

DATA SHEET

# SKY13642-485LF: 5 MHz to 1.5 GHz Ultra-High-Linearity SP6T 75 Ω Switch

## Applications

- Cable modems
- Set-top boxes
- Filter band switching
- Relay/replacement to switch between DOCSIS 3.0 and DOCSIS 3.1 configurations

## Features

- Ultra-high-linearity performance:
  - CTB <-100 dBc
  - CSO <-100 dBc
- Low insertion loss: 0.45 dB typical @ 1.5 GHz
- High isolation: >28 dB @ 1.5 GHz
- No external DC blocking capacitors required
- DC supply voltage: 2.5 V to 4.8 V
- Integrated logic
- Small QFN (14-pin, 2.0 x 2.0 mm) package (MSL1, 260 °C per JEDEC J-STD-020)

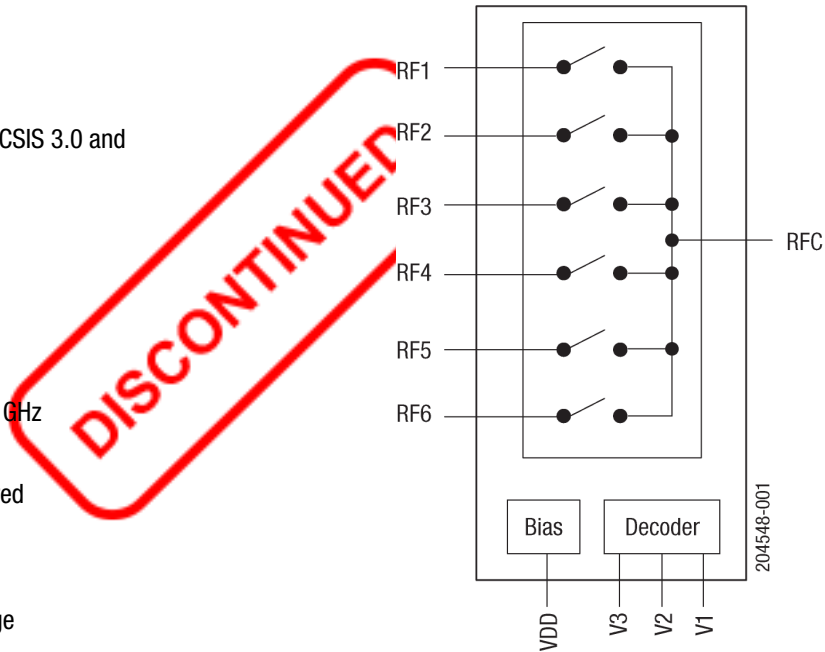


Figure 1. SKY13642-485LF Block Diagram



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## Description

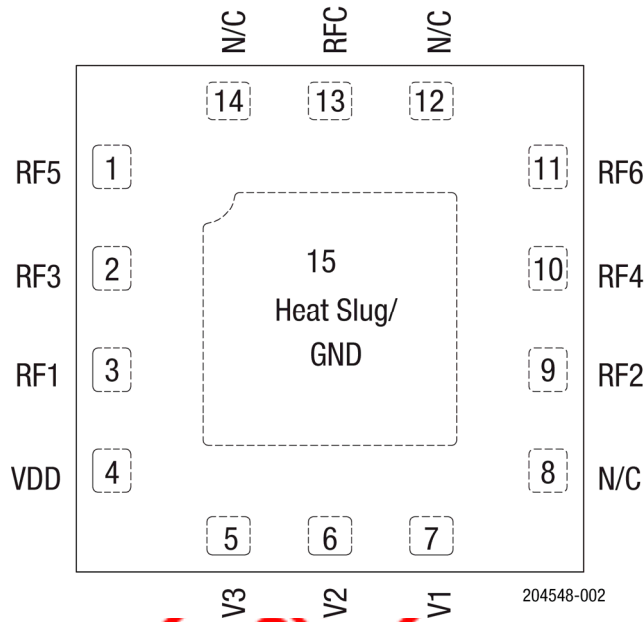
The SKY13642-485LF is a single pole, six-throw (SP6T) 75 Ω switch. The high-linearity performance and low insertion loss of the SKY13642-485LF meet the most stringent requirements of DOCSIS 3.1 applications.

The SKY13642-485LF is a "reflective short" on the isolated port.

Switching is controlled by three CMOS/TTL-compatible control voltage inputs (V1, V2, and V3). Depending on the logic voltage level applied to the control pins, the RFC pin is connected to one of six switched RF outputs (RF1 to RF6) using a low insertion loss path, while the paths between the RFC pin and the other RF pins are in a high isolation state. No external blocking capacitors are required on the RF paths unless VDC is externally applied.

The SKY13642-485LF is manufactured in a compact, 14-pin 2.0 x 2.0 mm, Quad Flat No-Lead (QFN) 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. SKY13642-485LF Pinout (Top View)**

**Table 1. SKY13642-485LF Signal Descriptions**

Pin	Name	Description	Pin	Name	Description
1	RF5	RF I/O path 5	9	RF2	RF I/O path 2
2	RF3	RF I/O path 3	10	RF4	RF I/O path 4
3	RF1	RF I/O path 1	11	RF6	RF I/O path 6
4	VDD	DC power supply	12	N/C <sup>1</sup>	Not connected
5	V3	DC control voltage 3	13	RFC	Common port
6	V2	DC control voltage 2	14	N/C <sup>1</sup>	Not connected
7	V1	DC control voltage 1	15	Heat slug/GND <sup>1</sup>	Must be connected to ground
8	N/C <sup>1</sup>	Not connected			

<sup>1</sup> Note that the Heat Slug/GND (Pin 15) is the only valid connection to ground. The N/C pins (8, 12, 14) are not wire-bonded internally and cannot be used for grounding.

## Functional Description

The SKY13642-485LF includes an internal negative voltage generator and decoder that eliminate the need for external DC blocking capacitors on the RF ports. No external components are required for proper operation. DC decoupling capacitors may be added on the VDD and control lines if necessary.

Switching is controlled by three control voltage inputs, V1, V2, and V3. Depending on the logic voltage level applied to the control pins, the RFC pin is connected to one of six switched RF outputs.

A seventh state enables RF3 and RF5 at the same time. The output power measured at RF3 and RF5 in this state is 3 dB less than the typical insertion loss.

Shutdown mode is enabled by connecting all three control pins (V1, V2, and V3) to logic high. This mode reduces the overall current consumption of the device to 5 μA typical.

## Electrical and Mechanical Specifications

The absolute maximum ratings of the SKY13642-485LF are provided in Table 2. Electrical specifications are provided in Table 3.

The state of the SKY13642-485LF is determined by the logic shown in Table 4.

Table 5 and Table 6 list the typical RFC-to-PORT and PORT-to-PORT isolation at various frequency points as measured on the Evaluation Board.

**Table 2. SKY13642-485LF Absolute Maximum Ratings<sup>1</sup>**

Parameter	Symbol	Minimum	Maximum	Units
Supply voltage	V <sub>DD</sub>	2.5	5.0	V
Control voltage (V1, V2, and V3)	V <sub>CTL</sub>	-0.5	+3.0	V
RF input power (RF1 to RF6), 0.1 to 1.5 GHz	P <sub>IN</sub>		+84.5	dBmV
Operating temperature	T <sub>OP</sub>	-40	+85	°C
Storage temperature	T <sub>STG</sub>	-55	+150	°C
Electrostatic discharge:	ESD			
Charged-Device Model (CDM), Class C3			500	V
Human Body Model (HBM), Class 1B			1000	V

<sup>1</sup> 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.

**ESD HANDLING:** *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 when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.*

**Table 3. SKY13642-485LF General Electrical Specifications**

(V<sub>DD</sub> = 2.6 V, V<sub>1</sub> = V<sub>2</sub> = V<sub>3</sub> = 0/1.8 V, P<sub>IN</sub> = 47 dBmV, T<sub>OP</sub> = +25 °C, Characteristic Impedance [Z<sub>0</sub>] = 75 Ω, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
<b>DC Specifications<sup>1</sup></b>						
Supply voltage	V <sub>DD</sub>		2.5	3.0	4.8	V
Supply current	I <sub>DD</sub>			40	50	μA
Control voltage: High Low	V <sub>CTL_H</sub> V <sub>CTL_L</sub>		1.35	1.80	2.70 0.4	V V
Control current	I <sub>CTL</sub>	V <sub>CTL</sub> = 1.8 V		0.5	1.0	μA
Shutdown mode supply current	I <sub>OFF</sub>	V <sub>1/2/3</sub> = 1.8 V, V <sub>DD</sub> = 3 V		5	10	μA
Turn-on switching time <sup>2</sup>	t <sub>ON</sub>	50% of final control voltage to 90% of final RF power, switching between RF1/2/3/4/5/6		1.75		μs
<b>RF Specifications (Pins De-Embedded)<sup>2</sup></b>						
Insertion loss (RFC pin to RF1/2/3/4/5/6 pins)	IL	5 to 200 MHz 0.2 to 1.5 GHz		0.4 0.45		dB dB
Isolation (RFC pin to RF1/2/3/4/5/6 pins)	ISO	5 to 200 MHz 0.2 to 1.5 GHz		39 28		dB dB
Return loss (RFC pin to RF1/2/3/4/5/6 pins)	RL	5 to 200 MHz 0.2 to 1.5 GHz		27 25		dB dB
2 <sup>nd</sup> harmonics (RFC pin to RF1/2/3/4/5/6 pins)	2fo	P <sub>IN</sub> = +73 dBmV, 5 MHz to 1.5 GHz		96		dBc
3 <sup>rd</sup> harmonics (RFC pin to RF1/2/3/4/5/6 pins)	3fo	P <sub>IN</sub> = +73 dBmV, 5 MHz to 1.5 GHz		99		dBc
0.1 dB compression point (RFC pin to RF1/2/3/4/5/6 pins)	P <sub>0.1dB</sub>	0.1 @ 1.0 GHz		+84.5		dBmV
CTB		79 channels, +45 dBmV per channel output power		-100		dBc
CSO		79 channels, +45 dBmV per channel output power		-100		dBc
<b>Typical RF Performance (Measured in EVB)<sup>2</sup></b>						
Insertion loss (RFC port to RF1/2/3/4/5/6 ports)	IL-EVB	5 to 200 MHz 0.2 to 1.5 GHz		0.7 1.1		dB dB
Return loss (RFC port to RF1/2/3/4/5/6 ports)	RL-EVB	5 to 200 MHz 0.2 to 1.5 GHz		-20 -15		dB dB

<sup>1</sup> Performance is guaranteed.

<sup>2</sup> Typical performance only; not guaranteed.

**Table 4. SKY13642-485LF Control Logic<sup>1</sup>**

Control Pins			RFC to Switched RF Outputs					
V1 (Pin 7)	V2 (Pin 6)	V3 (Pin 5)	RF1 (Pin 3)	RF2 (Pin 9)	RF3 (Pin 2)	RF4 (Pin 10)	RF5 (Pin 1)	RF6 (Pin 11)
0	0	0	Insertion Loss	Isolation	Isolation	Isolation	Isolation	Isolation
0	0	1	Isolation	Insertion Loss	Isolation	Isolation	Isolation	Isolation
0	1	0	Isolation	Isolation	Insertion Loss	Isolation	Isolation	Isolation
0	1	1	Isolation	Isolation	Isolation	Insertion Loss	Isolation	Isolation
1	0	0	Isolation	Isolation	Isolation	Isolation	Insertion Loss	Isolation
1	0	1	Isolation	Isolation	Isolation	Isolation	Isolation	Insertion Loss
1	1	0	Isolation	Isolation	Insertion Loss	Isolation	Insertion Loss	Isolation
1	1	1	Shutdown Mode					

<sup>1</sup> “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. Insertion loss in V1/V2/V3 = 110b state is 3 dB lower than typical insertion loss.

**Table 5. Isolation Matrix (Common Port RFC ↔ Output Port N) (1 of 2)**

Selected Output Port	Frequency (MHz)	Isolation (Common Port RFC ↔ Output Port N) (typical) (dB)					
		RF1	RF2	RF3	RF4	RF5	RF6
RF1	50	Insertion Loss	-75	-72	-70	-66	-65
RF1	250	Insertion Loss	-61	-62	-57	-53	-52
RF1	500	Insertion Loss	-54	-53	-50	-47	-45
RF1	750	Insertion Loss	-52	-48	-48	-44	-44
RF1	1000	Insertion Loss	-49	-44	-46	-41	-42
RF1	1250	Insertion Loss	-45	-41	-42	-37	-39
RF1	1500	Insertion Loss	-46	-45	-42	-37	-39
RF2	50	-75	Insertion Loss	-69	-71	-65	-68
RF2	250	-60	Insertion Loss	-55	-59	-51	-55
RF2	500	-54	Insertion Loss	-48	-50	-44	-48
RF2	750	-51	Insertion Loss	-47	-47	-43	-45
RF2	1000	-49	Insertion Loss	-45	-44	-41	-42
RF2	1250	-45	Insertion Loss	-41	-42	-38	-37
RF2	1500	-45	Insertion Loss	-42	-46	-38	-38
RF3	50	-69	-75	Insertion Loss	-71	-76	-66
RF3	250	-57	-60	Insertion Loss	-57	-73	-52
RF3	500	-48	-54	Insertion Loss	-50	-56	-46
RF3	750	-45	-51	Insertion Loss	-48	-48	-44
RF3	1000	-43	-49	Insertion Loss	-46	-43	-43
RF3	1250	-42	-45	Insertion Loss	-42	-38	-39
RF3	1500	-47	-45	Insertion Loss	-43	-38	-39

**Table 5. Isolation Matrix (Common Port RFC ↔ Output Port N) (2 of 2)**

Selected Output Port	Frequency (MHz)	Isolation (Common Port RFC ↔ Output Port N) (typical) (dB)					
		RF1	RF2	RF3	RF4	RF5	RF6
RF4	50	-73	-68	-70	Insertion Loss	-66	-74
RF4	250	-59	-55	-56	Insertion Loss	-52	-73
RF4	500	-53	-47	-48	Insertion Loss	-45	-57
RF4	750	-51	-44	-47	Insertion Loss	-43	-49
RF4	1000	-48	-43	-45	Insertion Loss	-41	-43
RF4	1250	-44	-42	-42	Insertion Loss	-38	-38
RF4	1500	-45	-49	-42	Insertion Loss	-38	-39
RF5	50	-77	-75	-69	-72	Insertion Loss	-68
RF5	250	-72	-61	-57	-58	Insertion Loss	-54
RF5	500	-61	-54	-49	-51	Insertion Loss	-47
RF5	750	-54	-52	-45	-49	Insertion Loss	-45
RF5	1000	-48	-49	-43	-47	Insertion Loss	-43
RF5	1250	-43	-45	-41	-43	Insertion Loss	-40
RF5	1500	-44	-46	-45	-43	Insertion Loss	-40
RF6	50	-72	-71	-70	-70	-67	Insertion Loss
RF6	250	-60	-72	-56	-56	-53	Insertion Loss
RF6	500	-53	-62	-49	-48	-46	Insertion Loss
RF6	750	-51	-53	-48	-45	-44	Insertion Loss
RF6	1000	-49	-48	-46	-44	-42	Insertion Loss
RF6	1250	-45	-44	-42	-42	-39	Insertion Loss
RF6	1500	-45	-45	-42	-48	-39	Insertion Loss

**Table 6. Isolation Matrix (Selected Output Port ↔ Output Port N) (1 of 2)**

Selected Output Port	Frequency (MHz)	Isolation (Selected Output Port ↔ Output Port N) (typical) (dB)					
		RF1	RF2	RF3	RF4	RF5	RF6
RF1	50	Common Port terminated	-83	-59	-83	-72	-71
RF1	250	Common Port terminated	-69	-45	-73	-58	-60
RF1	500	Common Port terminated	-62	-39	-63	-51	-52
RF1	750	Common Port terminated	-57	-37	-59	-48	-50
RF1	1000	Common Port terminated	-53	-35	-55	-44	-49
RF1	1250	Common Port terminated	-49	-31	-52	-39	-48
RF1	1500	Common Port terminated	-50	-32	-54	-40	-54
RF2	50	-85	Common Port terminated	-79	-59	-68	-69
RF2	250	-71	Common Port terminated	-67	-45	-57	-57
RF2	500	-63	Common Port terminated	-58	-38	-50	-49
RF2	750	-58	Common Port terminated	-55	-36	-48	-46
RF2	1000	-54	Common Port terminated	-53	-34	-47	-43
RF2	1250	-49	Common Port terminated	-52	-31	-47	-39
RF2	1500	-50	Common Port terminated	-56	-32	-52	-39
RF3	50	-58	-85	Common Port terminated	-83	-62	-73
RF3	250	-45	-70	Common Port terminated	-74	-47	-61
RF3	500	-38	-63	Common Port terminated	-64	-40	-53
RF3	750	-36	-59	Common Port terminated	-58	-38	-51
RF3	1000	-34	-54	Common Port terminated	-55	-36	-49
RF3	1250	-31	-50	Common Port terminated	-51	-32	-49
RF3	1500	-31	-51	Common Port terminated	-53	-33	-54

**Table 6. Isolation Matrix (Selected Output Port ↔ Output Port N) (2 of 2)**

“ON” Port	Frequency (MHz)	Isolation (Selected Output Port ↔ Output Port N) (typical) (dB)					
		RF1	RF2	RF3	RF4	RF5	RF6
RF4	50	-95	-58	-81	Common Port terminated	-71	-61
RF4	250	-75	-44	-68	Common Port terminated	-58	-47
RF4	500	-66	-37	-60	Common Port terminated	-50	-40
RF4	750	-60	-35	-57	Common Port terminated	-49	-38
RF4	1000	-55	-33	-54	Common Port terminated	-47	-36
RF4	1250	-50	-31	-52	Common Port terminated	-47	-32
RF4	1500	-51	-31	-55	Common Port terminated	-51	-33
RF5	50	-64	-85	-58	-92	Common Port terminated	-76
RF5	250	-50	-68	-45	-81	Common Port terminated	-64
RF5	500	-44	-61	-38	-66	Common Port terminated	-56
RF5	750	-42	-58	-36	-59	Common Port terminated	-53
RF5	1000	-40	-53	-34	-54	Common Port terminated	-50
RF5	1250	-36	-49	-31	-50	Common Port terminated	-48
RF5	1500	-37	-50	-31	-51	Common Port terminated	-51
RF6	50	-90	-63	-82	-58	-73	Common Port terminated
RF6	250	-72	-50	-72	-44	-61	Common Port terminated
RF6	500	-64	-43	-63	-38	-53	Common Port terminated
RF6	750	-59	-41	-58	-36	-50	Common Port terminated
RF6	1000	-54	-39	-54	-34	-49	Common Port terminated
RF6	1250	-50	-36	-51	-31	-47	Common Port terminated
RF6	1500	-51	-37	-53	-31	-52	Common Port terminated





### Evaluation Board Description

The SKY13642-485LF Evaluation Board is used to test the performance of the SKY13642-485LF SP6T Switch.

An Evaluation Board schematic diagram is provided in Figure 3. An assembly drawing for the Evaluation Board is shown in Figure 4. A photograph of a typical Evaluation Board is shown in Figure 5. Table 7 lists the Bill of Materials (BOM) for the Evaluation Board.

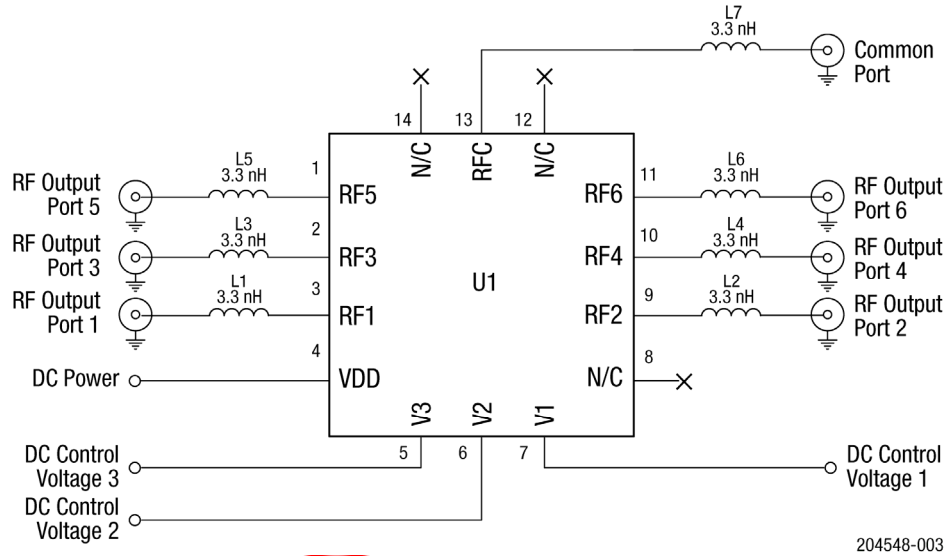


Figure 3. SKY13642-485LF Evaluation Board Schematic

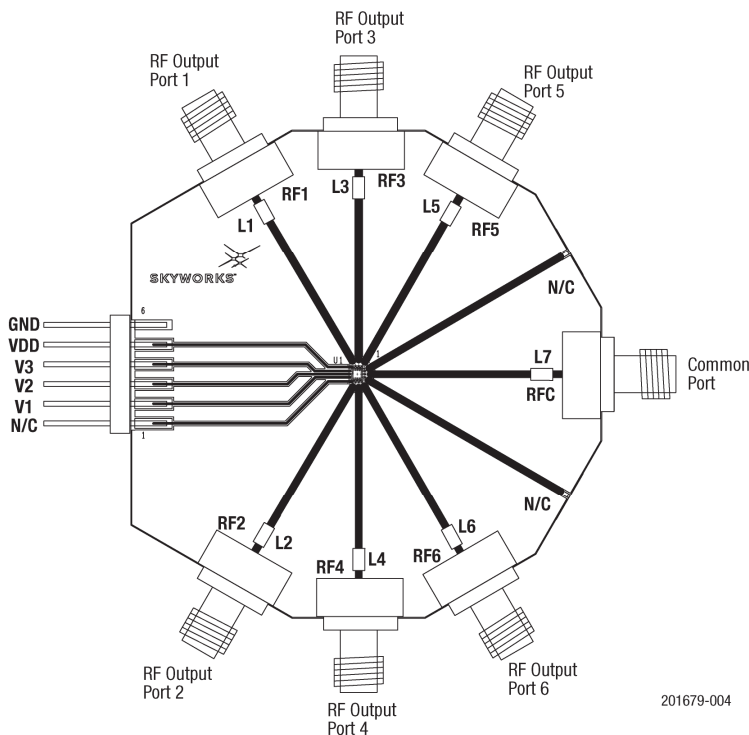


Figure 4. SKY13642-485LF Evaluation Board Assembly Diagram

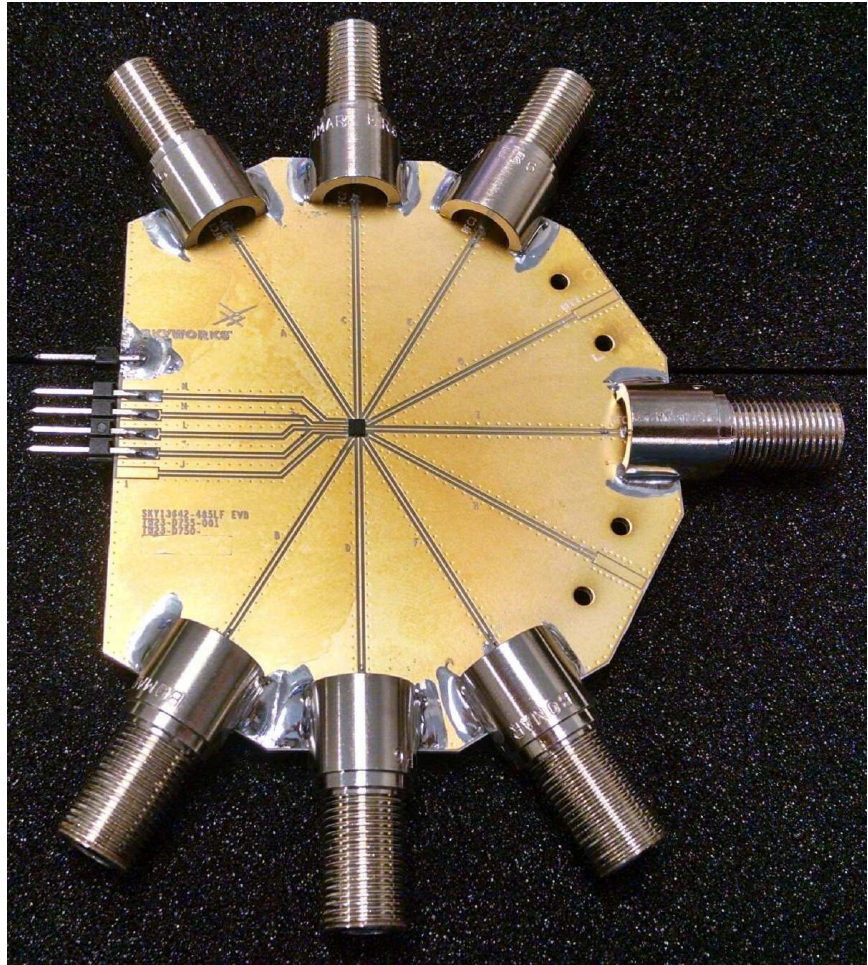


Figure 5. SKY13642-485LF Evaluation Board Photograph

Table 7. SKY13642-485LF Bill of Materials (BOM)

Component	Description	Value	Mfr Part Number	Vendor
J1	Header, in-line	5 pos.	5-146280-5	TE Connectivity
L1 - L7	Inductor, 0201	3.3 nH	LQP03TN3N3B00D	Murata
RF6 - RF7	Connector, F	75 Ω	861V509ER6	Bomar Interconnect
PCB			PTW23-D755-001	South Coast Circuits
U1	RF Switch, SP6T	75 Ω	SKY13642-485LF	Skyworks

### Package Dimensions

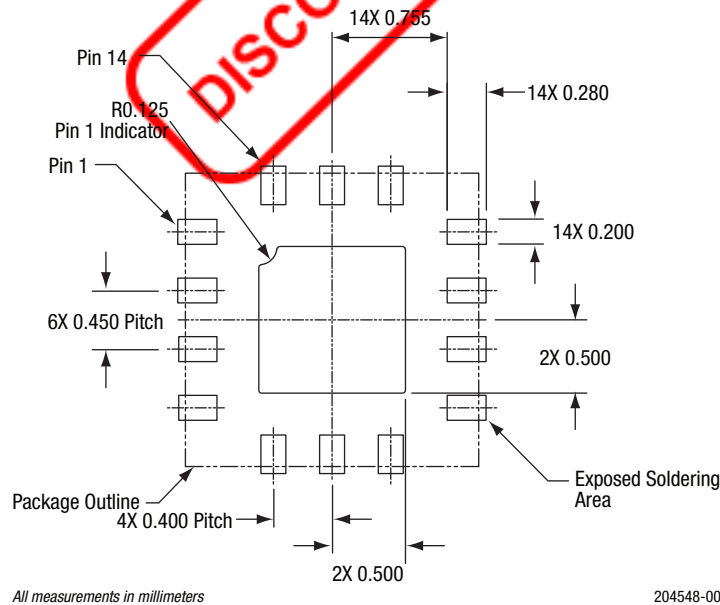
The PCB layout footprint for the SKY13642-485LF is provided in Figure 6. Typical part markings are shown in Figure 7. Package dimensions are shown in Figure 8, and tape and reel dimensions are provided in Figure 9.

### 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 SKY13642-485LF 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.



**Figure 6. SKY13642-485LF PCB Layout Footprint (Top View)**

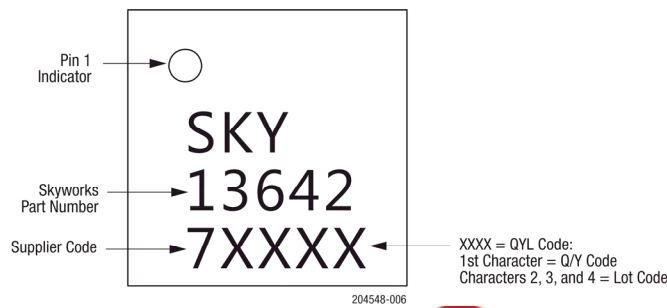


Figure 7. Typical Part Markings (Top View)

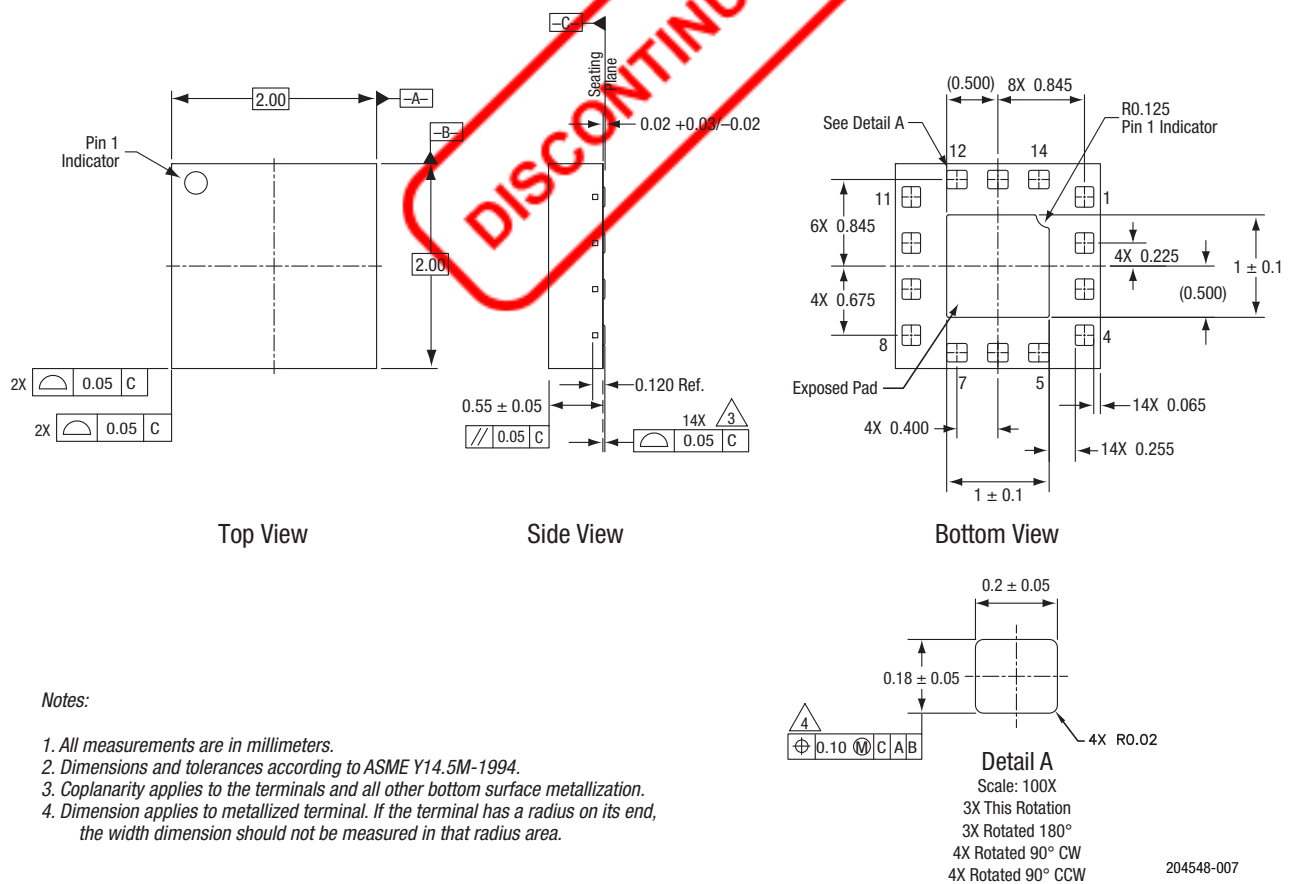
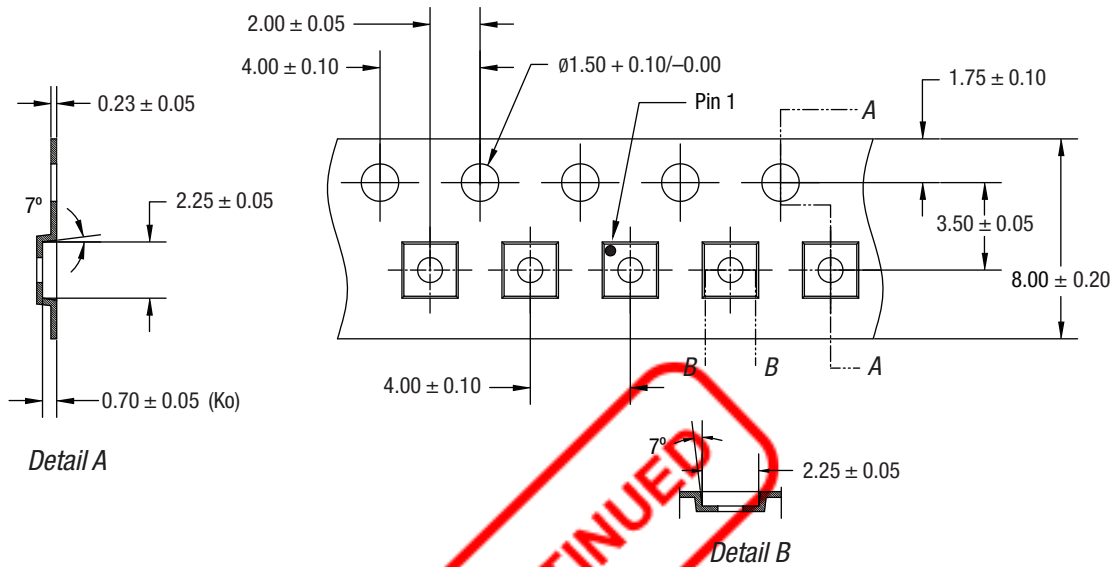


Figure 8. SKY13642-485LF Package Dimensions



Notes:

1. Carrier tape must meet all requirements of Skyworks GP01-D232 procurement spec for tape and reel shipping.
2. Carrier tape shall be black conductive polycarbonate bakeable material at 125 °C temperature.
3. Cover tape shall be transparent conductive with 5.40 mm width.
4. ESD-surface resistivity must meet all ESD requirements of Skyworks specified on GP01-D232.
5. All measurements are in millimeters.

204548-008

Figure 9. SKY13642-485LF Tape and Reel Dimensions

## Ordering Information

Part Number	Product Description	Evaluation Board Part Number
SKY13642-485LF	5 MHz to 1.5 GHz Ultra-High-Linearity SP6T 75 Ω Switch	SKY13642-485LF-EVB



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