3.5 W High Efficiency Power Amplifier GSM 880 - 915 MHz

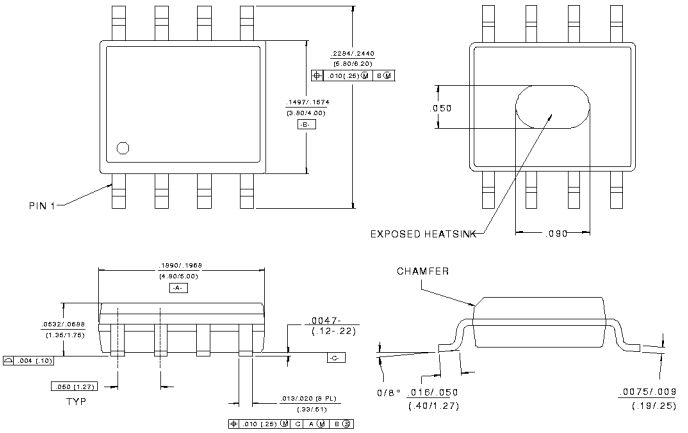
AM52-0002

V1.00

Features

- SOIC-8 Thermally Efficient Plastic Package
- +35.5 dBm Typical Power Out With 5.8 V Drain Voltage
- +34.5 dBm Typical Power Out With 4.8 V Drain Voltage
- +33.0 dBm Typical Power Out With 3.6 V Drain Voltage
- Greater than 50% Typical Power Added Efficiency,
- 26 dB Typical Power Gain
- Flexible External Output Matching
- Occupies very small PCB footprint

SOIC-8P



Description

M/A-COM's AM52-0002 is a GaAs MMIC power amplifier in a thermally efficient low cost SOIC-8 plastic package. The AM52-0002 is designed for high efficiency pulsed output power and high associated gain in the GSM 880-915 MHz frequency band. The AM52-0002 is unconditionally stable in both small and large signal operation. It features flexible biasing for improved dynamic range and off-chip matching for improved efficiency and flexibility. The AM52-0002 is specifically designed for high efficiency final output power amplification in the GSM class 4 handset but can be used in numerous 900 MHz applications.

M/A-COM's AM52-0002 is fabricated using a mature 0.5 micron gate length GaAs MESFET power process. The process features full passivation for increased performance and reliability. The AM52-0002 can be used with standard automated SMT assembly equipment (See M/A-COM application note M558).

Ordering Information

Part Number	Package
AM52-0002	SOIC-8 Lead Plastic
AM52-0002TR	Forward Tape and Reel *
AM52-0002SMB	Designer's Kit

* If specific reel size is required, consult factory for part number assignment.

Electrical Specifications: $V_{D1} = V_{D2} = V_{DD}$, T_A = +25°C, Freq. = 880-915 MHz, $V_G = V_{G2} = V_{G1}$ adjusted for 1.12 A_{DDQ}

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Output Power: V_{DD} = 5.8 V	Pin = 10 dBm	dBm		35.5	
V_{DD} = 4.8 V	Pulsed mode:			34.5	
V_{DD} = 3.6 V	Duty Cycle = 12.5%			33	
PAE: V_{DD} = 5.8 V	Pulse width = 570us	%		50	
V_{DD} = 4.8 V				50	
V_{DD} = 3.6 V				55	
Power Gain, V_{DD} = 5.8 V		dB		26	
Second Harmonic		dBc		-35	
Third Harmonic		dBc		-45	
Stability[1]		VSWR			7:1
Load Mismatch[2]		VSWR			10:1
Avg. Gate Current		mA			2
Adjustable Power Control (APC)	V_{GG} = -3.5→ 0V	dB		30	

1. Parasitic Oscillation defined as any spurious output less than 60 dBc with respect to desired signal level. Measured with nominal Pin and an output VSWR of 7:1 any phase, Vdd = 3.6 - 5.8 V.
2. No permanent degradation with nominal Pin and an output VSWR of 10:1 at any phase (360 rotation in 10 sec.) with V_{DD} up to 10V. .

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Absolute Maximum Ratings[1]

Parameter	Absolute Maximum
Input Power[2]	+23 dBm
Operating Voltage[2]	V_{DD} = + 10 Volts
	V_{GG} = - 6 Volts
Junction Temperature[3]	+150 °C
Storage Temperature	-65 °C to +150 °C
Operating Temperature	-40 °C to +85 °C

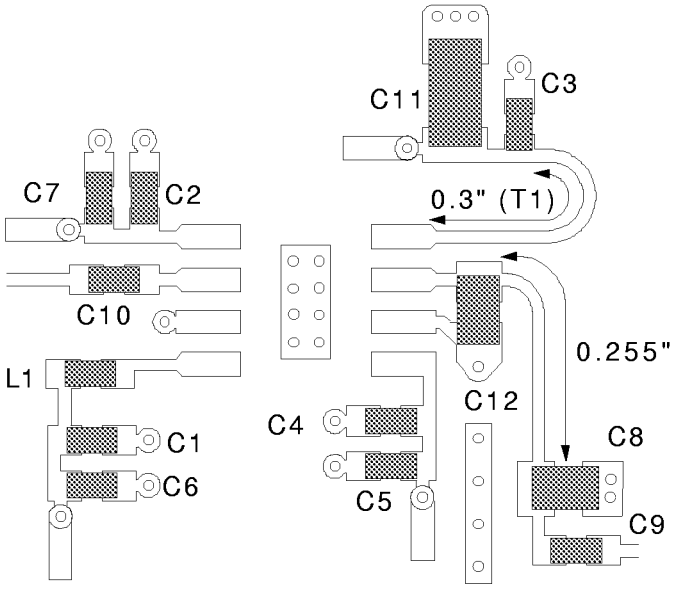
1. Exceeding any one or combination of these limits may cause permanent damage.
2. Ambient Temperature (T_A) = + 25°C
3. See temperature derating curve.

Pin Configuration

Pin No.	Pin Name	Description
1	V_{G1}	Negative supply voltage, First stage
2	RF IN	RF Input of the amplifier
3	GND	DC and RF Ground
4	V_{D1}	Positive supply voltage, First stage
5	V_{G2}	Negative supply voltage, First stage
6	GND	DC and RF Ground
7	RF OUT	RF Output of the amplifier
8	V_{D2}	Positive supply voltage, Second stage
9	PUCK	DC and RF Ground

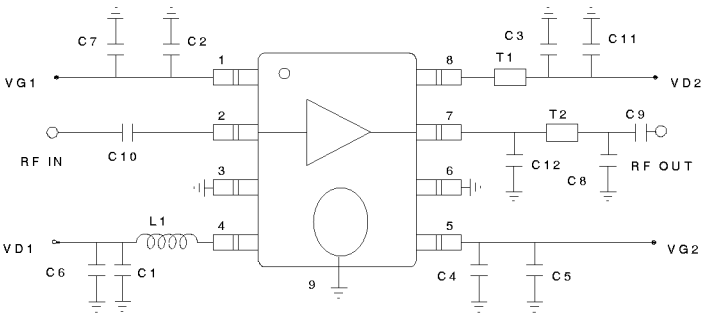
Recommended PCB Configuration

Layout View (GSM 880-915 MHz)



Functional Block Diagram

(GSM 880-915 MHz)



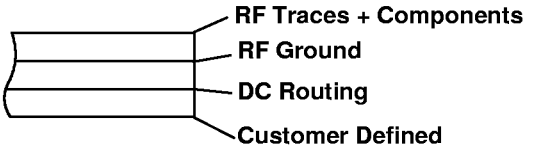
External Circuitry Parts List

(GSM 880-915 MHz)

Part	Value	Purpose
C1 - C2	220 pF	By-Pass
C3	220 pF	Power Tuning
C4 - C7	0.1 uF	By-Pass
C8	4 pF	Power Tuning
C9, C10	47 pF	DC Block
C12	12 pF	Power Tuning
C11	1.5 uF	By-Pass
L1	8.2nH	Bias Inductor
T1	0.300"	Matching Transmission
T2	0.255"	Lines (50 Ω)

1. The recommended layout is specifically for the GSM application. It shows EIA code size 0603 and 0805 standard SMT capacitors with the exception of C11 which is a EIA code size 3528
2. The location of C9, C10 and C11 is not critical to the performance of the amplifier.

Cross Section View



The PCB dielectric between RF traces and RF ground layers should be chosen to reduce RF discontinuities between 50 Ω lines and package pins. M/A-COM recommends an FR-4 dielectric thickness of 0.008"(0.2 mm) yielding a 50 Ω line width of 0.015"(0.38 mm). The recommended metalization thickness is 1 oz. copper and ground metalization thickness is 2 oz.. Shaded traces are vias to DC Routing layer and traces on DC Routing layer.

Biasing Procedure

The AM52-0002 requires that V_{GG} bias be applied prior to **ANY** V_{DD} bias. Permanent damage will occur if this procedure is not followed. All FETs in the PA will draw IDSS and damage internal circuitry. Resistance added in series with V_{G1} and V_{G2} may degrade performance.

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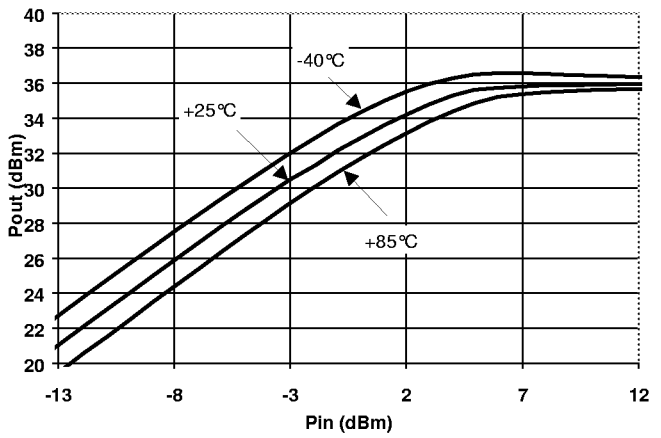
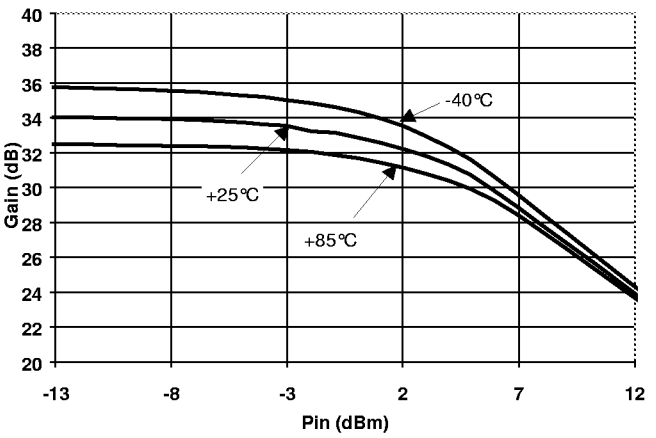
Typical Power Data (GSM 880 - 915 MHz, V_{DD} = V_{D1} = V_{D2} = 5.8V)

Test Conditions (unless otherwise noted) : Pin = 10 dBm, Freq. = 900 MHz$_{GG}$ V_{G1} = V_{G2} adjusted for 1.12 A total quiescent drain current. External output matching circuitry is optimized for the 880 - 915 MHz GSM application. Pulsed mode: Duty cycle= 12.5%, Pulse width = 570us.

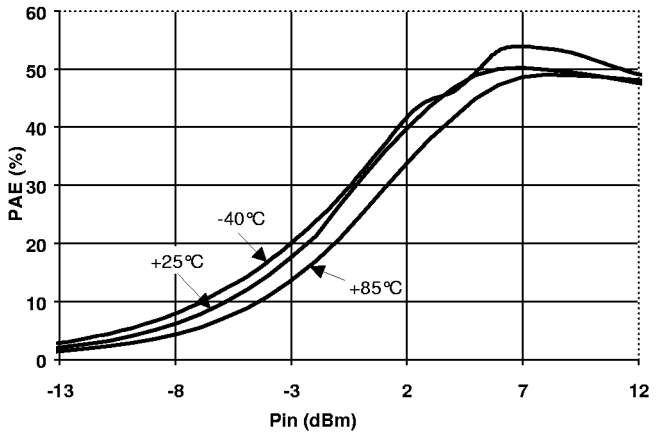
OUTPUT POWER VSINPUT POWER



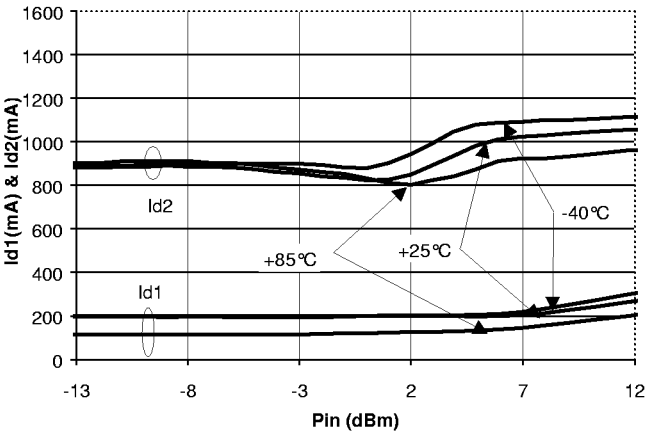
GAIN VS. INPUT POWER



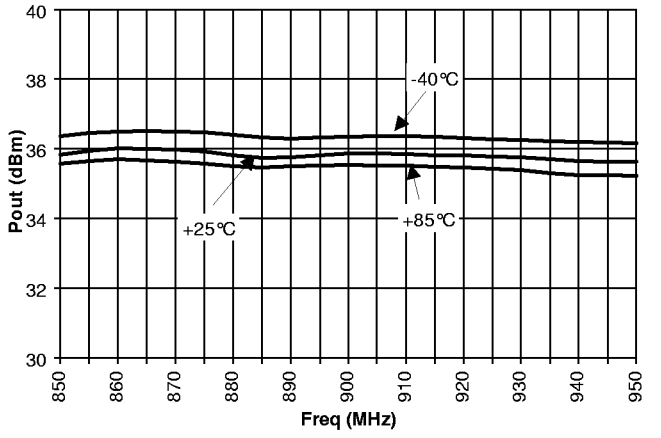
PAE VS. INPUT POWER



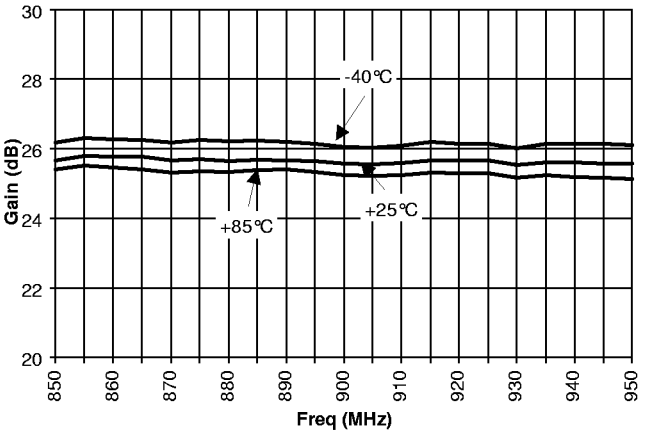
DRAIN CURRENT VS. INPUT POWER



OUTPUT POWER VS. FREQUENCY

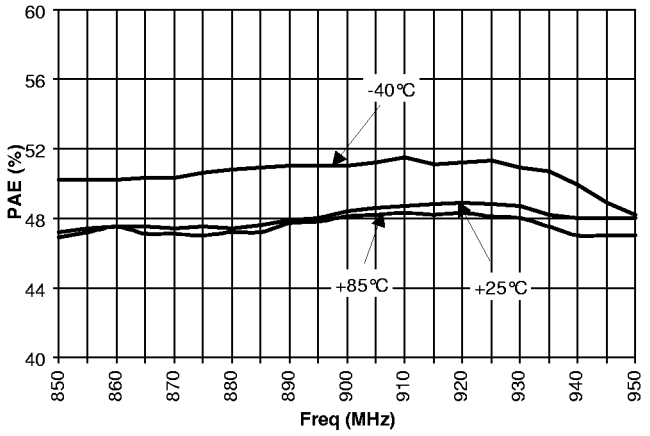


GAIN VS. FREQUENCY

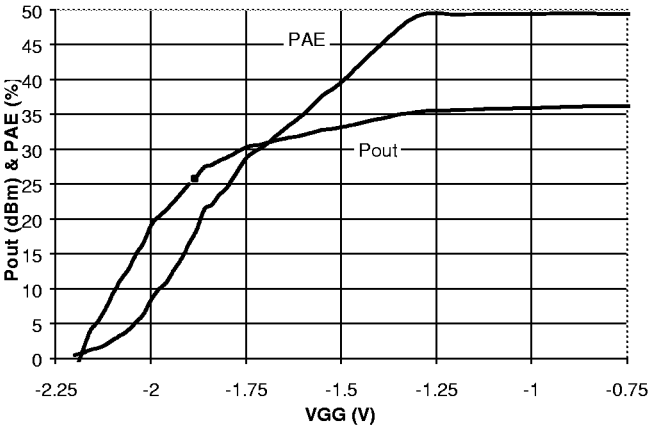


Typical Power Data (cont'd)

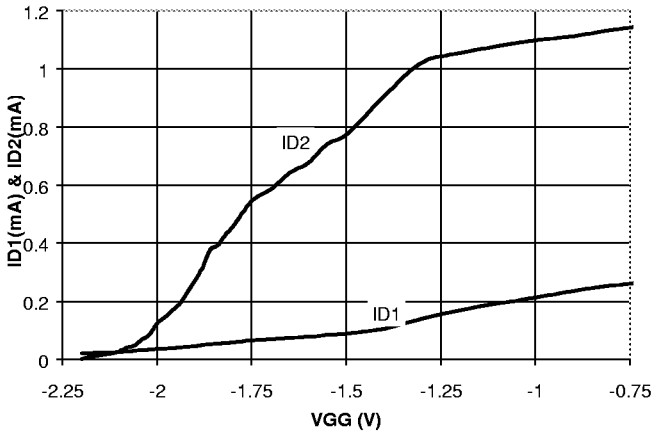
PAE VS. FREQUENCY



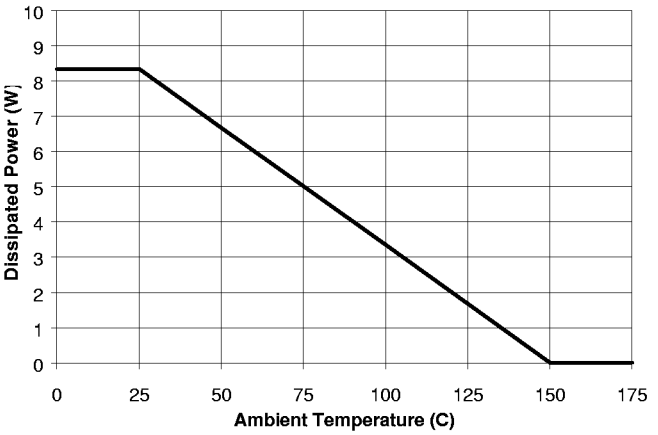
POUT, PAE VS. V_{GG}



DRAIN CURRENT VS. V_{GG}



TEMPERATURE DERATING CURVE



TEMPERATURE DERATING CURVE

Note: Dissipated power in the above curve refers to power dissipated in output FET and is defined as (Pdiss=Vdd*Id2-Pout). Typical Thermal Resistance θjc) = 15°C/W.

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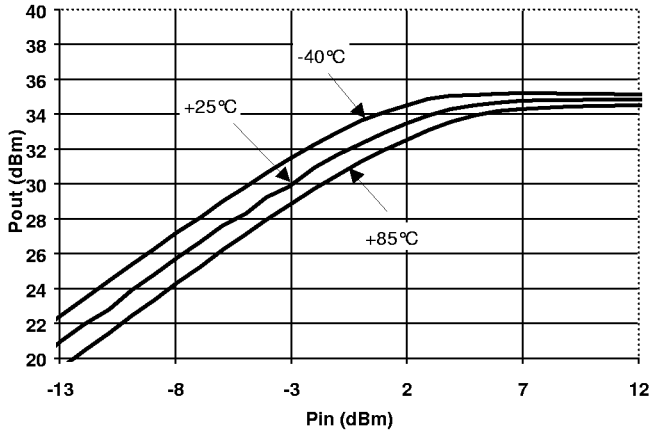
Typical Power Data (GSM 880 - 915 MHz, V_{DD} = V_{D1} = V_{D2} = 4.8V)

Test Conditions (unless otherwise noted) : Pin = 10 dBm, Freq. = 900 MHz$_{GG}$ V_{G1} = V_{G2} adjusted for 1.12 A total quiescent drain current. External output matching circuitry is optimized for the 880 - 915 MHz GSM application. Pulsed mode: Duty cycle= 12.5%, Pulse width = 570us.

OUTPUT POWER VS. INPUT POWER



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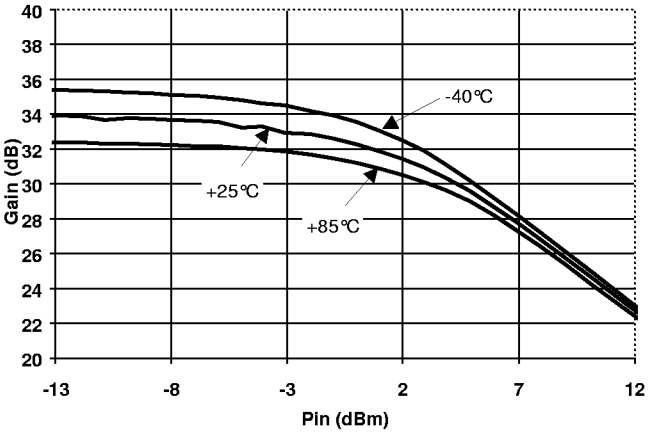

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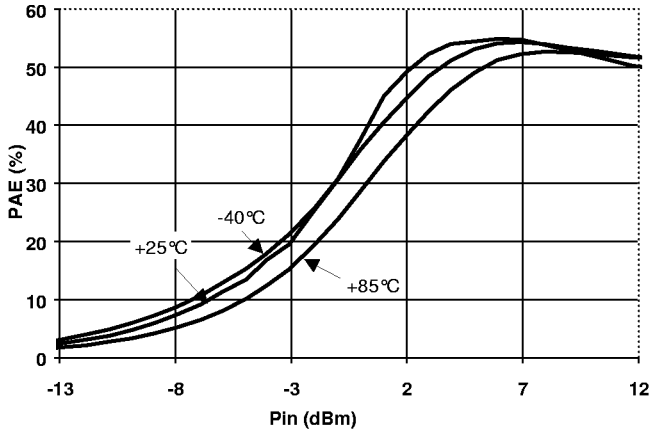
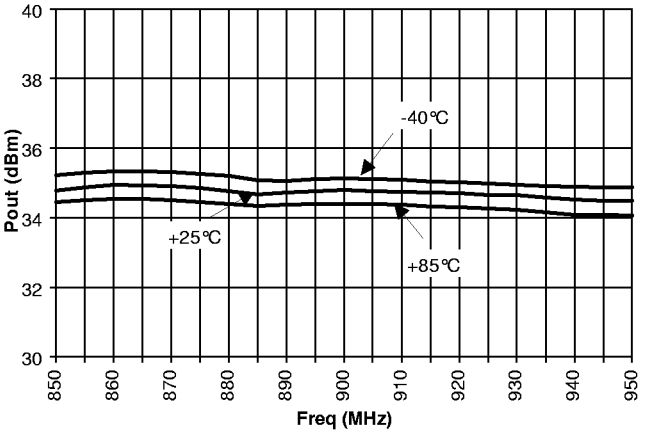


OUTPUT POWER VS. FREQUENCY



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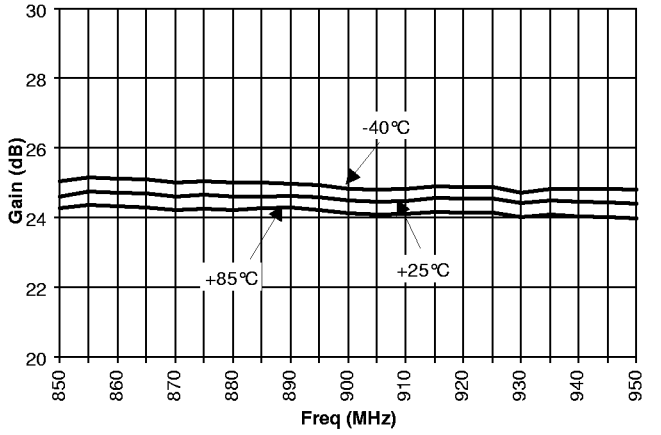

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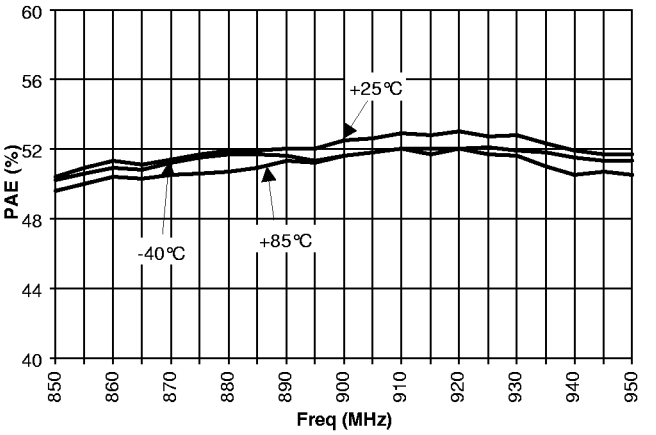

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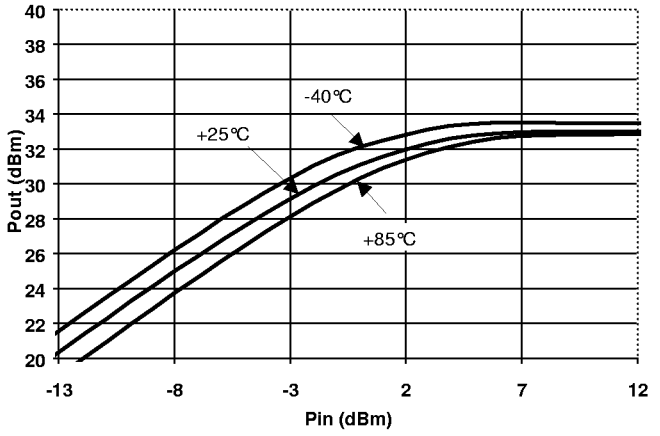
Typical Power Data (GSM 880 - 915 MHz, $V_{DD} = V_{D1} = V_{D2} = 3.6V$)

Test Conditions (unless otherwise noted) : Pin = 10 dBm, Freq. = 900 MHz, $V_{GG} = V_{G1} = V_{G2}$ adjusted for 1.12 A total quiescent drain current. External output matching circuitry is optimized for the 880 - 915 MHz GSM application. Pulsed mode: Duty cycle= 12.5%, Pulse width = 570us.

OUTPUT POWER VS. INPUT POWER



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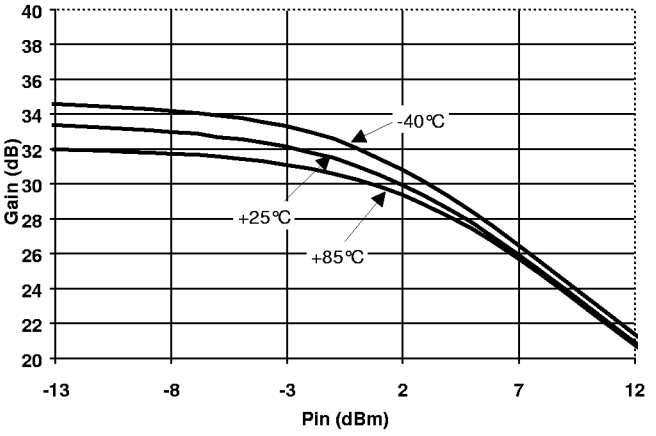
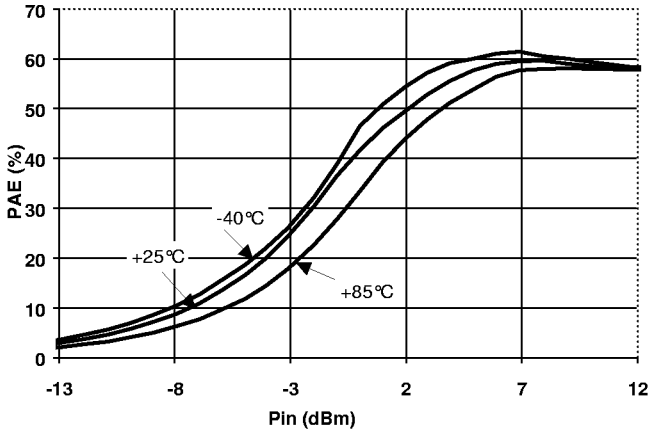


PAE VS. INPUT POWER



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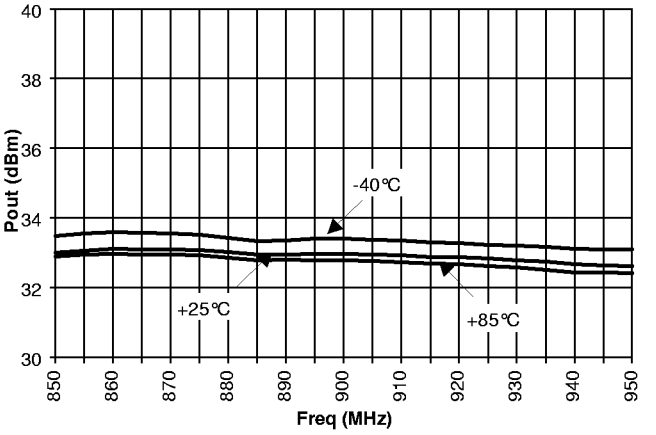

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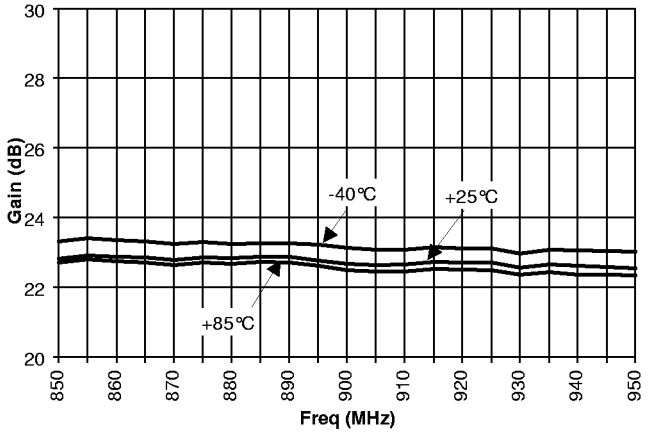
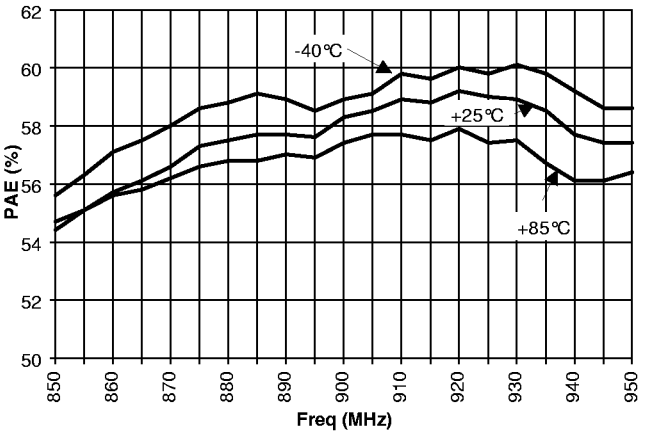


PAE VS. FREQUENCY



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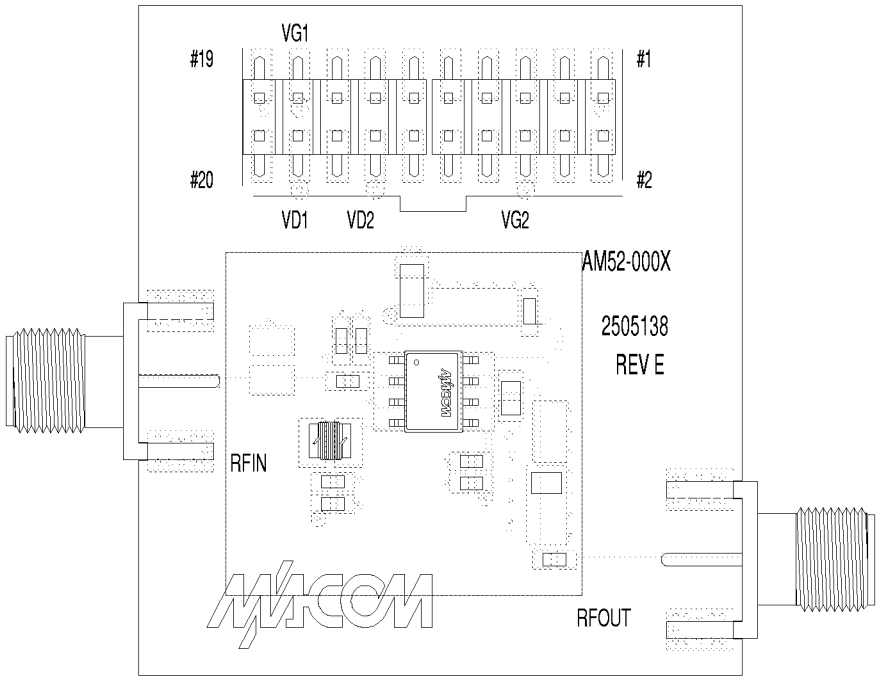
Designer's Kit AM52-0002SMB

The AM52-0002SMB Designer's Kit allows for immediate evaluation of M/A-COM's AM52-0002. The evaluation board consists of an AM52-0002, recommended external surface mount circuitry, RF connectors, and a DC multi-pin connector, all mounted to a multi-layer FR-4 PCB. Other items included in the Designer's Kit, a floppy disk (with typical performance data and a DXF file of the recommended PCB layout) and any additional Application Notes. The AM52-0002SMB evaluation PCB is illustrated below with all functional ports labeled.



AMPLIFIER PCB

DC Connector Pinout

PCB DC Connector	Function	Device Pin Number	PCB DC Connector	Function	Device Pin Number
1	GND	6 & Puck	11		
2			12		
3			13		
4			14	V_{D2}	8
5			15		
6	V_{G2}	5	16		
7			17	V_{G1}	1
8			18	V_{D1}	4
9			19	GND	6 & Puck
10			20		

Designer's Kit Biasing Procedure

In order to prevent transients which may damage the MMIC, please adhere to the following procedure.

- Turn on all power supplies and set all voltages to 0 volts BEFORE connecting the power supplies to the DC connector.
- Apply a -5.0 volt supply to DC connector pin 17 (V_{G1}) and pin 6 (V_{G2}).
- Apply a +5.8 volt supply to the DC connector pin 18 (V_{D1}) and pin 14 (V_{D2})
- Adjust all V_{GG} supplies to -5 volts
- Adjust all V_{DD} supplies to +5.8 volts
- Adjust $V_{GG} = V_{G1} = V_{G2}$ supply for desired V_{DD} quiescent current (typically 1.120 A)
- To power off, reverse above procedure

1) Set V_{D1} & V_{D2} to 0 volts
2) Set V_{G1} & V_{G2} to 0 volts
3) Disconnect bias lines from DC connector
4) Turn off power supplies

Evaluation PCB + RF Connector Losses

Port Reference	Loss (dB)
PA IN	0.1
PA OUT	0.1

The DC connector on the Designer's Kit PCB allows convenient DC line access. This is accomplished by one or more of the following methods:

1. A mating female multi-pin connector (Newark Electronics Stock # 46F-4658, not included)
2. Wires soldered to the necessary pins (not included)
3. Clip leads (not included)
4. A combination of clip leads or wires and jumpers (jumpers included as required).

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