TrueTriangle™

Preliminary Product Information

July 2002 *(1 of 8)*

824 to 849 MHz 28.5 dBm, Cellular InGaP HBT Amplifier Module

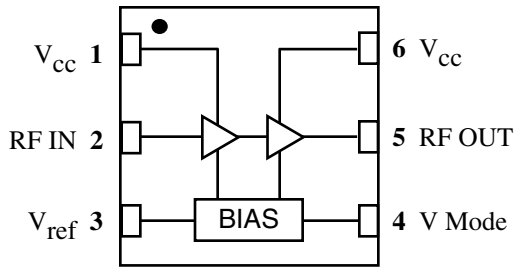
Features

- ❑ InGaP HBT Technology
- ❑ 6mm Square, 50 Ohm Power Module Package
- ❑ Single Positive Supply
- ❑ 35% Linear Power Added Efficiency
- ❑ +28.5 dBm Output Power (CDMA Mode)
- ❑ 29 dB Gain at Operating Output Power
- ❑ On-Board Power Down Mode
- ❑ 7 dB Gain Control via Vmode

Applications

- ❑ Cellular Multi-Mode Handsets
- ❑ Cellular Infrastructure
- ❑ Wireless Local Loop Subscriber Units
- ❑ CDMA Handsets
- ❑ CDMA2K 1X Handsets

Functional Block Diagram



Ground connection is on backside

Description

The CHP0232-PM is a 50 ohm matched, single supply, linear power amplifier module intended for use in cellular handsets and wireless local loop subscriber units. The highly integrated amplifier meets the requirements of CDMA and CDMA2K 1X systems. It is a member of Celeritek's new ***TrueTriangle***™ family of 3V power amplifier modules.

The CHP0232-PM is packaged in a low-cost, space efficient, 6mm square, matched module that provides excellent electrical stability and low thermal resistance. The module operates from a fixed positive voltage and requires no external matching which significantly reduces space, cost and enhances ease of use. The device features 7 dB of gain control via an integrated attenuator.

The 6x6 mm package is self contained, incorporating 50 ohm input and output matching networks optimized for output power, linearity and efficiency.

Celeritek's InGaP HBT technology offers a thermally robust and reliable PAM (power amplifier module) solution.

Absolute Maximum Ratings

Parameter	Rating	Parameter	Rating	Parameter	Rating
Collector Voltage (+V_{cc})	+4.5 V*	Reference Voltage (V_{ref})	+3.1 V	Operating Temperature	-40°C to +85°C
Collector Current (I_{cc})	1.2 A	Power Dissipation	5 W	Storage Temperature	-65°C to +150°C
RF Input Power (High Mode)	7 dBm	V Mode	+3.1 V	Soldering Temperature	260°C for 5 Sec.
RF Input Power (Low Mode)	13 dBm				

* RF Off.

Recommended Operating Conditions

Parameter	Typ	Units	Parameter		Typ	Units
Collector Voltage (+V_{cc})	3.2 to 4.1	Volts	Operating Temperature (PC Board)		-20 to +70	°C
Reference Voltage (V_{ref}) (Fixed and regulated)	+2.95 (±1.1%)	Volts	Mode Control Voltage (Vmode)	High Low	3.0 (±5%) <1.2	V V

Application Information

The CHP0232-PM is a two-stage amplifier that requires a single regulated positive supply along with the unregulated battery voltage for proper operation. Vref is a regulated 2.95 reference voltage for the bias control circuitry. It can also be used as a power down mode select. Vcc is an unregulated supply voltage directly from the battery. Vcc should be applied prior to Vref and before RF input power. Vmode is a control voltage selection between high and low gain mode. The CHP0232-PM can be operated over a range of supply voltages and bias points by adjustment of Vref. It is important that the maximum power dissipation of the package be observed at all times and that the maximum voltage across the device is not exceeded.

Circuit Design Considerations

Biasing The positive Vcc supply voltages are applied to pins 1 and 6. Most bypass decoupling is provided on-board. Vref is applied to pin 3.

The recommended DC bypass capacitance is shown in the schematic diagram on Page 8.

Inadequate bypass capacitance and inductance around the DC supply lines can compromise the adjacent channel power ratio (ACPR), reduce power gain and/or create oscillations.

– Continued on Page 2 –

Electrical Characteristics

Unless otherwise specified, the following specifications are guaranteed at room temperature with collector voltage ($+V_{cc}$) = 3.5 V.

Parameter	Condition		Min	Typ	Max	Units
Frequency Range			824		849	MHz
Gain	Pout = 28.5 dBm	Vmode = High	28	29		dB
		Vmode = Low	21	22		dB
Gain Ripple*	824-849 MHz			1.0		dB
Gain Variation	Over supply voltage			2		dB/V
	Over temperature			0.03		dB/°C
Power Output	CDMA mode			+28.5		dBm
Harmonics	2nd @ Po = +28.5 dBm			-30		dBc
	3rd @ Po = +28.5 dBm			-30		dBc
Noise Power in Receive Band	30 kHz bandwidth			-90		dBm
Linearity (ACPR)	CDMA mode @ +28.5 dBm Pout, 885 kHz offset			-52	-48	dBc/30kHz
	+28.5 dBm Pout, 1.98 MHz offset			-60	-56	dBc/30 kHz
	CDMA2K 1X** @ +28.0 dBm Pout, 885 kHz offset			-52	-48	dBc/30 kHz
	CDMA2K 1X** @ +28.0 dBm Pout, 1.98 MHz offset			-61	-56	dBc/30 kHz
Noise Figure					5.0	dB
Input Return Loss					-10	dB
Efficiency	Pout = +28.5 dBm - CDMA			38		%
Positive Supply Current (I_{cc})	Pout CDMA (12 dBm)			105	115	mA
	Pout CDMA (28.5 dBm)			535	560	mA
Quiescent Current (I_q)	No RF			75		mA
V_{ref} Supply Current (I_{ref})				2.0	5.0	mA
V_{ref} Supply Voltage (V_{ref})	Fixed and regulated (1.2% tolerance)			2.95		V
Vmode	Vmode = Low			0.1	0.4	V
Vmode	Vmode = High		2.85	3.0	3.15	V
Imode	Vmode = High			400	800	µA
Leakage Current	Vref = 0V, Vcc = 3.5V				10	µA

* Specifications guaranteed over the temperature range of -20°C to +70°C. ** Modulation HPSK in 1.2288 MHz, RC3 PAR = 4.7 @ 1% CCDF.

– Continued from Page 1 –

Modulation When biased as specified, the CHP0232-PM will achieve the required adjacent channel response for the digital system specified. Celeritek tests each product under digital modulation to ensure correlation to customer applications.

Thermal

1. The ground pad on the backside of the CHP0232-PM must be soldered to the ground plane.
2. All leads of the package must be soldered to the appropriate electrical connection.

Physical Dimensions and PCB Footprint

Contact the factory for detailed information and dimensions of HBT power module package and recommended printed circuit board footprint.

CDMA 1xRTT

In 1999 the International Telecommunications Union specified five different IMT-2000 standards colloquially known as Third Generation (3G) mobile phone services. Besides the WCDMA standard used by NTT Ducomo in Japan, the most important other 3G technology is Qualcomm's CDMA2000. CDMA2000 is available in several subsets, the first two of which are now in commercial operation.

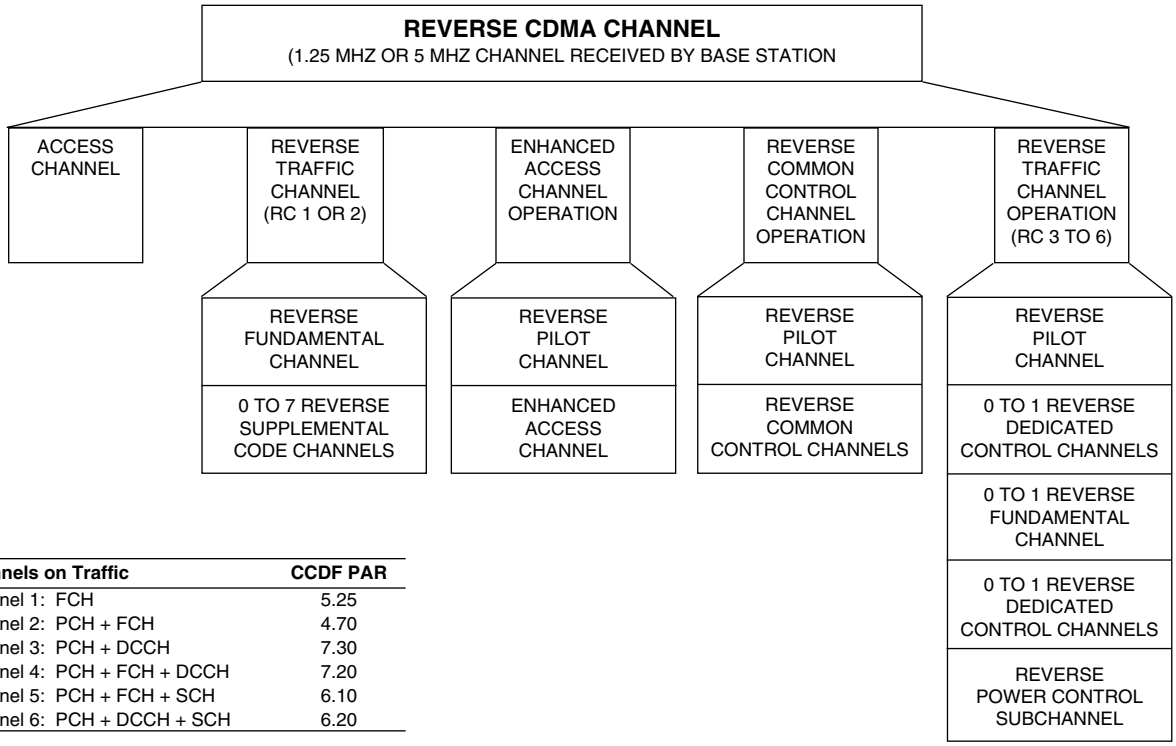
- CDMA2000 1xRTT roughly doubles a network voice capacity compound to the original CDMA One Technology. It also enables packet data transfers at up to 307 KB/s on a single 1.25 MHz carrier.
- CDMA2000 1xEV provides up to 2.4 MB/s packet data transfers on a single 1.25 MHz carrier in its current "data only" Phase 1 (1xEV-DO) version. Phase 2 (1xEV-DV) will provide up to 4.8 MB/s of integrated voice and data communications
- CDMA 3x will operate on newly licensed 5 MHz carriers and will potentially offer 3 times the number of voice and date channels, or higher data rates.

First launched in South Korea, operators in the United States and elsewhere are expected to migrate to CDMA2000 1xRTT in 2002.

The rapid progression from 2nd generation CDMAOne to CDMA2000 is an evolutionary migration. Service operators have the option to implement CDMA2000 1xRTT at their existing 1.25 MHz frequency bands. In this case the RF section of both the mobile phone and base station remains the same. But there are significant changes in the channel configuration which ultimately creates a need for additional linearity within the Power Amplifier Module. The major influence of the multi-channel configuration is a change in the Code Complementary Distribution Function (CCDF) commonly referred to as the peak-to-average ratio (PAR).

The handset re-use channel configuration is shown in Figure 1. Reverse Channel Configuration Details – Traffic Channels Defined. The parameters of each channel as detailed and interpreted from the CDMA2000 standard is detailed in Figure 2. Channel Configurations as Set Up in ESG Signal Source.

Figure 1. Reverse Channel Configuration Details – Traffic Channels Defined.



Channels on Traffic	CCDF PAR
Channel 1: FCH	5.25
Channel 2: PCH + FCH	4.70
Channel 3: PCH + DCCH	7.30
Channel 4: PCH + FCH + DCCH	7.20
Channel 5: PCH + FCH + SCH	6.10
Channel 6: PCH + DCCH + SCH	6.20

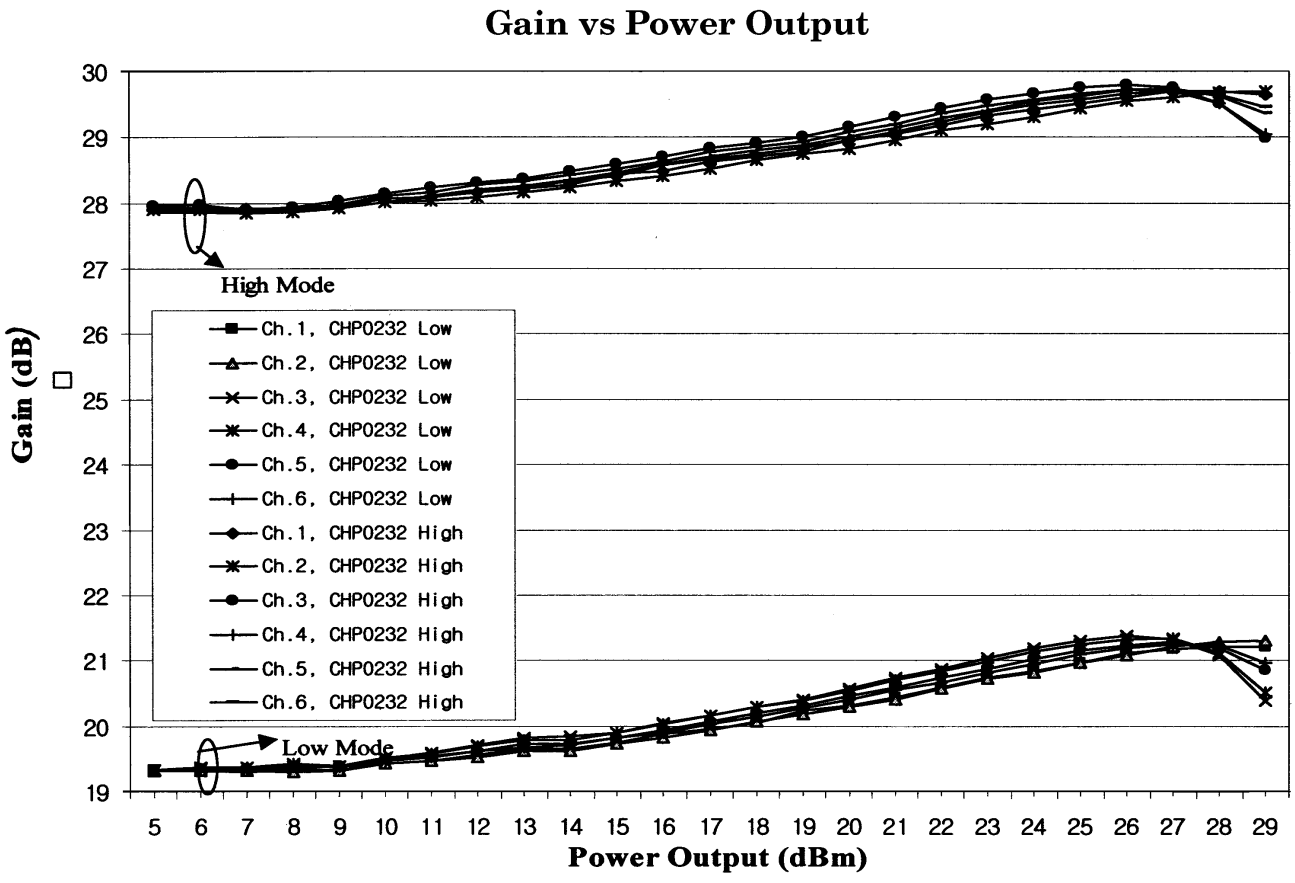
DCCH = Dedicated Control Channel
FCH = Fundamental Channel
PCH = Pilot Channel
SCH = Supplemental Code Channel

Figure 2. Channel Configurations as Set Up in ESG Signal Source

Channels on Traffic		Channel Voltage Gain				Channel Power Ratio			
		PCH	FCH	DCCH	SCH	PCH	FCH	DCCH	SCH
Ch 1: FCH	V Gain, dB		1.0				0		
	Bits per Sec.		9600				9600		
Ch 2: PCH + FCH	V Gain, dB	1.0	1.54			-5.278	-1.528		
	Bits per Sec.	On	9600			On	9600		
Ch 3: PCH + DCCH	V Gain, dB	1.0		1.54		-5.278		-1.528	
	Bits per Sec.	On		9600		On		9600	
Ch 4: PCH + FCH	V Gain, dB	1.0	0.512	1.54		-5.60	-11.48	-1.85	
	Bits per Sec.	On	1500	9600		On	1500	9600	
Ch 5: PCH + FCH + SCH	V Gain, dB	1.0	1.54		1.54	-7.59	-3.84		-3.84
	Bits per Sec.	On	9600		9600	On	9600		9600
Ch 6: PCH + DCCH + SCH	V Gain, dB	1.0		1.54	1.54	-7.59		-3.84	-3.84
	Bits per Sec.	On		9600	9600	On		9600	9600

DCCH = Dedicated Control Channel
FCH = Fundamental Channel
PCH = Pilot Channel
SCH = Supplemental Code Channel

Typical Performance



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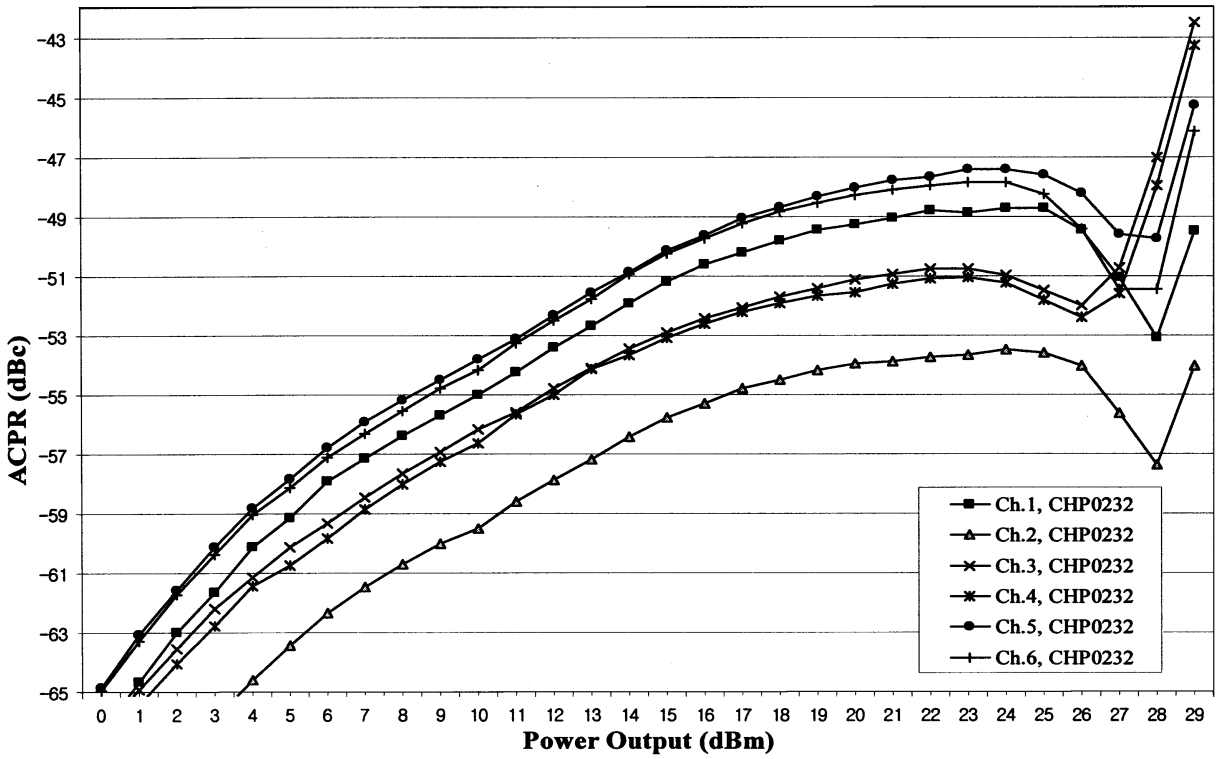
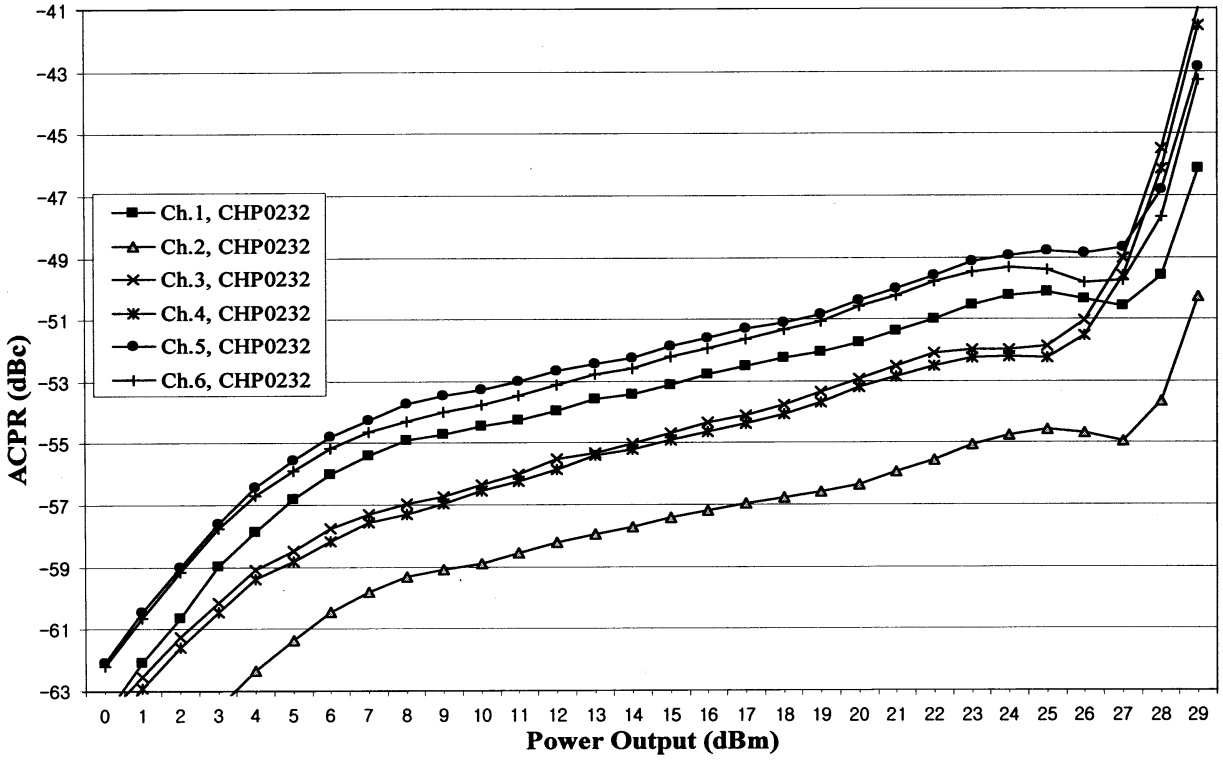
ACPR vs Power Output (High Mode)

(CDMA2K 1X Mode @ 885 kHz Offset)

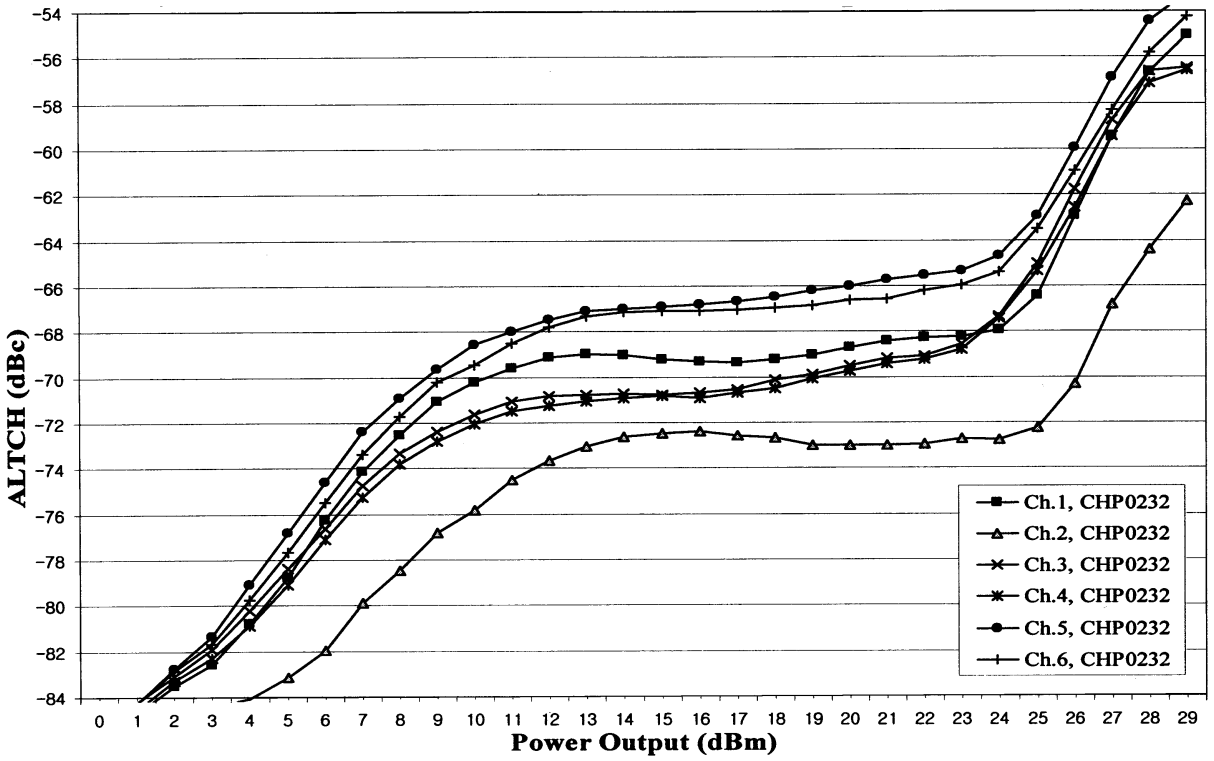


ACPR vs Power Output (Low Mode)

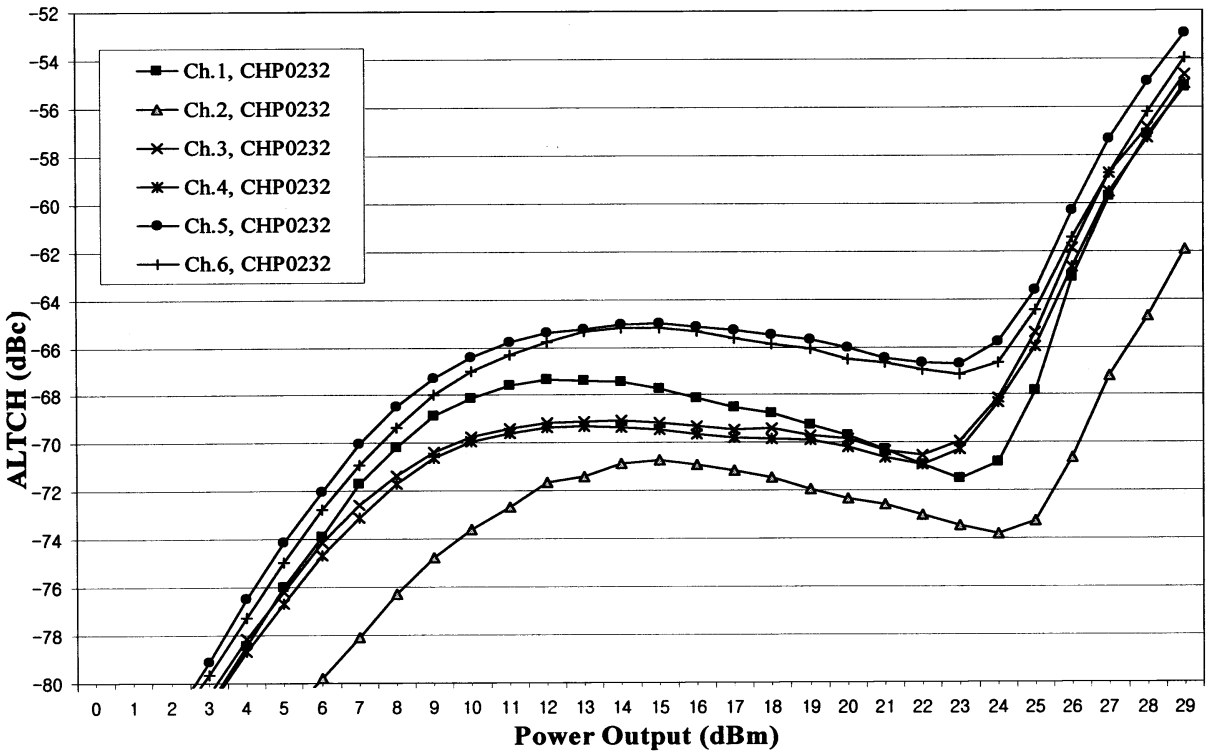
(CDMA 2K 1X Mode @ 885 kHz Offset)



ALTCH Power vs Power Output (High Mode)
(CDMA2K 1X Mode @ 1.98 MHz Offset)



ALTCH Power vs Power Output (Low Mode)
(CDMA 2K 1X Mode @ 1.98 MHz)



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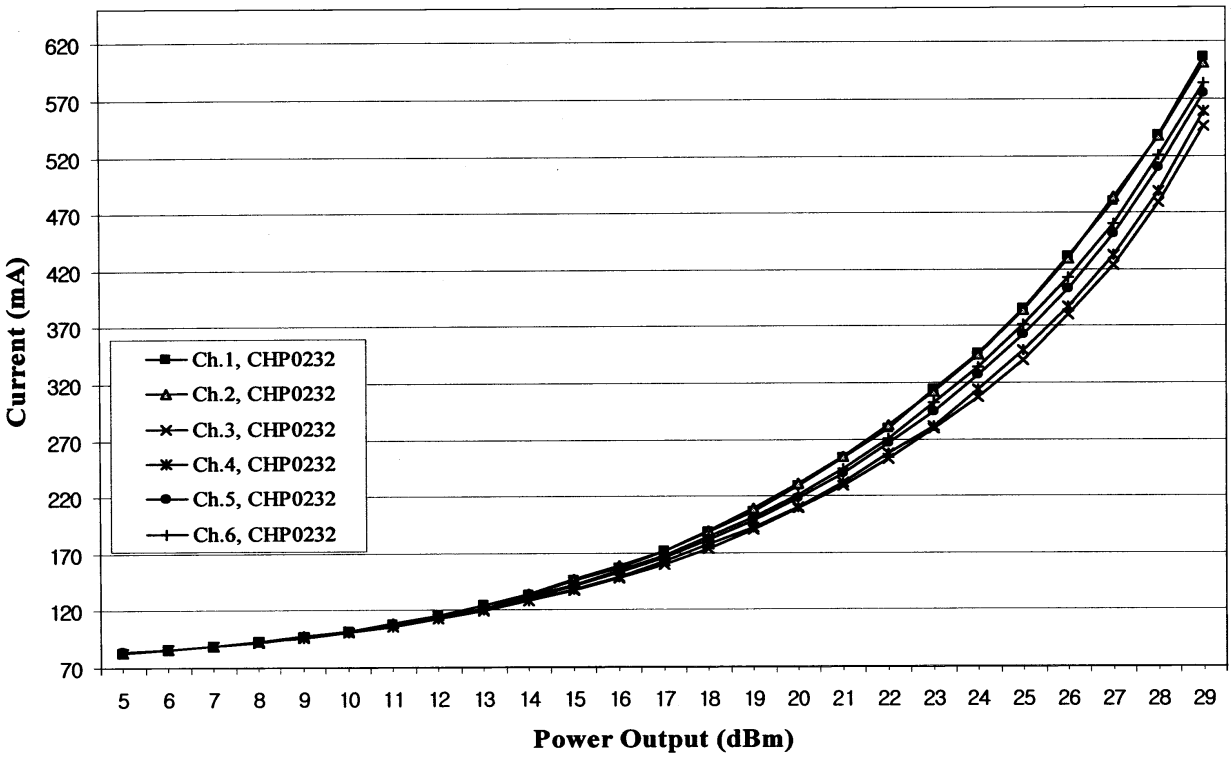
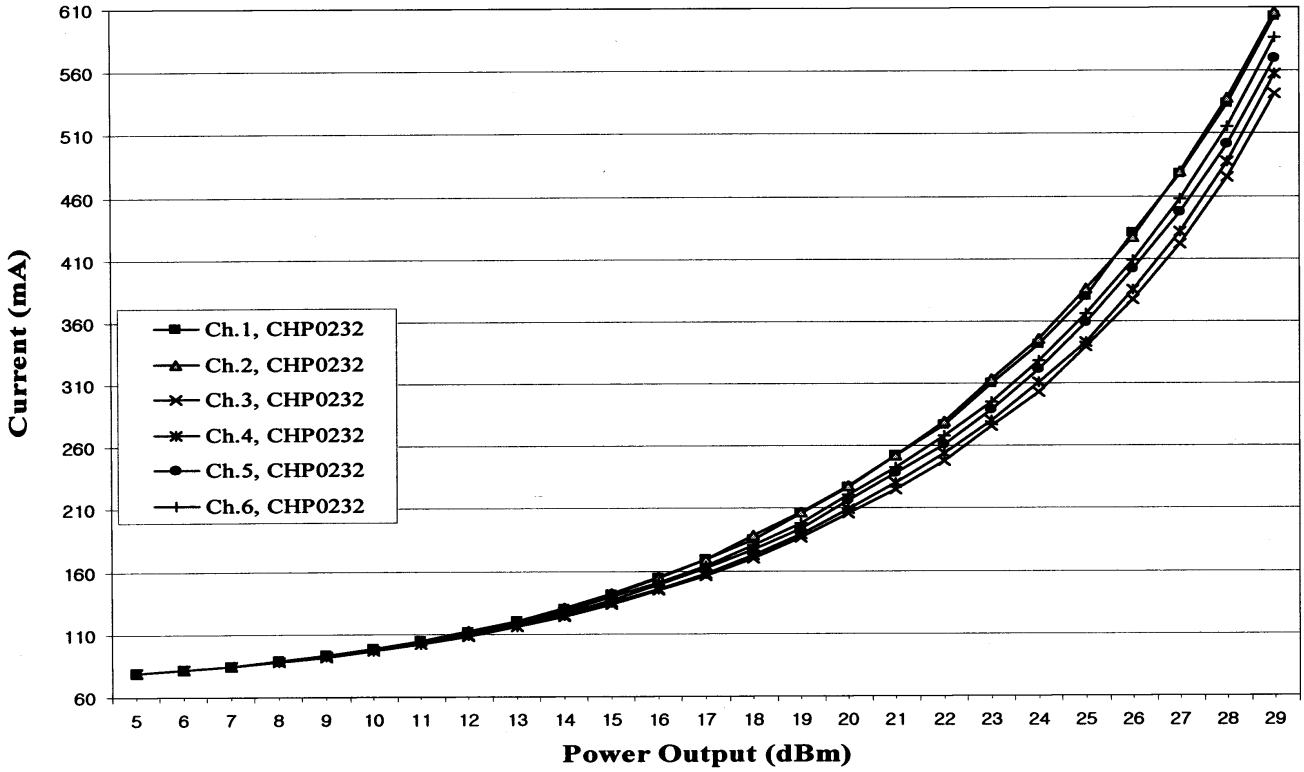
Current vs Power Output (High Mode)

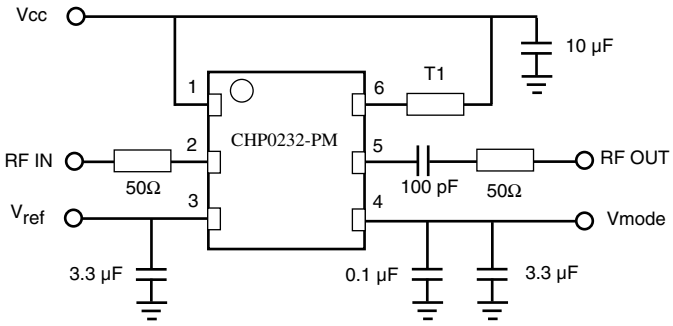


Current vs Power Output (Low Mode)



Recommended Application Circuit

Note: This schematic represents the topology of the application circuit recommended by Celeritek.

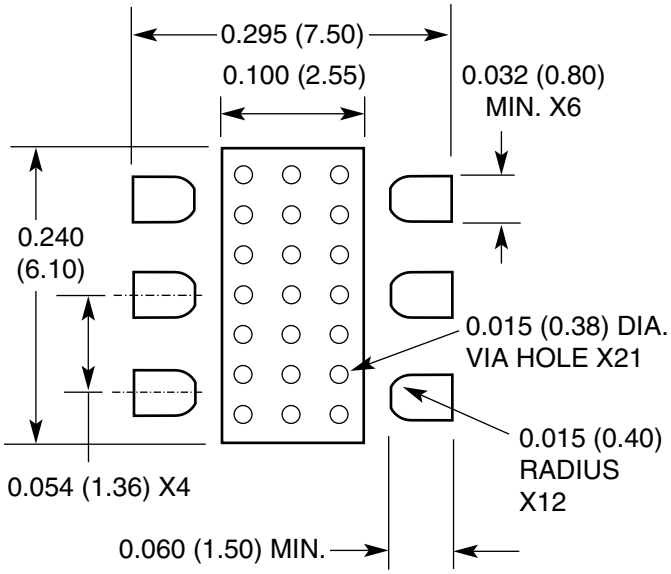


T1 line is important to ensure best bypassing. Optimum performance is achieved through an electrical length of min. 20° at 835 MHz.

Evaluation Board Schematic

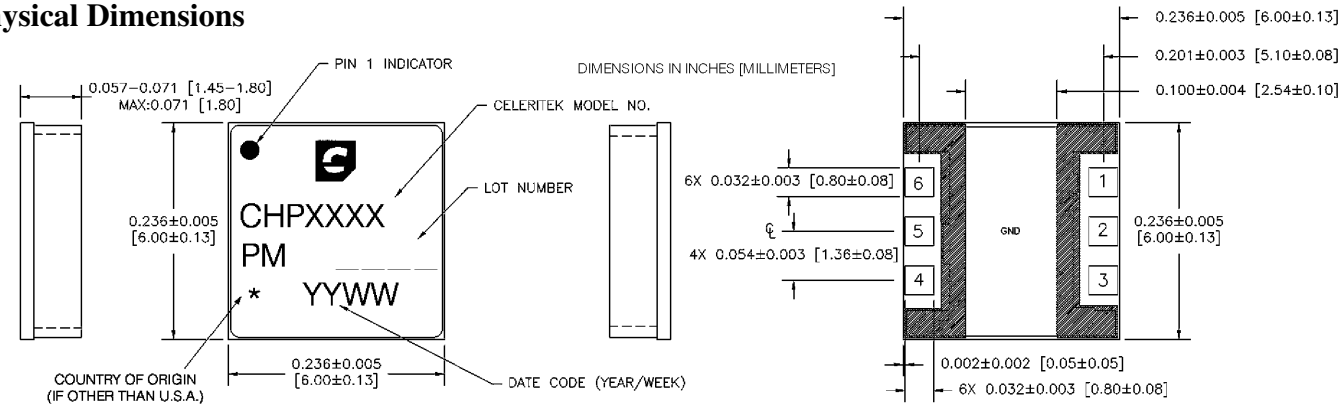
Board substrate:
ER = 4.60
Thickness = 0.031 in.

PCB Footprint (Minimum Pad Dimensions)



DIMENSIONS IN INCHES (mm)
DRAWING NOT TO SCALE

Physical Dimensions



Ordering Information

The CHP0232-PM is available in a surface mount 50 ohm matched module and devices are available in tube or tape and reel.

Part Number for Ordering	Package
CHP0232-PM-0000	**PM6 CDMA surface mount power package in tube**
CHP0232-PM-000T	**PM6 CDMA surface mount power package in tape and reel**
PB-CHP0232-PM	**Evaluation Board with SMA connectors for CHP0232-PM**