TAGORE TECHNOLOGY

TRUSTED GAN™

GaN-based RF Switch Improves SWaP and Takes the Complexity Out of High-Power Radio Design

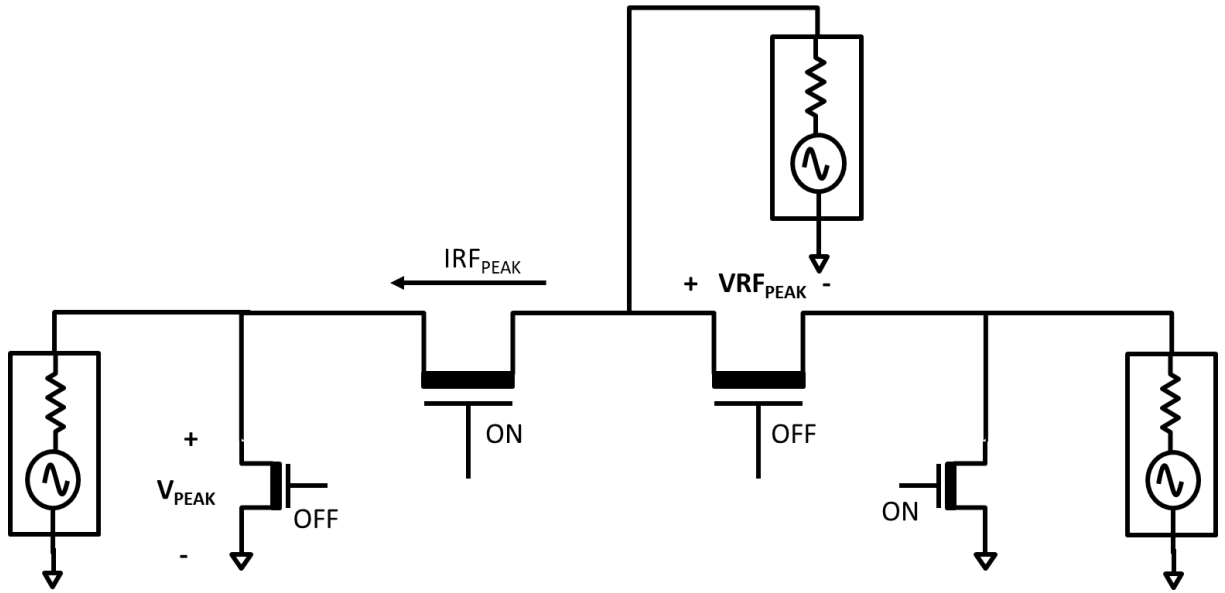
Session: WEMA16

Presenter: Manish Shah, VP of Engineering

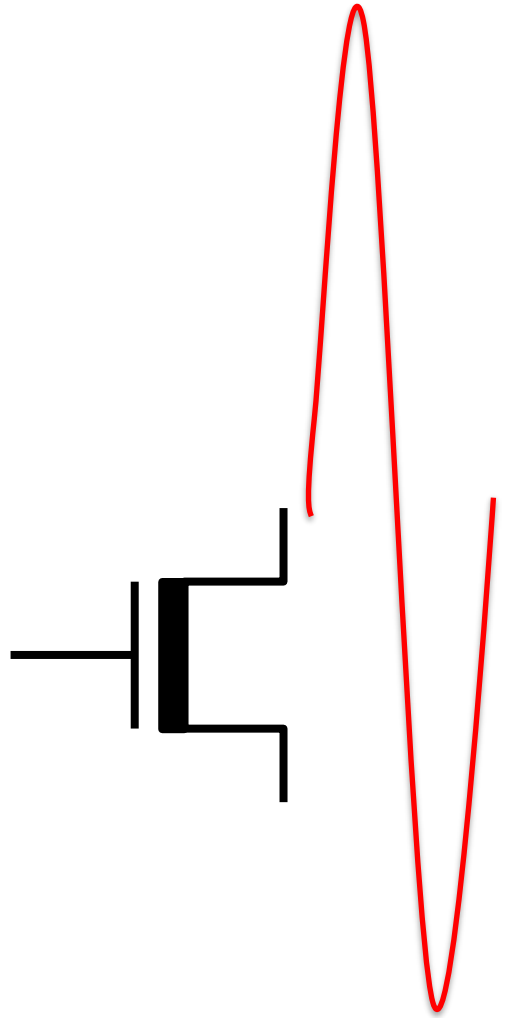
Objective

- RF Switch Basics
- RF Switch Technology options
- GaN Switch vs PIN Diode based Switch
- High Power Radio RFFE Requirement
- RF GaN Switch Performance
- Tagore's 2nd Generation GaN RF Switch Portfolio
- Q&A

RF Switch Design Basics



Power (Watt)	VRF$_{peak}$ (V)		IRF$_{peak}$ (A)	
	50 Ohm	4:1 VSWR	50 Ohm	4:1 VSWR
10	32	51	0.6	1.0
30	55	88	1.1	1.8
50	71	113	1.4	2.3
100	100	160	2.0	3.2

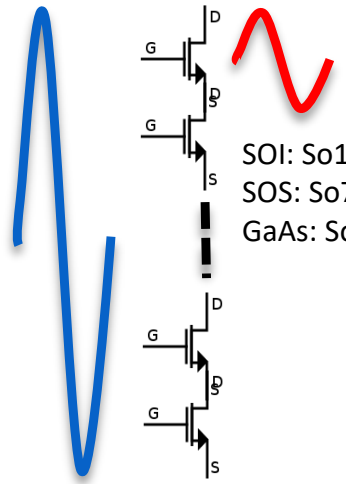


Differentiation vs Other technology

Property	Si	GaAs	GaN
Energy Gap (eV)	1.11	1.43	3.4
Critical Electric Field (MV/cm)	0.3	0.5	3.5
Charge Density (# x $1x10^{13}/cm^2$)	0.3	0.3	1
Thermal Conductivity (W/cm/K)	1.5	0.5	1.5
Mobility ($cm^2/V/s$)	1350	8000	1500
Saturation Velocity (x 10^7 cm/V)	1	1.4	2.7

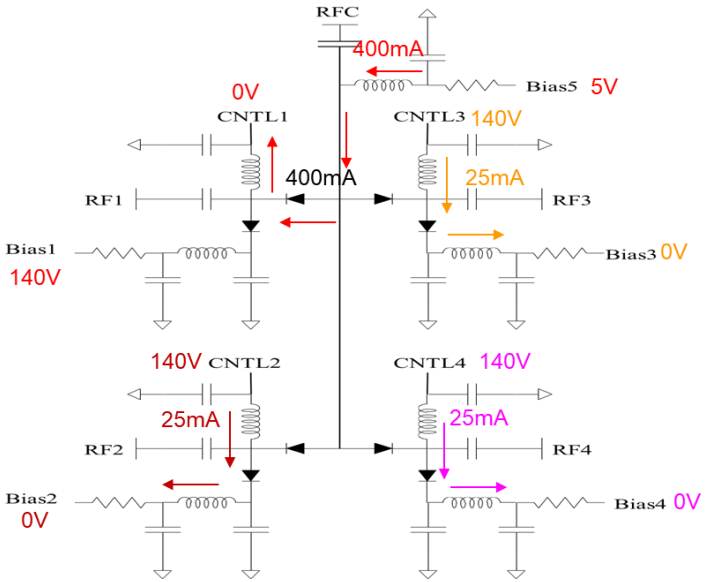
Higher Voltage & Better Linearity

Lower $RDS_{ON,}$ Higher Power & Frequency

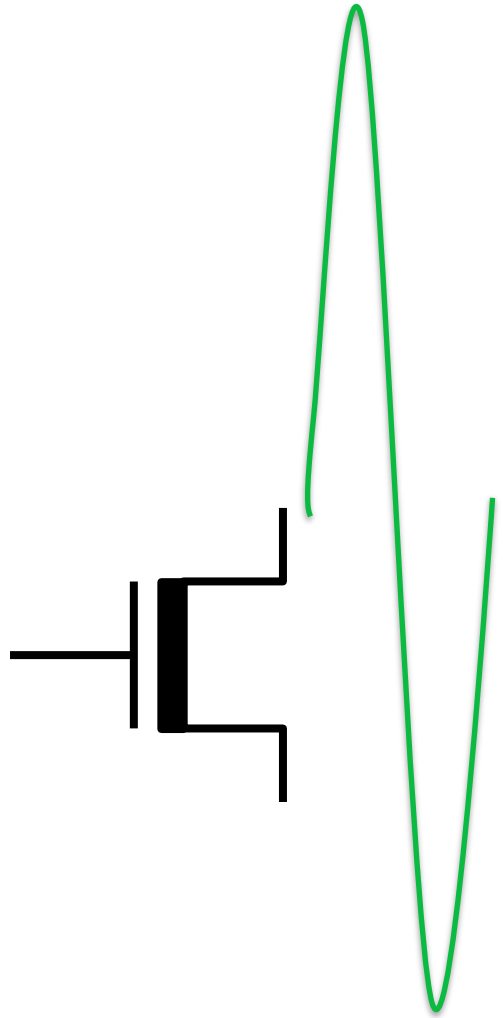


SOI: So10 to 14
SOS: So7 to 10
GaAs: So3 to 5

SOI, SOS, GaAs



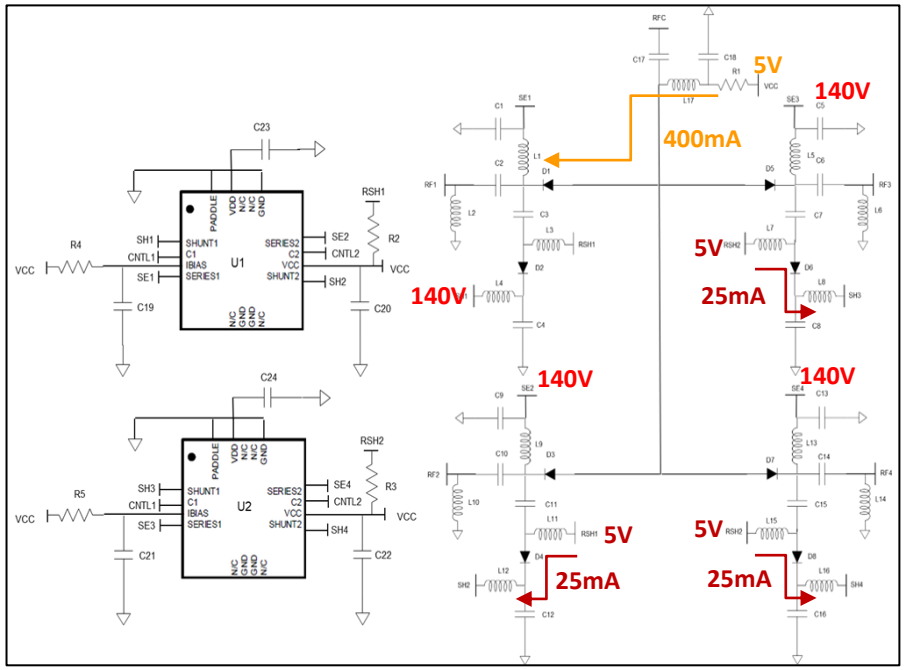
PIN Diode



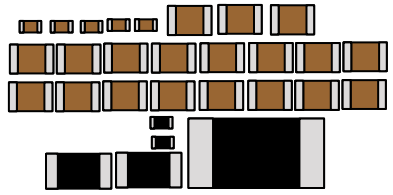
GaN

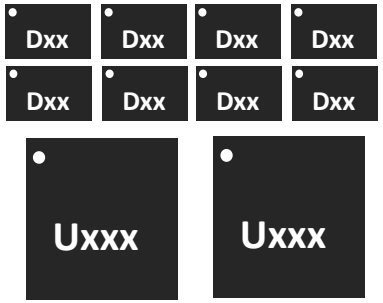
100 W PIN Diode Vs GaN based RF Switch

100W 4T pin diode switch solution



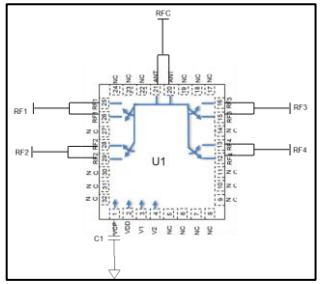
55 vs 2 components
275mm² vs 25.5mm²
2500mW vs 0.6mW



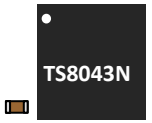


10x smaller

Tagore 100W 4T Solution



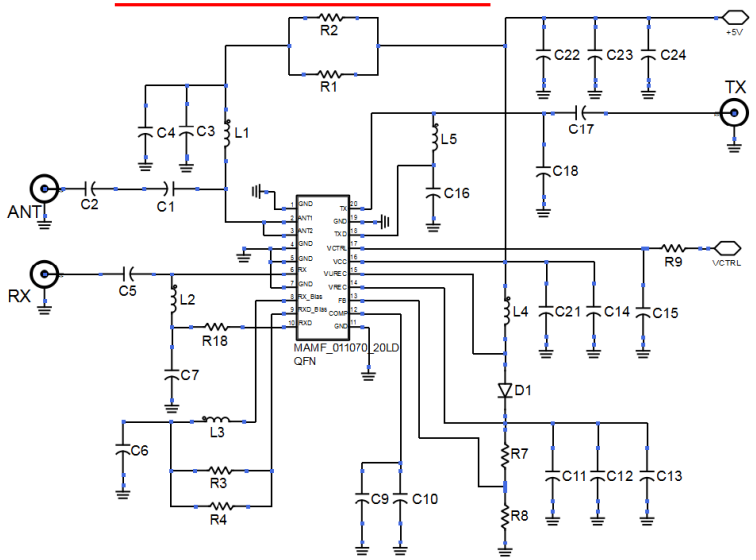
3V, 200uA

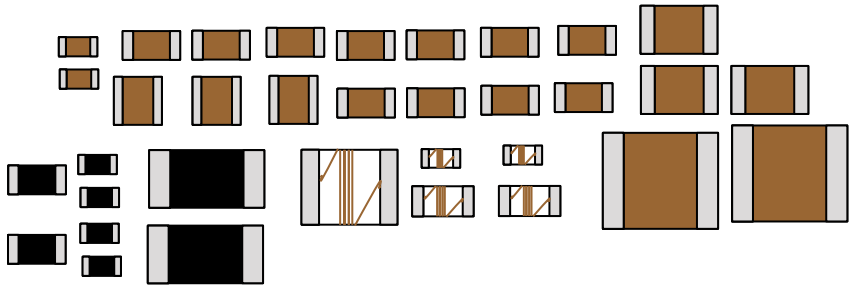


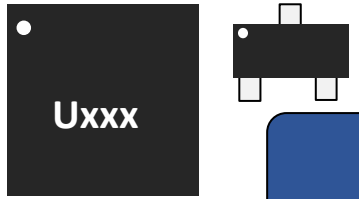
Drastic reduction in Component count, Power and Design time

Macro BS PIN Diode Vs GaN based Fail-Safe Switch

PIN Diode Solution







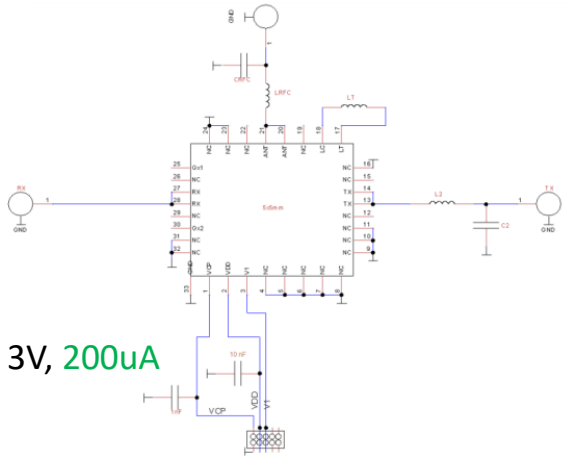
36 vs 8 components

96mm² vs 30mm²

850mW vs 0.6mW

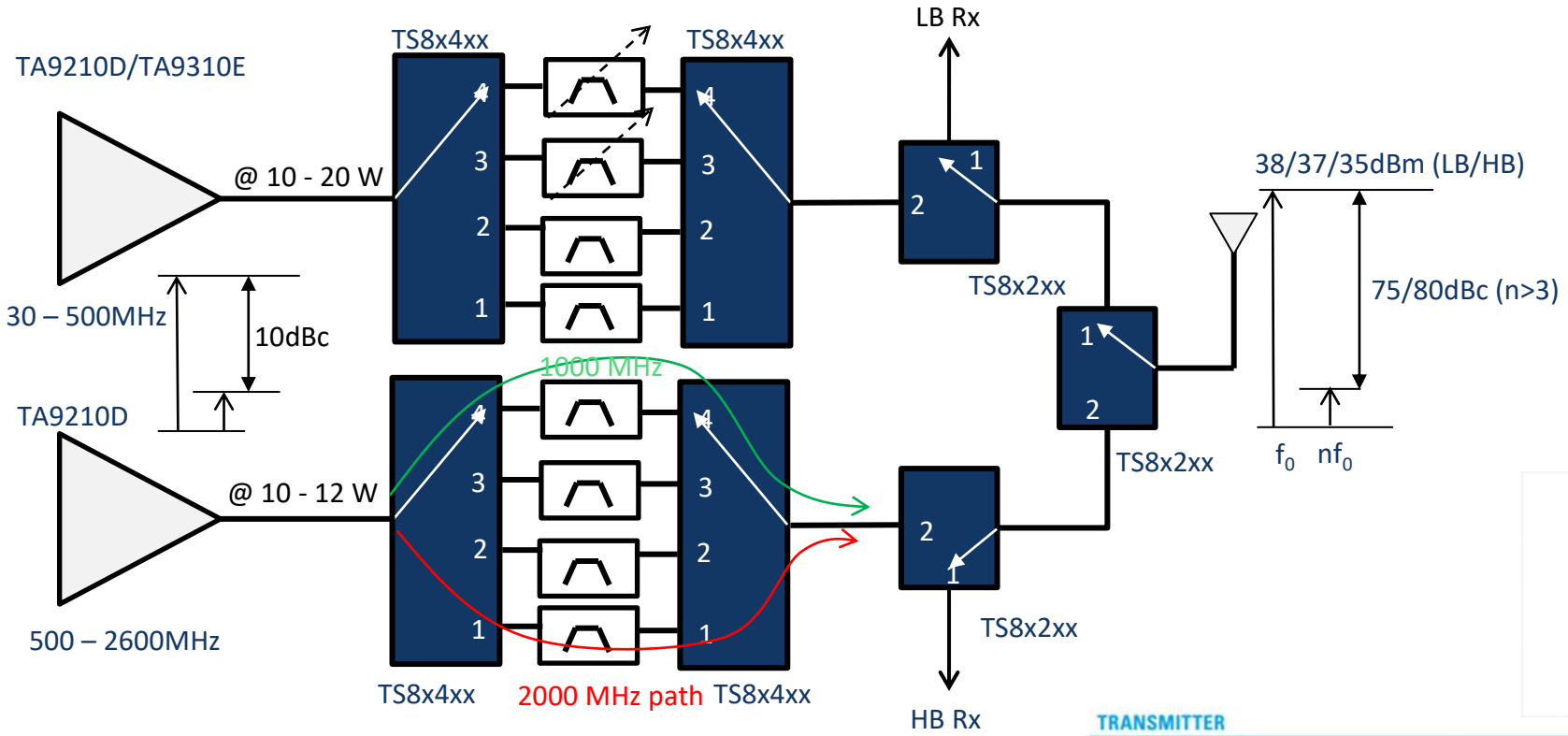
10x smaller

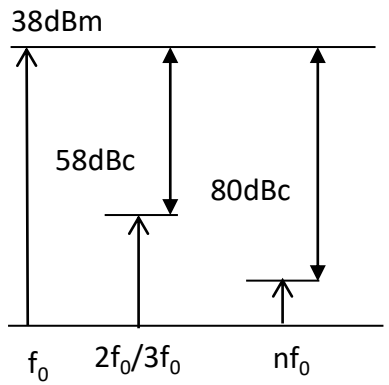
Tagore GaN Solution, TS8029N



Drastic reduction in Component count, Power and Design time

RFFE Requirement for LMR/PMR &Tactical Radio





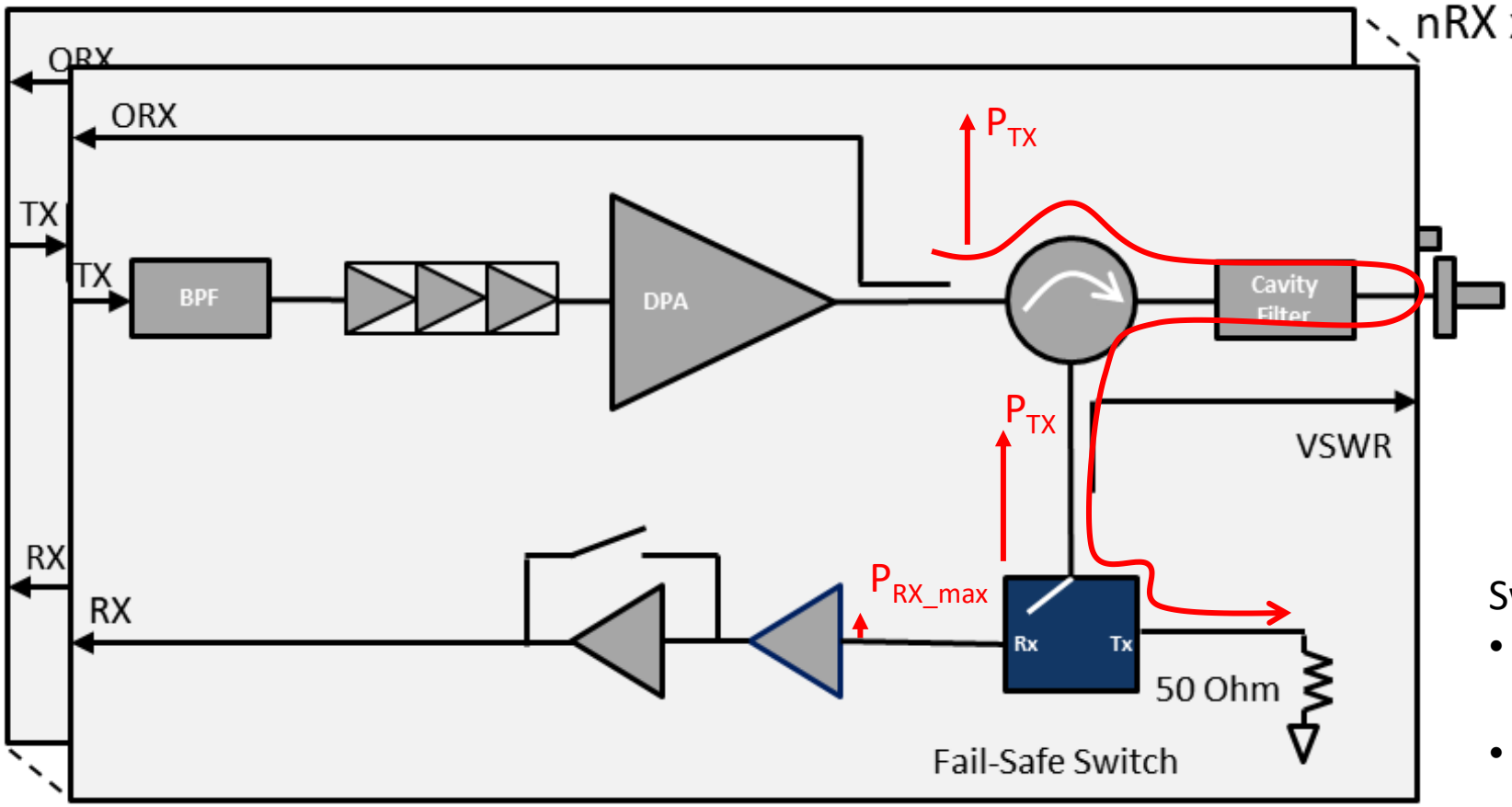
Switch Requirements:

- Low IL
- P_{AVG} > 20W
- 80dBc Harmonics @ 37dBm

TRANSMITTER

	Footnote	VHF	UHF Range 1	UHF Range 2	700 MHz	800 MHz
Frequency Range / Bandsplits	-	136-174 MHz	380-470 MHz	450-520 MHz	762-776, 792-806 MHz	806-825, 851-870 MHz
Channel Spacing	1	12.5 / 20 / 25 kHz	12.5 / 20 / 25 kHz	12.5 / 20 / 25 kHz	12.5 / 20 / 25 kHz	12.5 / 20 / 25 kHz
Maximum Frequency Separation	-	Full Bandsplit	Full Bandsplit	Full Bandsplit	Full Bandsplit	Full Bandsplit
Rated RF Output Power (Adjustable)	2	1-6 W	1-5 W	1-5 W	1-2.5 W	1-3 W
Frequency Stability (-30 °C to +60 °C; +25 °C Ref.)	2	±1.0 ppm	±1.0 ppm	±1.0 ppm	±1.0 ppm	±1.0 ppm
Modulation Limiting (12.5 / 20 / 25 kHz Channel)	2	±2.5 / ±4 / ±5 kHz	±2.5 / ±4 / ±5 kHz	±2.5 / ±4 / ±5 kHz	±2.5 / ±4 / ±5 kHz	±2.5 / ±4 / ±5 kHz
Emissions (Conducted and Radiated)	2	-75 dBc	-75 dBc	-75 dBc	-75 dBc	-75 dBc
Audio Response	2	+1, -3 dB	+1, -3 dB	+1, -3 dB	+1, -3 dB	+1, -3 dB
FM Hum and Noise (12.5 / 25 kHz Channel)	2	-53 / -55 dB	-52 / -54 dB	-51 / -54 dB	-50 / -55 dB	-49 / -53 dB
Audio Distortion (12.5 / 25 kHz Channel)	2	0.75% / 0.75%	0.75% / 0.75%	0.75% / 0.75%	0.85% / 0.85%	0.85% / 0.85%

RFFE Requirement for mMIMO 5G / Phased Array Radar

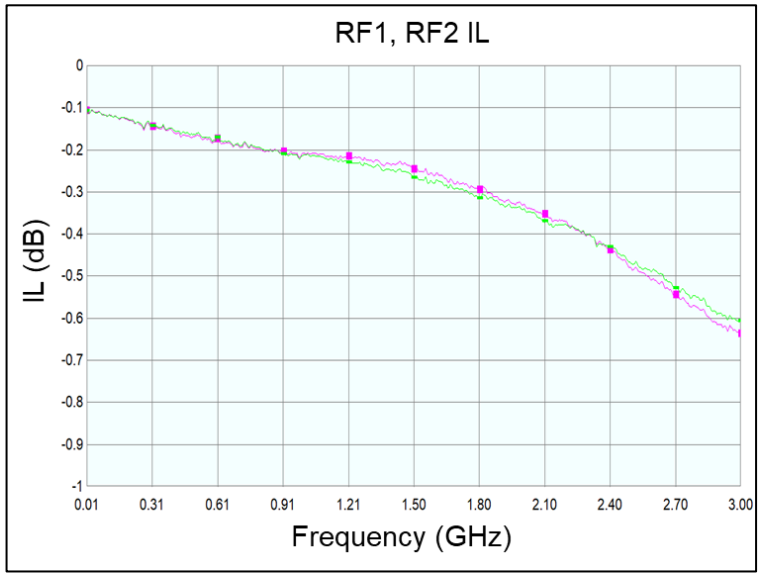


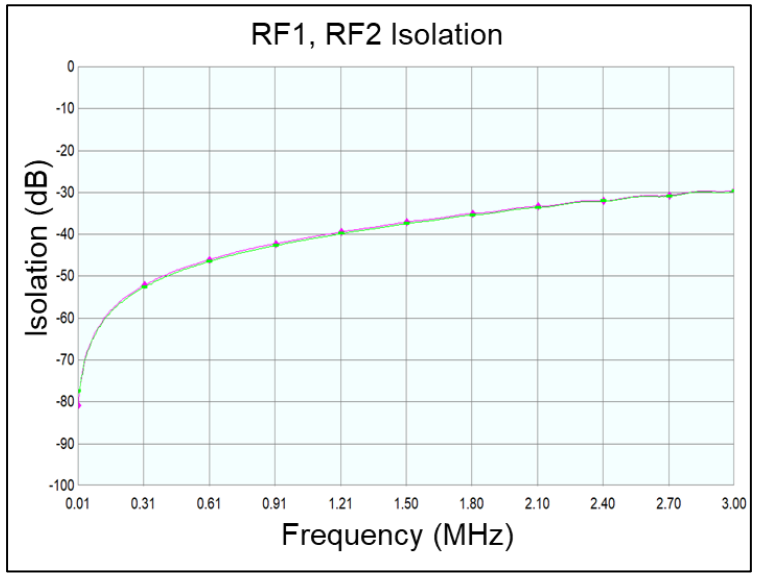
Poor VSWR Condition

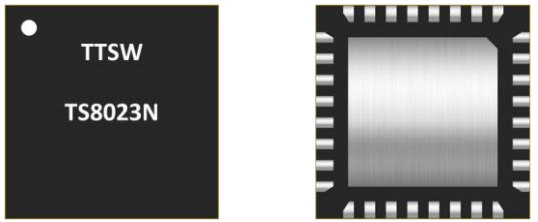
Switch Requirements:

- Max Pout of DPA Average Power handling
- Max Pout of DPA + PAPR Peak power handling
- Switch Rx Isolation: P_{TX} - P_{RX_max}
- Low Rx IL

TS8023N - 100W GaN RF Switch

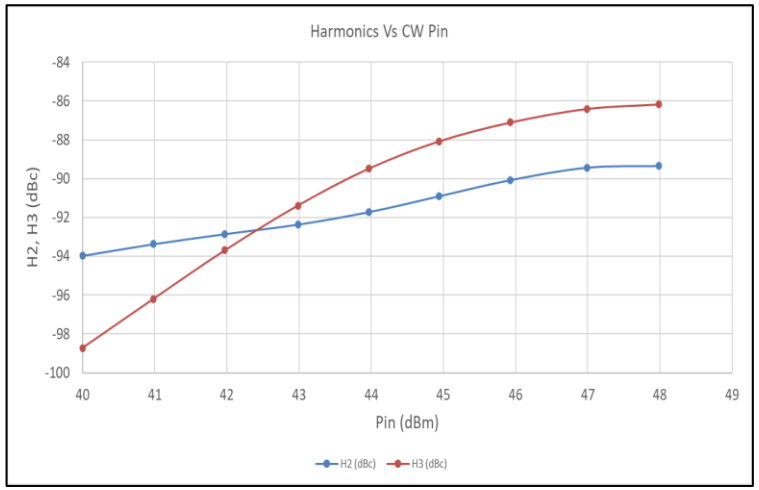


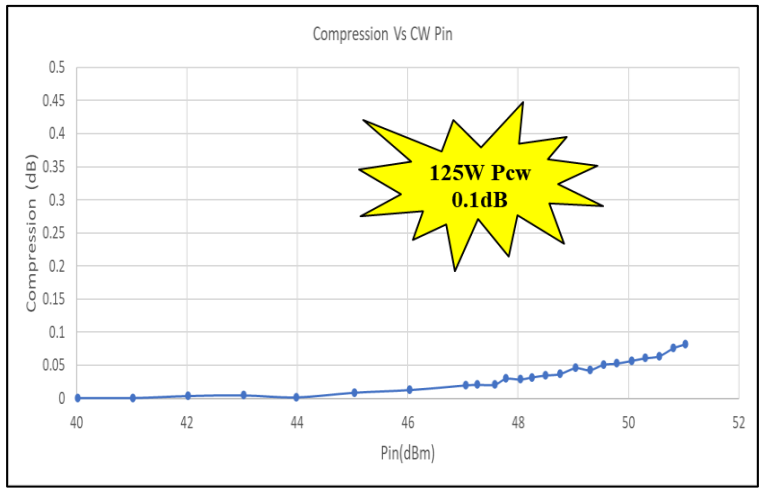




5x5mm QFN

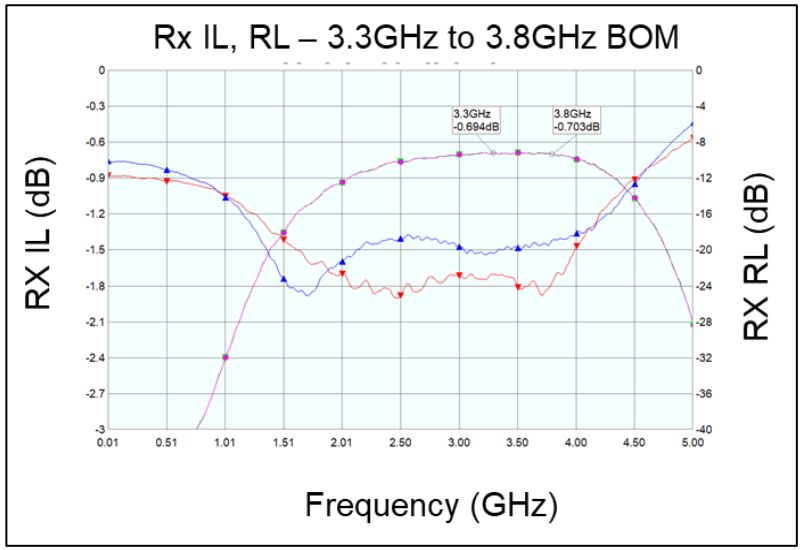
3V, 200uA

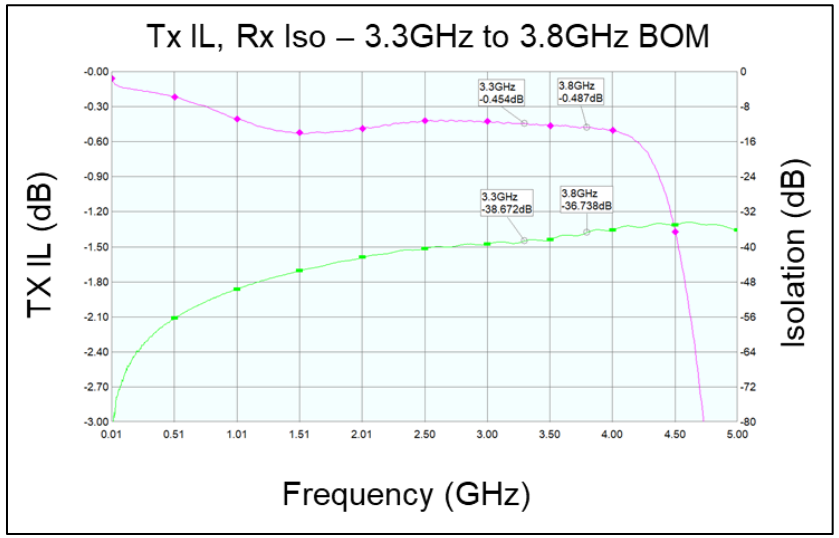


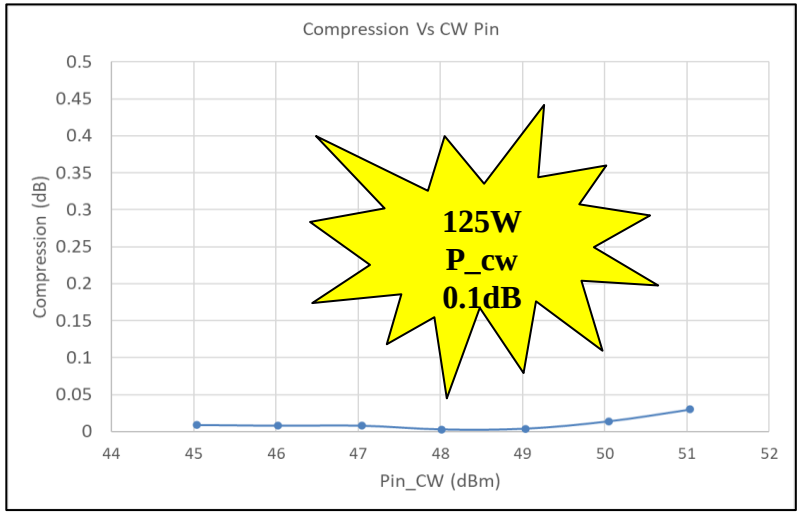


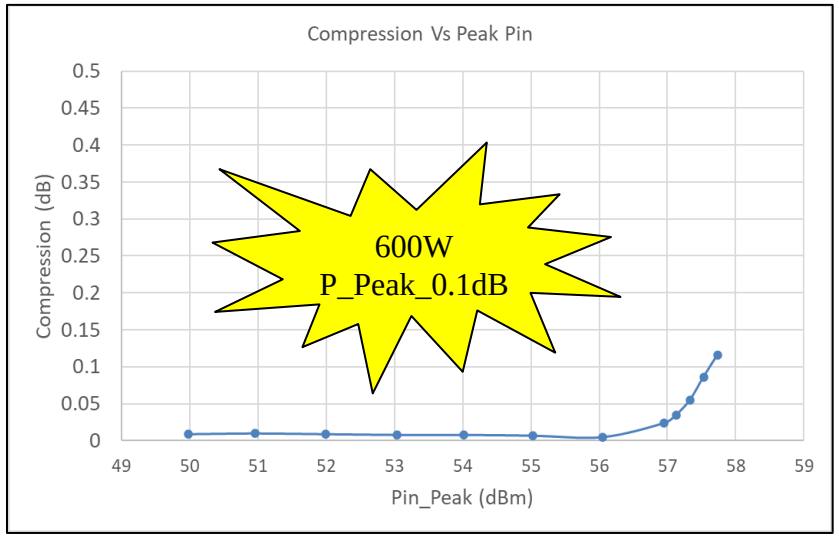
Parameter	Measured
P_CW_0.1dB	51dBm
P_pulse_0.1dB	54dBm
H2 @ Pin 47dBm	89dBc
H3 @ Pin 47dBm	86dBc

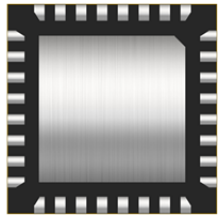
TS8029N – 100W CW, 600W Pulse Power GaN Fail-Safe Switch







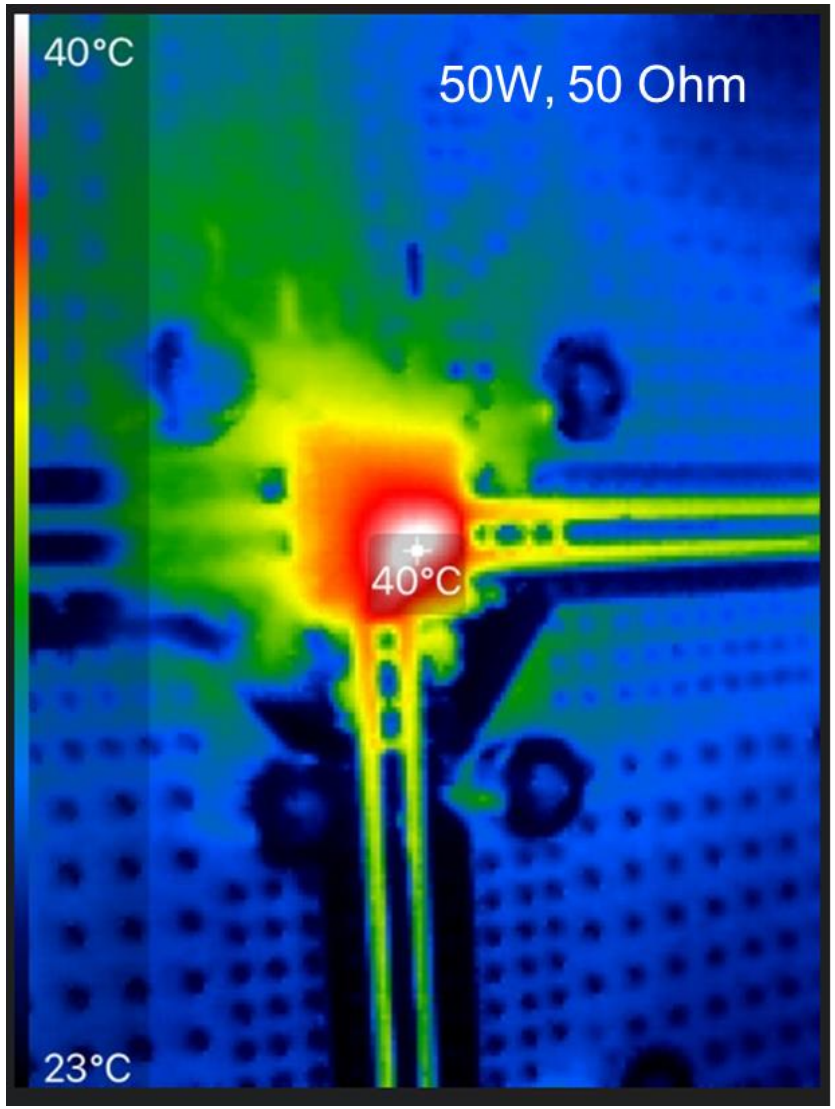


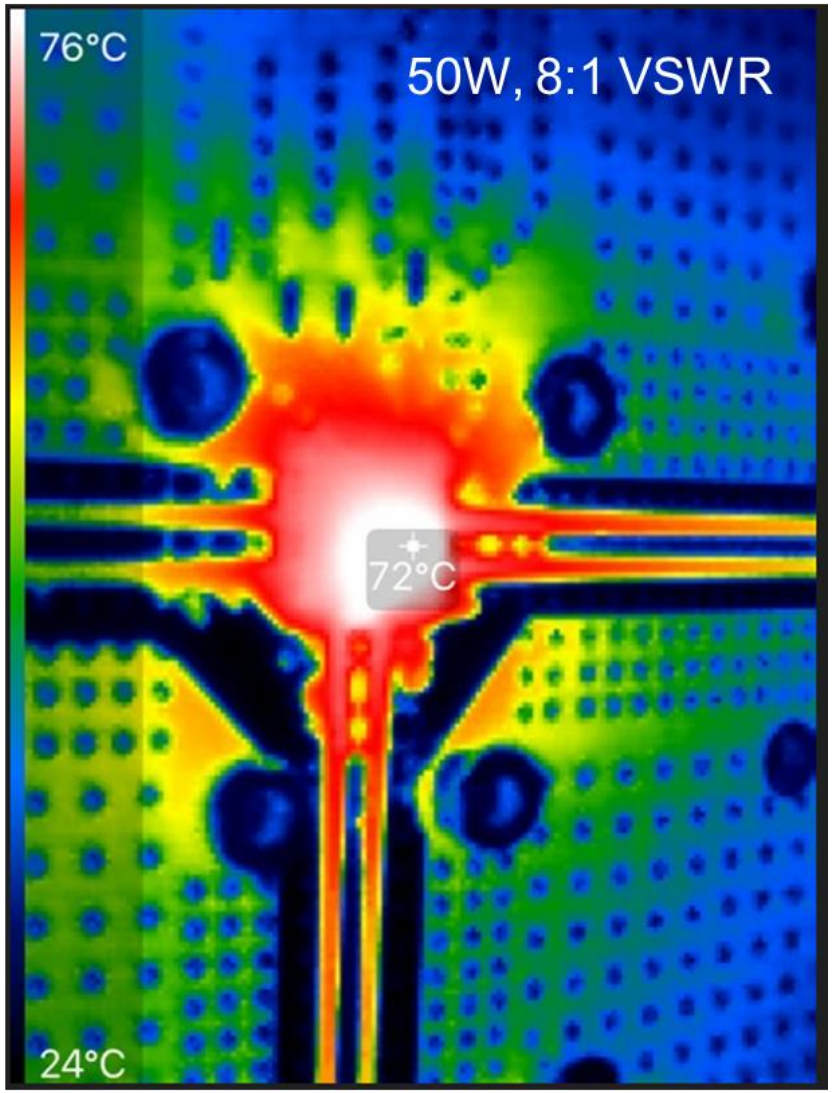


5x5mm QFN

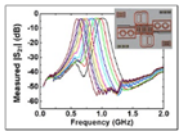
3V, 200uA

TS8021N – 50W Switch Thermal Performance





2nd Generation Switch Products – LMR / PMR / MIL-COM



SP4T

TTSW TS63421K

TTSW TS63410K

3x3 mm QFN

TTSW TS8242FK

TTSW TS82420FK

3x3 mm QFN

TTSW TS8441L

TTSW TS84410L

4x4 mm QFN

TTSW TS8541L

4x4 mm QFN

TTSW TS8043N

5x5 mm QFN

SP2T

TTSW TS64210K

4x4 mm QFN

TTSW TS8423FK

TTSW TS82250FK

3x3 mm QFN

TTSW TS8021N

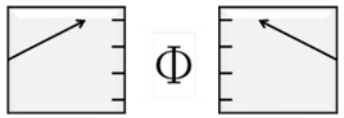
5x5 mm QFN

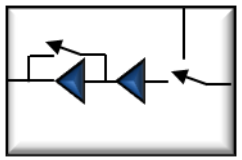
TTSW TS8023N

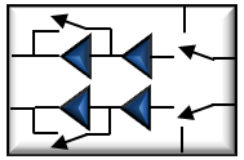
5x5 mm QFN

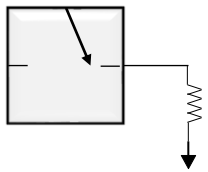
Tuning | 10W - 20W | 30W | 50W | 100W

2nd Generation Switch Products - 5G Cellular Infrastructure & Radar



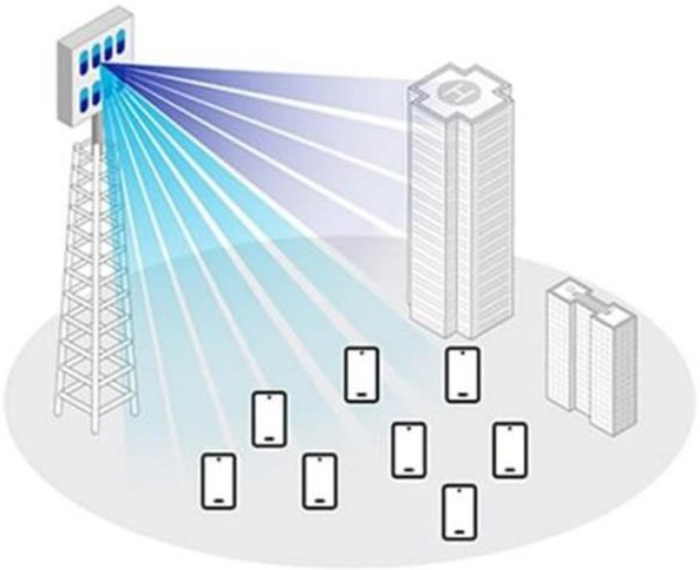






TTSW
TS8242FK

3x3 mm QFN



TTMD
TSL8329

6x6 mm QFN

TTSW
TS8329K

3x3 mm QFN

TTMD
TSL8029

5x5 mm QFN

TTSW
TS8029N

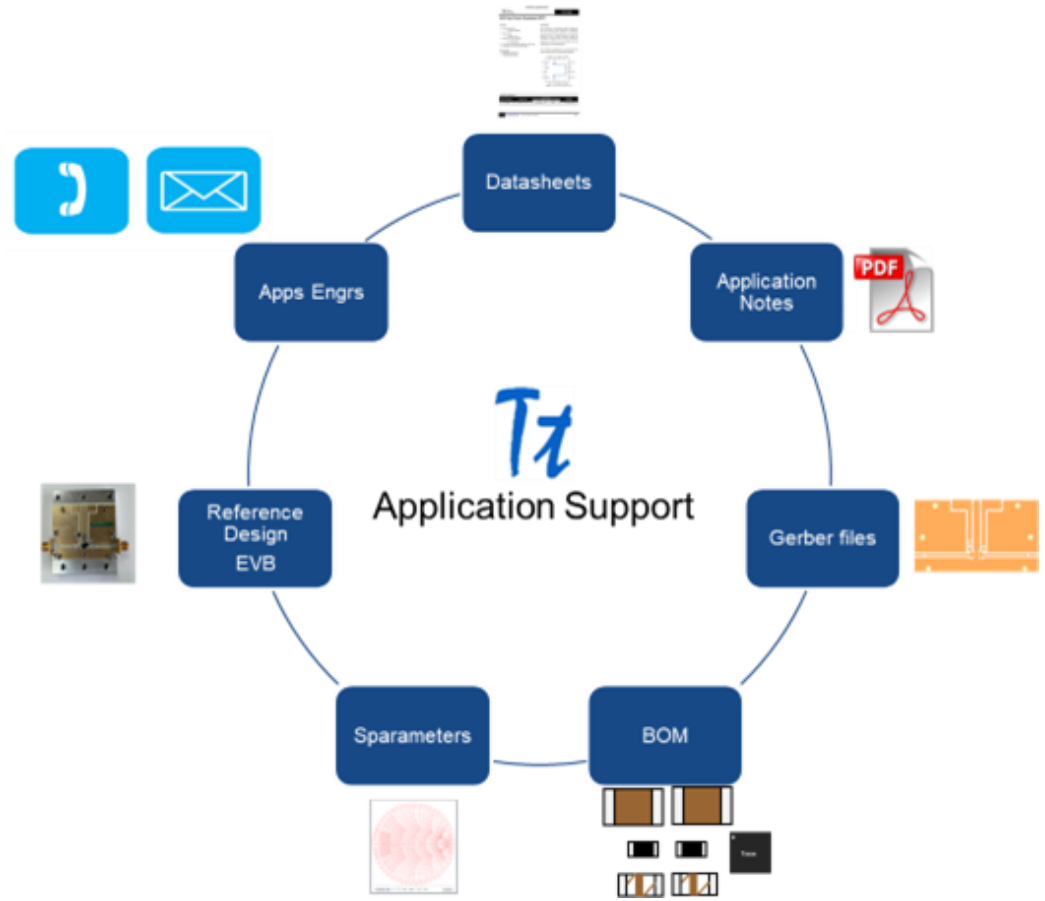
5x5 mm QFN

High Linearity | 100W Peak | 631W Peak

Responsive & Prompt Application Support

"Tagore is the most responsive company that I have seen in my many years as an Engineer. I would like to thank you and your team"

Lead Engineer, Space & Airborne System Supplier



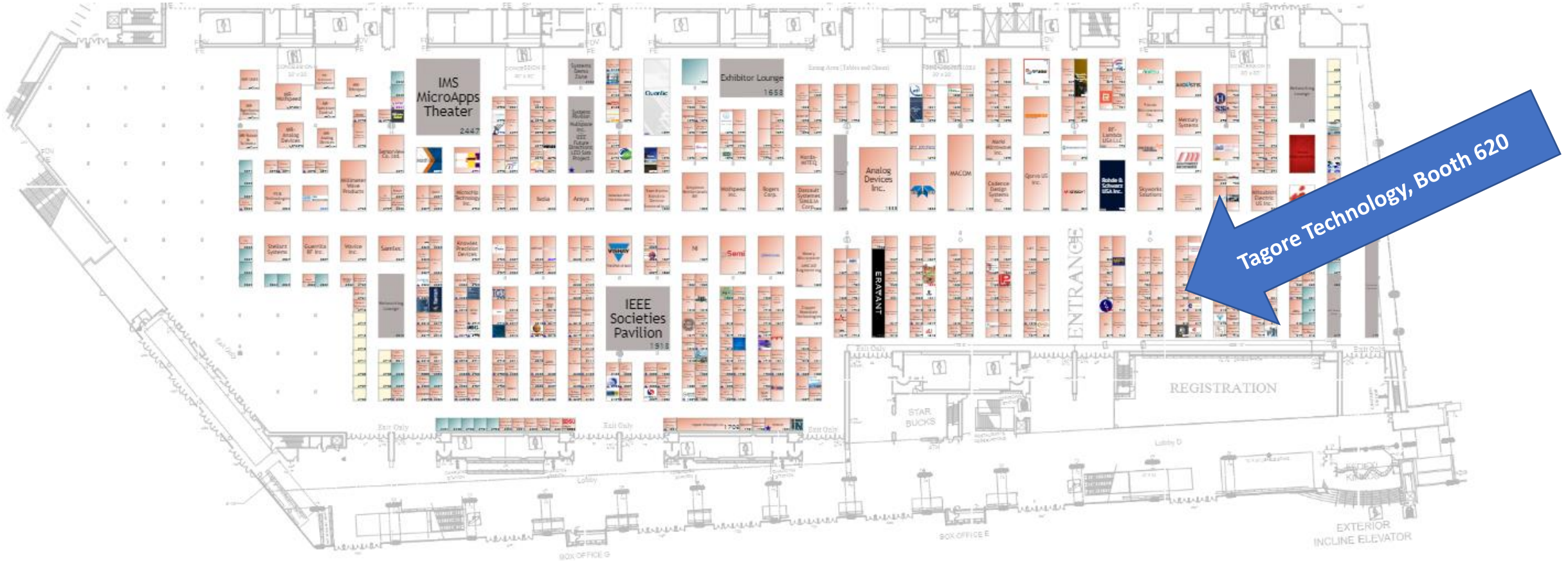
"Utilizing RF GaN switches from Tagore Technologies have enabled us to replace PIN diodes on as many of our products as possible. This has helped us to significantly reduce overall power consumption on our battery operated products. This has led us to reducing board space as well as overall system level battery life improvements. What uniquely differentiates Tagore Technologies from their competition is their ability to integrate the driver with their RF GaN switches. That by itself is a significant board space saving"

Scientist, Communication Systems, L3Harris Technology

"Tagore team in general always continue to impress us with your level of technical support and great products"

EE, Communication System Supplier

Questions



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