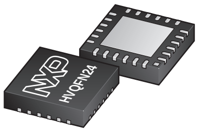



# BGX7101

## Transmitter IQ modulator

Rev. 5 — 25 January 2017 | Product data sheet

## 1. General description

The BGX7101 is, also known as the BTS8001A, a 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 BGX7101 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
- 100 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 BGX7101 operates in the RF frequency range of 400 MHz to 4000 MHz with modulation bandwidths up to 650 MHz.

# 5. Ordering information

**Table 1. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| BGX7101HN | HVQFN24 | plastic thermal enhanced very thin quad flat package; no leads; 24 terminals; body 4 × 4 × 0.85 mm | SOT616-3 |

# 6. Functional diagram

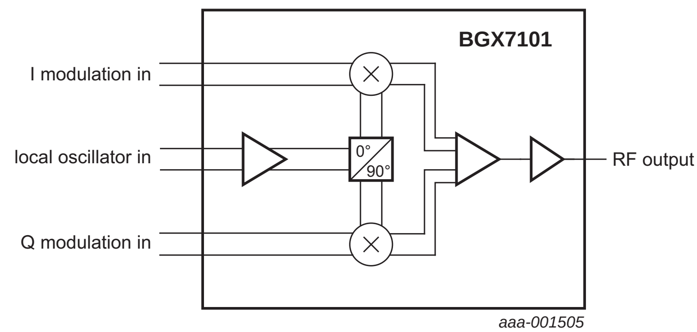



**Fig 1. Functional block diagram**

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 BGX7101 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”.

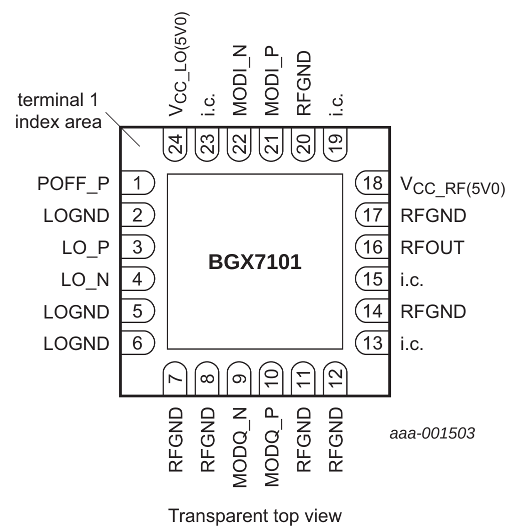



**Fig 2. Pin configuration**

## 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 100 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.

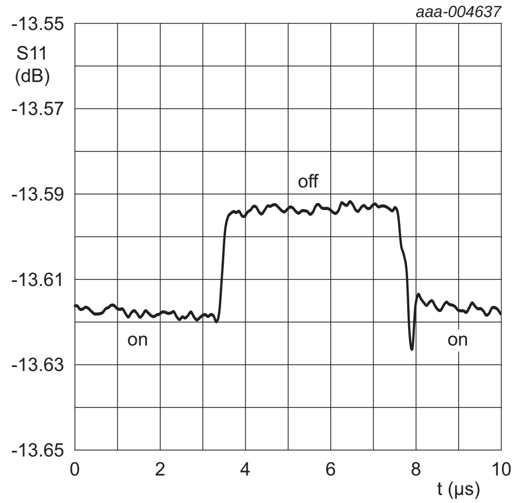



**Fig 3. LO input return loss variation (S11_LO)**

## 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 | –1 | +1 | 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 = 50 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 | - | 172 | - | mA |
| | | $f_{lo}$ = 2 GHz | - | 180 | - | mA |
| | | $f_{lo}$ = 2.5 GHz | - | 182 | - | mA |
| | | $f_{lo}$ = 3.5 GHz | - | 188 | - | 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; $R_S$ = 50 Ω | - | 650 | - | MHz |
| $R_{i(dif)}$ | differential input resistance | | - | 100 | - | 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 = 50 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] | | - | 4 | - | dBm |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | | - | 12 | - | 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 | | - | 28 | - | 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 | | - | 63 | - | dBc |
| CF | carrier feedthrough | unadjusted | | - | −51 | - | dBm |
| $\alpha_{HD(bb)}$ | baseband harmonic distortion level | harmonic distortion at $f_{LO}$ + 2 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 76 | - | dBc |
| | | harmonic distortion at $f_{LO}$ + 3 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 89 | - | dBc |

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

[2] Measurements done in supradyne mode.

**Table 8. Characteristics at 910 MHz**

*Modulation source resistance per pin = 50 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] | - | 4 | - | dBm |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | - | 12 | - | 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 | - | 28 | - | 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 | - | 75 | - | dBm |

**Table 8. Characteristics at 910 MHz** *…continued*

*Modulation source resistance per pin = 50 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 |
|---|---|---|---|---|---|---|---|
| $N_{flr(o)}$ | 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 | | - | –57 | - | dBm |
| $\alpha_{HD(bb)}$ | baseband harmonic distortion level | harmonic distortion at $f_{LO}$ + 2 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 77 | - | dBc |
| | | harmonic distortion at $f_{LO}$ + 3 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 92 | - | dBc |

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

[2] Measurements done in supradyne mode.

**Table 9. Characteristics at 1.840 GHz**

*Modulation source resistance per pin = 50 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] | | - | 4 | - | dBm |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | | - | 12 | - | 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 | | - | 71 | - | 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 | | - | 55 | - | dBc |
| CF | carrier feedthrough | unadjusted | | - | –50 | - | dBm |
| $\alpha_{HD(bb)}$ | baseband harmonic distortion level | harmonic distortion at $f_{LO}$ + 2 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 84 | - | dBc |
| | | harmonic distortion at $f_{LO}$ + 3 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 86 | - | dBc |

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

[2] Measurements done in supradyne mode.

**Table 10. Characteristics at 1.960 GHz**
*Modulation source resistance per pin = 50 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] | | - | 4 | - | dBm |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | | - | 12 | - | 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 | - | 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 | | - | 57 | - | dBc |
| CF | carrier feedthrough | unadjusted | | - | –47 | - | dBm |
| $\alpha_{HD(bb)}$ | baseband harmonic distortion level | harmonic distortion at $f_{LO}$ + 2 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 72 | - | dBc |
| | | harmonic distortion at $f_{LO}$ + 3 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 86 | - | dBc |

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

[2] Measurements done in supradyne mode.

**Table 11. Characteristics at 2.140 GHz**
*Modulation source resistance per pin = 50 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] | - | 4 | - | dBm |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | - | 12 | - | 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 |

**Table 11. Characteristics at 2.140 GHz** *…continued*

*Modulation source resistance per pin = 50 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 |
|---|---|---|---|---|---|---|---|
| $IP2_o$ | output second-order intercept point | IQ frequency 1 = 4.5 MHz; IQ frequency 2 = 5.5 MHz; output power per tone = –10 dBm | | - | 75 | - | 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 | | - | 63 | - | dBc |
| CF | carrier feedthrough | unadjusted | | - | –45 | - | dBm |
| $\alpha_{HD(bb)}$ | baseband harmonic distortion level | harmonic distortion at $f_{LO}$ + 2 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 68 | - | dBc |
| | | harmonic distortion at $f_{LO}$ + 3 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 86 | - | dBc |

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

[2] Measurements done in supradyne mode.

**Table 12. Characteristics at 2.650 GHz**

*Modulation source resistance per pin = 50 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] | - | 4 | - | dBm |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | - | 12 | - | 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 | - | 65 | - | 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 | - | 50 | - | dBc |

**Table 12. Characteristics at 2.650 GHz** *...continued*

*Modulation source resistance per pin = 50 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 |
|---|---|---|---|---|---|---|---|
| CF | carrier feedthrough | unadjusted | | - | –45 | - | dBm |
| $\alpha_{HD(bb)}$ | baseband harmonic distortion level | harmonic distortion at $f_{LO}$ + 2 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 65 | - | dBc |
| | | harmonic distortion at $f_{LO}$ + 3 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 88 | - | dBc |

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

[2] Measurements done in supradyne mode.

**Table 13. Characteristics at 3.650 GHz**

*Modulation source resistance per pin = 50 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] | | - | 4 | - | dBm |
| $P_{L(1dB)}$ | output power at 1 dB gain compression | | | - | 12 | - | 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 | | - | 64 | - | 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 | | - | 57 | - | dBc |
| CF | carrier feedthrough | unadjusted | | - | –42 | - | dBm |
| $\alpha_{HD(bb)}$ | baseband harmonic distortion level | harmonic distortion at $f_{LO}$ + 2 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 64 | - | dBc |
| | | harmonic distortion at $f_{LO}$ + 3 × baseband frequency measured with 1 MHz tone at 1 V (p-p) differential | [2] | - | 80 | - | dBc |

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

[2] Measurements done in supradyne mode.

## 12. Application information

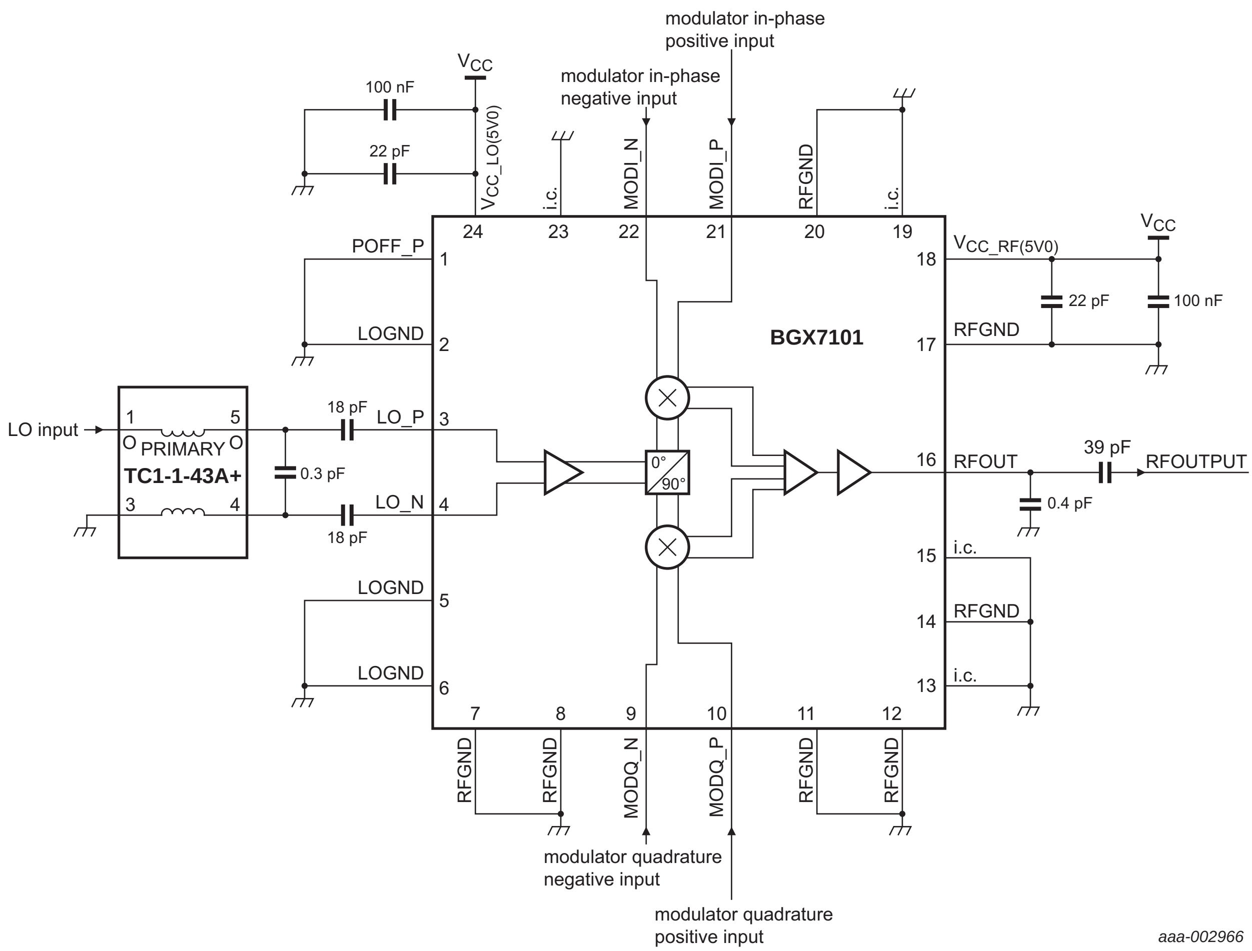



**Fig 4. Typical wideband application diagram**

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 to 20 mA. When driving into 25 Ω impedance, this creates 250 mV peak-single signal (1 V (p-p) differential). Half of the impedance is placed at the DAC outputs as 50 Ω load resistors, the other half is provided by the modulator itself. In this way, the differential filter can be properly terminated by 100 Ω at both ends.

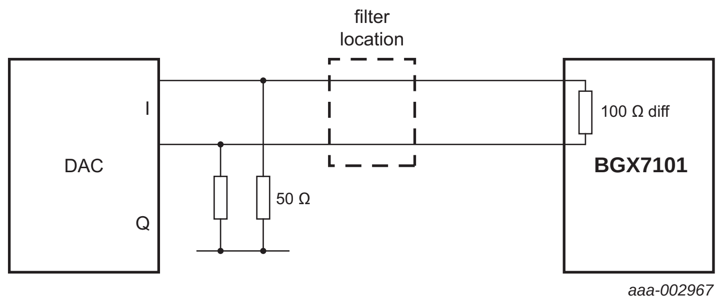


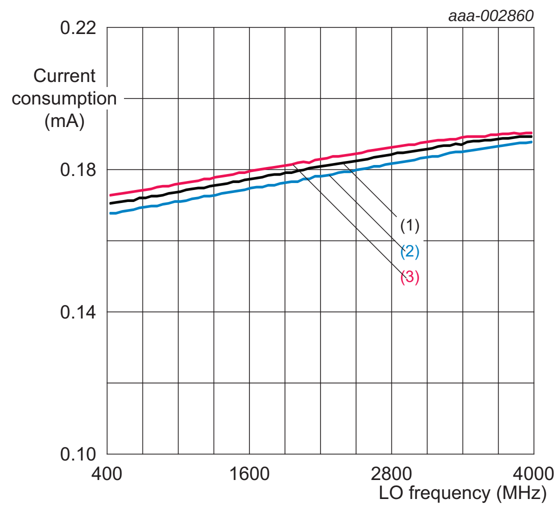

**Fig 5. Typical interface**

## 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 = 0.42 V (p-p) differential sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.



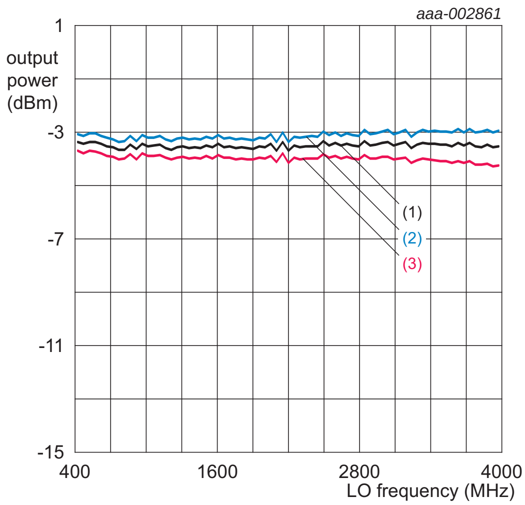

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 6. 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 = 0.42 V (p-p) differential sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.

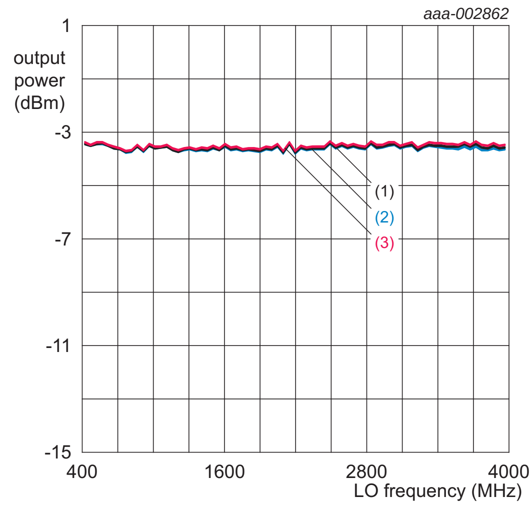



(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 7. $P_o$ versus $f_{lo}$ and $T_{mb}$**

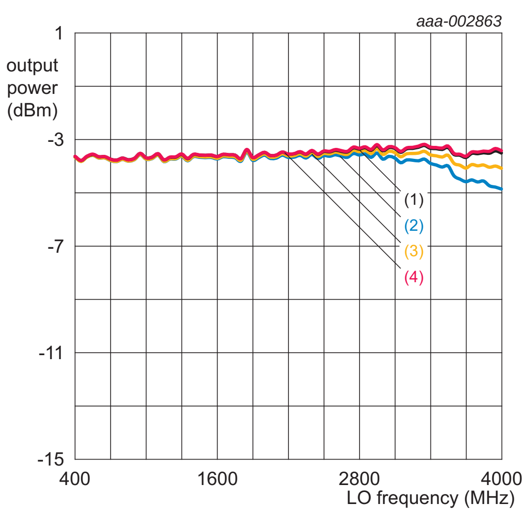



(1) $V_{CC}$ = 5 V.

(2) $V_{CC}$ = 4.75 V.

(3) $V_{CC}$ = 5.25 V

**Fig 8. $P_o$ versus $f_{lo}$ and $V_{CC}$**



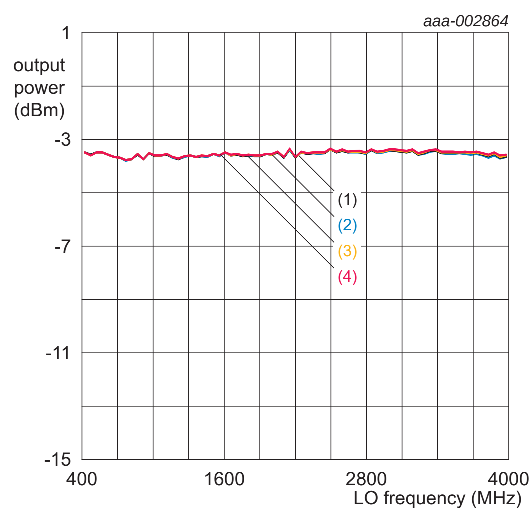

(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = −9 dBm.

(3) $P_{i(lo)}$ = −6 dBm.

(4) $P_{i(lo)}$ = +6 dBm.

**Fig 9. $P_o$ versus $f_{lo}$ and $P_{i(lo)}$**



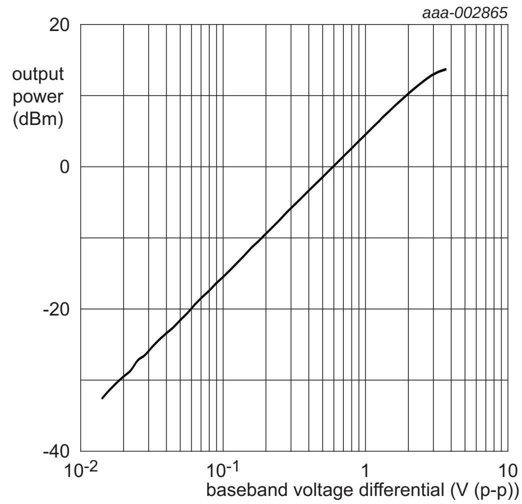

(1) $V_{i(cm)}$ = 0.5 V.

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

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

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

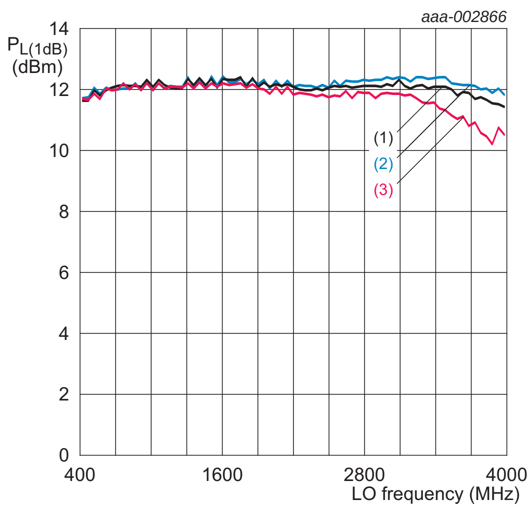
**Fig 10. $P_o$ versus $f_{lo}$ and $V_{i(cm)}$**




(1) $f_{lo}$ = 2140 MHz.

**Fig 11. $P_o$ 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 = 0.42 V (p-p) differential sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.

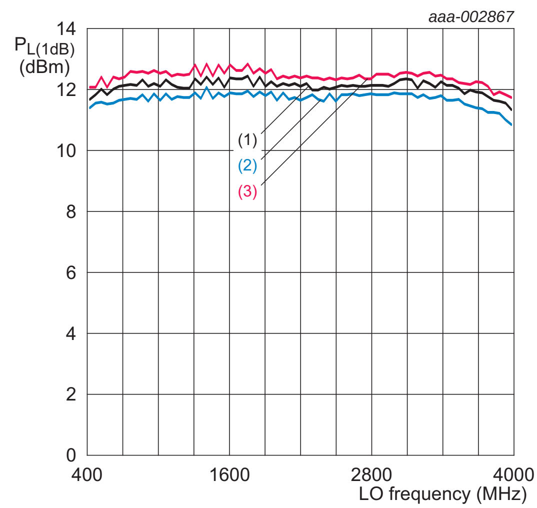



(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 12. $P_{L(1dB)}$ versus $f_{lo}$ and $T_{mb}$**

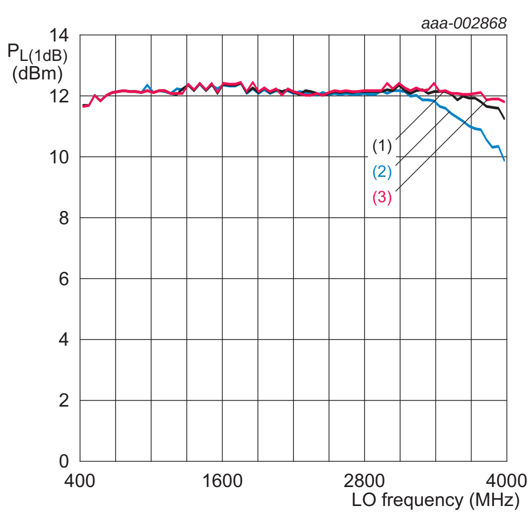



(1) $V_{CC}$ = 5 V.

(2) $V_{CC}$ = 4.75 V.

(3) $V_{CC}$ = 5.25 V.

**Fig 13. $P_{L(1dB)}$ versus $f_{lo}$ and $V_{CC}$**

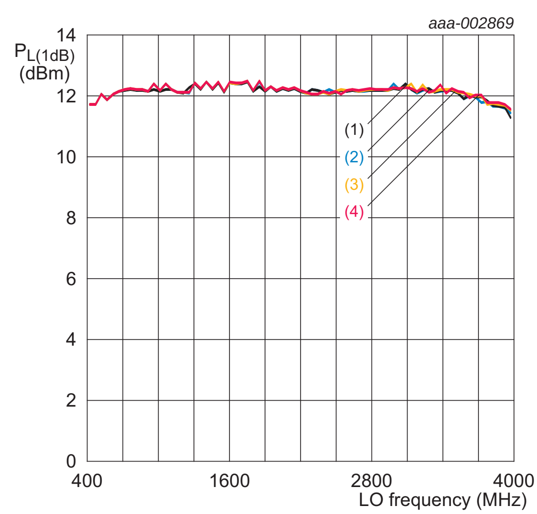



(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = −3 dBm.

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

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




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

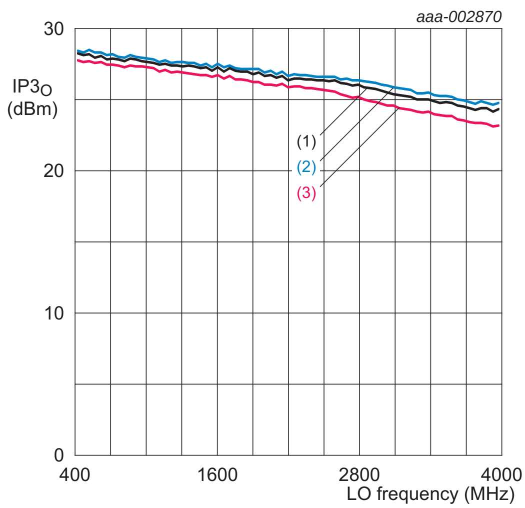
(2) $V_{i(cm)}$ = 0.25 V.

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

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

**Fig 15. $P_{L(1dB)}$ 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.

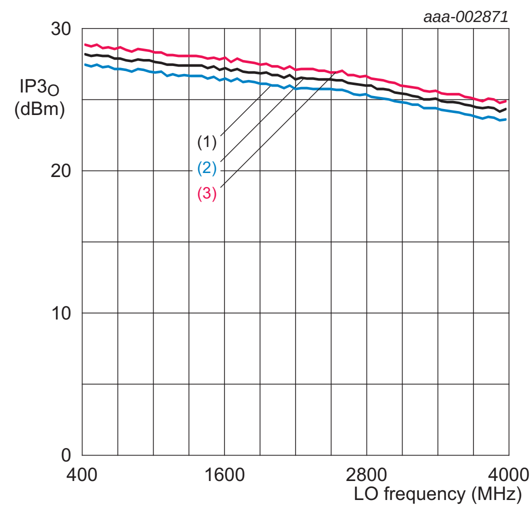



(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = –40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 16. $IP3_o$ versus $f_{lo}$ and $T_{mb}$**

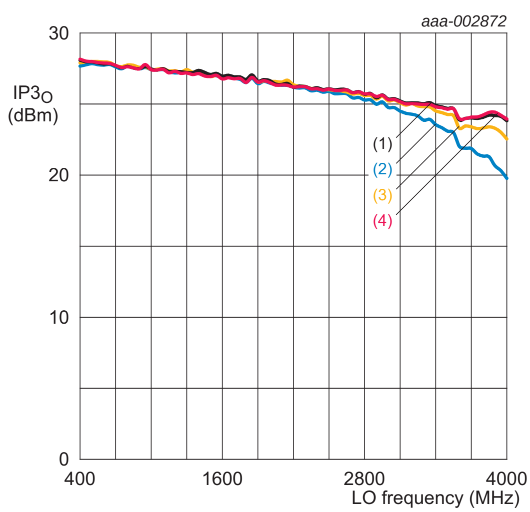



(1) $V_{CC}$ = 5 V.

(2) $V_{CC}$ = 4.75 V.

(3) $V_{CC}$ = 5.25 V.

**Fig 17. $IP3_o$ versus $f_{lo}$ and $V_{CC}$**



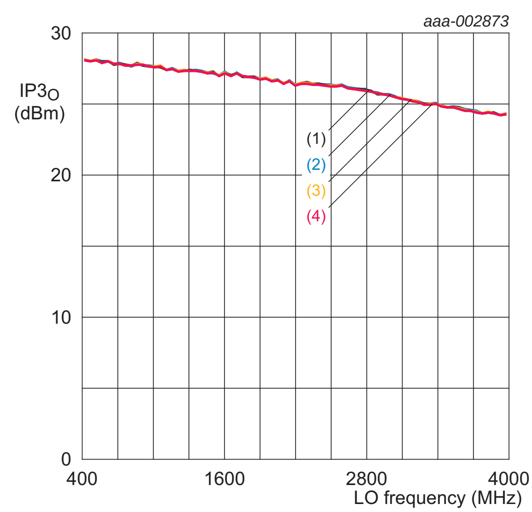

(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = –9 dBm.

(3) $P_{i(lo)}$ = –6 dBm.

(4) $P_{i(lo)}$ = +6 dBm.

**Fig 18. $IP3_o$ versus $f_{lo}$ and $P_{i(lo)}$**




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

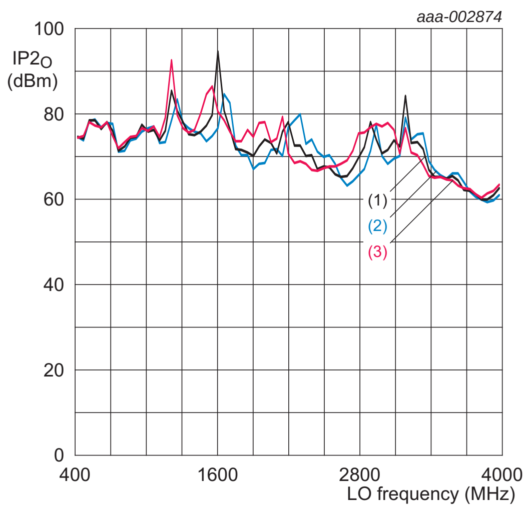
(2) $V_{i(cm)}$ = 0.25 V.

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

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

**Fig 19. $IP3_o$ 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.

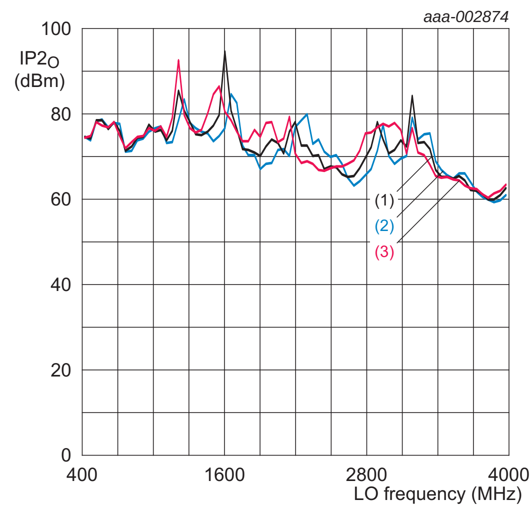



(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = –40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 20. $IP2_o$ versus $f_{lo}$ and $T_{mb}$**

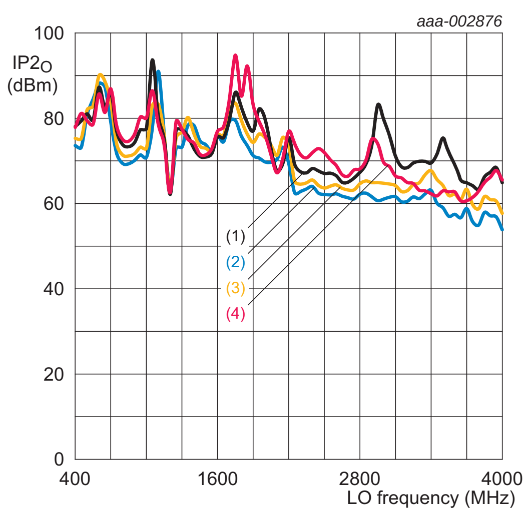



(1) $V_{CC}$ = 5 V.

(2) $V_{CC}$ = 4.75 V.

(3) $V_{CC}$ = 5.25 V.

**Fig 21. $IP2_o$ versus $f_{lo}$ and $V_{CC}$**



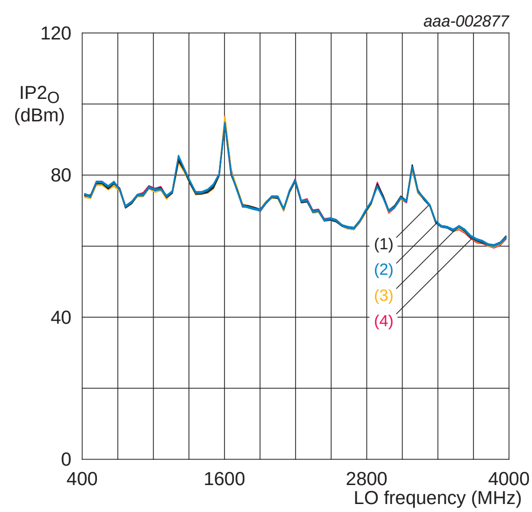

(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = –9 dBm.

(3) $P_{i(lo)}$ = –6 dBm.

(4) $P_{i(lo)}$ = +6 dBm.

**Fig 22. $IP2_o$ versus $f_{lo}$ and $P_{i(lo)}$**




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

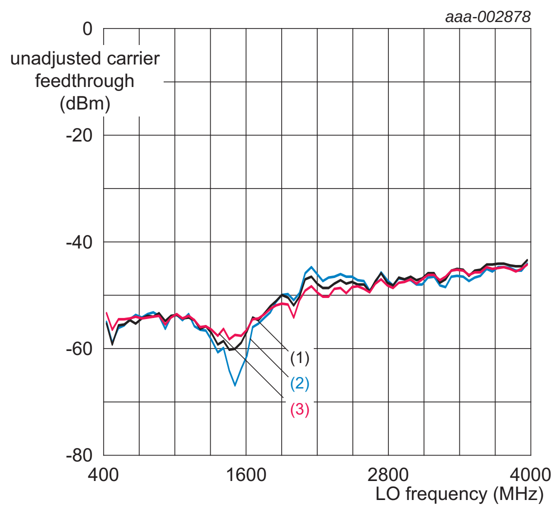
(2) $V_{i(cm)}$ = 0.25 V.

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

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

**Fig 23. $IP2_o$ 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 = 0.42 V (p-p) differential sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.

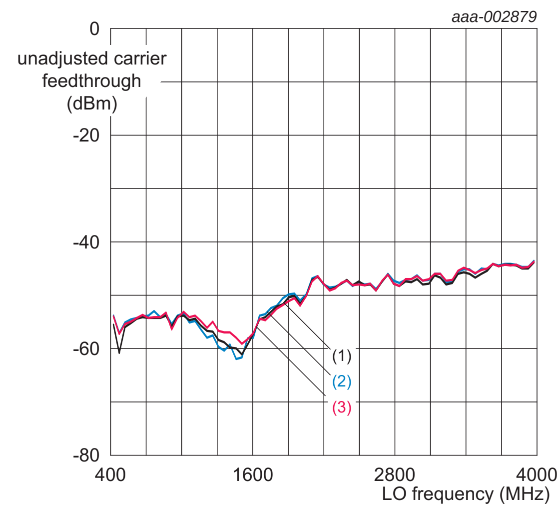



(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 24. Unadjusted CF versus $f_{lo}$ and $T_{mb}$**

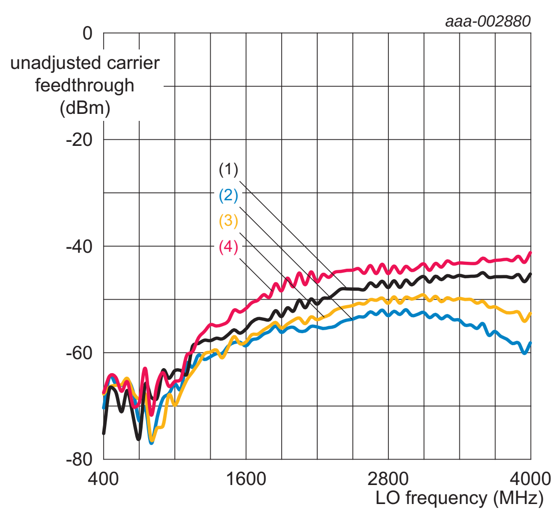



(1) $V_{CC}$ = 5 V.

(2) $V_{CC}$ = 4.75 V.

(3) $V_{CC}$ = 5.25 V.

**Fig 25. Unadjusted CF versus $f_{lo}$ and $V_{CC}$**



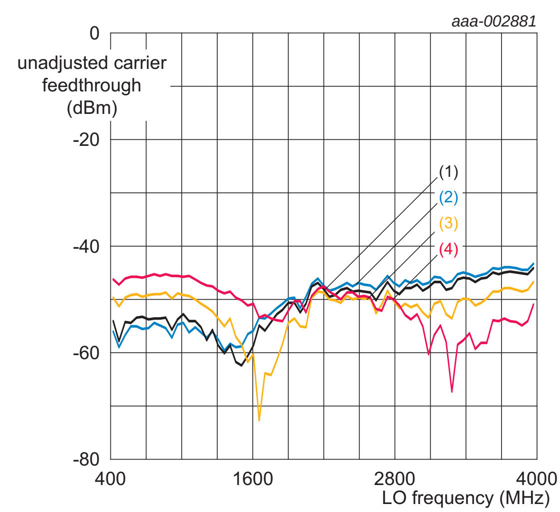

(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = −9 dBm.

(3) $P_{i(lo)}$ = −6 dBm.

(4) $P_{i(lo)}$ = +6 dBm.

**Fig 26. Unadjusted CF versus $f_{lo}$ and $P_{i(lo)}$**



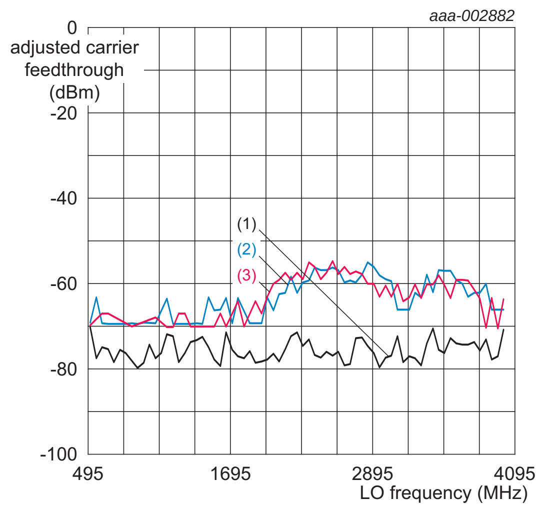

(1) $V_{i(cm)}$ = 0.5 V.

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

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

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

**Fig 27. Unadjusted CF versus $f_{lo}$ and $V_{i(cm)}$**



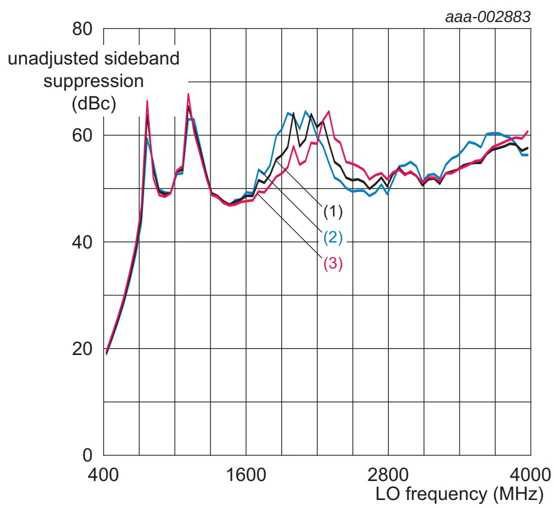

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 28. 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 = 0.42 V (p-p) differential sine wave; $V_{i(cm)}$ = 0.5 V; broadband output match; unless otherwise specified.

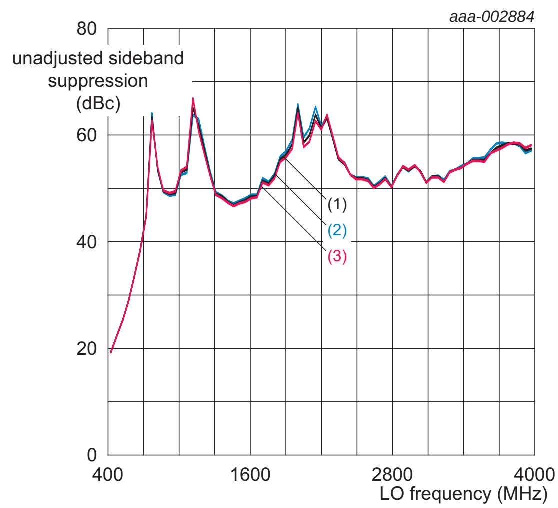



(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 29. Unadjusted SBS versus $f_{lo}$ and $T_{mb}$**

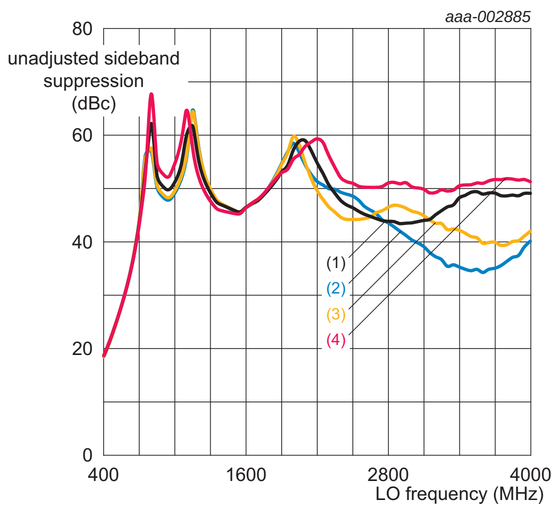



(1) $V_{CC}$ = 5 V.

(2) $V_{CC}$ = 4.75 V.

(3) $V_{CC}$ = 5.25 V.

**Fig 30. Unadjusted SBS versus $f_{lo}$ and $V_{CC}$**



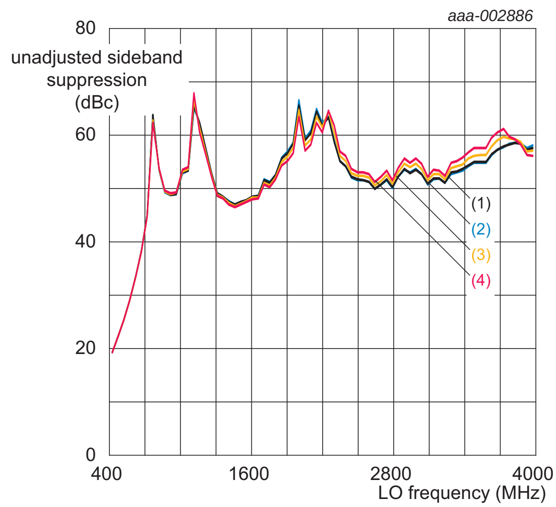

(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = −9 dBm.

(3) $P_{i(lo)}$ = −6 dBm.

(4) $P_{i(lo)}$ = +6 dBm.

**Fig 31. Unadjusted SBS versus $f_{lo}$ and $P_{i(lo)}$**



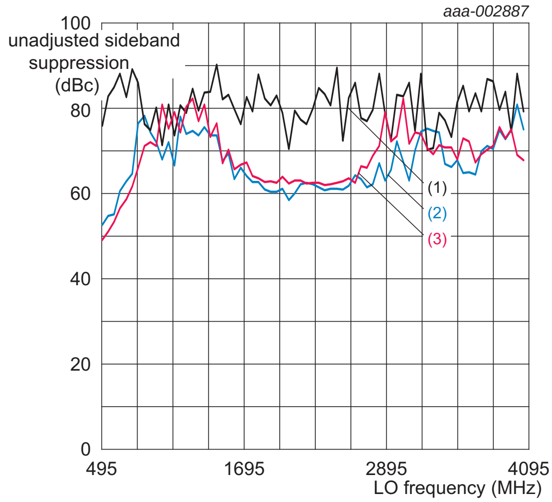

(1) $V_{i(cm)}$ = 0.5 V.

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

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

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

**Fig 32. Unadjusted SBS versus $f_{lo}$ and $V_{i(cm)}$**



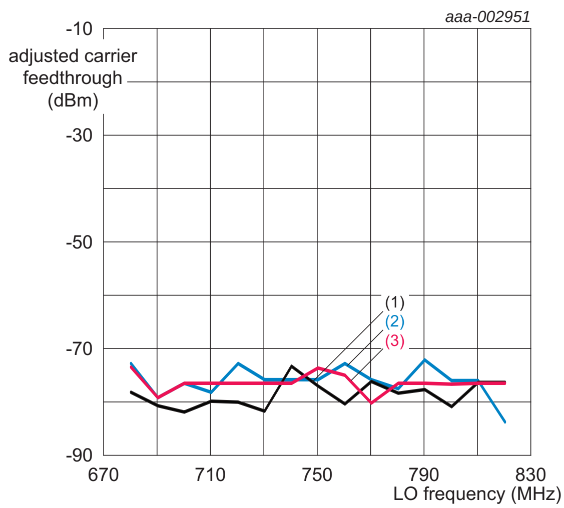

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 33. 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.



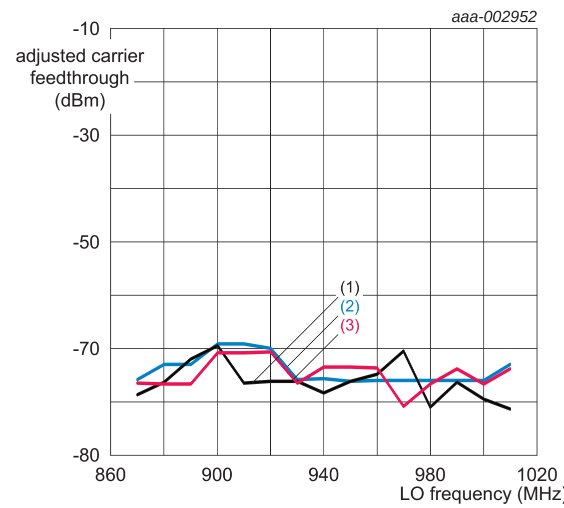

Adjusted at 750 MHz and after nulling $T_{mb}$ at 25 °C

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = –40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 34. Adjusted CF versus $f_{lo}$ and $T_{mb}$ (750 LTE band)**



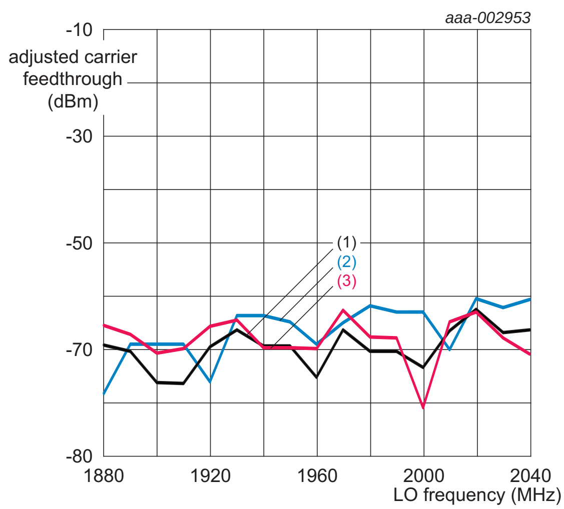

Adjusted at 942.5 MHz and after nulling $T_{mb}$ at 25 °C

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = –40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 35. Adjusted CF versus $f_{lo}$ and $T_{mb}$ (GSM band)**



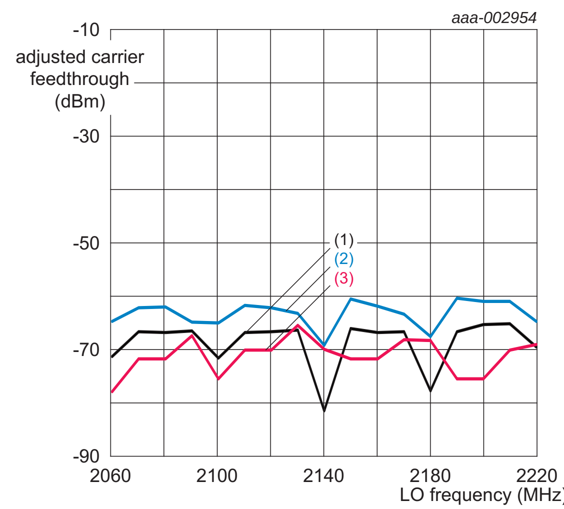

Adjusted at 1840 MHz and after nulling $T_{mb}$ at 25 °C

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = –40 °C.

(3) $T_{mb}$ = +85 °C.

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



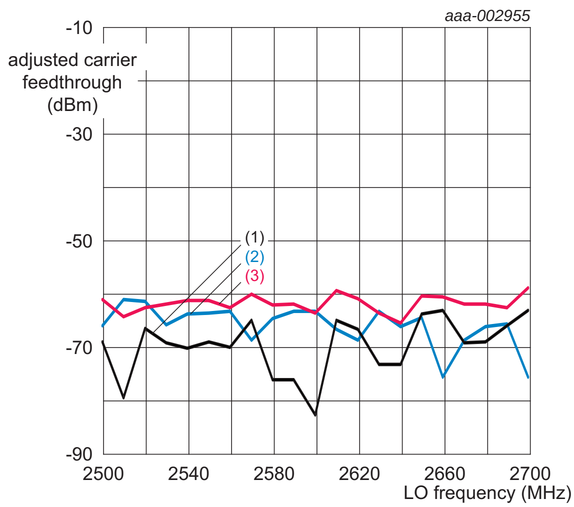

Adjusted at 2140 MHz and after nulling $T_{mb}$ at 25 °C

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = –40 °C.

(3) $T_{mb}$ = +85 °C.

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



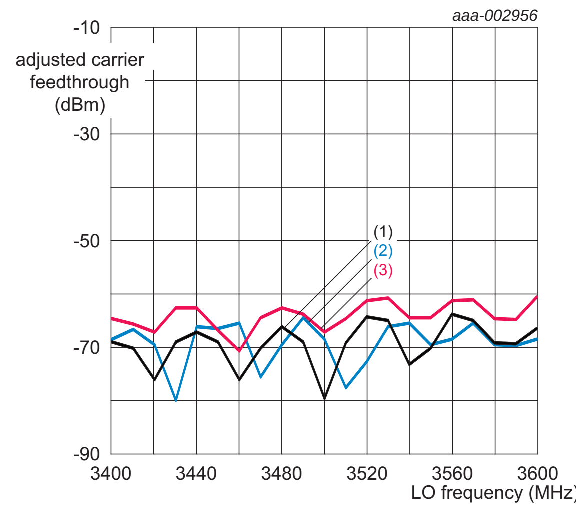

Adjusted at 2600 MHz and after nulling $T_{mb}$ at 25 °C

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 38. 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

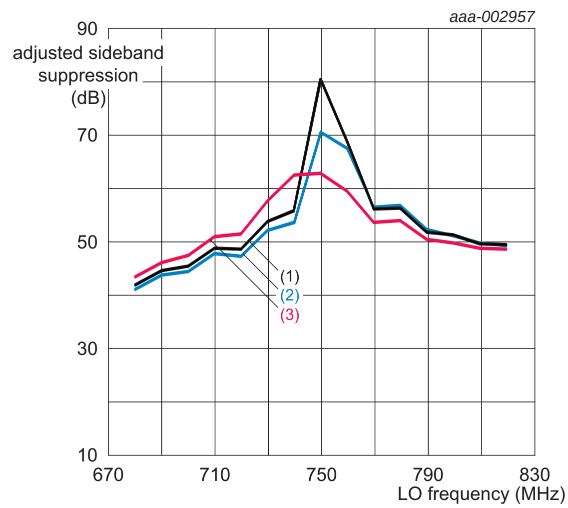
(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 39. 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.



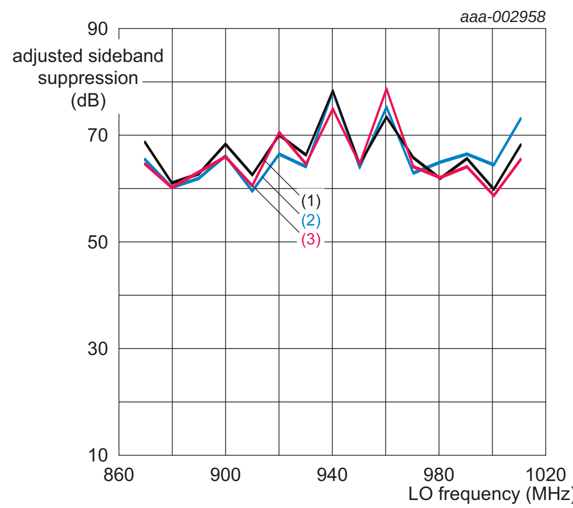

Adjusted at 750 MHz and after nulling $T_{mb}$ at 25 °C

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = –40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 40. Adjusted SBS versus $f_{lo}$ and $T_{mb}$ (750 LTE band)**



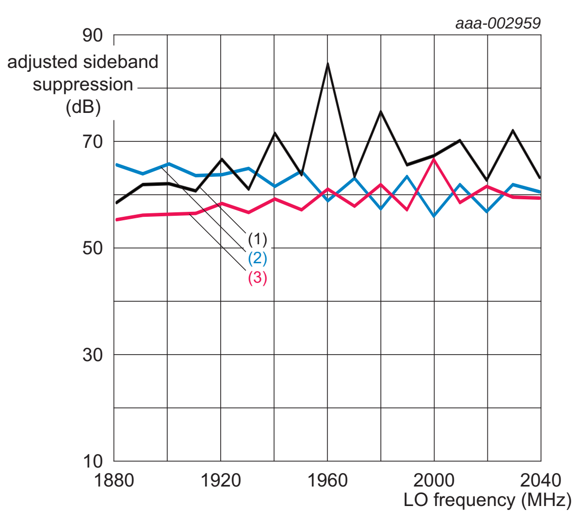

Adjusted at 942.5 MHz and after nulling $T_{mb}$ at 25 °C

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = –40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 41. Adjusted SBS versus $f_{lo}$ and $T_{mb}$ (GSM900 band)**



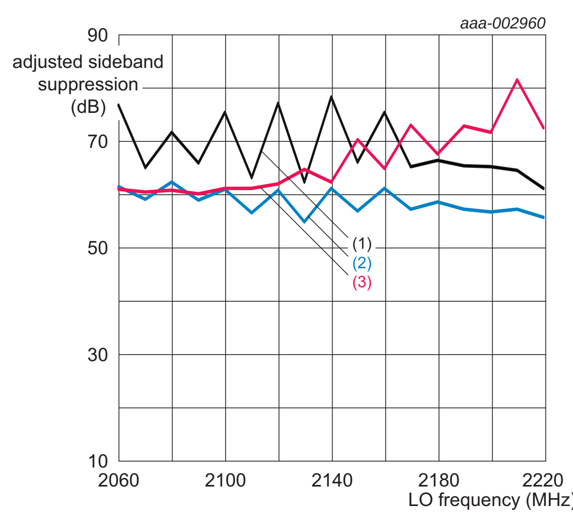

Adjusted at 1840 MHz and after nulling $T_{mb}$ at 25 °C

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = –40 °C.

(3) $T_{mb}$ = +85 °C.

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



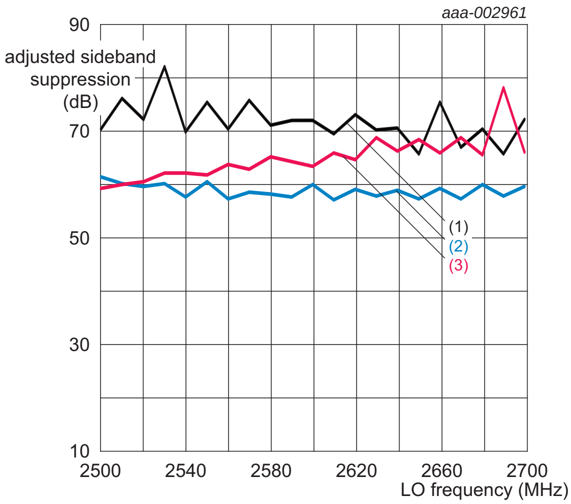

Adjusted at 2140 MHz and after nulling $T_{mb}$ at 25 °C

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = –40 °C.

(3) $T_{mb}$ = +85 °C.

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



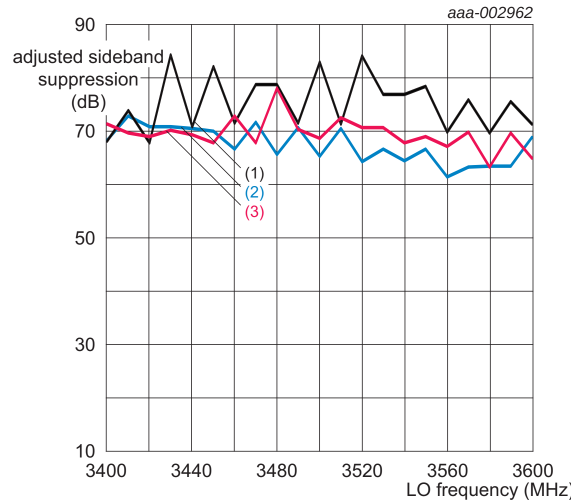

Adjusted at 2600 MHz and after nulling $T_{mb}$ at 25 °C

(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 44. Adjusted SBS versus $f_{lo}$ and $T_{mb}$ (2.6 GHz LTE band)**




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

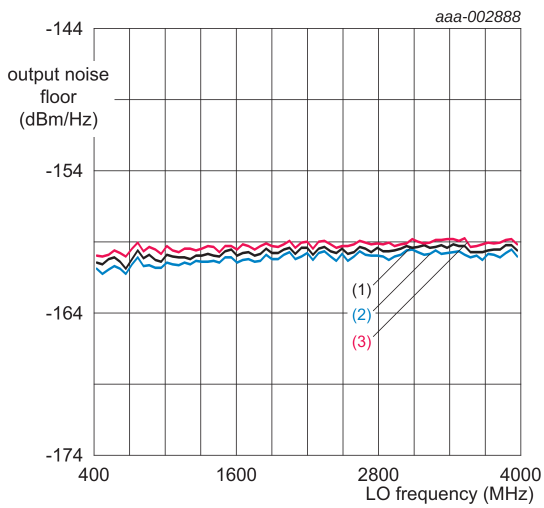
(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 45. Adjusted SBS versus $f_{lo}$ and $T_{mb}$ (Wi MAX/LTE band)**

Parameters for the three following drawings: noise floor without baseband; $V_{CC}$ = 5 V; $T_{mb}$ = 25 °C; $P_{i(lo)}$ = 0 dBm; offset frequency = 20 MHz; input baseband ports terminated in 50 Ω; unless otherwise specified.

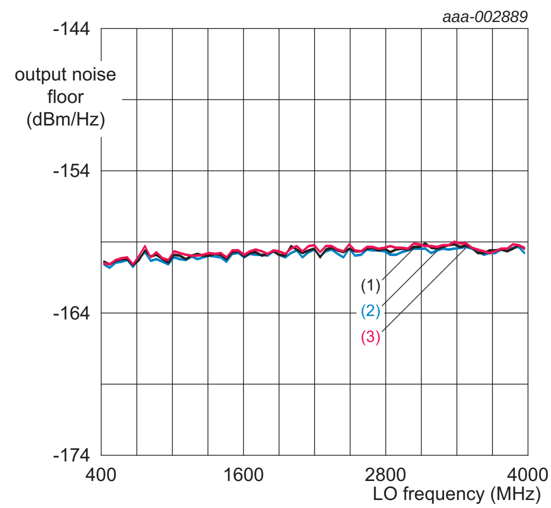



(1) $T_{mb}$ = +25 °C.

(2) $T_{mb}$ = −40 °C.

(3) $T_{mb}$ = +85 °C.

**Fig 46. $N_{flr(o)}$ versus $f_{lo}$ and $T_{mb}$**

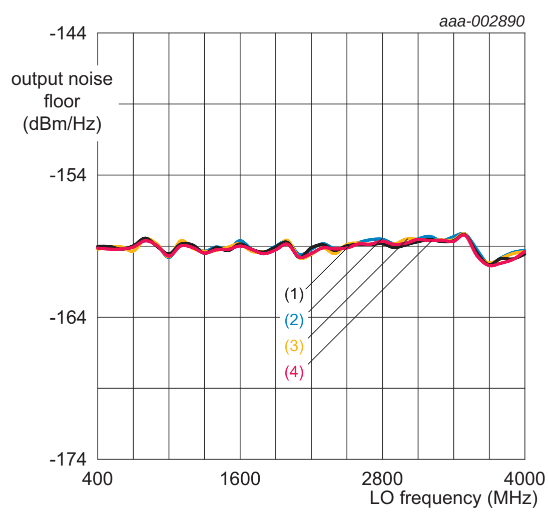



(1) $V_{CC}$ = 5 V.

(2) $V_{CC}$ = 4.75 V.

(3) $V_{CC}$ = 5.25 V.

**Fig 47. $N_{flr(o)}$ versus $f_{lo}$ and $V_{CC}$**




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

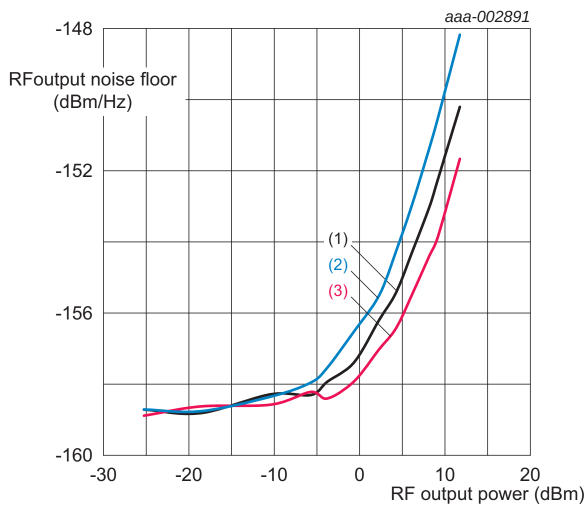
(2) $P_{i(lo)}$ = −9 dBm.

(3) $P_{i(lo)}$ = −6 dBm.

(4) $P_{i(lo)}$ = +6 dBm.

**Fig 48. $N_{flr(o)}$ versus $f_{lo}$ and $P_{i(lo)}$**

Parameters for the two following drawings: noise floor with baseband; $V_{CC}$ = 5 V; $T_{mb}$ = 25 °C; $P_{i(lo)}$ = 0 dBm; input baseband ports terminated on short circuit to ground for MODI_N, MODI_P and MODQ_N; DC signal on MODQ_P; unless otherwise specified.

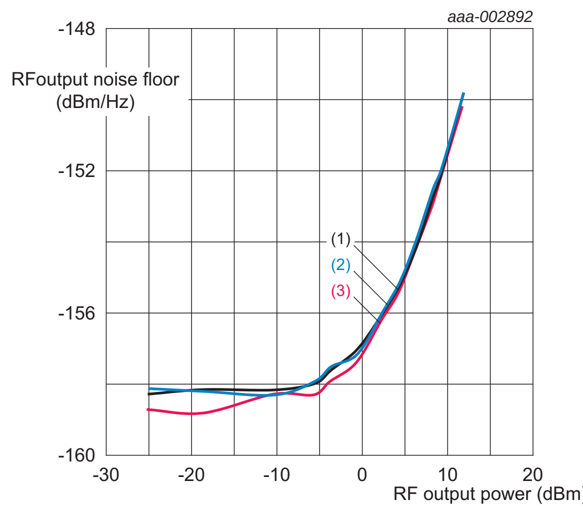



(1) $P_{i(lo)}$ = 0 dBm.

(2) $P_{i(lo)}$ = −3 dBm.

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

**Fig 49. $N_{flr(o)}$ versus $P_o$ at $f_{RF}$ = 2140 MHz with 30 MHz offset**



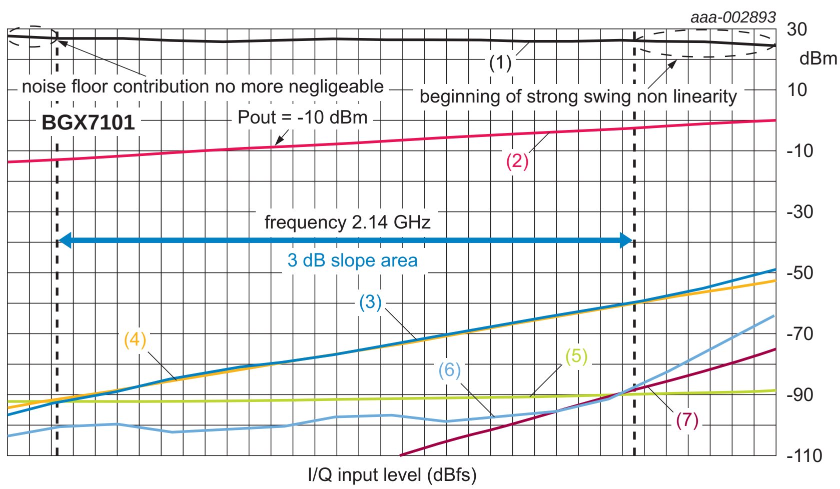

(1) RF = 1840 MHz.

(2) RF = 942.5 MHz.

(3) RF = 2140 MHz.

**Fig 50. $N_{flr(o)}$ versus $P_o$ at $P_{i(lo)}$ = 0 dBm**

Parameters for the following drawing: $T_{mb}$ = 25 °C; $P_{i(lo)}$ = 0 dBm; two tones for IM3, IM5, wanted and $IP3_o$; tone 1: IQ frequency = 4.5 MHz and tone 2: IQ frequency = 5.5 MHz; $V_{i(cm)}$ = 0.5 V; for noise floor measurement see preceding conditions; noise floor measurement has been integrated in 3.84 MHz bandwidth; unless otherwise specified.




(1) Measured $IP3_o$.

(2) Pout/Tone 1 dB step.

(3) Measured IM3.

(4) Trendline IM3.

(5) Noise floor in 3.84 MHz.

(6) Measured IM5.

(7) Trendline IM5.

**Fig 51. $IP3_o$, wanted, IM3, IM5 tone and noise floor**

## 14. Marking

**Table 14. Marking codes**

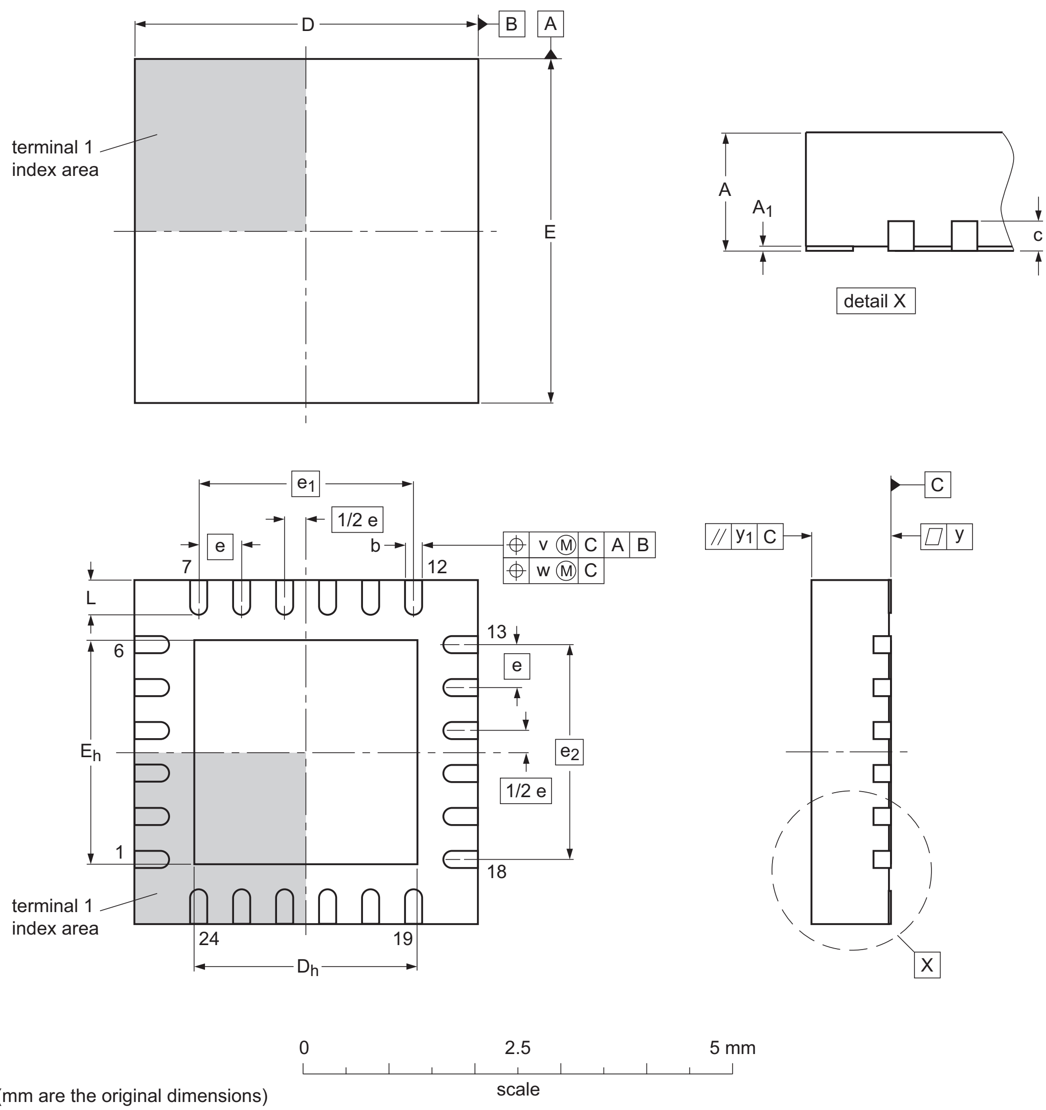
| Type number | Marking code |
|---|---|
| BGX7101HN | 7101 |

## 15. Package information

The BGX7101 uses an HVQFN 24-pin package with underside heat spreader ground.

## 16. Package outline

**HVQFN24: plastic thermal enhanced very thin quad flat package; no leads; 24 terminals; body 4 x 4 x 0.85 mm** **SOT616-3**




Dimensions (mm are the original dimensions)

| Unit[1] | | A[1] | $A_1$ | b | c | D[1] | $D_h$ | E[1] | $E_h$ | e | $e_1$ | $e_2$ | L | v | w | y | $y_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | max | 1 | 0.05 | 0.30 | | 4.1 | 2.75 | 4.1 | 2.75 | | | | 0.5 | | | | |
| | nom | | | | 0.2 | | | | | 0.5 | 2.5 | 2.5 | | 0.1 | 0.05 | 0.05 | 0.1 |
| | min | | 0.00 | 0.18 | | 3.9 | 2.45 | 3.9 | 2.45 | | | | 0.3 | | | | |

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

*sot616-3_po*

| Outline version | References | | | | European projection | Issue date |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT616-3 | | MO-220 | | | | ~~16-02-17~~ 16-07-14 |

**Fig 52. Package outline SOT616-3 (HVQFN24)**

# 17. Soldering of SMD packages

This text provides a very brief insight into a complex technology. A more in-depth account of soldering ICs can be found in Application Note *AN10365 “Surface mount reflow soldering description”*.

## 17.1 Introduction to soldering

Soldering is one of the most common methods through which packages are attached to Printed Circuit Boards (PCBs), to form electrical circuits. The soldered joint provides both the mechanical and the electrical connection. There is no single soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and Surface Mount Devices (SMDs) are mixed on one printed wiring board; however, it is not suitable for fine pitch SMDs. Reflow soldering is ideal for the small pitches and high densities that come with increased miniaturization.

## 17.2 Wave and reflow soldering

Wave soldering is a joining technology in which the joints are made by solder coming from a standing wave of liquid solder. The wave soldering process is suitable for the following:

- Through-hole components
- Leaded or leadless SMDs, which are glued to the surface of the printed circuit board

Not all SMDs can be wave soldered. Packages with solder balls, and some leadless packages which have solder lands underneath the body, cannot be wave soldered. Also, leaded SMDs with leads having a pitch smaller than ~0.6 mm cannot be wave soldered, due to an increased probability of bridging.

The reflow soldering process involves applying solder paste to a board, followed by component placement and exposure to a temperature profile. Leaded packages, packages with solder balls, and leadless packages are all reflow solderable.

Key characteristics in both wave and reflow soldering are:

- Board specifications, including the board finish, solder masks and vias
- Package footprints, including solder thieves and orientation
- The moisture sensitivity level of the packages
- Package placement
- Inspection and repair
- Lead-free soldering versus SnPb soldering

## 17.3 Wave soldering

Key characteristics in wave soldering are:

- Process issues, such as application of adhesive and flux, clinching of leads, board transport, the solder wave parameters, and the time during which components are exposed to the wave
- Solder bath specifications, including temperature and impurities

## 17.4 Reflow soldering

Key characteristics in reflow soldering are:

- Lead-free versus SnPb soldering; note that a lead-free reflow process usually leads to higher minimum peak temperatures (see Figure 53) than a SnPb process, thus reducing the process window
- Solder paste printing issues including smearing, release, and adjusting the process window for a mix of large and small components on one board
- Reflow temperature profile; this profile includes preheat, reflow (in which the board is heated to the peak temperature) and cooling down. It is imperative that the peak temperature is high enough for the solder to make reliable solder joints (a solder paste characteristic). In addition, the peak temperature must be low enough that the packages and/or boards are not damaged. The peak temperature of the package depends on package thickness and volume and is classified in accordance with Table 15 and 16

**Table 15. SnPb eutectic process (from J-STD-020D)**

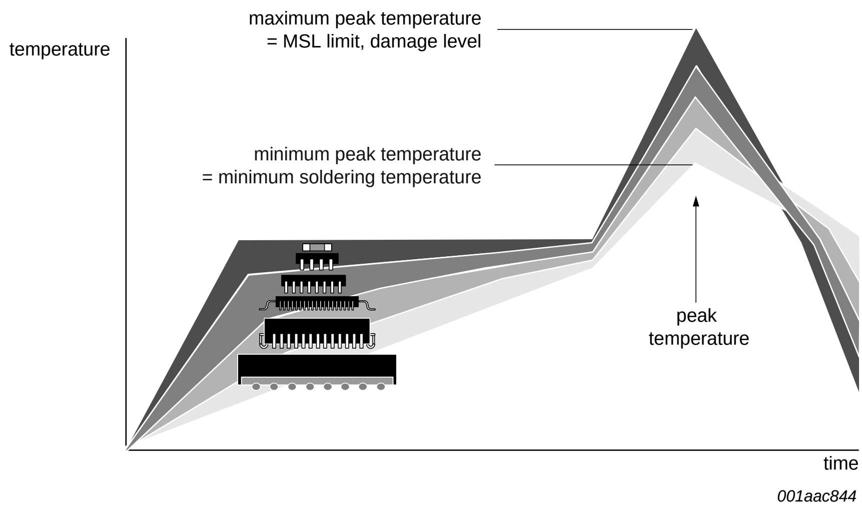
| Package thickness (mm) | Package reflow temperature (°C) | |
|---|---|---|
| | Volume (mm³) | |
| | < 350 | ≥ 350 |
| < 2.5 | 235 | 220 |
| ≥ 2.5 | 220 | 220 |

**Table 16. Lead-free process (from J-STD-020D)**

| Package thickness (mm) | Package reflow temperature (°C) | | |
|---|---|---|---|
| | Volume (mm³) | | |
| | < 350 | 350 to 2000 | > 2000 |
| < 1.6 | 260 | 260 | 260 |
| 1.6 to 2.5 | 260 | 250 | 245 |
| > 2.5 | 250 | 245 | 245 |

Moisture sensitivity precautions, as indicated on the packing, must be respected at all times.

Studies have shown that small packages reach higher temperatures during reflow soldering, see Figure 53.




MSL: Moisture Sensitivity Level

**Fig 53. Temperature profiles for large and small components**

For further information on temperature profiles, refer to Application Note *AN10365 “Surface mount reflow soldering description”*.

## 18. Abbreviations

**Table 17. Abbreviations**

| Acronym | Description |
|---|---|
| DAC | Digital-to-Analog Converter |
| DC | Direct Current |
| ESD | ElectroStatic Discharge |
| FCDM | Field-induced Charged-Device Model |
| HBM | Human Body Model |
| IF | Intermediate Frequency |
| LO | Local Oscillator |
| PCB | Printed-Circuit Board |
| RF | Radio Frequency |
| TDD | Time Division Duplex |

## 19. Revision history

**Table 18. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| BGX7101 v.5 | 20170125 | Product data sheet | - | BGX7101 v.4 |
| Modifications: | • Section 1: added BTS8001A according to our new naming convention | | | |
| BGX7101 v.4 | 20130110 | Product data sheet | - | BGX7101 v.3 |
| Modifications: | • Table 7: updated<br>• Table 8: updated<br>• Table 9: updated<br>• Table 10: updated<br>• Table 11: updated<br>• Table 12: updated<br>• Table 13: updated | | | |
| BGX7101 v.3 | 20120903 | Product data sheet | - | BGX7101 v.2 |
| BGX7101 v.2 | 20120809 | Product data sheet | - | BGX7101 v.1 |
| BGX7101 v.1 | 20120425 | Product data sheet | - | - |

# 20. Legal information

## 20.1 Data sheet status

| Document status[1][2] | Product status[3] | Definition |
|---|---|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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