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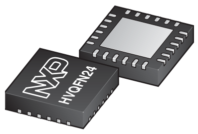


BGX7100

Transmitter IQ modulator

Rev. 5 — 3 September 2012 **Product data sheet**

1. General description

The BGX7100 device combines high performance, high linearity I and Q modulation paths for use in radio frequency up-conversion. It supports RF frequency outputs in the range from 400 MHz to 4000 MHz. The BGX7100 IQ modulator is performance independent of the IQ common mode voltage. The modulator provides a typical output power at 1 dB gain compression ($P_{L(1dB)}$) value of 12 dBm and a typical 27 dBm output third-order intercept point ($IP3_o$). Unadjusted sideband suppression and carrier feedthrough are 50 dBc and –45 dBm respectively. A hardware control pin provides a fast power-down/power-up mode functionality which allows significant power saving.

2. Features and benefits

- 400 MHz to 4000 MHz frequency operating range
- Stable performance across 0.25 V to 3.3 V common-mode voltage input
- Independent low-current power-down hardware control pin
- 12 dBm output –1 dB compression point
- 27 dBm output third-order intercept point (typical)
- Integrated active biasing
- Single 5 V supply
- 180 Ω differential IQ input impedance
- Matched 50 Ω single-ended RF output impedance
- ESD protection at all pins

3. Applications

- Mobile network infrastructure
- Microwave and broadband
- RF and IF applications
- Industrial applications

4. Device family

The BGX7100 operates in the RF frequency range of 400 MHz to 4000 MHz with modulation bandwidths up to 400 MHz.

5. Ordering information

Table 1. Ordering information

Type number	Package		
	Name	Description	Version
BGX7100HN	HVQFN24	plastic thermal enhanced very thin quad flat package; no leads; 24 terminals; body 4 × 4 × 0.85 mm	SOT616-3

6. Functional diagram

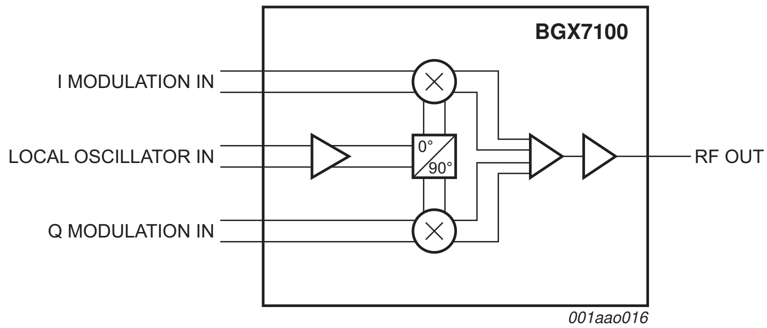


Fig 1. Functional block diagram

Differential I and Q baseband inputs are each fed to an associated upconverter mixer. The Local Oscillator (LO) carrier input is buffered and split into 0 degree and 90 degree signals. The in-phase signal is passed to the I mixer and the 90 degree phase-changed signal is passed to the Q mixer. The outputs of the mixers are summed to produce the resulting RF output signal.

7. Pinning information

7.1 Pinning

The BGX7100 device pinout is designed to allow easy interfacing when mounted on a Printed-Circuit Board (PCB). When viewing the device from above, the two differential IQ baseband input paths are at the top and bottom. The common LO input is at the left and the RF output at the right. Multiple power and ground pins allow for independent supply domains, improving isolation between blocks. A small package footprint is chosen to reduce bond-wire induced series inductance in the RF ports.

The input and output pin matching is described in Section 12 “Application information”.

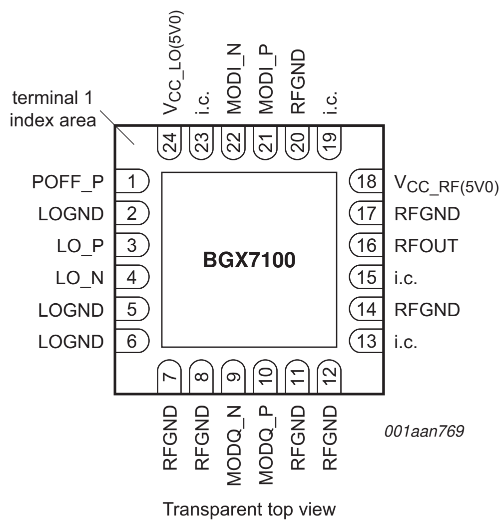


Fig 2. Pin configuration

7.2 Pin description

Table 2. Pin description

Symbol	Pin	Type[1]	Description
POFF_P	1	I	active HIGH logic input to power-down modulator
LOGND	2	G	LO ground
LO_P	3	I	LO positive input[2]
LO_N	4	I	LO negative input[2]
LOGND	5	G	LO ground
LOGND	6	G	LO ground
RFGND	7	G	RF ground
RFGND	8	G	RF ground
MODQ_N	9	I	modulator quadrature negative input
MODQ_P	10	I	modulator quadrature positive input
RFGND	11	G	RF ground
RFGND	12	G	RF ground
i.c.	13	-	internally connected; to be tied to ground
RFGND	14	G	RF ground
i.c.	15	-	internally connected; to be tied to ground
RFOUT	16	O	modulator single-ended RF output[2]
RFGND	17	G	RF ground
$V_{CC\_RF(5V0)}$	18	P	RF analog power supply 5 V
i.c.	19	-	internally connected; to be tied to ground
RFGND	20	G	RF ground
MODI_P	21	I	modulator in-phase positive input
MODI_N	22	I	modulator in-phase negative input

Table 2. Pin description *...continued*

Symbol	Pin	Type[1]	Description
i.c.	23	-	internally connected; to be tied to ground
$V_{CC\_LO(5V0)}$	24	P	LO analog power supply 5 V
Exposed die pad	-	G	exposed die pad; must be connected to RF ground

[1] G = ground; I = input; O = output; P = power.

[2] AC coupling required as shown in Figure 4 “Typical wideband application diagram”.

8. Functional description

8.1 General

Each IQ baseband input has a 180 Ω differential input impedance allowing straightforward matching, from the DAC output through the baseband filter. The device allows operation with IQ input common-mode voltages between 0.25 V and 3.3 V allowing direct connection to a broad family of DACs. The LO and RF ports provide broadband 50 Ω termination to RF source and loads.

The chip can be placed in inactive mode (see Section 8.2 “Shutdown control”).

8.2 Shutdown control

Table 3. Shutdown control

Mode	Mode description	Functional description	POFF_P
Idle	modulator fully off; minimal supply current	shutdown enabled	> 1.5 V
Active	modulator active mode	shutdown disabled	< 0.5 V

The modulator can be placed into inactive mode by the voltage level at power-up disable pin (pin 1, POFF_P). The time required to pass between active and low-current states is less than 1 μs.

The shutdown feature of IQ modulator during switching does not induce any unlock of the LO synthesizer in base station application thanks to the low impedance variation of the LO input.

The graph (see Figure 3) describes the impact on LO impedance variation during the switching time.

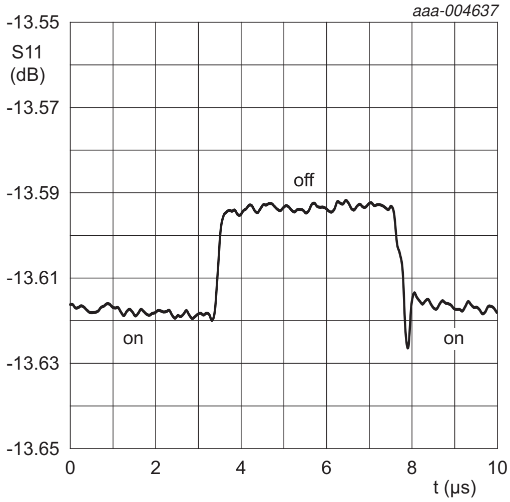


Fig 3. LO input return loss variation (S11_LO)

9. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-	5.5	V
$P_{i(lo)}$	local oscillator input power		-	16	dBm
$P_{o(RF)}$	RF output power		-	20	dBm
T_{mb}	mounting base temperature		−40	+85	°C
T_j	junction temperature		-	+150	°C
T_{stg}	storage temperature		−65	+150	°C
V_{ESD}	electrostatic discharge voltage	EIA/JESD22-A114 (HBM)	−2500	+2500	V
		EIA/JESD22-C101 (FCDM)	−650	+650	V

Table 4. Limiting values *...continued*

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
Pin POFF_P					
V_i	input voltage	active HIGH logic input to power-down modulator	-	3.5	V
Pins MODI_N, MODI_P, MODQ_N and MODQ_P					
V_i	input voltage		0	5	V
V_{ID}	differential input voltage	DC	−2	+2	V

10. Thermal characteristics

Table 5. Thermal characteristics

Symbol	Parameter	Conditions	Typ	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base		10	K/W

11. Characteristics

Table 6. Characteristics

Modulation source resistance per pin = 90 Ω; POFF_P connected to GND (shutdown disabled); V_{CC} = 5 V; T_{mb} range = −40 °C to +85 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz unless otherwise stated.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		4.75	5	5.25	V
$I_{CC(tot)}$	total supply current	modulator in active mode				
		f_{lo} = 900 MHz	-	165	-	mA
		f_{lo} = 2 GHz	-	173	-	mA
		f_{lo} = 2.5 GHz	-	178	-	mA
		f_{lo} = 3.5 GHz	-	184	-	mA
		modulator in inactive mode; T_{mb} = 25 °C	-	6	-	mA
f_{lo}	local oscillator frequency	[1]	400	-	4000	MHz
$P_{i(lo)}$	local oscillator input power	[1]	−9	0	+6	dBm
Pins MODI_x and MODQ_x[2]						
$V_{i(cm)}$	common-mode input voltage		0.25	-	3.3	V
S22_RF	RF output return loss		-	10	-	dB
S11_LO	LO input return loss		-	12	-	dB
MODI and MODQ[3]						
BW_{mod}	modulation bandwidth	gain fall off < 1 dB; R_S = 90 Ω	-	400	-	MHz
$R_{i(dif)}$	differential input resistance		-	180	-	Ω
$C_{i(dif)}$	differential input capacitance		-	1.8	-	pF

[1] Operation outside this range is possible but parameters are not guaranteed.

[2] x = N or P.

[3] MODI = MODI_P − MODI_N and MODQ = MODQ_P − MODQ_N.

Table 7. Characteristics at 750 MHz

Modulation source resistance per pin = 90 Ω; POFF_P connected to GND (shutdown disabled); V_{CC} = 5 V; T_{mb} range = –40 °C to +85 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz unless otherwise stated.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P_o	output power	1 V (p-p) differential on MODI and MODQ[1]	-	–0.2	-	dBm
$P_{L(1dB)}$	output power at 1 dB gain compression		-	11.5	-	dBm
$IP3_o$	output third-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	29	-	dBm
$IP2_o$	output second-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	71	-	dBm
$N_{flr(o)}$	output noise floor	no modulation present	-	–159	-	dBm/Hz
		modulation at MODI and MODQ[1]; $P_{o(RF)}$ = –10 dBm	-	–158.5	-	dBm/Hz
SBS	sideband suppression	unadjusted	-	55	-	dBc
CF	carrier feedthrough	unadjusted	-	–55	-	dBm

[1] MODI = MODI_P – MODI_N and MODQ = MODQ_P – MODQ_N.

Table 8. Characteristics at 910 MHz

Modulation source resistance per pin = 90 Ω; POFF_P connected to GND (shutdown disabled); V_{CC} = 5 V; T_{mb} range = –40 °C to +85 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz unless otherwise stated.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P_o	output power	1 V (p-p) differential on MODI and MODQ[1]	-	–0.2	-	dBm
$P_{L(1dB)}$	output power at 1 dB gain compression		-	11.5	-	dBm
$IP3_o$	output third-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	29	-	dBm
$IP2_o$	output second-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	72	-	dBm
$N_{flr(o)}$	output noise floor	no modulation present	-	–159	-	dBm/Hz
		modulation at MODI and MODQ[1]; $P_{o(RF)}$ = –10 dBm	-	–158.5	-	dBm/Hz
SBS	sideband suppression	unadjusted	-	49	-	dBc
CF	carrier feedthrough	unadjusted	-	–55	-	dBm

[1] MODI = MODI_P – MODI_N and MODQ = MODQ_P – MODQ_N.

Table 9. Characteristics at 1.840 GHz

Modulation source resistance per pin = 90 Ω; POFF_P connected to GND (shutdown disabled); V_{CC} = 5 V; T_{mb} range = –40 °C to +85 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz unless otherwise stated.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P_o	output power	1 V (p-p) differential on MODI and MODQ[1]	-	–0.2	-	dBm
$P_{L(1dB)}$	output power at 1 dB gain compression		-	11.5	-	dBm
$IP3_o$	output third-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	27	-	dBm
$IP2_o$	output second-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	69	-	dBm
$N_{flr(o)}$	output noise floor	no modulation present	-	–158.5	-	dBm/Hz
		modulation at MODI and MODQ[1]; $P_{o(RF)}$ = –10 dBm	-	–158	-	dBm/Hz
SBS	sideband suppression	unadjusted	-	47	-	dBc
CF	carrier feedthrough	unadjusted	-	–50	-	dBm

[1] MODI = MODI_P – MODI_N and MODQ = MODQ_P – MODQ_N.

Table 10. Characteristics at 1.960 GHz

Modulation source resistance per pin = 90 Ω; POFF_P connected to GND (shutdown disabled); V_{CC} = 5 V; T_{mb} range = –40 °C to +85 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz unless otherwise stated.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P_o	output power	1 V (p-p) differential on MODI and MODQ[1]	-	–0.2	-	dBm
$P_{L(1dB)}$	output power at 1 dB gain compression		-	11.5	-	dBm
$IP3_o$	output third-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	27	-	dBm
$IP2_o$	output second-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	72.5	-	dBm
$N_{flr(o)}$	output noise floor	no modulation present	-	–158.5	-	dBm/Hz
		modulation at MODI and MODQ[1]; $P_{o(RF)}$ = –10 dBm	-	–158	-	dBm/Hz
SBS	sideband suppression	unadjusted	-	49	-	dBc
CF	carrier feedthrough	unadjusted	-	–48	-	dBm

[1] MODI = MODI_P – MODI_N and MODQ = MODQ_P – MODQ_N.

Table 11. Characteristics at 2.140 GHz

Modulation source resistance per pin = 90 Ω; POFF_P connected to GND (shutdown disabled); V_{CC} = 5 V; T_{mb} range = –40 °C to +85 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz unless otherwise stated.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P_o	output power	1 V (p-p) differential on MODI and MODQ[1]	-	–0.2	-	dBm
$P_{L(1dB)}$	output power at 1 dB gain compression		-	11.5	-	dBm
$IP3_o$	output third-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	27	-	dBm
$IP2_o$	output second-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	74	-	dBm
$N_{flr(o)}$	output noise floor	no modulation present	-	–158.5	-	dBm/Hz
		modulation at MODI and MODQ[1]; $P_{o(RF)}$ = –10 dBm	-	–158	-	dBm/Hz
SBS	sideband suppression	unadjusted	-	51	-	dBc
CF	carrier feedthrough	unadjusted	-	–45	-	dBm

[1] MODI = MODI_P – MODI_N and MODQ = MODQ_P – MODQ_N.

Table 12. Characteristics at 2.650 GHz

Modulation source resistance per pin = 90 Ω; POFF_P connected to GND (shutdown disabled); V_{CC} = 5 V; T_{mb} range = –40 °C to +85 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz unless otherwise stated.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P_o	output power	1 V (p-p) differential on MODI and MODQ[1]	-	–0.2	-	dBm
$P_{L(1dB)}$	output power at 1 dB gain compression		-	11.5	-	dBm
$IP3_o$	output third-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	26	-	dBm
$IP2_o$	output second-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	62	-	dBm
$N_{flr(o)}$	output noise floor	no modulation present	-	–158	-	dBm/Hz
		modulation at MODI and MODQ[1]; $P_{o(RF)}$ = –10 dBm	-	–158	-	dBm/Hz
SBS	sideband suppression	unadjusted	-	60	-	dBc
CF	carrier feedthrough	unadjusted	-	–45	-	dBm

[1] MODI = MODI_P – MODI_N and MODQ = MODQ_P – MODQ_N.

Table 13. Characteristics at 3.650 GHz

Modulation source resistance per pin = 90 Ω; POFF_P connected to GND (shutdown disabled); V_{CC} = 5 V; T_{mb} range = –40 °C to +85 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz unless otherwise stated.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P_o	output power	1 V (p-p) differential on MODI and MODQ[1]	-	–0.2	-	dBm
$P_{L(1dB)}$	output power at 1 dB gain compression		-	11.5	-	dBm
$IP3_o$	output third-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	25	-	dBm
$IP2_o$	output second-order intercept point	IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm	-	60	-	dBm
$N_{flr(o)}$	output noise floor	no modulation present	-	–158	-	dBm/Hz
		modulation at MODI and MODQ[1]; $P_{o(RF)}$ = –10 dBm	-	–158	-	dBm/Hz
SBS	sideband suppression	unadjusted	-	53	-	dBc
CF	carrier feedthrough	unadjusted	-	–43	-	dBm

[1] MODI = MODI_P – MODI_N and MODQ = MODQ_P – MODQ_N.

12. Application information

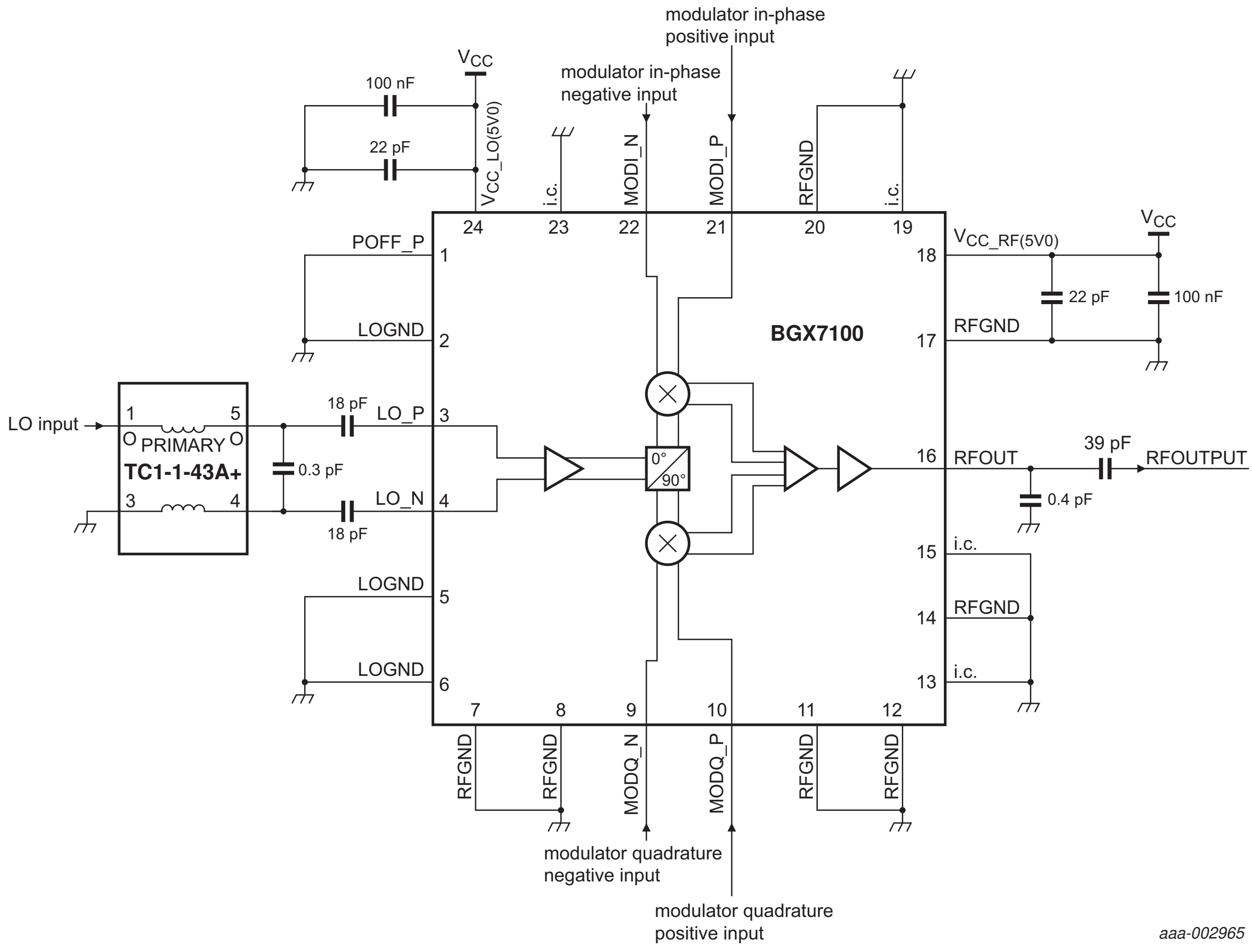


Fig 4. Typical wideband application diagram

Figure 4 shows a typical wideband (from 0.4 GHz to 4 GHz) application circuit. Refer to the application note for narrowband optimum component values.

12.1 External DAC interfacing

Nominal DAC single-ended output currents are between 0 mA and 20 mA.

If the DAC outputs are only designed for 1 V peak-to-peak differential (250 mV peak-single) then the single-ended impedance at the DAC needs to be limited to 25 Ω. This can be split as 50 Ω load resistors at the DAC outputs and a 225 Ω differential resistor in parallel to the modulator inputs (see Figure 5). In this way, the differential filter can be properly terminated by 100 Ω at both ends.

If the DAC outputs can withstand a higher swing without performance degradation, then 90 Ω load resistors can be placed at the DAC outputs. No external resistors are needed in this case, only the differential filter needs to be designed to have 180 Ω at both ends (see Figure 6).

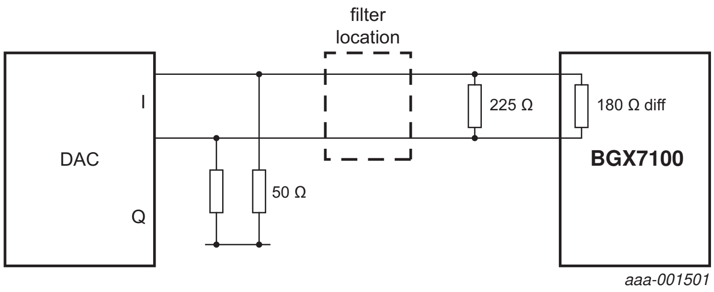


Fig 5. Typical low-power interface

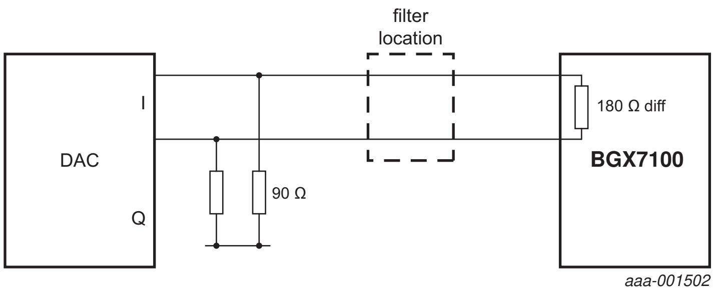


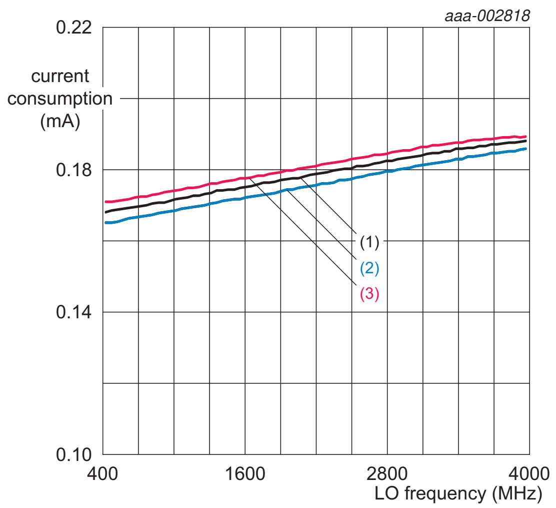
Fig 6. Typical high-power interface

12.2 RF

Good RF port matching typically requires some reactive components to tune-out residual inductance or capacitance. As the LO inputs and RF output are internally DC biased, both pins need a series AC-coupling capacitor.

13. Test information

Parameters for the following drawings: V_{CC} = 5 V; T_{mb} = 25 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz; IQ amplitude = 0.5 V (p-p) differential sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.



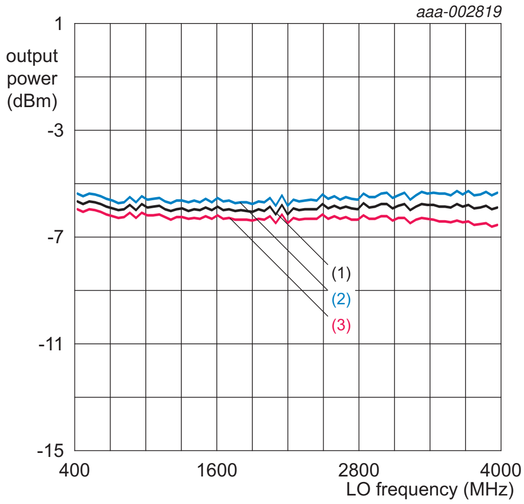
(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 7. Current consumption versus f_{lo} and T_{mb}

Parameters for the five following drawings: V_{CC} = 5 V; T_{mb} = 25 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz; IQ amplitude = 0.5 V (p-p) differential sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.

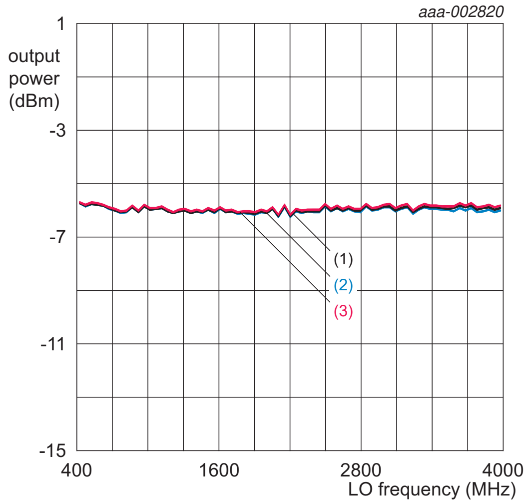


(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 8. P_o versus f_{lo} and T_{mb}

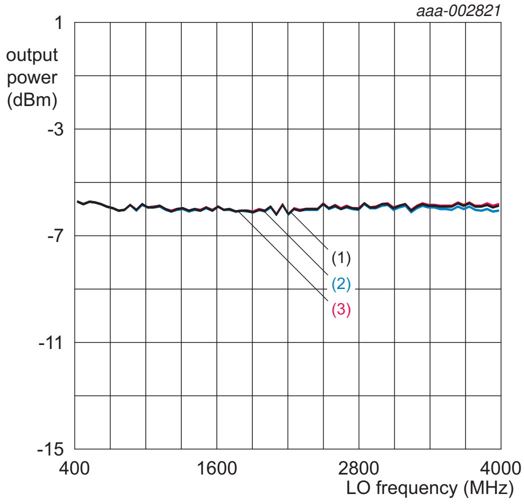


(1) V_{CC} = 5 V.

(2) V_{CC} = 4.75 V.

(3) V_{CC} = 5.25 V.

Fig 9. P_o versus f_{lo} and V_{CC}

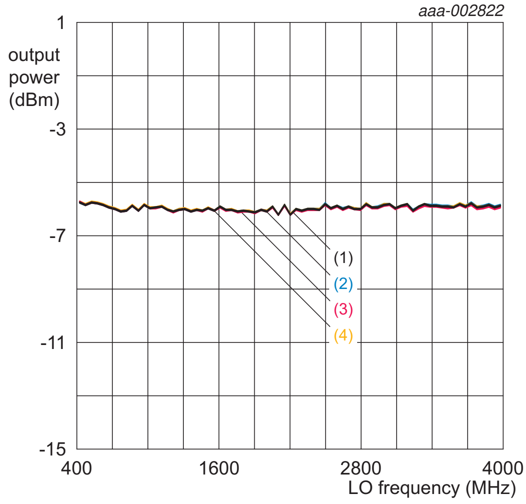


(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = −3 dBm.

(3) $P_{i(lo)}$ = +3 dBm.

Fig 10. P_o versus f_{lo} and $P_{i(lo)}$



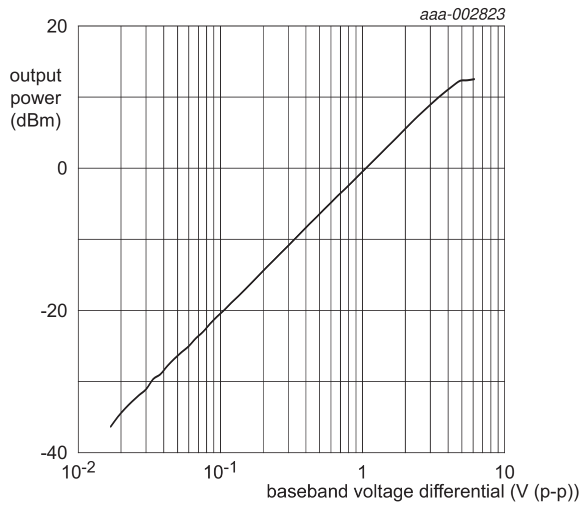
(1) $V_{i(cm)}$ = 0.5 V.

(2) $V_{i(cm)}$ = 0.25 V.

(3) $V_{i(cm)}$ = 1.5 V.

(4) $V_{i(cm)}$ = 2.5 V.

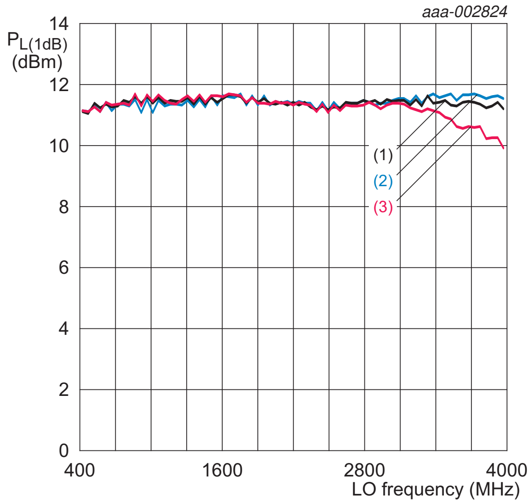
Fig 11. P_o versus f_{lo} and $V_{i(cm)}$



(1) f_{lo} = 2140 MHz.

Fig 12. P_o versus baseband voltage at 2140 MHz

Parameters for the four following drawings: V_{CC} = 5 V; T_{mb} = 25 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz; IQ amplitude = 0.5 V (p-p) differential sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.

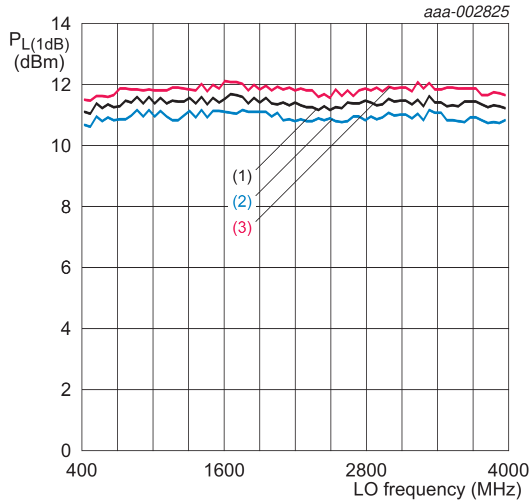


(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 13. $P_{L(1dB)}$ versus f_{lo} and T_{mb}

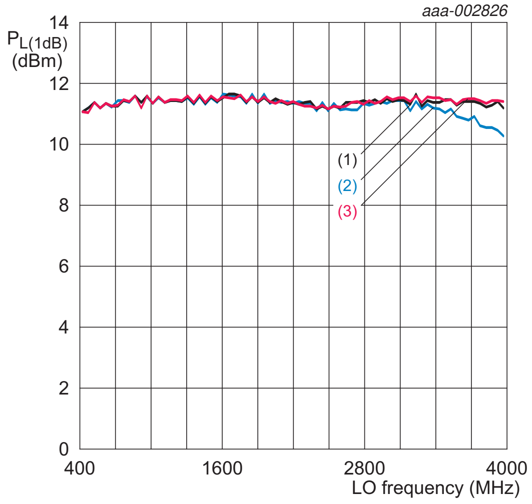


(1) V_{CC} = 5 V.

(2) V_{CC} = 4.75 V.

(3) V_{CC} = 5.25 V.

Fig 14. $P_{L(1dB)}$ versus f_{lo} and V_{CC}

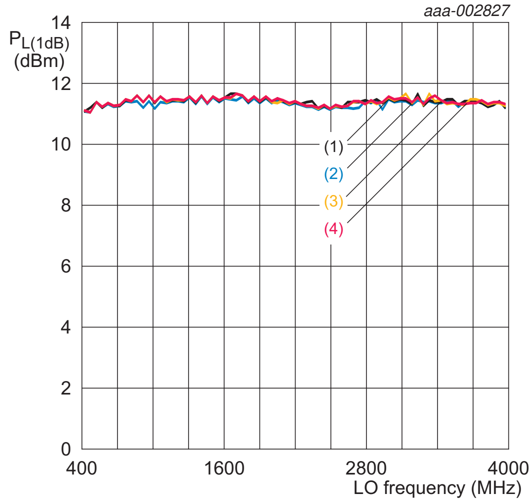


(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = −3 dBm.

(3) $P_{i(lo)}$ = +3 dBm.

Fig 15. $P_{L(1dB)}$ versus f_{lo} and $P_{i(lo)}$



(1) $V_{i(cm)}$ = 0.5 V.

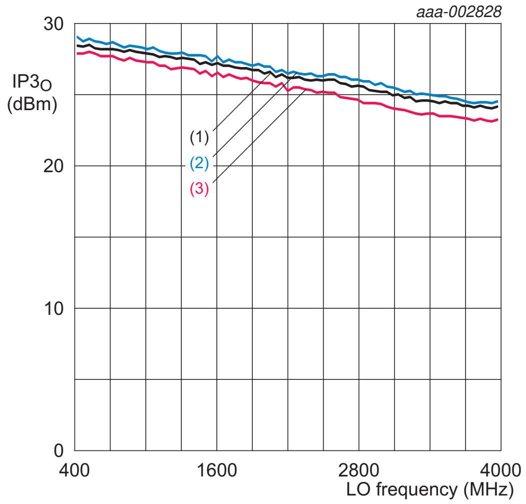
(2) $V_{i(cm)}$ = 0.25 V.

(3) $V_{i(cm)}$ = 1.5 V.

(4) $V_{i(cm)}$ = 2.5 V.

Fig 16. $P_{L(1dB)}$ versus f_{lo} and $V_{i(cm)}$

Parameters for the four following drawings: V_{CC} = 5 V; T_{mb} = 25 °C; $P_{i(lo)}$ = 0 dBm; two tones; tone 1: IQ frequency = 4.5 MHz and tone 2: IQ frequency = 5.5 MHz; P_o per tone = –10 dBm; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.

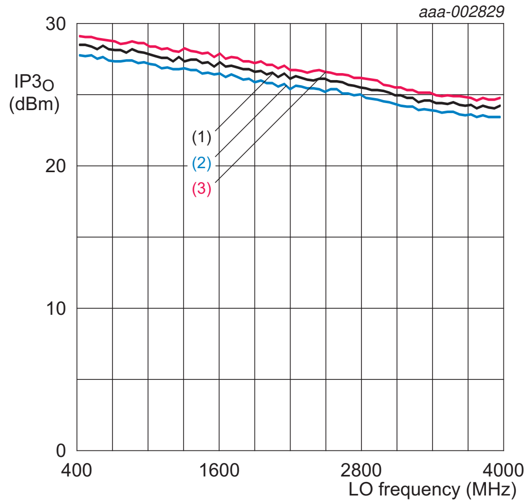


(1) T_{mb} = +25 °C.

(2) T_{mb} = –40 °C.

(3) T_{mb} = +85 °C.

Fig 17. $IP3_o$ versus f_{lo} and T_{mb}

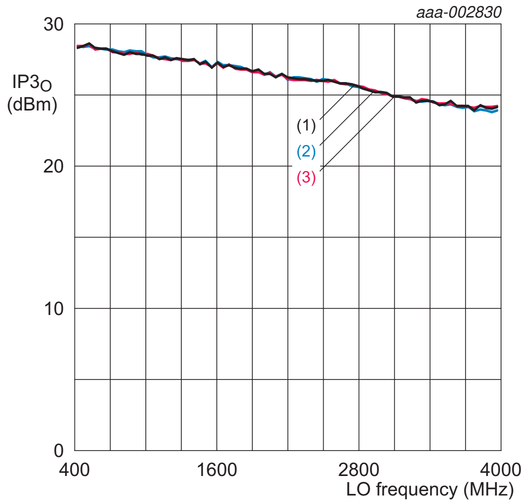


(1) V_{CC} = 5 V.

(2) V_{CC} = 4.75 V.

(3) V_{CC} = 5.25 V.

Fig 18. $IP3_o$ versus f_{lo} and V_{CC}

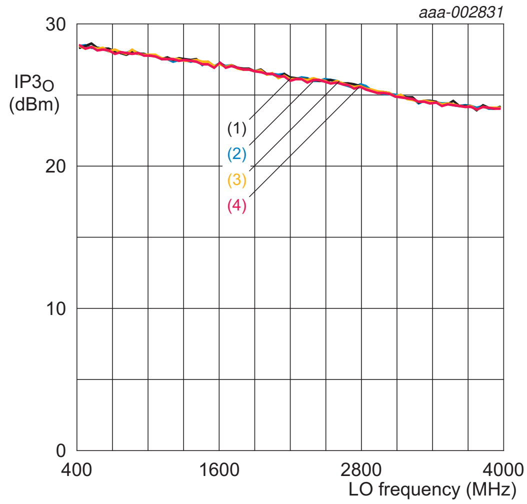


(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = –3 dBm.

(3) $P_{i(lo)}$ = +3 dBm.

Fig 19. $IP3_o$ versus f_{lo} and $P_{i(lo)}$



(1) $V_{i(cm)}$ = 0.5 V.

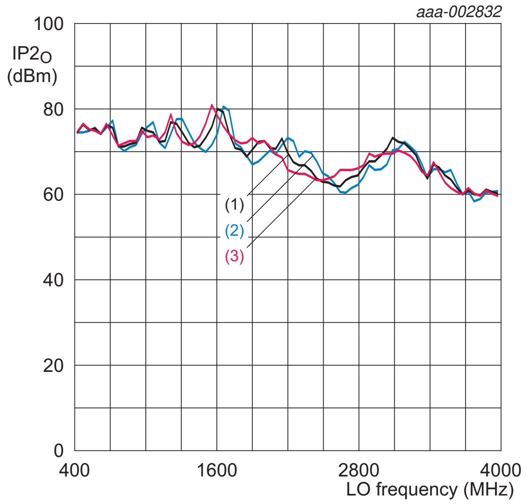
(2) $V_{i(cm)}$ = 0.25 V.

(3) $V_{i(cm)}$ = 1.5 V.

(4) $V_{i(cm)}$ = 2.5 V.

Fig 20. $IP3_o$ versus f_{lo} and $V_{i(cm)}$

Parameters for the four following drawings: V_{CC} = 5 V; T_{mb} = 25 °C; $P_{i(lo)}$ = 0 dBm; two tones; tone 1: IQ frequency = 4.5 MHz and tone 2: IQ frequency = 5.5 MHz; P_o per tone = –10 dBm; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.

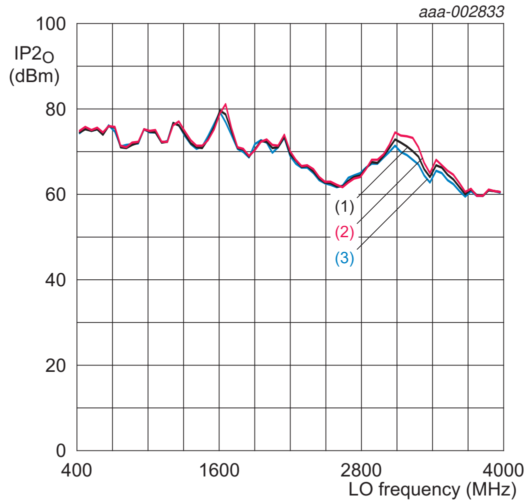


(1) T_{mb} = +25 °C.

(2) T_{mb} = –40 °C.

(3) T_{mb} = +85 °C.

Fig 21. $IP2_o$ versus f_{lo} and T_{mb}

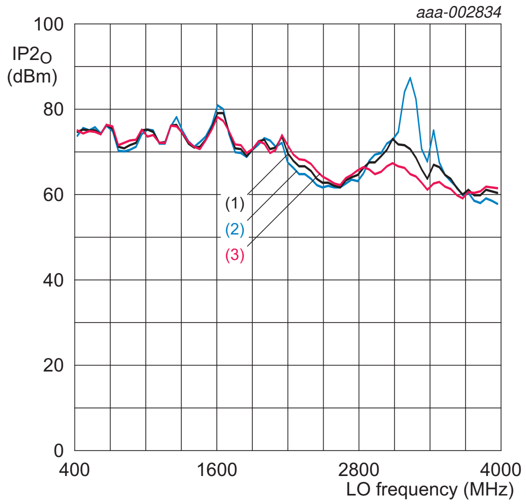


(1) V_{CC} = 5 V.

(2) V_{CC} = 4.75 V.

(3) V_{CC} = 5.25 V.

Fig 22. $IP2_o$ versus f_{lo} and V_{CC}

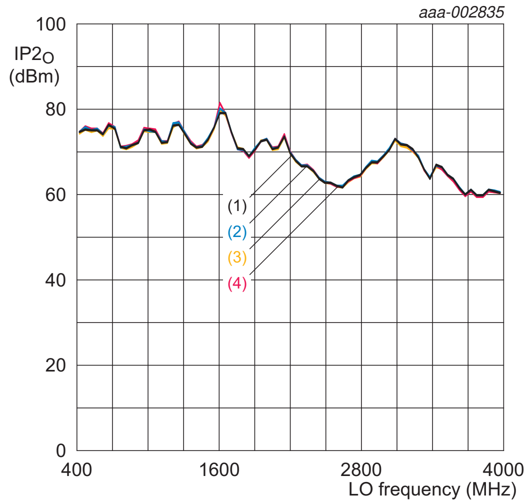


(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = –3 dBm.

(3) $P_{i(lo)}$ = +3 dBm.

Fig 23. $IP2_o$ versus f_{lo} and $P_{i(lo)}$



(1) $V_{i(cm)}$ = 0.5 V.

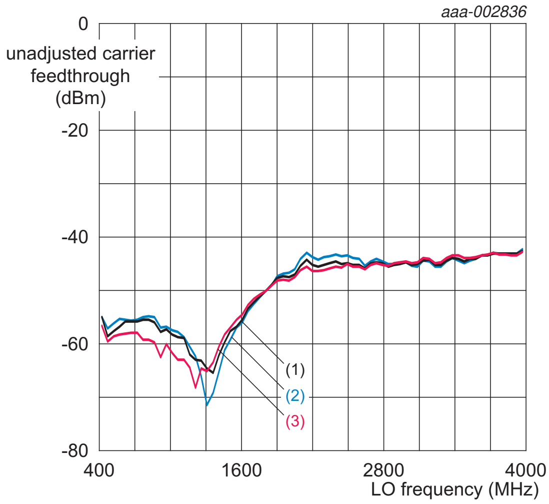
(2) $V_{i(cm)}$ = 0.25 V.

(3) $V_{i(cm)}$ = 1.5 V.

(4) $V_{i(cm)}$ = 2.5 V.

Fig 24. $IP2_o$ versus f_{lo} and $V_{i(cm)}$

Parameters for the five following drawings: V_{CC} = 5 V; T_{mb} = 25 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz; IQ amplitude = 0.5 V (p-p) differential sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.

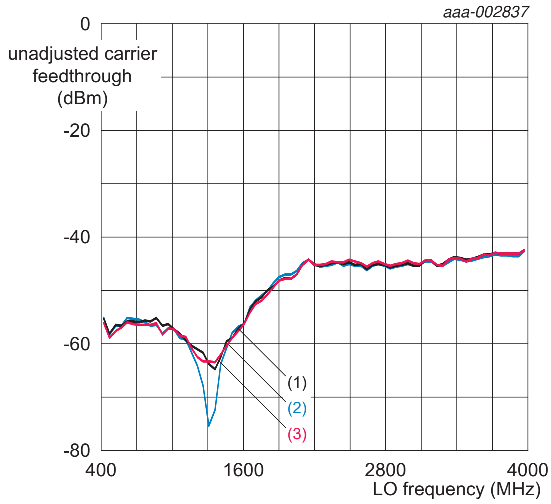


(1) T_{mb} = +25 °C.

(2) T_{mb} = –40 °C.

(3) T_{mb} = +85 °C.

Fig 25. Unadjusted CF versus f_{lo} and T_{mb}

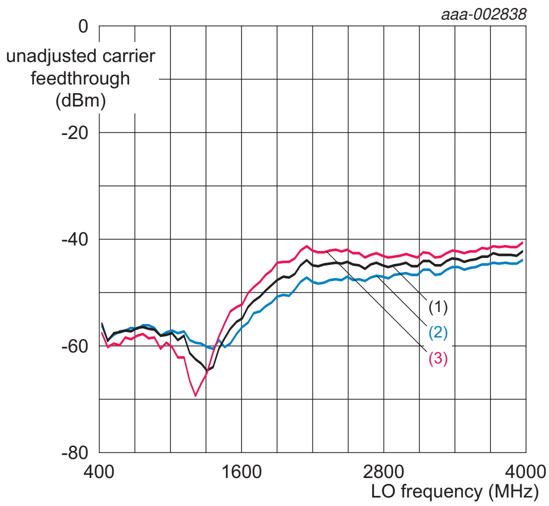


(1) V_{CC} = 5 V.

(2) V_{CC} = 4.75 V.

(3) V_{CC} = 5.25 V.

Fig 26. Unadjusted CF versus f_{lo} and V_{CC}

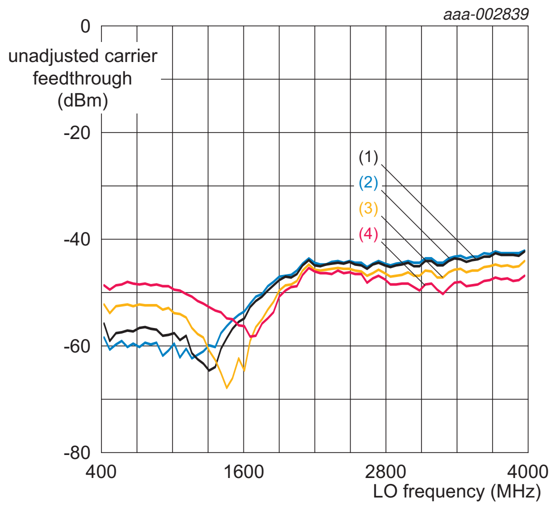


(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = –3 dBm.

(3) $P_{i(lo)}$ = +3 dBm.

Fig 27. Unadjusted CF versus f_{lo} and $P_{i(lo)}$



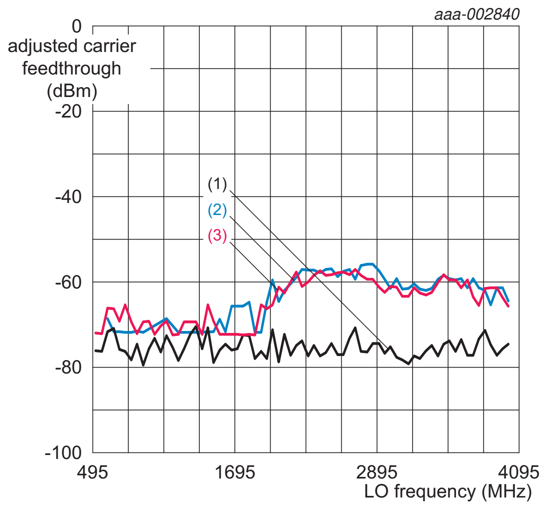
(1) $V_{i(cm)}$ = 0.5 V.

(2) $V_{i(cm)}$ = 0.25 V.

(3) $V_{i(cm)}$ = 1.5 V.

(4) $V_{i(cm)}$ = 2.5 V.

Fig 28. Unadjusted CF versus f_{lo} and $V_{i(cm)}$



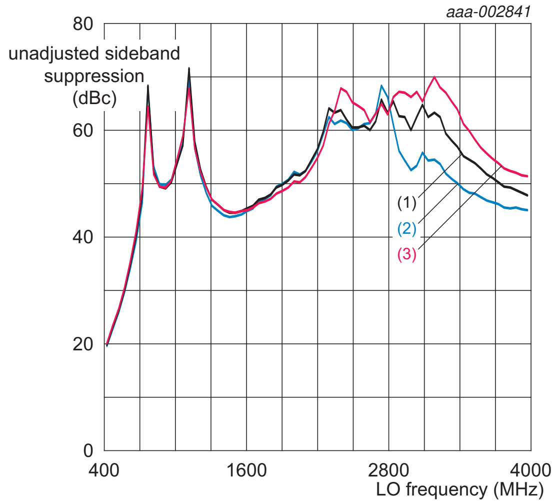
(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 29. Adjusted CF versus f_{lo} and T_{mb} after nulling at 25 °C

Parameters for the five following drawings: V_{CC} = 5 V; T_{mb} = 25 °C; $P_{i(lo)}$ = 0 dBm; IQ frequency = 5 MHz; IQ amplitude = 0.5 V (p-p) differential sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.

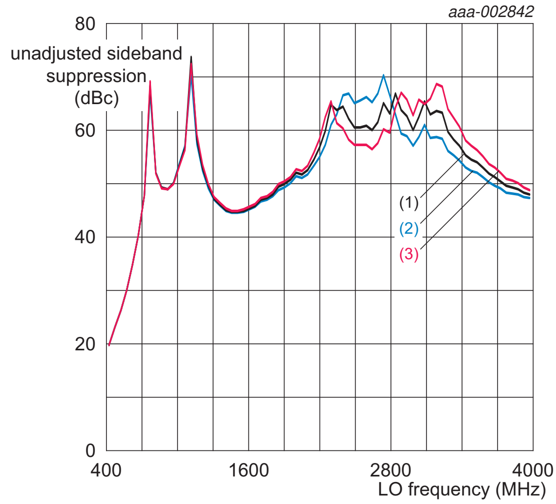


(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 30. Unadjusted SBS versus f_{lo} and T_{mb}

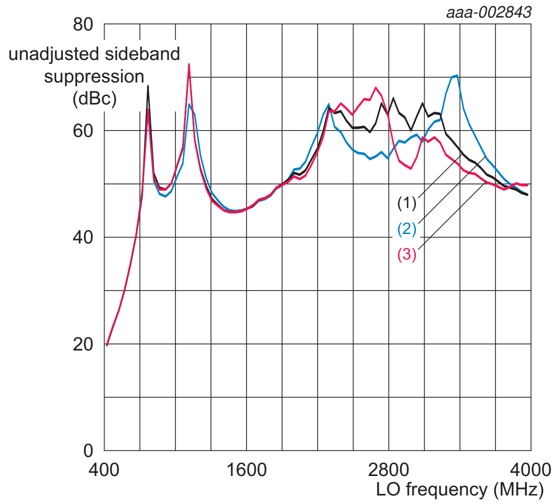


(1) V_{CC} = 5 V.

(2) V_{CC} = 4.75 V.

(3) V_{CC} = 5.25 V.

Fig 31. Unadjusted SBS versus f_{lo} and V_{CC}

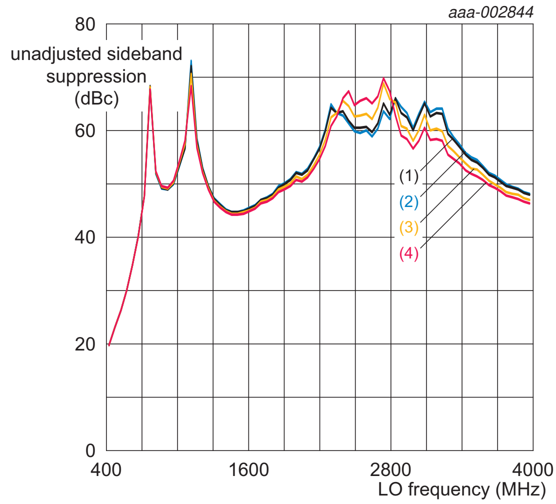


(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = −3 dBm.

(3) $P_{i(lo)}$ = +3 dBm.

Fig 32. Unadjusted SBS versus f_{lo} and $P_{i(lo)}$



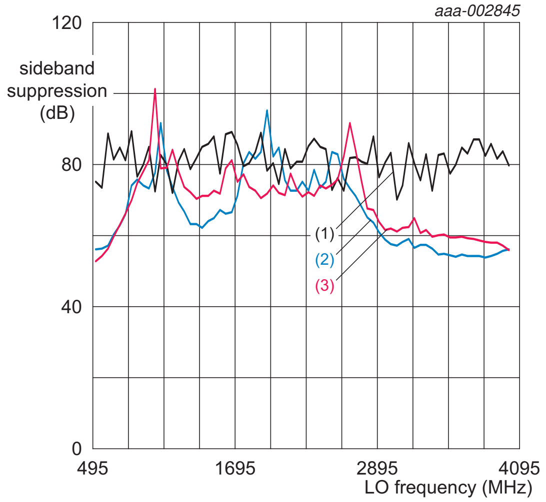
(1) $V_{i(cm)}$ = 0.5 V.

(2) $V_{i(cm)}$ = 0.25 V.

(3) $V_{i(cm)}$ = 1.5 V.

(4) $V_{i(cm)}$ = 2.5 V.

Fig 33. Unadjusted SBS versus f_{lo} and $V_{i(cm)}$



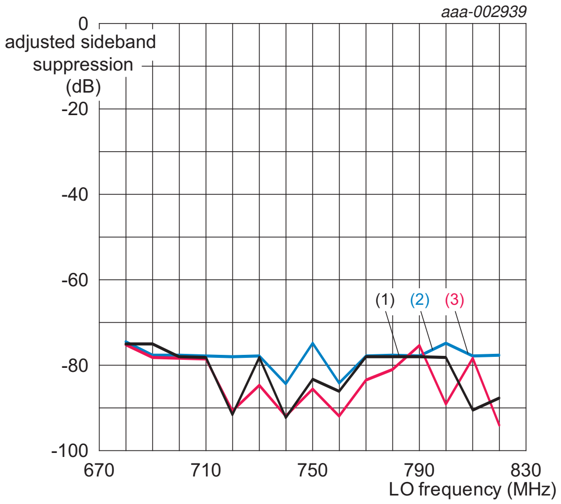
(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 34. Adjusted SBS versus f_{lo} and T_{mb} after nulling at 25 °C

Parameters for the six following drawings: V_{CC} = 5 V; T_{mb} = 25 °C; LO = 0 dBm; IQ frequency = 5 MHz; IQ amplitude = 0.25 V (p-p) single-ended sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.



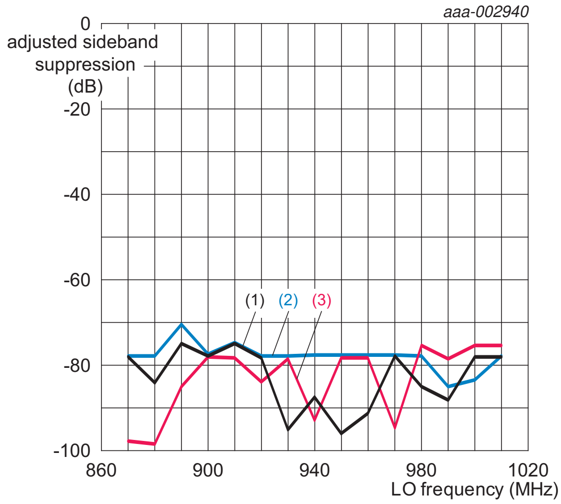
Adjusted at 750 MHz and after nulling T_{mb} at 25 °C

(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 35. Adjusted CF versus f_{lo} and T_{mb} (750 LTE band)



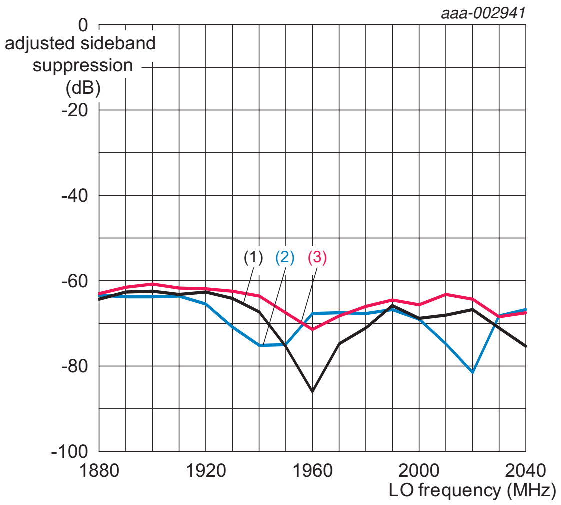
Adjusted at 942.5 MHz and after nulling T_{mb} at 25 °C

(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 36. Adjusted CF versus f_{lo} and T_{mb} (GSM band)



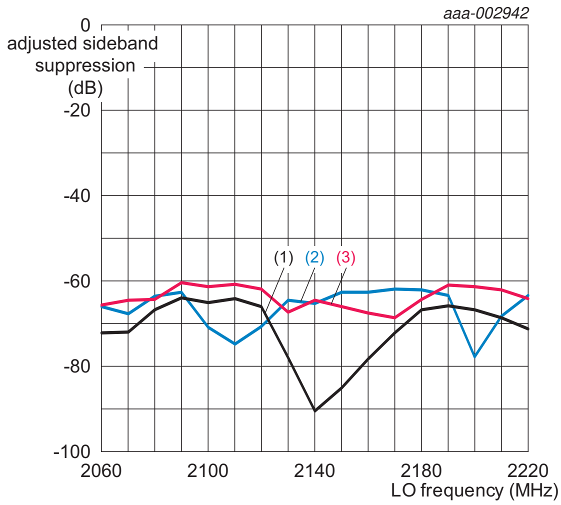
Adjusted at 1840 MHz and after nulling T_{mb} at 25 °C

(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 37. Adjusted CF versus f_{lo} and T_{mb} (PCS band)



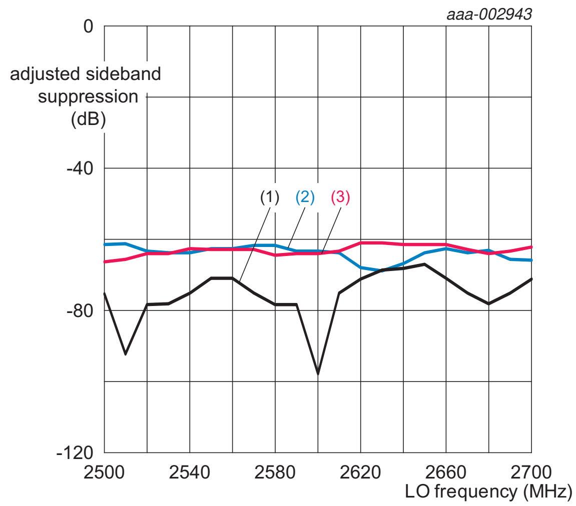
Adjusted at 2140 MHz and after nulling T_{mb} at 25 °C

(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 38. Adjusted CF versus f_{lo} and T_{mb} (UMTS band)



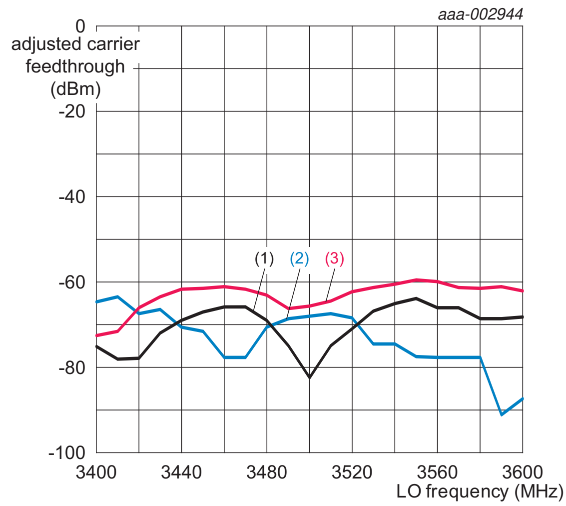
Adjusted at 2600 MHz and after nulling T_{mb} at 25 °C

(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 39. Adjusted CF versus f_{lo} and T_{mb} (2.6 GHz LTE band)



Adjusted at 3500 MHz and after nulling T_{mb} at 25 °C

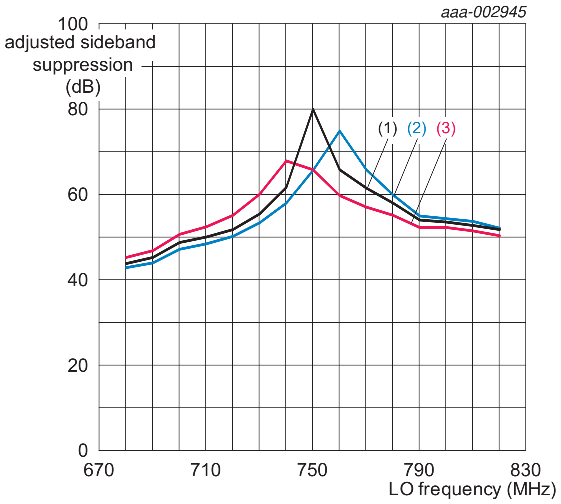
(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 40. Adjusted CF versus f_{lo} and T_{mb} (Wi MAX/LTE band)

Parameters for the six following drawings: V_{CC} = 5 V; T_{mb} = 25 °C; LO = 0 dBm; IQ frequency = 5 MHz; IQ amplitude = 0.25 V (p-p) single-ended sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.



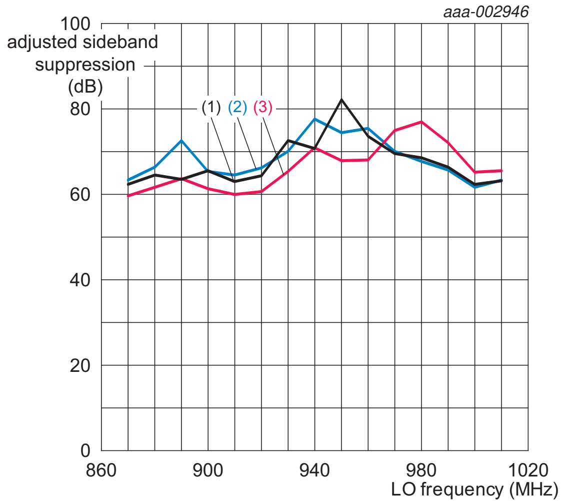
Adjusted at 750 MHz and after nulling T_{mb} at 25 °C

(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 41. Adjusted SBS versus f_{lo} and T_{mb} (750 LTE band)



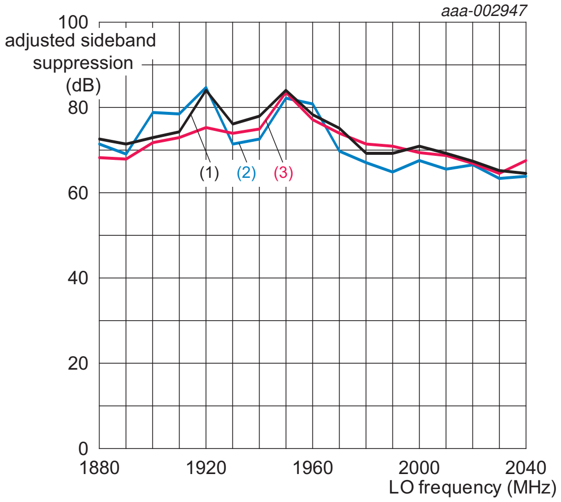
Adjusted at 942.5 MHz and after nulling T_{mb} at 25 °C

(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 42. Adjusted SBS versus f_{lo} and T_{mb} (GSM900 band)



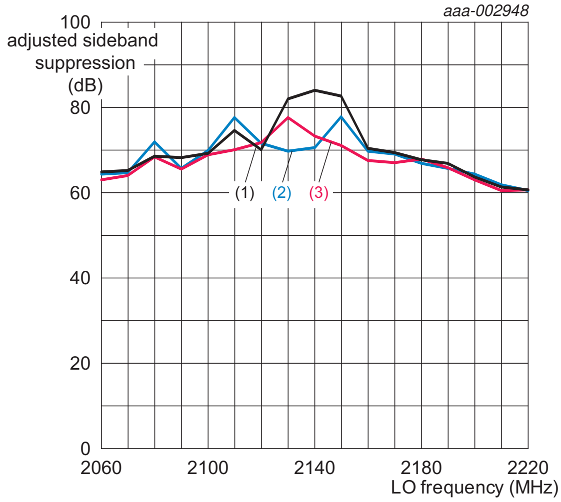
Adjusted at 1840 MHz and after nulling T_{mb} at 25 °C

(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 43. Adjusted SBS versus f_{lo} and T_{mb} (PCS band)



Adjusted at 2140 MHz and after nulling T_{mb} at 25 °C

(1) T_{mb} = +25 °C.

(2) T_{mb} = −40 °C.

(3) T_{mb} = +85 °C.

Fig 44. Adjusted SBS versus f_{lo} and T_{mb} (UMTS band)