

**FEATURES**

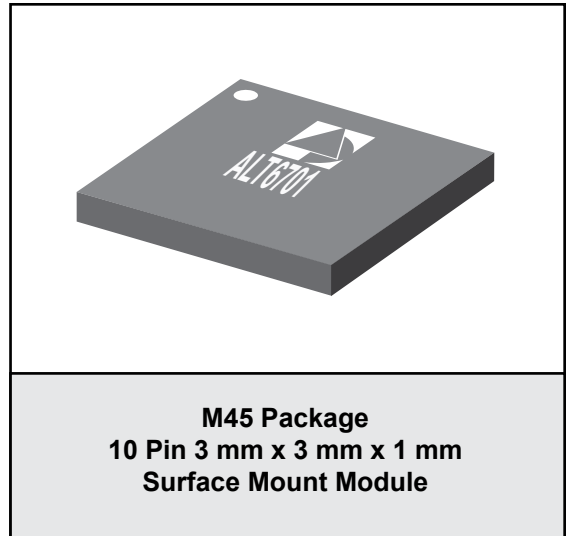
- CDMA/EVDO, WCDMA/HSPA and LTE Compliant
- 4th Generation HELP™ technology
- High Efficiency (R99 waveform):
  - 41 % @  $P_{OUT} = +28.4$  dBm
  - 31 % @  $P_{OUT} = +17$  dBm
  - 21 % @  $P_{OUT} = +13.5$  dBm
  - 26 % @  $P_{OUT} = +9$  dBm
  - 13 % @  $P_{OUT} = +3.5$  dBm
- Low Quiescent Current: 2 mA
- Low Leakage Current in Shutdown Mode:  $<5 \mu A$
- Internal Voltage Regulator
- Integrated “daisy chainable” directional coupler with CPL<sub>IN</sub> and CPL<sub>OUT</sub> port.
- Internal DC blocks on IN/OUT RF ports
- Optimized for a 50  $\Omega$  System
- 1.8 V Control Logic
- RoHS Compliant Package, 260 °C MSL-3

**APPLICATIONS**

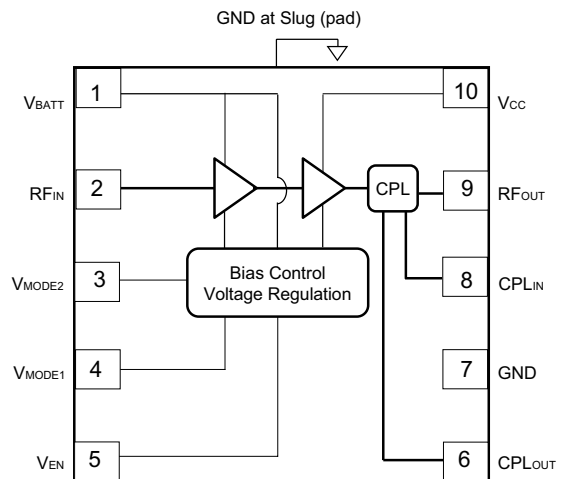
- Band 1 WCDMA/HSPA Wireless Devices
- Band 1 LTE Wireless Devices
- Band Class 6 CDMA/EVDO Wireless Devices

**PRODUCT DESCRIPTION**

The ALT6701 HELP4™ PA is a 4th generation HELP™ product for LTE and WCDMA devices operating in UMTS2100 (Band 1) and for CDMA devices operating in Band Class 6. This PA incorporates ANADIGICS’ HELP4™ technology to deliver exceptional efficiency at low power levels and low quiescent current without the need for external voltage regulators or converters. The device is manufactured using advanced InGaP-Plus™ HBT technology offering state-of-the-art reliability, temperature stability, and ruggedness. Three selectable bias modes that optimize efficiency for different output power levels and a shutdown mode with low leakage current increase handset



talk and standby time. A “daisy chainable” directional coupler is integrated in the module, thus eliminating the need of an external coupler. The self-contained 3 mm x 3 mm x 1 mm surface mount package incorporates matching networks optimized for output power, efficiency, and linearity in a 50  $\Omega$  system.


**Figure 1: Block Diagram**

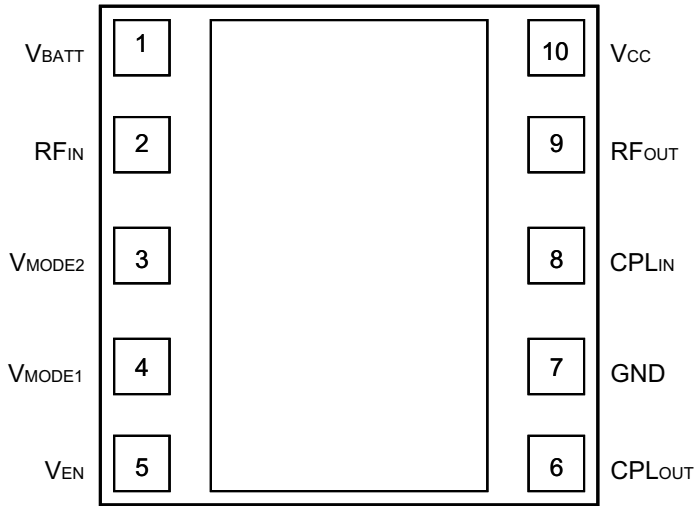


Figure 2: Pinout (X-ray Top View)

Table 1: Pin Description

PIN	NAME	DESCRIPTION
1	V <sub>BATT</sub>	Battery Voltage
2	R <sub>F</sub> IN	RF Input
3	V <sub>MODE2</sub>	Mode Control Voltage 2
4	V <sub>MODE1</sub>	Mode Control Voltage 1
5	V <sub>EN</sub>	PA Enable Voltage
6	C <sub>PL</sub> OUT	Coupler Output
7	GND	Ground
8	C <sub>PL</sub> IN	Coupler Input
9	R <sub>F</sub> OUT	RF Output
10	V <sub>CC</sub>	Supply Voltage

## ELECTRICAL CHARACTERISTICS

Table 2: Absolute Minimum and Maximum Ratings

PARAMETER	MIN	MAX	UNIT
Supply Voltage ( $V_{CC}$ )	0	+5	V
Battery Voltage ( $V_{BATT}$ )	0	+6	V
Control Voltages ( $V_{MODE1}$ , $V_{MODE2}$ , $V_{EN}$ )	0	+3.5	V
RF Input Power ( $P_{IN}$ )	-	+10	dBm
Storage Temperature ( $T_{STG}$ )	-40	+150	°C

Stresses in excess of the absolute ratings may cause permanent damage. Functional operation is not implied under these conditions. Exposure to absolute ratings for extended periods of time may adversely affect reliability.

Table 3: Operating Ranges

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (f)	1920	-	1980	MHz	
Supply Voltage ( $V_{CC}$ )	+3.1	+3.4	+4.35	V	$P_{OUT} < +28.4$ dBm
Enable Voltage ( $V_{EN}$ )	+1.35 0	+1.8 -	+3.1 +0.5	V	PA "on" PA "shut down"
Mode Control Voltage ( $V_{MODE1}$ , $V_{MODE2}$ )	+1.35 0	+1.8 -	+3.1 +0.5	V	Low Bias Mode High Bias Mode
WCDMA / UMTS Output Power <sup>(1,3)</sup> R99, HPM HSPA (MPR=0), HPM LTE <sup>(2)</sup> R99, MPM LTE <sup>(2)</sup> & HSPA (MPR=0), MPM R99, LPM LTE <sup>(2)</sup> & HSPA (MPR=0), LPM	27.6 26.6 26.2 - - 8.2 7.2	28.4 27.4 27.0 17.0 16.0 9.0 8.0	- - - - - - -	dBm	3GPP TS 34.121-1, Rel 8 Table C.11.1.3 for WCDMA SUBTEST 1  TS 36.101 Rel 8 for LTE
CDMA Output Power <sup>(1,3)</sup> HPM MPM LPM	26.9 - 7.2	27.7 16.0 8.0	- - -	dBm	CDMA 2000, RC-1
Case Temperature ( $T_c$ )	-40	-	+90	°C	

The device may be operated safely over these conditions; however, parametric performance is guaranteed only over the conditions defined in the electrical specifications.

## Notes:

(1) For Operation at 3.1 V,  $P_{OUT}$  is derated by 0.8 dB.

(2) LTE Waveform: Up to 20 MHz, 18 RB's, QPSK.

(3) For Operation at +105 °C,  $P_{OUT}$  is derated by 1.0 dB.

**Table 4: Electrical Specifications - LTE Operation (RB = 12, START = 0, QPSK)**  
**(T<sub>c</sub> = +25 °C, V<sub>BATT</sub> = V<sub>CC</sub> = +3.4 V, V<sub>EN</sub> = +1.8 V, 50 Ω system)**

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS		
					P <sub>OUT</sub>	V <sub>MODE1</sub>	V <sub>MODE2</sub>
Gain	24.5 16 7.5	27 19 10	29 22 12.5	dB	P <sub>OUT</sub> = +27 dBm P <sub>OUT</sub> = +16 dBm P <sub>OUT</sub> = +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
ACLR E-UTRA at ± 10 MHz offset	- - -	-39 -40 -40	-34 -34 -34	dBc	P <sub>OUT</sub> = +27 dBm P <sub>OUT</sub> = +16 dBm P <sub>OUT</sub> = +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
ACLR UTRA at ± 7.5 MHz offset	- - -	-40 -40 -41	-36.5 -36.5 -36.5	dBc	P <sub>OUT</sub> = +27 dBm P <sub>OUT</sub> = +16 dBm P <sub>OUT</sub> = +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
ACLR UTRA at ± 12.5 MHz offset	- - -	-59 -59 <-60	-40 -40 -40	dBc	P <sub>OUT</sub> = +27 dBm P <sub>OUT</sub> = +16 dBm P <sub>OUT</sub> = +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Power-Added Efficiency	31 24 18	35 28 23	- - -	%	P <sub>OUT</sub> = +27 dBm P <sub>OUT</sub> = +16 dBm P <sub>OUT</sub> = +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 0 V
Quiescent Current (I <sub>q</sub> ) Low Bias Mode	-	2	3.2	mA	through V <sub>CC</sub> pin	1.8 V	1.8 V
NS_05 PHS Emissions	-	-45	-42	dBm/300 kHz	P <sub>OUT</sub> ≤ 27 dBm		
Mode Control Current	-	0.08	0.15	mA	through V <sub>MODE</sub> pins, V <sub>MODE1,2</sub> = 1.8 V		
Enable Current	-	0.04	0.1	mA	through V <sub>EN</sub> pin, V <sub>EN</sub> = 1.8 V		
BATT Current	-	0.8	1.5	mA	through V <sub>BATT</sub> pin, V <sub>MODE1,2</sub> = 1.8 V		
Leakage Current	-	<5	10	μA	V <sub>BATT</sub> = V <sub>CC</sub> = +4.35 V V <sub>EN</sub> = 0 V, V <sub>MODE1,2</sub> = 0 V		
Noise Power	- - - -	-136 -138 -144 -38	-134 - - -35	dBm/Hz	2110 MHz to 2170 MHz GPS Band ISM Band B34 2010 - 2025 MHz		
Harmonics 2fo 3fo, 4fo	- - -	-43 -46	-35 -38	dBc	P <sub>OUT</sub> ≤ +27 dBm		
Coupling Factor	-	20	-	dB			
Directivity	-	20	-	dB			
Daisy Chain Insertion Loss	-	<0.25	-	dB			
Spurious Output Level (all spurious outputs)	-	-	<-70	dBc	P <sub>OUT</sub> ≤ +27 dBm In-band load VSWR < 5:1 Out-of-band load VSWR < 10:1 Applies over all operating conditions		
Load mismatch stress with no permanent degradation or failure	8:1	-	-	VSWR	Applies over full operating range		

Notes:

(1) ACLR and Efficiency measured at 1950 MHz.

**Table 5: Electrical Specifications - WCDMA Operation (R99 waveform)**  
**( $T_C = +25\text{ }^\circ\text{C}$ ,  $V_{BATT} = V_{CC} = +3.4\text{ V}$ ,  $V_{EN} = +1.8\text{ V}$ ,  $50\ \Omega$  system)**

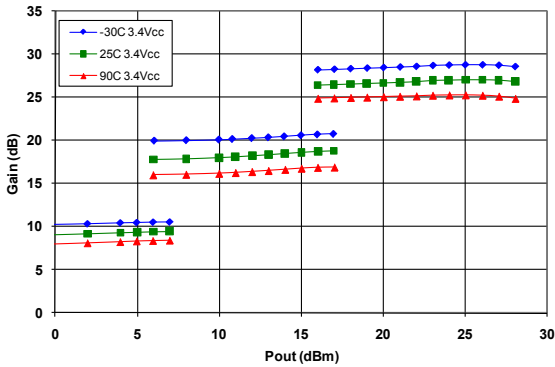
PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS		
					$P_{OUT}$	$V_{MODE1}$	$V_{MODE2}$
Gain	24.5 16 7.5	27 19 10	29 22 12.5	dB	$P_{OUT} = +28.4\text{ dBm}$ $P_{OUT} = +17\text{ dBm}$ $P_{OUT} = +9\text{ dBm}$	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
ACLR1 at 5 MHz offset <sup>(1)</sup>	- - -	-41 -41 -41	-37.5 -37.5 -37.5	dBc	$P_{OUT} = +28.4\text{ dBm}$ $P_{OUT} = +17\text{ dBm}$ $P_{OUT} = +9\text{ dBm}$	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
ACLR2 at 10 MHz offset	- - -	-53 -56 -60	-48 -48 -48	dBc	$P_{OUT} = +28.4\text{ dBm}$ $P_{OUT} = +17\text{ dBm}$ $P_{OUT} = +9\text{ dBm}$	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Power-Added Efficiency <sup>(1)</sup>	37 27 - 20 -	41 31 21 26 13	- - - - -	%	$P_{OUT} = +28.4\text{ dBm}$ $P_{OUT} = +17\text{ dBm}$ $P_{OUT} = +13.5\text{ dBm}$ $P_{OUT} = +9\text{ dBm}$ $P_{OUT} = +3.5\text{ dBm}$	0 V 1.8 V 1.8 V 1.8 V 1.8 V	0 V 0 V 0 V 1.8 V 1.8 V
Spurious Output Level (all spurious outputs)	-	-	-70	dBc	$P_{OUT} < +28.4\text{ dBm}$ In-band load VSWR < 5:1 Out-of-band load VSWR < 10:1 Applies over all operating conditions		
Load mismatch stress with no permanent degradation or failure	8:1	-	-	VSWR	Applies over full operating range		

**Table 6: Electrical Specifications - CDMA Operation (CDMA 2000, RC-1)**  
 (T<sub>c</sub> = +25 °C, V<sub>BATT</sub> = V<sub>CC</sub> = +3.4 V, V<sub>ENABLE</sub> = +1.8 V, 50 Ω system)

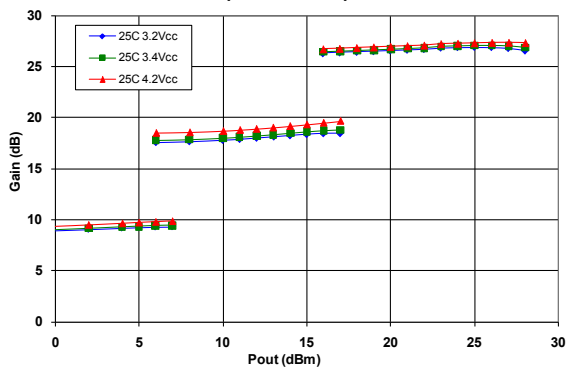
PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS		
					P <sub>OUT</sub>	V <sub>MODE1</sub>	V <sub>MODE2</sub>
Gain	24.5	27	29	dB	P <sub>OUT</sub> = +27.7 dBm	0 V	0 V
	16	19	22		P <sub>OUT</sub> = +16 dBm	1.8 V	0 V
	7.5	10	13		P <sub>OUT</sub> = +8 dBm	1.8 V	1.8 V
Adjacent Channel Power at ± 1.25 MHz offset Primary Channel BW = 1.23 MHz Adjacent Channel BW = 30 kHz	-	-50	-46.5	dBc	P <sub>OUT</sub> = +27.7 dBm	0 V	0 V
	-	-54	-46.5		P <sub>OUT</sub> = +16 dBm	1.8 V	0 V
	-	-56	-46.5		P <sub>OUT</sub> = +8 dBm	1.8 V	1.8 V
Adjacent Channel Power at ± 1.98 MHz offset Primary Channel BW = 1.23 MHz Adjacent Channel BW = 30 kHz	-	-56	-53	dBc	P <sub>OUT</sub> = +27.7 dBm	0 V	0 V
	-	<-60	-53		P <sub>OUT</sub> = +16 dBm	1.8 V	0 V
	-	<-60	-53		P <sub>OUT</sub> = +8 dBm	1.8 V	1.8 V
Power-Added Efficiency <sup>(1)</sup>	34	38	-	%	P <sub>OUT</sub> = +27.7 dBm	0 V	0 V
	25	29	-		P <sub>OUT</sub> = +16 dBm	1.8 V	0 V
	18	22	-		P <sub>OUT</sub> = +8 dBm	1.8 V	1.8 V
Spurious Output Level (all spurious outputs)	-	-	-70	dBc	P <sub>OUT</sub> < +27.7 dBm In-Band VSWR < 5:1 Out-Of-Band VSWR < 10:1 Applies to all operating conditions		
Load mismatch stress with no permanent degradation or failure	8:1	-	-	VSWR	Applies over full operating range		

**PERFORMANCE DATA PLOTS:  
(LTE Operation at 1950 MHz and 50 Ω system)**

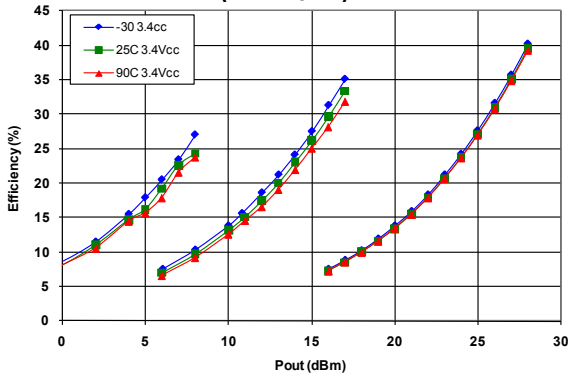
**Figure 4: WCDMA Gain (dB) over Temperature**  
( $V_{BATT} = V_{CC} = 3.4\text{ V}$ )



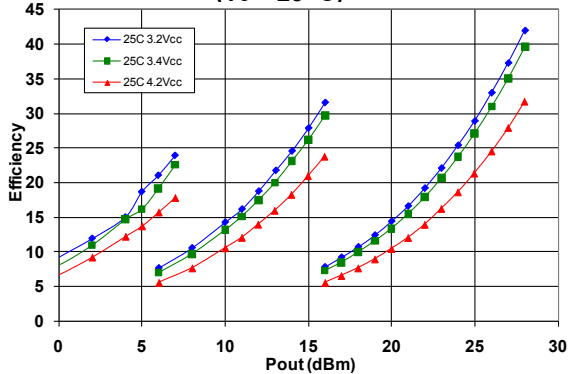
**Figure 5: LTE Gain (dB) over Voltage**  
( $T_c = 25\text{ °C}$ )



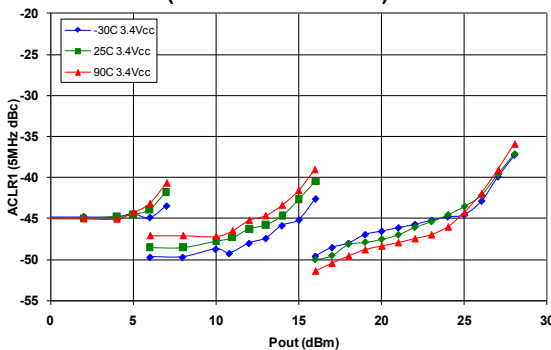
**Figure 6: LTE PAE (%) over Temperature**  
( $T_c = 25\text{ °C}$ )



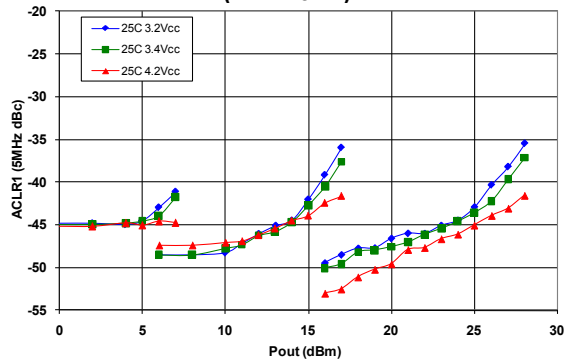
**Figure 7: LTE PAE (%) over Voltage**  
( $T_c = 25\text{ °C}$ )



**Figure 8: LTE ACLR1 (dBc) over Temperature**  
( $V_{BATT} = V_{CC} = 3.4\text{ V}$ )



**Figure 9: LTE ACLR1 (dBc) over Voltage**  
( $T_c = 25\text{ °C}$ )



**APPLICATION INFORMATION**

To ensure proper performance, refer to all related Application Notes on the ANADIGICS web site: <http://www.anadigics.com>

**Shutdown Mode**

The power amplifier may be placed in a shutdown mode by applying logic low levels (see Operating Ranges table) to the  $V_{EN}$ ,  $V_{MODE1}$  and  $V_{MODE2}$  voltages.

**Bias Modes**

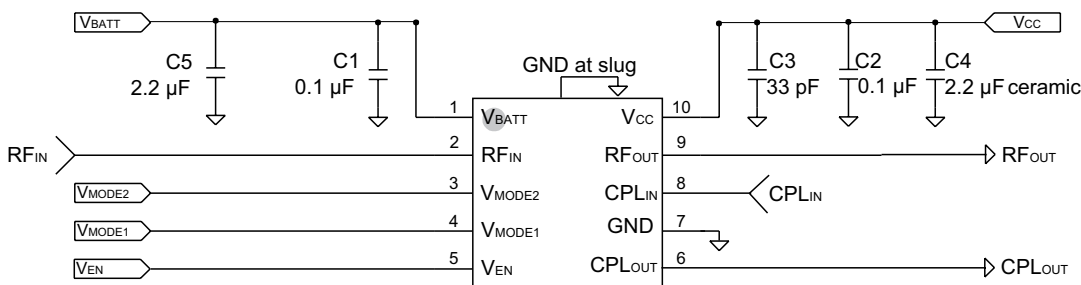
The power amplifier may be placed in either Low, Medium or High Bias modes by applying the appropriate logic level (see Operating Ranges table)

to the  $V_{MODE}$  pins. The Bias Control table below lists the recommended modes of operation for various applications.

Three operating modes are recommended to optimize current consumption. High Bias/High Power operating mode is for  $P_{OUT}$  levels  $\geq 16$  dBm. At  $\sim 17$ dBm - 6 dBm, the PA could be switched to Medium Power Mode. For  $P_{OUT}$  levels  $\leq -8$  dBm, the PA could be switched to Low Power Mode for extremely low current consumption.

**Table 7: Bias Control**

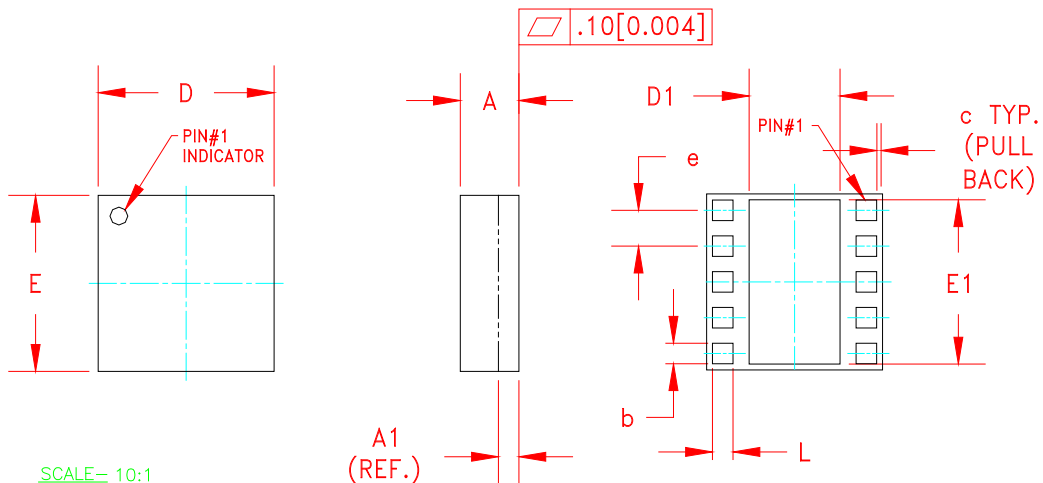
APPLICATION	$P_{OUT}$ LEVELS	BIAS MODE	$V_{EN}$	$V_{MODE1}$	$V_{MODE2}$	$V_{CC}$	$V_{BATT}$
Low power (Low Bias Mode)	< + 8 dBm	Low	+1.8 V	+1.8 V	+1.8 V	3.1 - 4.35 V	> 3.1 V
Med power (Medium Bias Mode)	> 6 dBm < 17 dBm	Low	+1.8 V	+1.8 V	0 V	3.1 - 4.35 V	> 3.1 V
High power (High Bias Mode)	> + 16 dBm	High	+1.8 V	0 V	0 V	3.1 - 4.35 V	> 3.1 V
Shutdown	-	Shutdown	0 V	0 V	0 V	3.1 - 4.35 V	> 3.1 V



**Figure 10: Evaluation Board Schematic**



PACKAGE OUTLINE



SYMBOL	MILLIMETERS			INCHES			NOTE
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	
A	0.91	1.03	1.13	0.035	0.041	0.044	—
A1	PLEASE REFER TO LAMINATE CONTROL DRAWING						—
b	0.32	0.35	0.40	0.013	0.014	0.016	3
c	—	0.10	—	—	0.004	—	—
D	2.88	3.00	3.12	0.113	0.118	0.123	—
D1	1.45	1.50	1.57	0.057	0.059	0.062	3
E	2.88	3.00	3.12	0.113	0.118	0.123	—
E1	2.70	2.75	2.85	0.106	0.108	0.112	3
e	0.60			0.024			3
L	0.32	0.35	0.40	0.013	0.014	0.016	3

NOTES:

1. CONTROLLING DIMENSIONS: MILLIMETERS
2. UNLESS SPECIFIED TOLERANCE=±0.076[0.003].
3. PADS (INCLUDING CENTER) SHOWN UNIFORM SIZE FOR REFERENCE ONLY. ACTUAL PAD SIZE AND LOCATION WILL VARY WITHIN MIN. AND MAX. DIMENSIONS ACCORDING TO SPECIFIC LAMINATE DESIGN.
4. UNLESS SPECIFIED DIMENSIONS ARE SYMMETRICAL ABOUT CENTER LINES SHOWN.
5. LAMINATE CONTROL DRAWING SPECIFIED BY PART NUMBER.

Figure 11: M45 Package Outline - 10 Pin 3 mm x 3 mm x 1 mm Surface Mount Module

TOP BRAND

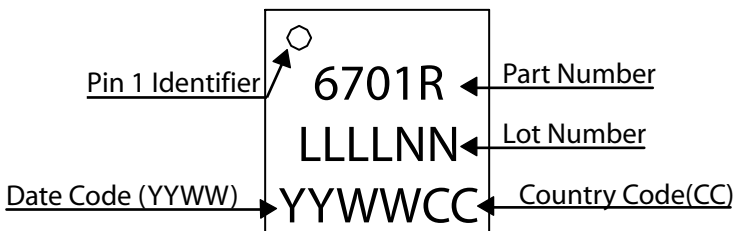
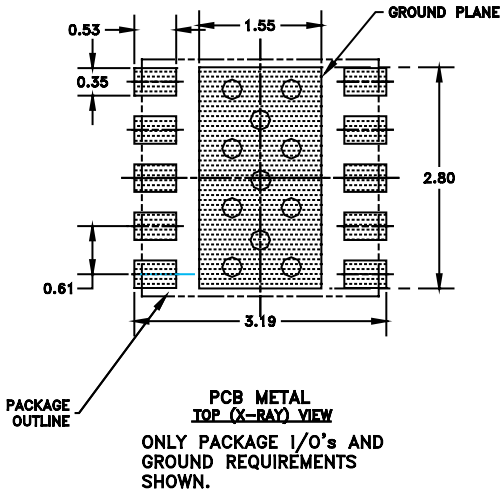


Figure 12: Branding Specification - M45 Package

PCB AND STENCIL DESIGN GUIDELINE



NOTES:

- (1) OUTLINE DRAWING REFERENCE: P8002478\_E
- (2) UNLESS SPECIFIED DIMENSIONS ARE SYMMETRICAL ABOUT CENTER LINES SHOWN.
- (3) DIMENSIONS IN MILLIMETERS.
- (4) VIAS SHOWN IN PCB METAL VIEW ARE FOR REFERENCE ONLY. NUMBER & SIZE OF THERMAL VIAS REQUIRED DEPENDENT ON HEAT DISSIPATION REQUIREMENT AND THE PCB PROCESS CAPABILITY.
- (5) RECOMMENDED STENCIL THICKNESS: APPROX. 0.150mm (6 Mils)

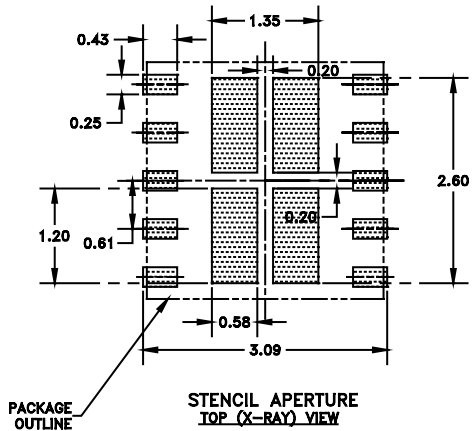
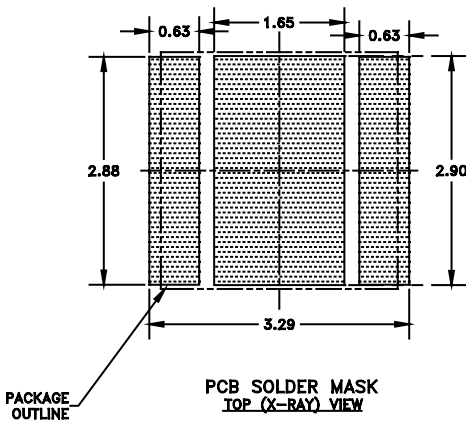
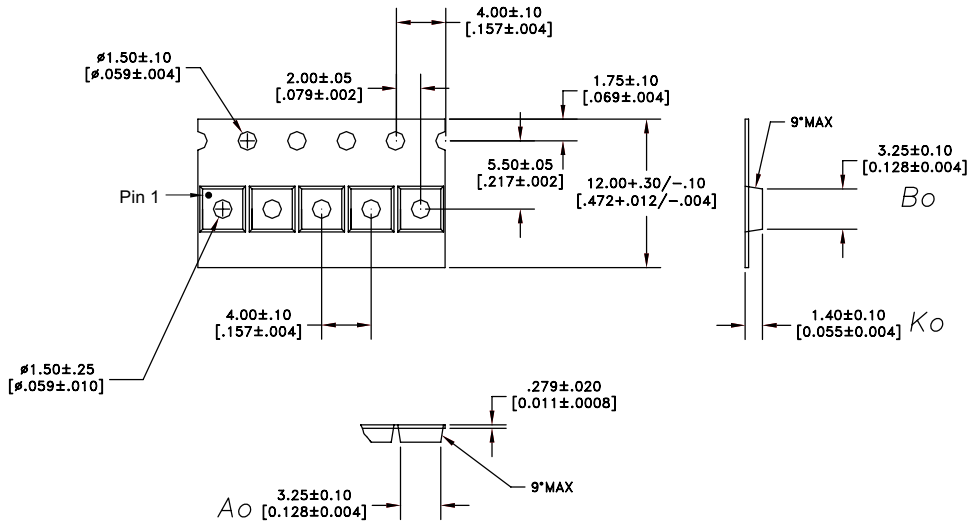


Figure 13: Recommended PCB Layout Information

COMPONENT PACKAGING



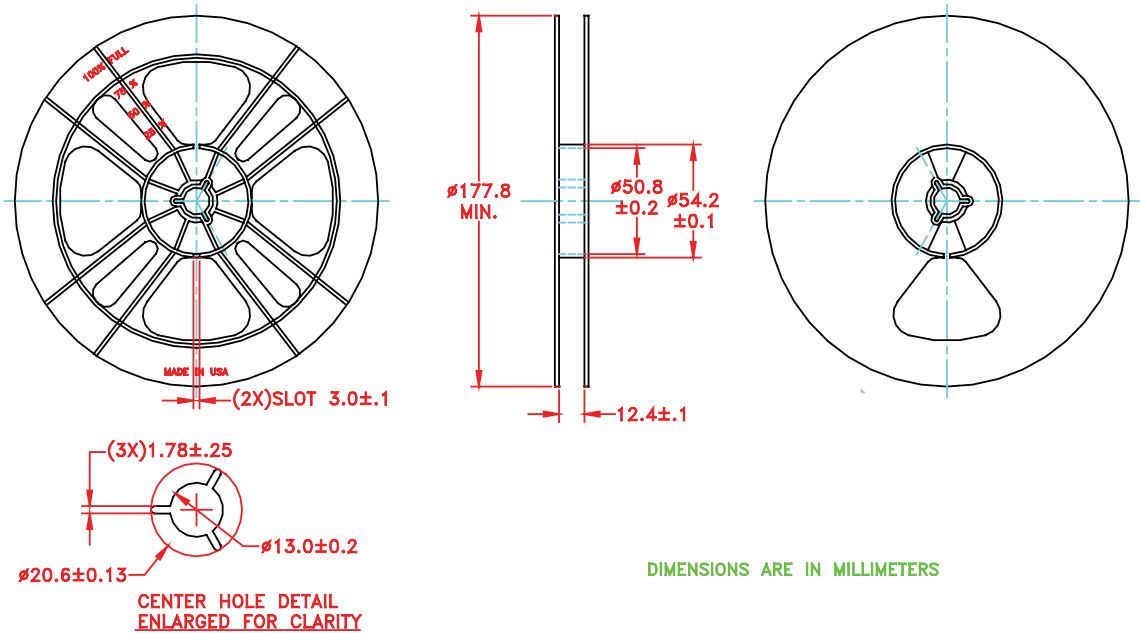
NOTES:

- 1. MATERIAL: 3000 (CARBON FILLED POLYCARBONATE)  
100% RECYCLABLE.

DIMENSIONS ARE IN MILLIMETERS [INCHES]

*DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994*

Figure 14: Carrier Tape



DIMENSIONS ARE IN MILLIMETERS

NOTES:

- 1. MATERIAL: BLACK CARBON POLYSTYRENE
- SURFACE RESISTIVITY: 1X10<sup>4</sup> TO 1X10<sup>9</sup> ohms/square

*DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994*

Figure 15: Reel

**ORDERING INFORMATION**

ORDER NUMBER	TEMPERATURE RANGE	PACKAGE DESCRIPTION	COMPONENT PACKAGING
ALT6701RM45Q7	-40 °C to +90 °C	RoHS Compliant 10 Pin 3 mm x 3 mm x 1 mm Surface Mount Module	Tape and Reel, 2500 pieces per Reel
ALT6701RM45P9	-40 °C to +90 °C	RoHS Compliant 10 Pin 3 mm x 3 mm x 1 mm Surface Mount Module	Partial Tape and Reel

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URL: <http://www.anadigics.com>**IMPORTANT NOTICE**

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