AWT6751

ProEficient Plus™ Dual-Band 1 & 8
WCDMA/CDMA Power Amplifier Module

DATA SHEET - Rev 2.1

FEATURES

- WCDMA Compliant
  - Band 1
    - 44% @ POUT = +28.2 dBm
    - 41% @ POUT = +17 dBm (without DC/DC converter)
  - Band 8
    - 43% @ POUT = +28.4 dBm
    - 39% @ POUT = +17 dBm (without DC/DC converter)
- Low Quiescent Current: 5 mA
- Low Leakage Current in Shutdown Mode: 6 µA
- Internal Voltage Regulator
- Integrated "daisy chainable" directional coupler with CPLIN and CPLOUT port
- Internal DC block on IN/OUT RF ports
- Suitable for SMPS and average power tracking systems with variable supply voltages
- 1.8 V Control Logic
- RoHS Compliant Package, 260 °C MSL-3

APPLICATIONS

- Dual-band Wireless Handsets and Data Devices for WCDMA and CDMA/EVDO networks:
  - UMTS Band 8
  - UMTS Band 1
  - CDMA BC 6

PRODUCT DESCRIPTION

AWT6751 addresses the demand for increased integration in dual-band handsets for WCDMA and CDMA/EVDO networks. The small footprint 3 mm x 4 mm x 0.92 mm surface mount RoHS compliant package contains independent RF PA paths to provide optimized performance in each frequency band in 1/3 less PCB area of two single-band PAs. The AWT6751 is part of ANADIGICS' ProEficient Plus™ family of power amplifiers, which deliver low quiescent currents and excellent efficiency from fixed or variable supply voltages. Two selectable bias modes optimize efficiency for different ranges of output power levels in average power tracking systems to improve device use time. The AWT6751 is designed for use both with and without average power tracking (APT). APT can be used to optimize the VCC level for the desired output power level and linearity, which greatly reduces the total current drawn from the battery. This feature, in conjunction with HPM and LPM operating modes, enables significant improvements in overall power added efficiency of the AWT6751 across the entire dynamic range of operating powers. APT requires use of an external variable voltage supply (DC-DC converter), which is used to provide the variable voltage to VCC pad of the amplifier. In some cases, the average current over the TS.09 power profile can be reduced by more than 25%. A low-leakage shutdown mode increases standby time.

The AWT6751 has built-in daisy-chainable RF couplers for each band, which provide high directivity and 20 dB coupling. The AWT6751 also incorporates matching networks optimized for output power, efficiency and linearity in a 50 Ω system. The device is designed for use in systems where a single RF input may be switched to drive band 1 and 8 antenna outputs. AWT6751 is manufactured on an advanced InGaP HBT MMIC technology offering state-of-the-art reliability, temperature stability, and ruggedness.

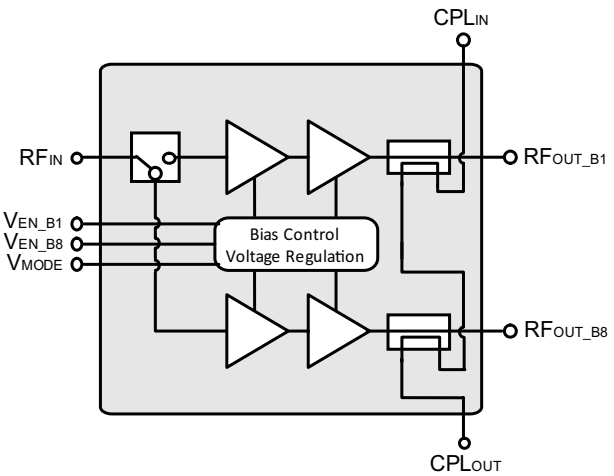


Figure 1: Functional Block Diagram

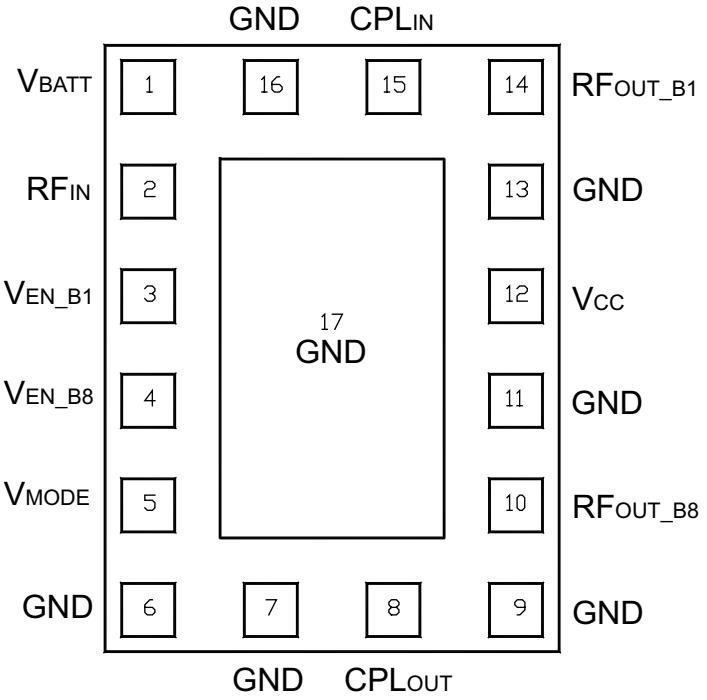


Figure 2: Pinout

Table 1: Pin Description

Pin #	Symbol	Description
1	V_{BATT}	PA Bias/Control Supply Voltage
2	RF_{IN}	RF TX Input Signal
3	V_{EN_B1}	Band 1 PA Enable Pin
4	V_{EN_B8}	Band 8 PA Enable Pin
5	V_{MODE}	Mode Select
6	GND	Ground
7	GND	Ground
8	CPL_{OUT}	Coupler Output
9	GND	Ground
10	RF_{OUT_B8}	Band 8 PA Output
11	GND	Ground
12	V_{CC}	PA Supply Voltage
13	GND	Ground
14	RF_{OUT_B1}	Band 1 PA Output
15	CPL_{IN}	Coupler Input
16	GND	Ground
17	GND PADDLE	Ground

ELECTRICAL CHARACTERISTICS

Table 2: Absolute Minimum and Maximum Ratings

PARAMETER	MIN	TYP	MAX	UNIT
Supply Voltage (V_{CC})	-1.2	3.4	+5	V
Battery Voltage (V_{BATT})	-1.2	3.4	+6	V
Control Voltage (V_{MODE})	0	0	+3.5	V
RF Input Power	-	+1	+10	dBm
Storage Temperature	-40	+25	+150	°C

Functional operation to the specified performance is not implied under these conditions. Operation of any single parameter in excess of the absolute ratings may cause permanent damage. No damage occurs if one parameter is set at the limit while all other parameters are set within normal operating ranges.

Table 3: Operating Ranges (Band 1)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (f)	1920	-	1980	MHz	
Supply Voltage High Power Mode (V_{CC})	+0.6	+3.4	+4.4	V	$P_{OUT} \leq$ +28.2 dBm
Battery Voltage (V_{BATT})	+3.1	+3.4	+4.4	V	$P_{OUT} \leq$ +28.2 dBm
Enable Voltage (V_{EN_B1})	+1.35 0	+1.8 -	+3.1 +0.6	V	PA “on” PA “shut down”
Mode Control Voltage (V_{MODE})	0 +1.35	- +1.8	+0.5 +3.1	V	High Bias Mode Low Bias Mode
WCDMA / UMTS Output Power (1) R99, HPM HSPA (MPR = 0), HPM R99, LPM HSPA (MPR = 0), LPM	 27.4 26.4 16.2 15.2	 28.2 27.2 17 16	 - - - -	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 (1) HPM LPM	 26.7 15.2	 27.5 16	 - -	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) P_{OUT} derated 0.8 dB for 3.1 V operation.

Table 4: Electrical Specifications - WCDMA Operation (R99 waveform) (Band 1)
(T_C = +25 °C, V_{CC} = +3.4 V, V_{EN} = +1.8 V, 50 Ω system)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS	
					P_{OUT}	V_{MODE}
Gain	24 13	27 15.5	30 19	dB	+28.2 dBm +17 dBm	0 V 1.8 V
ACLR1 at 5 MHz offset (1)	- -	-40 -44	-36 -36	dBc	+28.2 dBm +17 dBm	0 V 1.8 V
ACLR2 at 10 MHz offset (1)	- -	-53 -56	-47 -47	dBc	+28.2 dBm +17 dBm	0 V 1.8 V
Efficiency (1)	37 -	44 41	- -	%	+28.2 dBm +17 dBm	0 V 1.8 V
Quiescent Current (Icq) Low Bias Mode	-	6	-	mA	through V_{CC} pin	1.8 V
Mode Control Current	-	0.1	0.25	mA	through V_{MODE} pins, V_{MODE} = +1.8 V	
Enable Current	-	0.04	0.1	mA	through V_{EN} pin	
BATT Current	-	0.80	2.0	mA	through V_{BATT}, V_{MODE} = +1.8 V	
Leakage Current	-	6	15	μA	V_{BATT} = +4.4 V, V_{CC} = +4.4 V, V_{EN} = 0 V, V_{MODE} = 0 V	
Noise Power	- - -	-138 -136 -137	- - -	dBm/Hz	GPS Band, 1573 - 1578 MHz ISM Band, 2402 - 2480 MHz R_X Band, 2110 - 2170 MHz $P_{OUT} \leq$ +28.2 dBm	
Harmonics 2f_O 3f_O, 4f_O	- -	-45 -40	-35 -30	dBc	$P_{OUT} \leq$ +28.2 dBm	
Coupling Factor	18.5	20.5	22.5	dB		
Directivity	-	20	-	dB		
Daisy Chain Insertion Loss	-	<0.30	0.5	dB	698 - 2620 MHz Pin 15 through 8, shutdown mode	
Spurious Output Level (all spurious outputs)	-	-	-70	dBc	$P_{OUT} \leq$ +28.2 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 - CDMA Operation (CDMA2000, RC-1) (BC 6)
(T_C = +25 °C, V_{CC} = +3.4 V, V_{EN} = +1.8 V, 50 Ω system)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS	
					P_{OUT}	V_{MODE}
Gain	24 13	27 15.5	30 19	dB	+27.5 dBm +16 dBm	0 V 1.8 V
Adjacent Channel Power at ± 1.25 MHz (1) Primary Channel BW - 1.23 MHz Adjacent Channel BW = 30 kHz	- -	-51 -56	-46 -46	dBc	+27.5 dBm +16 dBm	0 V 1.8 V
Adjacent Channel Power at + 1.98 MHz (1) Primary Channel BW - 1.23 MHz Adjacent Channel BW = 30 kHz	- -	-55 -58	-53 -53	dBc	+27.5 dBm +16 dBm	0 V 1.8 V
Efficiency (1)	- -	41 36	- -	%	+27.5 dBm +16 dBm	0 V 1.8 V
Spurious Output Level (all spurious outputs)	-	-	-70	dBc	$P_{OUT} \leq$ +27.5 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 6: Operating Ranges (Band 8)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (f)	880	-	915	MHz	
Supply Voltage (V_{CC})	+0.6	+3.4	+4.4	V	$P_{OUT} \leq$ +28.4 dBm
Battery Voltage (V_{BATT})	+3.1	+3.4	+4.4	V	$P_{OUT} \leq$ +28.4 dBm
Enable Voltage (V_{EN_B8})	+1.35 0	+1.8 -	+3.1 +0.5	V	PA “on” PA “shut down”
Mode Control Voltage (V_{MODE})	0 +1.35	- +1.8	+0.5 +3.1	V	High Bias Mode Low Bias Mode
WCDMA / UMTS Output Power (1) R99, HPM HSPA (MPR = 0), HPM R99, LPM HSPA (MPR = 0), LPM	 27.6 26.5 16.2 15.2	 28.4 27.3 17 16	 - - - -	dBm	3GPP TS 34.121-1, Rel 8 Table C.11.1.3 for WCDMA, SUBTEST 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) P_{OUT} derated 0.8 dB for 3.1 V operation.

Table 7: Electrical Specifications - WCDMA Operation (R99 waveform) (Band 8)
(T_C = +25 °C, V_{CC} = +3.4 V, V_{EN} = +1.8 V, 50 Ω system)

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS	
					P_{OUT}	V_{MODE}
Gain	24.5 14	27.5 17	31 21	dB	+28.4 dBm +17 dBm	0 V 1.8 V
ACLR1 at 5 MHz offset (1)	- -	-40 -39	-36 -35	dBc	+28.4 dBm +17 dBm	0 V 1.8 V
ACLR2 at 10 MHz offset (1)	- -	-55 -55	-47 -47	dBc	+28.4 dBm +17 dBm	0 V 1.8 V
Efficiency (1)	37 -	43 39	- -	%	+28.4 dBm +17 dBm	0 V 1.8 V
Quiescent Current (Icq) Low Bias Mode	-	6	-	mA	through V_{CC} pin	1.8 V
Mode Control Current	-	0.1	0.25	mA	through V_{MODE} pins, V_{MODE} = +1.8 V	
Enable Current	-	0.04	0.1	mA	through V_{EN} pin	
BATT Current	-	0.80	2.0	mA	through V_{BATT}, V_{MODE} = +1.8 V	
Leakage Current	-	6	15	μA	V_{BATT} = +4.4 V, V_{CC} = +4.4 V, V_{EN} = 0 V, V_{MODE} = 0 V	
Noise Power	- - -	-138 -136 -133	- - -	dBm/Hz	GPS Band, 1573 - 1578 MHz ISM Band, 2402 - 2480 MHz R_X Band, 925 - 960 MHz $P_{OUT} \leq$ +28.4 dBm	
Harmonics 2f_O 3f_O, 4f_O	- -	-45 -50	-35 -35	dBc	$P_{OUT} \leq$ +28.4 dBm	
Coupling Factor	18.5	20.5	22.5	dB		
Directivity	-	20	-	dB		
Daisy Chain Insertion Loss	-	<0.30	0.5	dB	698 - 2620 MHz Pin 15 through 8, shutdown mode	
Spurious Output Level (all spurious outputs)	-	-	-70	dBc	$P_{OUT} \leq$ +28.4 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 897.5 MHz.

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} pads.

Bias Modes
The power amplifier may be placed in either Low or High Bias mode by applying the appropriate logic level (see Operating Ranges table) to the V_{MODE} pin. The Bias Control table below lists the recommended modes of operation for various applications.

Two operating modes are recommended to optimize current consumption. High Bias/High Power operating mode is for P_{OUT} levels ≥ 17 dBm. For P_{OUT} levels ≤ 17 dBm, the PA can be switched to Low Power Mode for extremely low current consumption.

Table 8: Bias Control

APPLICATION	P_{OUT} LEVELS	BIAS MODE	V_{EN}	V_{MODE}	V_{CC}	V_{BATT}
Low power (Low Bias Mode)	< +17 dBm	Low	+1.8 V	+1.8 V	1.7 - 4.4 V	> 3.1 V
High power (High Bias Mode)	> +15 dBm	High	+1.8 V	0 V	0.6 - 4.4 V	> 3.1 V
Shutdown	-	Shutdown	0 V	0 V	0.6 - 4.4 V	> 3.1 V

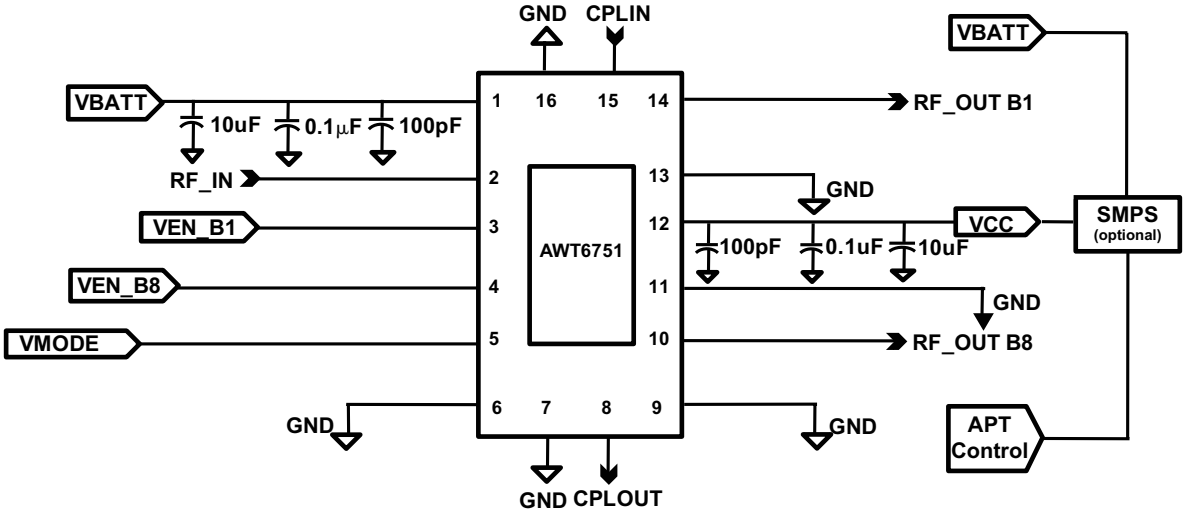
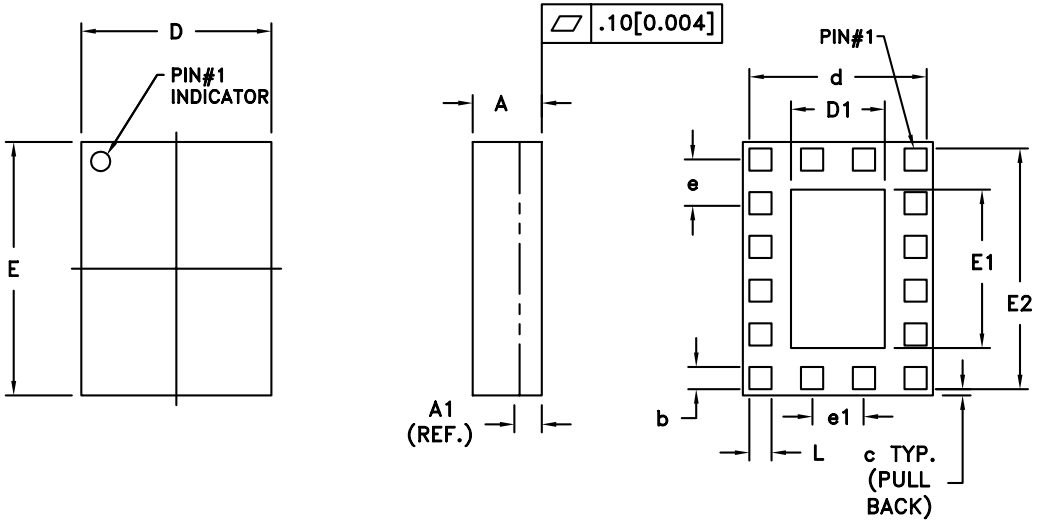


Figure 3: Evaluation Board Schematic

PACKAGE OUTLINE



SYMBOL	MILLIMETERS			INCHES			NOTE
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	
A	0.85	0.92	1.00	0.033	0.036	0.039	–
A1	PLEASE REFER TO LAMINATE CONTROL DRAWING						–
b	0.30	0.35	0.40	0.012	0.014	0.016	3
c	–	0.10	–	–	0.004	–	–
d	–	2.80	–	–	0.11	–	–
D	2.88	3.00	3.12	0.113	0.118	0.123	–
D1	1.43	1.50	1.65	0.056	0.059	0.065	3
E	3.88	4.00	4.12	0.152	0.157	0.162	–
E1	2.45	2.50	2.55	0.096	0.098	0.10	3
E2	–	3.80	–	–	0.15	–	–
e	–	0.69	–	–	0.027	–	4
e1	–	0.82	–	–	0.032	–	4
L	0.30	0.35	0.40	0.012	0.014	0.016	3

NOTES:

1. CONTROLLING DIMENSIONS IN MILLIMETERS.
2. UNLESS SPECIFIED, TOLERANCE=±0.076[0.003].
3. SIGNAL PADS SHOWN UNIFORM SIZE FOR REFERENCE ONLY. ACTUAL SIZE AND LOCATION WILL VARY WITHIN MIN. AND MAX. DIMENSIONS ACCORDING TO THE PRODUCT DESIGN.
4. GROUND PADS SHOWN UNIFORM SIZE FOR REFERENCE ONLY. ACTUAL SIZE AND LOCATION ARE REFERENCE ONLY.
5. PITCH MEASUREMENTS (e) TAKE CENTERLINE TO CENTERLINE OF SOLDERMASK OPENINGS.
6. UNLESS SPECIFIED DIMENSIONS ARE SYMMETRICAL ABOUT CENTER LINES SHOWN.
7. LAMINATE CONTROL DRAWING SPECIFIED BY PRODUCT DESIGN.

Figure 4: Outline 16 Pin 3 mm x 4 mm x 0.92 mm Surface Mount Module

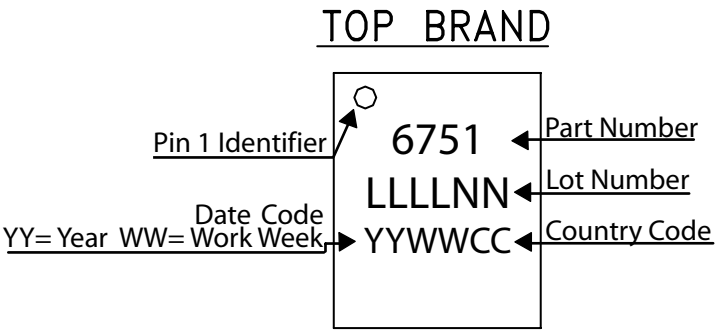
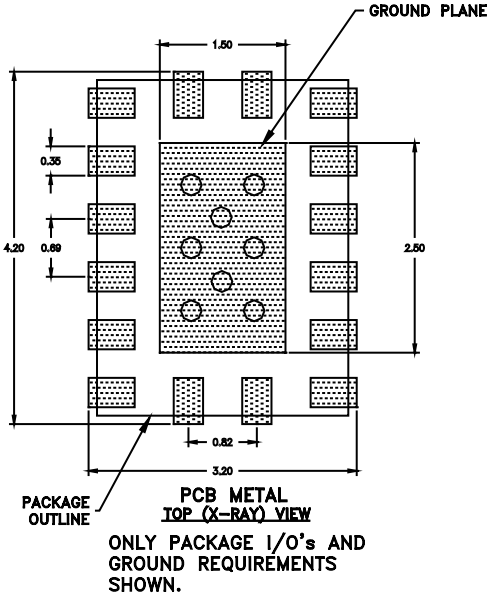


Figure 5: Branding Specification

PCB AND STENCIL DESIGN GUIDELINE



NOTES:

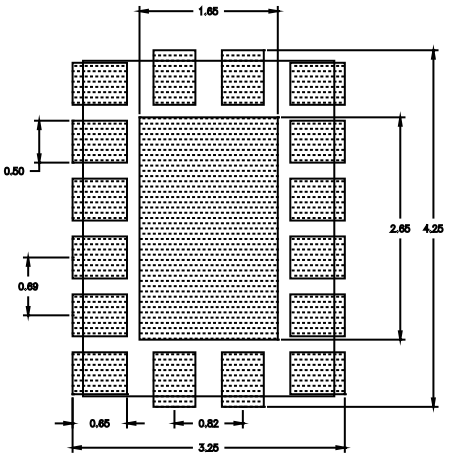
(1) OUTLINE DRAWING REF: P8002530

(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)



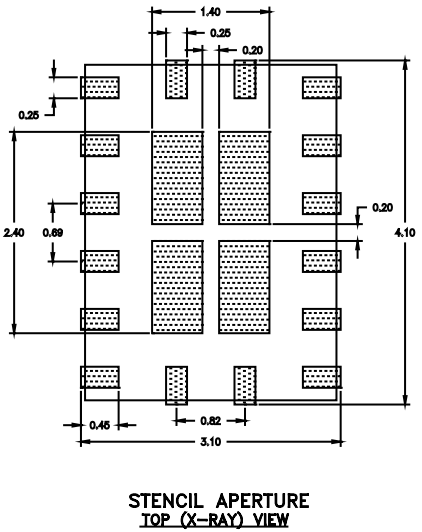
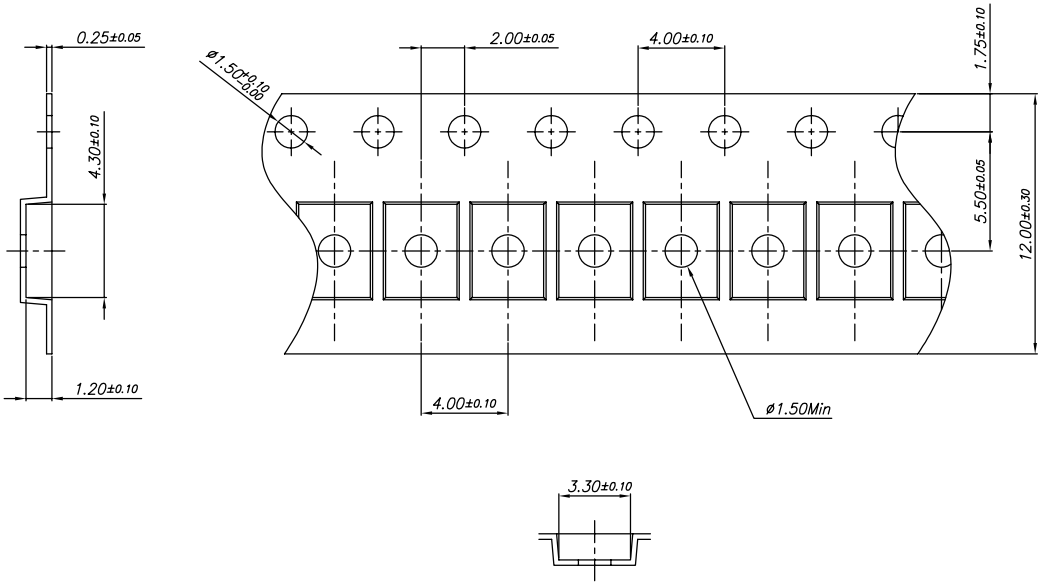


Figure 6: Recommended PCB Layout Information



NOTES:

(1) 10 sprocket hole pitch cumulative tolerance ±0.2.

(2) Camber not to exceed1 mm in 250 mm.

(3) Material: Black conductive Polystyrene.

(4) Ao and Bo measured on a plane 0.3 mm above the bottom of the pocket.

(5) Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.

(6) Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

(7) Pocket center and pocket hole center must be same position.

Figure 7: Carrier Tape

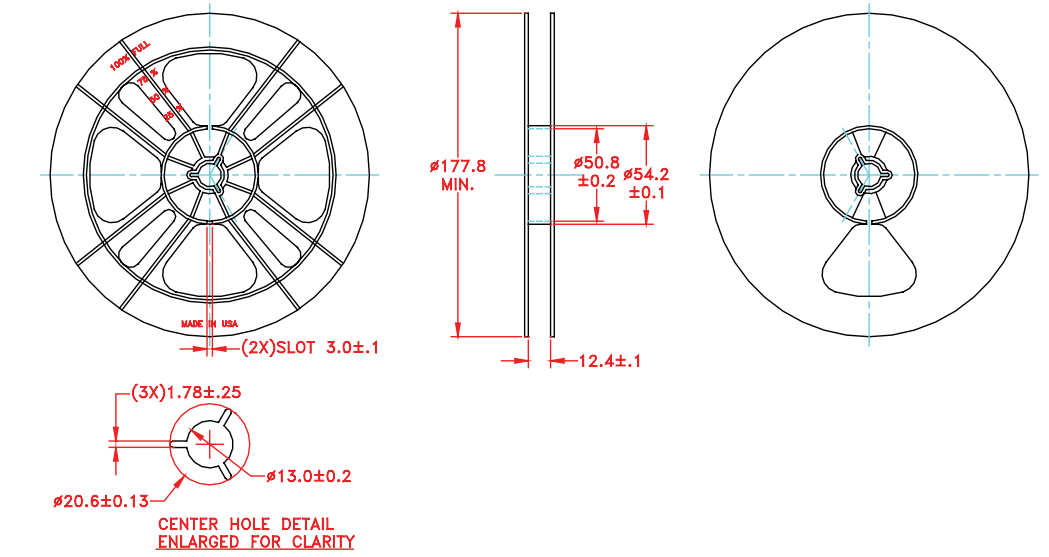


Figure 8: Reel

ORDERING INFORMATION

ORDER NUMBER	TEMPERATURE RANGE	PACKAGE DESCRIPTION	COMPONENT PACKAGING
AWT6751P7	-30 °C to +90 °C	RoHS Compliant 16 Pin 3 mm x 4 mm x 0.92 mm Surface Mount Module	Bags
AWT6751P9	-30 °C to +90 °C	RoHS Compliant 16 Pin 3 mm x 4 mm x 0.92 mm Surface Mount Module	Parital Tape and Reel
AWT6751Q7	-30 °C to +90 °C	RoHS Compliant 16 Pin 3 mm x 4 mm x 0.92 mm Surface Mount Module	Tape and Reel, 2500 pieces per Reel

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