The webinar will begin shortly…

IF YOU HAVE NOT SIGNED IN WITH YOUR FULL NAME & COMPANY, PLEASE DO SO
YOU CAN "RENAME" YOURSELF IN THE "PARTICIPANTS" TAB BY CLICKING THE THREE DOTS ⋮

IF YOU DO NOT INCLUDE YOUR NAME AND COMPANY
YOU MAY BE EJECTED FROM THE WEBINAR!

Welcome to Webinar Wednesday!

HOUSEKEEPING:

- Make sure you **SIGN IN** with your **FULL NAME & COMPANY**, as we may need it to unmute you and bring you into the discussion (If you do not include your name and company, you may be ejected from the call!)
- You can **"rename"** yourself in the "**participants**" tab by clicking the 3 dots ⋮ **"more"**
- Questions can be asked by either:
  - Clicking the **"Reactions"** tab and then "**Raise Hand**"
  - Click the **"Chat"** tab and use text box to ask a question
  - you can direct this privately to me or to everyone

- The **PRESENTATION PDF** and **RECORDING** of this webinar will be available for download to members from the IWPC research library at www.iwpc.org

Confirmed Workshop Topics for 2025

FEB 5: APPLYING AI/ML IN NETWORK TESTING AND ASSURANCE: Artificial intelligence is an already hyped technology. While the possibilities around generative AI (GenAI) are numerous and exciting, telecommunication companies have been using AI in their operations for some time. Assessing where AI/ML is being applied in network test and assurance today and how it is proving of value. What can AI realistically handle today and the how will it progress toward more intelligent and automated, AI-driven networks in the future.

AT&T, VIRTUAL PLATFORM

FEB 10-12: THE 5G-SA MATURATION TO CREATE A FAST PATH FOR 6G: Assessing 5G Standalone Maturation: Why does it take so long, what are the challenges, how can the industry deliver at pace? Exploring 5G SA benefits and value, Operator pain points and difficulties, Lessons learned on the way to 5G SA and how can the supply chain help to mature the ecosystem? Delivering 5G Monetization. Enhancements for the future success of home internet access with 5G Fixed Wireless Access (FWA). Considering O-RAN and AI-RAN. How to pave a smoother way to 6G, leveraging the 5G lessons learned today!

T-MOBILE, SEATTLE AREA

JUNE 24-26: AUTOMOTIVE RADAR AND ADAS EVOLUTION: IMPACT OF CENTRALISED AND DECENTRALISED ARCHITECTURES ON ADAS SYSTEMS: Driven to massive progress and innovation in SoC techniques and massive AI incorporation, a dramatic trend towards central processing is observed. For vision systems this has been the trend and has led to intelligent central units and simple camera heads. Can we expect the same path in automotive Radar? A second potential innovative path is radar networks. Can we envision radar networks that provide the radar performance of real imaging radars (today 48x48 RxTx)? Examining state-of-the-art technology innovation, assessing centralised and distributed architecture innovation. Identifying potential future development paths for SoC providers, Radar-Tier 2 and Tier1. Assessing optimum architectures for L1-5 vehicles and considering interconnect bus options.

BOSCH, STUTTGART AREA, GERMANY

OCT 7-9: THE ROAD TO 6G AND 3GPP 6G KICK-OFF REVIEW
Considering feedback from the inaugural 3GPP Meeting in Korea in March, the 3GPP Plenary in June and decisions made on the 6G Study scope in R20. Sharing viewpoints and perspectives on the challenges and opportunities ahead. Exploring how the emerging view of 6G Use-Cases and innovation will drive network requirements and necessary technologies. Considering some of the envisioned use cases for integrated sensing from basestations, evolutionary and revolutionary movements, including cloudification, sustainability, sub-THz IoT sensing and more. CPE/FWA Optimization for FR1/FR3 in Evolution to 6G, Positioning Technologies Integrated with Communications, 6G FR3 Regional Regulatory Requirement Updates, Spectrum Timing and Emissions Specifications. Joint Communication and Sensing (JCAS); Integrated Sensing and Communications (ISAC): What can we realistically expect and in which time frame? What are the constraints in terms of frequency band and bandwidth to deliver these use cases, and thus their feasibility domain? What is the expected impact on network capacity? How can sensing be used to improve network performance/efficiency?

ANRITSU, MORGAN HILL CA

NOV 3-5: MOBILE CONNECTIVITY, IoT, MEC & NON-TERRESTRIAL NETWORKS:
Considering 5G, NTN and MEC for Automotive and non-smartphone use cases. Assessing progress and exploring next steps in deploying end-to-end ubiquitous connectivity. With recent beta launches, initiatives are underway to address how satellite can augment global 5G roll-out, with the enhanced connectivity delivering more than just faster streaming and quicker downloads on mobile devices. Considering Platform Architecture and Strategy, linking vehicles with the cloud and the Internet of Things (IoT) to provide optimum management, over-the-air updates and control of four central domains: Considering fragmentation, pros, cons and optimum IoT strategies these long lyfecycle use-cases; of legacy and evolving technology; Cat-1, Cat-m, ND-IoT, RedCap and E-RedCap. Powertrain, Active Safety, Autonomous Driving, Infotainment and Body & Comfort Systems. Exploring the digitisation of vehicles, where platform development, seamless integration and harmonisation of software and electronics is key to optimum L1-L5 delivery. Platform development, EV platforms. Architecture, strategy, In-house hardware and software, Over the Air, connectivity, V2X and AI.

VERIZON, BOSTON, MA

Registration Now Open for October 6G Workshop

The Road to 6G
& 3GPP 6G Kick-Off Review

October 7-9, 2025 - Morgan Hill, CA, USA

Join these Industry Leaders

AT&T
NTT docomo
NEXT G ALLIANCE An ATIS Initiative
T-Mobile
verizon
cohere technologies
ERICSSON
muRata INNOVATOR IN ELECTRONICS
NOKIA
Northwestern University
Red Hat

Face-to-Face Workshop

The Hype-Free Global Wireless Community ™

ENABLING RELIABLE SPACE-TO-DEVICE CONNECTIVITY: LEVERAGING TECHNOLOGY FOR LOW-LOSS, HIGH-LINEARITY FILTERING IN LEO NETWORKS

Mark Walker

VP Aerospace and Defense BU

menlomicro

menlomicro

Enabling Reliable Space-to-Device Connectivity

*Leveraging Ideal Switch for Low-Loss, High-Linearity Filtering in **Lynk Global** LEO Network*

Mark Walker, VP Aerospace & Defense

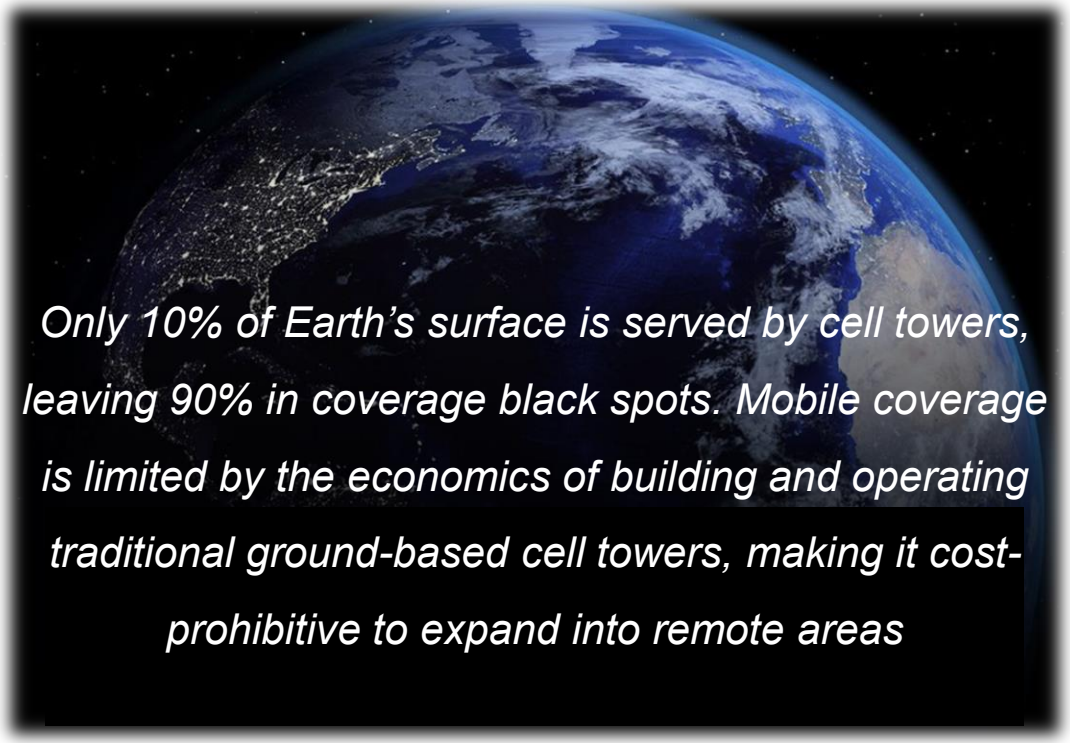
September 10, 2025

Context

- The Story of Menlo Micro
  - Performance Without Compromise
  - Roadmap Overview
- Lynk Global Direct-to-Device (D2D)
  - Lynk Global company
  - Key Customer Priorities
- The Ideal Switch Technology
  - Core Performance Pillars
  - Compliance with D2D Performance Parameters
- Switched filter Topology – 8 Channels
  - Switched Filter Use Cases
  - Phase Shift Design - *True Time Delay T*echnology
  - High Standoff Power for RFFE Protection
  - mmWave Switching up to 60 GHz
- Power Control Switches
- Q&A

Lynk Global

- Builds, launches, & operates ‘cell-tower-in-space’ satellites, providing direct-to-device connectivity
- Licensed direct-to-device system delivering service through its mobile network operator partners
- 2-way commercial & emergency messaging on all continents, scaling to service at broadband speeds

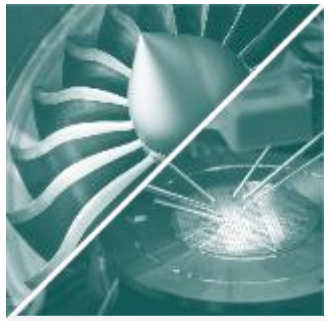


Menlo Micro

Reinventing the Circuit Breaker: Introducing the Ideal Switch

1835
Electromechanical Relay invented by Joseph Henry.

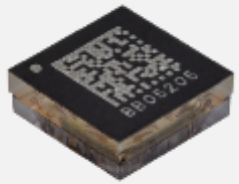
1879
Circuit breaker concept patented in Menlo Park, NJ by Thomas Edison.



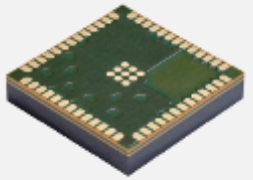
2004
GE sets out to reinvent the circuit breakers using a MEMS switch

PALADIN CAPITAL GROUP
CORNING
MICROCHIP

2016
GE spins out Menlo Micro

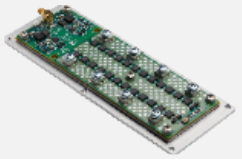


2020
The MM5130 26GHz 1P4T switch is introduced



2021
The industry's first 40 Gbps DPDT differential switch launches

2023
Menlo Micro announces the construction of the Ideal Fab

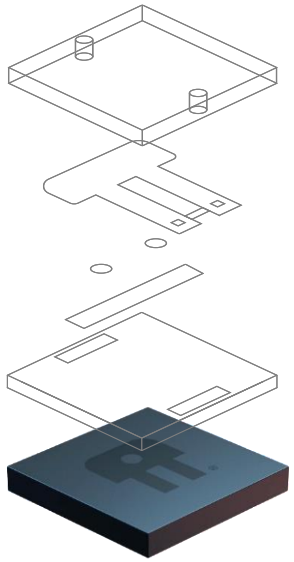


500V / 100A
Module Prototype

2024
Awarded 10MW US Navy Solid-State Circuit Breaker contract to deliver SSCB optimized for micro-nuclear reactor power with 5X SWaP improvement

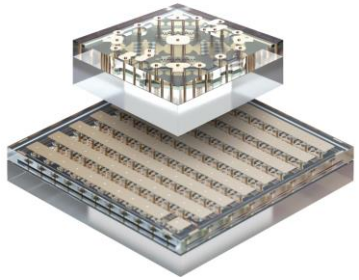
Performance without Compromise

The Ideal Switch simplifies power control while delivering reliable, high-performance



16 Mask Ideal Switch **vs** +25 Mask SSR

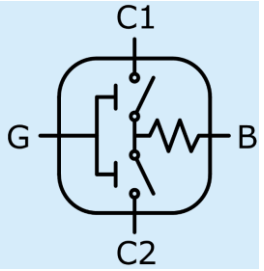
8” Fused Silica



System-In-Glass Low-Loss Packaging

Through-Glass-Vias and hermetically sealed package

- Low R_{ON}: 6 mΩ
- Voltage standoff: 300V
- Off-state resistance: >10 G Ω
- Current (AC or DC): 10A
- Fast switching: 10µs
- Vctrl: 90V gate control
- Endurance: 10M operations (3B RF)
- QFN : 6mm x 6.5mm, 1.5mm height



Unique Glass Packaging

- Better thermals & better power handling, improved RF performance

Highly Reliable

- >3B cycles spec, w/roadmap to >20B
- High-power capability

Through-Glass-Via

- Lower parasitics, lower resistance, small-size package, lowest cost

Simple & Scalable

- Simple design → lets us go *very* small (100µmx100µm unit cell)
- Small size → allows easy scaling for high power through massive switch arrays

Scalable & Versatile

- Small size → easy to scale costs down with production volume
- Standard Process Design Kit to create many products
- Short design cycles → faster time to market

Product Roadmap

Accelerating innovation to meet our customers' toughest challenges

	Current Products	Future Product Roadmap
RF & MICROWAVE SWITCHES	**MM5130** DC-26GHz 25W, SP4T **MM5230** DC-26GHz 25W, SP4T **MM58xx** SPDT,70GHz+ **MM60xx** DC-18GHz Switched & Tunable Filters **MM5120** DC-12GHz SP4T w/CP **MM5130-EDC** DC-26GHz 25W, SP4T **MM5170** DC-40GHz SP4T **MM5140** DC-8GHz SP4T w/CP **MM5815** 400W RF Limiter SPST **MM61xx** DC-18GHz TDU, Beam-formers	• Higher frequency, isolation • Smaller form factors • Higher reliability • System-in-package (SiP) heterogeneous integration with RF/digital/mixed signal ICs • 3D glass integration with passive devices
HIGH SPEED DIGITAL LOOPBACK	**MM5600** 40Gbps DPDT **MM5620** 64Gbps Diff. Loop. AC Coup. **MM5622** 80Gbps Diff. Loop. DC Coup. **MM5625** 80Gbps+ Asymmetric AC Coup. **MM56xx** 128Gbps-224Gbps 50% package shrink AC/DC coup	• Higher data rate (PCIe Gen7, and 224Gbps) • Smaller form factor, higher density • Custom/multichip switch configurations
LF SIGNAL RELAY	True replacement for high volume, low-cost PhotoMOS relays, EMR, reed relays **MM12xx** DC-3GHz 4xSPST 500mA	• Smallest form factor, highest density • Highest elec. performance over all key specs • Multiple switch configurations planned
POWER SWITCHES	**MM9200** 39mm² 300V/10A <10mΩ, SPST **MM9201** 39mm² 400V/10A <10mΩ, SPST **MM92xx** 16mm² >400V/10A <10mΩ, SPST **MM9xxx** 120V/100A Circuit Breaker Module	• Higher voltage, current, & power density • Smaller form factor • Lower Ron/mm² • Modules, integrated sense & control

Link Global Direct-to-Device Space System – Key Care Abouts

Switch Filtering: Antenna to RF Front End
(Bi-Directional)

- **Very low Insertion loss** enhances receive sensitivity and range
  - IL for 2 cascaded switches for filter: **0.3 dB**
- **Very high linearity** for improved signal integrity
  - Input Intercept Point (IP3) = **~95 dBm (3.2 MW)**
- **Minimal DC power dissipation**, optimizes payload power
  - Switch power dissipation: **178nW**
  - Controller (SPI/GPIO) power budget: **≤ 9.2 mW**
- **High RF Power Handling** for CW and pulsed signals
  - Power capacity = **45 W (CW) / 150 W (Pulsed)**
- **Excellent thermal stability** over temperature
  - Near Zero insertion loss variation: **~0 dB/°C**
- **Fast switching**, On/Off time: **10 µSec**
- **High-reliability switching** cycles: **30 billion typical**

LEO Direct-to-Device (D-2-D) communication link

- **Reliable, scalable, two-way connectivity** from Low Earth Orbit (LEO) direct to mobile devices
- **Innovative RF signal path control** enables optimized cascading of switched filters
- **System performance and user experience driven by:**
  - Power efficiency
  - High linearity
  - Low power dissipation
  - Low insertion loss
- **Menlo's Ideal Switch** is designed into **Lynk Global's space-based mobile network,** enabling high-performance RF switching for critical signal path functions

Ideal Switch Performance

- High RF Power Handling: up to 50 W(CW) & 150 W (pulsed)
- Low insertion loss: <1 dB at 26 GHz, 0.1 dB at 1 GHz
- High linearity (IP3): unmatched 95 dBm
- Fast switching: <10 µs
- Long Life: > 3 billion switch cycles, 10 billion typical (low replacement cost)
- Low DC power: from 0.1 mW to <10 mW (no heat sinks)
- Small size: from 6 mm^2 to 22 mm^2 footprint (SMT for PCB integration)

Space-based applications require:

Linearity • Low DC Power • Low Insertion Loss • High Power Handling • Thermal Insensitivity

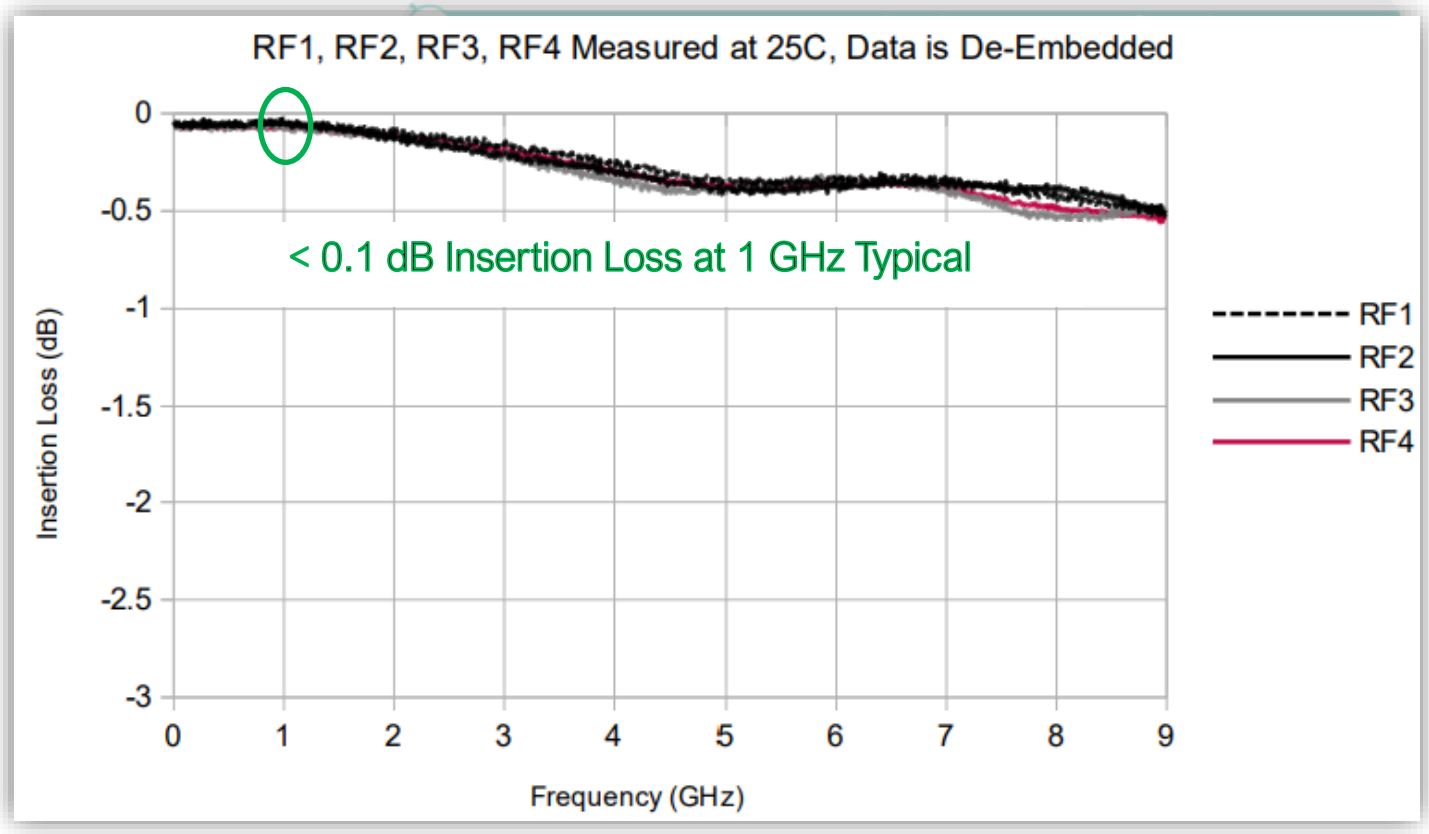
Ultra Low-Loss Switch Performance

Metal-to-metal conductivity, low parasitic

- DC – 60 GHz Wide Instantaneous Bandwidth
- Insertion Loss
  - **~0.1 dB** at 1 GHz
- Return Loss
  - **~27 dB** at 1 GHz
- Isolation Channel-to-Channel
  - **~40 dB** at 1 GHz

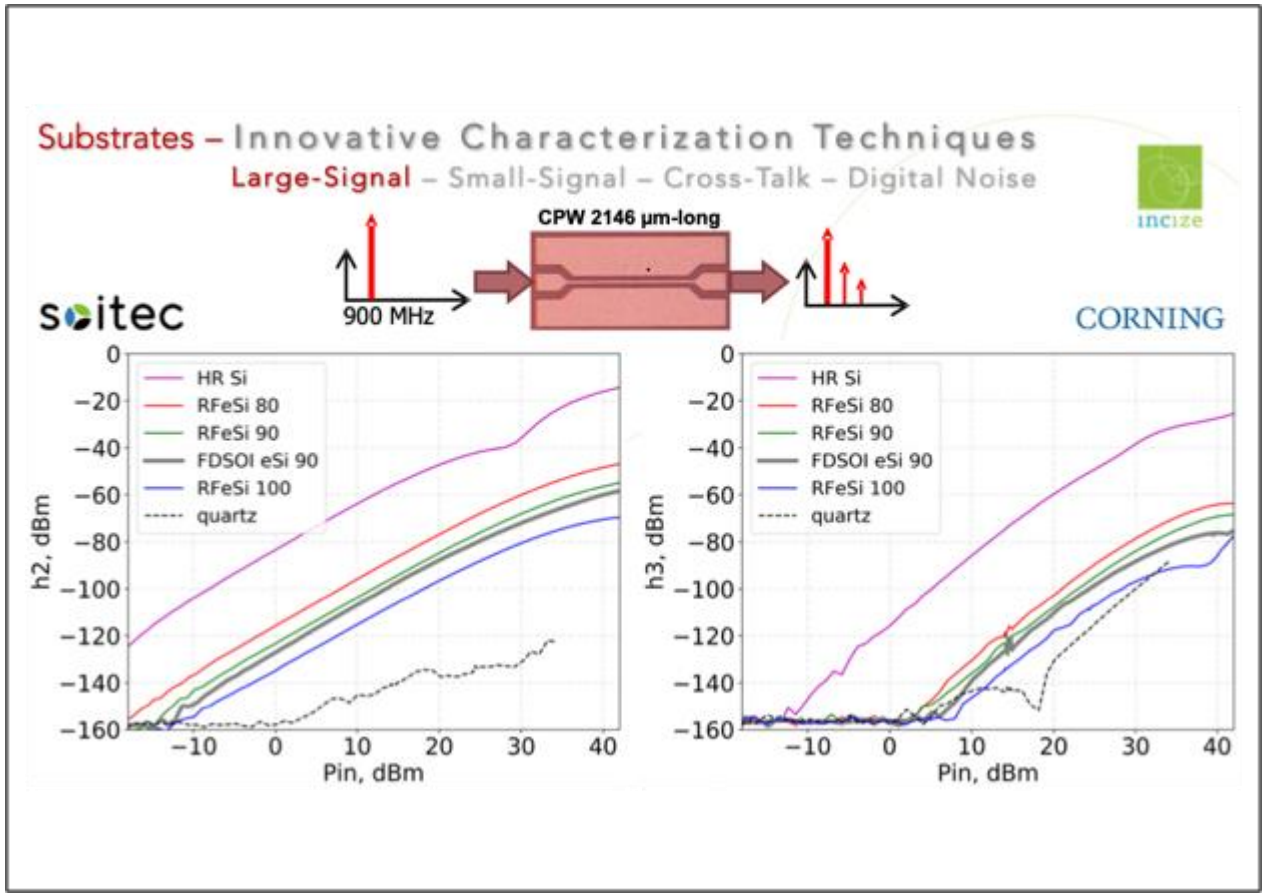
MM5140
DC-8GHz
SP4T w/CP

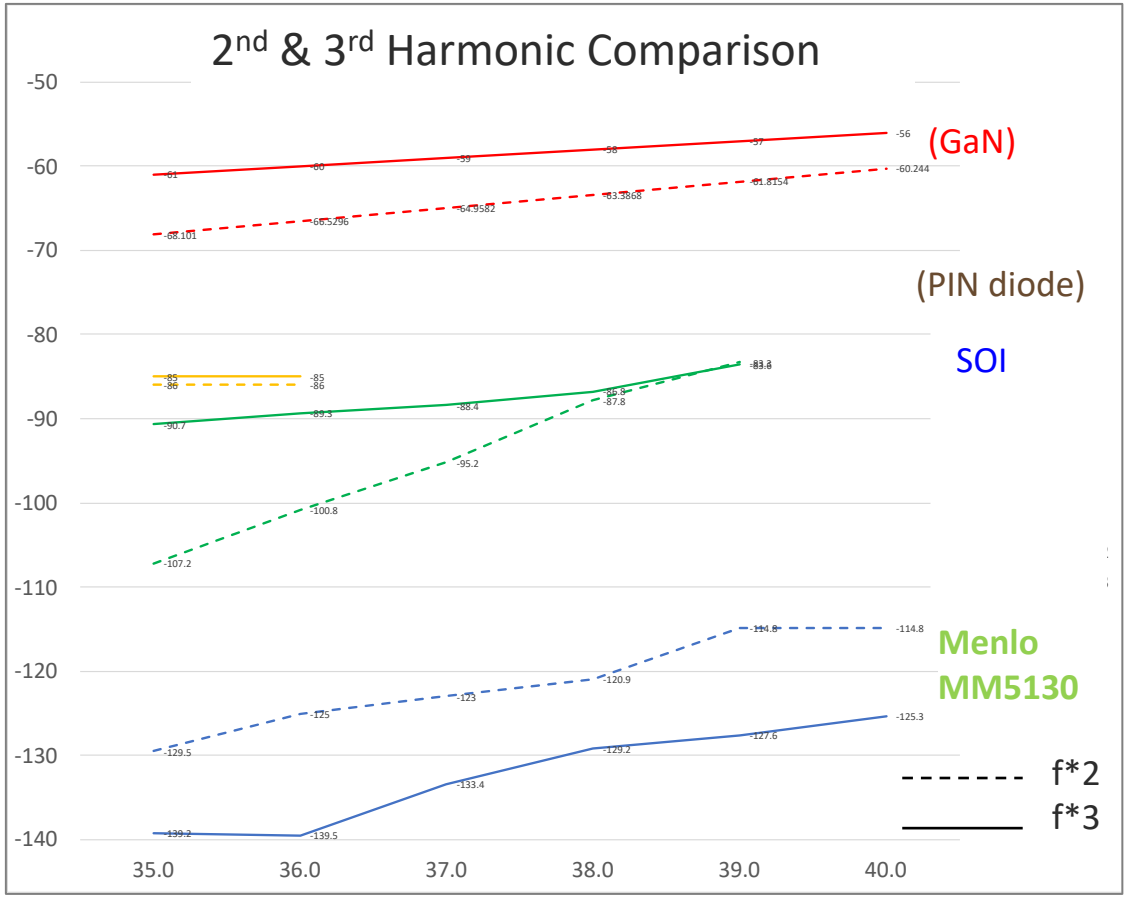
- High RF Power Handling – up to 50 W(CW) and 150 W (pulsed)
- Low insertion loss – less than 1 dB (26 GHz)
- High linearity (IP3) – unmatched 95 dBm
- Fast switching – less than 10 µs
- Long life – minimum 3 billion switch cycles, 10 billion typical (low replacement cost)
- Low DC power – from 0.1 mW to less than 10 mW (no heat sinks)
- Small size – from 6 mm^2 to 22 mm^2 footprint (SMT for PCB integration)



Metal-on-Glass for Highest Linearity

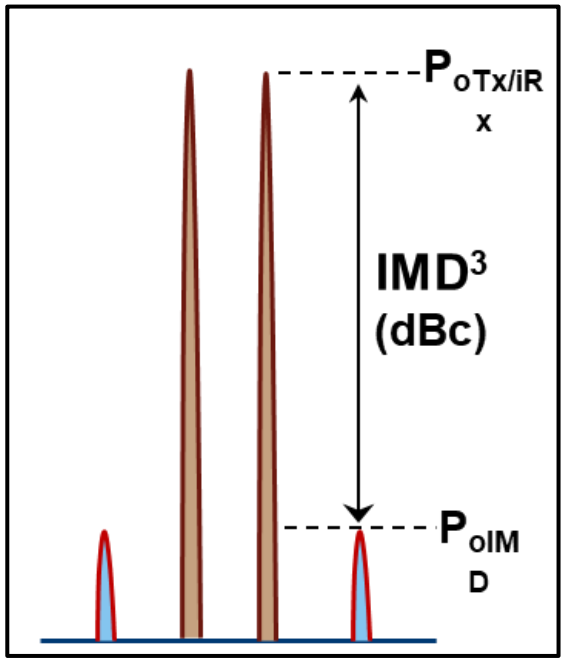
Typical 95 dBm IP3

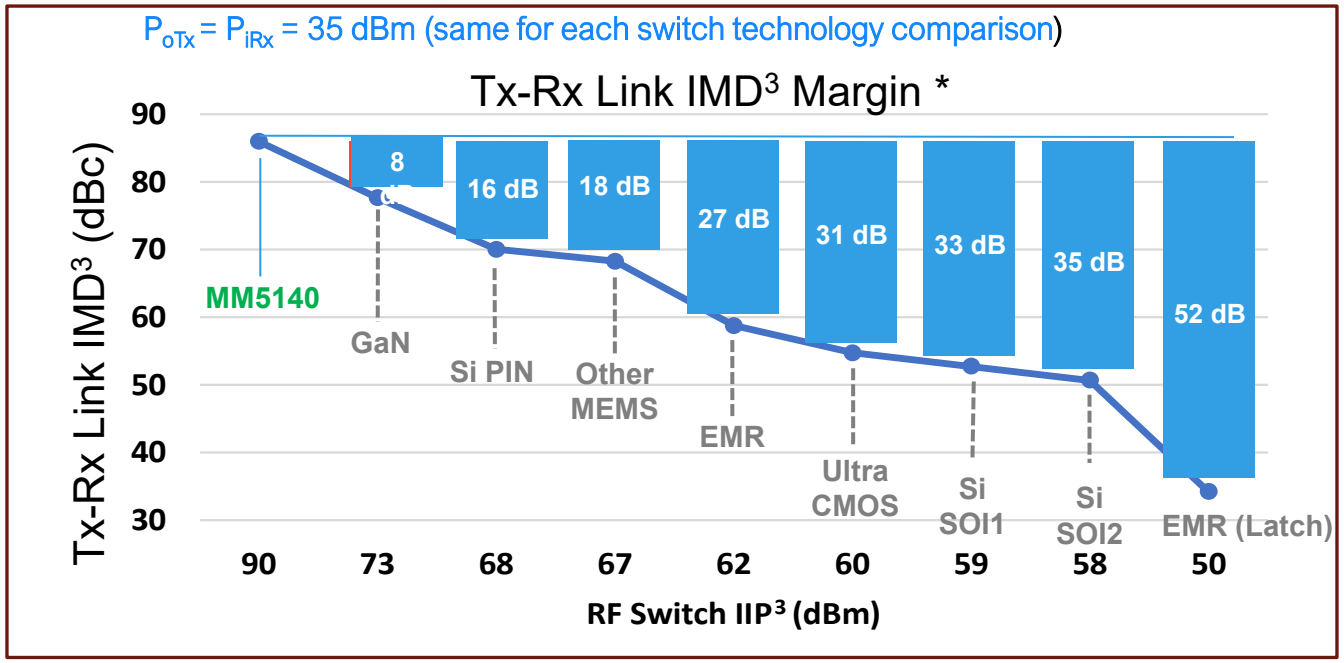


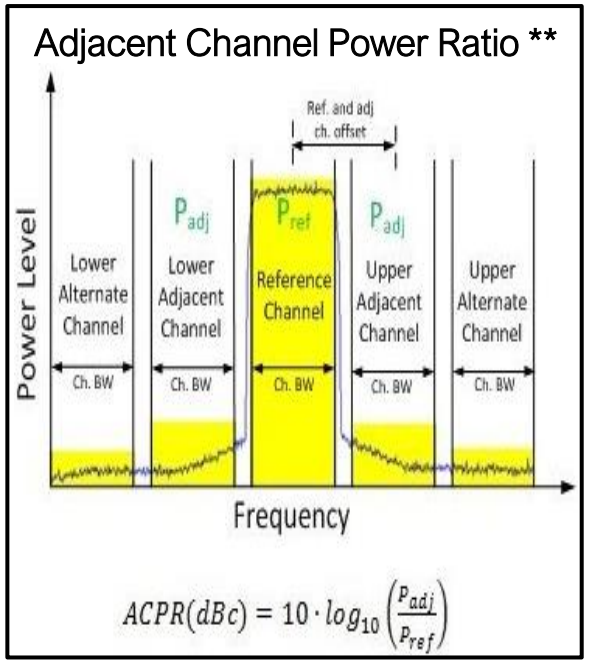


Avoiding silicon for fused silica glass without semiconductors from the RF signal chain reduces primary sources of non-linearity. IP3: >90 dBm

RF system linearity with integrated Ideal Switch







- RF switch with ultra high IP3 performance has negligible impact on multi-channel transmit-receive link IMD^3 & ACPR
  - System IP3 set by active components in RF chain, NOT in the switch
- High IMD^3 *improves* spectrum purity, *enhances* effective and efficient use of regulatory controlled spectrum resources across multi-channel transmit-receive links

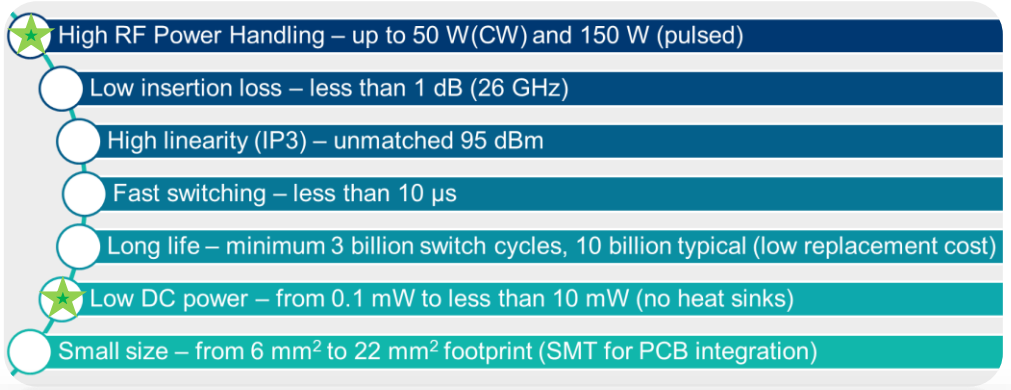
* Data taken from datasheet of leading RF switch suppliers, subject to updates, changes and verification
** RFWirelessWorld: https://www.rfwireless-world.com/terminology/acpr-vs-aclr-understanding-difference

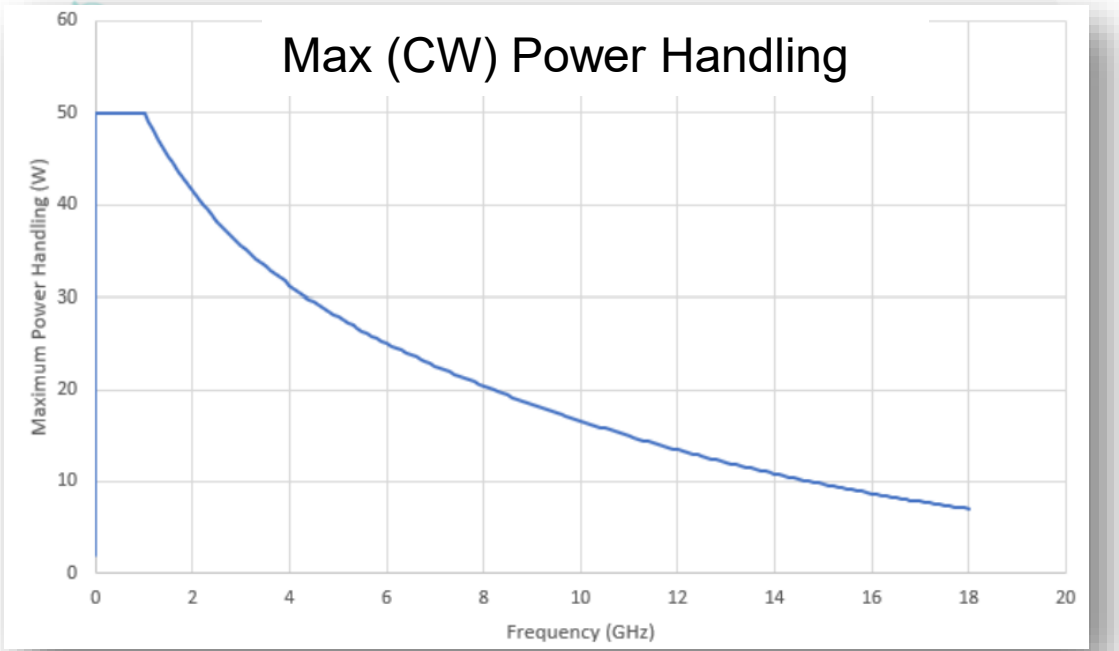
Superior Power Handling Performance & Low DC Power Requirements

No heat sinks

- DC – 60 GHz Wide Instantaneous Bandwidth
- Forward Power Handling
  - Up to 50W (CW)
  - Typically150W (pulsed)
- Off-Mode Power Handling
  - Up to 500W (Pulsed)
- Low DC power: from 0.1 mW to less than 10 mW
- Repeatability

MM5140
DC-8GHz
SP4T w/CP



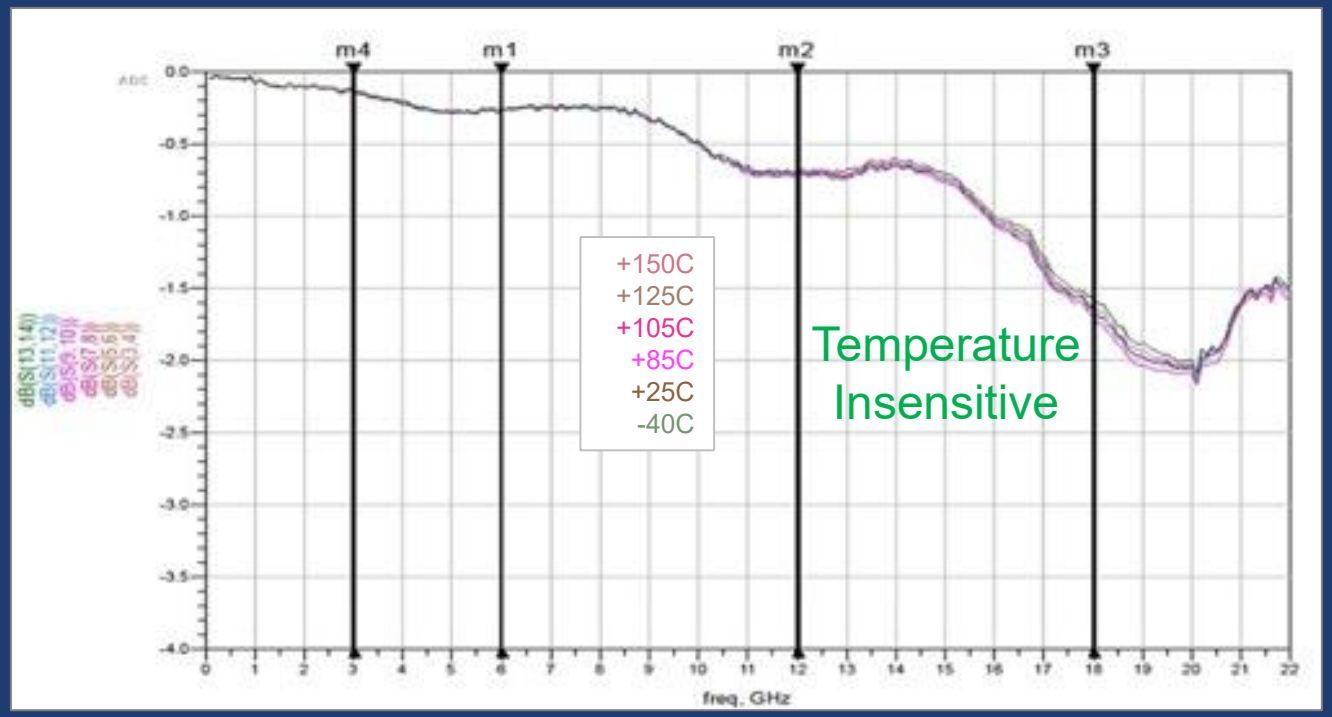


Superior Environmental Performance – Temperature Insensitive

ideal switch™

MM5130

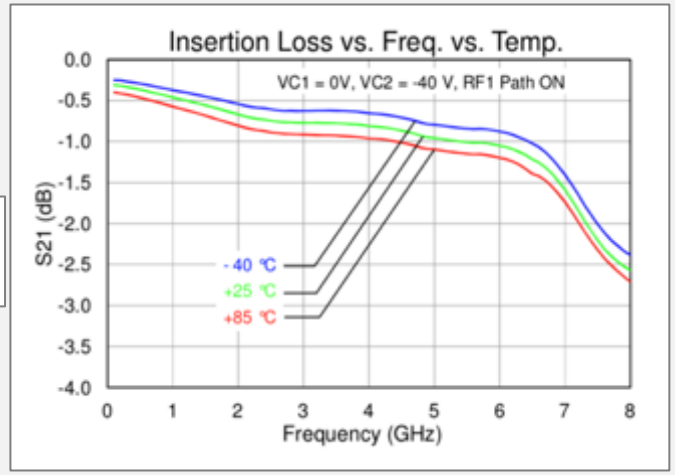
Near "0" thermal performance coefficient: < 0.05dB variation



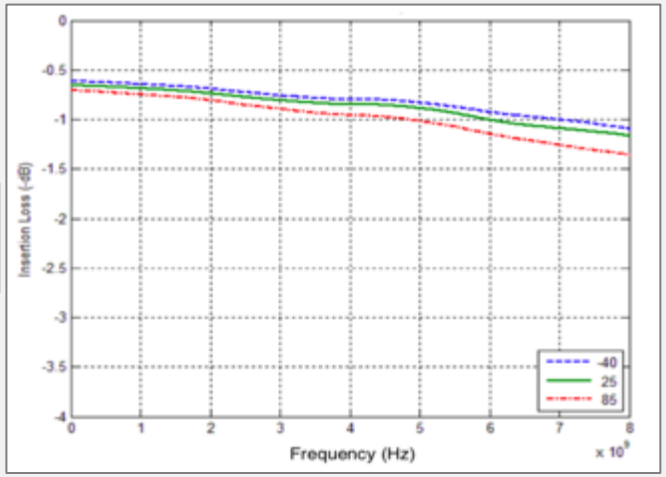
Typical Solid-state

Up to 0.50-dB variation / switch

GaN Datasheets



SOI Datasheet

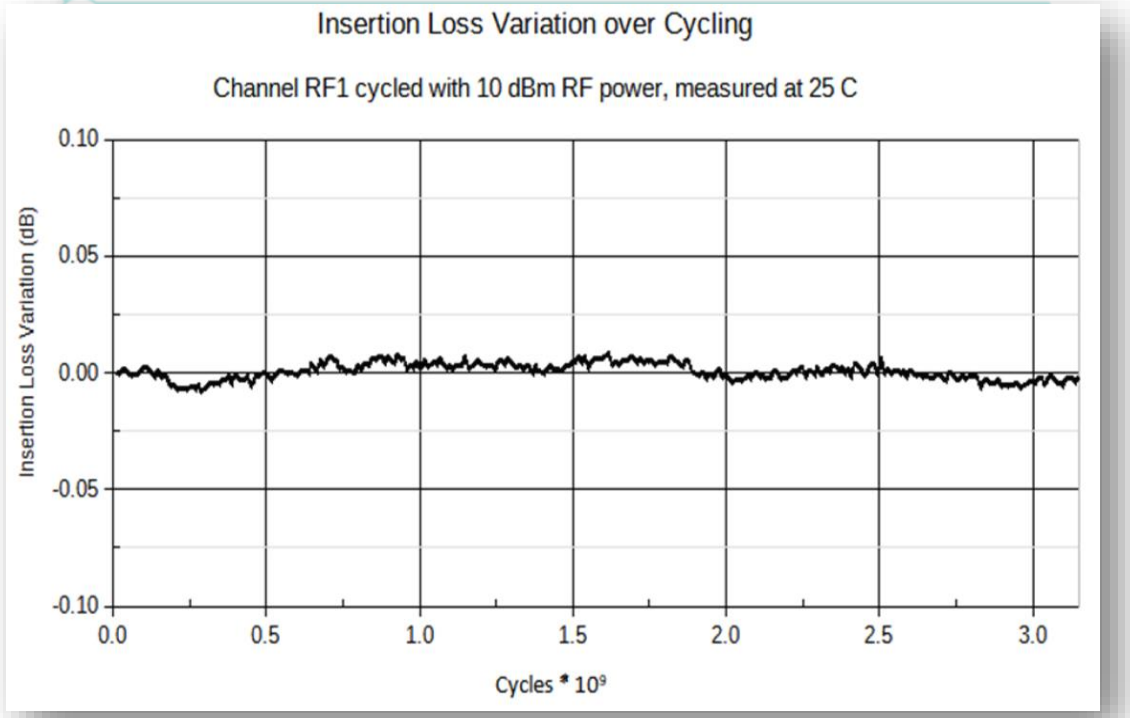


Repeatable Performance

- DC – 60 GHz Wide Instantaneous Bandwidth
- Demonstrated insertion loss variation
  - **± 0.01 dB** over **3 billion** cycles
    - Switch Cycled at 10kHz
    - Total IL Variation 0.015dB

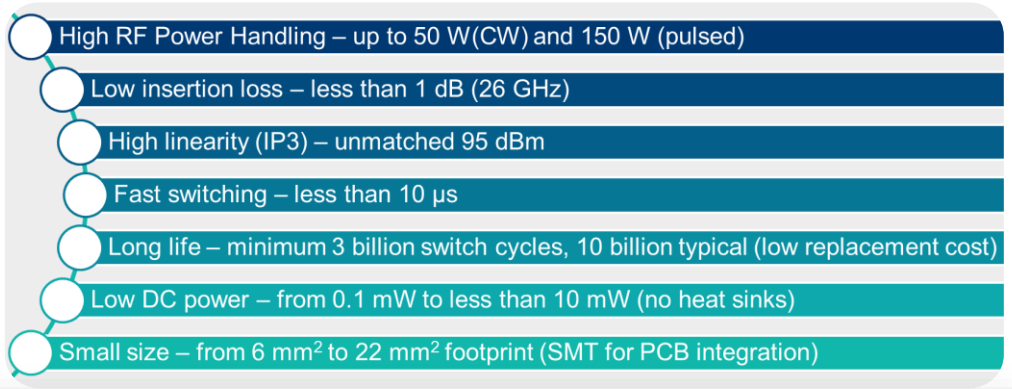
Menlo Micro's custom-designed RF hot-switch tester (4 ch, 33dBm, 6GHz)

- High RF Power Handling – up to 50 W(CW) and 150 W (pulsed)
- Low insertion loss – less than 1 dB (26 GHz)
- High linearity (IP3) – unmatched 95 dBm
- Fast switching – less than 10 µs
- Long life – minimum 3 billion switch cycles, 10 billion typical (low replacement cost)
- Low DC power – from 0.1 mW to less than 10 mW (no heat sinks)
- Small size – from 6 mm^2 to 22 mm^2 footprint (SMT for PCB integration)



Reliable Performance

- DC – 60 GHz Wide Instantaneous Bandwidth
- Qualified and demonstrated life cycles
  - ≥ 3 billion cycles at room temperature

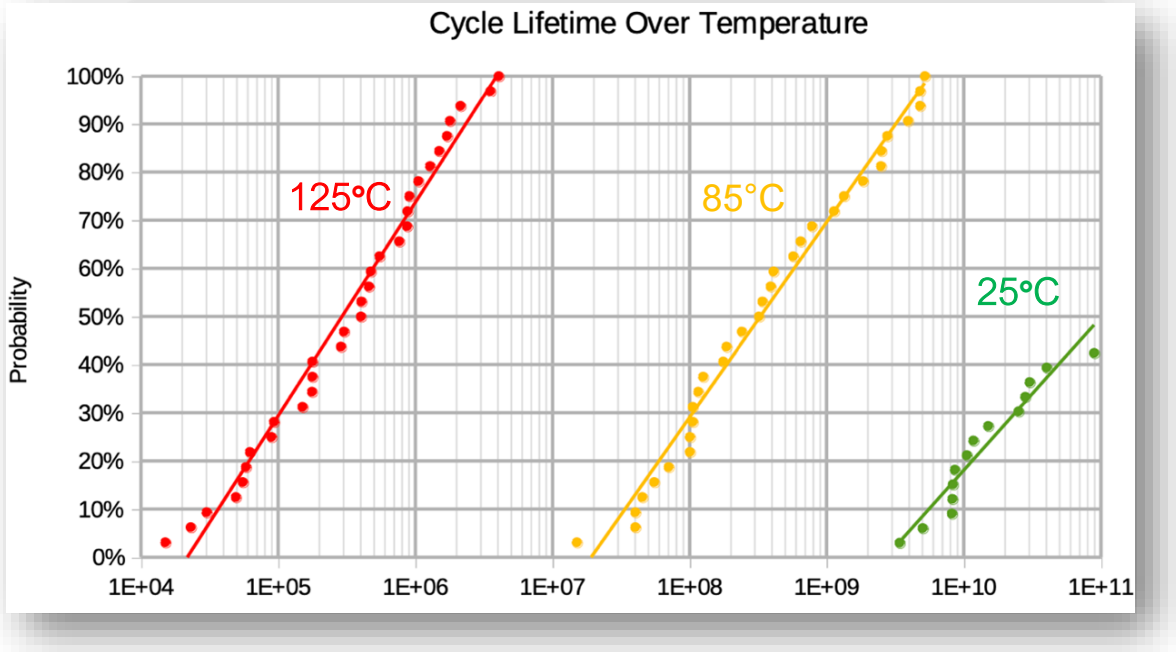


25°C Cycling

Min cycles: **3 Billion**
Typ. cycles: **> 50 Billion**
Sample Size: **33 units**

85°C Cycling

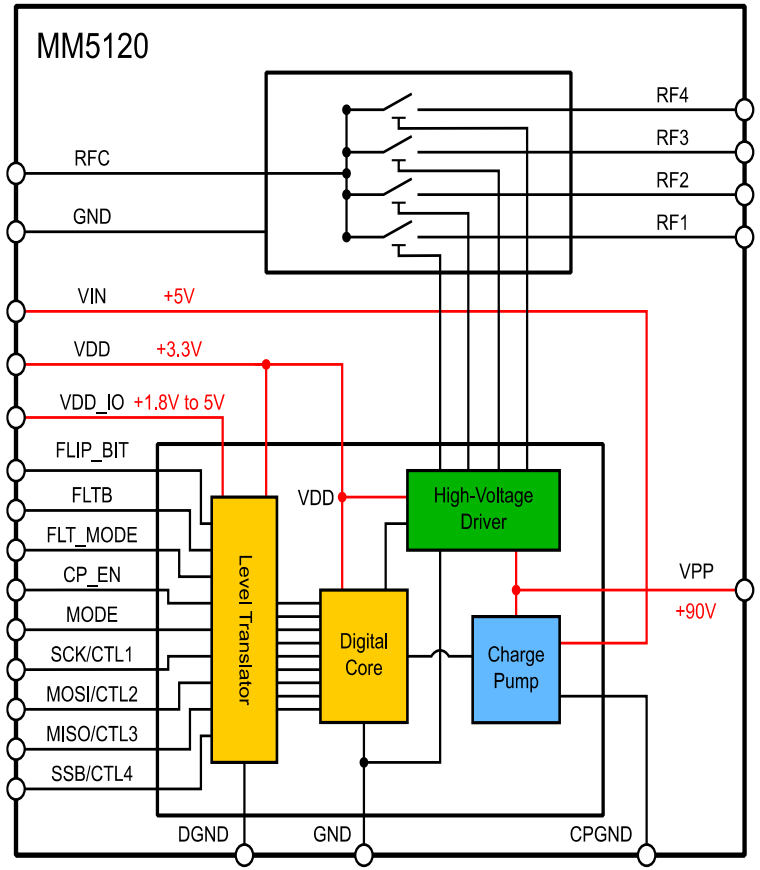
Min cycles: **20 Million**
Typ. cycles: **400 Million**
Sample Size: **33 units**



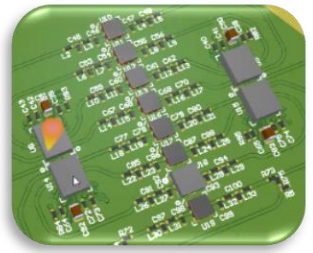
Menlo continues to drive improved cycling performance at both 25C and > 85C

MM5120 – Product Highlights

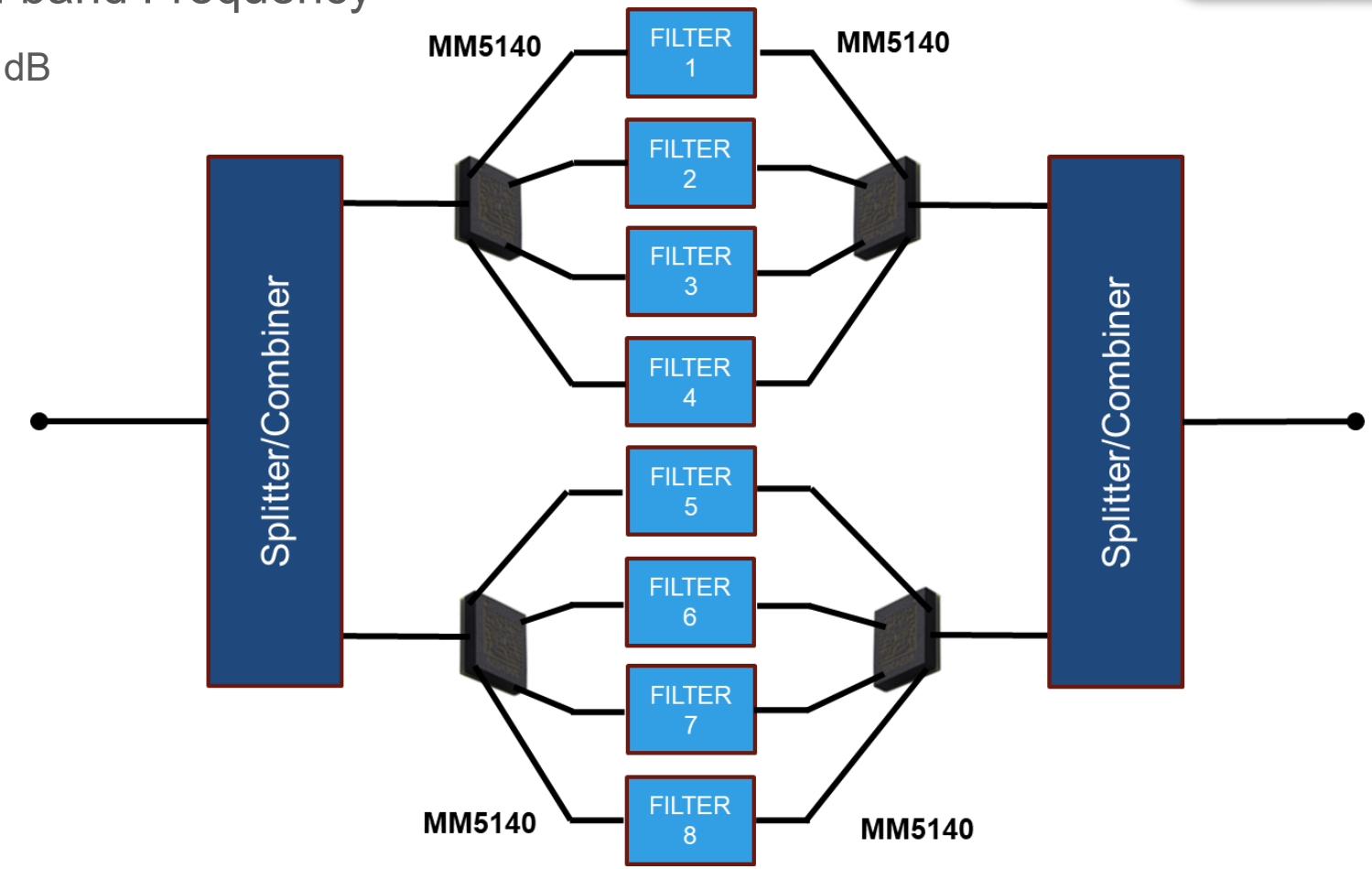
- DC to 18 GHz frequency range
- RF power 25 W (CW) to 6 GHz, 150 W (pulse)
- High linearity IP3 >90 dBm
- 25 dB isolation @ 6 GHz
- 0.7 dB on-state insertion loss @ 12 GHz
- Integrated high-voltage driver
- Power supply 5 V (voltage booster) 3.3 V (driver)
- SPI and GPIO interface
- High reliability >3B switching cycles
- 5.2 mm x 4.2 mm LGA



L-Band 8-Channel Switched Filter – Link Global D-2-D (LEO)



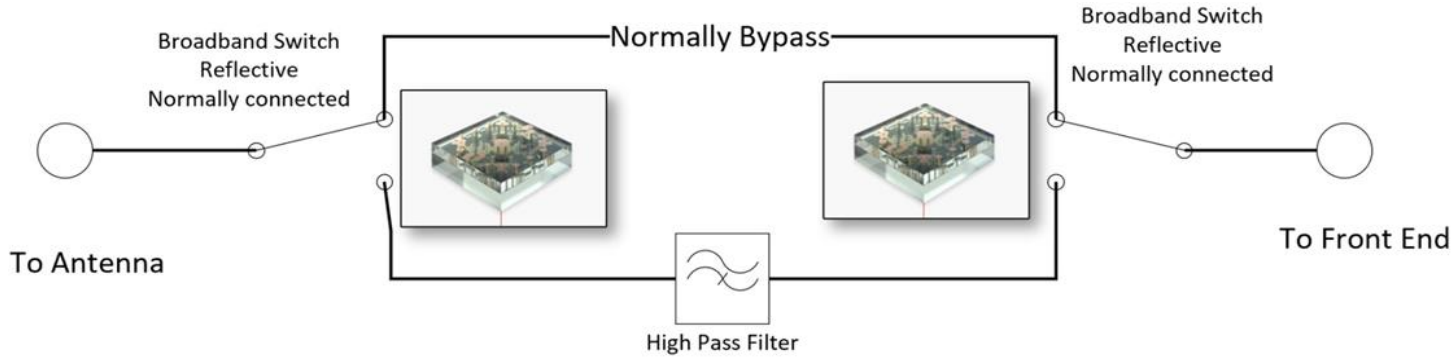
- Switch Related Performance – L-band Frequency
  - Cascaded switch Insertion loss: 0.3 dB
  - IP3: 90 dBm
  - Power handling:
    - ON: 45 W_{CW}, 150 W_{pulsed}
    - OFF: ~ 250 W_{pulsed}
  - Near zero thermal coefficient
  - T_S (on/off): 10 uSec

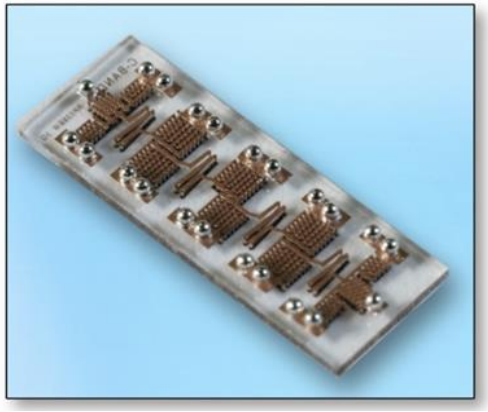


24 GHz Switched Filter Example

- Switch Related Performance (low/hi: 2-36 GHz) Super Port Mode MM5130

  - Cascaded Insertion loss (low/hi): 0.5 / 1.2 dB
  - Return loss: 15 dB (typ)
  - Channel Isolation (low/hi): 47 / 25 dB
  - IP3: 90 dBm
  - Near zero thermal coefficient
  - T_S (on/off): 10 uSec

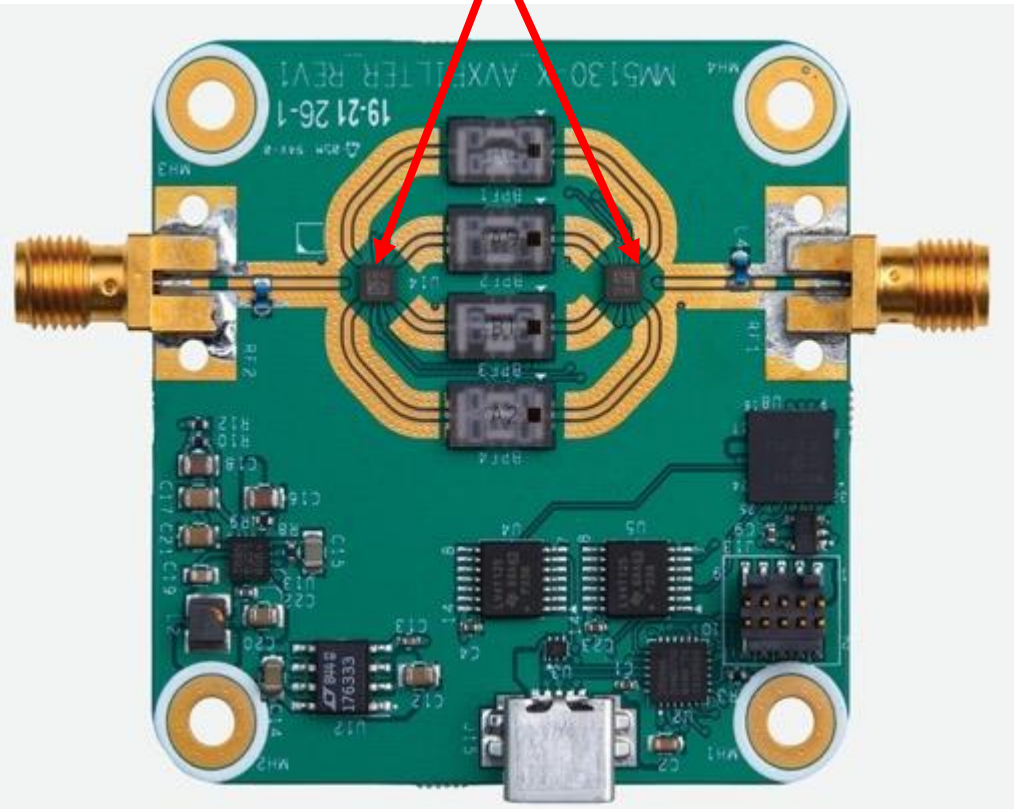




High Power Switched Filter Bank

More than half the power can be lost in a traditional SFB built with semiconductor switches!

ideal switch™



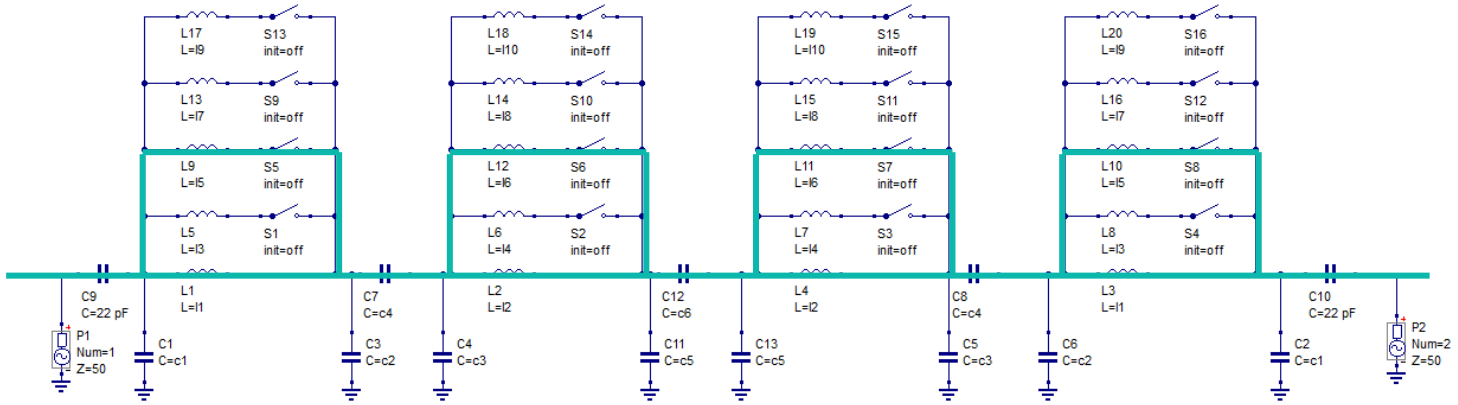
Frequency range: 700 MHz to 3 GHz
IL difference for SFB: 1.7-2.5 dB

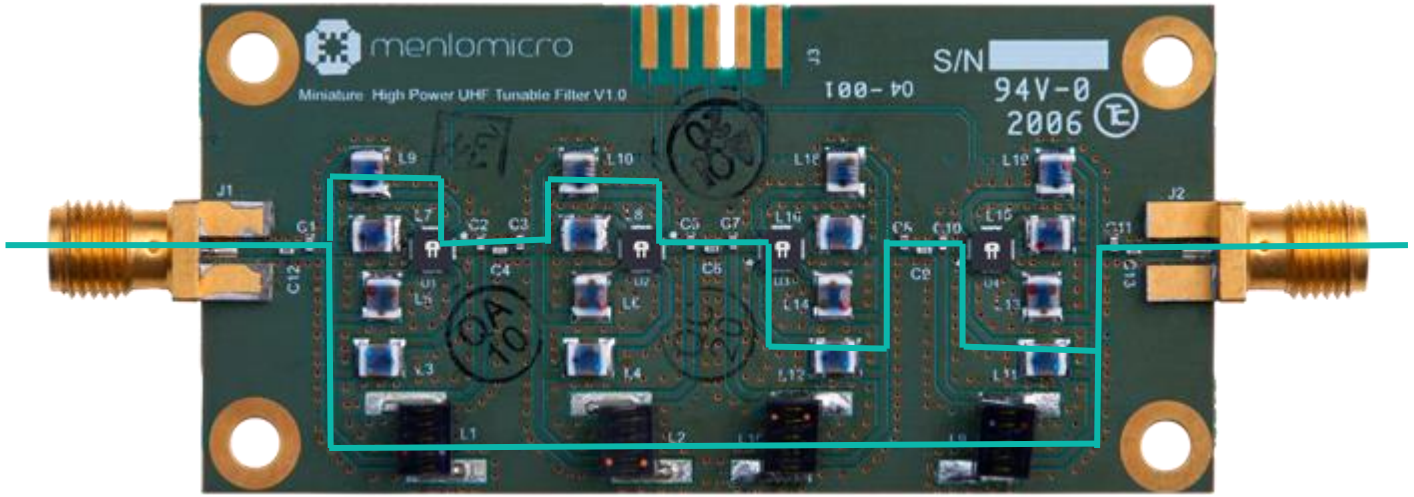
Specification	PIN diode (4 cascaded SPDT)	GaN (4 cascaded SPDT)	Ideal Switch (2 MM5130 SP4T)
Input power, CW (W)	100	20	25-50
Insertion loss (dB)	4 x 0.5 = 2.0	4 x 0.7 = 2.8	2 x 0.15 = 0.30
Switching speed	1.5 µs	0.05 µs	10 µs
Return loss	15	15	20
Isolation (dB)	35	25	30
Switching cycles	Unlimited	Unlimited	> 3 billion
IP3 (dBm)	75	60	>85

Frequency range: up to 12 GHz
IL differences for SFB can increase to greater than 4dB when comparing Ideal Switch to semiconductor solutions

MM6005: 7-channel UHF discrete tunable filter (225-512MHz)

Example: Replacing 7 fixed resonator and PIN diodes switches a single tunable resonator





BEFORE:

Typical SFB with high-power PIN diodes

- 7 channels, losses (**3 - 4 dB**)
- High Power (100W in = **<40W out)**
- Greater than **60W** lost as heat
- Fast Switching **(30us)**
- Size = **64 in²** or greater for multiple channels + thermal management

AFTER:

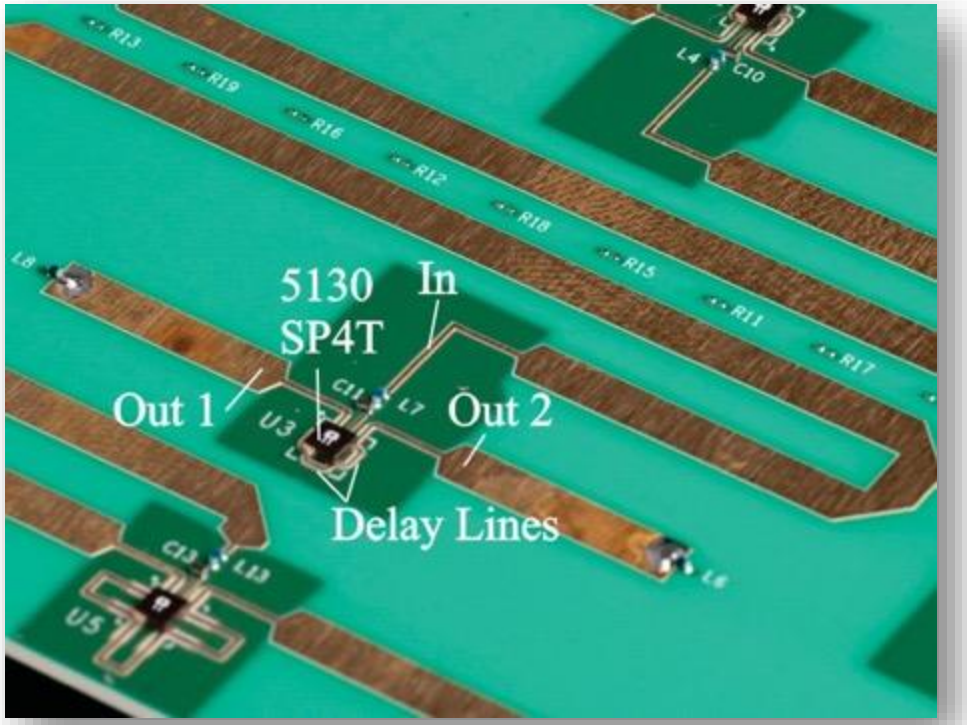
ideal switch

UHF Tunable Filter:

- 7 channels, Low Loss **(1.5dB)**
- High Power (60W CW**, >43W out)**
- Less than 17W lost as heat
- Fast Switching **(<10us)**
- Size = 6 in² a **91% reduction**

Menlo Phase Shift Design - “True Time Delay” technology

- Design achieves greater than 85 dBm of IP3 Linearity

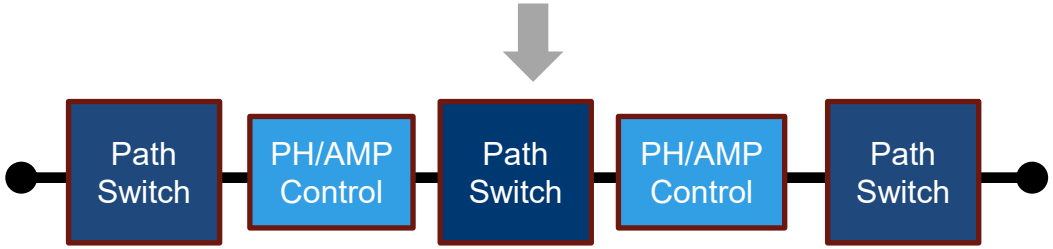


A “true time delay” phase shift networks based on Menlo Ideal Switch technology can bring significant advantages:

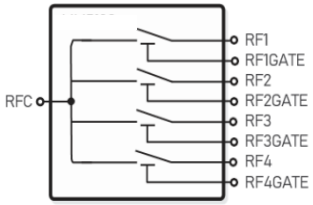
- Very small footprint
- Scalable delay lines for more phase states
- Low loss
- Fast switching speed
- Simple system with digital control
- High reliability
- Ideal for 5G beam steering deployments (MIMO-4T4R, 8T8R…)

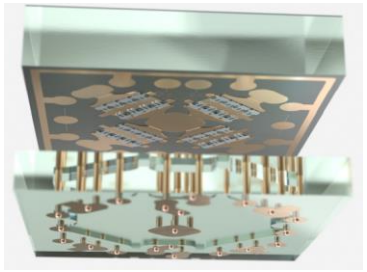
Beamforming System Application Benefits

Menlo BFIC Module
(development activities)

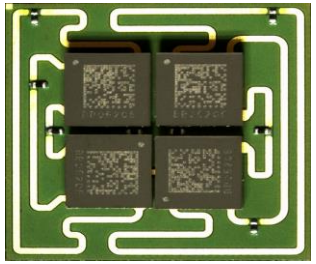


MM5130





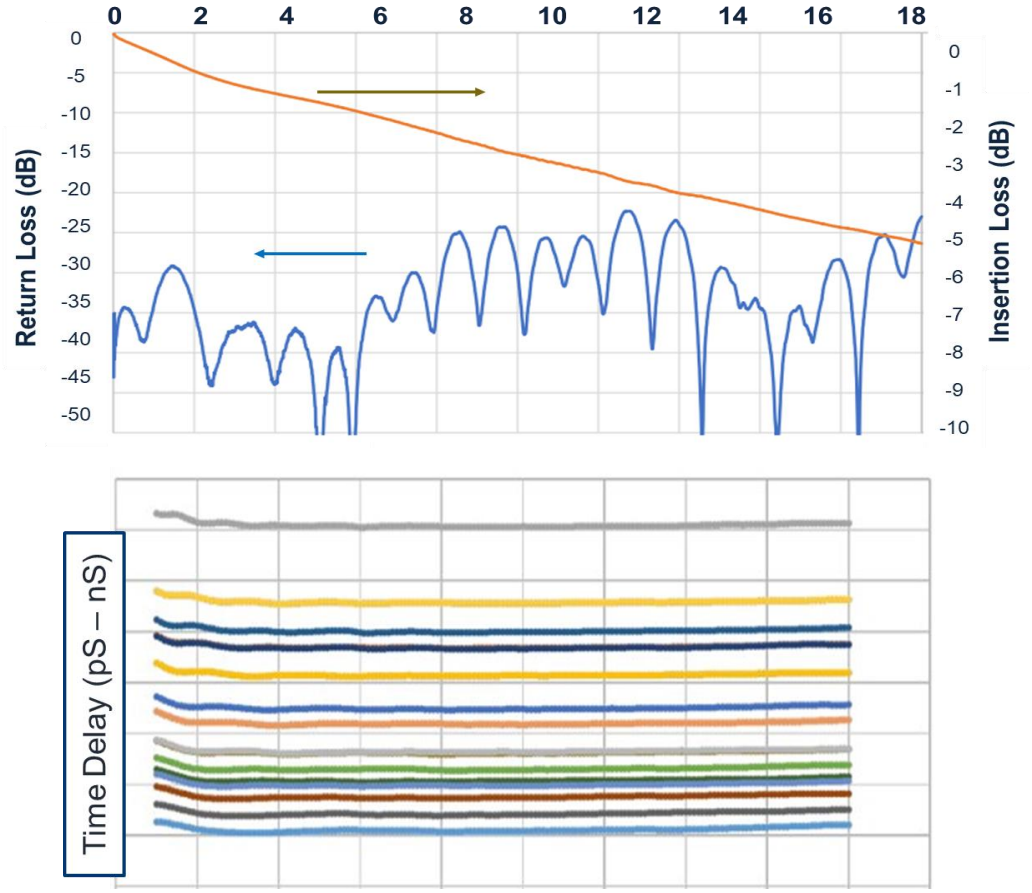
TDU on Glass



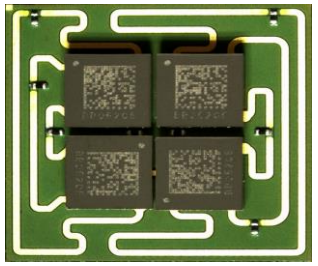
Time delay unit performances

- Scalable phase delay elements up to 2 nSec
- Wideband operation (2-18, 2-30 GHz)
- Low insertion loss demonstrated 2-18 GHz
  - low/hi frequency 1.3/3.8 dB
- High linearity IP3 95dBm
- Low RMS error
  - amplitude & time delay

RF System Application Benefits *(time delay shifter in reference state)*



- Flat time delay
- Very little ripple
- Excellent WB return loss
- 3.5-dB roll off without compression
- Very high IP3
- Very low insertion loss
- Very repeatable
- Stable over temperature
- SMT technology
- Custom configurations

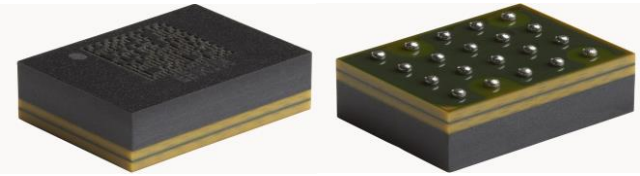


Digital TDU on Glass

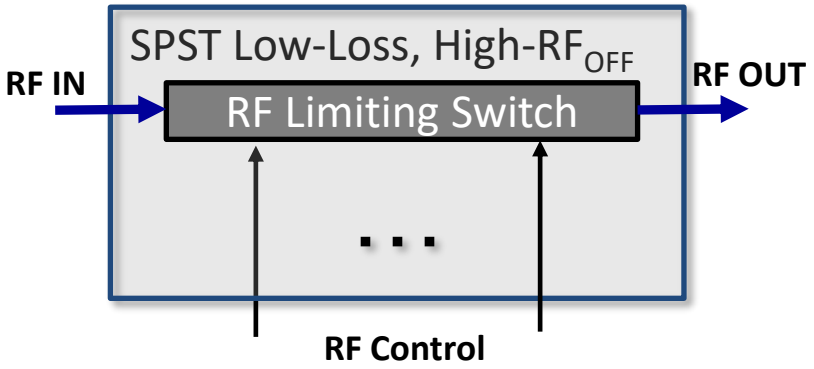
RF System Application: High Power Protection Switch – MM5815

Enabler for critical protect RFFE in mission critical applications

- RF Front-End (RFFE) Electronics Protection for high signals (DC – 26 GHz)
- Very small low-loss wideband
  - OFF mode: stand off 500 W (normally open mode)
  - ON mode: ultra low insertion loss (1dB at 18 GHz)
- Technology based solution to reduce size and improve performance
  - Ultra-high linearity, and ultra-low insertion loss
  - Protection for RFFE for both in-mission, and in storage locations



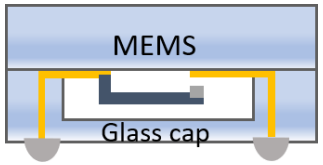
4.3x3.2mm BGA

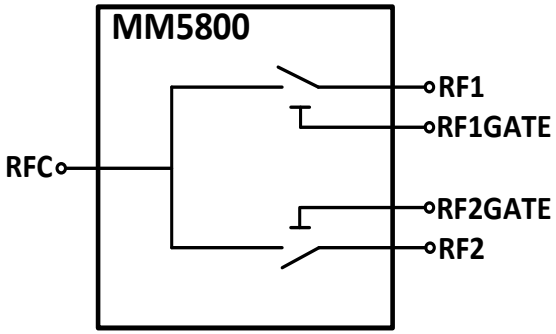


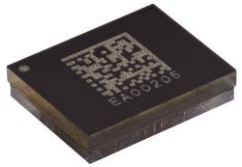
The only SMT technology capable of wide bandwidth RF stand-off to 100s Watts for RFFE protection

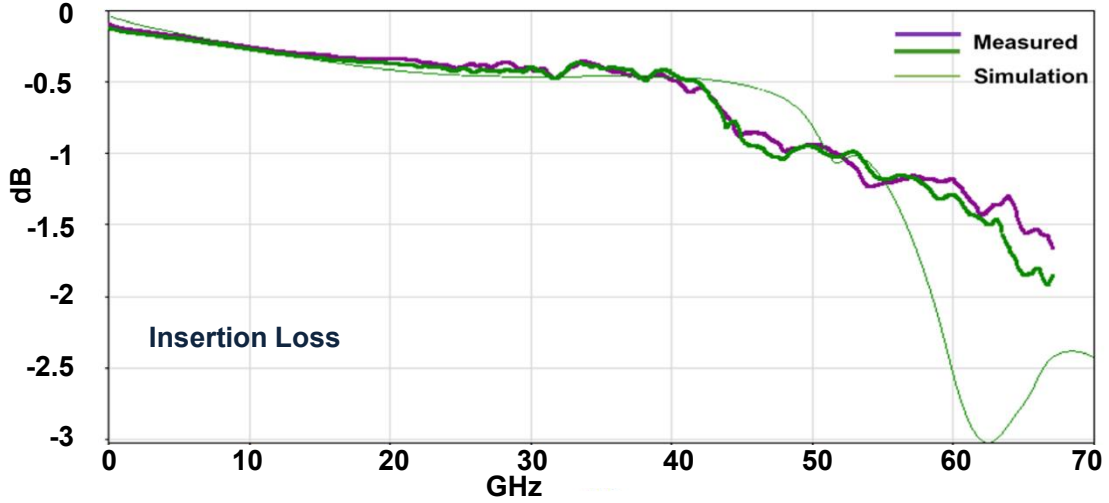
Millimeter Wave Switches (MM5800 & MM5170)

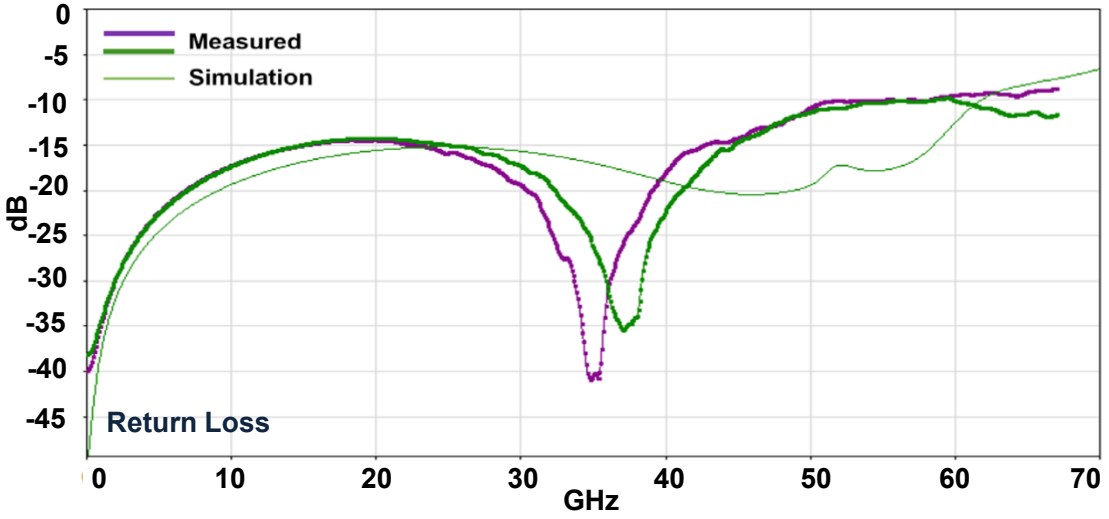
Active development programs











- SP2T in WL-CSP package (2.7mm x 3.4mm)
- Low loss: 0.5 dB @ 40 GHz
- High power: 2 W (CW) 20 W (pulsed), high linearity: 95 dBm (IP3)
- High isolation: 30 dB @ 40 GHz, high switching speed: 8 µs
- High reliability: >3 B switch cycles

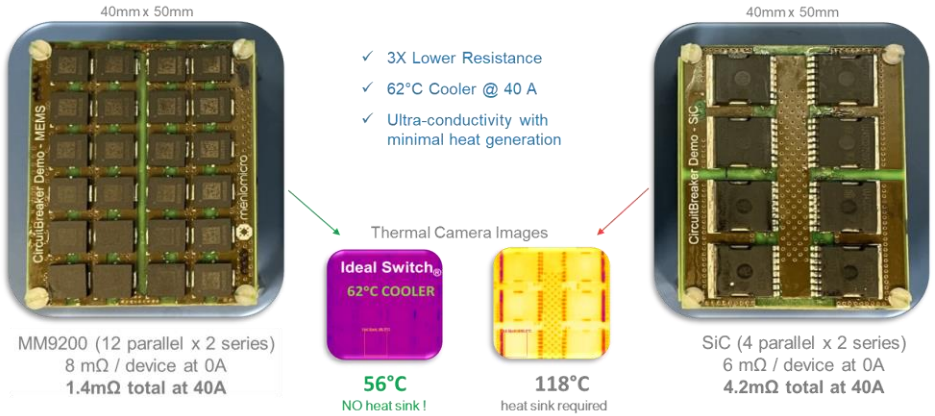
* Measured data shown for MM5800

Advanced Power Control Applications – Scalable Power Modules

Emerging as the power control technology of choice!

- **Rapid Market Adoption:** The Ideal Switch is experiencing exponential growth in customer adoption
- **Streamlined Manufacturing:** Simple, efficient fabrication process reduces complexity and cost
- **Thermal Simplicity:** No need for heat sinks or complex thermal management
- **Scalable Architecture:** Supports high voltage (series) and high current (parallel) configurations
- **Exceptional Performance:** Industry-leading R_{ON}, R_{OFF}, and reliable performance metrics
- **Smart Integration:** Seamless control with Advanced Switching Modules (ASMs) for simplified system management
- **Next-Gen Power Control:** The Ideal Switch is the solution of choice for modern power systems

MM9200 vs. SiC JFET
Comparison: 240VAC / 40A



Summary

Link Global: 90% of earth surface is not covered by cell towers. Link Global offers satellite based solutions for *Direct-to-Device* system for commercial or emergency services on all continents with broadband speeds for "*Cell-Tower-In-Space*"

- **Connectivity:** Reliable, scalable two-way connectivity from low Earth orbit (LEO) platforms require innovative RF signal path selectivity with industry leading performance COTs components
- **Performance Differentiation:** ● Linearity ● Low DC Power ● Low Insertion Loss ● High Power Handling
- **Reliable Operation:** 10 billion cycle typical performance at room temperature
- **Thermal Insensitivity**: Near zero thermal performance coefficient
- **Smart Integration:** Signal path control with switch technology offering system-in-package (SIP) evolution for simplification
- **Wide Bandwidth:** Frequency coverage between DC-70 GHz
- **Architectural options**: Wide variate of signal control architecture options with SMT SIP technologies
- **RFFE Protection**: High standoff OFF mode offers RFFE protection from high power RF interference
- **Next-Gen Signal Control:** The Ideal Switch is becoming the solution of choice for modern switched filter signal selection

Your presenter

Mark Walker
mark.walker@menlomicro.com
214-205-1207

Special thanks to:
Link Global: Joe Bravman, Andrew Loomis
Inner Harbor: Dominic Giarratano, Paul Giarratano

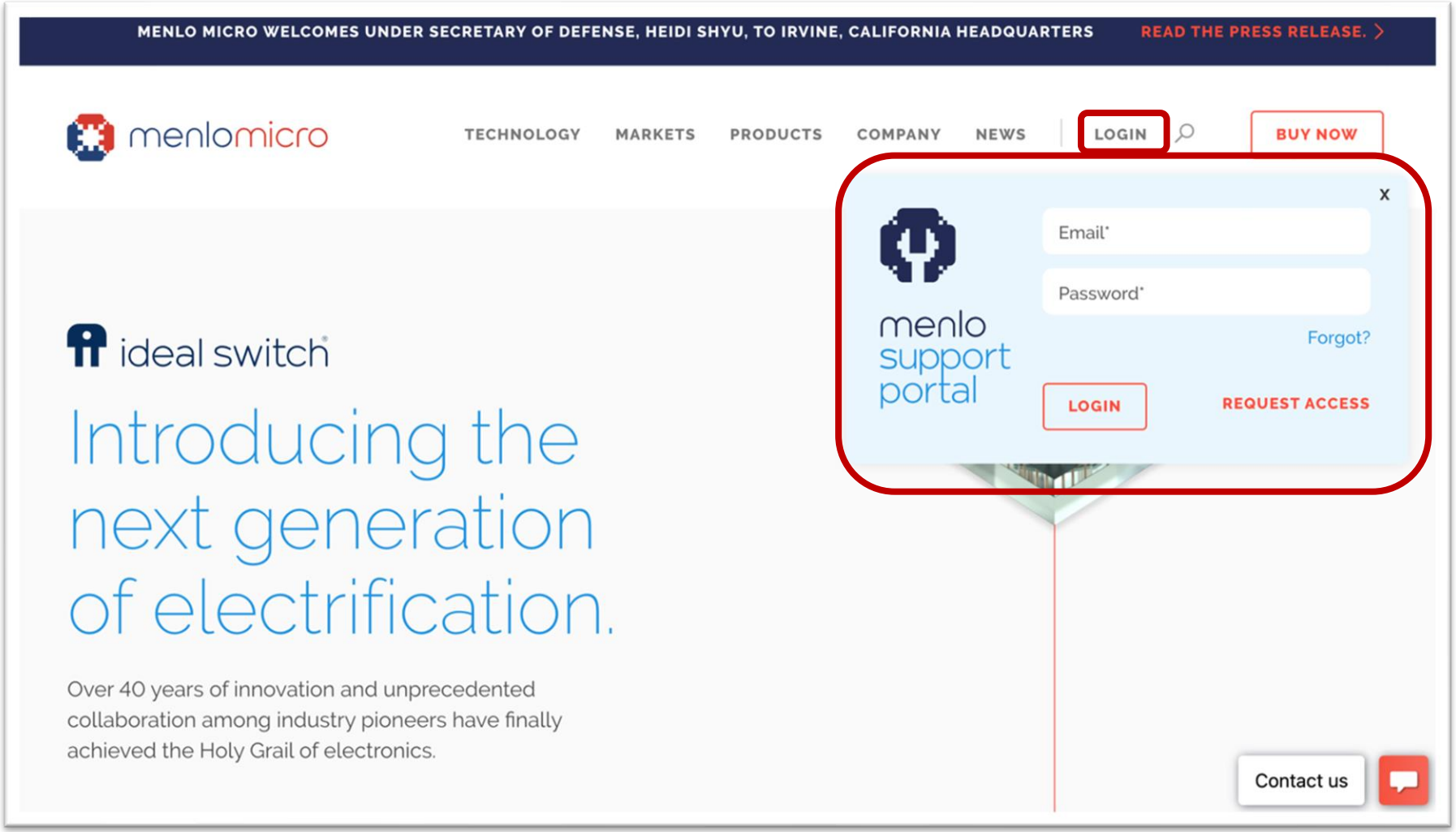
Thank you!

Backup

Website Resources – The Menlo Support Portal

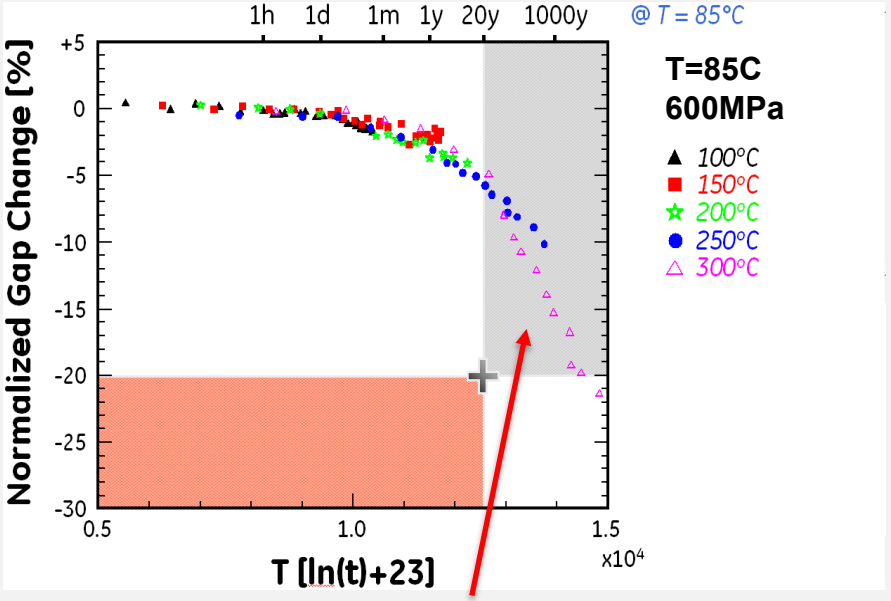
Additional product support/documentation can be found by logging in through Menlo's website http://www.menlomicro.com/

- Users can sign up by clicking on "Login" and then "Request Access"
- Access is typically granted within 24hrs



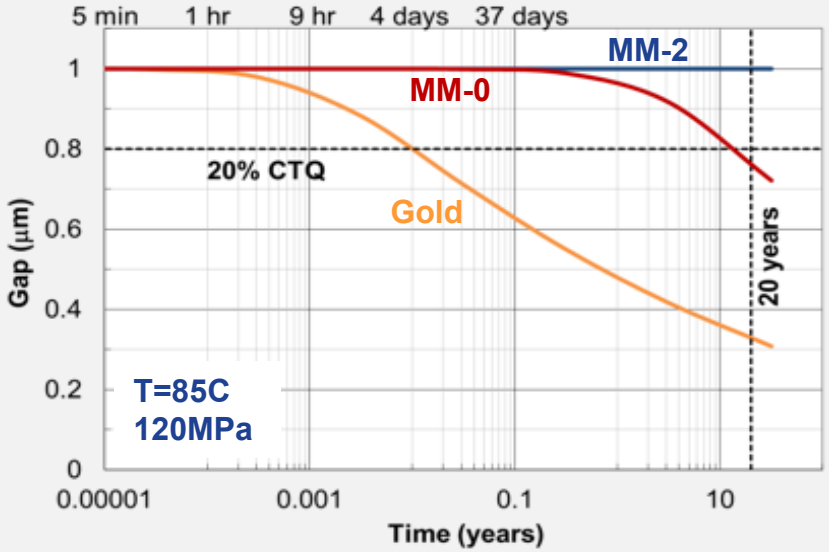
Better Beam Materials = No Metal Fatigue

MM-2 beam alloy w/accelerated mechanical test



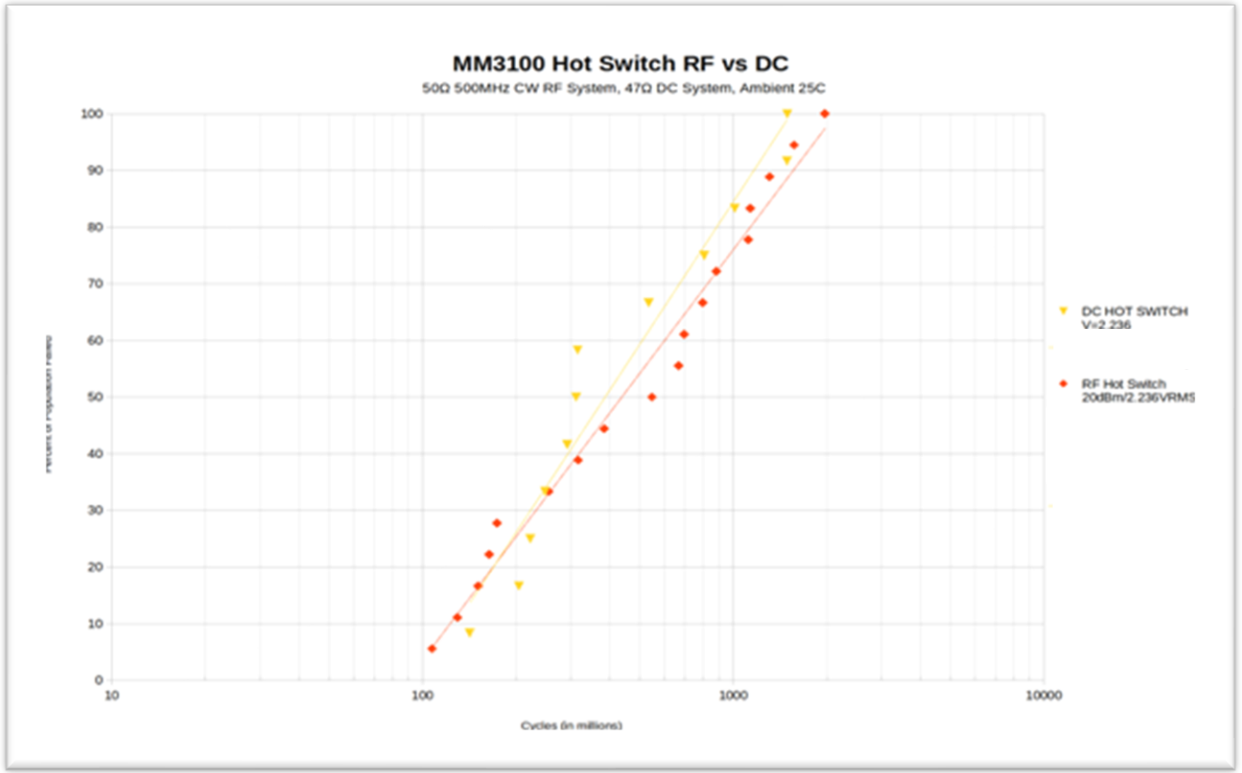
Takes stress at ***300◦C*** to deform beam to failure (20% gap change)

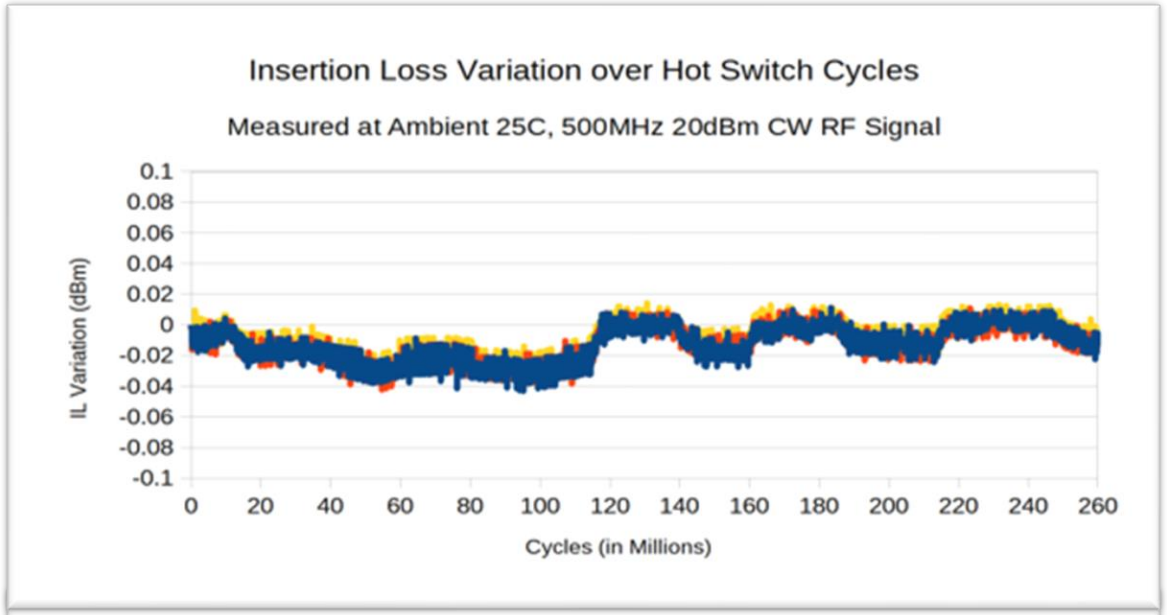
Ideal Switch beam performance

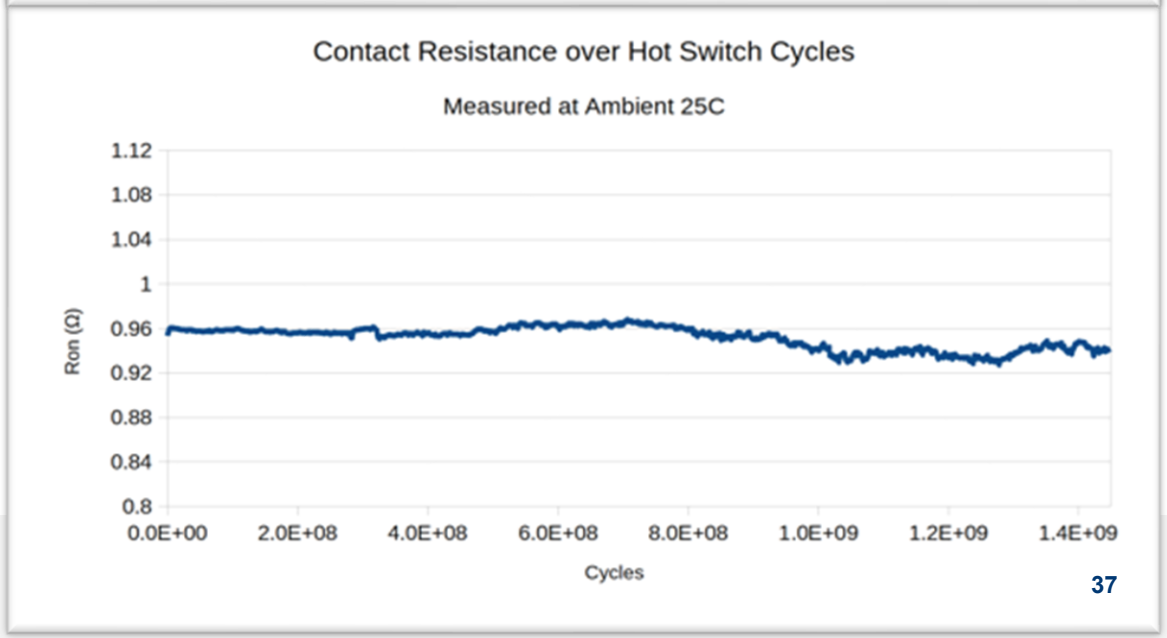


Ideal Switch beams have decades of life under typical operating conditions

RF Hot Switch vs DC Hot Switch Test Performance



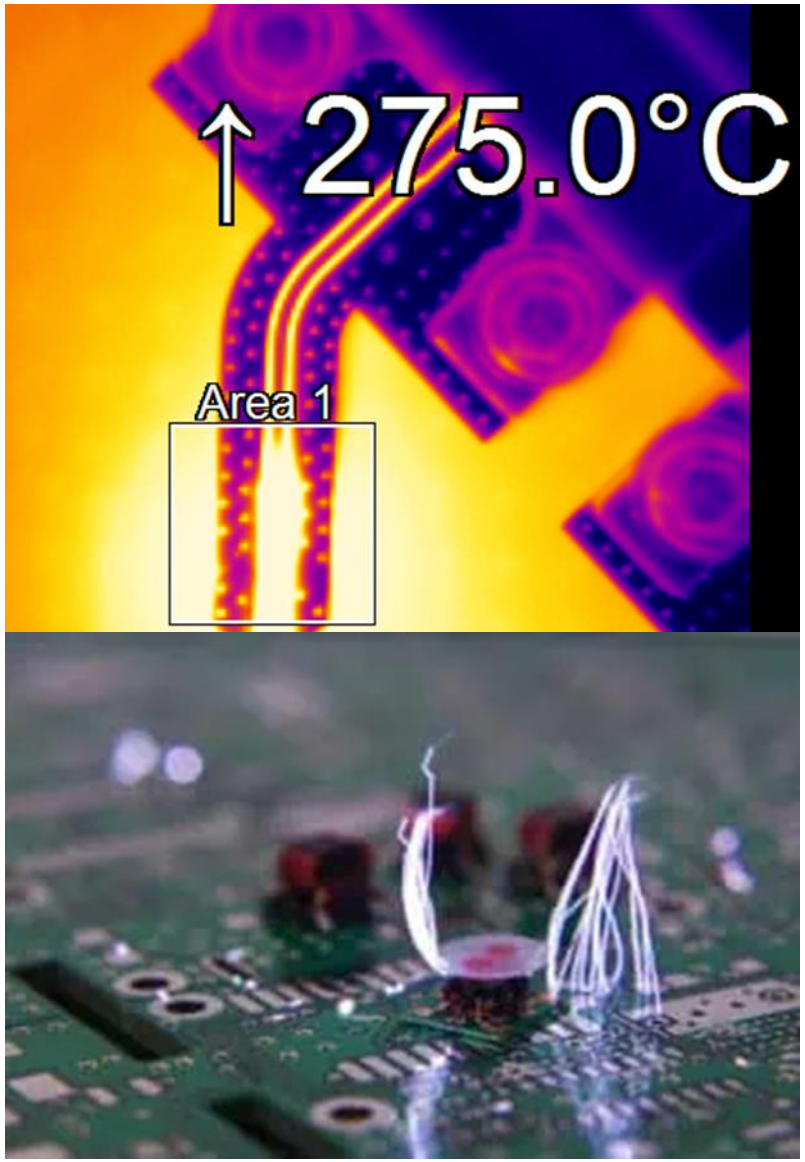




- RF system ran at 20dBm, 50Ω, Vrms = 2.236V
  - Insertion loss stable during test
  - Variation <0.05dBm over test
- DC system run at 2.236V with 47Ω load
  - Contact resistance stable during test
  - Variation <0.05Ω over test

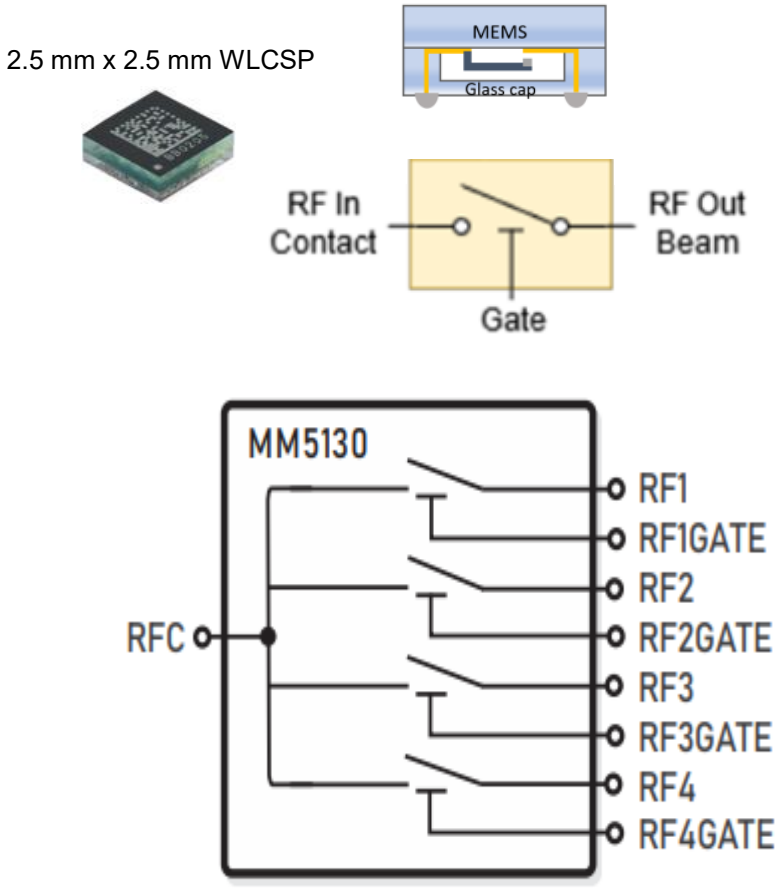
High Power Operation

- Current/Heating Effects
  - Insufficient current handling of components/traces
    - Fusing of traces
    - Overheating and failure of components
  - Insufficient thermal heat removal
    - Overheating and failure of components
    - Premature ageing impacting MTBF
- Voltage Effects
  - Insufficient voltage rating of components
    - Component failure
  - Insufficient spacing between voltage nodes
    - Voltage breakdown in air or dielectric
  - Derating and ageing
    - Need to account for temperature and altitude



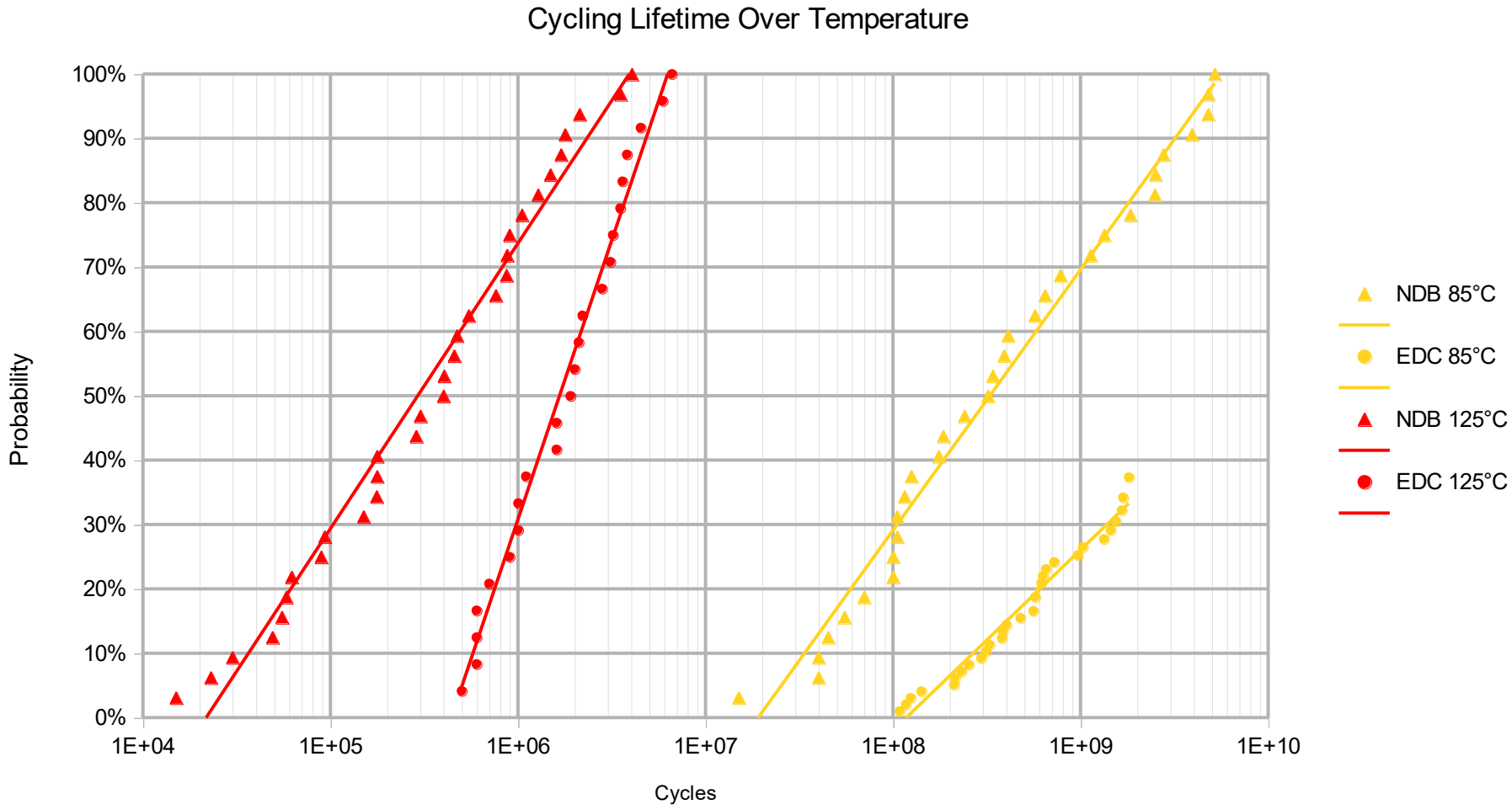
Product Enhancements – MM5130-***EDC***

- DC to 26 GHz (super-port) and 18 GHz (standard-port) frequency range
- RF power 25 W (CW) to 6 GHz, 150 W (pulse)
- High linearity IP3 >90 dBm
- <0.8 dB on-state insertion loss @ 18 GHz (super port)
- <30 dB isolation @ 18 GHz (super port)
- Power supply - requires 89 V gate control
- High reliability >3B switching cycles guarantee (25C)
- High reliability >100M switching cycles guarantee (85C)
- 2.5 mm x 2.5 mm WLCSP



MM5130-03 ***EDC*** High-Temp Cycling Enhancement

EDC version shows almost 10x improvement demonstrated over NDB



85C Cycling

Min cycles: **100M**
Typ. cycles: **6B**
Sample Size: 97 units
Only 31 tested to failure, most stopped at +1B cycles.

105C Cycling

Min cycles: **50M**
Typ. cycles: **300M**
Sample Size: 24 units

125C Cycling

Min cycles: **0.5M**
Typ. cycles: **3M**
Sample Size: 24 units

Menlo is in the process of characterizing at 25C, expecting >> 50B cycles

Superior environmental performance – Shock & Vibration

MM5130/5230 exceeds the IEC 60601/60068 standard, and also passes MIL-STD 810G/H stresses, and beyond…

MM5130
EVK Assembly

Shock/Vibration test system:
Westpak Labs, San Jose, CA & NTS Labs, Fullerton, CA

Purpose: Determine whether Ideal Switch technology suffers from inadvertent open or close of the actuator, while under extreme vibration

Test Setup:

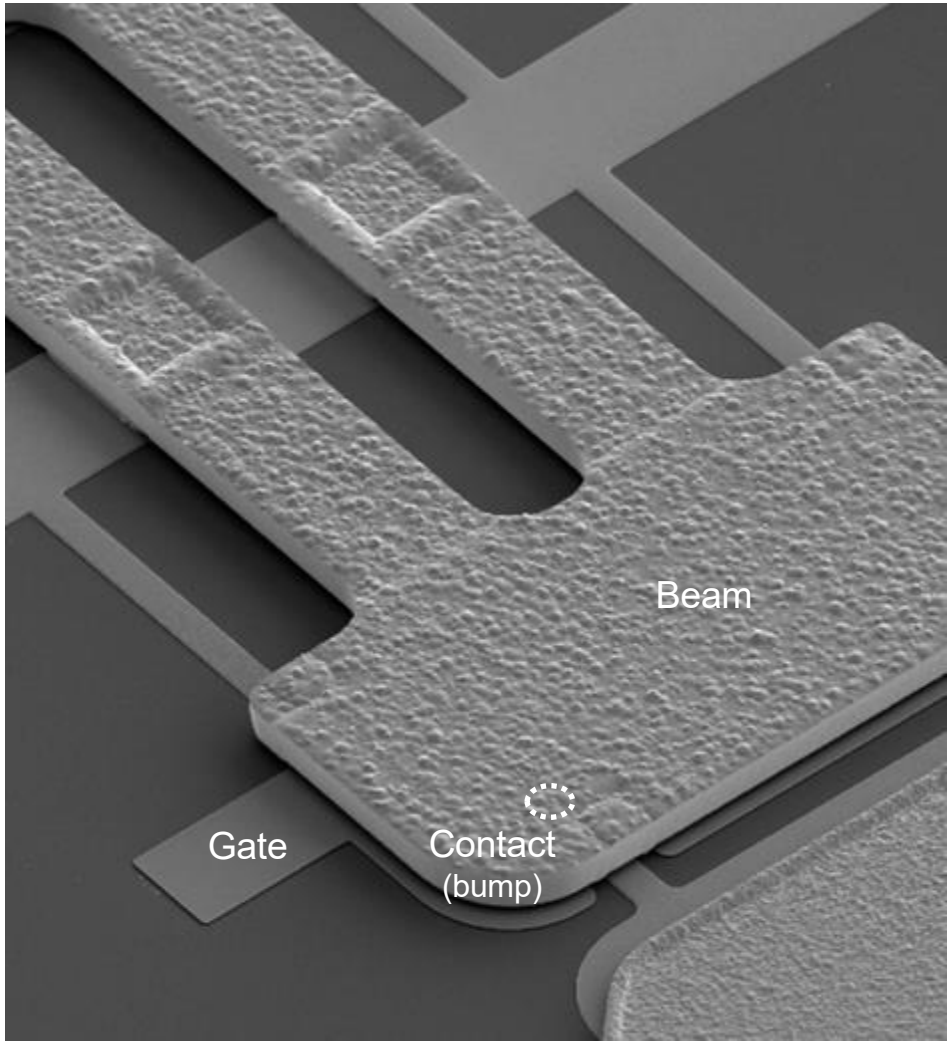
- Monitor switch *during* stress, analyze the data for any transients or anomalies (unexpected open or close).
- Test #1: IEC 60601/60068 standard – X,Y,Z-Axis 30 mins
- Test #2: MIL-STD-810G random vibration – X,Y,Z-Axis 30 mins
- Test #3: MIL-STD-810H random vibration – Z-Axis
- Test #4: Supplemental vibration testing in 6 dB increments above 810H to the maximum level of the vibration table (62 Grms)

Results:

- MM5130: under IEC 60601/60068 *and* Mil-Std-810G tests
- MM5130: under Mil-Std-810H up to 62 Grms tests — Pass
- Multiple devices showed no performance degradation
- Other mechanical relays subjected to same stress profile — Fail

The Beam

Smaller than a human hair, can handle >400 V



System-In-Glass Packaging

Close-up view of Through-Glass-Vias and hermetically sealed package