

# SP4T RF Switch

## JSW4-23DR-75+

75Ω High Power 3W 5 to 2000 MHz

### The Big Deal

- High Port count in super small size
- High Power P0.1dB, 3W
- Low Insertion Loss, 0.7 dB at 1 GHz



CASE STYLE: MT1817

### Product Overview

JSW4-23DR-75+ is a high power reflective SP4T RF switch, with reflective short on output ports in the off condition. Made using Silicon-on-Insulator process, it has very high IP3, a built-in CMOS driver and negative voltage generator. Its tiny 2x2mm, 14-lead case enables wideband performance in tight spaces and dense PCB layouts.

### Key Features

Feature	Advantages
Wideband operation 5-2000 MHz	Enables a single component to be used in a vast array of applications from VHF up to 2.0 GHz.
High IIP3: 55 dBm typ.	Results in little or negligible inter-modulation generation, meeting requirements for digital communication signals.
Low Loss, 0.7 dB at 1 GHz High input power, 3W	Low loss and high power capability enable a single switch to be used for a variety of applications, saving inventory.
Built in negative voltage generator	Operates with a single positive supply voltage; no need for DC blocking capacitors, unless external DC is present at the RF ports.
Built-in CMOS driver	No need for external driver, saving PCB space and cost.
Tiny MCLP package 2 x 2mm, 14-lead	Provides low inductance, repeatable transitions, and excellent thermal contact to PCB.



# SP4T RF Switch

75Ω 5-2000 MHz

Reflective RF Switch with internal driver.

Single Supply Voltage, +2.5V to +4.8V, High Power 3W

## Product Features

- High Isolation, 38 dB typ. at 1 GHz
- Low insertion loss, 0.7 dB typ. at 1 GHz
- High IP3, 59 dBm typ. at 1 GHz
- Low current consumption, 40 μA typ.
- High Power, P0.1dB 3W



## JSW4-23DR-75+

CASE STYLE: MT1817

**+RoHS Compliant**

The +Suffix identifies RoHS Compliance. See our web site for RoHS Compliance methodologies and qualifications

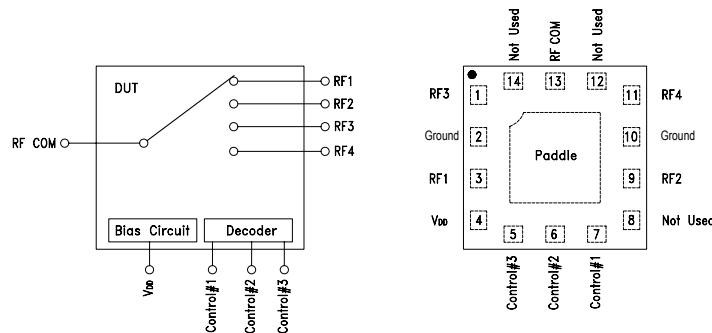
## Typical Applications

- CATV systems
- SATCOM system
- Automated Test Stations
- Telecom systems

## General Description

JSW4-23DR-75+ is a high power 3W reflective SP4T switch with integral driver, operates with single positive supply voltage while consuming, 40 μA typical. It has been designed for very wideband operation of 5-2000 MHz. It is packaged in a tiny 14-lead 2mm x 2mm x 0.55mm package and is rated MSL1 and class 1B ESD.

## Simplified Schematic and Pad Description



Function	Pad Number	Description
RF COM	13	RF Common/ SUM Port
RF1	3	RF Out #1/In Port #1
RF2	9	RF Out #2/In Port #2
Ground	2	Ground Externally
Ground	10	Ground Externally
RF3	1	RF Out #5/In Port #5
RF4	11	RF Out #6/In Port #6

Function	Pad Number	Description
Control #1	7	Control IN #1
Control #2	6	Control IN #2
Control #3	5	Control IN #3
VDD	4	Supply Voltage
Ground	Paddle	Ground Externally
Not Used	8,12,14	No Connection

RF Electrical Specifications<sup>(1)</sup>, 5 - 2000 MHz,  $T_{AMB}=25^{\circ}\text{C}$ ,  $V_{DD}=+2.5$  to 4.8V

Parameter	Condition (MHz)	Min.	Typ.	Max.	Units
Frequency Range		5		2000	MHz
Insertion Loss <sup>(2)</sup> (ON STATE)	5 to 1000	—	0.7	0.9	dB
	1000 to 1500	—	0.8	1.0	
	1500 to 2000	—	1.1	1.3	
Isolation between Common Port and RF1 to RF4 Ports <sup>(3)</sup>	5 to 1000	35	38	—	dB
	1000 to 1500	29	32	—	
	1500 to 2000	22	25	—	
Return Loss (ON STATE) RF-COM, RF1 to RF4 Ports	5 to 1000	—	15	—	dB
	1000 to 1500	—	14	—	
	1500 to 2000	—	10	—	
Input IP3	$V_{DD}=2.5$ to 4.8V	5 to 500	—	55	dBm
	$V_{DD}=3.0\text{V}$	1000 to 2000	—	59	
0.1dB Input Compression <sup>(4)</sup>	5 to 2000	—	35	—	dBm

## DC Electrical Specifications

Parameter	Min.	Typ.	Max.	Units
VDD, Supply Voltage	2.5	3.0	4.8	V
Supply Current ( $V_{DD} = 3\text{V}$ )		40		$\mu\text{A}$
Control Voltage Low	0		0.4	V
Control Voltage High <sup>(5)</sup>	1.35	1.8	2.7	V
Control Current		0.5	1.0	$\mu\text{A}$
Shutdown Current at $V_{DD} = 3\text{V}$		5		$\mu\text{A}$

## Notes:

- As measured in Mini-Circuit's test board TB-722-4-F+ (see Characterization Test Circuit, Fig.1).
- Insertion loss values are de-embedded from test board loss.
- Isolations for other port combinations, see Tables 1 & 2
- Do not exceed RF input power as shown in Absolute Maximum Rating table.
- If  $V_{DD} < 2.7\text{V}$ , then Max Control Voltage high= $V_{DD}$

## Switching Specifications

Parameter	Min.	Typ.	Max.	Units
Rise/Fall Time (10 to 90% or 90 to 10% RF)	—	0.42 (Rise Time) 0.84 (Fall Time)	—	$\mu\text{Sec}$
Switching Time, 50% CTRL to 90/10% RF (ON/OFF)	—	1.9 (ON Time) 1.4 (OFF Time)	—	$\mu\text{Sec}$
Video Feedthrough, (control 0 to 1.8V, freq.=10 KHz, $V_{DD}=3\text{V}$ )	—	4.0	—	$\text{mV}_{P-P}$

**Table 1. Isolation Matrix (RF-COM to RF1 to RF4 Ports)**

RF Com to Port	Frequency (GHz)	Isolation Typ. (dB) "ON" Port			
		RF1	RF2	RF3	RF4
RF1	0.01-1.0	---	49	47	48
RF1	1.0-1.5	---	45	42	44
RF1	1.5-2.0	---	42	39	41
RF2	0.01-1.0	49	---	48	47
RF2	1.0-1.5	45	---	43	41
RF2	1.5-2.0	42	---	40	38
RF3	0.01-1.0	41	41	---	42
RF3	1.0-1.5	35	37	---	38
RF3	1.5-2.0	33	35	---	35
RF4	0.01-1.0	41	41	42	---
RF4	1.0-1.5	37	36	38	---
RF4	1.5-2.0	35	33	35	---

**Table 2. Isolation Matrix (Between Output Ports)**

From Port	Frequency (GHz)	Isolation Typ. (dB) "ON" Port & to Port			
		RF1	RF2	RF3	RF4
RF1	0.01-1.0	---	52	32	52
RF1	1.0-1.5	---	48	28	48
RF1	1.5-2.0	---	44	27	44
RF2	0.01-1.0	51	---	52	34
RF2	1.0-1.5	47	---	47	31
RF2	1.5-2.0	43	---	44	26
RF3	0.01-1.0	40	49	---	53
RF3	1.0-1.5	36	45	---	46
RF3	1.5-2.0	34	44	---	43
RF4	0.01-1.0	50	42	53	---
RF4	1.0-1.5	45	38	47	---
RF4	1.5-2.0	44	34	43	---

**Absolute Maximum Ratings<sup>(6)</sup>**

Parameter	Ratings
Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to 150°C
V <sub>DD</sub> , Supply Voltage	5.0V
Voltage Control	-0.5V Min. 3.0 Max.
RF input power <sup>(7)</sup>	5 Watt

6. Operation of this device above any of these conditions may cause permanent damage.  
 7. Derate linearly to 2.5W at 85°C.

**Truth Table<sup>(8)</sup>** (State of control voltage selects the desired switch state)

State of Control Voltages			RF Common to			
Control #1	Control #2	Control #3	RF1	RF2	RF3	RF4
L	L	L	ON	—	—	—
L	L	H	—	ON	—	—
H	L	L	—	—	ON	—
H	L	H	—	—	—	ON
H	H	H	Shutdown			

8. Any control state not defined above, places the switch in an undefined state, but will not damage the switch.

**Characterization Test Circuit**

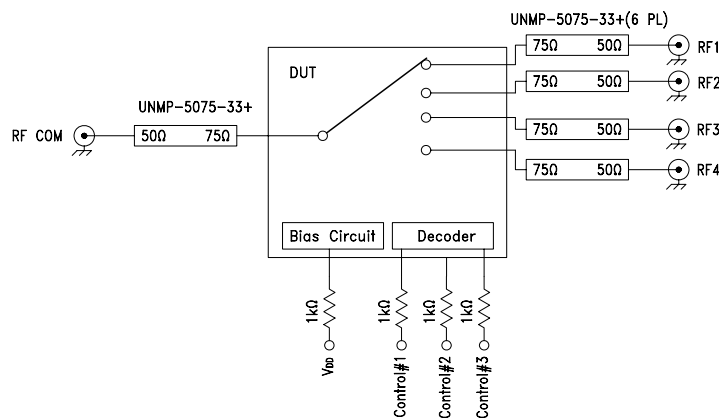


Figure 1: Block Diagram Of Test Circuit Used For Characterization.  
 (DUT soldered on Mini-Circuits' TB-722-4-F+)

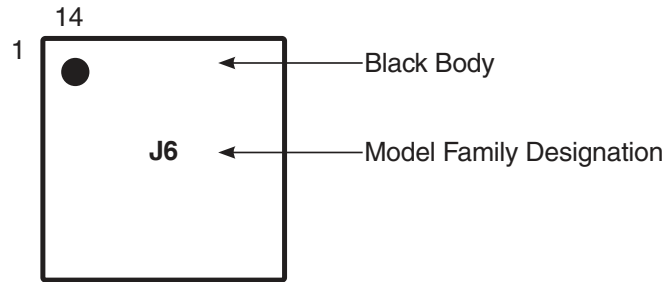
**Test Equipment:**

- For Insertion loss, Isolation, Return loss:**  
 Agilent's N5230A Network Analyzer , E3631A power supply. Mini-Circuits matching pads UNMP-5075-33+
- For Switching Time and Video Feed through**  
 Agilent's HP81110A pulse generator, 54833A Oscilloscope, E3631A power supply.  
 Agilent's N9020A Spectrum Analyzer , E8257D Generator, E3631A power supply
- For Compression:**  
 R&S Network Analyzer ZVA24, E3631A power supply.

**Conditions:**

- V<sub>DD</sub>= +2.5, +3.0 and +4.8V, Control= 0 and 1.35V.
- For Insertion loss, isolation and return loss:** Pin=0 dBm
- For Input IP3:** Pin=+10dBm/tone at V<sub>DD</sub>=3V
- For Switching time:** RF frequency: DC at 200mV, Control Frequency: 10 KHz and 0 and +8V.

Product Marking



Recommended Application Circuit

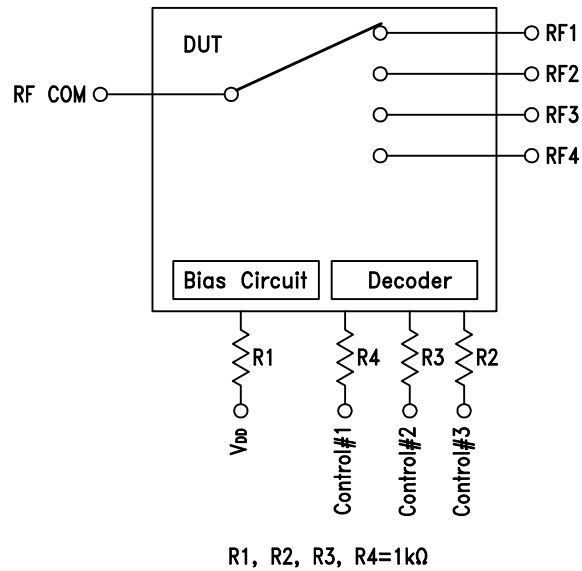


Fig. 2: Evaluation board includes case, connectors and components soldered to PCB.

Additional Detailed Technical Information	
<i>additional information is available on our dash board. To access this information <a href="#">click here</a></i>	
<b>Performance Data</b>	Data Table
	Swept Graphs
<b>Case Style</b>	MT1817 <i>Plastic package; Lead finish: Matte Tin</i>
<b>Tape &amp; Reel</b>	F108
<b>Standard quantities available on reel</b>	<i>7" reels with 20, 50, 100, 200, 500, 1K or 3K devices</i>
<b>Suggested Layout for PCB Design</b>	PL-459
<b>Evaluation Board</b>	TB-722-4-F+
<b>Environmental Ratings</b>	ENV75

**ESD Rating**

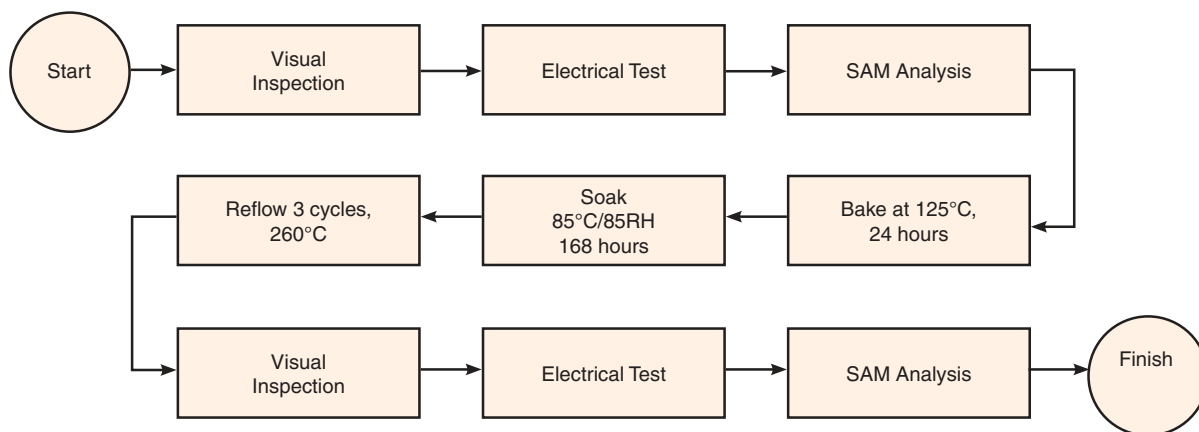
Human Body Model (HBM): Class 1B (500 to < 1000V) in accordance with JESD22-A114

Machine Model (MM): Class A (Pass 100V) in accordance with JESD22-A115

**MSL Rating**

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

**MSL Test Flow Chart**



**Additional Notes**

- A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
- B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
- C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the Standard Terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at [www.minicircuits.com/MCLStore/terms.jsp](http://www.minicircuits.com/MCLStore/terms.jsp)