HPMX-2003/5
Demonstration Circuit Board

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Applications Bulletin

Introduction

The circuit board described is designed for use with either the HPMX-2003 or the HPMX-2005 vector modulator MMICs. It allows testing of the MMICs for SSB, DSB, or QPSK modulation applications.

Assembly Notes

Table 1, below, lists the parts you will need to assemble the circuit board. If you are not familiar with surface mount PC board assembly, please read Application Note XXXX which details a recommended assembly technique.

1) **Always** use bypass capacitors on the Vcc lines to pins 1 and 2 and at pin 16. 1000 pF or more should be used to ensure adequate low frequency bypassing. Vcc should be set to 5 Volts. **It is strongly recommended that you do not exceed the maximum IC voltage ratings shown on the IC data sheet.**

It is also strongly recommended that you do not ground the Vcc input while there is DC bias applied to the I, Q, Iref, and/or Qref inputs! This means that you should not turn the Vcc supply down to zero when using a variable power supply. When you want to turn the modulator IC off, open the Vcc line. If Vcc is grounded while bias is applied to the I, Q and/or reference inputs the IC may be destroyed.

2) The layout includes a printed inductor that can be used in conjunction with a chip capacitor to optimally match the output VSWR of the HPMX-2003 for frequencies as low as 800 MHz. When the capacitor is placed next to the IC at pin 16, the VSWR will be minimum at 950 MHz. Moving the capacitor along the inductor line away from the IC increases the inductance seen by the IC and reduces the optimal match frequency. When using the HPMX-2005, the maximum inductance available on the inductor line has negligible effect due to the low frequency of operation so it is best to mount the capacitor close to the IC. Refer to the IC data sheet for more details.

3) A blocking capacitor is required at the LO input to both ICs. The LO input transmission line has a gap for mounting the capacitor. LO Gnd., pin 8, must be AC grounded through a capacitor.

4) The HPMX-2003 has an internal coupling capacitor at the RF output, so no external capacitor is needed. The HPMX-2005 does not have an internal output coupling capacitor, so a capacitor must be added. Installation can be accomplished by cutting a gap in the output trace at the location marked by two small triangles on either side of the output transmission line, or by using a connectorized blocking capacitor on the output SMA connector. In either case, a large value of capacitance such as 1000 pF should be

HPMX-2003 Qty.	HPMX-2005 Qty.	Part description
1	1	HPMX-2003/5 demo board
1		HPMX-2003 900 MHz vector modulator MMIC
	1	HPMX-2005 100 MHz vector modulator MMIC
4	5	1000pF chip capacitor
2	2	EF Johnson type 142 SMA connector

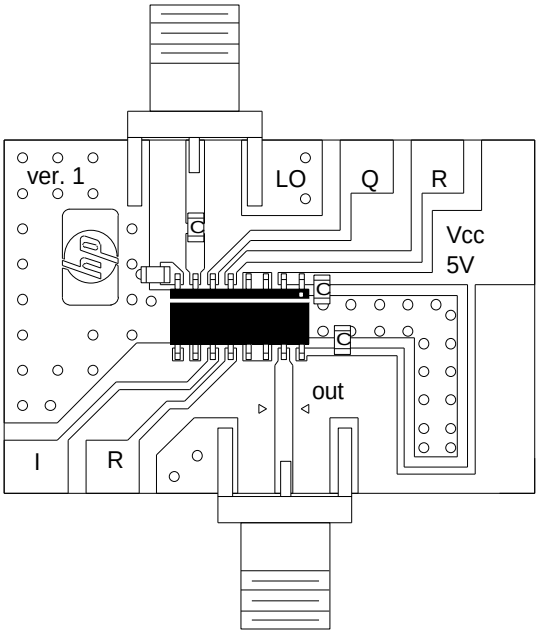

Figure 1. Assembled board showing HPMX-2003 with bypass and blocking capacitors.

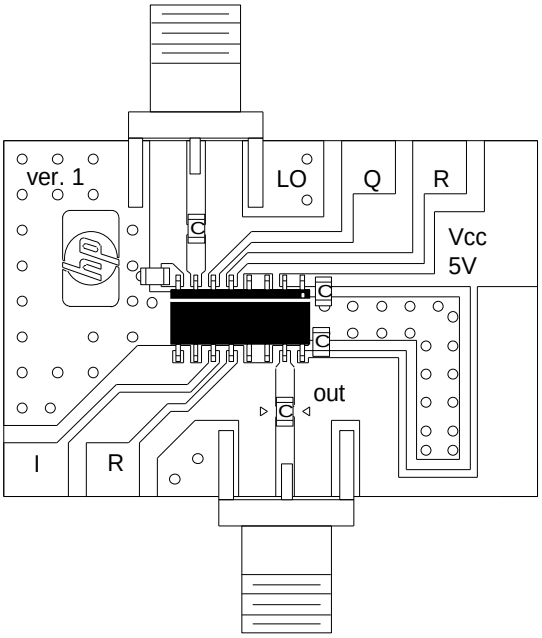

Figure 2. Assembled board showing HPMX-2005 with bypass and blocking capacitors.

used to assure minimal insertion loss.

5) The I and Q inputs require a DC offset of 2.5V. The offset can either be supplied by the I/Q signal generator or by using an op-amp circuit of the type shown in figure 3. The circuit provides inverting unity gain so the input signal should match the requirements of the modulator. 2.5 volt DC reference signals, equal in magnitude to the I/Q DC offsets must be connected to the pads marked "R" on the board. The R pads can be directly wired together. Note: performance of the IC is critically dependent on matching the DC levels at the reference inputs with the I/Q DC offsets. Imbalances of only a few millivolts will reduce the LO suppression resulting in gain and phase errors at the output. If you choose to use an op-amp circuit to provide the offsets, the op-amp chosen should have very low offset voltage specs. Use trim-pots to adjust the 2.5 V offset.

Though the modulator ICs were not specifically designed for balanced I, Q operation, they can be operated in the balanced mode. Figure 4, below, shows an op-amp circuit that can be used to drive the modulator using balanced I and Q drive. When operating in balanced mode, the I, Q drive voltage should be reduced to half the unbalanced drive voltage.

6) The board has been designed to accommodate EF Johnson model 142-0701-801 SMA connectors. These connectors are readily available from Newark, Digi-Key and others for about $7 each. The connectors will just slip on to the edge of the board without any drilling. Be sure to solder the pins on the bottom side of the connector to the ground-plane on the bottom side of the board to ensure low ground inductance.

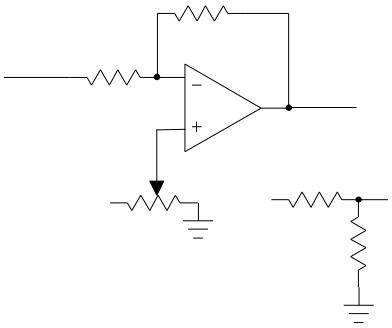

Figure 3. DC bias circuit for I and Q inputs (unbalanced drive)

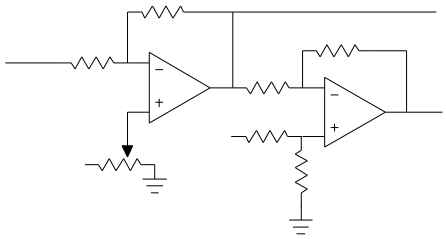

Figure 4. DC bias circuit for I and Q inputs (balanced drive)

7) Figure 5, below, shows a scale layout of the demonstration circuit board. The board should be made from 1/32" thick, FR-4 type fiberglass circuit board with 1 oz. copper on both sides. Only the top side of the board is shown. The bottom side remains unetched and is used as a ground plane. Tin/lead coating on both sides of the board will improve solderability. Finished size of the board is 1" x 1.5".

Use plenty of plated-through via holes in the ground areas for best performance. The via hole locations are indicated by white "+" marks in figure 5.

Detailed assembly instructions can be found in Application Bulletin XXXX, "Assembly Instructions for Communications Components Demonstration Circuit Boards".

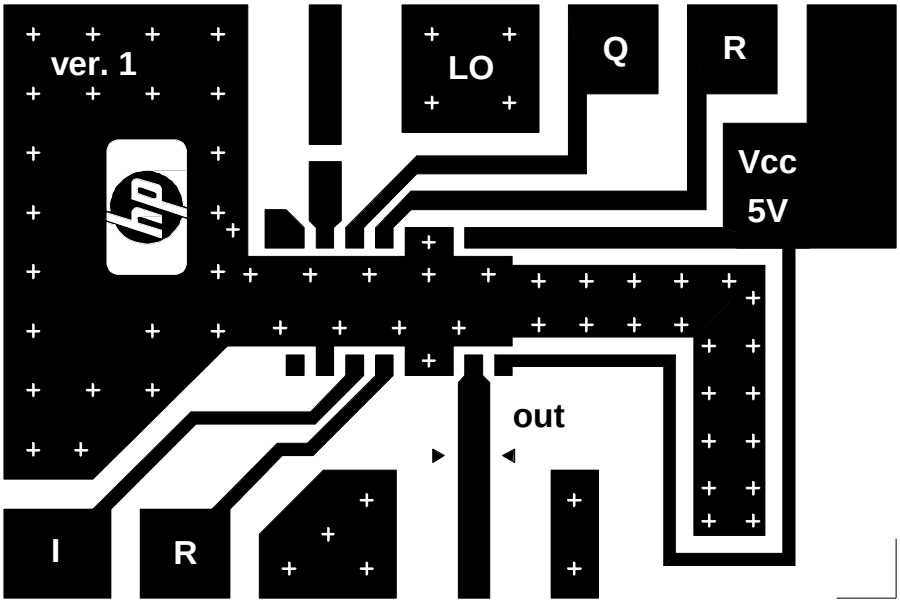

Figure 5. HPMX-2003/5 demonstration circuit board layout. Finished size: 1" x 1.5 " x 1/32".