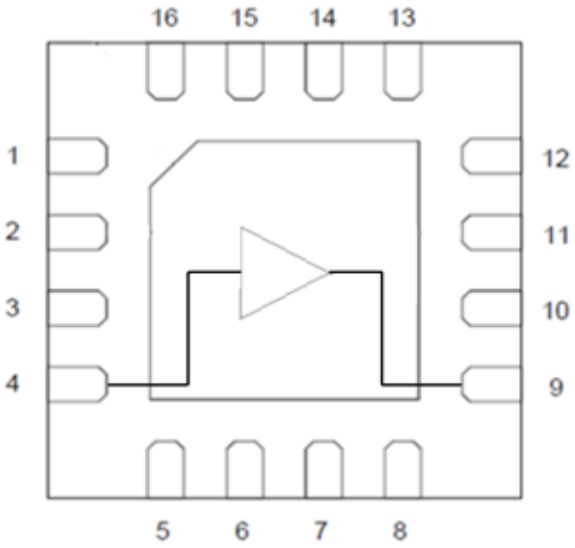
QPL7425

75 Ω 25 dB CATV Amplifier 5 – 1218 MHz

Product Overview

The QPL7425 is a GaAs pHEMT single ended RF amplifier IC featuring 25 dB of flat gain and low noise. This IC is designed for applications in the Upstream from 5 MHz to 684 MHz and in the Downstream from 47 MHz to 1218 MHz using a single 5 V supply, and it can be used from 5 V to 8 V depending on linearity requirements. QPL7425 offers low noise and distortion plus high gain in a 3 x 3 QFN package for convenient layout and design in set top and infrastructure projects for 75 Ω CATV and satellite applications.

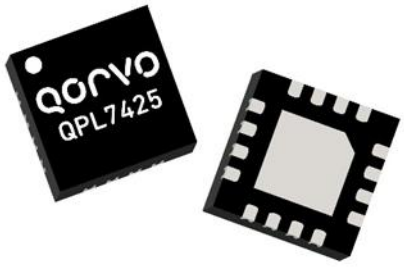
Functional Block Diagram



Top View

Ordering Information

Part Number	Description
QPL7425SB	Sample bag with 5 pieces
QPL7425SR	7" Reel with 100 pieces
QPL7425TR7	7" Reel with 2500 pieces
QPL7425EVB-01	47 – 1218 MHz Evaluation Board
QPL7425EVB-02	5 – 684 MHz Evaluation Board



3 x 3 QFN Package

Key Features

- 5 MHz to 1218 MHz Operation
- 5 V, and 8 V Operation
- Gain; 25 dB Typical
- Noise Figure; 1 dB Typical
- Adjustable Bias Using External Resistors
- Convenient QFN Package
- RoHS Compliant

Applications

- DOCSIS 3.1
- Upstream DOCSIS 3.1 and 4.0
- Downstream Applications, 47 to 1218 MHz
- Upstream Applications, 5 to 684 MHz
- Head End CMTS Equipment
- Optical Node and Amplifier
- FTTH GPON and GEPON
- Satellite Low Noise Amplifier
- Cable Modem and Set Top Box
- Single Ended Gain Block

Absolute Maximum Ratings

Parameter	Rating
Supply Voltage (V_{DD})	+10 V
Supply Current (I_{DD})	140 mA
Maximum Input Level	65 dBmV
Operating Temperature Range (Bottom of case)	-40 to +100 °C
Storage Temperature Range	−65 to +150 °C
Maximum Junction Temperature	+150 °C

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.

Electrical Specifications, 47 – 1218 MHz (5 V)

Parameter	Condition [1]	Min	Typ	Max	Unit
Supply Voltage (V_{DD})			5		V
Supply Current (I_{DD})			60		mA
Frequency Range		47		1218	MHz
Gain			25		dB
Gain Slope			0.9		dB
Reverse Isolation			-27		dB
Input Return Loss			23		dB
Output Return Loss			18		dB
Noise Figure			1.0		dB
OIP2L			44		dBm
OIP2H			38		dBm
OIP3			35		dBm
OP1dB			21		dBm
Thermal Resistance	Θ_{JC} (Bottom of Case)		28.8		˚C/W

Notes:

1. Typical performance at these conditions: Temp = +25 °C, V_{DD} = +5 V, 75 ohm system, Full band unless otherwise noted
2. OIP3; +9 dBm/ tone output, 6 MHz spacing
3. OIP2; +9 dBm/tone output, 30 MHz spacing

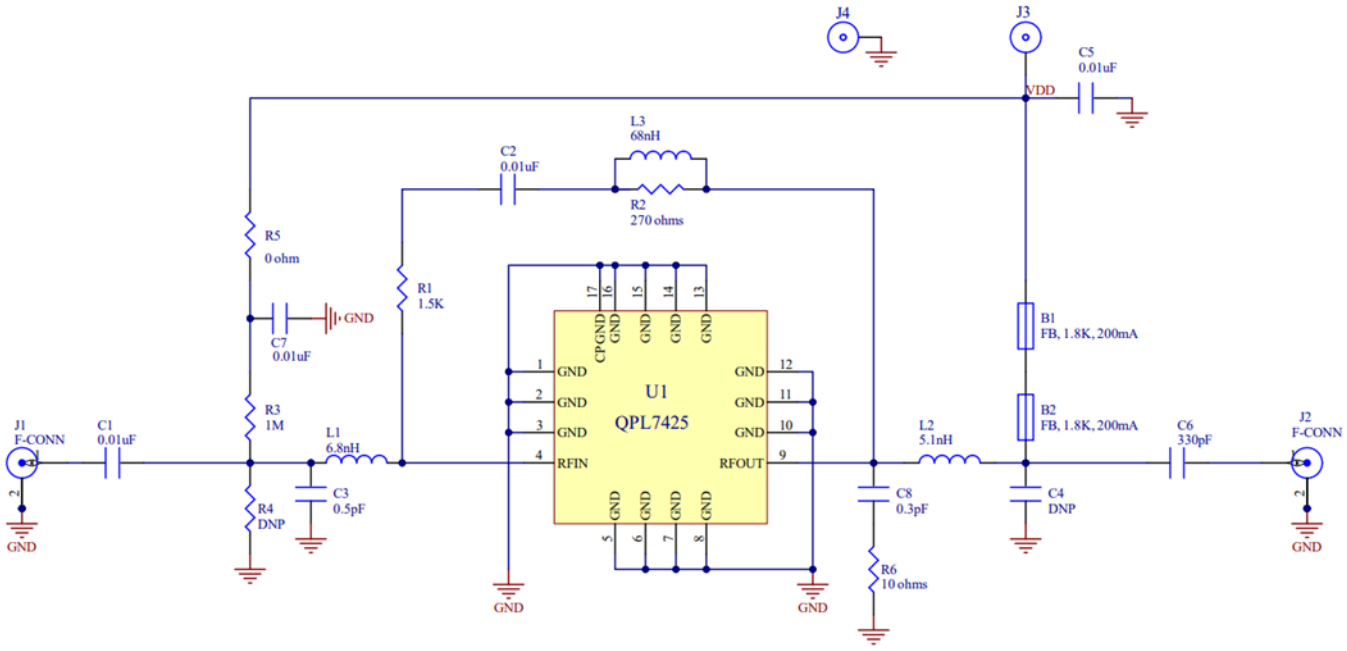
Electrical Specifications, 47 – 1218 MHz (8 V)

Parameter	Condition [1]	Min	Typ	Max	Unit
Supply Voltage (V_{DD})			8		V
Supply Current (I_{DD})			90		mA
Frequency Range		47		1218	MHz
Gain			25		dB
Gain Slope			-1		dB
Reverse Isolation			-27		dB
Input Return Loss			21		dB
Output Return Loss			-18		dB
Noise Figure			1.0		dB
OIP2L			51		dBm
OIP2H			43		dBm
OIP3			40		dBm
OP1dB			24		dBm
Thermal Resistance	Θ_{JC} (Bottom of Case)		28.8		˚C/W

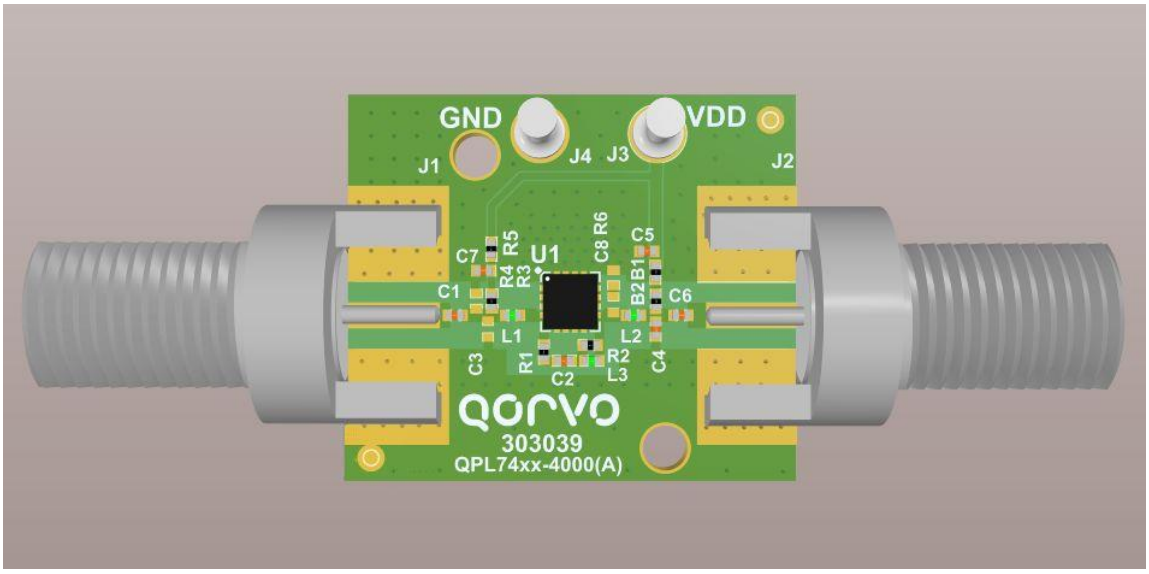
Notes:

1. Typical performance at these conditions: Temp = +25 °C, V_{DD} = +8 V, 75 ohm system, Full band unless otherwise noted
2. OIP3; +9 dBm/ tone output, 6 MHz spacing
3. OIP2; +9 dBm/tone output, 30 MHz spacing

Evaluation Board Schematic, 47 – 1218 MHz



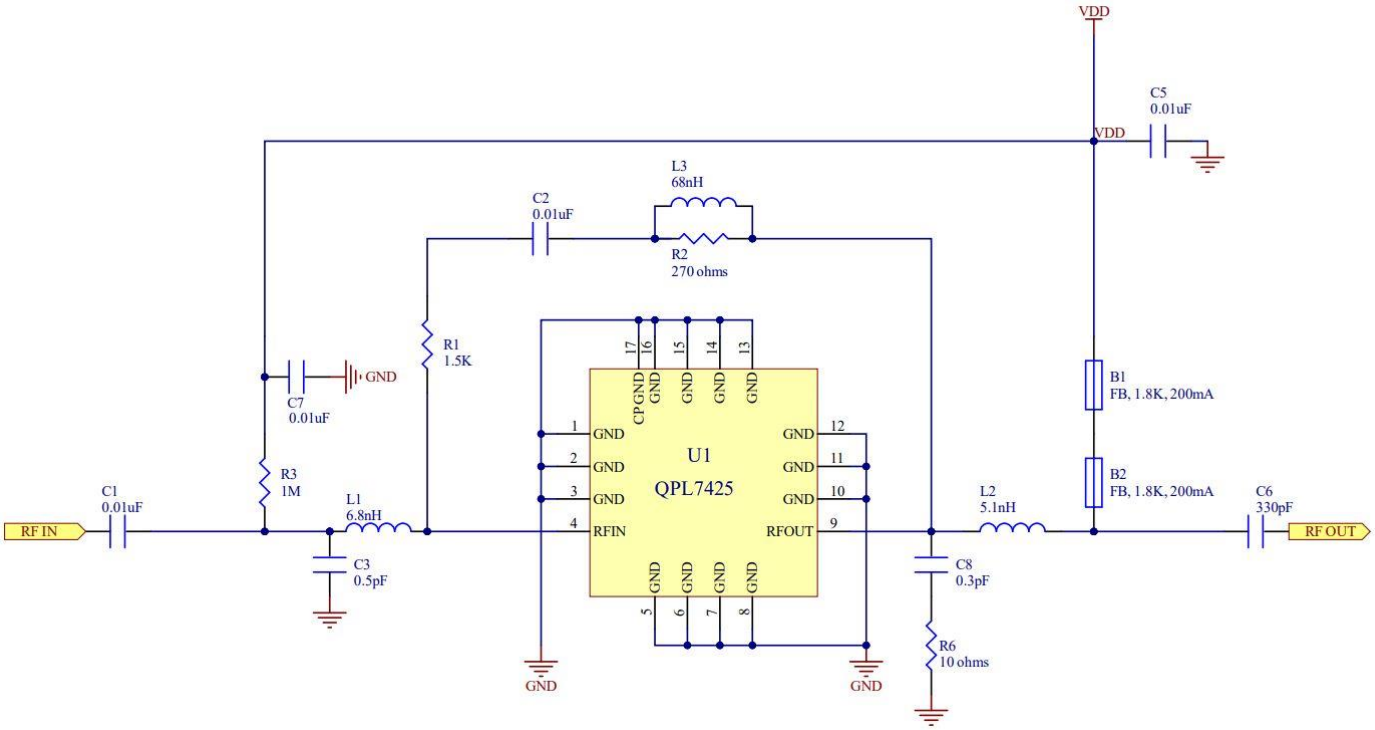
Evaluation Board Assembly Drawing, 47 – 1218 MHz



Evaluation Board Bill of Materials, 47 – 1218MHz

Designator	Description	Manufacturer	Part Number
PCB	QPL74xx-4000	TTM	QPL74xx-4000(A)
U1	25dB FTTH Amplifier	Qorvo	QPL7425
B1, B2	FER, BEAD, 1.8K, 200mA, 0402	TDK	MMZ1005A182ET000
C1, C2, C5, C7	CAP, 0.01uF, 10%, 50V, X7R, 0402	Murata Electronics	GCM155R71H103KA55D
C3	CAP,0.5pF,+/-0.1pF,50V,HI-Q,0402	Murata Electronics	GJM1555C1HR50BB01D
C6	CAP, 330pF, 10%, 50V, X8L, 0402	Murata Electronics	GCM155L81H331KA37D
C8	CAP, 0.3pF, +/-0.05pF, 50V, HI-Q, 0402	Murata Electronics	GJM1555C1HR30WB01D
J1, J2	CONN, F FEM EDGE MOUNT, 75 OHMS, 0.068"	Millimeter Wave Technologies	MW-846-C-DD-75
J3, J4	TERM. SOLDER TURRET, 0.062 PCB	Mill-Max Manufacturing	2533-0-00-44-00-00-07-0
L1	IND, 6.8nH, 5%, M/L, 0402	Murata Electronics	LQG15HN6N8J02D
L2	IND, 5.1nH,+/- 0.3nH, 300mA, M/L, 0402	Murata Electronics	LQG15HS5N1S02D
L3	IND, 68nH, 2%, 250mA, M/L, 0402	Murata Electronics	LQG15HS68NG02D
R1	RES, 1.5K, 5%, 1/16W, 0402	Kamaya, Inc	RMC1/16S-152JTH
R2	RES, 270 OHM, 5%, 1/16W, 0402	Kamaya, Inc	RMC1/16S-271JTH
R3	RES, 1M, 5%, 1/16W, 0402	Kamaya, Inc	RMC1/16S-105JTH
R5	RES, 0 OHM, 5%, 1/10W, 0402	Kamaya, Inc	RMC1/16SJPTH
R6	RES, 10 OHM, 5%, 1/16W, 0402	Kamaya, Inc	RMC1/16S-100JTH
C4, R4	Not Populated		

Typical Application Schematic, 47 – 1218 MHz



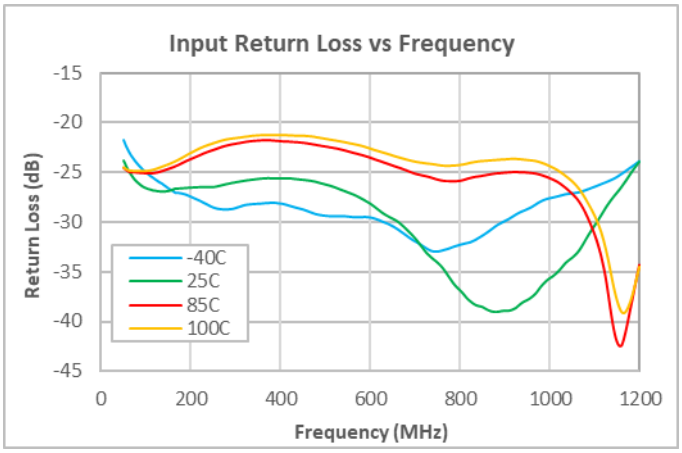
Notes:

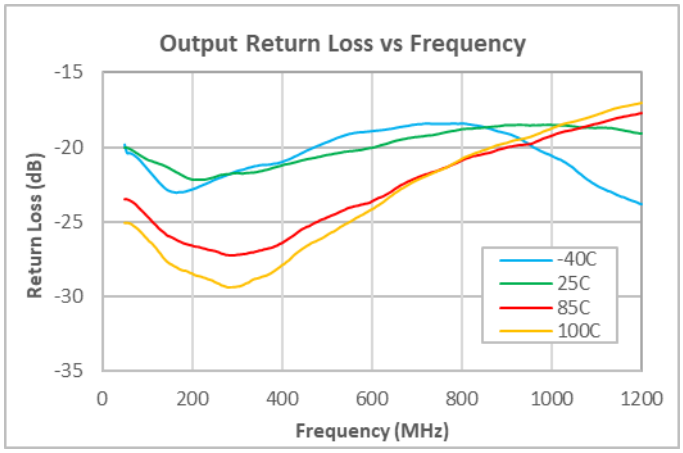
1. C3 / L1 tunes input return loss.
2. L2 / C8 tunes output return loss with some contribution from C6.
3. The feedback network is composed of R1 and R2, with C2 being a DC block and L3 providing high end peaking. The ratio of R1 to R2 controls flatness and tilt while the total feedback resistance affects device gain.
4. B1, B2 provides the bias path with RF isolation from the RF output path.
5. R3 is adjusted to increase linearity or shed power.

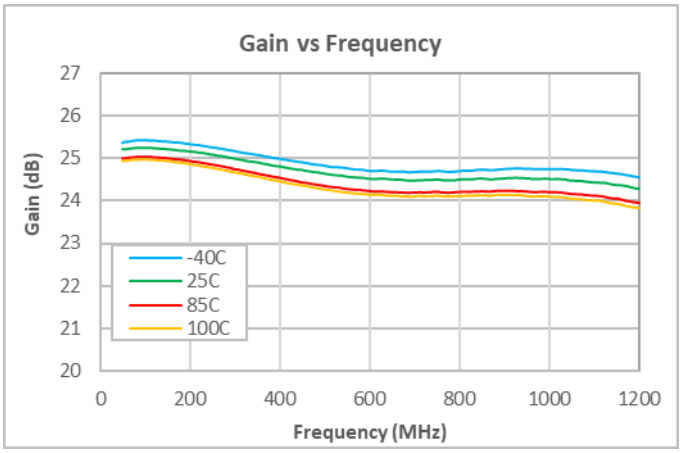
Table 1, Pullup Resistor Options

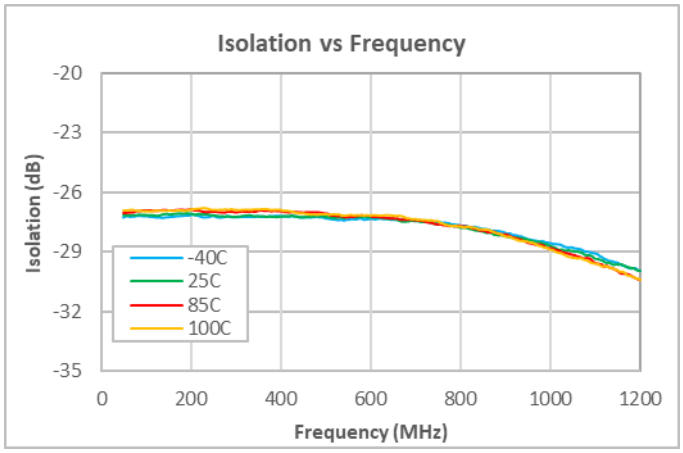
Bias Current vs R3/R4			
R3 Pullup (ohms)	R4 Pulldown (ohms	VDD (V)	IDD (mA)
DNP	DNP	8	80
1M	DNP	8	90
680K	DNP	8	100
360K	DNP	8	120
DNP	DNP	5	50
1M	DNP	5	60
300K	DNP	5	80
120K	DNP	5	120

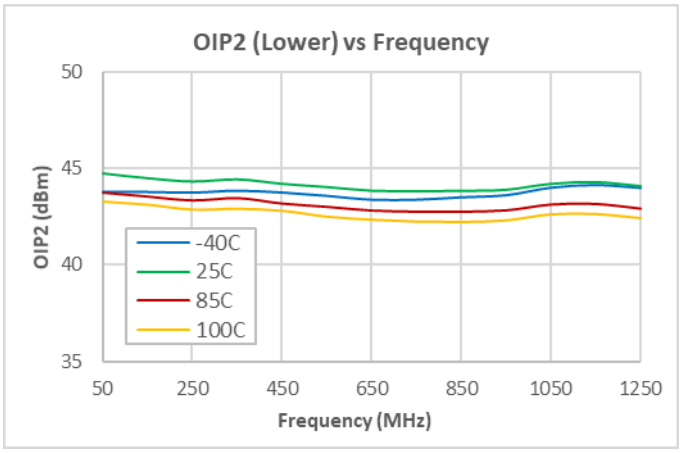
Performance Data, 47 – 1200 MHz (5 V)

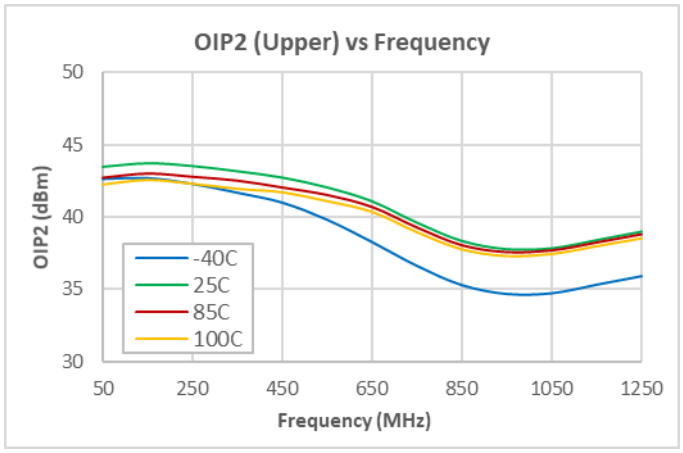






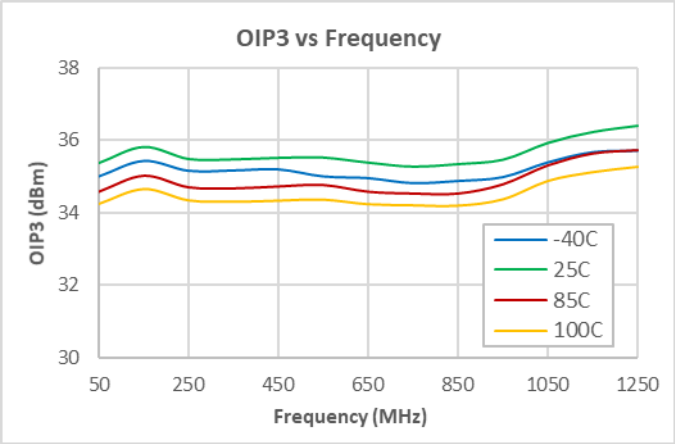


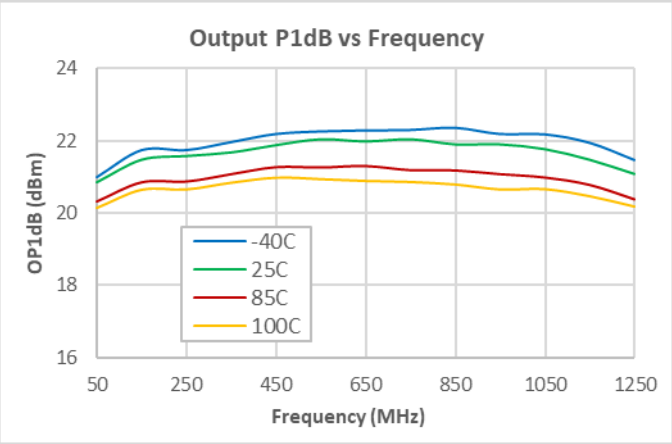


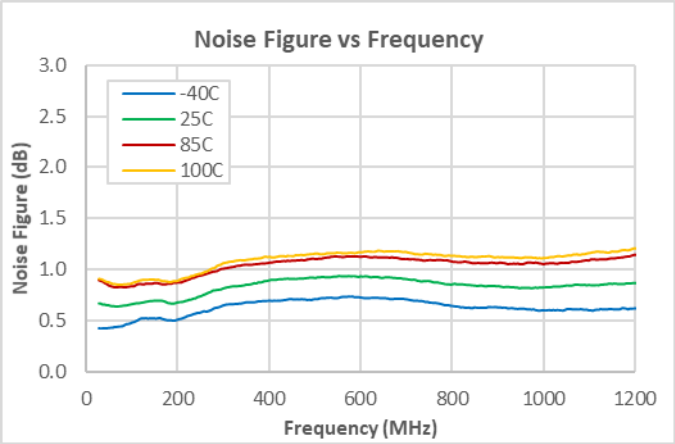


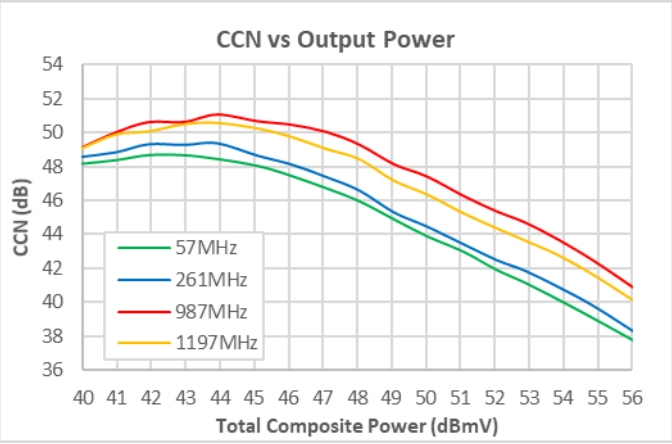
Notes:
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) OIP2: 9 dBm/tone output, 50 MHz spacing.

Performance Data, 47 – 1200 MHz (5 V)



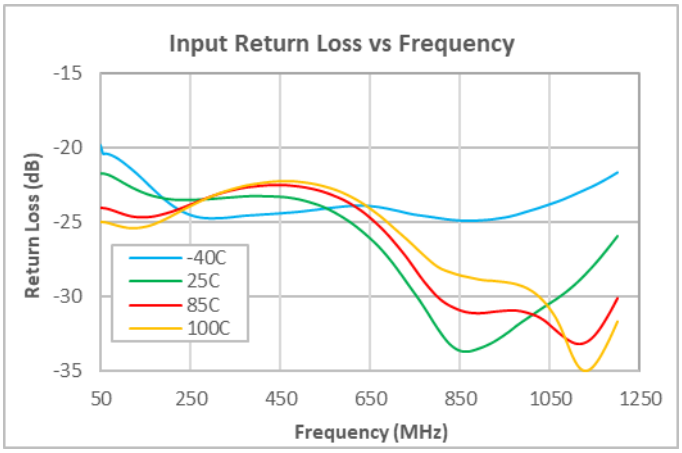


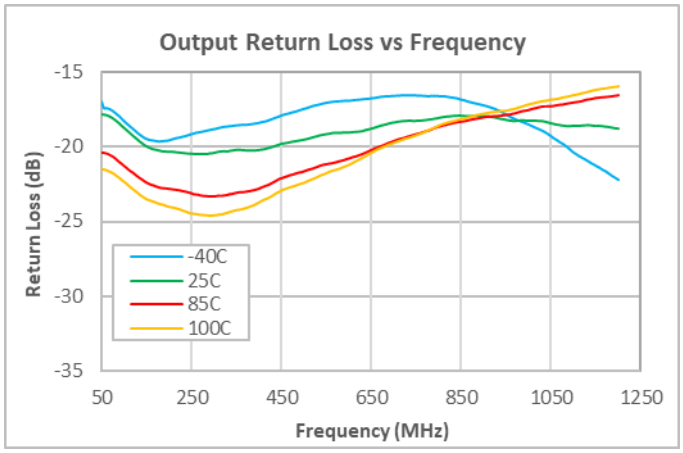


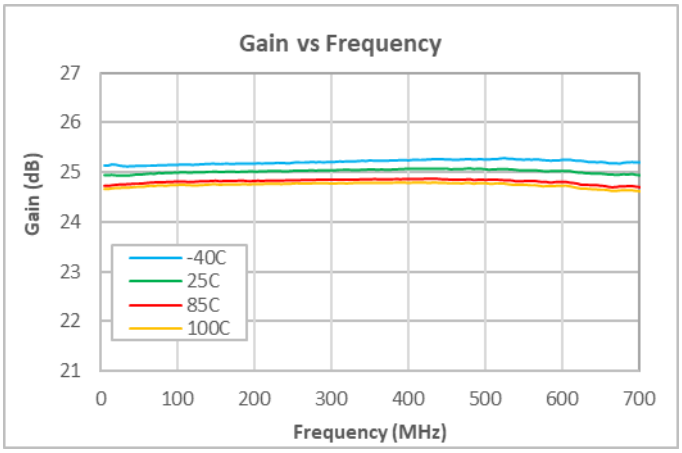


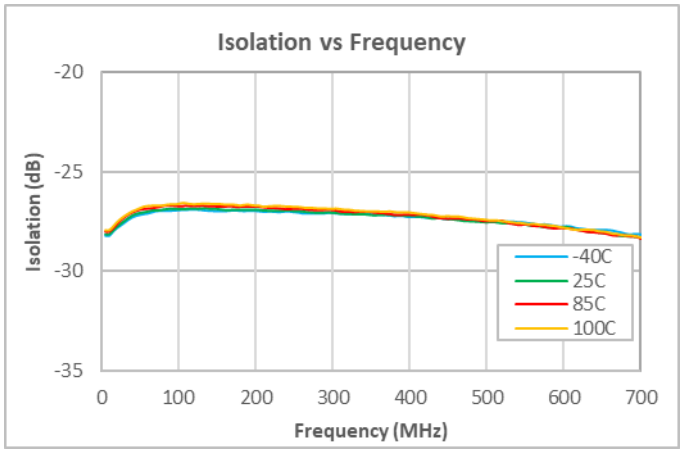
Notes:
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) OIP3: 9 dBm / tone output, 6 MHz spacing.
(3) CCN: 57 – 1215 MHz SC QAM, 0 dB Tilt.

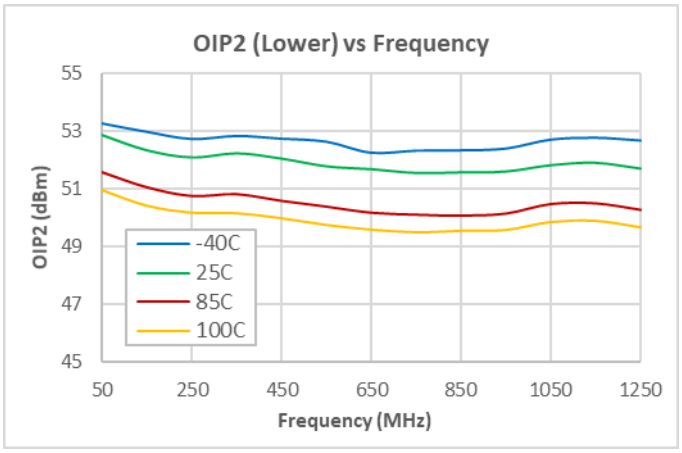
Performance Data, 47 – 1200 MHz (8 V)

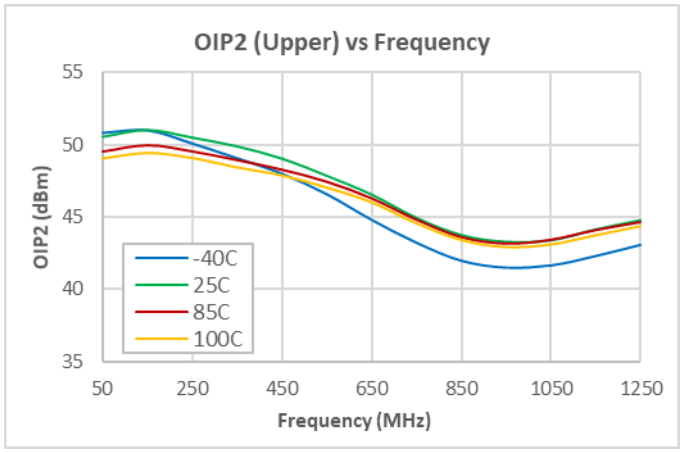






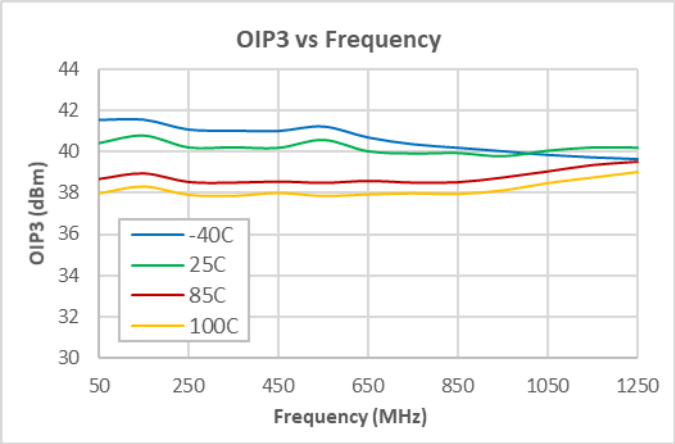


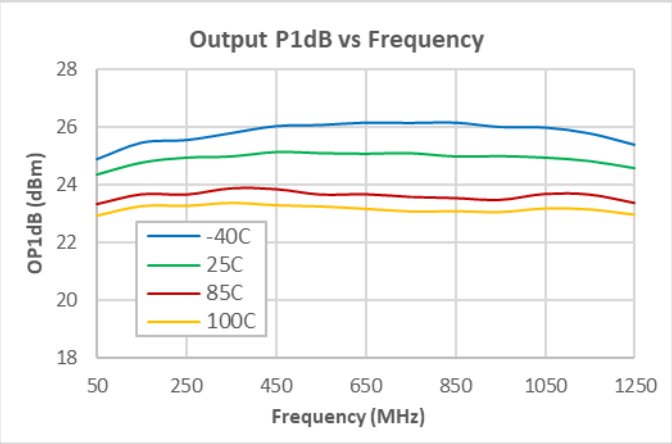


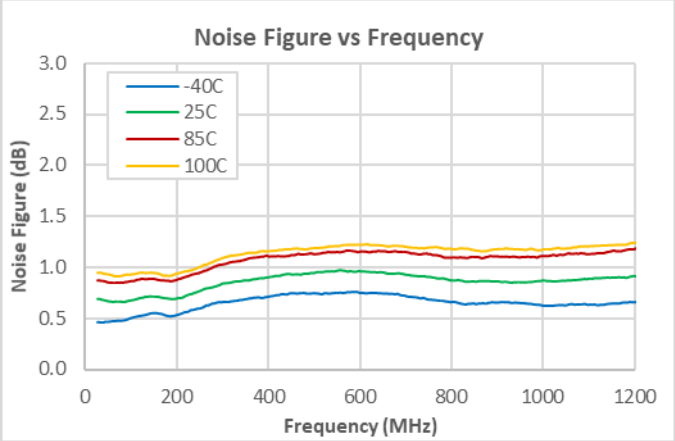


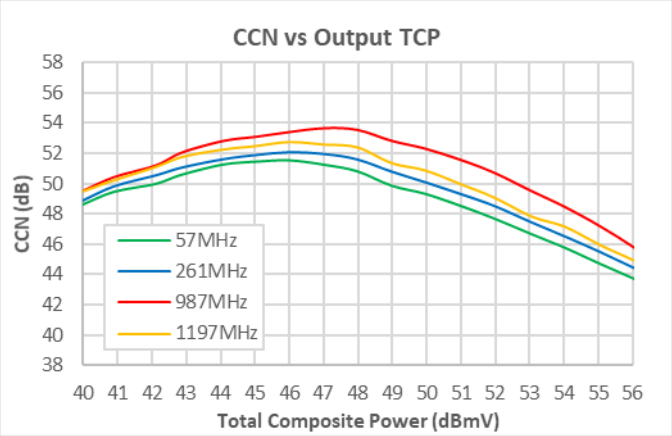
Notes:
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) OIP2: 9 dBm/tone output, 30 MHz spacing.

Performance Data, 47 – 1200 MHz (8 V)



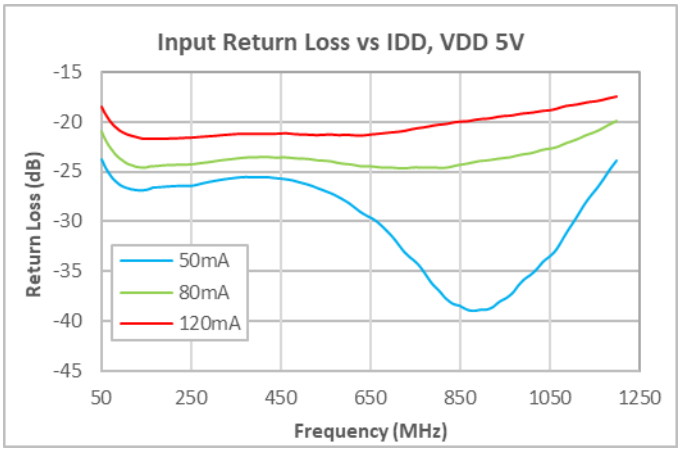


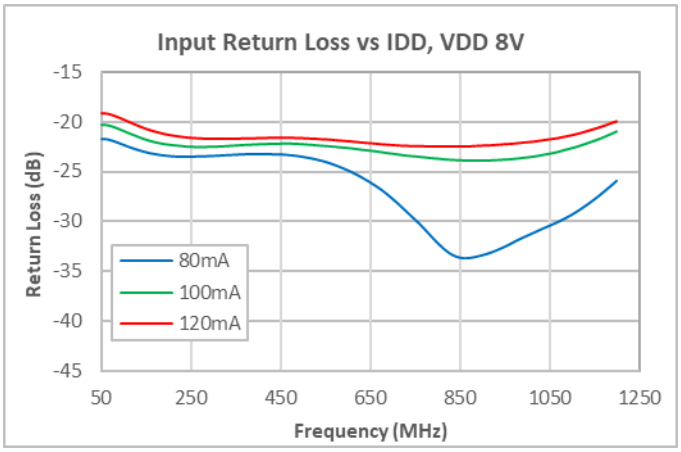


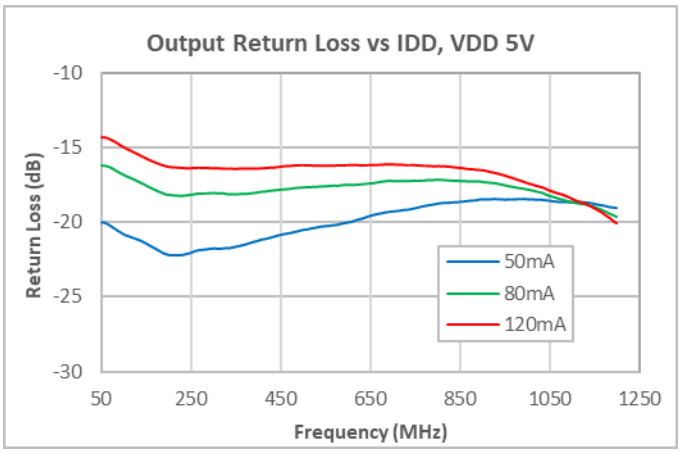


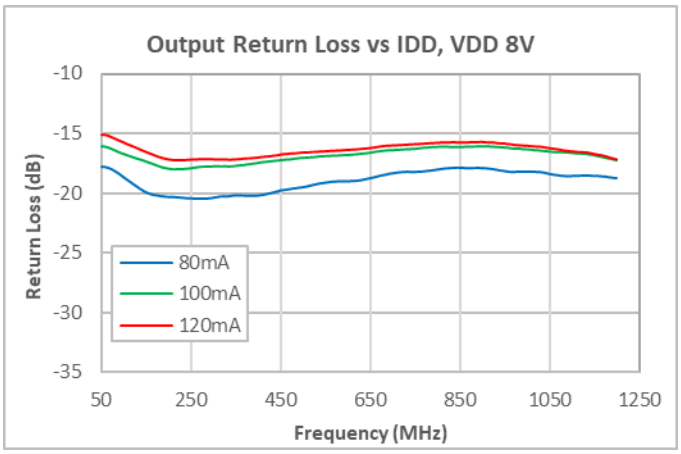
Notes:
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) OIP3: 9 dBm / tone output, 6 MHz spacing.
(3) CCN: 57 – 1215 MHz SC QAM, 0 dB Tilt.

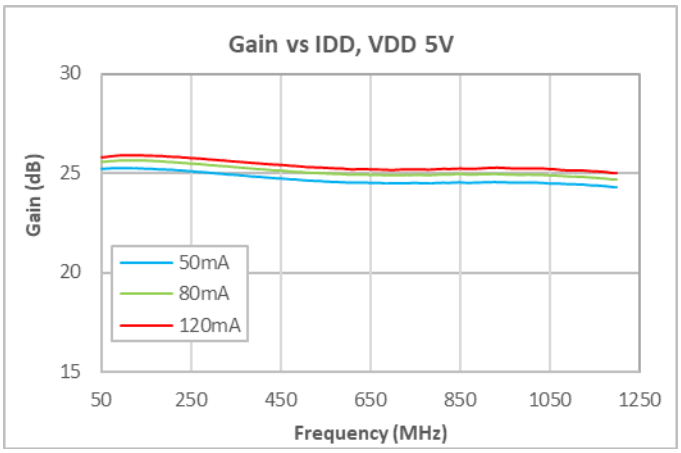
Performance Data vs Supply Voltage, 47 – 1200 MHz

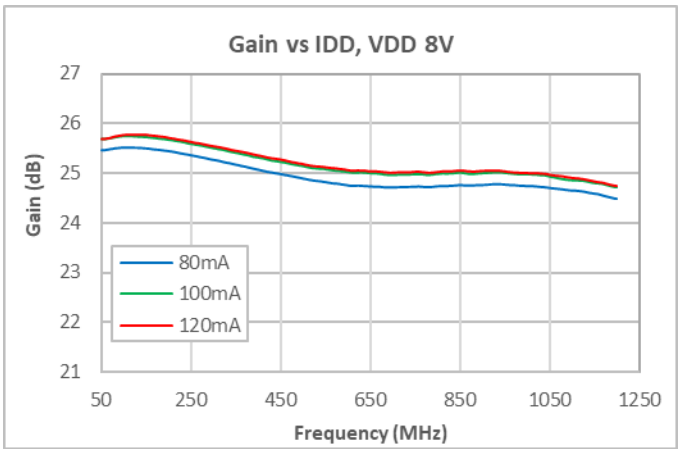








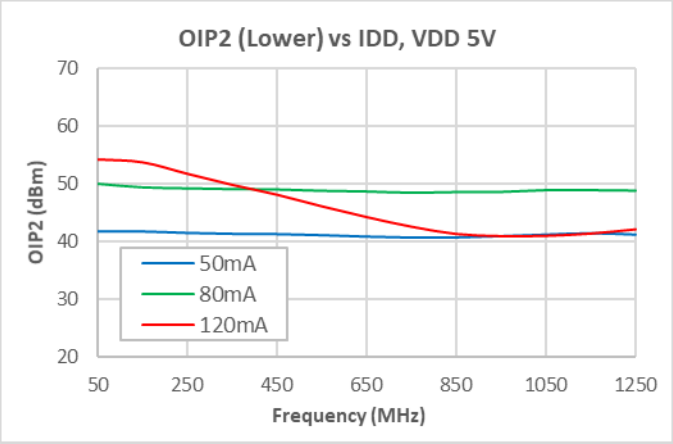


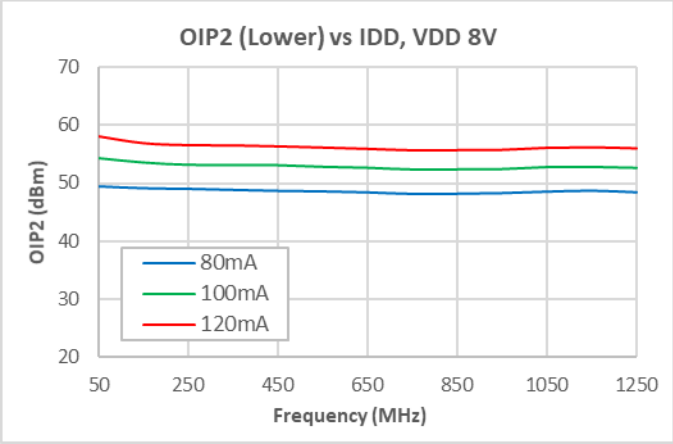


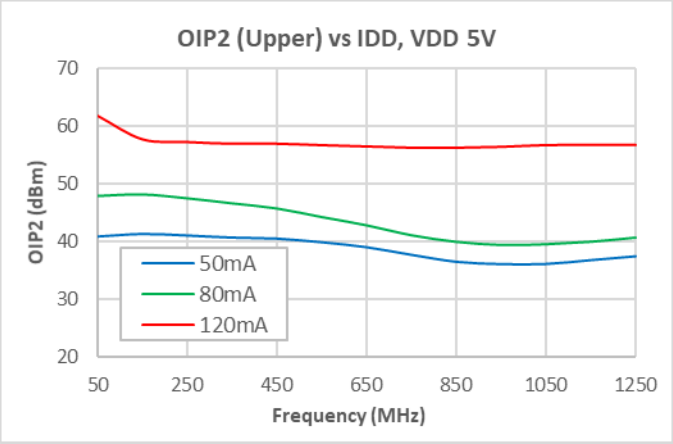
Notes:

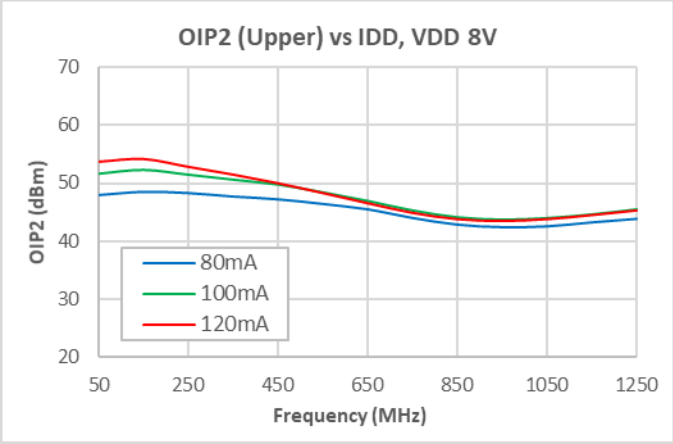
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).

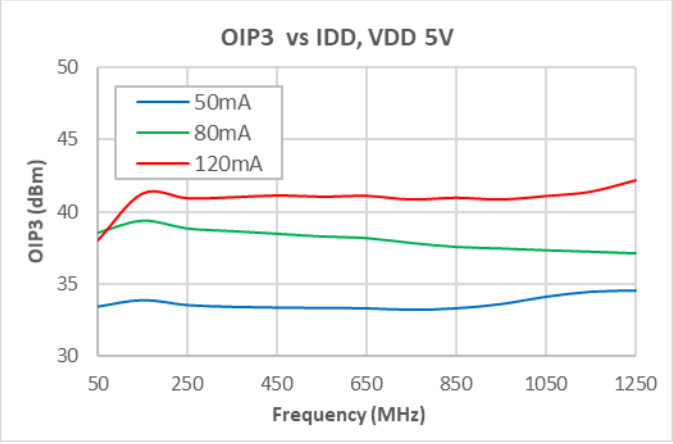
Performance Data vs Supply Voltage, 47 – 1200 MHz

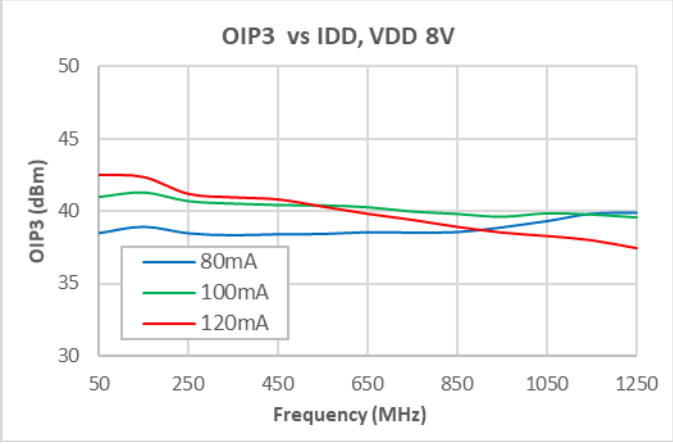








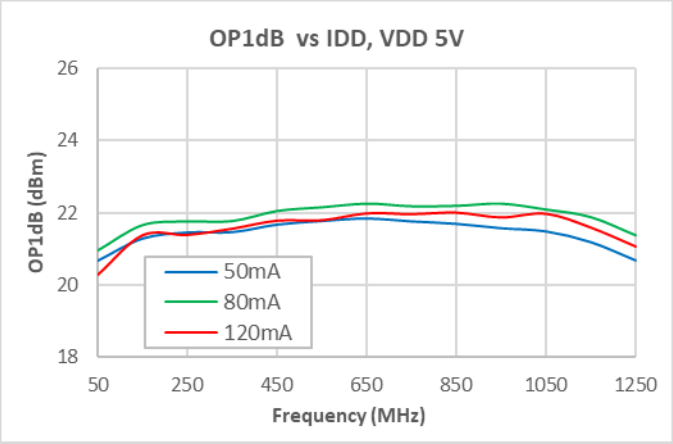


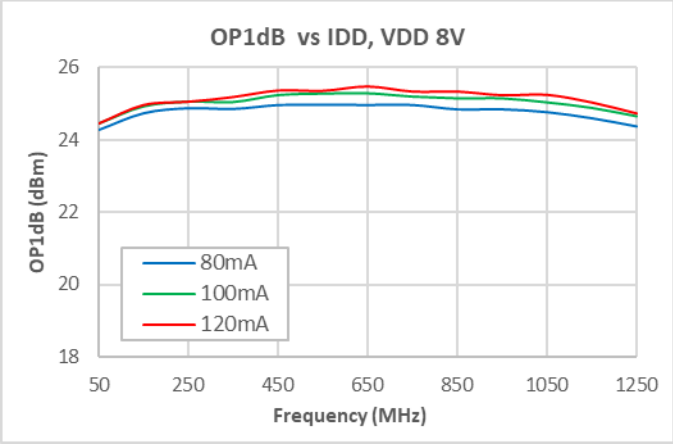


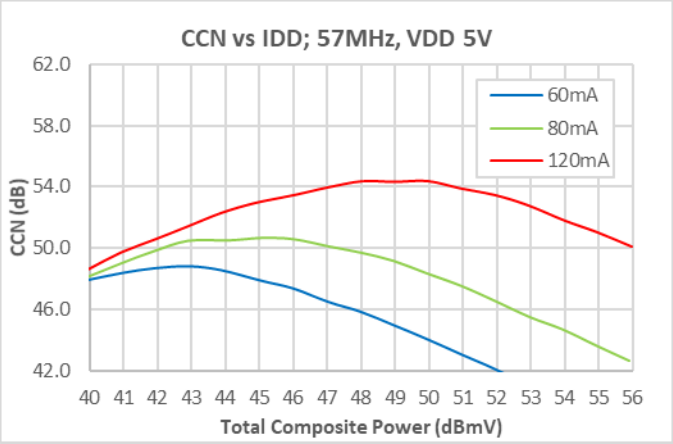
Notes:

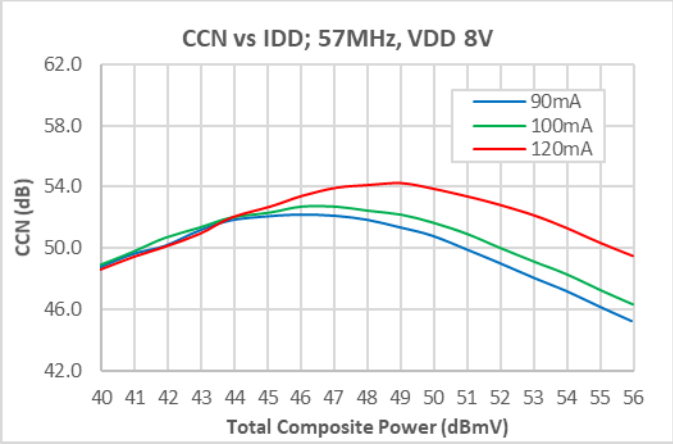
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) OIP2; 9 dBm/tone, 30 MHz spacing.
(3) OIP3; 9 dBm/tone, 6 MHz spacing.

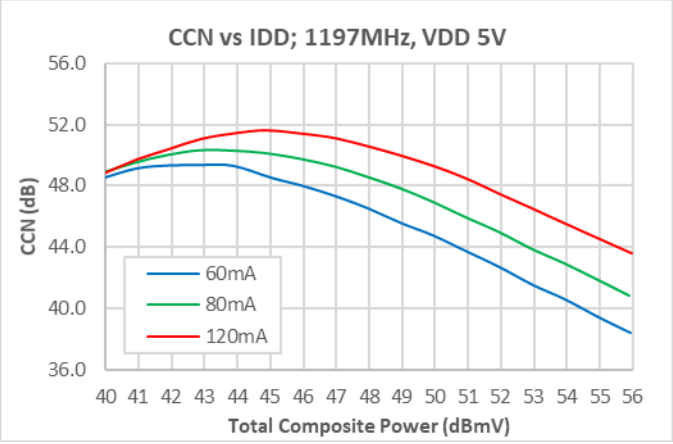
Performance Data vs Supply Voltage, 47 – 1200 MHz

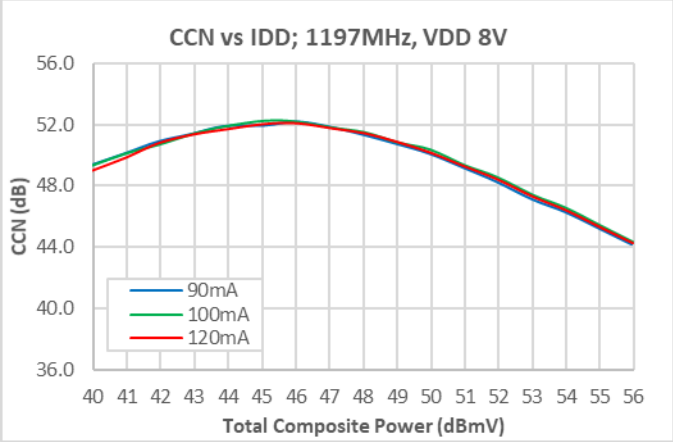






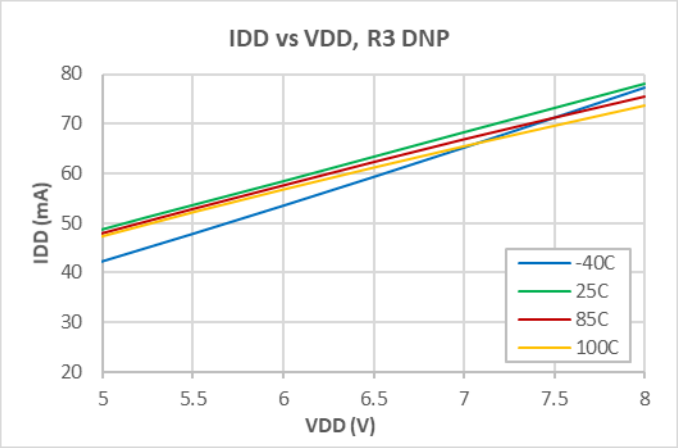


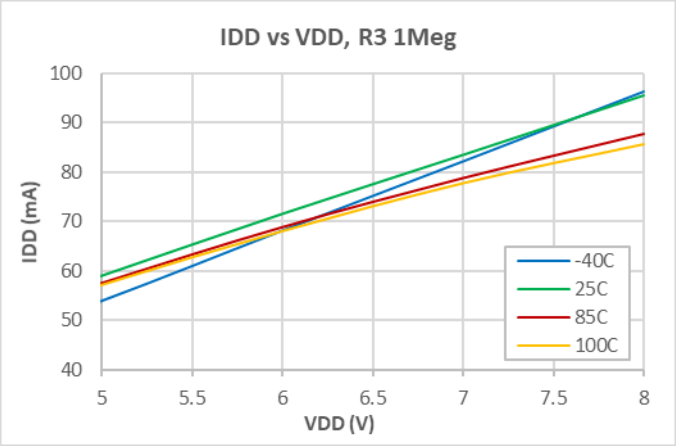


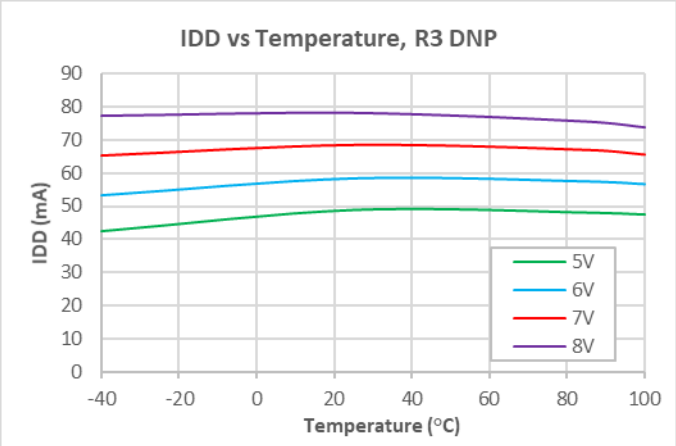


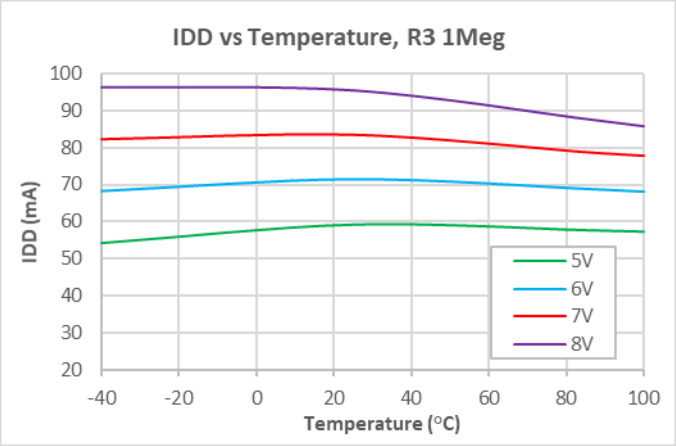
Notes:
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) CCN: 57 – 1215 MHz SC QAM.

Performance Data vs Supply Voltage, 47 – 1200 MHz









Notes:
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).

Electrical Specifications, 5 – 700 MHz (5 V)

Parameter	Condition [1]	Min	Typ	Max	Unit
Supply Voltage (V_{DD})			5		V
Supply Current (I_{DD})			50		mA
Frequency Range		5		700	MHz
Gain			25		dB
Gain Slope			0.0		dB
Reverse Isolation			-27		dB
Input Return Loss			18		dB
Output Return Loss			19		dB
Noise Figure			1.0		dB
MER	At 48.1 dBmV TCP, 5 - 204 MHz, 0dB tilt, 33ch 256QAM ITU-T J.83, Annex B		45		dB
OIP2L			40		dBm
OIP2H			37		dBm
OIP3			33		dBm
OP1dB	204 MHz		22		dBm
Thermal Resistance	Θ_{JC}, Bottom of Case		28.8		˚C/W

Notes:

1. Typical performance at these conditions: Temp = +25 °C, V_{DD} = +5 V, 75 ohm system, Full band unless otherwise noted
2. OIP3; +9 dBm/ tone output, 6 MHz spacing
3. OIP2; +9 dBm/tone output, 30 MHz spacing

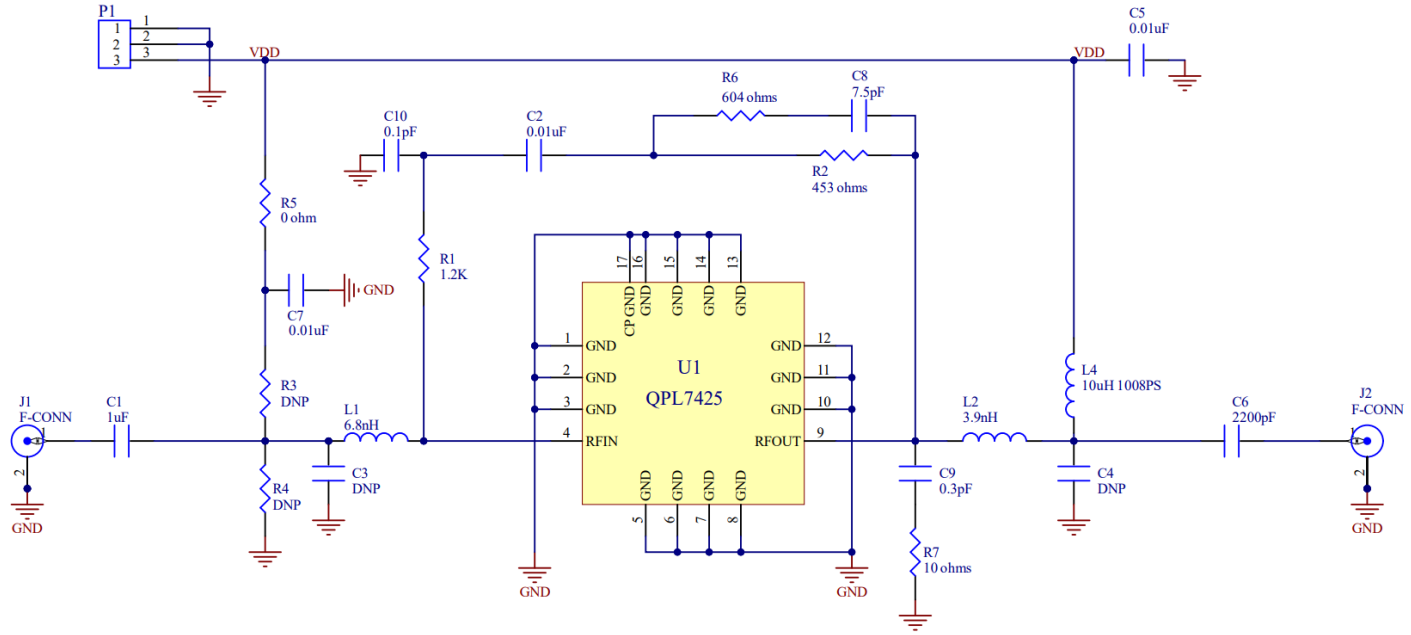
Electrical Specifications, 5 – 700 MHz (8 V)

Parameter	Condition [1]	Min	Typ	Max	Unit
Supply Voltage (V_{DD})			8		V
Supply Current (I_{DD})			80		mA
Frequency Range		5		700	MHz
Gain			25.4		dB
Gain Slope			0.0		dB
Reverse Isolation			-27		dB
Input Return Loss			19		dB
Output Return Loss			18		dB
Noise Figure			1.0		dB
MER	At 55.2 dBmV TCP, 5 - 204 MHz, 0 dB tilt, 33 ch 256 QAM ITU-T J.83, Annex B		45		dB
OIP2L			47		dBm
OIP2H			43		dBm
OIP3			38		dBm
OP1dB	204 MHz		25		dBm
Thermal Resistance	Θ_{JC}, Bottom of Case		28.8		˚C/W

Notes:

1. Typical performance at these conditions: Temp = +25 °C, V_{DD} = +5 V, 75 ohm system, Full band unless otherwise noted
2. OIP3; +9 dBm/ tone output, 6 MHz spacing
3. OIP2; +9 dBm/tone output, 30 MHz spacing

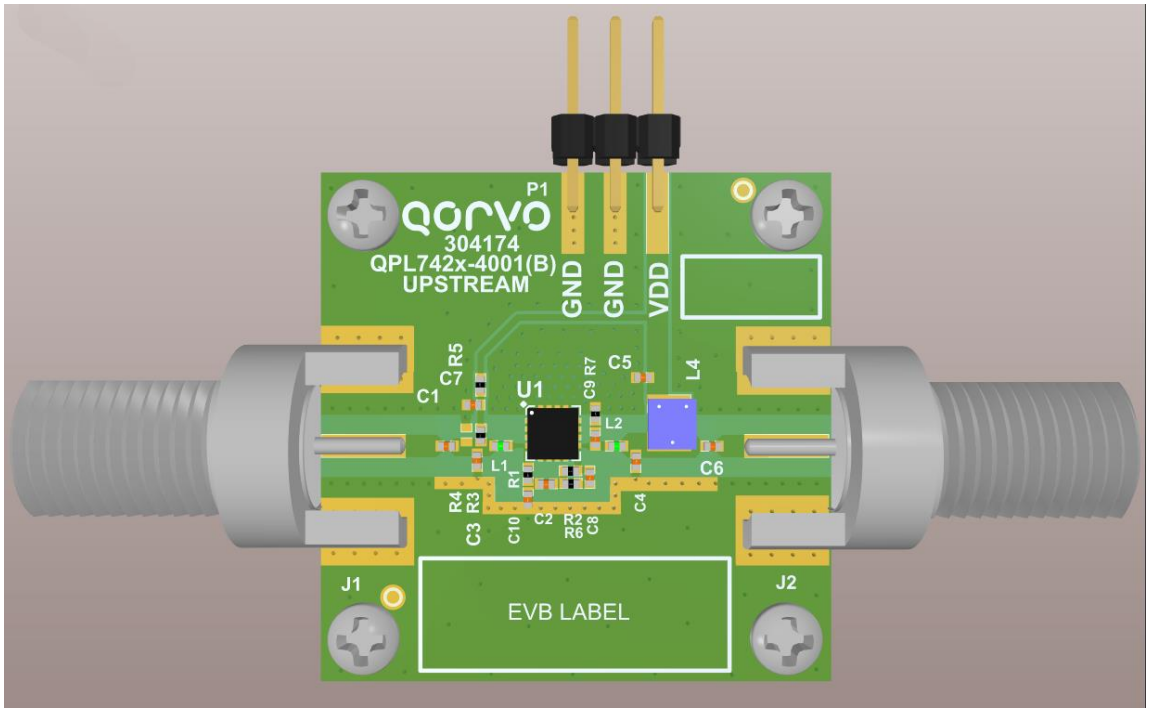
Evaluation Board Schematic, 5 – 700 MHz



Notes:

1. C3/L1 tunes input return loss.
2. L2/C4 tunes output return loss with some contribution from C6.
3. C9/R7 can also be used for output return loss tuning if needed for bandwidth limiting and stability enhancement.
4. R1, R2 , and the blocking cap, C2 are the basic feedback loop for setting gain.
5. C8 and R6 in parallel with R2 help improve gain flatness at low frequency.
6. C10 improves gain slope when C8 and R6 are present.
7. L4 provides the bias path with RF isolation from the RF output path. A variety of RF chokes may be used as long as sufficient inductance is provided to ensure good performance at 5MHz with bias without causing unwanted behavior out of band.
8. R3 and R4 are used to change the bias current bias current for desired linearity and NPR dynamic range (Refer to Table 1).

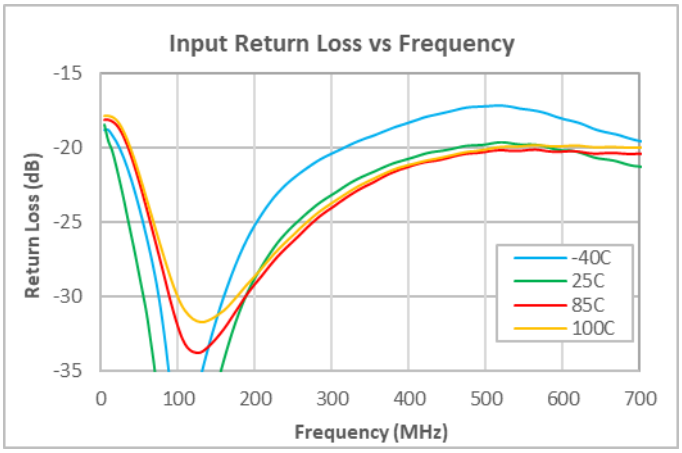
Evaluation Board Assembly Drawing, 5 – 700 MHz

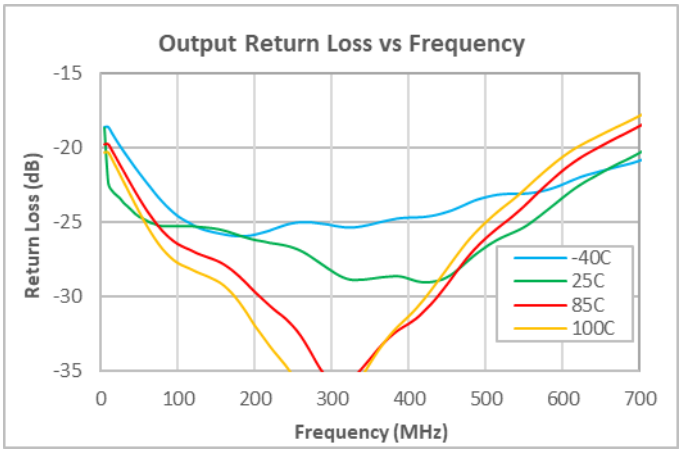


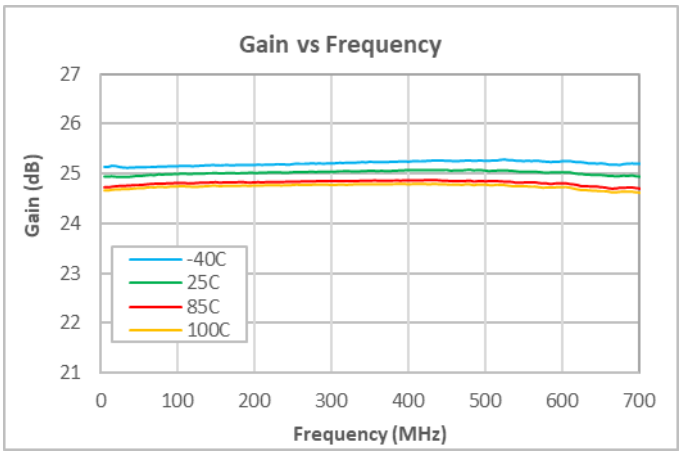
Evaluation Board Bill of Materials, 5 – 700 MHz

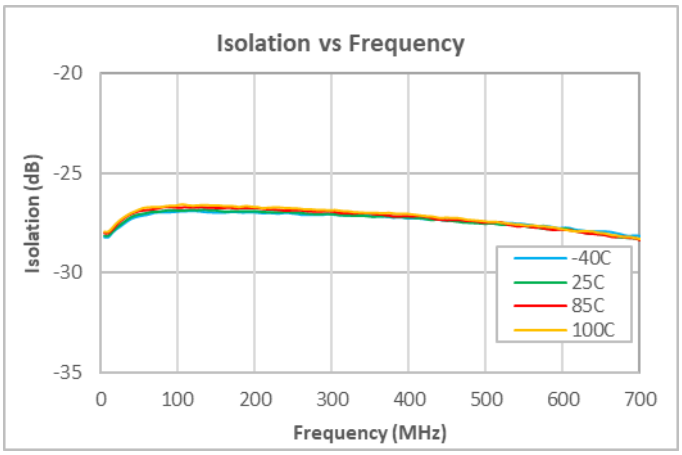
Designator	Description	Manufacturer	Part Number
PCB	QPL7425-4001	TTM	QPL7425-4001(B)
U1	20dB FTTH Amplifier	Qorvo	QPL7425
C1	CAP, 1uF, 20%, 16V, X5R, 0402	Murata	GRM155R61C105MA12D
C2, C5, C7	CAP, 0.01uF, 10%, 50V, X7R, 0402	Murata	GCM155R71H103KA55D
C9	CAP, 0.3pF, +/-0.05pF, 50V, HI-Q, 0402	Murata	GJM1555C1HR30WB01D
C10	CAP, 0.1pF, +/-0.05pF, 50V, HI-Q, 0402	Murata	GJM1555C1HR10WB01D
C6	CAP, 2200pF, 5%, 50V, X7R, 0402	Murata	GRM155R71H222JA01D
C8	CAP, 7.5pF, +/-0.1pF, 50V, HI-Q, 0402	Murata	GJM1555C1H7R5BB01D
L1	IND, 6.8nH, 2%, 600mA, M/L, 0402	Murata	LQG15HS6N8G02D
L2	IND, 3.9nH, +/-0.3nH, M/L, 0402	Murata	LQG15HN3N9S02D
L4	IND, 10uH, 10%, 1A, W/W, 1008	Coilcraft	1008PS-103KRC
R1	RES, 1.2K, 5%, 1/16W, 0402	Kamaya	RMC1/16S-122JTH
R2	RES, 453 OHM, 1%, 1/16W, 0402	Yageo	RC0402FR-07453RL
R5	RES, 0 OHM, 5%, 1/10W, 0402	Kamaya	RMC1/16SJPTH
R6	RES, 604 OHM, 1%, 1/10W, 0402	Kamaya	RMC1/16SK6040FTH
R7	RES, 10 OHM, 5%, 1/16W, 0402	Kamaya	RMC1/16S-100JTH
J1, J2	CONN, F FEM EDGE MOUNT, 75 OHMS, 0.068"	Millimeter Wave Technologies	MW-846-C-DD-75
P1	CONN, HDR, ST, 1x3, 0.100", HI-TEMP, T/H	Samtec Inc.	HTSW-103-07-G-S
Heat Sink	HEATSINK BLOCK, 1.16 SQ I	Robert S. Wells	EEF-102059
Screws	SCREW, 2-56X3/16", SOCKET HD	McMaster-Carr Supply Co.	92196A076
C3, C4, R3, R4	Not Populated Item		

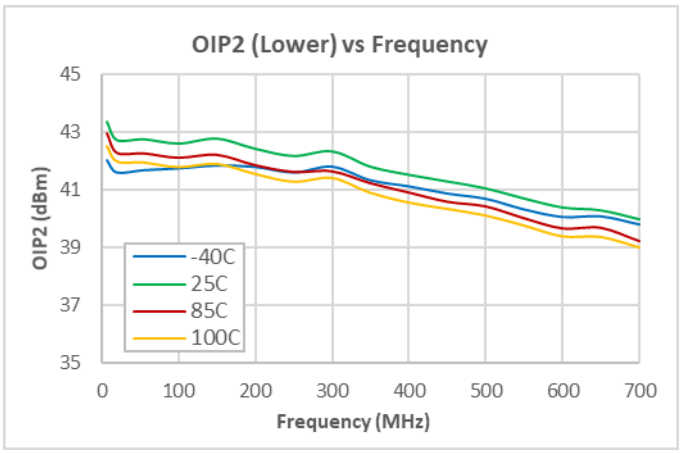
Performance Data, 5 – 700 MHz (5 V)

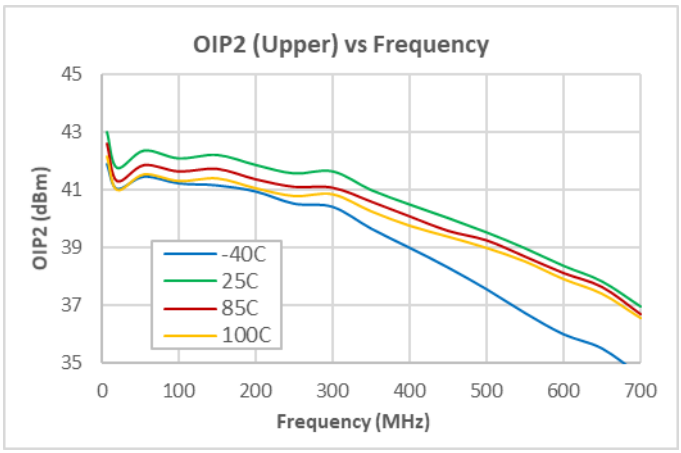






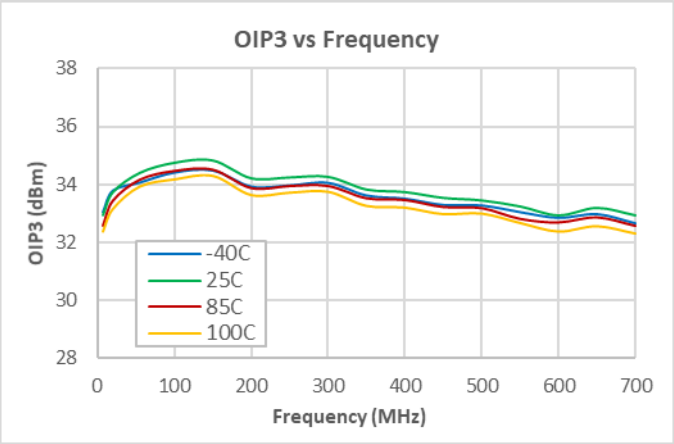


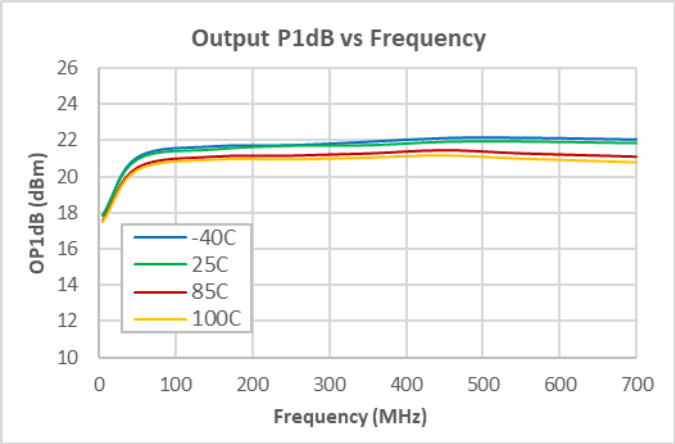


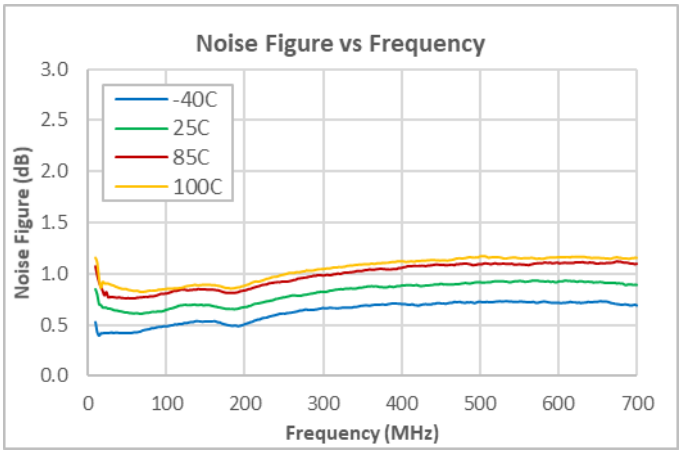


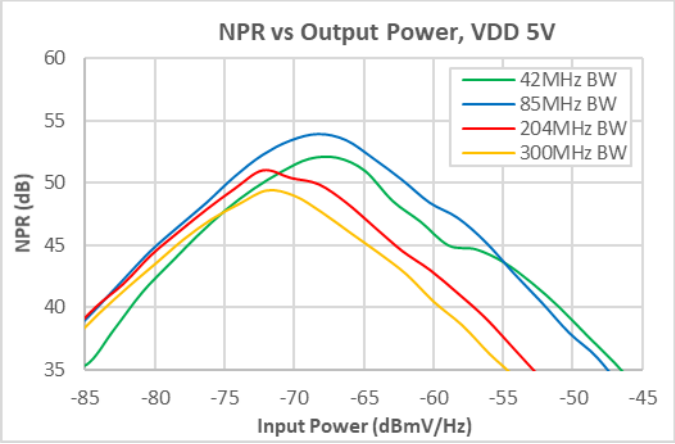
Notes:
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) OIP2; +9 dBm/tone output, 30 MHz spacing

Performance Data, 5 – 700 MHz (5 V)





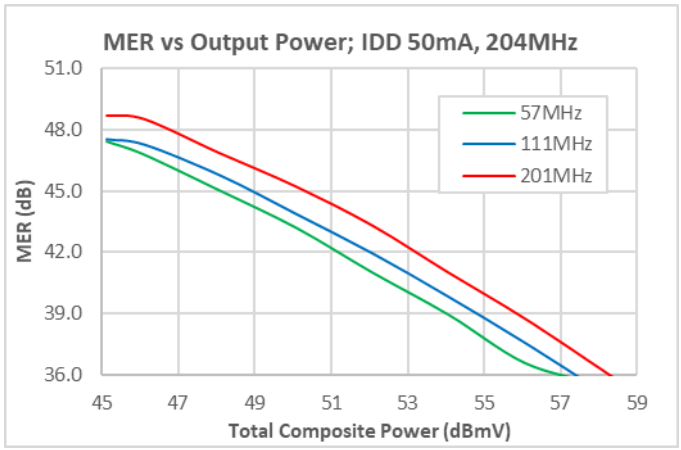


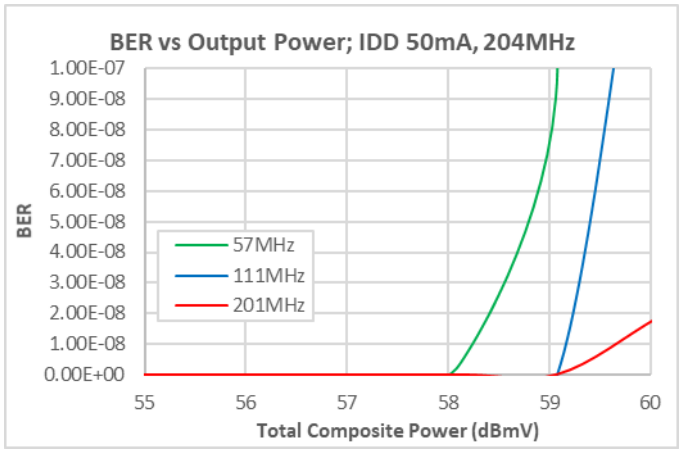


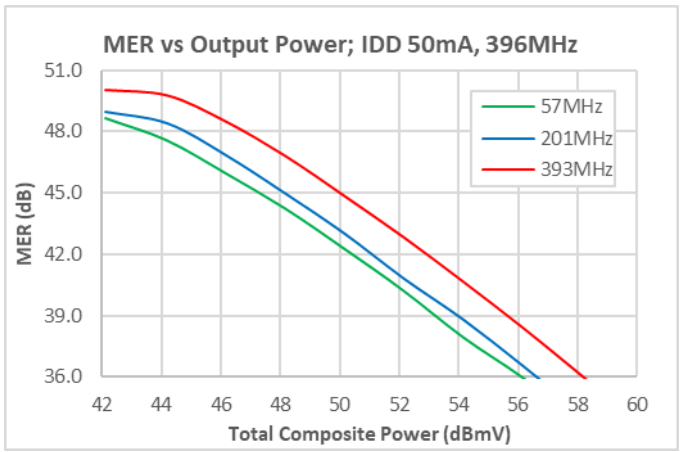
Notes:

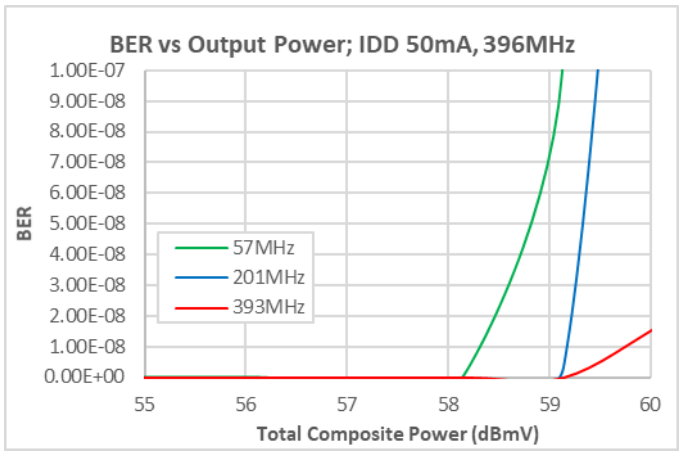
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) OIP3; +9 dBm/tone output, 6 MHz spacing

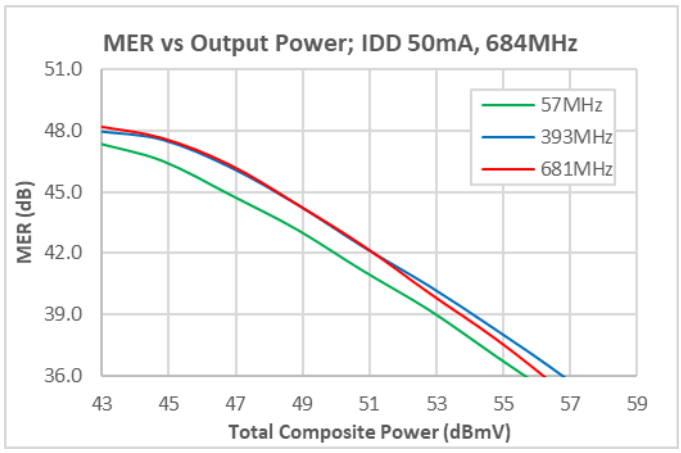
Performance Data, 5 – 700 MHz (5 V)

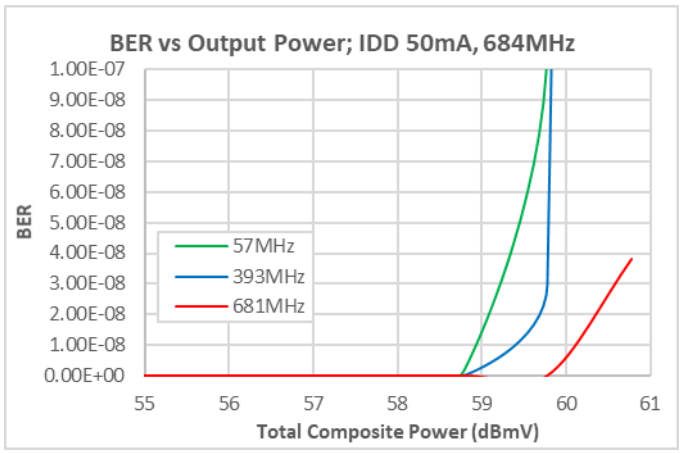








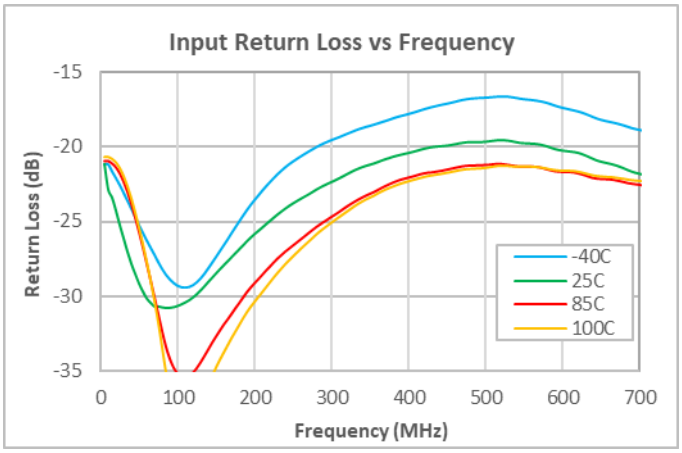


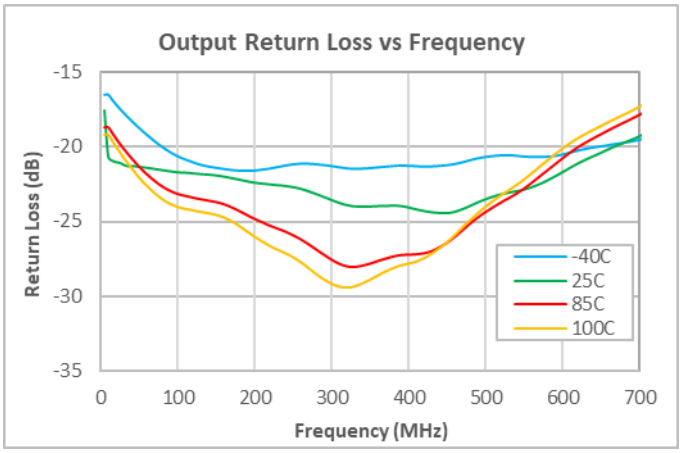


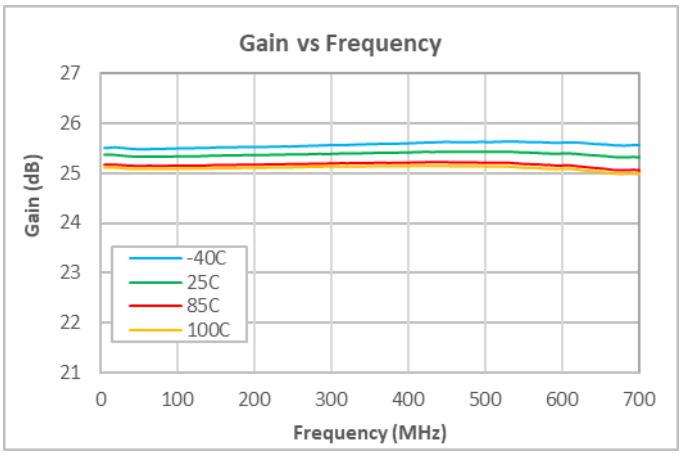
Notes:

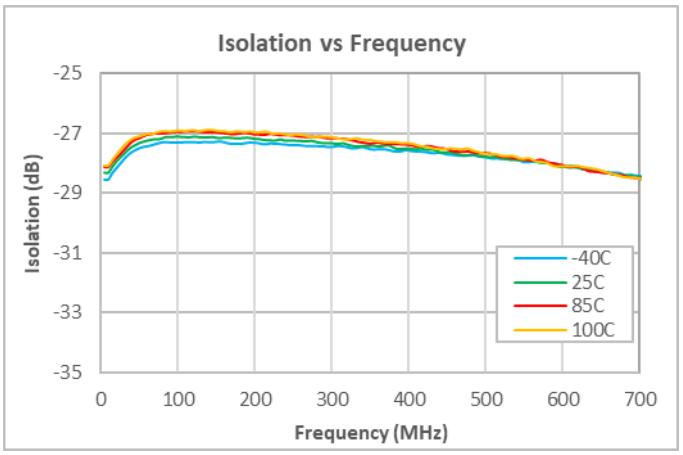
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) MER/BER; 256 QAM, 0dB Tilt, ITU-T J.83, Annex B, Source Corrected, Maximum Correction 4.3 dB
   a. 204 MHz; 33Ch. 5 – 204 MHz
   b. 396 MHz; 65Ch. 5 – 396 MHz
   c. 684 MHz; 133Ch. 5 – 684 MHz

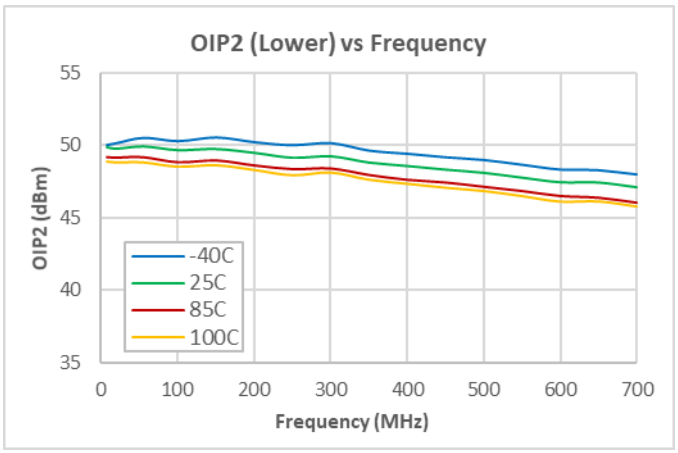
Performance Data, 5 – 700 MHz (8 V)

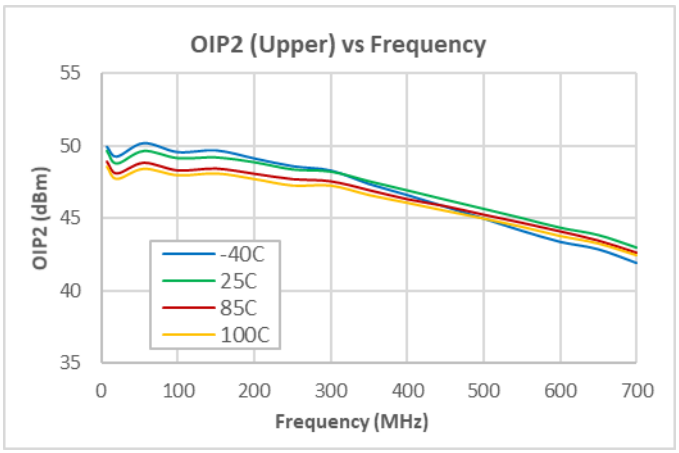








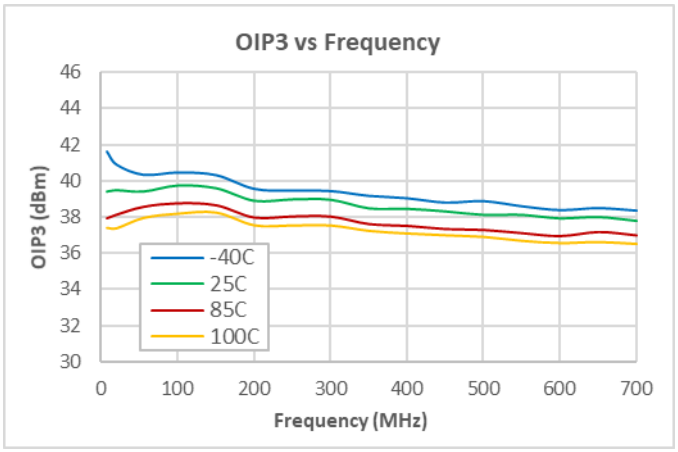


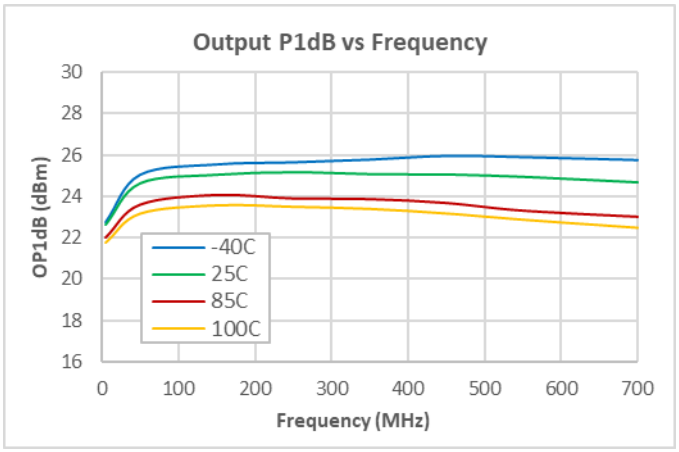


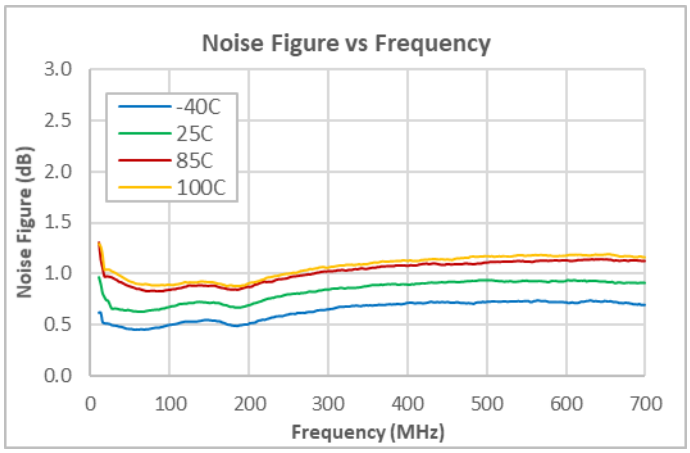
Notes:

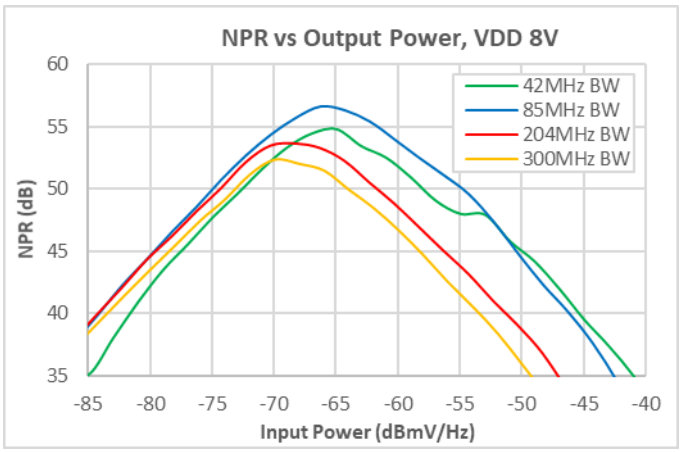
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) OIP2; +9 dBm/tone output, 30 MHz spacing

Performance Data, 5 – 700 MHz (8 V)



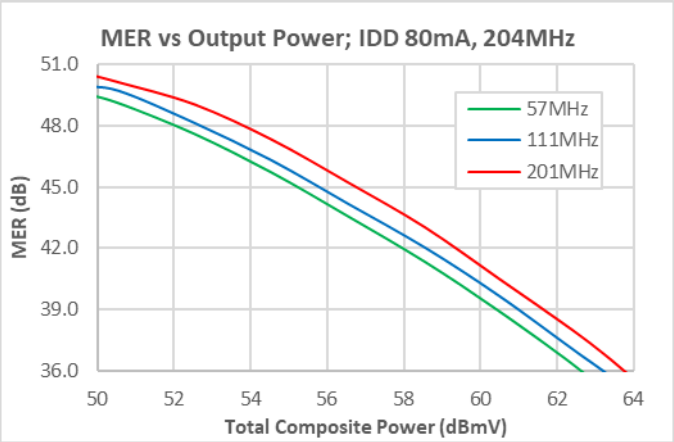


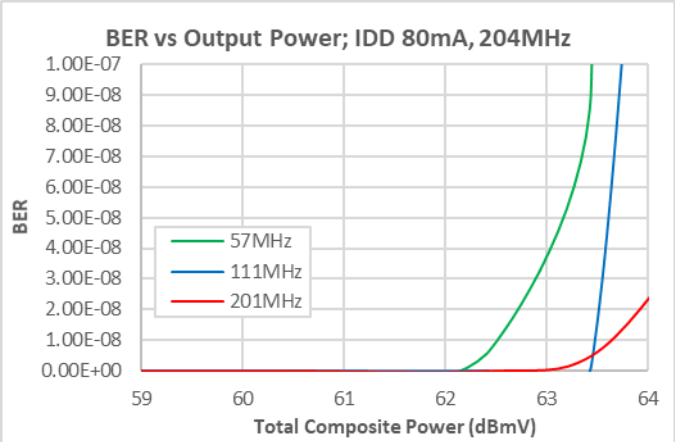


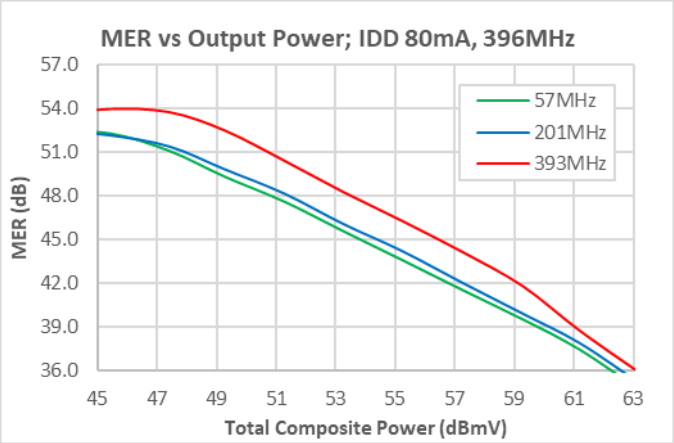


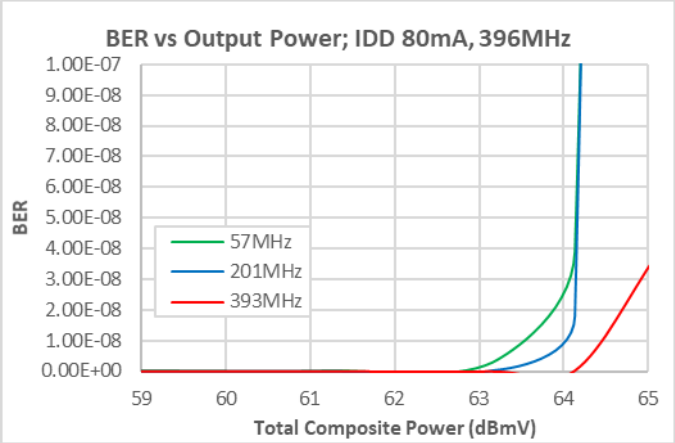
Notes:
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) OIP3; +9 dBm/tone output, 6 MHz spacing

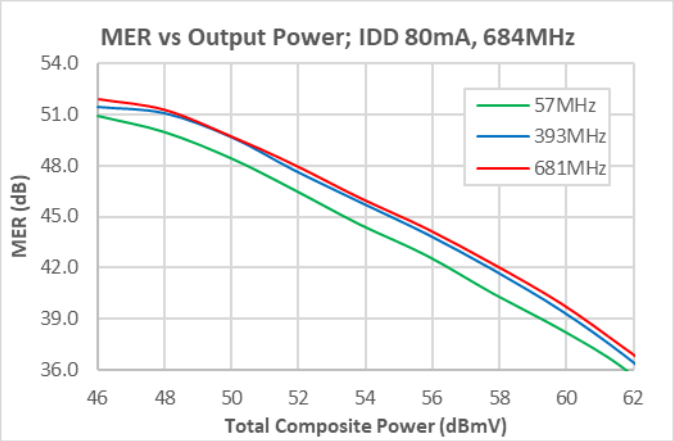
Performance Data, 5 – 700 MHz (8 V)

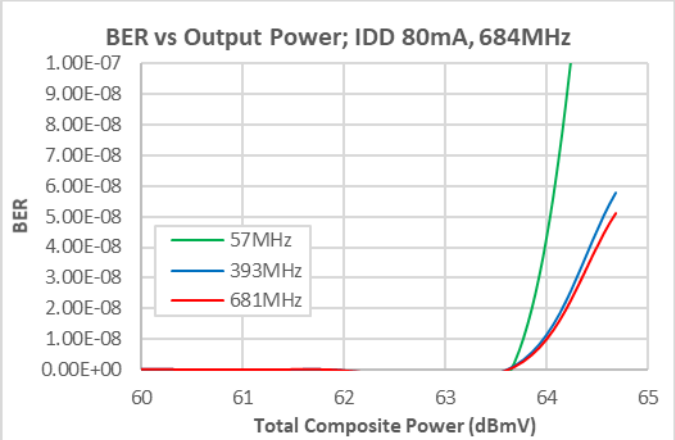








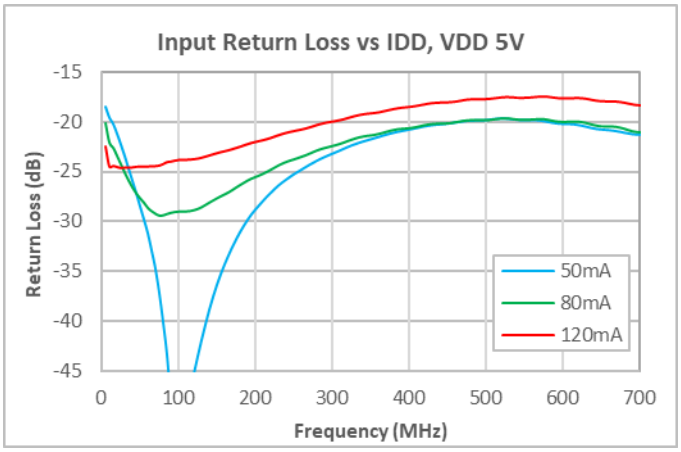


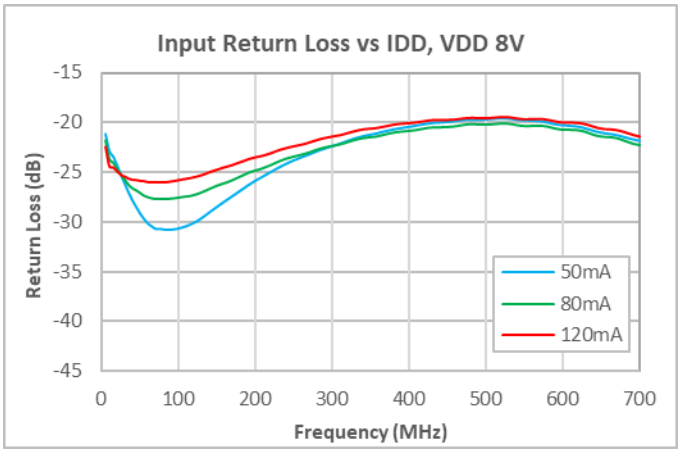


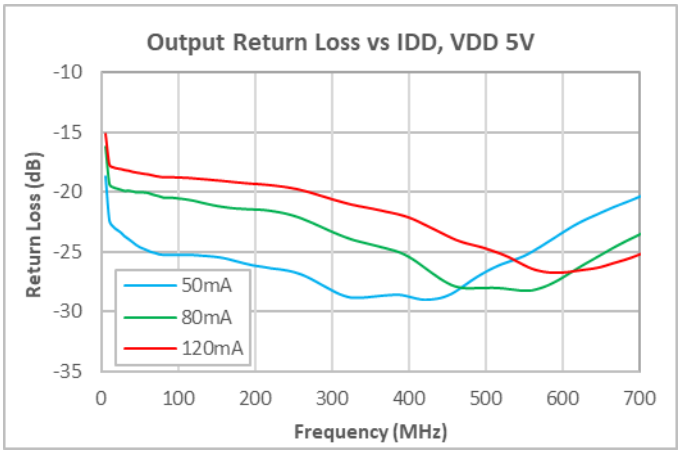
Notes:

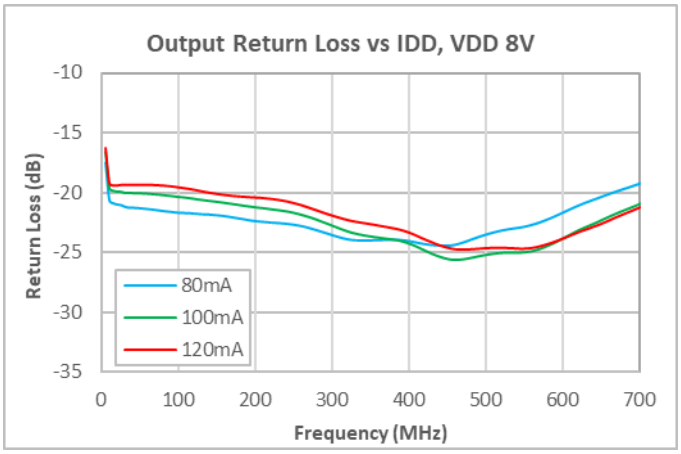
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) MER/BER; 256 QAM, 0dB Tilt, ITU-T J.83, Annex B, Source Corrected, Maximum Correction 4.3 dB.
   a. 204 MHz; 33Ch. 5 – 204 MHz
   b. 396 MHz; 65Ch. 5 – 396 MHz
   c. 684 MHz; 133Ch. 5 – 684 MHz

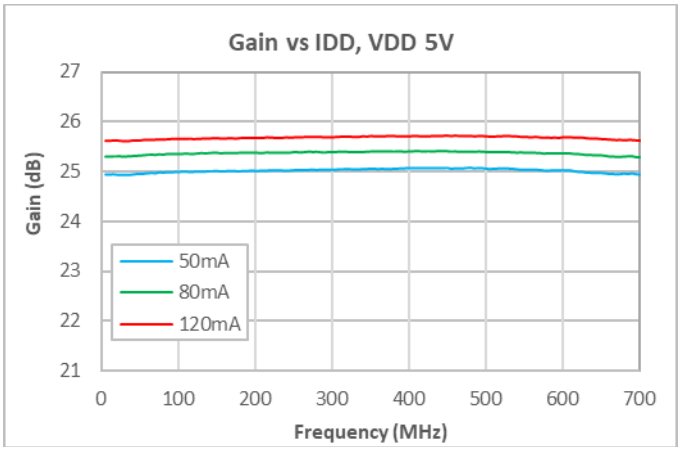
Performance Data vs Supply Voltage, 5 – 700 MHz

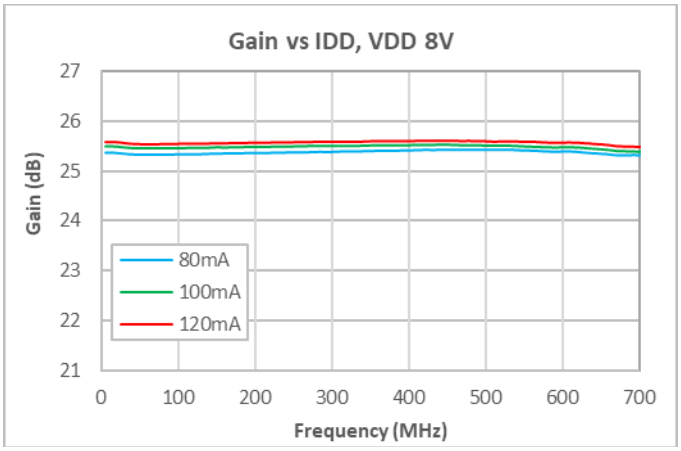






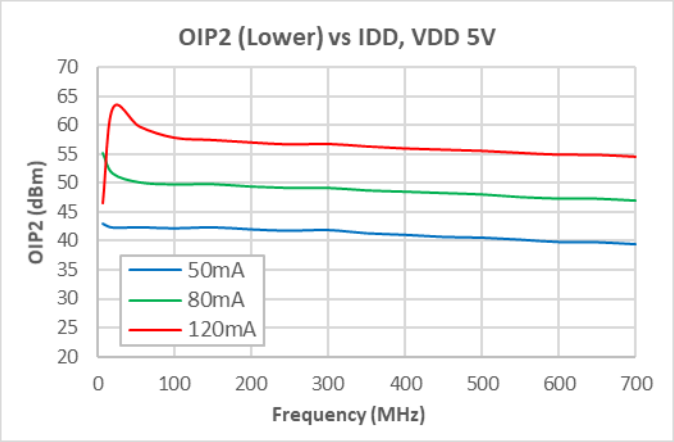


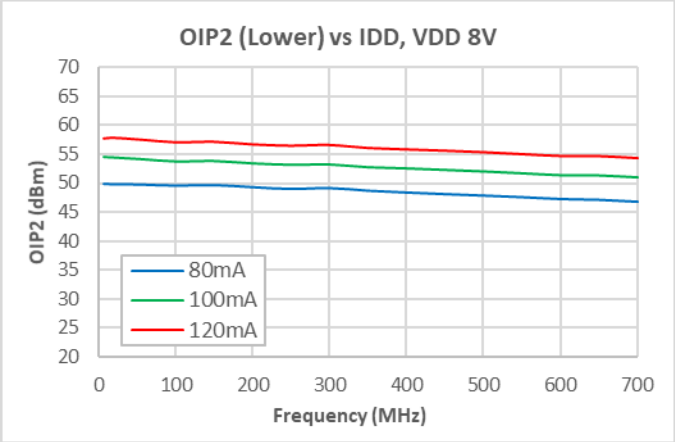


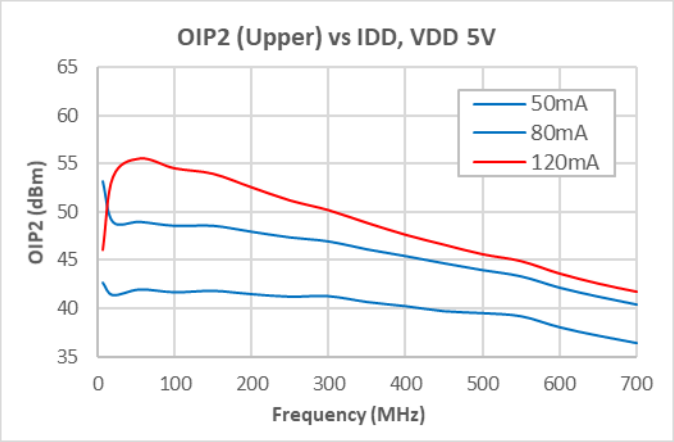


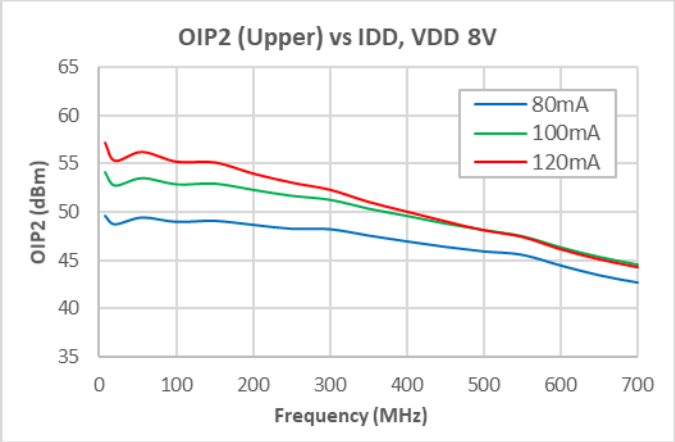
Notes:
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).

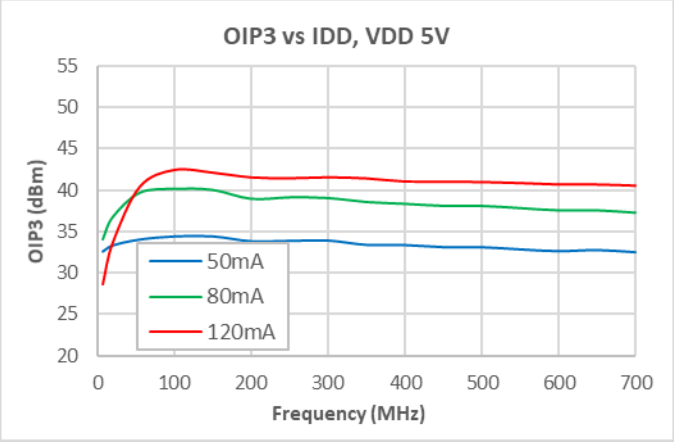
Performance Data vs Supply Voltage, 5 – 700 MHz

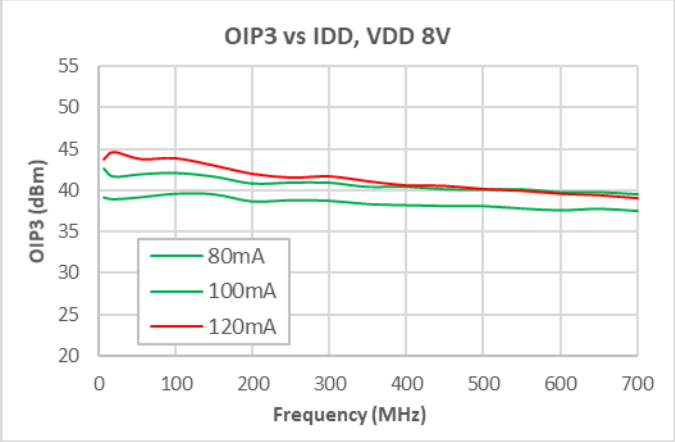






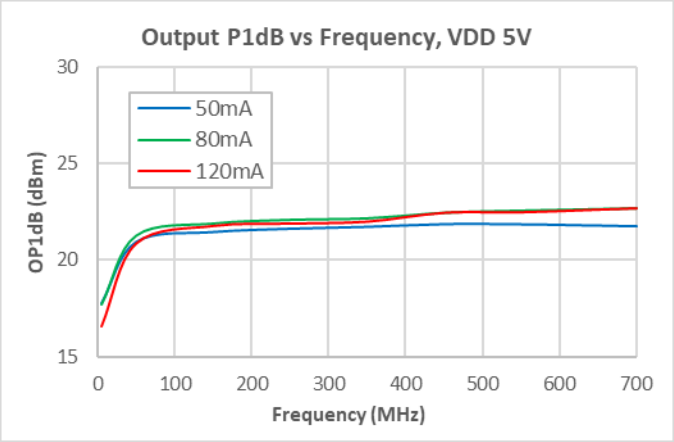


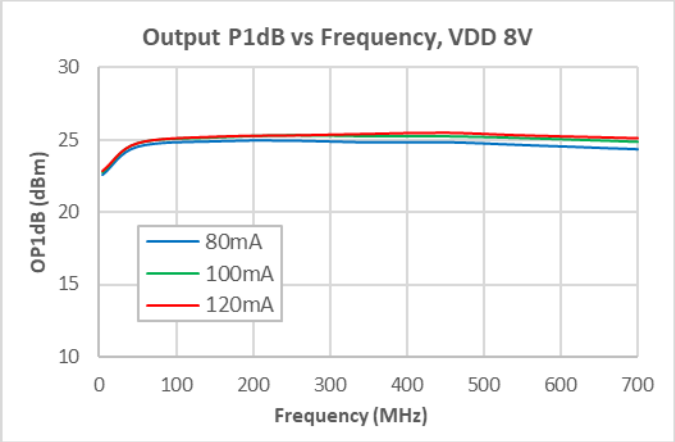


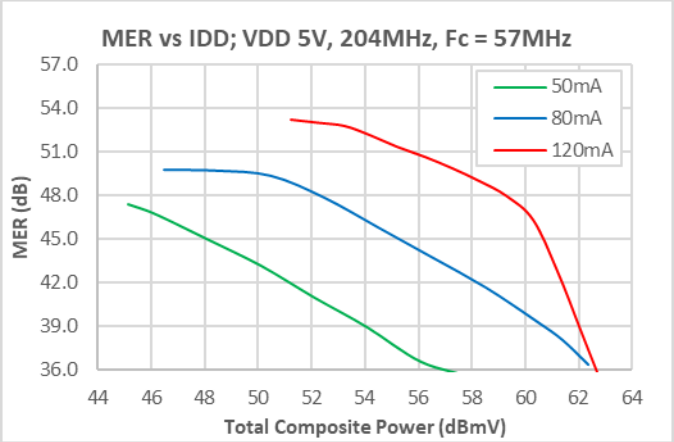


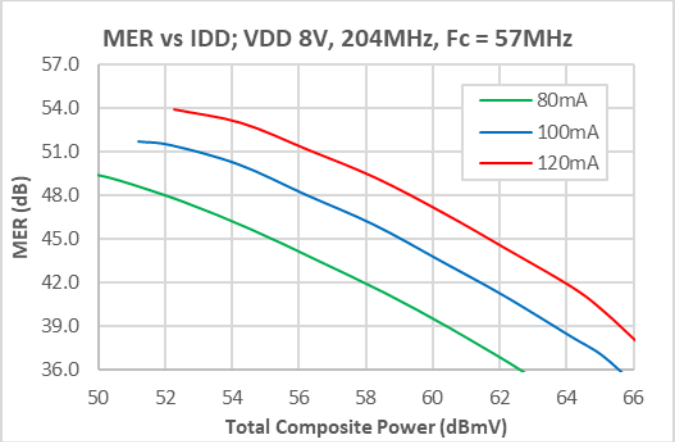
Notes:
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) OIP2; 9 dBm/tone, 30 MHz spacing.
(3) OIP3; 9 dBm/tone, 6 MHz spacing.

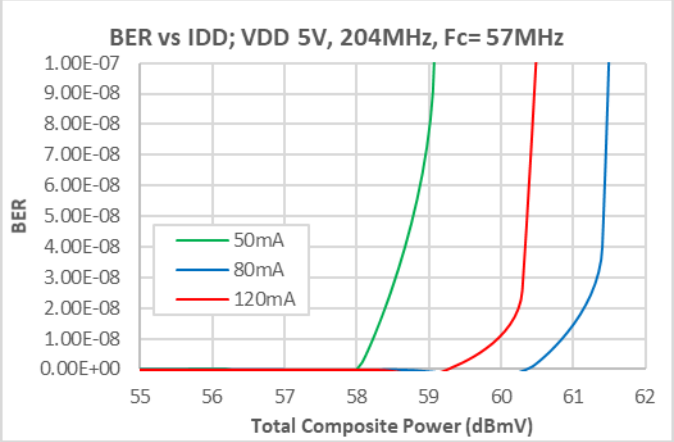
Performance Data vs Supply Voltage, 5 – 700 MHz

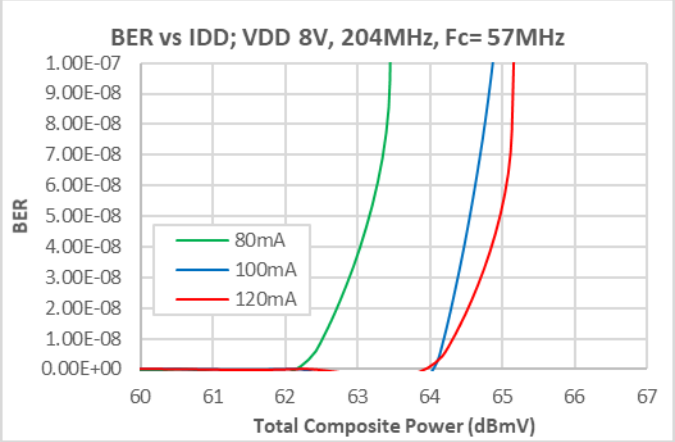








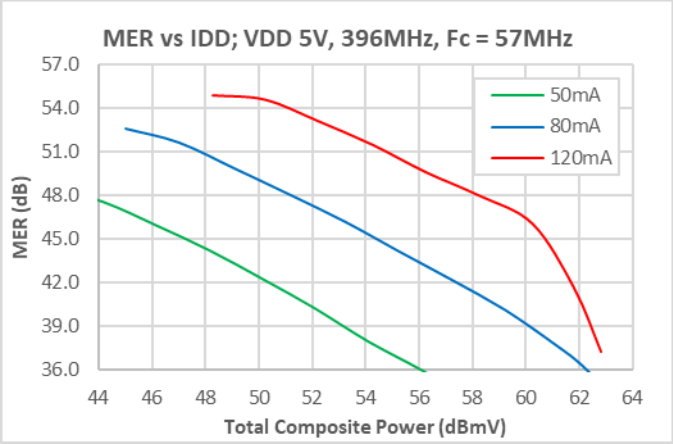


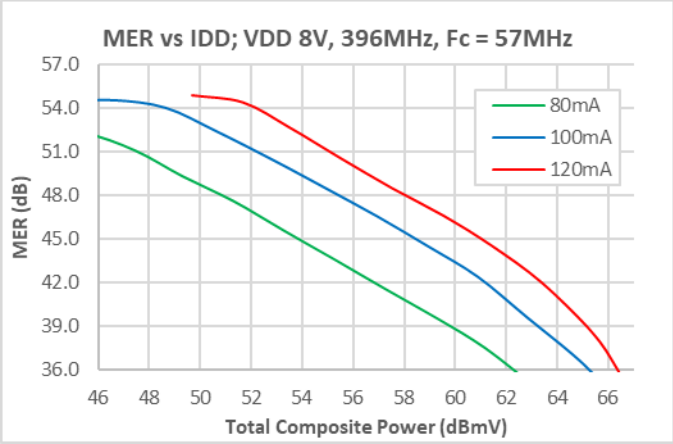


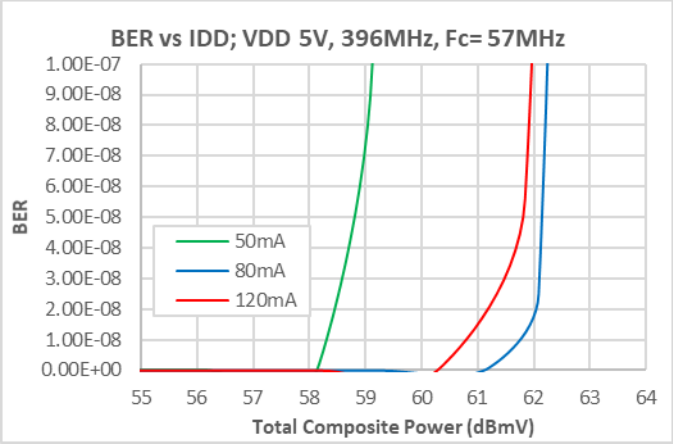
Notes:

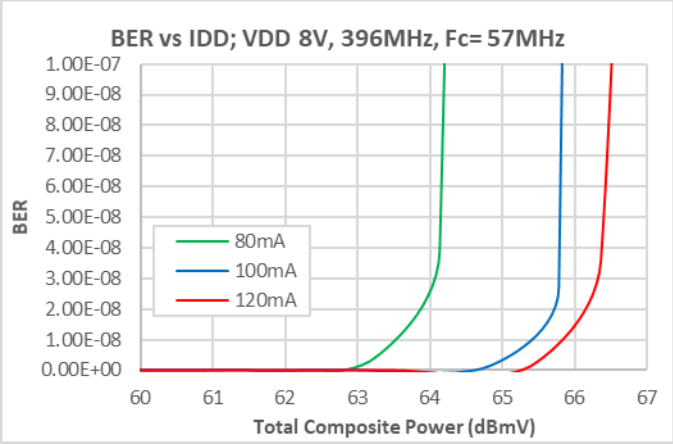
(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) MER/BER; 256 QAM, 0dB Tilt, ITU-T J.83, Annex B, Source Corrected, Maximum Correction 4.3 dB.
   a. 204 MHz; 33Ch. 5 – 204 MHz
   b. 396 MHz; 65Ch. 5 – 396 MHz
   c. 684 MHz; 133Ch. 5 – 684 MHz

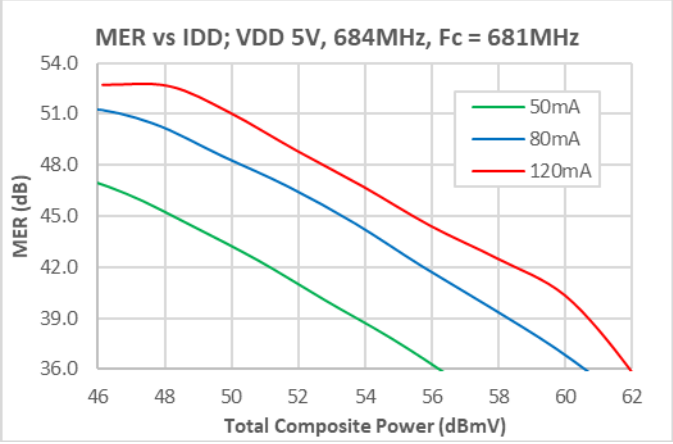
Performance Data vs Supply Voltage, 5 – 700 MHz

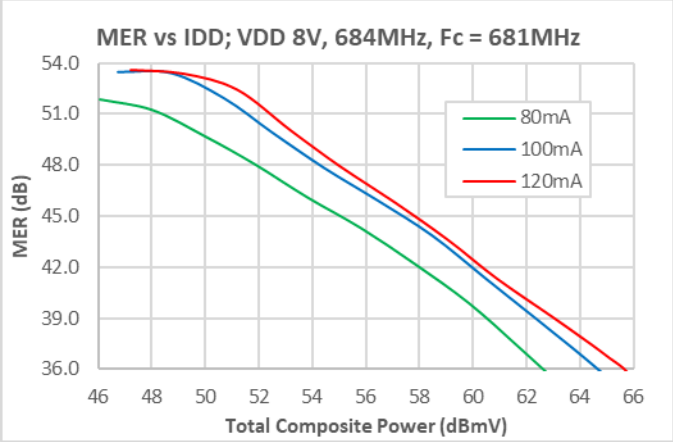












Notes:

(1) Temperature 25 °C, 75 ohm test system, nominal current (unless otherwise noted).
(2) MER/BER; 256 QAM, 0dB Tilt, ITU-T J.83, Annex B, Source Corrected, Maximum Correction 4.3 dB.
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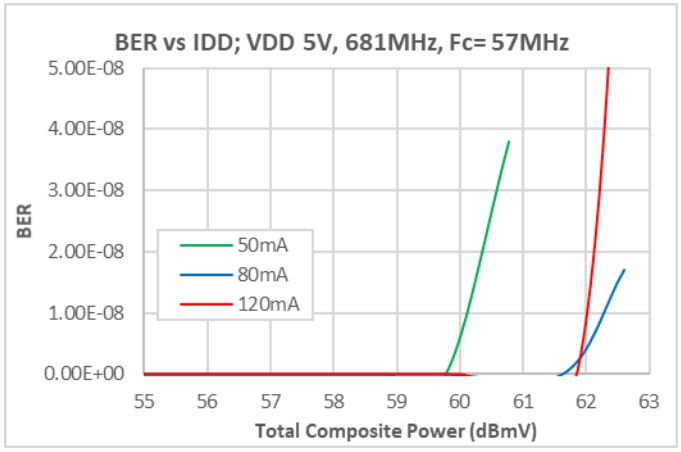
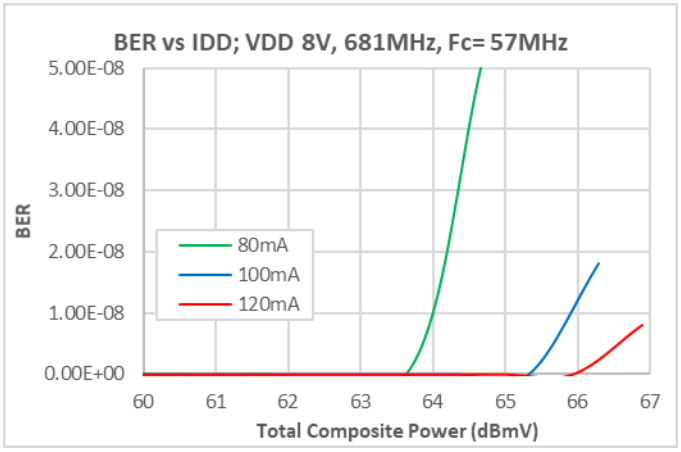
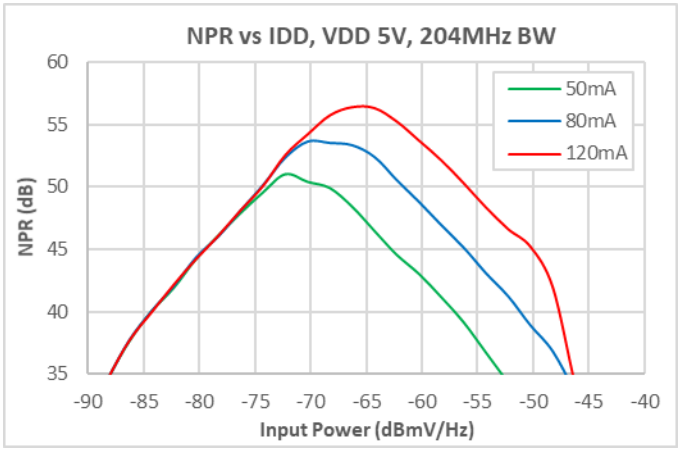
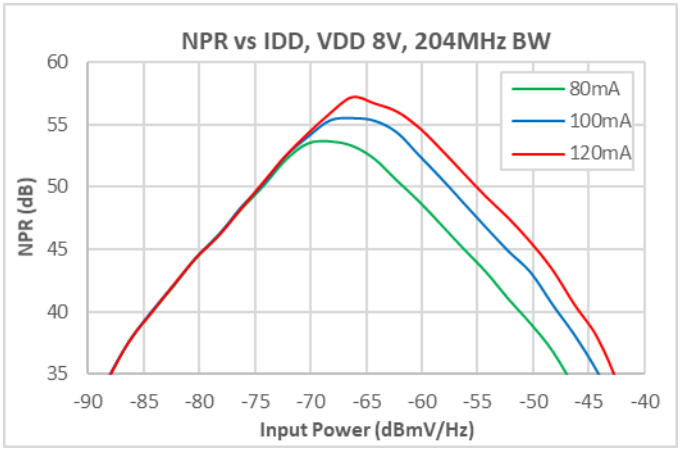
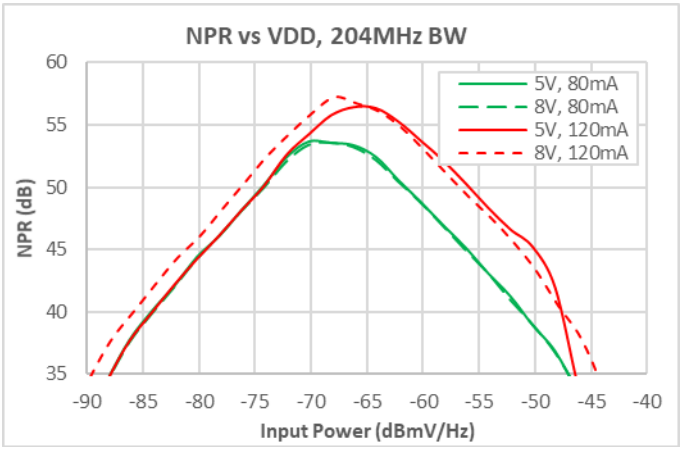
Performance Data vs Supply Voltage, 5 – 700 MHz











Notes:

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(2) MER/BER; 256 QAM, 0dB Tilt, ITU-T J.83, Annex B, Source Corrected, Maximum Correction 4.3 dB.
    a. 204 MHz; 33Ch. 5 – 204 MHz
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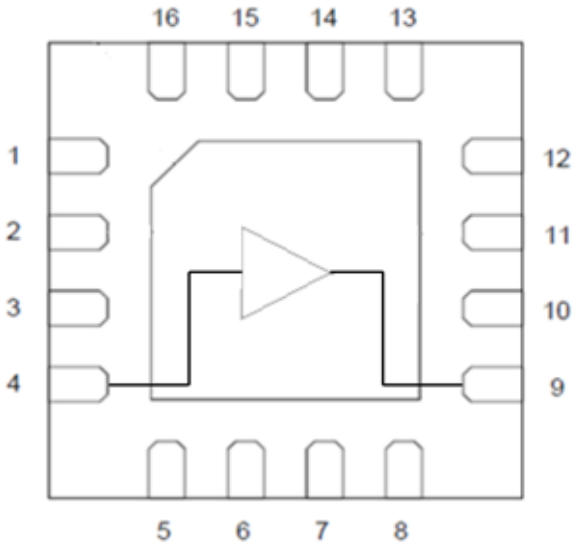
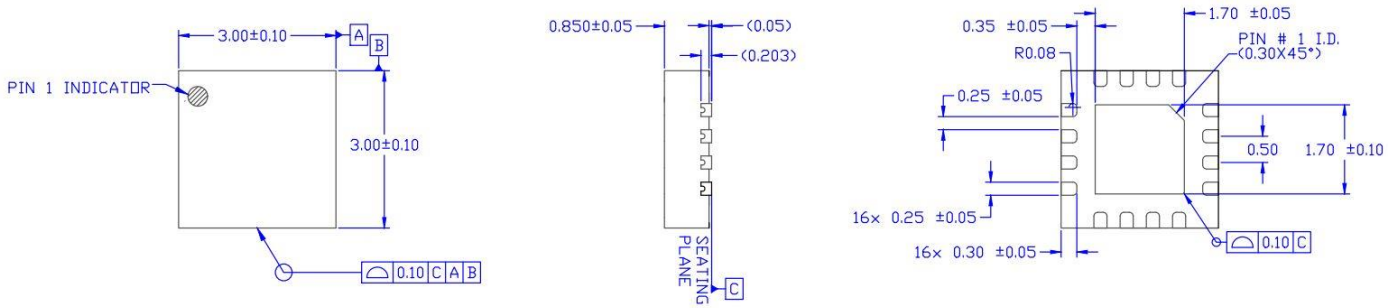
Pin Configuration and Description



Top View

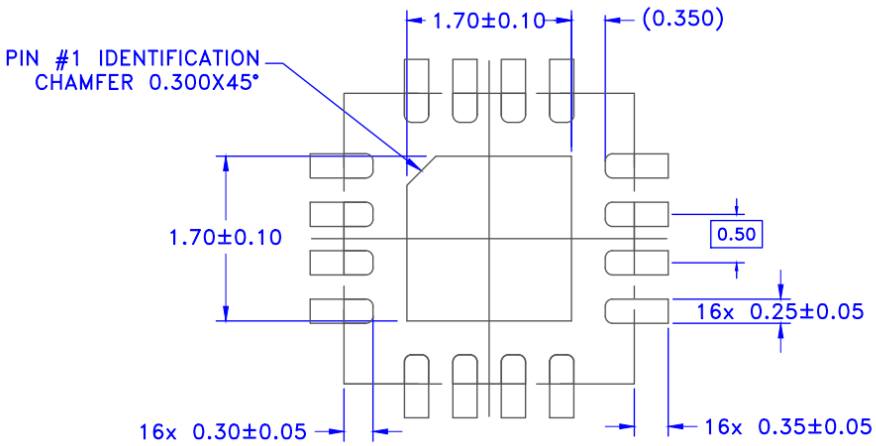
Pin Number	Label	Description
4	RF IN	RF Input, DC blocking capacitor required.
9	RF OUT / VDD	RF Output – VDD bias choke required.
1 -3, 5-8, 10-16	GND	Internally Not Connected.
Backside Paddle	GND	Ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint.

Package Outline

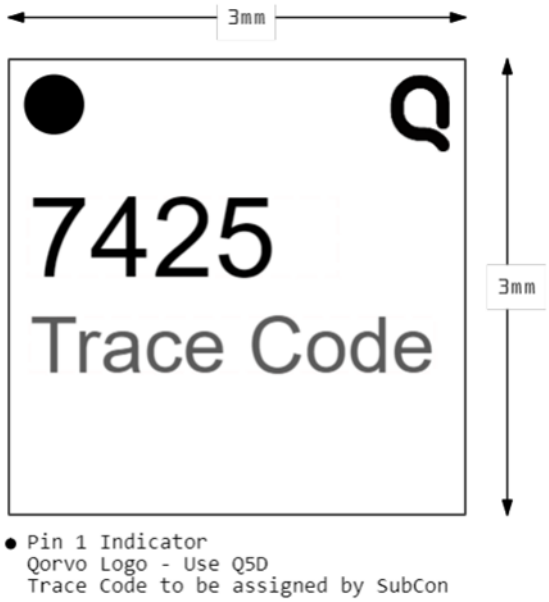


TOP VIEW | SIDE VIEW | BOTTOM VIEW

Recommended Mounting Pattern



Package Marking



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1B (500V to < 1000V)	ANSI/ESDA/JEDEC JS-001
ESD – Charged Device Model (CDM)	Class C3 (≥1000V)	ANSI/ESDA/JEDEC JS-002
MSL – Moisture Sensitivity Level	Level 2	IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive
Device

Solderability

Compatible with both lead-free (260 °C max. reflow temp.) and tin / lead (245 °C max. reflow temp.) soldering processes.
Solder profiles available upon request.

Contact plating: NiPdAu

RoHS 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:

Tel: 1-844-890-8163

Web: www.qorvo.com

Email: customer.support@qorvo.com

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