MAIA-007851-000100

Transmit Module for RFID
850-960 MHz

Rev. V1

Features

- Fully Integrated Buffer Amplifiers, Mixer, Power Amplifier
- 0 to +7 dBm LO Drive
- +3.6V Nominal Supply Voltage
- +32.5 dBm Typical Output Power
- PA Matching Included in Device
- Lead-Free PQFN Package
- 100% Matte Tin Plating over Copper
- Halogen-Free “Green” Mold Compound
- 260°C Reflow Compatible
- RoHS Compliant

Description

M/A-COM's MAIA-007851 is a 850-960 MHz, high efficiency, low cost transmit module designed for RFID applications. This module includes buffer amplifiers, a passive mixer, and a high efficiency power amplifier, encapsulated in a low cost, miniature surface mount PQFN 6 mm square, 28 lead plastic package. The dies utilize M/A-COM’s unique HMIC silicon/glass and GaAs processes. The product performance maximizes the advantages provided by these processes with the realization of low loss passive elements and efficient diode technology which in turn provides excellent harmonic suppression and output noise performance. In addition, this module includes matching networks to achieve 50 ohm input and output impedances, therefore no external RF matching is required.

Applications

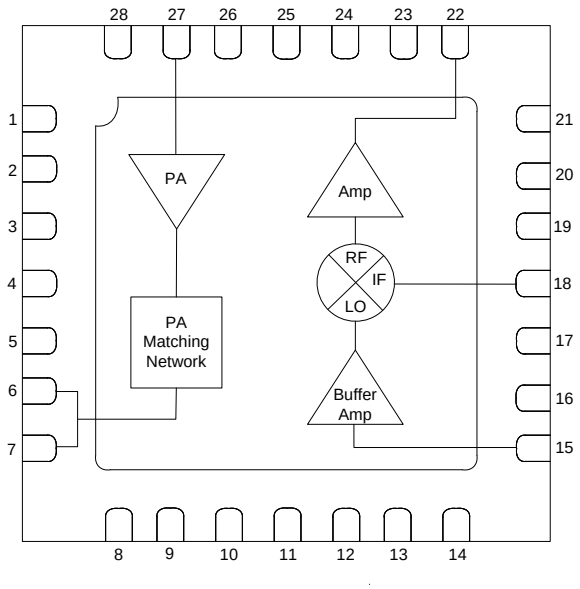
This transmit module is specifically targeted for the RFID market in the United States, European, and Japanese bands. This transmit module can also be used for other applications in the 850-960 MHz frequency range.

Ordering Information

Part Number	Package
MAIA-007851-000100	Bulk Packaging
MAIA-007851-0001TR	1000 piece reel
MAIA-007851-0001TB	Sample Test Board

Note: Reference Application Note M513 for reel size information.

Functional Block Diagram



Pin Configuration

Pin No.	Function	Pin No.	Function
1	VDD3 (VCC1)	15	LO_IN
2	VDD3 (VCS)	16	GND
3	N/C	17	GND
4	GND	18	IF_IN
5	VDD3 (VCC2)	19	GND
6	PA OUT	20	VDD2
7	PA OUT	21	GND
8	GND	22	RF_OUT
9	GND	23	GND
10	VDD3 (VCC3)	24	GND
11	VDD3 (VCC3)	25	GND
12	GND	26	VCTRL
13	VDD1	27	RF_IN
14	GND	28	GND

The exposed pad centered on the package bottom must be connected to RF and DC ground. (For PQFN Packages)

Pin 3 is an internal tie point and must not be connected to any external circuitry.

* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

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Electrical Specifications: T_A = 25°C, Z_0 = 50 Ω

Unless otherwise noted: LO_IN= +5 dBm, IF_IN= 10 mA DC, VDD1=VDD2=VDD3= +3.6V, VCTRL=2.6 V

Parameter	Test Conditions	Units	Min	Typ	Max
Frequency	-	MHz	850	-	960
PA Output Power (Saturated)	-	dBm	-	32.5	-
Power Added Efficiency	PA only	%	-	40	-
2nd Harmonic (PA Output)	-	dBc	-	-36	-27
3rd Harmonic (PA Output)	-	dBc	-	-60	-
VCTRL	-	V	0.0	-	3.3
ICTRL	-	mA	-	4.0	10.0
RF_OUT Power	Measured on Sample Board—includes 6 dB pad	dBm	-	6.0	-
PA Output VSWR	-	Ratio	--	1.9:1	--
PA Input VSWR	-	Ratio	-	2.6:1	-
LO Port VSWR	-	Ratio	--	2.0:1	--
LO_IN Power	-	dBm	0	-	7
IF 1 dB Bandwidth	IF Port is DC coupled	MHz	25	-	-
VDD1 VDD2 VDD3	- - -	Volts Volts Volts	3.3 3.3 3.3	3.6 3.6 3.6	3.9 3.9 3.9
IDD1 IDD2 IDD3	VDD1 = +3.3V (Min), +3.6V (Typ), +3.9V (Max) VDD2 = +3.3V (Min), +3.6V (Typ), +3.9V (Max) VDD3 = +3.3V (Min), +3.6V (Typ), +3.9V (Max)	mA mA mA	- - -	60 30 1200	- - -

Absolute Maximum Ratings [1,2]

Parameter	Absolute Maximum
VDD1, VDD2, VDD3	-0.5V to +5.0V
VCTRL	-0.5V to +3.8V
Incident Power – IF_IN	+20 dBm
Incident Power – LO_IN	+15 dBm
Incident Power – RF_IN	+8 dBm
Operating Temperature	-30°C to +70°C
Storage Temperature	-40°C to +125°C

1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. M/A-COM does not recommend sustained operation near these survivability limits.

Handling Procedures

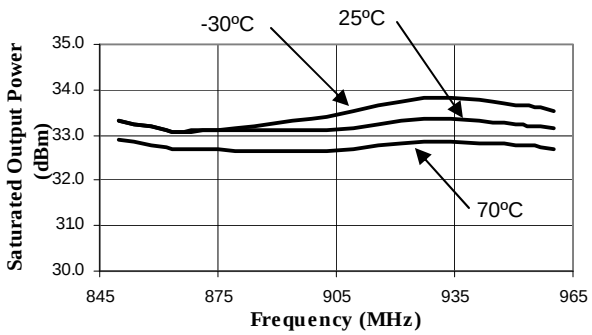
Please observe the following precautions to avoid damage:

Static Sensitivity

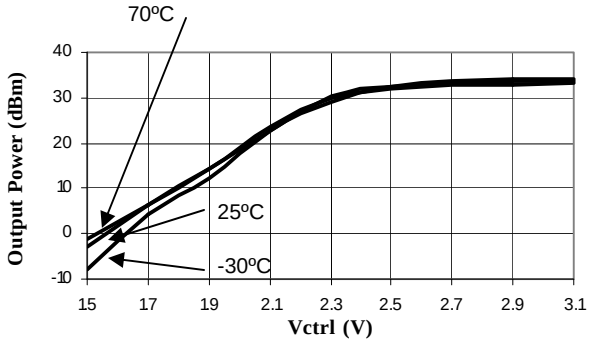
Gallium Arsenide and Silicon Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Typical Performance Curves

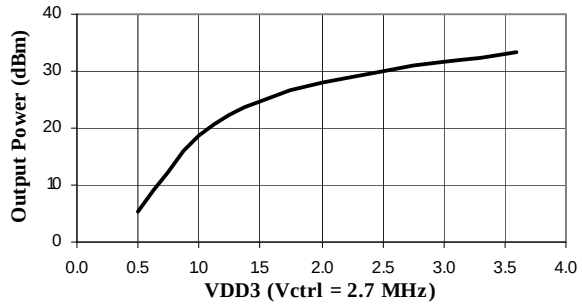
Saturated Output Power vs. Frequency: Power Amplifier Side—pulsed (dBm)



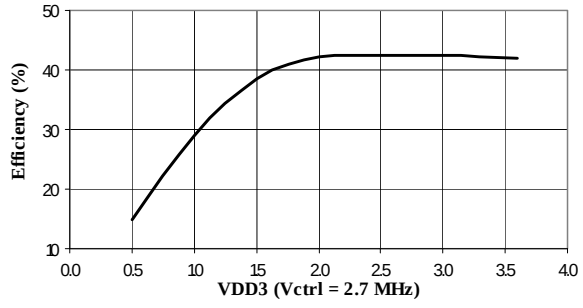
Output Power vs. Vctrl @ F=915MHz



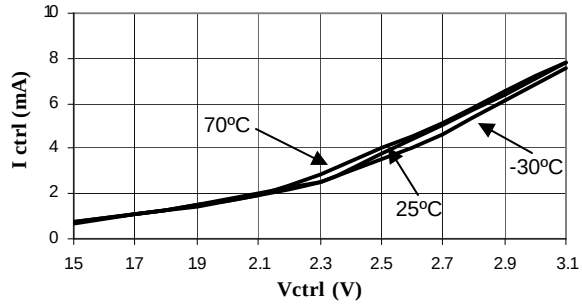
Output Power vs. VDD3 @ F=915 MHz Vctrl = 2.7V



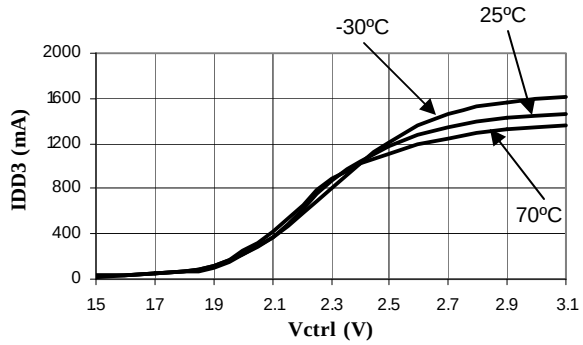
Efficiency vs. VDD3 @ F=915 MHz Vctrl = 2.7V



Ictrl vs. Vctrl @ F=915MHz



IDD3 vs. Vctrl @ F=915MHz



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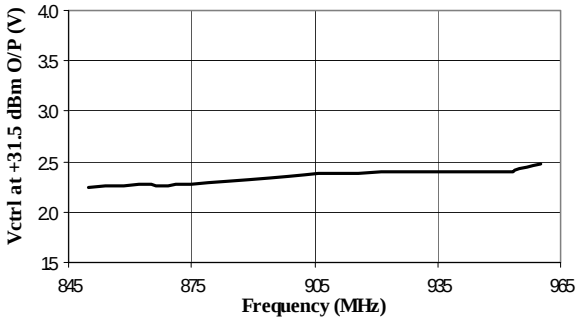
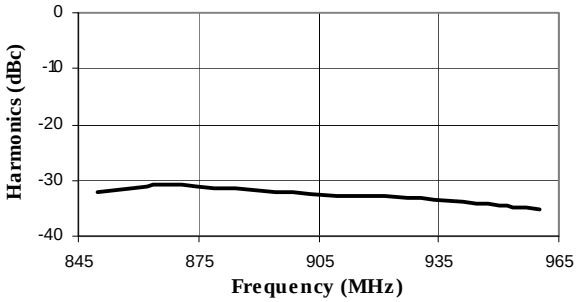
Typical Performance Curves

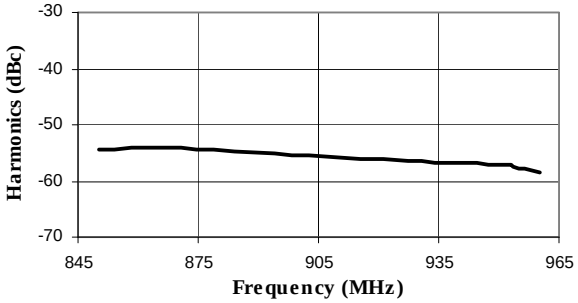
Vctrl at +31.5 (+/- 0.2 dBm) output power



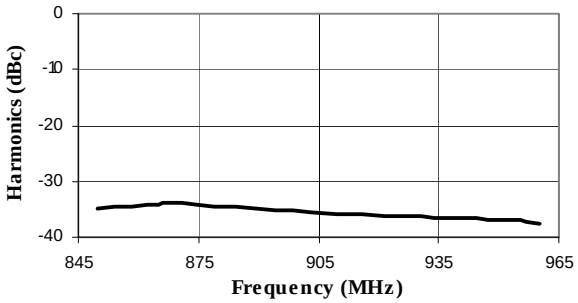
2nd Harmonics vs. Frequency:
Power Amplifier Side (dBc), Pout = +31.5 dBm



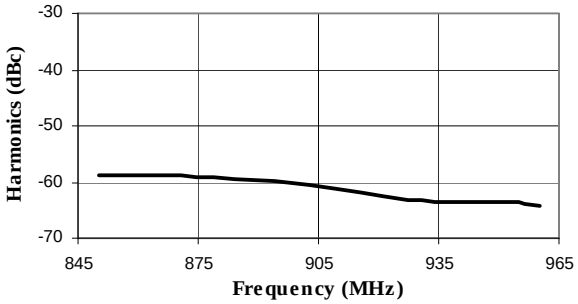
3rd Harmonics vs. Frequency:
Power Amplifier Side (dBc), Pout = +31.5 dBm



2nd Harmonics vs. Frequency:
Power Amplifier Side (dBc), Pout = +32.5 dBm

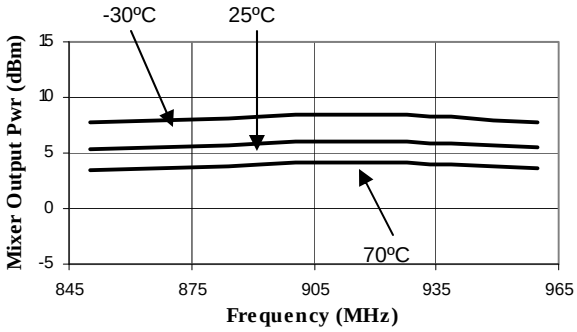


3rd Harmonics vs. Frequency:
Power Amplifier Side (dBc), Pout = +32.5 dBm

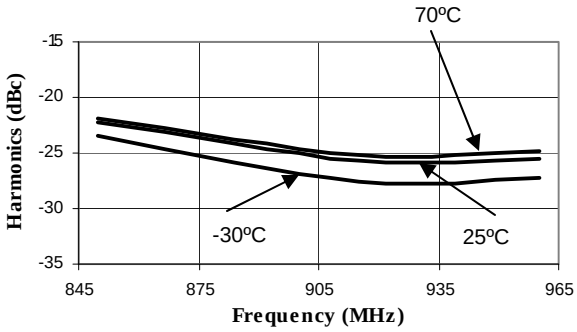


Typical Performance Curves

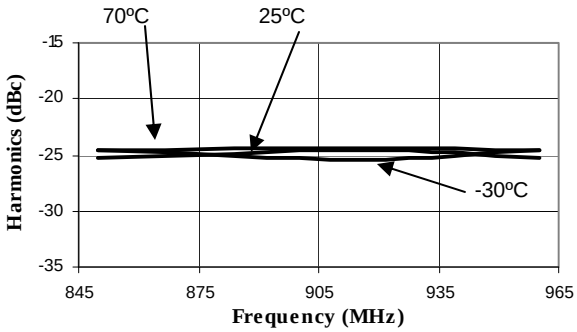
Output Power vs. Frequency:
Mixer Side (dBm); LO = +5 dBm, IF_IN = 10 mA DC
Measured on Sample Board. Includes 6 dB pad.



2nd Harmonics vs. Frequency:
Mixer Side (dBc)



3rd Harmonics vs. Frequency:
Mixer Side (dBc)



Applications

OOK Modulation

A common form of modulation used in RFID is On-Off Keying (OOK), also known as 2-level ASK. One level is the desired maximum power output, typically 1 Watt. The second level is usually the carrier-off level, the minimum that can be produced. For applications where 1 Watt output is desired, OOK modulation is easily produced by applying the modulation signal to the VCTRL pin as shown in figure 1. To control the radiated RF spectrum, simple R-C shaping is applied to the modulation signal.

To maintain high efficiency in applications requiring less than 1 Watt output, the circuit shown in figure 2 is recommended. This configuration allows the PA stage to operate in compression, increasing the efficiency. VCTRL is kept fixed at +2.7 volts, while VDD3 is adjusted to produce the desired RF power output. As in figure 1, the shaped modulation signal is applied to the VCTRL pin.

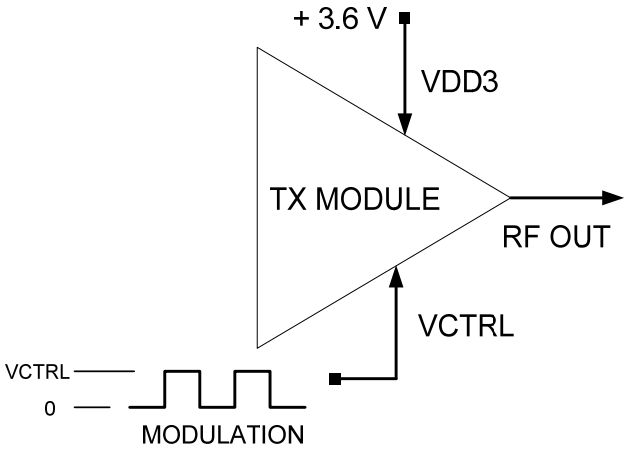


Figure 1. OOK modulation at 1 Watt RF Output.

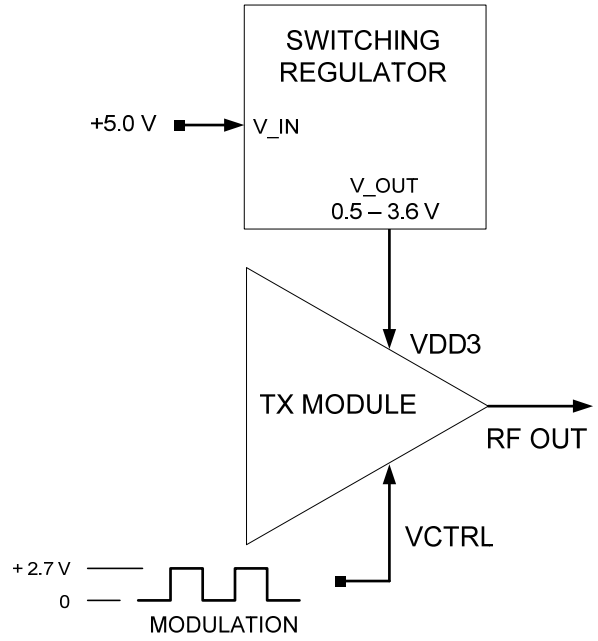
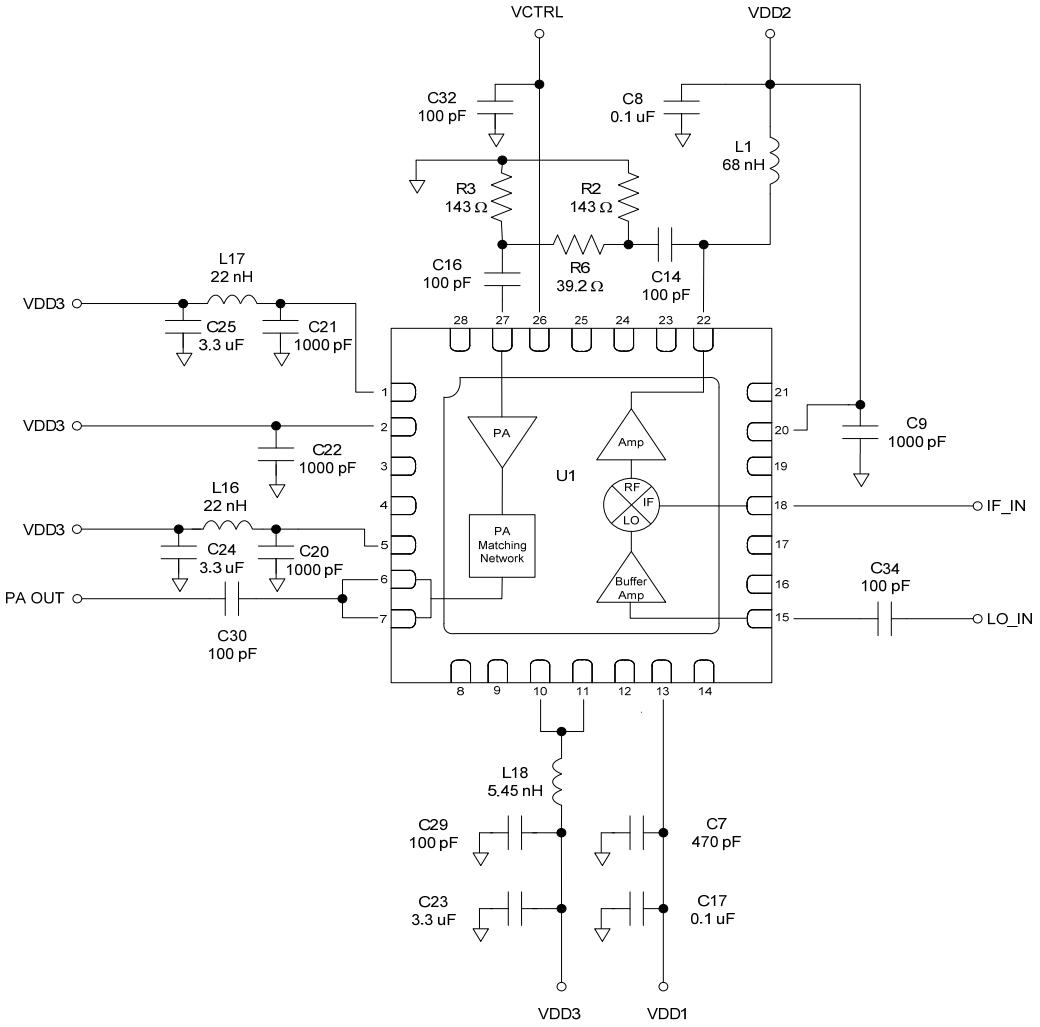


Figure 2. OOK modulation at <1 Watt RF Output.

Schematic with Off-Chip Components



Qty	Part Number	Description	Designator
1	MAIA-007851-000100	Transmit Module	U1
1	0402CS-68NXJLW	Inductor, Chip, 68nH, 5%, Coilcraft	L1
2	LL1608-FSL22NJ	Inductor, Chip, 22nH, 5%	L16,L17
1	0906-5JLC	Inductor, 5.45nH, 5%, Coilcraft	L18
2		Capacitor,0402,10V, 10%, X5R,0.1uF,SMT	C8, C17
6		Capacitor,0402,50V,COG,5%, 100pF,SMT	C14,C16,C29,C30,C32,C34
1		Capacitor,0402,50V, 5%, 470pF,COG,SMT	C7
4		Capacitor,0402,50V, 10%, 1000pF,COG,SMT	C9,C20,C21,C22
3		Capacitor,0805,10V,X5R,10%,3.3uF,SMT	C23,C24,C25
2		Resistor,0402,0 Ohms,SMT	R1,R5
2		Resistor,0402,1%,143 Ohms, SMT	R2,R3
1		Resistor,0402,1%,39.2 Ohms, SMT	R6

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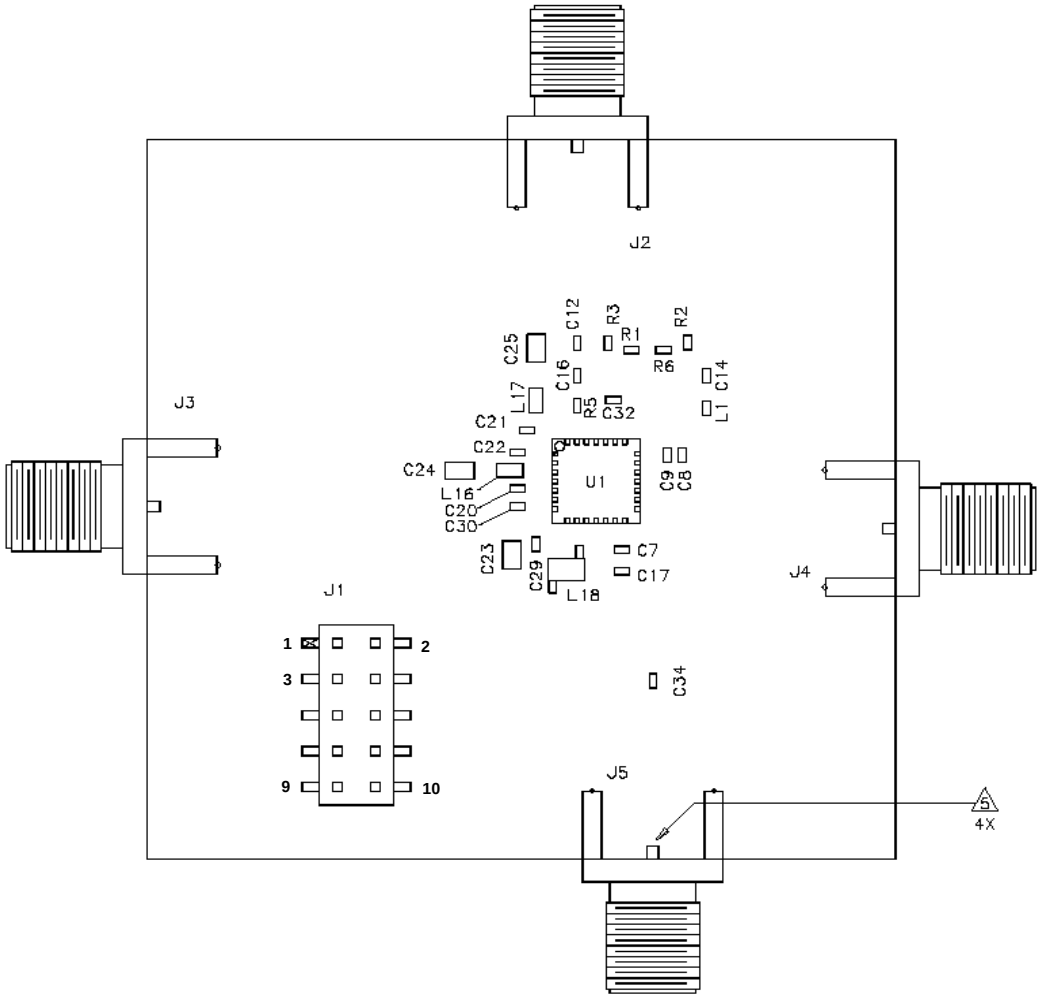
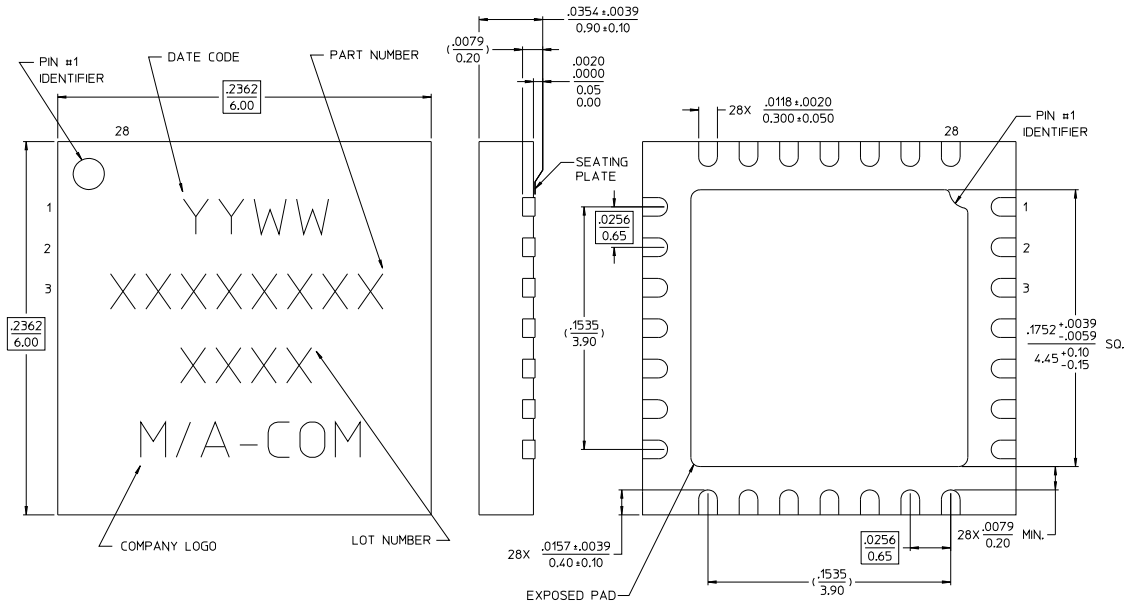
Sample Board Pin Configuration

Pin Configuration J1

Pin No.	Function	Pin No.	Function
1	VDD3	6	N/C
2	VDD3	7	VDD2
3	GND	8	VDD1
4	GND	9	GND
5	VCTRL	10	GND



Lead free, 6x6 mm, 28-Lead PQFN†



NOTES:
1. REFERENCE JEDEC MO-220-VJJC-4 FOR ADDITIONAL DIMENSIONAL AND TOLERANCE INFORMATION.
2. ALL DIMENSIONS SHOWN AS in/mm.
3. REFERENCE S2083 APPLICATION NOTE FOR PCB FOOTPRINT INFORMATION.

† Reference Application Note M538 for lead-free solder reflow recommendations.

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