Application Note AN100 - Hybrid Surface Mount Amplifiers

Introduction

The REMEC HSM product line is designed for use in high volume commercial applications. This application note provides mechanical, electrical and mounting details for proper use and installation of the HSM product line.

Package Outline and Printed Wiring Board Design

The HSM product line is manufactured in REMEC's standard package E52-19422. FIGURE 1 shows a cross-section of the HSM package and Figure 2 gives the mechanical outline dimensions of the package. The E52-19422 outline drawing is available by request from the factory (phone 321-727-1838; FAX 321-727-3729).

The HSM product line is designed using a thick film ceramic substrate that contains printed and discrete lines and components. A gold plated copper (copper/moly/copper) heat spreader is eutectically attached to the underside of the ceramic substrate. This copper carrier serves two important functions which makes proper mounting to the printed wiring board very important. First, the heat spreader removes heat from the HSM package. If not properly mounted, transistors inside of the HSM package could have excessively high junction temperatures. The second purpose of the heat spreader is for RF ground connection. If the copper carrier is not properly mounted amplifier performance will be adversely affected and in severe cases oscillations could occur.

To insure proper thermal and RF interconnection to the printed wiring board, the PCB should be designed with the printed pattern shown in Figure 3.

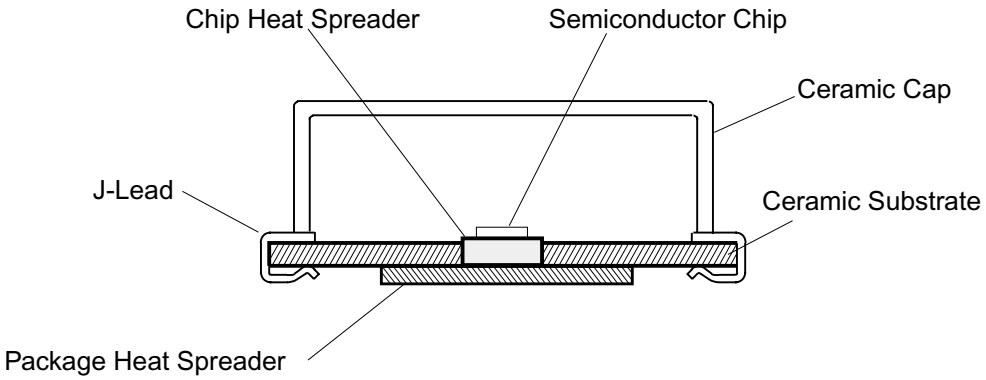
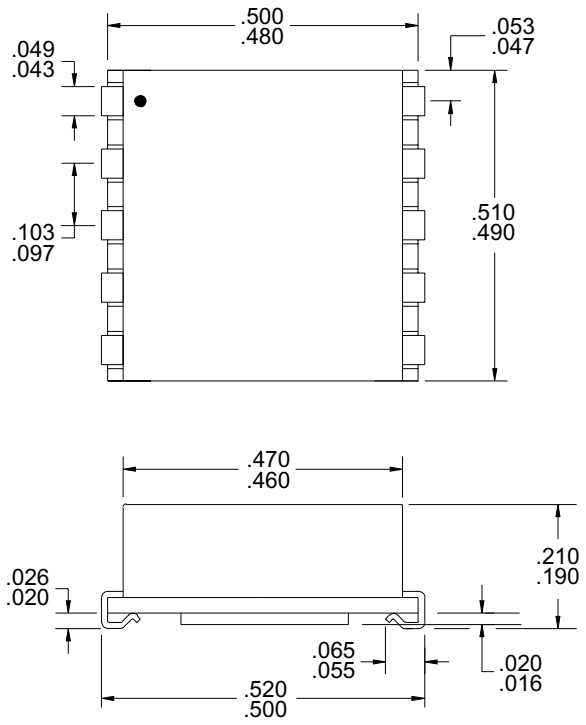


Figure 1: HSM Package Configuration



All dimensions are in inches.

Figure 2: Mechanical Outline Dimensions for HSM Package

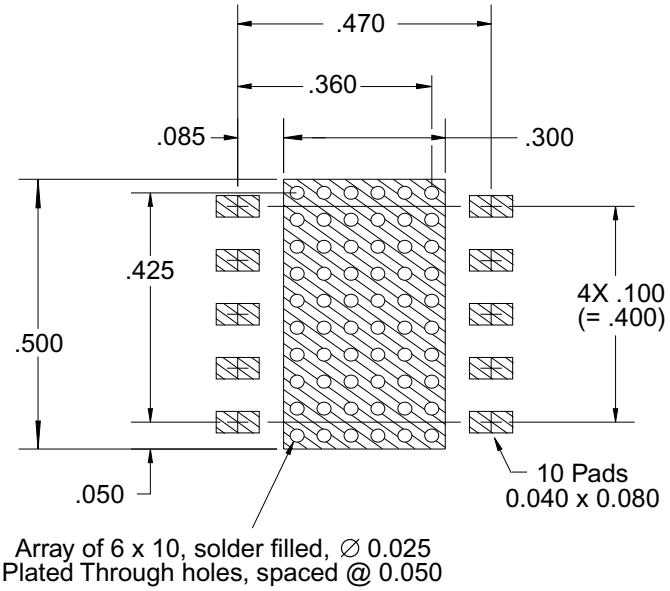


Figure 3: HSM Printed Wiring Board Layout

HSM Package Standard Pin Designations

FIG. 4 shows the standard pin designations for all HSM amplifiers.

All the pins designated as ground (GND) are internally interconnected. HSM amplifiers should be mounted using the Figure 3 printed wiring board layout.

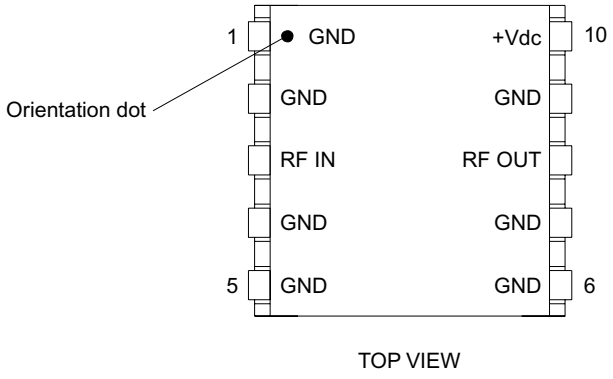


Figure 4: Typical Pin Designations for HSM Package

Printed Wiring Board Electrical Design

All HSM amplifiers contain internal blocking capacitors on the RF lines so that dc voltage is not present on the RF input or RF output lines. In a small number of designs, the dc resistance at the RF input and output pins is low because transformers or other components are connected before the dc blocking capacitors inside of the HSM package. If the RF input or RF output lines on the PCB contain a voltage, the amplifier may provide a dc load to the power supply feeding these lines; therefore, good design practice is to use decoupling capacitors on the printed wiring board at the RF input and RF output. If it is not desirable to use PCB mounted blocking capacitors, REMEC Q-bit engineering should be contacted to verify that they can be omitted.

HSM amplifiers contain internal filter and RF decoupling capacitors on the dc input line. External PCB mounted capacitors are not required; however, it is good design practice to provide PCB mounted capacitors close to the amplifier dc input pin.

Figure 5 shows typical HSM mounting with tips for optimum performance.

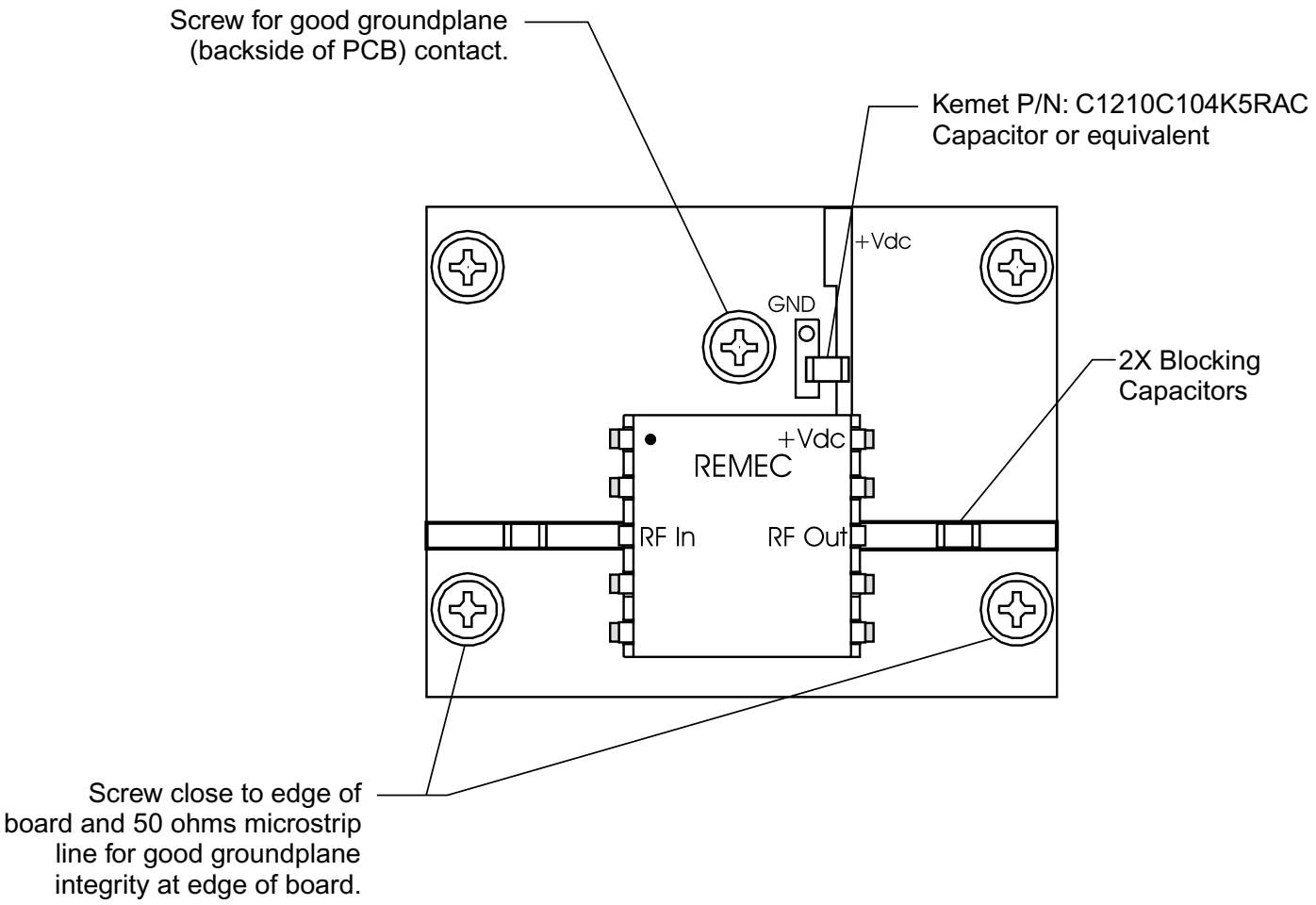


Figure 5: Typical HSM Mounting

Solder Attachment of REMEC HSM Packages

REMEC SMT Devices Reflow Procedure Recommendation:
REMEC SMT devices are manufactured using a high temperature Sn96.5/Ag3.5 no lead solder. This eutectic composition exhibits a liquidous temperature of 221 Centigrade.

This high melting temperature allows the use of a variety of solder compositions that exhibit liquidous temperatures at or below 190 Centigrade.

REMEC devices can be subjected to a lead temperature of 210 Centigrade during reflow.

Some of the recommended alloys are:

Composition	Melting range Fahrenheit	Melting range Centigrade
Sn60Pb40	361 – 374	183 - 190
Properties: rapid wetting action, low plastic melting range.		
Sn62Pb36Ag02	354 – 372	179 - 189
Properties: Excellent leaching resistance due to Ag content.		
Sn63Pb37	361	183 (Eutectic)
Properties: Good capillary action.		

There are additional alloys that can be used, provided that the liquidous temperature does not exceed 190 Centigrade.

The following fluxes can be used to help wet the solder joint:

"R" Rosin Non-Activated
"RMA" Rosin Mildly Activated
"OA" Organic Acid: Halogenated/nonhalogenated mixtures are used including water soluble and solvent soluble types.

Note: No-clean fluxes can be very sensitive to "flux activation time" and may require additional optimization of this reflow profile parameter.

The following reflow profile is typical of conditions necessary to achieve good reflow. The profile exhibits slow heat ramp-up, acceptable reflow dwell and a rapid cool-down.

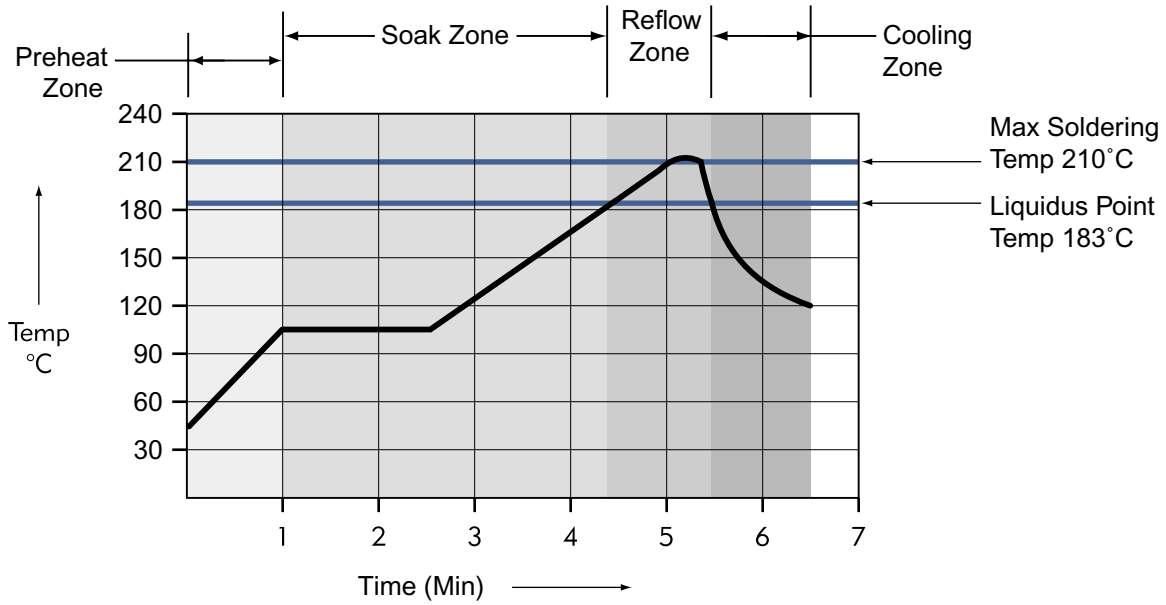


Figure 6: Typical Solder Reflow Time-Temp Profile

Convection and Infra-Red reflow methods are most commonly used for reflow. The total profile time varies by mass, density, and type of reflow equipment. Profile your ovens in a manner that will achieve best reflow results without damaging the circuit.

Remarks on solder profile

Preheat Zone
Ramp-up should not exceed 2C/sec; temperature should be 100-125°C. If the ramp is too fast, the solder paste may "explode" and cause solder balls & thermal shock to components made of ceramic.

Soak Zone
A soak zone at the beginning of profile will equilibrate temperature over large circuit boards.The length of the soak should be adjusted to achieve a maximum of 8-10°C temperature differential across the circuit board at the desired soak temperature (180°C for the referenced profile). The temperature is elevated to almost the melting point of the solder. The result of too high temperature in the soak zone will favor solder balls and solder splatter because of oxidation within the solder paste. This zone also acts as the flux activation stage. The maximum activation time between 150°C to 180°C should be 2.5 minutes for rosin solder paste and 2.0 minutes for water soluble solder paste.

Reflow Zone
If the temperature is too high, boards and components may char or burn. If too low, cold and grainy solder joints will result. The time above reflow is the measure of how long the solder on the PCB is liquidous. Generally solder liquidous times of 30-60 seconds are preferable, although liquidous times of 90 seconds or more are not uncommon on larger boards. If the solder is above reflow temperature too long, excessive growth of tin-copper intermetallics can occur and lead to a tin-depleted and brittle solder joint. If the solder is above the reflow temperature for less than 30 seconds, there is a risk that oven temperature fluctuation during sustained use could cause the profile to drop below reflow temperature.

Cooling Zone
The cooling rate after reflow is also important. The faster the cooling rate, the smaller the grain size of the solder. The cooling rate should be as fast as possible.

Application Note AN101 - Hybrid Surface Mount Test Fixture

Introduction

REMEC Hybrid Surface Mount (HSM) products that are supplied in the E52-19422 standard package, normally designated as QBH-8XXX, can be provided in a test fixture as shown in Figure 1 below.

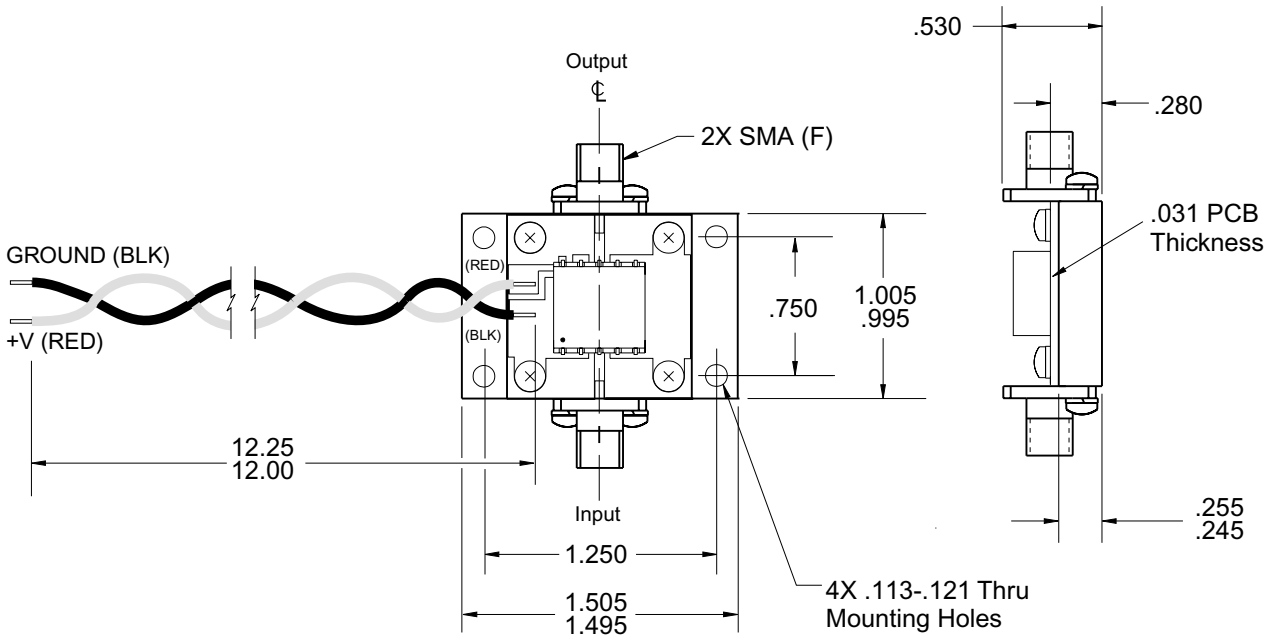


Figure 1: HSM Test Fixture
All dimensions are in inches.

When these parts are test fixture mounted, they are designated as QBH-4-8XXX. The fixture is supplied with female SMA connectors and with DC supply leads.

Please refer to the data sheet of the unmounted part to ascertain the correct supply voltage to use in each case.

An optional finned heatsink can be provided which can be attached to the Test Fixture as shown in Figure 2.

The heatsink helps maintain a safe baseplate temperature when operating for prolonged periods of time for the high intercept HSM amplifiers that dissipate in excess of 2 W.

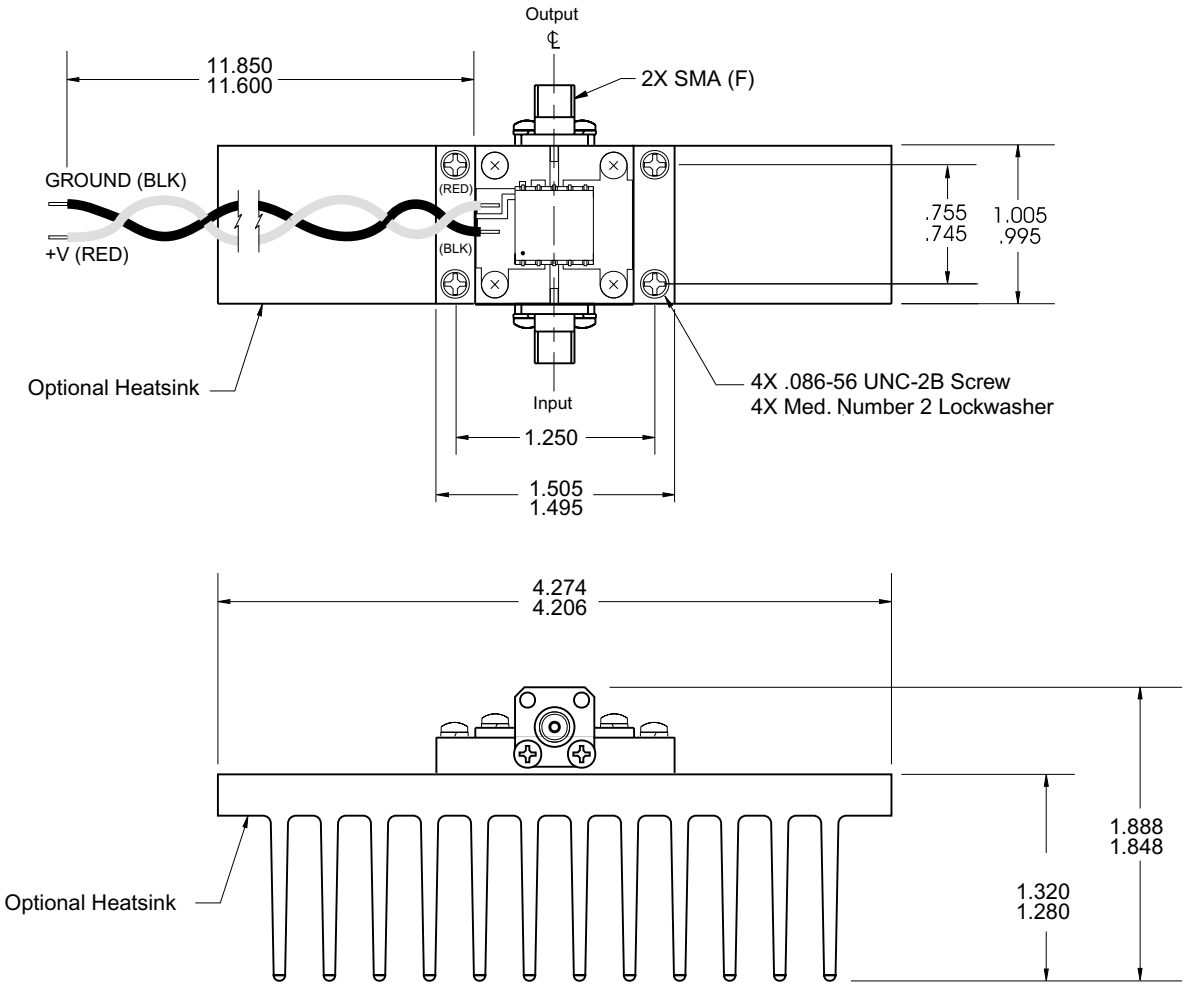


Figure 2: HSM Test Fixture with Heatsink
All dimensions are in inches.

The part number for the test fixture by itself is T12-16942-01 without Heatsink, -02 with Heatsink.

The optional heatsink shown in Figure 2 can be ordered separately as a kit with Part Number T12-16944 which includes the screws and washers to mount the HSM Test Fixture.

Application Note AN102 - Hybrid Surface Mount Procedure for Mounting

Scope

This application note details the requirements for mounting HSM (E52-19422) packaged components in a laboratory environment. This procedure is not recommended for manufacturing. Refer to application note AN-100 for assembly requirements in a manufacturing environment.

Equipment and Materials

Hot Plate - Weller WHP-300 (or equivalent)
Solder Paste Dispenser
Solder Paste - Solder Plus 62RMA-A, Alloy: Sn62Pb36Ag2
Teflon Tape - 3M #42HD7294-05

Assembly Procedure

Step 1
Apply tefllon tape to the bottom of the board of the printed wiring board to cover ground via holes. See Figure 1A.

Step 2
Using solder paste dispenser, apply solder paste to the printed wiring board as shown in Figure 1A. Set components on the printed wiring board. See Figure 1B.

Step 3
Turn on the hot plate and allow temperature to stabilize at 200°C.

Step 4
Place printed wiring board (with components) on hot plate. Visually observe solder paste until reflow occurs. When reflow is observed, remove the printed wiring board from the hotplate. Let the printed wiring board cool. Remove solder tape from back of the board.

Step 5
Clean assembly with Genesolv (or equivalent) solution.

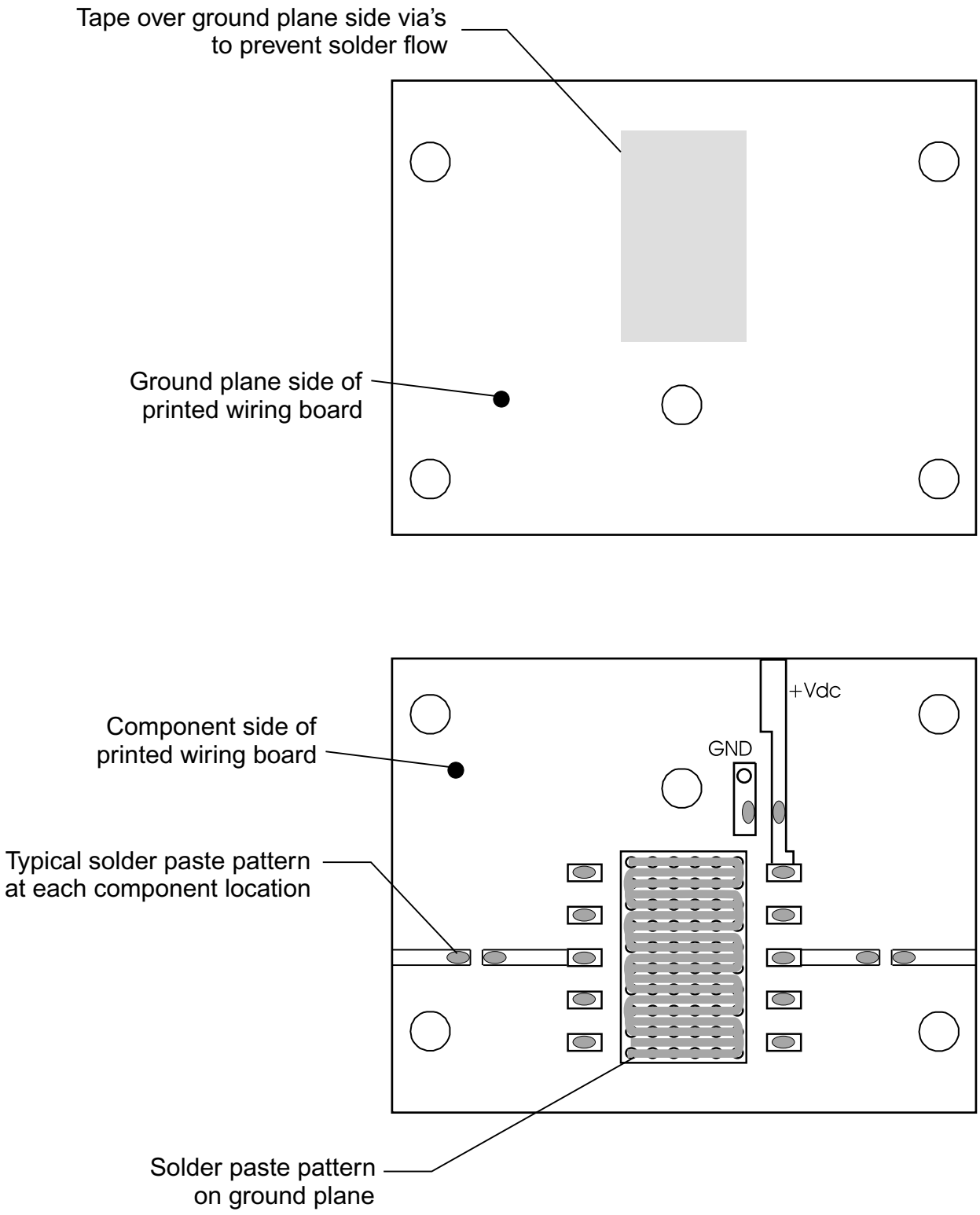


Figure 1A: Typical Solder Paste Pattern

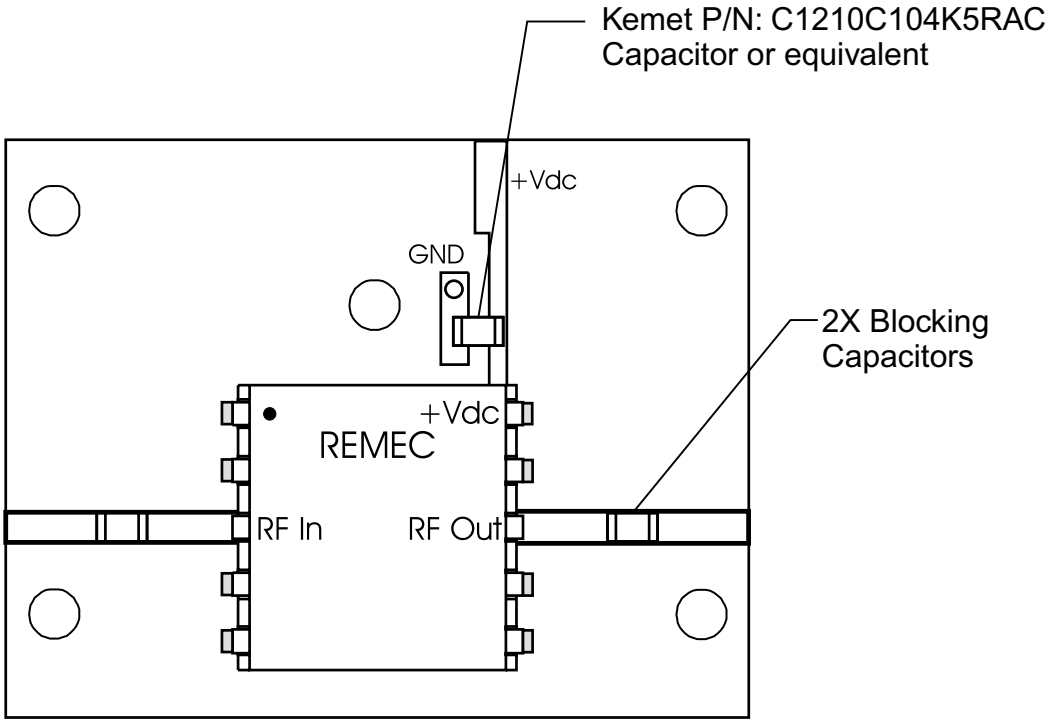


Figure 1B: Typical Board Assembly (after Reflow)

Application Note AN103 - QBH-2001 & QBH-2003 Product Information

Figure 1 is the suggested schematic diagram for properly using the QBH-2001 & QBH-2003.

The RF input and output port of the QBH-2001 & QBH-2003 are AC coupled so external blocking capacitors are not required.

Since these amplifiers are single ended low noise amplifiers, it is important the source impedance of the circuit connected to the RF input port is as close to 50 ohms as possible (source return loss better than 20 dB). Keeping good 50 ohm source impedance is important because good noise figure of the amplifier will be affected if source impedance degrades.

Another important factor affecting performance is input circuit losses. A good microwave transmission medium shall be chosen and T1 transmission line length should be kept as short as possible to maintain lowest possible noise figure. Table 1 lists several suggested transmission line materials that could be used with these amplifiers.

Figure 2 provides a mechanical outline drawing along with a recommended mounting pattern for these amplifiers.

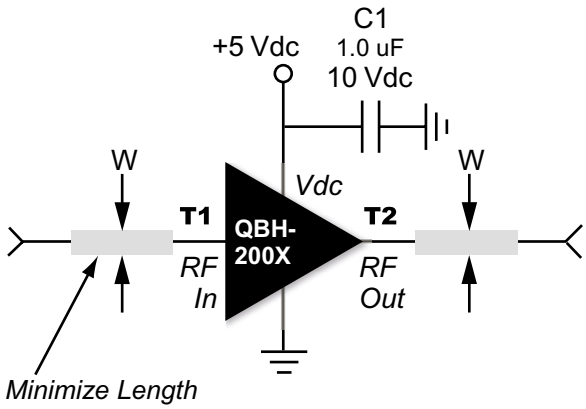


Figure 1: Schematic Diagram

Table 1
Suggested Transmission Line Materials

Material	Manufacturer	Dielectric Material	Material Thickness	T1, T2 Line Width (w)
AR320	Arlon	3.00	0.031	0.078″
TLE	Taconic	2.95	0.031	0.078″
R4003	Rogers	3.38	0.031	0.072″
FR4		4.30	0.031	0.058″

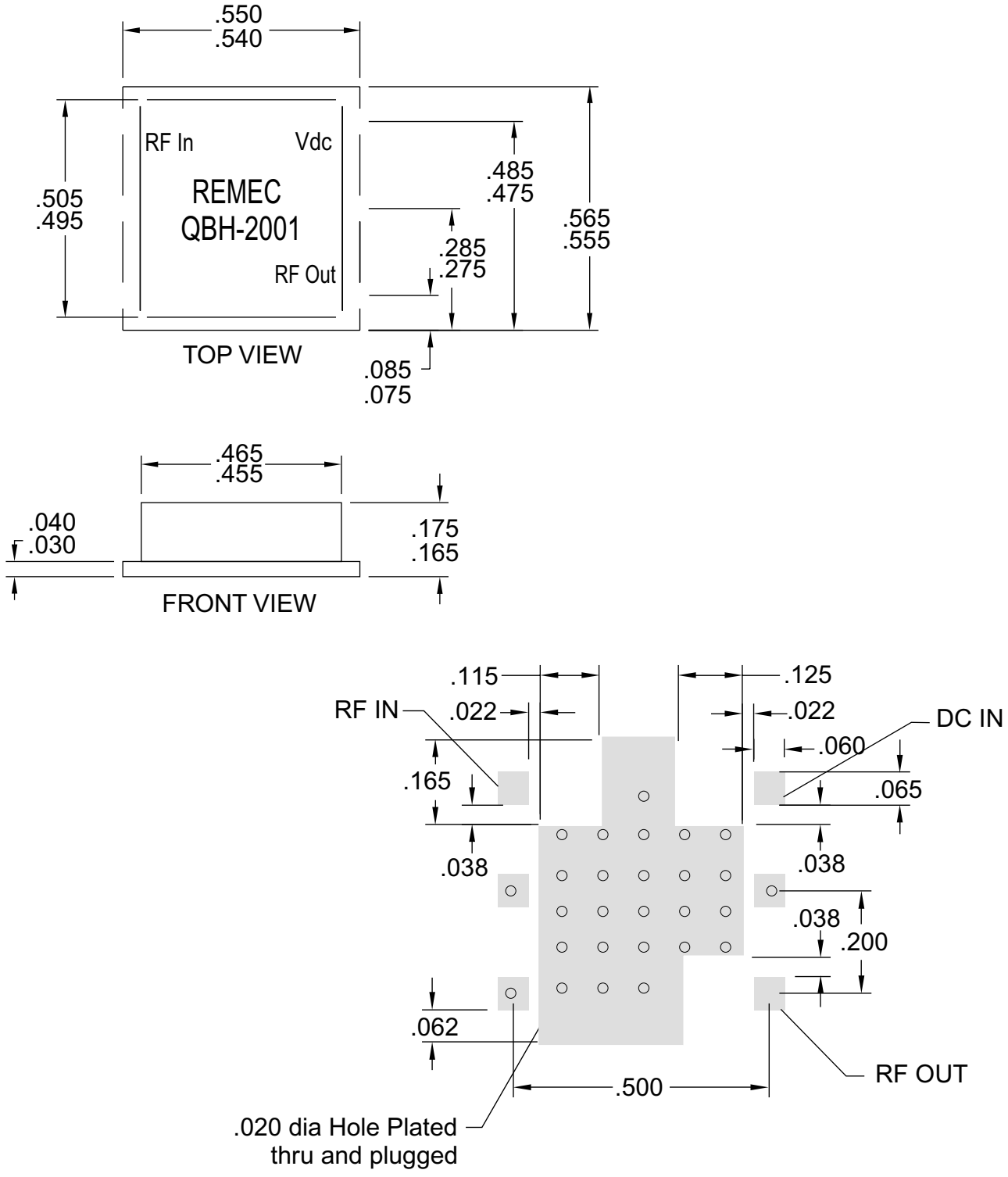


Figure 2: Outline Drawing and Recommended Mounting Pattern