SKYWORKS®

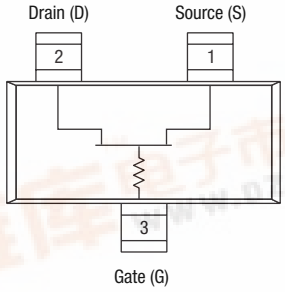
DATA SHEET

AF002C1-39, AF002C1-39LF, AF002C4-39, AF002C4-39LF: GaAs IC Control FET Series 300 kHz–2.5 GHz

Features

- Low-cost SOT-23 package
- Series or shunt configuration
- Low DC current drain
- Ideal switch building blocks
- Pin diode replacements
- High-power antenna switches
- Available lead (Pb)-free and RoHS-compliant MSL-1 @ 250 °C per JEDEC J-STD-020

Pin Out



Description

This group of GaAs control FETs can be used in both series and shunt configurations. They incorporate on-chip circuitry that eliminates the need for extra bias components and minimizes power drain to typically 25 µW. These features make the devices ideal replacements for PIN diodes, where low DC drain is critical. Isolation performance degrades at higher frequencies due to package parasitics. They can be tuned out in narrow band applications as shown in the circuit examples on the following pages.

NEW Skyworks offers lead (Pb)-free, RoHS (Restriction of Hazardous Substances)-compliant packaging.

Electrical Specifications at 25 °C (0, -5 V)

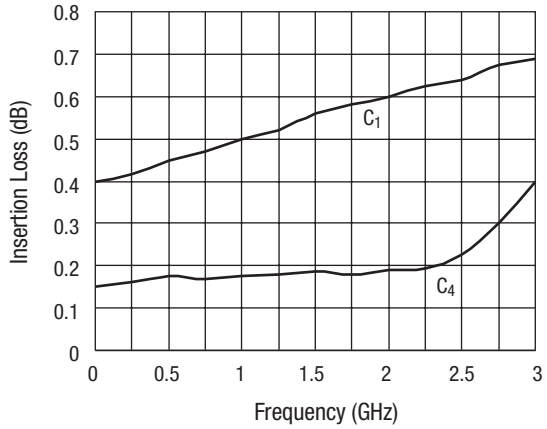
Part Number[1]	Frequency	R_{ON} (Ω)[2]		Insertion Loss (dB)[3, 4]		C_{OFF} (pF)[5]		Isolation (dB)[4]		$P_{-1\ dB}$ (W)
	(GHz)	Typ.	Max.	Series	Shunt	Typ.	Max.	Series	Shunt	Typ.
AF002C1-39	300 kHz–0.5 GHz	6.4	9	0.5	0.1	0.13	0.25	25	12	0.5
	300 kHz–1.0 GHz	6.4	9	0.6	0.15	0.13	0.25	17	8	1
	300 kHz–2.5 GHz	6.4	9	0.7	0.2	0.13	0.25	13	3	1
AF002C4-39	300 kHz–0.5 GHz	0.8	1.1	0.2	0.15	1.1	1.5	11	15	6
	300 kHz–1.0 GHz	0.8	1.1	0.25	0.25	1.1	1.5	6	9	7
	300 kHz–2.5 GHz	0.8	1.1	0.3	2	1.1	1.5	3	4	7

1. All measurements made in a 50 Ω system, unless otherwise specified.
2. R_{ON} - resistance in Ω in low impedance state when "0" V is applied to gate (G).
3. Insertion loss changes by 0.003 dB/°C.
4. Insertion loss and isolation typical values.
5. C_{OFF} - capacitance (pF) in high impedance state when -5 V is applied to gate (G).

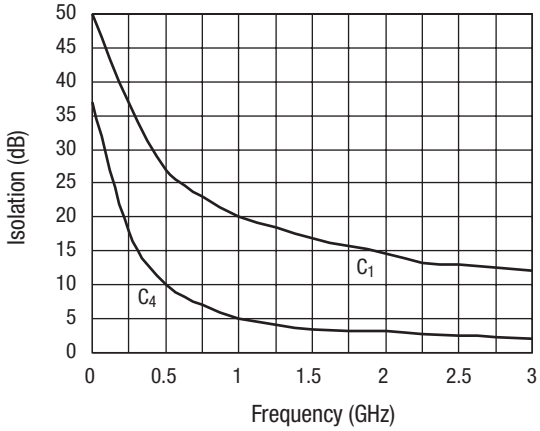
Operating Characteristics at 25 °C (0, -5 V)

Parameter	Condition	Frequency	Min.	Typ.	Max.	Unit
Switching characteristics						
Rise, fall	10/90% or 90/10% RF			6		ns
On, off	50% CTL to 90/10% RF			12		ns
Thermal resistance				25		°C/W
Control voltages	V_{LOW} = 0 to -0.2 V @ 20 µA max. V_{HIGH} = -5 V @ 50 µA to -9 V @ 200 µA max.					

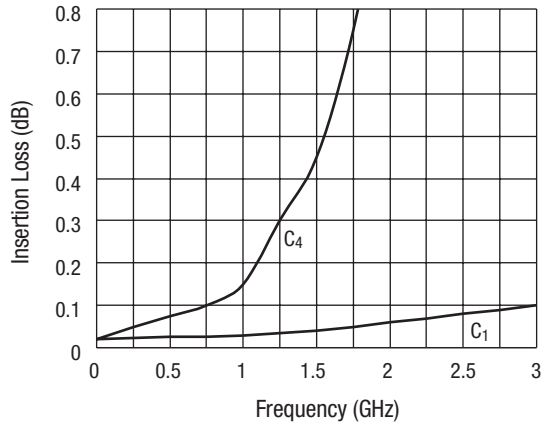
Typical Performance Data (0, -5 V)



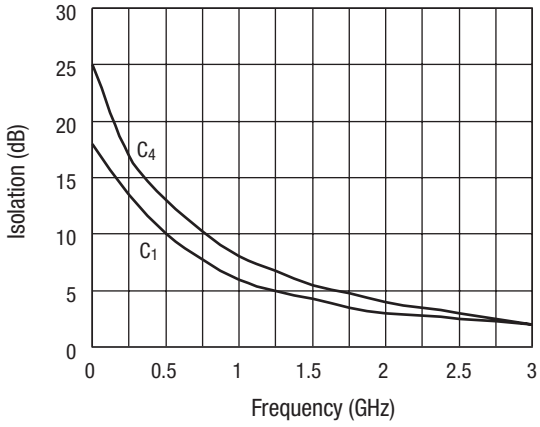
Insertion Loss vs. Frequency Series Configuration



Isolation vs. Frequency Series Configuration



Insertion Loss vs. Frequency Shunt Configuration



Isolation vs. Frequency Shunt Configuration

Absolute Maximum Ratings

AF002C1-39

Characteristic	Value
RF input power	2 W > 500 MHz 0/-8 V 0.5 W @ 50 MHz 0/-8 V
Control voltage	+0.2 V, -10 V
Operating temperature	-40 °C to +85 °C
Storage temperature	-65 °C to +150 °C

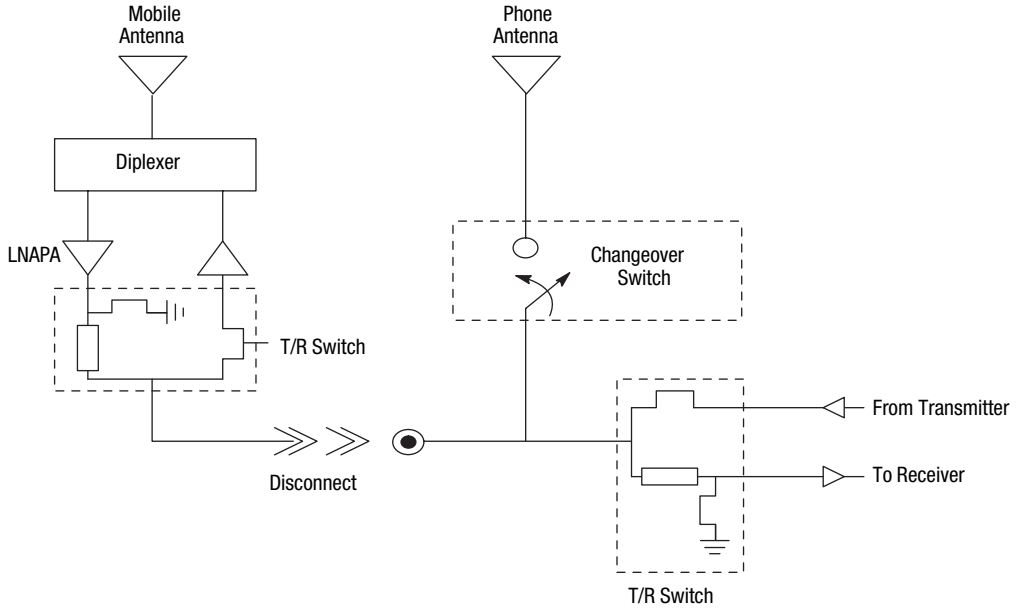
AF002C4-39

Characteristic	Value
RF input power	8 W > 450 MHz, 0/-12 V
Control voltage	+0.2, -12 V
Operating temperature	-40 °C to +85 °C
Storage temperature	-65 °C to +150 °C

Performance is guaranteed only under the conditions listed in the specifications table and is not guaranteed under the full range(s) described by the Absolute Maximum specifications. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void the warranty.

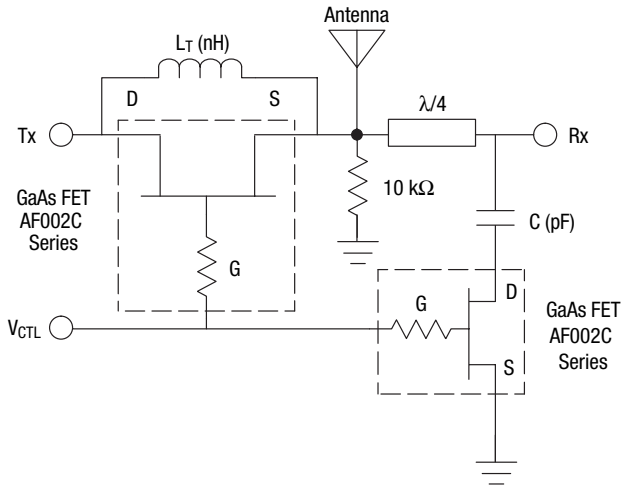
CAUTION: *Although this device is designed to be as robust as possible, ESD (Electrostatic Discharge) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without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

T/R and Antenna Changeover Switch for Mobile Cellular Systems

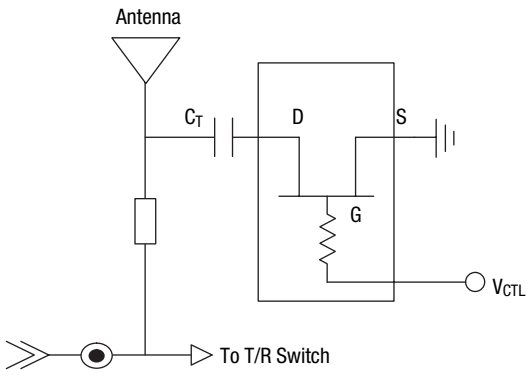


System Block Diagram

T/R Switch Schematic



Changeover Switch Schematic



Truth Table for T/R Switch

V_{CTL} (V)	Tx to Antenna	Rx to Antenna
0	Low loss	High isolation
-5	High isolation	Low loss

See next page for positive voltage operation.

Truth Table for Changeover Switch

V_{CTL} (V)	Antenna
-5	Connected
0	Isolated

See next page for positive voltage operation.

Component Values for T/R Switch Circuit

Part Number	L_T (nH)	C_T (pF)	Freq. (GHz)
AF002C1-39	165	18.8	0.45
AF002C4-39	85	18.8	0.45
AF002C1-39	44	4.7	0.9
AF002C4-39	22	4.7	0.9

Truth Table

Negative Voltage Operation

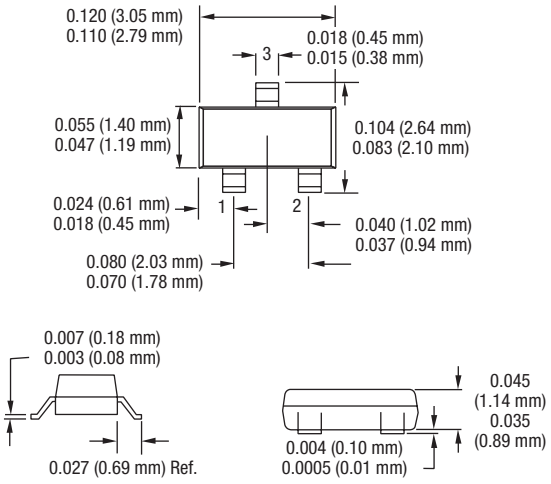
S	D	G	RF Path
Shunt			
GND	RF	-5	Insertion loss
		0	Isolation
Series			
RF	RF	0	Insertion loss
		-5	Isolation

Positive Voltage Operation

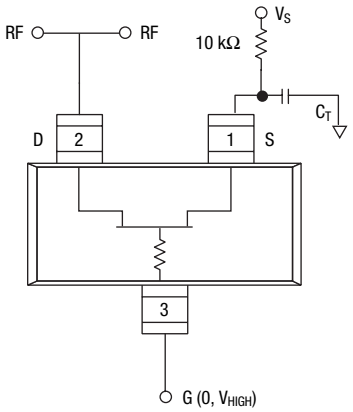
S	D	G	RF Path
Shunt			
GND	RF	0	Insertion loss
		V_{HIGH}	Isolation
Series			
RF	RF	0	Isolation
		V_{HIGH}	Insertion loss

V_{HIGH} = +5 to +9 V ($V_S = V_{HIGH} \pm 0.2$ V).

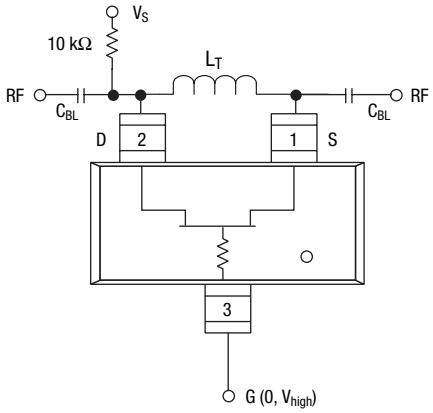
SOT-23



Positive Voltage Operation



Shunt Configuration



C_{BL} - Chose value for lowest impedance at desired operating frequency.

Series Configuration

Recommended Solder Reflow Profiles

Refer to the *"Recommended Solder Reflow Profile"* Application Note.

Tape and Reel Information

Refer to the *"Discrete Devices and IC Switch/Attenuators Tape and Reel Package Orientation"* Application Note.