



TAITIEN ELECTRONICS CO., LTD.

Proposal - Crystal Matching Test Report

Report No.: SL12110006

Information List:

1. Customer : Atmel Corporation
2. Project Name. or Part No. : B/T
3. PCB Part No. : TB2 MEGA RF
4. Original Report No.: SL12110005
5. Proposed By: ☐ TAITIEN ☒ Customer
6. Description: _____

Tester:

Test Date: 2012 / 11 / 01
Test by: MelodyChen Department: RD
Phone Number: (02)2686-1287#801
E-Mail Address: melodychen@taitien.com.tw

Measured Equipment:

1. Network Analyzer:
☐ ADVANTEST R3754 ☒ ADVANTEST R3755 ☐ S&A 250B ☐ Others: _____
2. Counter:
☐ TAITIEN ITC-5 ☐ Agilent 53181A ☒ Agilent 53132A ☐ Others: _____
3. Power Supply: _____
4. Oscilloscope: Tektronix DPO 7354
5. Multi-meter: TES 2620
6. Active Probe: _____
7. Current Probe: ☐ Tek CT-1 ☒ Tek CT-6 ☐ others : _____
8. Others: _____



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Original Test Result:

Original Summary - Matching Test Result

Q2 Freq. : 16.000000MHz , XX Type Crystal , CL : 9pF

C3 = 10pF , C4 = 10pF

Frequency and CL Matching: ☐ Good ☐ Passable ☒ Not matching

Crystal frequency on board: 16.000140 MHz , 8.75 ppm

Load Capacitance : (CL₂) = 8 pF

Specification:

CL ₁ (pF)	Frequency (FL ₁ , MHz)	Frequency (FL ₁ , ppm)	C0 (pF)	C1 (fF)	Rs (ohm)	L1 (mH)	Q (K)	Ts (ppm/pF)
9	15.999977	-1.5	0.91	2.1	25.4	46.5	183.8	10.8

Drive Level: ☒ Good ☐ Passable ☐ Over range

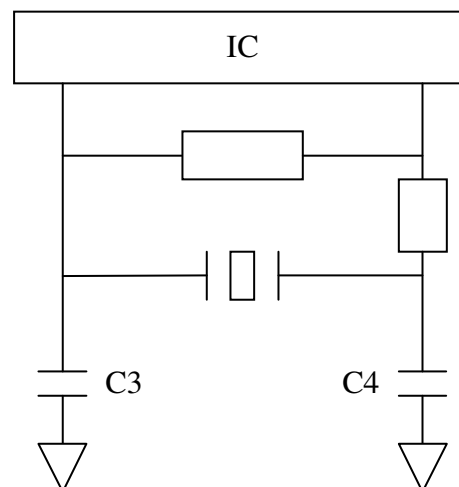
Drive Level = 1.48 uW

Negative Resistance (N.R.): ☒ Good ☐ Passable ☐ Poor or Not enough

N.R. = - 1031.51 ohm

Proposal - Test Result:

Item	C3 (pF)	C4 (pF)
Original	10	10
New	12	12





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Measuring the load capacitance on the PCB

Q2 Freq. : 16.000000MHz , XX Type Crystal , CL : 9pF

1. Measuring the crystal frequency on the PCB:

Frequency: 15.999972 MHz , -1.75 ppm

Base on:

C3 = 12 pF

C4 = 12 pF

2. To measure load capacitance on the PCB, 1) use measured Crystal frequency from the PCB and 2) use Network Analyzer to conduct Crystal's load capacitance test.

Load Capacitance (CL₂) = 9 pF .

Frequency (FL ₂ , MHz)	Frequency (FL ₂ , ppm)	C0 (pF)	C1 (fF)	Rs (ohm)	L1 (mH)	Q (K)	Ts (ppm/pF)
15.999971	-1.8	0.92	2.1	25.4	46.6	184.3	10.8

Measuring the Drive Level

Use AC current probe to conduct Vrms measuring (Tek CT-6, 50 ohms terminated)

$I_{rms} = V_{rms} / 5 \text{ (mA)}$

Measure Current: Vrms = 1.19 mV

$I_{rms} = \underline{1.19} / 5 = \underline{0.24} \text{ mA}$

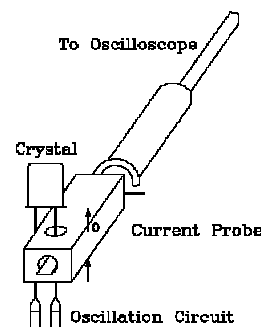
Calculation RL & Driver Level:

$RL = R_s (1 + C_0 / CL)^2$

$= \underline{25.40} * (1 + (\underline{0.92} / \underline{9}))^2 = \underline{30.86} \text{ ohms}$

Drive Level = $I_{rms}^2 * RL$

$= \underline{0.24}^2 * \underline{30.86} = \underline{1.75} \text{ uW}$





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Measuring negative resistance of oscillating circuits (-R or NR)

1. Use AC current probe and observe IC output waveform

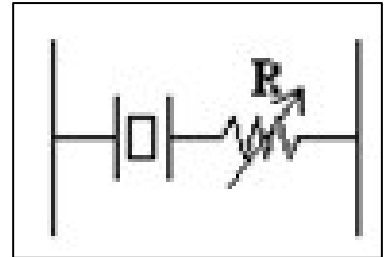
2. Adjust R so that the circuit does not oscillate; get the value of R at no oscillation.

$$R_n = R + R_L = \underline{979} + \underline{30.86} \text{ ohms}$$

$$|NR| = |-R_n| = \underline{1009.86} \text{ ohms}$$

$$\text{E.S.R.} = \underline{80.0} \text{ ohms}$$

$$n = |NR| / \text{E.S.R.} = \underline{1009.86} / \underline{80.0} = \underline{12.62}$$



n:

Poor -R value: $n < 5$

Normal -R value: $5 < n < 10$

Good -R value: $n > 10$



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Conclusion:

Q2 Freq. : 16.000000MHz , XX Type Crystal , CL : 9pF

Frequency and CL Matching: ☒ Good ☐ Passable ☐ Not matching

We try to change C3&C4 from 10pF&10pF to 12pF&12pF.

The frequency is -1.75ppm , and CL is 9pF.

The frequency and CL matching are good.

So we suggest that C3&C4 change into 12pF&12pF.

Drive Level: ☒ Good ☐ Passable ☐ Over range

The Driver Level is 1.75uW, and it is good .

N.R.: ☒ Good ☐ Passable ☐ Poor or Not enough

The n is 12.62, and it is good .