USB RF SPDT Switch Matrix

50Ω DC to 8000 MHz

The Big Deal
• DC passing & ultra-wide bandwidth, DC to 8 GHz
• Dual SPDT switch with single USB interface
• High isolation, 50 dB typ up to 4 GHz
• High power handling, +35 dBm max

Typical Applications
• Satcom / GNSS antenna switching (RF & DC paths)
• Signal routing / switch matrices
• High volume production testing / ATE
• Design verification testing

Product Overview
Minicircuits’ USB-2SP2T-DCH is a low cost, USB controlled, solid state matrix, containing two independent SPDT RF switches. Each fast switching, absorptive SPDT switch operates from true DC all the way to 8 GHz with 10 µs typical switch transition speed. High linearity (+50 dBm typ IP3), low insertion loss (1.5 dB typ) and high isolation (50 dB typical) allow the model to be used for a wide variety of RF applications.

Full software support is provided for USB control, including our user-friendly GUI application for Windows and a full API with programming instructions for Windows and Linux environments (both 32-bit and 64-bit systems). The latest version of the full software package can be downloaded from https://www.minicircuits.com/softwaredownload/solidstate.html at any time.

The USB-2SP2T-DCH is housed in a compact, low profile, rugged metal case (4.58” x 2.00” x 0.475”) with 6 SMA (F) connectors (COM, 1 and 2 for each switch), and a USB Mini-B port for power control.

Key Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Advantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>High speed switch transition (10 µsec typ)</td>
<td>High speed switching reduces the time the signal paths are interrupted and allows the switch to be used in a wider range of applications.</td>
</tr>
<tr>
<td>High Linearity (IP3 50 dBm typ.)</td>
<td>Results in little or negligible inter-modulation generation, meeting requirements for digital communications signals</td>
</tr>
<tr>
<td>Low insertion loss (1.5 dB typ)</td>
<td>Results in reduced system loss and heat build up</td>
</tr>
<tr>
<td>Full software support included</td>
<td>Mini-Circuits’ full software package, programming and user manual are available for download from <a href="https://www.minicircuits.com/softwaredownload/solidstate.html">https://www.minicircuits.com/softwaredownload/solidstate.html</a> at no extra cost.</td>
</tr>
</tbody>
</table>

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Rev. D
M176709
EDR-11445
USB-2SP2T-DCH
RAV
191120
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## USB RF SPDT Switch Matrix

### Electrical Specifications @ 0 to 50°C

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<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Frequency</td>
<td>DC to 300 MHz</td>
<td></td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td>DC to 300 - 3000 MHz</td>
<td></td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td>DC to 3000 - 6000 MHz</td>
<td></td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td>DC to 6000 - 8000 MHz</td>
<td></td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>Insertion Loss</td>
<td>COM to any active port</td>
<td>0.75</td>
<td>1.2</td>
<td>1</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>300 - 3000 MHz</td>
<td>1.0</td>
<td>1.5</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>3000 - 6000 MHz</td>
<td>1.3</td>
<td>2.5</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>6000 - 8000 MHz</td>
<td>1.7</td>
<td>3.0</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>COM to any terminated port</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>Between ports 1 and 2 of each switch</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>DC to 300 MHz</td>
<td>70</td>
<td>90</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>300 - 3000 MHz</td>
<td>46</td>
<td>57</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>3000 - 6000 MHz</td>
<td>33</td>
<td>44</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>6000 - 8000 MHz</td>
<td>28</td>
<td>37</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td>Isolation</td>
<td>COM to any terminated port</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>DC to 300 MHz</td>
<td>62</td>
<td>81</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>300 - 3000 MHz</td>
<td>40</td>
<td>51</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>3000 - 6000 MHz</td>
<td>31</td>
<td>41</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>6000 - 8000 MHz</td>
<td>26</td>
<td>36</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>Switch A to Switch B</td>
<td></td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td>DC to 8000 MHz</td>
<td>71</td>
<td>103</td>
<td>–</td>
<td>dB</td>
</tr>
<tr>
<td>VSWR</td>
<td>COM or any active port</td>
<td></td>
<td></td>
<td></td>
<td>:1</td>
</tr>
<tr>
<td></td>
<td>DC to 300 MHz</td>
<td>–</td>
<td>1.2</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3000 - 6000 MHz</td>
<td>–</td>
<td>1.25</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6000 - 8000 MHz</td>
<td>–</td>
<td>1.4</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DC to 3000 MHz</td>
<td></td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td>3000 - 6000 MHz</td>
<td></td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td>6000 - 8000 MHz</td>
<td></td>
<td></td>
<td></td>
<td>MHz</td>
</tr>
<tr>
<td>Power Input @1 dB Compression 1,2,3</td>
<td>COM to any active port</td>
<td>38</td>
<td>–</td>
<td>–</td>
<td>dBm</td>
</tr>
<tr>
<td>IP3 3,4</td>
<td>COM to any active port</td>
<td>50</td>
<td>–</td>
<td>–</td>
<td>dBm</td>
</tr>
<tr>
<td>Transition Time 5</td>
<td>–</td>
<td>–</td>
<td>10</td>
<td>14</td>
<td>µs</td>
</tr>
<tr>
<td>Minimum dwell time 6</td>
<td>High Speed Mode</td>
<td>–</td>
<td>20</td>
<td>–</td>
<td>µs</td>
</tr>
<tr>
<td>Switching Time (USB) 7</td>
<td>–</td>
<td>–</td>
<td>2</td>
<td>–</td>
<td>ms</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>USB port</td>
<td>4.75</td>
<td>5</td>
<td>5.25</td>
<td>V</td>
</tr>
<tr>
<td>Rated Current</td>
<td>–</td>
<td>–</td>
<td>150</td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td>Operating RF Input Power</td>
<td>Hot Switching 1</td>
<td>–</td>
<td>–</td>
<td>+23</td>
<td>dBm</td>
</tr>
<tr>
<td></td>
<td>COM to any active port</td>
<td>–</td>
<td>–</td>
<td>+23</td>
<td>dBm</td>
</tr>
<tr>
<td></td>
<td>Note 1</td>
<td>–</td>
<td>–</td>
<td>+23</td>
<td>dBm</td>
</tr>
<tr>
<td></td>
<td>Through path 2</td>
<td>–</td>
<td>–</td>
<td>+35</td>
<td>dBm</td>
</tr>
<tr>
<td>DC bias voltage</td>
<td>Any RF port</td>
<td>–</td>
<td>–</td>
<td>–7</td>
<td>V</td>
</tr>
<tr>
<td>DC pass-through current</td>
<td>COM to any active port</td>
<td>–</td>
<td>–</td>
<td>–60</td>
<td>mA</td>
</tr>
</tbody>
</table>

1 Max operating power at terminated port degrades linearly below 20 MHz to +17 dBm at 2 MHz and remains constant from 2 MHz to DC
2 Max operating power at through path degrades linearly below 30 MHz to +25 dBm at 2 MHz and remains constant from 2 MHz to DC
3 Compression and IP3 degrade below 40 MHz
4 IP3 Tested with 1 MHz span between signals.
5 Transition time spec represents the time that the RF signal paths are interrupted during switching and thus is specified without communication delays.
6 Minimum dwell time is the shortest time that can be achieved between 2 switch transitions when programming an automated switch sequence.
7 Switching time (USB) is the time from issuing a single software command via USB to the switch state changing. The most significant factor is the host PC, influenced by CPU load and USB protocol. The time shown is an estimate for a medium CPU load and USB 2.0 connection.
## USB RF SPDT Switch Matrix

### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature</td>
<td>0°C to 50°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-20°C to 60°C</td>
</tr>
<tr>
<td>DC supply voltage max.</td>
<td>6V</td>
</tr>
<tr>
<td>RF power into termination</td>
<td>DC - 20 MHz Derate linearly from +24 dBm@20 MHz to +18 dBm@2 MHz and remains constant from 2 MHz to DC</td>
</tr>
<tr>
<td></td>
<td>20 - 8000 MHz +24 dBm</td>
</tr>
<tr>
<td>RF power @ Through Path</td>
<td>DC - 30 MHz Derate linearly from +38 dBm@30 MHz to +28 dBm at 2 MHz and remains constant from 2 MHz to DC</td>
</tr>
<tr>
<td></td>
<td>30 - 8000 MHz 38 dBm</td>
</tr>
<tr>
<td>DC voltage @ RF Ports</td>
<td>±7V</td>
</tr>
<tr>
<td>DC pass-through current</td>
<td>80mA</td>
</tr>
</tbody>
</table>

Permanent damage may occur if any of these limits are exceeded. Operating in the range between operating power limits and absolute maximum ratings for extended periods of time may result in reduced life and reliability.

### Connections

<table>
<thead>
<tr>
<th>Connection</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF SPDT Switch A (1, 2, COM)</td>
<td>(SMA female)</td>
</tr>
<tr>
<td>RF SPDT Switch B (1, 2, COM)</td>
<td>(SMA female)</td>
</tr>
<tr>
<td>USB (USB type Mini-B receptacle)</td>
<td></td>
</tr>
</tbody>
</table>

### Simplified Diagram

![Simplified Diagram](attachment://xxxx-63_diagram_x12.ai)
USB RF SPDT Switch Matrix

USB-2SP2T-DCH

Outline Drawing (QM2468)

USB Mini-B Receptacle

LED Indicator

4X DIAM. L ±0.010

THRU.

6X Conn

SMA Female

Outline Dimensions (inches/millimeters)

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>WT. GRAMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.58</td>
<td>2.00</td>
<td>.475</td>
<td>.217</td>
<td>.69</td>
<td>.640</td>
<td>4.380</td>
<td>1.00</td>
<td>.010</td>
<td>.50</td>
<td>.106</td>
<td>260</td>
</tr>
<tr>
<td>116.33</td>
<td>50.8</td>
<td>12.07</td>
<td>5.51</td>
<td>17.53</td>
<td>16.26</td>
<td>111.25</td>
<td>25.40</td>
<td>2.54</td>
<td>12.70</td>
<td>2.69</td>
<td></td>
</tr>
</tbody>
</table>
USB RF SPDT Switch Matrix

Typical Performance Curves

### Insertion Loss over Temp.

- Frequency (MHz)
- Insertion Loss (dB)

- @ 0°C
- @ +25°C
- @ +50°C

### Insertion Loss of all switches in module vs. Frequency

- Frequency (MHz)
- Insertion Loss (dB)

- A1 - COM A
- A2 - COM A
- B1 - COM B
- B2 - COM B

### Insertion Loss with DC Bias at COM Port.

- Frequency (MHz)
- Insertion Loss (dB)

- DC = -7V
- DC = 0V
- DC = +7V

### Common Port VSWR over Temp.

- Frequency (MHz)
- VSWR (1)

- @ 0°C
- @ +25°C
- @ +50°C

### Active Port VSWR over Temp.

- Frequency (MHz)
- VSWR (1)

- @ 0°C
- @ +25°C
- @ +50°C

### Internal Term. VSWR over Temp.

- Frequency (MHz)
- VSWR (1)

- @ 0°C
- @ +25°C
- @ +50°C
USB RF SPDT Switch Matrix

Typical Performance Curves (Continued)

Com to Port Isolation over Temp.

Port 1 to Port 2 Isolation over Temp.

Isolation between switches over Temp.
USB RF SPDT Switch Matrix

USB-2SP2T-DCH

Software & Documentation Download:
- Mini-Circuits’ full software and support package including user guide, Windows GUI, DLL files, programming manual and examples can be downloaded free of charge from https://www.minicircuits.com/softwaredownload/solidstate.html
- Please contact testsolutions@minicircuits.com for support

Minimum System Requirements

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>USB HID</td>
</tr>
<tr>
<td>GUI:</td>
<td>Windows 32 &amp; 64 bit systems from Windows 98 up to Windows 10</td>
</tr>
<tr>
<td>USB API (ActiveX &amp; .Net)</td>
<td>Windows 32 &amp; 64 bit systems with ActiveX or .Net support from Windows 98 up to Windows 10</td>
</tr>
<tr>
<td>USB direct programming support</td>
<td>Linux, Windows systems from Windows 98 up to Windows 10</td>
</tr>
<tr>
<td>Hardware</td>
<td>Pentium® II or higher, RAM 256 MB</td>
</tr>
</tbody>
</table>

Graphical User Interface (GUI) for Windows

Key Features:
- Set each switch manually
- Set timed sequence of switching states
- Configure switch address and upgrade Firmware

Application Programming Interface (API)

Windows Support:
- API DLL files exposing the full switch functionality See programming manual at https://www.minicircuits.com/softwaredownload/Prog_Manual-Solid_State_Switch.pdf for details
  - ActiveX COM DLL file for creation of 32-bit programs
  - .Net library DLL file for creation of 32 / 64-bit programs
- Supported by most common programming environments (refer to application note AN-49-001 for summary of tested environments)

Linux Support:
- Full switch control in a Linux environment is achieved by way of USB interrupt commands. See programming manual at https://www.minicircuits.com/softwaredownload/Prog_Manual-H_Series_Switches.pdf for details
## USB RF SPDT Switch Matrix

**Model**
- USB-2SP2T-DCH

**Description**
- USB RF SPDT Switch matrix

### Ordering, Pricing & Availability Information see our web site

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB-2SP2T-DCH</td>
<td>USB RF SPDT Switch matrix</td>
</tr>
</tbody>
</table>

### Included Accessories

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUSB-CBL-3+</td>
<td>2.6 ft (0.8 m) USB Cable: USB type A(Male) to USB type Mini-B(Male)</td>
</tr>
</tbody>
</table>

### Optional Accessories

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUSB-CBL-3+ (Spare)</td>
<td>2.6 ft (0.8 m) USB Cable: USB type A(Male) to USB type Mini-B(Male)</td>
</tr>
<tr>
<td>MUSB-CBL-7+</td>
<td>6.6 ft (2.0 m) USB Cable: USB type A(Male) to USB type Mini-B(Male)</td>
</tr>
</tbody>
</table>

### 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.

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