

**FEATURES**

- Internal Reference Voltage
- Integrated Power Control Scheme
- InGaP HBT Technology
- ESD Protection on All Pins (2.5 kV)
- Low profile 1.3 mm
- Small Package Outline 7 mm x 7 mm
- EGPRS Capable (class 12)

**GMSK MODE**

- Integrated power control (CMOS)
- +35 dBm GSM850/900 Output Power
- +33 dBm DCS/PCS Output Power
- 55 % GSM850/900 PAE
- 50 % DCS/PCS PAE
- Power control range > 50 dB

**EDGE MODE**

- +30.5 dBm GSM850/900 Output Power
- +29.5 dBm DCS/PCS Output Power
- 25 % GSM850/900 PAE
- 25 % DCS/PCS PAE

**APPLICATIONS**

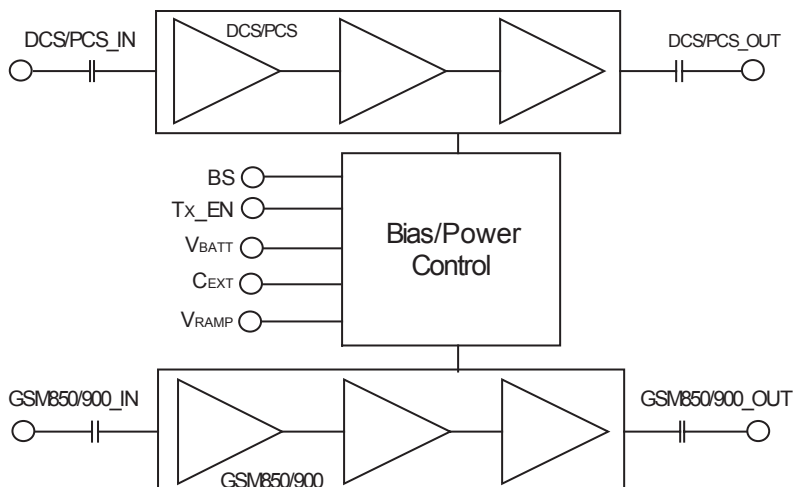
- GSM850/GSM900/DCS/PCS Handsets
- Dual/Tri/Quad Band PDA
- GMSK and 8-PSK Polar Modulation Schemes

**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.

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. 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  $50 \Omega$ . Internal DC blocks are provided at the RF inputs.


**Figure 1: Block Diagram**

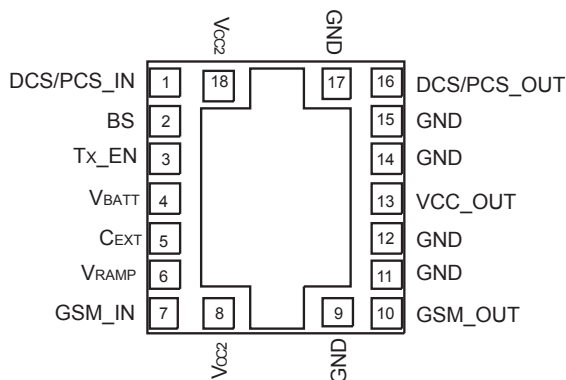


Figure 2: Pinout (X - ray Top View)

Table 1: Pin Description

PIN	NAME	DESCRIPTION	PIN	NAME	DESCRIPTION
1	DCS/PCS_IN	DCS/PCS RF Input	10	GSM_OUT	GSM850/900 RF Output
2	BS	Band Select Logic Input	11	GND	Ground
3	TX_EN	TX Enable Logic Input	12	GND	Ground
4	V <sub>BATT</sub>	Battery Supply Connection	13	VCC_OUT	Control Voltage Output which must be connected to V <sub>cc2</sub> , no decoupling
5	C <sub>EXT</sub>	Bypass	14	GND	Ground
6	V <sub>RAMP</sub>	Analog Signal used to control the output power	15	GND	Ground
7	GSM_IN	GSM850/900 RF Input	16	DCS/PCS_OUT	DCS/PCS RF Output
8	V <sub>cc2</sub>	VCC Control Input for GSM850/900 Pre-amplifier	17	GND	Ground
9	GND	Ground	18	V <sub>cc2</sub>	Vcc Control Input for DCS/PCS Pre-amplifier

## ELECTRICAL CHARACTERISTICS

Table 2: Absolute Maximum Ratings

PARAMETER	MIN	MAX	UNITS
Supply Voltage ( $V_{BATT}$ )	-	+7	V
RF Input Power ( $RF_{IN}$ )	-	11	dBm
Control Voltage ( $V_{RAMP}$ )	-0.3	1.8	V
Storage Temperature ( $T_{STG}$ )	-55	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: ESD Ratings

PARAMETER	METHOD	RATING	UNIT
ESD Threshold voltage (RF ports)	HBM	>2.5	kV
ESD Threshold voltage (control inputs)	HBM	>2.5	kV

Although protection circuitry has been designed into this device, proper precautions should be taken to avoid exposure to electrostatic discharge (ESD) during handling and mounting. Human body model HBM employed is resistance = 1500 $\Omega$ , capacitance = 100pF.

Table 4: Operating Conditions

PARAMETER	MIN	TYP	MAX	UNITS	COMMENTS
Case temperature (T <sub>C</sub> )	-20	-	85	°C	
Supply voltage (V <sub>BATT</sub> )	3.0	3.5	4.8	V	
Power supply leakage current	-	1	5	μA	V <sub>BATT</sub> = 4.8 V, V <sub>RAMP</sub> = 0 V, TX_EN = LOW No RF applied
Control Voltage Range	0.2	-	1.6	V	
Turn on Time (T <sub>ON</sub> )	-	-	1	μs	V <sub>RAMP</sub> = 0.2 V, TX_EN = LOW → HIGH P <sub>IN</sub> = 5 dBm
Turn Off Time (T <sub>OFF</sub> )	-	-	1	μs	V <sub>RAMP</sub> = 0.2 V, TX_EN = LOW → HIGH P <sub>IN</sub> = 5 dBm
Rise Time (T <sub>RISE</sub> )	-	-	1	μs	P <sub>OUT</sub> = -10 dBm → P <sub>MAX</sub> (within 0.2 dB)
Fall Time (T <sub>FALL</sub> )	-	-	1	μs	P <sub>OUT</sub> = P <sub>MAX</sub> → -10 dBm (within 0.2 dB)
V <sub>RAMP</sub> Input Capacitance	-	3	-	pF	
V <sub>RAMP</sub> 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 5: Digital Inputs

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Logic High Voltage	V <sub>IH</sub>	1.2	-	3.0	V
Logic Low Voltage	V <sub>IL</sub>	-	-	0.5	V
Logic High Current	I <sub>H</sub>	-	-	30	μA
Logic Low Current	I <sub>L</sub>	-	-	30	μA

Table 6: Logic Control Table

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

**Table 7: Electrical Characteristics for GSM850/900 GMSK mode**  
**Unless otherwise specified:  $V_{BATT} = 3.5\text{ V}$ ,  $P_{IN} = 5\text{ dBm}$ , Pulse Width = 1154  $\mu\text{s}$ , Duty 25%,  
 $Z_{IN} = Z_{OUT} = 50\ \Omega$ ,  $T_C = 25\ ^\circ\text{C}$ ,  $V_{RAMP} = 1.6\text{ V}$ ,  $BS = \text{LOW}$ ,  $TX\_EN = \text{HIGH}$ ,  $\text{MODE} = \text{LOW}$**

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency ( $F_o$ )	824 880	- -	849 915	MHz	
Input Power	3	5	8	dBm	
Output Power, $P_{MAX}$	34.5	35	-	dBm	Freq = 824 to 915 MHz
Degraded Output Power	32.0	32.5	-	dBm	$V_{BATT} = 3.0\text{ V}$ , $T_C = 85\ ^\circ\text{C}$ $P_{IN} = 3\text{ dBm}$
PAE @ $P_{MAX}$	-	55	-	%	Freq = 824 to 915 MHz
Forward Isolation 1	-	-37	-	dBm	$TX\_EN = \text{LOW}$ , $P_{IN} = 8\text{ dBm}$
Forward Isolation 2	-	-25	-	dBm	$TX\_EN = \text{HIGH}$ , $V_{RAMP} = 0.2\text{V}$ , $P_{IN} = 8\text{ dBm}$
Cross Isolation ( $2F_o$ @ DCS/PCS port)	-	-25	-	dBm	$V_{RAMP} = 0.2\text{V}$ to $V_{RAMP\_MAX}$
Second Harmonic	-	-20	-	dBm	Over all output power levels
Third Harmonic	-	-30	-	dBm	Over all output power levels
Stability	VSWR = 8:1 All Phases , $P_{OUT} \leq 34.5\text{ dBm}$				
	-	-	-36	dBm	$F_{OUT} < 1\text{ GHz}$
	-	-	-30	dBm	$F_{OUT} > 1\text{ GHz}$
Ruggedness	10:1	-	-	-	All Load Phases
RX Noise Power	-	-86	-	dBm	$F_{TX} = 849\text{ MHz}$ , $RBW = 100\text{ kHz}$ $F_{RX} = 869\text{ to }894\text{ MHz}$ , $P_{OUT} \leq 34.5\text{ dBm}$
	-	-80	-	dBm	$F_{TX} = 915\text{ MHz}$ , $RBW = 100\text{ kHz}$ , $F_{RX} = 925\text{ to }935\text{ MHz}$ , $P_{OUT} \leq 34.5\text{ dBm}$
	-	-86	-	dBm	$F_{TX} = 915\text{ MHz}$ , $RBW = 100\text{ kHz}$ , $F_{RX} = 935\text{ to }960\text{ MHz}$ , $P_{OUT} \leq 34.5\text{ dBm}$
Input Return Loss	-	-	2.5:1	VSWR	Over all output power levels

Table 8: Electrical Characteristics for GSM850/900 EDGE mode

Unless otherwise specified:  $V_{BATT} = 3.5$  V,  $P_{IN} = 5$  dBm,  $V_{RAMP} = 1.6$  V, Pulse Width = 1154 $\mu$ s, Duty 25%  $Z_{IN} = Z_{OUT} = 50$   $\Omega$ ,  $T_c = 25$   $^{\circ}$ C, BS = LOW, TX\_EN = HIGH, MODE = HIGH

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency ( $F_o$ )	824 880	- -	849 915	MHz	
PAE @ 30.5 dBm	-	25	-	%	
Dynamic Range	-	55	-	dB	$V_{RAMP} = 0.2$ V to 1.6 V
Gain Slope	-	-	300	dB/V	$P_{OUT} \geq 5$ dBm
AM - PM / S21 Phase Deviation	- - - - - - -	2.39 2.78 3.34 2.89 1.74 1.84 2.49	- - - - - - -	deg/dB	<5 dBm +5 dBm +10 dBm +15 dBm +20 dBm +25 dBm +30 dBm
Cross Isolation ( $2F_o$ @ DCS/PCS port)	-	-25	-	dBm	
Second Harmonic	-	-20	-	dBm	Over all output power levels
Third Harmonic	-	-30	-	dBm	Over all output power levels
Stability	VSWR = 8:1 All Phases, $P_{OUT} \leq 30.5$ dBm				
	-	-	-36	dBm	$F_{OUT} < 1$ GHz
	-	-	-30	dBm	$F_{OUT} > 1$ GHz
RX Noise Power	-	-86	-	dBm	$F_{TX} = 849$ MHz, RBW = 100 kHz $F_{RX} = 869$ to 894MHz, $P_{OUT} \leq 30.5$ dBm
	-	-80	-	dBm	$F_{TX} = 915$ MHz, RBW = 100 kHz, $F_{RX} = 925$ to 935 MHz, $P_{OUT} \leq 30.5$ dBm
	-	-86	-	dBm	$F_{TX} = 915$ MHz, RBW = 100 kHz, $F_{RX} = 935$ to 960 MHz, $P_{OUT} \leq 30.5$ dBm
Input Return Loss	-	-	2.5:1	VSWR	

**Table 9: Electrical Characteristics for DCS/PCS GMSK mode**  
**Unless otherwise specified:  $V_{BATT} = 3.5\text{ V}$ ,  $P_{IN} = 5\text{ dBm}$ , Pulse Width = 1154  $\mu\text{s}$ , Duty 25%,  
 $Z_{IN} = Z_{OUT} = 50\ \Omega$ ,  $T_C = 25\ ^\circ\text{C}$ ,  $V_{RAMP} = 1.6\text{ V}$ , BS = HIGH, TX\_EN = HIGH, MODE = LOW**

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency	1710 1850	- -	1785 1910	MHz	
Input Power	3	5	8	dBm	
Output Power, $P_{MAX}$	32	33	-	dBm	
Degraded Output Power	29.5	30.5	-	dBm	$V_{BATT} = 3.0\text{ V}$ , $T_C = 85\ ^\circ\text{C}$ $P_{IN} = 3\text{ dBm}$
PAE @ $P_{MAX}$	-	50	-	%	Freq = 1710 to 1910 MHz
Forward Isolation 1	-	-37	-	dBm	TX_EN = LOW, $P_{IN} = 8\text{ dBm}$
Forward Isolation 2	-	-17	-	dBm	TX_EN = HIGH, $V_{RAMP} = 0.2\text{ V}$ , $P_{IN} = 8\text{ dBm}$
Second Harmonic	-	-20	-	dBm	Over all output power levels
Third Harmonic	-	-30	-	dBm	Over all output power levels
Stability	VSWR = 8:1 All Phases , $P_{OUT} \leq 32\text{ dBm}$				
	-	-	-36	dBm	$F_{OUT} < 1\text{ GHz}$
	-	-	-30	dBm	$F_{OUT} > 1\text{ GHz}$
Ruggedness	10:1	-	-	-	All Load Phases
RX Noise Power	-	-80	-	dBm	$F_{TX} = 1785\text{ MHz}$ , RBW = 100 kHz, $F_{RX} = 1805\text{ to }1880\text{ MHz}$ , $P_{OUT} \leq 32\text{ dBm}$
	-	-80	-	dBm	$F_{TX} = 1910\text{ MHz}$ , RBW = 100 kHz, $F_{RX} = 1930\text{ to }1990\text{ MHz}$ , $P_{OUT} \leq 32\text{ dBm}$
Input Return Loss	-	-	2.5:1	VSWR	Over all output power levels

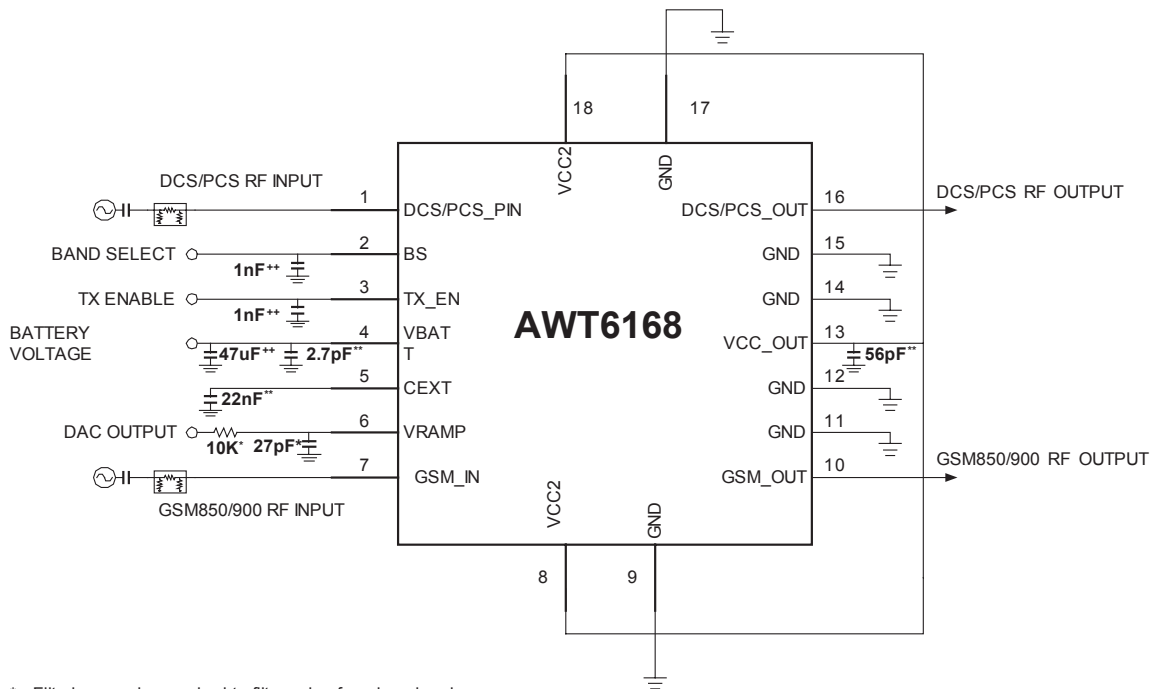
Table 10: Electrical Characteristics for DCS/PCS EDGE mode

Unless otherwise specified:  $V_{BATT} = 3.5\text{ V}$ ,  $P_{IN} = 5\text{ dBm}$ ,  $V_{RAMP} = 1.6\text{ V}$ , Pulse Width = 1154 $\mu\text{s}$ , Duty 25%,  
 $Z_{IN} = Z_{OUT} = 50\Omega$ ,  $TC = 25\text{ }^\circ\text{C}$ ,  $BS = \text{HIGH}$ ,  $TX\_EN = \text{HIGH}$ ,  $\text{MODE} = \text{HIGH}$

PARAMETER	MIN	TYP	MAX	UNIT	COMMENTS
Operating Frequency ( $F_o$ )	1710 1850	- -	1785 1910	MHz	
PAE @ 29.5 dBm	-	25	-	%	
Dynamic Range	-	50	-	dB	$V_{RAMP} = 0.2\text{ V to }1.6\text{ V}$
Gain Slope	-	-	300	dB/V	$P_{OUT} \geq 0\text{ dBm}$
AM - PM / S21 Phase Deviation	- - - - - - -	1.92 1.65 2.54 2.31 1.66 1.61 1.03 0.92	- - - - - - -	deg/dB	<0 dBm 0 dBm +5 dBm +10 dBm +15 dBm +20 dBm +25 dBm +28 dBm
Second Harmonic	-	-20	-	dBm	Over all output power levels
Third Harmonic	-	-30	-	dBm	Over all output power levels
Stability	VSWR = 8:1 All Phases, $P_{OUT} \leq 29.5\text{ dBm}$				
	-	-	-36	dBm	$F_{OUT} < 1\text{ GHz}$
	-	-	-30	dBm	$F_{OUT} > 1\text{ GHz}$
RX Noise Power	-	-80	-	dBm	$F_{TX} = 1785\text{ MHz}$ , RBW = 100 kHz $F_{RX} = 1805\text{ to }1880\text{ MHz}$ , $P_{OUT} \leq 29.5\text{ dBm}$
	-	-80	-	dBm	$F_{TX} = 1910\text{ MHz}$ , RBW = 100 kHz, $F_{RX} = 1930\text{ to }1990\text{ MHz}$ , $P_{OUT} \leq 29.5\text{ dBm}$
Input Return Loss	-	-	2.5:1	VSWR	



APPLICATION INFORMATION



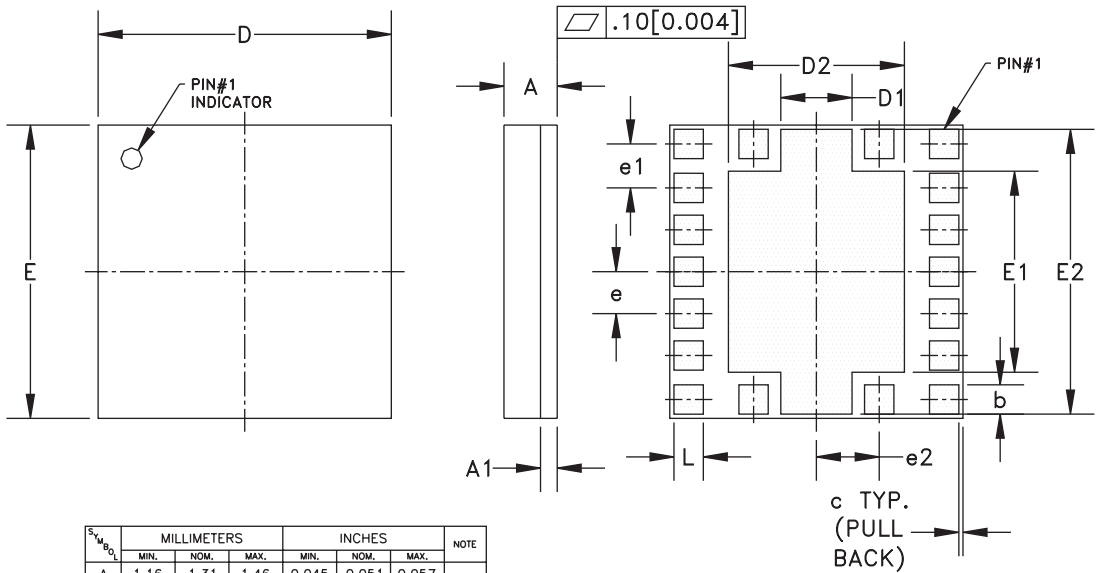
\* Filtering may be required to filter noise from baseband.

\*\* This component should be placed as close to the device pin as possible.

++ 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.

Figure 3: Recommended Application Circuit

**AWT6168  
PACKAGE OUTLINE**



S <sub>MBO</sub>	MILLIMETERS			INCHES			NOTE
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	
A	1.16	1.31	1.46	0.045	0.051	0.057	-
A1	-	0.30	-	-	0.012	-	-
b	-	0.70	-	-	0.027	-	-
c	-	0.10	-	-	0.004	-	-
D	6.88	7.00	7.12	0.270	0.275	0.280	-
D1	-	1.70	-	-	0.067	-	-
D2	-	4.19	-	-	0.165	-	-
E	6.88	7.00	7.12	0.270	0.275	0.280	-
E1	-	4.80	-	-	0.189	-	-
E2	-	6.78	-	-	0.267	-	-
e	-	1.00	-	-	0.039	-	8X
e1	-	1.05	-	-	0.041	-	4X
e2	-	1.50	-	-	0.059	-	4X
L	-	0.70	-	-	0.027	-	-

**NOTES:**

1. CONTROLLING DIMENSIONS: MILLIMETERS
2. UNLESS SPECIFIED TOLERANCE=±0.076[0.003].

**Figure 3: Package Outline**

**NOTES**



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