BGA3031

DOCSIS 3.0 plus upstream amplifier

Rev. 3 — 20 November 2014 Product data sheet

1. General description

The BGA3031 is an upstream amplifier meeting the Data Over Cable Service Interface Specifications (DOCSIS 3.0). It is designed for cable modem, CATV set top box and VoIP modem applications. The device operates from 5 MHz to 85 MHz. The BGA3031 provides 58 dB gain control range in 1 dB increments with high incremental accuracy. Its maximum gain setting delivers 34 dB voltage gain and a superior linear performance.

It supports high output power levels, exceeding the DOCSIS 3.0 power levels while minimizing distortion and output noise levels. The BGA3031 is capable of transmitting 1 to 8 64-QAM and 1 to 8 QPSK modulated carriers while meeting the DOCSIS 3.0 ACLR specification under DOCSIS 3.0 + 4 dB conditions.

The BGA3031 operates at 5 V supply. The gain is controlled via a 3-wire serial interface. The current consumption can be reduced in 4 steps via the serial interface. This enables the user to optimize between DC power efficiency and linearity. In addition the current is automatically reduced at lower gain settings while preserving the linearity performance. In disable mode the device draws typical 6 mA while it still can be programmed to new gain and current settings.

The BGA3031 is housed in 20 pins 5 mm $\times$ 5 mm leadless HVQFN package.

2. Features and benefits

- 58 dB gain control range in 1 dB steps using a 3-wire serial interface
- 5 MHz to 85 MHz frequency operating range
- $\pm$ 0.2 dB incremental gain step accuracy
- Maximum voltage gain 34 dB
- Excellent IMD3 of −70 dBc at 64 dBmV output power
- Excellent second harmonic level of −80 dBc at 64 dBmV output power
- Excellent third harmonic level of −67 dBc at 64 dBmV output power
- Excellent noise figure of 3.5 dB at maximum gain
- Capable of transmitting 1 to 8 64-QAM modulated carriers while meeting the DOCSIS 3.0 specification under DOCSIS 3.0 + 4 dB conditions (61 dBmV total output power)
- Capable of transmitting 1 to 8 QPSK modulated carriers while meeting the DOCSIS 3.0 specification under DOCSIS 3.0 + 4 dB conditions (65 dBmV total output power)
- 5 V single supply operation
- Excellent ESD protection at all pins
- Unconditionally stable

- Compliant to Directive 2002/95/EC, regarding Restriction of Hazardous Substances (RoHS)

3. Applications

- DOCSIS 3.0 and DOCSIS 3.0 + 4 dB cable modems
- VoIP modems
- Set-top boxes

4. Quick reference data

Table 1. Quick reference data

Typical values at V_{CC} = 5 V; current setting = 3; T_{amb} = 25 °C; Z_i = 200 Ω; Z_o = 75 Ω, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I_{CC}	supply current	transmit-enable mode; TX_EN = HIGH	-	325	-	mA
		transmit-disable mode; TX_EN = LOW	-	6.0	-	mA
G_v	voltage gain	gain code = 111111 [1][2]	-	34	-	dB
NF	noise figure	transmit-enable mode; gain code = 111111	-	3.5	-	dB
α_{2H}	second harmonic level	P_i = 30 dBmV; P_L = 64 dBmV into 75 Ω differential impedance	-	–80	-	dBc
α_{3H}	third harmonic level	P_i = 30 dBmV; P_L = 64 dBmV into 75 Ω differential impedance	-	–67	-	dBc
IMD3	third-order intermodulation distortion	P_i = 27 dBmV per tone; P_L = 61 dBmV per tone into 75 Ω differential impedance	-	–70	-	dBc
$P_{L(1dB)}$	output power at 1 dB gain compression	signal	-	74	-	dBmV

[1] Voltage gain does not include loss due to input and output transformers.

[2] P_i = 30 dBmV.

Table 2. ACLR quick reference data

Typical values at V_{CC} = 5 V; current setting = 3; T_{amb} = 25 °C; Z_i = 200 Ω; Z_o = 75 Ω; channel bandwidth = 1280 kHz; integration bandwidth = 1280 kHz; f = 5 MHz to 85 MHz, unless otherwise specified.

Symbol	Parameter	Conditions	DOCSIS 3.0 spec.	Min	Typ	Max	Unit
DOCSIS 3.0 + 4 dB; 64-QAM							
ACLR	adjacent channel leakage ratio	P_i = 29 dBmV; P_L = 61 dBmV					
		1 input channel	–50	-	–68	-	dBc
		2 input channels	–47	-	–62	-	dBc
		4 input channels	–44	-	–58	-	dBc
		8 input channels	-	-	–56	-	dBc
DOCSIS 3.0 + 4 dB; QPSK							
ACLR	adjacent channel leakage ratio	P_i = 33 dBmV; P_L = 65 dBmV					
		1 input channel	–50	-	–66	-	dBc
		2 input channels	–47	-	–58	-	dBc
		4 input channels	–44	-	–50	-	dBc
		8 input channels	-	-	–42	-	dBc

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5. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
BGA3031	HVQFN20	plastic thermal enhanced very thin quad flat package; no leads; 20 terminals; body 5 × 5 × 0.85 mm	SOT662-1

6. Functional diagram

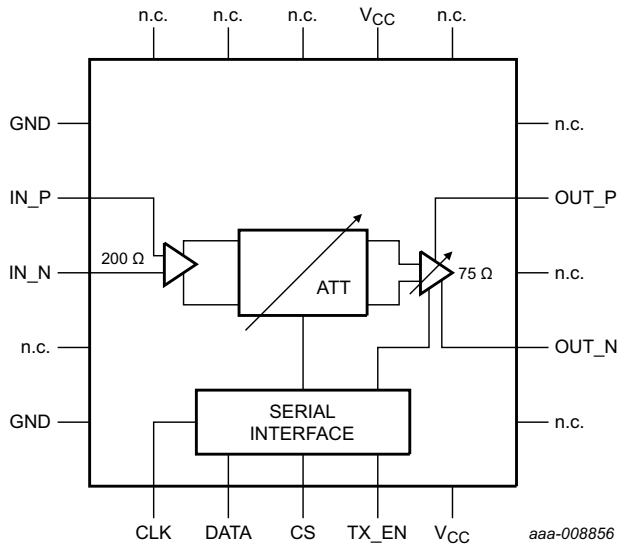


Fig 1. Functional diagram

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7. Pinning information

7.1 Pinning

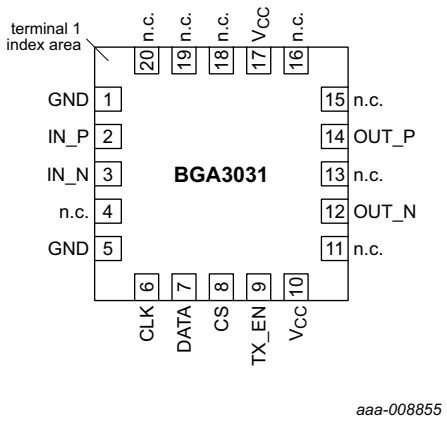


Fig 2. Pin configuration

7.2 Pin description

Table 4. Pin description

Symbol	Pin	Description
GND	1	ground
IN_P	2	amplifier input +
IN_N	3	amplifier input –
n.c.	4	not connected
GND	5	ground
CLK	6	clock
DATA	7	data
CS	8	chip select
TX_EN	9	transmit enable
V_{CC}	10	supply voltage for serial interface
n.c.	11	not connected
OUT_N	12	amplifier output –
n.c.	13	not connected
OUT_P	14	amplifier output +
n.c.	15	not connected
n.c.	16	not connected
V_{CC}	17	supply voltage for Variable Gain Amplifier (VGA)
n.c.	18	not connected

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Table 4. Pin description *...continued*

Symbol	Pin	Description
n.c.	19	not connected
n.c.	20	not connected
Paddle		ground

8. Functional description

8.1 Logic programming

The programming word is set through a shift register via the data, clock and chip select lines. The data is entered in order with the Most Significant Bit (MSB) first and the Least Significant Bit (LSB) last. The chip select line must be LOW for the duration of the data entry, then set HIGH to latch the shift register. The rising edge of the clock pulse shifts each data value into the register.

Table 5. Programming register

Data bit	11	10	9	8	7	6	5	4	3	2	1	0
Function	**Register address**				**Current setting [1]**		**attenuation (gain) setting [2]**					
Initialize	0	0	0	1	0	0	0	0	0	0	0	0
Set gain	0	0	0	0	C[1]	C[0]	G[5]	G[4]	G[3]	G[2]	G[1]	G[0]

[1] For current bit settings see Table 7.

[2] For gain bit settings see Table 6.

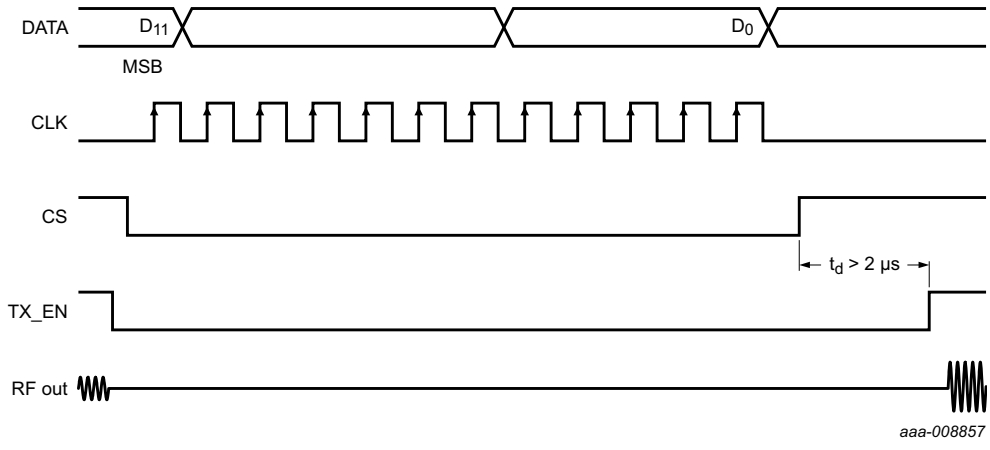


Fig 3. Serial Data Input Timing

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8.2 Register settings

8.2.1 Register address

Only addresses 0000 and 0001 are used. Using any other addresses will not affect the VGA.

8.2.2 Gain/attenuator setting

The gain shall be controlled via the 3-wire bus. Data bits D0 through D5 set the gain/attenuator level, with 111111 being the min attenuation setting, and 000101 being the max attenuation setting. A new gain/attenuator setting can be loaded while the VGA is on (transmit-enable), but shall not take effect until transmit-enable transitions from LOW to HIGH.

Table 6. Gain settings

Gain setting G[5:0]		Typical gain
binary notation	**decimal notation**	**(dB)**
000000 to 000101	0 to 5	–24
000110 [1]	6 [1]	–23
111110 [1]	62 [1]	33
111111 [1]	63 [1]	34

[1] With every increment of the gain setting between 000110 (6) and 111111 (63) the typical gain will increase accordingly.

8.2.3 Output stage current setting

The current (of the output stage) shall be controlled via the 3-wire bus. Data bits D6 and D7 set the current. Setting 11 will set the maximum current for maximum linearity. The current can be lowered for improved efficiency at lower output power levels, or lower linearity requirements. Setting 00 will set the minimum current. A new current setting can be loaded while the VGA is on (transmit-enable), but shall not take effect until transmit-enable transitions from LOW to HIGH.

Table 7. Supply current settings

At gain setting 63.

Current setting C[1:0]		Typical supply current
binary notation	**decimal notation**	**(mA)**
00	0	215
01	1	260
10	2	290
11	3	325

The current is automatically reduced at lower gain settings while preserving the linearity performance.

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Table 8. Supply current versus gain setting

Gain setting G[5:0]		Typical current (mA)			
binary notation	decimal notation	Current setting C[1:0]	Current setting C[1:0]	Current setting C[1:0]	Current setting C[1:0]
		00 (decimal = 0)	01 (decimal = 1)	10 (decimal = 2)	11 (decimal =3)
111111	63	215	260	290	325
110111	55	215	260	290	325
110110	54	165	190	200	215
110001	49	165	190	200	215
110000	48	135	150	160	160
101000	40	135	150	160	160
100111	39	120	125	125	125
000101	5	120	125	125	125

8.3 Tx enable / Tx disable

The amplifier can be disabled or enabled by making TX_EN (pin 9) LOW or HIGH. A LOW to HIGH Tx enable transition will activate new programed settings. If no new settings are programmed the last programmed setting will be re-activated.

9. Limiting values

Table 9. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).
Absolute Maximum Ratings are given as Limiting Values of stress conditions during operation, that must not be exceeded under the worst probable conditions.

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-	6.0	V
V_I	input voltage	on pin IN_P	–0.5	+6.0	V
		on pin IN_N	–0.5	+6.0	V
		on pin CLK [1]	–0.5	+6.0	V
		on pin DATA [1]	–0.5	+6.0	V
		on pin CS [1]	–0.5	+6.0	V
		on pin TX_EN [1]	–0.5	+6.0	V
		on pin OUT_N	–0.5	+6.0	V
		on pin OUT_P	–0.5	+6.0	V
$P_{i(max)}$	maximum input power		-	40	dBmV
T_{amb}	ambient temperature		–40	+85	°C
T_{stg}	storage temperature		–65	+150	°C
T_j	junction temperature		-	150	°C
V_{ESD}	electrostatic discharge voltage	Human Body Model (HBM); According JEDEC standard 22-A114E	-	4000	V
		Charged Device Model (CDM); According JEDEC standard 22-C101B	-	2000	V

[1] All digital pins may not exceed V_{CC} as the internal ESD circuit can be damaged. To prevent this it is recommended that control pins are limited to a maximum of 5 mA.

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10. Thermal characteristics

Table 10. Thermal characteristics

Symbol	Parameter	Conditions		Typ	Unit
$R_{th(j\text{-}bop)}$	thermal resistance from junction to bottom of package	in free air	[1]	14	K/W
$R_{th(j\text{-}a)}$	thermal resistance from junction to ambient	in free air	[2]	35	K/W

[1] Simulated using final element method model resembling the device mounted on the application board. See Section 13.

[2] Device mounted on application board.

11. Static characteristics

Table 11. Characteristics

Typical values at V_{CC} = 5 V; current setting = 3; T_{amb} = 25 °C; Z_i = 200 Ω; Z_o = 75 Ω, unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CC}	supply current	transmit-enable mode; TX_EN = HIGH		-	325	-	mA
		transmit-disable mode; TX_EN = LOW		-	6.0	-	mA
V_{IH}	HIGH-level input voltage		[1]	2.0	-	V_{CC} + 0.6	V
V_{IL}	LOW-level input voltage		[1]	0	-	0.8	V
P	power dissipation			-	1.625		W

[1] Voltage on the control pins.

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12. Dynamic characteristics

Table 12. Characteristics

Typical values at V_{CC} = 5 V; current setting = 3; Z_i = 200 Ω; Z_o = 75 Ω; T_{amb} = 25 °C, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
G_v	voltage gain	gain code = 111111 [1][2]	-	34	-	dB
		gain code = 000000 [1][2]	-	–24	-	dB
G_{flat}	gain flatness	f = 5 MHz to 42 MHz [2]	-	± 0.4	-	dB
		f = 5 MHz to 85 MHz [2]	-	± 0.6	-	dB
G_{step}	gain step	[2]	-	1.0	-	dB
$E_{G(dif)}$	differential gain error	[2]	-	± 0.2	-	dB
$R_{i(dif)}$	differential input resistance		-	200	-	Ω
$R_{o(dif)}$	differential output resistance		-	75	-	Ω
f_{range}	frequency range		5	-	85	MHz
P_n	noise power	transmit-disable mode; TX_EN = LOW; any bandwidth = 160 kHz from f = 5 MHz to 85 MHz	-	–69	-	dBmV
α_{isol}	isolation	transmit-disable mode; TX_EN = LOW; f = 85 MHz	-	–90	-	dB
NF	noise figure	transmit mode; gain code = 111111	-	3.5	-	dB
		transmit mode; gain code = 101110	-	6.5	-	dB
$t_{sw(G)}$	gain switch time	transmit-disable/transmit-enable transient duration	-	1.8	-	µs
V_{os}	overshoot voltage	transmit-disable/transmit-enable transient step size				
		55 dBmV output power	-	80	-	mV(p-p)
		49 dBmV output power	-	50	-	mV(p-p)
		43 dBmV output power	-	25	-	mV(p-p)
		37 dBmV output power	-	5	-	mV(p-p)
		≤ 31 dBmV output power	-	5	-	mV(p-p)
α_{2H}	second harmonic level	P_i = 30 dBmV; P_L = 64 dBmV into 75 Ω differential impedance	-	–80	-	dBc
α_{3H}	third harmonic level	P_i = 30 dBmV; P_L = 64 dBmV into 75 Ω differential impedance	-	–67	-	dBc
IMD3	third-order intermodulation distortion	P_i = 27 dBmV per tone; P_L = 61 dBmV per tone into 75 Ω differential impedance	-	–70	-	dBc
$P_{L(1dB)}$	output power at 1 dB gain compression	CW signal	-	74	-	dBmV

[1] Voltage gain does not include loss due to input and output transformers.

[2] P_i = 30 dBmV.

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Table 13. ACLR characteristics

Typical values at V_{CC} = 5 V; current setting = 3; T_{amb} = 25 °C; Z_i = 200 Ω; Z_o = 75 Ω; channel bandwidth = 1280 kHz; integration bandwidth = 1280 kHz; f = 5 MHz to 85 MHz, unless otherwise specified.

Symbol	Parameter	Conditions	DOCSIS 3.0 spec.	Min	Typ	Max	Unit
DOCSIS 3.0; 64-QAM							
ACLR	adjacent channel leakage ratio	P_i = 29 dBmV; P_L = 57 dBmV					
		1 input channel	–50	-	–68	-	dBc
		2 input channels	–47	-	–62	-	dBc
		4 input channels	–44	-	–58	-	dBc
		8 input channels	-	-	–56	-	dBc
DOCSIS 3.0; QPSK							
ACLR	adjacent channel leakage ratio	P_i = 33 dBmV; P_L = 61 dBmV					
		1 input channel	–50	-	–66	-	dBc
		2 input channels	–47	-	–58	-	dBc
		4 input channels	–44	-	–54	-	dBc
		8 input channels	-	-	–52	-	dBc
DOCSIS 3.0 + 3 dB; 64-QAM							
ACLR	adjacent channel leakage ratio	P_i = 29 dBmV; P_L = 60 dBmV					
		1 input channel	–50	-	–68	-	dBc
		2 input channels	–47	-	–62	-	dBc
		4 input channels	–44	-	–58	-	dBc
		8 input channels	-	-	–56	-	dBc
DOCSIS 3.0 + 3 dB; QPSK							
ACLR	adjacent channel leakage ratio	P_i = 33 dBmV; P_L = 64 dBmV					
		1 input channel	–50	-	–66	-	dBc
		2 input channels	–47	-	–58	-	dBc
		4 input channels	–44	-	–54	-	dBc
		8 input channels	-	-	–48	-	dBc
DOCSIS 3.0 + 4 dB; 64-QAM							
ACLR	adjacent channel leakage ratio	P_i = 29 dBmV; P_L = 61 dBmV					
		1 input channel	–50	-	–68	-	dBc
		2 input channels	–47	-	–62	-	dBc
		4 input channels	–44	-	–58	-	dBc
		8 input channels	-	-	–56	-	dBc
DOCSIS 3.0 + 4 dB; QPSK							
ACLR	adjacent channel leakage ratio	P_i = 33 dBmV; P_L = 65 dBmV					
		1 input channel	–50	-	–66	-	dBc
		2 input channels	–47	-	–58	-	dBc
		4 input channels	–44	-	–50	-	dBc
		8 input channels	-	-	–42	-	dBc

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13. Application information

13.1 External components

Matching the balanced output of the chip to a single-ended 75 Ω load is accomplished using a 1 : 1 ratio transformer. For measurements in a 50 Ω system R7 and R8 are added for impedance transformation from 75 Ω to 50 Ω. R7 and R8 are not required in the final application.

The transformer also cancels even mode distortion products and common mode signals, such as the voltage transients that occur while enabling and disabling the amplifiers. External capacitors are needed for the functionality of the circuit, the pins are internal nodes in the output amplifier.

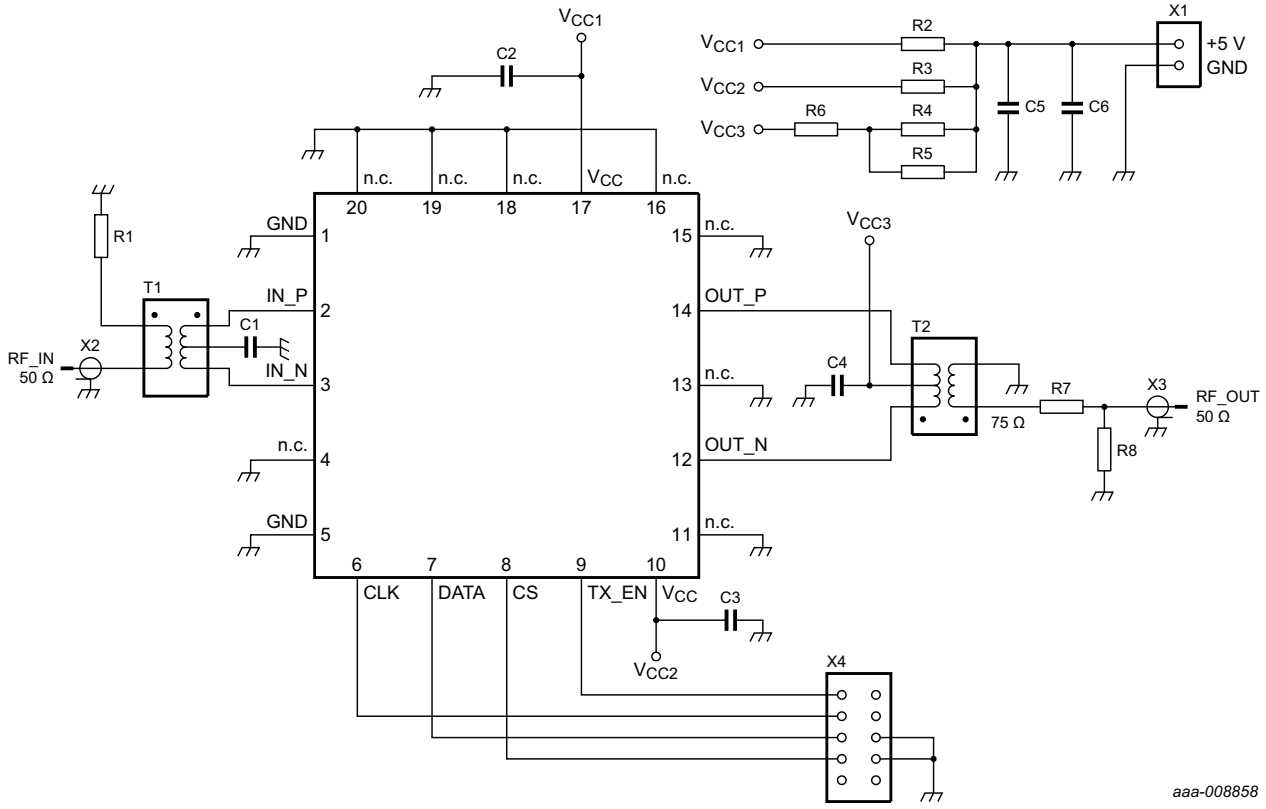


Fig 4. External components

Table 14. List of components

For application diagram, see Figure 4.

Component	Description	Value	Size	Supplier: Part No.
C1, C2, C3, C4	capacitor	10 nF	SMD 0603	
C5	capacitor	100 nF	SMD 0603	
C6	capacitor	10 μF	SMD 1206	
R1, R6	resistor	0 Ω	SMD 0603	
R2, R3	resistor	0 Ω	SMD 0805	
R4, R5	resistor	4.7 Ω	SMD 0603	

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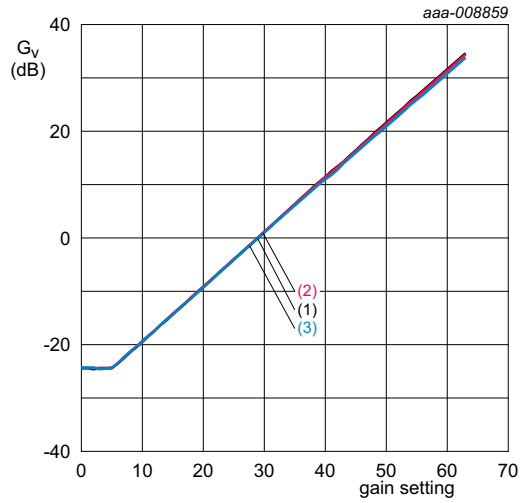
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Table 14. List of components *...continued*

For application diagram, see Figure 4.

Component	Description	Value	Size	Supplier: Part No.
R7	resistor	43.3 Ω	SMD 0603	
R8	resistor	86.6 Ω	SMD 0603	
T1	input balun	-	-	TOKO: #617DB-1714
T2	output balun	-	-	M/A-COM: MABA-009572-CF18A0
X1	2-pin header	-	-	
X2, X3	SMA connector	-	-	
X4	10-pin header	-	-	FCI: Minitek

13.2 Graphs



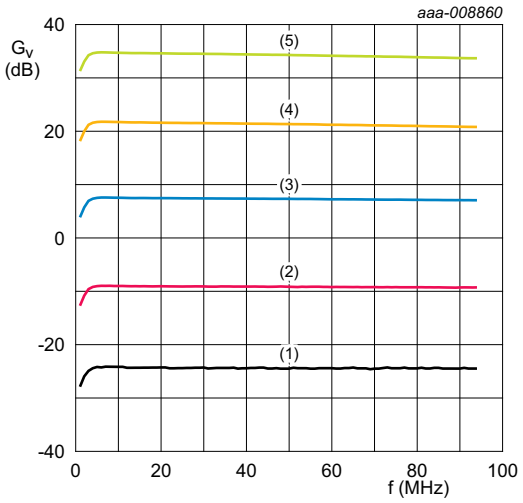
V_{CC} = 5 V; current setting = 3; T_{amb} = 25 °C; P_i = 30 dBmV.

(1) f = 5 MHz

(2) f = 42 MHz

(3) f = 85 MHz

Fig 5. Voltage gain as a function of gain setting; typical values



V_{CC} = 5 V; current setting = 3; T_{amb} = 25 °C; P_i = 30 dBmV.

(1) gain setting = 5

(2) gain setting = 20

(3) gain setting = 36

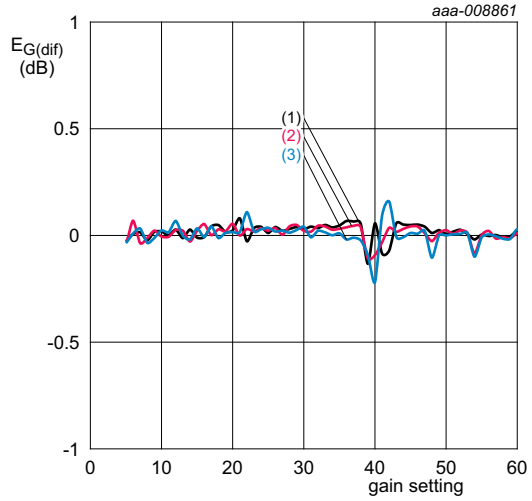
(4) gain setting = 50

(5) gain setting = 63

Fig 6. Voltage gain as a function of frequency; typical values

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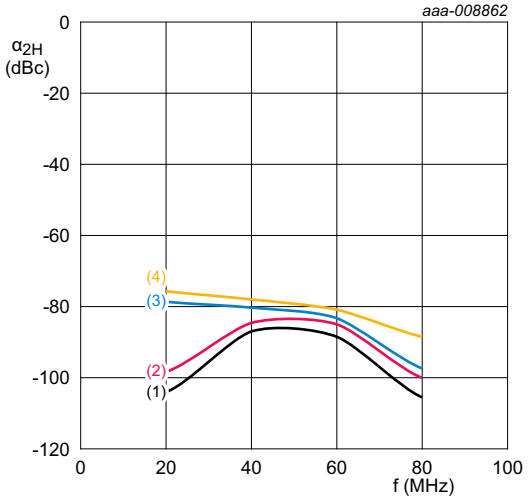
V_{CC} = 5 V; current setting = 3; T_{amb} = 25 °C; P_i = 30 dBmV.

(1) f = 5 MHz

(2) f = 42 MHz

(3) f = 85 MHz

Fig 7. Differential gain error as a function of gain setting; typical values



V_{CC} = 5 V; P_i = 30 dBmV; P_L = 64 dBmV; current setting = 3; gain setting = 63.

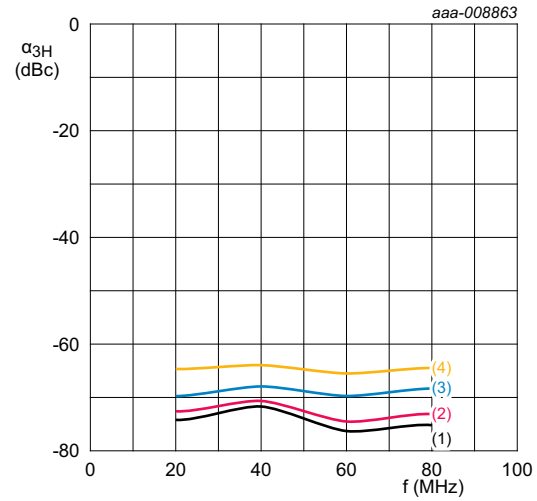
(1) T_{amb} = −40 °C

(2) T_{amb} = −10 °C

(3) T_{amb} = +25 °C

(4) T_{amb} = +85 °C

Fig 8. Second harmonic level as a function of frequency; typical values



V_{CC} = 5 V; P_i = 30 dBmV; P_L = 64 dBmV; current setting = 3; gain setting = 63.

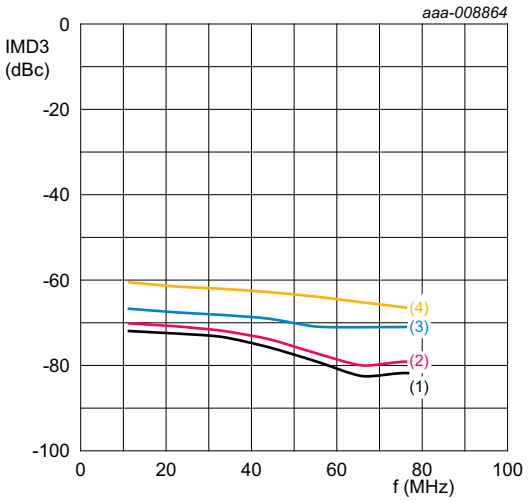
(1) T_{amb} = −40 °C

(2) T_{amb} = −10 °C

(3) T_{amb} = +25 °C

(4) T_{amb} = +85 °C

Fig 9. Third harmonic level as a function of frequency; typical values



V_{CC} = 5 V; P_i = 27 dBmV per tone; P_L = 61 dBmV per tone; current setting = 3; gain setting = 63.

(1) T_{amb} = −40 °C

(2) T_{amb} = −10 °C

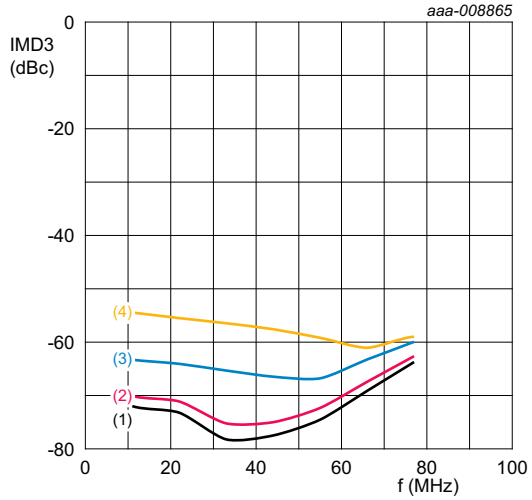
(3) T_{amb} = +25 °C

(4) T_{amb} = +85 °C

Fig 10. Third order intermodulation distortion as a function of frequency; typical values

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V_{CC} = 5 V; P_i = 30 dBmV per tone; P_L = 64 dBmV per tone; current setting = 3; gain setting = 63.

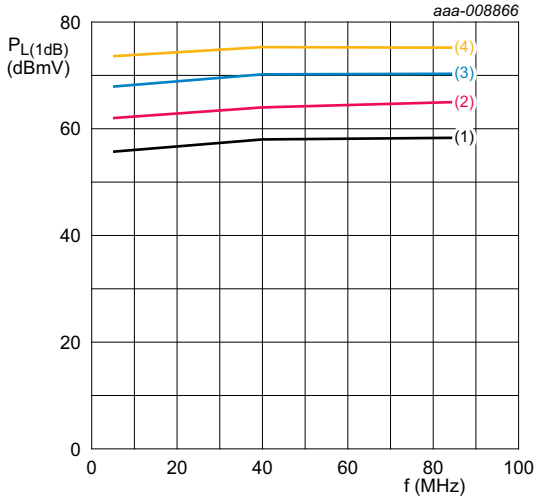
(1) T_{amb} = −40 °C

(2) T_{amb} = −10 °C

(3) T_{amb} = +25 °C

(4) T_{amb} = +85 °C

Fig 11. Third order intermodulation distortion as a function of frequency; typical values



V_{CC} = 5 V; current setting = 3; T_{amb} = 25 °C; P_i = 30 dBmV.

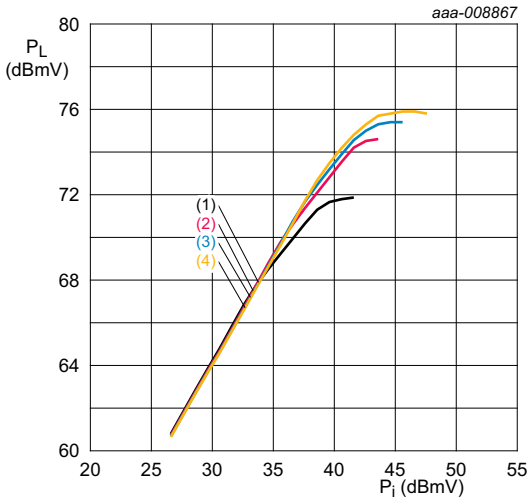
(1) gain setting = 39

(2) gain setting = 48

(3) gain setting = 54

(4) gain setting = 63

Fig 12. Output power at 1 dB gain compression as a function of frequency; typical values



T_{amb} = 25 °C; V_{CC} = 5 V; f = 85 MHz; gain setting = 63.

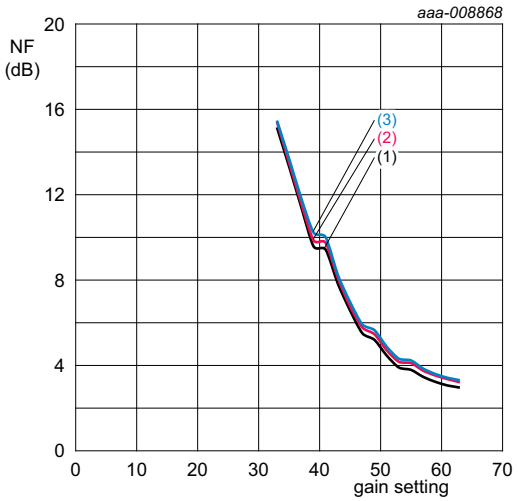
(1) current setting = 0

(2) current setting = 1

(3) current setting = 2

(4) current setting = 3

Fig 13. Output power as a function of input power; typical values



T_{amb} = 25 °C; V_{CC} = 5 V; current setting = 3.

(1) f = 5 MHz

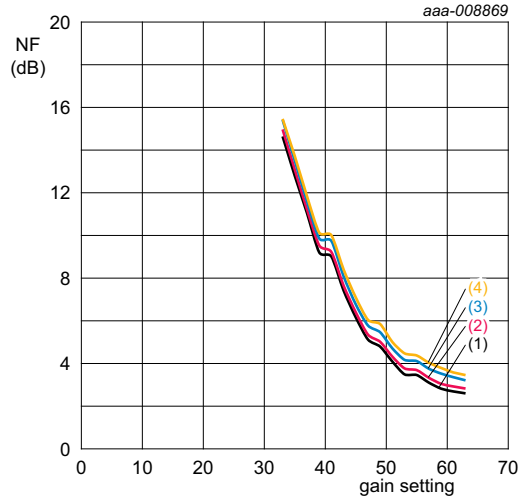
(2) f = 42 MHz

(3) f = 85 MHz

Fig 14. Noise figure as a function of gain setting; typical values

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f = 45 MHz; V_{CC} = 5 V; current setting = 3.

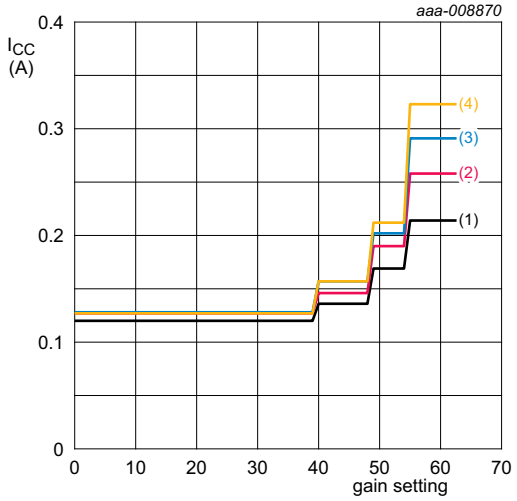
(1) T_{amb} = −40 °C

(2) T_{amb} = −10 °C

(3) T_{amb} = +25 °C

(4) T_{amb} = +85 °C

Fig 15. Noise figure as a function of gain setting; typical values



T_{amb} = 25 °C; V_{CC} = 5 V.

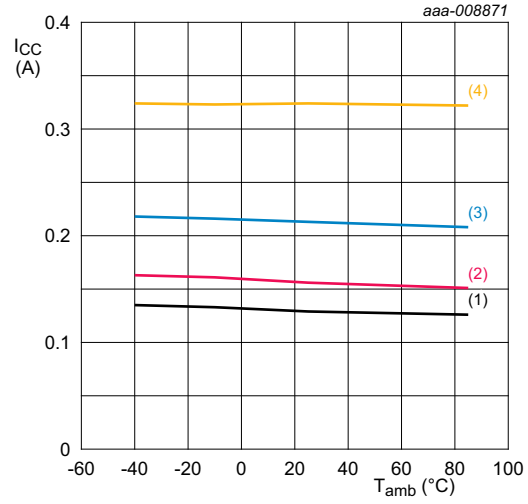
(1) current setting = 0

(2) current setting = 1

(3) current setting = 2

(4) current setting = 3

Fig 16. Supply current as a function of gain setting; typical values



V_{CC} = 5 V; current setting = 3.

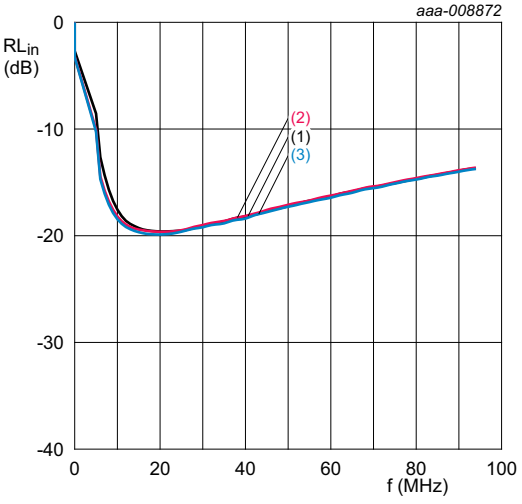
(1) gain setting = 20

(2) gain setting = 44

(3) gain setting = 52

(4) gain setting = 60

Fig 17. Supply current as a function of ambient temperature; typical values



T_{amb} = 25 °C; V_{CC} = 5 V; current setting = 3.

(1) gain setting = 5

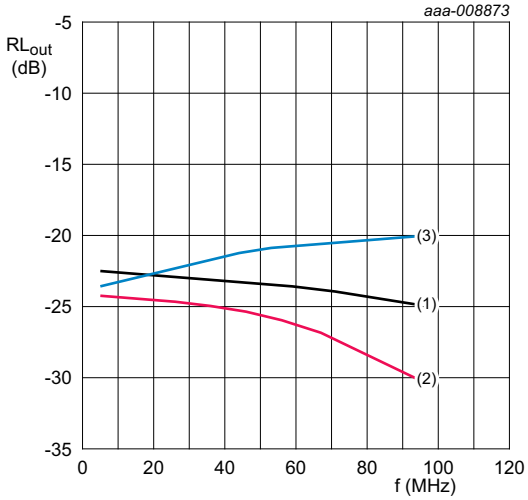
(2) gain setting = 36

(3) gain setting = 63

Fig 18. Input return loss as a function of frequency; typical values

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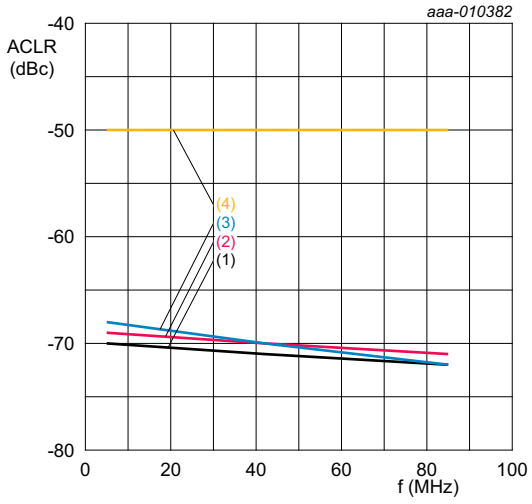
T_{amb} = 25 °C; V_{CC} = 5 V; current setting = 3.

(1) gain setting = 5

(2) gain setting = 63

(3) amplifier disabled (TX_EN LOW)

Fig 19. Output return loss as a function of frequency; typical values



One carrier 64-QAM; T_{amb} = 25 °C; V_{CC} = 5 V; max. current; P_i = 29 dBmV.

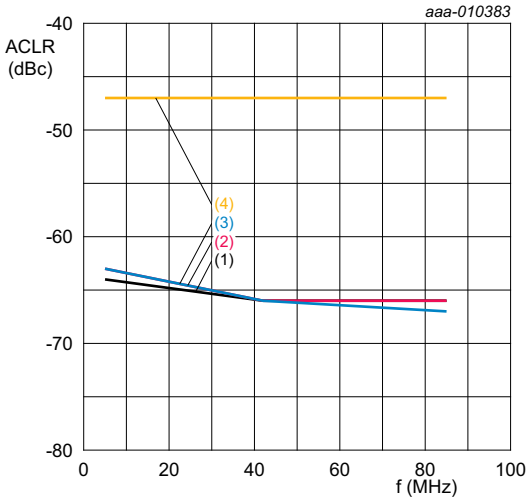
(1) P_L = 57 dBmV

(2) P_L = 60 dBmV

(3) P_L = 61 dBmV

(4) DOCSIS 3.0 specification

Fig 20. Adjacent channel leakage ratio as a function of frequency; typical values



Two carrier 64-QAM; T_{amb} = 25 °C; V_{CC} = 5 V; max. current; P_i = 29 dBmV.

(1) P_L = 57 dBmV

(2) P_L = 60 dBmV

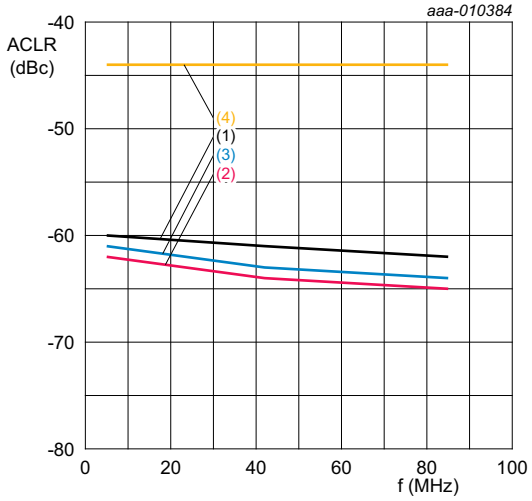
(3) P_L = 61 dBmV

(4) DOCSIS 3.0 specification

Fig 21. Adjacent channel leakage ratio as a function of frequency; typical values

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Four carrier 64-QAM; T_{amb} = 25 °C; V_{CC} = 5 V; max. current; P_i = 29 dBmV.

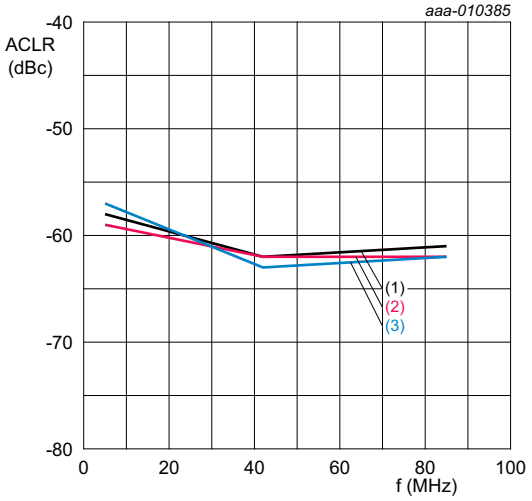
(1) P_L = 57 dBmV

(2) P_L = 60 dBmV

(3) P_L = 61 dBmV

(4) DOCSIS 3.0 specification

Fig 22. Adjacent channel leakage ratio as a function of frequency; typical values



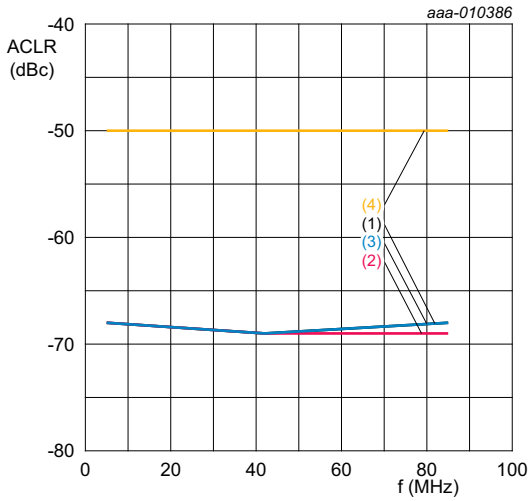
Eight carrier 64-QAM; T_{amb} = 25 °C; V_{CC} = 5 V; max. current; P_i = 29 dBmV.

(1) P_L = 57 dBmV

(2) P_L = 60 dBmV

(3) P_L = 61 dBmV

Fig 23. Adjacent channel leakage ratio as a function of frequency; typical values



One carrier QPSK; T_{amb} = 25 °C; V_{CC} = 5 V; max. current; P_i = 33 dBmV.

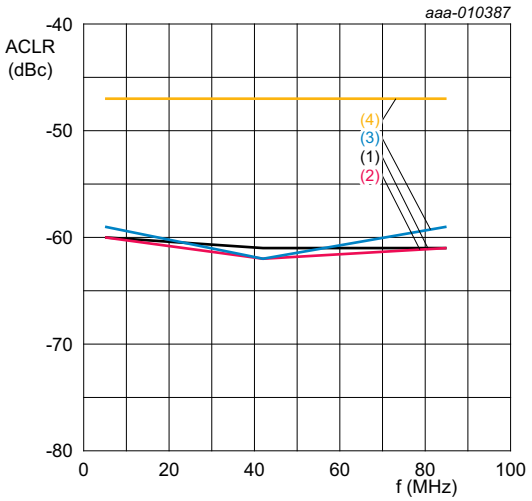
(1) P_L = 61 dBmV

(2) P_L = 64 dBmV

(3) P_L = 65 dBmV

(4) DOCSIS 3.0 specification

Fig 24. Adjacent channel leakage ratio as a function of frequency; typical values



Two carrier QPSK; T_{amb} = 25 °C; V_{CC} = 5 V; max. current; P_i = 33 dBmV.

(1) P_L = 61 dBmV

(2) P_L = 64 dBmV

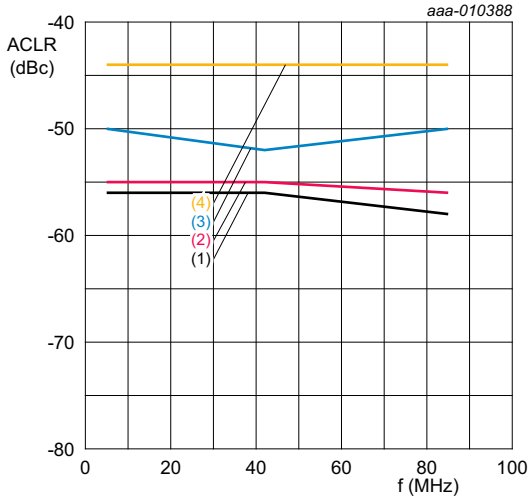
(3) P_L = 65 dBmV

(4) DOCSIS 3.0 specification

Fig 25. Adjacent channel leakage ratio as a function of frequency; typical values

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Four carrier QPSK; T_{amb} = 25 °C; V_{CC} = 5 V; max. current; P_i = 33 dBmV.

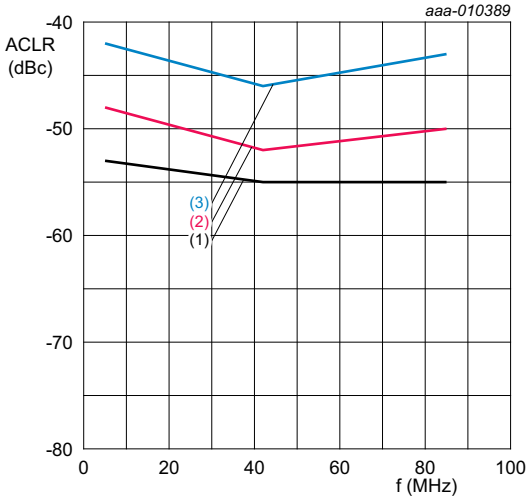
(1) P_L = 61 dBmV

(2) P_L = 64 dBmV

(3) P_L = 65 dBmV

(4) DOCSIS 3.0 specification

Fig 26. Adjacent channel leakage ratio as a function of frequency; typical values



Eight carrier QPSK; T_{amb} = 25 °C; V_{CC} = 5 V; max. current; P_i = 33 dBmV.

(1) P_L = 61 dBmV

(2) P_L = 64 dBmV

(3) P_L = 65 dBmV

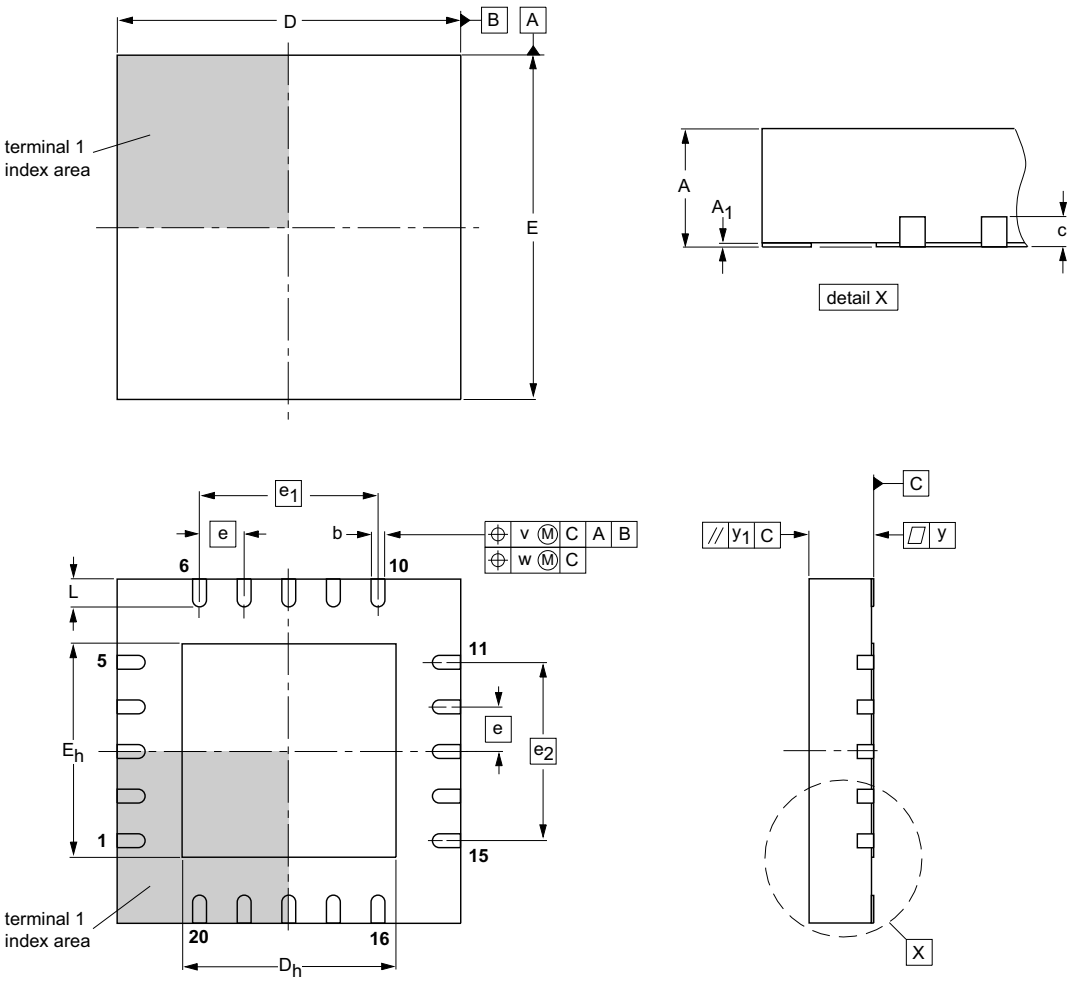
Fig 27. Adjacent channel leakage ratio as a function of frequency; typical values

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14. Package outline

HVQFN20: plastic thermal enhanced very thin quad flat package; no leads; 20 terminals; body 5 x 5 x 0.85 mm **SOT662-1**



DIMENSIONS (mm are the original dimensions)

UNIT	$A^{(1)}$ max.	A_1	b	c	$D^{(1)}$	D_h	$E^{(1)}$	E_h	e	e_1	e_2	L	v	w	y	y_1
mm	1	0.05 0.00	0.38 0.23	0.2	5.1 4.9	3.25 2.95	5.1 4.9	3.25 2.95	0.65	2.6	2.6	0.75 0.50	0.1	0.05	0.05	0.1

Note

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT662-1	- - -	MO-220	- - -			~~01-08-08~~ 02-10-22

Fig 28. Package outline SOT662-1 (HVQFN20)

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15. Handling information

15.1 Moisture sensitivity

Table 15. Moisture sensitivity level

Test methodology	Class
JESD-22-A113	1

16. Abbreviations

Table 16. Abbreviations

Acronym	Description
CATV	Community Antenna TeleVision
CW	Continuous Wave
ESD	ElectroStatic Discharge
HVQFN	Heatsink Very thin Quad Flat pack No leads
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase-Shift Keying
SMA	SubMiniature version A
SMD	Surface-Mounted Device
Tx	Transmission
VoIP	Voice over Internet Protocol

17. Revision history

Table 17. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
BGA3031 v.3	20141120	Product data sheet	-	BGA3031 v.2
Modifications	• T_{case} replaced by T_{amb} in whole document • Table 9 on page 7: added extra line: T_{amb}, ambient temperature, −40 °C min., +85 °C max. • Figure 8 on page 13: figure updated • Figure 9 on page 13: figure updated • Figure 10 on page 13: figure updated • Figure 11 on page 14: figure updated • Figure 15 on page 15: figure updated • Figure 17 on page 15: figure updated			
BGA3031 v.2	20140226	Product data sheet	-	BGA3031 v.1
BGA3031 v.1	20130815	Product data sheet	-	-

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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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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