Kelvin Testing Using a GHz socket for MLF/QFN packages

A measurement method called Kelvin probing for measuring resistance allows very accurate measurement of milliohm or sub-milliohm resistance. To accomplish this there are two leads, which provide a current source across the load to be measured, and two more leads across the load, which provide the sensing. This is shown in Fig. 1. The problem is that it takes twice as many connections as with a two-wire measurement. There is no lead resistance in the measurement as there is of course with the two-wire measurement. This can easily be several tenths of an OHM, thus swamping out the milliohms that are to be measured.

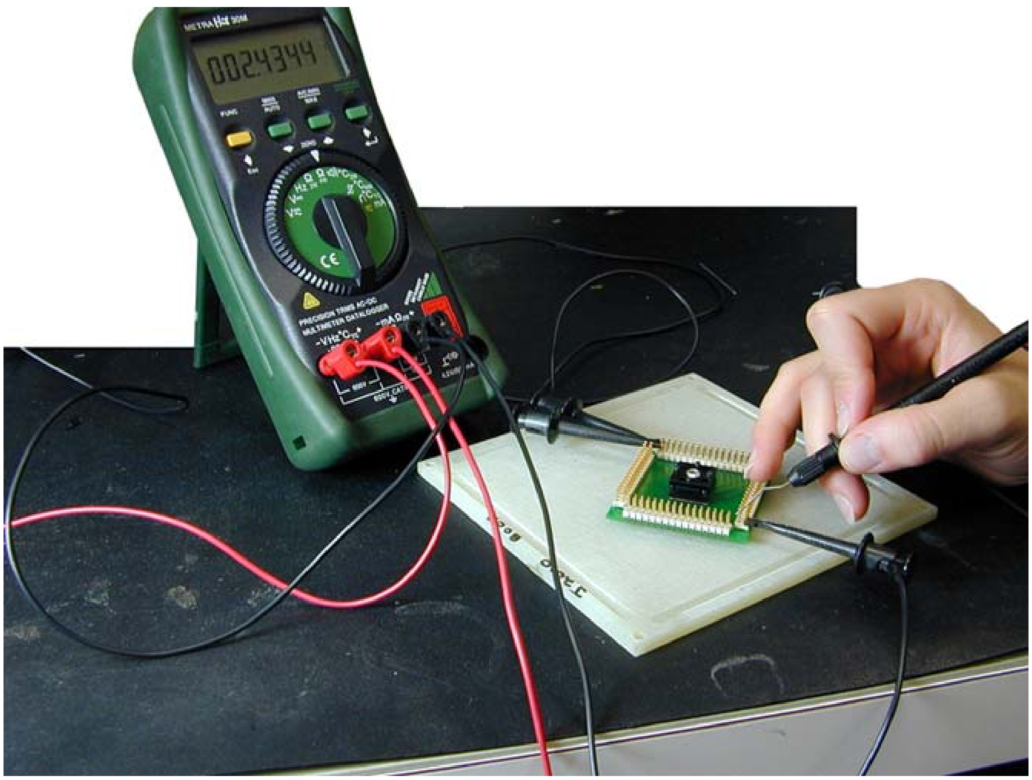

Figure 1: Test Setup.

A further complication arises when accurate measurements are required in very small packages. Many analog functions are being packaged in MLF/QFN packages. These devices have pitches as low as 0.4mm and lead dimensions in the range of 0.5mm x 0.25mm. A bottom view of an MLF/QFN package is shown in Fig. 2.

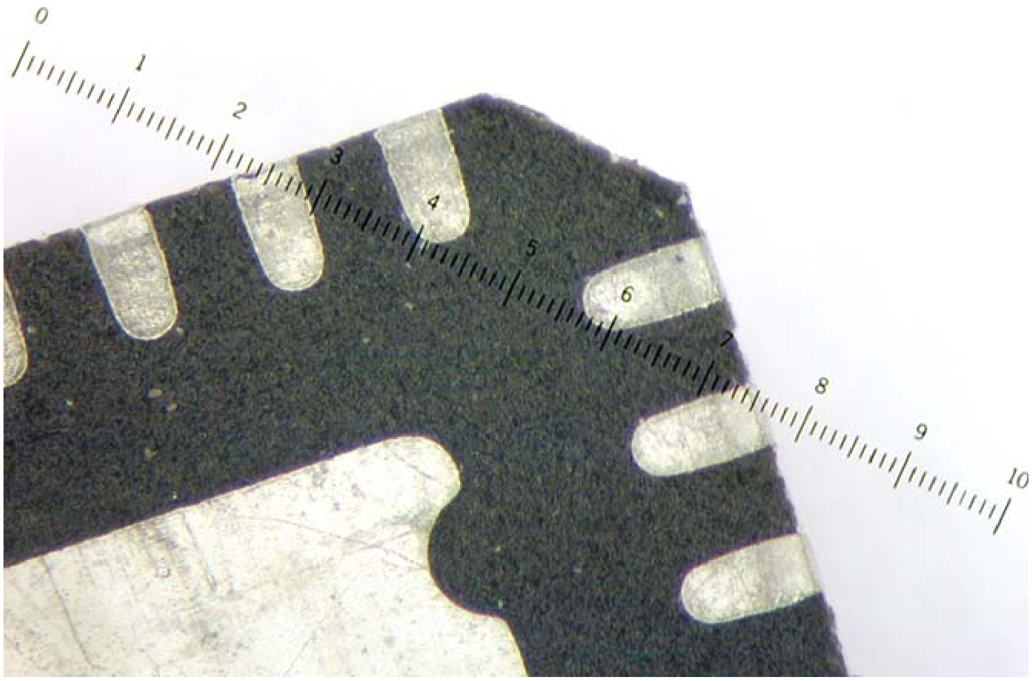

Figure 2: MLF pad detail

Ironwood Electronics, Inc. has developed a socket for MLF device, which has two features that allow the socket to be used for Kelvin probing in an MLF device. The first feature of the socket is that it has a very high density contactor which consists of tiny gold plated wires spaced 0.05mm apart or two thousandths of an inch mounted at a slight angle from vertical in an elastomer material. This sea of wires provides the connection between two parallel conductors forced together such as the lead on an MLF and a pad on a PCB with the contactor between. The second feature is a patent pending method for precisely positioning the MLF/QFN leads precisely over the pads on the target PCB. This socket was originally designed as a 10 GHz bandwidth socket for testing very high frequency circuits in MLF/QFN packages.

To use the GHz MLF socket as a Kelvin measurement device, the target board has to be designed as shown in Figure 3. Figure 3A shows the layout for use as a standard socket. Figure 3B shows the layout for use as a Kelvin measurement socket. The difference is that the pads for Figure 3B are split in the center and a gap of 0.125mm are inserted between the two sections of the pad. Each fragmentary section of the standard pad or two smaller pads is then connected to the measuring circuitry as shown in the figure. The current source is connected to one section of the pad and the sensing circuit is connected to the other section of the bisected pad.

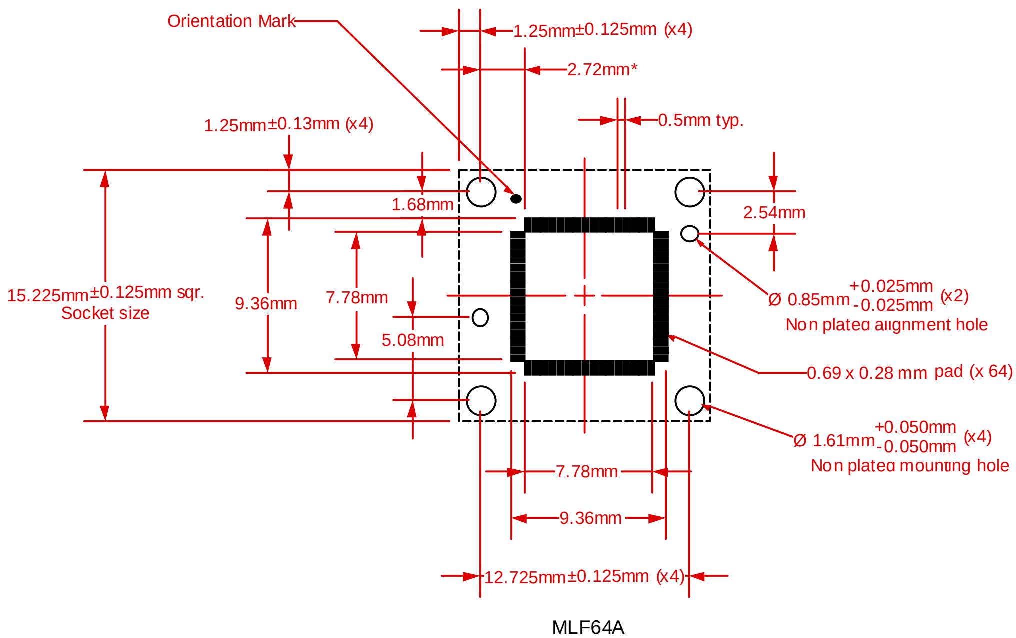

Figure 3A: Suggested PCB layout for SG-MLF-7008

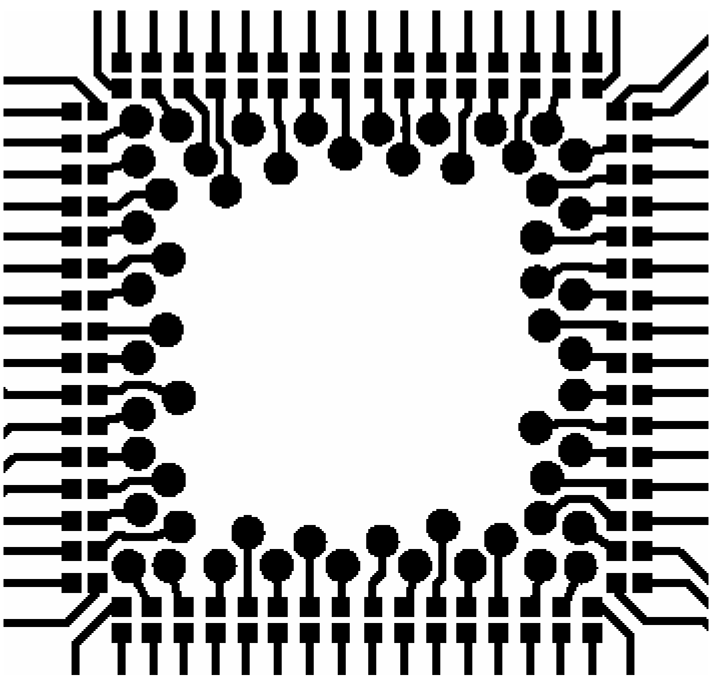

Figure 3B: Split pad layout

For our purposes, an SG-MLF-7008 was used with a 64-position MLF test chip. The chip was set up in a daisy chain pattern and provides a resistance through spiral circuitry from bottom to top of board (Figure 4). The target board allows Kelvin connections to every pin. The results are shown below in Fig. 5.

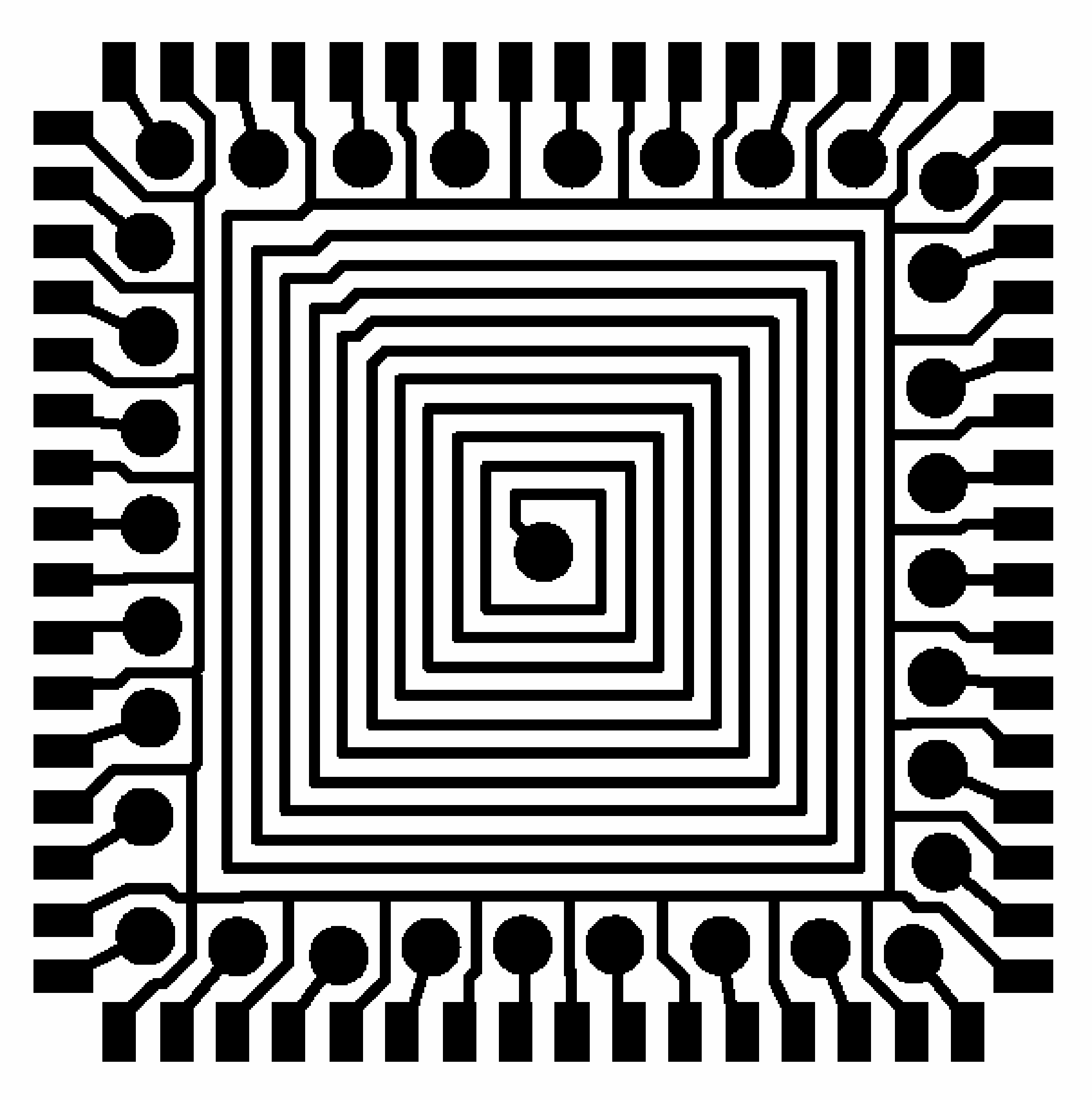

Figure 4: Test Chip layout

The MLF GHz sockets vary by package; call Ironwood Electronics, Inc. for assistance in choosing the proper socket before laying out your board. Tooling holes, etc must be in the correct locations to ensure the best test set-up. If needed, Ironwood Electronics, Inc. can also provide a board for Kelvin testing. Call for a quote.

Figure 5: Test Data

Leads	Resistance						
1:2	2.3543	1:20	2.4028	1:38	2.3932	1:56	2.3499

1:3	0.0112	1:21.	0.0483	1:39	0.0844	1:57	0.026
1:4	2.3584	1:22	2.409	1:40	2.418	1:58	2.3544
1:5	0.0155	1:23	0.0512	1:41	0.0865	1:59	0.023
1:6	2.3672	1:24	2.4156	1:42	2.4094	1:60	2.3637
1:7	0.0211	1:25	0.0555	1:43	0.0913	1:61	0.019
1:8	2.3754	1:26	2.4228	1:44	2.434	1:62	2.3701
1:9	0.0246	1:27	0.0601	1:45	0.0954	1:63	0.0163
1:10	2.3853	1:28	2.4308	1:46	2.4269	1:64	2.3753
1:11	0.0294	1:29	0.0643	1:47	0.1055		
1:12	2.3943	1:30	2.4381	1:48	2.4349		
1:13	0.0331	1:31	0.0686	1:49	0.045		
1:14	2.3984	1:32	2.4463	1:50	2.3341		
1:15	0.0365	1:33	0.0712	1:51	0.0407		
1:16	2.3944	1:34	2.3822	1:52	2.3402		
1:17	0.0388	1:35	0.0752	1:53	0.0351		
1:18	2.3933	1:36	2.3917	1:54	2.3457		
1:19	0.0444	1:37	0.0812	1:55	0.0305		

Conclusion: From the results in Figure 5, one can ascertain that using the GHz socket in the described setup can in fact measure the Kelvin resistance between two points. The test chip that was daisy chained in this pattern allowed us to see differences between points because of the length of the trace (more length = more resistance), you can see that the farther you got away from the first pin, the resistance increases slightly. It was used expressly for that purpose; a typical MLF chip will also work in this application although the results will be unique to that chip.

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