CEL

BIPOLAR ANALOG INTEGRATED CIRCUIT

UPC3224TB

5 V, SILICON MMIC WIDEBAND AMPLIFIER

DESCRIPTION

The μPC3224TB is a silicon monolithic IC designed as IF amplifier for DBS tuners. This IC is manufactured using our 30 GHz f_{max} UHS0 (Ultra High Speed Process) silicon bipolar process.

FEATURES

- Wideband response : f_u = 3.2 GHz TYP. @ 3 dB bandwidth
- Low current : I_{CC} = 9.0 mA TYP.
- Power gain : G_P = 21.5 dB TYP. @ f = 1.0 GHz
  : G_P = 21.5 dB TYP. @ f = 2.2 GHz
- Supply voltage : V_{CC} = 4.5 to 5.5 V
- Port impedance : input/output 50 Ω

APPLICATION

- IF amplifiers in DBS converters etc.

ORDERING INFORMATION (Solder Contains Lead)

Part Number	Package	Marking	Supplying Form
μPC3224TB-E3	6-pin super minimold	C3K	• Embossed tape 8 mm wide • 1, 2, 3 pins face the perforation side of tape • Qty 3 kpcs/reel

ORDERING INFORMATION (Pb-Free)

Part Number	Package	Marking	Supplying Form
μPC3224TB-E3-A	6-pin super minimold	C3K	• Embossed tape 8 mm wide • 1, 2, 3 pins face the perforation side of tape • Qty 3 kpcs/reel

Remark To order evaluation samples, contact your nearby sales office.
Part number for sample order: μPC3224TB

Caution Observe precautions when handling because these devices are sensitive to electrostatic discharge.

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.

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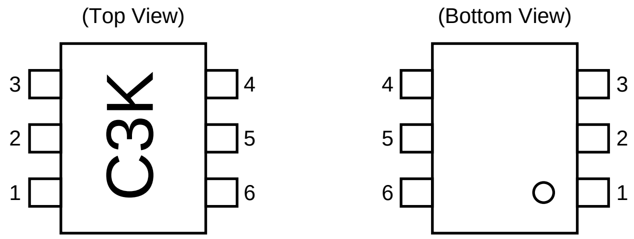
Date Published May 2004 CP(K)

PIN CONNECTIONS



Pin No.	Pin Name
1	INPUT
2	GND
3	GND
4	OUTPUT
5	GND
6	V_{CC}

PRODUCT LINE-UP OF 5 V-BIAS SILICON MMIC MEDIUM WIDEBAND AMPLIFIER

(T_A = +25°C, f = 1 GHz, V_{CC} = V_{out} = 5.0 V, Z_S = Z_L = 50 Ω)

Part No.	f_u (GHz)	$P_{O\ (sat)}$ (dBm)	G_P (dB)	NF (dB)	I_{CC} (mA)	Package	Marking
μPC2711TB	2.9	+1.0	13	5.0	12	6-pin super minimold	C1G
μPC2712TB	2.6	+3.0	20	4.5	12		C1H
μPC3215TB Note	2.9	+3.5	20.5	2.3	14		C3H
μPC3224TB	3.2	+4.0	21.5	4.3	9.0		C3K

Note μPC3215TB is f = 1.5 GHz

Remark Typical performance. Please refer to **ELECTRICAL CHARACTERISTICS** in detail.

PIN EXPLANATIONS

PIN No.	Pin Name	Applied Voltage (V)	Pin Voltage (V) Note	Function and Applications
1	INPUT	–	0.91	Signal input pin. A internal matching circuit, configured with resistors, enables 50 Ω connection over a wide band. A multi-feedback circuits is designed to cancel the deviations of h_{FE} and resistance. This pin must be coupled to signal source with capacitor for DC cut.
4	OUTPUT	–	4.42	Signal output pin. A internal matching circuit, configured with resistors, enables 50 Ω connection over a wide band. This pin must be coupled to next stage with capacitor for DC cut.
6	V_{CC}	4.5 to 5.5	–	Power suplly pin. This pin should be externally equipped with bypass capacitor to minimize its impedance.
2 3 5	GND	0	–	Ground pin. This pin should be connected to system ground with minimum inductance. Ground pattern on the board should be formed as wide as possible. All the ground pins must be connected together with wide ground pattern to decrease impedance difference.

Note Pin Voltage is measured at V_{CC} = 5.0 V

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Ratings	Unit
Supply Voltage	V_{CC}	T_A = +25°C	6.0	V
Total Circuit Current	I_{CC}	T_A = +25°C	25	mA
Power Dissipation	P_D	T_A = +85°C **Note**	270	mW
Operating Ambient Temperature	T_A		–40 to +85	°C
Storage Temperature	T_{stg}		–55 to +150	°C
Input Power	P_{in}	T_A = +25°C	+10	dBm

Note Mounted on double-sided copper-clad 50 × 50 × 1.6 mm epoxy glass PWB

RECOMMENDED OPERATING RANGE

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply Voltage	V_{CC}		4.5	5.0	5.5	V
Operating Ambient Temperature	T_A		–40	+25	+85	°C

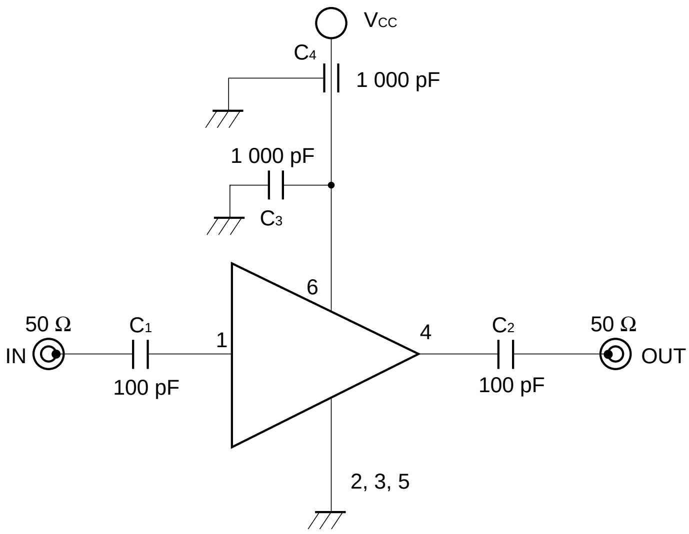
ELECTRICAL CHARACTERISTICS (T_A = +25°C, V_{CC} = 5.0 V, Z_S = Z_L = 50 Ω)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Circuit Current	I_{CC}	No input signal	7.0	9.0	12.0	mA
Power Gain	G_P	f = 1.0 GHz, P_{in} = –30 dBm	19.0	21.5	24.0	dB
		f = 2.2 GHz, P_{in} = –30 dBm	18.5	21.5	24.5	
Saturated Output Power	$P_{O\,(sat)}$	f = 1.0 GHz, P_{in} = –5 dBm	+1.5	+4.0	–	dBm
		f = 2.2 GHz, P_{in} = –5 dBm	–1.5	+1.5	–	
Gain 1 dB Compression Output Power	$P_{O\,(1\,dB)}$	f = 1.0 GHz	–6.5	–3.5	–	dBm
		f = 2.2 GHz	–8.5	–5.5	–	
Noise Figure	NF	f = 1.0 GHz	–	4.3	5.8	dB
		f = 2.2 GHz	–	4.3	5.8	
Upper Limit Operating Frequency	f_u	3 dB down below flat gain at f = 0.1 GHz	2.8	3.2	–	GHz
Isolation	ISL	f = 1.0 GHz, P_{in} = –30 dBm	35.0	40.0	–	dB
		f = 2.2 GHz, P_{in} = –30 dBm	37.0	42.0	–	
Input Return Loss	RL_{in}	f = 1.0 GHz, P_{in} = –30 dBm	9.0	12.0	–	dB
		f = 2.2 GHz, P_{in} = –30 dBm	10.0	14.0	–	
Output Return Loss	RL_{out}	f = 1.0 GHz, P_{in} = –30 dBm	11.0	17.0	–	dB
		f = 2.2 GHz, P_{in} = –30 dBm	8.0	12.0	–	
Gain Flatness	ΔG_P	f = 0.1 to 2.2 GHz	–	±0.8	–	dB

OTHER CHARACTERISTICS, FOR REFERENCE PURPOSES ONLY
(T_A = +25°C, V_{CC} = 5.0 V, Z_S = Z_L = 50 Ω)

Parameter	Symbol	Test Conditions	Reference Value	Unit
Output Intercept Point	OIP_3	f = 1.0 GHz	+7.0	dBm
		f = 2.2 GHz	+5.5	

TEST CIRCUIT



The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

COMPONENTS OF TEST CIRCUIT FOR MEASURING ELECTRICAL CHARACTERISTICS

	Type	Value
C_1, C_2	Chip Capacitor	100 pF
C_3	Chip Capacitor	1 000 pF
C_4	Feed-through Capacitor	1 000 pF

CAPACITORS FOR THE V_{CC}, INPUT AND OUTPUT PINS

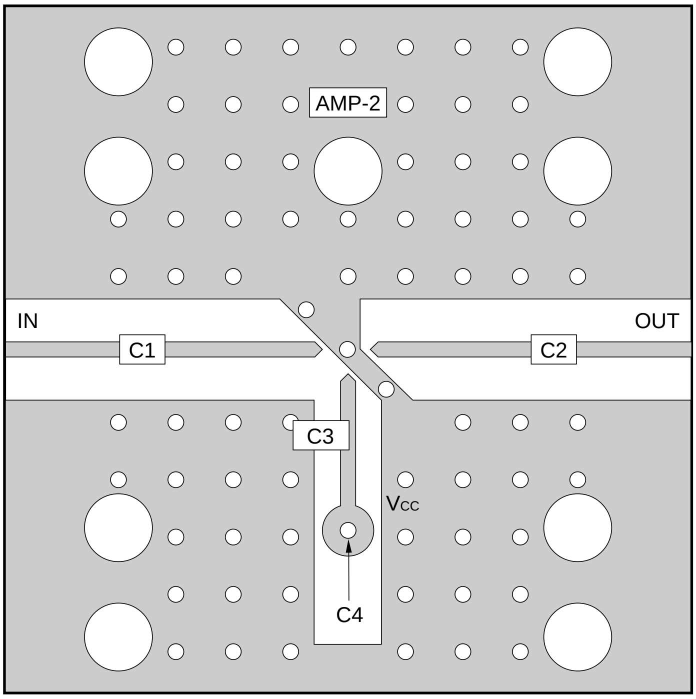
Capacitors of 1000 pF are recommendable as the bypass capacitor for the V_{CC} pin and the coupling capacitors for the input and output pins.

The bypass capacitor connected to the V_{CC} pin is used to minimize ground impedance of V_{CC} pin. So, stable bias can be supplied against V_{CC} fluctuation.

The coupling capacitors, connected to the input and output pins, are used to cut the DC and minimize RF serial impedance. Their capacitances are therefore selected as lower impedance against a 50 Ω load. The capacitors thus perform as high pass filters, suppressing low frequencies to DC.

To obtain a flat gain from 100 MHz upwards, 1 000 pF capacitors are used in the test circuit. In the case of under 10 MHz operation, increase the value of coupling capacitor such as 10 000 pF. Because the coupling capacitors are determined by equation, $C = 1/(2\pi Rfc)$.

ILLUSTRATION OF THE TEST CIRCUIT ASSEMBLED ON EVALUATION BOARD



COMPONENT LIST

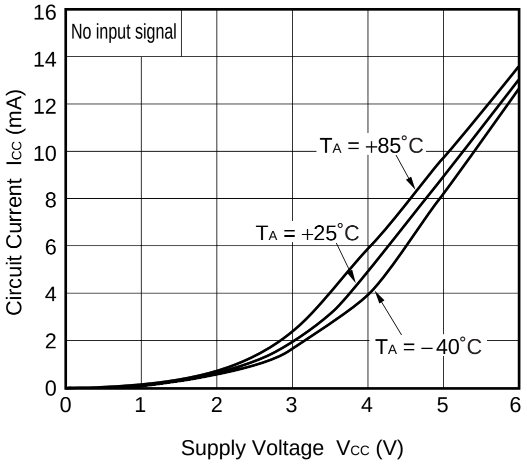
	Value
C_1, C_2	100 pF
C_3, C_4	1 000 pF

Notes

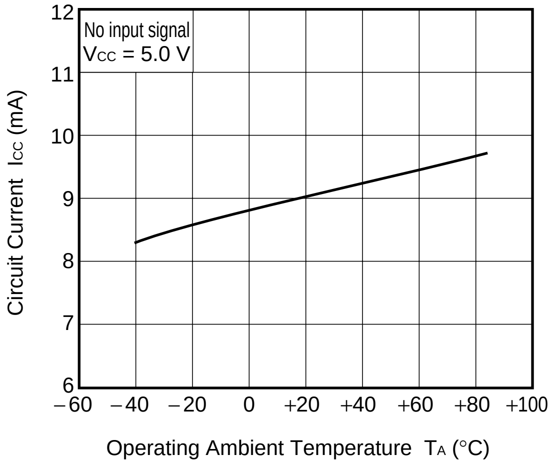
1. 30 × 30 × 0.4 mm double sided copper clad polyimide board.
2. Back side: GND pattern
3. Solder plated on pattern
4. o ◯: Through holes

TYPICAL CHARACTERISTICS (T_A = +25°C , unless otherwise specified)

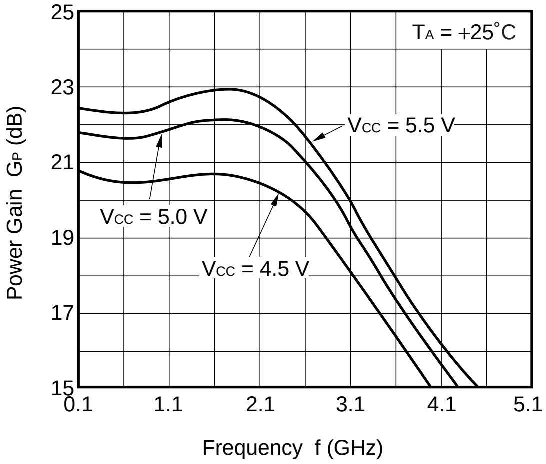
CIRCUIT CURRENT vs. SUPPLY VOLTAGE



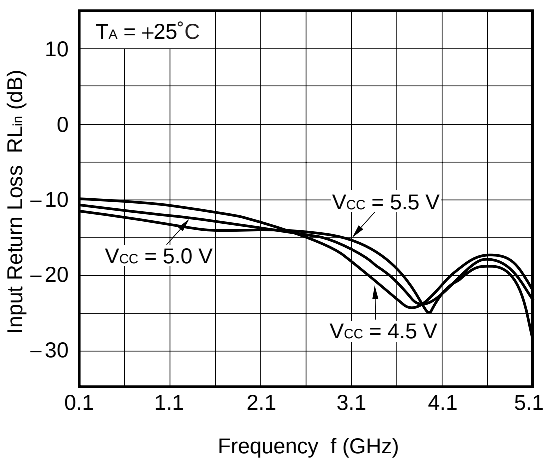
CIRCUIT CURRENT vs. OPERATING AMBIENT TEMPERATURE



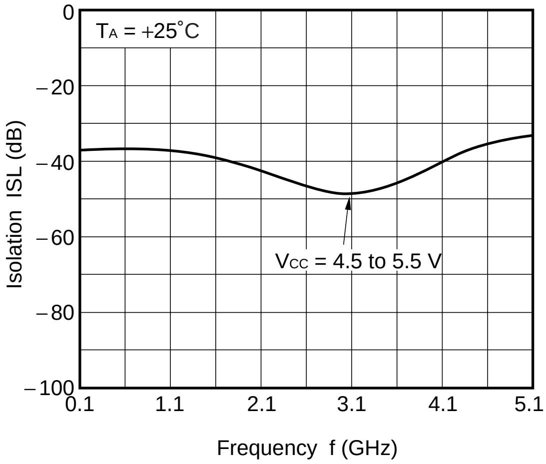
POWER GAIN vs. FREQUENCY



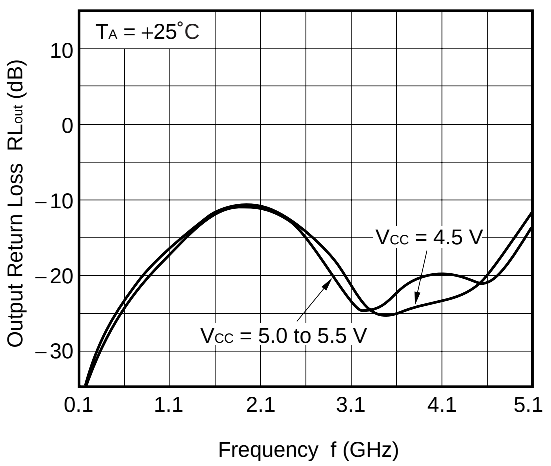
INPUT RETURN LOSS vs. FREQUENCY



ISOLATION vs. FREQUENCY

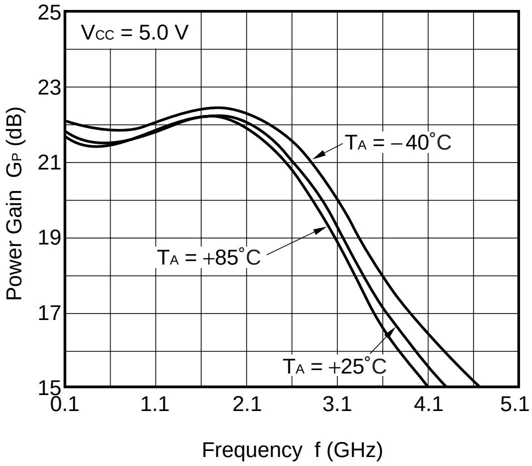


OUTPUT RETURN LOSS vs. FREQUENCY

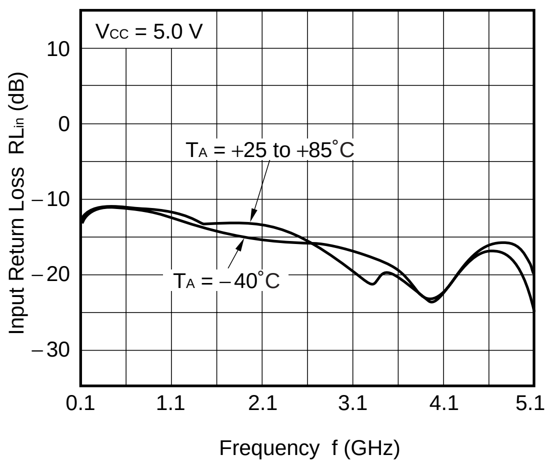


Remark The graphs indicate nominal characteristics.

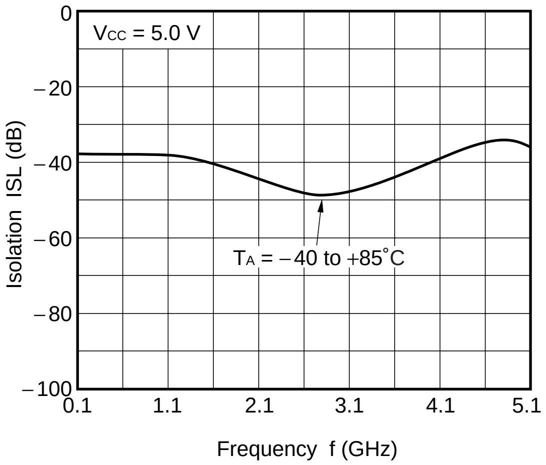
POWER GAIN vs. FREQUENCY



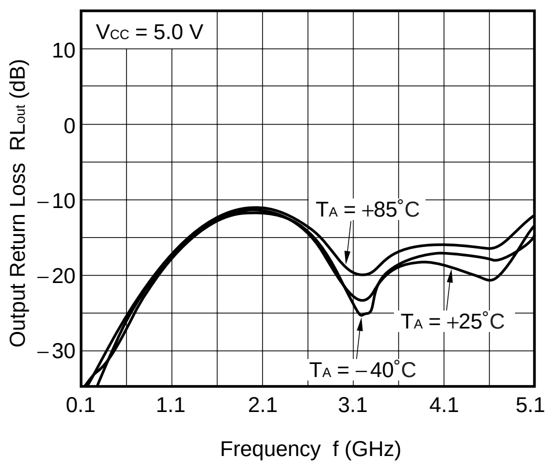
INPUT RETURN LOSS vs. FREQUENCY



ISOLATION vs. FREQUENCY

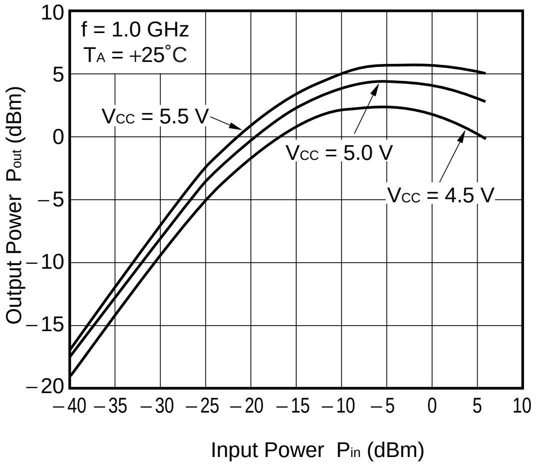


OUTPUT RETURN LOSS vs. FREQUENCY

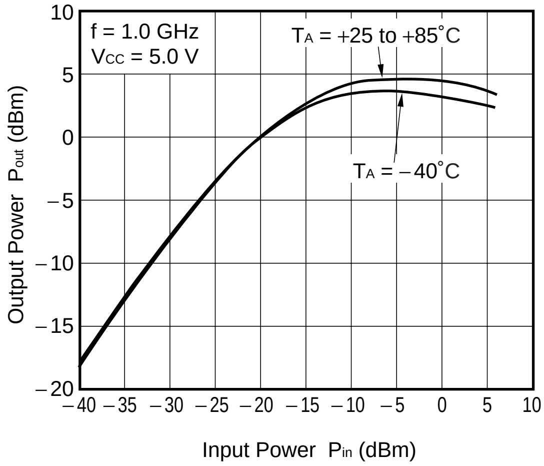


Remark The graphs indicate nominal characteristics.

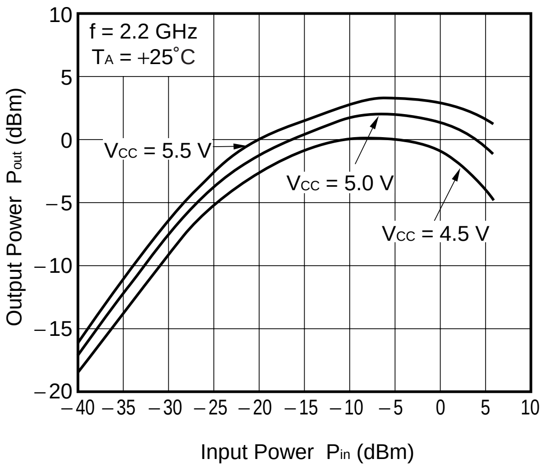
OUTPUT POWER vs. INPUT POWER



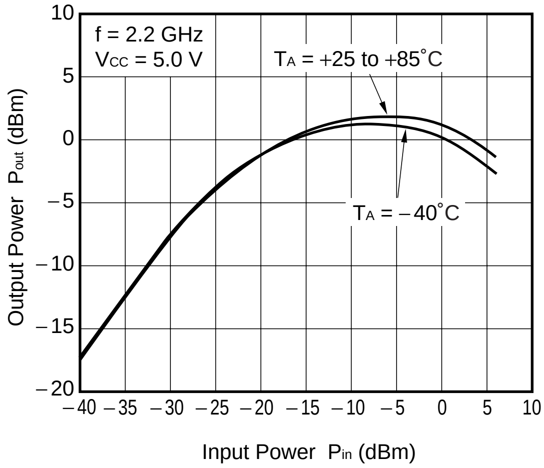
OUTPUT POWER vs. INPUT POWER



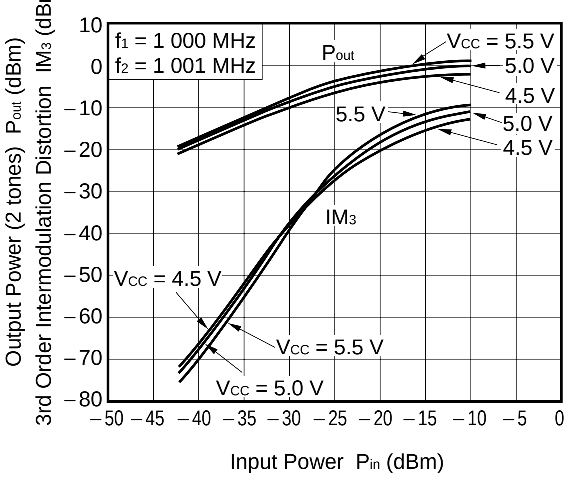
OUTPUT POWER vs. INPUT POWER



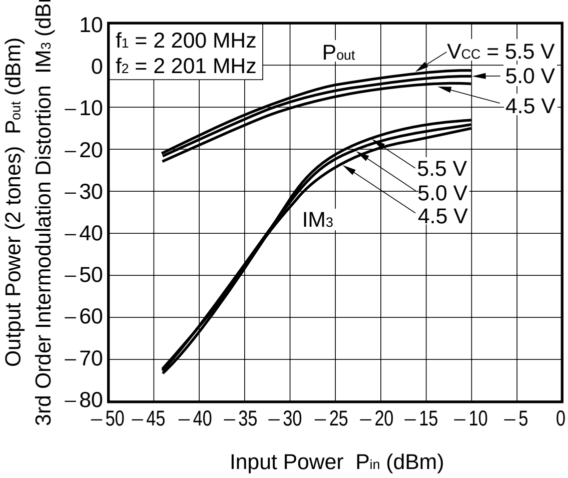
OUTPUT POWER vs. INPUT POWER



OUTPUT POWER (2 tones), IM3 vs. INPUT POWER



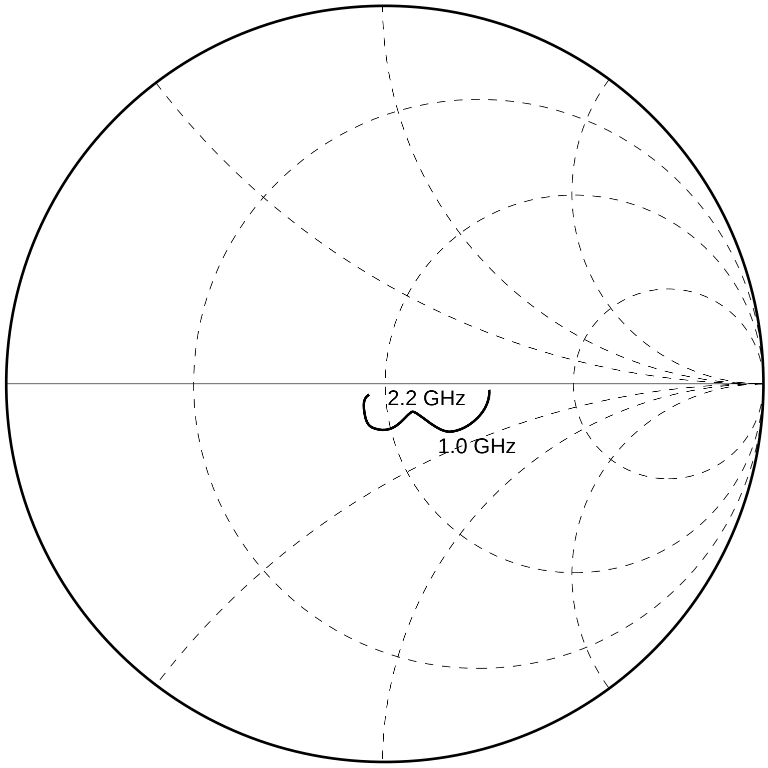
OUTPUT POWER (2 tones), IM3 vs. INPUT POWER



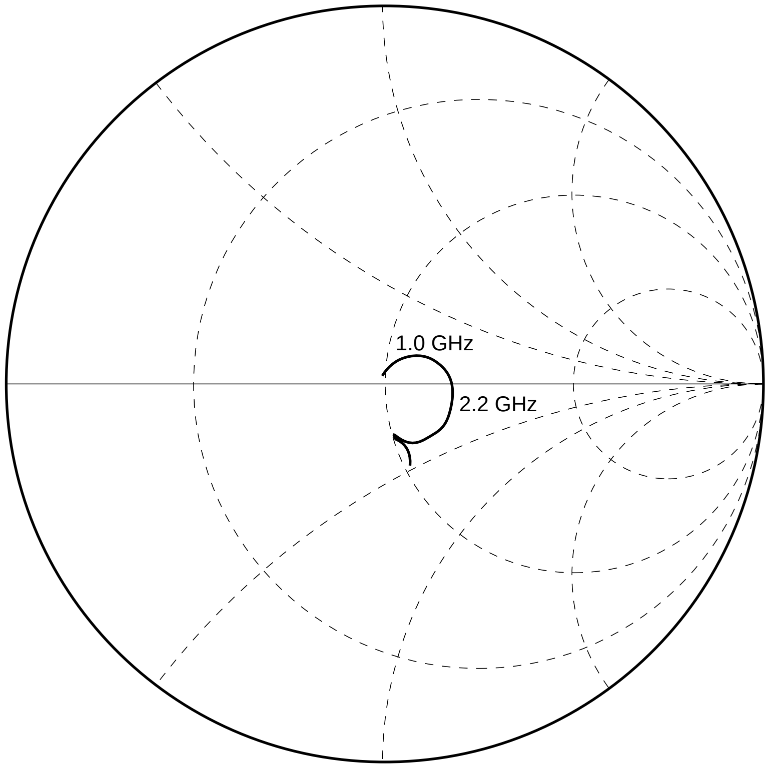
Remark The graphs indicate nominal characteristics.

S-PARAMETERS (T_A = +25°C, V_{CC} = 5.0 V)

S_{11}–FREQUENCY

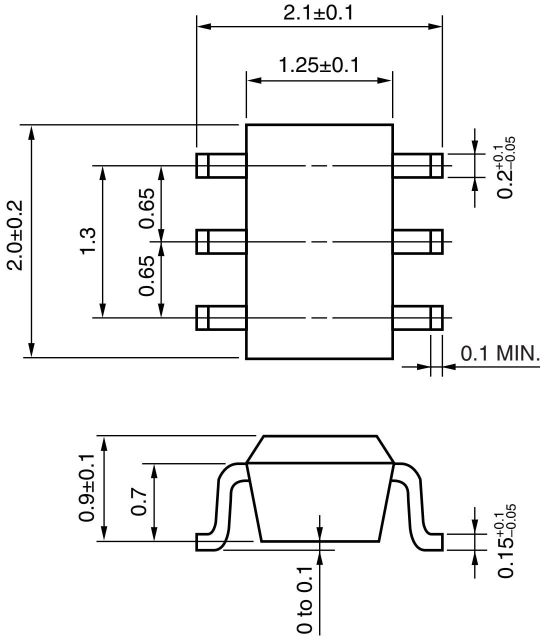


S_{22}–FREQUENCY



PACKAGE DIMENSIONS

6-PIN SUPER MINIMOLD (UNIT: mm)



NOTES ON CORRECT USE

(1) Observe precautions for handling because of electro-static sensitive devices.
(2) Form a ground pattern as widely as possible to minimize ground impedance (to prevent undesired oscillation). All the ground pins must be connected together with wide ground pattern to decrease impedance difference.
(3) The bypass capacitor should be attached to V_{CC} line.
(4) The DC cut capacitor must be each attached to input and output pin.

RECOMMENDED SOLDERING CONDITIONS

This product should be soldered and mounted under the following recommended conditions. For soldering methods and conditions other than those recommended below, contact your nearby sales office.

Soldering Method	Soldering Conditions		Condition Symbol
Infrared Reflow	Peak temperature (package surface temperature)	: 260°C or below	IR260
	Time at peak temperature	: 10 seconds or less	
	Time at temperature of 220°C or higher	: 60 seconds or less	
	Preheating time at 120 to 180°C	: 120±30 seconds	
	Maximum number of reflow processes	: 3 times	
	Maximum chlorine content of rosin flux (% mass)	: 0.2%(Wt.) or below	
Wave Soldering	Peak temperature (molten solder temperature)	: 260°C or below	WS260
	Time at peak temperature	: 10 seconds or less	
	Preheating temperature (package surface temperature)	: 120°C or below	
	Maximum number of flow processes	: 1 time	
	Maximum chlorine content of rosin flux (% mass)	: 0.2%(Wt.) or below	
Partial Heating	Peak temperature (pin temperature)	: 350°C or below	HS350
	Soldering time (per side of device)	: 3 seconds or less	
	Maximum chlorine content of rosin flux (% mass)	: 0.2%(Wt.) or below	

Caution Do not use different soldering methods together (except for partial heating).

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Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL's understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

Restricted Substance per RoHS	Concentration Limit per RoHS (values are not yet fixed)	Concentration contained in CEL devices	
		-A	-AZ
Lead (Pb)	< 1000 PPM	Not Detected	(*)
Mercury	< 1000 PPM	Not Detected	
Cadmium	< 100 PPM	Not Detected	
Hexavalent Chromium	< 1000 PPM	Not Detected	
PBB	< 1000 PPM	Not Detected	
PBDE	< 1000 PPM	Not Detected	

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.