

**FEATURES**

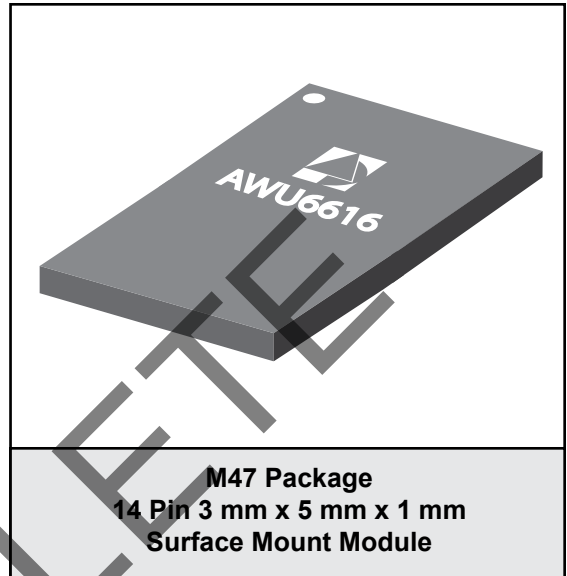
- InGaP HBT Technology
- High Efficiency (R99):
  - 37 % @  $P_{OUT} = +28.1$  dBm (Band 1)
  - 38 % @  $P_{OUT} = +28.7$  dBm (Band 5, 6)
  - 24 % @  $P_{OUT} = +16.5$  dBm
  - 8.5 % @  $P_{OUT} = +8$  dBm
- Low Quiescent Current: 4 mA
- Internal Voltage Regulation
- Built-in Directional Coupler
- Common  $V_{MODE}$  Control Line
- Simplified  $V_{CC}$  Bus PCB routing
- Reduced External Component Count
- Low Profile Surface Mount Package: 1 mm
- RoHS Compliant Package, 260 °C MSL-3

**APPLICATIONS**

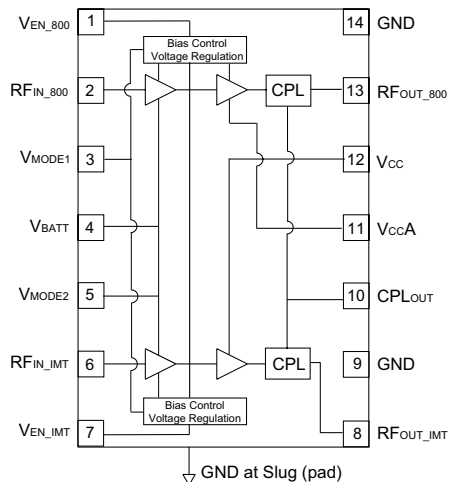
- Band 1 +5, 6 Dual-band WCDMA/HSPA wireless devices
- Band Class 0+6 Dual-band CDMA/EVDO wireless devices.
- Band Class 0+6 Dual-band EVDO Rev. B wireless devices.

**PRODUCT DESCRIPTION**

AWU6616 addresses the demand for increased integration in dual-band handsets for WCDMA and CDMA networks. The small footprint 3 mm x 5 mm x 1 mm surface-mount RoHS compliant package contains independent RF PA paths to ensure optimal performance in both frequency bands, while achieving a 25% PCB space savings compared with solutions requiring two single-band PAs. The package pinout was chosen to enable handset manufacturers to easily route bias to both power amplifiers and simplify control with common mode pins. The device is manufactured on an advanced InGaP HBT MMIC technology offering state-of-the-art reliability, temperature stability, and ruggedness. The AWU6616 is part of ANADIGICS' High-Efficiency-at-Low-Power (HELP™) family of WCDMA power amplifiers, which deliver low quiescent currents and significantly greater efficiency without the need of an external DC-DC converter. Through selectable bias modes, the AWU6616 achieves optimal efficiency, specifically at low- and mid-range



power levels where the PA typically operates, thereby dramatically increasing handset talk-time. Its built-in voltage regulator eliminates the need for external switches. This PA has built-in directional couplers for each band, with a common coupler output port CPL\_OUT. These couplers provide high directivity and 23 dB Coupling. The 3 mm x 5 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**

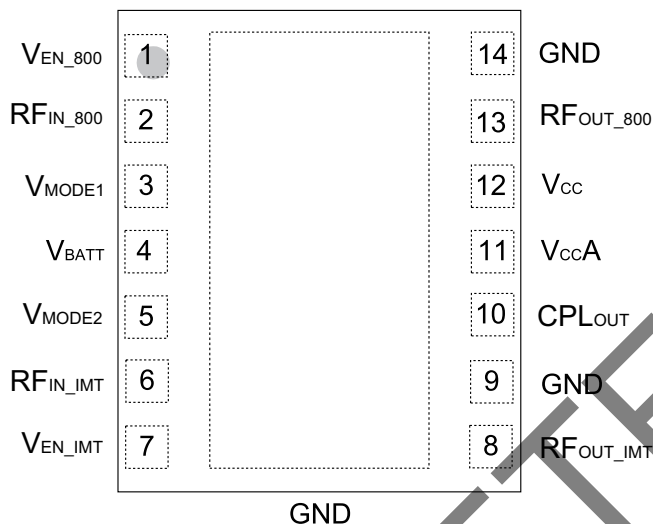


Figure 2: Pinout

Table 1: Pin Description

PIN	NAME	DESCRIPTION
1	V <sub>EN_800</sub>	Enable Voltage for CELL & JCELL Band
2	RF <sub>IN_800</sub>	RF Input for CELL & JCELL Band
3	V <sub>MODE1</sub>	Mode Control Voltage for CELL & JCELL & IMT Bands
4	V <sub>BATT</sub>	Battery Voltage
5	V <sub>MODE2</sub>	Mode Control Voltage for CELL & JCELL & IMT Band
6	RF <sub>IN_IMT</sub>	RF Input for IMT Band
7	V <sub>EN_IMT</sub>	Enable Voltage for IMT Band
8	RF <sub>OUT_IMT</sub>	RF Output for IMT Band
9	GND	Ground
10	CPL <sub>OUT</sub>	Coupler Output Port
11	V <sub>CC</sub> A	Battery Voltage A
12	V <sub>CC</sub>	Supply Voltage
13	RF <sub>OUT_800</sub>	RF Output for CELL & JCELL Band
14	GND	Ground

## ELECTRICAL CHARACTERISTICS

Table 2: Absolute Minimum and Maximum Ratings

PARAMETER	MIN	MAX	UNIT
Supply Voltage ( $V_{BATT}$ , $V_{CC}$ , $V_{CCA}$ )	0	+5	V
Mode Control Voltage ( $V_{MODE1}$ , $V_{MODE2}$ )	0	+3.5	V
Enable Voltage ( $V_{EN\_CELL}$ , $V_{EN\_PCS}$ )	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)	824 1920	-	849 1980	MHz	UMTS Band 5, 6, CDMA BC 0 UMTS Band 1, CDMA BC 6
Supply Voltage ( $V_{CC}$ and $V_{BATT}$ )	+3.2	+3.4	+4.2	V	
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
RF Output Power, Band 5, 6 UMTS R99 WCDMA, HPM HSPA (MPR = 0 dB), HPM R99 WCDMA, MPM HSPA (MPR = 0 dB), MPM R99 WCDMA, LPM HSPA (MPR = 0 dB), LPM	28.0 <sup>(1)</sup> 27.0 <sup>(1)</sup> 16.5 <sup>(1)</sup> 15.5 <sup>(1)</sup> 8.0 <sup>(1)</sup> 7.0 <sup>(1)</sup>	28.7 27.7 16.6 15.6 8.0 7.0	- - - - - -	dBm	3GPP TS 34.121-1, REL8 Table C.11.1.3 SUBTEST 1
RF Output Power, Band Class 0 CDMA2000, HPM CDMA2000, MPM CDMA2000, LPM	27.0 - -	27.8 16.0 7.5	- - -	dBm	CDMA2000 RC-1
RF Output Power, Band 1, UMTS R99 WCDMA, HPM HSPA (MPR = 0 dB), HPM R99 WCDMA, MPM HSPA (MPR = 0 dB), MPM R99 WCDMA, LPM HSPA (MPR = 0 dB), LPM	27.6 <sup>(1)</sup> 26.6 <sup>(1)</sup> 16.0 <sup>(1)</sup> 15.0 <sup>(1)</sup> 8.0 <sup>(1)</sup> 7.0 <sup>(1)</sup>	28.1 27.1 16.5 15.5 8.0 7.0	- - - - - -	dBm	3GPP TS 34.121-1, REL8 Table C.11.1.3 SUBTEST 1
RF Output Power, Band Class 6 CDMA2000, HPM CDMA2000, MPM CDMA2000, LPM	27.0 <sup>(1)</sup> - -	27.5 16.0 7.5	- - -	dBm	CDMA2000 RC-1
Case Temperature ( $T_C$ )	-30	-	+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  $V_{CC} = +3.2$  V,  $P_{OUT}$  is derated by 0.5 dB.

**Table 4: Electrical Specifications - WCDMA Operation (Band 5 & 6)**  
 (T<sub>C</sub> = +25 °C, V<sub>BATT</sub> = V<sub>CC</sub> = +3.4 V, V<sub>EN\_CELL</sub> = +1.8 V, 50 Ω system, R99 uplink waveform)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS		
					P <sub>OUT</sub>	V <sub>MODE1</sub>	V <sub>MODE2</sub>
Gain	25 14.5 9	27.5 17 12	30 20 14	dB	+28.7 dBm +16.6 dBm +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
ACLR1 @ 5 MHz Offset <sup>(1)</sup>	- - -	-42 -42 -41	-37.5 -37 -37	dBc	+28.7 dBm +16.6 dBm +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
ACLR2 @ 10 MHz Offset <sup>(1)</sup>	- - -	-58 -55 -54	-48 -48 -48	dBc	+28.7 dBm +16.6 dBm +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Power-Added Efficiency <sup>(1)</sup>	34 18 6	38 21 8	- - -	%	+28.7 dBm +16.6 dBm +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Quiescent Current (I <sub>q</sub> )	-	4	7	mA	through V <sub>BATT</sub> and V <sub>CC</sub> pins, V <sub>MODE1</sub> = +1.8 V, V <sub>MODE2</sub> = +1.8 V		
Mode Control Current	-	<0.1	0.2	mA	through V <sub>MODE</sub> pins, V <sub>MODE1</sub> = +1.8 V		
Battery Current	-	1.5	3	mA	through V <sub>BATT</sub> pin, V <sub>MODE1</sub> = +1.8 V, V <sub>MODE2</sub> = +1.8 V		
Enable Current	-	0.15	0.3	mA	through V <sub>EN_800</sub> pin		
Noise in Receive Band	-	-133	-	dBm/Hz	869 MHz to 894 MHz		
Harmonics 2fo 3fo, 4fo	- - -	-40 -50	-30 -38	dBc	P <sub>OUT</sub> < +28.7 dBm		
Input Impedance	-	-	2:1	VSWR			
Coupling Factor	-	23	-	dB			
Spurious Output Level (all spurious outputs)	-	-	-65	dBc	P <sub>OUT</sub> < +28.7 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 conditions		

Notes:

(1) PAE and ACP limit applies at 836.5 MHz.

**Table 5: Electrical Specifications - CDMA2000 Operation (Band Class 0)**  
 (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, RC-1 Waveform)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS		
					P <sub>OUT</sub>	V <sub>MODE1</sub>	V <sub>MODE2</sub>
Gain	24.5 13.5 7.5	26.5 16.5 11	30 19 14	dB	+27.8 dBm +16 dBm +7.5 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Adjacent Channel Power at ± 885 kHz offset Primary Channel BW = 1.23 MHz Adjacent Channel BW = 30 kHz	- - -	-51 -51 -51	-46.5 -46.5 -46.5	dBc	+27.8 dBm +16 dBm +7.5 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Adjacent Channel Power at ± 1.98 MHz offset Primary Channel BW = 1.23 MHz Adjacent Channel BW = 30 kHz	- - -	-60 -60 -60	-55 -55 -55	dBc	+27.8 dBm +16 dBm +7.5 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Power-Added Efficiency	- - -	35 19 7	- - -	%	+27.8 dBm +16 dBm +7.5 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Spurious Output Level (all spurious outputs)	-	-	-70	dBc	P <sub>OUT</sub> ≤ +27.8 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 all operating conditions		

**Table 6: Electrical Specifications - WCDMA Operation (Band 1)**  
 (T<sub>C</sub> = +25 °C, V<sub>BATT</sub> = V<sub>CC</sub> = +3.4 V, V<sub>EN\_PCS</sub> = +1.8 V, 50 Ω system, R99 uplink waveform)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS		
					P <sub>OUT</sub>	V <sub>MODE1</sub>	V <sub>MODE2</sub>
Gain	24 12 7	26.5 14.5 10	30 18 13	dB	+28.1 dBm +16.5 dBm +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
ACLR1 @ 5 MHz Offset <sup>(1)</sup>	- - -	-41 -41 -43	-37 -36 -36	dBc	+28.1 dBm +16.5 dBm +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
ACLR2 @ 10 MHz Offset <sup>(1)</sup>	- - -	-55 -56 -55	-48 -48 -48	dBc	+28.1 dBm +16.5 dBm +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Power-Added Efficiency <sup>(1)</sup>	33 20 6	37 24 8.5	- - -	%	+28.1 dBm +16.5 dBm +8 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Quiescent Current (I <sub>q</sub> )	-	4	7	mA	through V <sub>BATT</sub> and V <sub>CC</sub> pins, V <sub>MODE1</sub> = +1.8 V, V <sub>MODE2</sub> = +1.8 V		
Mode Control Current	-	0.1	0.2	mA	through V <sub>MODE</sub> pins, V <sub>MODE1</sub> = +1.8 V V <sub>MODE2</sub> = +1.8 V		
Battery Current	-	1.4	3	mA	through V <sub>BATT</sub> pin, V <sub>MODE1</sub> = +1.8 V, V <sub>MODE2</sub> = +1.8 V		
Enable Current	-	0.15	0.3	mA	through V <sub>EN_IMT</sub> pin		
HBT Leakage Current on V <sub>CC</sub> (Shutdown Mode)	-	<1	5	μA	V <sub>BATT</sub> = +4.2 V, V <sub>CC</sub> = +4.2 V, V <sub>EN_IMT</sub> = 0 V, V <sub>MODE1</sub> = 0 V, V <sub>MODE2</sub> = 0 V		
Total Decoder Current on V <sub>BATT</sub> (Shutdown Mode)	-	14	22	μA	V <sub>BATT</sub> = +4.2 V, V <sub>CC</sub> = +4.2 V, V <sub>EN_IMT</sub> = 0 V, V <sub>MODE1</sub> = 0 V, V <sub>MODE2</sub> = 0 V		
Noise in Receive Band	-	-136	-134	dBm/Hz	2110 MHz to 2170 MHz		
Harmonics 2fo 3fo, 4fo	- - -	-42 -50	-30 -38	dBc	P <sub>OUT</sub> < +28.1 dBm		
Input Impedance	-	-	2:1	VSWR			
Coupling Factor	-	23	-	dB			
Spurious Output Level (all spurious outputs)	-	-	-65	dBc	P <sub>OUT</sub> < +28.1 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 conditions		

Notes:

(1) ACPRs and Efficiency limits at 1950 MHz.

**Table 7: Electrical Specifications - CDMA2000 Operation (Band Class 6)**  
 (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, RC-1)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS		
					P <sub>OUT</sub>	V <sub>MODE1</sub>	V <sub>MODE2</sub>
Gain	23 10.5 6	25 13.5 9.5	29 17 13	dB	+27.5 dBm +16 dBm +7.5 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Adjacent Channel Power at +1.25 MHz offset Primary Channel BW - 1.23 MHz Adjacent Channel BW = 30 kHz	- - -	-51 -51 -51	-46.5 -46.5 -46.5	dBc	+27.5 dBm +16 dBm +7.5 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Adjacent Channel Power at +1.98 MHz Primary Channel BW=1.23 MHz Adjacent Channel BW=30 kHz	- - -	-55 -55 -55	-49 -49 -49	dBc	+27.5 dBm +16 dBm +7.5 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Power-Added Efficiency	- - -	33 18 7	- - -	%	+27.5 dBm +16 dBm +7.5 dBm	0 V 1.8 V 1.8 V	0 V 0 V 1.8 V
Spurious Output Level (all spurious outputs)	-	-	-70	dBc	P <sub>OUT</sub> < +27.5 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		

### APPLICATION INFORMATION

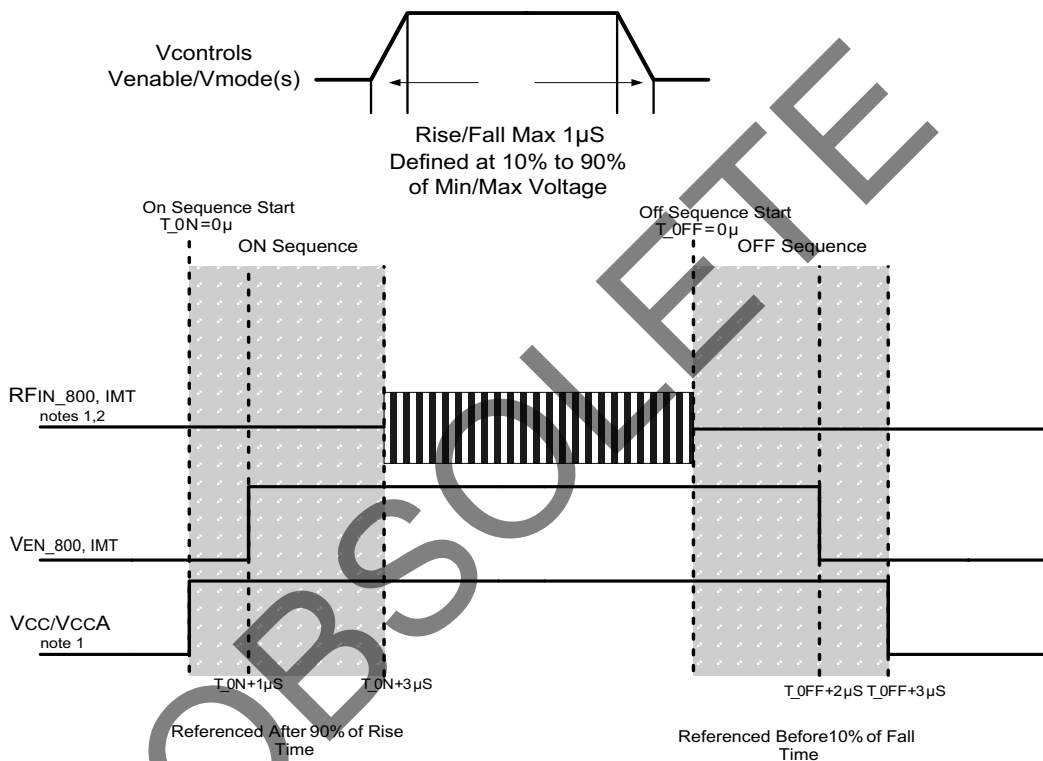
To ensure proper performance, refer to all related Application Notes on the ANADIGICS web site: <http://www.anadigics.com>

#### Shutdown Mode

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

#### Bias Modes, Medium Bias Mode

The power amplifier may be placed in Low Bias mode or a High Bias mode by applying the appropriate logic level (see Operating Ranges table) to the  $V_{MODE1}$  and  $V_{MODE2}$  pins. The Bias Control table lists the recommended modes of operation for various applications.



**Figure 3: Recommended ON/OFF Timing Sequence**

**Notes:**

- (1) Level might be changed after RF is ON.
- (2) RF OFF defined as  $P_{IN} \leq -30$  dBm.
- (3) Switching simultaneously between  $V_{MODE}$  and  $V_{EN}$  is not recommended.

Table 8: Bias Control

APPLICATION	P <sub>OUT</sub> LEVELS	BIAS MODE	V <sub>EN</sub>	V <sub>MODE1</sub>	V <sub>MODE2</sub>	V <sub>CC</sub>	V <sub>BATT</sub>
WCDMA - low power (Low bias Mode)	< +8 dBm	Low	+1.8 V	+1.8 V	+1.8 V	3.2 - 4.2 V	> 3.2 V
WCDMA- med power (Medium Bias Mode)	> 8 dBm ≤ +16.5 dBm	Low	+1.8 V	+1.8 V	0 V	3.2 - 4.2 V	> 3.2 V
WCDMA - high power (High Bias Mode)	> +16.5 dBm	High	+1.8 V	0 V	0 V	3.2 - 4.2 V	> 3.2 V
Shutdown	-	Shutdown	0 V	0 V	0 V	3.2 - 4.2 V	> 3.2 V

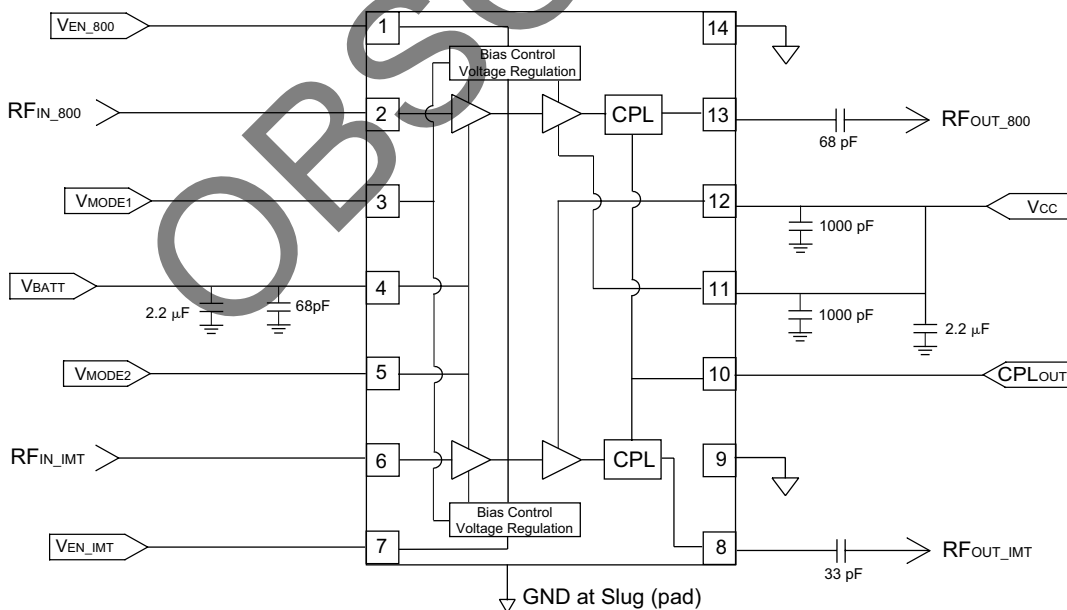
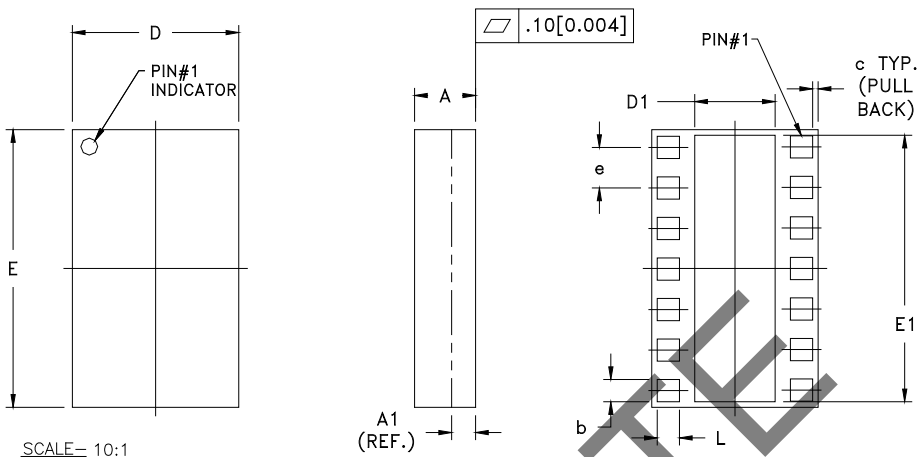


Figure 4: Application Circuit

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	0.37	0.41	0.013	0.015	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	4.88	5.00	5.12	0.192	0.197	0.202	—
E1	4.70	4.75	4.80	0.185	0.187	0.189	3
e	—	0.73	—	—	0.029	—	4
L	0.32	0.37	0.41	0.013	0.015	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. PITCH MEASUREMENT (e) TAKEN CENTERLINE TO CENTERLINE OF SOLDER MASK OPENINGS.
5. UNLESS SPECIFIED DIMENSIONS ARE SYMMETRICAL ABOUT CENTER LINES SHOWN.

Figure 5: Package Outline - 14 Pin 3 mm x 5 mm x 1 mm Surface Mount Module

TOP BRAND

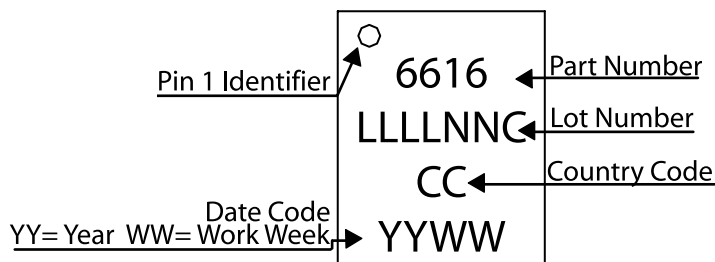


Figure 6: Branding Specification

**ORDERING INFORMATION**

ORDER NUMBER	TEMPERATURE RANGE	PACKAGE DESCRIPTION	COMPONENT PACKAGING
AWU6616Q7	-30 °C to +90 °C	RoHS Compliant 14 Pin 3 mm x 5 mm x 1 mm Surface Mount Module	Tape and Reel, 2500 pieces per Reel
AWU6616P9	-30 °C to +90 °C	RoHS Compliant 14 Pin 3 mm x 5 mm x 1 mm Surface Mount Module	Partial Tape and Reel

**ANADIGICS**

141 Mount Bethel Road  
Warren, New Jersey 07059, U.S.A.  
Tel: +1 (908) 668-5000  
Fax: +1 (908) 668-5132

URL: <http://www.anadigics.com>

**IMPORTANT NOTICE**

ANADIGICS, Inc. reserves the right to make changes to its products or to discontinue any product at any time without notice. The product specifications contained in Advanced Product Information sheets and Preliminary Data Sheets are subject to change prior to a product's formal introduction. Information in Data Sheets have been carefully checked and are assumed to be reliable; however, ANADIGICS assumes no responsibilities for inaccuracies. ANADIGICS strongly urges customers to verify that the information they are using is current before placing orders.

**WARNING**

ANADIGICS products are not intended for use in life support appliances, devices or systems. Use of an ANADIGICS product in any such application without written consent is prohibited.