



# AWT6223R

## WCDMA/GSM/GPRS/Polar EDGE

### Power Amplifier Module

#### with Integrated Power Control

Data Sheet - REV 2.0

### FEATURES

- InGaP HBT Technology
- Optimized for a 50  $\Omega$  System
- Internal Reference Voltage
- Integrated GSM/EDGE Power Control with Temperature Compensation
- Low Profile Surface Mount Package:  
6 mm x 8 mm x 1 mm
- RoHS Compliant Package, 250  $^{\circ}$ C MSL-3

### WCDMA MODE

- HSDPA Compliant
- High Efficiency:  
41% @  $P_{OUT} = +28.5$  dBm  
21% @  $P_{OUT} = +16$  dBm
- Low Quiescent Current: 12 mA
- Low Leakage Current in Shutdown Mode:  $<1$   $\mu$ A
- Internal Voltage Regulator Eliminates the Need for External Reference Voltage
- $V_{EN} = +2.4$  V (+2.2 V min over Temp)

### GMSK MODE

- +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
- EGPRS Capable (class 12)

### EDGE MODE

- +29 dBm GSM850/900 Output Power
- +28.5 dBm DCS/PCS Output Power
- 27 % GSM850/900 PAE
- 30 % DCS/PCS PAE
- -63 dBc/30 kHz Typical ACPR (400 kHz)
- -77 dBc/30 kHz Typical ACPR (600 kHz)

### APPLICATIONS

- 3G Handsets, Smartphones, Data Devices Incorporating:
  - WCDMA (IMT)
  - GSM850/GSM900/DCS/PCS Bands
  - GMSK and 8-PSK (Open Loop Polar) Modulations

### PRODUCT DESCRIPTION

The AWT6223R WEDGE module supports dual, tri, or quad band operation using GMSK/GPRS and 8-PSK (open loop polar) modulations, and WCDMA operation in the IMT band. The AWT6223R module is manufactured using ANADIGICS' advanced

InGaP HBT MMIC technology to provide reliability, temperature stability, and ruggedness. This penta-band module consists of three amplifier chains; one to support GSM/GPRS/EGPRS in cellular bands, one to support GSM/GPRS/EGPRS in DCS/PCS bands, and one to support WCDMA in the IMT band. In addition, the AWT6223R module includes an internal reference voltage and integrated power control with temperature compensation for use in GMSK and 8-PSK modes of operation. These features facilitate fast and easy production calibration, minimize performance variation over temperature, and reduce the number of external components required.

The WCDMA PA incorporates ANADIGICS' HELP2<sup>TM</sup> technology. Through selectable bias modes, the AWT6223R achieves optimal efficiency across different output power levels, specifically at low and mid-range power levels where the PA typically operates, thereby dramatically increasing handset talk-time and standby-time. Its built-in voltage regulator eliminates the need for an external reference voltage and switch components, reducing PCB area and BOM costs. All of the RF ports for this device are internally matched to 50  $\Omega$ . The RF inputs GSM\_IN and DCS/PCS\_IN both have shunt resistors to ground to maintain a good input VSWR as the  $V_{RAMP}$  power control voltage is varied. Internal DC blocks are provided at the RF outputs.

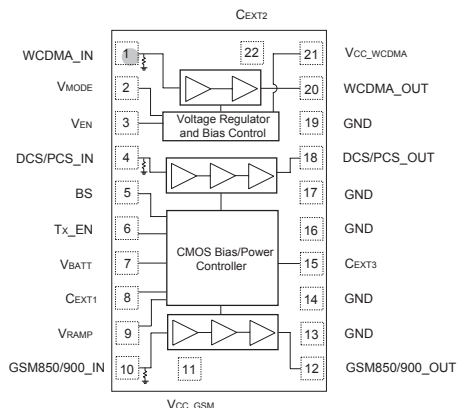


Figure 1: Block Diagram

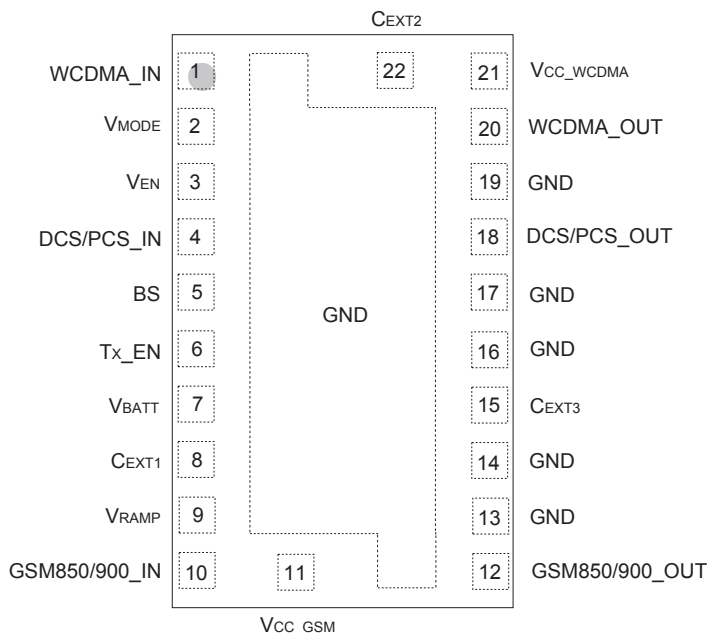


Figure 2: Pinout (X-ray Top View)

Table 1: Pin Description

| PIN | NAME                | DESCRIPTION                                                                | PIN | NAME                  | DESCRIPTION                        |
|-----|---------------------|----------------------------------------------------------------------------|-----|-----------------------|------------------------------------|
| 1   | WCDMA_IN            | WCDMA RF Input                                                             | 12  | GSM850/900_OUT        | GSM850/900 RF Output               |
| 2   | V <sub>MODE</sub>   | WCDMA Mode Control Voltage                                                 | 13  | GND                   | Ground                             |
| 3   | V <sub>EN</sub>     | WCDMA Shutdown                                                             | 14  | GND                   | Ground                             |
| 4   | DCS/PCS_IN          | DCS/PCS RF Input                                                           | 15  | C <sub>EXT3</sub>     | Bypass for Power Control Regulator |
| 5   | BS                  | Band Select Logic Input                                                    | 16  | GND                   | Ground                             |
| 6   | Tx_EN               | TX Enable Logic Input                                                      | 17  | GND                   | Ground                             |
| 7   | V <sub>BATT</sub>   | Battery Supply                                                             | 18  | DCS/PCS_OUT           | DCS/PCS RF Output                  |
| 8   | C <sub>EXT1</sub>   | Bypass for Internal Voltage Regulator                                      | 19  | GND                   | Ground                             |
| 9   | V <sub>RAMP</sub>   | Analog signal used to control the GSM output power                         | 20  | WCDMA_OUT             | WCDMA RF Output                    |
| 10  | GSM850/900_IN       | GSM850/900 RF Input                                                        | 21  | V <sub>CC_WCDMA</sub> | WCDMA Supply Voltage               |
| 11  | V <sub>CC_GSM</sub> | V <sub>CC</sub> test point for GSM section. Do not connect. Do not ground. | 22  | C <sub>EXT2</sub>     | Bypass for WCDMA V <sub>CC1</sub>  |

## ELECTRICAL CHARACTERISTICS

Table 2: Absolute Maximum Ratings

| PARAMETER                                        | MIN  | MAX | UNITS |
|--------------------------------------------------|------|-----|-------|
| Supply Voltage ( $V_{BATT}$ )                    | -    | +6  | V     |
| Supply Voltage ( $V_{CC\_WCDMA}$ )               | -    | +5  | V     |
| RF Input Power ( $RF_{IN}$ )                     | -    | 10  | dBm   |
| GSM/EDGE Output Control Voltage ( $V_{RAMP}$ )   | -0.3 | 1.8 | V     |
| WCDMA Control Voltages ( $V_{MODE}$ , $V_{EN}$ ) | 0    | 3.5 | 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.

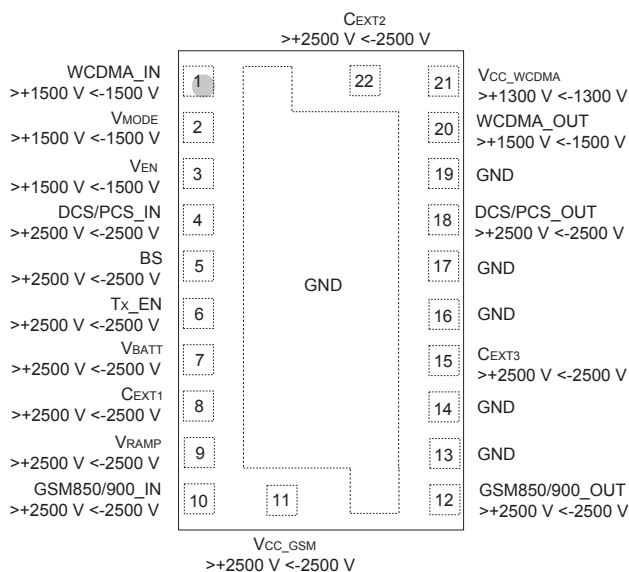


Figure 3: ESD Pin Rating

## Electrostatic Discharge Sensitivity

The AWT6223R part was tested to determine the ESD sensitivity of each package pin with respect to Ground. Non-ground pins are stressed with 1 positive pulse or 1 negative pulse with respect to the Ground using the Human Body Model apparatus and waveform outlined in JESD22-A114C.01. Determination of pass or fail is made according to whether the part passes key RF tests against the datasheet limits after stress. Results of the test are presented in Figure 3:

- Rating for WCDMA\_IN,  $V_{MODE}$ ,  $V_{EN}$ , and WCDMA\_OUT is +1500V and -1500V;
- Rating for  $V_{CC\_WCDMA}$  is +1300V and -1300V;
- Rating for DCS/PCS\_IN, BS, Tx\_EN,  $V_{BATT}$ , CEXT1,  $V_{RAMP}$ , GSM\_IN,  $V_{CC\_GSM}$ , GSM\_OUT, CEXT3 and DCS/PCS\_OUT is +2500V and -2500V

It is very important to take all necessary precautions, listed in Application Notes “ESD precautions for ANADIGICS GaAs MMIC,” to avoid ESD damage to

Table 3: GSM/EDGE 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     |                                                                                                                                                                  |
| Total Power Supply Leakage Current  | -   | 1   | 10  | μA    | V <sub>BATT</sub> = V <sub>CC_WCDMA</sub> = 4.8 V, V <sub>EN</sub> = 0 V, V <sub>MODE</sub> = 0 V, BS = 0 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<br>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<br>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.

Notes:

1. Do not apply a DC voltage to the GSM\_IN or DCS/PCS\_IN RF inputs.

Table 4: GSM/EDGE 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>IH</sub> | -   | -   | 30  | μA    |
| Logic Low Current  | I <sub>IL</sub> | -   | -   | 30  | μA    |

Table 5: GSM/EDGE Logic Control

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

Notes:

1. V<sub>BATT</sub> must be applied before taking BS and/or T<sub>X</sub>\_EN High.

**Table 6: Electrical Characteristics for GSM850 GMSK Mode**  
 (Unless Otherwise Specified:  $V_{BATT} = 3.5\text{ V}$ ,  $P_{IN} = 3.0\text{ dBm}$ , 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 = LOW,  $T_X\_EN = \text{HIGH}$ ,  $V_{EN} = \text{LOW}$ )

| PARAMETER                                                           | MIN                                                      | TYP        | MAX        | UNIT                           | COMMENTS                                                                                                              |
|---------------------------------------------------------------------|----------------------------------------------------------|------------|------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Operating Frequency ( $F_o$ )                                       | 824                                                      | -          | 849        | MHz                            |                                                                                                                       |
| Input Power                                                         | 0                                                        | 3          | 5          | dBm                            |                                                                                                                       |
| Output Power, $P_{MAX}$                                             | 34.5                                                     | 35         | -          | dBm                            | Freq = 824 to 849 MHz                                                                                                 |
| Degraded Output Power                                               | 32.0                                                     | 32.5       | -          | dBm                            | $V_{BATT} = 3.0\text{ V}$ , $T_C = 85\ ^\circ\text{C}$<br>$P_{IN} = 0\text{ dBm}$                                     |
| PAE @ $P_{MAX}$                                                     | 48                                                       | 52         | -          | %                              | Freq = 824 to 849 MHz                                                                                                 |
| Forward Isolation 1                                                 | -                                                        | -42        | -30        | dBm                            | $T_X\_EN = \text{LOW}$ , $P_{IN} = 5\text{ dBm}$                                                                      |
| Forward Isolation 2                                                 | -                                                        | -25        | -20        | dBm                            | $T_X\_EN = \text{HIGH}$ , $V_{RAMP} = 0.2\text{V}$ , $P_{IN} = 5\text{ dBm}$                                          |
| Cross Isolation<br>2 $F_o$ @ DCS/PCS port<br>3 $F_o$ @ DCS/PCS port | -<br>-                                                   | -36<br>-25 | -20<br>-20 | dBm                            | $V_{RAMP} = 0.2\text{V}$ to $V_{RAMP\_MAX}$                                                                           |
| Second Harmonic                                                     | -                                                        | -20        | -10        | dBm                            | Over all output power levels                                                                                          |
| Third Harmonic                                                      | -                                                        | -30        | -10        | dBm                            | Over all output power levels                                                                                          |
| $n \times F_o$ ( $n \geq 4$ ),<br>$F_o \leq 12.75\text{ GHz}$       | -                                                        | -30        | -10        | 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                                                          | No Permanent Degradation,<br>VSWR 10:1, All Phase Angles |            |            | $P_{OUT} \leq 34.5\text{ dBm}$ |                                                                                                                       |
| RX Noise Power                                                      | -                                                        | -86        | -83        | dBm                            | $F_{TX} = 849\text{ MHz}$ , RBW = 100 kHz<br>$F_{RX} = 869\text{ to }894\text{ MHz}$ , $P_{OUT} \leq 34.5\text{ dBm}$ |
| Input Return Loss                                                   | -                                                        | 1.5:1      | 2.5:1      | VSWR                           | Over all output power levels                                                                                          |

**Table 7: Electrical Characteristics for GSM900 GMSK Mode**  
(Unless Otherwise Specified:  $V_{BATT} = 3.5\text{ V}$ ,  $P_{IN} = 3.0\text{ dBm}$ , 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 = LOW, TX\_EN = HIGH, V\_EN = LOW)

| PARAMETER                                                           | MIN                                                      | TYP        | MAX        | UNIT                           | COMMENTS                                                                                                              |
|---------------------------------------------------------------------|----------------------------------------------------------|------------|------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Operating Frequency ( $F_o$ )                                       | 880                                                      | -          | 915        | MHz                            |                                                                                                                       |
| Input Power                                                         | 0                                                        | 3          | 5          | dBm                            |                                                                                                                       |
| Output Power, $P_{MAX}$                                             | 34.5                                                     | 35         | -          | dBm                            | Freq = 880 to 915 MHz                                                                                                 |
| Degraded Output Power                                               | 32.0                                                     | 32.5       | -          | dBm                            | $V_{BATT} = 3.0\text{ V}$ , $T_C = 85\ ^\circ\text{C}$<br>$P_{IN} = 0\text{ dBm}$                                     |
| PAE @ $P_{MAX}$                                                     | 50                                                       | 55         | -          | %                              | Freq = 880 to 915 MHz                                                                                                 |
| Forward Isolation 1                                                 | -                                                        | -40        | -30        | dBm                            | TX_EN = LOW, $P_{IN} = 5\text{ dBm}$                                                                                  |
| Forward Isolation 2                                                 | -                                                        | -25        | -20        | dBm                            | TX_EN = HIGH, $V_{RAMP} = 0.2\text{ V}$ , $P_{IN} = 5\text{ dBm}$                                                     |
| Cross Isolation<br>2 $F_o$ @ DCS/PCS port<br>3 $F_o$ @ DCS/PCS port | -<br>-                                                   | -34<br>-22 | -20<br>-17 | dBm                            | $V_{RAMP} = 0.2\text{ V}$ to $V_{RAMP\_MAX}$                                                                          |
| Second Harmonic                                                     | -                                                        | -25        | -10        | dBm                            | Over all output power levels                                                                                          |
| Third Harmonic                                                      | -                                                        | -27        | -10        | dBm                            | Over all output power levels                                                                                          |
| $n \times F_o$ ( $n \geq 4$ ),<br>$F_o \leq 12.75\text{ GHz}$       | -                                                        | -30        | -10        | 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                                                          | No Permanent Degradation,<br>VSWR 10:1, All Phase Angles |            |            | $P_{OUT} \leq 34.5\text{ dBm}$ |                                                                                                                       |
| RX Noise Power                                                      | -                                                        | -83        | -77        | dBm                            | $F_{TX} = 915\text{ MHz}$ , RBW = 100 kHz<br>$F_{RX} = 925\text{ to }935\text{ MHz}$ , $P_{OUT} \leq 34.5\text{ dBm}$ |
|                                                                     | -                                                        | -86        | -83        | dBm                            | $F_{TX} = 915\text{ MHz}$ , RBW = 100 kHz<br>$F_{RX} = 935\text{ to }960\text{ MHz}$ , $P_{OUT} \leq 34.5\text{ dBm}$ |
| Input Return Loss                                                   | -                                                        | 1.5:1      | 2.5:1      | VSWR                           | Over all output power levels                                                                                          |

**Table 8: Electrical Characteristics for GSM850 8PSK Mode**  
**(Unless Otherwise Specified:  $V_{BATT} = 3.5\text{ V}$ ,  $P_{IN} = 3.0\text{ dBm}$ , Pulse Width = 1154  $\mu\text{s}$ , Duty = 25%**  
 **$Z_{IN} = Z_{OUT} = 50\ \Omega$ ,  $T_C = 25\ ^\circ\text{C}$ , BS = LOW,  $T_X\_EN$  = HIGH,  $V_{EN}$  = LOW)**

| PARAMETER                                         | MIN              | TYP                      | MAX                      | UNIT                                                  | COMMENTS                                                                         |
|---------------------------------------------------|------------------|--------------------------|--------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------|
| Operating Frequency ( $F_{IN}$ )                  | 824<br>880       | -<br>-                   | 849<br>915               | MHz                                                   |                                                                                  |
| Input Power                                       | 0                | 3                        | 5                        | dBm                                                   |                                                                                  |
| PAE                                               | 20               | 27                       | -                        | %                                                     | $F_{IN} = 824\text{ to }849\text{ MHz}$<br>$P_{OUT}\text{ set} = +29\text{ dBm}$ |
| ACPR<br>200 kHz<br>400 kHz<br>600 kHz<br>1800 kHz | -<br>-<br>-<br>- | -39<br>-63<br>-74<br>-77 | -34<br>-58<br>-64<br>-68 | dBc/30 kHz<br>dBc/30 kHz<br>dBc/30 kHz<br>dBc/100 kHz | All conditions under Polar operation<br>$P_{OUT} = +29\text{ dBm}$               |
| EVM                                               | -                | 1                        | 5                        | %                                                     | All Conditions under Polar operation<br>$P_{OUT} = +29\text{ dBm}$               |

**Table 9: Electrical Characteristics for DCS GMSK Mode**  
**(Unless Otherwise Specified:  $V_{BATT} = 3.5\text{ V}$ ,  $P_{IN} = 3.0\text{ dBm}$ , 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, V\_EN = LOW)**

| PARAMETER                                                     | MIN                                                      | TYP   | MAX   | UNIT                         | COMMENTS                                                                                                                |
|---------------------------------------------------------------|----------------------------------------------------------|-------|-------|------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Operating Frequency                                           | 1710                                                     | -     | 1785  | MHz                          |                                                                                                                         |
| Input Power                                                   | 0                                                        | 3.0   | 5     | dBm                          |                                                                                                                         |
| Output Power, $P_{MAX}$                                       | 32                                                       | 33    | -     | dBm                          |                                                                                                                         |
| Degraded Output Power                                         | 29.5                                                     | 30.5  | -     | dBm                          | $V_{BATT} = 3.0\text{ V}$ , $T_C = 85\ ^\circ\text{C}$<br>$P_{IN} = 0\text{ dBm}$                                       |
| PAE @ $P_{MAX}$                                               | 45                                                       | 50    | -     | %                            | Freq = 1710 to 1910 MHz                                                                                                 |
| Forward Isolation 1                                           | -                                                        | -40   | -33   | dBm                          | TX_EN = LOW, $P_{IN} = 5\text{ dBm}$                                                                                    |
| Forward Isolation 2                                           | -                                                        | -24   | -20   | dBm                          | TX_EN = HIGH, $V_{RAMP} = 0.2\text{ V}$ ,<br>$P_{IN} = 5\text{ dBm}$                                                    |
| Second Harmonic                                               | -                                                        | -18   | -10   | dBm                          | Over all output power levels                                                                                            |
| Third Harmonic                                                | -                                                        | -24   | -10   | dBm                          | Over all output power levels                                                                                            |
| $n \times F_o$ ( $n \geq 4$ ),<br>$F_o \leq 12.75\text{ GHz}$ | -                                                        | -30   | -10   | 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                                                    | No Permanent Degradation,<br>VSWR 10:1, All Phase Angles |       |       | $P_{OUT} \leq 32\text{ dBm}$ |                                                                                                                         |
| RX Noise Power                                                | -                                                        | -86   | -80   | dBm                          | $F_{TX} = 1785\text{ MHz}$ , RBW = 100 kHz,<br>$F_{RX} = 1805\text{ to }1880\text{ MHz}$ , $P_{OUT} \leq 32\text{ dBm}$ |
| Input Return Loss                                             | -                                                        | 1.5:1 | 2.5:1 | VSWR                         | Over all output power levels                                                                                            |



**Table 10: Electrical Characteristics for PCS GMSK Mode**  
**(Unless Otherwise Specified:  $V_{BATT} = 3.5\text{ V}$ ,  $P_{IN} = 3.0\text{ dBm}$ , 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, V\_EN = LOW)**

| PARAMETER                                                     | MIN                                                      | TYP   | MAX   | UNIT                         | COMMENTS                                                                                                                |
|---------------------------------------------------------------|----------------------------------------------------------|-------|-------|------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Operating Frequency                                           | 1850                                                     | -     | 1910  | MHz                          |                                                                                                                         |
| Input Power                                                   | 0                                                        | 3.0   | 5     | dBm                          |                                                                                                                         |
| Output Power, $P_{MAX}$                                       | 32                                                       | 33    | -     | dBm                          |                                                                                                                         |
| Degraded Output Power                                         | 29.5                                                     | 30.5  | -     | dBm                          | $V_{BATT} = 3.0\text{ V}$ , $T_C = 85\ ^\circ\text{C}$<br>$P_{IN} = 0\text{ dBm}$                                       |
| PAE @ $P_{MAX}$                                               | 45                                                       | 50    | -     | %                            | Freq = 1710 to 1910 MHz                                                                                                 |
| Forward Isolation 1                                           | -                                                        | -37   | -33   | dBm                          | TX_EN = LOW, $P_{IN} = 5\text{ dBm}$                                                                                    |
| Forward Isolation 2                                           | -                                                        | -22   | -18   | dBm                          | TX_EN = HIGH, $V_{RAMP} = 0.2\text{ V}$ ,<br>$P_{IN} = 5\text{ dBm}$                                                    |
| Second Harmonic                                               | -                                                        | -28   | -10   | dBm                          | Over all output power levels                                                                                            |
| Third Harmonic                                                | -                                                        | -24   | -10   | dBm                          | Over all output power levels                                                                                            |
| $n \times F_o$ ( $n \geq 4$ ),<br>$F_o \leq 12.75\text{ GHz}$ | -                                                        | -30   | -10   | 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                                                    | No Permanent Degradation,<br>VSWR 10:1, All Phase Angles |       |       | $P_{OUT} \leq 32\text{ dBm}$ |                                                                                                                         |
| RX Noise Power                                                | -                                                        | -86   | -80   | dBm                          | $F_{TX} = 1910\text{ MHz}$ , RBW = 100 kHz,<br>$F_{RX} = 1930\text{ to }1990\text{ MHz}$ , $P_{OUT} \leq 32\text{ dBm}$ |
| Input Return Loss                                             | -                                                        | 1.5:1 | 2.5:1 | VSWR                         | Over all output power levels                                                                                            |

**Table 11: Electrical Characteristics for DCS 8PSK Mode**  
 (Unless Otherwise Specified:  $V_{BATT} = 3.5\text{ V}$ ,  $P_{IN} = 3.0\text{ dBm}$ , Pulse Width = 1154  $\mu\text{s}$ , Duty = 25%,  
 $Z_{IN} = Z_{OUT} = 50\ \Omega$ ,  $TC = 25\ ^\circ\text{C}$ , BS = HIGH,  $T_{X\_EN} = \text{HIGH}$ ,  $V_{EN} = \text{LOW}$ )

| PARAMETER                                         | MIN              | TYP                      | MAX                      | UNIT                                                  | COMMENTS                                                                             |
|---------------------------------------------------|------------------|--------------------------|--------------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------|
| Operating Frequency ( $F_{IN}$ )                  | 1710<br>1850     | -                        | 1785<br>1910             | MHz                                                   |                                                                                      |
| Input Power                                       | 0                | 3                        | 5                        | dBm                                                   |                                                                                      |
| PAE                                               | 25               | 30                       | -                        | %                                                     | $F_{IN} = 1710\text{ to }1785\text{ MHz}$<br>$P_{OUT}\text{ set} = +28.5\text{ dBm}$ |
| ACPR<br>200 kHz<br>400 kHz<br>600 kHz<br>1800 kHz | -<br>-<br>-<br>- | -38<br>-64<br>-77<br>-77 | -34<br>-58<br>-64<br>-68 | dBc/30 kHz<br>dBc/30 kHz<br>dBc/30 kHz<br>dBc/100 kHz | All conditions under Polar operation<br>$P_{OUT} = +28.5\text{ dBm}$                 |
| EVM                                               | -                | 1                        | 5                        | %                                                     | All Conditions under Polar operation<br>$P_{OUT} = +28.5\text{ dBm}$                 |

Table 12: WCDMA Operating Conditions

| PARAMETER                                                                                   | MIN                                                                                          | TYP                              | MAX              | UNITS | COMMENTS                                                                                                                  |
|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------|------------------|-------|---------------------------------------------------------------------------------------------------------------------------|
| Case temperature (T <sub>c</sub> )                                                          | -20                                                                                          | -                                | 85               | °C    |                                                                                                                           |
| Supply Voltage (V <sub>CC</sub> )                                                           | +3.2                                                                                         | +3.4                             | +4.2             | V     | P <sub>OUT</sub> ≤ +28.5 dBm                                                                                              |
| WCDMA Enable Voltage (V <sub>EN</sub> )                                                     | +2.2<br>0                                                                                    | +2.4<br>-                        | +3.1<br>+0.5     | V     | PA "on"<br>PA "shut down"                                                                                                 |
| Mode Control Voltage (V <sub>MODE</sub> )                                                   | +2.2<br>0                                                                                    | +2.4<br>-                        | +3.1<br>+0.5     | V     | Low Bias Mode<br>High Bias Mode                                                                                           |
| RF Output Power (P <sub>OUT</sub> )<br>3GPP<br>HSDPA Case A<br>HSDPA Case B<br>HSDPA Case C | +28.0 <sup>(1)</sup><br>+27.0 <sup>(1)</sup><br>+26.0 <sup>(1)</sup><br>+25.5 <sup>(1)</sup> | +28.5<br>+27.5<br>+26.5<br>+26.0 | -<br>-<br>-<br>- | dBm   | $1/15 \leq \beta_c/\beta_d \leq 12/15$<br>$13/15 \leq \beta_c/\beta_d \leq 15/8$<br>$15/7 \leq \beta_c/\beta_d \leq 15/0$ |

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) WCDMA operation at V<sub>CC</sub> = +3.2 V, P<sub>OUT</sub> is derated by 0.5 dB.

(2) Do not apply a DC voltage to the WCDMA\_IN RF input.

Table 13: WCDMA Bias Control

| APPLICATION        | P <sub>OUT</sub><br>LEVELS | LOGIC    | V <sub>EN</sub> | V <sub>MODE</sub> |
|--------------------|----------------------------|----------|-----------------|-------------------|
| WCDMA - low power  | ≤+16 dBm                   | Low      | +2.4 V          | +2.4 V            |
| WCDMA - high power | >+16 dBm                   | High     | +2.4 V          | 0 V               |
| Shutdown           | -                          | Shutdown | 0 V             | 0 V               |

Notes:

1. For WCDMA operation set T<sub>X\_EN</sub> = LOW.

Table 14: Electrical Characteristics for WCDMA

(Unless Otherwise Specified:  $T_C = 25\text{ }^\circ\text{C}$ ,  $V_{BATT} = +3.4\text{ V}$ ,  $T_{X\_EN} = \text{LOW}$ ,  $50\text{ }\Omega$  system,  $V_{EN} = 2.4\text{ V}$ )

| PARAMETER                                                     | MIN          | TYP          | MAX          | UNIT   | COMMENTS                                                                                                                            |
|---------------------------------------------------------------|--------------|--------------|--------------|--------|-------------------------------------------------------------------------------------------------------------------------------------|
| Operating Frequency                                           | 1920         | -            | 1980         | MHz    |                                                                                                                                     |
| Gain                                                          | 24.5<br>13.0 | 26.5<br>15.0 | 28.5<br>17.0 | dB     | $P_{OUT} = +28.5\text{ dBm}$ , $V_{MODE} = 0\text{ V}$<br>$P_{OUT} = +16\text{ dBm}$ , $V_{MODE} = +2.4\text{ V}$                   |
| ACLR1 at 5 MHz offset <sup>(1)</sup>                          | -<br>-       | -40<br>-43   | -38<br>-38   | dBc    | $P_{OUT} = +28.5\text{ dBm}$ , $V_{MODE} = 0\text{ V}$<br>$P_{OUT} = +16\text{ dBm}$ , $V_{MODE} = +2.4\text{ V}$                   |
| ACLR2 at 10 MHz offset                                        | -<br>-       | -56<br>-52   | -48<br>-48   | dBc    | $P_{OUT} = +28.5\text{ dBm}$ , $V_{MODE} = 0\text{ V}$<br>$P_{OUT} = +16\text{ dBm}$ , $V_{MODE} = +2.4\text{ V}$                   |
| Power-Added Efficiency <sup>(1)</sup>                         | 37<br>18     | 41<br>21     | -<br>-       | %      | $P_{OUT} = +28.5\text{ dBm}$ , $V_{MODE} = 0\text{ V}$<br>$P_{OUT} = +16\text{ dBm}$ , $V_{MODE} = +2.4\text{ V}$                   |
| Quiescent Current ( $I_{cq}$ )                                | -            | 12           | 20           | mA     | $V_{MODE} = +2.4\text{ V}$                                                                                                          |
| Enable Current                                                | -            | 0.2          | 1            | mA     | through $V_{EN}$ pin                                                                                                                |
| Battery Current                                               | -            | 3            | 5            | mA     | through $V_{BATT}$ pin, $V_{MODE} = +2.4\text{ V}$                                                                                  |
| Mode Control Current                                          | -            | 0.3          | 1            | mA     | through $V_{MODE}$ pin, $V_{MODE} = +2.4\text{ V}$                                                                                  |
| Noise in Receive Band                                         | -            | -138         | -135         | dBm/Hz | 2110 MHz to 2170 MHz                                                                                                                |
| Harmonics<br>2fo<br>3fo, 4fo                                  | -<br>-       | -43<br>-50   | -35<br>-35   | dBc    | $P_{OUT} \leq +28.5\text{ dBm}$                                                                                                     |
| Input Impedance                                               | -            | -            | 2:1          | VSWR   |                                                                                                                                     |
| Spurious Output Level<br>(all spurious outputs)               | -            | -            | -70          | dBc    | $P_{OUT} \leq +28.5\text{ dBm}$<br>In-band load VSWR < 5:1<br>Out-of-band load VSWR < 10:1<br>Applies over all operating conditions |
| Load mismatch stress with no permanent degradation or failure | 10:1         | -            | -            | VSWR   | Applies over full operating range                                                                                                   |

Notes:

(1) ACLR and Efficiency measured at 1950 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 WCDMA power amplifier may be placed in a shutdown mode by applying logic low levels (see Operating Ranges table) to both the  $V_{EN}$  and  $V_{MODE}$  voltages.

### Bias Modes

The WCDMA power amplifier may be placed in either a Low Bias mode or a High Bias mode by applying the

appropriate logic level (see Operating Ranges table) to the  $V_{MODE}$  voltage. The Bias Control table lists the recommended modes of operation for various applications.

Two operating modes are recommended to optimize current consumption. High Bias operating mode is for  $P_{OUT}$  levels  $\geq 16$  dBm. At or below +16 dBm, the PA should be "Mode Switched" to Low Bias Mode.

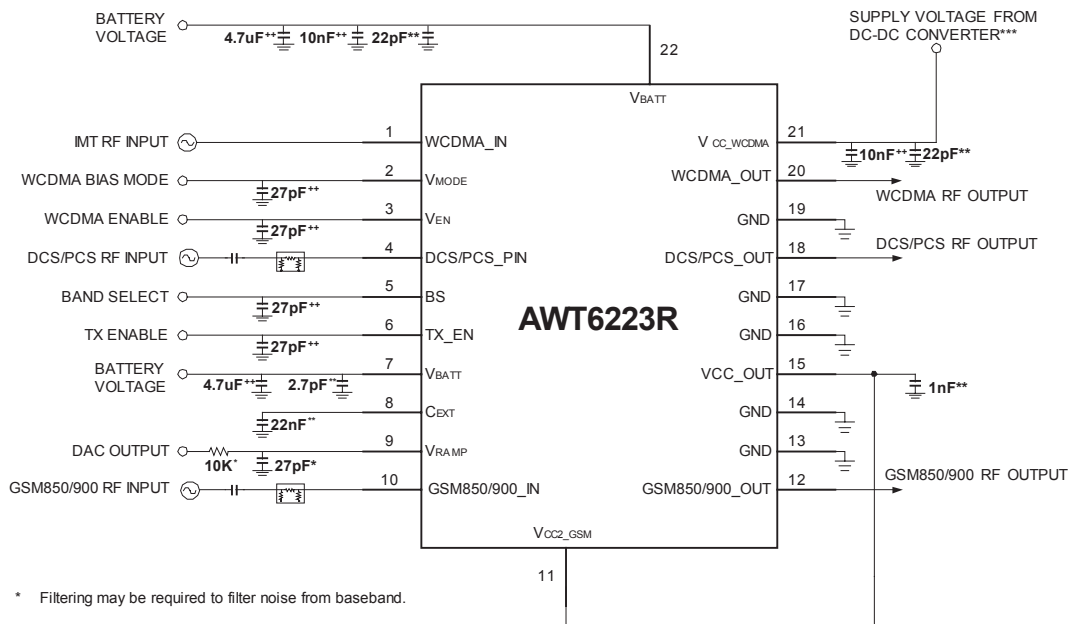
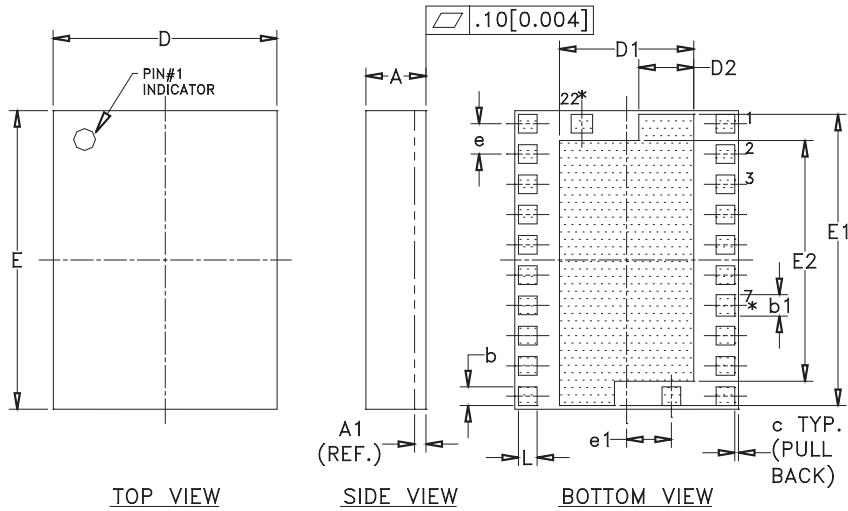


Figure 4: Application Circuit

# AWT6223R

## PACKAGE OUTLINE



|    | MILLIMETERS |      |      | INCHES       |       |       | NOTE |
|----|-------------|------|------|--------------|-------|-------|------|
|    | MIN.        | NOM. | MAX. | MIN.         | NOM.  | MAX.  |      |
| A  | 0.84        | 0.98 | 1.12 | 0.033        | 0.038 | 0.044 | —    |
| A1 | 0.32 (REF.) |      |      | 0.013 (REF.) |       |       | —    |
| b  | 0.47        | —    | 0.53 | 0.019        | —     | 0.021 | 20X  |
| b1 | 0.54        | —    | 0.60 | 0.021        | —     | 0.023 | 2X   |
| c  | —           | 0.10 | —    | —            | 0.004 | —     | —    |
| D  | 5.88        | 6.00 | 6.12 | 0.231        | 0.236 | 0.241 | —    |
| D1 | 3.54        | —    | 3.66 | 0.139        | —     | 0.144 | —    |
| D2 | 1.41        | —    | 1.53 | 0.056        | —     | 0.060 | 2X   |
| E  | 7.88        | 8.00 | 8.12 | 0.310        | 0.315 | 0.320 | —    |
| E1 | 7.74        | —    | 7.86 | 0.305        | —     | 0.309 | —    |
| E2 | 6.39        | —    | 6.51 | 0.252        | —     | 0.256 | —    |
| e  | —           | 0.81 | —    | —            | 0.032 | —     | —    |
| e1 | —           | 1.20 | —    | —            | 0.047 | —     | 2X   |
| L  | 0.47        | —    | 0.53 | 0.019        | —     | 0.021 | —    |

### 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.

**Figure 5: Package Outline - 22 Pin 6 mm x 8 mm x 1 mm Surface Mount Package**



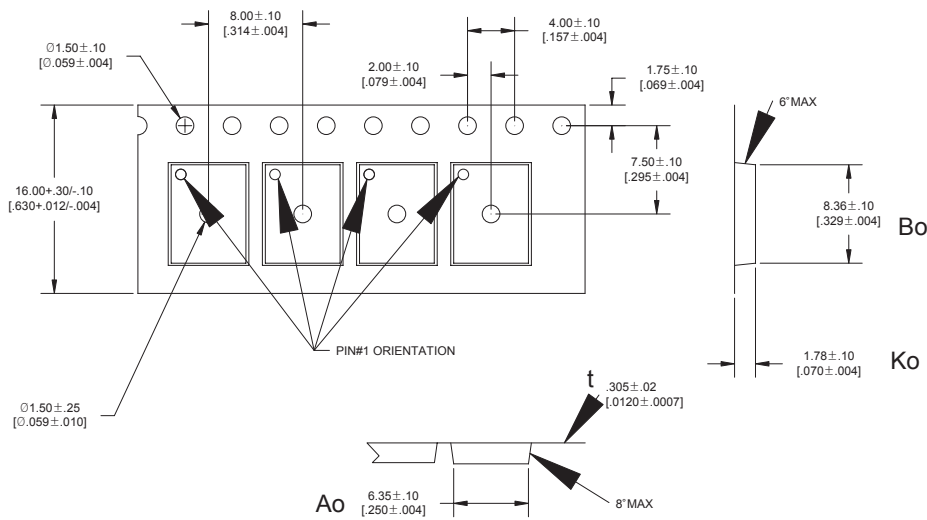
### BRANDING SPECIFICATION

#### NOTES:

1. PIN 1 INDICATOR: LASER MARK
2. ANADIGICS LOGO SIZE: X=0.040±0.010 Y=0.048±0.010
3. JEDEC LEADFREE MARK: 0.040 DIA.
4. TEXT : SIZE : AS LARGE AS POSSIBLE
5. PART # AWT6223R = RoHS COMPLIANT
6. YEAR AND WORK WEEK: YYWW: YY = YEAR, WW = WORK WEEK
7. WAFER LOT NUMBER: LLLLL = WAFER LOT#, SS = WAFER ID:
8. BOM NUMBER: 069
9. COUNTRY CODE: CC = TH -for- THAILAND, TW -for- TAIWAN, PH -for- PHILIPPINES, CH -for- CHINA, ID -for- INDONESIA, HK -for- HONG KONG

**Figure 6: Branding Specification**

COMPONENT PACKAGING



NOTES:

1. MATERIAL: 3000 (CARBON FILLED POLYCARBONATE)  
100% RECYCLABLE.

Figure 7: Tape & Reel Packaging

Table 14: Tape & Reel Dimensions

| PACKAGE TYPE       | TAPE WIDTH | POCKET PITCH | REEL CAPACITY | MAX REEL DIA |
|--------------------|------------|--------------|---------------|--------------|
| 6 mm x 8 mm x 1 mm | 16 mm      | 8 mm         | 2500          | 13"          |

**ORDERING INFORMATION**

| ORDER NUMBER  | TEMPERATURE RANGE | PACKAGE DESCRIPTION                                                 | COMPONENT PACKAGING                 |
|---------------|-------------------|---------------------------------------------------------------------|-------------------------------------|
| AWT6223RM26P8 | -20 °C to +85 °C  | RoHS Compliant 24 Pin<br>6 mm x 8 mm x 1 mm<br>Surface Mount Module | Tape and Reel, 2500 pieces per Reel |
| AWT6223RM26P9 | -20 °C to +85 °C  | RoHS Compliant 24 Pin<br>6 mm x 8 mm x 1 mm<br>Surface Mount Module | Tape and Reel, Partial Reel         |

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