ACPM-7081

Multiband Multimode PA

Quad-Band GSM/EDGE and Dual-Band UMTS (B1/B8)

Data Sheet

Description

The ACPM-7081 is a multiband multimode PA which supports GMSK and 8-PSK modulation schemes and UMTS bands 1 and 8. There are two amplifier chains, one is to support low band (GSM850/900 and UMTS Band8), and the other is to support high band (DCS1800/PCS1900 and UMTS band1).

CoolPAM technology, Avago Technologies' Power Amplifier technologies, provides extended talk time with extremely low quiescent current and enhanced efficiency at low and medium power modes.

The ACPM-7081 module adopted seventh generation of CoolPAM technology which accommodates features of previous versions of CoolPAM technologies and makes it possible to integrate both GSM/EDGE and UMTS PAs into one module. The PA is designed to enhance power efficiency by using digital power mode control. Three pins control application, operating frequency band and power mode.

A directional coupler is integrated for UMTS PAs and both coupling and isolation ports are available externally to support daisy chain.

Input and output terminals are internally matched to 50 Ω. The power amplifier is manufactured on an advanced InGaP HBT technology offering state-of-the-art reliability, temperature stability and ruggedness. This module is housed in a cost effective, extremely small and thin 5 x 7.5 mm package.

Features

- Quad Band GSM/EDGE
- UMTS Dual-Band
- Small Size (7.5 x 5 mm)
- Extremely low quiescent current
- Digital power mode control for higher efficiency
- 24-pin surface mounting package
- Internal 50 Ω matching networks for both RF input and output
- Green – Lead-free and RoHS compliant
- Compatible with APT application

Application

- GSM850/900, DCS1800/PCS1900
- UMTS Band1 and Band8

Ordering Information

Part Number	Number of Devices	Container
ACPM-7081-TR1	1000	178 mm (7") Tape/Reel
ACPM-7081-BLK	100	Bulk

Absolute Maximum Ratings

Description	Min	Typ	Max	Unit	Associated Pins
RF Input Power – GSM mode*	–		15	dBm	GSM LB&HB RF IN
RF Input Power – UMTS mode*	–		10	dBm	UMTS LB&HB RF IN
DC Supply Voltage *	0		5.5	V	Vbatt, Vcc UMTS, Vcc GSM
Enable Voltage	0		3.3	V	HB EN,LB EN
Mode Control Voltage	0		3.3	V	Vmode0, Vmode1, Mode
Storage Temperature	-55		+125	°C	

* under 50 Ω

Notes:

1. No damage assuming only one parameter is set at limit at a time with all other parameters set at or below nominal value
2. Operation of any single parameter outside these conditions with the remaining parameters set at or below nominal values may result in permanent damage

Recommended Operating Condition

Description	Symbol	Min	Typ.	Max	Unit
DC Supply Voltage – Vbatt, Vcc GSM		3.2	3.5	4.5	V
DC Supply Voltage – Vbatt, Vcc UMTS		3.2	3.4	4.2	V
Enable Voltage (HB EN,LB EN)	LOW HIGH	0 1.35	 2.6	0.5 3.3	V V
Mode Control Voltage (Mode, Vmode0, Vmode1)	LOW HIGH	0 1.35	 2.6	0.5 3.3	V V
Case Temperature		-20		+85	°C

Operating Logic Table

(GSM: T = 25° C, Vbatt&Vcc GSM = 3.5 V, GMSK Only, UMTS: T = 25° C, Vbatt&Vcc UMTS = 3.4 V, WCDMA Rel'99)

Power Mode	LB EN	HB EN	Mode	Vmode0	Vmode1	Pout
Power Down	L	L	X	X	X	–
GSM Low Freq Band – High Power Mode	H	L	L	L	L	~ Pmax
GSM Low Freq Band – Mid Power Mode	H	L	L	L	H	~ 30.3
GSM Low Freq Band – Low Power Mode	H	L	L	H	L	~ 12
GSM High Freq Band – High Power Mode	L	H	L	L	L	~ Pmax
GSM High Freq Band – Low Power Mode	L	H	L	H	L	~ 16
UMTS B1 – High Power Mode	L	H	H	L	X	Pout, max
UMTS B1 – Mid Power Mode	L	H	H	H	L	~ 17
UMTS B1 – Low Power Mode	L	H	H	H	H	~ 7
UMTS B8 – High Power Mode	H	L	H	L	X	Pout, max
UMTS B8 – Mid Power Mode	H	L	H	H	L	~ 17
UMTS B8 – Low Power Mode	H	L	H	H	H	~ 7

GSM850/GSM900 PA performance specifications

Conditions: Vbatt and Vcc GSM = 3.5 V, pulse width = 1154 µs, duty cycle = 25%, T = 25° C, Zin/Zout = 50 Ω unless specified otherwise

Parameter	Condition	Min	Typ	Max	Unit
Operating Frequency Range	GSM850 GSM900	824 880		849 915	MHz MHz
Input Power	Pin Max			9	dBm
Quiescent Current	High power mode	100	160	220	mA
	Medium power mode	60	110	140	mA
	Low Power mode	30	55	80	mA
Maximum Output Power	GMSK high power mode	34.3	35		dBm
	GMSK high power mode (degraded power for over Vcc GSM, over Temp)	32.3			dBm
	EDGE High Power Mode (RMS power)	29	29.5		dBm
	GMSK Medium Power Mode	30.3	31		dBm
	GMSK Medium Power Mode (over Vcc GSM/Temp)	28.5			dBm
	EDGE Medium Power Mode (RMS power)	23			dBm
	GMSK Low Power Mode (over Vcc GSM/Temp)	10	12		dBm
	EDGE Low Power Mode (RMS power)	8			dBm
Power Added Efficiency	GMSK High power mode, Po = Pmax		50		%
	EDGE high power mode, Po = 29 dBm		25		%
	GMSK medium power mode, Po = 30.3 dBm		33		%
	GMSK Low Power mode , Po = 12 dBm		2		%
Gain	High power mode, Po = Pmax	25.3		32	dB
	High power mode, Po = 33.5 dBm	26		32	dB
	Medium power mode, Po = 30.3 dBm	22		31	dB
	Low Power mode, Po = 12 dBm	7.5		14.5	dB
Gain Compression	High power mode, Po = 23.5 ~ 33.5 dBm		0.8	1.3	dB
Gain variation – Tc and Vbatt (all mode of operation)	-20 ≤ Tc ≤ 85° C 3.2 V ≤ Vbatt ≤ 4.2 V	-2.5		+2.5	dB
EDGE ACPR High Power Mode Po < 25 dBm** Medium Power Mode Po < 23 dBm Low Power Mode Po < 8 dBm	±400 kHz dBc or dBm*			-57 -40	dBc/30 kHz dBm/30 kHz
	±600 kHz dBc or dBm*			-63 -55	dBc/30 kHz dBm/30 kHz
	±3000 kHz dBc or dBm*			-68 -50	dBc/100 kHz dBm/100 kHz
	±6000 kHz dBc or dBm*			-74 -50	dBc/100 kHz dBm/100 kHz
EDGE EVM High Power Mode Po < 25 dBm** Medium Power Mode Po < 23 dBm Low Power Mode Po < 8 dBm			3	5	%
Output power Noise All gain mode	Rx = 869-894 MHz (Tx = 837 MHz)		-85		dBm/100 kHz
	Rx = 925-935 MHz (Tx = 898 MHz)		-84.5		dBm/100 kHz
	Rx = 935-960 MHz (Tx = 898 MHz)		-85.5		dBm/100 kHz

GSM850/GSM900 PA performance specifications (Continued)

Parameter	Condition	Min	Typ	Max	Unit
Harmonics Po < Pmax	2 fo			-5	dBm
	2 – 13 fo			-15	dBm
Stability	F < 1 GHz, 5:1 VSWR			-36	dBm
	F > 2 GHz, 5:1 VSWR			-30	dBm
Ruggedness	All load phases			10:1	VSWR
Input impedance	High & medium power mode			2.5:1	
	Low power mode			3:1	
Current under mismatch	VSWR = 5:1, all phase angles, Post PA loss =1.5 dB, Pin is servoed for Pout = Pmax (at 50 Ω) , Vcc GSM = 3.5 V		2.7	3.3	A
Forward Isolation	LB EN = Low, Pin = -10 dBm			-30	dBm
Cross Isolation	Spurious at HB Output, Low Band signal (fundamental) on HB output LB EN = High			-15 2	dBm dBm

* If the dBc specification is tighter than the dBm limit, then the dBm limit shall be applied instead.

** EDGE operation at high power mode can be extended up to 29 dBm in combination with the pre-distortion scheme of transceiver.

DCS1800/PCS1900 PA performance specifications

Conditions: Vbatt and Vcc GSM = 3.5 V, pulse width = 1154 µs, duty cycle = 25%, T = 25° C, Zin/Zout = 50 Ω unless specified otherwise

Parameter	Condition	Min	Typ	Max	Unit
Operating Frequency Range	DCS1800 PCS1900	1710 1850		1785 1910	MHz MHz
Input Power	Pin Max			6	dBm
Quiescent Current	High power mode	100	170	250	mA
	Low power mode	30	55	80	mA
Maximum Output Power	GMSK high power mode	32.5	33		dBm
	GMSK high power mode (degraded power for over Vcc GSM, over Temp)	30.5			dBm
	EDGE high Power Mode (RMS power)	28	28.5		dBm
	GMSK Low power mode (over Vcc GSM/temp)	17.8	19.8		dBm
	EDGE Low Power Mode (RMS power)	12			dBm
Power Added Efficiency	GMSK High power mode, Po = max		50		%
	EDGE high power mode, Po = 28.5 dBm		25		%
	GMSK Low Power mode, Po = 16 dBm		5		%
Gain	High power mode, Po = 32 dBm	26.5		32.5	dB
	High power mode, Po = 28.5 dBm	27		33	dB
	Low Power mode, Po = 16 dBm	11		23	dB
Gain variation – Tc and Vbatt (all mode of operation)	-20 ≤ Tc ≤ 85° C 3.2V ≤ Vbatt ≤ 4.2 V	-2.5		+2.5	dB
EDGE ACPR High Power Mode Po < 24 dBm** Low Power Mode Po < 12 dBm	±400 kHz dBc or dBm*			-57 -40	dBc/30 kHz dBm/30 kHz
	±600 kHz dBc or dBm*			-64 -60	dBc/30 kHz dBm/30 kHz
	±1800 kHz dBc or dBm*			-65 -55	dBc/100 kHz dBm/100 kHz
	±3000 kHz dBc or dBm*			-68 -55	dBc/100 kHz dBm/100 kHz
	±6000 kHz dBc or dBm*			-76 -55	dBc/100 kHz dBm/100 kHz
EDGE EVM High Power Mode Po < 24 dBm** Low Power Mode Po < 12 dBm			3	5	%
Output power Noise All gain mode	Rx = 1805-1880 MHz (Tx = 1750 MHz)		-83.5		dBm/100 kHz
	Rx = 1930-1990 MHz (Tx = 1880 MHz)		-83		dBm/100 kHz
Harmonics Po ≤ Pmax	2 fo			-5	dBm
	2 – 7 fo			-15	dBm
Stability	F < 1 GHz, 5:1 VSWR			-36	dBm
	F > 2 GHz, 5:1 VSWR			-30	dBm
Ruggedness	All load phases			10:1	VSWR
Input impedance	High & Low power mode			2:1	
Current under mismatch	VSWR = 5:1, all phase angles, Post PA loss =1.5 dB, Pin is servoed for Pout = Pmax (at 50 Ω) ,Vcc GSM = 3.5 V		2	2.5	mA
Forward Isolation	HB EN = Low, Pin = -10 dBm			-30	dBm
Cross Isolation	Spurious at LB Output, High Band signal (fundamental) on LB output HB EN = High			-20 5	dBm dBm

* If the dBc specification is tighter than the dBm limit, then the dBm limit shall be applied instead.

** EDGE operation at high power mode can be extended up to 28dBm in combination with the pre-distortion scheme of transceiver.

UMTS Band 1 and Band 8 Electrical Characteristics

Vbatt & Vcc UMTS = 3.4 V, T=25° C, Zin/Zout = 50 Ω, Signal Configuration = 3 GPP (DPCCH + 1DPDCH) Up-Link unless specified otherwise

Band 8						
Characteristics		**Condition**	**Min**	**Typ**	**Max**	**Unit**
Operating Frequency Range			880	–	915	MHz
Maximum output power		Rel'99 WCDMA waveform	28.5			dBm
Gain		High Power Mode, Pout = 28.5 dBm	24	29		dB
		Mid Power Mode, Pout = 17 dBm	16	21		dB
		Low Power Mode, Pout = 7 dBm	8	13		dB
Power Added Efficiency		High Power Mode, Pout = 28.5dBm	36.5	40		%
		Mid Power Mode, Pout = 17 dBm	14	19.5		%
		Low Power Mode, Pout = 7 dBm	4.6	9		%
Total Supply Current		High Power Mode, Pout = 28.5dBm		520	570	mA
		Mid Power Mode, Pout = 17 dBm		75	105	mA
		Low Power Mode, Pout = 7 dBm		15	30	mA
Quiescent Current		High Power Mode	70	100	150	mA
		Mid Power Mode	10	20	30	mA
		Low Power Mode	2	5	8	mA
Bypass Control Current				20		µA
Total Current in Power-down mode		LB EN=0		30		µA
Adjacent Channel Leakage Ratio (ACLR)	5 MHz offset 10 MHz offset	High Power Mode, Pout = 28.5 dBm		-43 -53	-36 -46	dBc dBc
	5 MHz offset 10 MHz offset	Mid Power Mode, Pout = 17 dBm		-45 -60	-36 -46	dBc dBc
	5 MHz offset 10 MHz offset	Low Power Mode, Pout = 7 dBm		-43 -56	-36 -46	dBc dBc
Harmonic Suppression	Second Third	High Power Mode, Pout = 28.5 dBm			-35 -45	dBc dBc
Input Impedance					2:1	VSWR
Stability (Spurious Output)		ANT VSWR <= 10:1, All Phase Forwarded power fixed			-60	dBc
Rx Band Noise Power		High Power Mode, Pout = 28.5dBm Over Vcc UMTS		-136		dBm/Hz
GPS Band Noise		High Power Mode, Pout = 28.5dBm Over Vcc UMTS		-140		dBm/Hz
ISM Band Noise		High Power Mode, Pout = 28.5dBm Over Vcc UMTS		-143		dBm/Hz
Phase Discontinuity		High power mode ↔ Mid power mode, at Pout = 17dBm Mid power mode ↔ Low power mode, at Pout = 7dBm		10 10		deg deg
Ruggedness		All load phases			10 : 1	VSWR

UMTS Band 1 and Band 8 Electrical Characteristics (Continued)

Band 1

Characteristics		Condition	Min	Typ	Max	Unit
Operating Frequency Range			1920	–	1980	MHz
Maximum output power		Rel'99 WCDMA waveform	28.25			dBm
Gain		High Power Mode, Pout = 28.25 dBm	24	29		dB
		Mid Power Mode, Pout = 17 dBm	18	23		dB
		Low Power Mode, Pout = 7 dBm	8	13		dB
Power Added Efficiency		High Power Mode, Pout = 28.25 dBm	36.0	40		%
		Mid Power Mode, Pout = 17 dBm	14.5	21		%
		Low Power Mode, Pout = 7 dBm	3.5	6		%
Total Supply Current		High Power Mode, Pout = 28.25 dBm		490	545	mA
		Mid Power Mode, Pout = 17 dBm		70	100	mA
		Low Power Mode, Pout = 7 dBm		23	40	mA
Quiescent Current		High Power Mode	65	95	125	mA
		Mid Power Mode	15	25	35	mA
		Low Power Mode	2	4	8	mA
Enable Current		High Power Mode		20		µA
		Mid Power Mode		20		µA
		Low Power Mode		20		µA
Bypass Control Current				20		µA
Total Current in Power-down mode		HB EN=0V		30		µA
Adjacent Channel Leakage Ratio (ACLR)	5 MHz offset 10 MHz offset	High Power Mode, Pout = 28.25 dBm		-43 -57	-36 -46	dBc dBc
	5 MHz offset 10 MHz offset	Mid Power Mode, Pout = 17 dBm		-44 -60	-36 -46	dBc dBc
	5 MHz offset 10 MHz offset	Low Power Mode, Pout = 7 dBm		-40 -60	-36 -46	dBc dBc
Harmonic Suppression	Second Third	High Power Mode, Pout = 28.25 dBm			-35 -45	dBc dBc
Input Impedance					2:1	VSWR
Stability (Spurious Output)		ANT VSWR < = 10:1, All Phase Forwarded power fixed			-60	dBc
Rx Band Noise Power		High Power Mode, Pout = 28.25 dBm Over Vcc UMTS		-137		dBm/Hz
GPS Band Noise		High Power Mode, Pout = 28.25 dBm Over Vcc UMTS		-140		dBm/Hz
ISM Band Noise		High Power Mode, Pout = 28.25 dBm Over Vcc UMTS		-143		dBm/Hz
Phase Discontinuity		High low power mode ↔ Mid power mode, at Pout = 17 dBm Mid low power mode ↔ Low power mode, at Pout = 7 dBm		10 20		deg deg
Ruggedness		All load phases			10 : 1	VSWR

Coupler

Characteristics	Condition	Min	Typ	Max	Unit
Frequency Range	WCDMA Band 1 and 8	880		1980	MHz
Coupling factor	RF Out to CPL port		20		dB
Pout variation on VSWR 2.5:1	All phases	-1		+1	dB

HSDPA Signal configuration used:

3GPP TS 34.121-1

Annex C (normative e): Measurement channels

C.10.1 UL reference measurement channel for HSDPA tests

Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH

Sub-test 2 (CM = 1.0, MPR = 0.0)

HSUPA signal configuration used:

3GPP TS 34.121-1

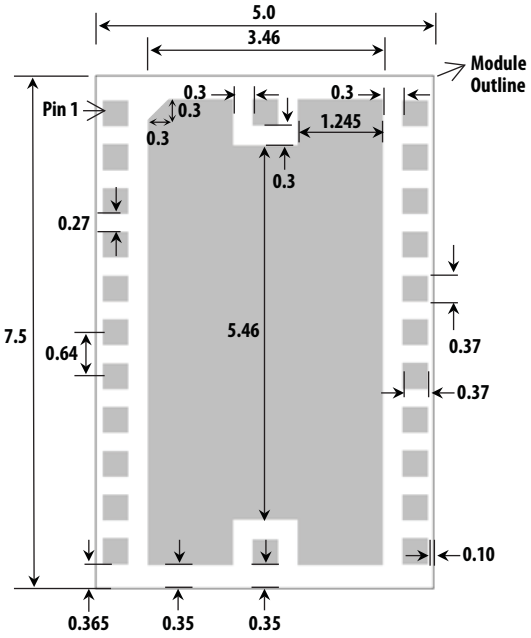
Annex C (normative): Measurement channels

C.11.1 UL reference measurement channel for E-DCH tests

Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

Sub-test 1 (CM = 1.0, MPR = 0.0)

Footprint

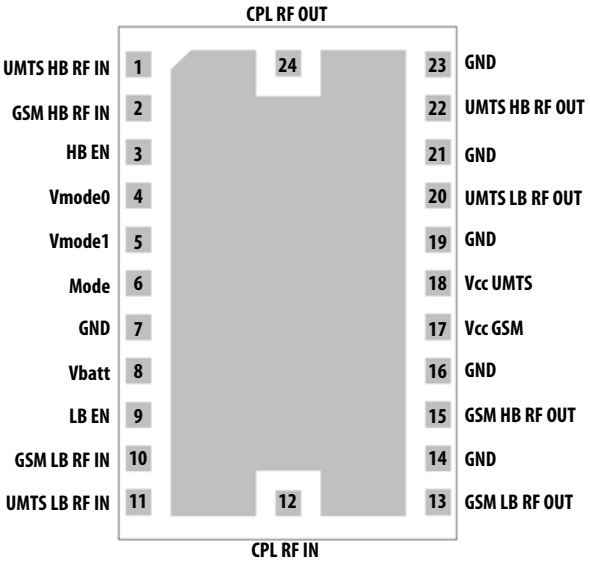


X-ray Top View

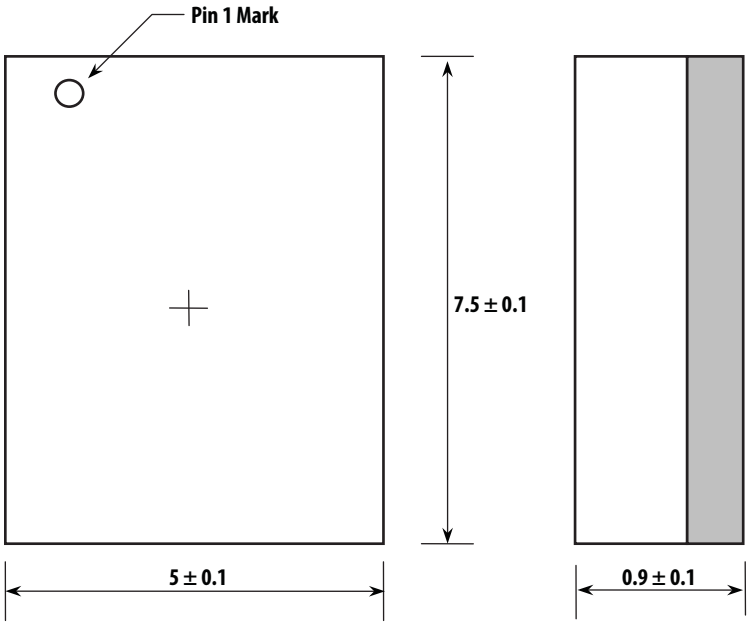
All dimensions are in millimeters

NOTE: PAD size is the same for all, from pin 1 to pin 24

Pin Description

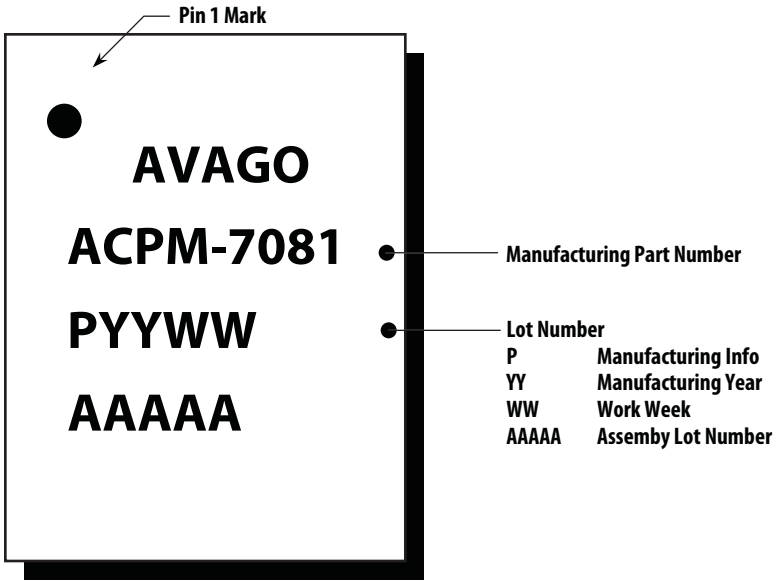


Package Dimensions

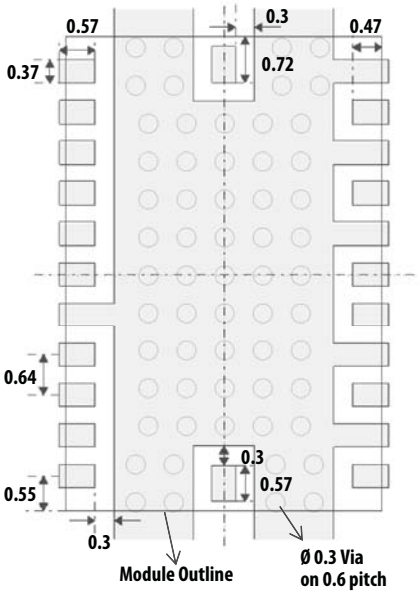


All dimensions ae in millimeter

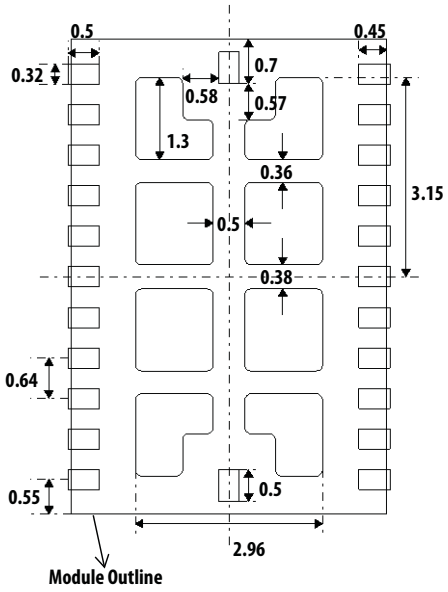
Marking Specification



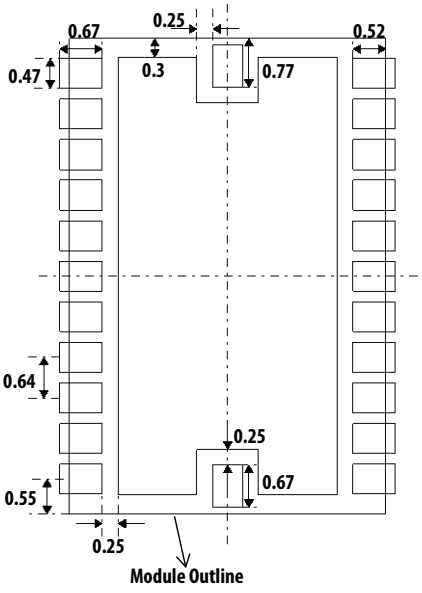
Metallization



Solder Paste Stencil Aperture



Solder Mask Opening



PCB Design Guidelines

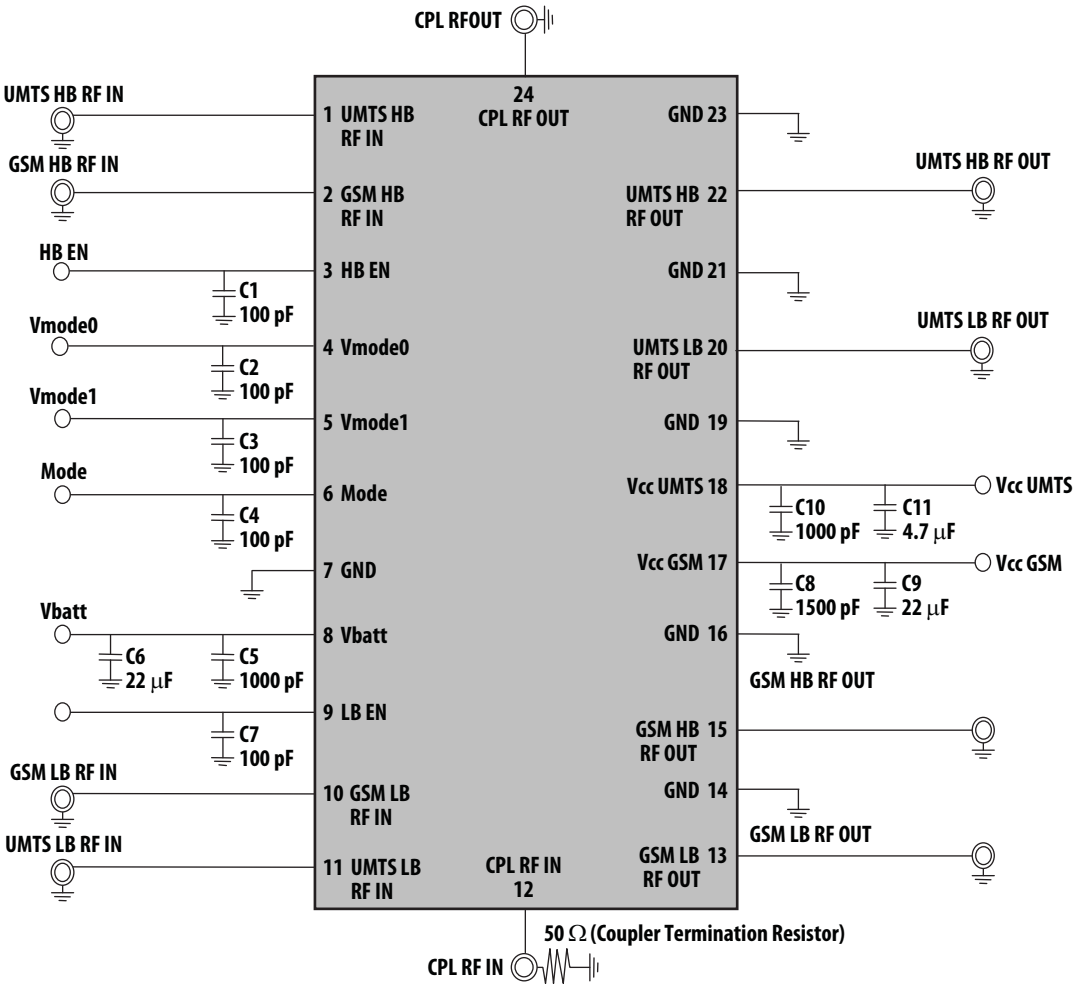
The recommended PCB land pattern is shown in figures on the left side. The substrate is coated with solder mask between the I/O and conductive paddle to protect the gold pads from short circuit that is caused by solder bleeding/bridging.

Stencil Design Guidelines

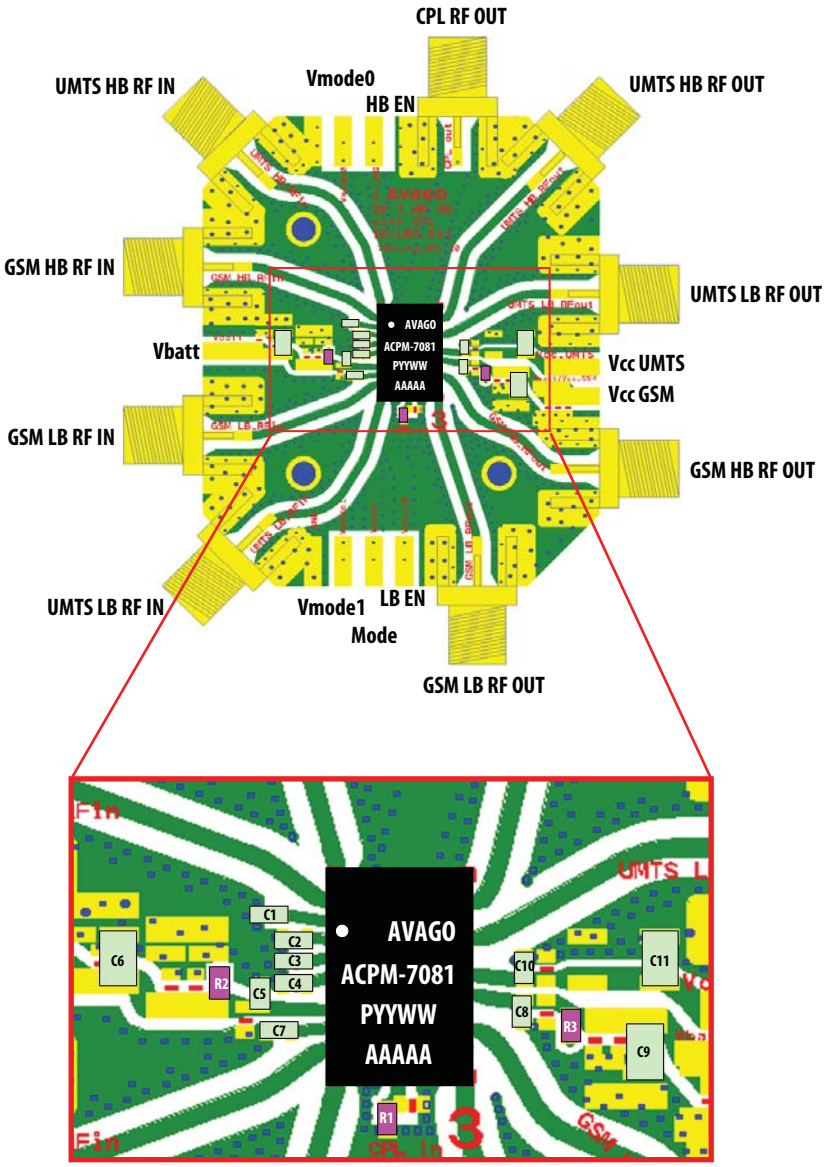
A properly designed solder screen or stencil is required to ensure optimum amount of solder paste is deposited onto the PCB pads.

The recommended stencil layout is shown here. Reducing the stencil opening can potentially generate more voids. On the other hand, stencil openings larger than 100% will lead to excessive solder paste smear or bridging across the I/O pads or conductive paddle to adjacent I/O pads. Considering the fact that solder paste thickness will directly affect the quality of the solder joint, a good choice is to use laser cut stencil composed of 0.100 mm (4 mils) or 0.127 mm (5 mils) thick stainless steel which is capable of producing the required fine stencil outline.

Evaluation Board Schematic



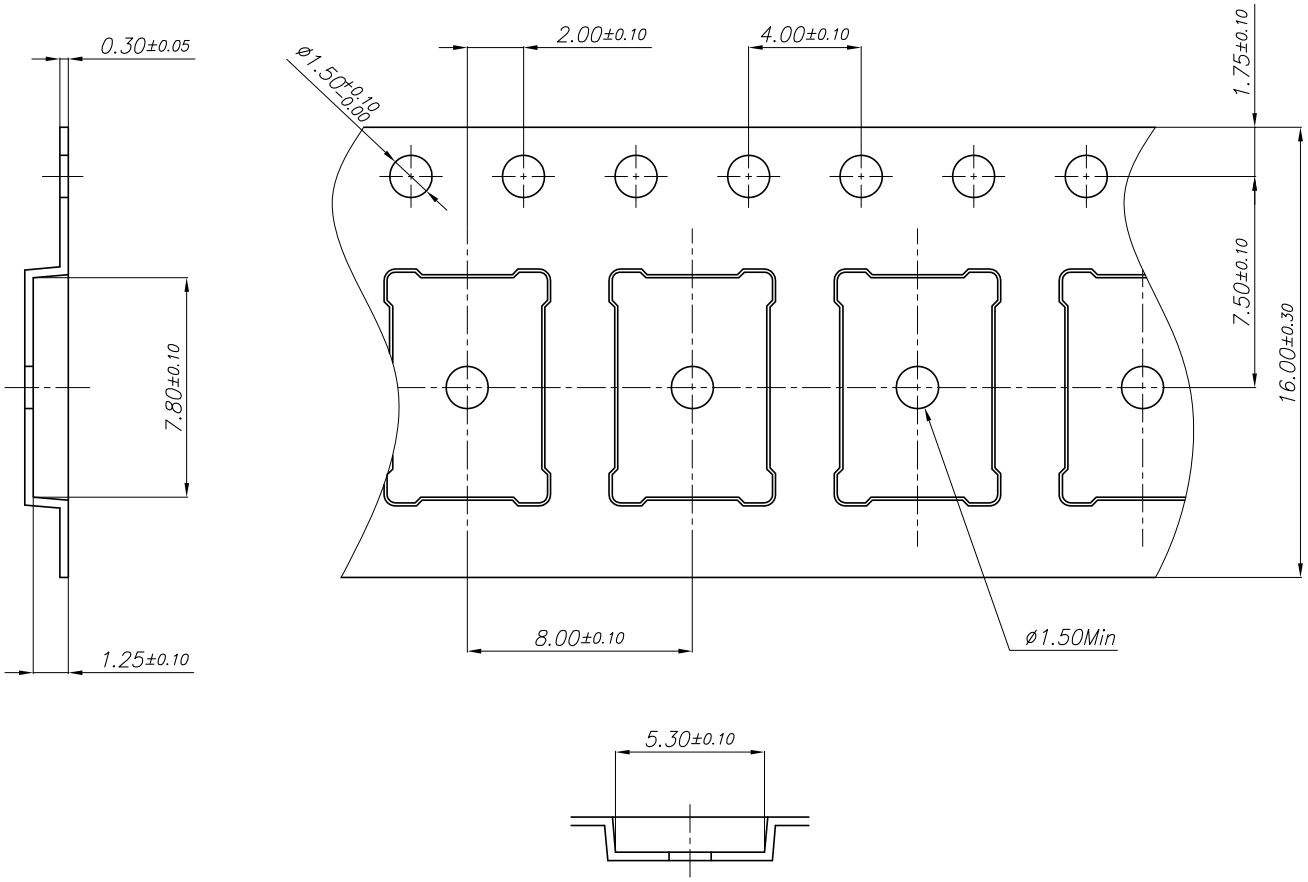
Evaluation Board Description



R1: Coupler Isolation termination (50 Ω) at the CPL RF IN port

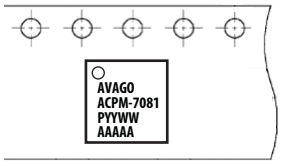
R2 (0 Ω) and R3 (0 Ω) are used for bias line connection between Vbatt and Vcc GSM

Tape and Reel Information

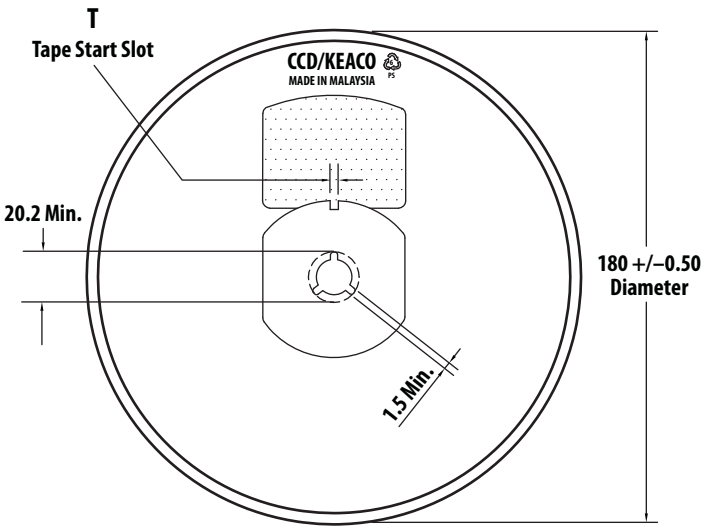


Tape and Reel Format – 5.0 mm x 7.5 mm.

Part Orientation



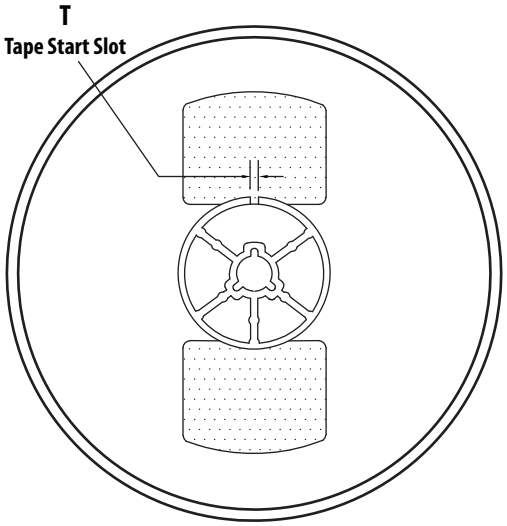
Plastic Reel Format



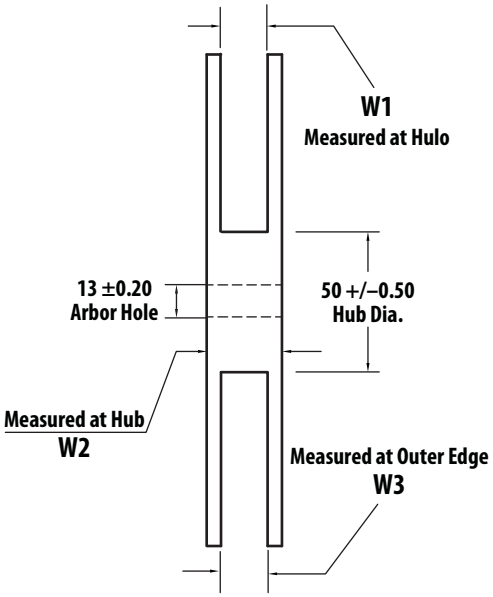
FRONT VIEW

Note:
1. Material : Polystrene
2. Surface Resistivity : < 10E12 Ohms/Sq
   Method : ASTM D-257 at 50% RH
3. Static Decay : < 2 Sec. at 50% RH

Note: Access Hole



BACK VIEW



SIDE VIEW

Tape Width	T	W1	W2	W3
16 mm	3 ± 0.50	16.4 $^{+1.5}_{-0.0}$	22.0 max	16.4 $^{+1.5}_{-0.5}$

All dimensions are in millimeters

Handling and Storage

ESD (Electrostatic Discharge)

Electrostatic discharge occurs naturally in the environment. With the increase in voltage potential, the outlet of neutralization or discharge will be sought. If the acquired discharge route is through a semiconductor device, destructive damage will result.

ESD countermeasure methods should be developed and used to control potential ESD damage during handling in a factory environment at each manufacturing site.

MSL (Moisture Sensitivity Level)

Plastic encapsulated surface mount package is sensitive to damage induced by absorbed moisture and temperature.

Avago Technologies follows JEDEC Standard J-STD 020B. Each component and package type is classified for moisture sensitivity by soaking a known dry package at various temperatures and relative humidity, and times. After soak, the components are subjected to three consecutive simulated reflows.

The out of bag exposure time maximum limits are determined by the classification test describe below which corresponds to a MSL classification level 6 to 1 according to the JEDEC standard IPC/JEDEC J-STD-020B and J-STD-033.

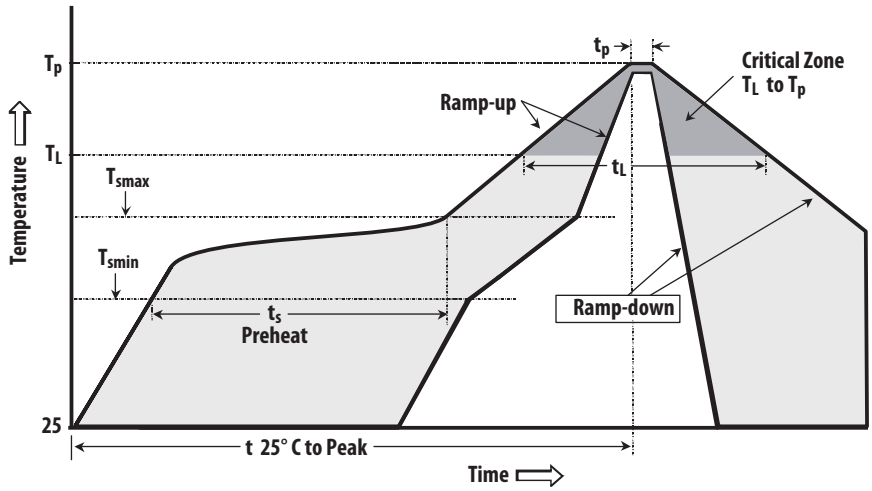
ACPM-7081 is MSL3. Thus, according to the J-STD-033 p.10, the maximum Manufacturers Exposure Time (MET) for this part is 168 hours. After this time period, the part would need to be removed from the reel, de-taped and then re-baked. MSL classification reflow temperature for the ACPM-7081 is targeted at 260° C +0/-5° C. Figure and table on next page show typical SMT profile for maximum temperature of 260 +0/-5° C.

Moisture Classification Level and Floor Life

MSL Level	Floor Life (out of bag) at factory ambient = < 30° C/60% RH or as stated
1	Unlimited at = < 30° C/85% RH
2	1 year
2a	4 weeks
3	168 hours
4	72 hours
5	48 hours
5a	24 hours
6	Mandatory bake before use. After bake, must be reflowed within the time limit specified on the label

Note:
1. The MSL Level is marked on the MSL Label on each shipping bag.

Reflow Profile Recommendations



Typical SMT Reflow Profile for Maximum Temperature = 260 +0/-5° C

Typical SMT Reflow Profile for Maximum Temperature = 260 +0/-5° C

Profile Feature	Sn-Pb Solder	Pb-Free Solder
Average ramp-up rate (T_L to T_P)	3° C/sec max	3° C/sec max
Preheat – Temperature Min (T_{smin}) – Temperature Max (T_{smax}) – Time (min to max) (t_s)	 100° C 150° C 60-120 sec	 150° C 200° C 60-180 sec
T_{smax} to T_L – Ramp-up Rate	 	 3° C/sec max
Time maintained above: – Temperature (T_L) – Time (T_L)	 183° C 60-150 sec	 217° C 60-150 sec
Peak temperature (T_P)	240 +0/-5° C	260 +0/-5° C
Time within 5° C of actual Peak Temperature (T_P)	10-30 sec	20-40 sec
Ramp-down Rate	6° C/sec max	6° C/sec max
Time 25° C to Peak Temperature	6 min max	8 min max

Storage Condition

Packages described in this document must be stored in sealed moisture barrier, antistatic bags. Shelf life in a sealed moisture barrier bag is 12 months at < 40° C and 90% relative humidity (RH) J-STD-033 p.6.

Out-of-Bag Time Duration

After unpacking the device must be soldered to the PCB within 168 hours with factory conditions < 30° C and 60% RH as listed in the Table 5-1 on the J-STD-020D p.6.

Baking

It is not necessary to re-bake the part if both conditions (storage conditions and out-of bag conditions) have been satisfied. Baking must be done if at least one of the conditions above has not been satisfied. The baking conditions are listed in the Table 4-1 on the J-STD-033 p.8.

CAUTION

Tape and reel materials typically cannot be baked at the temperature described above. If out-of-bag exposure time is exceeded, parts must be baked for a longer time at low temperatures, or the parts must be de-reeled, de-taped, re-baked and then put back on tape and reel. (See moisture sensitive warning label on each shipping bag for information of baking).

Board Rework

Component Removal, Rework and Remount

If a component is to be removed from the board, it is recommended that localized heating be used and the maximum body temperatures of any surface mount component on the board not exceed 200° C. This method will minimize moisture related component damage. If any component temperature exceeds 200° C, the board must be baked dry per 4-2 prior to rework and/or component removal. Component temperatures shall be measured at the top center of the package body. Any SMD packages that have not exceeded their floor life can be exposed to a maximum body temperature as high as their specified maximum reflow temperature.

Removal for Failure Analysis

Not following the above requirements may cause moisture/reflow damage that could hinder or completely prevent the determination of the original failure mechanism.

Baking of Populated Boards

Some SMD packages and board materials are not able to withstand long duration bakes at 125° C. Examples of this are some FR-4 materials, which cannot withstand a 24 hr bake at 125° C. Batteries and electrolytic capacitors are also temperature sensitive. With component and board temperature restrictions in mind, choose a bake temperature from Table 4-1 in J-STD 033; then determine the appropriate bake duration based on the component to be removed. For additional considerations see IPC-7711 andIPC-7721.

Derating due to Factory Environmental Conditions

Factory floor life exposures for SMD packages removed from the dry bags will be a function of the ambient environmental conditions. A safe, yet conservative, handling approach is to expose the SMD packages only up to the maximum time limits for each moisture sensitivity level as shown in table of Moisture Classification Level and Floor Life. This approach, however, does not work if the factory humidity or temperature is greater than the testing conditions of 30°C/60% RH. A solution for addressing this problem is to derate the exposure times based on the knowledge of moisture diffusion in the component package materials ref. JESD22-A120). Recommended equivalent total floor life exposures can be estimated for a range of humidities and temperatures based on the nominal plastic thickness for each device.

Table on following page lists equivalent derated floor lives for humidities ranging from 20-90% RH for three temperature, 20° C, 25° C, and 30° C.

This table is applicable to SMDs molded with novolac, biphenyl or multifunctional epoxy mold compounds. The following assumptions were used in calculating this table:

1. Activation Energy for diffusion = 0.35 eV (smallest known value).
2. For ≤ 60% RH, use Diffusivity = 0.121 exp (-0.35eV/kT) mm^2/s (this used smallest known Diffusivity @ 30° C).
3. For > 60% RH, use Diffusivity = 1.320 exp (-0.35eV/kT) mm^2/s (this used largest known Diffusivity @ 30° C).

Recommended Equivalent Total Floor Life (days) @ 20° C, 25° C & 30° C, 35° C

For ICs with Novolac, Biphenyl and Multifunctional Epoxies (Reflow at same temperature at which the component was classified) Maximum Percent Relative Humidity

Maximum Percent Relative Humidity												
Package Type and Body Thickness	**Moisture Sensitivity Level**	**5%**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	
Body Thickness ≥3.1 mm Including PQFPs >84 pin, PLCCs (square) All MQFPs or All BGAs ≥1 mm	Level 2a	∞	∞	94	44	32	26	16	7	5	4	35° C
		∞	∞	124	60	41	33	28	10	7	6	30° C
		∞	∞	167	78	53	42	36	14	10	8	25° C
		∞	∞	231	103	69	57	47	19	13	10	20° C
	Level 3	∞	∞	8	7	6	6	6	4	3	3	35° C
		∞	∞	10	9	8	7	7	5	4	4	30° C
		∞	∞	13	11	10	9	9	7	6	5	25° C
		∞	∞	17	14	13	12	12	10	8	7	20° C
	Level 4	∞	3	3	3	2	2	2	2	1	1	35° C
		∞	5	4	4	4	3	3	3	2	2	30° C
		∞	6	5	5	5	5	4	3	3	3	25° C
		∞	8	7	7	7	7	6	5	4	4	20° C
	Level 5	∞	2	2	2	2	1	1	1	1	1	35° C
		∞	4	3	3	2	2	2	2	1	1	30° C
		∞	5	5	4	4	3	3	2	2	2	25° C
		∞	7	7	6	5	5	4	3	3	3	20° C
	Level 5a	∞	1	1	1	1	1	1	1	1	1	35° C
		∞	2	1	1	1	1	1	1	1	1	30° C
		∞	3	2	2	2	2	2	1	1	1	25° C
		∞	5	4	3	3	3	2	2	2	2	20° C
Body 2.1 mm ≤ Thickness <3.1 mm including PLCCs (rectangular) 18-32 pin SOICs (wide body) SOICs ≥20 pins, PQFPs ≤80 pins	Level 2a	∞	∞	∞	∞	58	30	22	3	2	1	35° C
		∞	∞	∞	∞	86	39	28	4	3	2	30° C
		∞	∞	∞	∞	148	51	37	6	4	3	25° C
		∞	∞	∞	∞	∞	69	49	8	5	4	20° C
	Level 3	∞	∞	12	9	7	6	5	2	2	1	35° C
		∞	∞	19	12	9	8	7	3	2	2	30° C
		∞	∞	25	15	12	10	9	5	3	3	25° C
		∞	∞	32	19	15	13	12	7	5	4	20° C
	Level 4	∞	5	4	3	3	2	2	1	1	1	35° C
		∞	7	5	4	4	3	3	2	2	1	30° C
		∞	9	7	5	5	4	4	3	2	2	25° C
		∞	11	9	7	6	6	5	4	3	3	20° C
	Level 5	∞	3	2	2	2	2	1	1	1	1	35° C
		∞	4	3	3	2	2	2	1	1	1	30° C
		∞	5	4	3	3	3	3	2	1	1	25° C
		∞	6	5	5	4	4	4	3	3	2	20° C
	Level 5a	∞	1	1	1	1	1	1	1	0.5	0.5	35° C
		∞	2	1	1	1	1	1	1	0.5	0.5	30° C
		∞	2	2	2	2	2	2	1	1	1	25° C
		∞	3	2	2	2	2	2	2	2	1	20° C
Body Thickness <2.1 mm including SOICs <18 pin All TQFPs, TSOPs or All BGAs <1 mm body thickness	Level 2a	∞	∞	∞	∞	∞	∞	17	1	0.5	0.5	35° C
		∞	∞	∞	∞	∞	∞	28	1	1	1	30° C
		∞	∞	∞	∞	∞	∞	∞	2	1	1	25° C
		∞	∞	∞	∞	∞	∞	∞	2	2	1	20° C
	Level 3	∞	∞	∞	∞	∞	8	5	1	0.5	0.5	35° C
		∞	∞	∞	∞	∞	11	7	1	1	1	30° C
		∞	∞	∞	∞	∞	14	10	2	1	1	25° C
		∞	∞	∞	∞	∞	20	13	2	2	1	20° C
	Level 4	∞	∞	∞	7	4	3	2	1	0.5	0.5	35° C
		∞	∞	∞	9	5	4	3	1	1	1	30° C
		∞	∞	∞	12	7	5	4	2	1	1	25° C
		∞	∞	∞	17	9	7	6	2	2	1	20° C
	Level 5	∞	∞	7	3	2	2	1	1	0.5	0.5	35° C
		∞	∞	13	5	3	2	2	1	1	1	30° C
		∞	∞	18	6	4	3	3	2	1	1	25° C
		∞	∞	26	8	6	5	4	2	2	1	20° C
	Level 5a	∞	7	2	1	1	1	1	1	0.5	0.5	35° C
		∞	10	3	2	1	1	1	1	1	0.5	30° C
		∞	13	5	3	2	2	2	1	1	1	25° C
		∞	18	6	4	3	2	2	2	2	1	20° C

For product information and a complete list of distributors, please go to our web site: **www.avagotech.com**

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