MM5130

Application Note
March 2025

Contents

Introduction and Ideal Switch™ Technology

In today's defense, aerospace, industrial and telecom systems, high performance RF/microwave switching is required. This is becoming especially important for evolving radar and communication systems which require higher power handling and need to support a growing number of frequency bands. In many of these systems, low loss and high linearity are critical to overall system performance; and size, weight, power, and cost (SWaP-C) is a key criterion to be optimized.

With the advent of multiple antennas, new wireless protocols, Internet of Things (IoT) and next generation 3GPP telecommunications standards, new communication systems will need improved high performance switching and tuning functions, to support various Multiple Input and Multiple Output (MIMO) beamforming applications for base stations. As antenna technology transforms to accommodate more frequency bands, it has been shown that antenna transmission and reception performance is reduced. However, by utilizing active or adaptive tuning techniques to optimize the antenna frequency, pattern and gain, most of the decreased operating efficiency because of antenna detuning and environmental changes can be restored. Another important issue is the increased complexity of RF front-ends (RFFE). RFFEs need to support more frequency bands, with higher frequencies being added, all while exhibiting low insertion loss and high linearity. This is critical for preserving the receiver noise figure, maximizing transmitter power, and maintaining high data rates. By applying products manufactured with Menlo Micro's Ideal Switch™ technology, the performance, flexibility, and reliability of advanced RF/microwave systems can be greatly enhanced.

The MM5130, the latest high-frequency SP4T switch from Menlo Micro, employs a novel micro-mechanical switch structure fabricated with Menlo Micro's proprietary Ideal Switch™ technology. The technology has resolved fundamental reliability issues for micromechanical relays which in the past has limited the lifetime and power handling for these high-performance devices. Products like the MM5130 can now operate for billions of cycles under extreme environmental conditions while carrying very high-power levels.

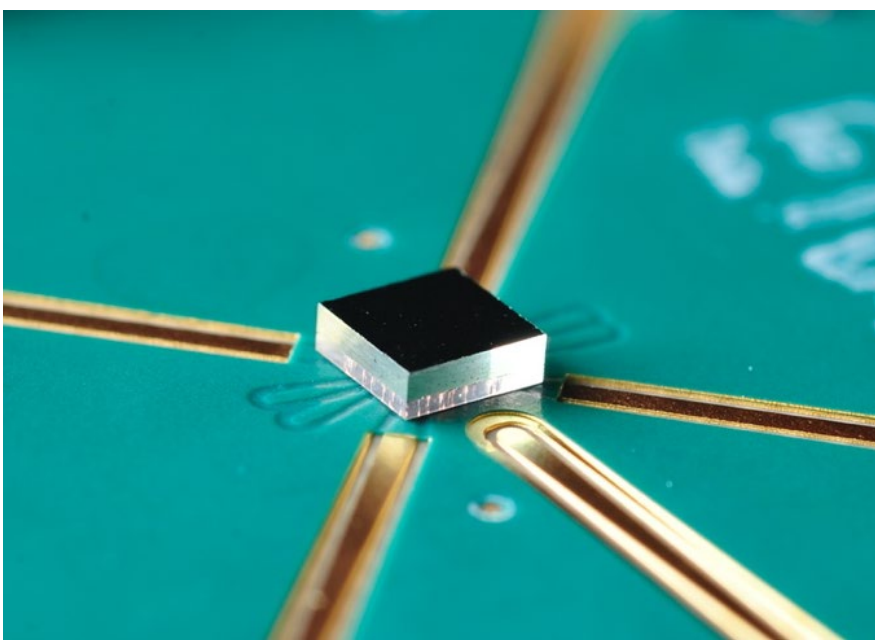


Figure 1: MM5130 in Surface-Mount Flip-Chip Package

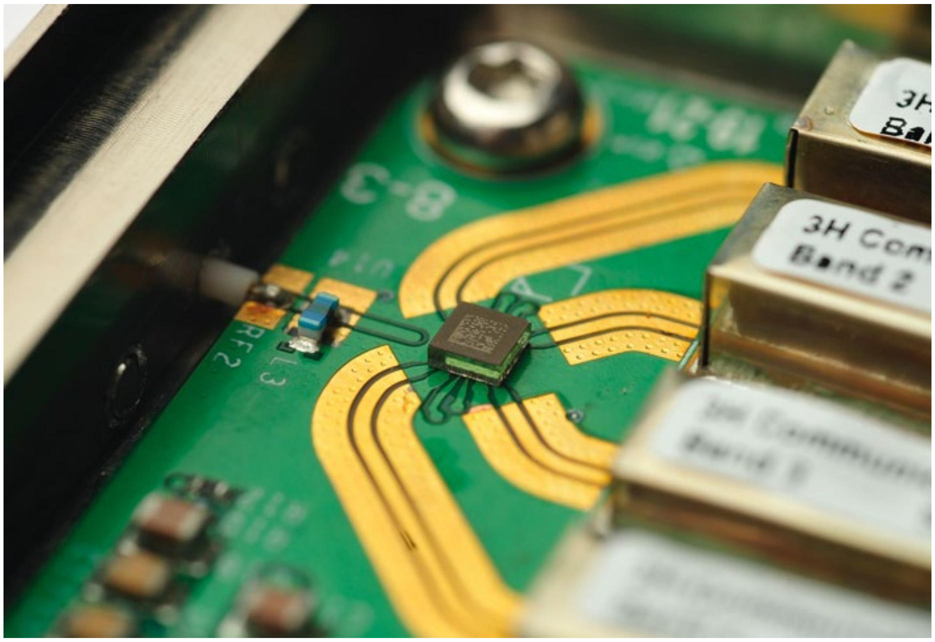


Figure 2: MM5130 Shown in a Typical Switched Filter Bank Design

The MM5130 is pictured in Figure 1 above. This shows the 2.5mm x 2.5mm, surface-mount flip-chip packaged device, as mounted to a typical evaluation board. Figure 2 is an example reference design, showing a four-channel switched filter bank. Each MM5130 channel is designed to handle up to 25W RF power (CW) at 6 GHz, without any active cooling, and demonstrates broadband low-loss performance up to 20 GHz.

The materials used to manufacture the MM5130 enable high power density for a surface mount SP4T switch, which can be deployed in antennas, transmitters, receivers, and other high-power RF front-ends utilized in terrestrial, airborne, seagoing and space-based platforms. In addition, the small size and low loss makes it ideal for high density switch matrices required for advanced test & measurement applications. Its four channels can also be used to switch capacitance or inductance into or out of an RF circuit, with very low parasitics, creating four-bits of selectivity for very high-Q tunable resonator circuits and flexible, adaptive impedance matching designs.

MM5130 Theory of Operation

The MM5130 SP4T switch works on the principle of electrostatic force to provide actuation of multiple cantilevered beams to multiple contacts, which in turn provides a connection between the input and output ports of the switch. Except for the glass substrate, all of the elements shown in Figure 3 are conductive materials and provide a low-resistance/low-impedance path between the RFC input and the four individual (RF1- RF4) outputs when a particular channel is selected. The glass substrate material provides high isolation and resistivity to the overlying conductive circuits, while reducing capacitive coupling, therefore maintaining good linearity and low loss for RF and microwave signals.

The basic operation of the switch is shown in Figure 3. As shown in the upper portion, the gate is set for a 0 V bias, so that the beam positions are in relaxed states. This means that the beam does not make connection with the contact, the path between RFC and RFx is isolated, and thus the switch is in the OFF state. Through design techniques that take advantage of Menlo's proprietary metal alloys, the MM5130 exhibits a very low C_{off}, typically 15 fF when the Switch is in the OFF State, making it useful for RF applications where low parasitics and high isolation are required. In addition, the switch is capable of a high withstanding voltage of 150V when in the OFF State, allowing it to be used in various impedance environments without resorting to the “transistor stacking” common with FET based RF switches.

As seen in the lower portion of Figure 3, the gate is now set to the switch actuation voltage of +89V, where the spring forces of the beams are overcome by the electrostatic force which now exists between the gate and beam metals. This brings the beam position to its fully deflected state, where the beam-bump now makes connection with the contact. The path between RFC and RFx is now connected with a low resistance/impedance characteristic, and thus the switch is in the ON state. Through careful design coupled with proprietary metal alloys, the switch exhibits a low R_{on}, typically < 1.0 Ohms when the switch is in the ON State. This allows the lowest possible losses for RF applications where minimized insertion loss is paramount.

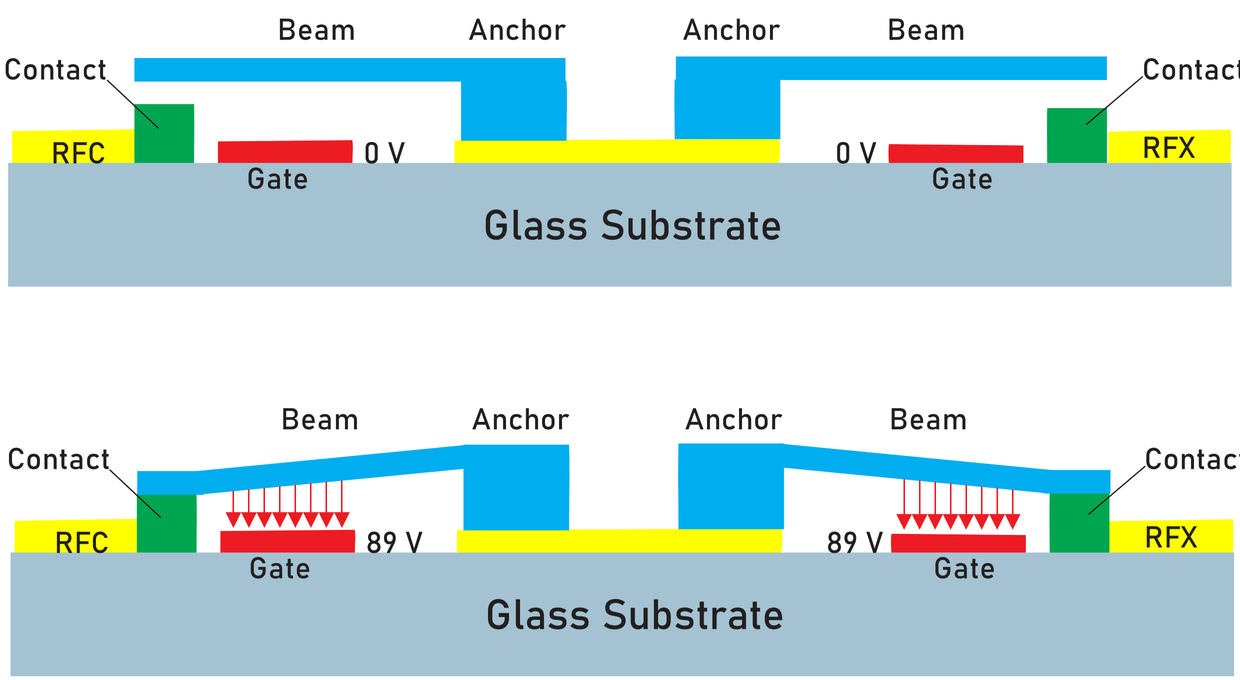


Figure 3 Switch OFF (top) and ON (bottom) states

MM5130 Block Diagram and Construction

The MM5130 device combines the above innovations and technology into a DC to 18 GHz SP4T switch. The functional block diagram below shows the RFC, RF GATES, and RF channel configurations. The four switch channels are individually controllable by applying voltage to the corresponding RF GATE pin and the configurations are represented in the functional block diagram. An illustration of the MM5130 cross-section shows the flip-chip Wafer-Level Flip-Chip Package (WL-FC) and bump configuration. The functional diagram is shown in Figure 4 below while Figure 5 depicts the mechanical design inside the package with RFC in the middle of the package.

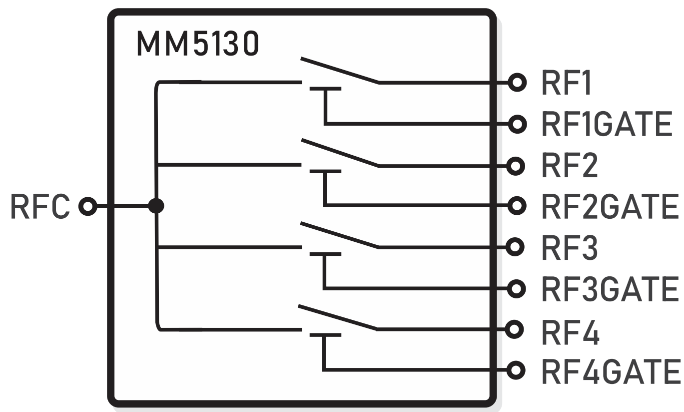


Figure 4: MM5130 Functional Block Diagram

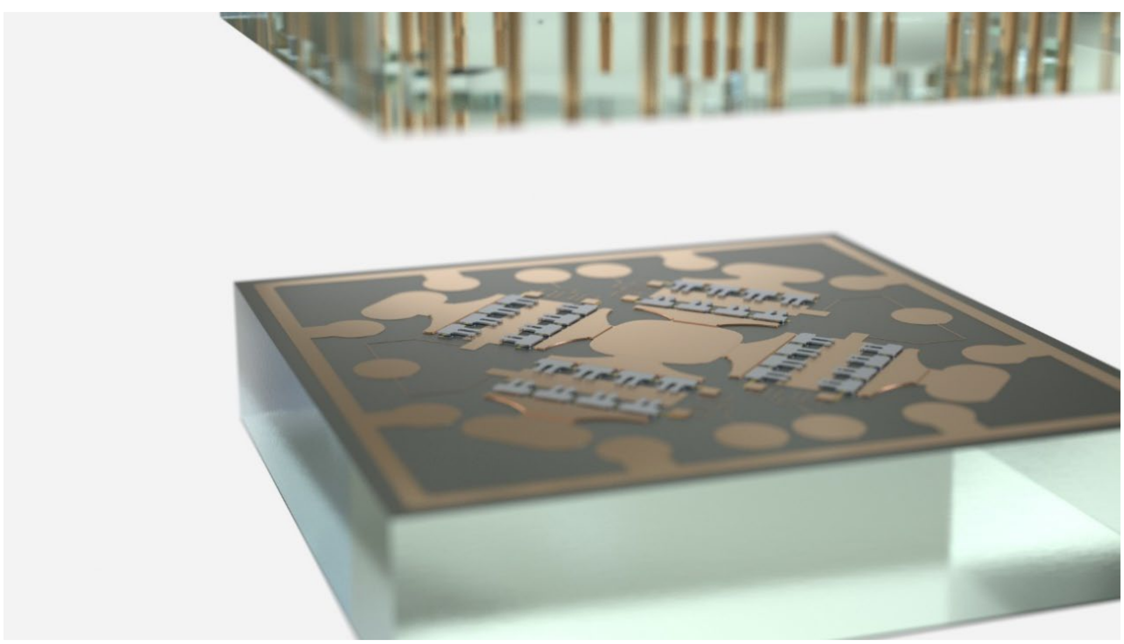


Figure 5: Inside of MM5130 SP4T Switch, center pad is RFC

Device Models

RF equivalent circuit models for the MM5130 are available in two forms:

- Lumped element model
- Transmission-line based model

The lumped element model (see Figure 5 below) is accurate in designs up to 10 GHz, and the transmission line model is accurate up to 18 GHz. For more details, please refer to the separate application note: *MM5130 Device Models Applications Note.*

In addition to equivalent circuit models, measured s-parameter files are also available from Menlo Micro. This section shows the equivalent circuit models only.

Two-port s-parameter data is available up to 20 GHz for both on and off states. Five port data (s5p file) is available up to 12 GHz.

Note: the DC effects of the internal biasing resistors are not included in the models.

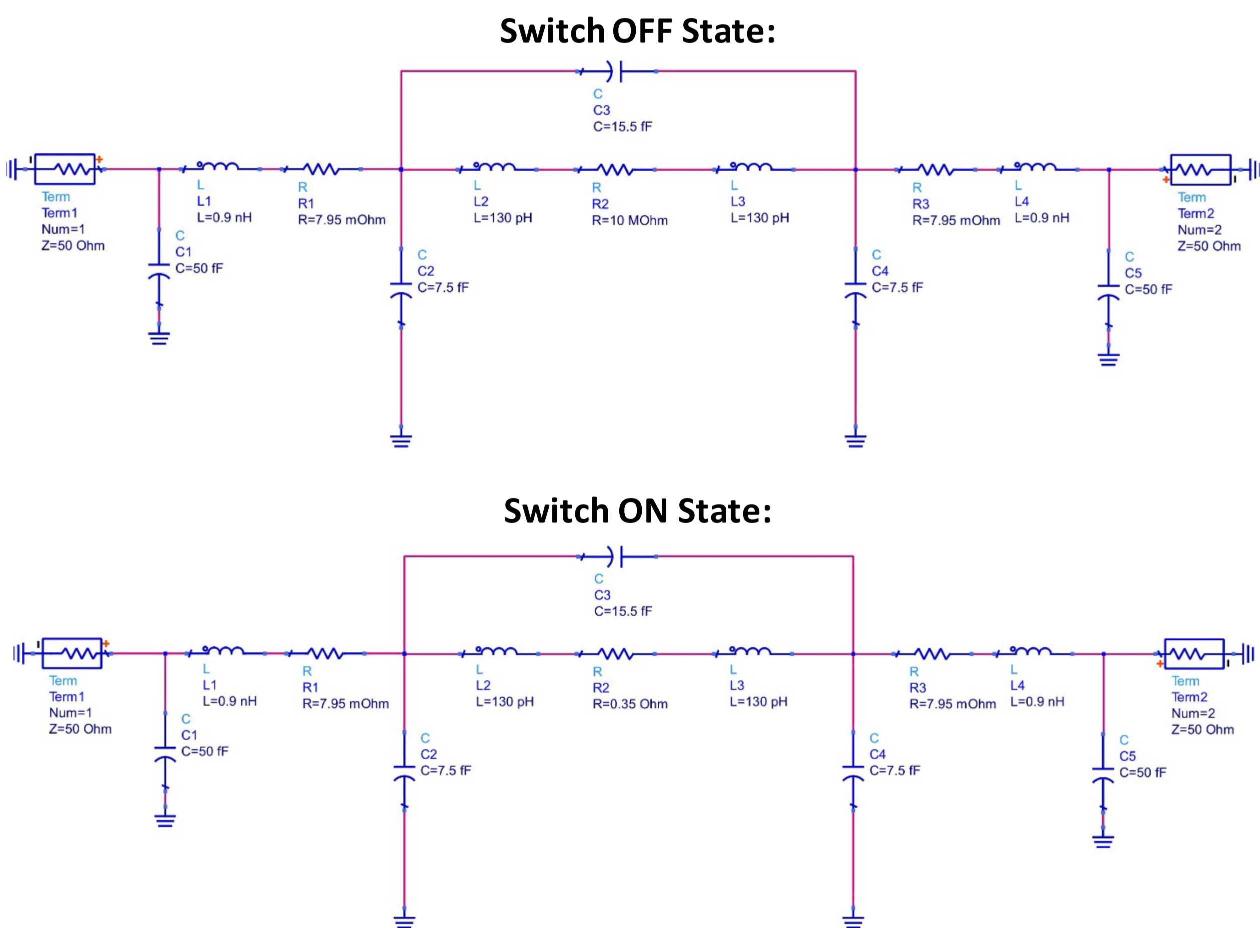


Figure 5 MM5130 typical Switch Equivalent Circuit (single Switch), OFF and ON States

Super-port Mode

Besides the normal SP4T mode, the MM5130 can also be configured in so called super-port mode to extend the frequency range up to 26 GHz. By isolating the RFC terminal and using one switch for input and another for output, a SP3T configuration with extended frequency range to 26 GHz can be achieved. See Figure 6.

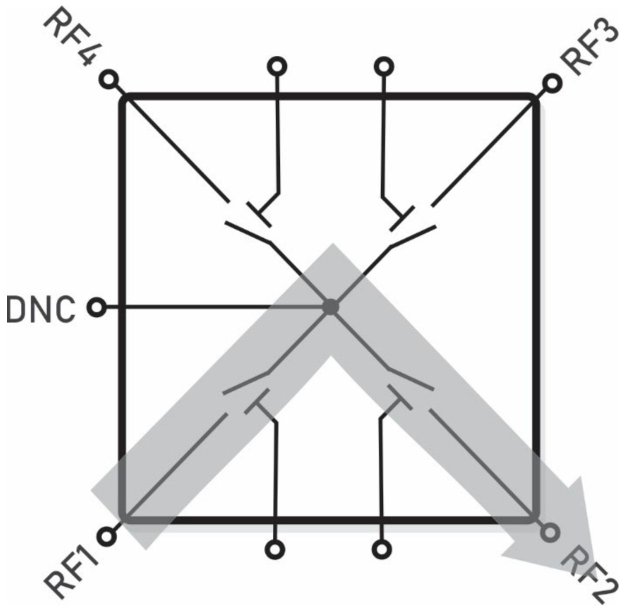


Figure 6: Super-port Mode Operation for Extended Frequency Range to 26 GHz

Operating in super-port mode improves high frequency return loss, extending the usable frequency range past 18 GHz. Note that two switches must be closed for this configuration to work. For measured performance of the super-port mode, please refer to the MM5130 datasheet.

MM5130 Power Handling - CW

Under normal low power operating conditions, the MM5130 case temperature mimics the environment temperature. However, during high power operation, the case will heat up due to power dissipation within the device. It is important to keep the device case temperature below 170 ºC for continued reliable operation. Based on an environmental hot temperature of 85 ºC, then an 85 ºC rise is allowable due to power dissipation. This results in a power dissipation limit of 1.13 W within the device. The operating power limit at a given frequency can then be calculated based on the device insertion loss.

Considering an insertion loss of -0.14 dB at 3000 MHz:

Power Handling = Max. Power Dissipation/(1-10^(Insertion Loss/10))

= 1.13/0.032

= 35.6 W

The MM5130 device insertion loss can also be approximated by a third order polynomial:

$$\text{Insertion Loss (dB)} = -1.1\text{E-}04 \cdot f^{3} + 1.2\text{E-}03 \cdot f^{2} - 0.024 \cdot f - 0.076$$

where f is frequency in GHz.

Alternatively, Figure 7 is provided below for the maximum power handling over frequency.

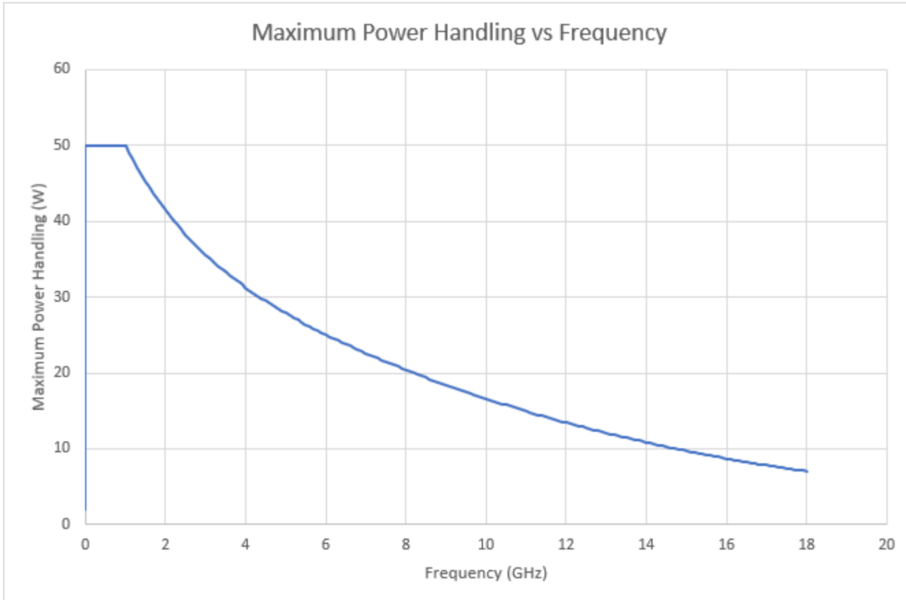


Figure 7:. Maximum Power Handling vs. Frequency (1 of 2)

This approach does not hold below 5 MHz, the maximum power handling is shown in Figure 8 for frequencies below 10 MHz.

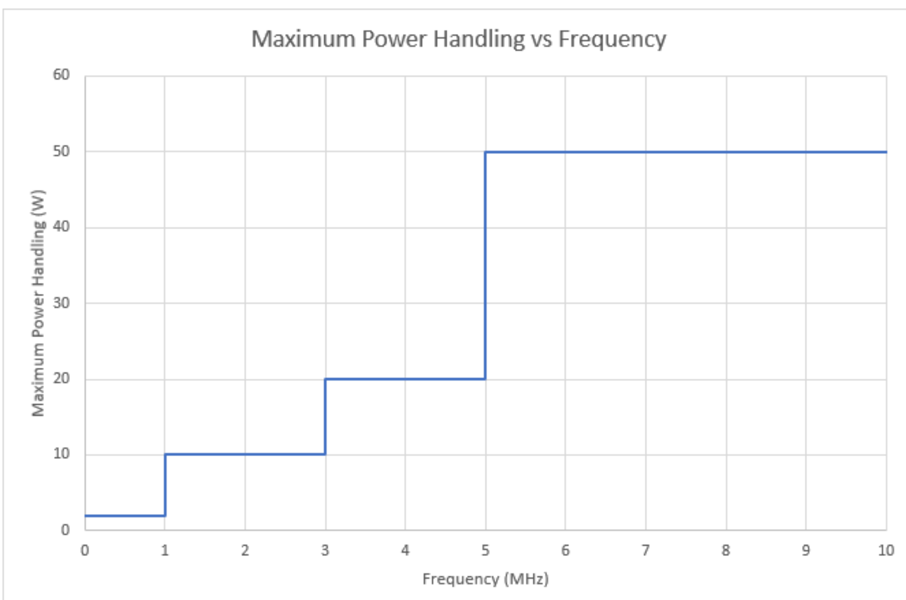


Figure 8. Maximum Power Handling vs. Frequency (2 of 2)

MM5130 Power Handling – Pulse/Peak

The MM5130 peak power operation is a function of CW power handling and voltage sufficient to cause unintended actuation. The peak power handling is determined by the maximum peak carry power (when switch is closed). Assumes maximum period of pulsed signal of 500 ms (i.e 250ms pulse width at 50% duty cycle) to avoid heating effects and operating in a 50 ohm system.

Peak power handling

Peak power is determined by the voltage on the device beam relative to the device gate. As the force keeping the switch closed is electrostatic and in proportion to the voltage difference between the gate and beam.

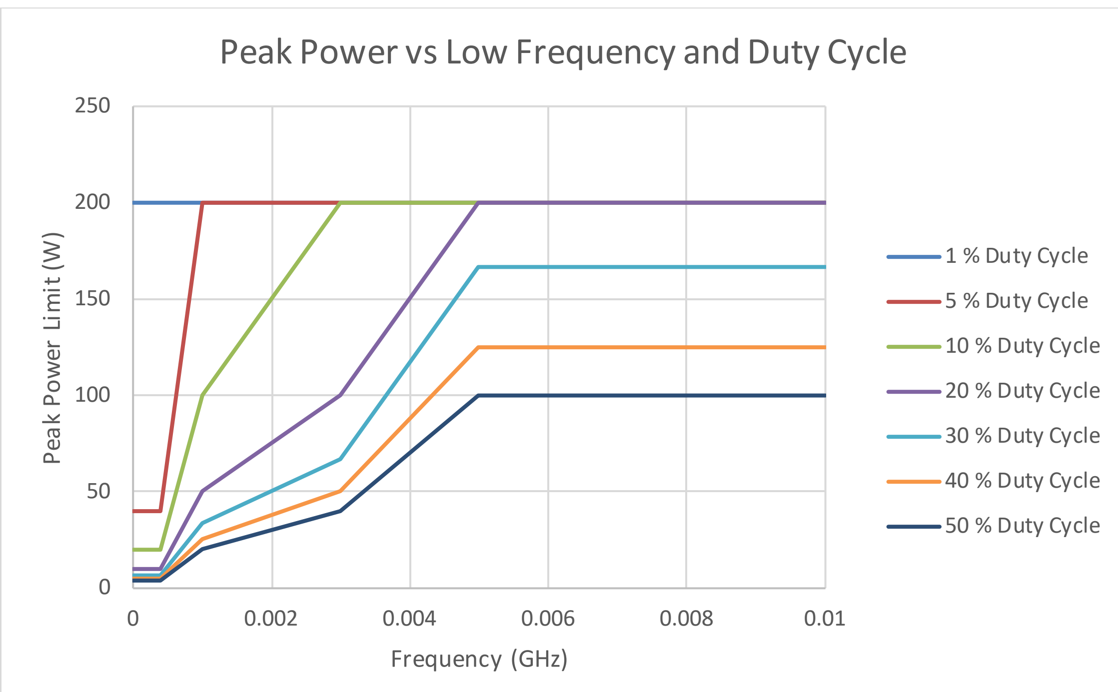
It is important to refer to the CW power limitations as described previously. This will be used along with the intended duty cycle of the pulsed power signal to determine the peak carry power limit.

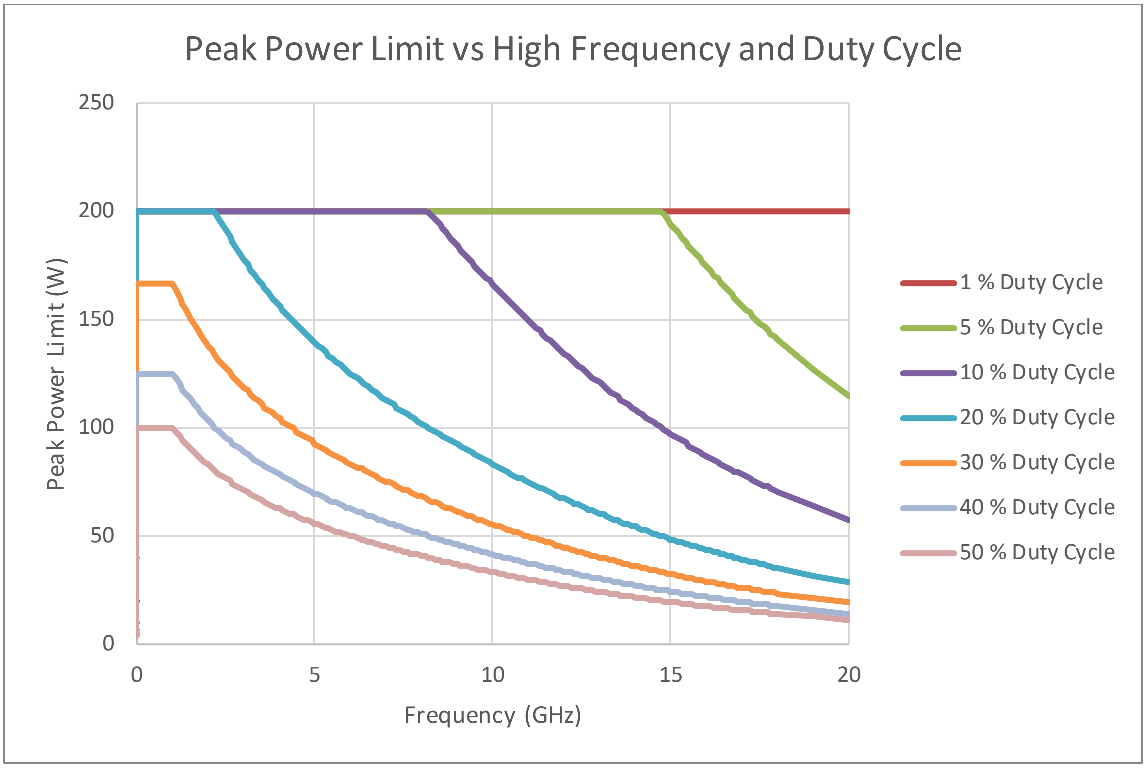
Maximum Peak carry power is given by:

Peak Power = CWpower * 1/(Duty cycle/100) <200W

For example, considering operation at say 3 GHz where the maximum CW power is 36 W, then for a 20% duty cycle the maximum peak power would be 180W. This is valid to a maximum of 200W.

The two charts below shows this for various duty cycles for both low frequency and high frequency:





MM5130 Applications

The MM5130 is well suited for unique RF/microwave frequency switching and tuning applications due to its low insertion loss, coupled with high power handling.

With the MM5130, many possible designs can be realized such as:

- Tunable Filters
- Filter Bank Select switches
- Antenna Tuners
- Programmable Attenuators
- Time delay/Phase delay circuits
- Tunable/Switchable Oscillators
- Switch Matrices/Multiplexers
- RF EM Relay Replacements

In this application note, we will cover the following applications in more detail:

- Tunable filter
- PXIe Multiplexer
- Delay shifter

Tunable Filter

The MM5130 is ideally suited for tunable filter applications. The low switch parasitics and low Ron/insertion loss enable the switch to be embedded within the filter structure at any point without significant degradation to overall filter performance. An example schematic is shown in Figure 7.

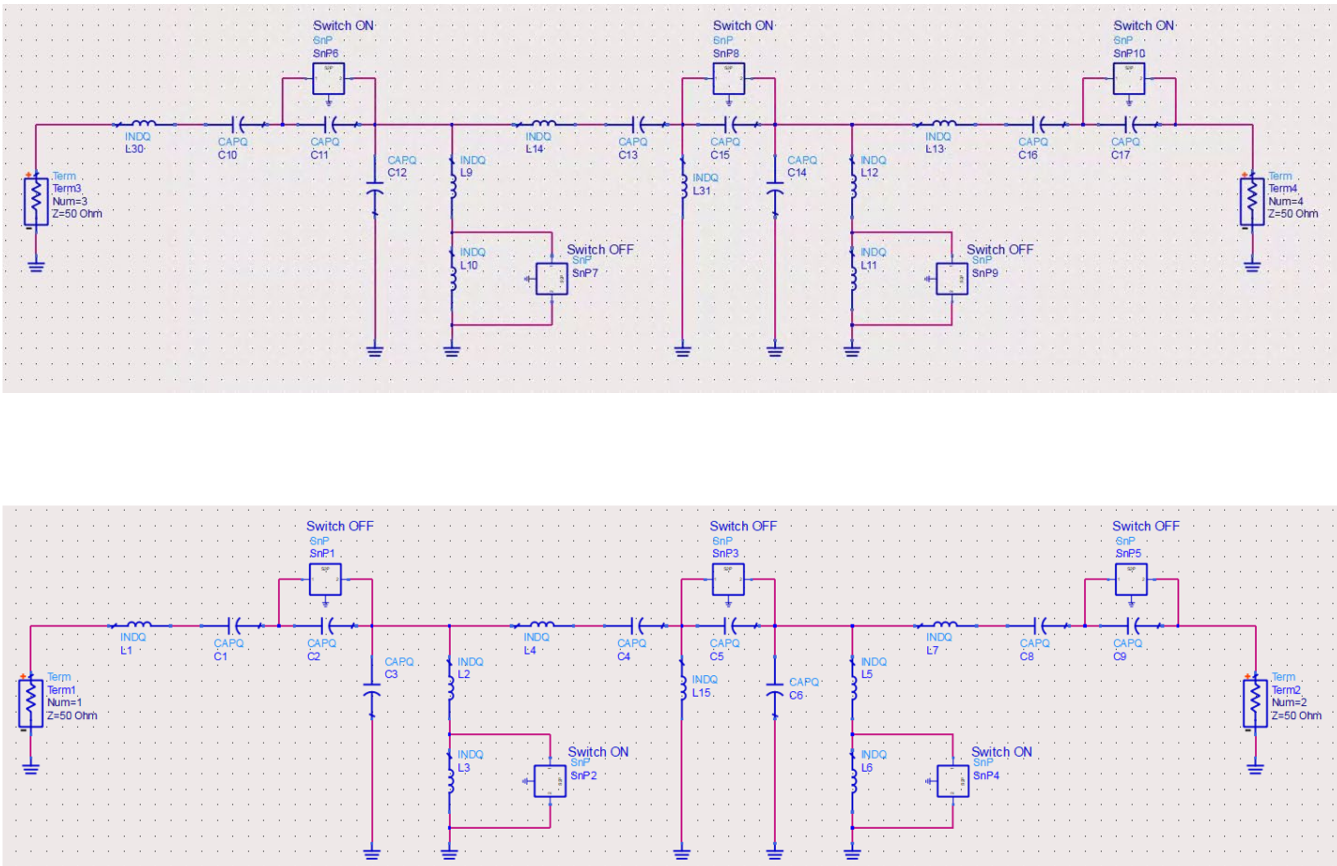


Figure 7: Example Tunable Filter Circuit

A novel tunable filter has been developed using the MM5130 Ideal Switch to tune the filter frequency over the 225 – 512 MHz range. The nominal schematic is shown in Figure 8.

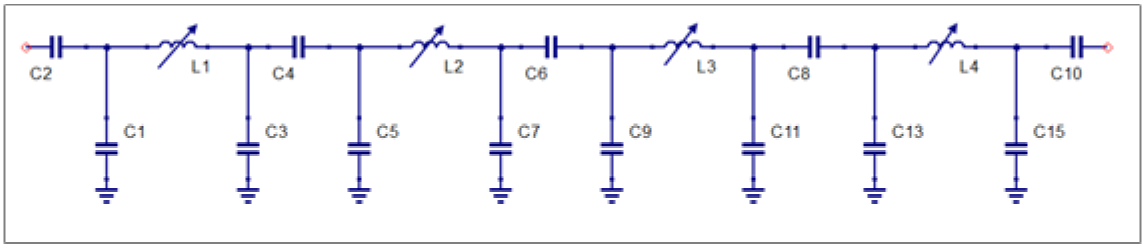


Figure 8: UHF Filter Schematic

The "PI" section of capacitors between each inductor have a constant ratio of reactance between each other as frequency is varied. This allows the response of the filter to be maintained over a wide frequency range. As only the inductors are varied and the capacitors remain constant, the percentage bandwidth is constant with frequency. This means the filter bandwidth increases with increasing frequency, which is generally desirable as the insertion loss and harmonic rejection then stay constant.

The variable inductors are realized by means of fixed inductors which are switched in and out of the circuit using the MEMS switches, as shown in Figure 9.

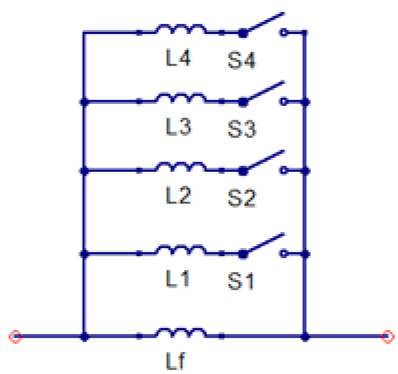


Figure 9: UHF Filter Switched Inductor

Switches S1 thru S4 are the arms of an MM5130 SP4T MEMS switch. Although the MM5130 is nominally an SP4T switch, each arm may be controlled independently giving a total of 16 possible switching states. Inductors L1 through L4 may be switched in parallel with the fixed inductor Lf effectively lowering the overall inductor value. At high frequencies, where minimum inductance is required, most of the switched can be closed. This effectively reduces the ON resistance of the switch, as multiple paths are closed in parallel.

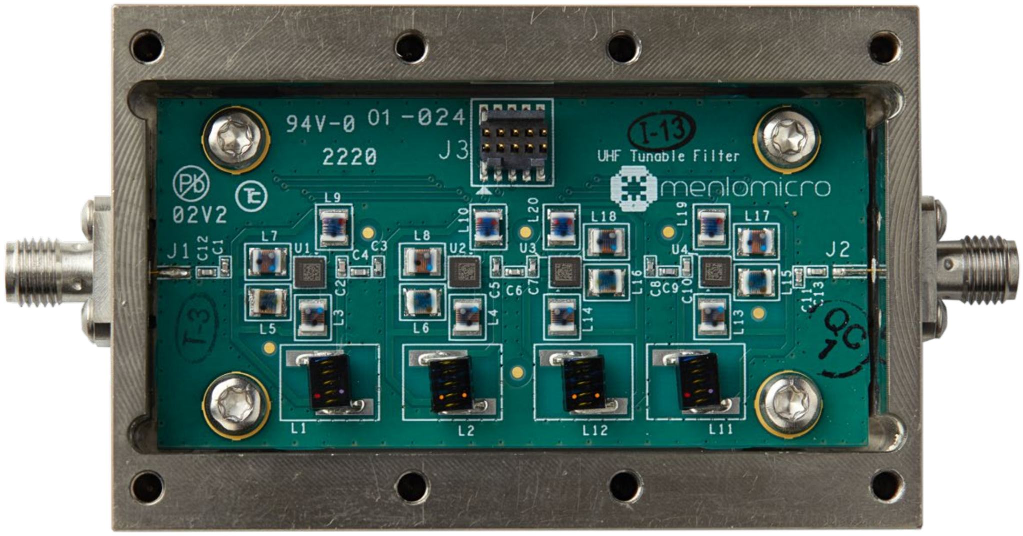


Figure 10: UHF Filter

For more detailed information, refer to the article in Microwave Journal August 2020 Issue.

https://menlomicro.com/images/general/A-Miniaturized-High-Power-UHF-Tunable-Filter-Using-MEMS-Switche-1.pdf

Switched Filter Banks

Switched filter banks are a key building block of frequency selective RF and microwave portions of many systems, both in the receive and transmit paths. The topology of the 'N channel' switched filter bank is simply N filters placed between a pair of SPNT switches. This is very effective, and many switch types can be used when the number of channels (N) is small, but as N increases and many switches are ganged in series, the insertion loss of semiconductor switches can become a significant proportion of (or even dominate) overall system loss.

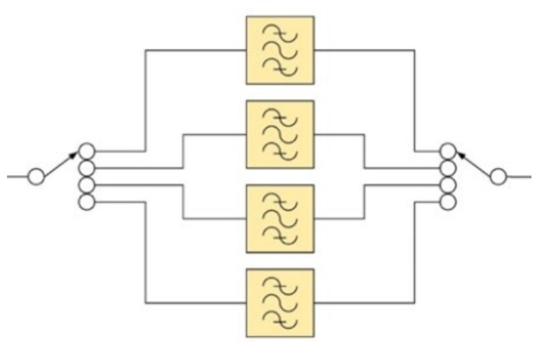


Figure 11 Switched Filter Bank

A single MM5130 can be configured for up to SP4T applications. The switches can operate well even when many are connected in series or parallel. This is due to the very low parasitics and C_{off} when the unused switches are open, and the very low insertion loss when switches are closed.

Antenna Tuning Techniques

Although the MM5130 is designed for 50 Ω operation and not specifically for antenna tuning applications, it can be used both for antenna impedance tuning and antenna aperture tuning. With the high voltage handling capability, it lends itself well to aperture tuning, where the tuning element is connected directly to the antenna element. In antenna impedance tuning, the tuning element is connected close to the feed point of the antenna and matches the impedance that the radio sees.

The MM5130 is operable between DC and 26 GHz and can handle tuning applications up to 8 GHz. Low C_{off} when unused switches are in the open state allows for flexibility in configuration. Tools, such as [Optenni Lab](), can be used to assist in selecting optimizing the network topology for a particular application.

The MM5130 is rated for 150 V peak. Care should be taken to keep RF voltage below this level. Circuit simulation can be used to assist in determining voltage levels. The MM5130 has a switching speed of less than 10 µs, which allows it to be used for rapid shifting antenna tuning applications. A gate control voltage of 89 V is used to control the switch, and it has a high reliability of > 3.0×10^9 switching operations. Several driver design options (for the 89 V) are included in this application note.

See the data sheet for additional information.

A switched inductor circuit that may be used both for antenna impedance and aperture tuning is shown in Figure 12.

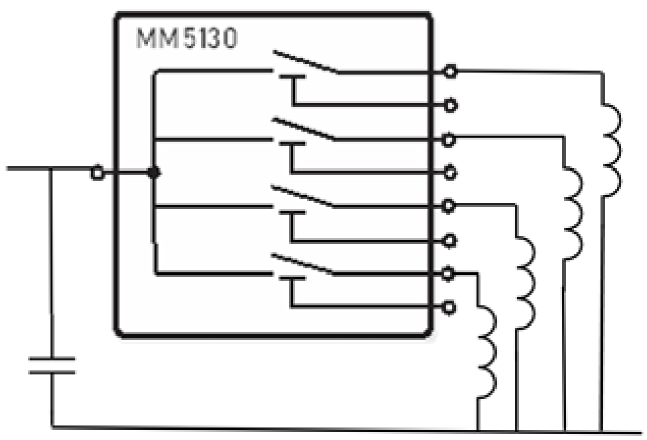


Figure 12: Switched Inductor Antenna Tuning Circuit

4-Bit Differential Delay Shifter

A high power, wideband, 4-bit, differential delay line phase shifter can be implemented using one MM5130 as illustrated in Figure 13. Typically, this type of phase shifter is used in antennas where the two outputs are connected to the top and bottom antenna elements, respectively. This implementation provides the functions of phase shifting and power divider in one unit.

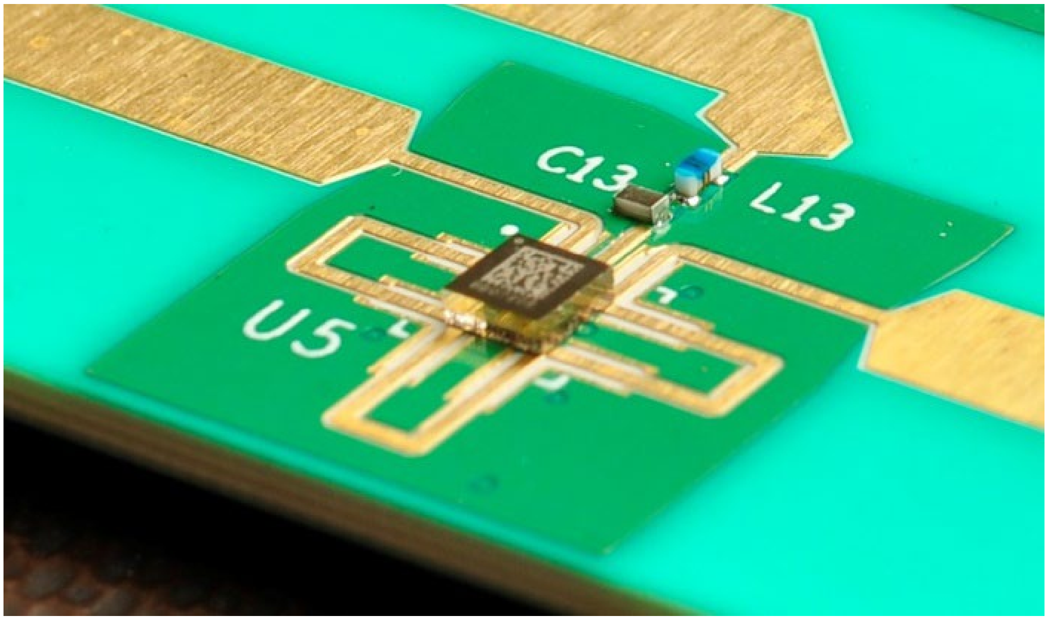


Figure 13: Differential Delay Shifter with R=Transitions to Microstrip Line

This design can be implemented both as a 50 Ω – 2 x 100 Ω configuration or as a 50 Ω – 2 x 50 Ω configuration as shown here. The matching network on the input line is important, as is the impedance of the delay lines. By combining several switches, the amount of possible phase states can be increased.

For more detailed information, refer to the article in Microwave Journal November 2020 Issue.

https://menlomicro.com/newsroom/microwave-journal-mems-switch-based-differential-delay-shifter-for-a-3.5-ghz-beam-steering-antenna

PXIe Dual SP8T Multiplexer Module

A PXIe dual SP8T multiplexer card can be implemented with a total of eleven switches. It operates up to 8 GHz, has on-board ESD protection on the RF ports and is rated for maximum of 8 W CW input power. The module consists of one controller board and dual SP8T boards. The module achieves a total insertion loss of <3 dB at 8 GHz from one input to one output. By using the super port mode of the MM5130 device, port to port isolation of up to 80 dB @8 GHz can be achieved. This design only occupies one PXI card slot making it a highly integrated dual SP8T multiplexer module.

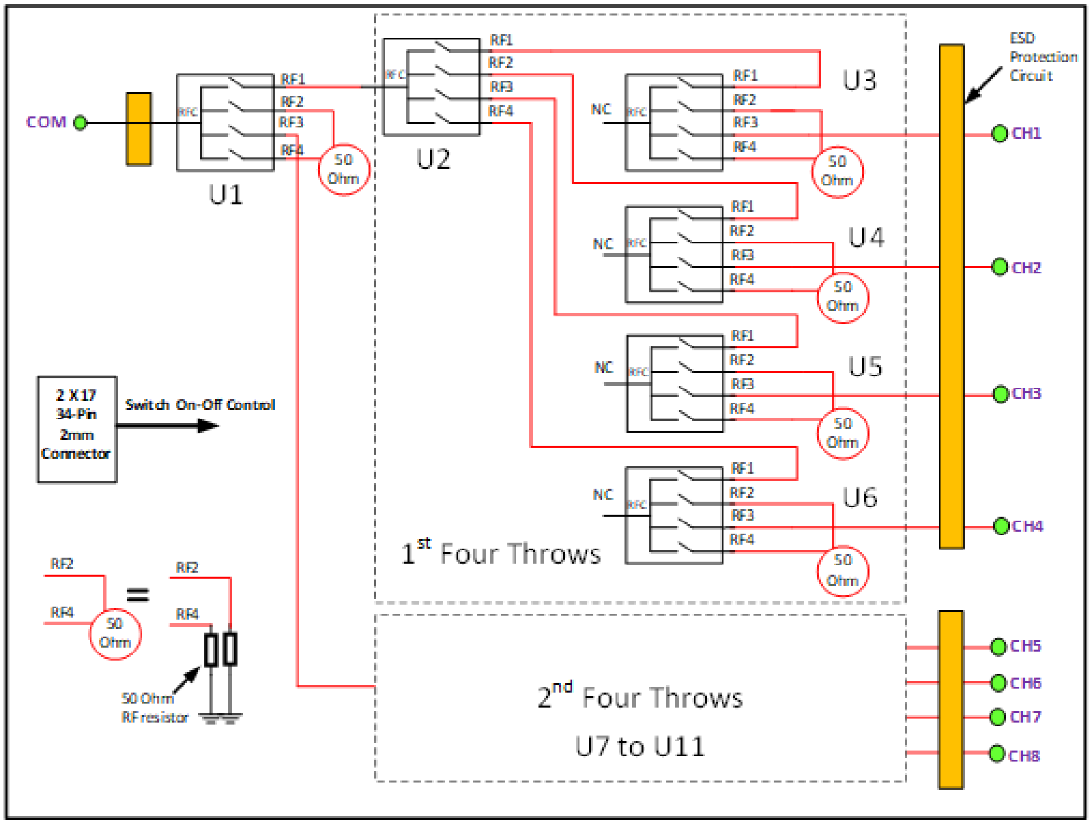


Figure 14: Simplified/Top-Level Schematic – SP8T RF Board

Figure 15 shows a photograph of the SP8T RF board. Six-layer PCB stack up used with Roger 4003C as dielectric layer to get optimum RF performance. The RF traces are routed on both top and bottom layers and a Grounded CPW (CPWG) transmission line is used for the design.

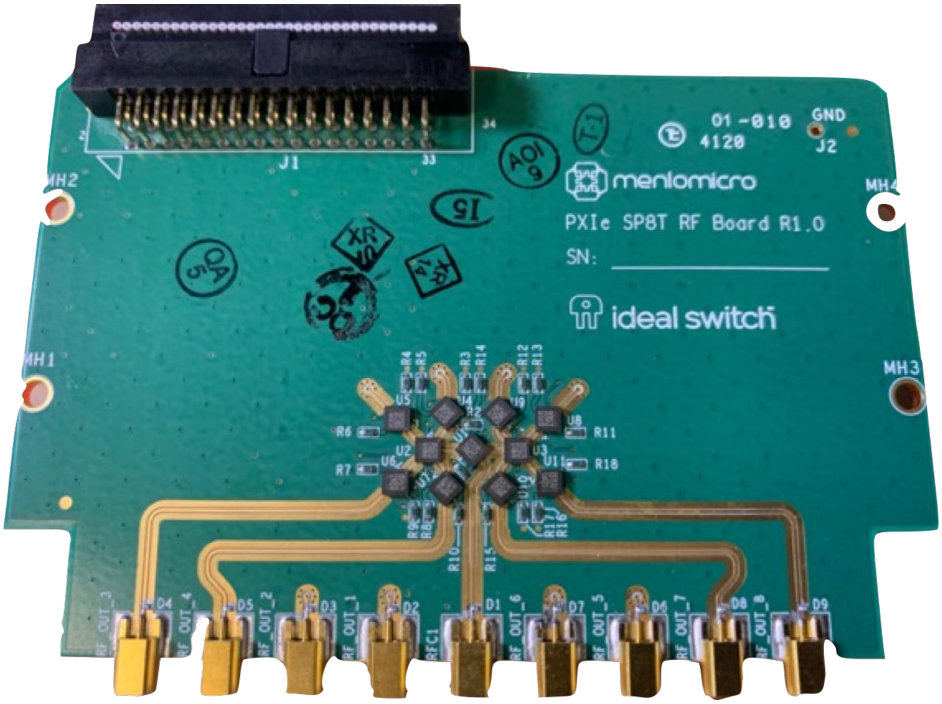


Figure 15: SP8T RF Board Design

High-Voltage Push-Pull Driver

A 64-channel, high-voltage driver is used to control gate pins of the MEMS switches. The table below shows some recommended high-voltage driver ICs for different channel counts.

Part Number	Output Channels
HV513	8
HV7620	32
HV3418	64

ESD Considerations

Due to the small internal dimension of the MM5130, the device is sensitive to ESD events. Depending on where in the application the MM5130 is used, it may be advisable to add ESD protection. There are many ways to do this. For RF applications, a large value inductor to ground provides a safe path to ground for the ESD pulse. It is important to choose the ESD protection device which fits for a specific application requirement such as operating frequency, maximum power, etc.

For the SP8T design, in order to protect the MM5130 against ESD damage, system-level protection for electrostatic discharge (ESD) is required. The chip should be placed as close to the RF connector as possible.

The table below contains the part number and relevant specifications of the recommended ESD suppressor. Figure 16 shows measured insertion loss for the part.

Manufacturer	Panasonic
Part number	EZAEG1N50AC
Chip Size	0201
Capacitance (pF)	0.04 +0.04/-0.03
Peak voltage [max] (V)	500
Clamping voltage [max] (V)	100
Rated voltage (V)	30
ESD withstanding IEC61000-4-2 discharge (kV)	8
Temperature range (deg C)	-55 to +125

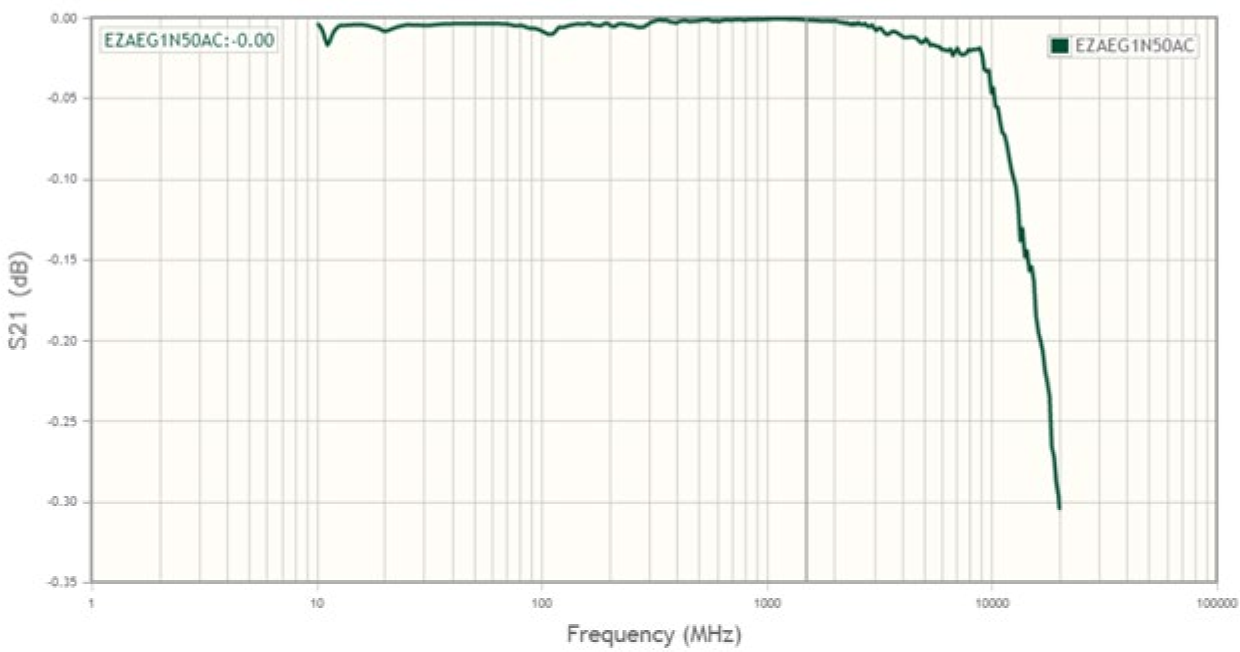


Figure 16: Measured Insertion Loss

Handling, ESD, and Maximum Ratings

Handling of the MM5130 must follow anti-static procedures, typical of any static-sensitive semiconductor device. This includes NO ESD applied to any of the device pins in excess of 150V, using the JEDEC Human Body Model (HBM).

Package Handling

Due to the small size and tight assembly tolerance of the WL-FC package, proper handling and assembly is required to optimize reliability and performance. The WL-FC should only be handled in a clean and controlled Electrostatic Discharge (ESD) safe environment. Using non-conductive tweezers or vacuum pick-up tools are suitable for WL-FC handling.

<u>Avoid using metal tweezers as this may damage the glass material used in the package</u>.

Avoid touching the WL-FC package with fingers as it can contaminate the package pads and interfere with solder reflow. Always keep the WL-FC in the original packaging until ready for usage.

DC Model including GATE Circuit and Bias Resistors

For applications that rely on measuring leakage of a DUT, it is important to remember that the MM5130 is designed with two resistors inside. The MM5130 consists of two switch units connected in series. The resulting island in the middle cannot be allowed to float so it has been connected to ground via a 125 kΩ resistor on the substrate. If this resistor is undesirable in a low frequency application, it may be possible to DC-isolate the ground of the package, where the other end of the resistor is terminated. For a high frequency application, this is not a viable option, as the ground reference is important.

Note that in the off state, both switches in a channel are open and there is no leakage from the midpoint resistor.

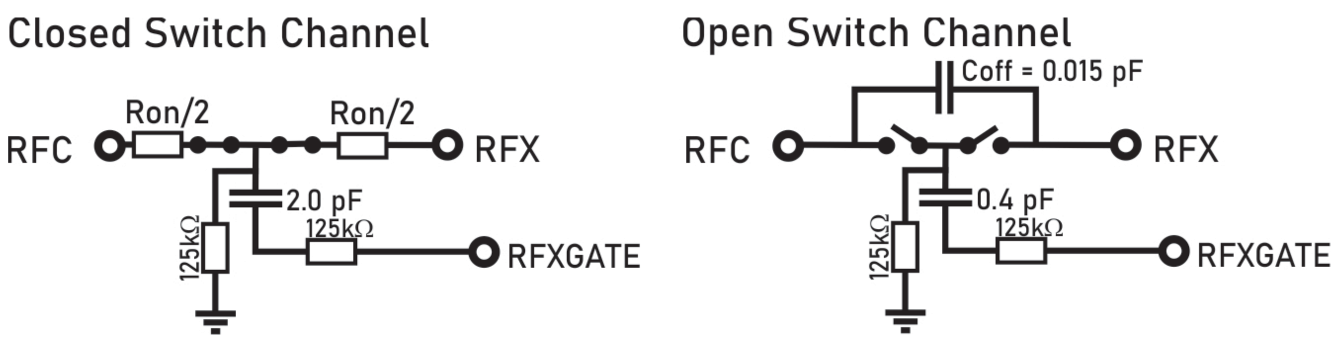


Figure 17: DC Model for Closed and Open States

Avoiding Accidental Hot Switching

It is best practice to open or close the MM5130 device with zero voltage across the terminals so that maximum lifetime is ensured. It is possible to open or close MM5130 switches with up to 0.5 V across the terminals without lifetime degradation. See datasheet for full hot switching specification details.

Note: Using a digital multimeter (DMM) to check the resistance can lead to device damage if the measurement is active during a state transition. Voltages between 3.0 V and 7.0 V from handheld DMM are common. Multimeters CAN be used to measure the device as long and they are not connected during the state transitions (off-on or on-off).

Methods for Controlling DC Potential on Circuit Nodes

MM5130 switches are generally sensitive to voltage across the contacts when the switch is transitioning between the open and closed states. This is also referred to as “hot-switching”. To protect the switches from RF hot switching events, signal level must be reduced during the switch event. This section of the application note outlines how to avoid un-intentional DC-hot switching due to DC-isolated nodes in the system where charge can build up over time. When designing circuits, it is important to keep the DC level constant over each switch or ideally, throughout the entire system. Typically, a DC level at 0 V is recommended, but it can be at any other DC voltage level if this voltage level is equal on both sides of the switch as it opens or closes.

Another important consideration is that the Output/Beam side of the switch must be at 0 V DC for the electrostatic actuation mechanism (opening and closing of the switch) to work reliably.

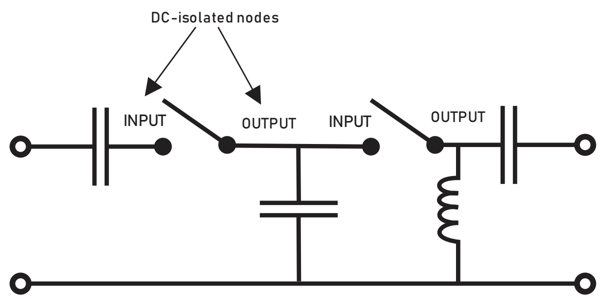


Figure 17: Switch L-C Network with Two DC-Isolated Nodes

There are several ways to approach this issue. In order of preference, they are:

1. Design the circuit to have a DC path through the system, so that there are no DC-isolated nodes. This is the preferred method as it does not impact Q value of the circuit, nor the DC isolation properties. Isolate system input and output so that no DC bias is entering the MEMS network.
2. If one or several DC isolated nodes are necessary to achieve desired circuit topology, use of large value inductors to GND to connect otherwise DC-isolated nodes should be considered. The inductor will provide a DC path to ground while blocking the path for RF signal. This may be an option for higher frequency applications (in the GHz range), where a large value (large reactance) inductor is reasonably small.
3. For lower frequency applications (HF for example), where inductors are impractical due to physical size, it is recommended to use large value resistor between the isolated nodes and ground. This ensures that any charge that accumulates over time has a way to discharge. If the system cannot be designed without DC-isolated nodes, and the frequency is too low to use inductors, then this method using "pull-down" resistors is recommended. Recommended value is 100 kΩ to 10 MΩ.

For RF circuits with high Q values such as resonators, Resistor values at the upper end of the range are recommended. Likewise, for circuits where DC-leakage is critical, again, resistor values at the upper end of the range are recommended. Figure 18 shows an L-C network with two DC-isolated nodes (with the switches open). Apart from possible overvoltage due to stored charge on the isolated nodes, the switch on the left has an output that is DC isolated. Since the output is also the reference for the gate voltage, this will lead to problems with actuation and de-actuation of the switch. The switch on the right side has its output DC-grounded so no action required there, but the input is DC-isolated. To remedy the situation and fix the DC-isolated nodes, Figure 19 shows how 10 MΩ resistors have been added to connect the DC-isolated nodes to ground. With the output of the switch on the right side now at ground potential, the switch will actuate and de-actuate as intended. Any charges that accumulate will discharge safely to ground and the switches are safe to operate.

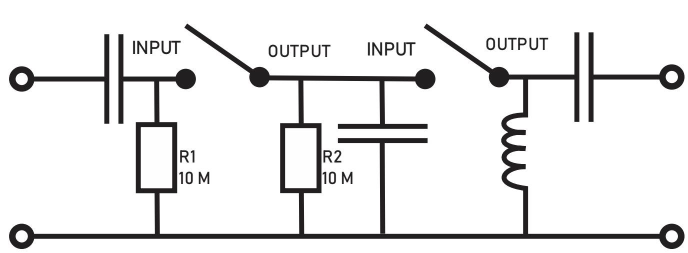


Figure 18: L-C Network from Figure 18 with Added Resistors Eliminates the Isolated Nodes

Node Impedance and Loading on High-Q Circuits and Resonators

In systems with many switches, resistive losses can add up and it may be desirable to use the method that provides the least amount of loading on the node, especially if the isolated node is a high impedance point such as a filter resonator.

Note that only one method for DC-grounding per network node is required.

LT3482 High-Voltage DC/DC Converter Circuit

A high voltage DC/DC converter is required for the MM5130 that can provide +89 V DC for switch control. The [LT3482](https://www.analog.com/en/products/lt3482.html) uses a 1.1 MHz frequency current mode step-up DC/DC converter with a voltage doubler. Since the LT3482 can be adjusted to provide up to 90 VDC output at about 2 milliamps of current, it works well as a high voltage bias source for Menlo Switches. The supply current required at the 3.3V input supply is typically 4mA. The output current is converted to a filtered voltage through a fixed load resistor and bypass capacitor that is stable over the temperature range from -40°C to +85°C. The LT3482 operates from 2.5 to 16 VDC input and available in 16-lead 3mm x 3mm LGA package. This device can be easily integrated into the various designs. A recommended practical circuit is shown in Figure 20 below.

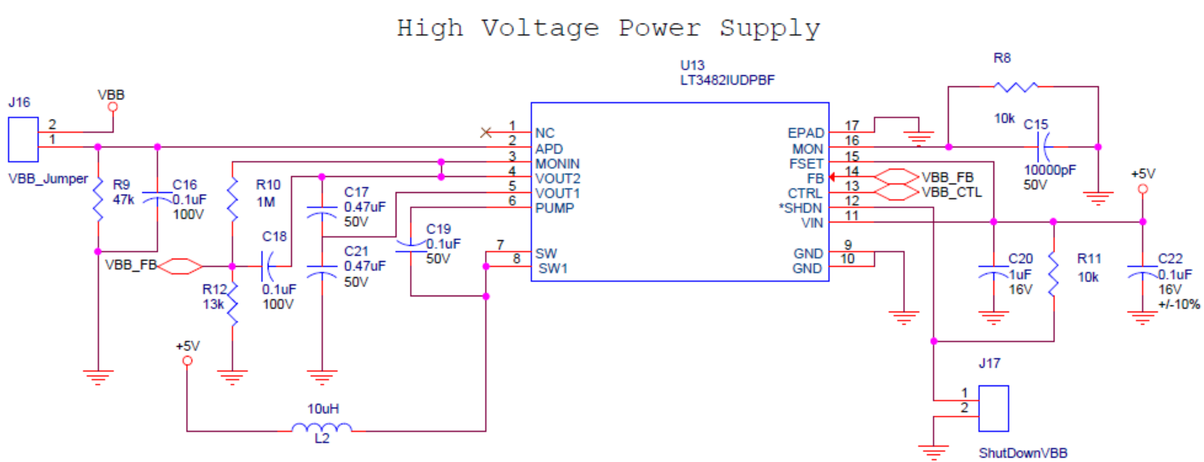


Figure 19: LT3482 DC/DC Converter Schematic

https://www.analog.com/en/products/lt3482.html

Driver Circuits for Driving the Gate Control

We have tested the Microchip [HV513](#) driver and it is also used in our evaluation kit control board. It is available in several different packages.

Recommended PCB Layout and SMT Parameters, Assembly

It is recommended to use coplanar RF lines to connect to the MM5130. The RF lines should be tapered to the landing pad, while keeping ground spacing constant and identical to the spacing used for the line.

Note: Refer to MM5130 datasheet for recommended PCB layout.

Note: For detailed information on soldering the MM5130, please refer to application note: "MM5130 Assembly Instructions".

PCB Material Recommendations

As for PCB laminate material, care must be taken to ensure reasonable CTE compatibility, typically < 16 ppm, and electrical loss factor suitable for the application. In Menlo EVK we have successfully used Rogers RO4003 and RO4350. Many other materials are available.

Mechanical stiffness is also of great importance for reliable operation. It is not recommended to mount the MM5130 to flex substrates.

Ordering Information - Test and Evaluation Boards

Part Number	ECCN	Package	Temperature Range
MM5130EVK1	EAR99	Evaluation Board MM5130 <12 GHz	
MM5130EVK2	EAR99	Evaluation Board MM5130 18 GHz	
MM5130EVK3	EAR99	Evaluation Board MM5130 Superport Mode 26 GHz	

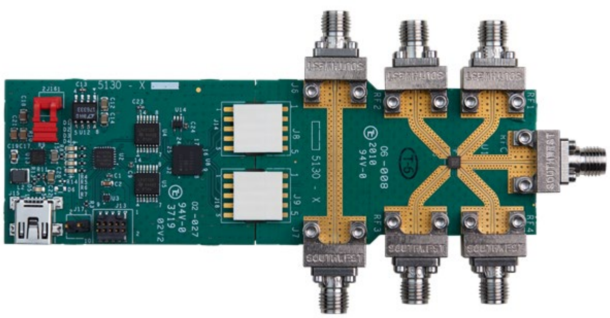


Figure 20: MM5130 Test and Evaluation Board

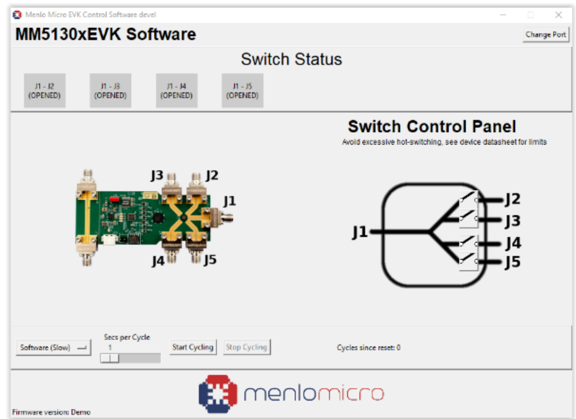


Figure 21: Software for Controlling Evaluation Board

A test and evaluation board kit MM5130-EVK is available as shown in Figure 21. Please refer to the ***Menlo MM5130 EVK Evaluation Kit Instructions*** for information on how to run and operate the MM5130-EVK. To assist evaluation work Menlo can also supply drivers for LabView and Python commands for control of the EVK.

Note: The interface control board part of the EVK has been programmed with device-specific firmware that enables loading of the correct GUI when it is connected to the PC.

The USB and driver part of the EVK is located on a separate board and connects to the RF-part of the EVK with edge – edge connectors. There is a possibility to separate the two board and use a ribbon cable between them for added flexibility.

Figure 22 Ribbon Cable Between Driver Board and RF Board

Using Python and LabView to Control EVK Boards

For customers that want to control the MM5130 EVK with LabView during the evaluation process, Menlo can supply a VI that controls the DUT via USB and the interface board.

Another good way to control the board is using the Python HID library to access the interface board over USB. Tested example code is included below. This code may also be run as command line Python commands via LabView. This code has been tested and verified.

```
import hid
menlo_vid = 0x04D8
menlo_pid = 0xEDFB

dev = hid.device()

dev.open(menlo_vid,menlo_pid)

dev.write([0]+[0]+[0x01])
dev.write([0]+[2])
print("Channel 1 is now turned on/closed")
```

Other Important Information

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Revision History

Rev	Description of Change	Author	Release Date
1.0	Initial revision	Menlo Micro	11/16/2020
1.1	Update for peak power	IB	3/25/25