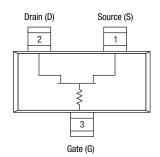


DATA SHEET

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

Features Pin Out

- 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



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 μ W. 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.



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}	$(\Omega)^{(2)}$	Insertion Lo	oss (dB) ^(3, 4)	C _{OFF} ((pF) ⁽⁵⁾	Isolatio	n (dB) ⁽⁴⁾	P _{-1 dB} (W)
	(GHz)	Тур.	Max.	Series	Shunt	Тур.	Max.	Series	Shunt	Тур.
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_{0N} - resistance in Ω in low impedance state when "0" V is applied to gate (G).

^{3.} Insertion loss changes by 0.003 dB/°C.

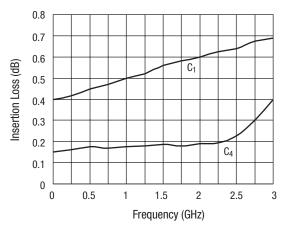
^{4.} Insertion loss and isolation typical values.

^{5.} C_{OFF} - capacitance (pF) in high impedance state when -5 V is applied to gate (G).

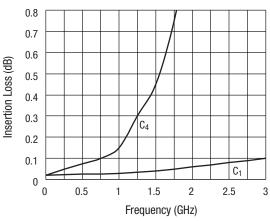
Operating Characteristics at 25 °C (0, -5 V)

Parameter	Condition	Frequency	Min.	Тур.	Max.	Unit
Switching characteristics Rise, fall On, off	10/90% or 90/10% RF 50% CTL to 90/10% RF			6 12		ns ns
Thermal resistance	2					°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.					

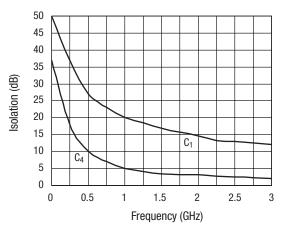
Typical Performance Data (0, -5 V)



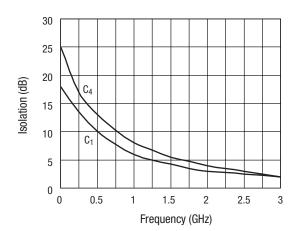
Insertion Loss vs. Frequency Series Configuration



Insertion Loss vs. Frequency Shunt Configuration



Isolation vs. Frequency Series 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

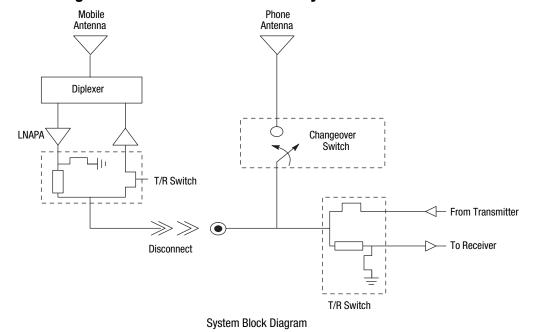
AF002C4-39

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		

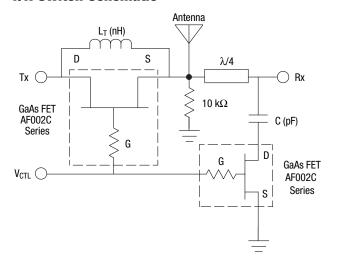
Performance is guaranteed only under the conditions listed in the specifications table and is not guaranteed under the full range(s) described by the Absolute Maximum specifications. Exceeding any of the absolute maximum/minimum specifications may result in permanent damage to the device and will void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

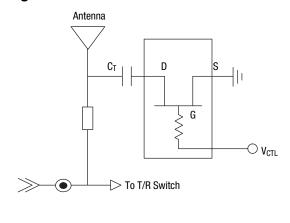
T/R and Antenna Changeover Switch for Mobile Cellular Systems



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

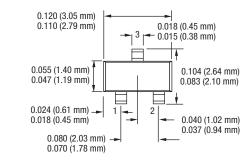
S	D	G	RF Path				
Shunt							
GND	RF	-5	Insertion loss				
นเทบ	ni Ni	0	Isolation				
Series							
RF	RF	0	Insertion loss				
NΓ	KF.	-5	Isolation				

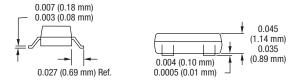
Positive Voltage Operation

S	D	G	RF Path				
Shunt							
GND	RF	0	Insertion loss				
GND	Tu	V _{HIGH}	Isolation				
Series							
RF	RF	0	Isolation				
111	111	V _{HIGH}	Insertion loss				

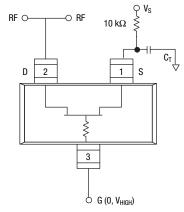
 $V_{HIGH} = +5 \text{ to } +9 \text{ V } (V_S = V_{HIGH} \pm 0.2 \text{ V}).$

SOT-23

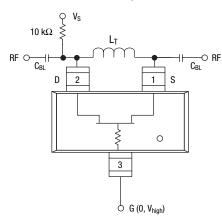




Positive Voltage Operation



Shunt Configuration



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

Series Configuration

Recommended Solder Reflow Profiles

Refer to the "<u>Recommended Solder Reflow Profile</u>" Application Note.

Tape and Reel Information

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

Copyright © 2002, 2003, 2004, 2005, 2006, Skyworks Solutions, Inc. All Rights Reserved.

Information in this document is provided in connection with Skyworks Solutions, Inc. ("Skyworks") products or services. These materials, including the information contained herein, are provided by Skyworks as a service to its customers and may be used for informational purposes only by the customer. Skyworks assumes no responsibility for errors or omissions in these materials or the information contained herein. Skyworks may change its documentation, products, services, specifications or product descriptions at any time, without notice. Skyworks makes no commitment to update the materials or information and shall have no responsibility whatsoever for conflicts, incompatibilities, or other difficulties arising from any future changes.

No license, whether express, implied, by estoppel or otherwise, is granted to any intellectual property rights by this document. Skyworks assumes no liability for any materials, products or information provided hereunder, including the sale, distribution, reproduction or use of Skyworks products, information or materials, except as may be provided in Skyworks Terms and Conditions of Sale.

THE MATERIALS, PRODUCTS AND INFORMATION ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHERWISE, INCLUDING FITNESS FOR A PARTICULAR PURPOSE OR USE, MERCHANTABILITY, PERFORMANCE, QUALITY OR NON-INFRINGEMENT OF ANY INTELLECTUAL PROPERTY RIGHT; ALL SUCH WARRANTIES ARE HEREBY EXPRESSLY DISCLAIMED. SKYWORKS DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. SKYWORKS SHALL NOT BE LIABLE FOR ANY DAMAGES, INCLUDING BUT NOT LIMITED TO ANY SPECIAL, INDIRECT, INCIDENTAL, STATUTORY, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS THAT MAY RESULT FROM THE USE OF THE MATERIALS OR INFORMATION, WHETHER OR NOT THE RECIPIENT OF MATERIALS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Skyworks products are not intended for use in medical, lifesaving or life-sustaining applications, or other equipment in which the failure of the Skyworks products could lead to personal injury, death, physical or environmental damage. Skyworks customers using or selling Skyworks products for use in such applications do so at their own risk and agree to fully indemnify Skyworks for any damages resulting from such improper use or sale.

Customers are responsible for their products and applications using Skyworks products, which may deviate from published specifications as a result of design defects, errors, or operation of products outside of published parameters or design specifications. Customers should include design and operating safeguards to minimize these and other risks. Skyworks assumes no liability for applications assistance, customer product design, or damage to any equipment resulting from the use of Skyworks products outside of stated published specifications or parameters.

Skyworks, the Skyworks symbol, and "Breakthrough Simplicity" are trademarks or registered trademarks of Skyworks Solutions, Inc., in the United States and other countries. Third-party brands and names are for identification purposes only, and are the property of their respective owners. Additional information, including relevant terms and conditions, posted at www.skyworksinc.com, are incorporated by reference.