AJAV-5602

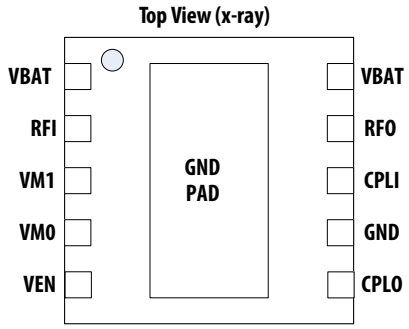
W-CDMA/HSPA Band II Power Amplifier

Data Sheet

Description

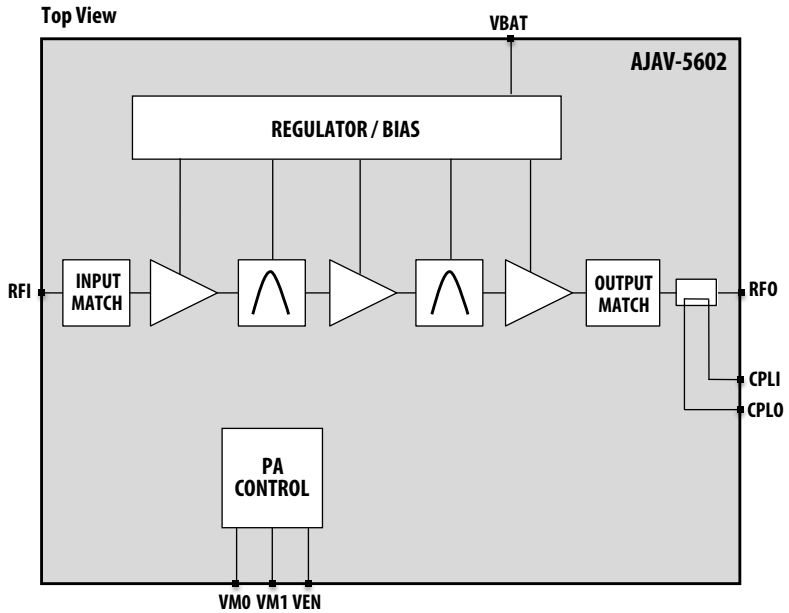
The AJAV-5602 is a complete, high-performance power amplifier for W-CDMA and HSPA wireless communications. Based on a unique, patented architecture, the AJAV-5602 integrates circuitry for TX filtering, RF coupling, power regulation, input and output matching and power control. The PA is powered by a single connection to the battery and is implemented in a standard CMOS process.

Pin Assignments



US Patent # 7,728,661; 7,768,350; 7,872,528; 8,022,766
Other patents pending

Functional Block Diagram



Features

- High-performance 3G power amplifier
  - UMTS Band 2 (1850 – 1910 MHz)
  - W-CDMA, HSPA, and HSPA+ Compliant
- Integrated TX filtering
  - Delivers best noise in the industry
- Integrated directional coupler
- Integrated regulators and PA bias
- Single direct connection to the battery
  - No external switches or isolation inductors
- High linear efficiency
- Low average current
- High capacity CMOS process
- Small 3×3 mm package

Applications

- Smartphones, data cards and 3G modules
- Tablets, netbooks and network PCs
- E-books and wireless electronic readers

Electrical Characteristics

Table 1. Absolute Minimum and Maximum Ratings [1]

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage [2]	V_{BATT}		-0.3	-	4.5	V
Control Voltage [3]	V_{CTRL}	$V_{CTRL} < V_{BATT}$	-0.3	-	4.5	V
RF Input Power [4]			-	-	+10	dBm
Electrostatic Discharge (ESD) [5]		Human Body Model (HBM)	-	-	3.0	kV
Storage Temperature	T_{STG}		-55	-	125	°C

Notes:
1. Permanent device damage may occur if the ratings above are exceeded. Functional operation is not guaranteed under these conditions and should be restricted to the recommended operating conditions in Table 2. Exposure to absolute ratings for extended periods may affect device reliability.
2. Supply voltage is applied to VBAT pin.
3. Control voltages are applied to VEN, VM0, VM1 pins.
4. RF input is applied to RFI, CPLI pins.
5. For all pins.

Table 2. Operating Conditions [1]

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage [2]	V_{BATT}		2.5	3.8	4.2	V
Control Voltage – High [3]	V_{IH}	$V_{IH} < V_{BATT}$	1.3	1.8	V_{BATT}	V
Control Voltage – Low [3]	V_{IL}		0.0	-	0.5	V
Ambient Temperature	T_A		-30	25	90	°C

Notes:
1. To ensure proper operation, the VEN pin should be asserted from V_{IL} to V_{IH} at least 2 µs after power is applied to the VBAT pin.
2. Device remains functional down to V_{BATT} = 2.5 V. At V_{BATT} < 3.4 V, output power is derated by 0.5 dB.
3. Logic states for VEN, VM0, VM1 pins.

Table 3. Mode Control Logic [1]

Mode	Output Power Range [2]	VEN	VM0	VM1
High Power Mode (HP)	16.5 dBm < $P_{OUT} \le P_{MAX}$	High	Low	Low
Mid Power Mode (MP)	6.0 dBm < $P_{OUT} \le$ 16.5 dBm	High	High	Low
Low Power Mode (LP)	$P_{OUT} \le$ 6.0 dBm	High	High	High
Powerdown		Low	X	X

Notes:
1. The VM0 and VM1 pins are controlled externally to achieve maximum PA efficiency. High and low logic states are specified in Table 2.
2. Maximum linear output power, P_{MAX}, is defined in Table 4.

Table 4. Electrical Specifications [1]

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Frequency	F_{RF}		1850	-	1910	MHz
Maximum Linear Output Power [2]	P_{MAX}	HP mode	+26.5	+27.0	-	dBm
		MP mode	+16.0	+16.5	-	dBm
		LP mode	+5.5	+6.0	-	dBm
Gain [2]	G	HP mode	25.0	27.0	-	dB
		MP mode	16.0	18.0	-	dB
		LP mode	6.0	8.0	-	dB
RX Band Gain [2,3]	G_{RX}	RX Band, 80 MHz offset	-	-4	-	dBc
		GPS Band, 1524 – 1577 MHz	-	-32	-	dBc
		ISM Band, 2400 – 2484 MHz	-	-39	-	dBc
Adjacent Channel Leakage Ratio [2,4]	ACLR1	± 5 MHz offset	-	-42	-38	dBc
	ACLR2 [5]	± 10 MHz offset	-	-53	-48	dBc
Noise [14]	N	RX Band, 80 MHz offset	-	-138	-	dBm/Hz
		GPS Band, 1524 – 1577 MHz	-	-159	-	dBm/Hz
		ISM Band, 2400 – 2484 MHz	-	-163	-	dBm/Hz
Error Vector Magnitude [2,4,5]	EVM	$P_{OUT} \leq P_{MAX}$	-	1.5	3.35	%
Power Added Efficiency [2,5,6]	PAE	HP mode	-	40	-	%
		MP mode	-	23	-	%
Quiescent Idle Current	I_{CQ}	LP mode	-	8	10	mA
Average Current [2,5,7]	I_{AVG}	Fixed battery	-	25	-	mA
		Average power tracking	-	18	-	mA
Powerdown Current [4,8]	I_{PD}	VEN = V_{IL}	-	5	10	µA
Logic Current [4,9]	I_{CTRL}		-	7	10	µA
Input Impedance [5]	Z_{IN}		-	1.4:1	2.5:1	VSWR
Reverse Intermodulation [4,5,10]		± 5 MHz offset	-	-	-31	dBc
		± 10 MHz offset	-	-	-41	dBc
Harmonics [2,4,5]	$2F_0$	Second harmonic	-	-	-35	dBc
	$3F_0$, $4F_0$	Third and fourth harmonic	-	-	-35	dBc
Instantaneous Phase Change [4,5,15]		Between power modes	-	5	10	degree
Coupling Factor [11]			-	-21	-	dB
Daisy Chain Insertion Loss [5]	s34	UMTS Band I	-	-0.8	-	dB
		UMTS Band V, VIII	-	-0.5	-	dB
Daisy Chain Return Loss [5,11]	s33, s44	UMTS Band I	-	-25	-	dB
		UMTS Band V, VIII	-	-29	-	dB
Output Power Error [5,12]		Load VSWR = 2.5:1	-1	-	+1	dB
Turn-on Time [13]	T_{ON}		-	12	15	µs
Turn-off Time [5,13]	T_{OFF}		-	8	10	µs
Other Spurious [4,5]		Load VSWR ≤ 5:1	-	-	-70	dBc
Ruggedness [5]		No permanent damage or degradation	-	-	10:1	VSWR

Notes:
1. Specifications at nominal operating conditions VIH = 1.8 V, VEN = 1.8 V, VBAT = 3.8 V, TA = 25 °C, RF ports at 50 Ω, guaranteed over the full range of operating frequency and guaranteed by production test unless indicated otherwise.
2. Specification is guaranteed using W-CDMA modulation RMC (12.2 kbps) in compliance with 3GPP Release 99.
3. RX band gain is specified relative to PA gain at 1880 MHz.
4. Specification is guaranteed over all power modes given in Table 3.
5. Specification is guaranteed by characterization.
6. Power added efficiency (PAE) includes total current consumption through all pins while PA is operating at maximum linear output power.
7. Calculated using three power modes (HP, MP, LP) with handset W-CDMA transmitter power distribution in GSMA DG.09 specification assuming 3 dB of post-PA loss.
8. Total supply current measured when the PA is disabled.
9. Specification applies to each VEN, VM0, and VM1 pin.
10. Interferer is CW at a relative power level of -40 dBc and offset from the W-CDMA modulated carrier.
11. Measured at CPLO pin.
12. Power variation measured at the RFO pin across 8 phase angles while power at CPLO pin is held constant.
13. Specified from the start of the PA enable transition to when the output power is within ±1 dB of final value.
14. Specification is guaranteed by characterization at PMAX.
15. Phase change should be measured at the center channel at each switch point and compensated in the baseband.

Application Information

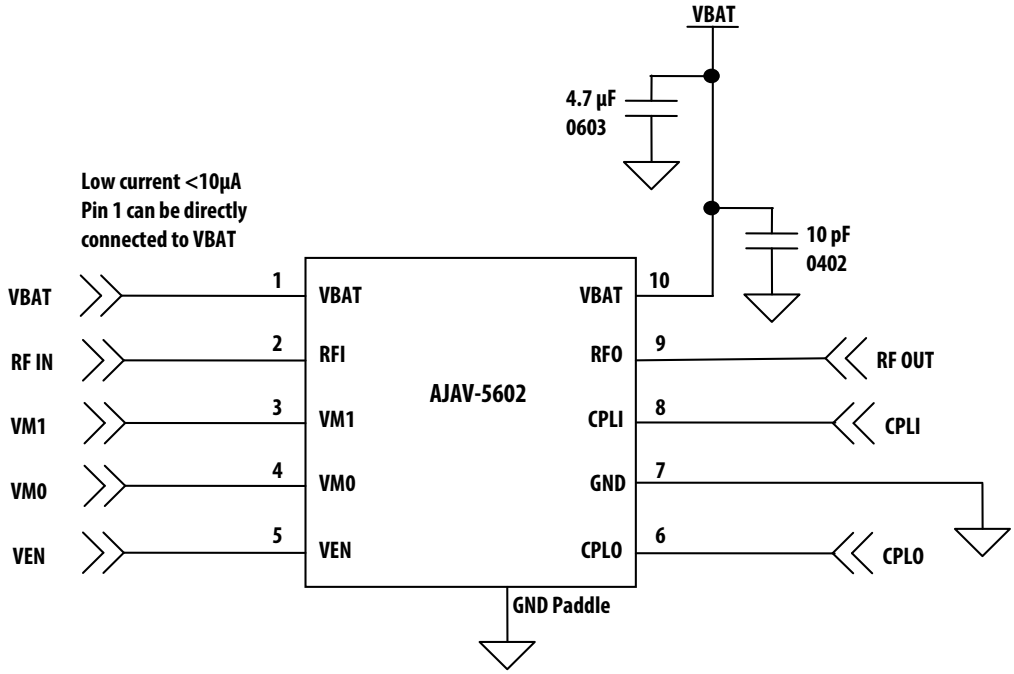


Figure 1. Typical Single-Band Application Circuit

The AJAV-5602 is a complete, high-performance 3G Band 2 power amplifier (PA) implemented in a standard CMOS process. The AJAV-5602 delivers low current and integrates TX filtering that produces the best noise in the industry. Only a single RF bypass capacitor is required, enabling a very low bill-of-materials (BOM). The AJAV-5602 is fully compliant with W-CDMA, HSPA and HSPA+ standards through 3GPP Release 7 and supports power class 3 and 4.

Figure 1 shows the typical application circuit. The AJAV-5602 supports three power modes controlled by a standard CMOS interface enabling a direct connection to the baseband with no level shifters. The VEN, VM0 and VM1 power control pins are high impedance with logic levels defined in Table 2.

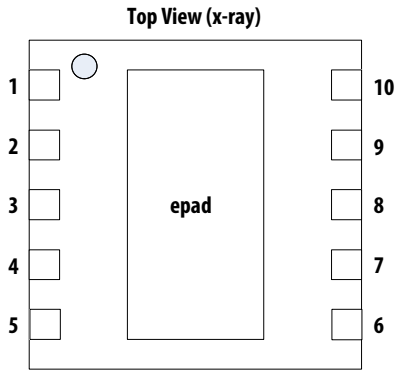
The AJAV-5602 may be powered by a single direct connection to the battery, or controlled with an external DC-DC converter. All power supply current flows through pin 10. Pin 1 is a low current input that can be directly connected to VBAT or any other high level signal. No external switches, isolation inductors, or bypass capacitors are required on Pin 1.

Standard RF practice should be followed for the PCB layout of the RF traces for pins 2, 6, 8, and 9. Multiple vias should be placed underneath the GND paddle to create a low resistance path to ground and to ensure good heat conduction. Refer to Application Note 5565, (AV02-4080EN) *AJAV-5xxx PCB Guidelines*, for additional information.

The AJAV-5602 features an integrated directional coupler that can be daisy chained through the CPLI and CPLO ports. For best performance, at least one port should see a 50 Ω path to GND. The CPLI port accepts an RF input or can be terminated. The CPLO port provides the coupled RF output that can be passed to the RF detector, terminated or passed to the next PA in the daisy chain.

The AJAV-5602 includes integrated TX filtering that ensures excellent receiver sensitivity. As the RF signal passes through the PA, the unwanted out-of-band noise produced by the transceiver is filtered out. Furthermore, the thermal noise at the PA output is greatly reduced below the level of a conventional GaAs PA. The resulting signal at the output of the AJAV-5602 is spectrally very clean, ensuring the best receiver sensitivity and producing minimal interference to other radios in the system.

The AJAV-5602 integrates the RF Front-End Control Interface (RFFE) version 1.1 from the MIPI Alliance. This optional interface is available for advanced features including power control. For additional information on using the MIPI interface, please contact your Avago support.



Pin #	Name	Description
1	VBAT	DC Supply Voltage
2	RFI	RF Input
3	VM1	Mode Control
4	VM0	Mode Control
5	VEN	PA Enable
6	CPLO	Coupler Output
7	GND	Ground
8	CPLI	Coupler Input
9	RFO	RF Output
10	VBAT	DC Supply Voltage
epad	GND	Ground

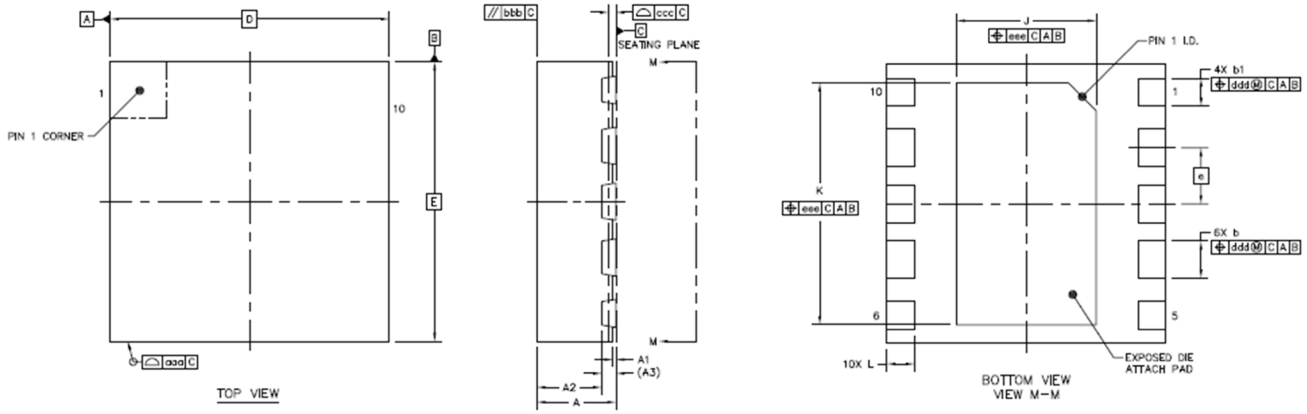
Figure 2. Pin Descriptions

TOP BRAND

Pin 1 indicator: **Laser dot**
Manufacturing part number: **J5602**
Trace code: **YWWXX**
Y - Year
WW - Work week
XX - Lot number
Manufacturing information: **RFAT**

Figure 3. Package Marking

DFN Package Information



		Symbol	Min.	Nom.	Max.
Total Thickness		A	0.8	0.85	0.9
Stand Off		A1	0	0.035	0.05
Mold Thickness		A2	-	0.7	-
L/F Thickness		A3		0.152 REF	
Lead Width		b	0.35	0.4	0.45
Lead Width		b1	0.25	0.3	0.35
Body Size	X	D		3 BSC	
	Y	E		3 BSC	
Lead Pitch		e		0.6 BSC	
EP Size	X	J	1.4	1.5	1.6
	Y	K	2.5	2.6	2.7
Lead Length		L	0.25	0.3	0.35
Package Edge Tolerance		aaa		0.1	
Mold Flatness		bbb		0.1	
Coplanatary		ccc		0.08	
Lead Offset		ddd		0.1	
Exposed Pad Offset		eee		0.1	

(dimensions in mm)

Figure 5. DFN Package Information

Ordering Guide

Part Number	Description	Package Type	Operating Temperature	Quantity	Container
AJAV-5602-BLK	W-CDMA/HSPA Band II Power Amplifier	3×3 DFN	-30 to 90 °C	100	Antistatic bag
AJAV-5602-TR1				5000	Tape & Reel

Note: Shipping method is tape and reel, quantity 5000 pieces per reel.

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

AV02-4068EN - May 16, 2013