



MMIC

SP4T RF Switch

HSWA4-63DR+

Absorptive RF Switch with internal driver
Single Supply Voltage, +2.3V to +5.5V

THE BIG DEAL

- High Isolation, 61 dB @ 0.9 GHz
- Low insertion loss, 0.9 dB at 0.9 GHz
- High IP3, +58 dBm
- Fast switching, 255 ns typ.
- Low current consumption, 110µA
- Immune to latch-up



CASE STYLE: DG984-1

Generic photo used for illustration purposes only

+RoHS Compliant

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

APPLICATIONS

- Defense
- Test and Measurements
- Switch matrices

PRODUCT OVERVIEW

Mini-Circuits' HSWA4-63DR+ is a MMIC SP4T absorptive switch with an internal driver designed for wideband operation from 30 MHz to 6 GHz, supporting many applications requiring high performance across a wide frequency range. This model provides excellent isolation, fast switching speed and high linearity in a tiny 4x4mm 24-Lead MCLP package. Produced using a unique CMOS process on silicon, it offers the performance of GaAs with the advantages of conventional CMOS devices. HSWA4-63DR+ provides a high level of ESD protection, MSL1 moisture sensitivity rating, and excellent repeatability.

KEY FEATURES

| Feature | Advantages |
|--|--|
| Wideband, 30 MHz to 6.0 GHz | One model can be used in many applications, saving component count. Also ideal for wideband applications such as military and instrumentation. |
| Absorptive switch | In the off condition, RF output ports which are not switched ON are terminated into 50Ω. This enables proper impedance termination of the circuitry following the RF output ports, preventing any unintended action such as oscillation. |
| High Isolation: <ul style="list-style-type: none"> • 61 dB at 0.9 GHz • 32 dB at 6 GHz | High isolation significantly reduces leakage of power into OFF ports. |
| High linearity <ul style="list-style-type: none"> • +58 dBm IIP3 • +97 dBm IIP2 at 1.9 GHz | High linearity minimizes unwanted intermodulation products which are difficult or impossible to filter in multi-carrier environments such as CATV, or in the presence of strong interfering signal from adjacent circuitry or received by antenna. |
| Built-in negative voltage generator | Operates with 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. |
| Wide Supply Voltage and low current +2.3 to 5.5V and 110µA typ. | Ideal for battery operated systems consuming very low current for long battery life. |
| Immune to Latch-up | Unlike conventional CMOS devices, HSWA is immune to latch-up |
| Tiny size, 4 x 4mm QFN package | Tiny footprint saves space in dense layouts while providing low inductance, repeatable transitions, and excellent thermal contact to the PCB. |



**MMIC**

SP4T RF Switch

HSWA4-63DR+

Absorptive RF Switch with internal driver
Single Supply Voltage, +2.3V to +5.5V

RF ELECTRICAL SPECIFICATIONS¹, 30 MHz - 6 GHz, TAMB=25°C, VDD= +3.3V

| Parameter | Condition (MHz) | Min. | Typ. | Max. | Units |
|---|-----------------|------|------|------|-------|
| Frequency range | | 30 | | 6000 | MHz |
| Insertion loss ² | 30 - 900 | — | 0.9 | 1.1 | dB |
| | 900 - 2100 | — | 1.1 | 1.35 | |
| | 2100 - 2700 | — | 1.15 | 1.4 | |
| | 2700 - 4000 | — | 1.25 | 1.5 | |
| | 4000 - 6000 | — | 1.9 | 2.5 | |
| Isolation between Common port and output ports | 30 - 900 | 55 | 61 | — | dB |
| | 900 - 2100 | 52 | 55 | — | |
| | 2100 - 2700 | 50 | 52 | — | |
| | 2700 - 4000 | 42 | 43 | — | |
| | 4000 - 6000 | 27 | 32 | — | |
| Isolation among output ports | 30 - 900 | 56 | 61 | — | dB |
| | 900 - 2100 | 51 | 54 | — | |
| | 2100 - 2700 | 50 | 52 | — | |
| | 2700 - 4000 | 41 | 44 | — | |
| | 4000 - 6000 | 29 | 32 | — | |
| Return loss (ON STATE) | 30 - 4000 | — | 17 | — | dB |
| | 4000 - 6000 | — | 12 | — | |
| Return loss (OFF STATE) | 30 - 4000 | — | 22 | — | dB |
| | 4000 - 6000 | — | 19 | — | |
| Input IP2 | 1900 | — | 97 | — | dBm |
| Input IP3 | 1900 | — | 58 | — | dBm |
| 0.1 dB Input compression ³ | 900 | — | 35 | — | dBm |
| RF Input operating power, CW | 30 - 6000 | — | — | 33 | dBm |
| RF input power into terminated output ports, CW | 30 - 6000 | — | — | 24 | dBm |

DC ELECTRICAL SPECIFICATIONS

| Parameter | Min. | Typ. | Max. | Units |
|---------------------------------|------|------|------|-------|
| Supply voltage, V _{DD} | 2.3 | | 5.5 | V |
| Supply current | | 110 | | μA |
| Control voltage Low | -0.3 | | 0.6 | V |
| Control voltage High | 1.17 | | 3.6 | V |
| Control current | | 9 | 1 | μA |

SWITCHING SPECIFICATIONS

| Parameter | Condition | Min. | Typ. | Max. | Units |
|---|---|------|------|------|-------------------|
| Switching time 50% control to 90/10%RF | fFR=50 MHz fctrl=50 KHz Vctrl High=3.3V Vctrl Low=0V | | 255 | 330 | nS |
| Video feed-through | | | 14 | | mV _{p,p} |
| Rise/Fall time 10 to 90% or 90 to 10% | | | 100 | | nS |

Notes:

1. Tested on Mini-Circuits' test board TB-927+, using Agilent's N5230A network analyzer (see Characterization test circuit, Fig.1).

2. Insertion loss values are de-embedded from test board loss.

3. Do not exceed RF input power as shown in Absolute Maximum Ratings table.





SP4T RF Switch

Absorptive RF Switch with internal driver
Single Supply Voltage, +2.3V to +5.5V

MAXIMUM RATINGS⁴

| Parameter | Ratings |
|----------------------------------|---------------------|
| Operating temperature | -40°C to +105°C |
| Storage temperature | -65°C to 150°C |
| V _{DD} , Supply voltage | -0.3 to 5.5V |
| Voltage control | -0.3V Min. 3.6 Max. |
| RF Input power, CW | +34 dBm |

4. Operation of this device above any of these conditions may cause permanent damage.

TRUTH TABLE - 3 PIN CONTROL

| Mode | State of Control Voltage | | |
|---------------|--------------------------|-----------|-----------|
| | Control 3 | Control 2 | Control 1 |
| RF COM-RF1 ON | LOW | LOW | HIGH |
| RF COM-RF2 ON | LOW | HIGH | LOW |
| RF COM-RF3 ON | LOW | HIGH | HIGH |
| RF COM-RF4 ON | HIGH | LOW | LOW |
| | LOW | LOW | LOW |
| ALL OFF | HIGH | LOW | HIGH |
| ALL OFF | HIGH | HIGH | LOW |
| Unsupported | HIGH | HIGH | HIGH |

TRUTH TABLE - 2 PIN CONTROL⁵

| Mode | State of Control Voltage | |
|---------------|--------------------------|-----------|
| | Control 2 | Control 1 |
| RF COM-RF1 ON | LOW | HIGH |
| RF COM-RF2 ON | HIGH | LOW |
| RF COM-RF3 ON | HIGH | HIGH |
| RF COM-RF4 ON | LOW | LOW |

5. Pad 19= control 3 must be grounded.



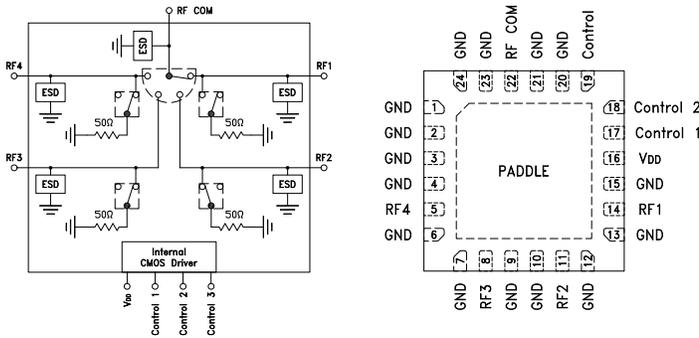
MMIC

SP4T RF Switch

HSWA4-63DR+

Absorptive RF Switch with internal driver
Single Supply Voltage, +2.3V to +5.5V

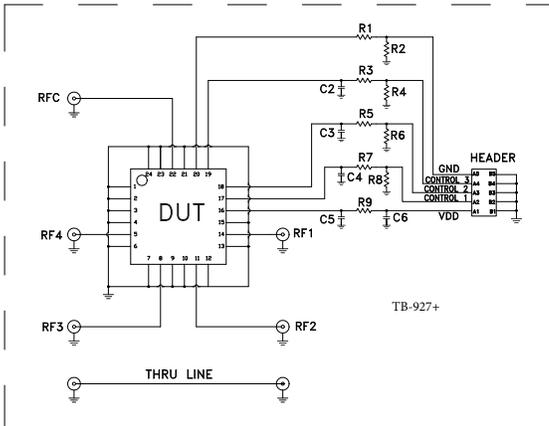
SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION



| Function | Pad Number | Description |
|-----------|---------------------------------|-----------------------|
| RF COM | 22 | RF Common/ SUM port* |
| RF1 | 14 | RF out #1/In port #1* |
| RF2 | 11 | RF out #2/In port #3* |
| RF3 | 8 | RF out #3/In port #2* |
| RF4 | 5 | RF out #4/In port #4* |
| Control 1 | 17 | CMOS Control IN #1 |
| Control 2 | 18 | CMOS Control IN #2 |
| Control 3 | 19 | CMOS Control IN #3 |
| VDD | 16 | Supply voltage |
| GND | 1-4,6,9,10,12,13,15,20,21,23,24 | RF Ground |

*Must be held at 0VDC. If required add DC blocking capacitors on these ports.

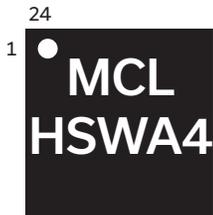
CHARACTERIZATION & APPLICATION CIRCUIT



| Component | Value | Size |
|------------------------|-------------|--------|
| DUT | HSWA4-63DR+ | 4x4 mm |
| C2, C3, C4, C5 | 100pF | 0402 |
| C6 | 1uF | |
| R1, R2, R3, R5, R7, R9 | 0 Ohm | |
| R4, R6, R8 | 1 MOhm | |

Figure 1. Block Diagram of test Circuit used for characterization (DUT soldered on Mini-Circuit's TB-927+).

PRODUCT MARKING



| Parameter | Conditions $V_{DD}=+2.3V$ and $5.5V$ Control= $0V$ and $3.3V$ | Test Equipment |
|---|---|---|
| Insertion loss, Isolation, Return loss and DC current | Pin=0 dBm | Keysight N5242A Network Analyzer, E3631A power supply. Cblock: Internal to network Analyzer. |
| Switching time and DC Current | RF frequency: 50 MHz at 0 dBm, Control frequency: 50 KHz | Keysight 54832B oscilloscope, 81110A pulse generator and E3631A power supply |
| Input IP3 | +15 dBm / tone | Keysight ES257D signal generators, E4416A power meter, N9020A Signal analyzer and E3631A power supply |
| Compression | — | Keysight N5242A Network Analyzer, E3631A power supply |



MMIC

SP4T RF Switch

HSWA4-63DR+

Absorptive RF Switch with internal driver
Single Supply Voltage, +2.3V to +5.5V

[CLICK HERE](#)

ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD. TO ACCESS

| | |
|--|---|
| Performance Data | Data Table Swept Graphs |
| Case Style | DG984-1 Plastic package, exposed paddle , termination finish=NiPdAu |
| Tape & Reel Standard quantities available on reel | F68 7" reels with 20, 50, 100, 200, 500, 1000 & 3000 devices |
| Suggested Layout for PCB Design | PL-514 |
| Evaluation Board | TB-927+ |
| Environmental Ratings | ENV84 |

ESD RATING

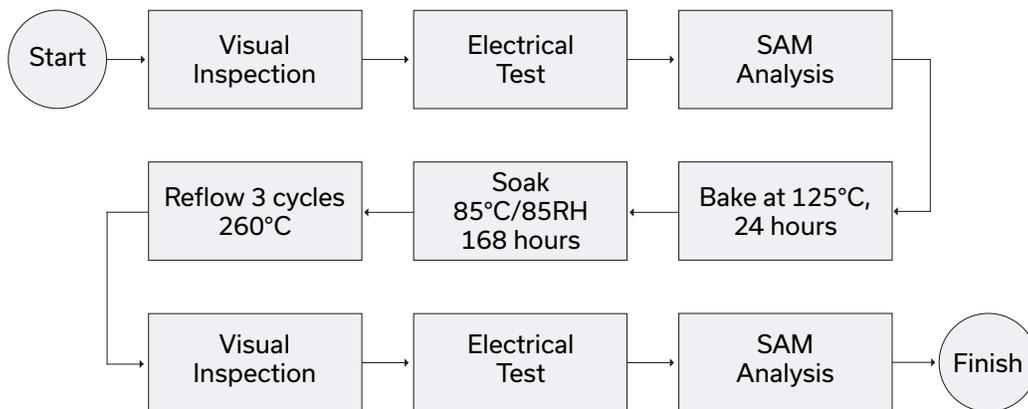
Human Body Model (HBM): Class 2 (Pass 2000V) in accordance with MIL-STD-883, Method 3015

Charge Device Model (CDM): Class C1 (Pass 250V) in accordance with JESD22-C101

MSL RATING

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

MSL TEST FLOW CHART



- 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/terms/viewterm.html

