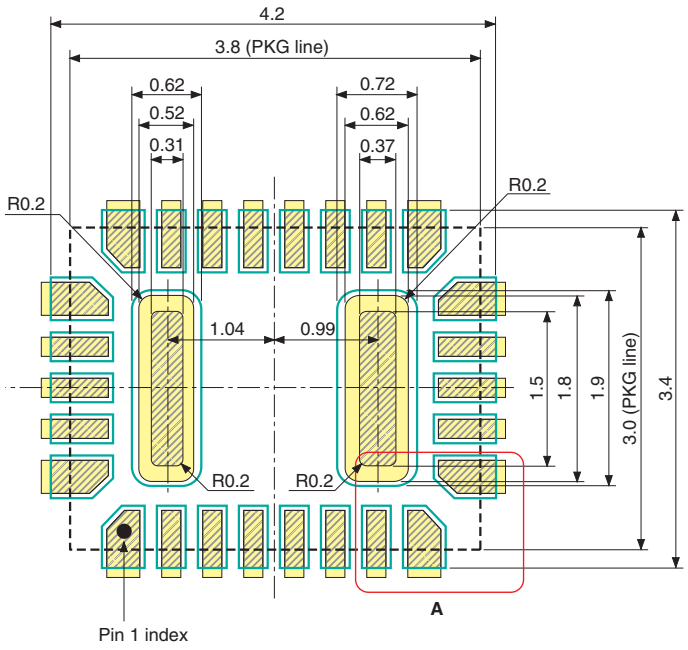
PCB Layout Template

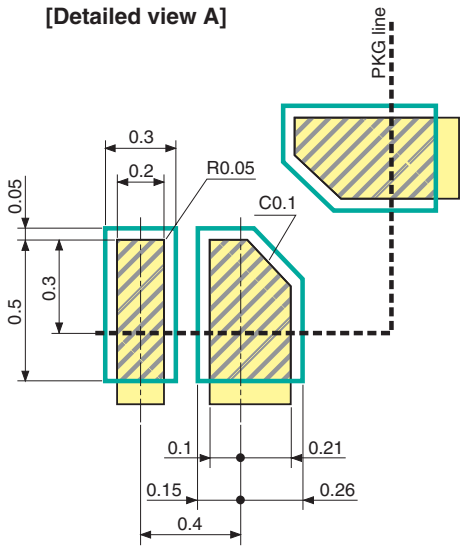
VQFN-26P-01 Macro (Reference)

• PKG size: 3.8mm × 3.0mm
• Pin pitch: 0.4mm pitch

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

* Metal mask thickness: 110µm



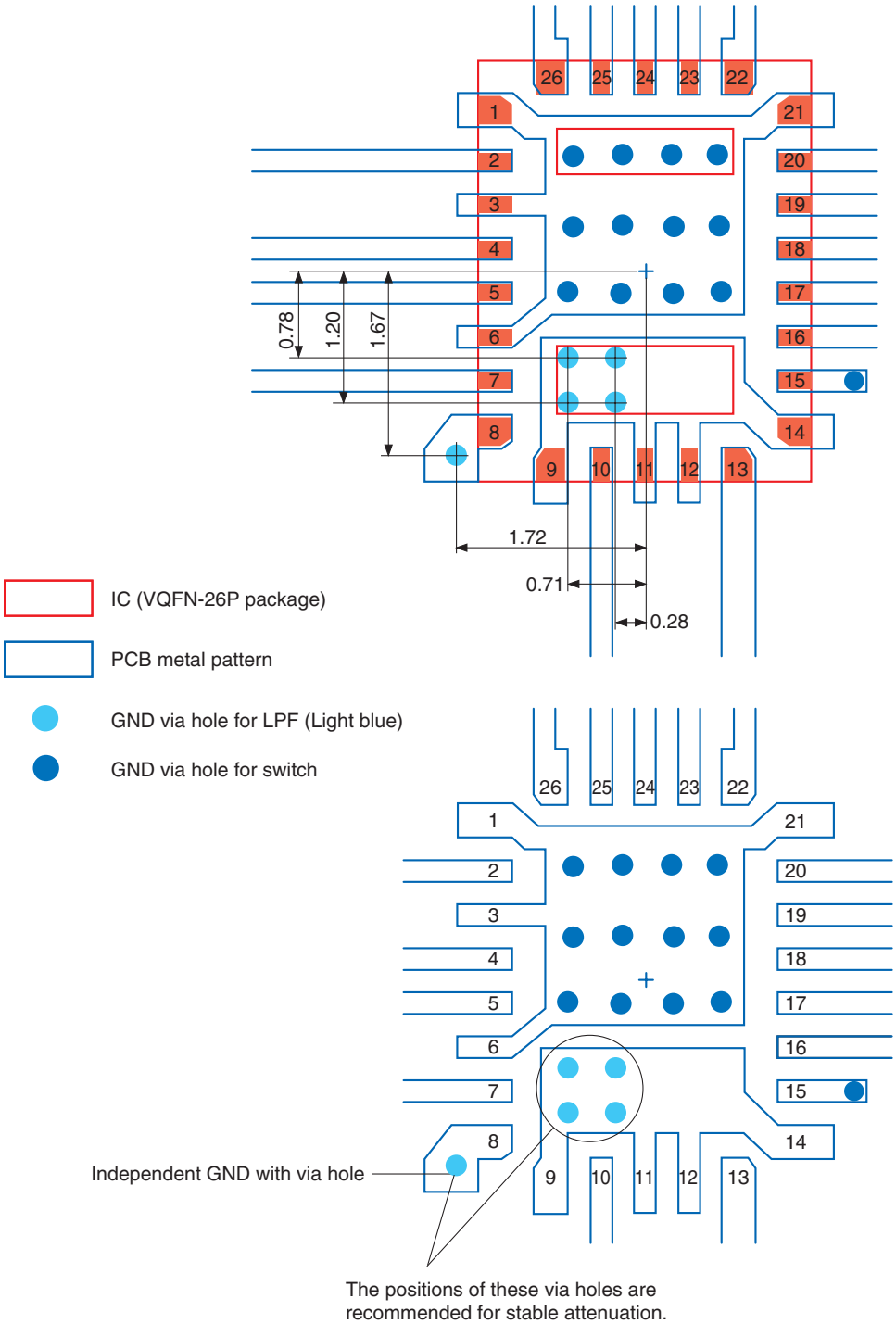


* Mask corner R = 0.05mm

Recommended PCB Design

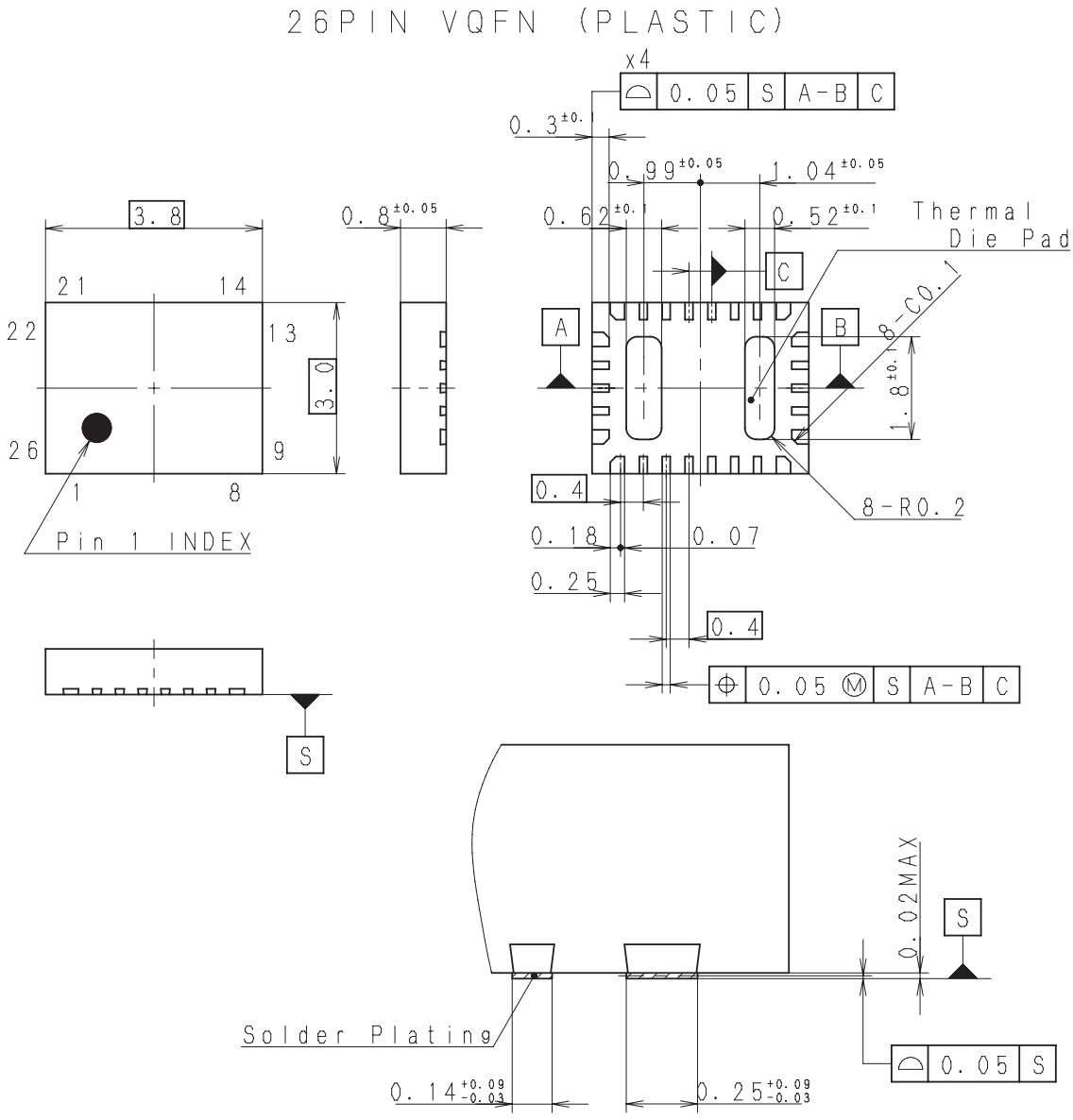
Ex). GSM (4 bands) / UMTS (4 bands)

The positions of the light blue via holes and relative GND patterns are strongly recommended for getting stable attenuation.



Package Outline

(Unit: mm)



Note:Cutting burr of lead are 0.05mm MAX.

PACKAGE STRUCTURE

SONY CODE	VQFN-26P-01
JEITA CODE	————
JEDEC CODE	————

PACKAGE MATERIAL	EPOXY RESIN
TERMINAL TREATMENT	SOLDER PLATING
TERMINAL MATERIAL	COPPER ALLOY
PACKAGE MASS	0.03g

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