ASL38G Data Sheet

GPS Low Noise Two-Stage Amplifier with External Filter Connectable

1. Product Overview

1.1 General Description

ASL38G is low noise high gain amplifier applicable to from about a few hundred MHz to about 3 GHz and especially for use in the RF front-end of GPS, GLONASS, Galileo, and COMPASS. It consists of two amplifier stages (AMP1 and AMP2) which allow an external (off-chip) filter to be connected in between. It has an active bias circuit for stable current over temperature and process variation. The amplifier is available in ten-lead TDFN10 package and passes through the stringent DC, RF, and reliability tests

1.2 Features

- First Amp Noise Figure : 0.9 dB at 1575 ~ 1610 MHz
- High Gain : 37 dB (AMP1 & AMP2 Cascaded) at 1575 ~ 1610 MHz
- First Amp Noise Figure : 0.8 dB at 1164 ~ 1300 MHz
- High Gain : 38 dB (AMP1 & AMP2 Cascaded) at 1164 ~ 1300 MHz
- For each amplifier, V_{DD} and I_{DD} in 1.8 ~ 5.0 V and 6 ~ 18 mA, respectively
- Small, Low-Cost Package (3mm x 3mm)

1.3 Applications

- 300 ~ 3000 MHz low power consumption, high gain, and low noise application
- GPS, GLONASS, Galileo, COMPASS Receivers
- Automotive antenna

1.4 Package Profile & RoHS Compliance

 TDFN 10 Package	RoHS-compliant GREEN Package RoHS-compliant

2. Summary on Product Performances

2.1 Typical Performance

Test conditions : T = +25 °C, V_{DD} = +3 V, CW, Z_O = 50 Ω.

Parameters	Test Conditions					Units
Operation Frequency		1176	1227	1278	1575	MHz
AMP1 Gain	50 Ω source with input match Pin = -40 dBm	19.0	19.0	19.0	18.5	dB
AMP1 Noise Figure		0.8	0.8	0.8	0.9	dB
AMP1 Input Third-Order Intercept Point	Two tones at 1574.5 MHz and 1575.5 MHz, -30 dBm per tone	-1.5	-1.0	0.5	-7.0	dBm
AMP1 Input Return Loss	Pin = -40 dBm	-10	-12	-15	-12	dB
AMP1 Output Return Loss	Pin = -40 dBm	-10	-10	-10	-15	dB
AMP1 Reverse Isolation	Pin = -40 dBm	-40	-40	-40	-40	dB
AMP1 Supply Current		10	10	10	10	mA
AMP2 Gain	Pin = -40 dBm	19.0	19.0	19.0	18.5	dB
AMP2 Noise Figure		0.8	0.8	0.8	0.9	dB
AMP2 Output Third-Order Intercept Point	Two tones at 1574.5 MHz and 1575.5 MHz, Pin = -30 dBm per tone	18.0	19.0	19.5	12.0	dBm
AMP2 Output 1dB Compression Point		5.0	5.0	5.5	1.0	dBm
AMP2 Input Return Loss	Pin = -40 dBm	-10	-12	-15	-12	dB
AMP2 Output Return Loss	Pin = -40 dBm	-10	-10	-10	-15	dB
AMP2 Reverse Isolation	Pin = -40 dBm	-40	-40	-40	-40	dB
AMP2 Supply Current		10	10	10	10	mA

2.2 Product Specifications

Test conditions : T = +25 °C, V_{DD} = +3 V, CW, Z_O = 50 Ω, for AMP1 and AMP2 cascaded.

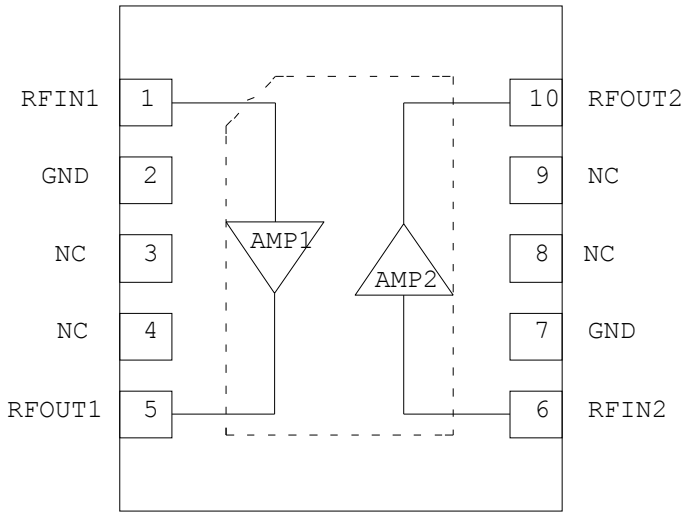
Parameters	Min	Typ	Max	Units
Operation Frequency		1575		MHz
Small Signal Gain		37		dB
Input Return Loss		-12		dB
Output Return Loss		-15		dB
Supply Current	16	20	28	mA

2.3 Absolute Maximum Ratings, T_A = +25 °C

Parameters	Max. Ratings
Operating Case Temperature (Tc)	-40 to + 105 °C
Storage Temperature (Tstg)	-40 to + 150 °C
Device Voltage (V_{DD})	+ 6 V
AMP1 Input RF Power (Pin)*	+ 15 dBm

The operation of this device in excess of any of these limits may cause permanent damage.
* The max. input RF power, in principle, depends upon application frequency, matching circuit, and device voltage.

2.4 Pin Descriptions



TOP VIEW

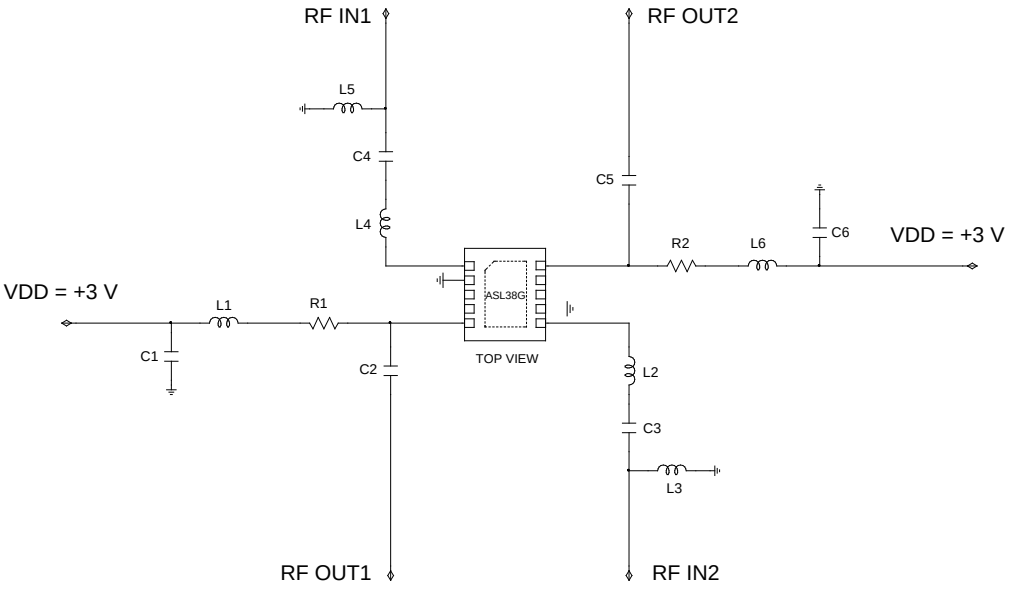
Pin	Pin Name	Description
1	RFIN1	AMP1 input. Requires external DC-blocking capacitor and input matching circuits.
2,7	GND	Electrical Ground
5	RFOUT1	AMP1 output. This output is externally configured to RF choke and matching circuit. This output is connected to be a bandpass filter.
6	RFIN2	AMP2 input. Requires external DC-blocking capacitor. This input is connected to be a bandpass filter.
10	RFOUT2	AMP2 output. This output is externally configured to RF choke.
3,4,8,9	NC	Not connected

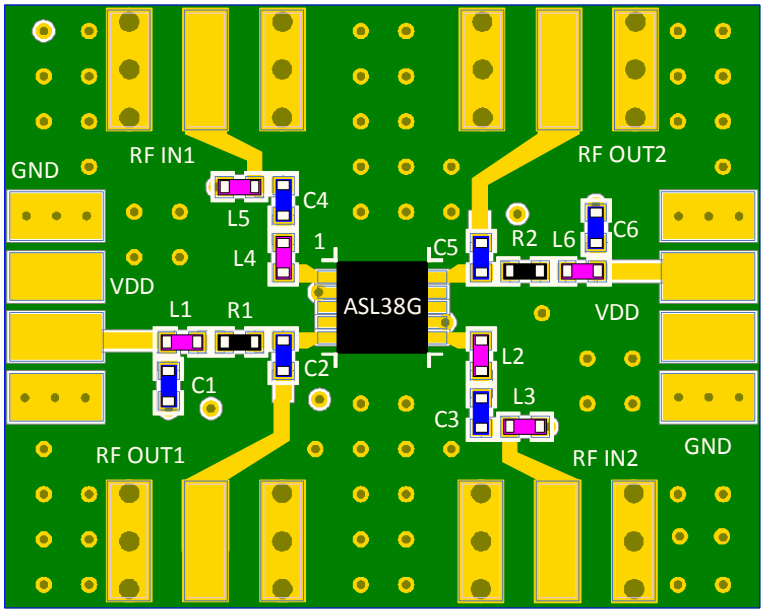
2.5 ESD Classification & Moisture Sensitivity Level

ESD Classification	
HBM	Class 0 Voltage Level: 200 V
MM	Class A Voltage Level: 50 V
CAUTION:	Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices
Moisture Sensitivity Level (MSL)	
	Level 3 at 260 °C reflow

3. Application1: 1575 ~ 1610 MHz

3.1 Application Circuit & Evaluation Board





Bill of Material

Symbol	Size	Value	Manufacturer	Symbol	Size	Value	Manufacturer
ASL38G	3x3	-	ASB	R1, R2	1005	10 Ω	Samsung
C1, C6	1005	1.0 μF	MURATA	L3, L5	1005	5.6 nH	MURATA
C2, C5	1005	1.0 pF	MURATA	L2, L4	1005	5.1 nH	MURATA
C3, C4	1005	5 pF	MURATA	L1, L6	1005	4.7 nH	MURATA

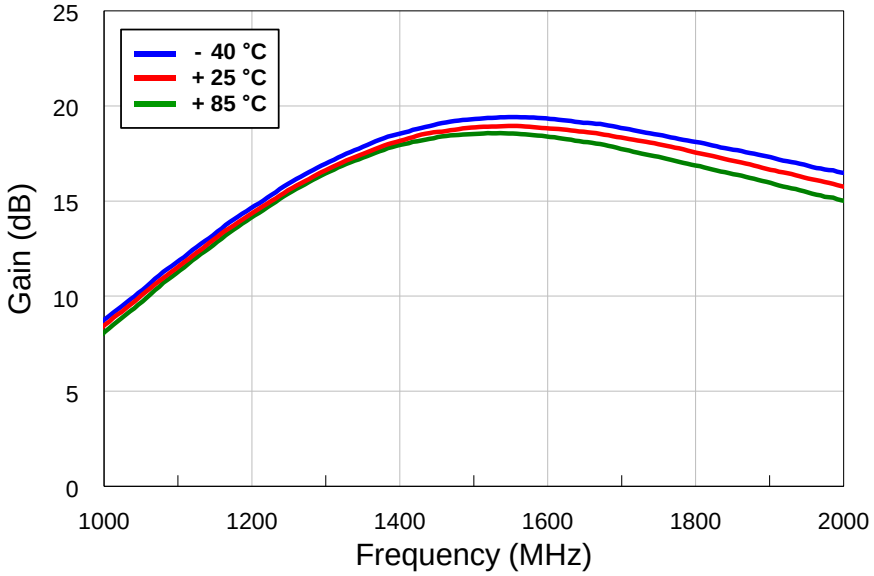
3.2 Typical Performance

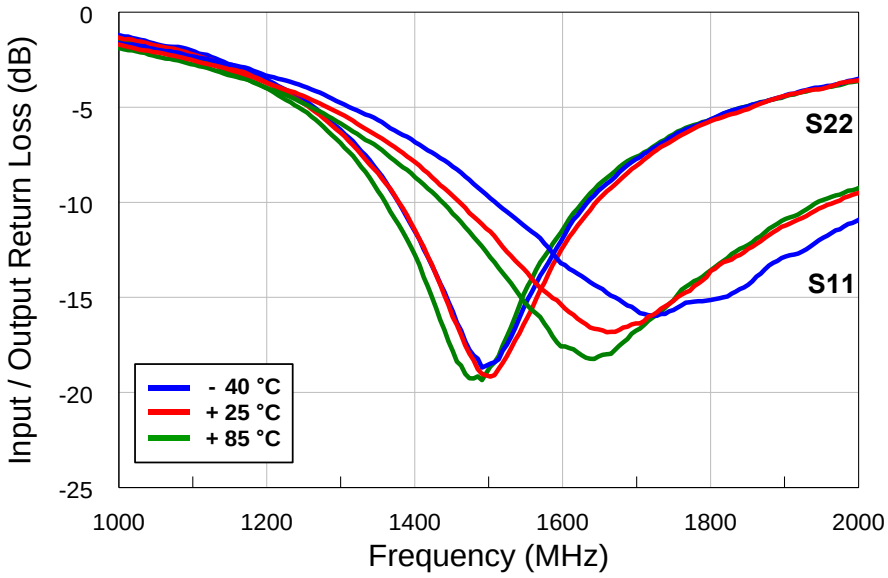
Test conditions : T = +25 °C, V_{DD} = +3 V, +4 V, +5 V, CW, Z_O = 50 Ω.

Parameters	Test Conditions	+ 3 V	+ 4 V	+ 5 V	Units
Operation Frequency		1575	1575	1575	MHz
AMP1 Gain	50 Ω source with input match Pin = -40 dBm	18.5	19.0	19.3	dB
AMP1 Noise Figure		0.90	0.85	0.85	dB
AMP1 Input Third-Order Intercept Point	Two tones at 1574.5 MHz and 1575.5 MHz, -30 dBm per tone	-7	-4	-2	dBm
AMP1 Input Return Loss	Pin = -40 dBm	-12	-10	-10	dB
AMP1 Output Return Loss	Pin = -40 dBm	-15	-12	-12	dB
AMP1 Reverse Isolation	Pin = -40 dBm	-40	-40	-40	dB
AMP1 Supply Current		10	14	18	mA
AMP2 Gain	Pin = -40 dBm	18.5	19.0	19.3	dB
AMP2 Noise Figure		0.90	0.85	0.85	dB
AMP2 Output Third-Order Intercept Point	Two tones at 1574.5 MHz and 1575.5 MHz, Pin = -30 dBm per tone	12	16	18	dBm
AMP2 Output 1dB Compression Point		1	4	6	dBm
AMP2 Input Return Loss	Pin = -40 dBm	-12	-10	-10	dB
AMP2 Output Return Loss	Pin = -40 dBm	-15	-12	-12	dB
AMP2 Reverse Isolation	Pin = -40 dBm	-40	-40	-40	dB
AMP2 Supply Current		10	14	18	mA

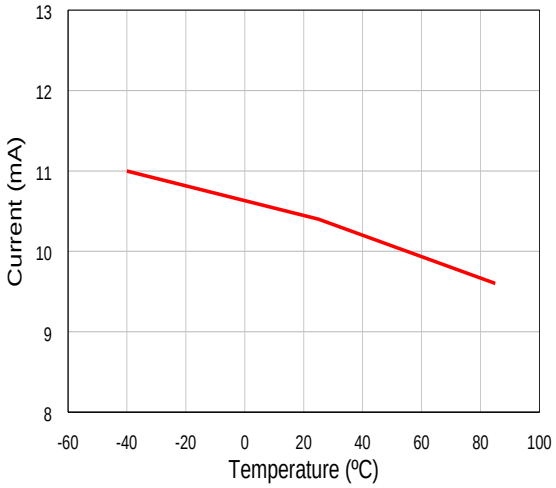
3.3 Plots of Performances

AMP1 S-parameter (V_{DD} = +3 V, I_{DD} = 10 mA, Pin = -40 dBm)

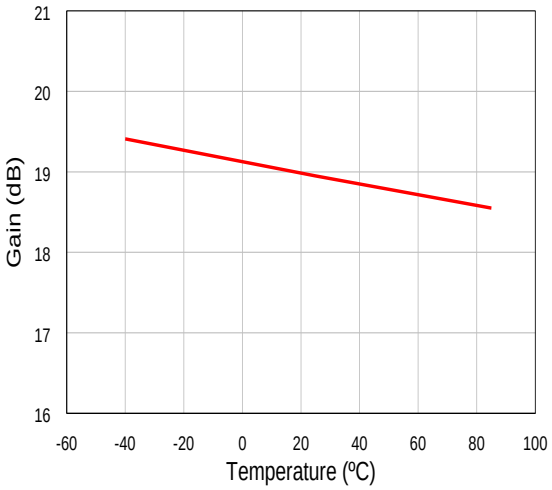




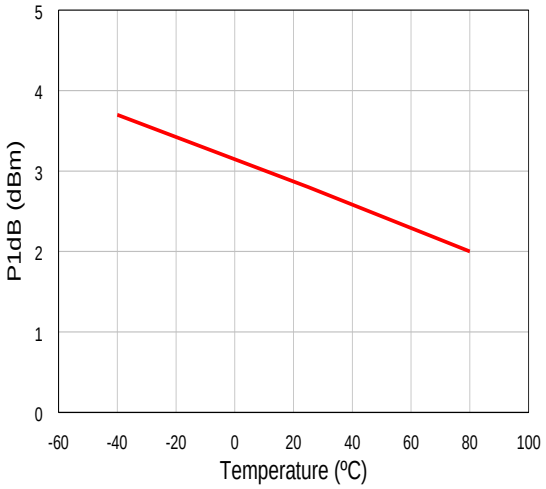
AMP1 Current vs. Temperature



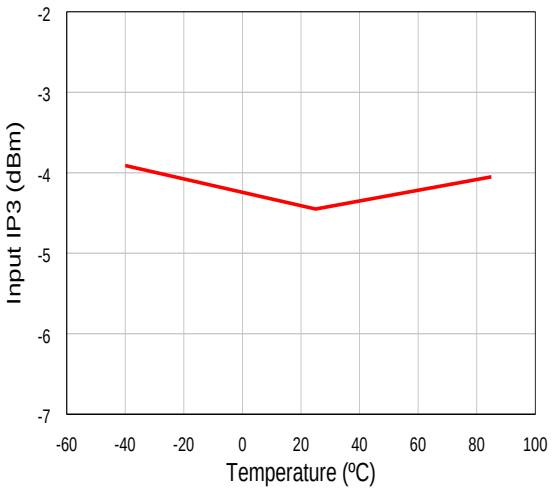
AMP1 Gain vs. Temperature



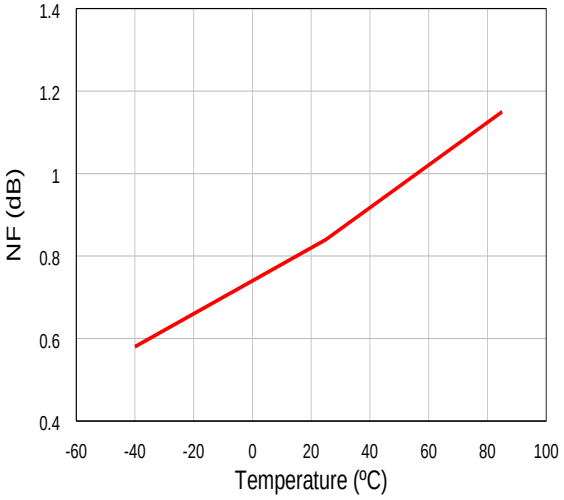
AMP1 P1dB vs. Temperature



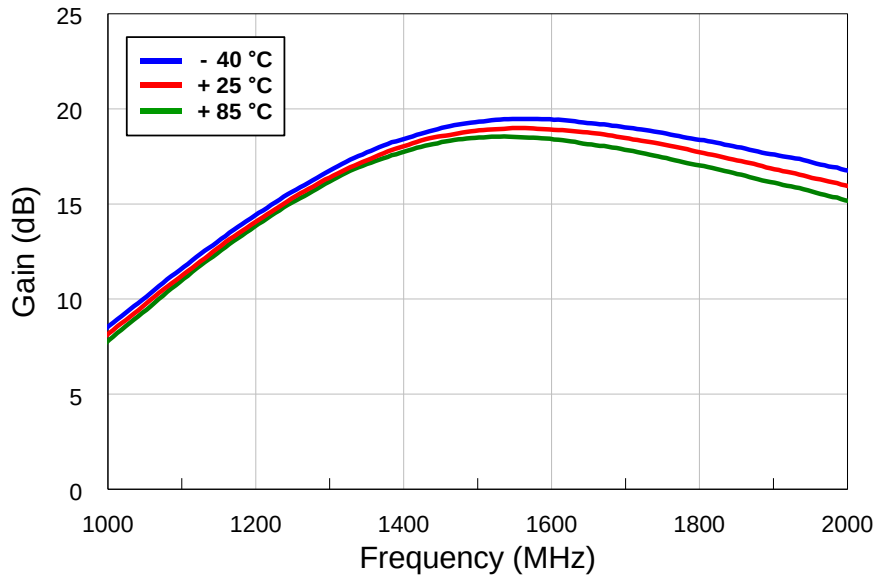
AMP1 Input IP3 vs. Temperature

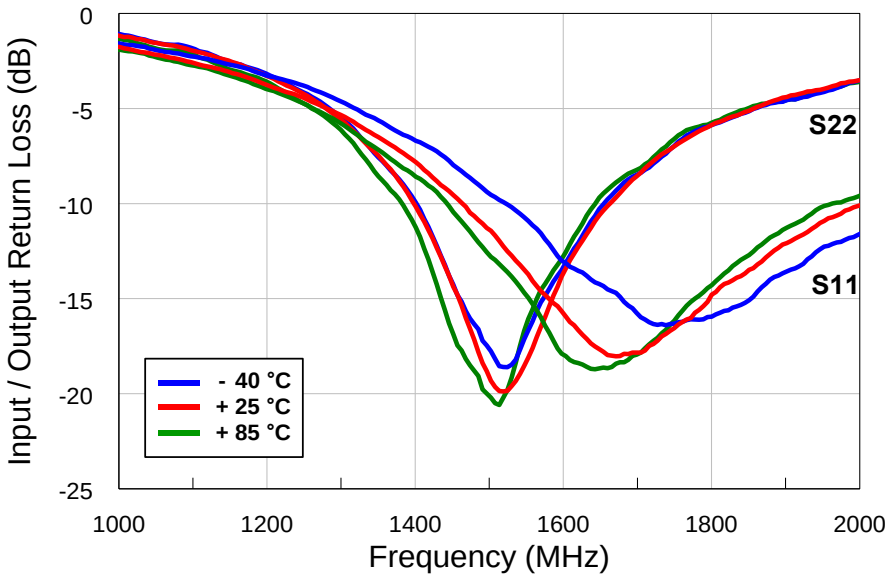


AMP1 NF vs. Temperature

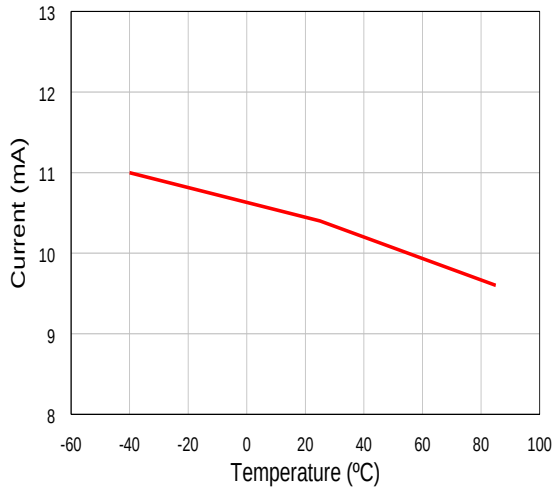


AMP2 S-parameter (V_{DD} = +3 V, I_{DD} = 10 mA, Pin = -40 dBm)

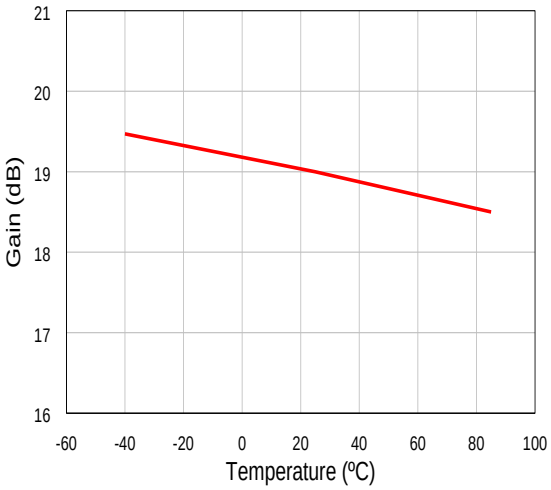




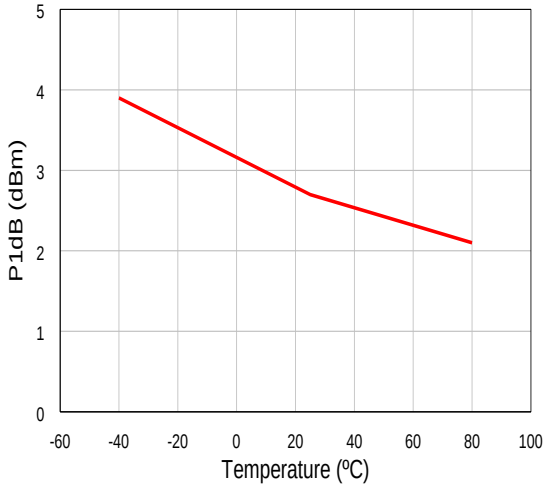
AMP2 Current vs. Temperature



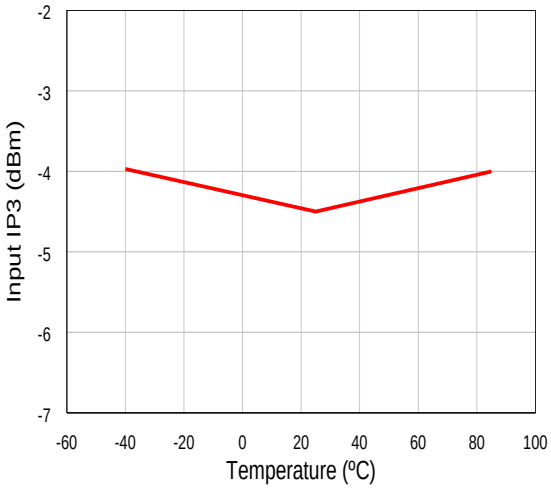
AMP2 Gain vs. Temperature



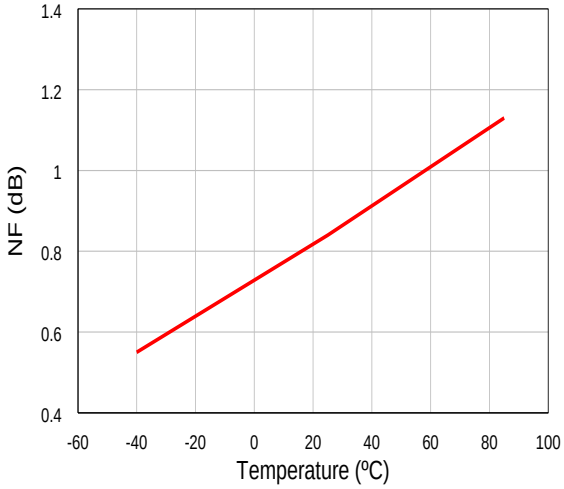
AMP2 P1dB vs. Temperature



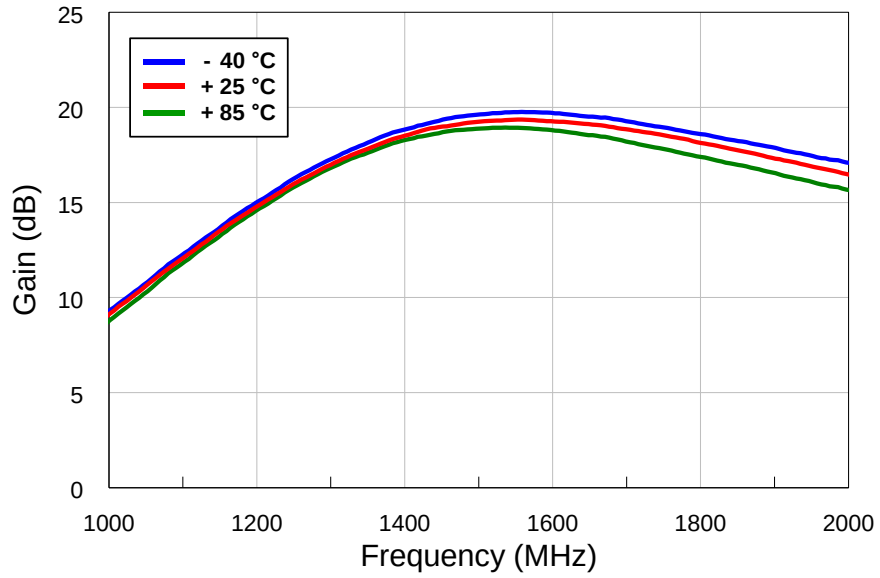
AMP2 Input IP3 vs. Temperature

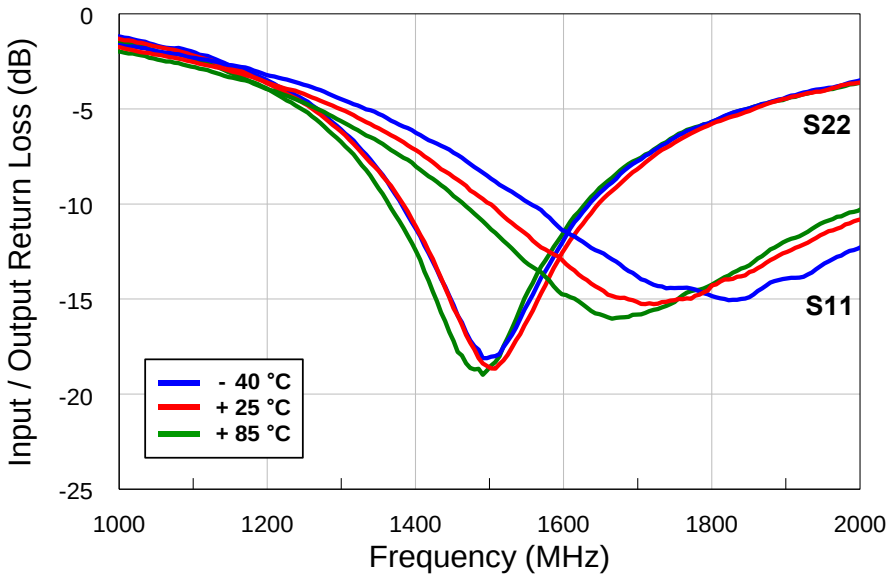


AMP2 NF vs. Temperature

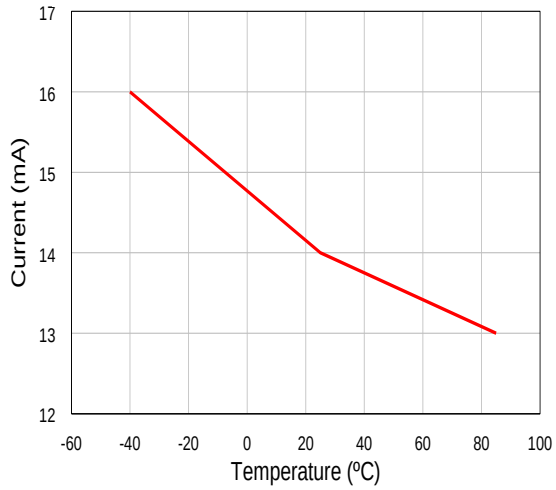


AMP1 S-parameter (V_{DD} = +4 V, I_{DD} = 14 mA, Pin = -40 dBm)

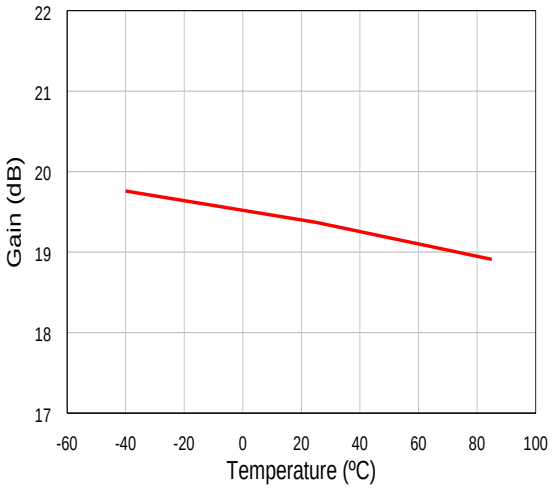




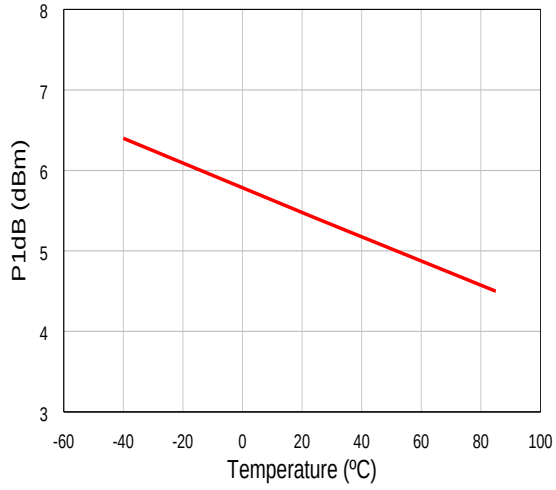
AMP1 Current vs. Temperature



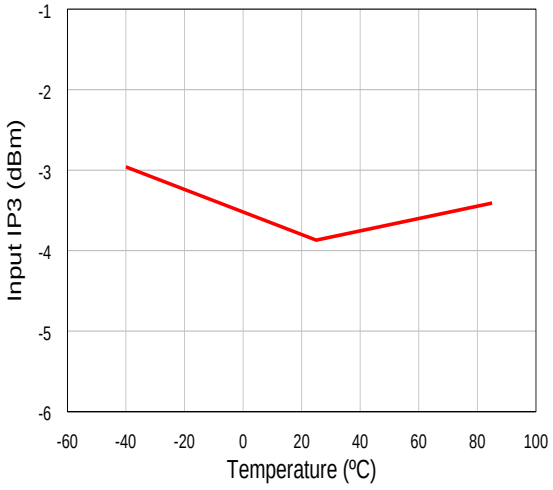
AMP1 Gain vs. Temperature



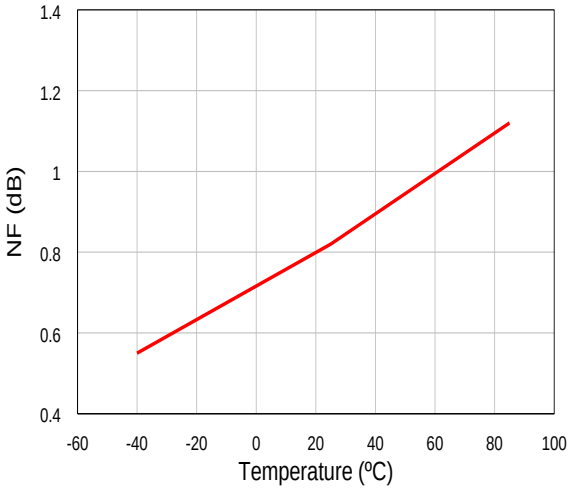
AMP1 P1dB vs. Temperature



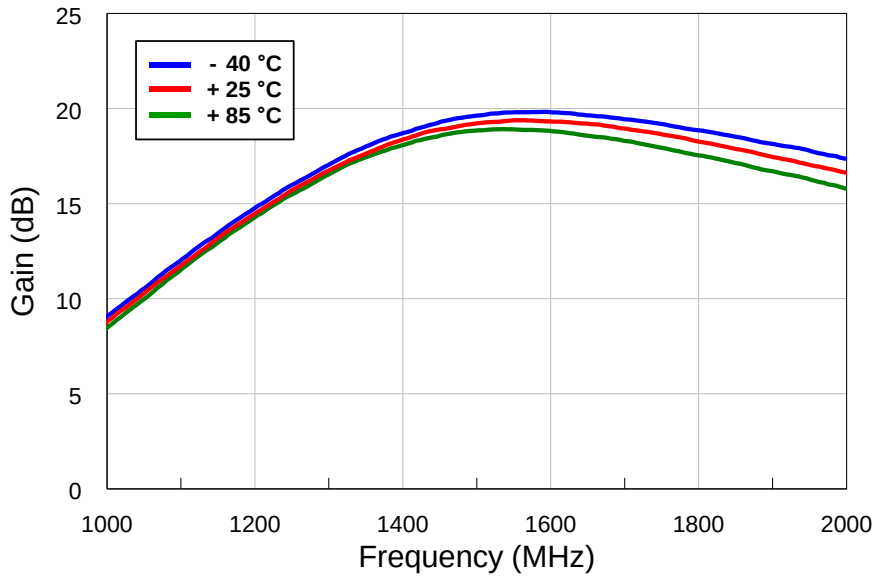
AMP1 Input IP3 vs. Temperature

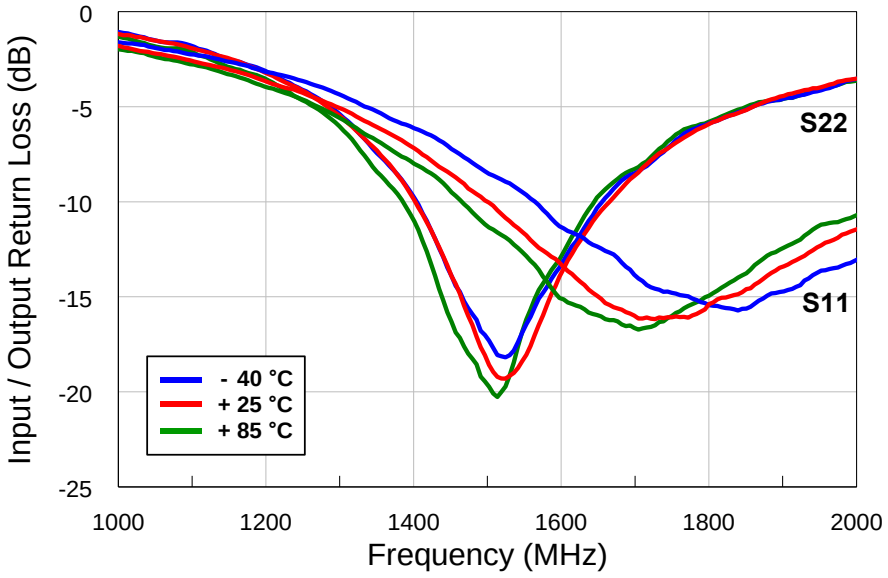


AMP1 NF vs. Temperature

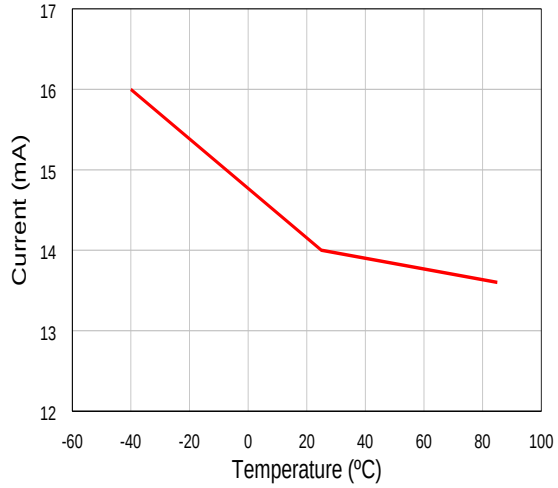


AMP2 S-parameter (V_{DD} = +4 V, I_{DD} = 14 mA, Pin = -40 dBm)

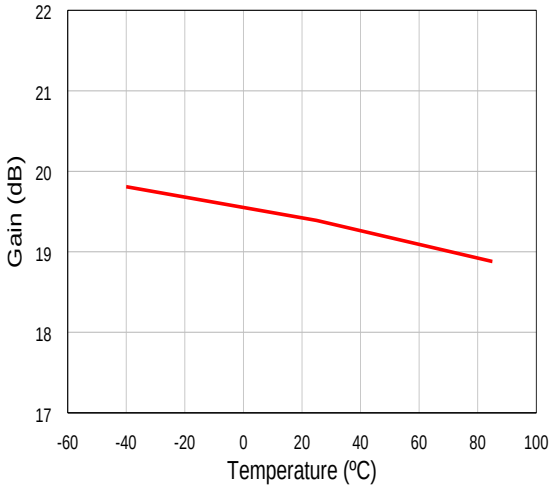




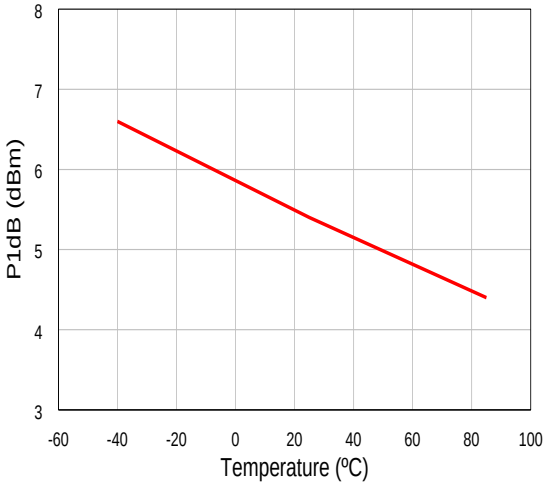
AMP2 Current vs. Temperature



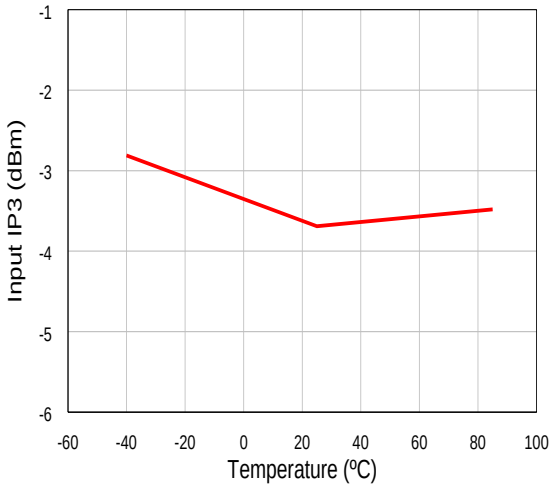
AMP2 Gain vs. Temperature



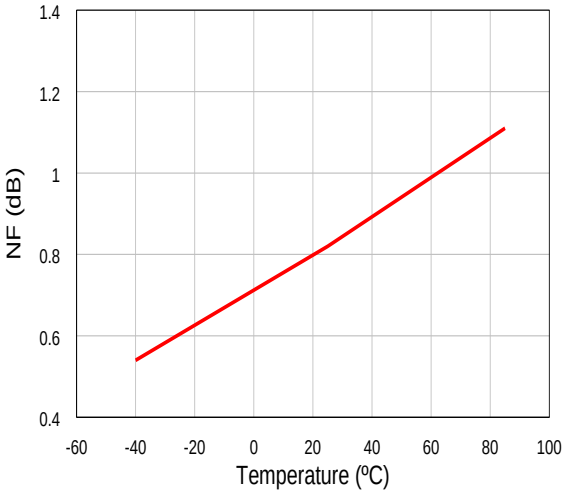
AMP2 P1dB vs. Temperature



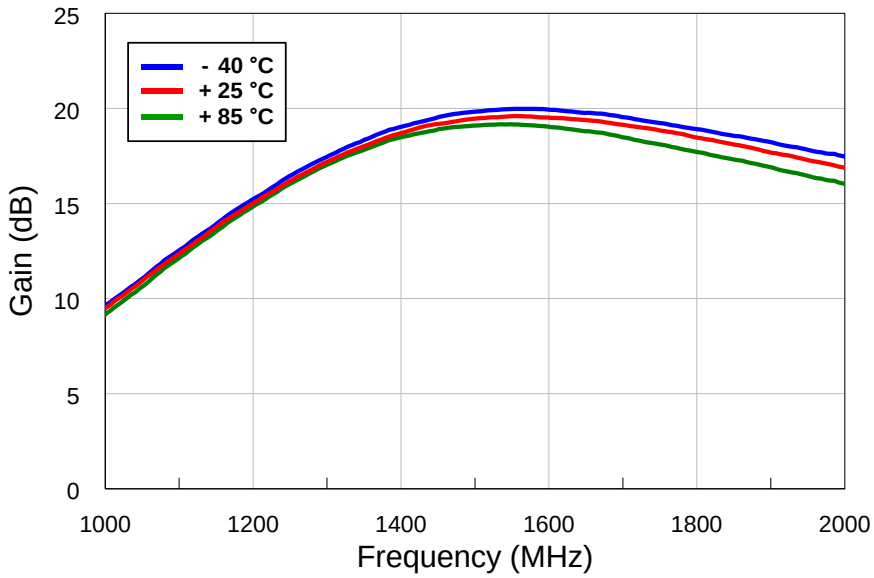
AMP2 Input IP3 vs. Temperature

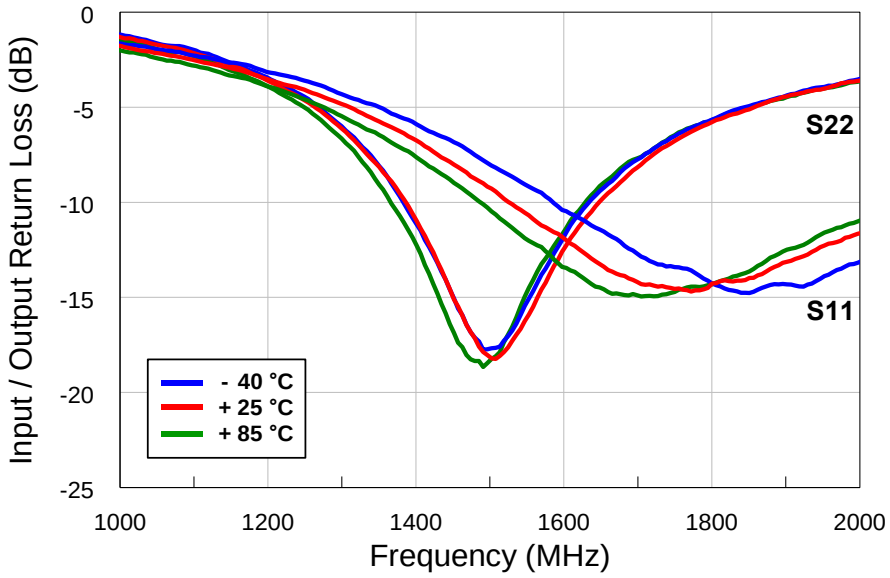


AMP2 NF vs. Temperature

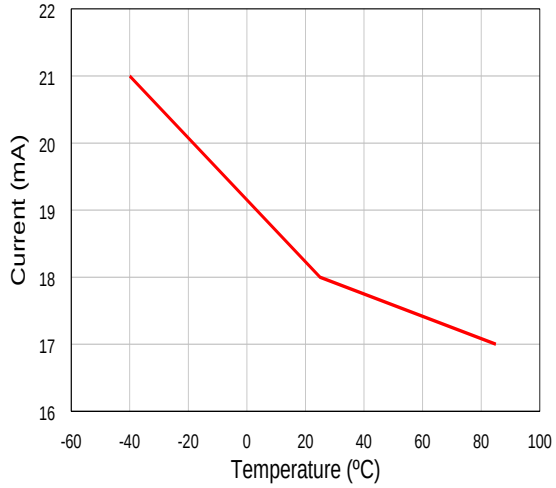


AMP1 S-parameter (V_{DD} = +5 V, I_{DD} = 18 mA, Pin = -40 dBm)

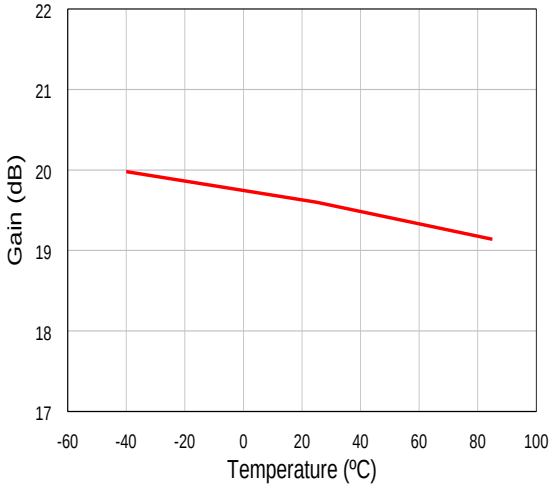




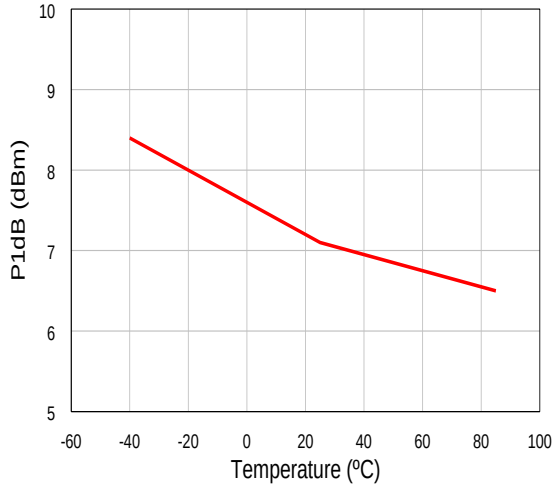
AMP1 Current vs. Temperature



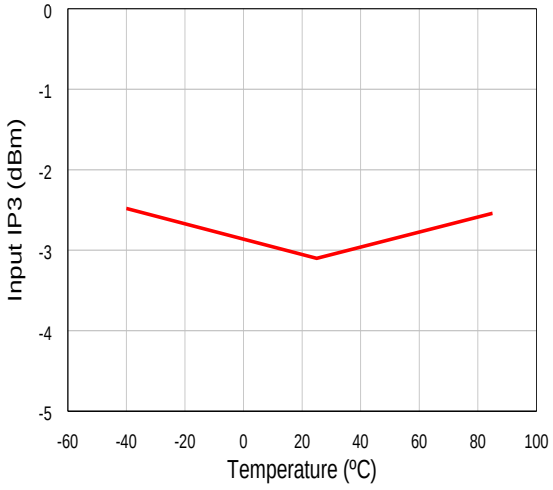
AMP1 Gain vs. Temperature



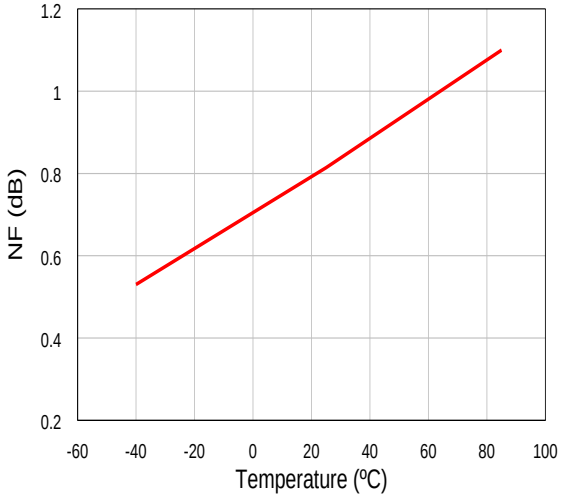
AMP1 P1dB vs. Temperature



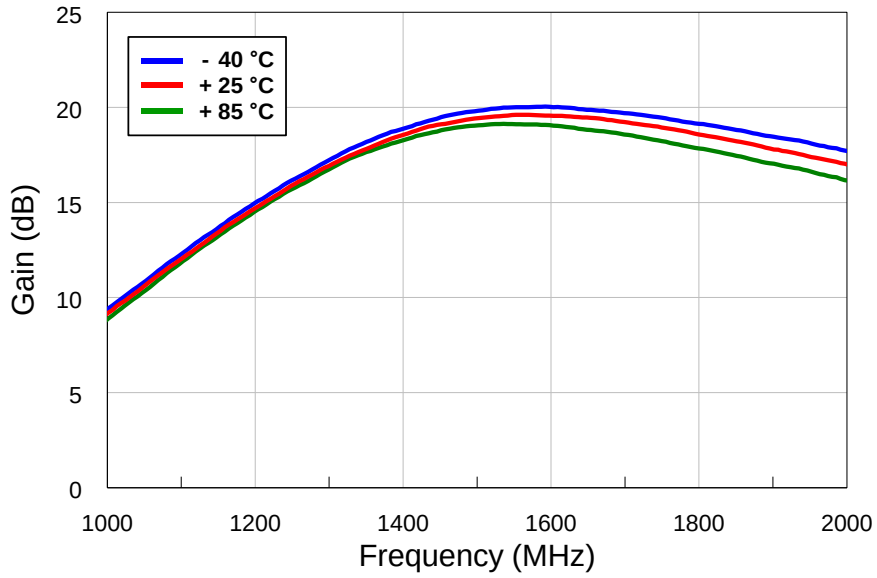
AMP1 Input IP3 vs. Temperature

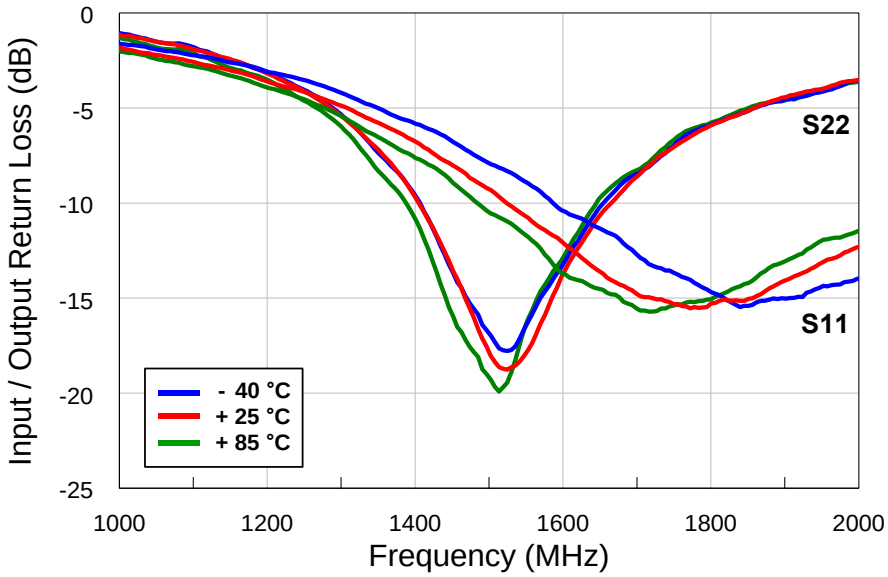


AMP1 NF vs. Temperature

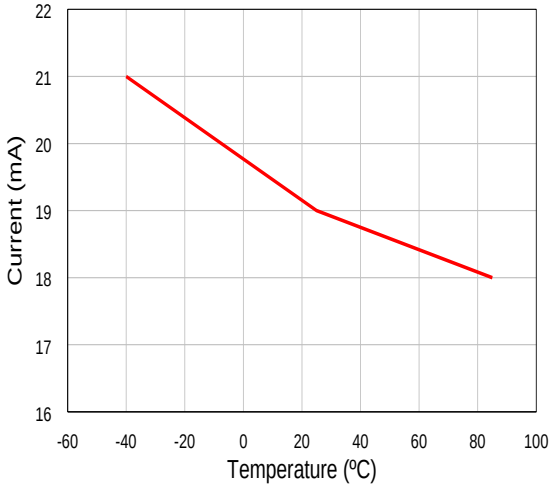


AMP2 S-parameter (V_{DD} = +5 V, I_{DD} = 18 mA, Pin = -40 dBm)

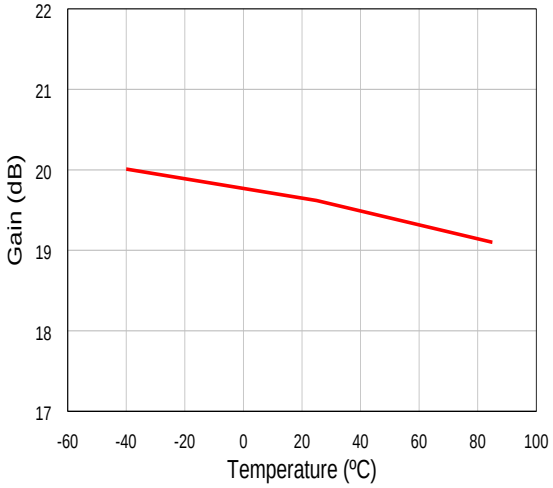




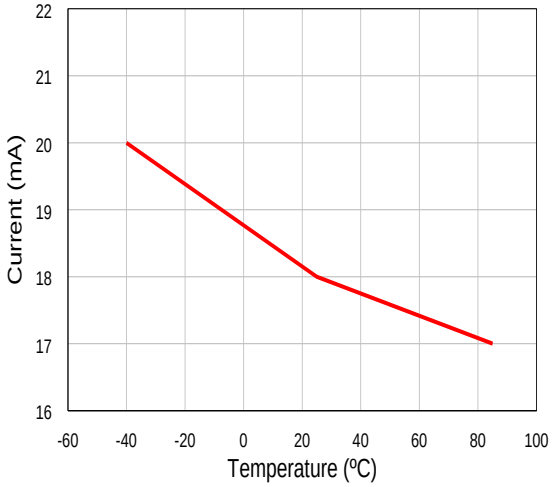
AMP2 Current vs. Temperature



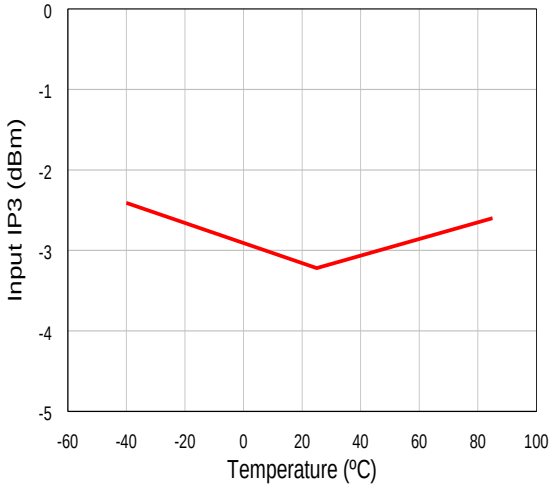
AMP2 Gain vs. Temperature



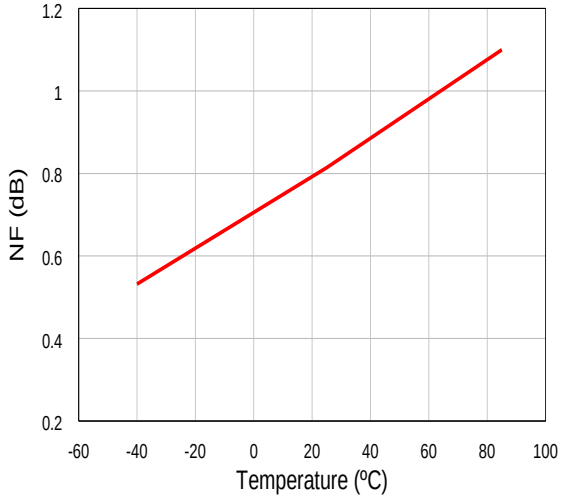
AMP2 P1dB vs. Temperature



AMP2 Input IP3 vs. Temperature



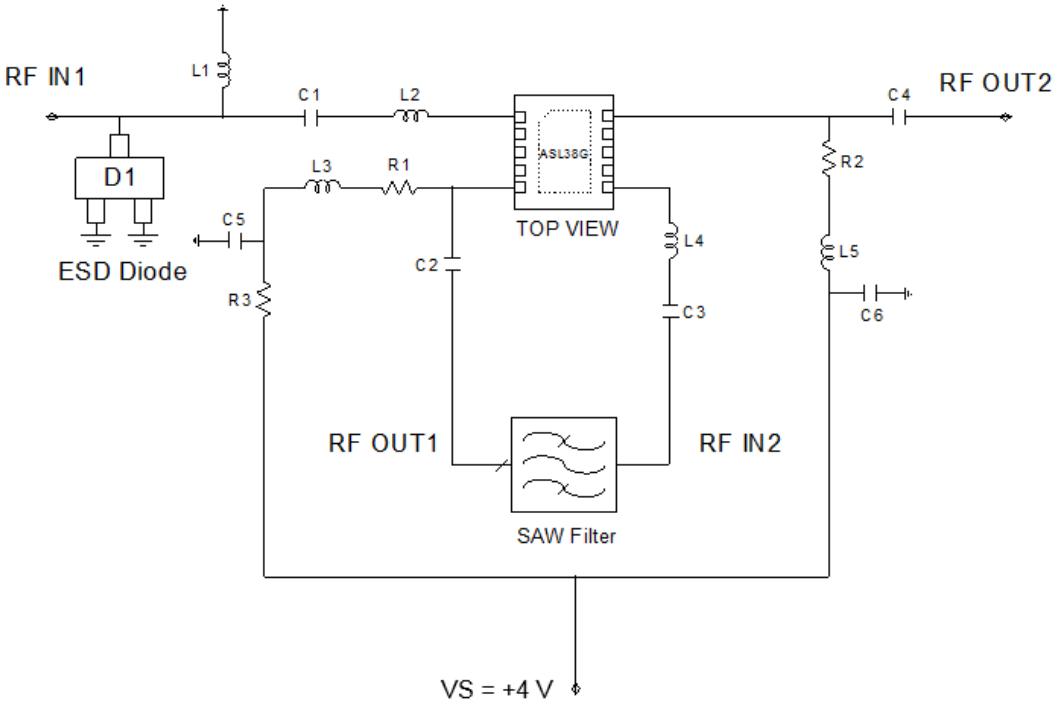
AMP2 NF vs. Temperature

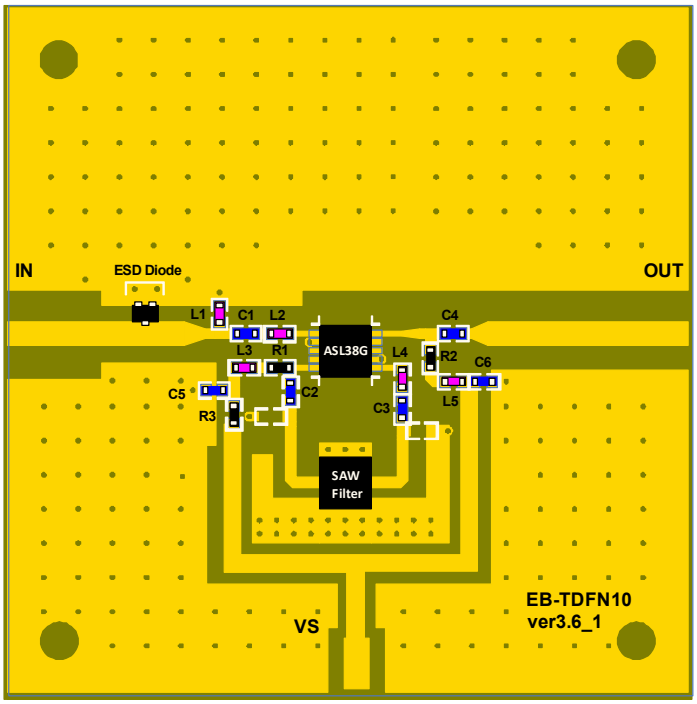


4. Application2 : ESD Diode + AMP1 + SAW Filter + AMP2

Robust ESD : ≥±15 kV

4.1 Application Circuit & Evaluation Board





Bill of Material

Symbol	Size	Value	Manufacturer
ASL38G	-	-	ASB
C1	1005	3 pF	MURATA
C2	1005	2.7 pF	MURATA
C3	1005	4 pF	MURATA
C4	1005	1 pF	MURATA
C5,C6	1005	1 μF	MURATA
R1	1005	18 Ω	Samsung
R2	1005	10 Ω	Samsung
R3	1005	390 Ω	Samsung
L1	1005	5.1 nH	MURATA
L2	1005	6.8 nH	MURATA
L3	1005	4.3 nH	MURATA
L4	1005	9.1 nH	MURATA
L5	1005	3.9 nH	MURATA
SAW Filter[1)]	3x3	-	EPCOS
D1 : ESD Diode[2)]	2x1	-	Infineon

1) Part number : B3415
2) Part number : ESD1P0RFW

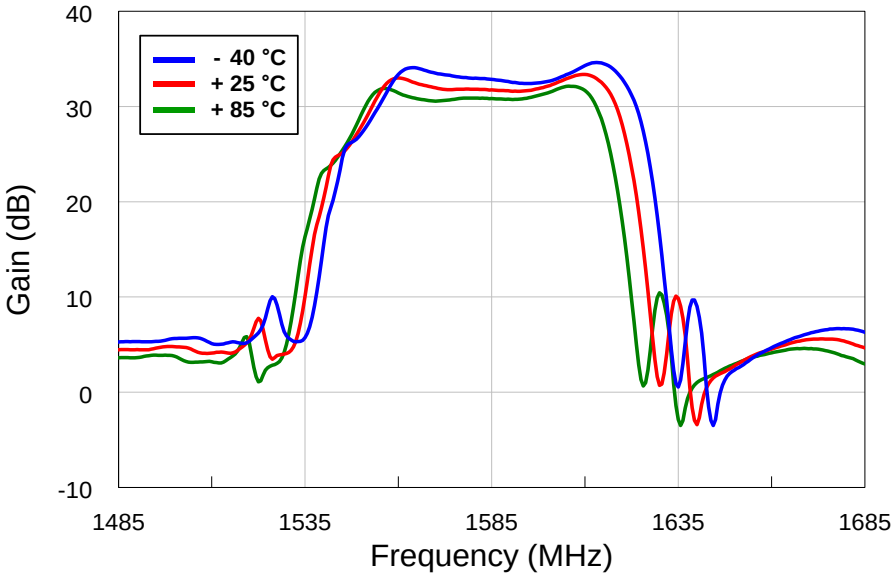
4.2 Typical Performance

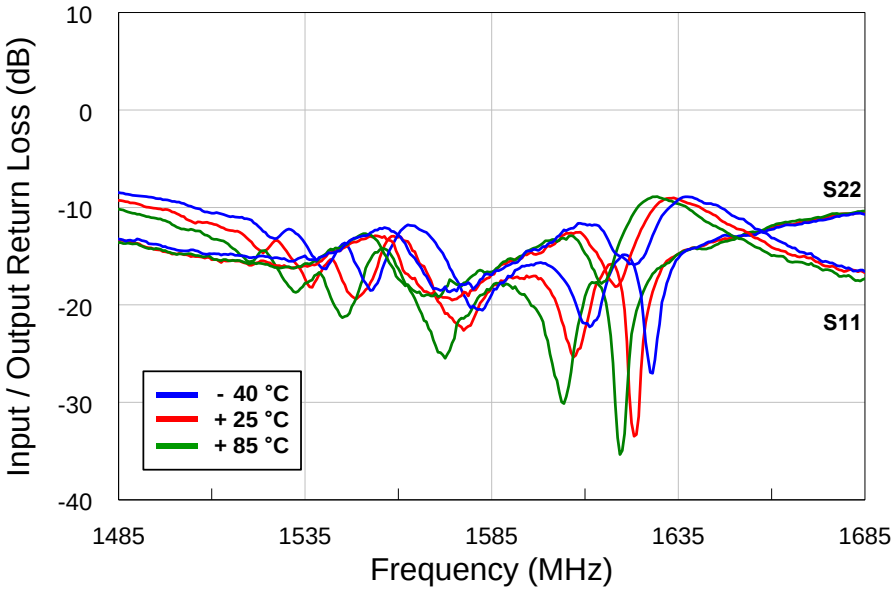
Test conditions : T = +25 °C, V_{supply} = +4 V, CW, Z_O = 50 Ω.

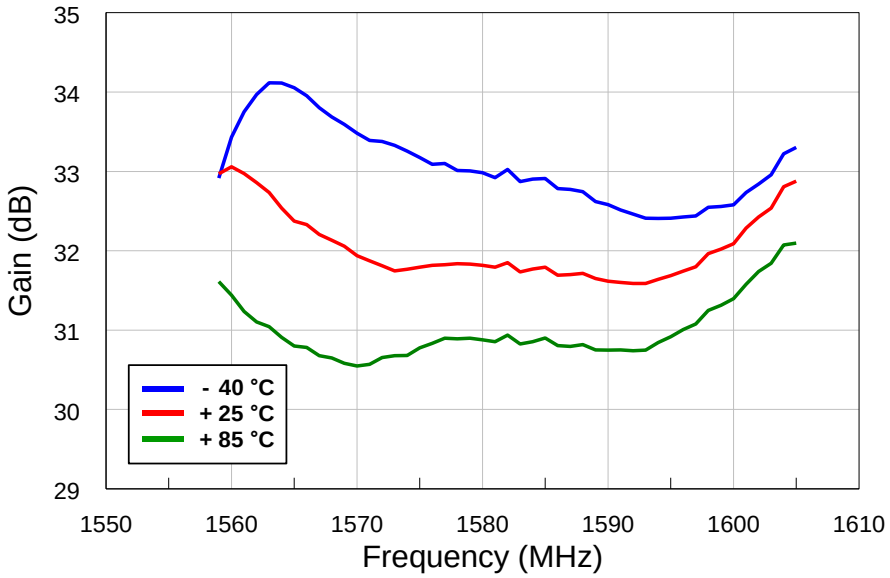
Parameters	Test Conditions	Values	Units
Operation Frequency		1559-1605	MHz
Small Signal Gain	50 Ω source with input match	32	dB
Noise Figure		1.3	dB
Input Third-Order Intercept Point	two tones at the output power of -30 dBm/tone separated by 1 MHz.	-15	dBm
Output Third-Order Intercept Point	two tones at the output power of -30 dBm/tone separated by 1 MHz.	17	dBm
Output 1dB Compression Point		4	dBm
Input Return Loss		-12	dB
Output Return Loss		-15	dB
Reverse Isolation		-40	dB
Supply Current		20	mA

4.3 Plots of Performances

S-parameter (V_{supply} = +4 V, I_{DD} = 20 mA, Pin = -40 dBm)

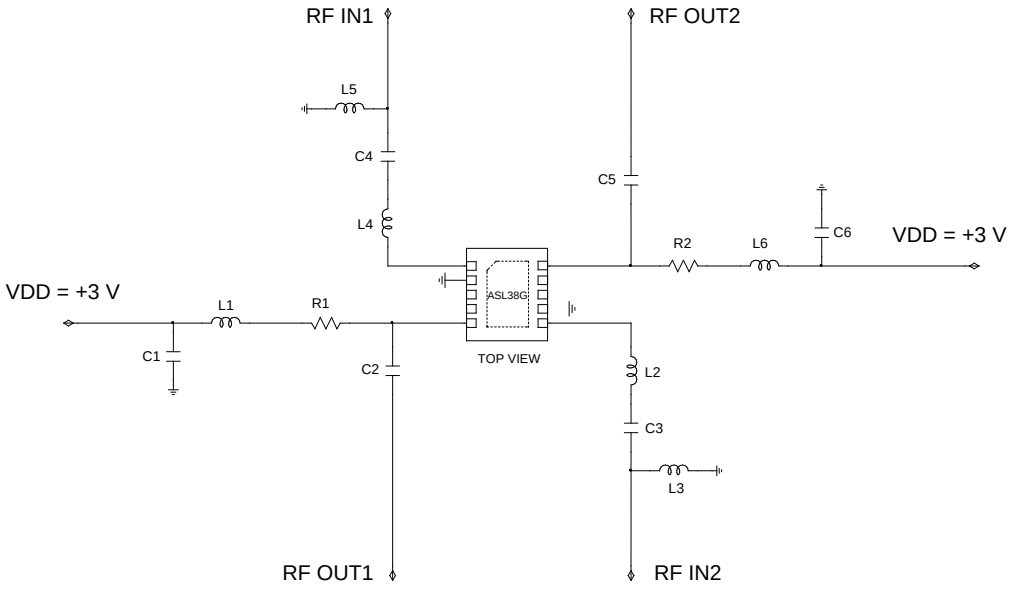


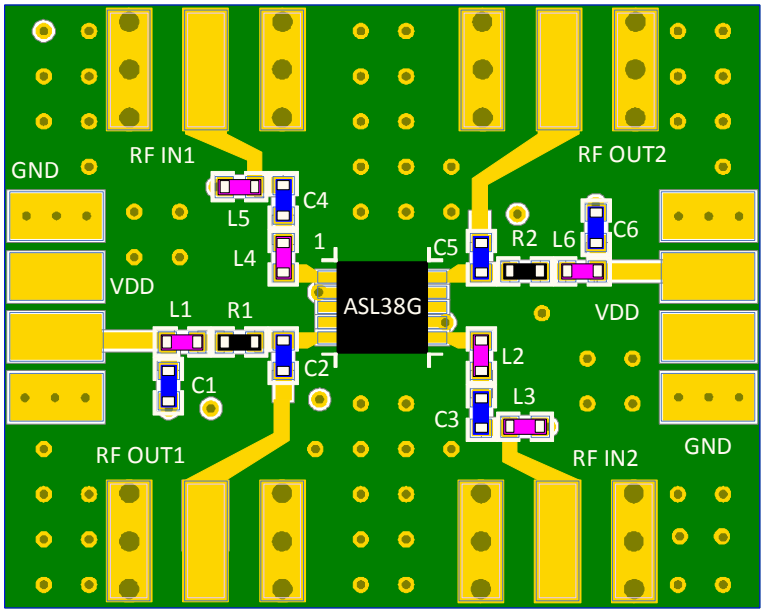



35
34
33
32
31
30
29
Gain (dB)
1550
1560
1570
1580
1590
1600
1610
Frequency (MHz)
- 40 °C
+ 25 °C
+ 85 °C

5. Application3: 1164 ~ 1300 MHz (L2, L5, L6 band)

5.1 Application Circuit & Evaluation Board





Bill of Material

Symbol	Size	Value	Manufacturer	Symbol	Size	Value	Manufacturer
ASL38G	3x3	-	ASB	R1, R2	1005	12 Ω	Samsung
C1, C6	1005	1.0 μF	MURATA	L3, L5	1005	12 nH	MURATA
C2, C5	1005	1.8 pF	MURATA	L2, L4	1005	10 nH	MURATA
C3, C4	1005	5 pF	MURATA	L1, L6	1005	5.6 nH	MURATA

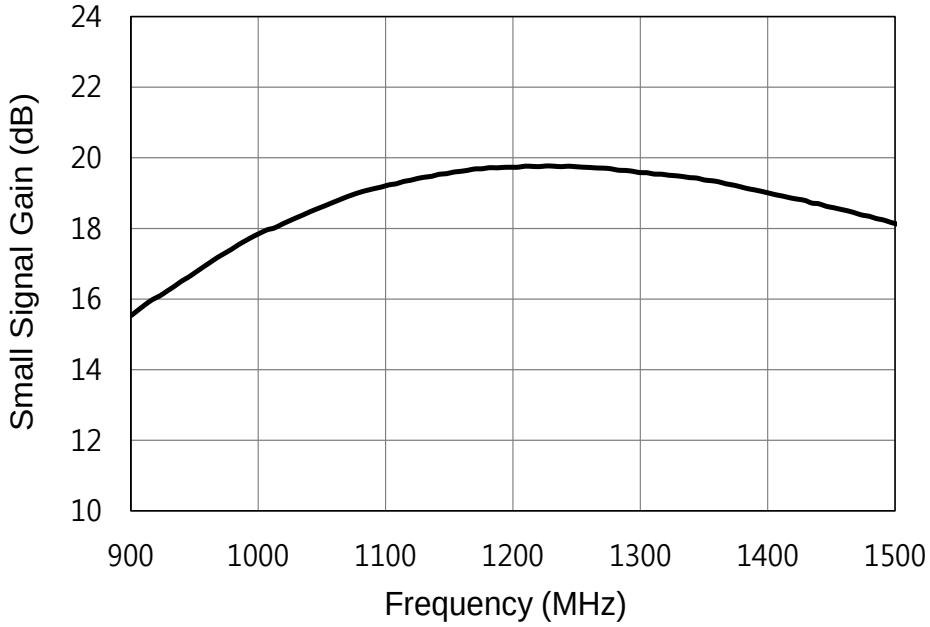
5.2 Typical Performance

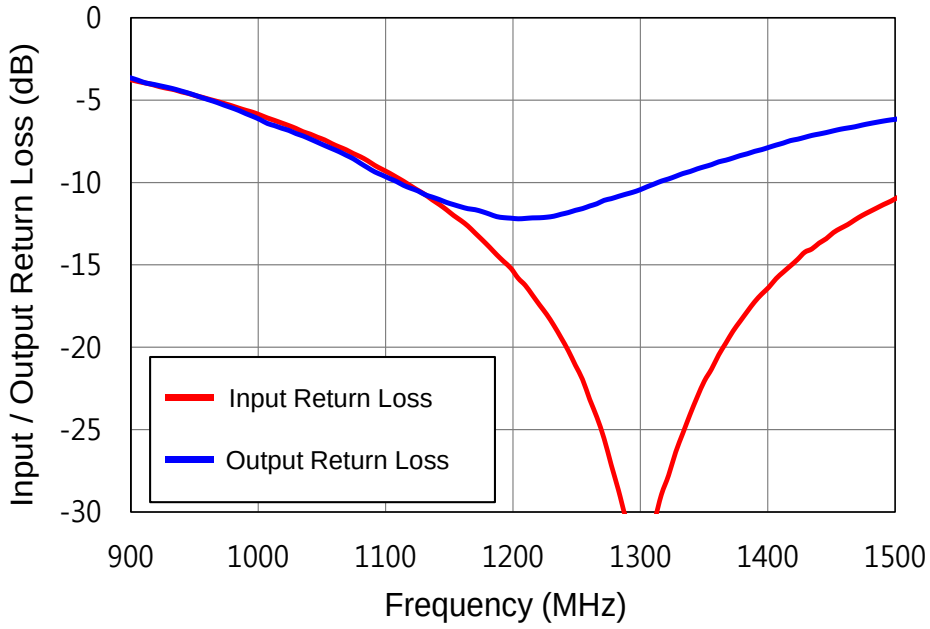
Test conditions : T = +25 °C, V_{DD} = +3 V, CW, Z_O = 50 Ω.

Parameters	Test Conditions		+ 3 V		Units
Operation Frequency		1176	1227	1278	MHz
AMP1 Gain	50 Ω source with input match Pin = -40 dBm	19.0	19.0	19.0	dB
AMP1 Noise Figure		0.8	0.8	0.8	dB
AMP1 Input Third-Order Intercept Point	Tone separated by 1 MHz Pout = -10 dBm per tone	-1.5	-1.0	0.5	dBm
AMP1 Input Return Loss	Pin = -40 dBm	-10	-12	-15	dB
AMP1 Output Return Loss	Pin = -40 dBm	-10	-10	-10	dB
AMP1 Reverse Isolation	Pin = -40 dBm	-40	-40	-40	dB
AMP1 Supply Current		10	10	10	mA
AMP2 Gain	Pin = -40 dBm	19.0	19.0	19.0	dB
AMP2 Noise Figure		0.8	0.8	0.8	dB
AMP2 Output Third-Order Intercept Point	Tone separated by 1 MHz Pout = -10 dBm per tone	18.0	19.0	19.5	dBm
AMP2 Output 1dB Compression Point		5.0	5.0	5.5	dBm
AMP2 Input Return Loss	Pin = -40 dBm	-10	-12	-15	dB
AMP2 Output Return Loss	Pin = -40 dBm	-10	-10	-10	dB
AMP2 Reverse Isolation	Pin = -40 dBm	-40	-40	-40	dB
AMP2 Supply Current		10	10	10	mA

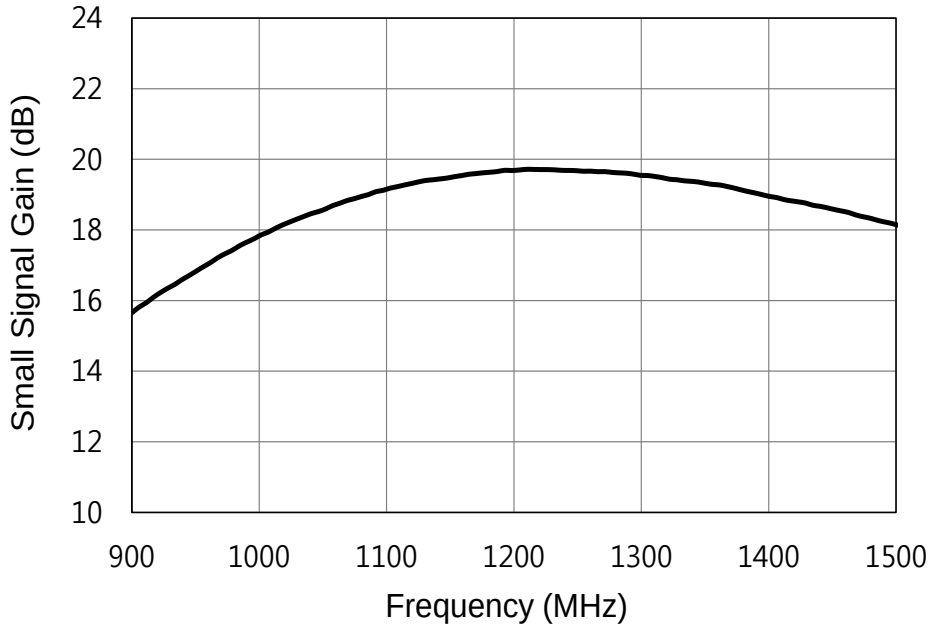
5.3 Plots of Performances

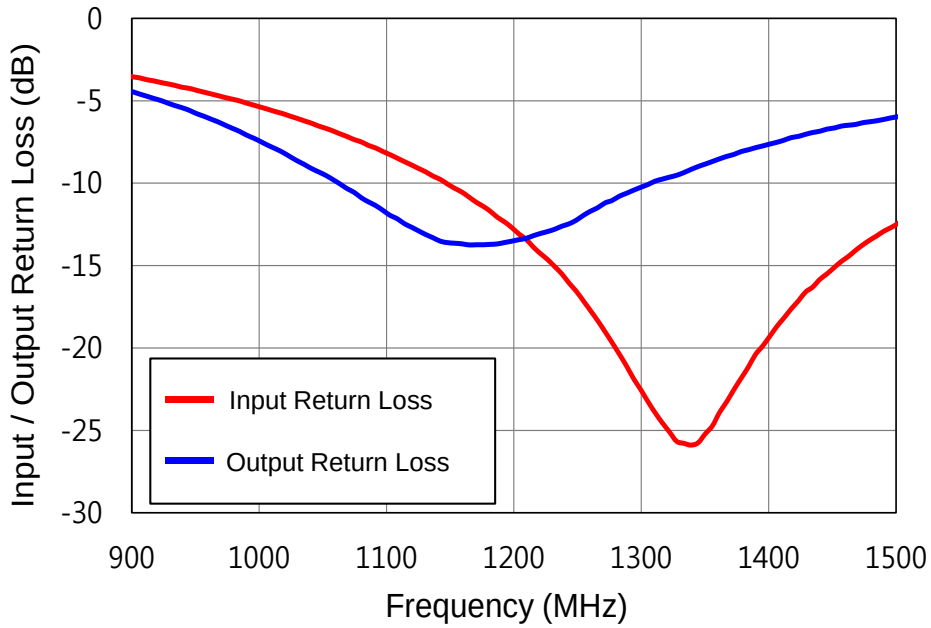
AMP1 S-parameter (V_{DD} = +3 V, I_{DD} = 11 mA, Pin = -40 dBm)



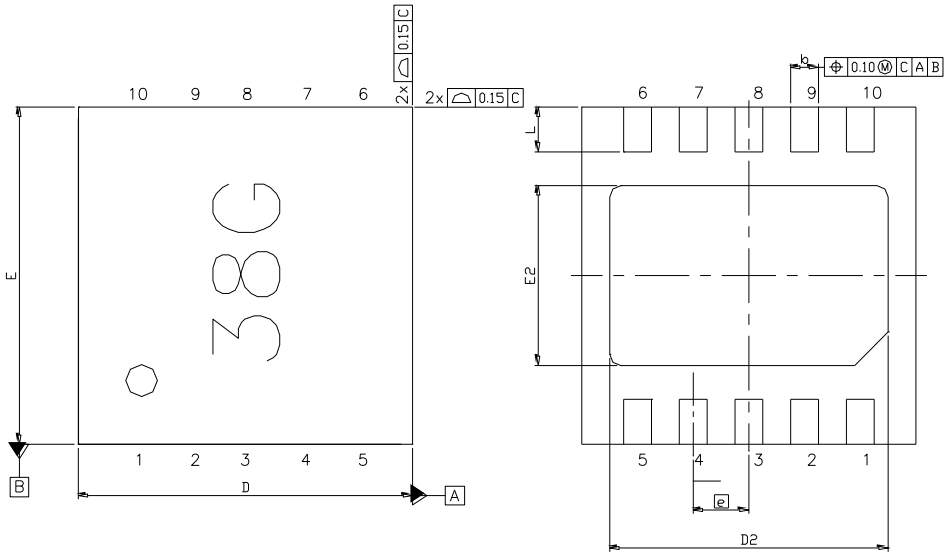


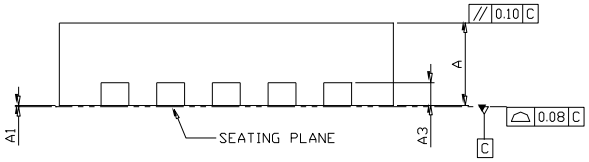
AMP2 S-parameter (V_{DD} = +3 V, I_{DD} = 11 mA, Pin = -40 dBm)





6. Package Outline





SYMBOL	DIMENSION (MM)			DIMENSION (MIL)		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	28	30	32
A1	0.00	0.02	0.05	0	0.8	2
A3	0.203 REF			8 REF		
b	0.18	0.25	0.30	7	10	12
D	2.90	3.00	3.10	114	118	122
D2	2.40	2.50	2.60	94	98	102
E	2.90	3.00	3.10	114	118	122
E2	1.50	1.60	1.70	59	63	67
L	0.35	0.40	0.45	14	16	18
e	0.45	0.50	0.55	18	20	22

(End of Datasheet)