SONY

SP10T Antenna Switch Module 4TRx/2Tx/4Rx for GSM and UMTS/CDMA Multi Mode Handset

CXM3558ER

Description

The CXM3558ER is a SP10T antenna switch module for GSM and UMTS/CDMA multi-mode handset.
The CXM3558ER 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.
(Application: GSM/UMTS/CDMA multi-mode handset)

Features

- ◆ Low insertion loss (SP10T): 1.15dB (Typ.) Tx1 (GSM Low band Tx)
  1.00dB (Typ.) Tx2 (GSM High band Tx)
  0.70dB (Typ.) TRx1 (UMTS band I)
- ◆ High attenuation: 29dB (Typ.) Tx1 @1648-1830MHz
  28dB (Typ.) Tx2 @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.

E10511-PS

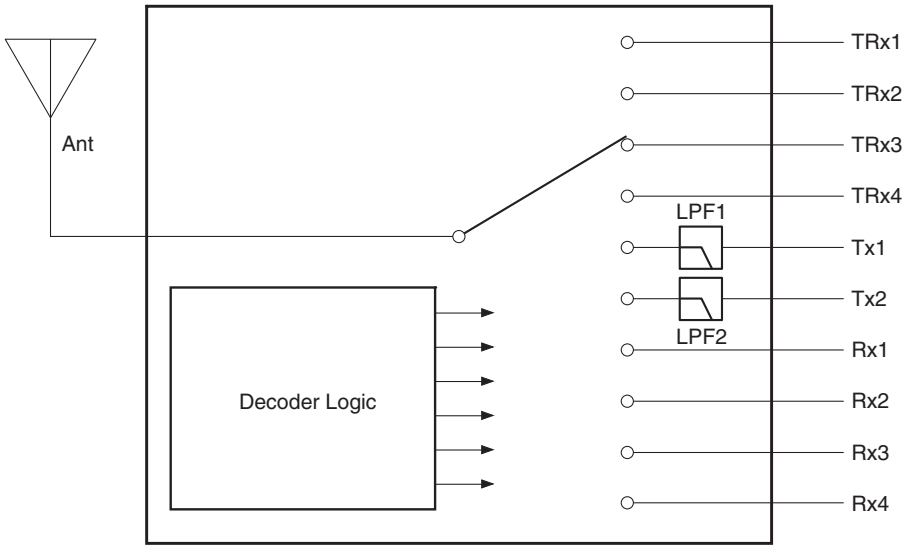
Absolute Maximum Ratings

(Ta = 25℃)

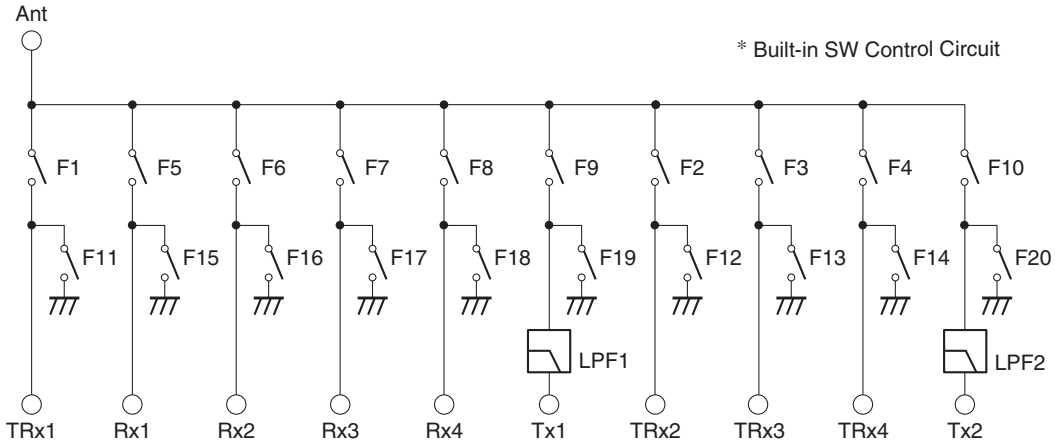
Bias voltage	V_{DD}	4	V
Control voltage (CTL-A/B/C/D)	Vctl	4	V
Input power max. (Tx1)		36	dBm (Duty cycle = 12.5%)
Input power max. (Tx2)		34	dBm (Duty cycle = 12.5%)
Input power max. (TRx1, 2, 3, 4)		32	dBm
Input power max. (Rx1, 2, 3, 4)		13	dBm
Operating temperature		–35 to +90	℃
Storage temperature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

Block Diagram

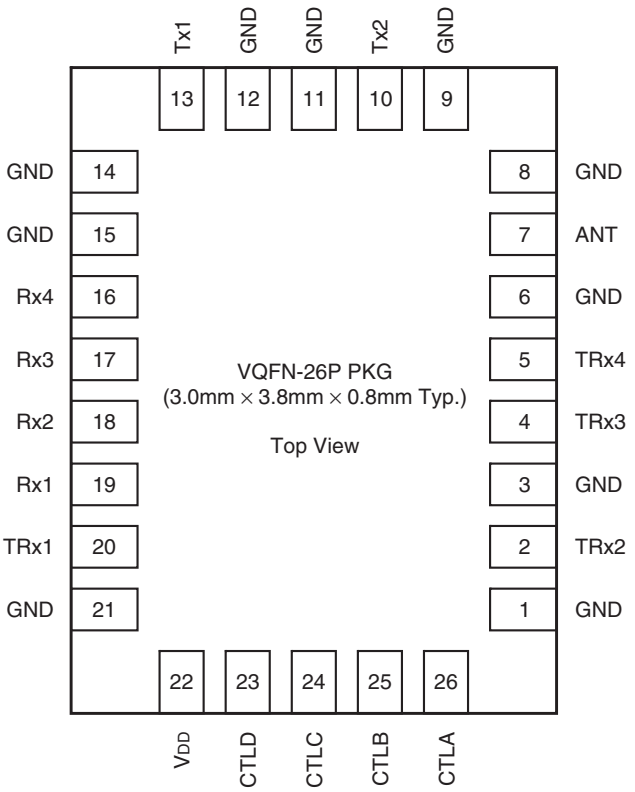
SP10T Antenna Switch Module



SP10T 4TRx/2Tx/4Rx



Pin Configuration



Pin No.	Name	Pin No.	Name
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

Truth Table

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

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

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

*3 Each TRx path can be used over a wide frequency range from 824MHz to 2170MHz.

Supply Voltage Value

(Ta = 25℃)

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

Logic Value

(Ta = 25℃)

Item	State	Min.	Typ.	Max.	Unit
Control voltage (CTL-A/B/C/D)	High	+1.35	+1.8	+3.3	V
	Low	0	—	+0.45	

Electrical Characteristics

(V_{DD} = +2.65V, Vctl = +1.80V, Ta = +25℃)

Item	Symbol	Path	Condition	Min.	Typ.	Max.	Unit
Insertion loss	I.L.	Ant - Tx1	*1	—	1.15	1.30	dB
		Ant - Tx2	*2	—	1.00	1.20	
		Ant - TRx1, 2, 3, 4	*3	—	0.66	0.81	
			*4	—	0.71	0.86	
			*5	—	0.48	0.58	
			*6	—	0.67	0.82	
		Ant - Rx1, 2, 3, 4	*7	—	0.84	0.94	
			*8	—	1.00	1.15	

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

*1 Frequency = 824 to 915MHz, Pin on Tx1: +35dBm C.W. GSM850/900 Tx
*2 Frequency = 1710 to 1910MHz, Pin on Tx2: +32dBm C.W. GSM1800/1900 Tx
*3 Frequency = 1920 to 1980MHz, Pin on TRx: +26dBm C.W. Band 1 Tx
*4 Frequency = 2110 to 2170MHz, Pin on TRx: +26dBm C.W. Band 1 Rx, Band 4 Rx
*5 Frequency = 824 to 960MHz, Pin on TRx: +26dBm C.W. Band 5, Band 8
*6 Frequency = 1710 to 1990MHz, Pin on TRx: +26dBm C.W. Band 1 Tx, Band 2 Tx, Band 3 Tx, Band 4 Tx
*7 Frequency = 869 to 960MHz, Pin on Ant: +10dBm C.W. GSM850/900 Rx
*8 Frequency = 1805 to 1990MHz, Pin on Ant: +10dBm C.W. GSM1800/1900 Rx

(V_{DD} = +2.65V, Vctl = +1.80V, Ta = +25℃)

Item	Symbol	Path	Condition	Min.	Typ.	Max.	Unit
Isolation	ISO	Tx1 - Rx1, 2, 3, 4, TRx1, 2, 3	State 1*1	45	—	—	dB
		Tx1 - TRx4		35			
		Tx1 - Tx2		20	—	—	
		Tx1 - Tx2	State 1*1, 1648 to 1830MHz	20	—	—	
		Tx2 - Ant		20	—	—	
		Tx2 - Rx1, 2, 3, 4, TRx1, 2, 3	State 2*2	40	—	—	
		Tx2 - TRx4		30	—	—	
		Tx2 - Tx1		25	—	—	
		Rx4 - Ant	State 5*8	25	—	—	
		Rx3 - Ant	State 6*8	25	—	—	
		TRx1 - Rx1	State 7*3, *5, *6	20	—	—	
		TRx1 - Rx2, 3, 4, Tx1		35	—	—	
		TRx1 - Tx2		25	—	—	
		TRx1 - TRx2, 3		40	—	—	
		TRx1 - TRx4		30	—	—	
		TRx2 - Rx1, 2, 3, 4, Tx1	State 8*3, *5, *6	40	—	—	
		TRx2 - Tx2		25	—	—	
		TRx2 - TRx1, 4		35	—	—	
		TRx2 - TRx3		25	—	—	
		TRx3 - Rx1, 2, 3, 4, Tx1	State 9*3, *5, *6	40	—	—	
		TRx3 - Tx2, TRx2, 4		25	—	—	
		TRx3 - TRx1		35	—	—	
		TRx4 - Rx1, 2, 3, 4, Tx1, TRx1	State 10*3, *5, *6	40	—	—	
		TRx4 - Tx2, TRx3		25	—	—	
		TRx4 - TRx2		30	—	—	

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

*1 Frequency = 824 to 915MHz, Pin on Tx1: +35dBm C.W. GSM850/900 Tx
*2 Frequency = 1710 to 1910MHz, Pin on Tx2: +32dBm C.W. GSM1800/1900 Tx
*3 Frequency = 1920 to 1980MHz, Pin on TRx: +26dBm C.W. Band 1 Tx
*4 Frequency = 2110 to 2170MHz, Pin on TRx: +26dBm C.W. Band 1 Rx, Band 4 Rx
*5 Frequency = 824 to 960MHz, Pin on TRx: +26dBm C.W. Band 5, Band 8
*6 Frequency = 1710 to 1990MHz, Pin on TRx: +26dBm C.W. Band 1 Tx, Band 2 Tx, Band 3 Tx, Band 4 Tx
*7 Frequency = 869 to 960MHz, Pin on Ant: +10dBm C.W. GSM850/900 Rx
*8 Frequency = 1805 to 1990MHz, Pin on Ant: +10dBm C.W. GSM1800/1900 Rx

(V_{DD} = +2.65V, Vctl = +1.80V, Ta = +25℃)

Item	Symbol	Path	Condition	Min.	Typ.	Max.	Unit
Attenuation	ATT	Tx1 - Ant	1648 to 1830MHz	25	—	—	dB
			2472 to 2745MHz	25	—	—	
			3296 to 12750MHz	20	—	—	
		Tx2 - Ant	3420 to 3820MHz	25	—	—	
			5130 to 5730MHz	25	—	—	
			6840 to 6950MHz	17	—	—	
			6950 to 12750MHz	20	—	—	
Harmonics	2fo	Ant - Tx1	*1	—	–45	–36	dBm
	3fo			—	–50	–36	
	2fo	Ant - Tx2	*2	—	–55	–36	
	3fo			—	–50	–36	
	2fo	Ant - TRx1, 2, 3, 4	*3, *4	—	–55	–36	
	3fo			—	–65	–36	
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 - 90% ON	—	3	5	μs
Control current	Ictl		Vctl = 1.8V	—	5	20	μA
Supply current	I_{DD}		V_{DD} = 2.65V	—	0.27	0.40	mA

Electrical Characteristics are measured with all RF ports terminated in 50Ω.
Measured with the recommended circuit.

*1 Frequency = 824 to 915MHz, Pin on Tx1: +35dBm C.W. GSM850/900 Tx
*2 Frequency = 1710 to 1910MHz, Pin on Tx2: +32dBm C.W. GSM1800/1900 Tx
*3 Frequency = 824 to 960MHz, Pin on TRx: +26dBm C.W. Band 5, Band 8
*4 Frequency = 1710 to 1990MHz, Pin on TRx: +26dBm C.W. Band 1 Tx, Band 2 Tx, Band 3 Tx, Band 4 Tx

(V_{DD} = +2.65V, Vctl = +1.80V, Ta = +25℃)

Item	Symbol	Path	Condition	Min.	Typ.	Max.	Unit
Intermodulation distortion level in Rx band	IMD2	Ant - TRx1, 2, 3, 4	A, B, E, F, I, J	—	—	–105	dBm
	IMD3		C, D, G, H, K, L	—	—	–105	
Input IP2	IIP2	Ant - TRx1, 2, 3, 4	M, N, O, P, R	95.5	—	—	
			Q	113.5	—	—	
Triple beat ratio	TBR	Ant - TRx1, 2, 3, 4	S, T	81	—	—	dBc

Electrical Characteristics are measured with all RF ports terminated in 50Ω.
Measured with the recommended circuit.

IMD Condition

Band	f_{Rx} on TRx	f_{Tx} +20dBm on TRx	$f_{Blocker}$ –15dBm on Ant		IMD condition
Band I	2140MHz	1950MHz	IMD2 ($f_{Rx} - f_{Tx}$)	190MHz	A
			IMD2 ($f_{Rx} + f_{Tx}$)	4090MHz	B
			IMD3 ($2f_{Tx} - f_{Rx}$)	1760MHz	C
			IMD3 ($2f_{Tx} + f_{Rx}$)	6040MHz	D
Band II	1960MHz	1880MHz	IMD2 ($f_{Rx} - f_{Tx}$)	80MHz	E
			IMD2 ($f_{Rx} + f_{Tx}$)	3840MHz	F
			IMD3 ($2f_{Tx} - f_{Rx}$)	1800MHz	G
			IMD3 ($2f_{Tx} + f_{Rx}$)	5720MHz	H
Band V	880MHz	835MHz	IMD2 ($f_{Rx} - f_{Tx}$)	45MHz	I
			IMD2 ($f_{Rx} + f_{Tx}$)	1715MHz	J
			IMD3 ($2f_{Tx} - f_{Rx}$)	790MHz	K
			IMD3 ($2f_{Tx} + f_{Rx}$)	2550MHz	L

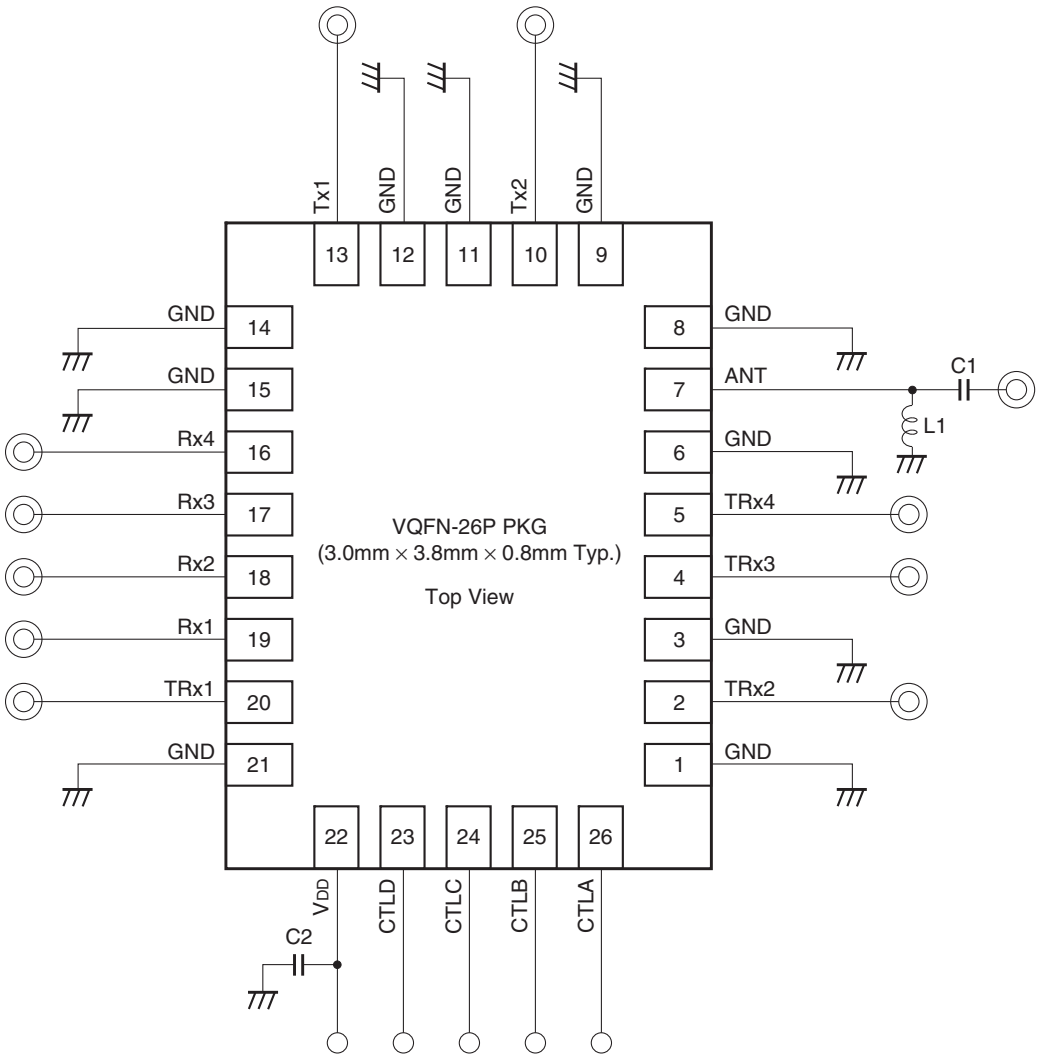
IIP2 Condition

Band	f_{Tx} +24dBm on TRx	$f_{Blocker}$ –20dBm on Ant	IM2 product on TRx		IIP2 condition
Band II	1885MHz	3850MHz	$f_{Blocker} - f_{Tx}$	1965MHz	M
		80MHz	$f_{Blocker} + f_{Tx}$	1965MHz	N
Band IV	1732.5MHz	3865MHz	$f_{Blocker} - f_{Tx}$	2132.5MHz	O
		400MHz	$f_{Blocker} + f_{Tx}$	2132.5MHz	P
Band V	836.61MHz	1718.61MHz	$f_{Blocker} - f_{Tx}$	881.61MHz	Q
		45MHz	$f_{Blocker} + f_{Tx}$	881.61MHz	R

TBR Condition

Band	f_1 +21.5dBm on TRx	f_2 +21.5dBm on TRx	$f_{Blocker}$ –30dBm on Ant	Triple beat product on TRx	TBR condition
Band II	1880MHz	1881MHz	1960MHz	1960 ± 1MHz	S
Band V	835.5MHz	836.5MHz	881.5MHz	881.5 ± 1MHz	T

Recommended Circuit



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.

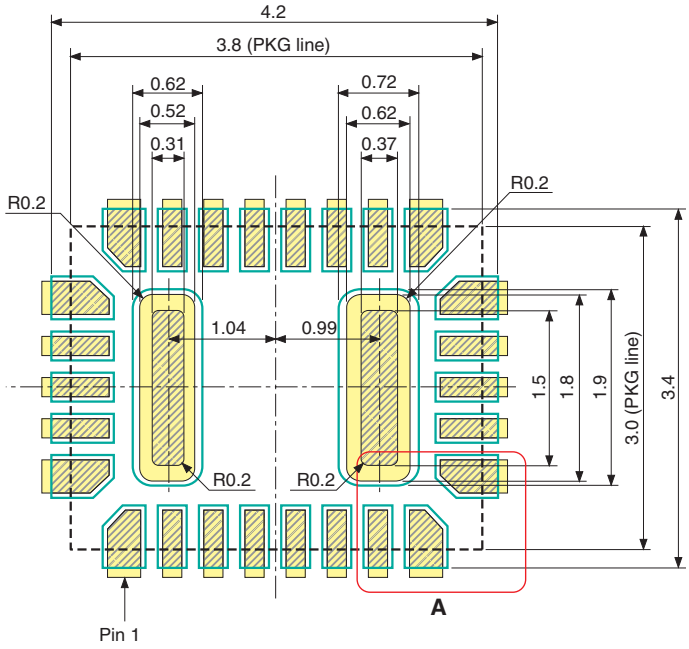
Foot Pattern

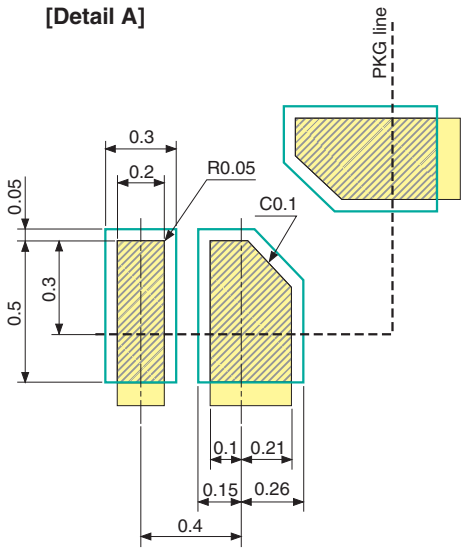
VQFN-26P-01 Macro (Reference)

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

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

* Metal mask thickness: 110µm



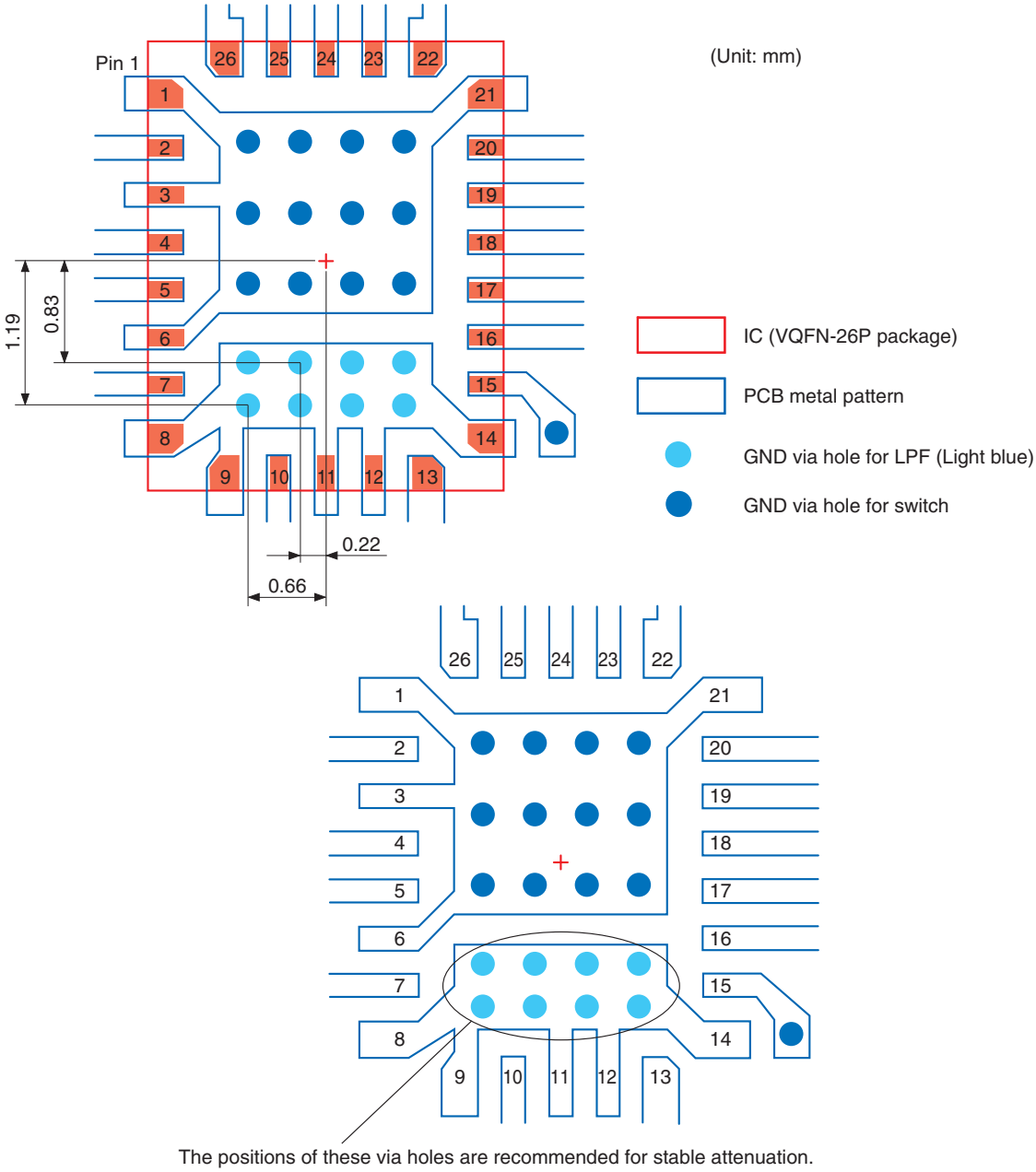


* Mask corner R = 0.05mm

(Unit: mm)

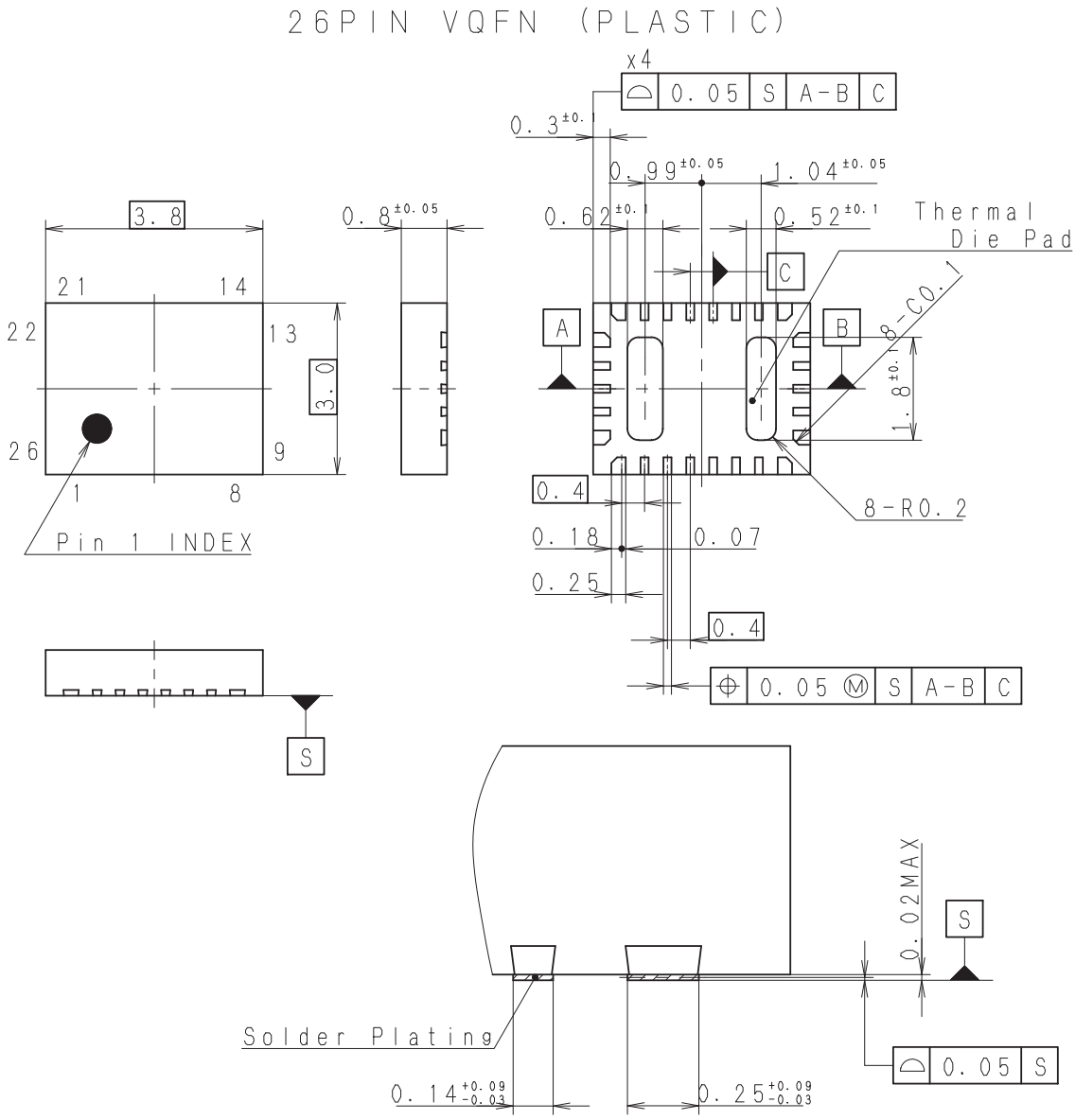
Recommended PCB Design

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



Package Outline

(Unit: mm)



TERMINAL SECTION

Note:Cutting burr of lead are 0.05mm MAX.

PACKAGE STRUCTURE

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

AP-4000-26008S Rev. 0

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

LEAD PLATING SPECIFICATIONS

ITEM	SPEC.
LEAD MATERIAL	COPPER ALLOY
SOLDER COMPOSITION	Sn-Bi Bi:1-4wt%
PLATING THICKNESS	5-18µm