GRL-C3-MP Test Tool
LCR-JIG User Guide

Version 2.0
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Approved by	Shibin P V	31st Jan 2024

Revision History

Version Number	Date	Prepared by	Changes
1.0	25th Sep, 2023	Harshavardhan G	• Initial version of document is created
2.0	31st Jan 2024	Gils Kuriakose	• LQK Measurement Procedure added

Table of Contents

1. Introduction

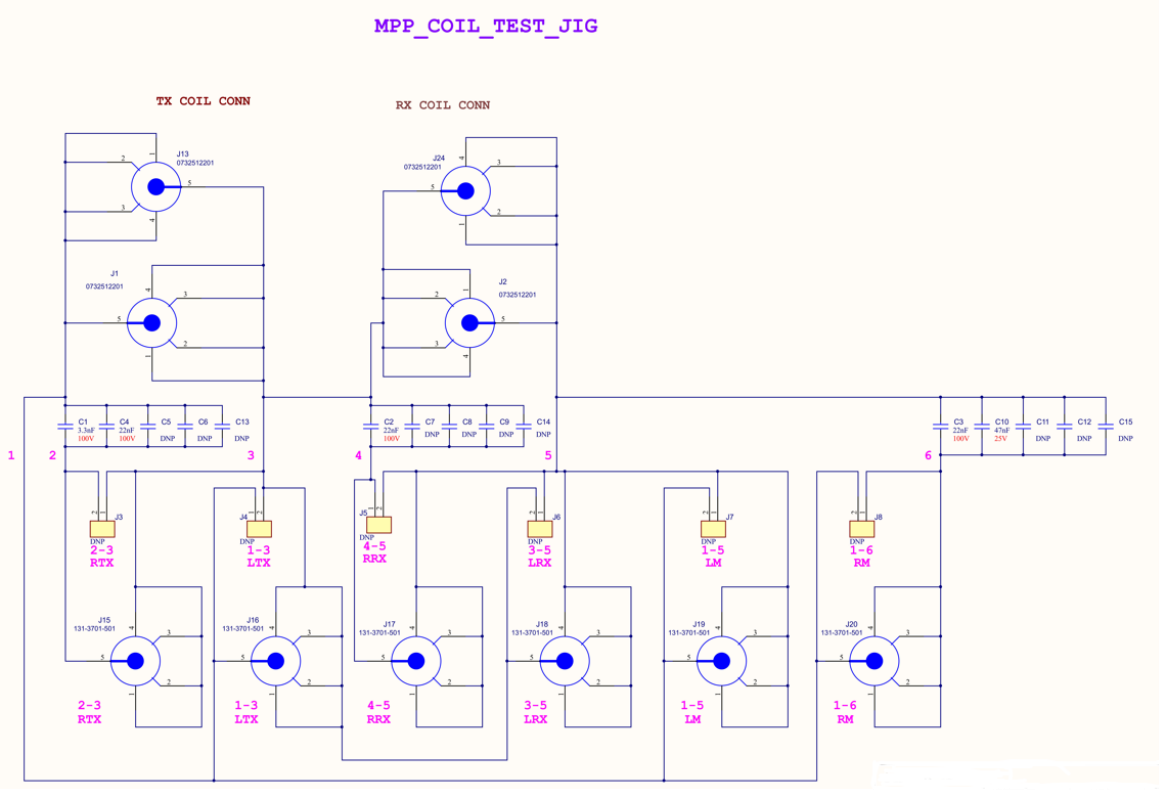
This document provides the details of GRL LCR Test jig calibration and procedure to measure Coupling Property (LQK) Parameters as per MPP TPR/TPT Compliance tests requirements.

2. List of Equipment

- GRL-C3-MP-LCR-JIG
- Keysight E4980AL LCR Meter
- GRL LCR SMA Fixture

3. Calibration Procedure

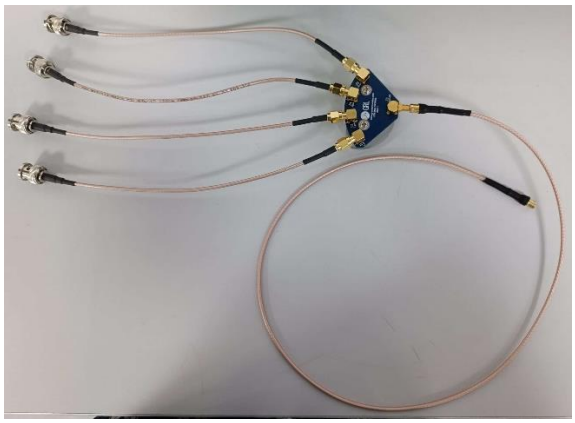
3.1. GRL-C3-MP-LCR-JIG Schematic

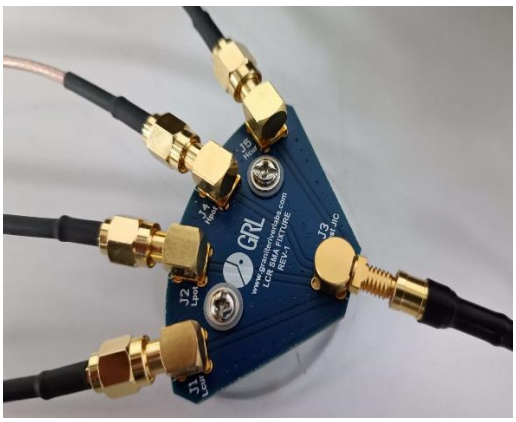


3.2. Images

MPP COIL TEST JIG

GRL LCR SMA FIXTURE



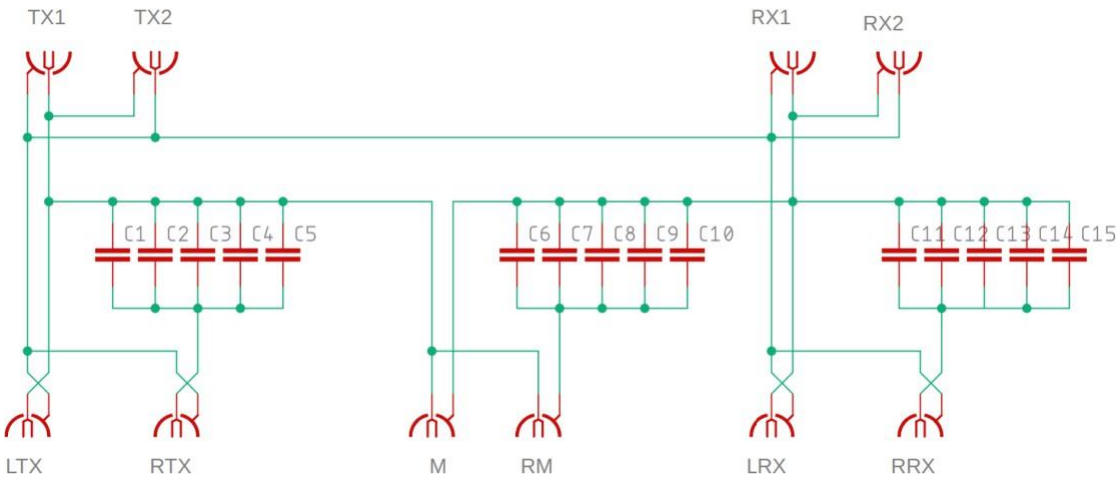


SMA SHORT

SMB SHORT

3.3 Test Points

1. Test points are named and mapped exactly same as test tool books ref design.



3.4 LCR Meter Calibration with GRL LCR SMA Fixture

1. Connect LCR meter to power via an isolation transformer (to avoid a ground loop).
2. Connect GRL LCR SMA Fixture to the LCR meter

    Connect Fixture Lcur to LCR Meter Lcur
    Connect Fixture Lpot to LCR Meter Lpot
    Connect Fixture Hcur to LCR Meter Hcur
    Connect Fixture Hpot to LCR Meter Hpot

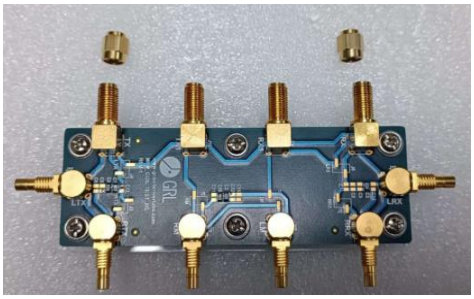
3. Connect SMB Cable to the LCR SMA Fixture
4. Set a marker at frequency of interest for the Jig, e.g. 360kHz on LCR meter screen.
5. Follow LCR Meter OPEN & SHORT calibration steps (manufacturer-dependent)

- Keep the SMB cable other end will open while doing OPEN calibration

- Use the SMB short provided for SHORT Calibration of the LCR Meter

3.5 COIL Test JIG Parasitic Measurement

1. Connect LCR meter to power via an isolation transformer (to avoid a ground loop).
2. Follow LCR calibration steps (manufacturer-dependent)
3. Set a marker at frequency of interest for the Jig, e.g. 360kHz on LCR meter screen.
4. **Short circuit ports TX1, RX1 of LCR Jig. Short circuit must be with 0Ω SMA Connector.**




   a. Connect LCR meter cable to port LTX (Tx Coil Inductance) of Jig. Record reactance at frequency of interest for the Jig.
      Note down this **Ltx11_parasitic_360k**
   b. Connect LCR meter cable to port RTX (Tx Coil Resistance) of Jig. Record resistance at frequency of interest for the Jig.
      Note down this **Rtx11_parasitic_360k**
   c. Connect LCR meter cable to port LRX (Rx Coil Inductance) of Jig. Record reactance at frequency of interest for the Jig.
      Note down this **Lrx11_parasitic_360k**
   d. Connect LCR meter cable to port RRX (Rx Coil Resistance) of Jig. Record resistance at frequency of interest for the Jig.
      Note down this **Rrx11_parasitic_360k**
   e. Connect LCR meter cable to port M (Mutual Inductance) of Jig. Record reactance at frequency of interest for the Jig.
      Note down this **M11-parasitic_360k**
   f. Connect LCR meter cable to port RM (Mutual Resistance) of Jig. Record resistance at frequency of interest for the Jig.
      Note down this **Rm11_parasitic_360k**

5. **Short circuit ports TX2, RX2 of LCR Jig. Short circuit must be with 0Ω SMA Connector.**
   a. Connect LCR meter cable to port LTX of Jig. Record reactance at frequency of interest for the Jig.
      Note down this **Ltx22_parasitic_360k**

b. Connect LCR meter cable to port RTX of Jig. Record resistance at frequency of interest for the Jig.
   Note down this **Rtx22_parasitic_360k**
c. Connect LCR meter cable to port LRX of Jig. Record reactance at frequency of interest for the Jig.
   Note down this **Lrx22_parasitic_360k**
d. Connect LCR meter cable to port RRX of Jig. Record resistance at frequency of interest for the Jig.
   Note down this **Rrx22_parasitic_360k**
e. Connect LCR meter cable to port M of Jig. Record reactance at frequency of interest for the Jig.
   Note down this **M22-parasitic_360k**
f. Connect LCR meter cable to port RM of Jig. Record resistance at frequency of interest for the Jig.
   Note down this **Rm22_parasitic_360k**

6. Change the frequency to 128K In LCR Meter.

7. Follow LCR calibration steps (manufacturer-dependent)

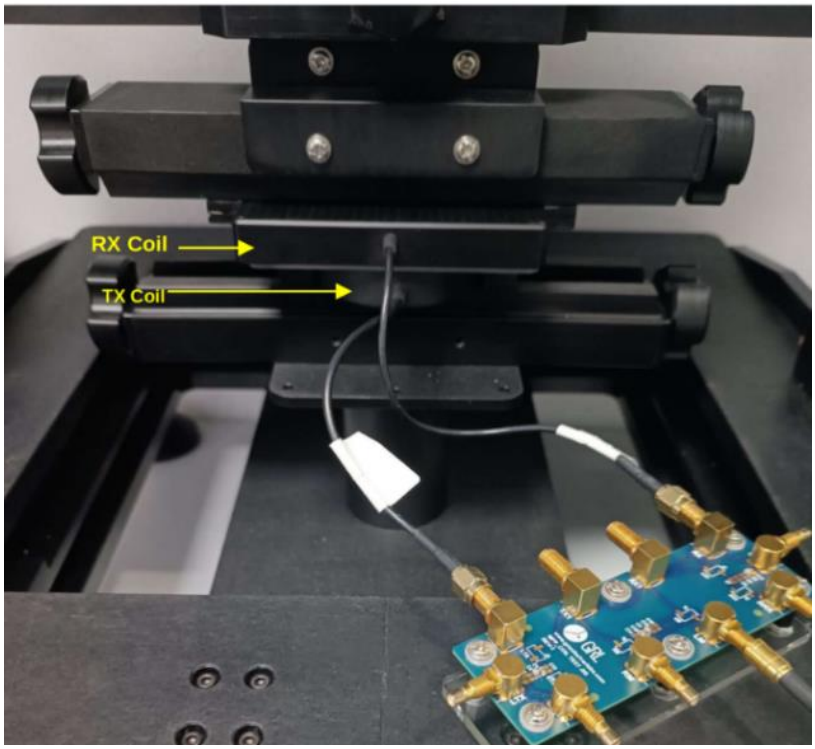
8. Repeat the same for 128K note down the parasitic values.

3.6 Tx & Rx Coil Cable Parasitic Measurement

1. Tx and Rx Coil Cable Parasitic will be Provided by the Coil Manufacturer.

4. Measurement Procedure at 0,0 Position

1. Connect LCR meter to power via an isolation transformer (to avoid unexpected ground loop).
2. Fix the TX & RX Coils in to the Manual Positioning Tool
3. Connect TX Coil at **TX1** SMA Connector and RX coil at **RX1** SMA Connector. (Make sure that SMA Short caps are removed)



4. Set a marker at frequency of interest for the Jig, e.g., 360kHz on LCR meter screen.
5. Follow LCR calibration steps (manufacturer-dependent)
6. Connect LCR meter to **port LM of Jig.**
    a. Find the least LM by adjusting the manual positioning tool
    b. Measure reactance at frequency of interest for the Jig.
        i. If value is positive,

        To find out the Compensated Mutual Inductance (LM')

LM'= (LM_360K) - (Ltx Cable parasitic_360K) - (Lrx Cable parasitic_360K) - (M11 parasitic_360K)

        ii. If value is Higher (>10uH), Connect TX Coil at TX2 or RX coil at RX2.

        To find out the Compensated Mutual Inductance (LM')

LM'= (LM_360K) - (Ltx Cable parasitic_360K) - (Lrx Cable parasitic_360K) - (M22 parasitic_360K)

    c. Record the Results as LM'

7. Connect LCR meter to port **LTX of Jig.**
    a. Measure reactance at frequency of interest for the Jig.
    b. To find out the compensated L'TX

L'TX = Ltx – (Ltx11_360K+Ltx Cable Parasitic_360K)

    c. Record the results as L'TX

8. Connect LCR meter to port **LRX of Jig.**
    a. Measure reactance at frequency of interest for the Jig.
    b. To find out the compensated L'RX

L'RX = Lrx – (Lrx11_360K+Lrx Cable Parasitic_360K)

    c. Record the results as L'RX

9. Connect LCR meter to port **RTX of Jig.**
    a. Measure resistance at frequency of interest for the Jig.
    b. To find out the compensated R'TX

R'TX = Rtx – (Rtx11_360K+Rtx Cable Parasitic_360K)

    c. Record the results as R'TX

10. Connect LCR meter to port **RRX of Jig.**
    a. Measure resistance at frequency of interest for the Jig.
    b. To find out the compensated R'RX

R'RX = Rrx – (Rrx11_360K+Rrx Cable Parasitic_360K)

    c. Record the results as R'RX

11. Connect LCR meter to **port RM of Jig.**
    a. Measure resistance at frequency of interest for the Jig.
    b. To find out the Compensated Mutual Resistance (RM')

RM'= (RM_360K) - (Rtx Cable parasitic_360K) - (Rrx Cable parasitic_360K) - (Rm11 parasitic_360K)

    c. Record the results as RM'
    d. Compute and record ki (Inductive Coupling) using the following equations.

$$K_i = \frac{M}{\sqrt{L'_{TX} \cdot L'_{RX}}}$$

Where M = (L'TX +L'RX-LM') / 2

12. Compute and record Kr (Resistive Coupling) using the following equation

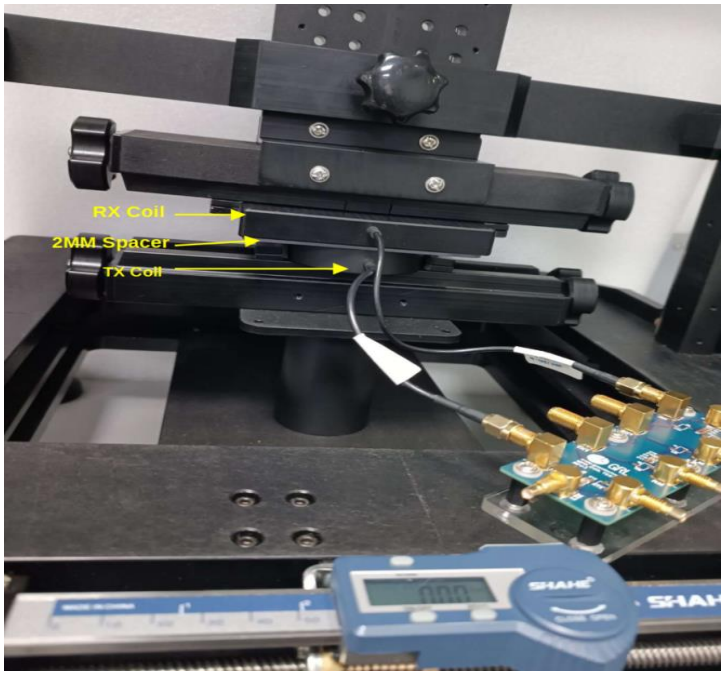
$$K_r = \frac{R_M}{\sqrt{R'_{TX} \cdot R'_{RX}}}$$

Where RM = (R'TX +R'RX-RM') / 2

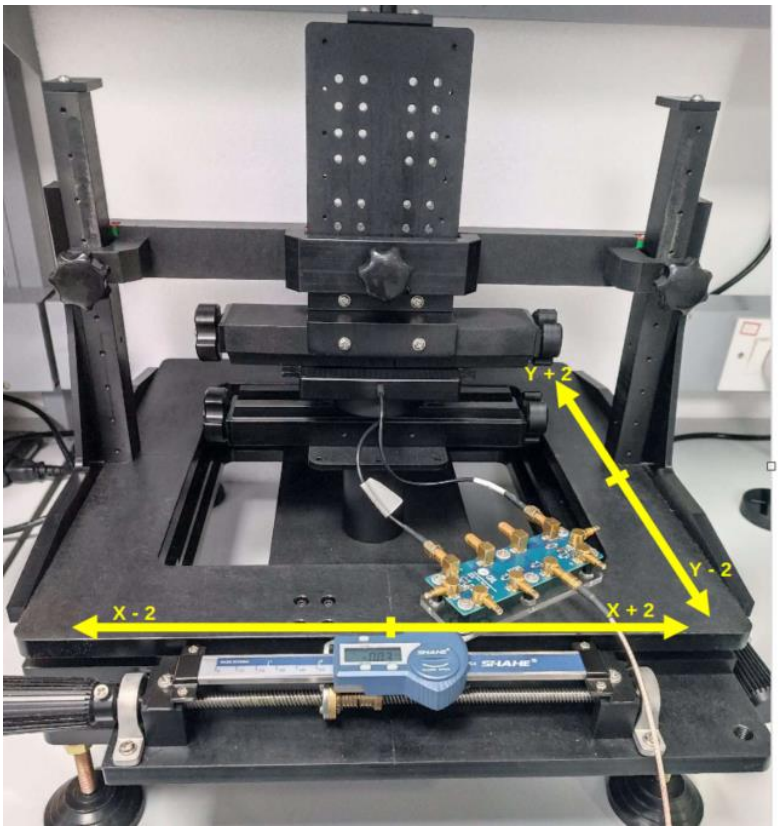
13. Repeat procedure at different frequency.
14. Compare the data with test limits to Validate the results.

5. Measurement Procedure at 2,2 Position

1. Connect LCR meter to power via an isolation transformer (to avoid unexpected ground loop).
2. Fix the TX & RX Coils in to the Manual Positioning Tool
3. Connect TX Coil at **TX1** SMA Connector and RX coil at **RX1** SMA Connector. (Make sure that SMA Short caps are removed)
4. Place 2MM Spacer in between Tx & Rx Coil



5. Set a marker at frequency of interest for the Jig, e.g., 360kHz on LCR meter screen.
6. Follow LCR calibration steps (manufacturer-dependent)
7. Connect LCR meter to **port LM of Jig.**
    a. Find the least LM by adjusting manual positioning tool
    b. Set both of the Scales in Position Tool to zero.
    c. Move 2MM towards **X+2** or **X-2** or **Y+2** or **Y-2** in the positioning Tool



d. Measure reactance at frequency of interest for the Jig (LM_360K).

To find out the Compensated Mutual Inductance (LM')

LM'= (LM_360K) - (Ltx Cable parasitic_360K) - (Lrx Cable parasitic_360K) - (M11 parasitic_360K)

e. Record the Results as LM'

8. Connect LCR meter to port **LTX of Jig.**
   a. Measure reactance at frequency of interest for the Jig.
   b. To find out the compensated L'TX

   L'TX = Ltx – (Ltx11_360K+Ltx Cable Parasitic_360K)

   c. Record the results as L'TX

9. Connect LCR meter to port **LRX of Jig.**
   a. Measure reactance at frequency of interest for the Jig.
   b. To find out the compensated L'RX

   L'RX = Lrx – (Lrx11_360K+Lrx Cable Parasitic_360K)

   c. Record the results as L'RX

10. Connect LCR meter to port **RTX of Jig.**
    a. Measure resistance at frequency of interest for the Jig.
    b. To find out the compensated R'TX

R'TX = Rtx – (Rtx11_360K+Rtx Cable Parasitic_360K)

c. Record the results as R'TX

11. Connect LCR meter to port **RRX of Jig.**
    a. Measure resistance at frequency of interest for the Jig.
    b. To find out the compensated R'RX

R'RX = Rrx – (Rrx11_360K+Rrx Cable Parasitic_360K)

c. Record the results as R'RX

12. Connect LCR meter to **port RM of Jig.**
    a. Measure resistance at frequency of interest for the Jig.
    b. To find out the Compensated Mutual Resistance (RM')

RM'= (RM_360K) - (Rtx Cable parasitic_360K) - (Rrx Cable parasitic_360K) - (Rm11 parasitic_360K)

c. Record the results as RM'

13. Compute and record ki using the following equations.

$$K_i = \frac{M}{\sqrt{L'_{TX} \cdot L'_{RX}}}$$

Where M = (L'TX +L'RX-LM') / 2

14. Compute and record Kr using the following equation

$$K_r = \frac{R_M}{\sqrt{R'_{TX} \cdot R'_{RX}}}$$

Where RM = (R'TX +R'RX-RM') / 2

15. Repeat procedure at different frequency.
16. Compare the data with test limits to Validate the results.

6. References

1. MPP TPT / TPR Test tool Books V3