

DATA SHEET

SKY18120-11: 0.4-2.7 GHz SP9T Antenna Switch Module With GSM Transmit Filters

Applications

- Dual-mode, multi-band handsets and data cards (GSM/EDGE, Quad/UMTS or LTE dual mode)
- Low-cost, ultra-small footprint embedded modules

Features

- Supports quad-band GSM, tri-band UMTS, LTE, or TD-SCDMA
- Low insertion loss:
 - 1.1 dB @ 1 GHz GSM transmit
 - 0.8 dB @ 1 GHz GSM receive
 - 1.1 dB @ 2 GHz GSM receive
 - 0.7 dB @ 2 GHz UMTS transmit
- Good 2nd/3rd harmonic performance:
 - -52/-52 dBm @ P_{IN} = +35 dBm (2G low-band transmit)
 - -67/-60 dBm @ P_{IN} = +32 dBm (2G high-band transmit)
- State-of-the-art SOI process with GPIO logic
- Ultra-small MCM (16-pin, 2.5 x 2.5 mm) package (MSL3, 260 °C per JEDEC J-STD-020)



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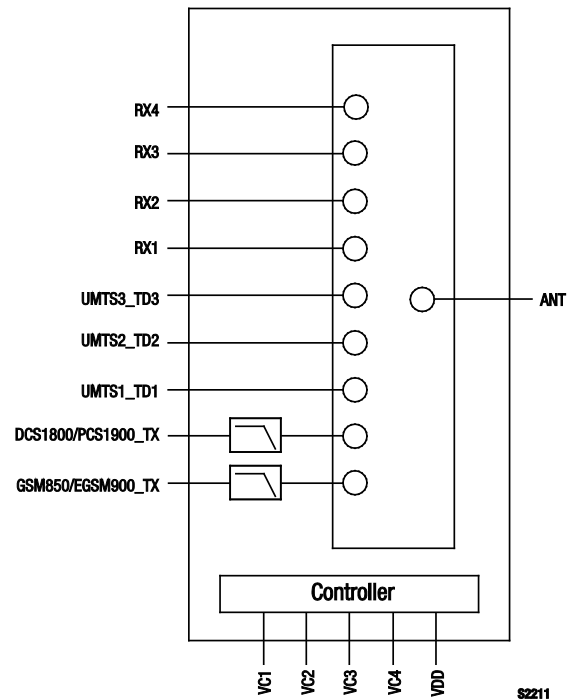


Figure 1. SKY18120-11 Block Diagram

Description

The SKY18120-11 is a Single Pole, Nine-Throw (SP9T) antenna switch Front-End Module (FEM) designed for dual-mode, high power band switching applications that require low harmonics and low insertion loss. The device is optimized for GSM/EDGE, TD-SCDMA, and WCDMA/LTE applications.

The SKY18120-11 consists of an SP9T switch, GSM transmit signal low-pass harmonic filters, and a GPIO controller. The low current consumption makes this device very suitable for battery operated applications.

The SKY18120-11 is manufactured in a compact, 2.5 x 2.5 mm, 16-pin Multi-Chip Module (MCM) package.

A functional block diagram is shown in Figure 1. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

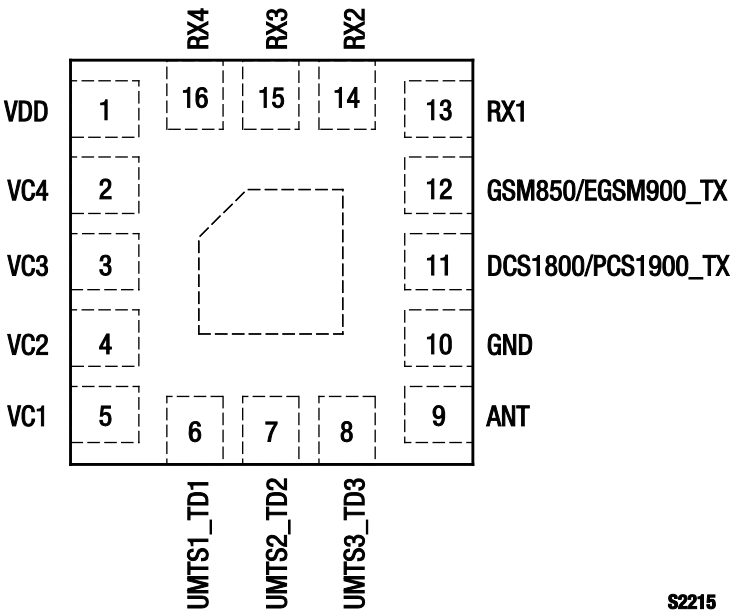


Figure 2. SKY18120-11 Pinout – 16-Pin MCM
(Top View)

Table 1. SKY18120-11 Signal Descriptions

Pin #	Name	Description	Pin #	Name	Description
1	VDD	Supply voltage	9	ANT	Antenna
2	VC4	Antenna switch control logic pin	10	GND	Ground
3	VC3	Antenna switch control logic pin	11	DCS1800/PCS1900_TX	RF input for DCS1800/PCS1900 transmit
4	VC2	Antenna switch control logic pin	12	GSM850/EGSM900_TX	RF input for GSM850/EGSM900 transmit
5	VC1	Antenna switch control logic pin	13	RX1	RF output for GSM receive
6	UMTS1_TD1	RF input/output for UMTS transmit/receive	14	RX2	RF output for GSM receive
7	UMTS2_TD2	RF input/output for UMTS transmit/receive	15	RX3	RF output for GSM receive
8	UMTS3_TD3	RF input/output for UMTS transmit/receive	16	RX4	RF output for GSM receive

Note: Bottom ground paddles must be connected to ground.

Table 2. SKY18120-11 Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V _{DD}	2.65	3.30	V
Control voltage	V _{CTRL}	1.55	3.30	V
RF input power: GSM850/EGSM900 transmit DCS1800/PCS1900 transmit UMTS transmit All receive ports	P _{IN}		+36 (Note 2) +33 (Note 2) +30 +13	dBm dBm dBm dBm
Operating temperature	T _{OP}	−35	+85	°C
Storage temperature	T _{STG}	−60	+150	°C

Note 1: Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

Note 2: 12.5% to 50% duty cycle.

CAUTION: Although this device is designed to be as robust as possible, Electrostatic Discharge (ESD) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.

Functional Description

The SKY18120-11 SP9T Antenna Switch Module can operate in one of nine states when the VDD signal is high. These states are controlled by the VC1 to VC4 pin signals.

Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY18120-11 are provided in Table 2. Electrical specifications are provided in Table 3.

The state of the SKY18120-11 is determined by the logic shown in Table 4.

Table 3. SKY18120-11 General Electrical Specifications (Note 1) (1 of 4)**(V_{DD} = 2.8 V, T_{OP} = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition (Note 2)	Min	Typical	Max	Units
Insertion Loss						
GSM850/EGSM900_TX pin to ANT pin	IL	824 to 915 MHz (NTC) 824 to 915 MHz (ETC)		1.12 1.21	1.30 1.50	dB dB
DCS1800/PCS1900_TX pin to ANT pin	IL	1710 to 1910 MHz (NTC), 1710 to 1910 MHz (ETC)		1.12 1.23	1.40 1.60	dB dB
ANT pin to RX1 to RX4 pins	IL	869 to 960 MHz (NTC), 869 to 960 MHz (ETC) 1805 to 1990 MHz (NTC), 1805 to 1990 MHz (ETC)		0.79 0.88 1.08 1.19	1.20 1.40 1.40 1.60	dB dB dB dB
UMTS_TD1/TD2/TD3 pins to ANT pin	IL	700 to 960 MHz (NTC), 700 to 960 MHz (ETC) 1710 to 1920 MHz (NTC), 1710 to 1920 MHz (ETC) 2010 to 2700 MHz (NTC) 2010 to 2700 MHz (ETC)		0.48 0.55 0.72 0.81 0.80 0.90	1.00 1.20 1.20 1.40 1.30 1.50	dB dB dB dB dB dB
Harmonic Attenuation						
GSM850/EGSM900_TX pin to ANT pin, 2 nd harmonics	2fo	1648 to 1698 MHz, 1760 to 1830 MHz	25 25	37 31		dB dB
GSM850/EGSM900_TX pin to ANT pin, 3 rd harmonics	3fo	2472 to 2547 MHz, 2640 to 2745 MHz	25 25	28 31		dB dB
DCS1800/PCS1900_TX pin to ANT pin, 2 nd harmonics	2fo	3420 to 3820 MHz	25	33		dB
DCS1800/PCS1900_TX pin to ANT pin, 3 rd harmonics	3fo	5130 to 5730 MHz	25	28		dB
Isolation						
GSM850/EGSM900_TX pin to RX1 pin GSM850/EGSM900_TX pin to RX2 pin GSM850/EGSM900_TX pin to RX3 pin GSM850/EGSM900_TX pin to RX4 pin	Iso	824 to 915 MHz	25.0 25.0 30.0 30.0	30.4 36.7 42.8 44.5		dB dB dB dB
GSM850/EGSM900_TX pin to ANT pin	Iso	GSM receive mode, 824 to 915 MHz	20.0	26.4		dB
DCS1800/PCS1900_TX pin to RX1 pin DCS1800/PCS1900_TX pin to RX2 pin DCS1800/PCS1900_TX pin to RX3 pin DCS1800/PCS1900_TX pin to RX4 pin DCS1800/PCS1900_TX pin to ANT pin	Iso	1710 to 1910 MHz GSM receive mode	25.0 25.0 30.0 30.0 20.0	31.8 36.4 35.9 40.2 24.3		dB dB dB dB dB
UMTS1_TD1 pins to RX1 pin UMTS1_TD1 pins to RX2 pin UMTS1_TD1 pins to RX3 pin UMTS1_TD1 pins to RX4 pin	Iso	700 to 960 MHz, UMTS1_TD1 mode	30.0 30.0 30.0 30.0	51.0 56.0 57.2 52.7		dB dB dB dB
UMTS1_TD1 pins to RX1 pin UMTS1_TD1 pins to RX2 pin UMTS1_TD1 pins to RX3 pin UMTS1_TD1 pins to RX4 pin	Iso	1710 to 2170 MHz, UMTS1_TD1 mode	25.0 25.0 30.0 30.0	41.7 42.2 44.5 41.1		dB dB dB dB
UMTS1_TD1 pins to RX1 pin UMTS1_TD1 pins to RX2 pin UMTS1_TD1 pins to RX3 pin UMTS1_TD1 pins to RX4 pin	Iso	2170 to 2700 MHz, UMTS1_TD1 mode	30 30 30 30	40 40 40 40		dB dB dB dB

Table 3. SKY18120-11 General Electrical Specifications (Note 1) (2 of 4)**(V_{DD} = 2.8 V, T_{OP} = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition (Note 2)	Min	Typical	Max	Units
Isolation (continued)						
UMTS2_TD2 pins to RX1 pin	Iso	700 to 960 MHz, UMTS2_TD2 mode	30.0	51.9		dB
UMTS2_TD2 pins to RX2 pin			30.0	56.2		dB
UMTS2_TD2 pins to RX3 pin			30.0	58.1		dB
UMTS2_TD2 pins to RX4 pin			30.0	55.2		dB
UMTS2_TD2 pins to RX1 pin	Iso	1710 to 2170 MHz, UMTS2_TD2 mode	25.0	41.6		dB
UMTS2_TD2 pins to RX2 pin			25.0	43.6		dB
UMTS2_TD2 pins to RX3 pin			30.0	46.3		dB
UMTS2_TD2 pins to RX4 pin			30.0	44.6		dB
UMTS2_TD2 pins to RX1 pin	Iso	2170 to 2700 MHz, UMTS2_TD2 mode	30	40		dB
UMTS2_TD2 pins to RX2 pin			30	40		dB
UMTS2_TD2 pins to RX3 pin			30	40		dB
UMTS2_TD2 pins to RX4 pin			30	40		dB
UMTS3_TD3 pins to RX1 pin	Iso	700 to 960 MHz, UMTS3_TD3 mode	30.0	54.2		dB
UMTS3_TD3 pins to RX2 pin			30.0	56.6		dB
UMTS3_TD3 pins to RX3 pin			30.0	58.0		dB
UMTS3_TD3 pins to RX4 pin			30.0	56.8		dB
UMTS3_TD3 pins to RX1 pin	Iso	1710 to 2170 MHz, UMTS3_TD3 mode	25.0	41.4		dB
UMTS3_TD3 pins to RX2 pin			25.0	43.9		dB
UMTS3_TD3 pins to RX3 pin			30.0	47.3		dB
UMTS3_TD3 pins to RX4 pin			30.0	46.4		dB
UMTS3_TD3 pins to RX1 pin	Iso	2170 to 2700 MHz, UMTS3_TD3 mode	30	37		dB
UMTS3_TD3 pins to RX2 pin			30	37		dB
UMTS3_TD3 pins to RX3 pin			30	37		dB
UMTS3_TD3 pins to RX4 pin			30	37		dB
UMTS1_TD1 pin to UMTS2_TD2 pin	Iso	700 to 960 MHz, UMTS1_TD1 mode	25.0	31.1		dB
UMTS1_TD1 pin to UMTS3_TD3 pin			25.0	40.2		dB
UMTS1_TD1 pin to UMTS2_TD2 pin	Iso	1710 to 2170 MHz, UMTS1_TD1 mode	15.0	22.3		dB
UMTS1_TD1 pin to UMTS3_TD3 pin			15.0	28.6		dB
UMTS1_TD1 pin to UMTS2_TD2 pin	Iso	2170 to 2700 MHz, UMTS1_TD1 mode	15	19		dB
UMTS1_TD1 pin to UMTS3_TD3 pin			15	24		dB
UMTS2_TD2 pin to UMTS1_TD1 pin	Iso	700 to 960 MHz, UMTS2_TD2 mode	25.0	31.8		dB
UMTS2_TD2 pin to UMTS3_TD3 pin			25.0	36.0		dB
UMTS2_TD2 pin to UMTS1_TD1 pin	Iso	1710 to 2170 MHz, UMTS2_TD2 mode	15.0	23.9		dB
UMTS2_TD2 pin to UMTS3_TD3 pin			15.0	24.1		dB
UMTS2_TD2 pin to UMTS1_TD1 pin	Iso	2170 to 2700 MHz, UMTS2_TD2 mode	15	20		dB
UMTS2_TD2 pin to UMTS3_TD3 pin			15	19		dB
UMTS3_TD3 pin to UMTS1_TD1 pin	Iso	700 to 960 MHz, UMTS3_TD3 mode	25.0	38.5		dB
UMTS3_TD3 pin to UMTS2_TD2 pin			25.0	31.9		dB
UMTS3_TD3 pin to UMTS1_TD1 pin	Iso	1710 to 2170 MHz, UMTS3_TD3 mode	15.0	29.9		dB
UMTS3_TD3 pin to UMTS2_TD2 pin			15.0	23.6		dB
UMTS3_TD3 pin to UMTS1_TD1 pin	Iso	2170 to 2700 MHz, UMTS3_TD3 mode	15	26		dB
UMTS3_TD3 pin to UMTS2_TD2 pin			15	20		dB

Table 3. SKY18120-11 General Electrical Specifications (Note 1) (3 of 4)**(V_{DD} = 2.8 V, T_{OP} = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition (Note 2)	Min	Typical	Max	Units
Voltage Standing Wave Ratio (VSWR)						
Input VSWR @ GSM850/EGSM900_TX pin	VSWR	824 to 915 MHz, GSM850/EGSM900_TX mode		1.2:1	1.6:1	–
Output VSWR @ ANT pin	VSWR	824 to 915 MHz, GSM850/EGSM900_TX mode		1.4:1	1.6:1	–
Input VSWR @ DCS1800/PCS1900_TX pin	VSWR	1710 to 1910 MHz, DCS1800/PCS1900_TX mode		1.2:1	1.7:1	–
Output VSWR @ ANT pin	VSWR	1710 to 1910 MHz, DCS1800/PCS1900_TX mode		1.4:1	1.7:1	–
Input VSWR @ ANT pin	VSWR	GSM receive mode: 869 to 960 MHz 1805 to 1990 MHz		1.3:1 1.3:1	1.7:1 1.7:1	– –
Output VSWR @ RX1/2/3/4 pins	VSWR	GSM receive mode: 869 to 960 MHz 1805 to 1990 MHz		1.3:1 1.3:1	1.7:1 1.7:1	– –
Input VSWR @ ANT pin	VSWR	UMTS/TD mode: 824 to 960 MHz 1710 to 2170 MHz		1.2:1 1.2:1	1.6:1 1.6:1	– –
Output VSWR @ UMTS1/2/3_TD1/2/3 pins	VSWR	UMTS/TD mode: 824 to 960 MHz 1710 to 2170 MHz		1.2:1 1.2:1	1.6:1 1.6:1	– –
Operating Modes and Current Consumption						
GSM850/EGSM900 transmit	I _{CC}			25	50	μA
DCS1800/PCS1900 transmit	I _{CC}			25	50	μA
TD-SCDMA transmit	I _{CC}			25	50	μA
GSM receive	I _{CC}			25	50	μA
TD-SCDMA receive	I _{CC}			25	50	μA
Control current	I _{CTRL}			1.5	20.0	μA
Switching Time						
Rise/fall		50% V _{CTRL} to 90% RF		2.5	5.0	μs

Table 3. SKY18120-11 General Electrical Specifications (Note 1) (4 of 4)**(V_{DD} = 2.8 V, T_{OP} = +25 °C, Characteristic Impedance [Z₀] = 50 Ω, Unless Otherwise Noted)**

Parameter	Symbol	Test Condition (Note 2)	Min	Typical	Max	Units
Harmonic Power						
GSM850/EGSM900_TX pin to ANT pin		1648 to 1830 MHz, P _{IN} = +35 dBm		-52	-35	dBm
		2472 to 2745 MHz, P _{IN} = +35 dBm		-52	-35	dBm
DCS1800/PCS1900_TX pin to ANT pin		3420 to 3820 MHz, P _{IN} = +32 dBm		-67	-35	dBm
		5130 to 5730 MHz P _{IN} = +32 dBm		-60	-35	dBm
UMTSx_TDx pins to ANT pin		1648 to 1698 MHz, P _{IN} = +26 dBm		-62	-34	dBm
		2472 to 2547 MHz, P _{IN} = +26 dBm		-60	-34	dBm
		3700 to 3960 MHz, P _{IN} = +26 dBm		-62	-34	dBm
		5550 to 5940 MHz, P _{IN} = +26 dBm		-60	-34	dBm

Note 1: Performance is guaranteed only under the conditions listed in this Table.**Note 2:** NTC = Normal test conditions (T_A = 25 °C, V_{DD} = 2.8 V).ETC = Extreme test conditions (T_A = -35 °C to +85 °C, V_{DD} = 2.65 to 3.30 V).**Table 4. SKY18120-11 Control Logic**

Pin/Mode	VC1 (Pin 5)	VC2 (Pin 4)	VC3 (Pin 3)	VC4 (Pin 2)
GSM850/EGSM900_TX	High	Low	Low	High
DCS1800/PCS1900_TX	High	Low	Low	Low
RX1	Low	High	Low	High
RX2	Low	High	Low	Low
RX3	Low	Low	Low	High
RX4	Low	Low	Low	Low
UMTS1_TD1	Low	Low	High	Low
UMTS2_TD2	Low	Low	High	High
UMTS3_TD3	Low	High	High	Low

Note 1: "High" = 1.8 V; "Low" = 0 V. Any state other than that described in this Table places the switch into an undefined state. An undefined state will not damage the device.

Evaluation Board Description

The SKY18120-11 Evaluation Board is used to test the performance of the SKY18120-11 SP9T Antenna Switch Module. An Evaluation Board schematic diagram is provided in Figure 3. Table 5 provides the Bill of Materials (BOM) list for Evaluation Board components. An assembly drawing for the Evaluation Board is shown in Figure 4.

Package Dimensions

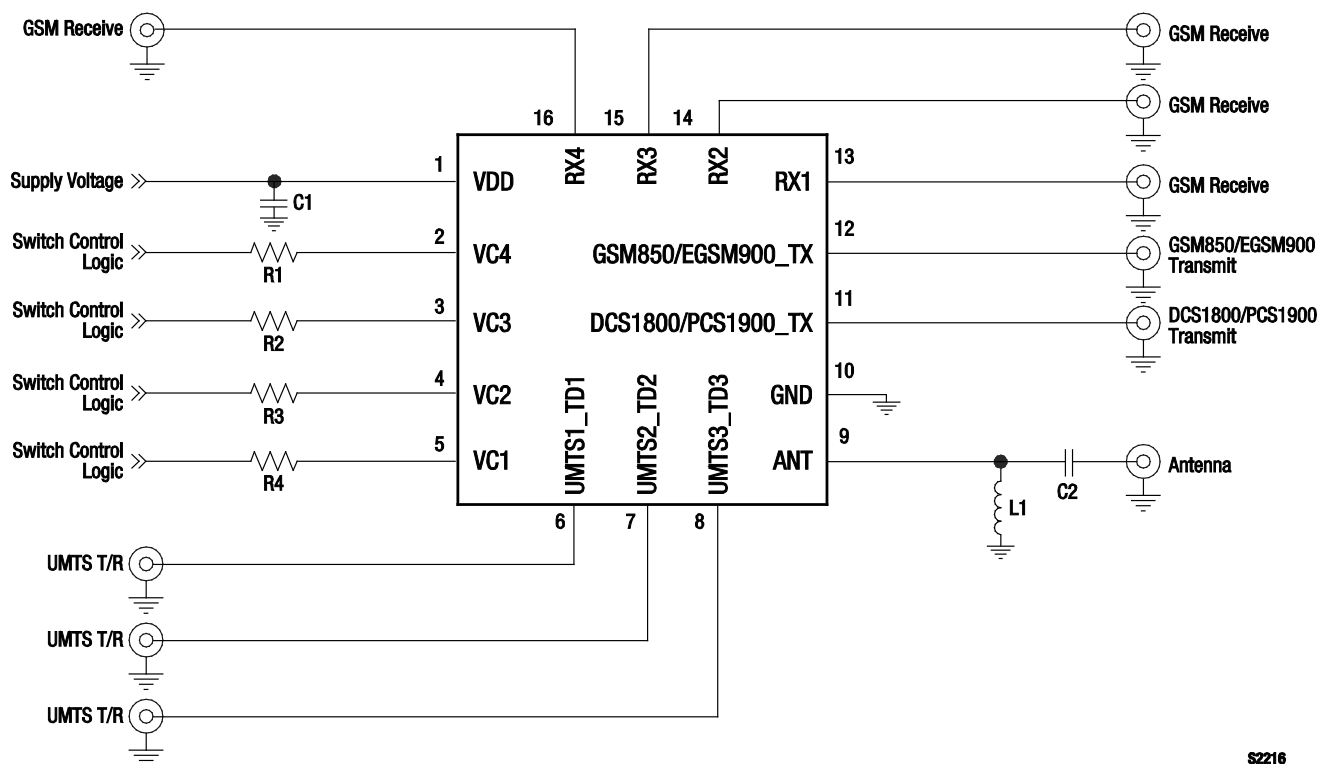
The PCB layout footprint for the SKY18120-11 is provided in Figure 5. Typical case markings are shown in Figure 6. Package dimensions for the 16-pin MCM are shown in Figure 7, and tape and reel dimensions are provided in Figure 8.

Package and Handling Information

Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

THE SKY18120-11 is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *PCB Design & SMT Assembly/Rework Guidelines for MCM-L Packages*, document number 101752.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.

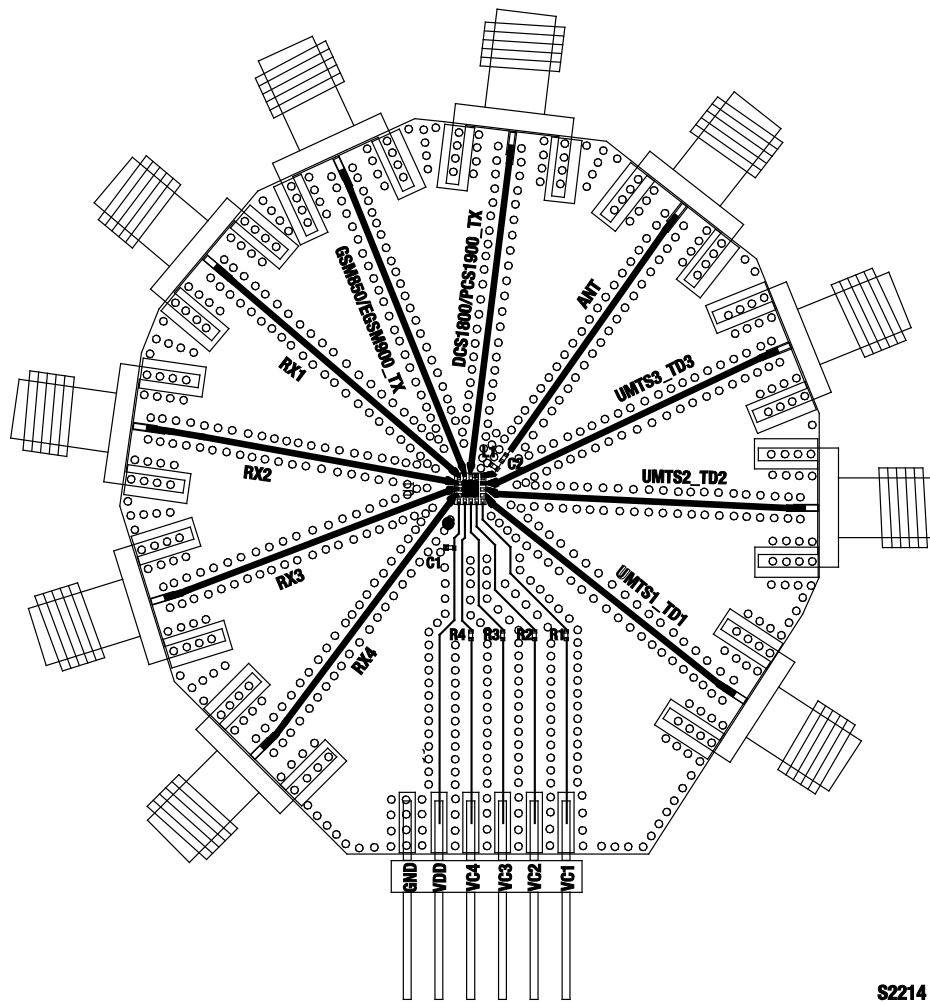


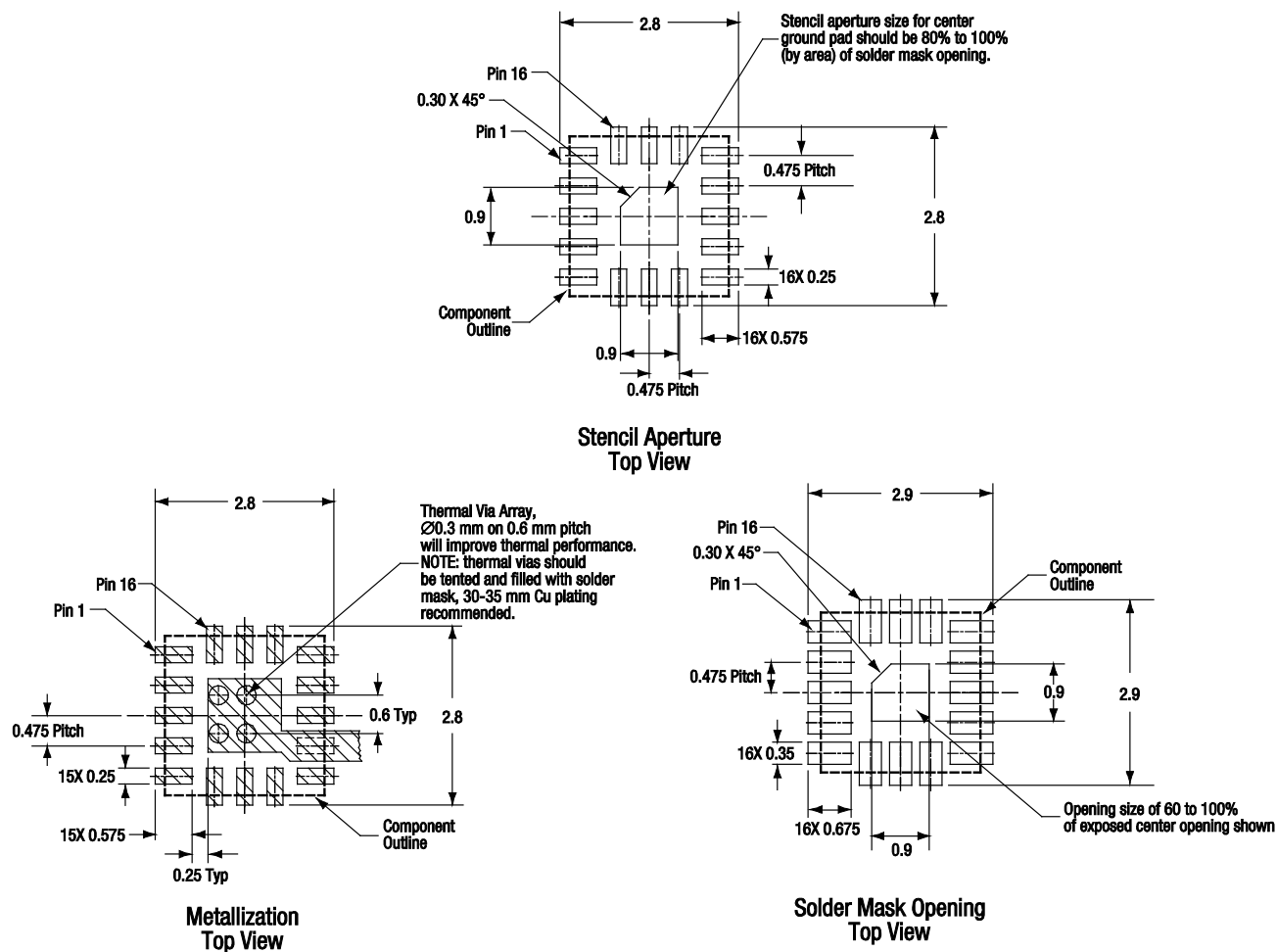
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Figure 3. SKY18120-11 Evaluation Board Schematic

Table 5. SKY18120-11 Evaluation Board Bill of Materials

Component	Value	Size
C1	100 nF	0201
C2	10 pF	0201
L1	18 nH	0201
R1	1.3 k Ω	0201
R2	1.3 k Ω	0201
R3	1.3 k Ω	0201
R4	1.3 k Ω	0201

**Figure 4. SKY18120-11 Evaluation Board Assembly Diagram**



All dimensions are in millimeters

S2212

Figure 5. SKY18120-11 PCB Layout Footprint (Top View)

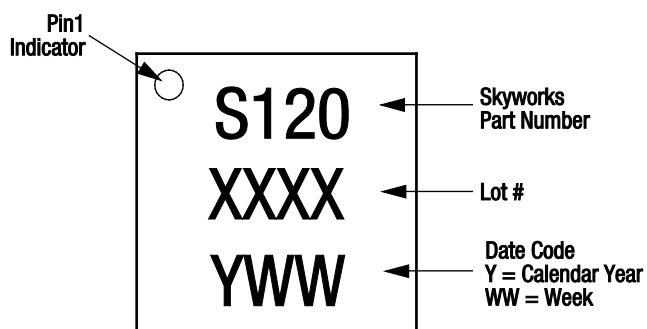
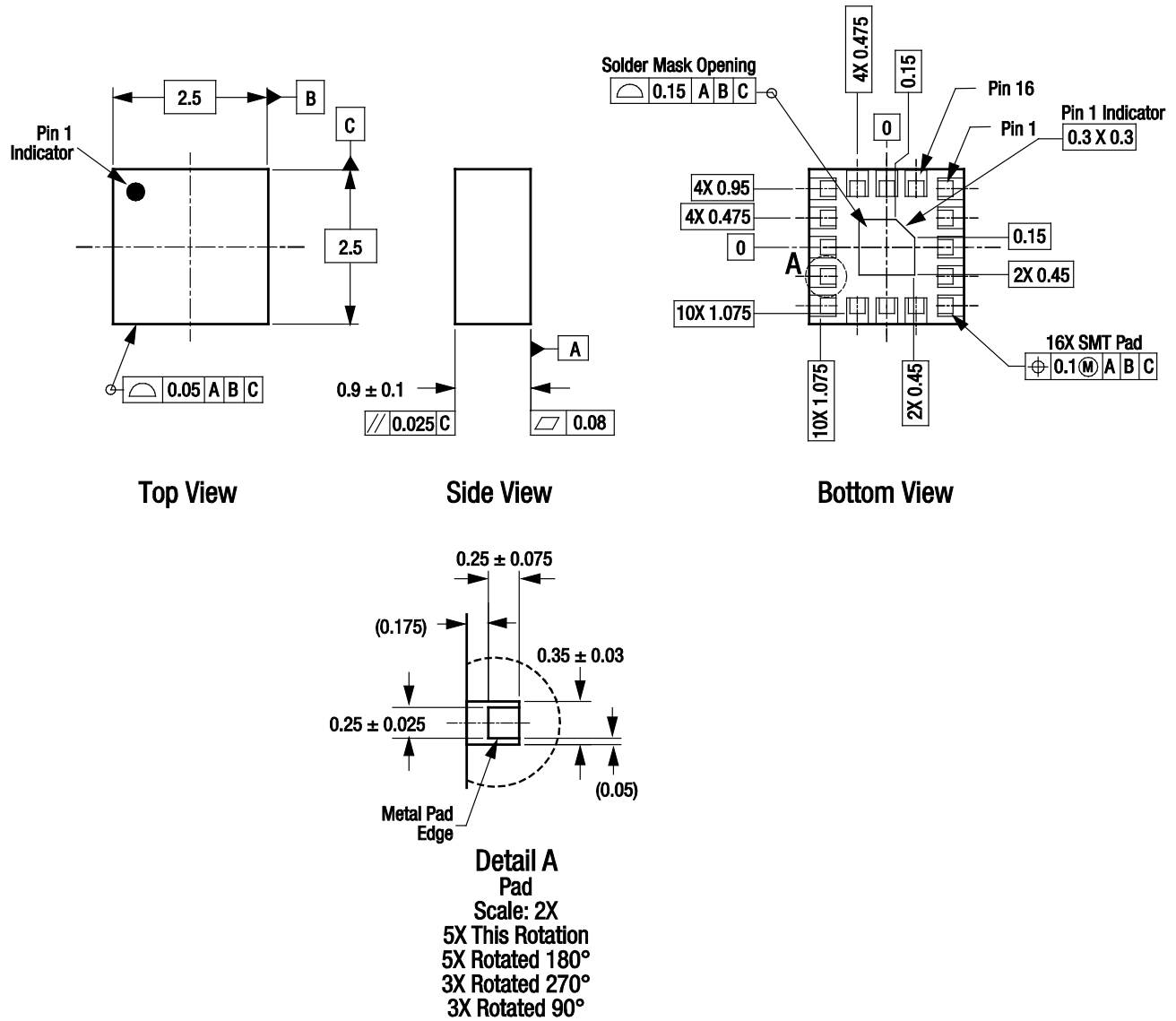


Figure 6. Typical Part Markings (Top View)

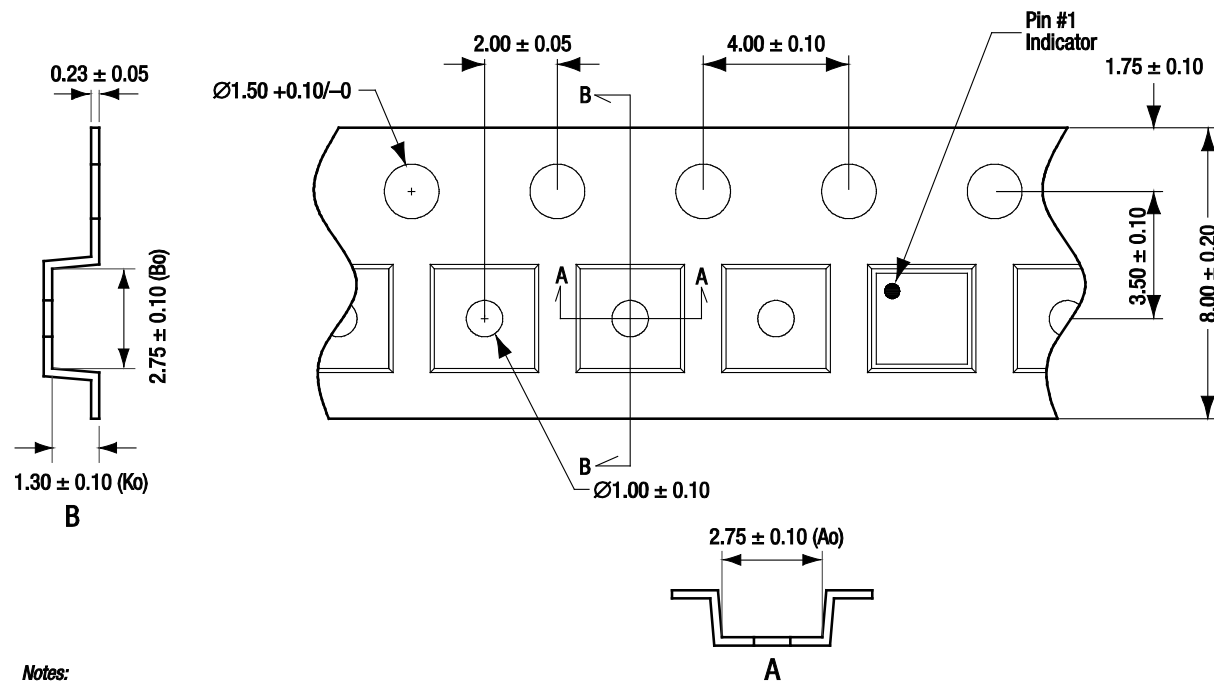


Dimensioning and tolerancing according to ASME Y14.5M-1994

All measurements are in millimeters

S2316a

Figure 7. SKY18120-11 16-Pin MCM Package Dimensions



Notes:

1. Carrier tape: black conductive polycarbonate.
2. Cover tape material: transparent adhesive material.
3. ESD-surface resistivity is from $\geq 1 \times 10^5$ Ohms/square to $\leq 1 \times 10^8$ Ohms/square per EIA, JEDEC TNR Specification.
4. 10 sprocket hole pitch cumulative tolerance: ± 0.20 mm
5. Ao and Bo measured on plane 0.30 mm above the bottom of the pocket.
6. All measurements are in millimeters.

\$2730

Figure 8. SKY18120-11 Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
SKY18120-11 0.7-2.7 GHz SP9T Antenna Switch Module With GSM Transmit Filters	SKY18120-11	EN31-D858-003

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