SP6245: SP4T Switch, 2.3 – 4.3 GHz

General Description

The SP6245C is a DC coupled reflective, single-pole, four-throw (SP4T) switch manufactured on silicon semiconductor technology. Application support for single supply operation or negative supply using the Vneg pin.

The SP6245 is suitable for application in 5G infrastructure antenna electronic tilt systems as well as other applications where a high linearity switch is required. It operates from 2300 MHz to 4300 MHz. It maintains very high linearity, high power handling and low insertion loss to minimize reduction of system budget.

As a general purpose switch the part also finds applications in switched filter banks at the front-end of many high performance wireless/radio applications in a number of 3GPP frequency bands.

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Applications

- Cellular wireless infrastructure
- Public safety radios
- Pin diode switch replacement
- General purpose high linearity switching

Features

- Frequency Range of 2300 to 4300 MHz
- P_{AVE} = 40 dBm (LTE, 10 dB PAPR)
- IP3 > 85 dBm
- P0.1dB > 49 dBm
- Insertion Loss typ.
    - 0.4 dB @ 2.6 GHz
    - 0.49 dB @ 3.6 GHz
- Single supply operation
- CMOS logic control compatible
- RoHS compliant 20 pin 4 x 4 mm^2 package

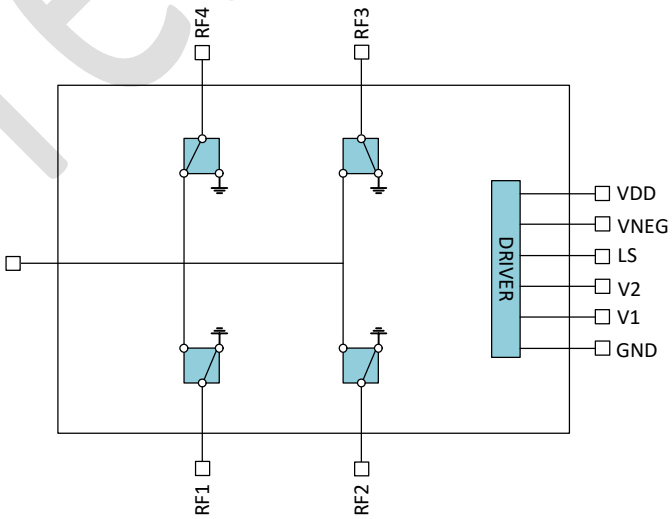

Figure 1 Functional Diagram

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1 Pin Configuration

1.1 Pin Configuration Diagram

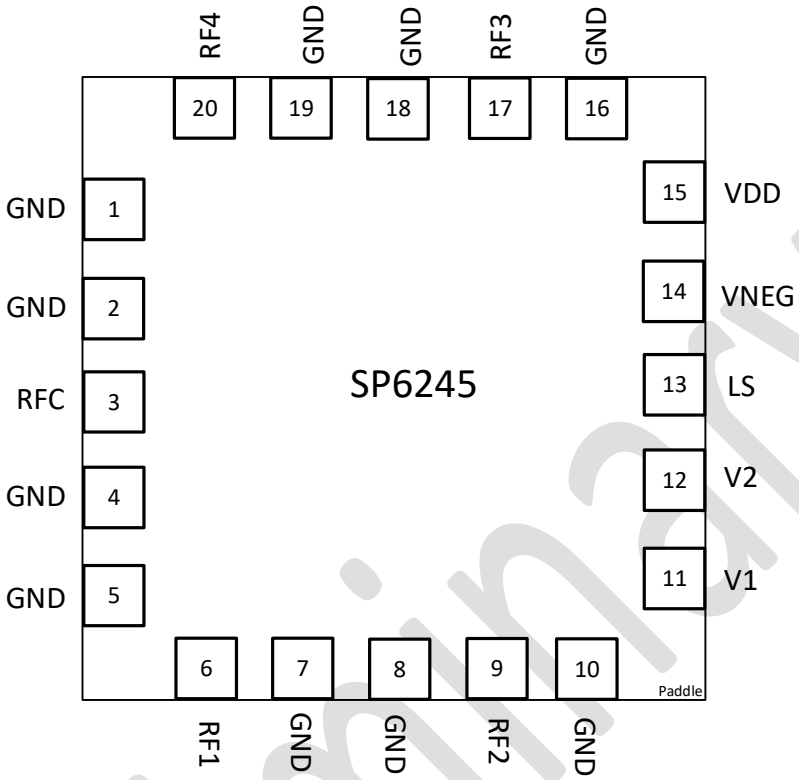


Figure 2 SP6245 Pin Diagram

1.2 Pin Description

Table 1 Pin Description

Pin Name	Pin No	Description
GND	exposed paddle	Ground
GND	1,2,4,5,7, 8,10,16, 18,19	Ground
RFC	3	RF Common Port
RF1	6	RF Switch Port 1
RF2	9	RF Switch Port 2
V1	11	Control Input 1
V2	12	Control Input 2
LS	13	Logic Select
VNEG	14	Connect to GND or -3.3 V depending on use-case (see 3 Theory of Operation)
VDD	15	Supply
RF3	17	RF Switch Port 3
RF4	20	RF Switch Port 4

2 Electrical Specifications

Table 2 Absolute Maximum Ratings

Parameter	Conditions	Symbol	Min		Typ	Max	Units
Supply Voltage			-0.3			5.5	V
Control Pin Input Voltage			-0.3			3.6	V
Peak RF Input Power (RFIN) 5G NR 20MHz						Peak RF power + 1 dB	dBm
Maximum Junction Temperature						TBD	°C
Storage Temperature			-65			150	°C

Table 2 notes:

1) Exceeding absolute maximum ratings may cause permanent damage.
2) Operation should only occur within the limits specified in Table 5 Recommended Operating Conditions
3) Operating between the maximum operating range and the absolute maximum for extended periods may reduce the reliability of the product.

Table 3 Handling Precautions

Observe standard procedures as with other ESD-sensitive devices when handling the product. The product includes ESD protection circuitry, but precautions should be taken not to exceed the ratings specified in this table.

Parameter	Level	Test Standard
ESD voltage HBM, all pins	1 kV	JS-001-2017
ESD voltage CDM, all pins	1 kV	JS-002-2018
Moisture Sensitivity Level	3	J-STD-020E

Table 4 Device Thermal Resistances

Parameter	θjc	Unit
Junction to case top	TBC	°C/W
Junction to case bottom	TBC	°C/W

Table 5 Recommended Operating Conditions

Parameter	Conditions	Symbol	Min	Typ	Max	Units
Supply Voltage (VDD)			4.75	5	5.25	V
Control Input			0		3.3	V
VNEG	Use-case 1		-3.4	-3.3	-3.2	V
	Use-case 2			0		V
RF Input Power, average					40	dBm
RF Input Power, peak (5G NR 20MHz PAPR 10 dB)					50	dBm
Operating Temperature Range (Tcase)			-40		105	°C

Notes:

- Table 5 lists the recommended conditions. The product should not be operated outside these recommended operating conditions.

Table 6 Electrical Characteristics

Vcc=5 V, Tcase=25 °C unless otherwise stated

Parameter	Conditions	Symbol	Min	Typ	Max	Units
Frequency		f	2300		4300	MHz
Insertion Loss @2.6GHz	RFC to RF1-RF4 (ON)	S21		0.40		dB
Insertion loss @ 3.6GHz	RFC to RF1-RF4 (ON)	S21		0.49		dB
Insertion Loss Variation	RFC to RF1-RF4 (ON) in any 100MHz bandwidth	Sx1_Var		0.1		dB
Isolation	RFC to RF1-RF4 (OFF)	S31		35		dB
Input Return Loss	RFC to RF1-RF4 (ON)	S11		25		dB
Output Return Loss	RF1-RF4 to RFC (ON)	S22		25		dB
Cross Talk		Sx		35		dB
Switching Time	From 50% V1, V2 or LS to 0.5 dB of final RF output at new through port output.				2	us
	From 50% V1, V2 or LS to 0.1 dB of final RF output at new through port output.				3	us
Third Order Intercept	Two tone input power = 30 dBm per tone,	IP3		85		dBm
Power at 0.1dB Compression	Pulsed CW (1% duty cycle 100us)	P0.1dB		50		dBm
Digital Control Input Low		VIL	0		0.8	V
Digital Control Input High		VIH	1.2		3.3	V
Digital Control Input Impedance			30			kΩ
Supply Current		ICC		5		mA
VNEG current	Use-case 1			TBD		mA

3 Theory of Operation

Table 7 Truth Table

Digital Control Inputs			RFx Paths			
LS	V1	V2	RF1 to RFC	RF2 to RFC	RF3 to RFC	RF4 to RFC
Low	Low	Low	On	Off	Off	Off
Low	High	Low	Off	On	Off	Off
Low	Low	High	Off	Off	On	Off
Low	High	High	Off	Off	Off	On
High	Low	Low	Off	Off	Off	On
High	High	Low	Off	Off	On	Off
High	Low	High	Off	On	Off	Off
High	High	high	On	Off	Off	Off

The SP6245 has two use-cases, schematics for each are shown in Figure 3 and Figure 4. Use-case 1 requires an external -3.3 V supply on pin 14 (VNEG). Use-case 2 generates negative voltage internally and requires that pin 14 is connected to GND. Optionally, it is possible to switch between use-cases by populating C7 as a 0 Ω link. The recommended decoupling for VDD, VNEG and the 3 logic lines (V1, V2 and LS) is shown in the application schematics. All RF ports are internally matched to 50 Ω, internally AC coupled and do not require external decoupling.

Table 7 shows the truth table for the SP6245, where 'On' means the common port (RFC) is connected to one of the ports RF1, RF2, RF3 or RF4. 'Off' means that the common port is isolated from all but the connected port. An integrated logic driver allows the SP6245 to be compatible with Low Voltage CMOS and Low Voltage TTL control interfaces.

LS control inverts the sense of the V1 & V2. This allows a pair of SP6245 to be connected 'back-to-back' using a common V1 & V2 control. This facility is of benefit in applications such as antenna phase shifters.

3.1 Bias Sequence

To use the device, apply signals in the following order:

1) Ground
2) VDD
3) VNEG
4) V1, V2, LS
5) RF

Reverse the sequence for power down.

4 Schematic Diagram

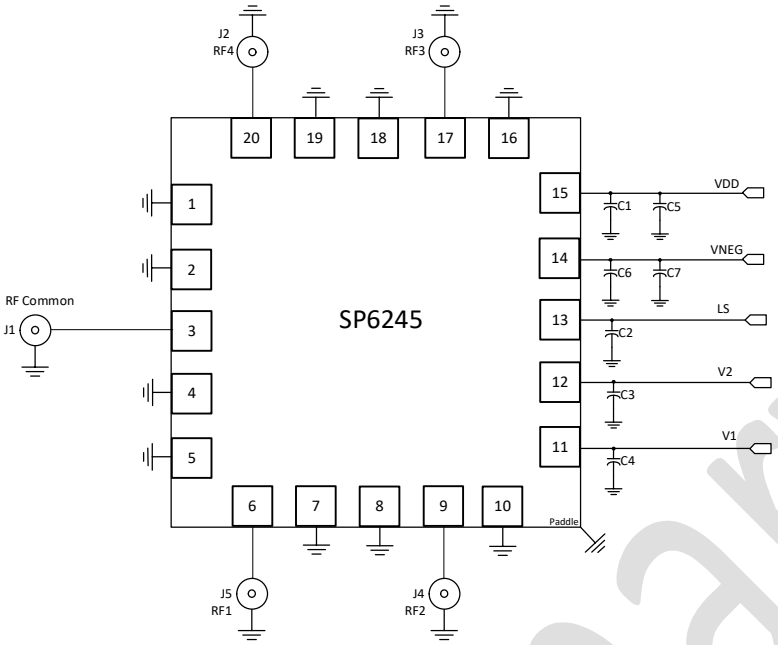


Figure 3 Schematic Diagram – Use-case 1

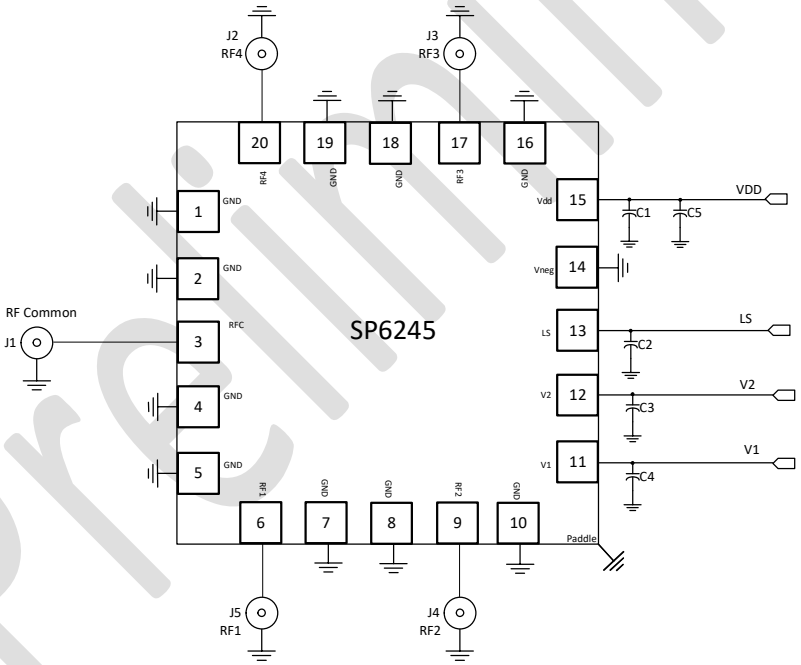
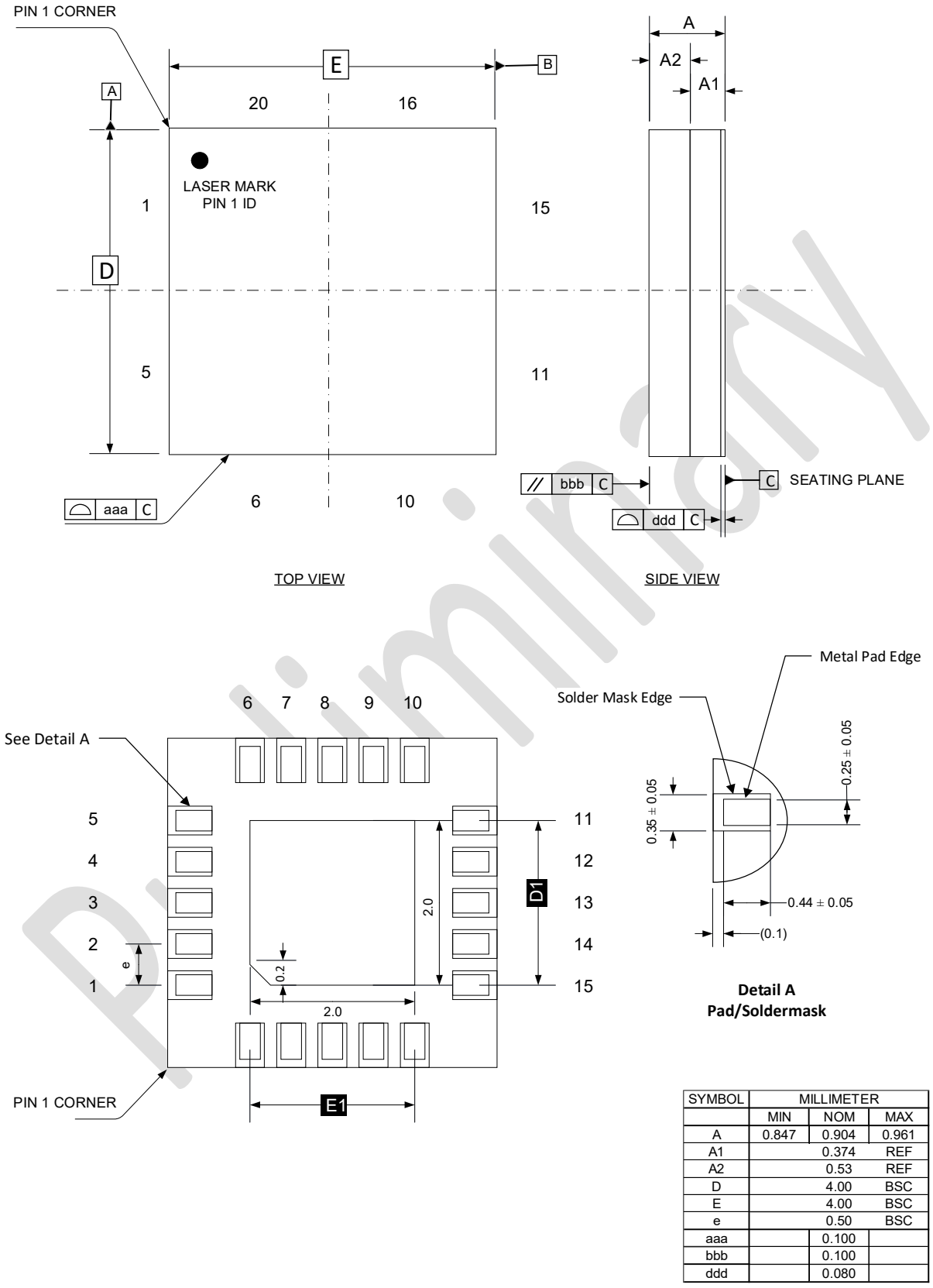


Figure 4 Schematic Diagram – Use-case 2

Table 8 Bill of Materials

Reference Designator	Part Value	Part Number	Mfr
J1, J2, J3, J4, J5	SMA female	142-0701-851	Johnson/Cinch
C1, C2, C3, C4, C6	100pF C0G	GCM1555C1H101JA16D	MuRata
C5, C7	4.7uF X7S	GRM219C81C475KA73D	MuRata

5 Package Information



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.847	0.904	0.961
A1		0.374	REF
A2		0.53	REF
D		4.00	BSC
E		4.00	BSC
e		0.50	BSC
aaa		0.100	
bbb		0.100	
ddd		0.080	

Figure 5 Package Dimensions

6 Recommended PCB Footprint

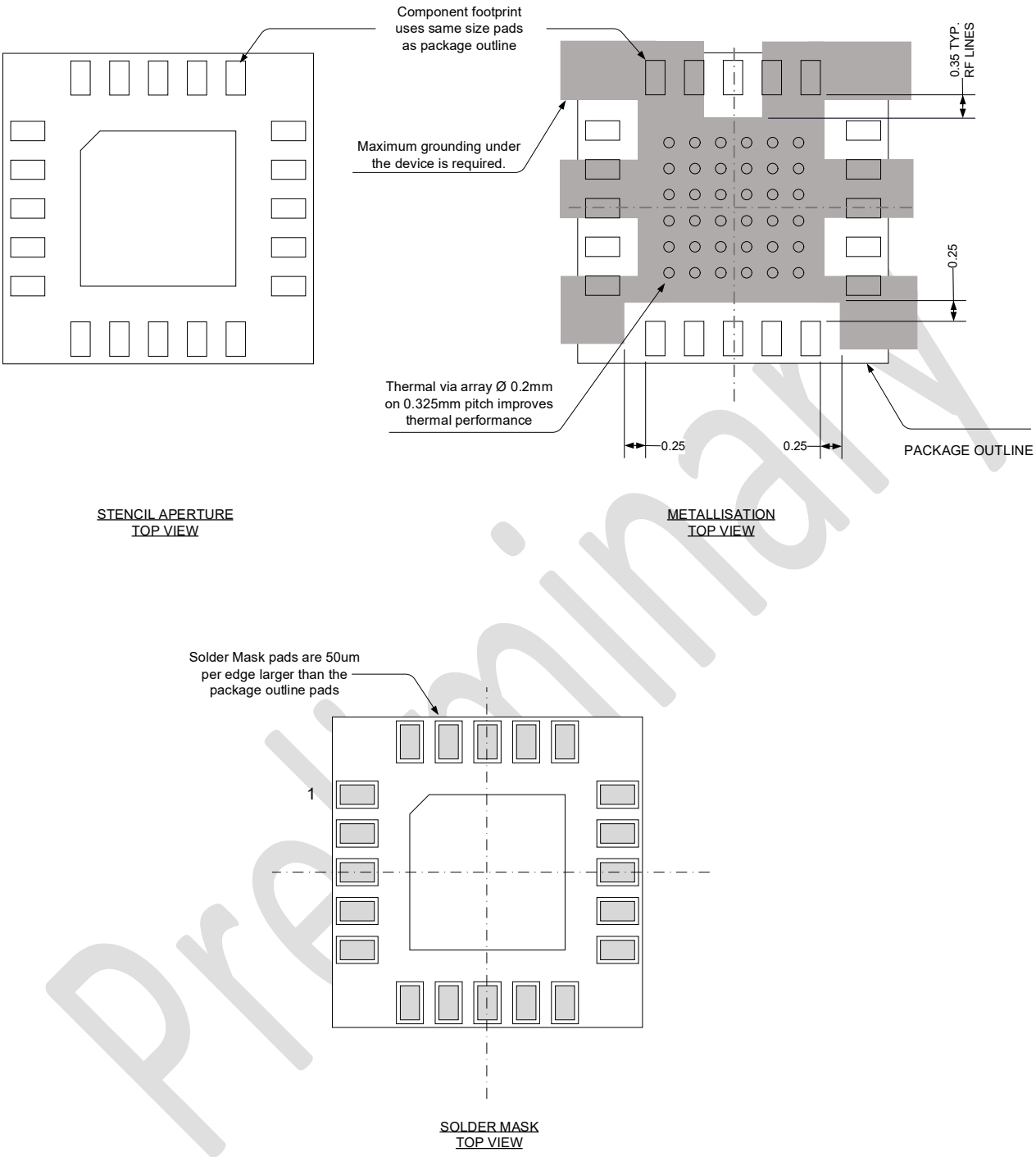


Figure 6 Recommended PCB Footprint Detail

7 Tape and Reel Information

TBC

8 Part Markings

TBC

9 Ordering Information

Table 9 Ordering Information

Ordering Part Number (OPN)	Marking	Package	Shipping Package	Temperature Range
TBC			Tape and Reel	-

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