

Silicon Image

PanelLink[®]
Technology



DVI Compliance Test Kit User's Guide

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Application Information

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Revision History

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Introduction

The DVI specification, released in 1999, has been widely implemented by a number of computer OEMs, monitor makers, graphics board vendors, and cable manufacturers. PC 2001 Design Guide requires host systems with the DVI interface, which output digital graphics data to be DVI compliant.

The intent of this document is to provide users of DVI and HDMI Technology with the information to enable validation of their DVI implementations and ensure compliance with the DVI electrical specifications. It is an elaboration on the requirements and test procedures described in the original specification, and describes specific test hardware and recommended measurement equipment and techniques that should be used.

As DVI hardware from multiple vendors becomes more widespread and configurations where components from more than one silicon vendor are required to interface with each other, the ability to guarantee compliance with the specification is paramount. Furthermore, due to the high speed signaling supported by the DVI standard, design issues such as board layout, routing and other system parameters can affect the integrity of the DVI transmission link.

The DVI Compliance Test Kit should be used to ensure that the Transmitter design meets the DVI standard of compliance for single link and dual link designs. The subsequent chapters will describe each part of the DVI Compliance Test Kit and describe the correct method to set the kit for accurate measurements.

DVI Compliance Test Kit Description

The DVI Compliance Test Kit contains 6 different boards and other components listed below. Each CRU board will be hand tuned separately (please see page 5 for explanation) and marked for either CE or PC resolutions. The boards can be used to measure at test points TP2 and TP3 as illustrated in Figure 1:

- CRU (Clock Recovery Unit) Board used in all test points as a trigger source.
- TPA2 Plug Board V.2– to measure DVI compliance at TP2
- TPA2 Receptacle Board V.1 – to measure DVI compliance at TP3
- Two 6.0 inch / 15.25 cm (as measured from end of connector) 50-ohm SMA to SMA Cables
- One SMA to BNC Cable
- 120V AC to 12V DC Power Supply (Center +ve)
- CD containing:
 - a. Pseudo-random and Half-clock patterns in .BMP format for UXGA, SXGA, XGA, SVGA and VGA resolutions.
 - b. User's Guide (this document)

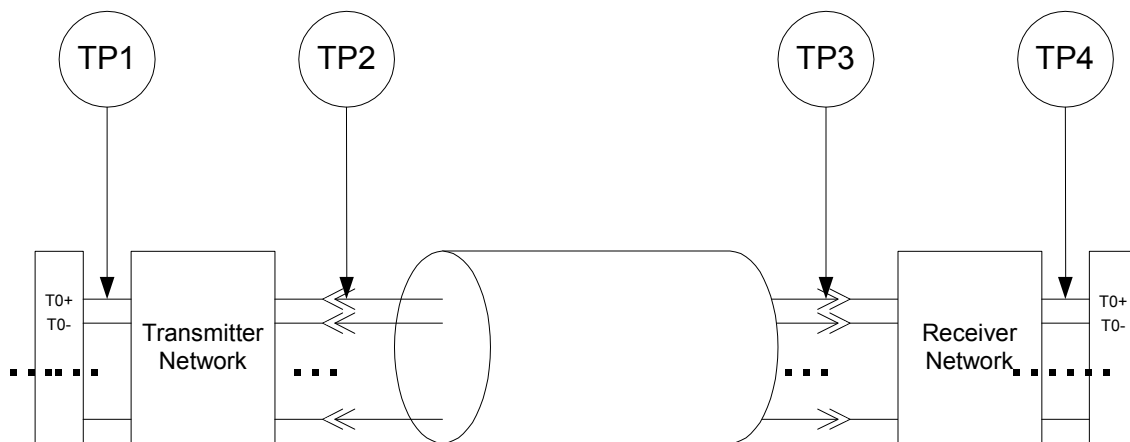


Figure 1. Test Point Guide

Several additional pieces of equipment are needed to measure the DVI Eye Diagram using the DVI Compliance Test Kit. The required equipment includes:

- Oscilloscope with 3.5GHz or greater bandwidth and “DPO” mode (as provided on some Tektronix scopes) or any comparable feature found in equipment from other manufacturers.
- Active Differential probes (at least 3.5GHz)

Board Description

The DVI Compliance Test Kit includes one Clock Recovery Unit (CRU) board and two Test Point Access (TPA2) boards.

CRU Board Outline

Figure 1 illustrates the board outline and component list for the CRU board.

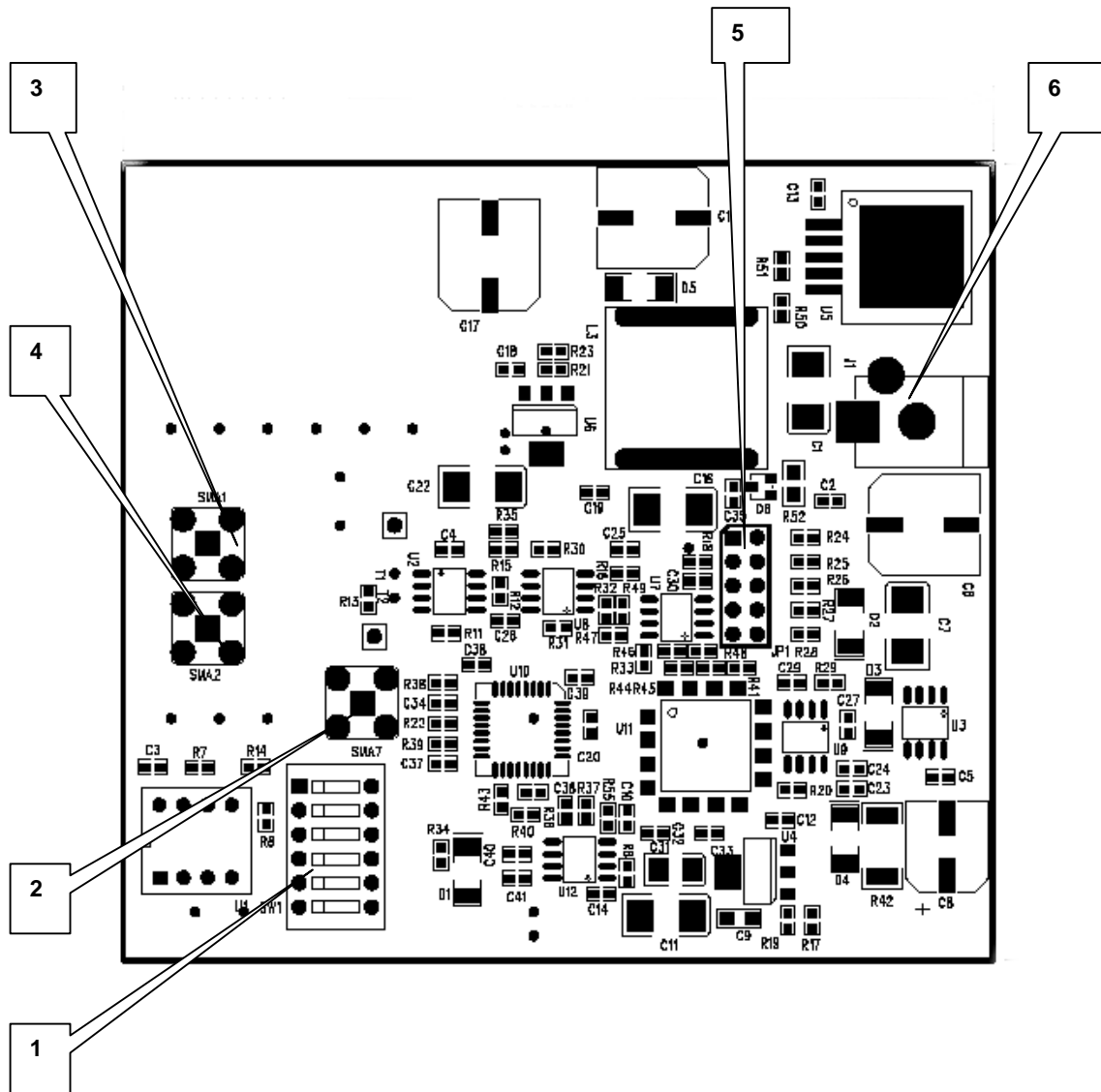


Figure 2. CRU Board Outline and Components

CRU Board Description

The clock transmitted over the TMDS link contains both low frequency and high-frequency components of jitter. The Clock Recovery Unit board PLL will pass the low-frequency jitter components, and block the high-frequency jitter components. The clock output of the CRU board will in this way follow slow clock jitter such as drift and wander.

Therefore, using the output of the CRU board to trigger the scope when making DVI compliance measurements will effectively remove the impact of low-frequency jitter from the measurement. The DVI architecture is designed to render low-frequency jitter unimportant, so only high-frequency jitter needs to be considered when determining link performance.

Devices selected for the CRU board including the Operational Amplifier, Differential Amplifier and VCO have been carefully tested for optimal performance. The Bill of Materials lists the all devices used in the CRU and TPA2 boards. Table 1 includes description of the headers and connectors that are called out in Figure 2.

Table 1. CRU Component Description and Function

Item	Description	Function
1	SW1, Divider Switch	Feedback Divider for CRU
2	SMA7 header for Recovered Clock	Recovered Clock from CRU
3	SMA1 connector for RC+	TMDS Clock from Transmitter
4	SMA2 connector for RC-	TMDS Clock from Transmitter
5	JP1, Gain Tuning Header	Gain Tuning selector
6	J1	12V Power Supply Power Jack +ve center

Once configured correctly (see Table 3 for configuration settings), the CRU board will output a 1X clock that can be used as a reliable trigger source. Note that the previous family of TPA-P and TPA-R boards output a 2.5X clock.

Note: The duty cycle of the output clock is **not** designed to provide 50/50 operation. In addition, its amplitude will range from 700mV to 1V. Figure 3 shows a snapshot of the expected waveform of a 65MHz recovered clock.

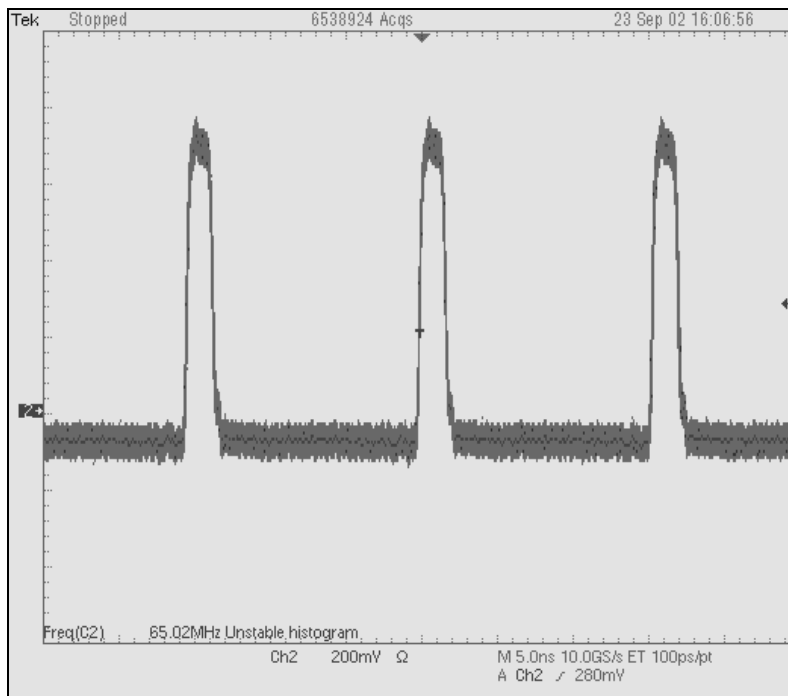


Figure 3. Recovered PLL Clock

Power to the CRU should be supplied by a 12V external power supply via power jack J1. The CRU will not operate unless power is supplied.

Jumper and Switch Setting

Each CRU board is hand-calibrated using precision measurement equipment (such as a spectrum analyzer) to achieve the best possible accuracy. The Main Amplifier is tuned using a main set of resistors and an auxiliary set of resistors that correspond to each of the selectable frequencies.

Main resistors R24, R25, R26, R27 and R28 are in parallel with R1, R2, R3, R4 and R5, respectively (refer to schematic on page 17). The first phase of calibration is to come close to a “target value” that should provide the proper gain for 4MHz bandwidth at the frequency of interest. Table 2 lists the Target Values, along with the typical Main Resistor and parallel Auxiliary Resistor used to achieve that target value.

The second phase of calibration involves spectrum analysis measurement of each board at the frequencies of interest to determine whether further gain adjustment is required. Part-to-part differences, especially regarding the VCO itself, will cause variation in the gain and therefore frequency response from one board to the next.

The ultimate accuracy of adjustment is somewhat limited by the availability of standard resistor values. Because of this, the accuracy after calibration can be expected to be within the limits listed in Table 3.

Table 2. Main VCO Resistor Values for PC and CE Application

CE				PC			
Frequency (MHz)	Target Value	Main Resistor	Auxiliary Resistor	Frequency (MHz)	Target Value	Main Resistor	Auxiliary Resistor
162	1420Ω	R24=1.5kΩ	R1=24kΩ	162	1420Ω	R24=1.5kΩ	R1=24kΩ
108	888Ω	R25=910Ω	R2=36kΩ	108	892-960Ω	R25=910Ω	R2=36kΩ
74	620-650Ω	R26=650Ω	R3=TBD	65	610-620Ω	R26=650Ω	R3=13kΩ
54	448Ω	R27=470Ω	R4=10kΩ	50	432-435Ω	R27=470Ω	R4=6kΩ
27	275Ω	R28=1.5kΩ	R5=300Ω	25	267-270Ω	R28=1.5kΩ	R5=330Ω

To ensure accurate and stable clock recovery, SW1 and JP1 must be set according to the incoming frequency. Table 3 shows how to set SW1 to select the 1/N feedback divider for the frequency range of interest, and then set JP1 to calibrate the clock voltage gain for that frequency range. The last column lists the accuracy of the bandwidth relative to the target 4MHz bandwidth of the VCO.

Table 3. Jumper and Switch Setting For the Correct Frequency Range

Frequency Range	JP1 Setting	SW1 Setting	CE Mode: When used for this frequency	PC Mode: When used for this frequency	Worst case accuracy
23-30MHz	5	001011	27MHz	25MHz	10%
45-60MHz	4	100101	54MHz	40MHz	10%
63-83MHz	3	101101	74MHz	65MHz	10%
89-118MHz	2	110011	108MHz	108MHz	10%
125-166MHz	1	110111	162MHz	162MHz	10%

Using FET Probes instead of SMA Cables for Trigger Source

The CRU board design is flexible. While the SMA to BNC cable is recommended for connecting the recovered clock signal to the Oscilloscope, it is also possible to use a FET probe to achieve the same objective. To use a FET Probe in place of the SMA to BNC Cable, remove the SMA connector. Mount 2 headers, one for the clock signal and the other for the ground. Attach the FET Probe directly into the header.

TPA2 Board

The DVI Compliance Test Kit includes two separate TPA2 boards for different purposes. Figure 4 shows an outline of the two boards.

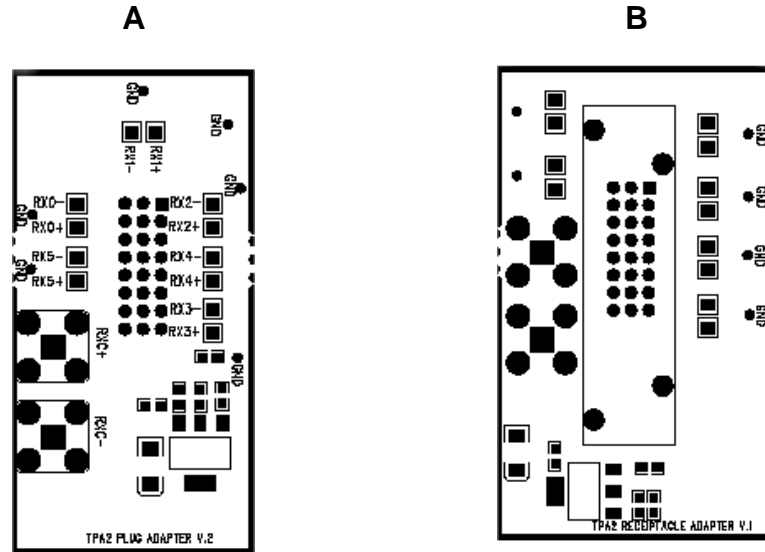


Figure 4. Outlines for TPA2 Board Adapters

Table 4. TPA2 Board Types

Item	Description	Function
A	TPA2 P (Plug) Adapter Board	Measure DVI Eye Diagram at TP2 (transmitter end)
B	TPA2 R (Receptacle) Adapter Board	Measure DVI Eye Diagram at TP3 (cable end)

TPA2 Plug Adapter Board

The TPA2 Plug Adapter board is exclusively designed to measure the Transmitter Eye diagram at TP2 as listed in Figure 1. It should be connected directly at the DVI connector of the Transmitter. It includes a DVI male connector, an EDID PROM and test points. The differential TMDS data input signals are pulled high with 50Ω resistors and are accessed by way of the test points. **Do not mount or solder headers** on the test points. The EDID PROM is powered by the 5V supplied by the DVI connector.

TPA2 Receptacle Adapter Board

The TPA2 Plug Adapter board is exclusively designed to measure the Transmitter Eye diagram at TP3 as listed in Figure 1. It should be connected directly at the end of the DVI cable connecting the Transmitter. It includes a DVI female connector, an EDID PROM and test points. The differential TMDS data input signals are pulled high with 50Ω resistors and are accessed by way of the test points. **Do not mount or solder headers** on the test points. The EDID PROM is powered by the 5V supplied by the DVI connector.

Eye Diagram Measurement Procedure

Setting up for Measurements at TP2 or TP3

Patterns used: Half-clock and Pseudo-random

Test equipment:

- Active Differential probe
 - SMA to SMA cables
 - SMA to BNC cable or FET Probe (see page 5 for instructions)
 - Oscilloscope
 - Power supply
 - UXGA capable monitor with DVI connector
- Attach the DVI monitor to the graphics unit.
 - Select a resolution for test and display the Half-clock pattern in full screen mode.
 - Unplug the monitor and connect the TPA2 Plug board directly to the DVI output of the video source.
 - Confirm the frequency output of the DVI device by measuring RC+ or RC- on the TPA2 board with the oscilloscope.
 - Ensure the CRU is set to operate in the correct frequency. See Table 3 for the correct settings.
 - The CRU must be warmed up for reliable operation. To achieve this, power the CRU for 5 minutes before proceeding to the next step. Note that the board normally runs somewhat hot.
 - Attach the SMA-to-SMA cable from the RC+ and RC- from TPA2 Plug board to the respective CRU SMA input headers. Once completed the setup should look like the illustration in Figure 5.
 - Proceed to the instructions in the next section on how to use the Tektronix semi-automated DVI Software to verify DVI Compliance results.

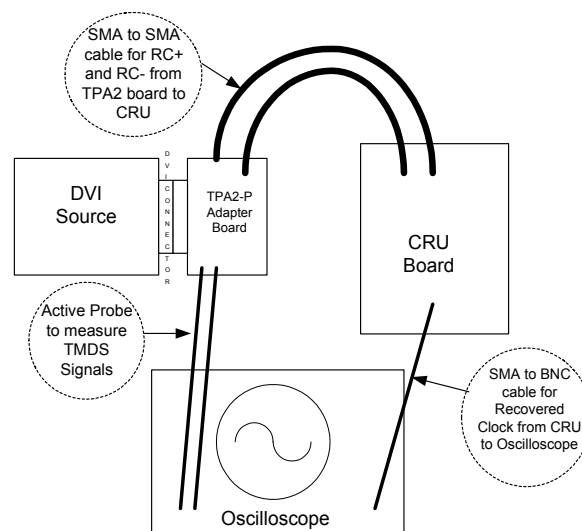


Figure 5. Setup Block Diagram for Measurement at TP2

Using the Tektronix DVI Compliance Test Software

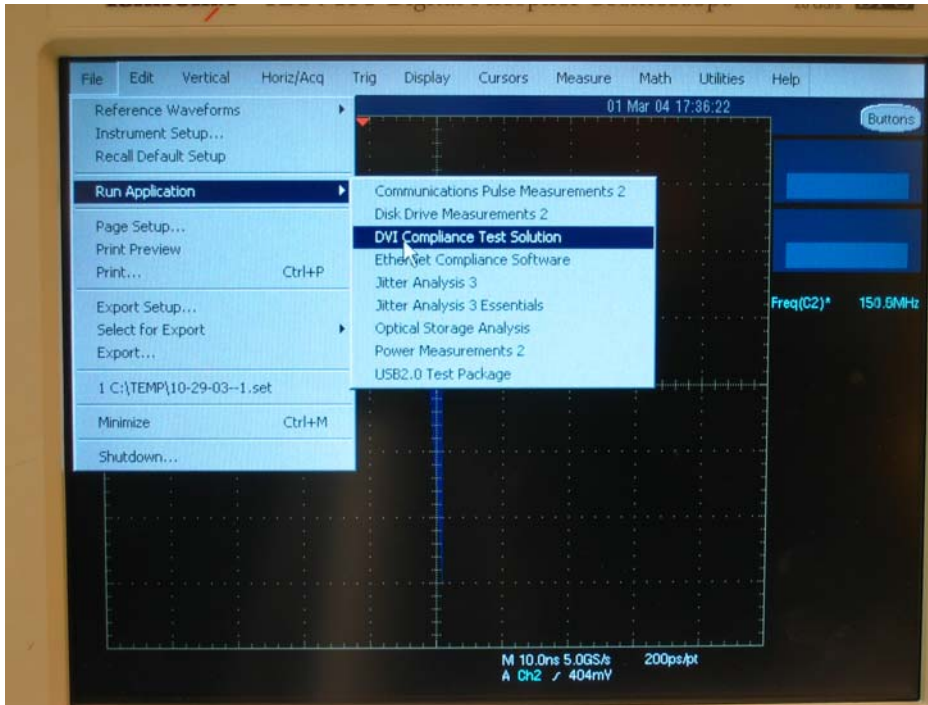
The DVI Compliance Test Solution application version 1.0.0 is the only application that has been verified by Silicon Image, Inc. to reliably determine DVI signal compliance. Other solutions may also provide this capability.

The following section provides guidance in using this application to capture and generate a DVI compliance report.

Step 1

a. Launch the DVI Compliance Test Solution version 1.0.0 software in the Tektronix oscilloscope via the file pull-down menu.

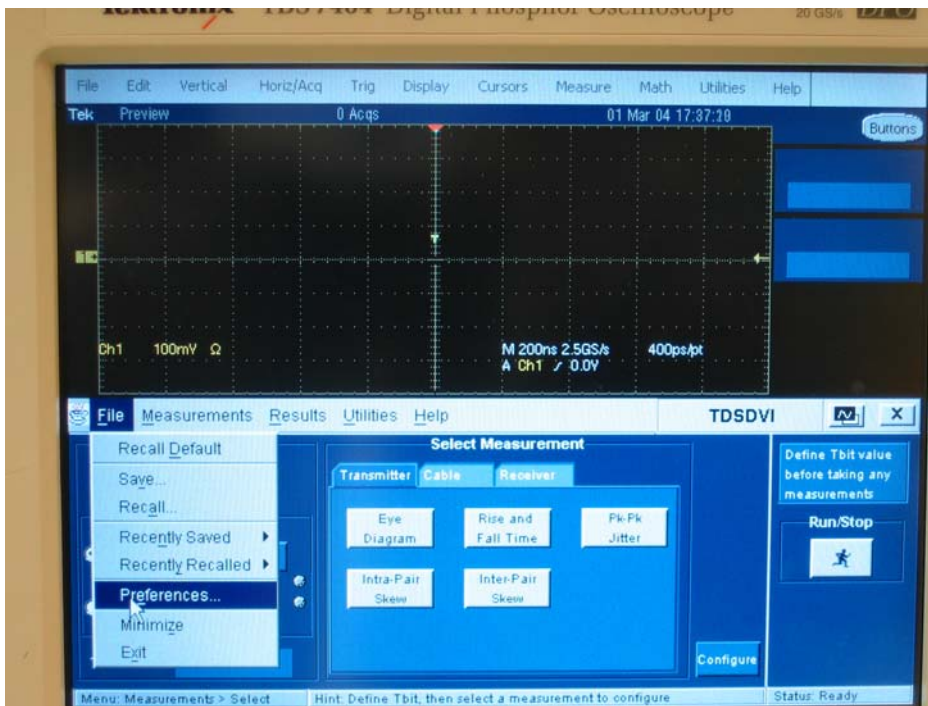
b. Select the DVI Compliance Test Solution application.

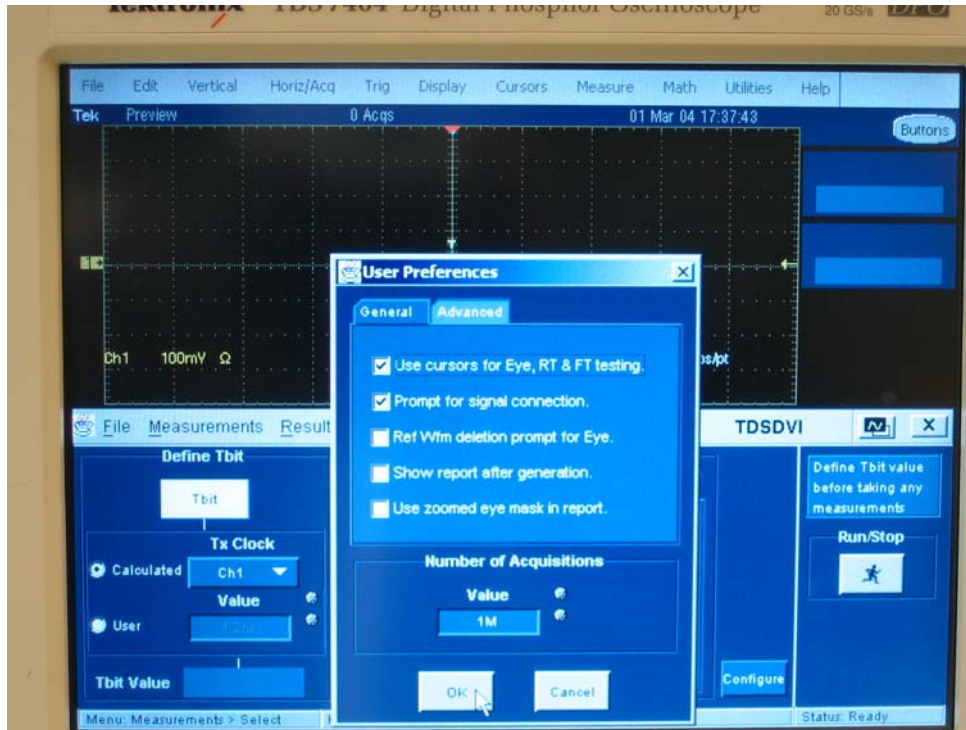


Step 2

a. After launching the application, ensure the clock is connected to Channel 1

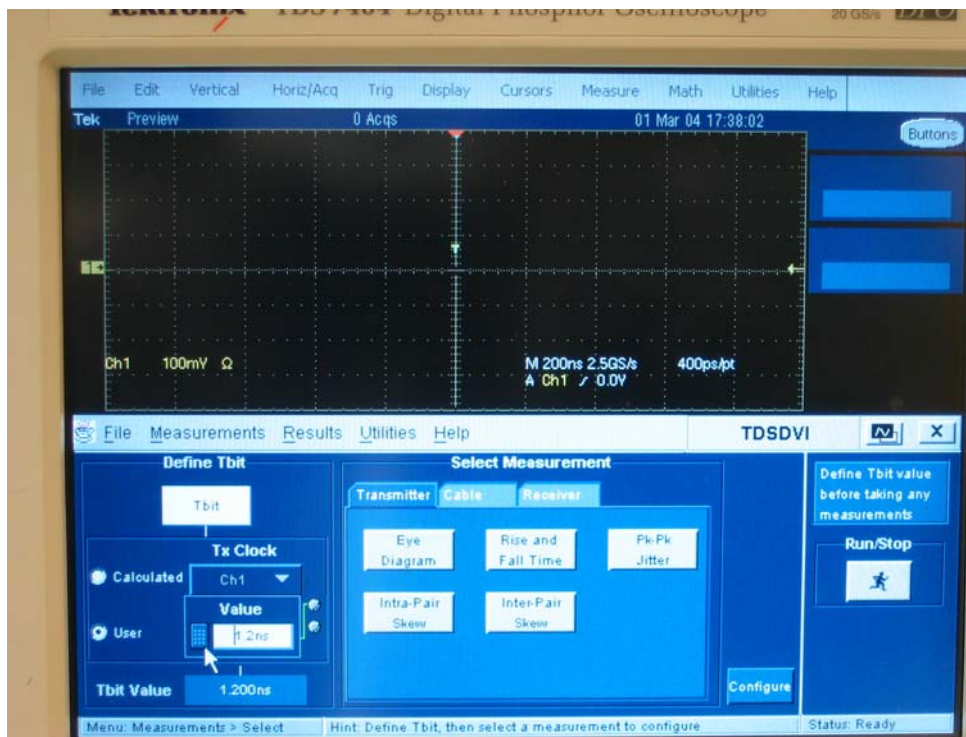
b. Click on the File menu of the application and select Preferences.





Step 3

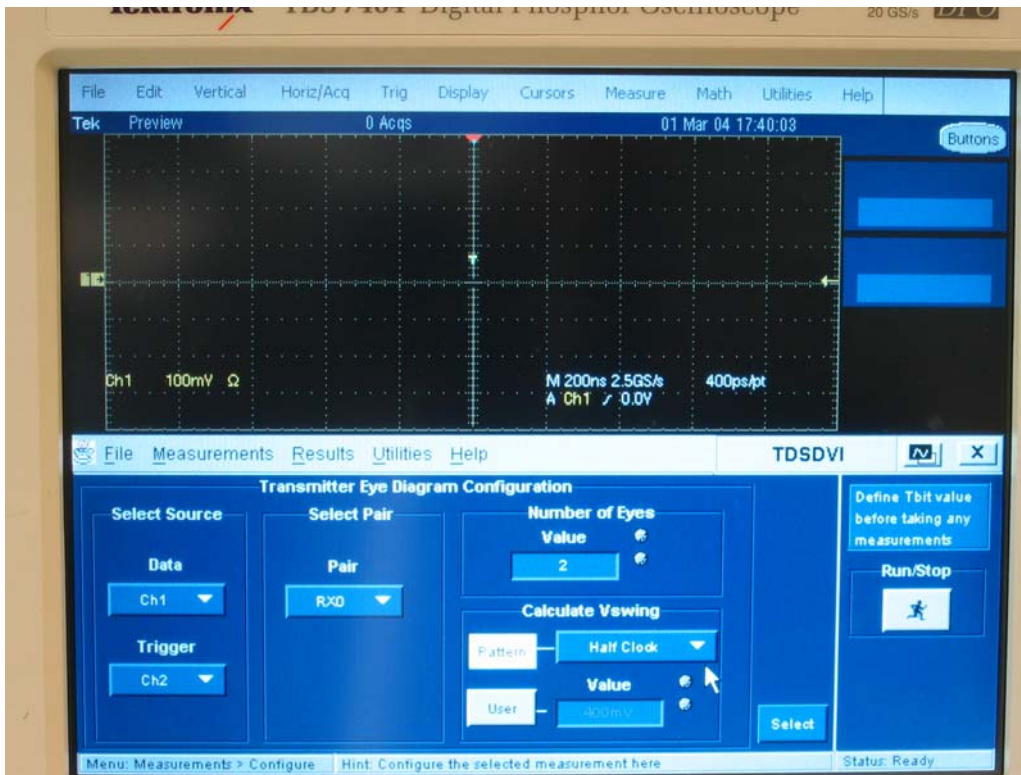
- a. Check only the first two check boxes.
- b. Click OK to proceed to the next step.



Step 4

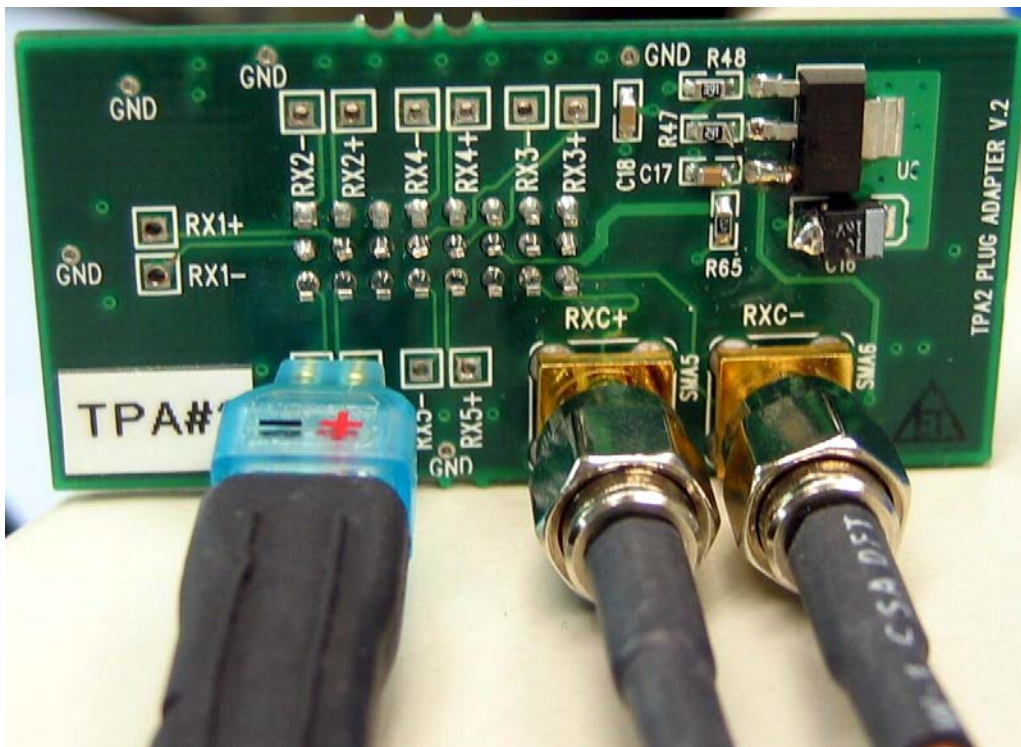
- a. Check the User button and input the exact T_{bit} for the resolution to be verified.

For the example case, enter 617ps for UXGA @ 60Hz.



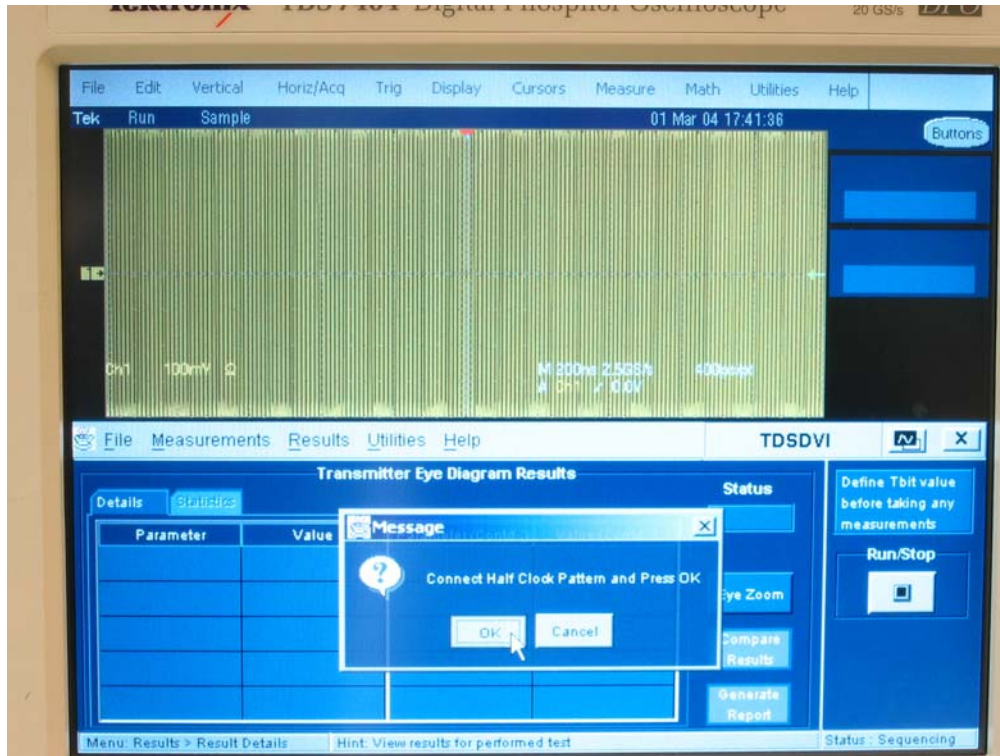
Step 5

- a. Click on the Configure button
- b. Select Half-clock in the Pattern box.
- c. The system to be tested must display the Half Clock Pattern on the UXGA display. Use the Irfanview program (which is unique in that it can display edge-to-edge bitmaps without borders). Select the UXGA Half-clock bitmap file. Both are provided on the DCT Kit CD. Check the output on the DVI Display. The bitmap should fill in all areas of the DVI Display screen.



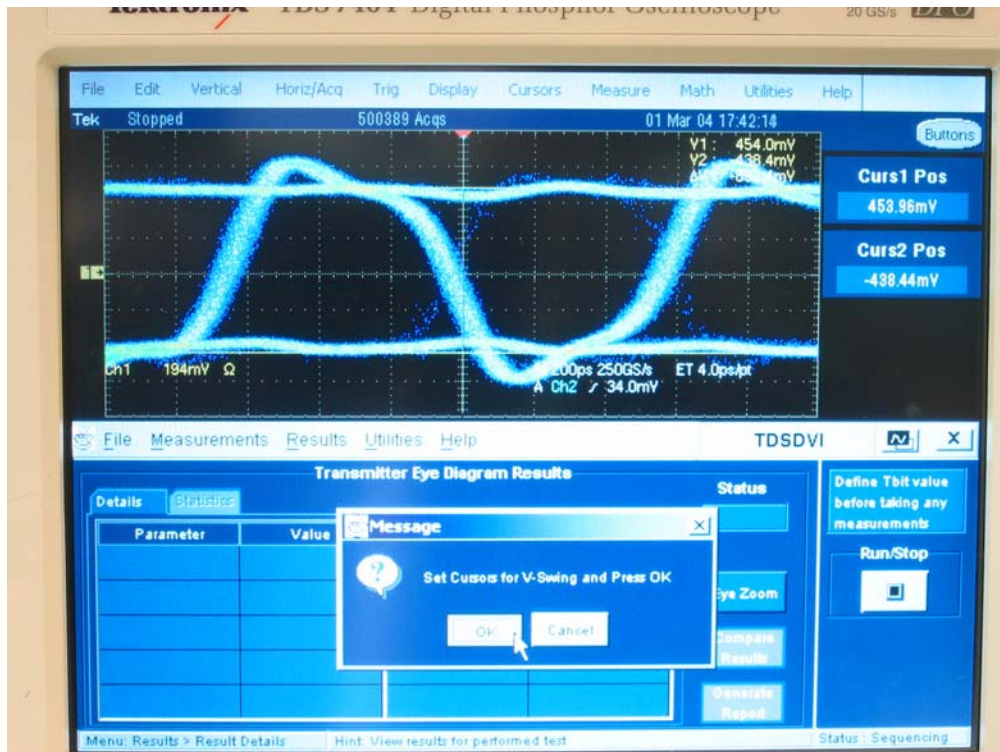
Step 6

- a. The TPA2-P board should be connected with the Differential Probes and SMA cables as shown in this picture.
- b. Connect the TPA2-P board to the DVI connector of the graphics system to be tested.



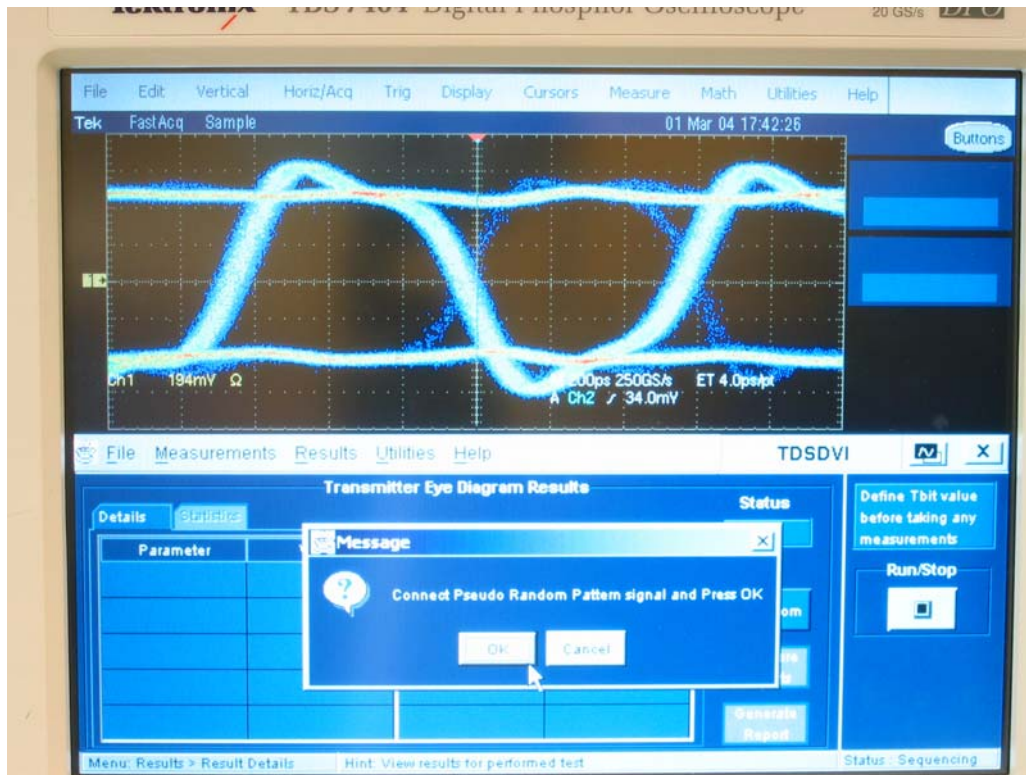
Step 6

- a. Once steps 4 & 5 have been completed, click OK.
- b. Wait until the DVI Compliance Test Solution software prompts for the next instruction.



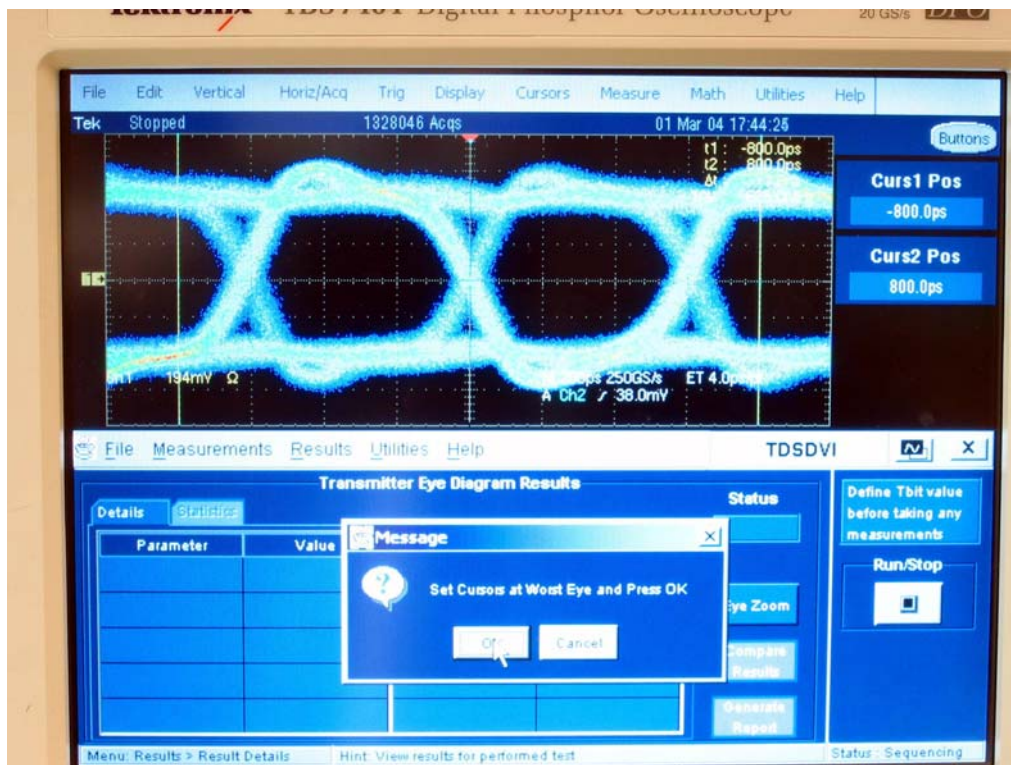
Step 7

- a. Use the horizontal cursors to set the Voltage Swing.
- b. Ensure that the Vswing for both levels are not set at the peak but at the level shown in the picture.
- c. Click OK to proceed to the next step.



Step 8

- a. The application will prompt for usage of Pseudo-random pattern.
- b. Follow the method listed in step 5, substituting the Half-clock pattern with Pseudo-random pattern.
- c. Once this is done, click OK to proceed to the next step.



Step 9

- a. Set the vertical cursors at the worst-case intersections of the eye opening. If one eye is smaller than the adjacent eye, choose the smaller eye.
- b. Click OK to proceed.



Step 10

a. The application will complete the evaluation and will list the status of the DVI eye diagram.

Appendix A – Eye Measurement Accuracy

Differential probes and the way they are handled can adversely affect the outcome of an eye diagram measurement. This appendix shows ways to make DVI measurements as accurately as possible using the Tektronix TDS 7404 series of scopes, and their associated differential probes P6330, P7330, and P7350, but can also be applied to other brands of test and measurement equipment.

Differential Probes Accuracy Specification

Tektronix differential probes, namely P6330, P7330, and P7350 models that are used in the Silicon Image, Inc. DVI Compliance Test Center, have voltage measurement accuracy in the range of +/-100mV. Refer to Figure 6 for two actual measurements of the same source (shown in Figure 7) or from page 23 of the P7330 user manual. In situations where the performance of the device under test is close to the limits of compliance with the DVI specification, this variation in probe performance could falsely indicate a compliance failure.

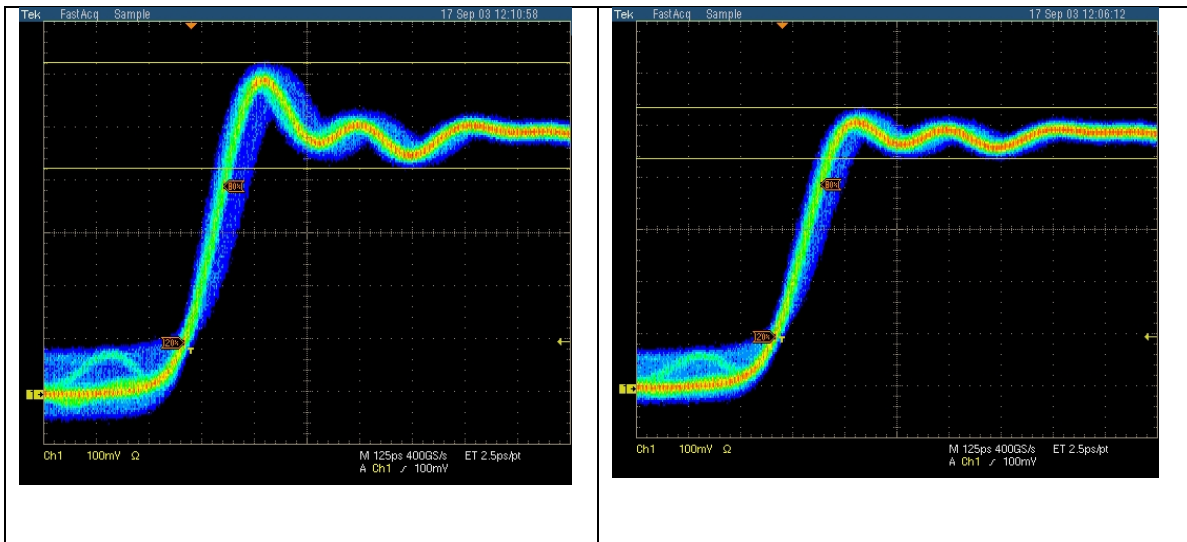


Figure 6. P7330 Result from Precision Source of Figure 2. Left: P7330 Probe. Right: P6330 Probe.

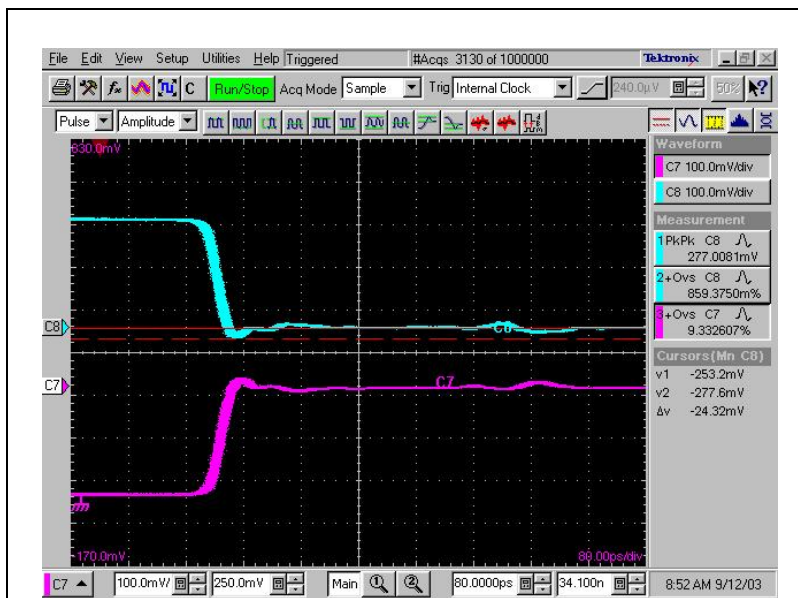


Figure 7. Precision Source from TDS 8000 & 80E04 Generator

Getting to Know the Differential Probe

Probe artifacts, which will be injected into the overall measurement result, must be known. In order to extract the artifact information, the probe output must either be measured against a known precision source or directly compared against a flat frequency response passive probe.

In the first method, a suitable precision source can be the step output signal from a TDS 8000 scope with its associated 80E04 sample module. This scope and sample module can output a signal with less than 17.5ps rise time and greater than 10mV voltage accuracy. Refer to Figure 7 and Figure 8.

In the second method, a flat frequency response thevenin equivalent terminator can be used as a passive scope probe. One such commercially available unit is the PECL terminator model 5622-107 from Picosecond Pulse Labs. Measure and compare the results of the differential probe against the precision output source or the flat frequency response probe. Once probe artifact characteristics are known, an adjustment in measurement can be made intuitively.

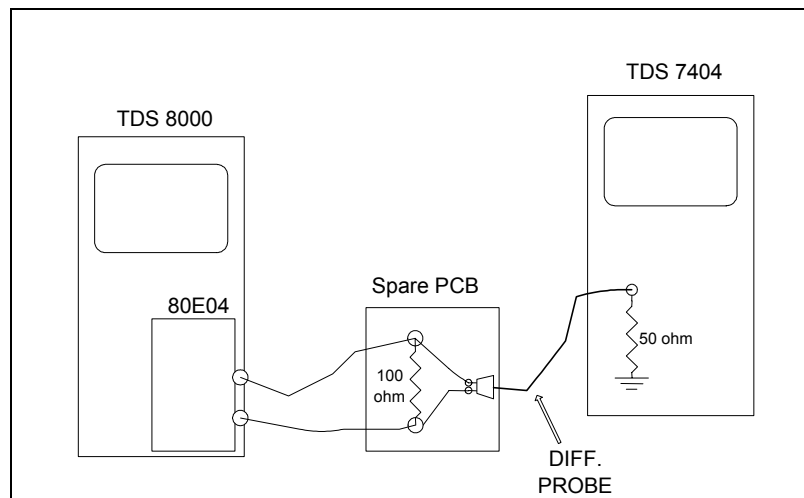


Figure 8. Setup Used to Measure Precision Source

Measurement Effects of Probe Tip and Probe Tip Adapters

Tektronix P6 and P7 series of probes come with two tip adapters: a variable spacing adapter and a square pin adapter. Tip adapters make connection easier, but also add artifacts to the measurement result. Experiments in the lab show an addition of 120mV and 65mV overshoot results from using the square pin adapter and variable spacing adapter respectively versus the probe-only (without adapter) result. Since the probe-only solution is very expensive in terms of the cost of replacing entire probe assemblies if damaged, use this only when the data is marginal. **Avoid using the square pin adapter under all circumstances.** The recommended method is to use the variable tip adapter for most of the measurements. Figure 9 below, from Tektronix P7330 user manual, shows different tips adapters and their effect on the signal measurements.

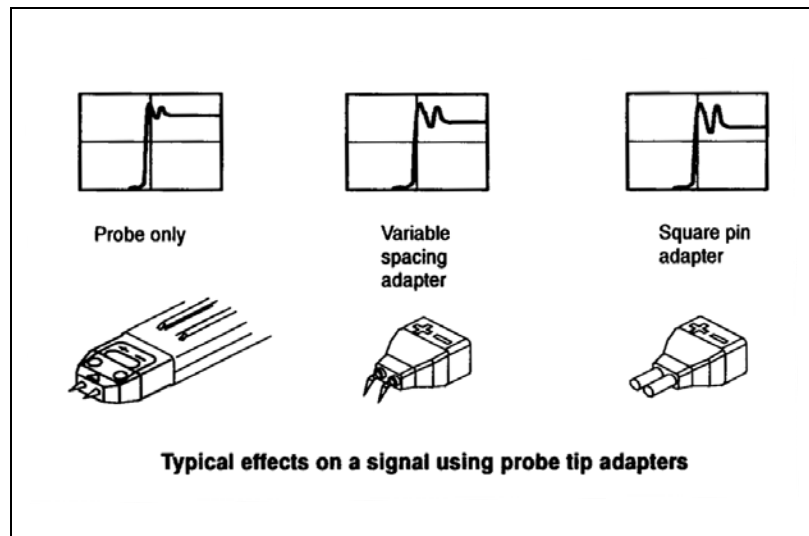


Figure 9. Probe Tip Adapters and Their Effects on a Signal

Use of Silicon Image DVI Test Boards

The Test Point Access (TPA2) boards provided by Silicon Image as part of its DVI Compliance Test kits provide access holes for probe tips or probe tip adapters. **Under no circumstances should two-pin headers be installed in these holes.** Header pins will add massive artifacts to the signal being measured and must never be used. If two-pin headers are ever found they should be removed and the holes cleared of any remaining solder.

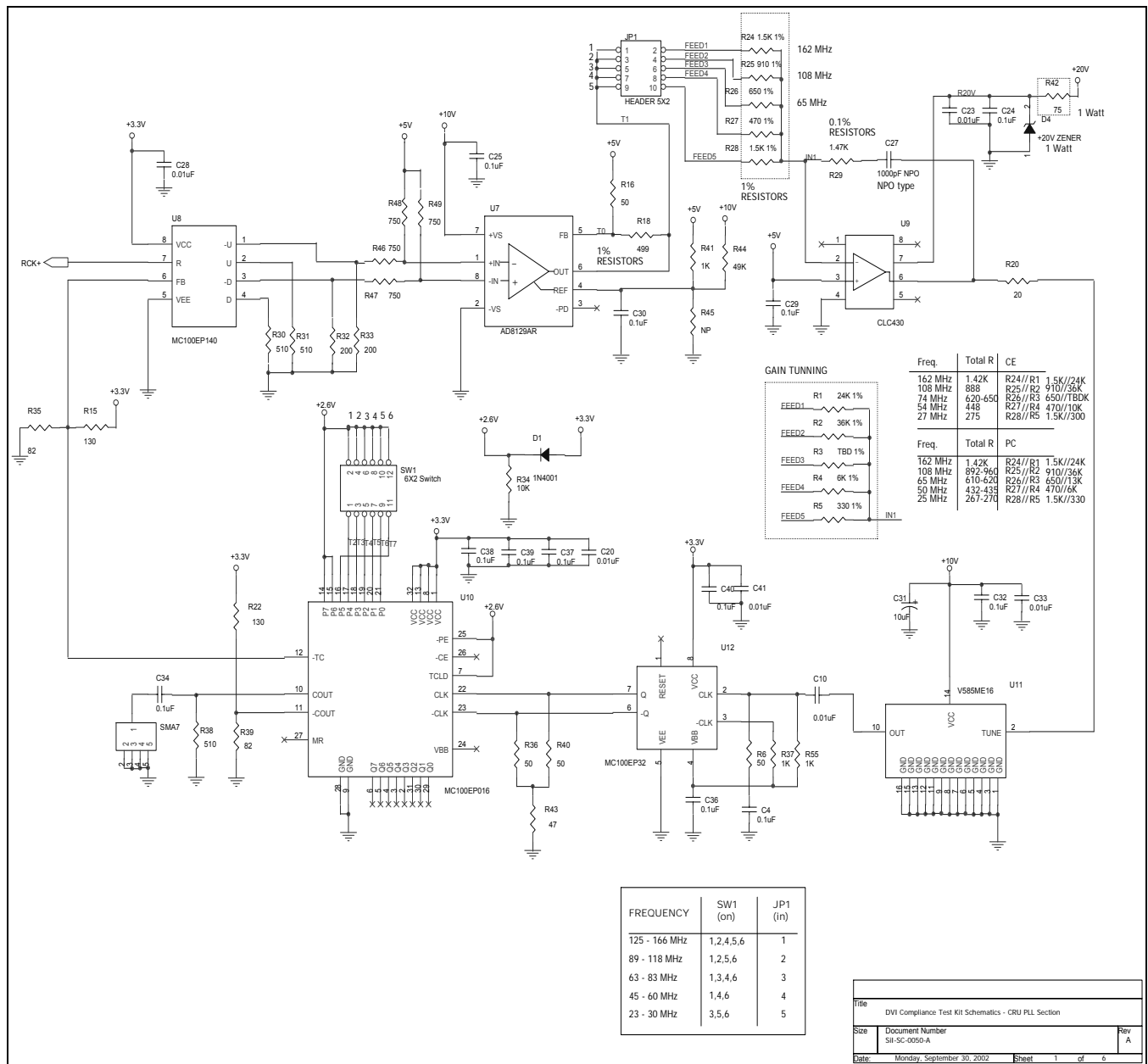
The Clock Recovery Unit (CRU) boards in the test kit are designed to work properly only when warmed up for at least 5 minutes. The CRU board runs hot; this is normal. However, if the board has been running for over an hour it may get too hot to operate correctly. This condition will be indicated by the output clock not locking reliably to the input frequency. When this occurs, simply unplug the board and let it cool down. It will once again need to be warmed up for at least 5 minutes before use.

Probe/Scope Handling

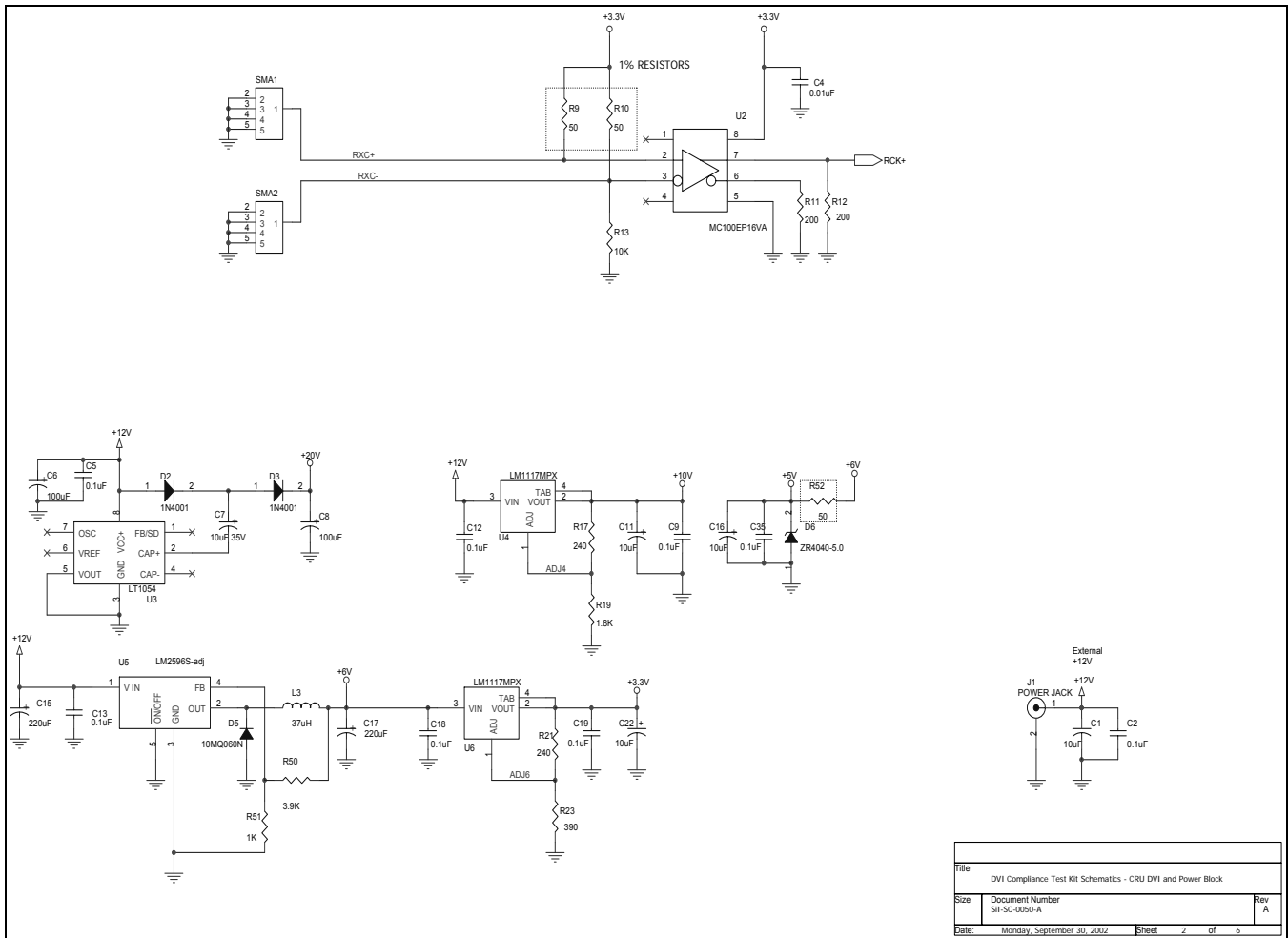
Tektronix recommends running Signal Path Compensation on the TDS 7404 scope at least once a week or any time the temperature of this scope is changed by 5°C. The probe should be calibrated to the channel of the scope, especially whenever it has been removed from that channel. The whole instrument must be warmed up at least 20 minutes before any measurement can be taken.

Appendix B - Schematics

CRU Schematics

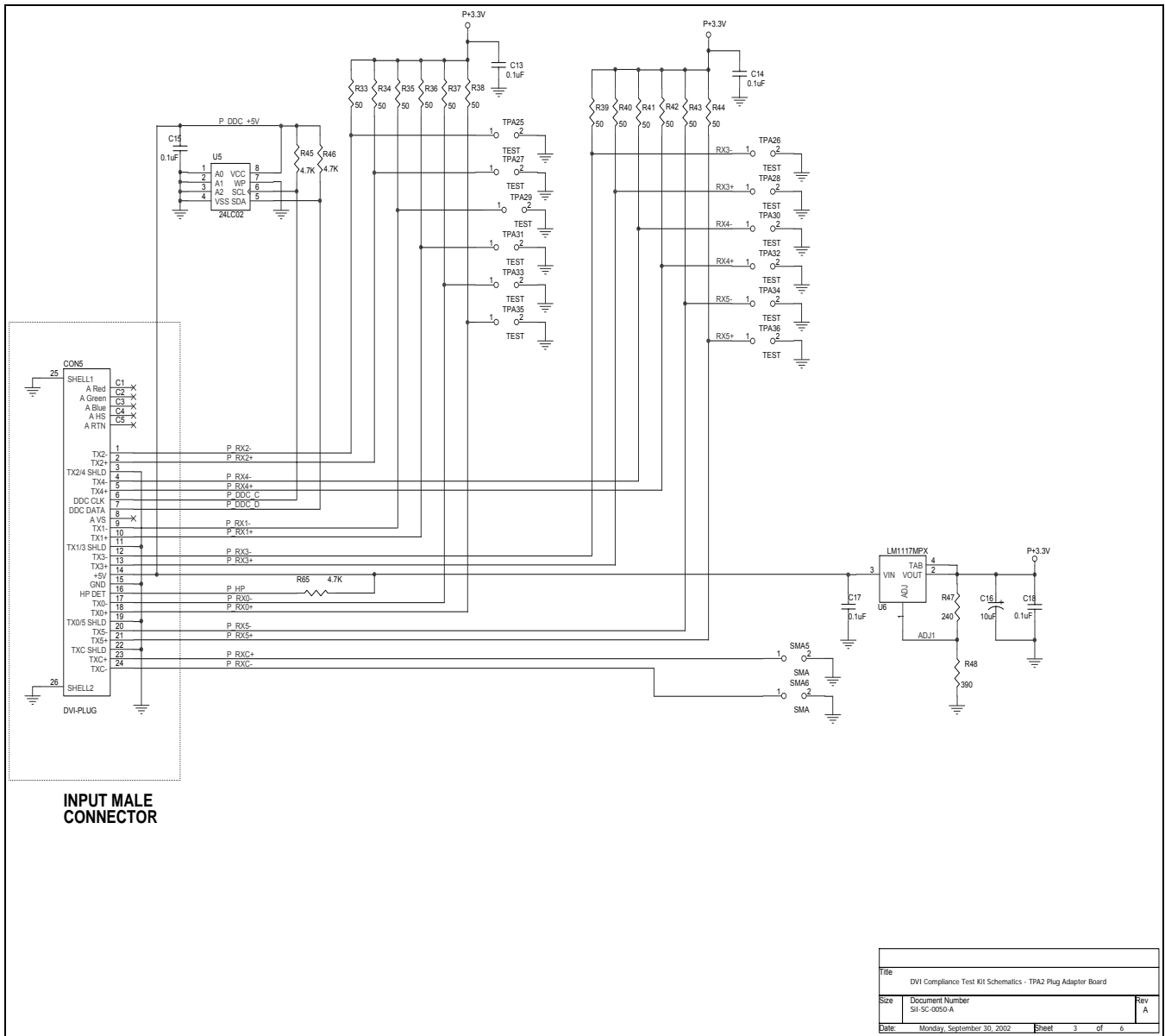


CRU Power Supply Schematics



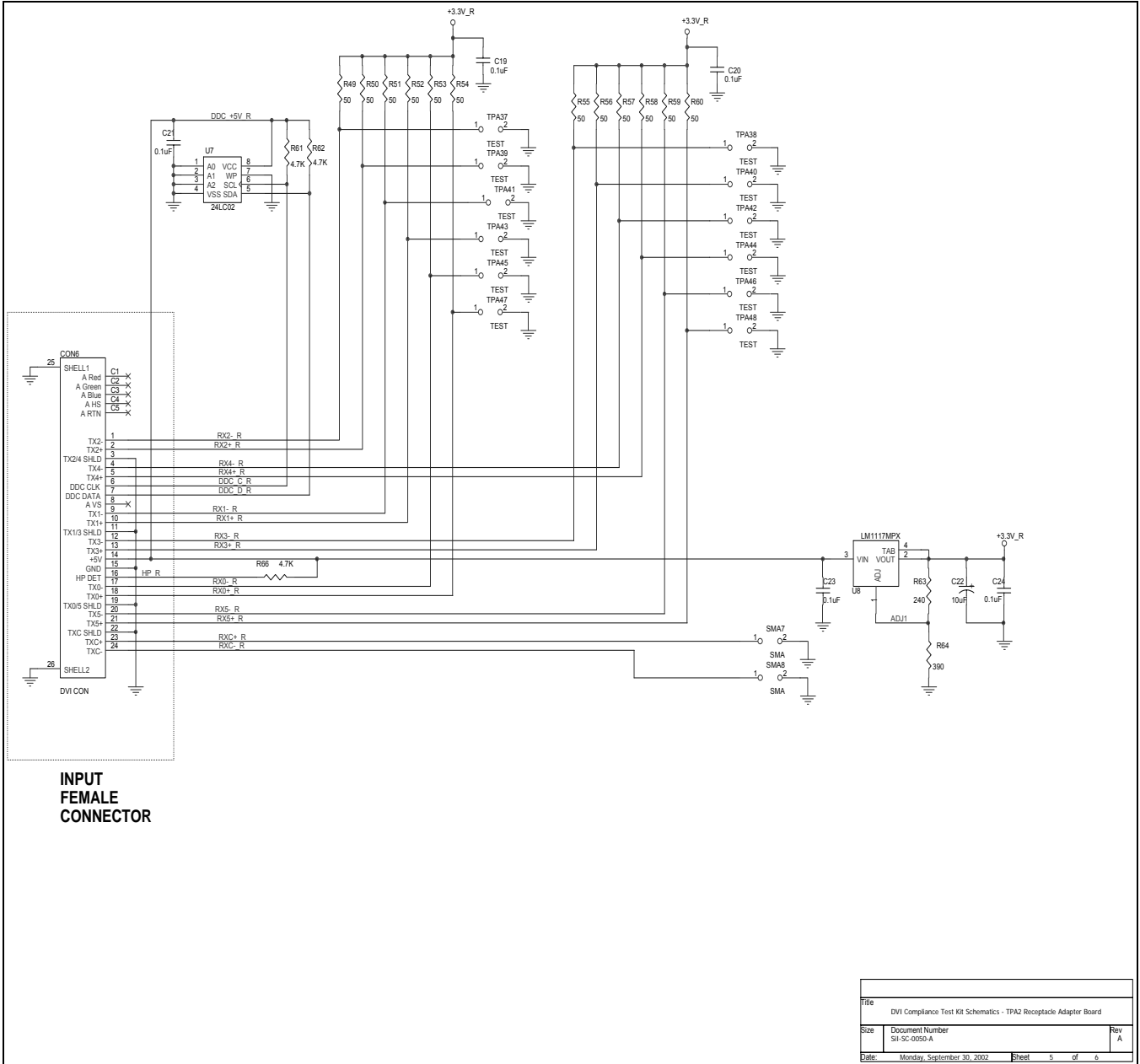
Title		
DVI Compliance Test Kit Schematics - CRU DVI and Power Block		
Size	Document Number SII-SC-0050-A	Rev A
Date	Monday, September 30, 2002	Sheet 2 of 6

TPA2 Plug Adapter Schematic



Title		
DVI Compliance Test Kit Schematics - TPA2 Plug Adapter Board		
Size	Document Number	Rev
	SI-SC-0050-A	A
Date	Monday, September 30, 2002	Sheet 3 of 6

TPA2 Receptacle Adapter Schematics



Appendix C - Bill of Materials

CRU Bill of Materials

Table C1. CRU Board Bill of Materials

Item	Units	Reference	Part	Description	Size	Vendor	P/N
1	1	JP1	HEADER 5X2	0.1" 10-PIN HEADER THRUHOLE		MOLEX	DIGIKEY
2	1	SW1	6X2 Switch	0.1" 6x2 DIP SWITCHES THRUHOLE		CTX	DIGIKEY
3	1	C27	1000pF NPO	CERAMIC CAP NPO	SMT 0603	PANASONIC	DIGIKEY PCC2151CT- ND
4	20	C2,C5,C9,C12,C13,C18, C19 ,C24,C25,C29,C30,C32, C34 ,C35,C36,C37,C38,C39, C40,C14	0.1uF	CERAMIC CAP. X7R SMT	SMT 0603	PANASONIC	DIGIKEY 399-1137-1-ND
5	7	C4,C10,C20,C23,C28,C33, C41	0.01uF	CERAMIC CAP. X7R	SMT 0603	PANASONIC	DIGIKEY 399-1092-1-ND
6	5	C1,C11,C16,C22,C31	10uF	TANTALUM CAP. 16V	SMT B	PANASONIC	DIGIKEY PCS3106CT- ND
7	1	C7	10uF 35V	TANTALUM CAP. 35V	SMT B	PANASONIC	DIGIKEY PCS3106CT- ND
8	2	C8,C6	100uF	ELECTROLYTIC CAP. 35V	SMT G	PANASONIC	DIGIKEY PCE3152CT- ND
9	2	C17,C15	220uF	ELECTROLYTIC CAP. 16V	SMT G	PANASONIC	DIGIKEY PCE3147CT- ND
10	3	SMA1,SMA2,SMA7	SMA	SMA CONNECTOR THRUHOLE		AMPHENOL	DIGIKEY ARFX1231-ND
11	3	D1,D2,D3	1N4001	RECTIFIER DIODE	SMD MELF	M.C.C	DIGIKEY DL4001MSCT- ND
12	1	D5	10MQ060N	2.1A SCHOTTKY DIODE	D-64	IRF	DIGIKEY 10MQ060N-ND
13	1	D4	+20V ZENER	ZENER DIODE 1W OR HIGHER	DL-41	DIODES	DIGIKEY ZN4747ADICT- ND
14	1	D6	ZR4040-5.0	5V VOLTAGE REFERENCE	SOT-23	ZETEX	DIGIKEY ZR40401F50CT-ND
15	1	J1	POWER JACK	2.1 mm POWER JACK THRUHOLE		SWITCHCRA FT	DIGIKEY SC1153-ND
16	1	R3	13K	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
17	1	R45	NP	DO NOT POPULATE			
18	1	L3	37uH	2A INDUCTOR	SMT S4	TALEMA	DIGIKEY TE2063-ND
19	1	R20	20	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
20	1	R43	47	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
21	7	R6,R9,R10,R16,R36,R40, R52	50	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
22	1	R42	75	RESISTOR 1W 5%	SMT 2512	PANASONIC	DIGIKEY
23	2	R39,R35	82	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
24	2	R22,R15	130	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
25	4	R11,R12,R32,R33	200	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
26	2	R21,R17	240	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
27	1	R5	330	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
28	1	R27	470	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
29	1	R25	910	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY

Table C1. CRU Board Bill of Materials Continued

Item	Units	Reference	Part	Description	Size	Vendor	P/N
30	1	R26	650	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
31	2	R28,R24	1.5K	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
32	1	R1	24K	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
33	1	R4	6K	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
34	1	R18	499	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
35	1	R23	390	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
36	3	R30,R31,R38	510	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
37	4	R46,R47,R48,R49	750	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
38	4	R37,R41,R51,R55	1K	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
39	1	R29	1.47K	RESISTOR 0.5%	SMT 0603	SUSUMU	DIGIKEY
40	1	R19	1.8K	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
41	1	R50	3.9K	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
42	2	R34,R13	10K	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
43	1	R2	36K	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
44	1	R44	49K	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
45	1	U2	MC100EP16VA	ECL DIFF. RECEIVER ON SEMICONDUCTOR	SO-8	ON SEM.	AVNET MC100EP16VA
46	1	U3	LT1054	DC-DC UP CONVERTER	SO-8	LINEAR TECH	DIGIKEY LT1054
47	1	U7	AD8129AR	270MHz DIFF. AMP	SO-8	ADI	ANALOG DEVICE AD8129AR
48	1	U8	MC100EP140	3.3V ECL PFD ON SEMICONDUCTOR	SO-8	ON SEM.	AVNET MC100EP140
49	1	U9	CLC430	100MHz OP AMP	SO-8	NATIONAL SEM.	DIGIKEY CLC430AJE-ND
50	1	U10	MC100EP016	8-BIT UP COUNTER	TQFP-32	ON SEM.	AVNET MC100EP016
51	1	U11	V585ME16	1-2 GHz VCO Z - COMMUNICATION	MINI-14S	Z-COMM.	Z-COMM. V585ME16
52	1	U12	MC100EP32	5V ECL 2 DIVIDER ON SEMICONDUCTOR	SO-8	ON SEM.	AVNET MC100EP32
53	2	U4,U6	LM1117-ADJ	ADJ. VOLTAGE REGULATOR	SOT-223	NATIONAL SEM.	DIGIKEY LM1117MPX-ADJ-ND
54	1	U5	LM2596S-ADJ	ADJ. VOLTAGE REGULATOR	TO-263	NATIONAL SEM.	DIGIKEY LM2596S-ADJ-ND

TPA2 Plug Board Bill of Materials

Table C2. TPA2 Plug Board Bill of Materials

Item	Units	Reference	Part	Description	Size	Vendor	P/N
1	1	CON5	DVI-PLUG	DVI MALE CONNECTOR	NA	MOLEX	0743232003
2	5	C13, C14, C15, C17, C18	0.1uF	CERAMIC CHIP CAP. X7R, 16V	SMT 0603	PANASONIC	DIGIKEY PCC1762CT-ND
3	1	C16	10uF	TANTALUM CAP. 16V	SMT B	PANASONIC	DIGIKEY PCS3106CT-ND
4	2	SMA5, SMA6	SMA	SMA CONNECTOR THRUHOLE	NA	AMP TYCO	DIGIKEY ARFX 1231-ND
5	12	TPA25, TPA26, TPA27, TPA28, TPA29, TPA30, TPA31, TPA32, TPA33, TPA34, TPA35, TPA36	TEST	TEST POINT	NA		
6	12	R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44	50	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
7	1	R47	240	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
8	1	R48	390	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
9	3	R45, R46, R65	4.7K	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
10	1	U5	24LC02B	2KB EEPROM	SO-8	MICROCHIP	24LC02B
11	1	U6	LM1117	LDO ADJ. VOLTAGE REGULATOR	SOT-223	NATIONAL SEM.	DIGIKEY LM1117MPX-ADJ

TPA2 Receptacle Board Bill of Materials
Table C3. TPA2 Receptacle Board Bill of Materials

Item	Units	Reference	Part	Description	Size	Vendor	P/N
1	1	CON6	DVI CON	DVI RECEPTACLE CONNECTOR vertical		MOLEX	74320-5000
2	5	C19, C20, C21, C23, C24, C25	0.1uF	CERAMIC CHIP CAP. 16V, X7R	SMT 0603	PANASONIC	DIGIKEY PCC1762CT-ND
3	1	C22	10uF	TANTALUM CAP. 16V SMT B	SMT B	PANASONIC	DIGIKEY PCS3106CT-ND
4	2	SMA7,SMA8	SMA	SMA CONNECTOR THRUHOLE		AMP TYCO	DIGIKEY ARFX 1231-ND
5	12	TPA37,TPA38,TPA39,TPA40,TPA41,TPA42,TPA43,TPA44,TPA45,TPA46,TPA47,TPA48	TEST	TEST POINT			
6	12	R49,R50,R51,R52,R53,R54 R55,R56,R57,R58,R59,R60	50	RESISTOR 1%	SMT 0603	PANASONIC	DIGIKEY
7	1	R63	240	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
8	1	R64	390	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
9	10	R61,R62, C67	4.7K	RESISTOR 5%	SMT 0603	PANASONIC	DIGIKEY
10	4	U7	24LC02B	2KB EEPROM	SO-8	MICROCHIP	24LC02B
11	4	U8	LM1117	LDO ADJ. VOLTAGE REGULATOR	SOT-223	NATIONAL SEM.	DIGIKEY LM1117MPX-ADJ-ND

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