AWE6159R
Quad-band GSM/GPRS/EDGE Power Amplifier Module with Integrated Power Control

Data Sheet - Rev 2.2

FEATURES

- Internal Reference Voltage
- Integrated Power Control
- InGaP HBT Technology
- ESD Protection on All Pins (2.5 kV)
- Automatic V_{BATT} tracking
- Low profile 1.0 mm
- Small Package Outline 5 mm x 5 mm
- EGPRS Capable (class 12)
- RoHS Compliant Package, 250 °C MSL-3
- Halogen-Free

GMSK MODE

- Integrated power control (CMOS)
- +35 dBm GSM850/900 Output Power
- +33 dBm DCS/PCS Output Power
- 53 % GSM 850/900 PAE
- 49 % DCS/PCS PAE
- Power control range > 50 dB

EDGE MODE

- +29 dBm GSM850/900 Output Power
- +28.5 dBm DCS/PCS Output Power
- 28% GSM850/900 PAE
- 28% DCS/PCS PAE
- 64 dB Typical ACPR (400 kHz)
- 74 dB Typical ACPR (600 kHz)

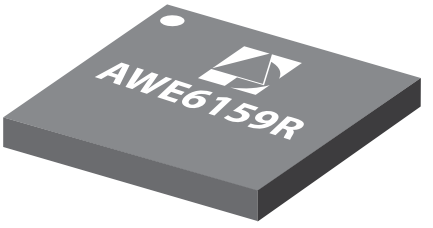
APPLICATIONS

- Dual/Tri/Quad Band Handsets and PDAs
- Dual/Tri/Quad Band Wireless Data Cards

PRODUCT DESCRIPTION

This power amplifier module supports dual, tri and quad band applications for GMSK and 8-PSK modulation schemes using a polar architecture. There are two amplifier chains, one to support GSM850/900 bands, the other for DCS/PCS bands. Each amplification chain is optimized for excellent EDGE efficiency, power, and linearity in a Polar loop environment while maintaining high efficiency in the GSM/GPRS mode.

The module includes an internal reference voltage and integrated power control scheme for use in both GMSK and 8-PSK operation. This facilitates fast and easy production calibration and reduces the number of external components required to complete a power control function.



M46 Package
11 Pin 5 mm x 5 mm x 1.0 mm
Surface Mount Module

Furthermore, the power control function includes battery detection circuitry for robust ORFS transient spectrum performance at low battery voltages.

The amplifier's power control range is typically 55 dB, with the output power set by applying an analog voltage to V_{RAMP}. All of the RF ports for this device are internally matched to 50 Ω.

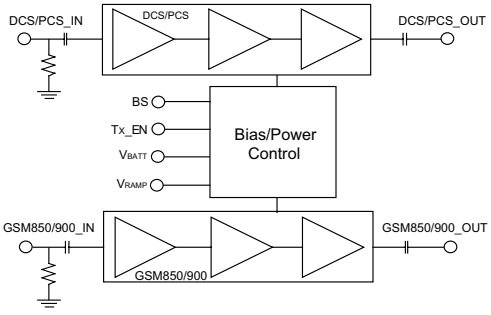


Figure 1: Block Diagram

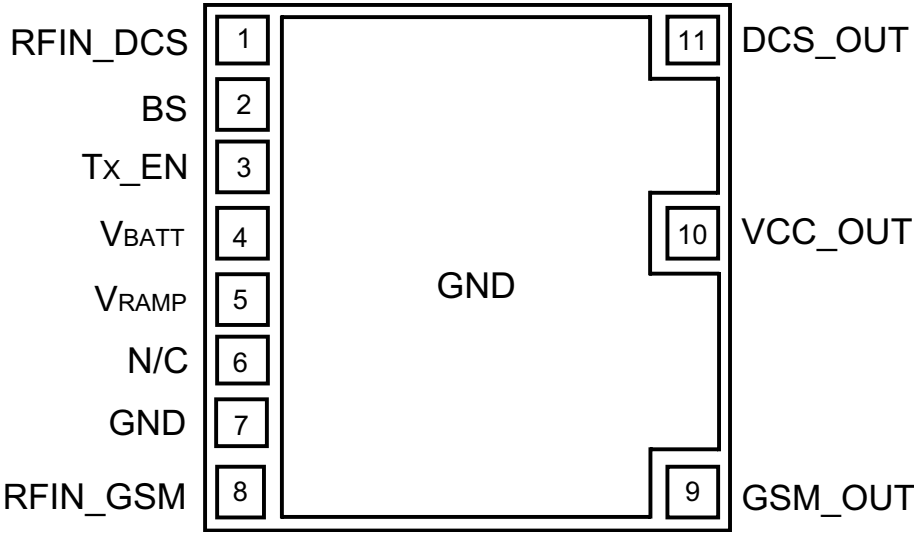


Figure 2: Pinout (X - ray Top View)

Table 1: Pin Description

PIN	NAME	DESCRIPTION	PIN	NAME	DESCRIPTION
1	RFIN_DCS	DCS RF Input	7	GND	Ground
2	BS	Band Select Logic Input	8	RFIN_GSM	GSM900 RF Input
3	TX_EN	TX Enable Logic Input	9	GSM_OUT	GSM900 RF Output
4	V_{BATT}	Battery Supply Connection	10	VCC_OUT	V_{RAMP} test point Do not connect
5	V_{RAMP}	Analog Signal used to control output power	11	DCS_OUT	DCS RF Output
6	N/C	No Connection			

ELECTRICAL CHARACTERISTICS

Table 2: Absolute Maximum Ratings(1)

PARAMETER	MIN	MAX	UNITS
Supply Voltage (V_{BATT})	-	+5.5	V
RF Input Power (RF_{IN})	-	11	dBm
Control Voltage (V_{RAMP})(2)	-0.3	2.2	V
Digital Inputs (Logic Voltage)(2) TX_EN, BS, V_{RAMP}	-0.5	+3.0	V
Storage Temperature (T_{STG})	-55	150	°C

Notes:
(1a) No Damage or degradation assuming only one parameter at a time is set at limit with all other parameters set at nominal conditions.
(1b) Functional operation is not implied under these conditions.
(1c) Exposure to absolute ratings for extended periods of time may adversely affect reliability.
(2) V_{BATT} must be ≥ logic and control voltages to prevent damage to ESD diodes.

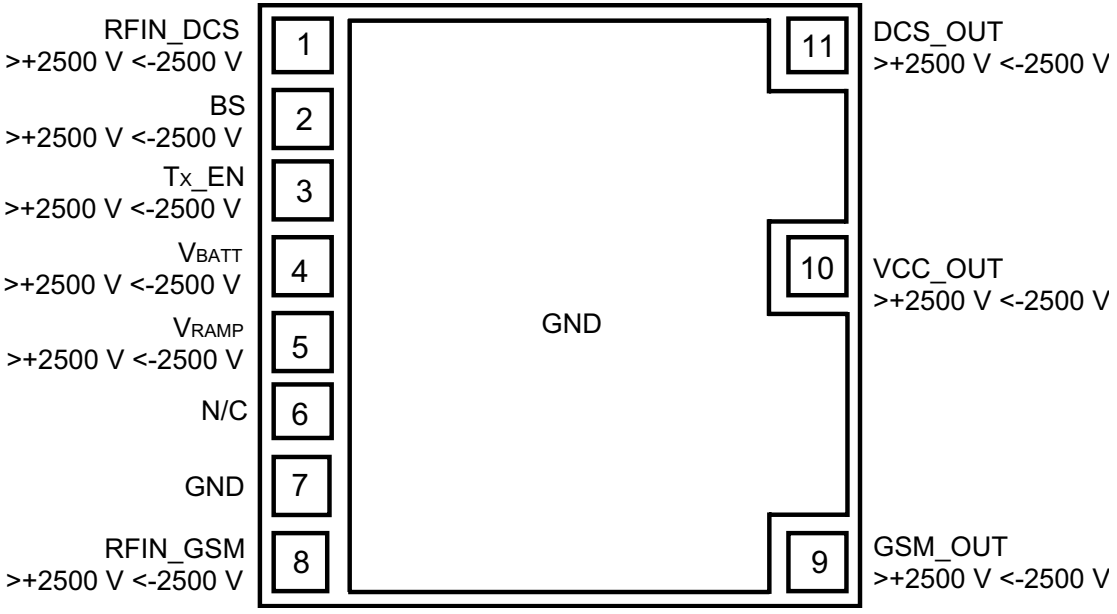


Figure 3: ESD Pin Rating

ELECTROSTATIC DISCHARGE SENSITIVITY

The AWE6159R part was tested to determine the ESD sensitivity of each package pin with respect to ground. All the package pins were subjected to an ESD pulse event using the Human Body Model outlined in JESD22-A114C.01 in either polarity with respect to ground. The pre and post test I-V characteristics of each pin are recorded. The ratings on each pin require that it sustain the ESD event and show no degradation.

Table 3: Operating Conditions

PARAMETER	MIN	TYP	MAX	UNITS	COMMENTS
Case temperature (T_C)	-30	-	+85	°C	
Supply voltage (V_{BATT})	3.0	3.5	4.8	V	
Power supply leakage current	-	1	10	µA	V_{BATT} = 4.8 V, V_{RAMP} = 0 V, TX_EN = LOW No RF applied
Control Voltage Range	0.2	-	1.6	V	
Turn on Time (T_{ON})	-	-	1	µs	V_{RAMP} = 0.2 V, TX_EN = LOW → HIGH P_{IN} = 5 dBm
Turn Off Time (T_{OFF})	-	-	1	µs	V_{RAMP} = 0.2 V, TX_EN = HIGH → LOW P_{IN} = 5 dBm
Rise Time (T_{RISE})	-	-	1	µs	P_{OUT} = -10 dBm → P_{MAX} (within 0.2 dB)
Fall Time (T_{FALL})	-	-	1	µs	P_{OUT} = P_{MAX} → -10 dBm (within 0.2 dB)
V_{RAMP} Input Capacitance	-	3	-	pF	
V_{RAMP} Input Current	-	-	10	µA	
Duty Cycle	-	-	50	%	

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

Table 4: Digital Inputs

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Logic High Voltage	V_{IH}	1.2	-	3.0	V
Logic Low Voltage	V_{IL}	-	-	0.5	V
Logic High Current	$\|I_{IH}\|$	-	-	30	µA
Logic Low Current	$\|I_{IL}\|$	-	-	30	µA

Table 5: Logic Control Table

OPERATIONAL MODE	BS	TX_EN
GSM850/900	LOW	HIGH
DCS/PCS	HIGH	HIGH
PA DISABLED	-	LOW

Table 6: Electrical Characteristics for GSM850 GMSK mode
Unless otherwise specified: V_{BATT} = 3.5 V, P_{IN} = 3.0 dBm, Pulse Width = 1154 µs, Duty = 25%
Z_{IN} = Z_{OUT} = 50 Ω, T_C = 25 °C, V_{RAMP} = 1.6 V, BS = LOW, TX_EN = HIGH

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (F_{IN})	824	-	849	MHz	
Input Power (P_{IN})	0	3	5	dBm	
Output Power (P_{MAX})	34.5	35.2	-	dBm	Freq = 824 to 849 MHz
Degraded Output Power (P_{OUT})	32	32.8	-	dBm	V_{BATT} = 3.0 V, T_C = +85 °C P_{IN} = 0 dBm
PAE @ P_{MAX}	48	52	-	%	Freq = 824 to 849 MHz
Supply Current (I_{BATT})	-	1.82	2.2	A	P_{OUT} = P_{MAX}, V_{RAMP} = 1.6 V
Forward Isolation 1	-	-51	-30	dBm	TX_EN = 0 V, P_{IN} = 5 dBm
Forward Isolation 2	-	-27	-15	dBm	TX_EN = HIGH ,V_{RAMP} = 0.2 V P_{IN} = 5 dBm
Cross Isolation (2Fo @ DCS/PCS port)	-	-23	-15	dBm	P_{OUT} < 34.5 dBm
Cross Isolation (3Fo @ DCS/PCS port)	-	-23	-12	dBm	P_{OUT} < 34.5 dBm
Second Harmonic	-	-19	-10	dBm	P_{OUT} < 34.5 dBm
Third Harmonic	-	-24	-10	dBm	P_{OUT} < 34.5 dBm
n * fo (n > 4), $F_o \leq$ 12.75 GHz	-	-30	-8	dBm	P_{OUT} < 34.5 dBm
Stability	VSWR = 6:1 All Phases				
	-	-	-36	dBm	F_{OUT} < 1 GHz
	-	-	-30	dBm	F_{OUT} > 1 GHz
Ruggedness	No Permanent Degradation VSWR 10:1, All Phase Angles				
RX Noise Power	-	-88	-82	dBm	F_{TX} = 849 MHz, RBW = 100 kHz, F_{RX} = 869 to 894 MHz, P_{OUT} < 34.5 dBm
Input Return Loss	-	1.5:1	2.5:1	VSWR	P_{OUT} < 34.5 dBm

Table 7: Electrical Characteristics for GSM850 8-PSK mode
Unless otherwise specified: V_{BATT} = 3.5 V, P_{IN} = 3.0 dBm, Pulse Width = 1154 µs, Duty = 25%
Z_{IN} = Z_{OUT} = 50 Ω, T_C = 25 °C, BS = LOW, TX_EN = HIGH

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (F_{IN})	824	-	849	MHz	
Input Power	0	3	5	dBm	
PAE	20	28	-	%	F_{IN} = 824 to 849 MHz P_{OUT} set = +29 dBm
ACPR 200 kHz 400 kHz 600 kHz 1800 kHz	 - - - -	 -37 -62 -74 -78	 -34 -58 -64 -66	 dBc/30 kHz dBc/30 kHz dBc/30 kHz dBc/100 kHz	 All conditions under Polar operation P_{OUT} = +29 dBm
EVM	-	1	5	%	All Conditions under Polar operation P_{OUT} = +29 dBm

Table 8: Electrical Characteristics for GSM900 GMSK mode
Unless otherwise specified: V_{BATT} = 3.5 V, P_{IN} = 3.0 dBm, Pulse Width = 1154 µs, Duty = 25%
Z_{IN} = Z_{OUT} = 50 Ω, T_C = 25 °C, V_{RAMP} = 1.6 V, BS = LOW, TX_EN = HIGH

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (F_{IN})	880	-	915	MHz	
Input Power (P_{IN})	0	3	5	dBm	
Output Power (P_{MAX})	34.5	35	-	dBm	Freq = 880 to 915 MHz
Degraded Output Power (P_{OUT})	32	32.8	-	dBm	V_{BATT} = 3.0 V, T_C = +85 °C P_{IN} = 0 dBm
PAE @ P_{MAX}	48	53	-	%	Freq = 880 to 915 MHz
Supply Current (I_{BATT})	-	1.7	2.1	A	P_{OUT} = P_{MAX}, V_{RAMP} = 1.6 V
Forward Isolation 1	-	-43	-30	dBm	TX_EN = 0 V, P_{IN} = 5 dBm
Forward Isolation 2	-	-27	-15	dBm	TX_EN = HIGH ,V_{RAMP} = 0.2 V P_{IN} = 5 dBm
Cross Isolation (2F_O @ DCS/PCS port)	-	-20	-15	dBm	P_{OUT} < 34.5 dBm
Cross Isolation (3F_O @ DCS/PCS port)	-	-20	-12	dBm	P_{OUT} < 34.5 dBm
Second Harmonic	-	-22	-10	dBm	P_{OUT} < 34.5 dBm
Third Harmonic	-	-21	-10	dBm	P_{OUT} < 34.5 dBm
n * fo (n > 4), F_O ≤ 12.75 GHz	-	-29	-8	dBm	P_{OUT} < 34.5 dBm
Stability	VSWR = 6:1 All Phases				
	-	-	-36	dBm	F_{OUT} < 1 GHz
	-	-	-30	dBm	F_{OUT} > 1 GHz
Ruggedness	No Permanent Degradation VSWR 10:1, All Phase Angles				
RX Noise Power	-	-87	-76	dBm	F_{TX} = 915 MHz, RBW = 100 kHz, F_{RX} = 925 to 935 MHz, P_{OUT} < 34.5 dBm
	-	-87	-82	dBm	F_{TX} = 915 MHz, RBW = 100 kHz, F_{RX} = 935 to 960 MHz, P_{OUT} < 34.5 dBm
Input Return Loss	-	1.5:1	2.5:1	VSWR	P_{OUT} < 34.5 dBm

Table 9: Electrical Characteristics for GSM900 8-PSK mode
Unless otherwise specified: V_{BATT} = 3.5 V, P_{IN} = 3.0 dBm, Pulse Width = 1154 µs, Duty = 25%
Z_{IN} = Z_{OUT} = 50 Ω, T_C = 25 °C , BS = LOW, TX_EN = HIGH

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (F_{IN})	880	-	915	MHz	
Input Power	0	3	5	dBm	
PAE	20	28	-	%	F_{IN} = 880 to 915 MHz P_{OUT} set = +29 dBm
ACPR 200 kHz 400 kHz 600 kHz 1800 kHz	 - - - -	 -38 -65 -74 -78	 -34 -58 -64 -66	 dBc/30 kHz dBc/30 kHz dBc/30 kHz dBc/100 kHz	 All conditions under Polar operation P_{OUT} = +29 dBm
EVM	-	1	5	%	All Conditions under Polar operation P_{OUT} = +29 dBm

Table 10: Electrical Characteristics for DCS GMSK mode
Unless otherwise specified: V_{BATT} = 3.5 V, P_{IN} = 3.0 dBm, V_{RAMP} = 1.6 V, Pulse Width = 1154 µs Duty = 25%, Z_{IN} = Z_{OUT} = 50 Ω, T_C = 25 °C , BS = HIGH, TX_EN = HIGH

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (F_{IN})	1710	-	1785	MHz	
Input Power (P_{IN})	0	3	5	dBm	
Output Power (P_{MAX})	32.0	33	-	dBm	Freq = 1710 to1785 MHz
Degraded Output Power (P_{OUT})	30.0	31.0	-	dBm	V_{BATT} = 3.0 V, T_C = +85 °C P_{IN} = 0 dBm
PAE @ P_{MAX}	44	48	-	%	Freq = 1710 to1785 MHz
Supply Current (I_{BATT})	-	1.2	1.6	A	P_{OUT} = P_{MAX}, V_{RAMP} = 1.6 V
Forward Isolation 1	-	-43	-30	dBm	TX_EN = 0 V, P_{IN} = 5 dBm
Forward Isolation 2	-	-23	-15	dBm	TX_EN = HIGH ,V_{RAMP} = 0.2 V P_{IN} = 5 dBm
Second Harmonic	-	-17	-10	dBm	P_{OUT} < 32.0 dBm
Third Harmonic	-	-27	-15	dBm	P_{OUT} < 32.0 dBm
n * fo (n > 4), $F_o \leq$ 12.75 GHz	-	-34	-8	dBm	P_{OUT} < 32.0 dBm
Stability	VSWR = 6:1 All Phases				
	-	-	-36	dBm	F_{OUT} < 1 GHz
	-	-	-30	dBm	F_{OUT} > 1 GHz
Ruggedness	No Permanent Degradation VSWR 10:1, All Phase Angles				
RX Noise Power	-	-89	-82	dBm	F_{TX} = 1785 MHz, RBW = 100 kHz, F_{RX} = 1805 to1880 MHz, P_{OUT} < 32.0 dBm
Input Return Loss	-	1.5:1	2.5:1	VSWR	P_{OUT} < 32.0 dBm

Table 11: Electrical Characteristics for DCS 8-PSK mode
Unless otherwise specified: V_{BATT} = 3.5 V, P_{IN} = 3.0 dBm, Pulse Width = 1154 µs, Duty = 25%
Z_{IN} = Z_{OUT} = 50 Ω, T_C = 25 °C , BS = HIGH, TX_EN = HIGH

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (F_{IN})	1710	-	1785	MHz	
Input Power	0	3	5	dBm	
PAE	22	28	-	%	F_{IN} = 1710 to 1785 MHz P_{OUT} set = +28.5 dBm
ACPR 200 kHz 400 kHz 600 kHz 1800 kHz	 - - - -	 -37 -64 -74 -78	 -34 -58 -63 -66	 dBc/30 kHz dBc/30 kHz dBc/30 kHz dBc/100 kHz	 All conditions under Polar operation P_{OUT} = +28.5 dBm
EVM	-	1	5	%	All Conditions under Polar operation P_{OUT} = +28.5 dBm

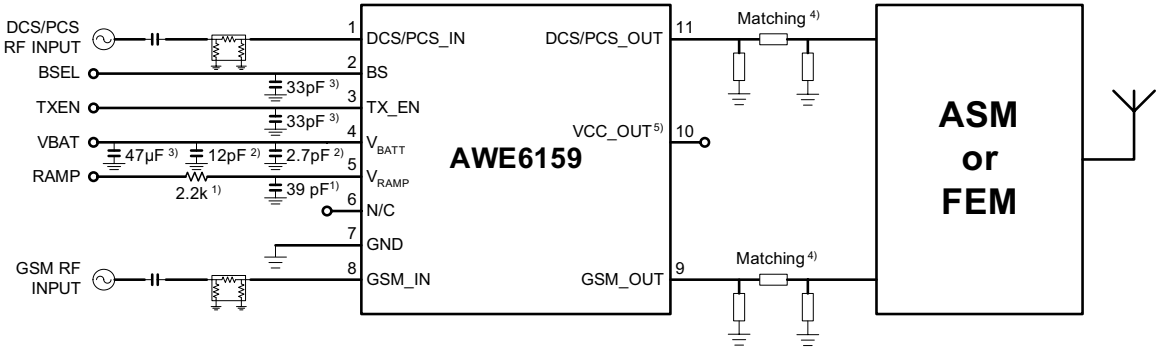
Table 12: Electrical Characteristics for PCS GMSK mode
Unless otherwise specified: V_{BATT} = 3.5 V, P_{IN} = 3.0 dBm, V_{RAMP} = 1.6 V, Pulse Width = 1154 µs
Duty = 25%, Z_{IN} = Z_{OUT} = 50 Ω, T_C = 25 °C , BS = HIGH, TX_EN = HIGH

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (F_{IN})	1850	-	1910	MHz	
Input Power (P_{IN})	0	3	5	dBm	
Output Power (P_{MAX})	32.0	33.1	-	dBm	Freq = 1850 to1910 MHz
Degraded Output Power (P_{OUT})	30.0	31.0	-	dBm	V_{BATT} = 3.0 V, T_C = +85 °C P_{IN} = 0 dBm
PAE @ P_{MAX}	45	50	-	%	Freq = 1850 to1910 MHz
Supply Current (I_{BATT})	-	1.2	1.5	A	P_{OUT} = P_{MAX}, V_{RAMP} = 1.6 V
Forward Isolation 1	-	-42	-30	dBm	TX_EN = 0 V, P_{IN} = 5 dBm
Forward Isolation 2	-	-22	-15	dBm	TX_EN = HIGH ,V_{RAMP} = 0.2 V P_{IN} = 5 dBm
Second Harmonic	-	-19	-10	dBm	P_{OUT} < 32.0 dBm
Third Harmonic	-	-29	-15	dBm	P_{OUT} < 32.0 dBm
n * fo (n > 4), $F_o \leq$ 12.75 GHz	-	-33	-8	dBm	P_{OUT} < 32.0 dBm
Stability	VSWR = 6:1 All Phases				
	-	-	-36	dBm	F_{OUT} < 1 GHz
	-	-	-30	dBm	F_{OUT} > 1 GHz
Ruggedness	No Permanent Degradation VSWR 10:1, All Phase Angles				
RX Noise Power	-	-90	-82	dBm	F_{TX} = 1910 MHz, RBW = 100 kHz, F_{RX} = 1930 to1990 MHz, P_{OUT} < 32.0 dBm
Input Return Loss	-	1.5:1	2.5:1	VSWR	P_{OUT} < 32.0 dBm

Table 13: Electrical Characteristics for PCS 8-PSK mode
Unless otherwise specified: V_{BATT} = 3.5 V, P_{IN} = 3.0 dBm, Pulse Width = 1154 µs, Duty = 25%
Z_{IN} = Z_{OUT} = 50 Ω, T_C = 25 °C , BS = HIGH, TX_EN = HIGH

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency (F_{IN})	1850	-	1910	MHz	
Input Power	0	3	5	dBm	
PAE	22	28	-	%	F_{IN} = 1850 to 1910 MHz P_{OUT} set = +28.5 dBm
ACPR 200 kHz 400 kHz 600 kHz 1800 kHz	 - - - -	 -37 -64 -74 -78	 -34 -58 -64 -66	 dBc/30 kHz dBc/30 kHz dBc/30 kHz dBc/100 kHz	 All conditions under Polar operation P_{OUT} = +28.5 dBm
EVM	-	1	5	%	All Conditions under Polar operation P_{OUT} = +28.5 dBm

APPLICATION INFORMATION



1) Component values depends on baseband chipset used.

2) These components should be placed as close to the device pin as possible.

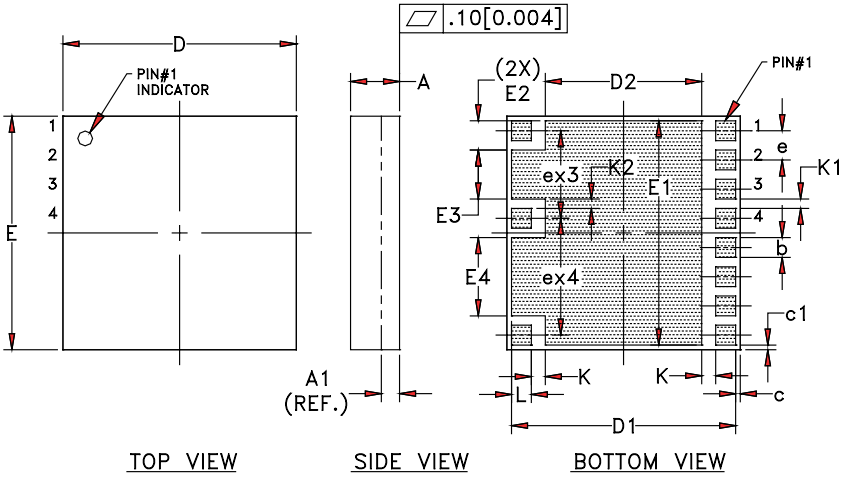
3) These components are recommended as good design practice for improving noise rejection characteristics
The values specified are not critical as they may not be required in the final application.

4) Actual matching component values depend on PCB layout and ASM/FEM used.

5) VRAMP test point, do not connect.

Figure 4: Recommended Application Circuit

PACKAGE OUTLINE



SYMBOL	MILLIMETERS			INCHES			NOTE
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	
A	0.980	1.080	1.180	0.0386	0.0425	0.0465	–
A1	0.420 (REF.)			0.0165 (REF.)			–
b	0.326	0.376	0.426	0.0129	0.0148	0.0168	–
c	–	0.100	–	–	0.0039	–	–
c1	–	0.124	–	–	0.0049	–	–
D	4.900	5.000	5.100	0.1929	0.1969	0.2008	–
D1	4.751	4.801	4.851	0.1870	0.1890	0.1910	–
D2	3.399	3.449	3.499	0.1338	0.1358	0.1378	–
E	4.900	5.000	5.100	0.1929	0.1969	0.2008	–
E1	4.751	4.801	4.851	0.1870	0.1890	0.1910	–
E2	0.626	0.676	0.726	0.0246	0.0266	0.0286	2X
E3	0.849	0.899	0.949	0.0334	0.0354	0.0374	–
E4	1.474	1.524	1.574	0.0580	0.0600	0.0620	–
e	0.625 BSC			0.0246 BSC			7X
K	0.250	0.300	0.350	0.0098	0.0118	0.0138	–
K1	0.199	0.249	0.299	0.0078	0.0098	0.0118	–
K2	0.250	0.300	0.350	0.0098	0.0118	0.0138	4X
L	0.326	0.376	0.426	0.0128	0.0148	0.0168	–

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. METAL PAD DIMENSION IS MEASURED AT THE BOTTOM OF THE METAL LAYER.

Figure 5: M46 Package Outline - 11 Pin 5 mm x 5 mm x 1.0 mm Surface Mount Module

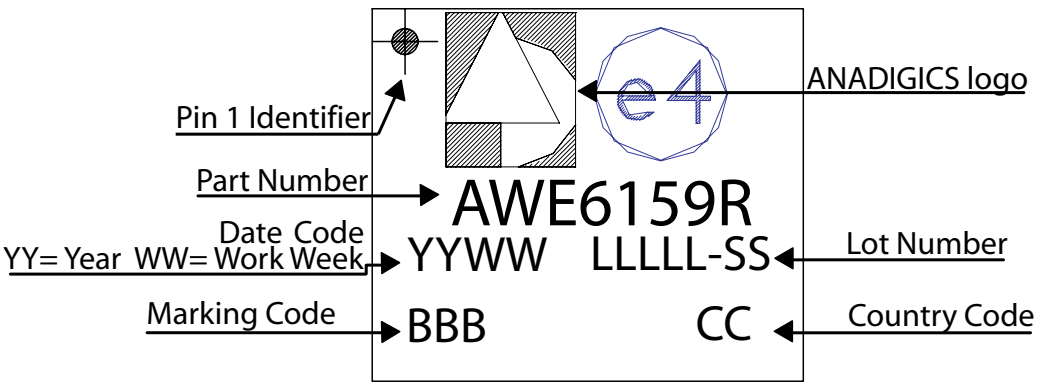


Figure 6: Branding Specification Diagram

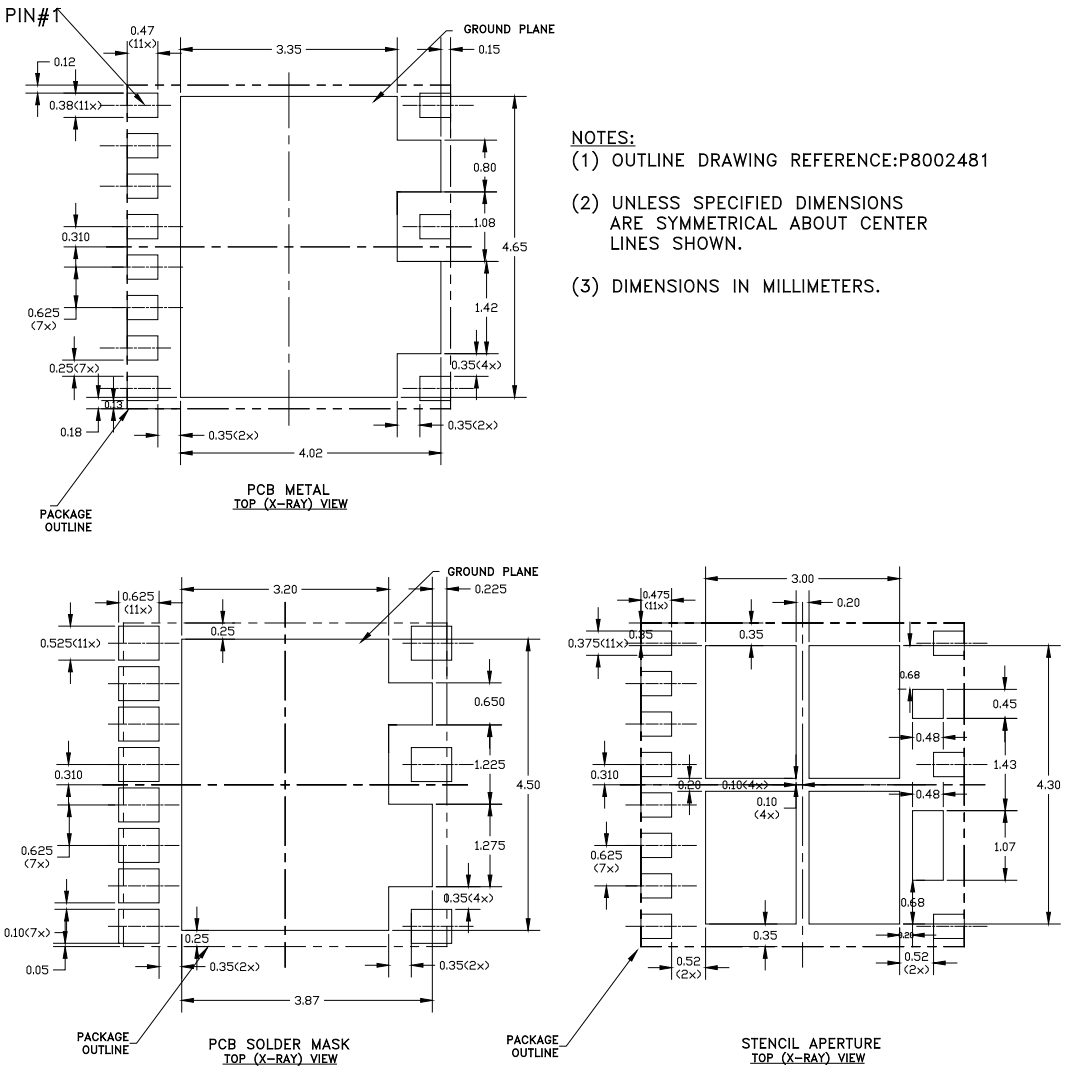


Figure 7: Recommended PCB Layout Information

ORDERING INFORMATION

ORDER NUMBER	TEMPERATURE RANGE	PACKAGE DESCRIPTION	COMPONENT PACKAGING
AWE6159RM46P8	-30 °C to +85°C	RoHS-compliant 11 Pin 5 mm x 5 mm x 1.0 mm Surface Mount Module	Tape and Reel, 2500 pieces per reel
AWE6159RM46P9	-30 °C to +85°C	RoHS-compliant 11 Pin 5 mm x 5 mm x 1.0 mm Surface Mount Module	Partial Tape and Reel

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Tel: +1 (908) 668-5000
Fax: +1 (908) 668-5132

URL: http://www.anadigics.com