



# AWS5524

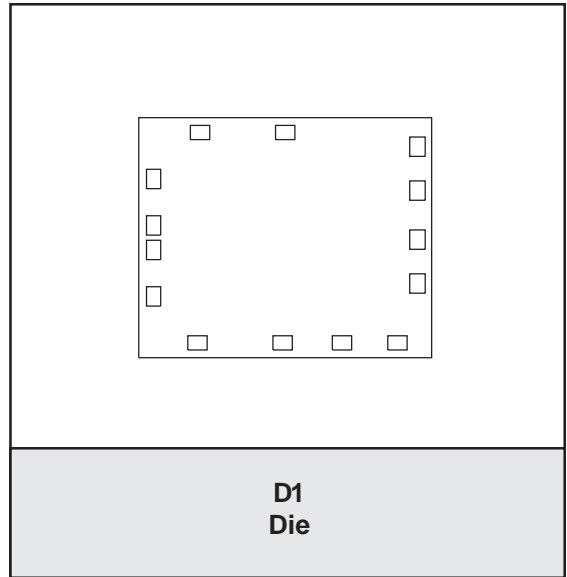
0.5 to 2.5 GHz SP4T Switch  
 ADVANCED PRODUCT INFORMATION - Rev 0.1

## FEATURES

- Low Insertion Loss: 0.8 dB at 2 GHz
- High Isolation: > 25 dB
- Low Harmonic Levels: < -65 dBc at max. GSM power
- Low Control Voltage Operation: to +2.5 V

## APPLICATIONS

- Front-end Modules for GSM Wireless Handsets



## PRODUCT DESCRIPTION

The AWS5524 is a single pole, four throw (SP4T) RF switch developed to meet the stringent requirements of GSM systems. Manufactured in ANADIGICS' state-of-the-art pHEMT process, the device uses patent-pending circuit topologies to

provide the low insertion loss, high port-to-port isolation and high linearity needed to enhance the performance of GSM radios. The AWS5524 is offered as an unpackaged MMIC die.

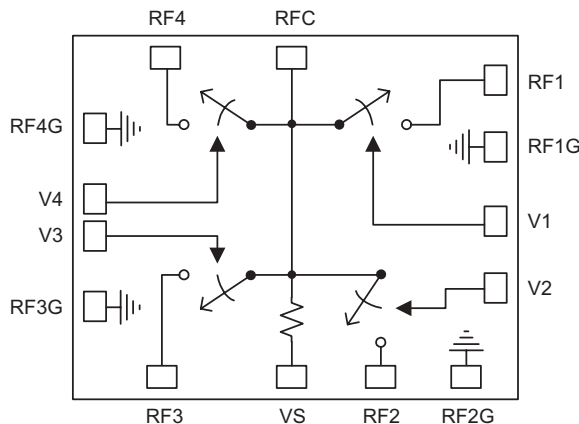
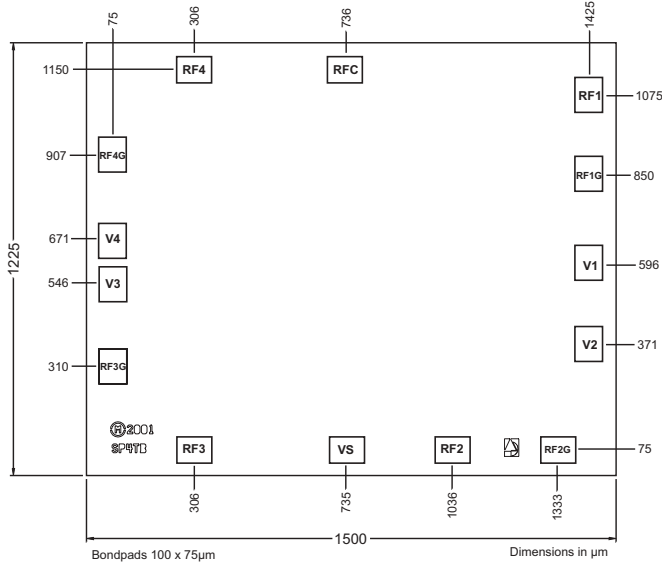


Figure 1: Block Diagram



Dimensions in μm  
 Bond Pads: 100 μm x 75 μm  
 Die Thickness: 178 μm  
 Figure 2: Die Configuration

Table 1: Pad Description

NAME	DESCRIPTION	NAME	DESCRIPTION
RF1	RF port, path 1	RF3	RF port, path 3
RFG1	Ground	RFG3	Ground
V1	Control voltage, RF path 1	V3	Control voltage, RF path 3
V2	Control voltage, RF path 2	V4	Control voltage, RF path 4
RFG2	Ground	RF4G	Ground
RF2	RF port, path 2	RF4	RF port, path 4
VS	Common port bias voltage (logic high)	RFC	RF common port

**ELECTRICAL CHARACTERISTICS****Table 2: Absolute Minimum and Maximum Ratings**

PARAMETER	MIN	MAX	UNIT	COMMENTS
Common Port Bias Voltage ( $V_S$ ) <sup>(1)</sup>	-0.2	+8.0	V	
Control Voltages ( $V_1, V_2, V_3, V_4$ )	-0.2	+8.0	V	
RF Input Power ( $P_{IN}$ )	-	10	W	at all RF ports
Storage Temperature <sup>(2)</sup>	-65	+150	°C	

Stresses in excess of the absolute ratings may cause permanent damage. Functional operation is not implied under these conditions. Exposure to absolute ratings for extended periods of time may adversely affect reliability.

Notes:

(1) The  $V_S$  port may remain open-circuited without damage to the device.

(2) Storage Temperature limits apply to the die only after it has been removed from the ANADIGICS shipping material.

3. All RF ports should be AC-coupled. No external DC bias should be applied.

**Table 3: Operating Ranges**

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
RF Frequency (f)	0.5	-	2.5	GHz	
Common Port Bias Voltage ( $V_S$ )	-	<sup>(1)</sup>	-	-	applied at $V_S$ port
Control Voltages ( $V_1, V_2, V_3, V_4$ )	0 +2.5	- -	+0.2 +3.5	V	RF path OFF state RF path ON state
Ambient Temperature ( $T_A$ )	-30	-	+85	°C	

The device may be operated safely over these conditions; however, parametric performance is guaranteed only over the conditions defined in the electrical specifications.

Notes:

(1) For optimal linearity performance, the Common Port Bias Voltage ( $V_S$ ) should be set to the same Control Voltage used to turn ON any of the individual RF paths. The  $V_S$  port may remain open-circuited without damage to the device, but with some degradation in linearity.

Table 4: Electrical Specifications

( $T_A = +25\text{ }^\circ\text{C}$ ; RF ports terminated with  $50\ \Omega$ ;  $V_n = +2.7\ \text{V}$  and is the Control Voltage for the ON path, RFC - RFn;  $V_x = 0\ \text{V}$  and is the Control Voltage for the OFF paths, RFC - RFx)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Insertion Loss 1 GHz 2 GHz	- -	0.5 0.8	0.7 1.0	dB	RFC port to selected RFn port
Return Loss <sup>(1)</sup> 1 GHz 2 GHz	- -	-25 -17	-20 -15	dB	RFC port and selected RFn port
Isolation 1 GHz 2 GHz	25 25	27 27	- -	dB	RFC port to isolated RFx ports
Input Third Order Intercept <sup>(2)</sup> 800 MHz Cellular Band 1900 MHz PCS Band	- -	+66 +59	- -	dBm	RFC port to selected RFn port
2nd Harmonic Rejection 1 GHz 2 GHz	- -	-71 -72	-65 -65	dBc	RFC port to selected RFn port $P_{IN} = +34\ \text{dBm}$ $P_{IN} = +32\ \text{dBm}$
3rd Harmonic Rejection <sup>(3)</sup> 1 GHz 2 GHz	- -	-88 -80	-65 -65	dBc	RFC port to selected RFn port $P_{IN} = +34\ \text{dBm}$ $P_{IN} = +32\ \text{dBm}$
Current Consumption	- -	- -	30 5	$\mu\text{A}$ $\mu\text{A}$	each $V_n$ port VS port

Notes:

(1) Isolated RFx ports have a return loss of approximately -3 dB.

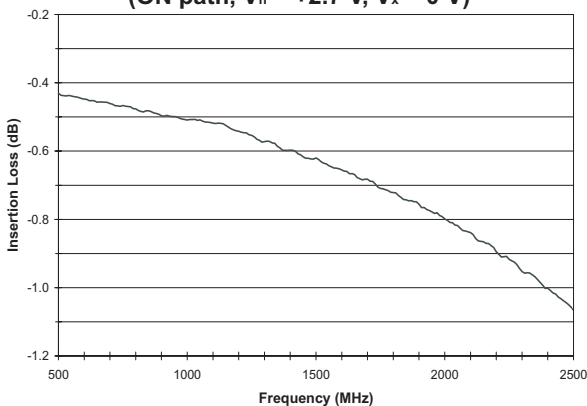
(2) For the Cellular Band, two tones with  $P_{IN} = +22.5\ \text{dBm}$  each, at 837 and 838 MHz. For the PCS Band, two tones with  $P_{IN} = +21\ \text{dBm}$  each, at 1880 and 1881 MHz.

(3)  $V_s = V_n$

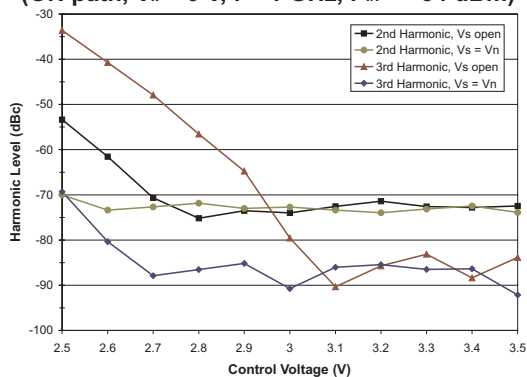
Table 5: Switch Control Truth Table

CONTROL VOLTAGES	$V_1$	+2.5 to +3.5 V	0 to +0.2 V	0 to +0.2 V	0 to +0.2 V
	$V_2$	0 to +0.2 V	+2.5 to +3.5 V	0 to +0.2 V	0 to +0.2 V
	$V_3$	0 to +0.2 V	0 to +0.2 V	+2.5 to +3.5 V	0 to +0.2 V
	$V_4$	0 to +0.2 V	0 to +0.2 V	0 to +0.2 V	+2.5 to +3.5 V
RF PATH SELECTION	RFC - RF1	ON	OFF	OFF	OFF
	RFC - RF2	OFF	ON	OFF	OFF
	RFC - RF3	OFF	OFF	ON	OFF
	RFC - RF4	OFF	OFF	OFF	ON

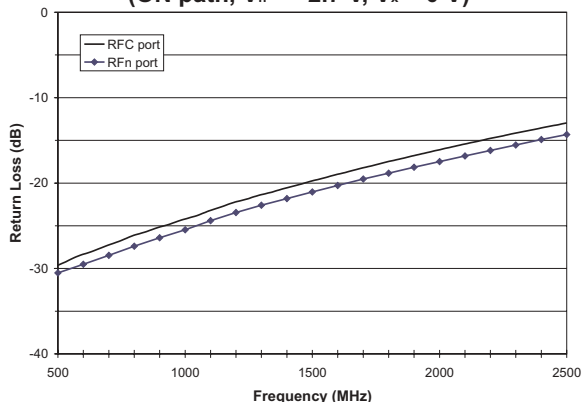
**Figure 3: Insertion Loss vs. Frequency**  
 (ON path,  $V_n = +2.7\text{ V}$ ,  $V_x = 0\text{ V}$ )



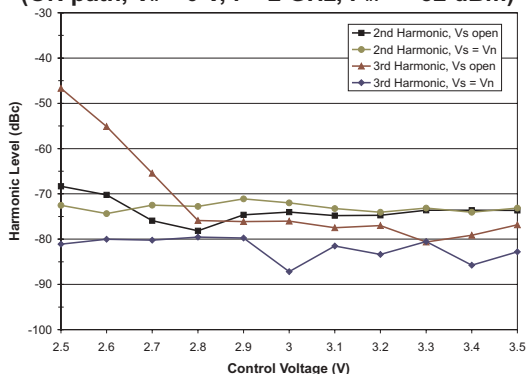
**Figure 4: Harmonics of 1 GHz vs. Control Voltage**  
 (ON path,  $V_x = 0\text{ V}$ ,  $f = 1\text{ GHz}$ ,  $P_{IN} = +34\text{ dBm}$ )



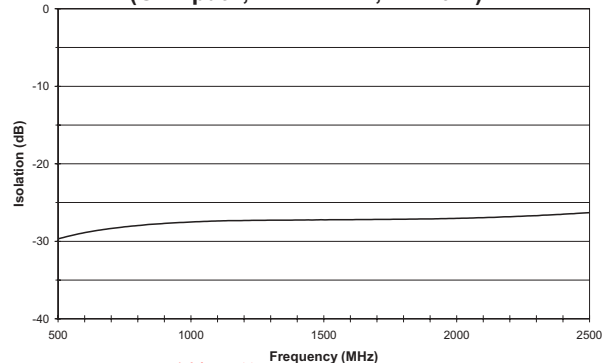
**Figure 5: Return Loss vs. Frequency**  
 (ON path,  $V_n = +2.7\text{ V}$ ,  $V_x = 0\text{ V}$ )



**Figure 6: Harmonics of 2 GHz vs. Control Voltage**  
 (ON path,  $V_x = 0\text{ V}$ ,  $f = 2\text{ GHz}$ ,  $P_{IN} = +32\text{ dBm}$ )



**Figure 7: Isolation vs. Frequency**  
 (OFF path,  $V_n = +2.7\text{ V}$ ,  $V_x = 0\text{ V}$ )



**APPLICATION INFORMATION**

**Die Applications**

Bonding and circuit connections for the unpackaged AWS5524 die are shown in Figure 8, and application details are listed in the following notes:

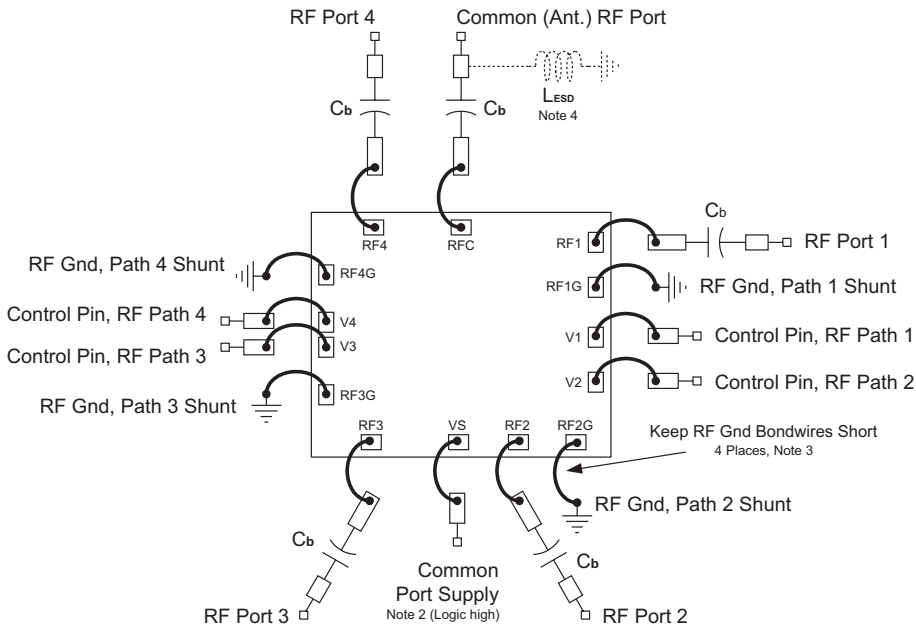
1. C<sub>b</sub> are DC blocking capacitors external to the device. A value of 100 pF is sufficient for operation to 500 MHz. The values may be tailored to provide specific electrical responses. The isolation of the switch provides enough decoupling of RF ports 1 through 4 so that overall switch performance is not affected.

2. The VS pin provides a fixed voltage potential to the common port of the switch. To get the best linear performance, it should be tied to the logic high voltage potential (not the power supply). Current draw on this pin is less than 5 μA.

3. The RF Ground bondwires should be kept as short as possible and bonded directly to a good RF ground for best broadband performance.

4. L<sub>ESD</sub> provides a means to increase the ESD protection on a specific RF port, typically the port attached to the antenna. The ESD rating of the device is ±125 V HBM overall. This rating is associated with the control pin to RF port path. RF port to RF Gnd has been determined to be >±500 V HBM for this technology. By using L<sub>ESD</sub> as an RF choke on a port, an ESD protection to ±8 kV contact discharge can be achieved.

5. The die may be attached by either conductive or non-conductive epoxy formulated for attaching semiconductor parts. The back of the die is electrically isolated from the switch circuit and can be grounded or left isolated.



**Figure 8: Application Schematic**

**NOTES**

**AWS5524**

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**ORDERING INFORMATION**

ORDER NUMBER	TEMPERATURE RANGE	PACKAGE DESCRIPTION	COMPONENT PACKAGING
AWS5524D1	-30 °C to +85 °C	Die	(contact ANADIGICS for details)



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