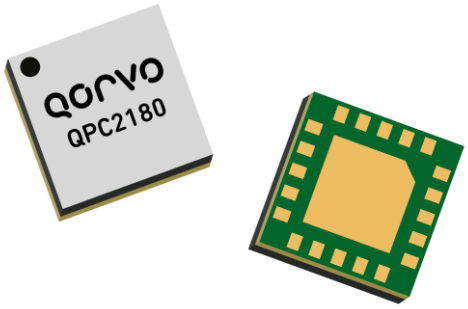
QPC2180

0.1 – 8.0 GHz SOI SP8T Switch

Product Overview

Qorvo's QPC2180 is a SOI Single-Pole, Eight-Throw (SP8T) reflective switch. Operating from 0.1 to 8 GHz, the QPC2180 offers a very low insertion loss of less than 1.0 dB and, along with excellent linearity performance.

QPC2180 is compatible with +1.8V control logic and is packaged in a compact 3 x 3 mm plastic over molded package which allows a small solution size with no need for external DC blocking capacitors when no DC is present external to the device.



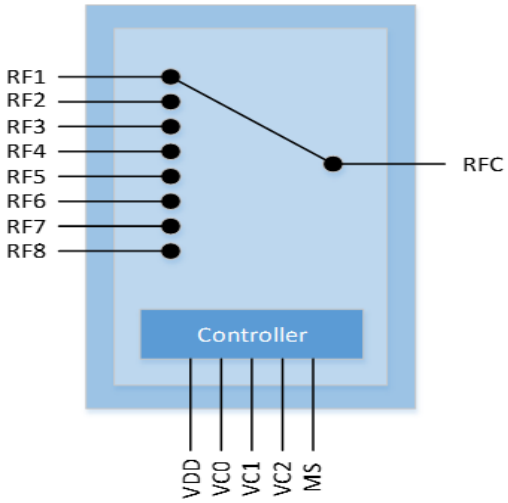
3mm x 3mm 20 Lead OVM QFN

Key Features

- SP8T
- Frequency Range: 0.10 to 8.0 GHz
- Insertion Loss: < 0.6 dB @ 4 GHz Typical
- Isolation: >30 dB
- High Linearity with 72 dBm OIP3 Typical
- Switching Speed: 400 ns
- Digital Control with CMOS Compatibility
- Package Dimensions: 3 x 3 x 0.954 mm

Performance is typical across frequency. Please reference electrical specification table and data plots for more details.

Functional Block Diagram



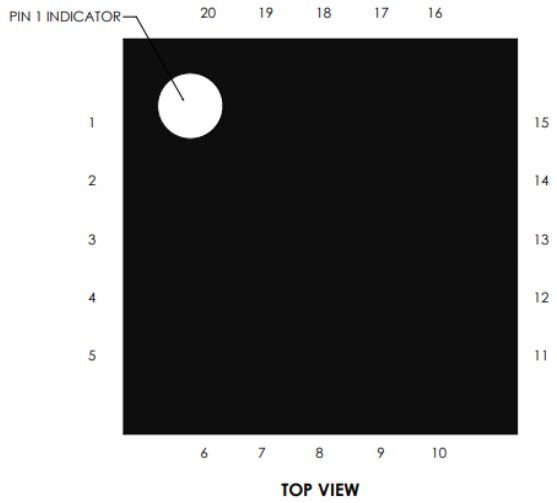
Applications

- Commercial and Military Radar
- Communications
- Electronic Warfare
- Test Instrumentation
- General Purpose

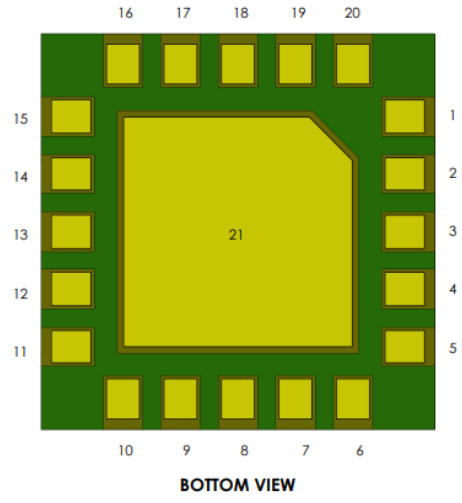
Ordering Information

Part No.	Description
QPC2180TR7	0.1 to 8 GHz SOI SP8T Reflective Switch 750 Piece 7" Reel
QPC2180SR	100 Piece 7" Short Reel
QPC2180EVB01	Evaluation Board

Pin Configuration



TOP VIEW



BOTTOM VIEW

Pin Description

Pin No.	Label	Description
1	RF2	RF switched port 2; matched to 50 Ω; DC coupled
2, 4, 12, 14, 17, 19	GND	Ground. Connected to GND paddle (Pin 21); should be grounded on PCB to improve isolation
3	RF3	RF switched port 3; matched to 50 Ω; DC coupled
5	RF4	RF switched port 4; matched to 50 Ω; DC coupled
6	V_{DD}	Supply voltage
7	VC0	Control voltage #0; External components are not required
8	VC1	Control voltage #1; External components are not required
9	VC2	Control voltage #2; External components are not required
10	MS	Mode selects bit. "Low", standard logic. "High", reversed logic.
11	RF5	RF switched port 5; matched to 50 Ω; DC coupled
13	RF6	RF switched port 6; matched to 50 Ω; DC coupled
15	RF7	RF switched port 3; matched to 50 Ω; DC coupled
16	RF8	RF switched port 7; matched to 50 Ω; DC coupled
18	RFC	RF Common
20	RF1	RF switched port 1; matched to 50 Ω; DC coupled
21	GND	Ground connection. The back side of the package should be connected to the ground plan though as short of a connection as possible. PCB vias under the device are recommended.

Absolute Maximum Ratings [1]

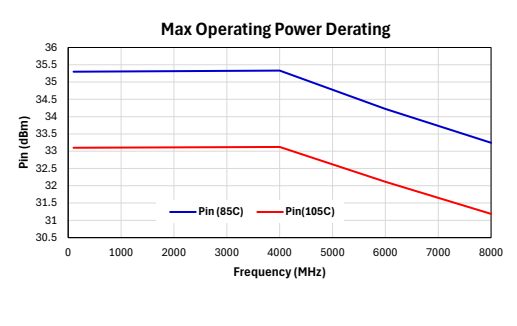
Parameter	Min Value	Max Value	Units
Storage Temperature	-55	+125	°C
Operating Temperature	-40	+105	°C
Switch Supply Voltage (V_{DD})	-	6.0	V
Control Voltage (CTL1 – CTL3)	-0.3	6.0	V
RF Input Power - Test conditions: CW @ 85°C	-	36.5	dBm
RF Input Power - Test conditions: CW @ 105°C	-	34	dBm
RF Input Power - Test conditions: Hot Switching, CW @ 85°C	-	34	dBm
RF Input Power - Pulsed Test conditions: PW=10ms; DC=1% @ 85°C	-	42	dBm
Channel Temperature: Tj for ≥10^6 hours MTTF	-	125	°C
Mounting Temperature (30 Seconds)	-	260	°C

1. Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

Recommended Operating Conditions

Parameter [1]	Min	Typ.	Max	Units
Device Voltage (V_{DD})	+3.3	+5.0	+5.5	V
Supply Current (I_{DD})	-	100	-	µA
RF Input Power - Test conditions: CW @ 85°C	-	-	35.5	dBm
RF Input Power - Test conditions: CW @ 105°C	-	-	33	dBm
RF Input Power - Test conditions: Hot Switching, CW @ 85°C	-	-	33	dBm
Switching Time (50% of V_{C0-C2} to 10/90% of RF Output)	-	<400	-	ns
Low Control Voltage (1.8 V logic compatible) [2]	-0.3	-	0.63	V
High Control Voltage (1.8 V logic compatible) [2]	1.17	-	V_{DD}	V
Control Current (Each CTL)	-	2.1	-	µA

1 Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.
2 This product is designed for 1.8V control logic, with a low logic voltage of 0.63 V max. Otherwise an external voltage divider or logic converter must be used.



Electrical Specifications

Test conditions unless otherwise noted: Temp = 25°C, 50 Ω system, See Truth Table on page 24

Parameter	Conditions (1) (2)	Min	Typ.(3)	Max	Unit
Frequency Range		0.1	-	8.0	GHz
Insertion Loss (On State)	Frequency = 0.5 GHz	-	0.58	-	dB
	Frequency = 1.0 GHz	-	0.61	-	
	Frequency = 2.0 GHz	-	0.65	-	
	Frequency = 3.0 GHz	-	0.71	-	
	Frequency = 4.0 GHz	-	0.79	-	
	Frequency = 5.0 GHz	-	0.84	-	
	Frequency = 6.0 GHz	-	0.92	-	
	Frequency = 7.0 GHz	-	1.04	-	
	Frequency = 8.0 GHz	-	1.25	-	
Input Return Loss (On State) Common Port RL	Frequency = 0.5 GHz	-	28.2	-	dB
	Frequency = 1.0 GHz	-	26.4	-	
	Frequency = 2.0 GHz	-	30.2	-	
	Frequency = 3.0 GHz	-	25.2	-	
	Frequency = 4.0 GHz	-	21.8	-	
	Frequency = 5.0 GHz	-	20.2	-	
	Frequency = 6.0 GHz	-	21.4	-	
	Frequency = 7.0 GHz	-	26.7	-	
	Frequency = 8.0 GHz	-	25.4	-	
Output Return Loss (On State) Switched Port RL	Frequency = 0.5 GHz	-	30.6	-	dB
	Frequency = 1.0 GHz	-	27.2	-	
	Frequency = 2.0 GHz	-	26.1	-	
	Frequency = 3.0 GHz	-	22.9	-	
	Frequency = 4.0 GHz	-	20.7	-	
	Frequency = 5.0 GHz	-	24.2	-	
	Frequency = 6.0 GHz	-	19.5	-	
	Frequency = 7.0 GHz	-	17.8	-	
	Frequency = 8.0 GHz	-	15.1	-	

Notes:
1. In production, devices will be tested at room temperature to a guard-banded specification to ensure compliance over temperature.
2. Electrical margin has been built into the design to account for variations due to temperature drift and manufacturing tolerances.
3. Typical values are based on average measurements at room temperature.

Electrical Specifications - Continued

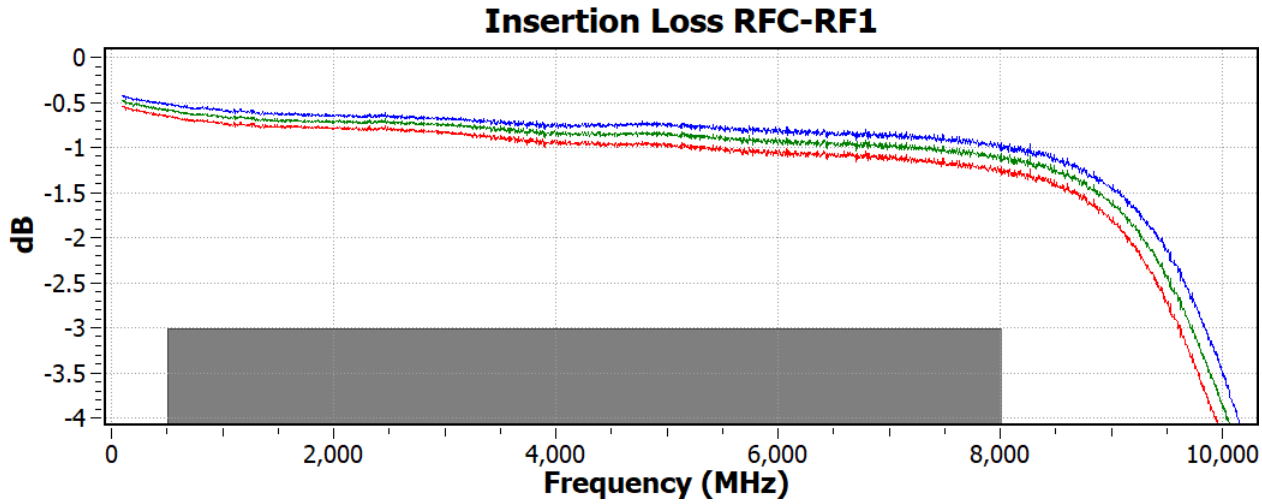
Test conditions unless otherwise noted: Temp = 25°C, 50 Ω system, See Truth Table on page 24

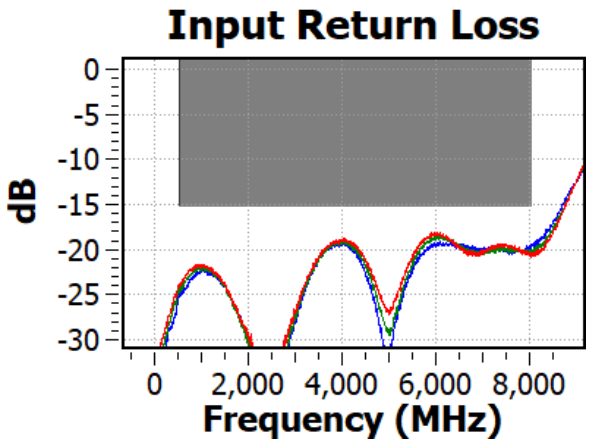
Parameter	Conditions (1) (2)	Min	Typ.(3)	Max	Unit
Frequency Range		0.1	-	8.0	GHz
Isolation: RFC – RF1	Frequency = 1.0 GHz	-	55	-	dB
	Frequency = 4.0 GHz	-	41	-	
	Frequency = 8.0 GHz	-	34	-	
Isolation: RFC – RF2	Frequency = 1.0 GHz	-	55	-	dB
	Frequency = 4.0 GHz	-	41	-	
	Frequency = 8.0 GHz	-	34	-	
Isolation: RFC – RF3	Frequency = 1.0 GHz	-	55	-	dB
	Frequency = 4.0 GHz	-	41	-	
	Frequency = 8.0 GHz	-	34	-	
Isolation: RFC – RF4	Frequency = 1.0 GHz	-	55	-	dB
	Frequency = 4.0 GHz	-	41	-	
	Frequency = 8.0 GHz	-	34	-	
Isolation: RFC – RF5	Frequency = 1.0 GHz	-	55	-	dB
	Frequency = 4.0 GHz	-	41	-	
	Frequency = 8.0 GHz	-	34	-	
Isolation: RFC – RF6	Frequency = 1.0 GHz	-	55	-	dB
	Frequency = 4.0 GHz	-	41	-	
	Frequency = 8.0 GHz	-	34	-	
Isolation: RFC – RF7	Frequency = 1.0 GHz	-	55	-	dB
	Frequency = 4.0 GHz	-	41	-	
	Frequency = 8.0 GHz	-	34	-	
Isolation: RFC – RF8	Frequency = 1.0 GHz	-	55	-	dB
	Frequency = 4.0 GHz	-	41	-	
	Frequency = 8.0 GHz	-	34	-	
Input P1dB: RFC – RFx (PW=10ms; DC=1%)	Frequency = 2.0 GHz	-	41.8	-	dBm
	Frequency = 4.0 GHz	-	41.5	-	
	Frequency = 6.0 GHz	-	39.8	-	
OIP3 RFC - RFx	Frequency = 2.6 GHz	-	72	-	dBm
2nd Harmonic	Pin = 30 dBm, CW, F0 = 2.3 GHz	-	-68	-	dBm
3rd Harmonic	Pin = 30 dBm, CW, F0 = 2.3 GHz	-	-55	-	dBm
Switching Speed		-	400	420	ns
Thermal Resistance (θ_{JC}) (4), T_{BASE} = 85 °C		-	55	-	C °/W

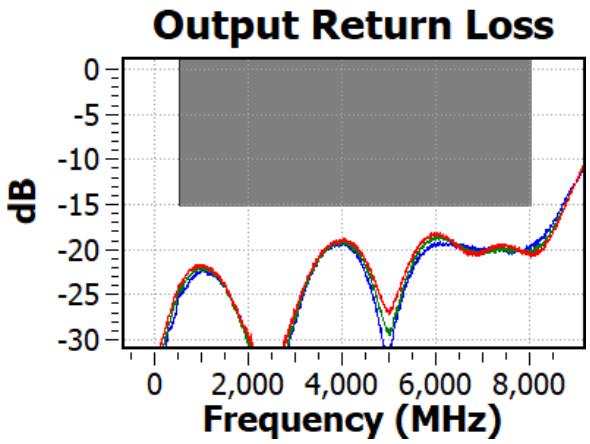
Notes:
1. In production, devices will be tested at room temperature to a guard-banded specification to ensure compliance over temperature.
2. Electrical margin has been built into the design to account for variations due to temperature drift and manufacturing tolerances.
3. Typical values are based on average measurements at room temperature.
4. Measured to the back of the package

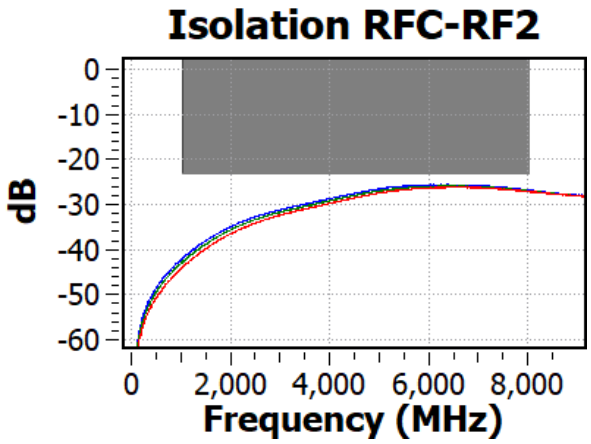
Performance Plots – Small Signal: RF Port 1 – Temperature Performance

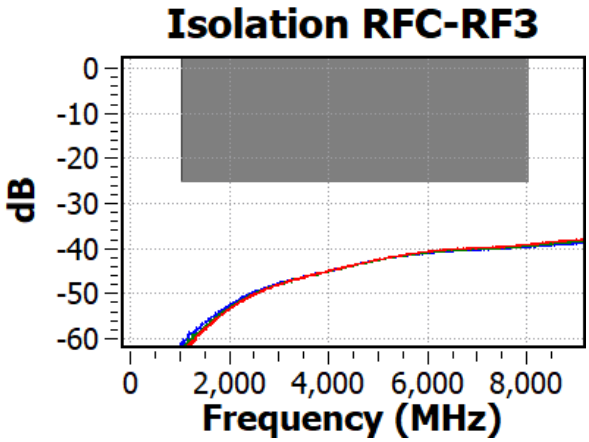
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





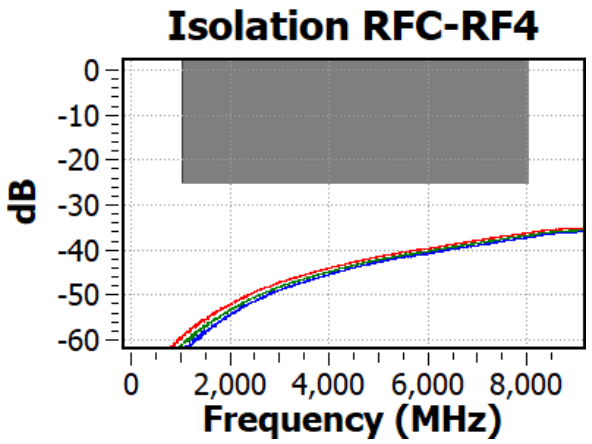


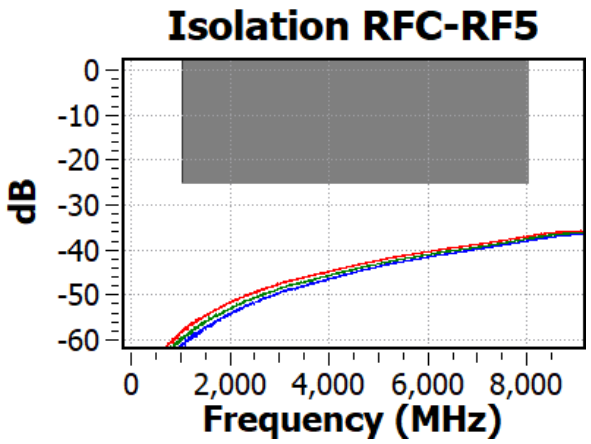


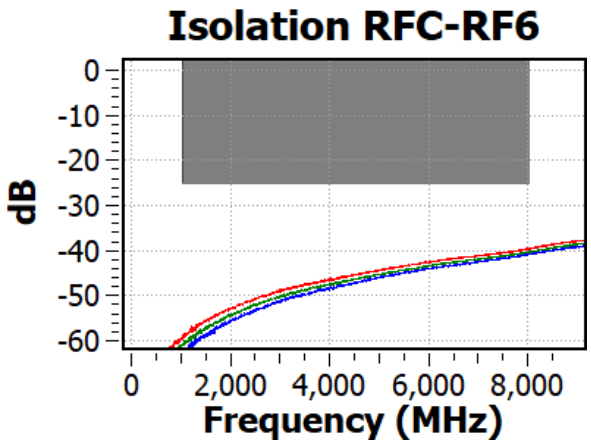


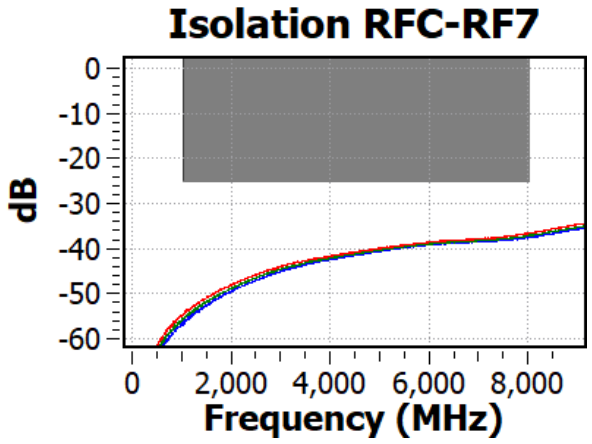
Performance Plots – Small Signal: RF Port 1 – Temperature Performance (Cont.)

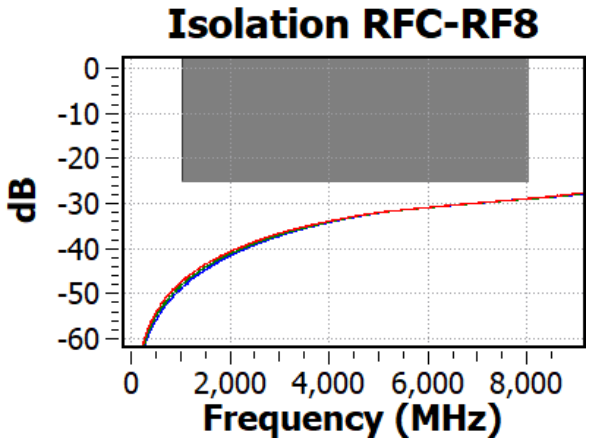
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





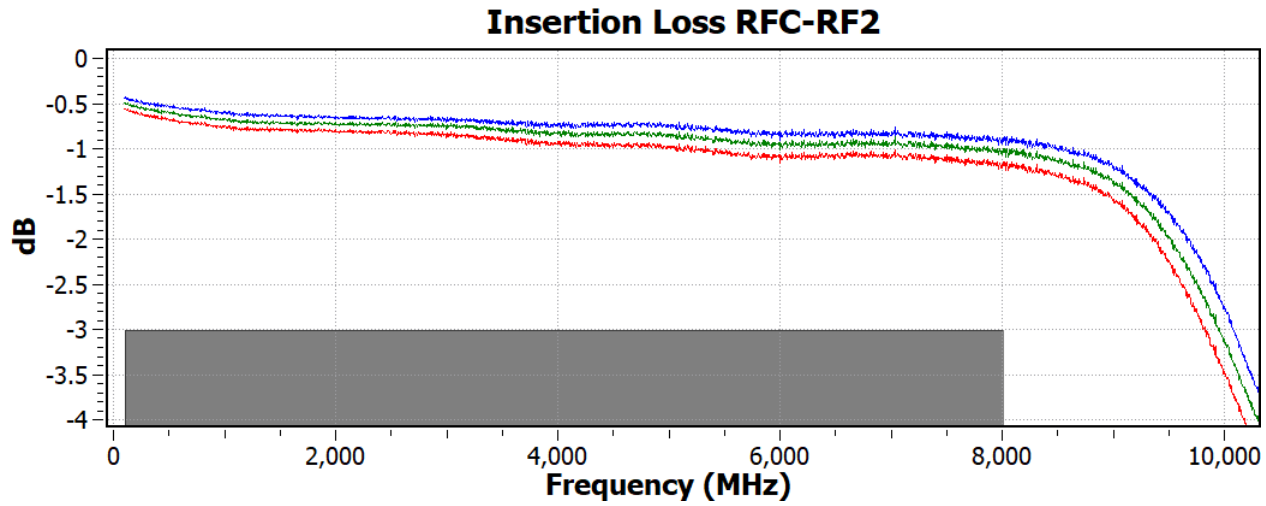


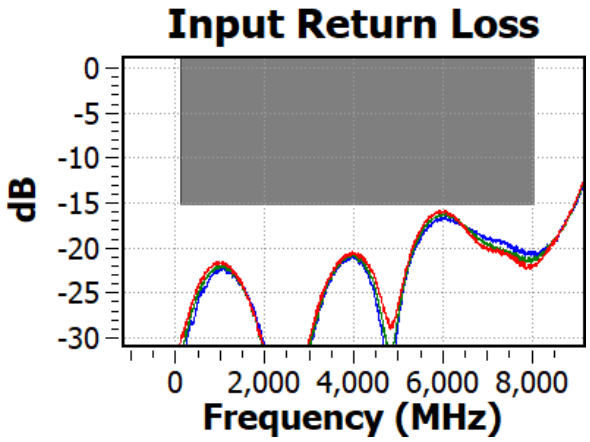


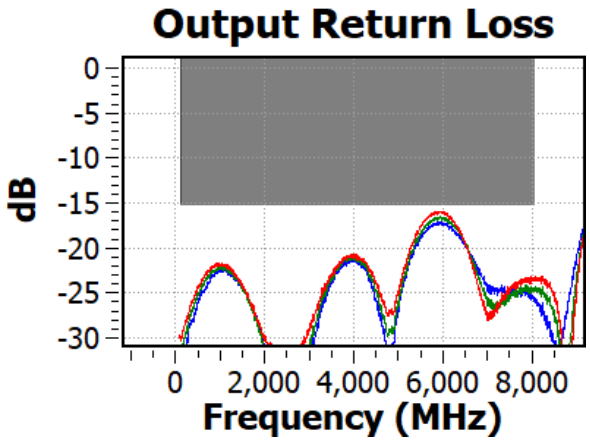


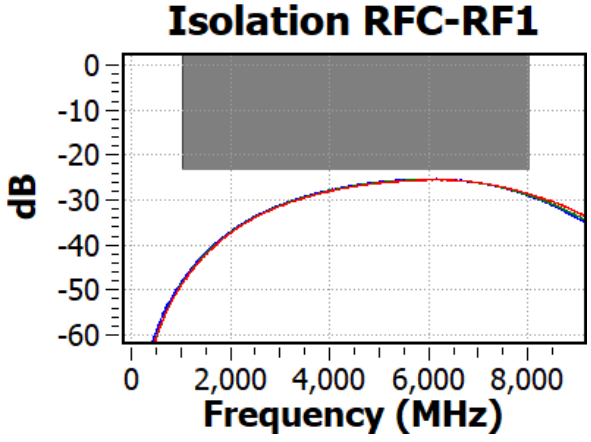
Performance Plots – Small Signal: RF Port 2 – Temperature Performance

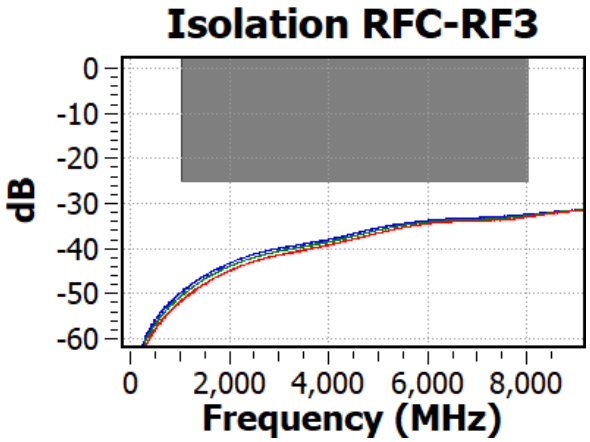
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





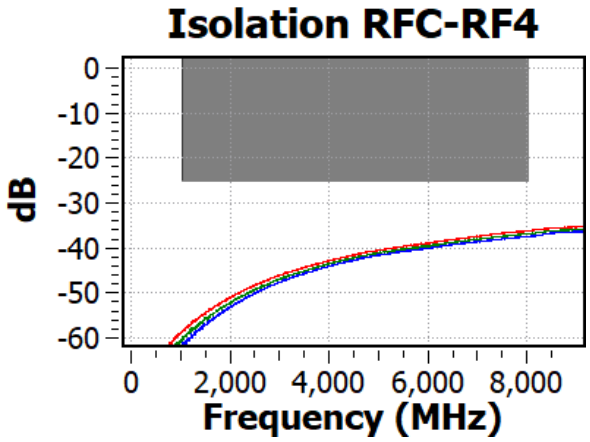


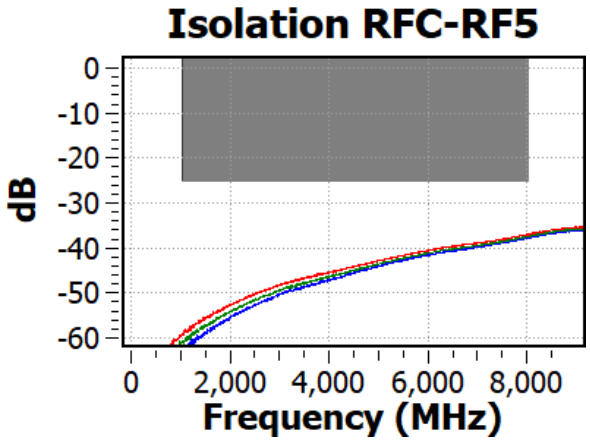


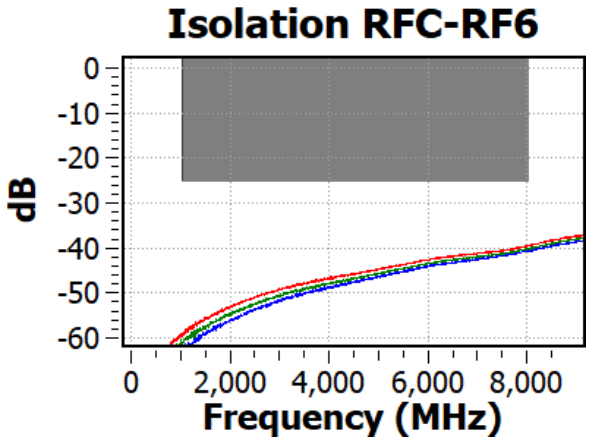


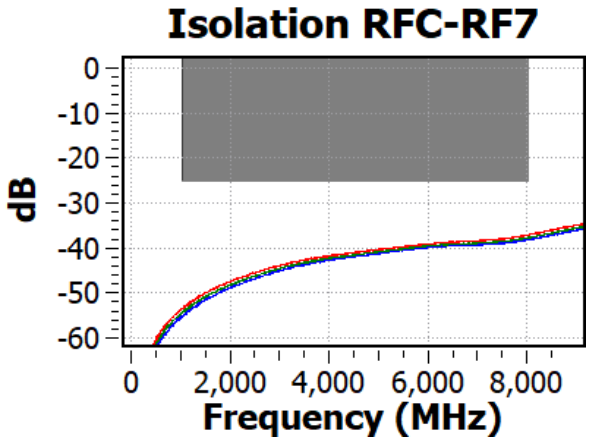
Performance Plots – Small Signal: RF Port 2 – Temperature Performance (Cont.)

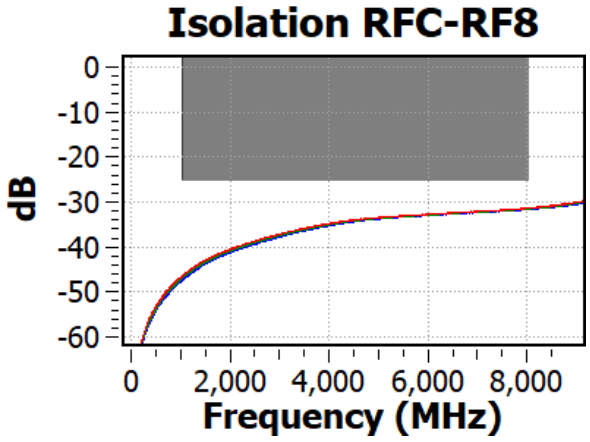
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





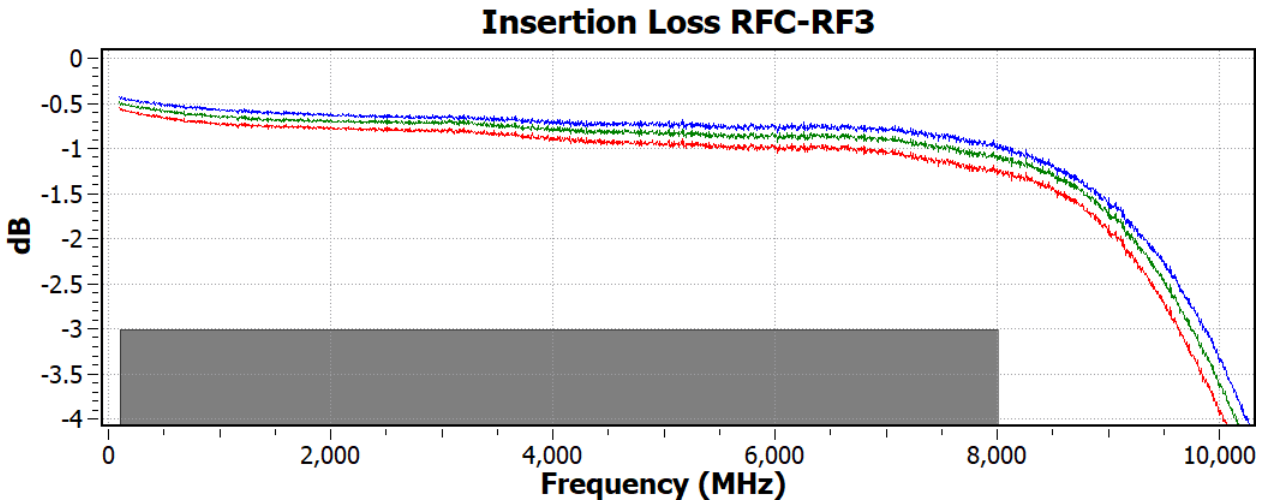


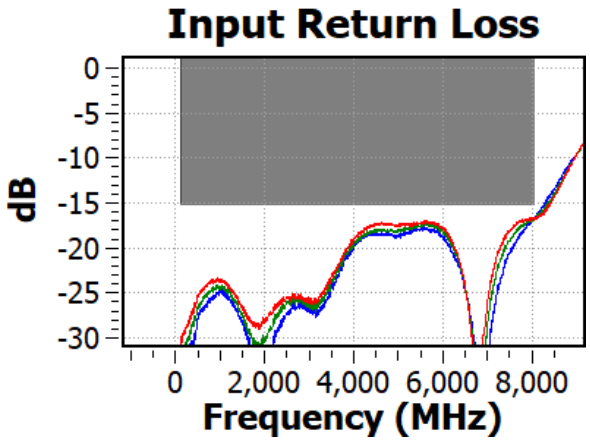


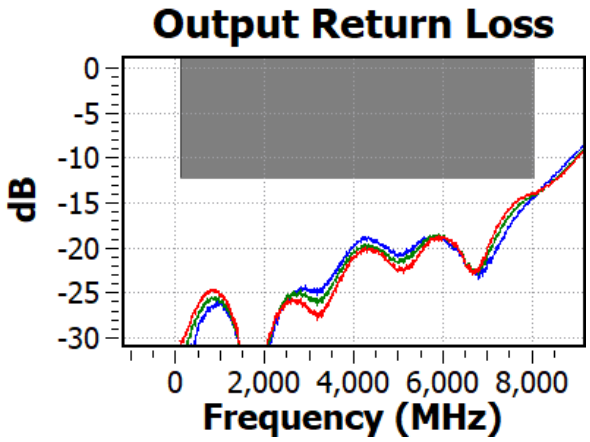


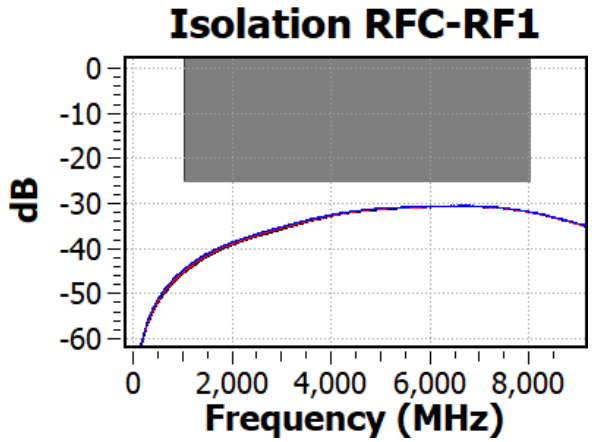
Performance Plots – Small Signal: RF Port 3 – Temperature Performance

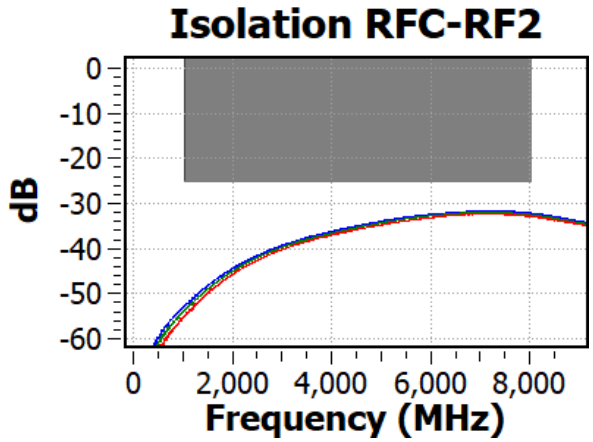
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





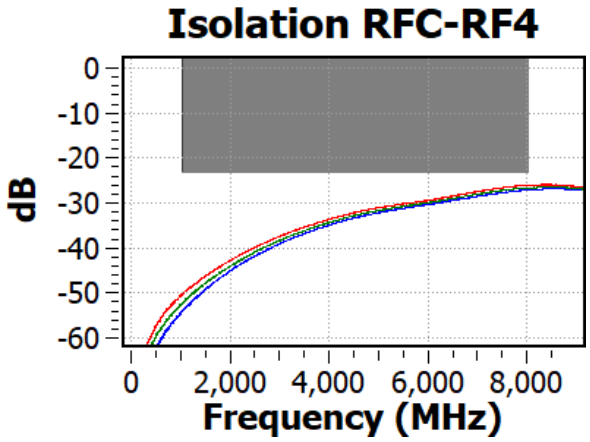


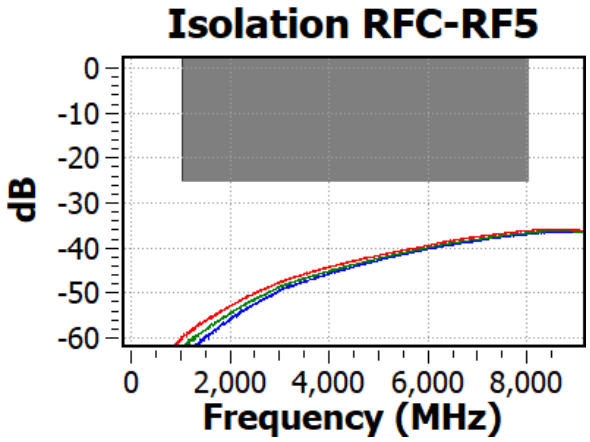


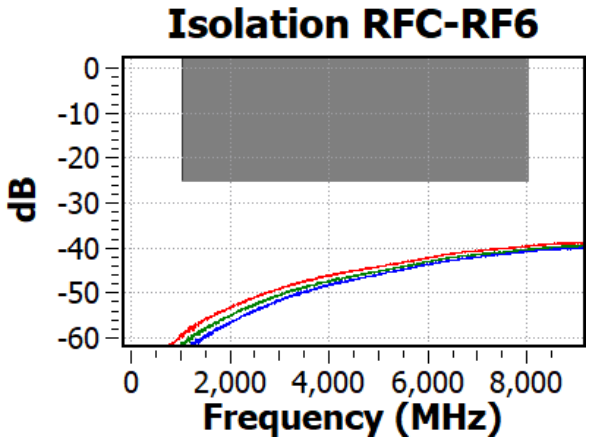


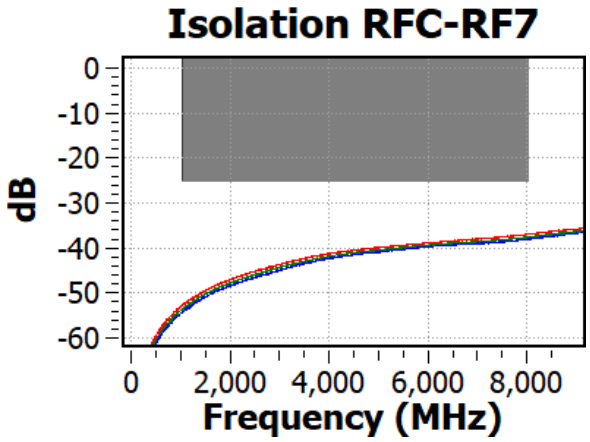
Performance Plots – Small Signal: RF Port 3 – Temperature Performance (Cont.)

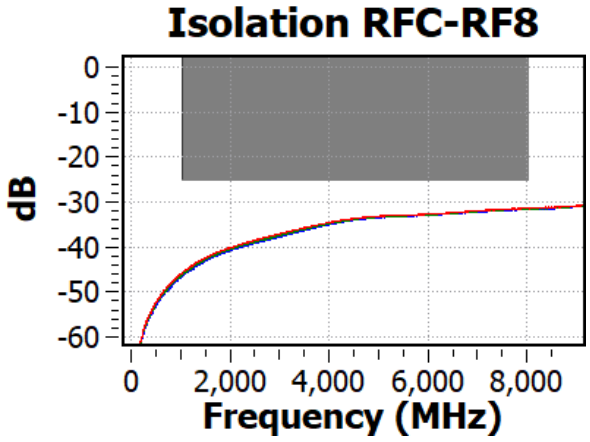
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





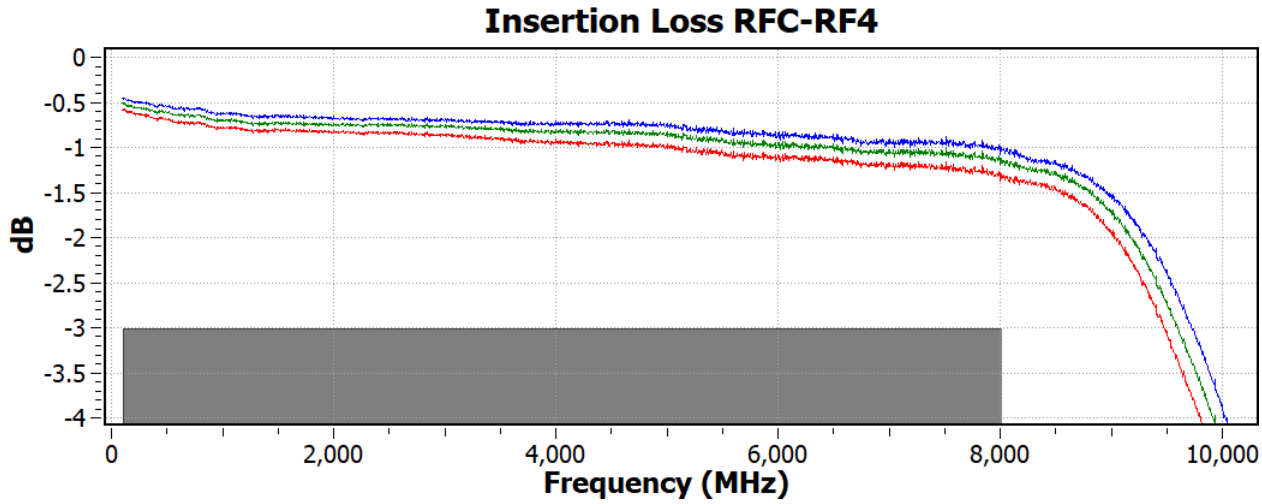


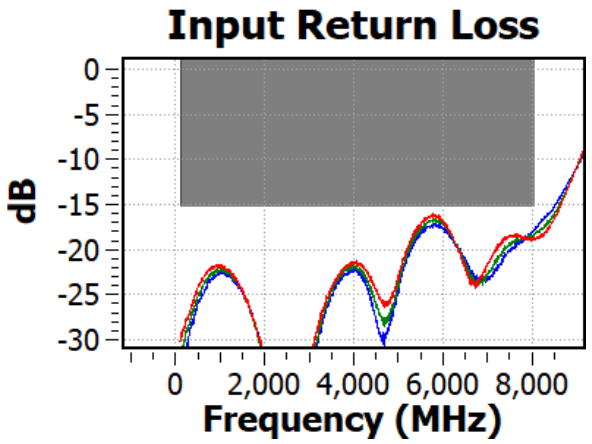


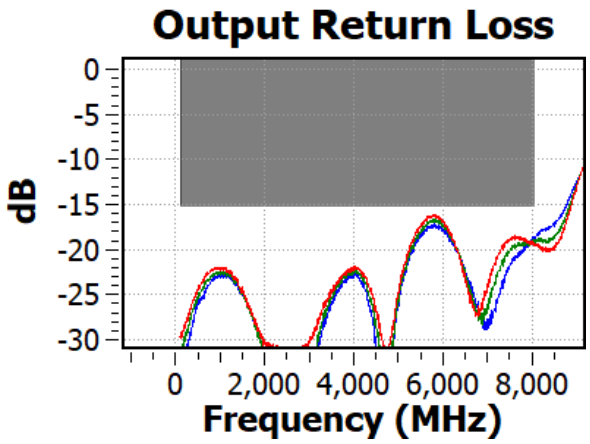


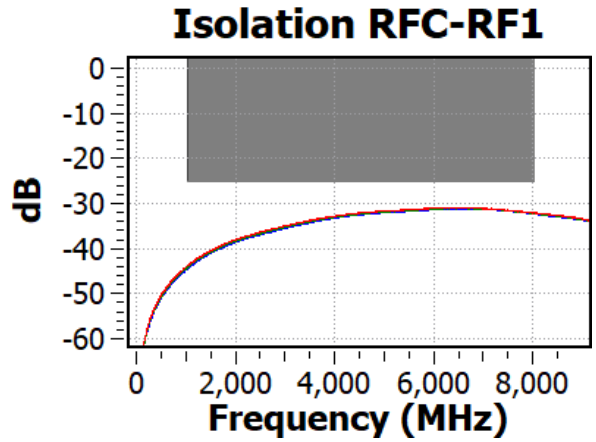
Performance Plots – Small Signal: RF Port 4 – Temperature Performance

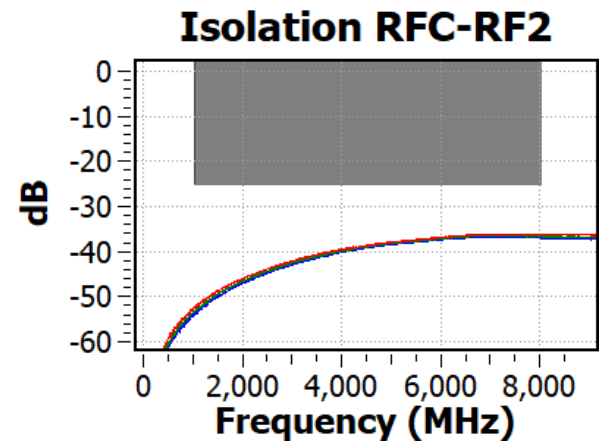
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





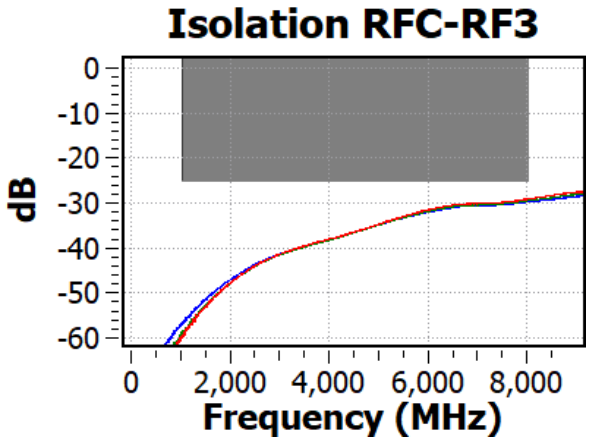


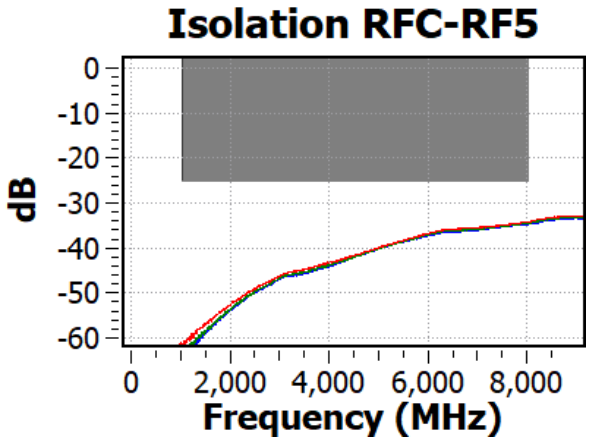


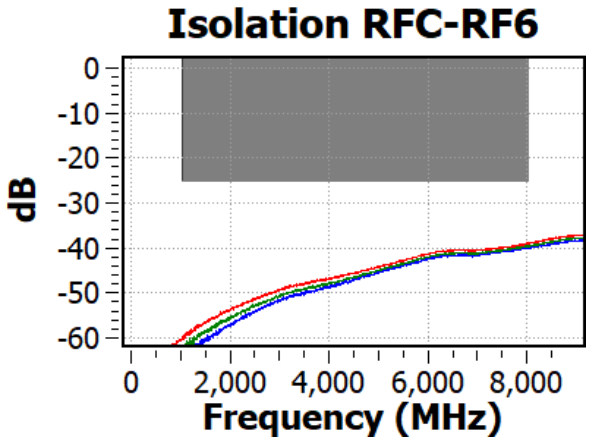


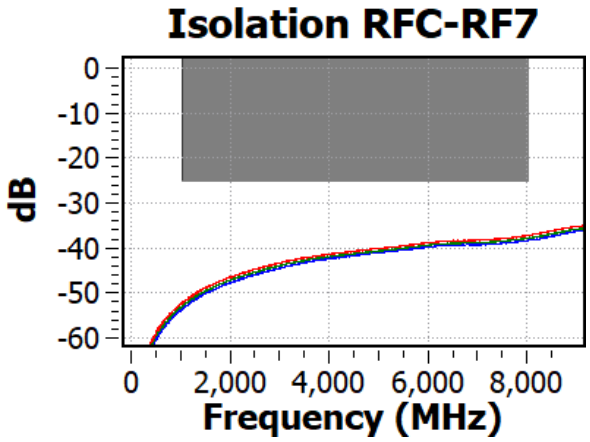
Performance Plots – Small Signal: RF Port 4 – Temperature Performance (Cont.)

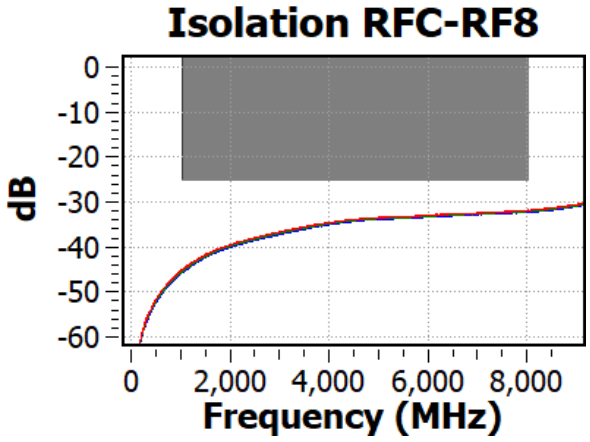
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





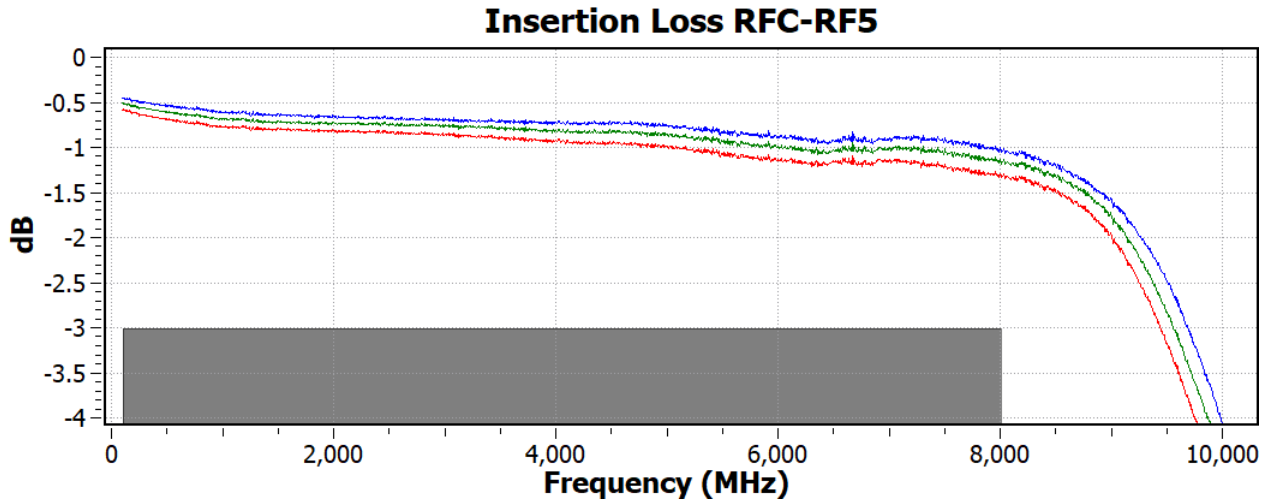


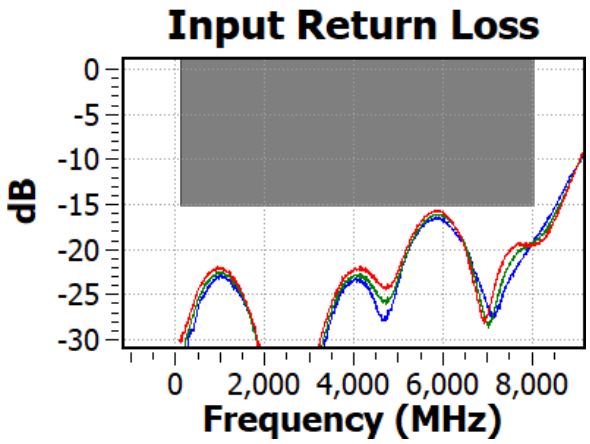


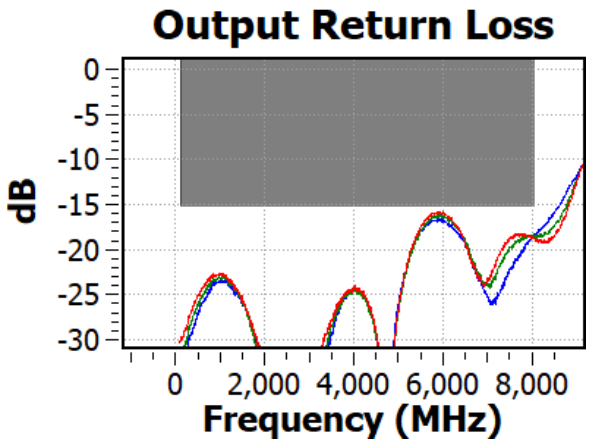


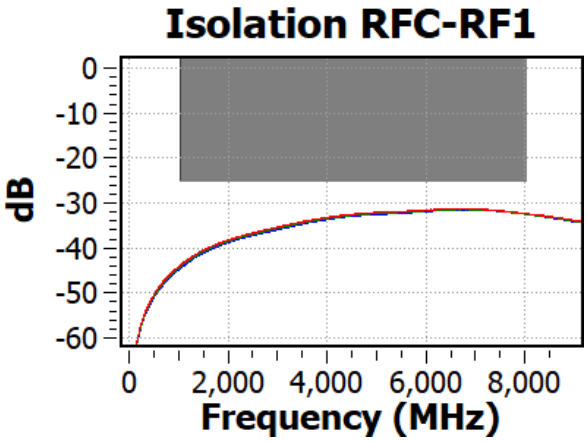
Performance Plots – Small Signal: RF Port 5 – Temperature Performance

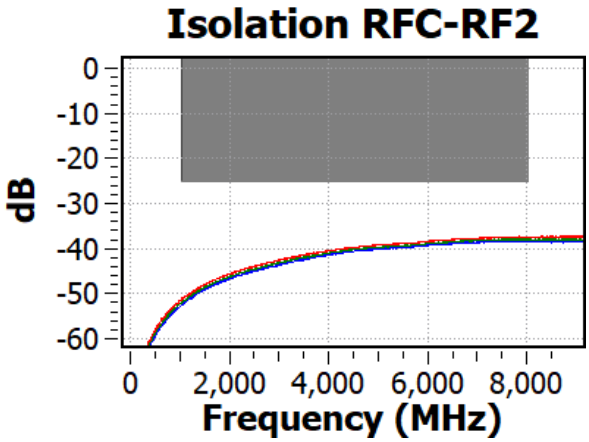
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





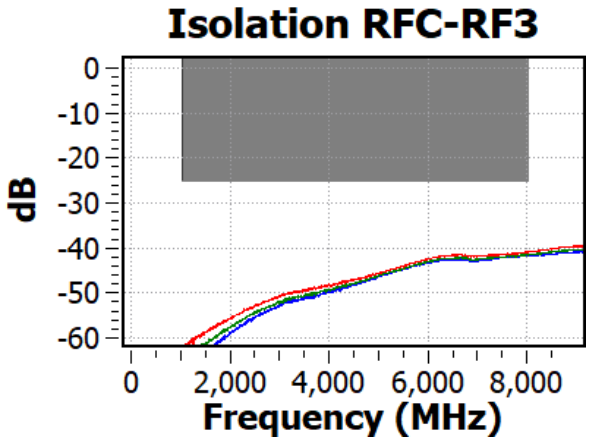


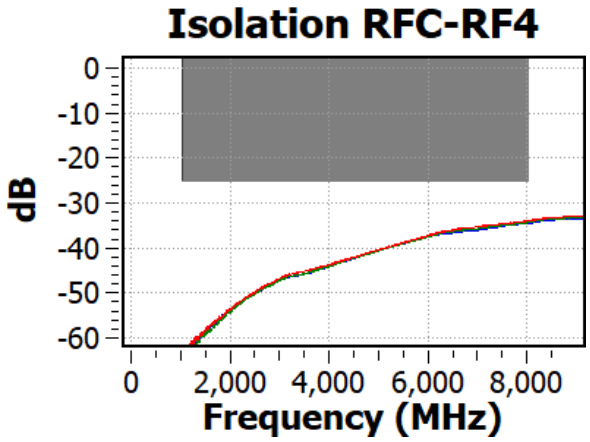


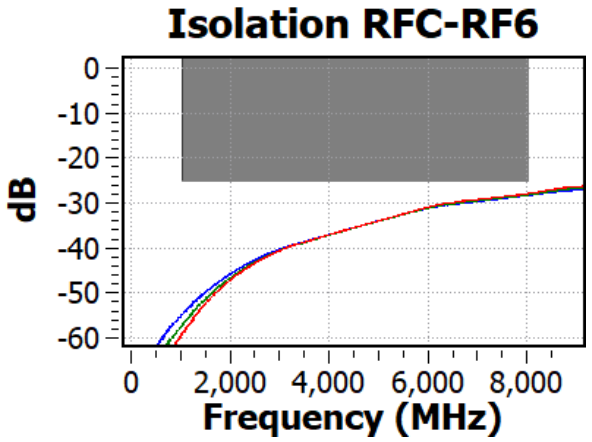


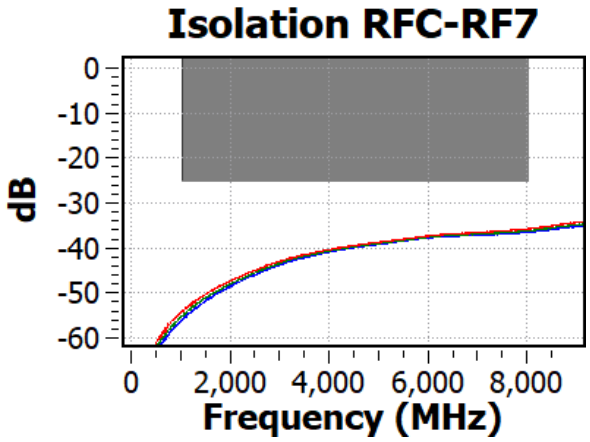
Performance Plots – Small Signal: RF Port 5 – Temperature Performance (Cont.)

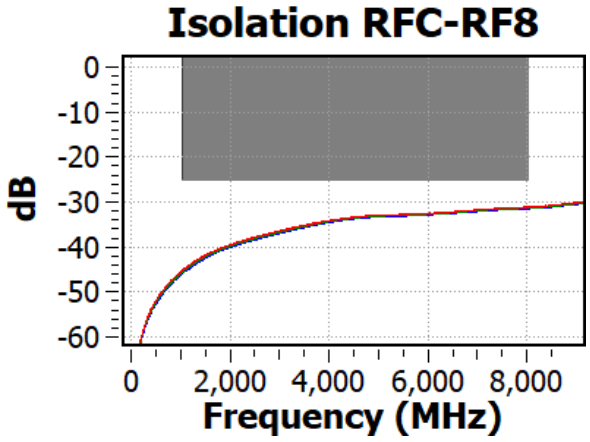
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





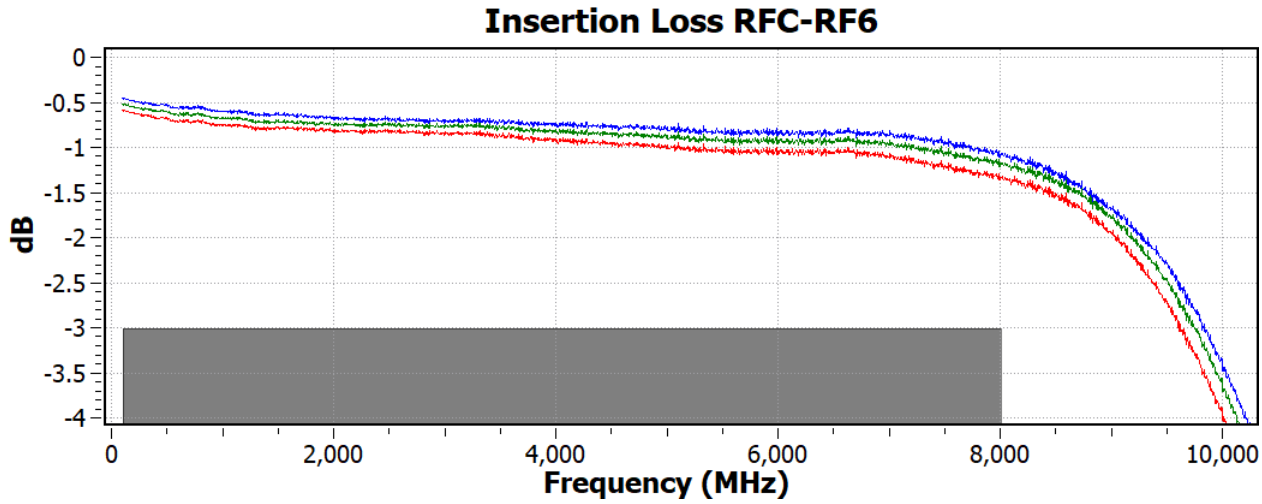


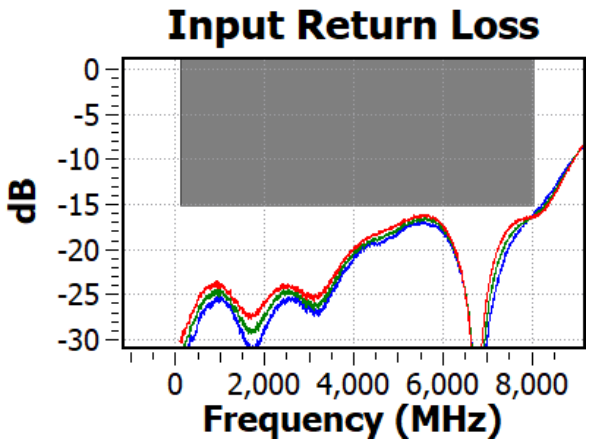


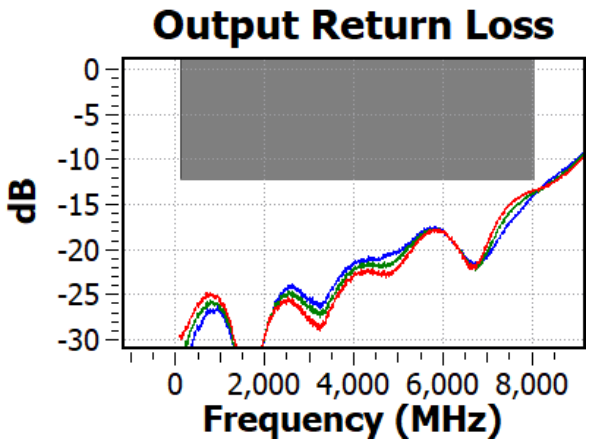


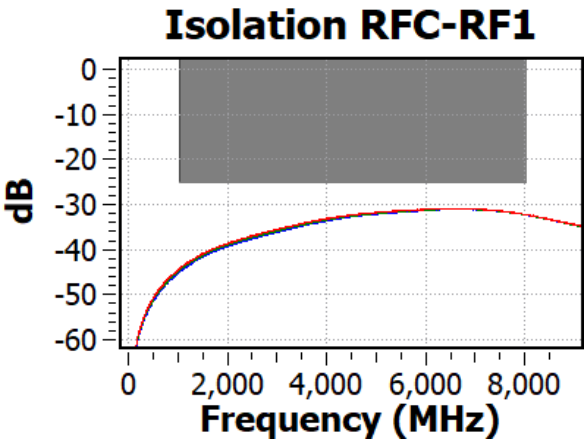
Performance Plots – Small Signal: RF Port 6 – Temperature Performance

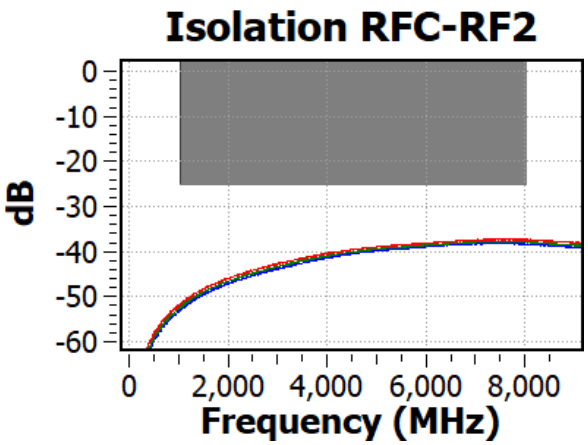
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





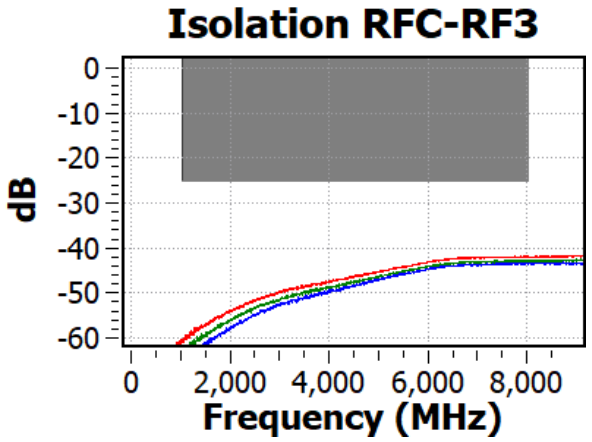


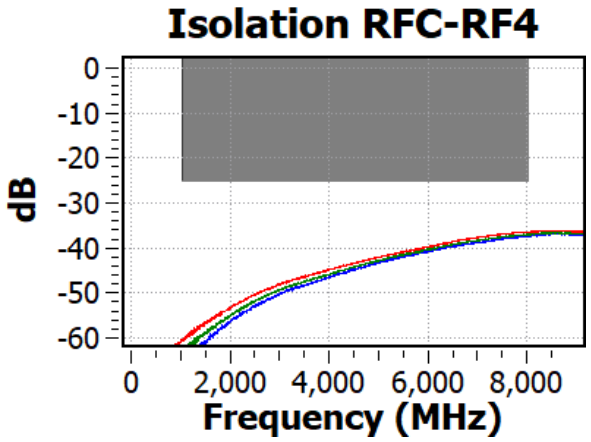


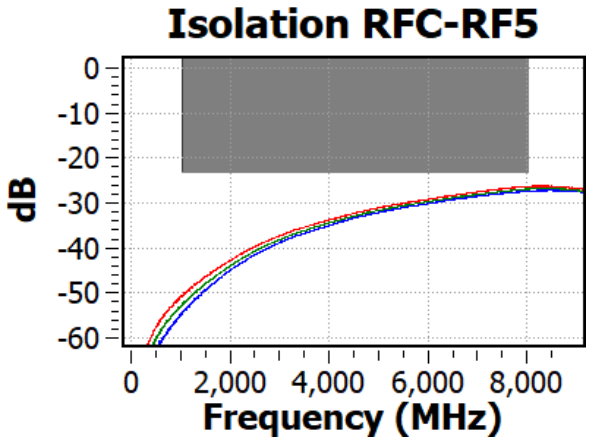


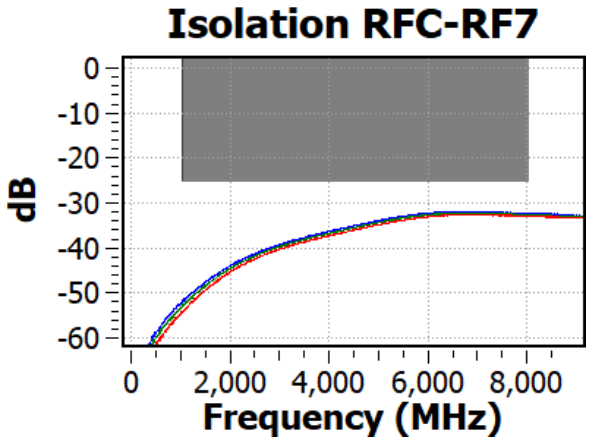
Performance Plots – Small Signal: RF Port 6 – Temperature Performance (Cont.)

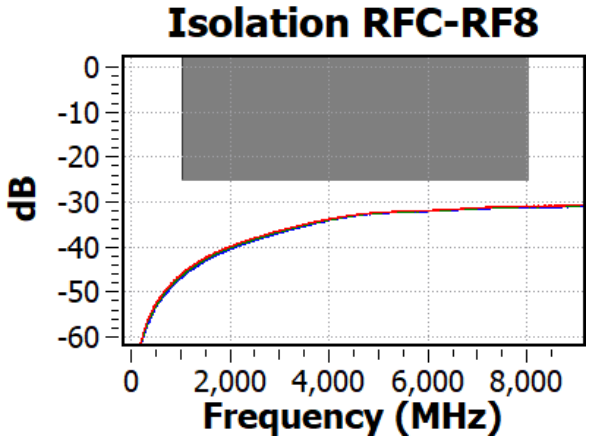
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





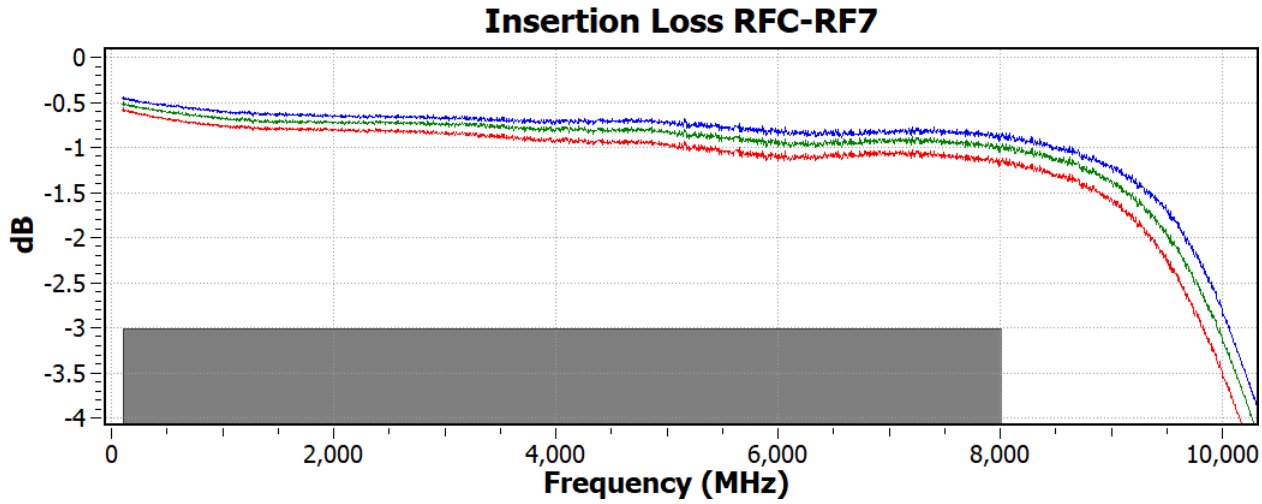


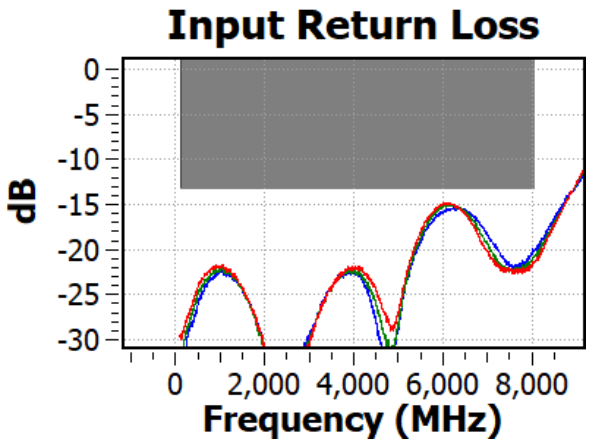


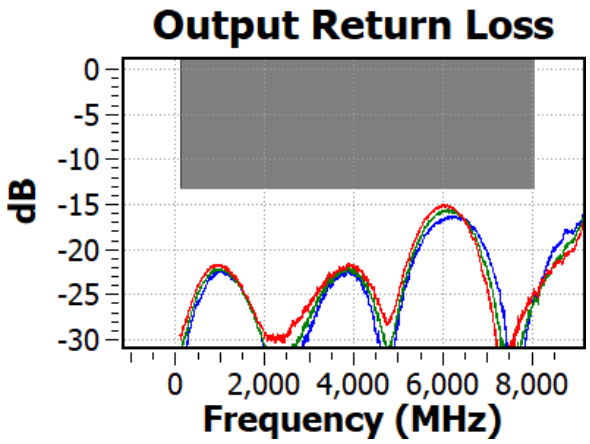


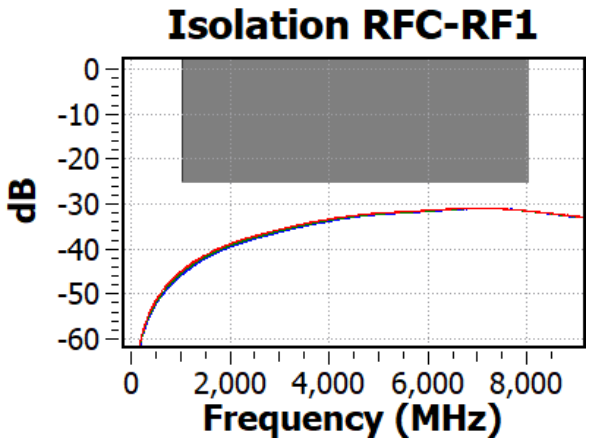
Performance Plots – Small Signal: RF Port 7 – Temperature Performance

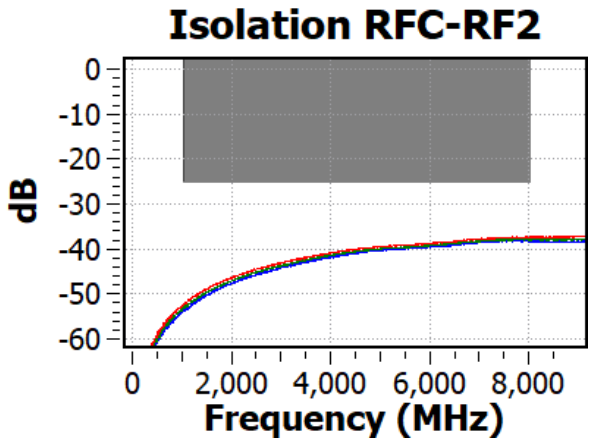
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





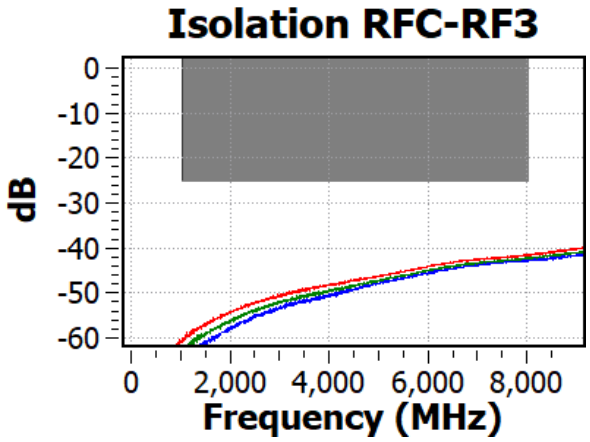


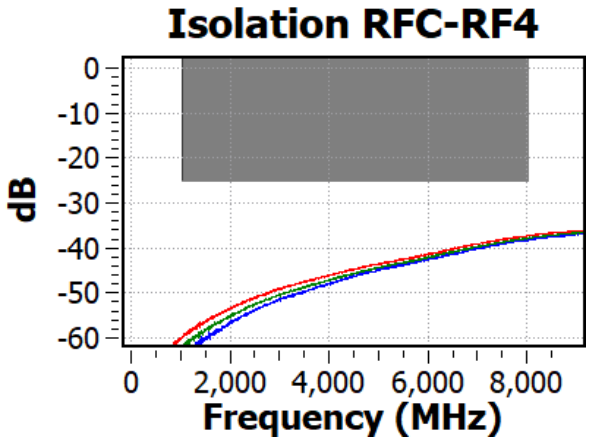


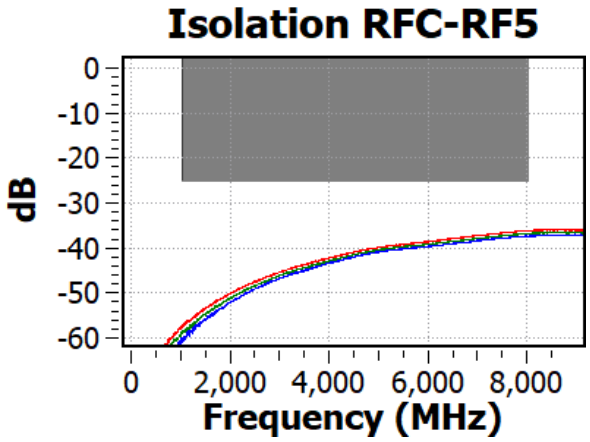


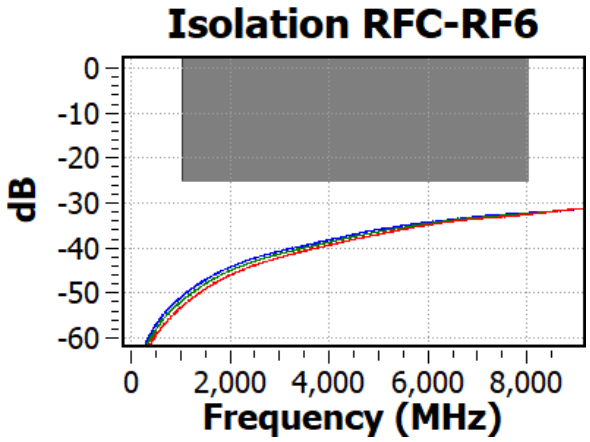
Performance Plots – Small Signal: RF Port 7 – Temperature Performance (Cont.)

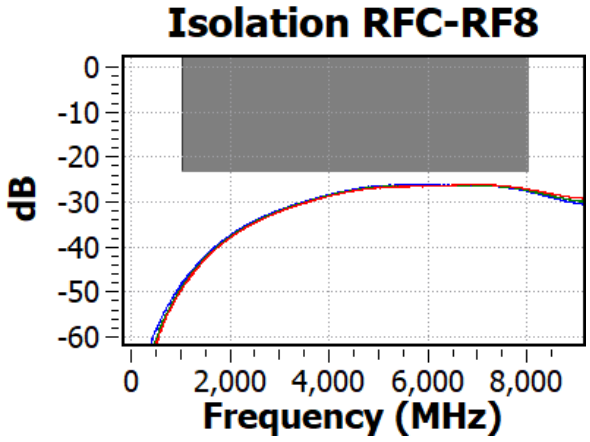
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





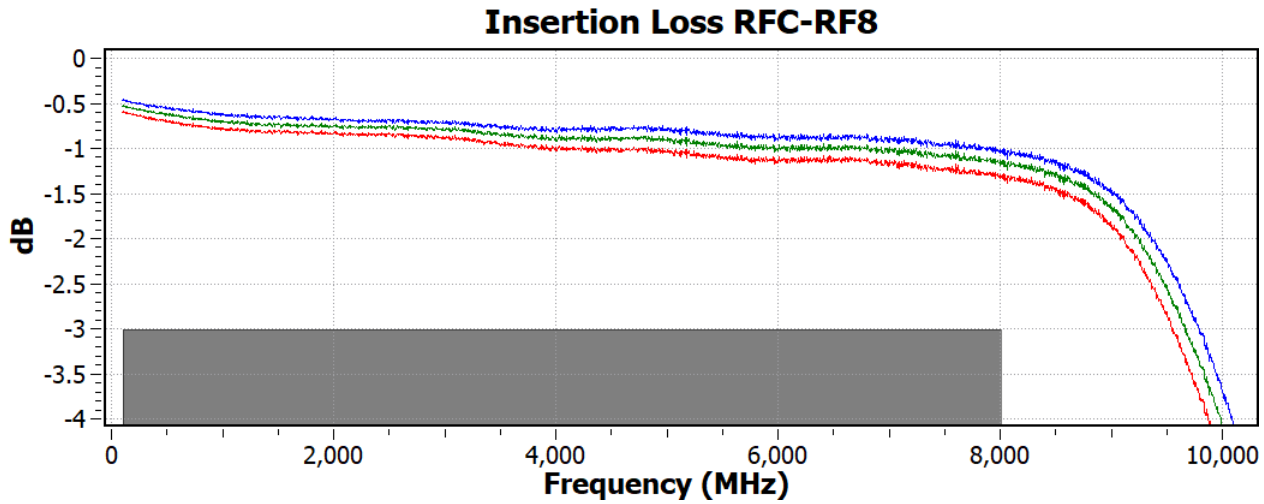


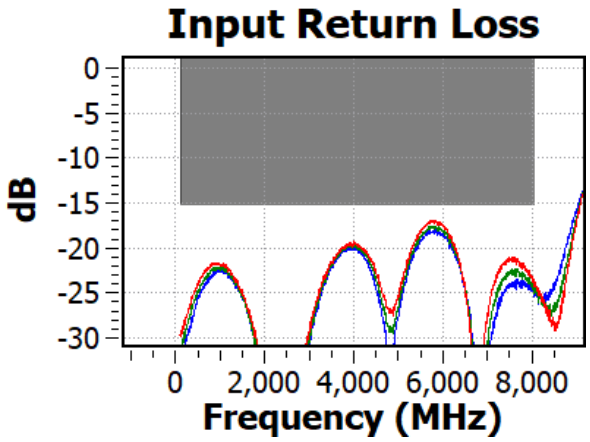


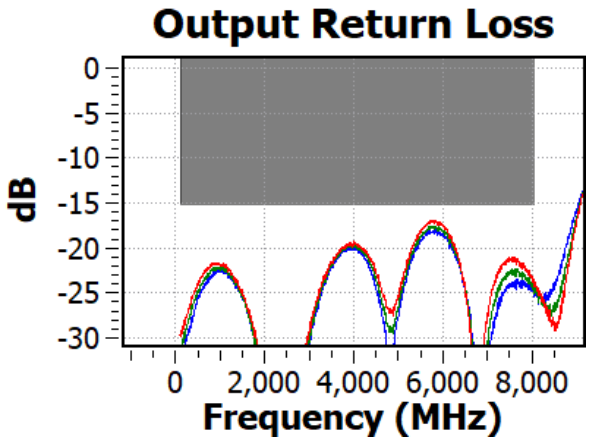


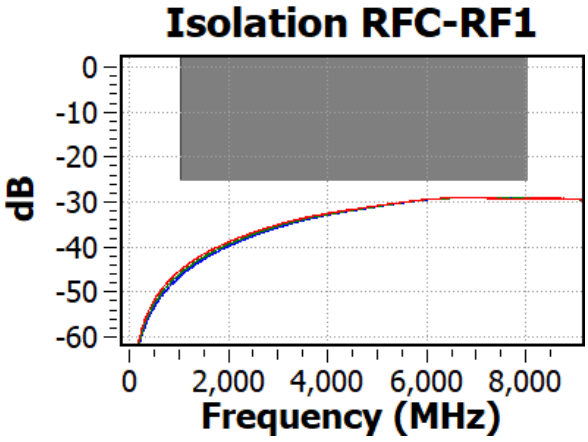
Performance Plots – Small Signal: RF Port 8 – Temperature Performance

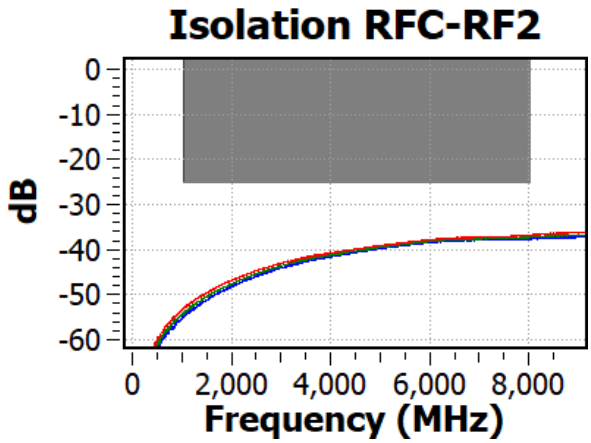
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





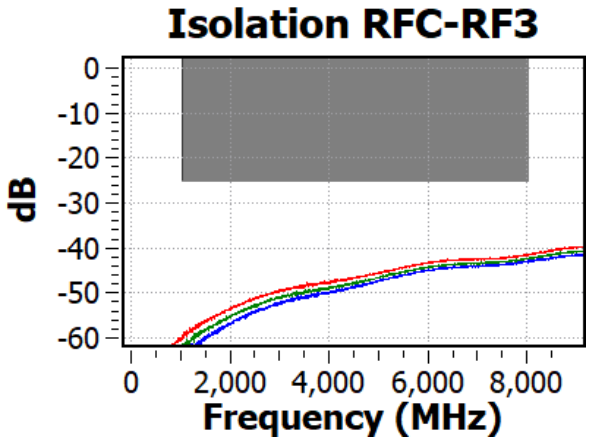


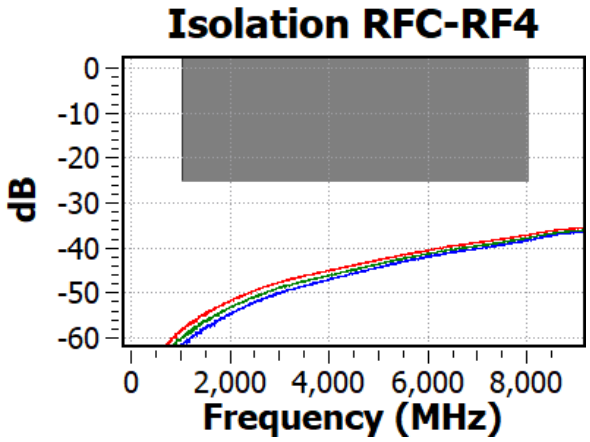


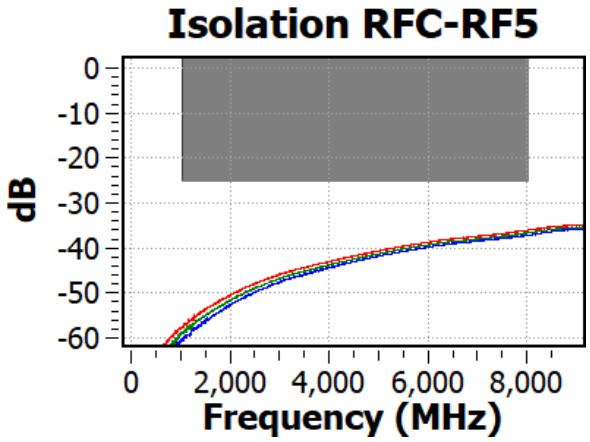


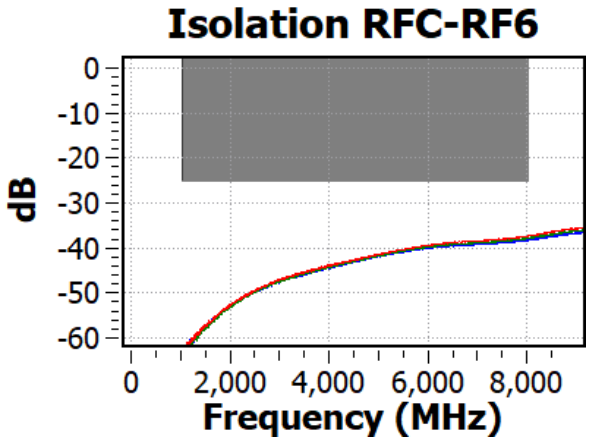
Performance Plots – Small Signal: RF Port 8 – Temperature Performance (Cont.)

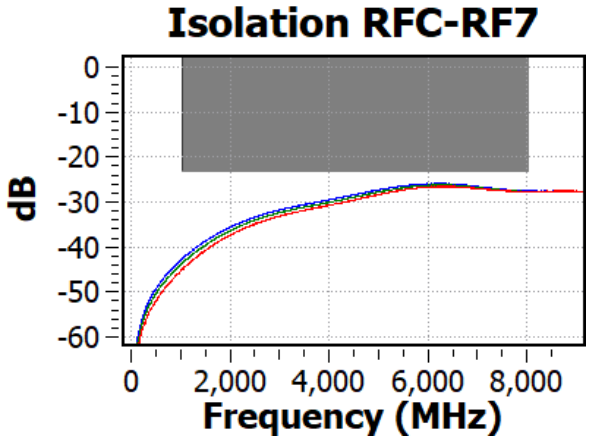
Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C





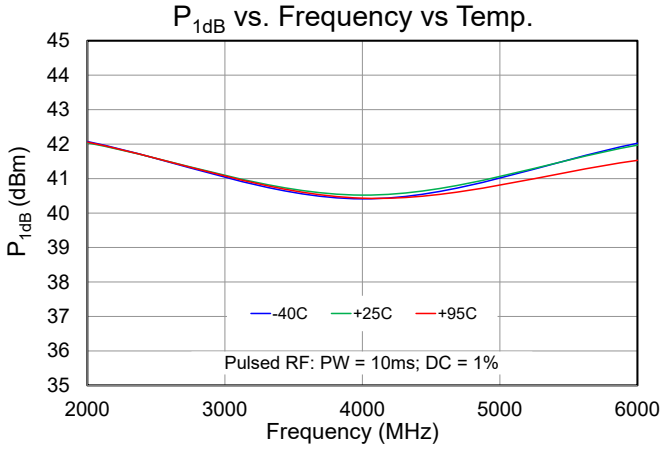


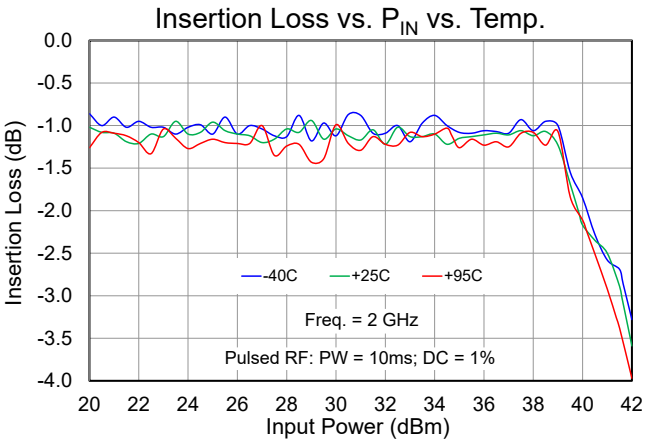


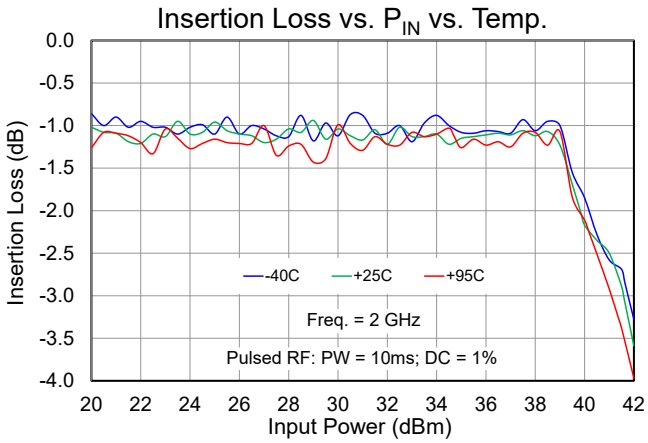


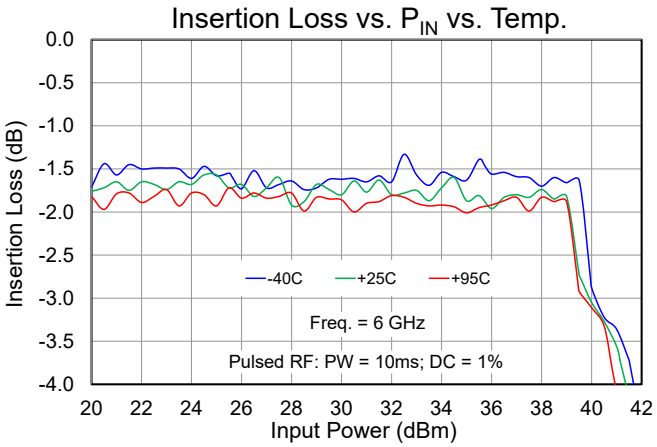
Performance Plots – Large Signal: Temperature Performance

Test conditions unless otherwise noted: V_{DD} = 5V; Blue = -40°C; Green = +25°C; Red = +95°C



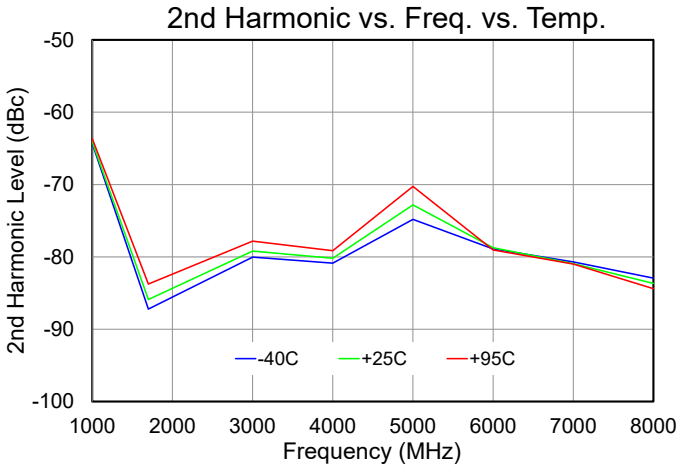


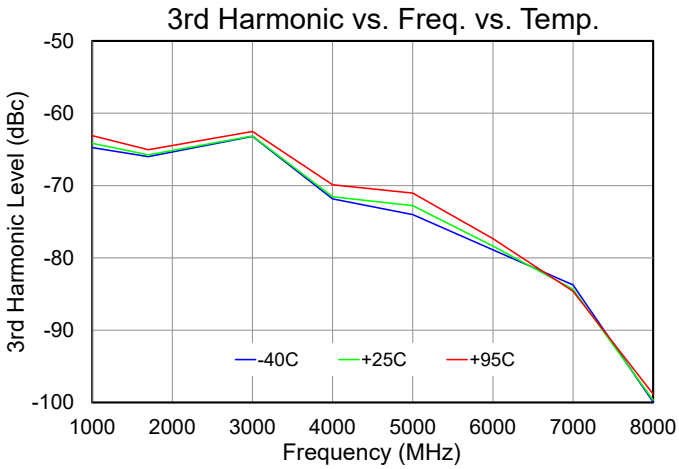




Performance Plots – Harmonics: Temperature Performance

Test conditions unless otherwise noted: V_{DD} = 5V; P_{IN} = 30dBm; CW; Blue = -40°C; Green = +25°C; Red = +95°C



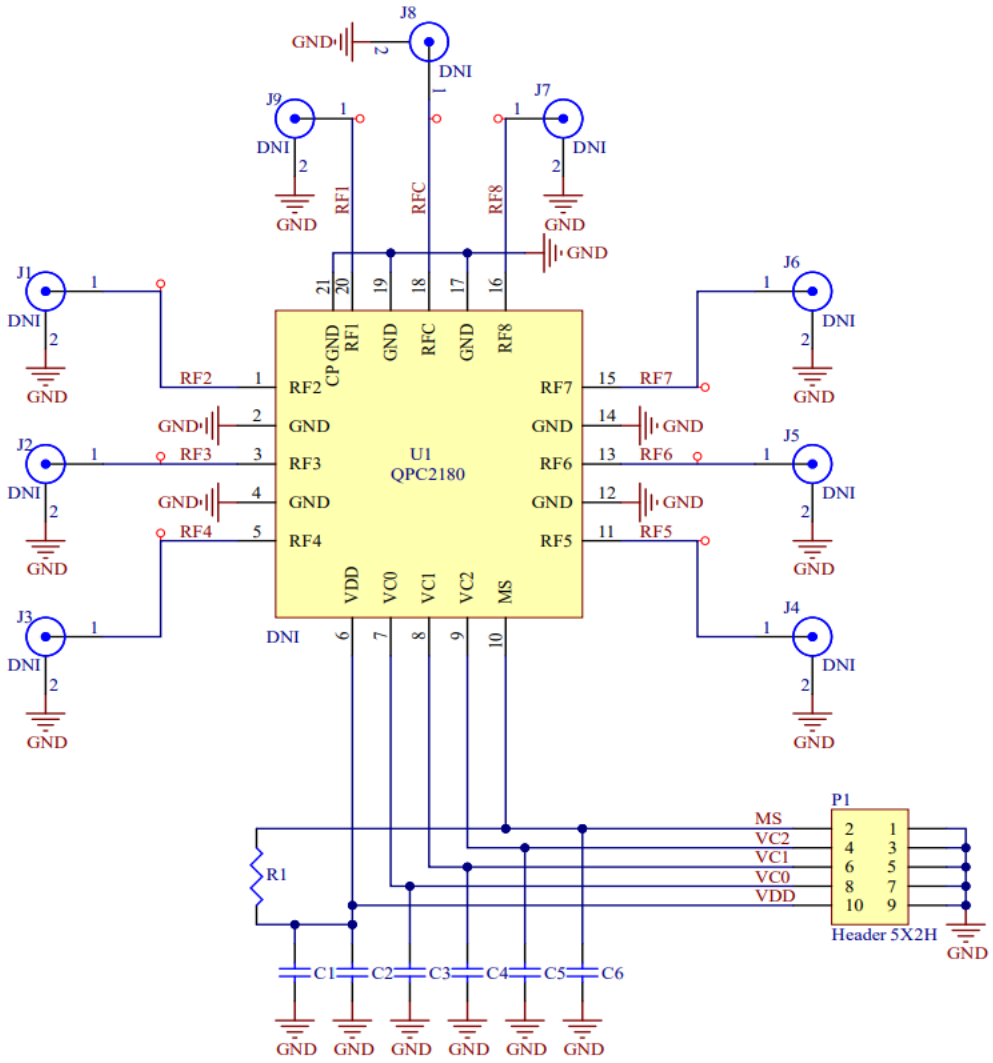


Switch Control Logic Truth Table

Logic “0” and Logic “1” levels refer to Recommended Operating Conditions Table

Operation Modes	VC2	VC1	VC0	MS = 0 (Grounded)	MS = 1 (Floating)
	0	0	0	RFC – RF1	RFC – RF8
	0	0	1	RFC – RF2	RFC – RF7
	0	1	0	RFC – RF3	RFC – RF6
	0	1	1	RFC – RF4	RFC – RF5
	1	0	0	RFC – RF5	RFC – RF4
	1	0	1	RFC – RF6	RFC – RF3
	1	1	0	RFC – RF7	RFC – RF2
	1	1	1	RFC – RF8	RFC – RF1

Application Circuit

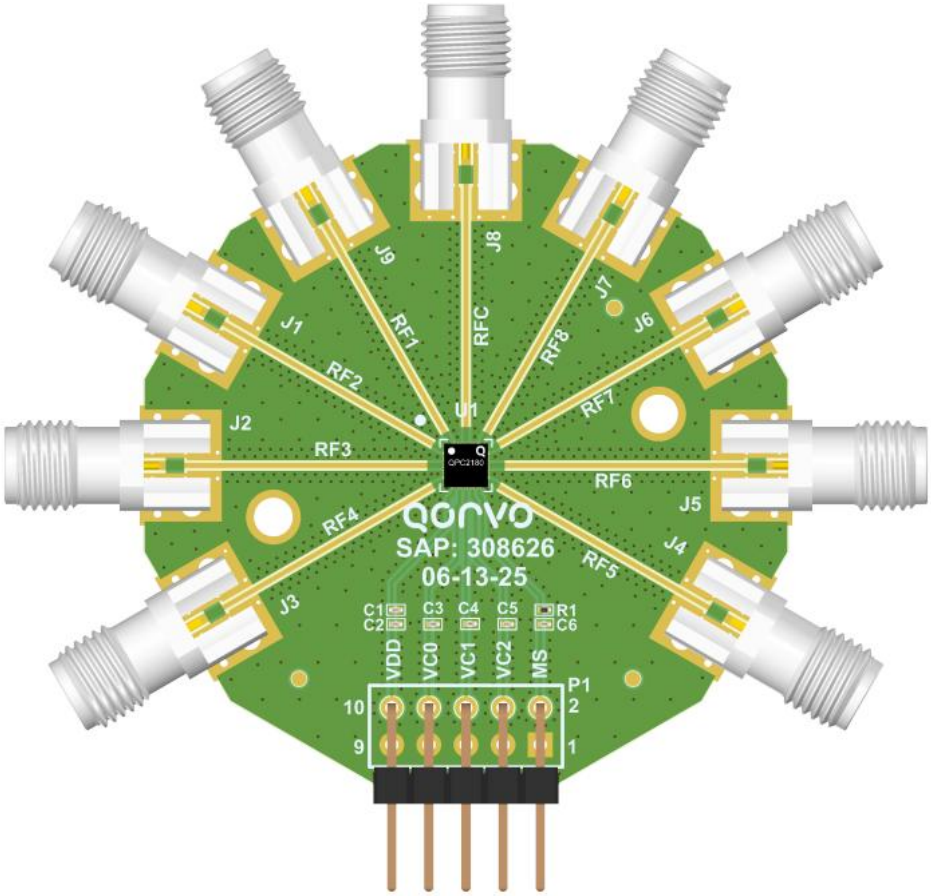


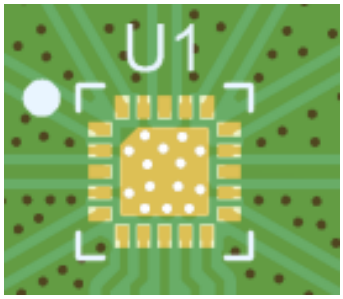
Notes: This switch can be configured as a Single Pole, Single Throw (SPST) by terminating seven unused RF switched ports with a 50 Ohm load.

Bill of Materials for EVB – QPC2180

Reference Des.	Value	Description	Manuf.	Part Number
C1	100 pF	CAP, 5%, 25V, COG, 0201	Various	–
C2, C3, C4, C5, C6, R1	N/A	Not Populated	Various	-
J1 to J9	N/A	CONN, SMA, R/A JACK, END LAUNCH, T/H	Various	-

Evaluation Board (EVB) Assembly Layout.





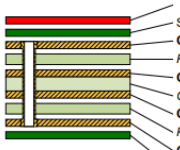
Mounting Detail

Notes:

1. No DC blocking capacitor is necessary when the RF line potential is equal to 0V dc.
2. See Truth Table on page 24 for biasing the voltage controls.

Evaluation Board (EVB) PCB Information

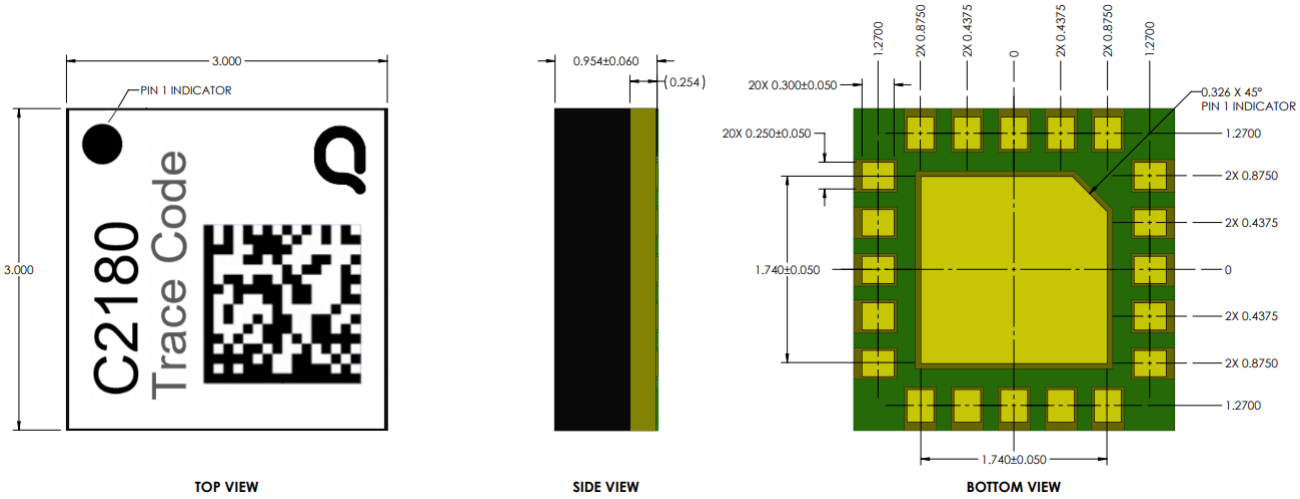
LAYER STACK LEGEND



Material	Layer	Thickness	Dielectric Material	Type	Dk	Note
	TOP SILKSCREEN			Legend		HIGH TEMPERATURE, NON-CONDUCTIVE, WHITE EPOXY BASED INK
Surface Material	TOP SOLDERMASK	0.0008in	Solder Resist	Solder Mask	3.5	LPI (LIQUID PHOTO-IMAGEABLE), OR LDI (LASER DIRECT IMAGEABLE), GREEN, MAX FINISH THICKNESS TO BE 0.001in.
Copper	**METAL 1 (TOP)**	**0.0007in**		**Signal**		**FINISH THICKNESS = 0.25oz COPPER CLADDING + SURFACE PLATING/VIA PLATING/FINISH**
Prepreg		*0.0066in*	*Rogers R4350B*	*Dielectric*	*3.48*	
Copper	**METAL 2**	**0.0007in**		**Signal**		
Core		*0.0230in*	*FR4*	*Dielectric*	*4.1*	
Copper	**METAL 3**	**0.0007in**		**Signal**		
Prepreg		*0.0066in*	*Rogers R4350B*	*Dielectric*	*3.38*	
Copper	**METAL 4 (BOTTOM)**	**0.0007in**		**Signal**		**FINISH THICKNESS = 0.25oz COPPER CLADDING + SURFACE PLATING/VIA PLATING/FINISH**
Surface Material	BOTTOM SOLDERMASK	0.0008in	Solder Resist	Solder Mask	3.5	LPI (LIQUID PHOTO-IMAGEABLE), OR LDI (LASER DIRECT IMAGEABLE), GREEN, MAX FINISH THICKNESS TO BE 0.001in.

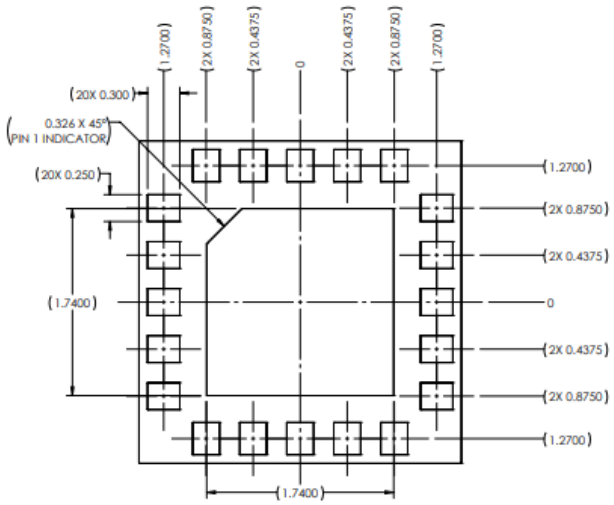
Total thickness: 0.0406in

Mechanical Information

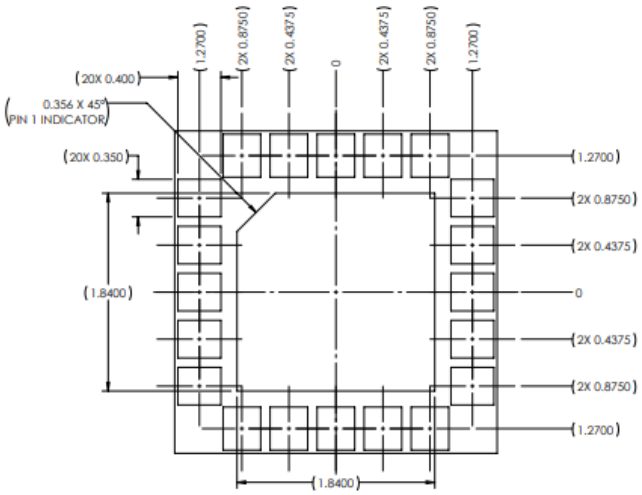


Units: millimeters
Tolerances: unless specified
x.xx = ± 0.25
x.xxx = ± 0.100
Materials:
Package Base: Laminate
Packaged Lid: Mold Compound
Package Exposed Metallization is Gold Plated.
Part is Mold Encapsulated
Marking:
● Pin 1 Indicator
Qorvo Logo – Use Q5D
Part #: 2180
Trace Code to be assigned by SUBCON

PCB Mounting Pattern



RECOMMENDED LANDING PATTERN



RECOMMENDED LANDING PATTERN MASK

Notes:

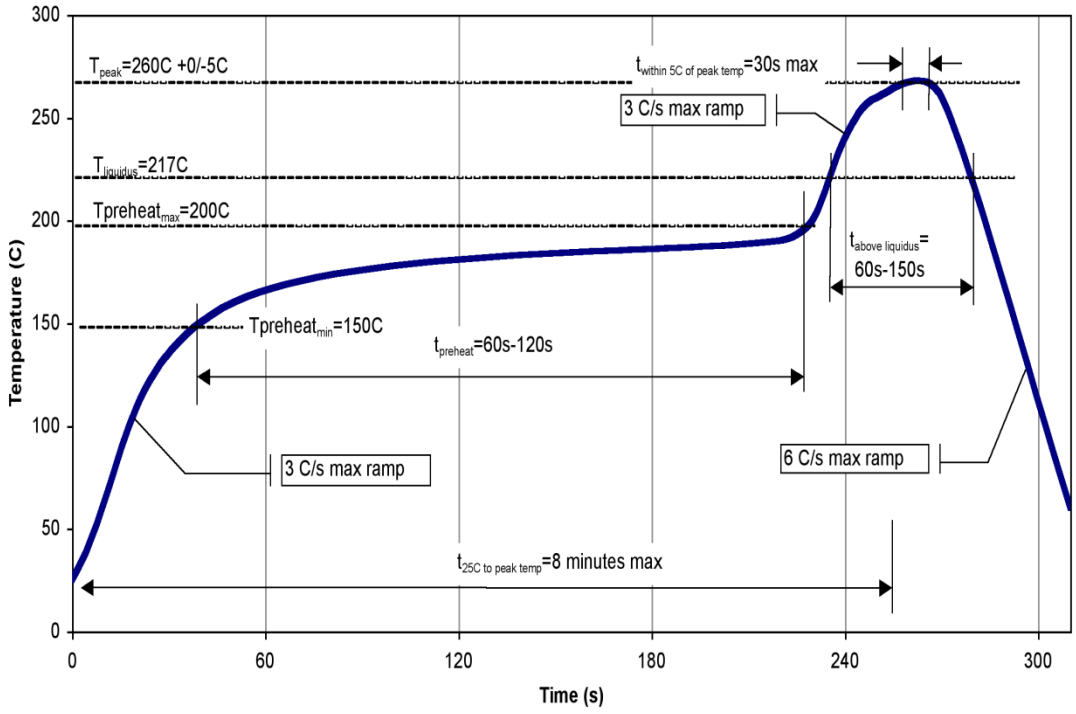
1. All dimensions are in millimeters. Angels are in degrees.
2. This drawing specifies the mounting pattern used on the Qorvo evaluation board for this product. Some modification may be necessary to suit end user assembly materials and processes.

Solderability

Compatible with both lead-free (260 °C max. reflow temperature) and tin/lead (245 °C max. reflow temperature) soldering processes.

Contact plating: Thin NiENEPIG.

Recommended Soldering Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1C	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	ESDA / JEDEC JS-002-2014
MSL – Convection Reflow 260 °C	Level 3	JEDEC standard IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

Environmental Compliance

This part is compliant with 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Web: www.qorvo.com

Tel: 1-844-890-8163

Email: customer.support@qorvo.com

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