Technical Reference Manual

Tektronix

TLA 700 Series
TLA 7QS QuickStart Training Board

070-9716-00

There are no current European directives that apply to this product. This product provides cable and test lead connections to a test object of electronic measuring and test equipment.

This document supports firmware version 1.00 and above.

Warning
The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

Printed in the U.S.A.

Tektronix, Inc., P.O. Box 1000, Wilsonville, OR 97070–1000

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General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of the system. Read the *General Safety Summary* in other system manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Connect and Disconnect Properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and marking on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Use Proper AC Adapter. Use only the AC adapter specified for this product.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Use Proper Fuse. Use only the fuse type and rating specified for this product.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in Wet/Damp Conditions.

Do Not Operate in an Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Provide Proper Ventilation. Refer to the manual's installation instructions for details on installing the product so it has proper ventilation.

Symbols and Terms

Terms in this Manual. These terms may appear in this manual:

WARNING. *Warning statements identify conditions or practices that could result in injury or loss of life.*

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product. These terms may appear on the product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols on the Product. The following symbols may appear on the product:

WARNING
High Voltage

Protective Ground
(Earth) Terminal

CAUTION
Refer to Manual

Double
Insulated

Service Safety Summary

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Disconnect Power. To avoid electric shock, disconnect the main power by means of the power cord or, if provided, the power switch.

Use Care When Servicing With Power On. Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Preface

The *TLA 7QS Technical Reference Manual* is an optional accessory to the TLA 7QS package. It is intended to provide technical and service information for the TLA 7QS training board.

How to Use This Document

The manual is made up of the following sections:

- The *Getting Started* chapter provides a brief overview of the product.
- The *Reference* chapter consists of basic reference information on the training board. It consists of subsections describing the hardware features, software features, memory maps, and programming information for using the training board.
- The *Specifications* chapter lists specifications and various characteristics of the training board.
- The *Theory of Operation* chapter describes the basic operation of the electronic circuitry on the training board. This chapter can be used in conjunction with the schematics to provide an overall understanding of the operation and capabilities of the training board.
- The *Functional Verification Procedures* chapter provides information for verifying functional operation beyond the power-on diagnostics.
- The *Maintenance* chapter provides information on the basic service strategy, static handling procedures, inspection and cleaning procedures, simple troubleshooting procedures, and repackaging instructions.
- The *Replaceable Electrical Parts* chapter lists the electronic components on the training board.
- The *Schematics* chapter provides individual schematics for the circuitry on the training board.
- The *Replaceable Mechanical Parts* chapter lists the mechanical replaceable parts and accessories for the training board.
- *Appendix A: Source Code* provides information on the program code used with the training board software. It also provides examples of code that can be used to create programs and to download them to the training board.

Related Documentation

Several other pieces of documentation are available to use with the TLA 700 Series Logic Analyzers. The information consists of both online documentation and paper copies.

- The *TLA 700 Series Logic Analyzer User Manual* provides basic user information for the TLA 700 Series Logic Analyzers.
- Use the online help in the TLA 700 Series logic analyzer to obtain operating information and for specific information on windows, menus, and fields within the application.
- The *TLA 7QS QuickStart Training Manual* provides examples of exercises to demonstrate the capabilities of the TLA 700 Series logic analyzers.

Manual Conventions

The following manual conventions are found in this document:

- Active low signals are identified by an asterisk (*) after the signal name.
- The term training board represents the TLA 7QS QuickStart training board.

Contacting Tektronix

Product Support	For application-oriented questions about a Tektronix measurement product, call toll free in North America: 1-800-TEK-WIDE (1-800-835-9433 ext. 2400) 6:00 a.m. – 5:00 p.m. Pacific time Or contact us by e-mail: tm_app_supp@tek.com For product support outside of North America, contact your local Tektronix distributor or sales office.
Service Support	Contact your local Tektronix distributor or sales office. Or visit our web site for a listing of worldwide service locations. http://www.tek.com
For other information	In North America: 1-800-TEK-WIDE (1-800-835-9433) An operator will direct your call.
To write us	Tektronix, Inc. P.O. Box 1000 Wilsonville, OR 97070-1000

Getting Started

This document provides technical reference information for the TLA 7QS training board. The manual provides information for running the embedded programs, downloading user-defined programs from a host, specifications, schematics, parts lists, and miscellaneous service information.

Product Description

The TLA 7QS training board is used to demonstrate the Tektronix logic analyzer products. It consists of an electronic circuit board with rubber feet standoff and a digital display. The circuit board has a built-in M68340 microcontroller with supporting electronic circuitry, and several connectors.

The training board has several embedded programs accessible by the user interface or by a remote host connection. The embedded programs are designed to send digital and analog signals to the various connectors on the training board. These signals can be used to demonstrate the capabilities of the TLA 700 Series Logic Analyzers.

The training board is used with the TLA 7QS Training Manual. The training manual provides examples of using the training board to demonstrate the capabilities of the TLA 700 Series Logic Analyzers.

Accessories

The training board is available with the following standard accessories:

- TLA 7QS Training Manual
- TLA 7QS Software
- Wall mount power adapter (power dependent on country)

The TLA 7QS Technical Reference Manual is available as an optional accessory and comes with the TLA 7QS. development software.

Configuration

The default training board has no configurations. The training board can be set up, however, to download user specific programs. The programs reside in the flash memory.

Functional Check

The basic operation of the TLA 7QS training board is verified by the power-up diagnostics. The power-up diagnostics run at power-on or when the RESET signal is asserted by pressing the RESET button.

To perform a more detailed functional verification of the training board, refer to the *Functional Verification Procedures* beginning on page 5–1.

Hardware Features

This section describes the hardware features of the TLA 7QS training board. It provides information on using the hardware to demonstrate features of logic analyzers and oscilloscopes. Detailed information on individual circuits is provided in the *Theory of Operation* beginning on page 4–1.

Circuit Board Modules

The training board can be divided into the following circuit board modules:

- Microprocessor module
- Signal sources module
- User interface module
- Input/output module
- Power supply module

Microprocessor Module

The microprocessor module consists of a Motorola M68340 microcontroller in a TQFP package and the associated static RAM and flash memory. The flash memory is divided into a user flash and system flash. The user flash area is intended for use with additional applications; it can be modified with the proper software development tools. The system Flash is initially programmed at the factory and can be updated by field service upgrade kits (when they become necessary).

Microprocessor Chip Selects. Four programmable chip select lines are used on the training board. Table 2–1 lists the chip select lines and how they are used. For information on the memory mapping, refer to *Memory Maps* beginning on page 2–22.

Table 2–1: Microprocessor chip select lines

Chip select	Memory space usage
CS0*	Boot and system Flash ROM
CS1*	User and system RAM
CS2*	User and application ROM
CS3*	Memory mapped input and output

Microprocessor Interrupts. Four external interrupts are used on the training board: IRQ3*, IRQ5*, IRQ6*, and IRQ7*. You can assert the signals through the push buttons on the training board or through the parallel control port.

Microprocessor Parallel Input/Output Port. The microprocessor has a general purpose parallel input/output port (PORTA) that uses the upper eight address lines. The port is used for general purpose (application defined) input and output bits, serial clock bits, and serial data bits. Table 2–2 shows the bits of the port and the corresponding signals. The PORTA signals are accessible on bus interface connector (J180).

Table 2–2: PORTA signals

Bit	Signal name	Function
0	SCL	Serial clock bit
1	SDA	Serial data bit
2	CNTLIN1	Application defined input control bit
3	CNTLIN2	Application defined input control bit
4	CNTLIN3	Application defined input control bit
5	CNTLOUT1	Application defined output control bit
6	CNTLOUT2	Application defined output control bit
7	CNTLOUT3	Application defined output control bit

Microprocessor Output Bits. The microprocessor has an output port that shares the signal lines with the signal lines of the dedicated serial ports (A and B). Two of the bits have specific uses. The OP4 bit generates the clears the external trigger input. The OP6 bit generates the trigger output signal (EXTRIGOUT). Both signals are active low signals.

Delay Line Memory. The delay line memory is a 16-bit read and write register to demonstrate setup and hold timing violations during read operations. Data can be written and then read from the same memory location; the data read should equal the written data. When you program the delay line with a small delay, a setup violation occurs during the read operation and the data read back will be different than the written data. When you program the delay line with a large delay, a hold violation occurs during the read operation and the returned data will be different than the written data.

Figure 2–1 shows a block diagram of the programmable delayed read memory.

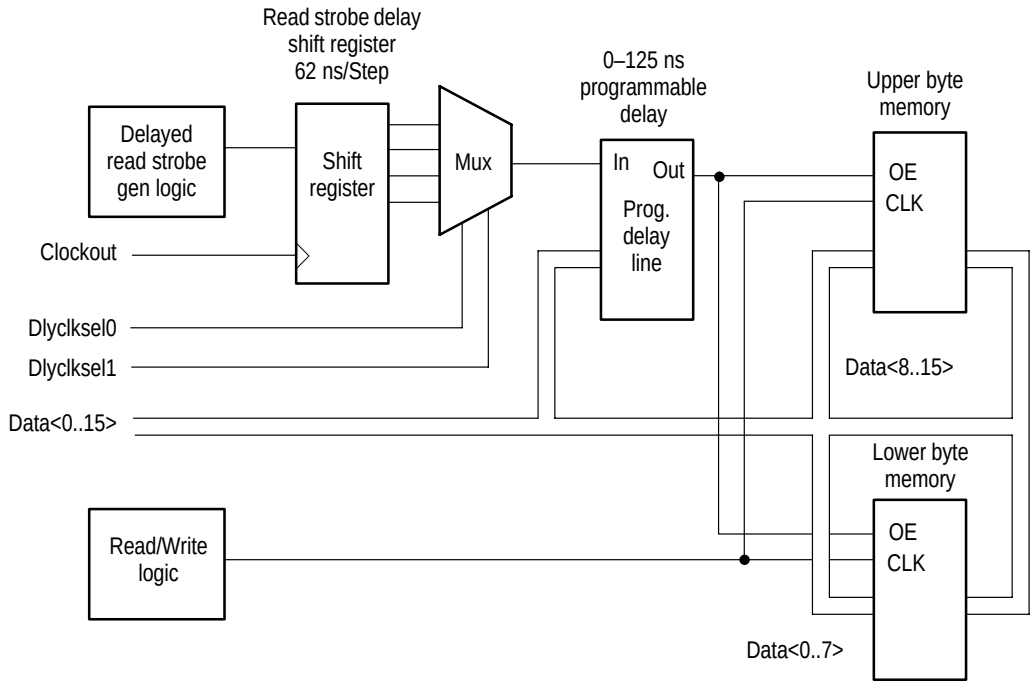


Figure 2–1: Programmable delayed read memory block diagram

Programmable Delay Clock Select. The programmable delay clock select consists of a serial shift register clocked by the microprocessor system clock. The input to the shift register is the delayed shift register read strobe which is delayed in multiples of the clock period. The input read strobe and three output bits of the shift register are routed to a four-bit input multiplexer. The multiplexer selects one of the four read strobes.

Programmable Delay Line. The programmable setup and hold delay line is an eight-bit register with 256 programmable delay settings. The delay line delays the read strobe to the delay line memory to demonstrate setup and hold timing violations. Each delay count increment is a 0.5 ns time delay. The minimum delay is 00 and the maximum is FF.

Signal Sources Module

The signal sources module consists of the following groups of signals that can be used to demonstrate logic analyzer and oscilloscope features:

- Counter and pattern generator signals
- Setup & Hold and trigger signals
- Tapped delay line
- Burst signal
- Glitch signal
- Metastable data and clock signals
- Step signal
- Runt pulse and missing pulse signal
- Single-shot and narrow pulse signal
- Staircase signal

Counter and Pattern Generator Signals. You can use the two 16-bit (or one 32-bit) counter and pattern generators to demonstrate multiple logic analyzer and logic scope capabilities. Both counter and pattern generators can be configured by software. The counters can be programmed to count up or down. They can be clocked by the 50 MHz oscillator or through an external trigger input.

Setup and Hold Trigger Signals. Use the setup and hold trigger signals to demonstrate how logic analyzers can measure or trigger on setup and hold signals. The setup and hold signals are generated by a four-bit counter. The counter can be controlled by software to demonstrate setup violations or hold violations.

Tapped Delay Line. Use the tapped delay line as basic pattern generator to show signal skew, timing resolution, and sampling rates.

Burst Signal. Use the burst signal to demonstrate logic analyzer transitional timing.

Glitch Signal. Use the glitch signal to demonstrate logic analyzer and oscilloscope triggering.

Metastable Data and Clock Signals. Use the metastable data and clock signals to demonstrate logic analyzer and oscilloscope setup and hold triggering.

Step Signal. Use the step signal to demonstrate analog bandwidth and triggering of oscilloscopes and logic analyzers.

Runt Pulse and Missing Pulse Signal. Use the runt pulse and missing pulse signal to demonstrate oscilloscope pulse triggering features. You can also use it to demonstrate logic analyzer 4 ns counter/timers and time-qualified triggers.

Single-Shot Narrow Pulse Signal. Use the single-shot narrow pulse signal to demonstrate analog bandwidths of oscilloscopes and logic analyzers. You can also use this signal to demonstrate real-time sampling capabilities of the oscilloscopes and logic analyzers.

Staircase Signal. Use the staircase signal to demonstrate the oscilloscope acquisition modes and glitch detection.

User Interface Module

The user interface module consists of the following elements:

- A two-line by 16-character LCD display
- Four push-button switches
- A reset switch
- Two 10-segment LED indicators

LCD Display. The main display device is a two line by 16 character LCD display. The readout is controlled by software and by the four push-button switches.

The microprocessor communicates with the display by placing the upper eight bits on the data bus. The LCD display has a register select (RS) bit. When the RS bit is low, it selects the instruction register; when the bit is high, it selects the data register.

Push-button Switches. The four push-button switches connect to the four external interrupt lines of the microcontroller. The switches select and control the programs in the training board. The LCD readout displays the push-button switch functions. The right-most switch halts the program and asserts a nonmaskable interrupt (NMI) signal to IRQ7.

Reset Switch. The Reset switch is a momentary push-button switch that provides a system reset to the microcontroller.

LED Indicators. Two 10-segment LED indicators display bit patterns for various software and hardware demonstrations. The first sixteen LED segments (labeled 0 through 15) represent data bits. Bits 16 and 17 represent the LAPort input and output enable status. Bit 18 indicates whether the external trigger input is enabled. Bit 19 shows the status of the Halt signal line.

Input and Output Connectors

The TLA 7QS Training Board has the following input and output port connectors:

- Two serial ports
- A logic analyzer control port
- Two trigger BNC connectors
- A background debug mode connector
- A JTAG connector (pins not installed on board)
- Power input connectors
- Bus interface connector

These connectors and their pin information are described in the *Theory of Operation* chapter beginning on page 4–9.

Serial Port Requirements

Serial Port B is the main serial port for connecting the training board to an external host. It is also used to monitor programs and to download and execute firmware. The serial port uses hardware handshaking to control communications between the host and the training board.

In addition to the minimum RS-232 signals (RX, TX, and GND) for serial communications, the handshaking signals (CTS and RTS) are required for connection between a terminal (or computer) and the training board.

Serial Port B on the training board is designed as a DTE (data terminal equipment) device. Most terminals and personal computers with serial ports are also configured as DTE devices. Therefore, the signal connections between the terminal and Serial Port B on the training board may require an null modem connection.

The left side of Figure 2–2 shows the standard full null modem connection. The minimum null modem connection required for the training board is shown on the right side of Figure 2–2.

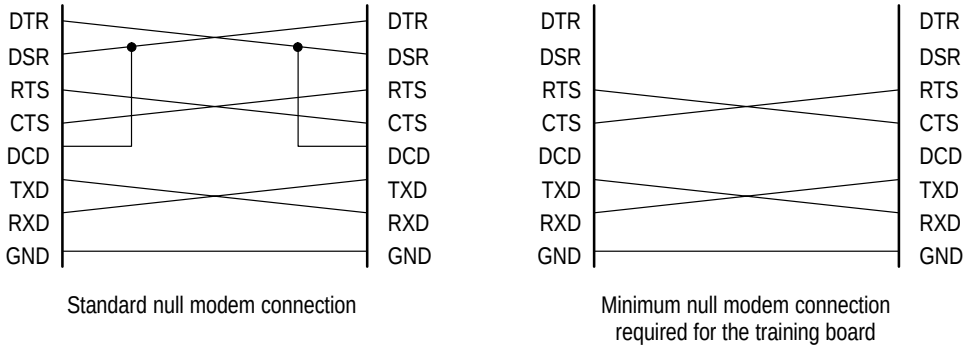


Figure 2–2: Null modem connections

Table 2–3 shows the connector pinouts for the DB9 and DB25 serial port connectors.

Table 2–3: RS-232 connector pinouts

Signal	Name	DB9 pins	DB25 pins
DCD	Data carrier detect	1	8
RXD	Receive data	2	3
TXD	Transmit data	3	2
DTR	Data terminal ready	4	20
GND	Signal ground	5	7
DSR	Data set ready	6	6
RTS	Request to send	7	4
CTS	Clear to send	8	5
RI	Ring indicator	9	22

For more information on the serial ports on the training board refer to the *Serial Ports* on page 4–11.

Software Features

This section describes software operation, embedded programs, and diagnostics available with the TLA 7QS Training Board.

When you first apply power to the the training board, or when you press the Reset button, the training board initializes the 68340 registers, runs the power-on diagnostics, and then starts the normal operation.

Operating Modes

There are three modes of normal operation for the training board:

- Stand-alone mode
- Host-controlled mode
- Debug mode

The software routines are available in both stand-alone operation and host controlled mode (unless specified otherwise).

Stand-Alone Mode

In the stand-alone mode, operation of the training board is controlled by the button interface. All program information is sent to the liquid crystal display (LCD). Menu selections are displayed on the LCD as well as the current function of the four buttons mounted directly below the display.

You can scroll through the menu selection by pressing the UP or DN (down) buttons. Pressing the RUN button starts the selected software routine. Pressing the STOP button halts the selected routine. The display on the LCD may change depending on the selected software routine. Refer to *LCD User Interface* on page 2–15 for more detailed information on controlling the training board in the stand-alone mode.

Host-Controlled Mode

In the host-controlled mode, the operation of the training board is controlled through Serial Port B. You can connect the training board to a host (such as a PC running an RS-232 application such as HyperTerminal). The menu selections are the same as in the stand-alone mode; however, because of the larger display, more verbose descriptions are possible.

NOTE. *You may need to use a null modem to connect the training board to your PC. For information on using a null modem, refer to* Serial Port Requirements *on page 2–6.*

Additional menu choices are available that are not used in the stand-alone mode. These choices include downloading an S-record file to user flash memory and starting the SDS (Software Development Systems) target monitor program. A list of embedded programs and routines is described in detail under *Embedded Programs* beginning on page 2–10.

While the training board is connected to host, the training board operation can still be controlled from the buttons and data will be displayed on the LCD as well as on the remote menu.

Debug Mode

The debug mode is intended to be used during program development. While in the debug mode, the training board runs a target monitor (a ROM resident program) that communicates with the SDS SingleStep development software.

The debug mode lets you develop, download, and test programs before you commit them to flash memory. The debug mode also provides direct access to the hardware on the training board.

Main Software Routine

The main software routine is a message processor that runs in an endless loop. User and instrument actions, such as pressing a button, generate messages which are posted to a message stack. The routine continuously checks the stack for messages and sends new messages to the appropriate action routine.

Most messages are generated by an interrupt service routine. The buttons, timers, and RS-232 circuitry have individual interrupt service routines. When an interrupt is serviced, the interrupt service routine posts the appropriate message to the message stack and then returns control to the processor.

Embedded Programs

This section describes the embedded programs that are available with the current version of the training board. The programs, routines, or tests described in this subsection are available at product introduction. Others can be added by the user as necessary.

The programs use several subroutines to provide logic analyzers a means of demonstrating performance analysis. All initialized variables are mapped into SRAM so values can be changed. The variables return to the default values at power-on or when the training board is reset.

LITES The Lites program strobes the LED segments from right to left and then left to right. The program also writes the phrase “Making It Happen” to Serial Port B.

STOP LITES The Stop Lites program lights specific LEDs in a predetermined sequence. The LEDs are lighted in a sequence to emulate two traffic lights (hence the name Stop Lites). One set of lights change from green to amber to red. After the light is red, a second set of lights cycles from green to amber to red. The sequence continues until interrupted by the user.

STRINGS The Strings program continuously sends the string “The quick brown fox jumped over the lazy dog” to Serial Port B.

COUNTER The Counter program controls the counter-pattern generator circuitry on the training board (J840, J940, J830, and J930). Push the RUN button to start the program and to display the current settings. To change any of the settings, push the F1, F2, or F3 buttons. You can change the program settings by pushing the appropriate buttons as described below:

- Push the F1 button to select the counter size, 16 bits or 32 bits.
- Push the F2 button to select the counter direction, up or down.
- Push the F3 button to select the counter clock source, internal or external.
- Push the F4 button to accept the changes.

PATTERN GEN The Pattern Gen program controls the counter-pattern generator circuitry on the training board (J840, J940, J830, and J930). Push the RUN button to start the program and to display the current settings. To change any of the settings, Push the F1, F2, or F3 buttons. You can change the program settings by pushing the appropriate buttons as described below:

- Push the F1 button to select the data pattern, A5 or F0.
- Push the F2 button to select the clock speed, normal, divide-by-four, divide-by-sixteen, or SIM timer module 2.
- Push the F4 button to accept the changes.

SHOW CYCLES The Show Cycle program routes the M68340 internal bus cycles to the external bus. The logic analyzer can be set up to capture and analyze these bus cycles.

WAIT STATE The Wait State program varies the M68340 wait states from zero to three on CS2 and CS3. After starting the program, push the F1 button to select the number of wait states. You can then use a logic analyzer to capture and analyze the impact of the wait states on system performance.

INT LATENCY The INT Latency program generates an interrupt at random intervals of time. This program provides a means for logic analyzers to measure the time between an INT assertion and an INT acknowledge. The LEDs strobe across the LED display while the program runs.

PGM DELAY The PGM Delay program controls the Setup and Hold circuitry on the training board (J850). You can use the buttons to select the clock speed and to specify a delay from 00 Hex to FF Hex.

When the program runs, it sends a value of 5555 Hex to a register and is then read back. The read select line is delayed by the programmed amount. The resulting value is displayed by the LED bank. If the displayed value is not 5555 Hex, then you know that an error occurred.

Push the RUN button to start the program and to display the current settings. To change any of the settings, push the F1, F2, or F3 buttons. You can change the program settings by pushing the appropriate buttons as described below:

- Push the F1 button to select the clock, normal, divide-by-two, divide-by-four, or divide-by-eight.
- Push the F2 button to change the most-significant byte of the delay value.
- Push the F3 button to change the least-significant byte of the delay value.
- Push the F4 button to accept the changes.

AUTO DELAY The Auto Delay program is similar to the PGM Delay program except that the clock and delay times are automatically sequenced through all possible values.

PULSE The Pulse program generates a monostable pulse when you press the F1 button. The pulse is generated by SIM timer module 1. The 1 V pulse is sent to the PULSE pins (J971-3 and J870-5, 6) in the Analog Signals section of the training board. A TTL-level pulse is available on the C0-4 section (T1) of the microprocessor signals section on J750-5.

SETUP/HOLD The Setup/Hold program controls the Setup and Hold circuitry on the training board (J850). The program sends a four bit count pattern to DATA pins 0–3 (J850-1 though J850-4). The same pattern is sent to the QOUT pins 0–3 (J850-5 through J850-8). However, the count data at the QOUT pins is skewed by a specified amount of time.

Push the RUN button to start the program and to display the current settings. To change any of the settings, Push the F1, F2, or F3 buttons. You can change the program settings by pushing the appropriate buttons as described below:

- Push the F1 button to select the clock, normal, Setup (CLK 2), or Hold (CLK 1).
- Push the F2 button to enable (YES) or disable (NO) a toggle feature. The feature toggles the clock between Normal and Hold or between Setup and Hold when a count of 0A H is reached.
- Push the F4 button to accept the changes.

PGM FLASH The PGM flash program provides a means for loading user programs into the User area of the flash ROM. You can also use the program to bulk-erase the user flash ROM. Any new user programs will be added to the menu display and can be selected in the same manner as any other program. To use this program, you must be operating in the host-controlled mode. Instructions for creating a new user program are described in *Creating Programs for the Training Board* beginning on page 2–29.

CAUTION. *Exiting or interrupting the program prematurely can corrupt the user flash memory. Do not execute this program if you are not operating in the host-controlled mode.*

If you start the program from the training board, you will be asked to verify your intentions (select YES to continue, NO to exit the program). You can only exit or interrupt the program by pushing the Reset button on the training board.

LAPORT ENABLE The LAPort Enable program controls the LAPort functions of the training board. The LAPort is normally enabled during reset or when you apply power to the training board. This program allows you to enable or disable the port.

Push the RUN button to start the program and to display the current settings. To change any of the settings, push the F1 button. You can change the program settings by pushing the appropriate buttons as described below:

- Push the F1 button to enable or disable the port.
- Push the F2 button to count up to select the port lines.

- Push the F3 button to count down to select the port lines.
- Push the F4 button to accept the changes.

The three LAPort lines are selected by binary values from the F2 or F3 buttons. The value written to the output is displayed on the LCD as a binary number. For example, to set the LAPort output line 1 high and others low, select the binary value 010.

TRIG ENABLE The Trig Enable program enables or disables the Trigger In or Trigger Out features on the training board. When enabled, a Trigger In signal will generate an IRQ7 interrupt and a Trigger Out signal will generate an IRQ6 interrupt.

When disabled, the Trigger In signal functions as an external clock for the counters. The Trigger Out circuitry functions normally but does not assert an IRQ6 interrupt.

Push the RUN button to start the program and to display the current settings. Push the F2 button to enable or disable the Trigger In and Trigger Out feature. Push the F1 button to manually generate a Trigger Out pulse; the training board responds by displaying an asterisk on the LCD.

DIAGS The Diags program executes the extended diagnostics. For more information on diagnostics, see *Diagnostics* on page 2–16.

MONITOR The Monitor program starts the SDS Target Monitor routine in preparation for running the SDS SingleStep debugger. This selection is only useful if you have a copy of the SDS SingleStep program running on a host computer. You will be prompted to verify your intention to run this program. To exit this program, push the Reset button.

Interrupt Service Routines

Interrupts 3, 5, 6, and 7 have individual handlers. Each handler posts a global message that will be read by the main function. Timer 1, Timer 2, and RS-232 can also generate interrupts that will have their own interrupt service routines.

LCD User Interface

The LCD Interface consists of the liquid crystal display and four buttons on the training board. The UP, DN, RUN, and STOP images on the LCD correspond to the buttons located directly below the display.

UP and DN Buttons Pushing either button causes interrupts. The interrupts post messages to the main routine. Push the UP button to scroll backward through a list of programs. Push the DN button to scroll forward through a list of programs.

RUN Button Push the RUN button to start a program. While a program runs, the UP, DN, and RUN images on the display are replaced by the prompt “RUNNING.” Other buttons are ignored, except when the program prompts you to push a button.

STOP Button Push the STOP button to halt a program. Pushing the STOP button while no tests are running has no effect.

RS-232 Interface

The RS-232 interface provides a means of controlling the training board from a host. The host connects to the training board through RS-232 Serial Port B. The interface displays a menu (see Figure 2–3) containing all of the tests programmed in the training board.

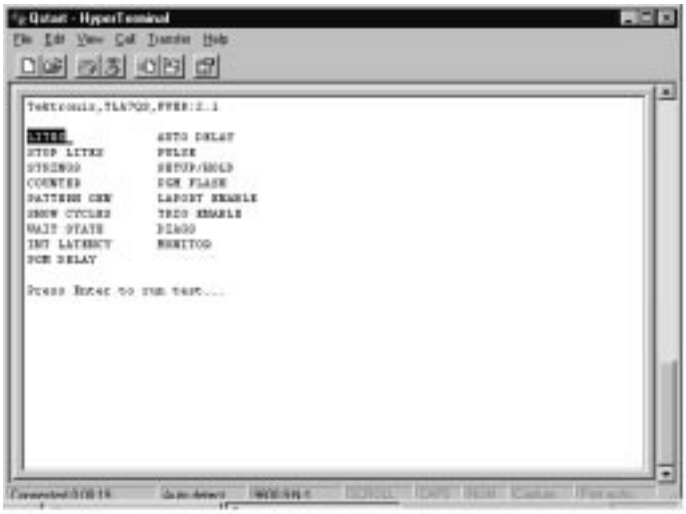


Figure 2–3: Remote menu

The interface runs at a baud rate of 9600 with hardware flow control. You should use a terminal emulation program on a PC such as HyperTerminal.

The ANSI escape codes provide cursor control. Press an arrow key on the terminal keyboard to move between highlight selections in the menu. If the terminal does not have any arrow keys, press the J or K keys to change selections.

Press the Enter or Return key to start a program or test. The terminal displays the following message:

```
RUNNING... Press any key to stop test
```

Press any key to stop a test. The terminal returns control to the menu selections.

Diagnostics

The diagnostics test the basic operation of the training board. The power-up diagnostics run when power is applied to the training board or when the RESET is asserted. Some of the extended diagnostics require human interaction.

To start the extended diagnostics, select DIAGS on the display. Push the run button to start the extended diagnostics. The diagnostics run automatically and only require user interaction when connecting the RS-232 cables. The extended diagnostics test the following areas of the training board:

- LCD
- Serial ports
- ROM
- RAM

Upon completing the diagnostics, the test results are temporarily listed on the display.

LCD Test

The LCD is tested by displaying a pattern that illuminates all bits on the display. Visually verify that all bits are illuminated.

Serial Port Tests

The serial port test consists of two kinds of tests. The first test is an internal loopback test. The test places the serial ports into the loopback mode. A character is transmitted to the port, received, and compared. The test passes when the received character matches the transmitted character.

The second test requires connecting a terminal to Serial Port A (9-pin subminiature D connector). The test pauses until you connect the cable and then push the Run button to continue. The test string, “Testing serial port A,” is transmitted through the port. The test passes when when you see the test string is on the terminal screen.

The test is repeated for Serial Port B using a two by five shrouded square-pin connector (see Table 4–8 on page 4–11 for pinout information).

ROM Test The ROM test checks the read-only memory. The ROM is checked by reading a specific location for a confidence word. If the returned value matches the confidence word, the ROM is assumed to be good. A Pass/Fail condition is displayed on the LCD at the completion of the tests.

RAM Test The RAM is tested by writing a value and then reading the value. If the returned value matches the written value, the test passes. A Pass/Fail condition is displayed on the LCD at the completion of the tests.

Memory Maps

This section provides information on the memory maps for the TLA 7QS Training board. The first part of this section provides information on the memory mapped input and output. The rest of this section lists the actual memory maps.

Memory Mapped Input and Output

The training board has 2 Mbytes of memory mapped input and output. The memory is divided into eight equal segments. Table 2–4 lists the names and addresses of the memory mapped input and output devices.

Table 2–4: Input and output device addresses

Device	Address	Input/output type	Memory depth and width
LCD display	$40 0000	Read/write	1 X 8
LED display	$44 0000	Write only	1 X 16
Input control bits	$48 0000	Read only	1 X 8
Output control bits	$4C 0000	Write only	1 X 16
Setup and hold delay line	$50 0000	Write only	1 X 8
Setup and hold memory	$54 0000	Read/write	1 X 16
Low counter /pattern generator	$58 0000	Write only	1 X 16
High counter/pattern generator	$5C 0000	Write only	1 X 16

LCD Display

The liquid crystal display has two eight-bit registers selected by the register select (RS) bit. When the RS bit is low, it selects the instruction register, when it is high it selects the data register.

LED Displays

The training board has two 10-segment LED displays. The segments are used as follows:

- The first 16 segments connect directly to the 16-bit data lines and are used for general purpose applications. Bit 0 is the right-most segment on DS880.
- Bit 16 represents the LAPort input enable status. The input circuit uses a flip-flop to clock in data by an external computer. The enable control bit connects to the output enable of the flip-flop. When the LED is on (low signal) the input is enabled and input signals are connected to the training board.

- Bit 17 represents the LAPort output enable status. The output circuit uses a transparent latch. When the LED is on (low signal), the output is enabled and signal changes on the training board are sent to the output port. When the LED is off, the output data is latched to last transmitted value (unknown at power-on). The bit is inverted for proper polarity to the latch.
- Bit 18 represents the external trigger input and output interrupt enable status. When the LED is on, an external input or output trigger causes interrupts IRQ7 and IRQ6 respectively.
- The last bit represents the status of the Halt* signal. When the LED is on, the Halt* line is asserted.

Input Control Bits Register

The input control bits register is a general purpose register that monitors signals. Table 2–5 lists the input control bits and the associated signals. The signals are intended for diagnostic read-back purposes. See Figure 2–7 on 2–26 page for memory mapping information.

Table 2–5: Input control bits

Bit	Signal name	Function
0	LAPORTIN*	Control bit readback
1	LAPORTOUT*	Control bit readback
2	TRIGGERIN	Control bit readback
3	CNTRDIAG	Control bit readback from Mux
4	SIGCLK1	Microprocessor timer 1 readback
5	SIGCLK2	Microprocessor timer 1 readback
6	SCL	Serial clock (PortA bit 0) readback
7	SDA	Serial clock (PortA bit 1) readback

Output Control Bits Register

The output control bits register is a 16-bit input register used to assert signals. Table 2–6 lists the output control bits and the associated signals. See Figure 2–7 on 2–26 page for memory mapping information.

Table 2–6: Output control bits

Bit	Signal name	Function
0	LCDRS	LCD register select
1	DLYCLKSEL0	Delay generator clock select Mux bit 0
2	DLYCLKSEL1	Delay generator clock select Mux bit 1
3	LAPORTIN*	LAPort input enable
4	LAPORTOUT*	LAPort output enable
5	TRIGGERIN*	External trigger input enable
6	EXTCLKEN	External counter clock enable
7	CNTR16BIT*	16-bit or 32-bit counter select
8	PATCLKSEL0	Pattern generator clock selector Mux bit 0
9	PATCLKSEL1	Pattern generator clock selector Mux bit 1
10	LOCNTREN*	Low counter count enable
11	LOCNTRSEL*	Low counter or pattern select
12	LOCNTRUP*	Low counter count up/down select
13	HICNTREN*	High counter count enable
14	HICNTRSEL*	High counter or pattern select
15	HICNTRUP*	High counter count up/down select

Programmable Delay Setup and Hold Violation Circuit

The programmable setup and hold delay line is an eight-bit register with 256 programmable delay settings. The delay line delays the read strobe to the delay line memory to demonstrate setup and hold timing violations. Each delay count increment is a 0.5 ns time delay. The minimum delay is 00 and the maximum is FF.

Read-Write Setup and Hold Violation Memory

The delay line memory is a 16-bit read and write register to demonstrate setup and hold timing violations during read operations. Data can be written and then read from the same memory location; the data read should equal the written data. When you program the delay line with a small delay, a setup violation occurs during the read operation and the data read back will be different than the written data. When you program the delay line with a large delay, a hold violation occurs during the read operation and the data will be different than the written data.

Low Counter Pattern Generator Data

The low counter pattern generator data register is a 16-bit write-only register that stores a data value in the low counter pattern generator.

High Counter Pattern Generator Data

The high counter pattern generator data register is a 16-bit write-only register that stores a data value in the high counter pattern generator.

Memory Maps

Figures 2–4 through 2–8 show the following memory maps for the TLA 7QS Training board:

- A full memory map
- System and user static RAM
- User EEPROM and flash
- Input and output
- System EEPROM and flash

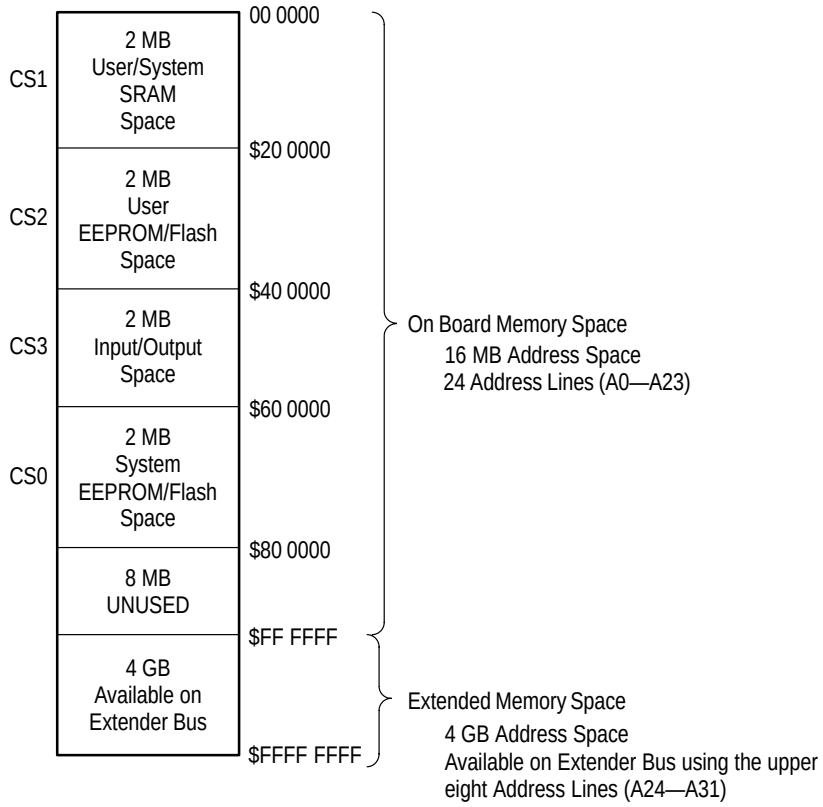


Figure 2–4: Full Memory Map

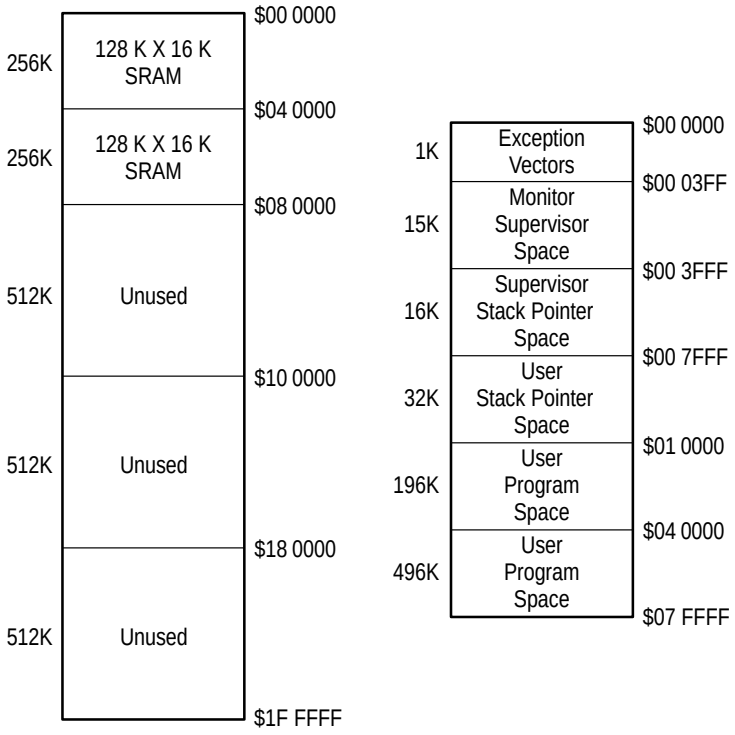


Figure 2–5: System and user static RAM

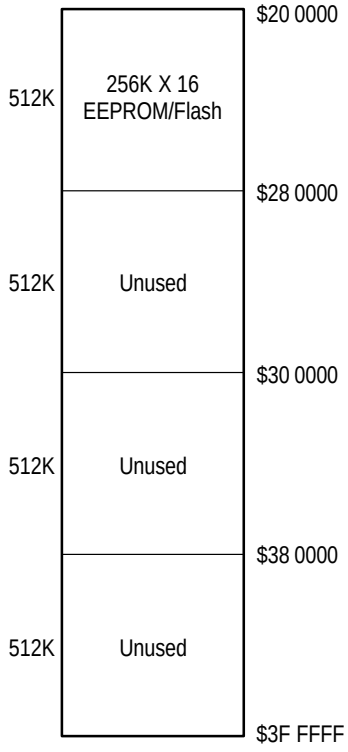


Figure 2–6: User EEPROM and Flash

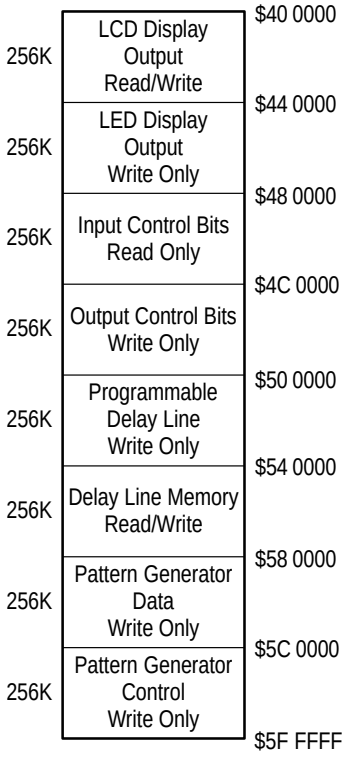


Figure 2–7: Input and output

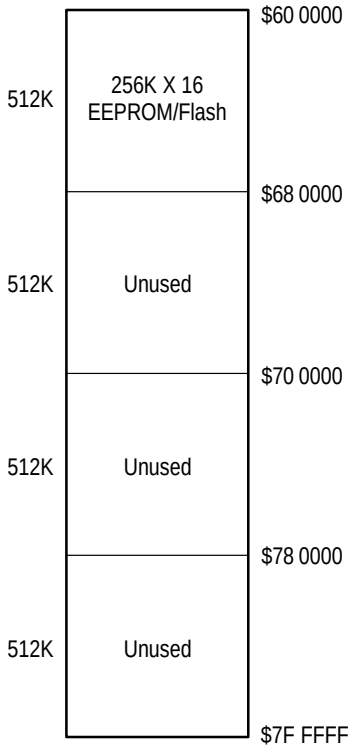


Figure 2–8: System EEPROM and Flash

Creating Programs for the Training Board

This section provides information on creating programs for use with the training board. Information is provided under the following subsections:

- Preparation
- Writing the program
- Compiling and linking code
- Writing an image to the flash memory
- Rebooting and running the program

Preparation

To create programs for the training board you will need the SDS CrossCode C 68K software package from Software Development Systems (the C++ option is not required) and some software tools from Tektronix. You will use these packages to write the code and to download the programs to the training board.

Software Development Systems Tools

The SDS CrossCode C/C++ 68K package includes the C compiler, assembler, linker, and other utilities necessary to convert your source code into 68K code. Although not required, the SDS SingleStep debugger package may also prove to be helpful.

The software packages come in several versions which vary mainly in the connections to the target. The OnChip debugger connects to the background Debug Mode (BDM) port on the training board through a cable adapter from the PC printer port. The Target Monitor version connects through a standard serial COM port to the SDS monitor program which is resident on the training board. The Target Monitor version is easier to connect, but it is also slower than the BDM version. The BDM version was used to develop the training board.

Tektronix Software Tools

In addition to the software packages from Software Development Systems, you will also need the object file (mongoose.obj) and the linker specification file (combine.spc). If you intend to reuse some of the code already present on the training board (such as the code to display strings on the LCD), you will also need the include files for the training board.

Appendix A: Source Code contains examples of the combine.spc file and a list of the Tektronix supplied software available with this technical reference manual.

Writing the Program

The following procedures provide information on writing the program code for the training board. You may want to refer to *Appendix A: Source Code* for a sample program. The procedures consist of the following steps:

- Create the menu entry
- Include the user header file
- Create a dummy function
- Write the code

Create the Menu Entry

The menu for the training board is a linked list structure. The menu structure is defined in the include file, menu.h. The file is type defined as MENU. You need to define the following information in the structure:

- The menu text to be displayed
- The row location of the remote menu text
- The column location of the remoter menu text
- A pointer to the function to be executed

The following example shows how a sample menu entry with all of the definitions provided.

```
MENU myItem = {
    "My Text",     /*text that will be displayed on the menu */
    3,             /*row location of the remote menu item */
    35,            /*column location of the remote menu item */
    mytestfunction /*pointer to the function to be executed */
};
```

Include the User Header File

You must include the user header file, user.h. This file declares a constant that is located in a specific place in the user memory on the training board. The constant is checked every time the training board is reset. If the header file finds the constant, the software will look for menu entries to be added to the menu list.

Create a Dummy Function

You must include a dummy function to create the proper code and C frame. Do not include any code in the function, the function must remain empty. The dummy function is required to allow your code to be appended to the software on the training board.

Write the Code

Write your code using normal C or assembly language. You can use any of the functions for the training board, or create your own functions. Refer to *Appendix A: Source Code* for a sample program. You may also want to refer to the code supplied on the floppy disk accompanying this manual.

Compiling and Linking Code

The following procedure shows how to compile and link the code using the CrossCode 68K application.

Compile the Code

Compile the code using commands and flags as shown below:

```
cc68000 -f foo.c -o foo.o
```

Although you may want to use other combinations of compiler flags, not all combinations have been tested. However, the flags used in the above example should work for your application.

Link the Code

After compiling the code, you must link the code. To link the code into an object file, you will need the following items:

- An object file (the output file from the compile operation)
- The firmware object file (mongoose.obj)
- A linker specification file (combine.spc)

The firmware object file is necessary because a successful link requires the symbol table from the TLA 7QS software that is programmed in the system flash ROM. For the symbol table to be valid, the firmware object file must be the same revision as the firmware on the training board.

The linker specification file tells the linker file where to locate some specific regions, such as your code, data, and constants. For more information about the linker, regions, and partitions, refer to the SDS documentation on the linker program.

Refer to *Appendix A: Source Code* for examples of the C program that will add a menu item to the main menu on the training board. The program will display the string “Time to Switch” on the display. The appendix also includes the linker specification file and a batch file to compile, link, and convert the output to a Motorola S-record file.

Writing an Image to the Flash Memory

Prepare to download the code into flash memory on the training board using a downloader utility. The downloader utility will extract code bytes and convert them into a Motorola S-record file. Make sure that you use the proper flags to avoid ending up with an extremely large file.

Connect the training board to a PC running a terminal program such as Hyper-Terminal. Open up a session with the baud rate set to 9600 and with hardware control flow. If you are unsure of the HyperTerminal settings, check the configuration settings on the Property sheet under the File menu.

Complete the following steps to load the program in the flash memory:

1. Power on the training board and select PGM FLASH.
2. Start the PGM FLASH program and select YES when you are asked to confirm your actions.
3. Select PGM from the menu to prepare to download the program.
4. When you see the prompt “Start file transfer now,” start the file transfer by selecting Send Text File from the Transfer menu.
5. Enter the file name of the file created by the downloader program.
6. When the file transfer is complete, you will see the message “Verification is Complete.”

Running the Program

After you have written the program to the flash memory, you must reset the training board to activate the new menu. The new menu items should be displayed after the SDS Monitor menu entry. You can now select and run the new program using the buttons on the training board or by the cursor movement keys on the remote menu.

Specifications

This chapter contains the specifications for the TLA 7QS Training Board. Within each section, the specifications are arranged in functional groups such as: *Microprocessor System Characteristics, Signal Source Characteristics, Hardware Characteristics, Power distribution, Mechanical Characteristics,* and *Environmental Characteristics.*

All specifications are warranted unless they are designated *typical*. Typical characteristics describe typical or average performance and provide useful reference information.

Table 3–1: Microprocessor signal characteristics

Characteristic	Description
Microprocessor	
Microprocessor component	Motorola M68340
Microprocessor clock rate	16 MHz
System integration module	Provides the external bus interface for the CPU32 and the DMA. Provides programmable circuits to perform address decoding and chip selects, wait-state insertion, interrupt handling, clock generation, bus arbitration, watchdog timing, discrete I/O and power-on reset timing.
DMA controller module	The DMA module consists of two independent programmable channels. Each channel has separate request, acknowledge, and done signals. Each channel can operate in a single-address or in a dual-address mode.
Serial module	The serial module contains a two-channel USART, an on-chip baud rate generator, and is functionally equivalent to the MC68681/MC2681 DUART.
Timer module	The timer module consists of two general purpose counter/timers. Each timer consists of a 16-bit countdown counter with an 8-bit countdown prescaler.
Parallel input/output	The parallel port is part of the integrated external bus interface. It can function as a bidirectional parallel port or as address lines A24 through A31.
Background debug mode	
Description	The background debug mode (BDM) is a special operating mode available in the CPU32 where normal instruction execution is suspended while special on-chip microcode performs the functions of a debugger.
Interface	The interface connector is a two-by-five shrouded square-pin header. Signals are assigned to the pins using the standard Motorola and P&E Engineering format.
System memory	
SRAM memory	128 K by 16 (512 K total)
Flash ROM memory	two banks of 128 K by 16 (256 K total)
Serial EEPROM NVRAM	Serial 2 K by 8

Table 3–1: Microprocessor signal characteristics (Cont.)

Characteristic	Description
System reset signal	The reset signal is integrated into the M68340 microprocessor and connected to the external button to reset the system.
External interrupt requests	IRQ3, IRQ4, IRQ6, IRQ7
Memory-mapped functions	
Chip select decoder	One of eight chip select decoders to select memory-mapped functions
Input control bits register	An eight-bit register to read input bits for monitoring system status and diagnostic feedback
Output control bits register	A 16-bit register to write output bits to control circuit functions and to the LAPort output control bits
Liquid crystal display	A two line by 16 character LCD readout used for system status and for application program status
Ten-segment bar LED display	Two 10-segment multicolor LED bar displays. LEDs labeled 0 through 15 represent data bits and are used for application program output indicators. Three bits monitor system status. The last bit indicates the status of the microprocessor HALT* line.
Memory read violation module	
Memory read violation data register	One 16-bit register
Read strobe coarse delay (*typical*)	A four–to–one mulitplexer used to select one of four read strobes that are delayed by clocked processor cycles
Read strobe fine delay (*typical*)	256 steps from 10 ns to 137.5 ns
Delay line resolution (*typical*)	0.5 ns
Logic analyzer probe connections	
LASI-3 format processor probe connections	96 channels and six clocks with LASI-3 signal format
LASI-4 format processor probe connections	96 channels and six clocks with LASI-4 signal format

Table 3–2: Signal source characteristics

Characteristic	Description
Counter/Pattern generator signals	
Number of counter bits	One 32-bit counter or two 16-bit counters
Counter clock frequency (*typical*)	50 MHz
Number of pattern generator bits	32
Pattern generator toggle bits	Eight four-bit patterns
Pattern generator toggle frequency (*typical*)	50 MHz, 10 MHz, 1.25 MHz, and programmable
Counter/Pattern generator output amplitude (*typical*)	3.5 V to 5.1 V maximum 0 V to 0.2 V minimum
Setup and hold counter signals	
Counter data bits	4
Latched data bits	4
Normal setup and hold time (*typical*)	> –2 ns setup time
Violation setup time (*typical*)	< –2 ns setup time
Violation hold time (*typical*)	> 2 ns hold time
Violation rate (*typical)*	625 KHz
Clock frequency (*typical*)	10 MHz
Signal amplitude (*typical*)	3.1 V to 5.1 V maximum 0 V to 0.2 V minimum
Tapped Delay Signals	
Output bits	8
Delay time (*typical*)	4 ns
Output amplitude (*typical*)	3.1 V to 5.1 V maximum 0 V to 0.2 V minimum
Counter clock frequency (*typical*)	10 MHz
Fast edge signal	
Amplitude (*typical)*	0.5 V high, 0 V low
Rise time (*typical)*	< 2.0 ns
Frequency (*typical)*	1.5 KHz to 3.5 KHz
Narrow pulse signal	
Amplitude (*typical)*	0.5 V to 1.0 V maximum
Pulse-width (*typical)*	1.0 ns to 4.0 ns
Runt pulse and missing pulse signal	
Normal pulse amplitude (*typical)*	3.5 V to 5.5 V
Normal pulse frequency (*typical)*	8 MHz to 12 MHz
Runt pulse amplitude (*typical)*	2.0 V to 3.0 V

Table 3–2: Signal source characteristics (Cont.)

Characteristic	Description
Runt pulse frequency (*typical)*	1.6 Hz to 2.5 Hz
Missing pulse frequency (*typical)*	1.6 Hz to 2.5 Hz
Staircase signals source	
Step intervals (*typical)*	0.5 ms per step
Staircase interval (*typical)*	8.0 ms per staircase
Amplitude (*typical)*	900 mV_{p-p}
Metastable glitch signal	
Clock frequency (*typical)*	36 MHz to 44 MHz
Data frequency (*typical)*	8 MHz to 12 MHz
Glitch amplitude (*typical)*	±2 V minimum for largest glitches
Burst pulse signal	
Data amplitude (*typical)*	3.5 V to 5.1 V
Low frequency burst pulse modulation rate (*typical)*	Single pulse at 763 Hz ± 75 Hz
Mid frequency burst pulse modulation rate (*typical)*	Four pulses at 3.13 MHz ± 310 KHz
High frequency burst pulse modulation rate (*typical)*	Eight pulses at 50 MHz ± 5 MHz
Signal sources probe connections	
Counter and pattern generator connections	2 by 16 square pin headers
Setup and hold counter connections	2 by 8 square pin header and oscilloscope probe header
Digital signal connections	2 by 8 square pin header and oscilloscope probe header
Analog signal connections	2 by 8 square pin header and oscilloscope probe header

Table 3–3: Hardware characteristics

Characteristic	Description
User interface	
Halt indicator LED	One LED connected to the microprocessor halt line. The LED is on when the halt line is enabled (the microprocessor is in the halted state)
Trigger input enable LED	One LED connected to the external trigger enable control bit. The LED is on when external triggers are enabled.
LAPort output enable LED	One LED connected to the LAPort output control bit. The LED is on when the LAPort output is enabled.

Table 3–3: Hardware characteristics (Cont.)

Characteristic	Description
LAPort input enable LED	One LED connected to the LAPort input control bit. The LED is on when the LAPort input is enabled.
Memory mapped LEDs	16 memory mapped LEDs
Liquid crystal display	Two line by 16 character LCD memory mapped display
External interrupt request switches	Four interrupt request signal switches for microprocessor signals IRQ3, IRQ4, IRQ6, and IRQ7. The switches control the system software.
Reset switch	One microprocessor system reset switch
Power on/off switch	Applies power to the circuit board
Power indicator LED	Power-on indicator LED
Signal input and output ports	
Main serial port (Port B)	One DB-9 connector
Auxiliary serial port (Port A)	Two by five square-pin shrouded header
LAPort parallel control port	DB-25 connector
Logic analyzer trigger output	BNC connector
Logic analyzer trigger intput[1]	BNC connector
Background debug port connector	Two by five square-pin shrouded header
JTAG Port	One by six square-pin connector (square pins not installed)

1 **The logic analyzer trigger input BNC connector can also be used as the external clock input connector with for clock frequencies up to 50 MHz.**

Table 3–4: Power distribution characteristics

Characteristic	Description
Low voltage power supply	
Power supply input voltage (*typical)*	+8.0 V to +15.0 V
Power supply input voltage connector	2 mm male connector with 3 A 24 V rating
Power supply output voltage (*typical)*	+4.8 V to +5.2 V
Power supply output current (*typical)*	1.0 A maximum
Input power supplies	
North American	120 VAC, 60 Hz input; +13.5 V, 1.5 A output
European	220 VAC, 50 Hz input; +13.5 V, 1.3 A output
United Kingdom	240 VAC, 50 Hz input; +12.0 V, 1.5 A output
Japan	100 VAC, 50 Hz to 60 Hz input; +12.0 V, 1.5 A output

Table 3–5: Mechanical characteristics

Characteristic	Description
Construction material	
Circuit board	Glass laminate
Physical Dimensions	
Height	1.0 in (2.54 cm)
Length	8.1 in (20.57 cm)
Width	5.3 in (13.46 cm)
Package Dimensions	
Height	3 in (7.62 cm)
Length	12.9 in (32.77 cm)
Width	11.4 in (28.96 cm)
Shipping weight	4.5 lbs (2.03 kg)

Theory of Operation

This chapter provides the theory of operation of the TLA 7QS training board. It provides information on the built-in circuit modules and on the connectors on the training board.

Circuit Board Modules

The following circuit board modules are discussed in this section:

- Microprocessor module
- Signal Sources module
- User interface module
- Input/output module
- Power supply module

Microprocessor Module

The microprocessor module (schematic sheets 2, 3, 4, 5, 6, 7, and 10) consists of a Motorola M68340 microcontroller in a TQFP package, the associated static memory, programmable memory, nonvolatile EEPROM memory, and a read/write register.

Static Memory. The static memory consists of two banks of 128 K by 16 (memory implemented) using two 128 K by eight memory components. The standard training board is loaded with only one bank of static RAM for a total of 256 K bytes.

Programmable Memory. The programmable memory (PROM) is designed to be either EEPROM or flash memory. The PROM consists of system PROM and user PROM. Each bank can be implemented with two 128 K by eight parts, two 256 K by eight parts, or two 512 K by eight parts.

The standard training board has both banks or PROM loaded with 128 K flash memory for a total of 256 Kbytes of system flash and 256 Kbytes of user flash. The system flash contains the monitor program, board utilities, and a basic set of application programs.

The system flash is programmed at the factory and can be upgraded through field service upgrade kits. The user flash is provided for additional applications and is intended to be modified or added to the product by users with the proper software development tools.

EEPROM Memory. The EEPROM memory is implemented with a serial 2 K by eight serial EEPROM. The EEPROM memory is intended to be used by user applications to store miscellaneous data such as adjustment settings and bit patterns for the pattern generators. The EEPROM uses the I2C two-wire serial port for reading and writing data. The two-wire port consists of a clock and a data line. The clock and data lines are connected to two of the microcontroller input and output Port A bits. Software routines must be written by the user to properly read and write serial data from the EEPROM in the correct format.

Read/Write Register. A one by 16 bit read/write register implemented with D-flip-flops is used to create memory read errors. The read errors can be demonstrated by writing data to the register and reading the data back. The read strobe is set to provide timing for a proper read operation or to cause a read error.

The read strobe control consists of a coarse adjustment and a fine adjustment. The coarse adjustment delays the strobe in increments of processor clock cycles (62.5 ns) using a clock shift register and a multiplexer to select a specific output. The fine strobe control adjusts the time delay in 256 increments of 0.5 ns steps for a total range of 127 ns. The time adjustment is fine enough so that it can be calibrated to be just on the threshold of creating a read error.

You can use the high resolution (MagniVu) mode of the TLA 700 Series Logic Analyzers to demonstrate and measure small changes in delay adjustments.

Signal Sources Module

The signal sources module (schematic sheets 21, 22, 23,and 24) consists of several groups of signals that can be used to demonstrate logic analyzer and oscilloscope features.

Counter and Pattern Generator Signals. Two 16-bit counter and pattern generators can be individually programmed to operate as counters, pattern generators, or combined as a single 32-bit counter. The counters can be programmed to count up or down. The counter-pattern generator is controlled by the output control bits port of the microprocessor. Table 4–1 shows the output control bits.

Table 4–1: Output control bits

Bit	Signal name	Function
0	LCDRS	LCD register select
1	DLYCLKSEL0	Delay generator clock select Mux bit 0
2	DLYCLKSEL1	Delay generator clock select Mux bit 1
3	LAPORTIN*	LAPort input enable
4	LAPORTOUT*	LAPort output enable
5	TRIGGERIN*	External trigger input enable

Table 4–1: Output control bits (Cont.)

Bit	Signal name	Function
6	EXTCLKEN	External counter clock enable
7	CNTR16BIT*	16-bit or 32-bit counter select
8	PATCLKSEL0	Pattern generator clock selector Mux bit 0
9	PATCLKSEL1	Pattern generator clock selector Mux bit 1
10	LOCNTREN*	Low counter count enable
11	LOCNTRSEL*	Low counter or pattern select
12	LOCNTRUP*	Low counter count up/down select
13	HICNTREN*	High counter count enable
14	HICNTRSEL*	High counter or pattern select
15	HICNTRUP*	High counter count up/down select

The output control bits port is a 16-bit input register used to assert signals. The bit designations and signal names are listed in Table 4–1.

The two 16-bit counter-pattern generators operate the same. They can be configured individually as counters or pattern generators using the LOCNTRSEL* and HICNTRSEL* bits. The count up and count down bits (LOCNTRUP* and HICNTRUP*) control the count direction. The counters can be started or stopped with the count enable control bits LOCNTREN* and HICNTREN*.

When the counter-pattern generators function as pattern generators with the LOCNTRSEL* and HICNTRSEL* bits, you must select a pattern clock. The pattern clock toggles the low and high nibble of each patten bytes. The clock selection uses a four-to-one multiplexer which is controlled using pattern clock select bits PATCLKSEL0 and PATCLKSEL1. Table 4–2 shows the clock select truth table. Normal pattern generator operation includes disabling the counting so that the pattern at the output is the pattern that was loaded.

Table 4–2: Pattern generator clock select truth table

PATCLKSEL0	PATCLKSEL1	Clock select
0	0	Sigclk2; Microprocessor timer2 used as clock
0	1	TSTHD<3>; Setup and hold counter output bit 3
1	0	TSTHD<1>; Setup and hold counter output bit 1
1	1	CNTRCLK; Counter-pattern generator master clock

The Sigclk2 clock is the microprocessor timer2 output which can be programmed to any frequency and duty cycle. It can also be programmed to stay high or low, thus selecting the direct or alternate nibble of each byte. With the Sigclk2 signal set low, the direct nibble is selected; the signal is high, the alternate nibble is selected as shown in Table 4–3.

Table 4–3: Sigclk2 selections

Bit Value	Counter byte output nibble
0	Direct nibble; counter bits 0–3 go to output bits 0–3
1	Alternate nibble; counter bits 0–3 go to output bits 4–7

When the counters are used as pattern generators, the patterns can be loaded by writing the 16-bit counter value to the appropriate address. The individual counter load strobe is enabled with a write to the high counter-pattern generator or to the low counter-pattern generator. Table 4–4 shows the counter addresses.

Table 4–4: Counter-pattern generator addresses

Memory mapped device	Device address	Input/output type	Memory depth and width
Low Cntr/Pat Gen	$58 000	Write only	1 X 16
High Cntr/Pat Gen	$5C 000	Write only	1 X 16

The 50 MHz oscillator is the master clock for the counter-pattern generators. An external clock can be used to clock the counters. The external signal is a standard TTL level signal into the Trigger-In BNC connector. The counter clock is selected with the memory mapped external clock control bit EXTCLKEN (bit 6 of the 16-bit output control register at address 0X4C 0000.

Setup and Hold Trigger Signals. The setup and hold signals (schematic 25) are generated by a four-bit counter clocked at a 50 MHz rate. The four bits of the counter connect to four signal ground square pin pairs so they can be measured by a logic analyzer or by an oscilloscope. The counter output bits are routed to a latch which is clocked by a modified version of the 50 MHz clock counter clock. The counter clock is delayed to create a setup violation or a hold violation. The four output bits of the latch connect to four signal-ground square pin pairs. The delayed clock signal also connects to a signal-ground square pin pair.

Figure 4–1 shows the block diagram of the setup and hold violation counter. You may want to refer to this block diagram as you read the following paragraphs.

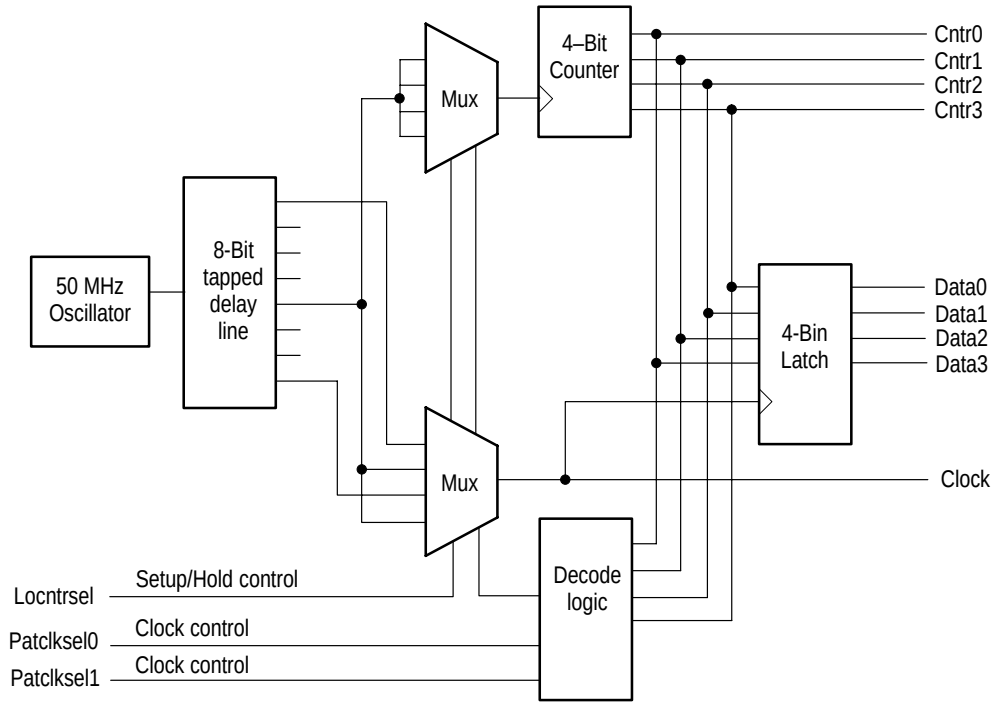


Figure 4–1: Setup and hold violation counter block diagram

The counter clock signal is delayed by an eight-bit tapped delay line. The clock signal is derived from one of the middle taps so it is delayed approximately 12 ns. The signal is routed through a multiplexer for time delay matching purposes. All four inputs of the multiplexer have the same clock signal so that the clock input to the counter always has a steady clock signal.

The delayed counter clock is selected by the setup and hold clock multiplexer (Mux). Three clock signals go to the four inputs of the Mux. A nominal delay clock goes to two inputs of the Mux. A setup delay clock with less delay than the counter clock and a hold delay with more delay than the counter clock are the other two inputs to the Mux.

The setup and hold violation counter operates in the following manner. The four-bit counter has a continuous count at 50 MHz. The four output bits and the clock can be measured. However, the clock is skewed in time at a specific counter output bit pattern of 1010. The time skew can be in either direction, positive or negative, compared to the counter clock. The time skew can be measured and analyzed with a logic analyzer.

The counter output bits and the time-skewed clock are applied to the four-bit latch. The time skew in the clock creates setup or hold violations when latching the data. These violations should be apparent when capturing the four output bits from the latch and measuring data errors at specific counts.

Three bits control the setup and hold violation counter operation (these bits also control the counter-pattern generators). The two circuits are not intended to be used at the same time. The LOCNTRSEL* bit selects either a setup clock or a hold clock (see Table 4–5). The PATCLKSEL0* and PATCLKSEL1* bits control the circuit operation as shown in Table 4–6.

Table 4–5: LOCNTRSEL bit operation

LOCNTRSEL bit	Selection
0	Selects the setup clock to cause a violation
1	Selects the hold clock to cause a violation

Table 4–6: PATCLKSEL0 and PATCLKSEL1 bit operation

PATCLKSEL0 bit	PATCLKSEL1 bit	Selection
0	0	Set to skewed clock (setup or hold) don't toggle
0	1	Set to norm clock (setup or hold) don't toggle
1	0	Set to skewed clock don't toggle (same as 00)
1	1	Run; toggle between norm and skewed clock

Tapped Delay Line. The tapped delay line (schematic 25) is an eight-bit digital delay with approximately 4 ns of delay between each bit. The on-board 100 MHz clock the input source for the delay line.

Burst Signal. The burst signal (schematic 29) consists of multiple signals at different frequencies from two different clock sources. The signals are combined with combinational logic to create a gated pulse. View the burst signal with an oscilloscope to see different features of the burst signal at different time base settings.

Glitch Signal. The glitch signal (schematic 28) is generated by gating the microprocessor programmable timers. The timers can be changed in frequency and duty cycle. The actual glitch signal is generated by delaying one of the timer signals into an exclusive-or gate with a resistor-capacitor network. The time difference of the two transitioning signals causes the glitch.

Metastable Data and Clock Signals. The metastable condition is created by applying a 10 MHz clock into the data input of a latch and clocking the data with an asynchronous 50 MHz clock (see schematic 26).

Step Signal. The step signal (schematic 28) is generated by rapidly turning off an RF transistor with a drive transistor. This creates a low-to-high transition at the collector of the output transistor. A resistor-capacitor-speedup network in the base circuit of the RF transistor speeds up the switching time and provides a method for high frequency compensation of the step signal.

Runt Pulse and Missing Pulse Signal. The runt pulse and missing pulse signals (schematic 26) are created by applying a 2 Hz data clock to a D-flip-flop. The flip-flop is clocked by a 10 MHz clock. The 2 Hz signal is divided by an additional flip-flop and the outputs are gated together to create pulses that drive one transistor that creates the runt pulses and another transistor that creates the missing pulses.

Single-Shot Narrow Pulse Signal. The single-shot narrow pulse (schematic 28) is created by applying a step signal to a gated resistor-capacitor network that differentiates the step to create the pulse. The pulse input steps are generated either from a 1 Hz continuous clock or from the processor timer number 1 (which is intended to be used for user initiated single-shot pulses).

Staircase Signal. The staircase (schematic 27) is generated by summing the outputs of a four-bit counter to create the stairs. The stairs are combined with a 50 MHz clock to create noisy glitches.

Clock Signals. The following clock signals are present on the training board:

- 50 MHz system clock
- An asynchronous 2 KHz clocks that is divided down to create lower frequencies
- An asynchronous 10 MHz clock
- Two programmable microprocessor timers

User Interface Module

The user interface module (schematic sheets 8 and 9) provides a means to control and observe the actions of the hardware features on the training board.

LCD Display. The main display device is a two by 16 character LCD display. The readout is controlled by software and by the four push-button switches.

The microprocessor communicates with the display by placing the upper eight bits on the data bus. The LCD display has a register select (RS) bit. When the RS bit is low, it selects the instruction register; when the bit is high, it selects the data register.

Push-button Switches. The four push-button switches connect to the four external interrupt lines of the microcontroller. The switches select and control the programs in the training board. The LCD readout displays the push-button switch functions. The right-most switch halts the program and asserts a nonmaskable interrupt (NMI) signal to IRQ7.

Reset Switch. The Reset switch is a momentary push-button switch that provides a system reset to the microcontroller.

LED Indicators. Two 10-segment LED indicators display bit patterns for various software and hardware demonstrations. The first sixteen LED segments (labeled 0 through 15) represent data bits. Bits 16 and 17 represent the LAPort input and output enable status. Bit 18 indicates whether the external trigger input is enabled. Bit 19 shows the status of the Halt signal line.

Power Supply Module

The power supply module (schematic 12) consists of a power input jack, fuse, power switch, power LED indicator, and the power supply circuitry. The power input jack accepts power from the wall mount power adapter. The battery input pins allow battery operation from a 9 V to 15 V battery.

The power supply is a 1.5 A switching power supply that steps down voltages between +15 V and +8 V to +5 V.

Input and Output Connectors

The TLA 7QS Training Board has the following input and output port connectors:

- Two serial ports
- A logic analyzer control port
- Two external trigger BNC connectors
- A background debug mode connector
- A JTAG connector (pins not installed on board)
- Power input connectors
- Bus interface connector
- Probe interfaces

Figure 4–2 shows the location of the connectors on the training board.

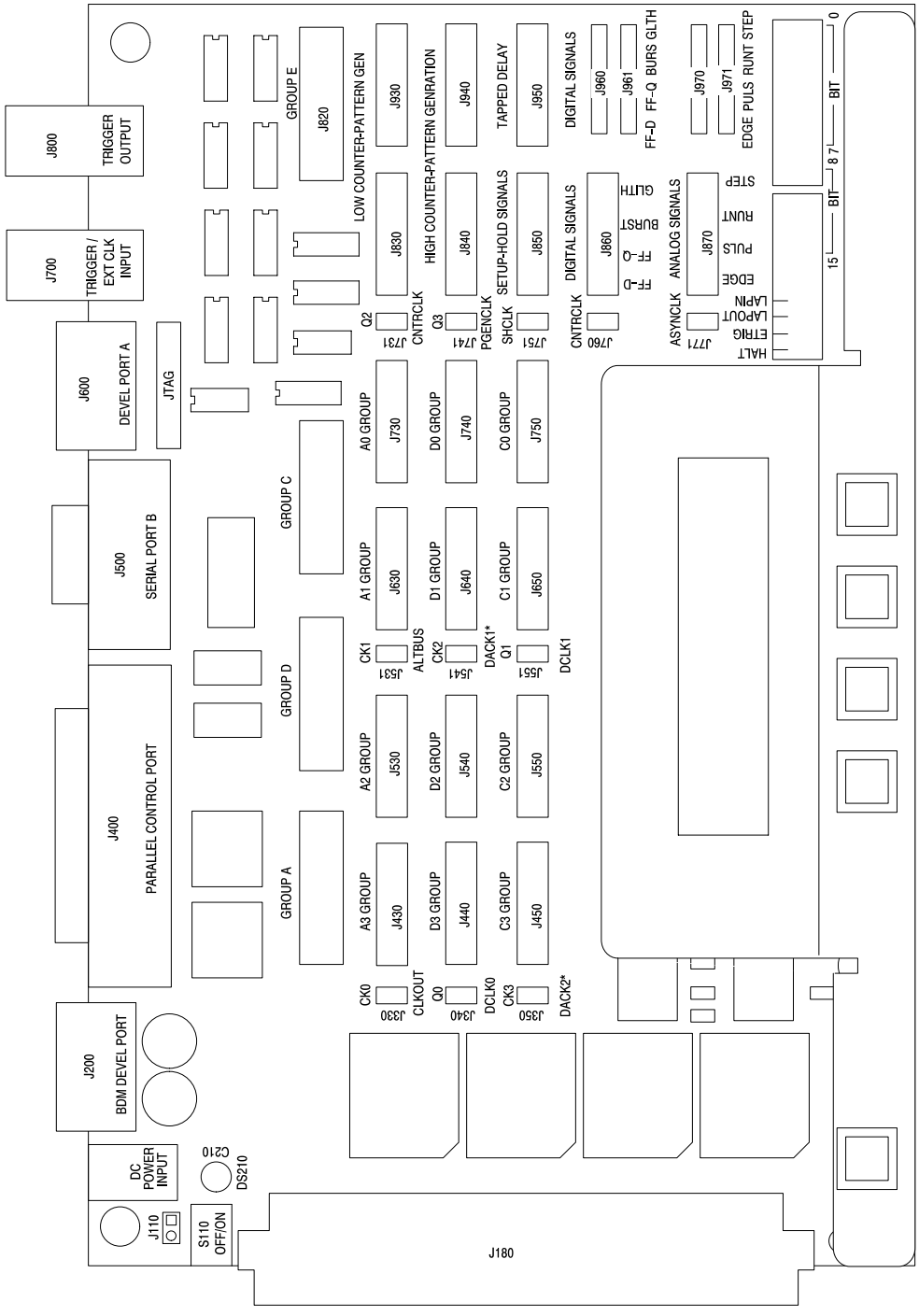


Figure 4–2: Input and output connector locations

Serial Ports

The main serial port, J500, (schematic 18) is a nine-pin subminiature D-connector that provides an RS-232 serial interface for controlling the computer system and for reading program data. This serial port uses the integrated serial port B of the M68340 microprocessor. The connector signals are compatible with a standard PC serial port; Table 4–7 lists the main serial port signals.

Table 4–7: Serial Port B pinout (J500)

Pin	Signal
1	Protective ground (shield)
2	Transmit data (TXD)
3	Receive data (RXD)
4	–
5	Ground
6	–
7	Clear to send (CTS)
8	Ready to send (RTS)
9	–

The secondary serial port, J600, (schematic 18) is a two by five shrouded square-pin connector that provides an RS-232 serial interface for monitoring the computer system and for software development. This serial port uses the integrated serial port A of the M68340 microprocessor. The signals are assigned to pins such that a standard nine-conductor ribbon cable subminiature D-connector can interface the port to a PC. Table 4–8 lists the secondary serial port signals.

Table 4–8: Serial Port A pinout (J600)

Pin	Signal
1	Protective ground (shield)
2	–
3	Transmit data (TXD)
4	Clear to send (CTS)
5	Receive data (RXD)
6	Ready to Send (RTS)
7	–
8	–
9	Ground
10	–

Logic Analyzer Control Port

The logic analyzer control port (schematic 19) is a 25-pin subminiature D-connector and provides parallel input and output control signals for monitoring and controlling the training board hardware and software. The port is compatible with any version of the standard PC parallel interface port.

There are eight input lines, five output lines, and read and write handshaking control signals. You can use any PC software capable of reading and writing bytes to the parallel port with the control port. The electronic circuitry provides a data register for writing data to the output port and a control/status register for monitoring the port status.

Table 4–9 lists the control port pins, LAPort signal definitions, the PC parallel port signal definitions, and the signal names.

Table 4–9: Logic analyzer control port signals (J400)

Pin	LAPort definition	Parallel port definition	Signal name
1	Write input strobe[1]	Data input strobe[1]	Write control strobe
2	Data input bit 0	Data0	Reset*
3	Data input bit 1	Data1	Cntlin1
4	Data input bit 3	Data2	Cntlin2
5	Data input bit 3	Data3	Cntlin3
6	Data input bit 4	Data4	IRQ3*
7	Data input bit 5	Data5	IRQ5
8	Data input bit 6	Data6	IRQ6*
9	Data input bit 7	Data7	IRQ7*
10	Data output bit 0	Ack* (status output bit 6)	Power-on monitor
11	Data output bit 1	Busy (status output bit 7)	Halt*
12	Data output bit 2	Error (status output bit 5)	Cntlout1
13	Data output bit 3	Select (status output bit 4)	Cntlout2
14	No connection	Autofd* (Cntl input bit 1)	–
15	Data output bit 4	Fault* (status output bit 3)	Cntlout3
16	No connection	Init* (Cntl input bit 2)	–
17	Read input strobe[1]	Select (Cntl input bit 3)	Read control strobe
18 – 25	Ground	Ground	Ground

[1] **Active low signal**

External Trigger BNC Connectors

Two external trigger BNC connectors (schematic 20) provide input and output trigger connections.

External Trigger Input Signal Connector (J700). This connector is an input for TTL-level signals. The signal connects to the microprocessor interrupt request level 5 input line and is gate-enabled through software control. This connector is also used as the external clock input to the training board. You can use an external clock frequency up to 50 Mhz.

External Trigger Output Signal Connector (J800). This connector is an output for TTL-level signals. The signal connects to the microprocessor interrupt request level 3 input line and is gate-enabled through software control.

Background Debug Mode Connector

The background debug port connector, J200, (schematic 20) is a right-angled, two by five shrouded square-pin header array. The port connects to an external serial software debugger that causes the microprocessor to run in the background debug mode (BDM). The signal lines are compatible with the P&E Microsystems BDM interface cable that has a pseudo standard software that supports BDM operation. Table 4–10 lists the pins and signals on the connector.

Table 4–10: BDM mode connector(J200)

Pin	Signal
1	DS*
2	BERR*
3	Ground
4	BKPT*
5	Ground
6	BFREEZE
7	RESET*
8	IFETCH*
9	Vcc
10	IPIPE*

JTAG Port

The JTAG port, J601, (schematic 20) does not have square pins installed. If desired, you can install six square pins in the circuit board to connect a JTAG tester to the microprocessor and to the programmable logic device (PLD) signal generator. Table 4–11 lists the pins and signals on the connector.

Table 4–11: JTAG port (J601)

Pin (not installed)	Signal
1	TDO
2	Ground
3	TCK
4	Ground
5	TMS
6	TDI

Power Input Connectors

Two power connectors (schematic 12) are available on the training board; a power-input jack (J111) and a battery header (J110). The inner connector is positive and the outer connector is connected to ground. Use one of the wall power adapters to connect to the power-input jack.

You can also connect a 9 V to 14 V battery; however, battery operation should only be used when there are no other ways to power the training board. If you use the battery connector, you need to install square pins to the J110 battery header.

Bus Interface Connector

The Bus Interface connector, J180, (schematic 11) provides a means for connecting the training board to other test fixtures. The connector is a standard 3 by 32 male receptacle DIN connector. Use a 3 by 32 female connector (Tektronix part number 131–2950–00 or similar) to connect to this connector.

The connector allows you to add additional circuitry to the training board. Use the schematics in this manual and the signals listed in Table 4–12 to design the circuitry to add to the connector.

Table 4–12: Bus interface connector (J180)

Pin	Row A signal	Row B signal	Row C signal
1	DATA0	PORTA7	DATA8
2	DATA1	PORTA6	DATA9
3	DATA2	PORTA5	DATA10
4	DATA3	PORTA4	DATA11
5	DATA4	PORTA3	DATA12
6	DATA5	PORTA2	DATA13
7	DATA6	PORTA1	DATA14
8	DATA7	PORTA0	DATA15
9	Ground	TOUT2	Ground
10	CLKOUT	TIN2	HALT*
11	Ground	IGATE2*	BERR*
12	DSACK0*	BR*	RESET*
13	DSACK1*	BG*	SIZ0
14	R/W*	BGACK*	SIZ1
15	Ground	RMC*	ADDR23
16	TOUT1	FC0	ADDR22
17	TIN1	FC1	ADDR21
18	IGATE1*	FC2	ADDR20
19	Ground	FC3	ADDR19
20	BKPT*	Ground	ADDR18
21	FREEZE	DS*	ADDR17
22	IPIPE*	AS*	ADDR16
23	IFETCH*	Ground	ADDR15
24	ADDR7	IRQ7*	ADDR14
25	ADDR6	IRQ6*	ADDR13
26	ADDR5	IRQ5*	ADDR12
27	ADDR4	IRQ3*	ADDR11
28	ADDR3	CS3*	ADDR10
29	ADDR2	CS2*	ADDR9
30	ADDR1	CS1*	ADDR8
31	ADDR0	CS0*	Ground
32	VCC	VCC	VCC

Probe Interfaces

The training board provides connections for Tektronix logic analyzer probes (schematic sheets 13, 14, 15, 16, and 17). The connectors comply with the Tektronix LASI-3 (0.10-inch square pins) and LASI-4 (high-density) interfaces. This provides connections for 96 data channels and six clock channels. The data channels and clock channels connect to the 68340 microprocessor and the related control lines. The signals are compatible with the Tektronix 68340 microprocessor control package.

The counter and pattern generator signals can be probed with standard logic analyzer probes on two by eight square-pin headers. They can also be probed by connecting to the high-density interface connectors.

The four-bit setup and hold counter can be probed on two by eight square-pin headers or on two by eight oscilloscope probe headers. The same is true for the analog and digital groups of signals on the training board.

Functional Verification Procedures

This chapter provides basic functional check procedures to verify that the TLA 7QS Training Board is operational beyond power-up diagnostics. There are no specific performance verification procedures for the training board.

The basic functional verification is accomplished by performing the following procedures:

- Microprocessor circuitry check
- Counter-pattern generator circuitry check
- Digital and analog circuitry check

Equipment Required

Table 5–1 summarizes the test equipment required to complete the functional check procedures.

Table 5–1: Test equipment

Item number and description	Minimum requirements	Example
1. Logic analyzer	TLA 700 Series	TLA 711 Benchtop Chassis or TLA 704 Portable Mainframe
2. Logic analyzer module	102 channel or 136 channel TLA 700 Series Logic Analyzer Module	TLA 7M3, TLA 7M4, TLA 7L3 or TLA 7L4
3. Logic Analyzer Probes	6 P6417 Probes and 3 P6434 Probes	–
4. TLA 7QS Software	TLA 7QS Application software and TLA 7QS Microprocessor Analysis Files	–
5. Training Manual	TLA 7QS QuickStart Training Manual	Included with the TLA 7QS QuickStart Training Manual
6. Oscilloscope	1 GHz analog bandwidth	Tektronix TDS 684B
7. Oscilloscope Probe	1 GHz analog bandwidth	Tektronix P6245

Microprocessor Circuitry Check

The following checks verify the functionality of the microprocessor circuitry on the training board. This procedure is based on the microprocessor exercises in the *TLA 7QS Training Manual*.

NOTE*. To complete the functional check procedure, it is assumed that the* TLA 7QS *application software and Microprocessor Analysis software files are installed on the logic analyzer. If not, refer to the* TLA 7QS Training Manual *for information on installing the software on the logic analyzer.*

To perform the check, refer to the *TLA 7QS Training Manual* and perform the following steps:

1. Connect the P6417 probes to the training board as indicated in the *Microprocessor Exercises Setup* chapter.
2. Power on the training board.
3. Perform the steps under *Microprocessor Exercise 1: Trigger on a Power-on Reset and Capture the Controller Startup Code* in the training manual.
4. Check that the Listing Data window shows disassembled data similar to that in the exercise.

   If the disassembled data is similar to that shown in the exercise example, you have verified the functionality of the microprocessor circuitry for the P6417 probe connections.
5. Disconnect the P6417 probes from the training board and from the logic analyzer and connect the P6434 probes.
6. Repeat the exercise using the P6434 probes.

   If the disassembled data is similar to that shown in the exercise example, you have verified the functionality of the microprocessor circuitry for the P6434 probe connections.

Counter-Pattern Generator Circuitry Check

The following procedure verifies the functionality of the counter-pattern generator circuitry.

1. Disconnect the P6434 probe connected to the Group C connector on the training board and connect the probe to the counter–pattern generator connector (J820).

2. Use the UP or DN buttons on the training board to select the PATTERN GEN program.
3. Push the RUN button on the training board to start the pattern generator program.
4. On the logic analyzer, restore the default setups (select Default System from the File menu).
5. Open the Setup menu from the logic analyzer icon in the system menu.
6. Click on the Show Activity button to open the Activity monitor.
7. Check that the probe channels connected to the training board show activity represented by up and down arrows for each channel.

   Figure 5–1 shows an example of the Activity monitor with active signals for the probes connected to the training board.

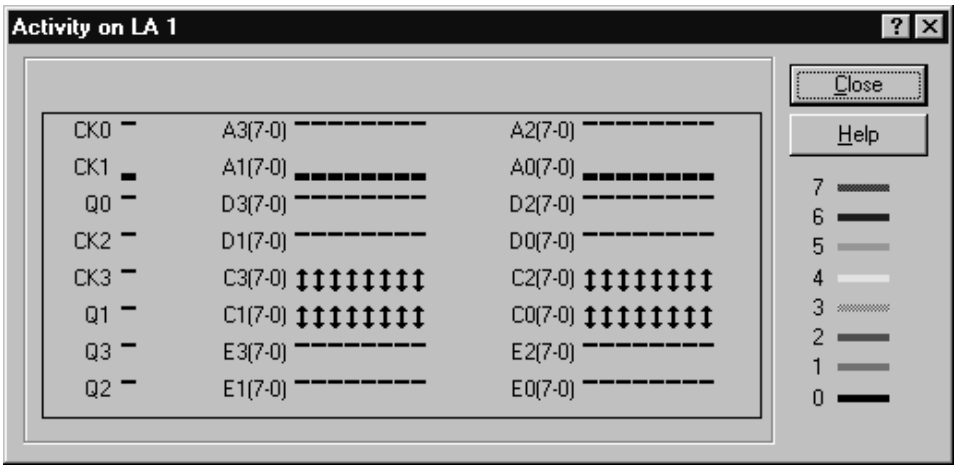


Figure 5–1: Sample Activity Monitor

If all signal channels show activity, you have verified the functionality of the counter-pattern generator circuitry for the P6434 probe connections.

8. Disconnect the P6434 probes from the training board and from the logic analyzer and connect the P6417 probes to the High Counter-Pattern Generator and Low Counter-Pattern Generator connectors on the training board (J840, J940, J830, and J930).
9. Check that the probe channels connected to the training board show activity represented by up and down arrows for each channel.

If all signal channels show activity, you have verified the functionality of the counter-pattern generator circuitry for the P6417 probe connections.

10. Disconnect one of the P6417 probes and connect one set of the 8-channel lead sets to the Setup-Hold Signal connector (J850).

11. Connect the other set of 8-channel lead sets to the Tapped Delay connector (J950)

12. Check that the probe channels connected to the training board show activity on each channel.

If all signal channels show activity, you have verified the functionality of the Setup-Hold Signal connector and the Tapped Delay connector.

13. Disconnect the logic analyzer probes from the training board.

Digital and Analog Circuitry Check

The procedures in this section check the following signals on the training board:

- Runt pulse and missing pulse
- Narrow pulse
- Burst pulse
- Fast edge signal
- Metastable glitch signal
- Staircase signal

To complete these checks, you will need a 1 GHz analog bandwidth oscilloscope and an oscilloscope probe (Tektronix TDS 684B with a P6345 probe).

Runt Pulse and Missing Pulse Check

Perform the followings steps to verify basic functionality of the runt pulse and missing pulse.

1. Set up the vertical input of the oscilloscope to measure a 2 V pulse.
2. Set horizontal controls as follows:
   - Time/Div 100 ns
   - Position Trigger at center
   - Trigger position 50%
3. Set up the trigger controls as follows:
   - Type Pulse, Width, Neg, Trig Outside 15–128 ns
   - Level 3.2 V
   - Source Ch1
   - Polarity Positive
   - Threshold 220 mV
4. Connect the Channel 1 probe to the RUNT pin on the training board (J870–3). Connect the probe ground lead to a nearby ground pin.
5. Check for a series of pulses, with one of the pulses being a blinking runt pulse.

Narrow Pulse Check

Perform the followings steps to verify basic functionality of the narrow pulse signal.

1. Set up the vertical input of the oscilloscope to measure a 500 mV signal.
2. Set horizontal controls as follows:
   - Time/Div 2 ns
   - Trigger position 50%
3. Set up the trigger controls as follows:
   - Type Edge
   - Source Ch1
   - Slope Rising
   - Level 500 mV

4. Connect the Channel 1 probe to the PULS pin on the training board (J870–5). Connect the probe ground lead to a nearby ground pin.
5. Adjust the trigger level control on the oscilloscope for a positive pulse (the pulse may have some jitter).
6. Check for a 0.5 ns – 6.0 ns pulse with an amplitude between 0.3 V and 2.0 V.

Burst Pulse Check

Perform the followings steps to verify basic functionality of the burst pulse signal.

1. Set up the vertical input of the oscilloscope to measure a 2 V signal.
2. Set horizontal controls as follows:
   - Time/Div 50 ns
   - Trigger position 50%
3. Set up the trigger controls as follows:
   - Type Edge
   - Source Ch1
   - Slope Rising
   - Level 3.2 V
4. Connect the Channel 1 probe to the BURST pin on the training board (J860–3). Connect the probe ground lead to a nearby ground pin.
5. Adjust the trigger level control on the oscilloscope for a stable signal.
6. Check for a signal with bursts of pulses.

Fast Edge Signal Check

Perform the followings steps to verify basic functionality of the fast edge signal.

1. Set up the vertical input of the oscilloscope to measure a 200 mV signal. Set the position two divisions below the center graticule.
2. Set horizontal controls as follows:
   - Time/Div 100 µs
   - Position Trigger at center
   - Trigger position 50%

3. Set up the trigger controls as follows:
   - Type — Edge
   - Source — Ch1
   - Slope — Rising
   - Level — 220 mV
4. Connect the Channel 1 probe to the EDGE pin on the training board (J870–7). Connect the probe ground lead to a nearby ground pin.
5. Check for a signal from 250 mV to 1500 mV with a frequency from 1.5 KHz to 3.5 KHz. The rise time should be from 0 to 300 ps.

Metastable Glitch Signal Check

Perform the following steps to verify basic functionality of the metastable glitch signal.

1. Set up the vertical input of the oscilloscope to measure a 2 V signal.
2. Set horizontal controls as follows:
   - Time/Div — 20 ns
   - Position — Trigger at center
   - Trigger position — 50%
3. Set up the trigger controls as follows:
   - Type — Edge
   - Source — Ch1
   - Slope — Rising
   - Polarity — Positive
   - Level — 1.3 V
   - Threshold — 1.3 V
4. Connect the Channel 1 probe to the FF-D pin on the training board (J870–5). Connect the probe ground lead to a nearby ground pin.
5. Check for a glitch in the square wave signal that is over 2 V.

Staircase Signal Check

Perform the followings steps to verify basic functionality of the staircase signal.

1. Set up the vertical input of the oscilloscope to measure a 200 mV signal. Set the position two divisions below the center graticule.
2. Set horizontal controls as follows:
   - Time/Div 1 ms
   - Position Trigger at center
   - Trigger position 90%
3. Set up the trigger controls as follows:
   - Mode Auto
   - Type Edge
   - Source Ch1
   - Slope Falling
   - Level 400 mV
4. Connect the Channel 1 probe to the STEP pin on the training board (J870–1). Connect the probe ground lead to a nearby ground pin.
5. Adjust the oscilloscope trigger level control for a stable staircase signal.
6. Check for a staircase signal with a peak-to-peak amplitude between 800 mV and 1200 mV and a frequency between 63 Hz and 250 Hz.
7. Disconnect the probes from the training board.
8. Power off the training board.

Maintenance

This chapter contains the information needed for periodic and corrective maintenance of the TLA 7QS Training Board. The following sections are included:

- Preventing ESD
- Service Strategy
- Inspection and Cleaning (see page 6–2)
- Troubleshooting (see page 6–3)
- Repackaging Instructions (see page 6–3)

Preventing ESD

When performing any service adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive components.
2. Transport and store static-sensitive components in their static protected containers or on a metal rail. Label any package that contains static-sensitive components.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these components.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.

Service Strategy

Tektronix provides service to cover repair under warranty as well as other services that may provide a cost-effective answer to your service needs.

Warranty Repair Service

Tektronix warrants the training board for three months from the date of shipment. Any failures will be replaced with an exchange module from the Beaverton Exchange center. Tektronix technicians provide in-service center warranty service at most Tektronix service locations worldwide. For the latest information on Tektronix products, refer to the Tektronix Internet site at `http://www.tek.com`.

Customer site service is also available from most of the same service locations.

Repair or Calibration Service

Tektronix offers several standard-priced adjustment (calibration) and repair services:

- A single repair and/or adjustment
- Calibrations using equipment and procedures that meet the traceability standards specific to national standards requirements (Calibrations do not apply to the TLA 7QS QuickStart Training Board)
- Annual prearranged service do not apply to the TLA 7QS QuickStart Training Board

Of these services, the annual prearranged service offers a particularly cost-effective approach to service for many owners of the TLA 700 series logic analyzers.

Self Service

Tektronix supports repair to the module level by providing Module Exchange.

Module Exchange. Use this service to reduce down time for repair by exchanging circuit boards for remanufactured ones. Tektronix ships an updated and tested exchange circuit board from the Beaverton, Oregon service center. Each circuit board comes with a 90-day service warranty.

For More Information. Contact your local Tektronix service center or sales engineer for more information on any of the repair or adjustment services just described.

Inspection and Cleaning

This section describes how to inspect for dirt and damage, and how to clean the training board. Inspection and cleaning are done as preventive maintenance. Preventive maintenance, when done regularly, may prevent malfunctions and enhance reliability.

Preventive maintenance consists of visually inspecting and cleaning the training board, and using general care when operating it. How often to do maintenance depends on the severity of the environment in which the training board is used.

Inspect and clean the training board as often as operating conditions require. Collection of dirt on internal components can cause them to overheat and break down. Dirt acts as an insulating blanket, preventing efficient heat dissipation. Dirt also provides an electrical conduction path that can cause failures, especially under high-humidity conditions.

CAUTION. *Avoid using chemical cleaning agents that might damage the plastics and external labels used on the training board. Use a cloth dampened with water to clean external surfaces. Before using any cleaner, consult your Tektronix Service Center or representative.*

To clean the exterior, perform the following steps:

1. Remove loose dust on the outside of the training board with a lint free cloth.
2. Remove remaining dirt with a lint free cloth dampened with water. Do not use abrasive cleaners.

Troubleshooting Procedures

Most troubleshooting is accomplished by use of diagnostics and probing for signals on the training board with an oscilloscope, a logic analyzer, or a logic probe.

Diagnostics

Diagnostics run when you first apply power to the training board or when you press the Reset button. You can also select the diagnostics from the menu in the user interface. For information on diagnostics refer to page 2–16.

Signal Tracing

Use an oscilloscope or a logic probe to trace faults to specific areas on the training board. Use the schematics in this manual to help isolate problems to a component or connector.

Parts Replacement

Refer to the *Replaceable Electrical Parts* list for part numbers of all electrical parts on the training board. Refer to the *Replaceable Mechanical Parts* list for part numbers of all mechanical parts and accessories.

Repackaging Instructions

This section contains the information needed to repackage the training board for shipment.

If at all possible, use the original packaging to ship or store the training board. If the original packaging is not available, use a corrugated cardboard shipping carton having a test strength of at least 275 pounds (125 kg) and with an inside dimension at least six inches (15.25 cm) greater than the training board dimensions. Add cushioning material to prevent the training board from moving around in the shipping container.

If the training board is being shipped to a Tektronix Service Center, enclose the following information:

- The owner’s address
- Name and phone number of a contact person
- Type and serial number of the training board
- Reason for returning
- A complete description of the service required

Seal the shipping carton with an industrial stapler or strapping tape.

Mark the address of the Tektronix Service Center and also your own return address on the shipping carton in two prominent locations.

Replaceable Electrical Parts

This section contains a list of the electrical components for the TLA 7QS training board. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix products are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If you order a part that has been replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

Using the Replaceable Electrical Parts List

The tabular information in the Replaceable Electrical Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find all of the information you need for ordering replacement parts. The following table describes each column of the electrical parts list.

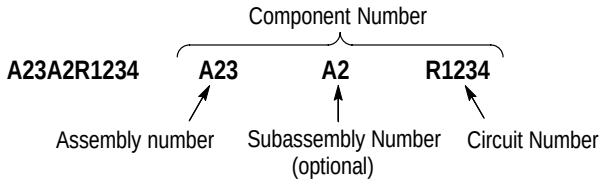
Parts list column descriptions

Column	Column name	Description
1	Component number	The component number appears on diagrams and circuit board illustrations, located in the diagrams section. Assembly numbers are clearly marked on each diagram and circuit board illustration in the *Diagrams* section, and on the mechanical exploded views in the *Replaceable Mechanical Parts* list section. The component number is obtained by adding the assembly number prefix to the circuit number (see Component Number illustration following this table). The electrical parts list is arranged by assemblies in numerical sequence (A1, with its subassemblies and parts, precedes A2, with its subassemblies and parts). Chassis-mounted parts have no assembly number prefix, and they are located at the end of the electrical parts list.
2	Tektronix part number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entry indicates the part is good for all serial numbers.
5	Name & description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.
6	Mfr. code	This indicates the code number of the actual manufacturer of the part.
7	Mfr. part number	This indicates the actual manufacturer's or vendor's part number.

Abbreviations

Abbreviations conform to American National Standard ANSI Y1.1–1972.

Component Number



Read: Resistor 1234 (of Subassembly 2) of Assembly 23

List of Assemblies

A list of assemblies is located at the beginning of the electrical parts list. The assemblies are listed in numerical order. When a part's complete component number is known, this list will identify the assembly in which the part is located.

Chassis Parts

Chassis-mounted parts and cable assemblies are located at the end of the Replaceable Electrical Parts List.

Mfr. Code to Manufacturer Cross Index

The table titled Manufacturers Cross Index shows codes, names, and addresses of manufacturers or vendors of components listed in the parts list.

Manufacturers cross index

Mfr. code	Manufacturer	Address	City, state, zip code
00779	AMP INC.	CUSTOMER SERVICE DEPT PO BOX 3608	HARRISBURG, PA 17105–3608
01295	TEXAS INSTRUMENTS INC	SEMICONDUCTOR GROUP 13500 N CENTRAL EXPRESSWAY PO BOX 655303	DALLAS, TX 75272–5303
04222	AVX/KYOCERA	PO BOX 867	MYRTLE BEACH, SC 29577
04426	ITW SWITCHES	AN ILLINOIS TOOL WORKS CO. 6615 W. IRVING PARK RD.	CHICAGO, IL 60634
04713	MOTOROLA INC	SEMICONDUCTOR PRODUCTS SECTOR 5005 E MCDOWELL ROAD	PHOENIX, AZ 85008–4229
06090	RAYCHEM CORP	300 CONSTITUTION DR	MENLO PARK, CA 94025–1111
09969	DALE ELECTRONIC COMPONENTS	EAST HWY 50 P.O. BOX 180	YANKTON, SD 57078
0B0A9	DALLAS SEMICONDUCTOR	4350 BELTWOOD PKWY S	DALLAS, TX 75244
0HAF7	EPSON AMERICA	20770 MADRONA AVE	TORRANCE, CA 90503
0LUT2	TOYOCOM USA INC	617 E GOLF ROAD SUITE 172	ARLINGTON HEIGHTS, IL 60005
1CH66	PHILIPS SEMICONDUCTORS	811 E ARQUES AVE PO BOX 3409	SUNNYVALE, CA 94086–3409
1ES66	MAXIM INTEGRATED PRODUCTS INC	120 SAN GABRIEL DR	SUNNYVALE, CA 94086
27014	NATIONAL SEMICONDUCTOR CORP	2900 SEMICONDUCTOR DR PO BOX 58090 MS 30–115	SANTA CLARA, CA 95051–0606
29454	JOHANSON DIELECTRICS INC	15191 BLEDSOE STREET	SYLMAR, CA 91342
31918	ITT SWITCH PRODUCTS	8081 WALLACE RD	EDEN PRAIRIE, MN 55344–8798
34335	ADVANCED MICRO DEVICES INC	ONE AMD PLACE PO BOX 3453	SUNNYVALE, CA 94088–3453
50139	ALLEN–BRADLEY COMPANY INC	ELECTRONIC COMPONENTS DIVISION 1414 ALLEN BRADLEY DRIVE	EL PASO, TX 79936
50434	HEWLETT PACKARD	370 W TRIMBLE ROAD	SAN JOSE, CA 95131–1008
53387	3M COMPANY	ELECTRONICS PRODUCTS DIV 3M AUSTIN CENTER	AUSTIN, TX 78769–2963
55680	NICHICON (AMERICA) CORP	927 E STATE PARKWAY	SCHAUMBURG, IL 60195–4526
57924	BOURNS INC	INTEGRATED TECHNOLOGY DIV. 1400 NORTH 1000 WEST	LOGAN, UT 84321
59124	KOA SPEER ELECTRONICS INC	BOLIVAR DRIVE PO BOX 547	BRADFORD, PA 16701
60395	XICOR INC	851 BUCKEYE CT	MILPITAS, CA 95035–7408
61429	FOX ELECTRONICS	DIV OF FOX ENTERPRIXED INC 5842 CORPORATION CIRCLE	FORT MEYERS, FL 33905
62712	SEIKO INSTRUMENTS USA INC	ELECTRONIC COMPONENTS DIV 2990 W LOMITA BLVD	TORRANCE, CA 90505
62786	HITACHI AMERICA LTD	HITACHI PLAZA 2000 SIERRA POINT PKWY	BRISBAINE, CA 94005
63058	BERG ELECTRONICS INC.	MCKENZIE SOCKET DIV 910 PAGE AVE	FREMONT, CA 94538–7340
64155	LINEAR TECHNOLOGY CORP.	1630 MCCARTHY BOULEVARD	MILPITAS, CA 950357487

Manufacturers cross index (Cont.)

Mfr. code	Manufacturer	Address	City, state, zip code
76493	BELL INDUSTRIES	JW MILLER DIVISION 306 E ALONDRA BLVD PO BOX 2859	GARDENA, CA 90247–1059
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077–0001
91637	DALE ELECTRONIC COMPONENTS	1122 23RD ST	COLUMBUS, NE 68601
TK2449	SINGATRON ENTERPRISE CO LTD	13925 MAGNOLIA AVE	CHINO, CA 91710

Replaceable electrical parts list

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01	671–3684–00			CIRCUIT BOARD:LA QUICKSTART	80009	671–3684–00
A01C130	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C150	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0151	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C160	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C170	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C180	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C210	283–5114–00			CAP,FXD,CERAMIC:MLC,0.1UF,10%,50V,X7R,1206,SMD,8MM T&R	04222	12065C104KAT(1A OR 3A)
A01C211	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC ALUMINUM	55680	UVX1V101MPA
A01C212	283–5114–00			CAP,FXD,CERAMIC:MLC,0.1UF,10%,50V,X7R,1206,SMD,8MM T&R	04222	12065C104KAT(1A OR 3A)
A01C213	290–0973–00			CAP,FXD,ELCTLT:100UF,20%,25VDC ALUMINUM	55680	UVX1V101MPA
A01C0240	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0260	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0270	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0271	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0280	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0281	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C282	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0283	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0284	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C285	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C350	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C370	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0410	290–5051–00			CAP,FXD,TANT:DRY,100UF,20%,16V,0.287 X 0.169,7343H, SMD,T&R	04222	TAJE107M016R
A01C411	290–5051–00			CAP,FXD,TANT:DRY,100UF,20%,16V,0.287 X 0.169,7343H,SMD, T&R	04222	TAJE107M016R
A01C0420	290–5051–00			CAP,FXD,TANT:DRY,100UF,20%,16V,0.287 X 0.169,7343H,SMD, T&R	04222	TAJE107M016R
A01C421	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0422	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0460	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0461	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0462	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C470	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C471	283–5267–00			CAP,FXD,CERAMIC:MLC,1UF,+80%–20%,25V,Y5V,1206,SMD,T&R	04222	12063G105ZAT4A
A01C472	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01C480	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0481	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C482	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C483	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0484	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C485	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0520	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0521	283–5267–00			CAP,FXD,CERAMIC:MLC,1UF,+80%–20%,25V,Y5V,1206,SMD,T&R	04222	12063G105ZAT4A
A01C0522	283–5267–00			CAP,FXD,CERAMIC:MLC,1UF,+80%–20%,25V,Y5V,1206,SMD,T&R	04222	12063G105ZAT4A
A01C0523	283–5267–00			CAP,FXD,CERAMIC:MLC,1UF,+80%–20%,25V,Y5V,1206,SMD,T&R	04222	12063G105ZAT4A
A01C550	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C551	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C560	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0561	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0562	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0563	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0564	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C565	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C570	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0571	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C572	283–5114–00			CAP,FXD,CERAMIC:MLC,0.1UF,10%,50V,X7R,1206,SMD,8MM T&R	04222	12065C104KAT(1A OR 3A)
A01C573	283–5196–00			CAP,FXD,CERAMIC:MLC,47PF,5%,100V,NPO,1206,SMD,8MM T&R	04222	12061A470JAT1A
A01C0574	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0575	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C576	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C580	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0581	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C582	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0583	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C584	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C586	283–5017–00			CAP,FXD,CERAMIC:MLC,1PF,+/–0.25PF,50V,NPO,1206,SMD,8MM T&R	04222	12065A1R0CAT1A
A01C600	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C610	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0611	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0612	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0620	283–5267–00			CAP,FXD,CERAMIC:MLC,1UF,+80%–20%,25V,Y5V,1206,SMD,T&R	04222	12063G105ZAT4A

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01C0621	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C622	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C650	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0660	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C661	283–5334–00			CAP,FXD CERAMIC:MLC,10PF,5%,100V,NPO,0603,SMD,T&R.	29454	250R14N100CV4T
A01C670	283–5334–00			CAP,FXD CERAMIC:MLC,10PF,5%,100V,NPO,0603,SMD,T&R.	29454	250R14N100CV4T
A01C671	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C672	283–5358–00			CAP,FXD,CERAMIC:100PF,5%,100V,NPO,0603,SMD,T&R	04222	06031A101JAT2A
A01C0673	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C680	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C710	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0711	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C712	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C713	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0714	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C720	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0721	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0722	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C723	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0724	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0725	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0790	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0791	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C800	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C810	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C811	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0812	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C813	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C820	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0821	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C822	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C890	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0891	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0910	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C911	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C0920	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C921	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A
A01C990	283–5353–00			CAP,FXD,CERAMIC:0.1UF,20%,16V,X7R,0603,SMD,T&R	04222	0603YC104MAT2A

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01C0214	283–5114–00			CAP,FXD,CERAMIC:MLC,0.1UF,10%,50V,X7R,1206,SMD,8MM T&R	04222	12065C104KAT(1A OR 3A)
A01CR120	152–5084–00			DIODE,RECT:SCHTKY,40V,3A,80A IFSM,MBRS340,DO–214AB/SMC,16MM T&R	04713	MBRS340T3
A01CR220	152–5084–00			DIODE,RECT:SCHTKY,40V,3A,80A IFSM,MBRS340,DO–214AB/SMC,16MM T&R	04713	MBRS340T3
A01CR0310	152–5084–00			DIODE,RECT:SCHTKY,40V,3A,80A IFSM,MBRS340,DO–214AB/SMC,16MM T&R	04713	MBRS340T3
A01CR670	152–5047–00			DIODE,SIG:ULTRA FAST,DUAL,COMMON CATHODE,100V,0.74VF,4NS,2.0PF,MMBD1204,TO–236/SOT–23,8 MM	27014	MMBD1204
A01CR671	152–5047–00			DIODE,SIG:ULTRA FAST,DUAL,COMMON CATHODE,100V,0.74VF,4NS,2.0PF,MMBD1204,TO–236/SOT–23,8 MM	27014	MMBD1204
A01CR800	152–0843–00			DIODE,SIG:SCHTKY,SER–PAIR,20V,410MV,1.3PF,HSMS–2812,SO T–23,T&R	50434	HSMS–2812–T31
A01CR801	152–0843–00			DIODE,SIG:SCHTKY,SER–PAIR,20V,410MV,1.3PF,HSMS–2812,SO T–23,T&R	50434	HSMS–2812–T31
A01DS210	150–1132–00			DIODE,OPTO:LED,GRN,569MCD,10.6MCD AT 10MA,40 DEG VIEW ANGL,HLMP–3568,T–1 3/4,LOW PROFILE	50434	HLMP–3568
A01DS780	150–1137–00			DIODE,OPTO:LED,BAR GRAPH ARRAY,MULTI–COLOR,10–ELEMENT	50434	HDSP–4836
A01DS880	150–1137–00			DIODE,OPTO:LED,BAR GRAPH ARRAY,MULTI–COLOR,10–ELEMENT	50434	HDSP–4836
A01F220	159–5008–00			FUSE,THRM,CHIP:SELF RESETTING FUSE,1.5A HOLD,3.0A TRIP AT 20 DEG C,30V MAX,SMD150	06090	SMD150–2
A01J111	131–5527–00			JACK,POWER DC:PCB,MALE,RTANG,2MM PIN,11MM H(0.433) X 3.5MM(0.137) TAIL,9MM(0.354) W,TIN,W/SWI	TK2449	DJ–005–A
A01J180	131–3692–00			CONN,DIN:PCB,MALE,RTANG,3 X 32,0.1CTR,0.209 MLG X 0.104 TAIL0.437 H,BD RETENTION,HIGH TE	00779	536416–5
A01J200	131–3358–00			CONN,HDR:PCB,MALE,RTANG,2 X 5,0.1 CTR,0.390 MLG X 0.112 TAIL,0.33 H,SHRD/4 SIDES,MIL PLZ	53387	2510–5002UB
A01J320	131–6134–00			CONN,PLUG:SMD,MICTOR,PCB,FEMALE,STR,38 POS,0.025 CTR,0.245 H,GOLD	00779	767004–1
A01J330	131–4917–00			CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD,TUBE,HIGH TEMP,	00779	104350–1
A01J340	131–4917–00			CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD,TUBE,HIGH TEMP,	00779	104350–1
A01J350	131–4917–00			CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD,TUBE,HIGH TEMP,	00779	104350–1
A01J400	131–3395–00			CONN,DSUB:PCB,MALE,RTANG,25 POS,0.318 MLG X 0.125 TAIL,30 GOLD,W/4–40 THD INSERTS,BD RETE	00779	747842–4
A01J420	131–6134–00			CONN,PLUG:SMD,MICTOR,PCB,FEMALE,STR,38 POS,0.025 CTR,0.245 H,GOLD	00779	767004–1

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01J430	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J440	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J450	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J500	131–3925–00			CONN,DSUB:PCB,FEMALE,RTANG,9 POS,0.112 CTR,0.318 MLG X 0.125 TAIL,4–40 THD INSERT,BD RETE	00779	747844–4
A01J530	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J531	131–4917–00			CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD,TUBE,HIGH TEMP,	00779	104350–1
A01J540	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J541	131–4917–00			CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD,TUBE,HIGH TEMP,	00779	104350–1
A01J550	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J551	131–4917–00			CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD,TUBE,HIGH TEMP,	00779	104350–1
A01J600	131–3358–00			CONN,HDR:PCB,MALE,RTANG,2 X 5,0.1 CTR,0.390 MLG X 0.112 TAIL,0.33 H,SHRD/4 SIDES,MIL PLZ	53387	2510–5002UB
A01J620	131–6134–00			CONN,PLUG:SMD,MICTOR,PCB,FEMALE,STR,38 POS,0.025 CTR,0.245 H,GOLD	00779	767004–1
A01J630	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J640	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J650	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J700	131–5999–00			CONN,RF:BNC,FEMALE,50 OHM,RTANG,PCB,0.340 H X 0.110 TAIL,W/O MTG THD,NICKEL PL DIECAST/	00779	414373–1
A01J730	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J731	131–4917–00			CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD,TUBE,HIGH TEMP,	00779	104350–1
A01J740	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J741	131–4917–00			CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD,TUBE,HIGH TEMP,	00779	104350–1
A01J750	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J751	131–4917–00			CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD,TUBE,HIGH TEMP,	00779	104350–1
A01J760	131–4917–00			CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD,TUBE,HIGH TEMP,	00779	104350–1

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01J771	131–4917–00			CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD,TUBE,HIGH TEMP,	00779	104350–1
A01J800	131–5999–00			CONN,RF:BNC,FEMALE,50 OHM,RTANG,PCB,0.340 H X 0.110 TAIL,W/O MTG THD,NICKEL PL DIECAST/	00779	414373–1
A01J820	131–6134–00			CONN,PLUG:SMD,MICTOR,PCB,FEMALE,STR,38 POS,0.025 CTR,0.245 H,GOLD	00779	767004–1
A01J830	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J840	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J850	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J860	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J870	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J930	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J940	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J950	131–5267–00			CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP,	00779	104326–4
A01J960	131–6226–00			CONN,HDR:PCB,MALE,STR,1 X 4,0.2 CTR,0.0.166 MLG,0.03 DIA X 0.0.115 TAIL,0.021 DIA,GOLDUS	63058	SST63150–001
A01J961	131–6226–00			CONN,HDR:PCB,MALE,STR,1 X 4,0.2 CTR,0.0.166 MLG,0.03 DIA X 0.0.115 TAIL,0.021 DIA,GOLDUS	63058	SST63150–001
A01J970	131–6226–00			CONN,HDR:PCB,MALE,STR,1 X 4,0.2 CTR,0.0.166 MLG,0.03 DIA X 0.0.115 TAIL,0.021 DIA,GOLDUS	63058	SST63150–001
A01J971	131–6226–00			CONN,HDR:PCB,MALE,STR,1 X 4,0.2 CTR,0.0.166 MLG,0.03 DIA X 0.0.115 TAIL,0.021 DIA,GOLDUS	63058	SST63150–001
A01L310	108–5163–00			INDUCTOR,FXD:POWER,22UH,+20%,–15%,IDC<2.20 A,RDC<0.07 OHM,SRF(TYP.) = 15.2 MHZ,SMD,T&R	76493	PM125S–220M
A01L410	108–5162–00			INDUCTOR,FXD:POWER,10UH,25%,IDC<2.65 A,RDC<0.05 OHM,SRF(TYP.) = 24.2 MHZ,SMD,T&R	76493	PM125S–100M
A01Q0310	151–5088–00			TRANSISTOR,PWR:MOS,P–CH,30V,4.6A,0.07/0.135 OHM,STD/LOGIC LEVEL,SI9435DY,SO8.150,12MM T&R	27014	NDS9435
A01Q670	151–5079–00			TRANSISTOR,SIG:BIPOLAR,NPN,12V,60MA,6GHZ,AMPLIFIER,MMBR911L,TO–236/SOT–23,8MM,T&R	04713	MMBR911LT1
A01Q671	151–5012–00			TRANSISTOR,SIG:BIPOLAR,PNP,15V,10MA,2.0GHZ,AMPLIFIER, MMBTH69L,TO–236/SOT–23,8MM T&R	04713	MMBTH69LT1
A01Q672	151–5029–00			TRANSISTOR,SIG:BIPOLAR,NPN,15V,500MA,SWITCHING,MMBT 2369L/MMBT2369AL,TO–236/SOT–23,8MM T&R	04713	MMBT2369ALT1
A01Q673	151–5029–00			TRANSISTOR,SIG:BIPOLAR,NPN,15V,500MA,SWITCHING,MMBT 2369L/MMBT2369AL,TO–236/SOT–23,8MM T&R	04713	MMBT2369ALT1

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01Q680	151–5000–00			TRANSISTOR,SIG:BIPOLAR,PNP,40V,200MA,250MHZ,AMPLIFIER,MMBT3906L,TO–236/SOT–23,8MM T&R	04713	MMBT3906LT1
A01R180	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FRT–1
A01R181	321–5432–00			RES,FXD,FILM:100K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06031003FRT–1
A01R210	321–5018–00			RES,FXD:THICK FILM,1.0K OHM,1%,0.125W,TC=100 PPM,1206,T&R	50139	BCK1001FT
A01R211	321–5390–00			RES,FXD:THICK FILM,0.2 OHM,10%,0.125W,TC=600 PPM,1206,T&R	91637	CRCW1206–26–.2 OHM 10%
A01R212	321–5390–00			RES,FXD:THICK FILM,0.2 OHM,10%,0.125W,TC=600 PPM,1206,T&R	91637	CRCW1206–26–.2 OHM 10%
A01R0270	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FRT–1
A01R0310	321–5051–00			RES,FXD:THICK FILM,0 OHM,1%,0.125W,TC=100 PPM,1206,T&R	09969	CRCW1206 JUMPER
A01R0311	321–5051–00			RES,FXD:THICK FILM,0 OHM,1%,0.125W,TC=100 PPM,1206,T&R	09969	CRCW1206 JUMPER
A01R390	321–5426–00			RES,FXD,FILM:8.25K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06038251FRT–1
A01R410	307–5082–00			RES NTWK,FXD,FI:8,10 OHM,2%,ISOLATED,0.16W EA,1.28W PKG,SMD,SO16.220	57924	4816P–001–100
A01R450	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FRT–1
A01R451	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FRT–1
A01R452	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FRT–1
A01R453	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FRT–1
A01R454	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FRT–1
A01R0460	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FRT–1
A01R0461	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FRT–1
A01R0462	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FRT–1
A01R0463	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FRT–1
A01R470	307–5041–01			RES,NTWK,FXD,FI:15,4.7K OHM,2%,PIN 16 COMMON,0.08W EA,1.2W PKG,50PPM,SMD,SO16.200,T&R	57924	4816P–002–472
A01R471	321–5427–00			RES,FXD,FILM:10.0K,1%,100V,62.5MW,0603,SMD,T&R	59124	RK73H1J1002FT
A01R480	307–5041–01			RES,NTWK,FXD,FI:15,4.7K OHM,2%,PIN 16 COMMON,0.08W EA,1.2W PKG,50PPM,SMD,SO16.200,T&R	57924	4816P–002–472
A01R481	321–5451–00			RES,FXD,FILM:150 OHM,1%,100V,62.5MW,0603,SMD,T&R	59124	RK73H1JT1500F

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01R482	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FR T–1
A01R483	321–5432–00			RES,FXD,FILM:100K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06031003FR T–1
A01R484	321–5432–00			RES,FXD,FILM:100K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06031003FR T–1
A01R500	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FR T–1
A01R501	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FR T–1
A01R510	307–5082–00			RES NTWK,FXD,FI:8,10 OHM,2%,ISOLATED,0.16W EA,1.28W PKG,SMD,SO16.220	57924	4816P–001–100
A01R511	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FR T–1
A01R512	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FR T–1
A01R513	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FR T–1
A01R551	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FR T–1
A01R552	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FR T–1
A01R560	321–5426–00			RES,FXD,FILM:8.25K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06038251FR T–1
A01R561	321–5028–00			RES,FXD:THICK FILM,6.81K OHM,1%,0.125W,TC=100 PPM,1206,T&R	50139	BCK6811FT
A01R562	321–5426–00			RES,FXD,FILM:8.25K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06038251FR T–1
A01R0562	321–5445–00			RES,FXD,FILM:49.9 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060349R9FR T–1
A01R0564	321–5445–00			RES,FXD,FILM:49.9 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060349R9FR T–1
A01R570	321–5421–00			RES,FXD,FILM:1.00K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06031001FR T–1
A01R580	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FR T–1
A01R0580	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FR T–1
A01R581	321–5432–00			RES,FXD,FILM:100K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06031003FR T–1
A01R0581	321–5448–00			RES,FXD,FILM:75.0 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060375R0FR T–1
A01R582	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FR T–1
A01R583	321–5432–00			RES,FXD,FILM:100K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06031003FR T–1

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01R584	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FR T–1
A01R585	321–5415–00			RES,FXD,FILM:0 OHM JUMPER,100V,62MW,0603,SMD,T&R	59124	RM73Z1J000ZT
A01R0610	307–5041–01			RES,NTWK,FXD,FI:15,4.7K OHM,2%,PIN 16 COMMON,0.08W EA,1.2W PKG,50PPM,SMD,SO16.200,T&R	57924	4816P–002–472
A01R0611	321–5445–00			RES,FXD,FILM:49.9 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060349R9FR T–1
A01R621	321–5426–00			RES,FXD,FILM:8.25K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06038251FR T–1
A01R660	321–5439–00			RES,FXD,FILM:18.2 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060318R2FR T–1
A01R661	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FR T–1
A01R662	321–5426–00			RES,FXD,FILM:8.25K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06038251FR T–1
A01R663	321–5445–00			RES,FXD,FILM:49.9 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060349R9FR T–1
A01R670	321–5418–00			RES,FXD,FILM:221 OHM,1%,100V,62MW,0603,SMD,T&R	59124	RK73H1J2210FT
A01R671	321–5463–00			RES,FXD,FILM:5.62K OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06035621FR T–1
A01R672	321–5425–00			RES,FXD,FILM:4.75K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034751FR T–1
A01R673	321–5466–00			RES,FXD,FILM:12.1K OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06031212FR T–1
A01R674	321–5428–00			RES,FXD,FILM:22.1K,1%,100V,62.5MW,0603,SMD,T&R	59124	RK73H1J2212FT
A01R675	321–5471–00			RES,FXD,FILM:47.5K OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034752FR T–1
A01R676	321–5426–00			RES,FXD,FILM:8.25K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06038251FR T–1
A01R677	321–5421–00			RES,FXD,FILM:1.00K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06031001FR T–1
A01R678	321–5421–00			RES,FXD,FILM:1.00K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06031001FR T–1
A01R679	321–5426–00			RES,FXD,FILM:8.25K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06038251FR T–1
A01R680	321–5461–00			RES,FXD,FILM:2.21K OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06032211FR T–1
A01R681	321–5421–00			RES,FXD,FILM:1.00K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06031001FR T–1
A01R682	321–5471–00			RES,FXD,FILM:47.5K OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06034752FR T–1
A01R683	321–5455–00			RES,FXD,FILM:562 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06035620FR T–1
A01R684	321–5454–00			RES,FXD,FILM:332 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW0603332RFR T–1

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01R685	321–5454–00			RES,FXD,FILM:332 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW0603332RFRT–1
A01R700	321–5445–00			RES,FXD,FILM:49.9 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060349R9FRT–1
A01R712	321–5415–00			RES,FXD,FILM:0 OHM JUMPER,100V,62MW,0603,SMD,T&R	59124	RM73Z1J000ZT
A01R713	321–5415–00			RES,FXD,FILM:0 OHM JUMPER,100V,62MW,0603,SMD,T&R	59124	RM73Z1J000ZT
A01R715	321–5426–00			RES,FXD,FILM:8.25K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06038251FRT–1
A01R720	321–5415–00			RES,FXD,FILM:0 OHM JUMPER,100V,62MW,0603,SMD,T&R	59124	RM73Z1J000ZT
A01R721	321–5415–00			RES,FXD,FILM:0 OHM JUMPER,100V,62MW,0603,SMD,T&R	59124	RM73Z1J000ZT
A01R730	321–5415–00			RES,FXD,FILM:0 OHM JUMPER,100V,62MW,0603,SMD,T&R	59124	RM73Z1J000ZT
A01R751	321–5415–00			RES,FXD,FILM:0 OHM JUMPER,100V,62MW,0603,SMD,T&R	59124	RM73Z1J000ZT
A01R752	321–5415–00			RES,FXD,FILM:0 OHM JUMPER,100V,62MW,0603,SMD,T&R	59124	RM73Z1J000ZT
A01R760	321–5415–00			RES,FXD,FILM:0 OHM JUMPER,100V,62MW,0603,SMD,T&R	59124	RM73Z1J000ZT
A01R770	321–5454–00			RES,FXD,FILM:332 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW0603332RFRT–1
A01R772	321–5445–00			RES,FXD,FILM:49.9 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060349R9FRT–1
A01R800	321–5445–00			RES,FXD,FILM:49.9 OHM,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW060349R9FRT–1
A01R0890	307–5077–00			RES NTWK,FXD,FI:1K,2%,0.080W,SOMG16	57924	4816P–002–102
A01R0891	307–5077–00			RES NTWK,FXD,FI:1K,2%,0.080W,SOMG16	57924	4816P–002–102
A01R900	321–5426–00			RES,FXD,FILM:8.25K,1%,100V,62.5MW,0603,SMD,T&R	91637	CRCW06038251FRT–1
A01S110	260–0960–01			SWITCH,SLIDE:DPST,ALT MAKE/BREAK,FORM Z,0.5A,175VAC,75VDC,CHASSIS MNT,	04426	023–021–304
A01S290	260–2072–00			SWITCH,PUSH:SPST,10MA,35VDC,MOMENTARY	31918	D60101
A01S490	260–2072–00			SWITCH,PUSH:SPST,10MA,35VDC,MOMENTARY	31918	D60101
A01S590	260–2072–00			SWITCH,PUSH:SPST,10MA,35VDC,MOMENTARY	31918	D60101
A01S591	260–2072–00			SWITCH,PUSH:SPST,10MA,35VDC,MOMENTARY	31918	D60101
A01S690	260–2072–00			SWITCH,PUSH:SPST,10MA,35VDC,MOMENTARY	31918	D60101
A010U210	156–6966–01			IC,LINEAR:CMOS,SW–REGULATOR CONTROLLER,PFM,STEP DOWN,5V/ADJ,SHUTDOWN,USES EXT PWR MOSFET,M	1ES66	MAX649CSA–T
A01U231	156–6663–00			IC,MEMORY:CMOS,EPROM,128K X 8,120NS,5V FLASH,29F010,PLCC32	34335	AM29F010–120JC
A01U251	156–6663–00			IC,MEMORY:CMOS,EPROM,128K X 8,120NS,5V FLASH,29F010,PLCC32	34335	AM29F010–120JC
A010U260	156–6151–01			IC,MEMORY:CMOS,SRAM,128K X 8,100NS,15UA,OE,431000,SO32.440,T&R	62786	HM628128LFP–10SL
A01U261	156–6663–00			IC,MEMORY:CMOS,EPROM,128K X 8,120NS,5V FLASH,29F010,PLCC32	34335	AM29F010–120JC

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01U0270	156–6151–01			IC,MEMORY:CMOS,SRAM,128K X 8,100NS,15UA,OE,431000,SO32.440,T&R	62786	HM628128LFP–10SL
A01U271	156–6663–00			IC,MEMORY:CMOS,EPROM,128K X 8,120NS,5V FLASH,29F010,PLCC32	34335	AM29F010–120JC
A01U0290	156–6127–00			IC,DIGITAL:ACTCMOS,FLIP FLOP,OCTAL D–TYPE,CLEAR,74ACT273,SO20.300	04713	MC74ACT273DW
A01U291	156–5754–00			IC,DIGITAL:ACTCMOS,MUX,DUAL 4–TO–1,ENABLE,74ACT153,SO16.150	04713	MC74ACT153D
A01U292	156–5386–01			IC,DIGITAL:FTTL,REGISTER,4–BIT BIDIRECTIONAL UNIVERSAL SHIFT,74F194,SO16.150,16MM T&R	04713	MC74F194DR2
A01U0360	156–5143–01			IC,DIGITAL:HCTCMOS,FLIP FLOP,OCTAL D–TYPE,3–STATE,74HCT374,SO20.300,24MM T&R	04713	MC74HCT374ADWR2
A01U0370	156–5143–01			IC,DIGITAL:HCTCMOS,FLIP FLOP,OCTAL D–TYPE,3–STATE,74HCT374,SO20.300,24MM T&R	04713	MC74HCT374ADWR2
A01U371	119–3130–00			DISPLAY,MODULE:LCD,16 CHARACTERS X 2 LINES,5 X 7 DOT MATRIX,REFLECTIVE	62712	M16320A
A01U0380	156–6617–01			IC,DIGITAL:CMOS,DELAY LINE,PROGRAMMABLE,256 TAPS,0.5NS PER TAP,DS1020–05,SO16.300,T&R	0B0A9	DS1020S–50/TR
A01U0390	156–5220–01			IC,DIGITAL:HCTCMOS,BUFFER,OCTAL,FLOW THRU,3–STATE,74HCT541,SO20.300,24MM T&R	01295	SN74HCT541DWR
A01U0410	156–5408–00			IC,DIGITAL:ACTCMOS,LATCH,OCTAL D–TYPE,3–STATE,74ACT373,SO20.300	04713	MC74ACT373DW
A01U460	156–5306–01			IC,DIGITAL:HCTCMOS,COUNTER,DUAL 4–BIT BINARY RIPPLE,ASYNCH CLEAR,74HCT393,SO14.150,16MM T&R	1CH66	74HCT393DT
A01U461	156–6751–01			IC,MEMORY:CMOS,EEPROM,2K X 8,SERIAL,24C16,S08.150,T&R	60395	X24C16S8T1
A01U0462	156–5190–01			IC,DIGITAL:FTTL,DECODER,1–OF–8,ACTIVE LOW,74F138,SO16.150,16MM T&R	01295	SN74F138DR
A01U0470	156–7083–00			IC,PROCESSOR:CMOS,MICROCONTOLLER,32 BIT,25MHZ,MC68340PV,TQFP144	04713	MC68340PV–25E
A01U471	156–5085–01			IC,DIGITAL:HCTCMOS,GATE,QUAD 2–INPUT OR,74HCT32,SO14.150,16MM T&R	04713	MC74HCT32ADR2
A01U480	156–5144–01			IC,DIGITAL:HCTCMOS,FLIP FLOP,QUAD D–TYPE,CLEAR,COMPLEMENTARY OUTPUTS,74HCT175	01295	SN74HCT175D
A01U0510	156–5408–00			IC,DIGITAL:ACTCMOS,LATCH,OCTAL D–TYPE,3–STATE,74ACT373	04713	MC74ACT373DW
A01U511	156–6895–00			IC,MISC:CMOS,INTERFACE,RS–232,5 DRIVERS,5 RECEIVERS,+5V VCC	64155	LT1130ACSW
A01U560	156–5668–01			IC,DIGITAL:ASTTL,GATE,DUAL 4–INPUT AND,74AS21,SO14.150,16MM T&R	01295	SN74AS21DR
A01U0561	156–5355–00			IC,DIGITAL:HCTCMOS,GATE,TRIPLE 3–INPUT AND,74HCT11,SO14.150	1CH66	74HCT11D
A01U0562	156–5146–01			IC,DIGITAL:HCTCMOS,GATE,QUAD 2–INPUT AND,74HCT08,SO14.150,16MM T&R	01295	SN74HCT08DR
A01U563	156–5503–00			IC,DIGITAL:FTTL,GATE,DUAL 5–INPUT NOR,74F260	01295	SN74F260D
A01U564	156–5084–00			IC,DIGITAL:HCTCMOS,GATE,DUAL 4–INPUT NAND,74HCT20	1CH66	74HCT20D

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01U0570	156–5085–01			IC,DIGITAL:HCTCMOS,GATE,QUAD 2–INPUT OR,74HCT32,SO14.150,16MM T&R	04713	MC74HCT32ADR2
A01U0571	156–5085–01			IC,DIGITAL:HCTCMOS,GATE,QUAD 2–INPUT OR,74HCT32,SO14.150,16MM T&R	04713	MC74HCT32ADR2
A01U572	156–5131–01			IC,DIGITAL:HCTCMOS,GATE,HEX INVERTER,SCHMITT TRIG,74HCT14,SO14.150,16MM T&R	04713	MC74HCT14ADR2
A01U580	156–5146–01			IC,DIGITAL:HCTCMOS,GATE,QUAD 2–INPUT AND,74HCT08,SO14.150,16MM T&R	01295	SN74HCT08DR
A01U0610	156–6695–00			IC,DIGITAL:ABTCMOS,BUFFER,OCTAL,RESISTOR TERMINATED OUTPUTS,3–STATE,74ABT2244,SO20.300	01295	SN74ABT2244DW
A01U0660	156–5799–00			IC,DIGITAL:ALSTTL,GATE,HEX BUFFER,OPEN–COLLECTOR,74ALS1035,SO14.150	01295	SN74ALS1035D
A01U661	156–5188–01			IC,DIGITAL:FTTL,GATE,QUAD 2–INPUT XOR,74F86,SO14.150,16MM T&R	01295	SN74F86DR
A01U0680	156–6127–00			IC,DIGITAL:ACTCMOS,FLIP FLOP,OCTAL D–TYPE,CLEAR,74ACT273,SO20.300	04713	MC74ACT273DW
A01U681	156–5306–01			IC,DIGITAL:HCTCMOS,COUNTER,DUAL 4–BIT BINARY RIPPLE,ASYNCH CLEAR,74HCT393,SO14.150,16MM T&R	1CH66	74HCT393DT
A01U0682	156–5085–01			IC,DIGITAL:HCTCMOS,GATE,QUAD 2–INPUT OR,74HCT32,SO14.150,16MM T&R	04713	MC74HCT32ADR2
A01U710	156–5054–01			IC,DIGITAL:FTTL,GATE,QUAD 2–INPUT OR,74F32,SO14.150,16MM T&R	01295	SN74F32DR
A01U0711	156–5168–01			IC,DIGITAL:FTTL,FLIP FLOP,OCTAL D–TYPE,3–STATE,74F374,SO20.300,24MM T&R	01295	SN74F374DWR
A01U712	156–5510–00			IC,DIGITAL:FTTL,COUNTER,SYNCH 4–BIT UP/DOWN BINARY,PRESET,74F169,SO16.150,TUBE	01295	SN74F169D
A01U0713	156–5510–00			IC,DIGITAL:FTTL,COUNTER,SYNCH 4–BIT UP/DOWN BINARY,PRESET,74F169,SO16.150	01295	SN74F169D
A01U720	156–5754–00			IC,DIGITAL:ACTCMOS,MUX,DUAL 4–TO–1,ENABLE,74ACT153,SO16.150	04713	MC74ACT153D
A01U0721	156–5497–00			IC,DIGITAL:FTTL,COUNTER,SYNCH 4–BIT BINARY,PRESET AND CLEAR,74F163,SO16.150	01295	SN74F163AD
A01U722	156–5053–01			IC,DIGITAL:FTTL,GATE,QUAD 2–INPUT AND,74F08,SO14.150,16MM T&R	01295	SN74F08DR
A01U723	156–5192–01			IC,DIGITAL:FTTL,MUX,QUAD 2–TO–1,ENABLE,74F157A,SO16.150,16MM T&R	01295	SN74F157ADR
A01U0724	156–5192–01			IC,DIGITAL:FTTL,MUX,QUAD 2–TO–1,ENABLE,74F157A,SO16.150,16MM T&R	01295	SN74F157ADR
A01U0725	156–5504–01			IC,DIGITAL:FTTL,GATE,DUAL 4–INPUT NAND,74F20,SO14.150,16MM T&R	01295	SN74F20DR
A01U726	156–5754–00			IC,DIGITAL:ACTCMOS,MUX,DUAL 4–TO–1,ENABLE,74ACT153,SO16.150	04713	MC74ACT153D
A01U0790	156–5085–01			IC,DIGITAL:HCTCMOS,GATE,QUAD 2–INPUT OR,74HCT32,SO14.150,16MM T&R	04713	MC74HCT32ADR2
A01U791	156–6127–00			IC,DIGITAL:ACTCMOS,FLIP FLOP,OCTAL D–TYPE,CLEAR,74ACT273,SO20.300	04713	MC74ACT273DW

Replaceable electrical parts list (Cont.)

Component number	Tektronix part number	Serial no. effective	Serial no. discont'd	Name & description	Mfr. code	Mfr. part number
A01U810	156–5510–00			IC,DIGITAL:FTTL,COUNTER,SYNCH 4–BIT UP/DOWN BINARY,PRESET,74F169,SO16.150	01295	SN74F169D
A01U0811	156–5510–00			IC,DIGITAL:FTTL,COUNTER,SYNCH 4–BIT UP/DOWN BINARY,PRESET,74F169,SO16.150	01295	SN74F169D
A01U812	156–5510–00			IC,DIGITAL:FTTL,COUNTER,SYNCH 4–BIT UP/DOWN BINARY,PRESET,74F169,SO16.150	01295	SN74F169D
A01U0813	156–5510–00			IC,DIGITAL:FTTL,COUNTER,SYNCH 4–BIT UP/DOWN BINARY,PRESET,74F169,SO16.150	01295	SN74F169D
A01U0820	156–5052–01			IC,DIGITAL:FTTL,GATE,HEX INVERTER,74F04,SO14	01295	SN74F04DR
A01U821	156–5192–01			IC,DIGITAL:FTTL,MUX,QUAD 2–TO–1,ENABLE,74F157A	01295	SN74F157ADR
A01U822	156–5192–01			IC,DIGITAL:FTTL,MUX,QUAD 2–TO–1,ENABLE,74F157A	01295	SN74F157ADR
A01U0823	156–5192–01			IC,DIGITAL:FTTL,MUX,QUAD 2–TO–1,ENABLE,74F157A	01295	SN74F157ADR
A01U824	156–5192–01			IC,DIGITAL:FTTL,MUX,QUAD 2–TO–1,ENABLE,74F157A	01295	SN74F157ADR
A01U0825	156–5192–01			IC,DIGITAL:FTTL,MUX,QUAD 2–TO–1,ENABLE,74F157A	01295	SN74F157ADR
A01U890	156–6127–00			IC,DIGITAL:ACTCMOS,FLIP FLOP,OCTAL D–TYPE,CLEAR,74ACT273	04713	MC74ACT273DW
A01U910	156–5510–00			IC,DIGITAL:FTTL,COUNTER,SYNCH 4–BIT UP/DOWN BINARY,PRESET,74F169	01295	SN74F169D
A01U0911	156–5510–00			IC,DIGITAL:FTTL,COUNTER,SYNCH 4–BIT UP/DOWN BINARY,PRESET,74F169	01295	SN74F169D
A01U920	156–5192–01			IC,DIGITAL:FTTL,MUX,QUAD 2–TO–1,ENABLE,74F157A	01295	SN74F157ADR
A01U0921	156–5192–01			IC,DIGITAL:FTTL,MUX,QUAD 2–TO–1,ENABLE,74F157A	01295	SN74F157ADR
A01U0565	156–5081–01			IC,DIGITAL:HCTCMOS,GATE,HEX INVERTER,74HCT04,SO14	01295	SN74HCT04DR
A01U0573	156–5081–01			IC,DIGITAL:HCTCMOS,GATE,HEX INVERTER,74HCT04,SO14	01295	SN74HCT04DR
A01U0670	156–5055–01			IC,DIGITAL:FTTL,FLIP FLOP,DUAL D–TYPE,SET,CLEAR,74F74,SO14	01295	SN74F74DR
A01Y360	158–5020–00			OSCILLATOR,RF:CRYSTAL CONTROLLED,3.6864 MHZ,0.01%	61429	F3160–3.6864MHZ
A01Y380	158–5062–00			OSCILLATOR:CRYSTAL CONTROLLED,16MHZ,100 PPM	0HAF7	SG–615P 16.000MCT TUBE
A01Y610	158–5029–01			OSCILLATOR:50MHZ,0.01%	0LUT2	TC0–711JTC 50. MHZ

Diagrams and Circuit Board Illustrations

This section contains the troubleshooting procedures, block diagrams, circuit board illustrations, component locator tables, waveform illustrations, and schematic diagrams.

Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975. Abbreviations are based on ANSI Y1.1-1972.

Logic symbology is based on ANSI/IEEE Standard 91-1984 in terms of positive logic. Logic symbols depict the logic function performed and can differ from the manufacturer's data.

The tilde (~) or asterisk (*) preceding a signal name indicates that the signal performs its intended function when in the low state.

Other standards used in the preparation of diagrams by Tektronix, Inc., include the following:

- Tektronix Standard 062-2476 Symbols and Practices for Schematic Drafting
- ANSI Y14.159-1971 Interconnection Diagrams
- ANSI Y32.16-1975 Reference Designations for Electronic Equipment
- MIL-HDBK-63038-1A Military Standard Technical Manual Writing Handbook

Component Values

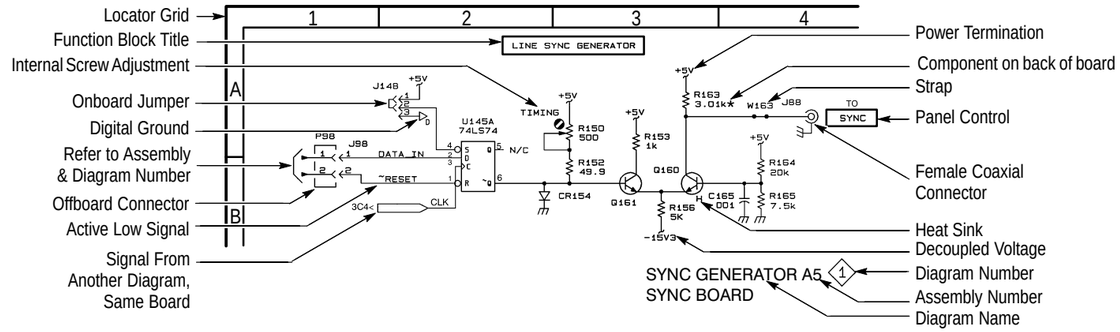
Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors: Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).

Resistors: Values are in Ohms (Ω).

Graphic Items and Special Symbols Used in This Manual

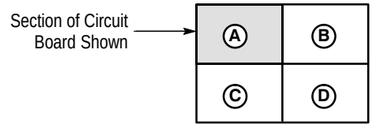
Each assembly in the instrument is assigned an assembly number (for example A5). The assembly number appears in the title on the diagram, in the lookup table for the schematic diagram, and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assembly in numerical sequence; the components are listed by component number.

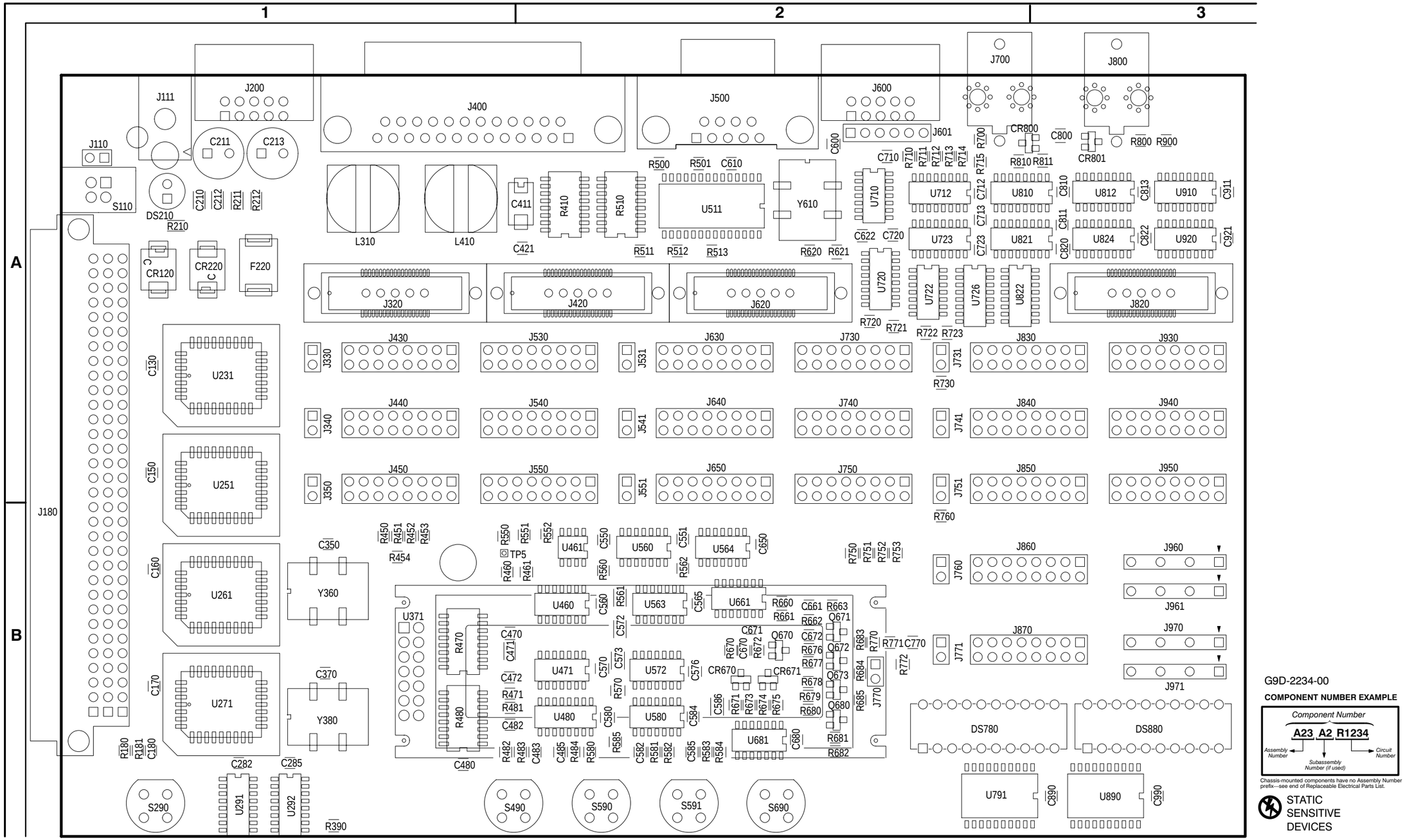


Component Locator Diagrams

The schematic diagram and circuit board component location illustrations have grids marked on them. The component lookup tables refer to these grids to help you locate a component. The circuit board illustration appears only once; its lookup table lists the diagram number of all diagrams on which the circuitry appears.

Some of the circuit board component location illustrations are expanded and divided into several parts to make it easier for you to locate small components. To determine which part of the whole locator diagram you are looking at, refer to the small locator key shown below. The gray block, within the larger circuit board outline, shows where that part fits in the whole locator diagram. Each part in the key is labeled with an identifying letter that appears in the figure titles under component locator diagrams.





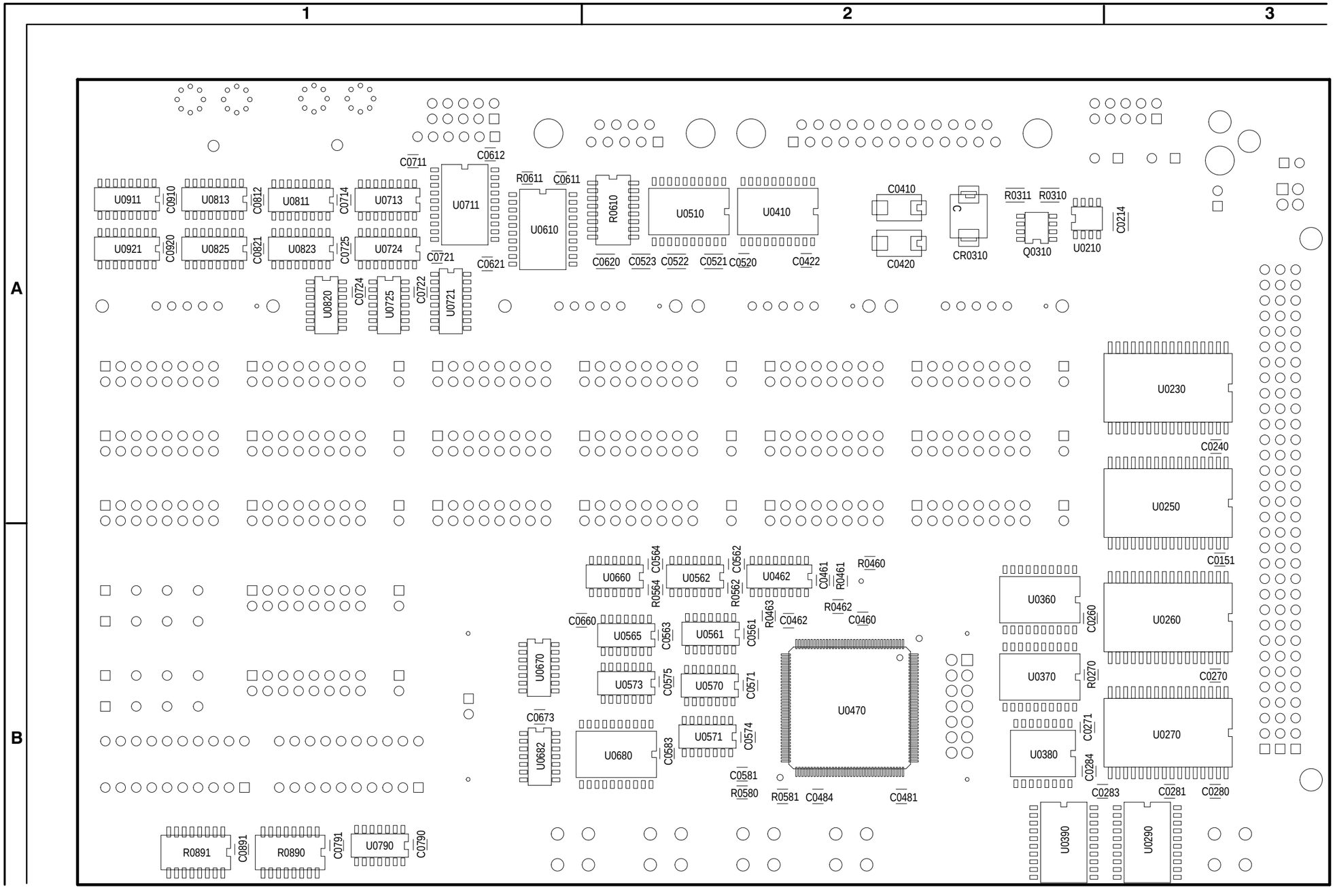
G9D-2234-00

COMPONENT NUMBER EXAMPLE

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

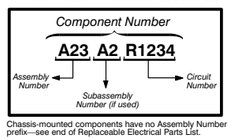
STATIC SENSITIVE DEVICES

A01 TLA 7QS Quickstart Training Board (front)



G9D-2234-00

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

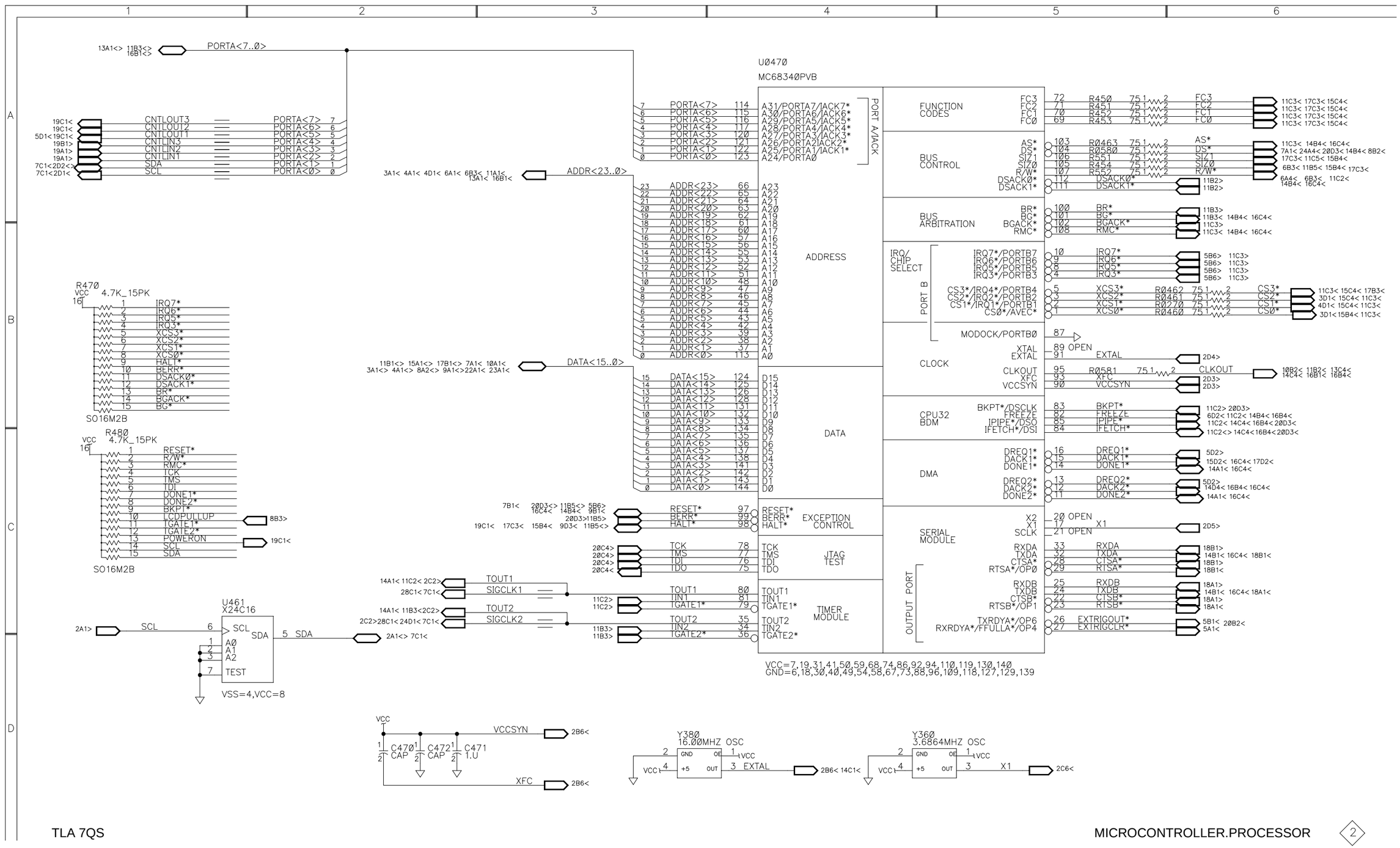
STATIC SENSITIVE DEVICES

A01 TLA 7QS Quickstart Training board (back)

A01 TLA 7QS Quickstart Training Board Component Locator

CIRCUIT NUMBER	BOARD LOCATION	SCHEM LOCATION	CIRCUIT NUMBER	BOARD LOCATION	SCHEM LOCATION	CIRCUIT NUMBER	BOARD LOCATION	SCHEM LOCATION	CIRCUIT NUMBER	BOARD LOCATION	SCHEM LOCATION	CIRCUIT NUMBER	BOARD LOCATION	SCHEM LOCATION	CIRCUIT NUMBER	BOARD LOCATION	SCHEM LOCATION	CIRCUIT NUMBER	BOARD LOCATION	SCHEM LOCATION	CIRCUIT NUMBER	BOARD LOCATION	SCHEM LOCATION
C0151*	B3	30A5	C180	B1	8C1	C911	A3	30B6	J760	B2	21A5	R390	B1	10B3	R682	B2	27C4	U0562*	B2	5C4	U271	B1	3C2
C0214*	A3	12C2	C210	A1	12C1	C921	A3	30D5	J770	B2	8B5	R410	A2	19C3	R683	B2	28A3	U0562*	B2	6C5	U291	B1	10B4
C0240*	A3	30B5	C211	A1	12C2	C990	B3	30D6	J771	B2	21A6	R450	B1	2A5	R684	B2	26C5	U0565*	B2	4C1	U292	B1	10A3
C0260*	B2	30B6	C212	A1	12C1	CR0310*	A2	12C4	J800	A3	20A4	R451	B1	2A5	R685	B2	26B4	U0565*	B2	6A5	U371	B1	8B5
C0270*	B3	30C6	C213	A1	12C2	CR120	A1	12B2	J820	A3	17B5	R452	B1	2A5	R700	A2	20A3	U0565*	B2	6B5	U460	B2	29B2
C0271*	B2	30C5	C282	B1	30A6	CR220	A1	12B2	J830	A3	21B1	R453	B1	2A5	R710	A2	25B2	U0565*	B2	6B5	U461	B2	2C1
C0280*	B3	30B5	C285	B1	30B6	CR670	B2	27B4	J840	A3	21B3	R454	B1	2A5	R711	A2	25B2	U0565*	B2	6C4	U471	B2	6B5
C0281*	B3	30B5	C350	B1	30A5	CR671	B2	27B5	J850	A3	21A4	R460	B1	5D2	R712	A2	25C2	U0565*	B2	10C4	U471	B2	6C5
C0283*	B3	30C6	C370	B1	30C5	CR800	A3	20A4	J860	B3	21A5	R461	B1	5D2	R713	A2	25C3	U0570*	B2	5A2	U471	B2	6D3
C0284*	B2	30C6	C411	A1	12C6	CR801	A3	20A4	J870	B3	21A6	R470	B1	2B1	R714	A2	25B3	U0570*	B2	5B2	U471	B2	14C1
C0410*	A2	12C5	C421	A1	30A5	DS210	A1	12C6	J930	A3	21A1	R471	B1	8B5	R715	A2	20A3	U0570*	B2	10C3	U480	B2	26C3
C0420*	A2	12C5	C470	B1	2D2	DS780	B2	9C5	J940	A3	21A3	R480	B1	2C1	R720	A2	25A2	U0571*	B2	10A2	U511	A2	18A4
C0422*	A2	30B6	C471	B1	2D2	DS880	B3	9A5	J950	A3	21B4	R481	B1	8B5	R721	A2	25A2	U0571*	B2	10D3	U560	B2	29B5
C0460*	B2	30B5	C472	B1	2D2	F220	A1	12B2	J960	B3	21C5	R482	B1	8C3	R722	A2	25A2	U0571*	B2	10D4	U563	B2	29B4
C0461*	B2	30C5	C480	B1	30C6	FD0191*	A1	30C1	J961	B3	21B5	R483	B1	8C3	R723	A2	25A2	U0573*	B2	7A6	U563	B2	29C4
C0462*	B2	30C6	C482	B1	30C5	FD0901*	B3	30C1	J970	B3	21C6	R484	B2	8D3	R730	A2	14D1	U0573*	B2	7B6	U564	B2	14A5
C0481*	B2	30A6	C483	B1	8C3	FD190	A3	30C2	J971	B3	21B6	R500	A2	19A1	R750	B2	28C3	U0573*	B2	7C6	U564	B2	15A4
C0484*	B2	30B5	C485	B2	8D3	FD900	B1	30C2	L310	A1	12C4	R501	A2	19A1	R751	B2	28D3	U0573*	B2	8A3	U572	B2	24B1
C0520*	A2	30C6	C550	B2	30A5	J110	A1	12B1	L410	A1	12C5	R510	A2	19A3	R752	B2	28D3	U0573*	B2	8B3	U572	B2	24C1
C0521*	A2	18A5	C551	B2	30D5	J111	A1	12A1	MH0100*	A3	30B2	R511	A2	19A2	R753	B2	28C3	U0573*	B2	14A5	U572	B2	26A1
C0522*	A2	18B4	C560	B2	30D6	J180	A1	11B3	MH0190*	A1	30B1	R512	A2	19A2	R760	B2	14D1	U0610*	A1	25C2	U572	B2	26C2
C0523*	A2	18B4	C565	B2	30C6	J180	A1	11B4	MH0620*	B2	30B1	R513	A2	19A1	R770	B2	28A3	U0660*	B2	5B5	U572	B2	29B1
C0561*	B2	30C5	C570	B2	30C5	J180	A1	11B6	MH0660*	B1	30B2	R550	B1	14B4	R771	B2	28A3	U0670*	B1	5A2	U580	B2	26C4
C0562*	B2	30C6	C572	B2	29B1	J200	A1	20C4	MH0900*	B3	30C1	R551	B1	2A5	R772	B2	28B3	U0670*	B1	26B5	U580	B2	26D4
C0563*	B2	30B6	C573	B2	26A1	J320	A1	16B3	MH0990*	B1	30B3	R552	B2	2A5	R800	A3	20A3	U0680*	B2	7B4	U580	B2	28C2
C0564*	B2	30A6	C576	B2	30A5	J330	A1	13C5	MH1	B1	30C2	R560	B2	29B5	R810	A2	25B3	U0682*	B1	7A2	U661	B2	5A1
C0571*	B2	30A5	C580	B2	30C5	J340	A1	15C5	MH2	B2	30C2	R561	B2	29B1	R811	A3	25B3	U0682*	B1	7A3	U661	B2	24B2
C0574*	B2	30C5	C582	B2	8C4	J350	A1	14D5	Q0310*	A2	12C4	R562	B2	14A5	R900	A3	20A3	U0682*	B1	7B2	U661	B2	28B3
C0575*	B2	30C6	C584	B2	30B6	J400	A1	19A5	Q670	B2	28A2	R570	B2	26A1	S110	A1	12A2	U0682*	B1	7B3	U661	B2	28D4
C0581*	B2	30C6	C585	B2	8D4	J420	A2	17B3	Q671	B2	28A3	R580	B2	8D3	S290	B1	8C1	U0711*	A1	25B5	U681	B2	27A3
C0583*	B2	30C6	C586	B2	27B4	J430	A1	13B5	Q672	B2	26C5	R581	B2	8C4	S490	B1	8C2	U0713*	A1	23A3	U681	B2	29C2
C0611*	A1	30D6	C600	A2	30B5	J440	A1	15C5	Q673	B2	26D5	R582	B2	8C4	S590	B2	8D2	U0721*	A1	25A4	U710	A2	24A4
C0612*	A1	30A6	C610	A2	30A5	J450	A1	14B5	Q680	B2	27B5	R583	B2	8D4	S591	B2	8C4	U0724*	A1	23A4	U710	A2	24A5
C0620*	A2	18A5	C622	A2	30A6	J500	A2	18A6	R0270*	B2	2B5	R584	B2	8D4	S690	B2	8D4	U0725*	A1	25B4	U710	A2	24B5
C0621*	A1	30A6	C650	B2	30D6	J530	A1	13A5	R0310*	A2	12C4	R585	B2	26A2	TP5	B1	14B4	U0725*	A1	28B2	U712	A2	22A3
C0660*	B1	30A5	C661	B2	28B3	J531	A2	13C3	R0311*	A2	12C4	R620	A2	25B2	U0210*	A2	12C3	U0790*	B1	9A2	U720	A2	24D2
C0673*	B1	30C5	C670	B2	28D3	J540	A1	15B5	R0460*	B2	2B5	R621	A2	25A4	U0230*	A3	4C4	U0790*	B1	9A3	U722	A2	24B2
C0711*	A1	30A6	C671	B2	30C5	J541	A2	15C3	R0461*	B2	2B5	R660	B2	28B3	U0250*	A3	4A4	U0790*	B1	9B2	U722	A2	25B4
C0714*	A1	30C5	C672	B2	28A3	J550	A1	14A5	R0462*	B2	2B5	R661	B2	28C3	U0260*	B3	4C3	U0790*	B1	9B3	U722	A2	25C4
C0721*	A1	30A6	C680	B2	30B5	J551	A2	14C2	R0463*	B2	2A5	R662	B2	28A2	U0270*	B3	4A3	U0811*	A1	23B3	U723	A2	22A4
C0722*	A1	30B5	C710	A2	30D6	J600	A2	18C6	R0562*	B2	29C5	R663	B2	28C4	U0290*	B3	7A4	U0813*	A1	23C3	U726	A2	25A3
C0724*	A1	30A5	C712	A2	30B6	J601	A2	20C4	R0564*	B2	29B5	R670	B2	28D3	U0360*	B2	10C5	U0820*	A1	25B4	U791	B2	9B4
C0725*	A1	30C6	C713	A2	30C5	J620	A2	16B5	R0580*	B2	2A5	R671	B2	27B4	U0370*	B2	10C5	U0820*	A1	25B4	U810	A2	22B3
C0790*	B1	30D5	C720	A2	30D6	J630	A2	13B3	R0581*	B2	2B5	R672	B2	28A2	U0380*	B2	10B5	U0820*	A1	25B5	U812	A3	22C3
C0791*	B1	30D5	C723	A2	30D6	J640	A2	15C3	R0610*	A2	19B3	R673	B2	27B5	U0390*	B2	7C3	U0820*	A1	25B5	U821	A2	22B4
C0812*	A1	30A6	C770	B2	28A3	J650	A2	14B2	R0611*	A1	24A2	R674	B2	27B5	U0410*	A2	19C2	U0820*	A1	25C5	U822	A2	24C5
C0821*	A1	30C5	C800	A3	30D5	J700	A2	20A4	R0890*	B1	9C6	R675	B2	27B5	U0462*	B2	6A2	U0823*	A1	23B4	U824	A3	22C4
C0891*	B1	30B6	C810	A3	30D6	J730	A2	13A3	R0891*	B1	9A6	R676	B2	28A3	U0470*	B2	2A4	U0825*	A1	23C4	U890	B3	9A4
C0910*	A1	30B5	C811	A3	30D5	J731	A2	21A1	R180	B1	8C1	R677	B2	26C4	U0510*	A2	19A2	U0911*	A1	23C3	U910	A3	22C3
C0920*	A1	30A5	C813	A3	30D6	J740	A2	15B3	R181	B1	8C1	R678	B2	26D5	U0561*	B2	5A4	U0921*	A1	23C4	U920	A3	22C4
C130	A1	30D5	C820	A3	30B6	J741	A2	21A3	R210	A1	12C6	R679	B2	27B3	U0561*	B2	5B4	U231	A1	3A4	Y360	B1	2D4
C150	A1	30B6	C822	A3	30C5	J750	A2	14A2	R211	A1	12C3	R680	B2	27B3	U0561*	B2	8A3	U251	A1	3C4	Y380	B1	2D3
C160	B1	30D5	C890	B3	30D5	J751	A2	21A4	R212	A1	12C3	R681	B2	27C5	U0562*	B2	5A4	U261	B1	3A2	Y610	A2	24A1
C170	B1	30D6																					

***Asterisks indicate components located on the back of the board.**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U0470
MC68340PVB
PORT A/JACK
A31/PORTA7/IACK7*
A30/PORTA6/IACK6*
A29/PORTA5/IACK5*
A28/PORTA4/IACK4*
A27/PORTA3/IACK3*
A26/PORTA2/IACK2*
A25/PORTA1/IACK1*
A24/PORTA0
ADDR<23..0>
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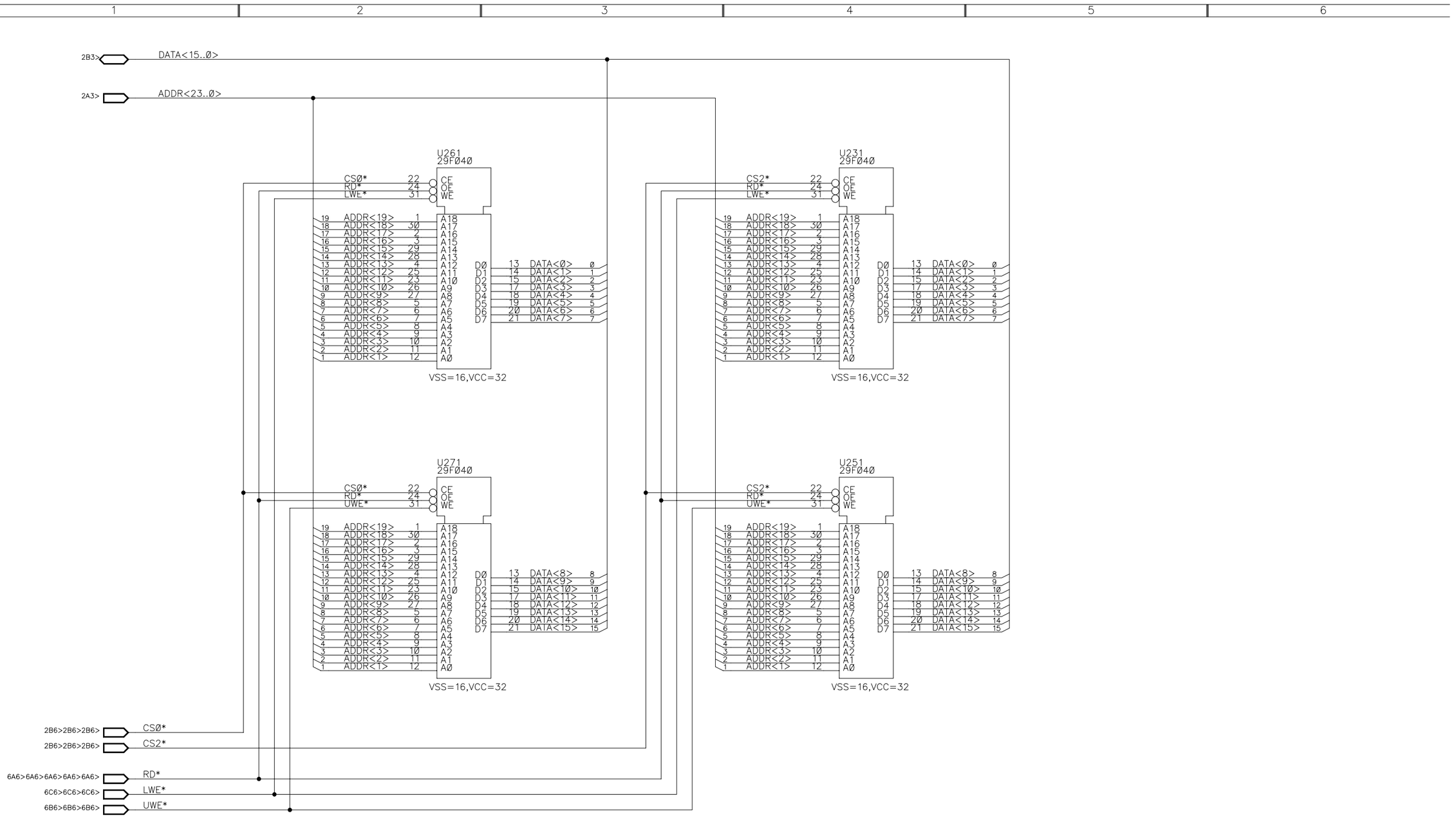
A22
A21
A20
A19
A18
A17
A16
A15
A14
A13
A12
A11
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
ADDRESS
DATA<15..0>
D15
D14
D13
D12
D11
D10
D9
D8
D7
D6
D5
D4
D3
D2
D1
D0
DATA
RESET*
BERR*
HALT*
EXCEPTION CONTROL
TCK
TMS
TDI
TDO
JTAG TEST
TOUT1
TIN1
TGATE1*
TOUT2
TIN2
TGATE2*
TIMER MODULE
FUNCTION CODES
FC3
FC2
FC1
FC0
BUS CONTROL
AS*
DS*
SIZ1
SIZ0
R/W*
DSACK0*
DSACK1*
BUS ARBITRATION
BR*
BG*
BGACK*
RMC*
IRQ/ CHIP SELECT
PORT B
IRQ7*/PORTB7
IRQ6*/PORTB6
IRQ5*/PORTB5
IRQ3*/PORTB3
CS3*/IRQ4*/PORTB4
CS2*/IRQ2*/PORTB2
CS1*/IRQ1*/PORTB1
CS0*/AVEC*
MODOCK/PORTB0
CLOCK
XTAL
EXTAL
CLKOUT
XFC
VCCSYN
CPU32 BDM
BKPT*/DSCLK
FREEZE
IPIPE*/DSO
IFETCH*/DSI
DMA
DREQ1*
DACK1*
DONE1*
DREQ2*
DACK2*
DONE2*
SERIAL MODULE
X2
X1
SCLK
RXDA
TXDA
CTSA*
RTSA*/OP0
RXDB
TXDB
CTSB*
RTSB*/OP1
OUTPUT PORT
TXRDYA*/OP6
RXRDYA*/FFULLA*/OP4
EXTRIGOUT*
EXTRIGCLR*
R470
4.7K_15PK
IRQ7*
IRQ6*
IRQ5*
IRQ3*
XCS3*
XCS2*
XCS1*
XCS0*
HALT*
BERR*
DSACK0*
DSACK1*
BR*
BGACK*
BG*
SO16M2B
R480
4.7K_15PK
RESET*
R/W*
RMC*
TCK
TMS
TDI
LCDPULLUP
TGATE1*
TGATE2*
POWERON
SCL
SDA
SO16M2B
U461
X24C16
SCL
SDA
A0
A1
A2
TEST
VSS=4,VCC=8
TOUT1
SIGCLK1
TOUT2
SIGCLK2
C470
CAP
C472
CAP
C471
1.U
VCCSYN
XFC
Y380
16.00MHZ OSC
GND
OE
VCC
+5
OUT
EXTAL
Y360
3.6864MHZ OSC
X1
VCC=7,19,31,41,50,59,68,74,86,92,94,110,119,130,140
GND=6,18,30,40,49,54,58,67,73,88,96,109,118,127,129,139


1
2
3
4
5
6
A
B
C
D
2B3>
DATA<15..0>
2A3>
ADDR<23..0>
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RD*
LWE*
CE
OE
WE
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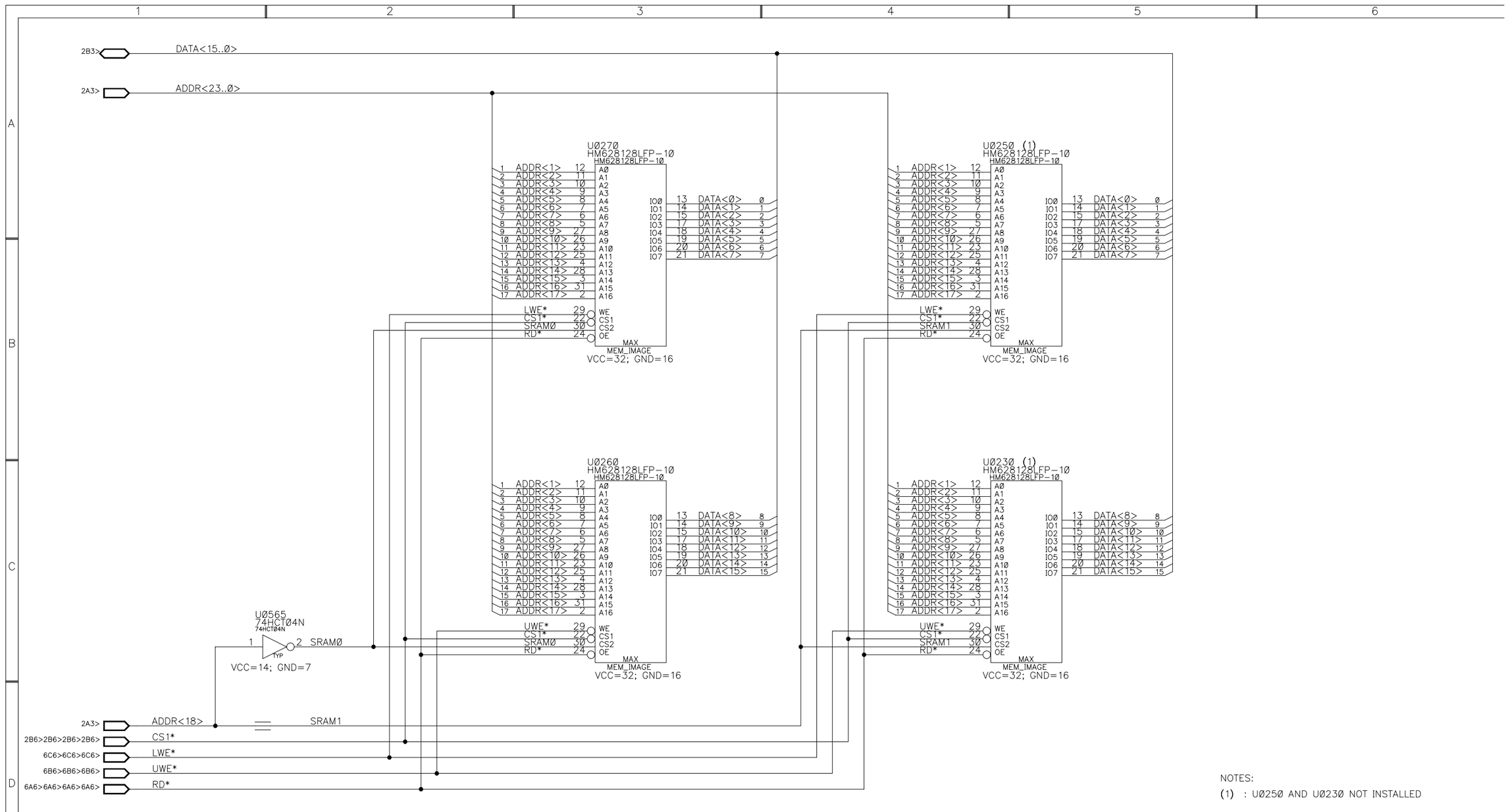
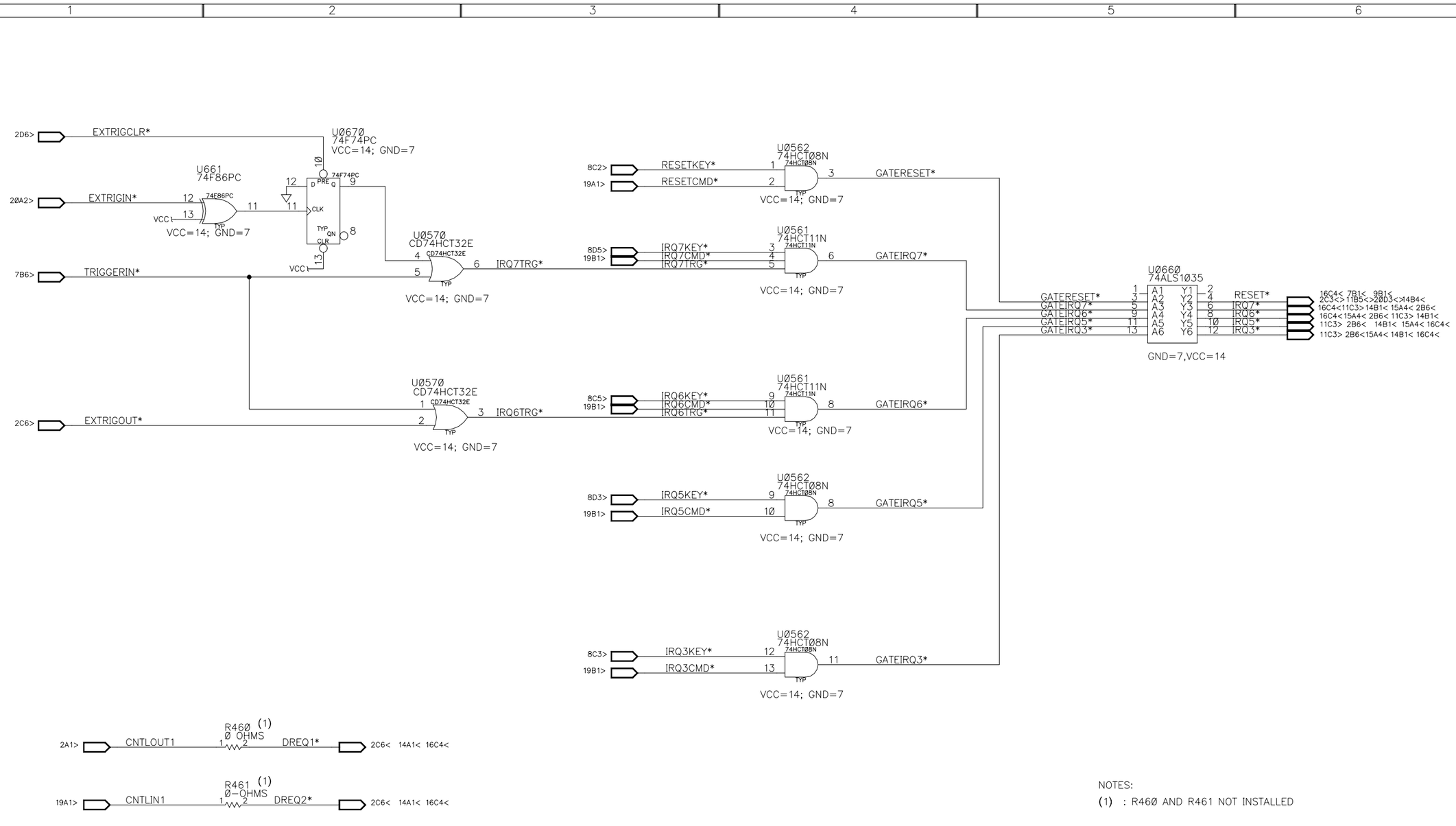
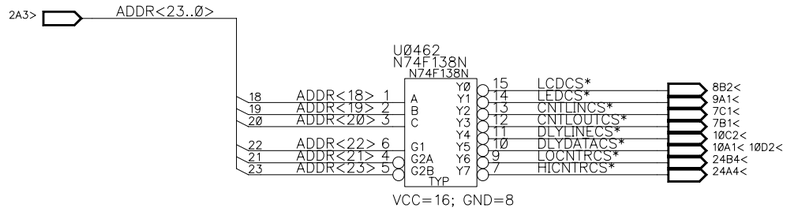
ADDR<18> 30 A17
ADDR<17> 2 A16
ADDR<16> 3 A15
ADDR<15> 29 A14
ADDR<14> 28 A13
ADDR<13> 4 A12
ADDR<12> 25 A11
ADDR<11> 23 A10
ADDR<10> 26 A9
ADDR<9> 27 A8
ADDR<8> 5 A7
ADDR<7> 6 A6
ADDR<6> 7 A5
ADDR<5> 8 A4
ADDR<4> 9 A3
ADDR<3> 10 A2
ADDR<2> 11 A1
ADDR<1> 12 A0
D0 13 DATA<0> 0
D1 14 DATA<1> 1
D2 15 DATA<2> 2
D3 17 DATA<3> 3
D4 18 DATA<4> 4
D5 19 DATA<5> 5
D6 20 DATA<6> 6
D7 21 DATA<7> 7
VSS=16,VCC=32
U231
29F040
CS2*
RD*
LWE*
CE
OE
WE
ADDR<19> 1 A18
ADDR<18> 30 A17
ADDR<17> 2 A16
ADDR<16> 3 A15
ADDR<15> 29 A14
ADDR<14> 28 A13
ADDR<13> 4 A12
ADDR<12> 25 A11
ADDR<11> 23 A10
ADDR<10> 26 A9
ADDR<9> 27 A8
ADDR<8> 5 A7
ADDR<7> 6 A6
ADDR<6> 7 A5
ADDR<5> 8 A4
ADDR<4> 9 A3
ADDR<3> 10 A2
ADDR<2> 11 A1
ADDR<1> 12 A0
D0 13 DATA<0> 0
D1 14 DATA<1> 1
D2 15 DATA<2> 2
D3 17 DATA<3> 3
D4 18 DATA<4> 4
D5 19 DATA<5> 5
D6 20 DATA<6> 6
D7 21 DATA<7> 7
VSS=16,VCC=32
U271
29F040
CS0*
RD*
UWE*
CE
OE
WE
ADDR<19> 1 A18
ADDR<18> 30 A17
ADDR<17> 2 A16
ADDR<16> 3 A15
ADDR<15> 29 A14
ADDR<14> 28 A13
ADDR<13> 4 A12
ADDR<12> 25 A11
ADDR<11> 23 A10
ADDR<10> 26 A9
ADDR<9> 27 A8
ADDR<8> 5 A7
ADDR<7> 6 A6
ADDR<6> 7 A5
ADDR<5> 8 A4
ADDR<4> 9 A3
ADDR<3> 10 A2
ADDR<2> 11 A1
ADDR<1> 12 A0
D0 13 DATA<8> 8
D1 14 DATA<9> 9
D2 15 DATA<10> 10
D3 17 DATA<11> 11
D4 18 DATA<12> 12
D5 19 DATA<13> 13
D6 20 DATA<14> 14
D7 21 DATA<15> 15
VSS=16,VCC=32
U251
29F040
CS2*
RD*
UWE*
CE
OE
WE
ADDR<19> 1 A18
ADDR<18> 30 A17
ADDR<17> 2 A16
ADDR<16> 3 A15
ADDR<15> 29 A14
ADDR<14> 28 A13
ADDR<13> 4 A12
ADDR<12> 25 A11
ADDR<11> 23 A10
ADDR<10> 26 A9
ADDR<9> 27 A8
ADDR<8> 5 A7
ADDR<7> 6 A6
ADDR<6> 7 A5
ADDR<5> 8 A4
ADDR<4> 9 A3
ADDR<3> 10 A2
ADDR<2> 11 A1
ADDR<1> 12 A0
D0 13 DATA<8> 8
D1 14 DATA<9> 9
D2 15 DATA<10> 10
D3 17 DATA<11> 11
D4 18 DATA<12> 12
D5 19 DATA<13> 13
D6 20 DATA<14> 14
D7 21 DATA<15> 15
VSS=16,VCC=32
2B6>2B6>2B6>
CS0*
2B6>2B6>2B6>
CS2*
6A6>6A6>6A6>6A6>6A6>
RD*
6C6>6C6>6C6>
LWE*
6B6>6B6>6B6>
UWE*

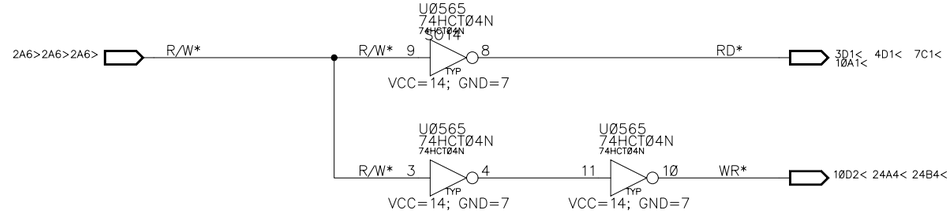


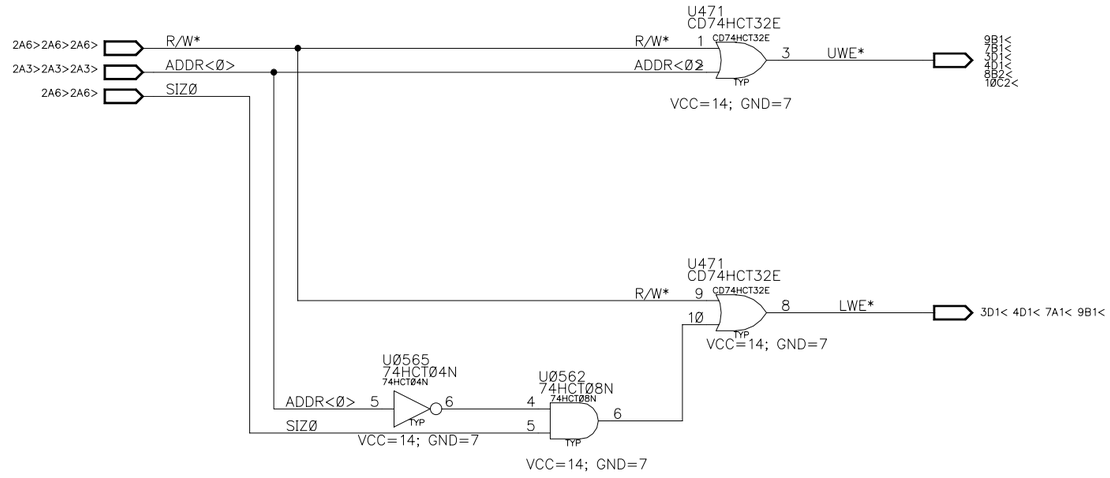
NOTES:
(1) : U0250 AND U0230 NOT INSTALLED

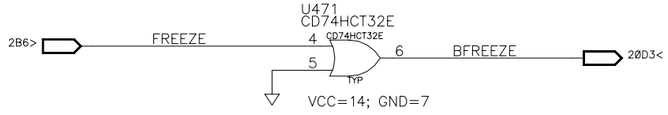


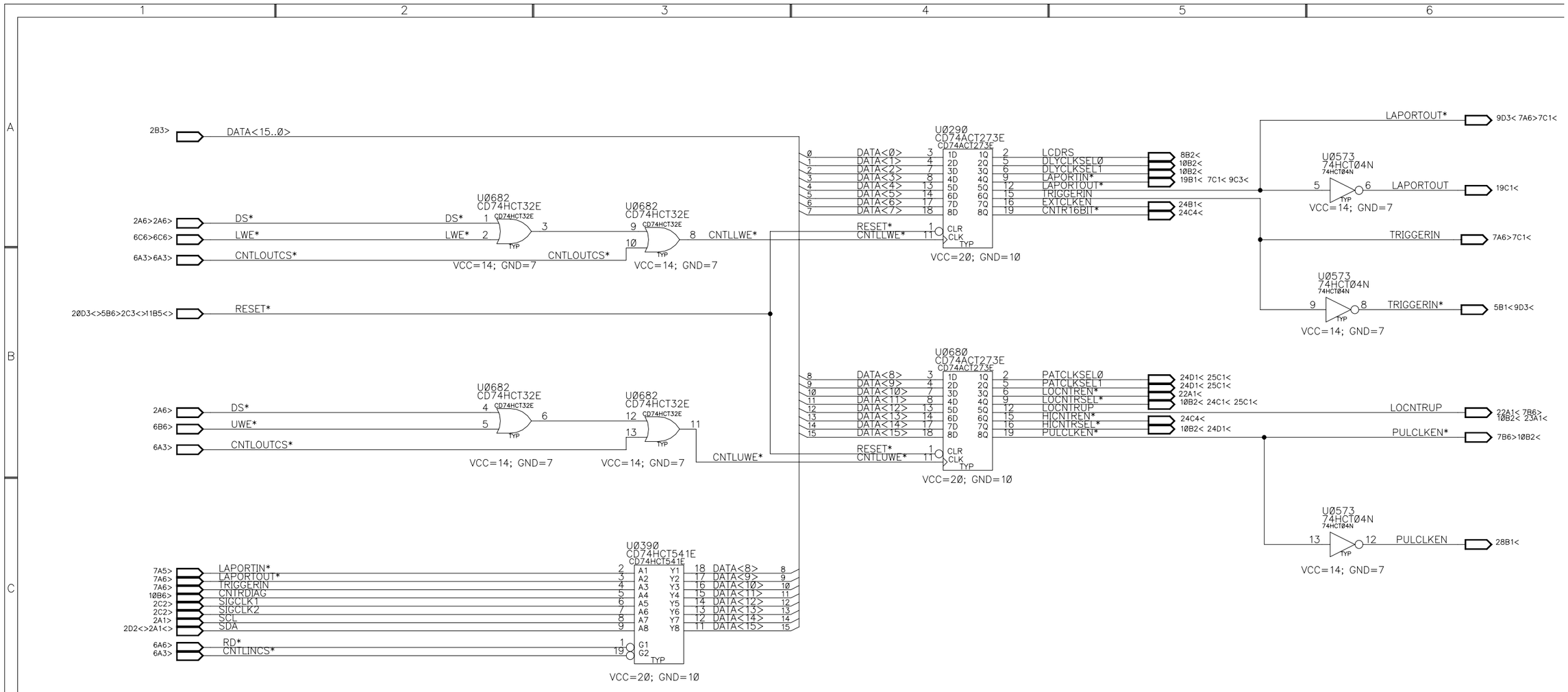
NOTES:
(1) : R460 AND R461 NOT INSTALLED

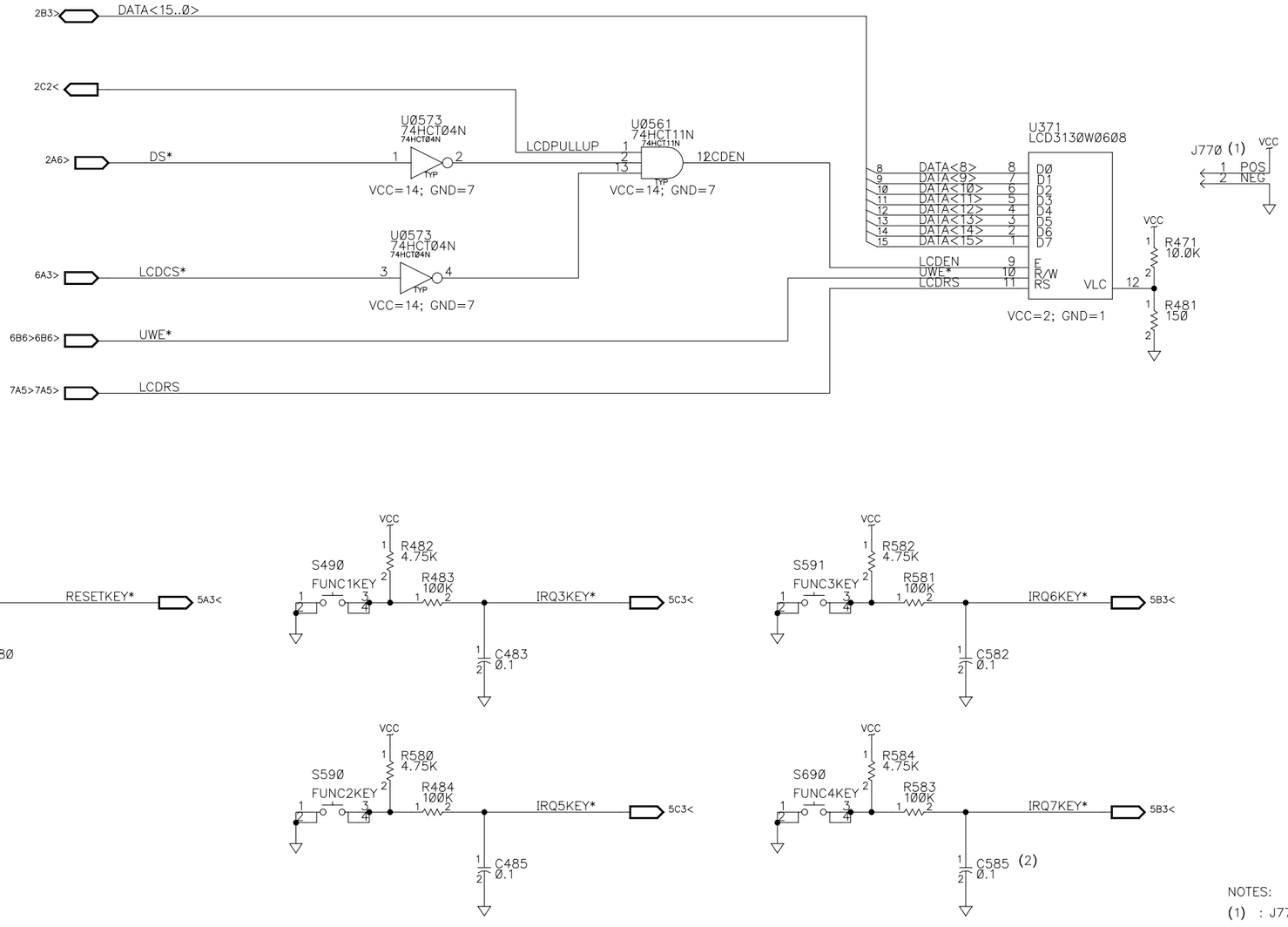

2A3>
ADDR<23..Ø>
U0462
N74F138N
N74F138N
18 ADDR<18> 1
19 ADDR<19> 2
2Ø ADDR<2Ø> 3
22 ADDR<22> 6
21 ADDR<21> 4
23 ADDR<23> 5
A
B
C
G1
G2A
G2B
TYP
Y0 15 LCDCS*
Y1 14 LEDCS*
Y2 13 CNTLINCS*
Y3 12 CNTLOUTCS*
Y4 11 DLYLINECS*
Y5 1Ø DLYDATACS*
Y6 9 LDCNTRCS*
Y7 7 HICNTRCS*
8B2<
9A1<
7C1<
7B1<
1ØC2<
1ØA1< 1ØD2<
24B4<
24A4<
VCC=16; GND=8


2A6>2A6>2A6>
R/W*
U0565
74HCTØ4N
74HCTØ4N
R/W* 9 8
TYP
RD*
3D1< 4D1< 7C1<
1ØA1<
VCC=14; GND=7
U0565
74HCTØ4N
74HCTØ4N
R/W* 3 4
TYP
VCC=14; GND=7
U0565
74HCTØ4N
74HCTØ4N
11 1Ø
TYP
WR*
1ØD2< 24A4< 24B4<
VCC=14; GND=7

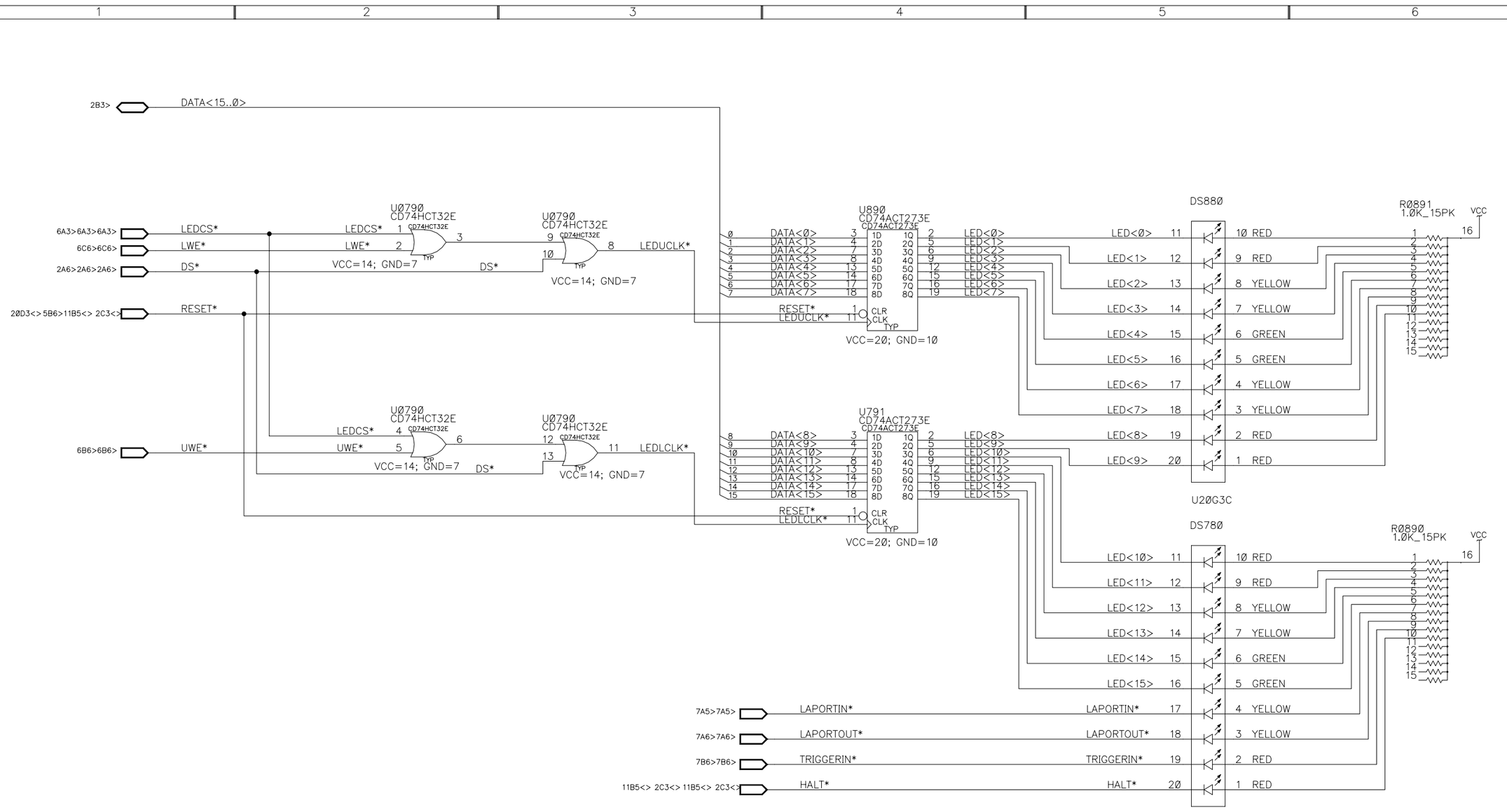

2A6>2A6>2A6>
R/W*
2A3>2A3>2A3>
ADDR<Ø>
2A6>2A6>
SIZØ
U471
CD74HCT32E
CD74HCT32E
R/W* 1
ADDR<Ø> 2
3
TYP
UWE*
9B1<
7B1<
5C1<
3D1<
8B2<
1ØC2<
VCC=14; GND=7
U471
CD74HCT32E
CD74HCT32E
R/W* 9 8
1Ø
TYP
LWE*
3D1< 4D1< 7A1< 9B1<
VCC=14; GND=7
U0565
74HCTØ4N
74HCTØ4N
ADDR<Ø> 5 6
TYP
SIZØ
VCC=14; GND=7
U0562
74HCTØ8N
74HCTØ8N
4 6
5
TYP
VCC=14; GND=7

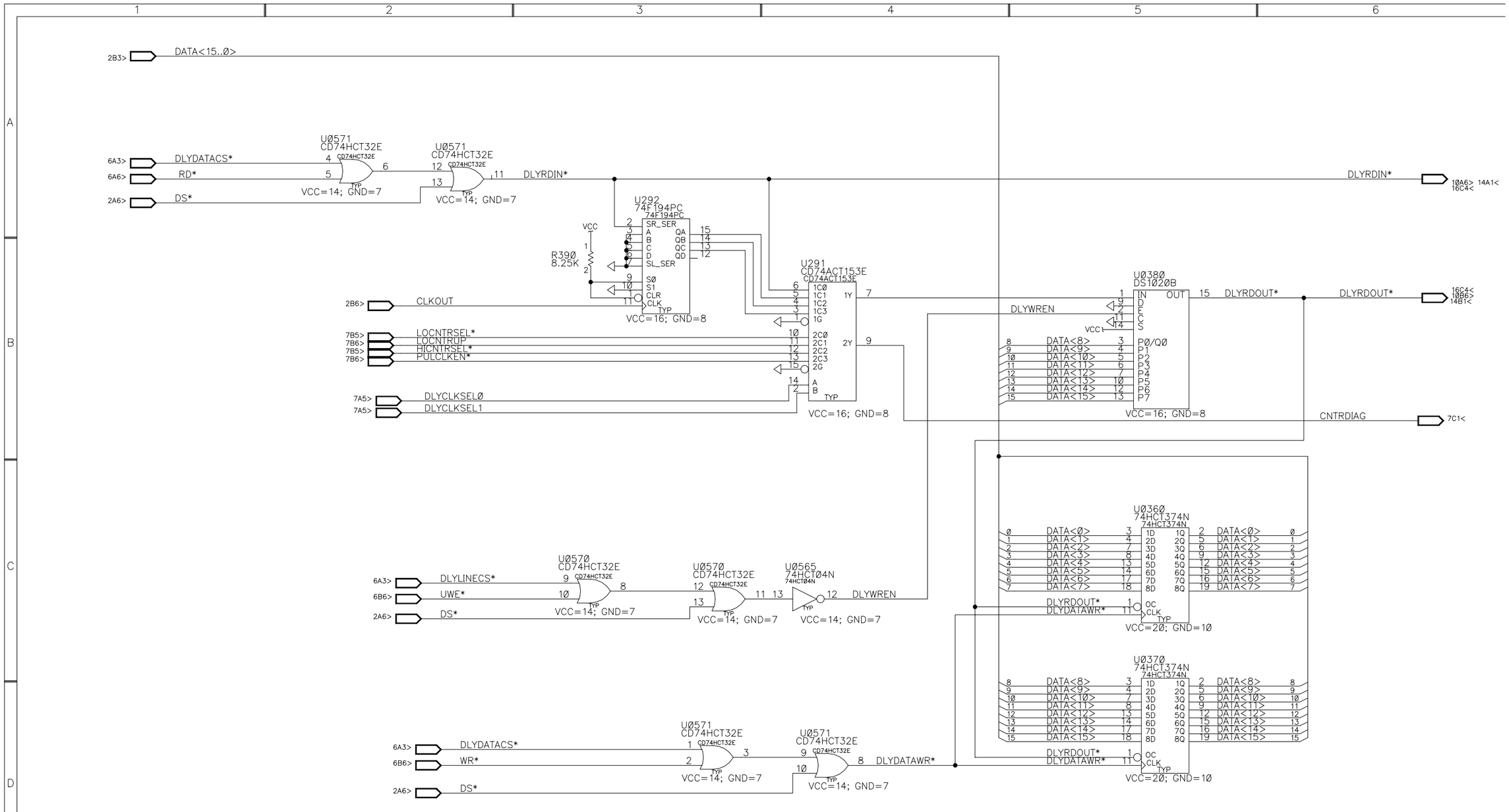

2B6>
FREEZE
U471
CD74HCT32E
CD74HCT32E
4
5
6
TYP
BFREEZE
20D3<
VCC=14; GND=7


2B3>
DATA<15..Ø>
U0682
CD74HCT32E
2A6>2A6>
6C6>6C6>
6A3>6A3>
DS*
LWE*
CNTLOUTCS*
VCC=14; GND=7
CNTLLWE*
2ØD3<>5B6>2C3<>11B5<>
RESET*
2A6>
6B6>
6A3>
UWE*
CNTLUWE*
U0680
CD74ACT273E
DATA<Ø>
DATA<1>
DATA<2>
DATA<3>
DATA<4>
DATA<5>
DATA<6>
DATA<7>
DATA<8>
DATA<9>
DATA<1Ø>
DATA<11>
DATA<12>
DATA<13>
DATA<14>
DATA<15>
LCDRS
DLYCLKSELØ
DLYCLKSEL1
LAPORTIN*
LAPORTOUT*
TRIGGERIN
EXTCLKEN
CNTR16BIT*
8B2<
1ØB2<
19B1< 7C1< 9C3<
24B1<
24C4<
VCC=2Ø; GND=1Ø
PATCLKSELØ
PATCLKSEL1
LOCNTREN*
LOCNTRSEL*
LOCNTRUP
HICNTREN*
HICNTRSEL*
PULCLKEN*
24D1< 25C1<
22A1<
1ØB2< 24C1< 25C1<
24C4<
1ØB2< 24D1<
U0573
74HCTØ4N
LAPORTOUT*
9D3< 7A6>7C1<
19C1<
7A6>7C1<
TRIGGERIN*
5B1<9D3<
LOCNTRUP
22A1< 7B6>
1ØB2< 23A1<
PULCLKEN*
7B6>1ØB2<
28B1<
U0390
CD74HCT541E
7A5>
7A6>
7A6>
1ØB6>
2C2>
2C2>
2A1>
2D2<>2A1<>
6A6>
6A3>
LAPORTIN*
LAPORTOUT*
TRIGGERIN
CNTRDIAG
SIGCLK1
SIGCLK2
SCL
SDA
RD*
CNTLINCS*
VCC=2Ø; GND=1Ø



NOTES:
(1) : J77Ø NOT INSTALLED
(2) : C585 NOT INSTALLED

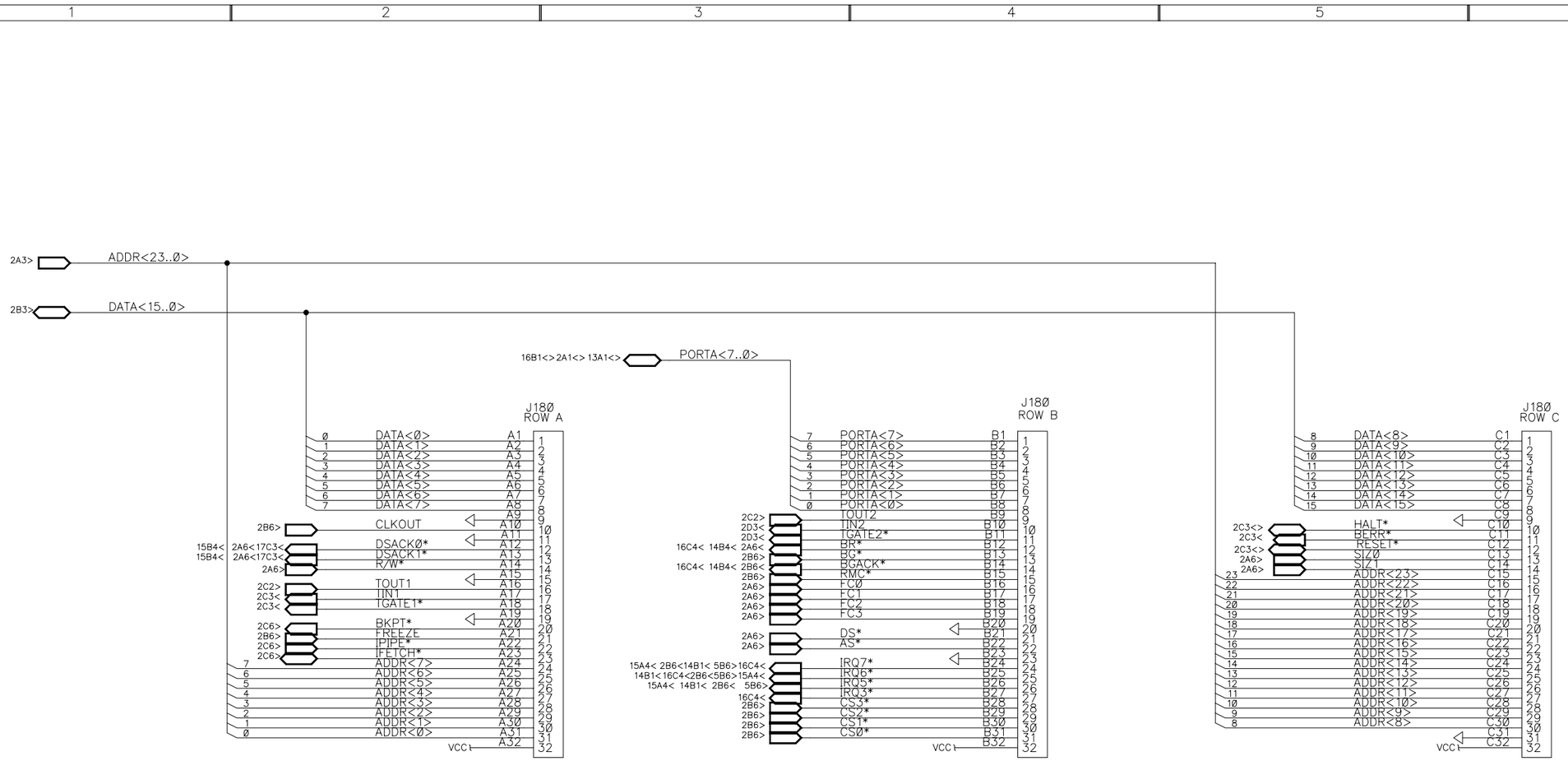

2B3>
DATA<15..0>
U0790
CD74HCT32E
6A3>6A3>6A3>
LEDCS*
6C6>6C6>
LWE*
2A6>2A6>2A6>
DS*
VCC=14; GND=7
TYP
LEDUCLK*
20D3<>5B6>11B5<> 2C3<>
RESET*
U890
CD74ACT273E
DATA<0>
DATA<1>
DATA<2>
DATA<3>
DATA<4>
DATA<5>
DATA<6>
DATA<7>
LED<0>
LED<1>
LED<2>
LED<3>
LED<4>
LED<5>
LED<6>
LED<7>
VCC=20; GND=10
DS880
R0891
1.0K_15PK
VCC
10 RED
9 RED
8 YELLOW
7 YELLOW
6 GREEN
5 GREEN
4 YELLOW
3 YELLOW
2 RED
1 RED
U20G3C
6B6>6B6>
UWE*
LEDLCLK*
U791
DATA<8>
DATA<9>
DATA<10>
DATA<11>
DATA<12>
DATA<13>
DATA<14>
DATA<15>
LED<8>
LED<9>
LED<10>
LED<11>
LED<12>
LED<13>
LED<14>
LED<15>
DS780
R0890
7A5>7A5>
LAPORTIN*
7A6>7A6>
LAPORTOUT*
7B6>7B6>
TRIGGERIN*
11B5<> 2C3<> 11B5<> 2C3<>
HALT*

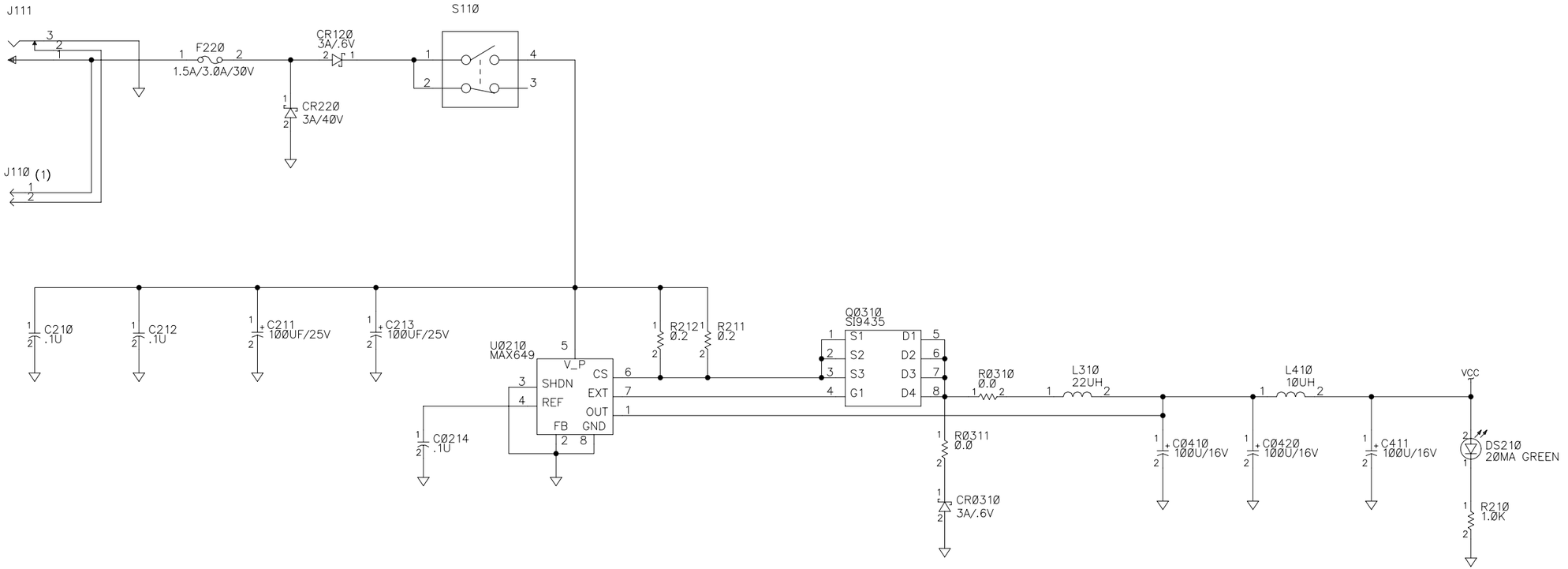


TLA 7QS

MICROCONTROLLER.DELAYGEN

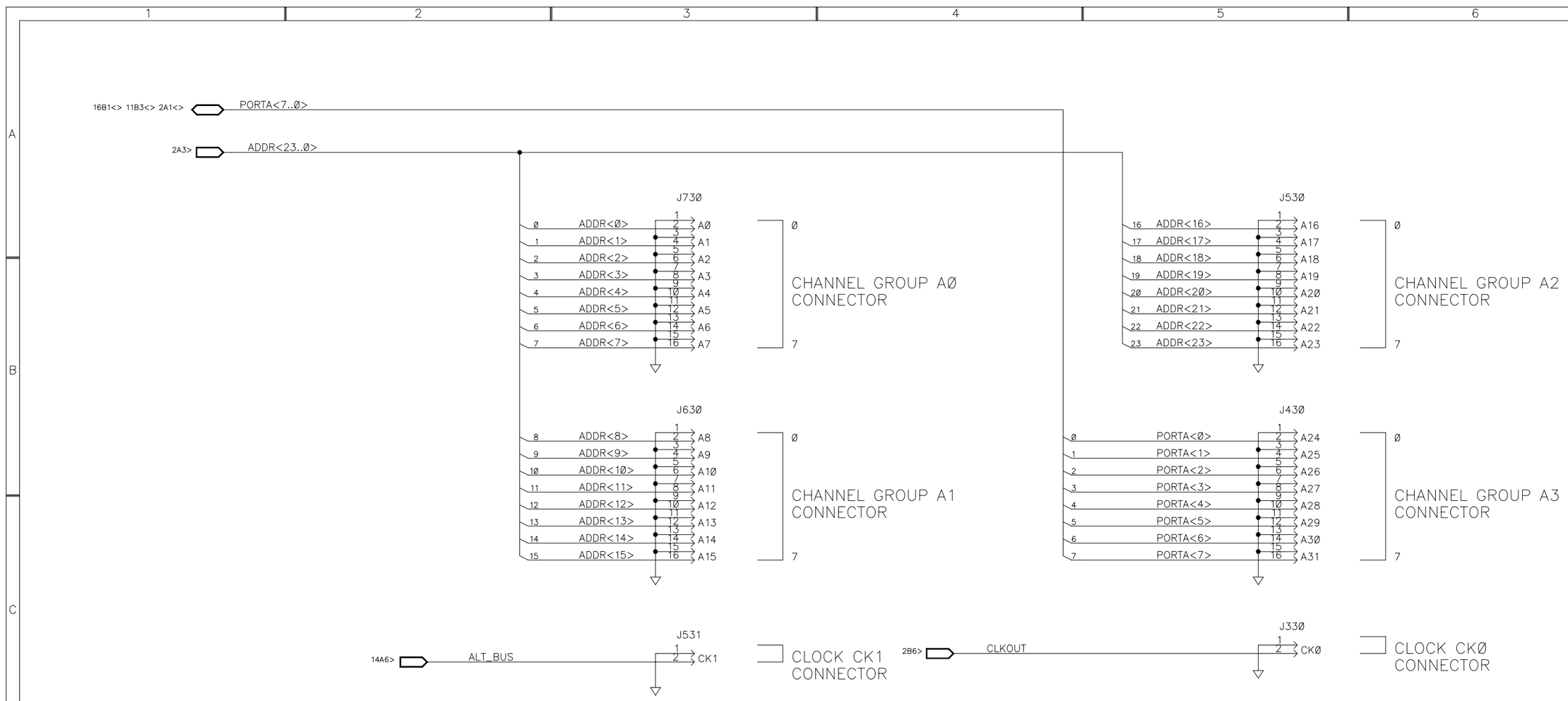
1Ø

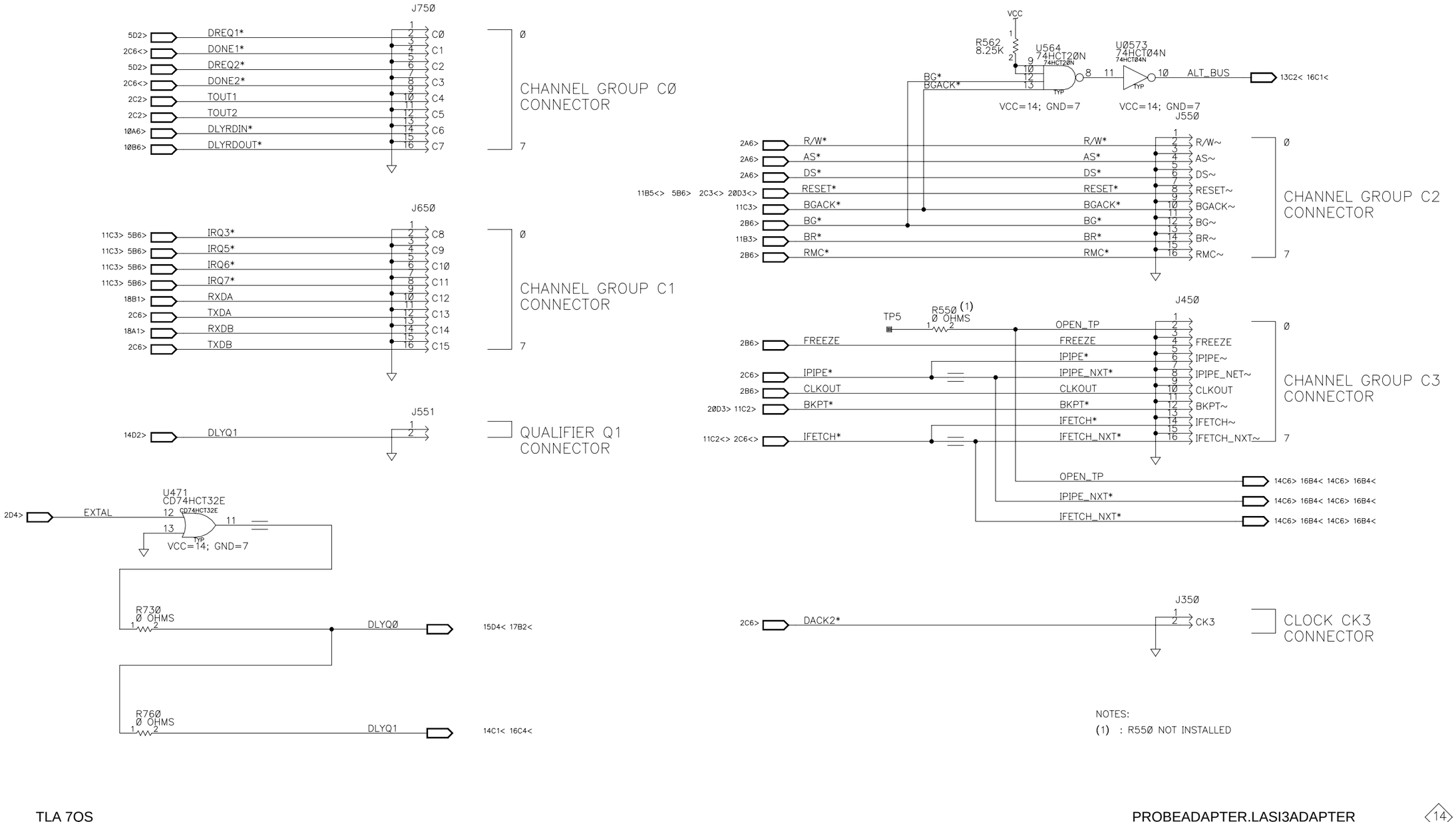

2A3> ADDR<23..0>
2B3> DATA<15..0>
16B1<> 2A1<> 13A1<> PORTA<7..0>
J18Ø ROW A
J18Ø ROW B
J18Ø ROW C
0 DATA<0> A1
1 DATA<1> A2
2 DATA<2> A3
3 DATA<3> A4
4 DATA<4> A5
5 DATA<5> A6
6 DATA<6> A7
7 DATA<7> A8
2B6> CLKOUT A10
15B4< 2A6<17C3< DSACKØ*
15B4< 2A6<17C3< DSACK1*
2A6> R/W* A14
2C2> TOUT1 A16
2C3< TIN1 A17
2C3< TGATE1* A18
2C6> BKPT* A20
2B6> FREEZE A21
2C6> IPIPE* A22
2C6> IFETCH* A23
7 ADDR<7> A24
6 ADDR<6> A25
5 ADDR<5> A26
4 ADDR<4> A27
3 ADDR<3> A28
2 ADDR<2> A29
1 ADDR<1> A30
Ø ADDR<Ø> A31
VCC A32
7 PORTA<7> B1
6 PORTA<6> B2
5 PORTA<5> B3
4 PORTA<4> B4
3 PORTA<3> B5
2 PORTA<2> B6
1 PORTA<1> B7
Ø PORTA<Ø> B8
2C2> TOUT2 B9
2D3< TIN2 B10
2D3< TGATE2* B11
16C4< 14B4< 2A6< BR* B12
2B6> BG* B13
16C4< 14B4< 2B6< BGACK* B14
2B6> RMC* B15
2A6> FCØ B16
2A6> FC1 B17
2A6> FC2 B18
2A6> FC3 B19
2A6> DS* B21
2A6> AS* B22
15A4< 2B6<14B1< 5B6>16C4< IRQ7* B24
14B1<16C4<2B6<5B6>15A4< IRQ6* B25
15A4< 14B1< 2B6< 5B6> IRQ5* B26
16C4< IRQ3* B27
2B6> CS3* B28
2B6> CS2* B29
2B6> CS1* B30
2B6> CSØ* B31
VCC B32
8 DATA<8> C1
9 DATA<9> C2
10 DATA<10> C3
11 DATA<11> C4
12 DATA<12> C5
13 DATA<13> C6
14 DATA<14> C7
15 DATA<15> C8
C9
2C3<> HALT* C10
2C3< BERR* C11
2C3<> RESET* C12
2A6> SIZØ C13
2A6> SIZ1 C14
23 ADDR<23> C15
22 ADDR<22> C16
21 ADDR<21> C17
20 ADDR<20> C18
19 ADDR<19> C19
18 ADDR<18> C20
17 ADDR<17> C21
16 ADDR<16> C22
15 ADDR<15> C23
14 ADDR<14> C24
13 ADDR<13> C25
12 ADDR<12> C26
11 ADDR<11> C27
10 ADDR<10> C28
9 ADDR<9> C29
8 ADDR<8> C30
C31
VCC C32

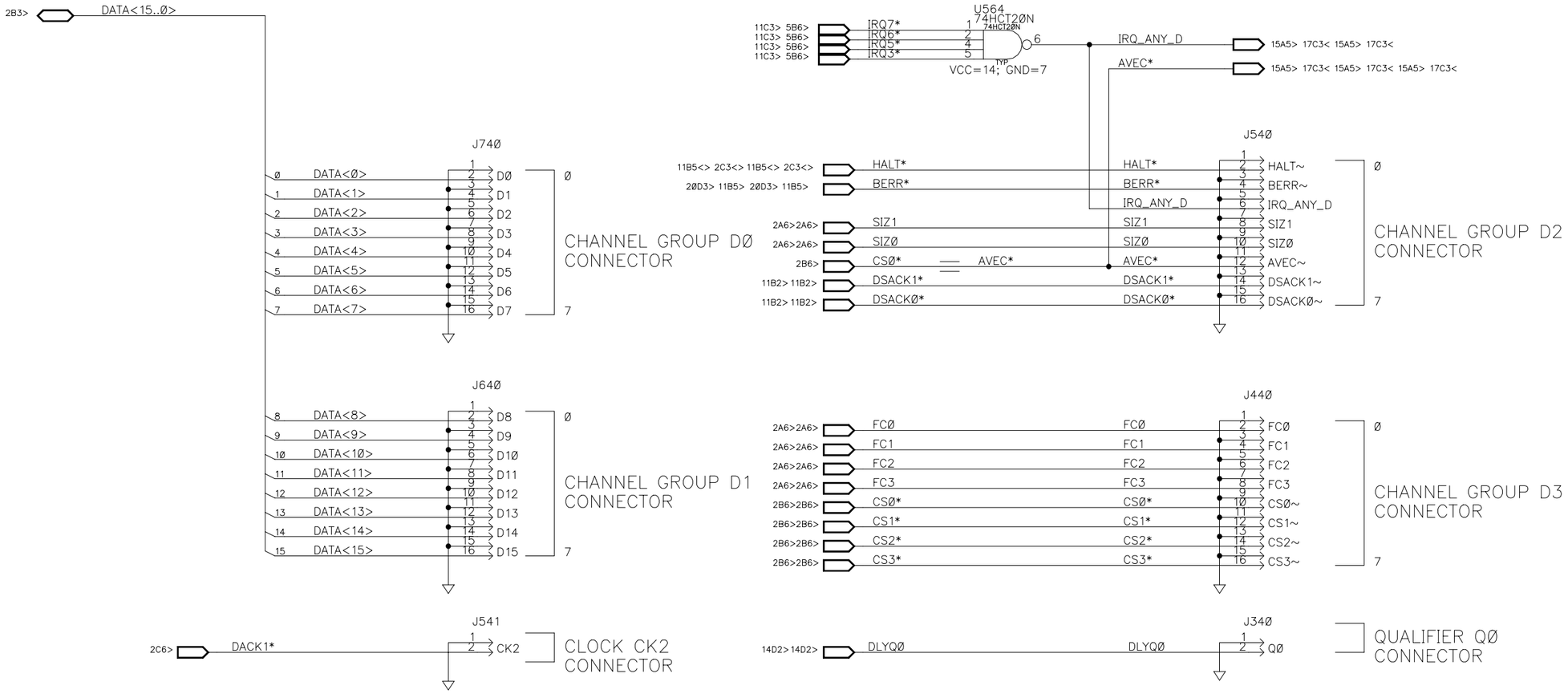


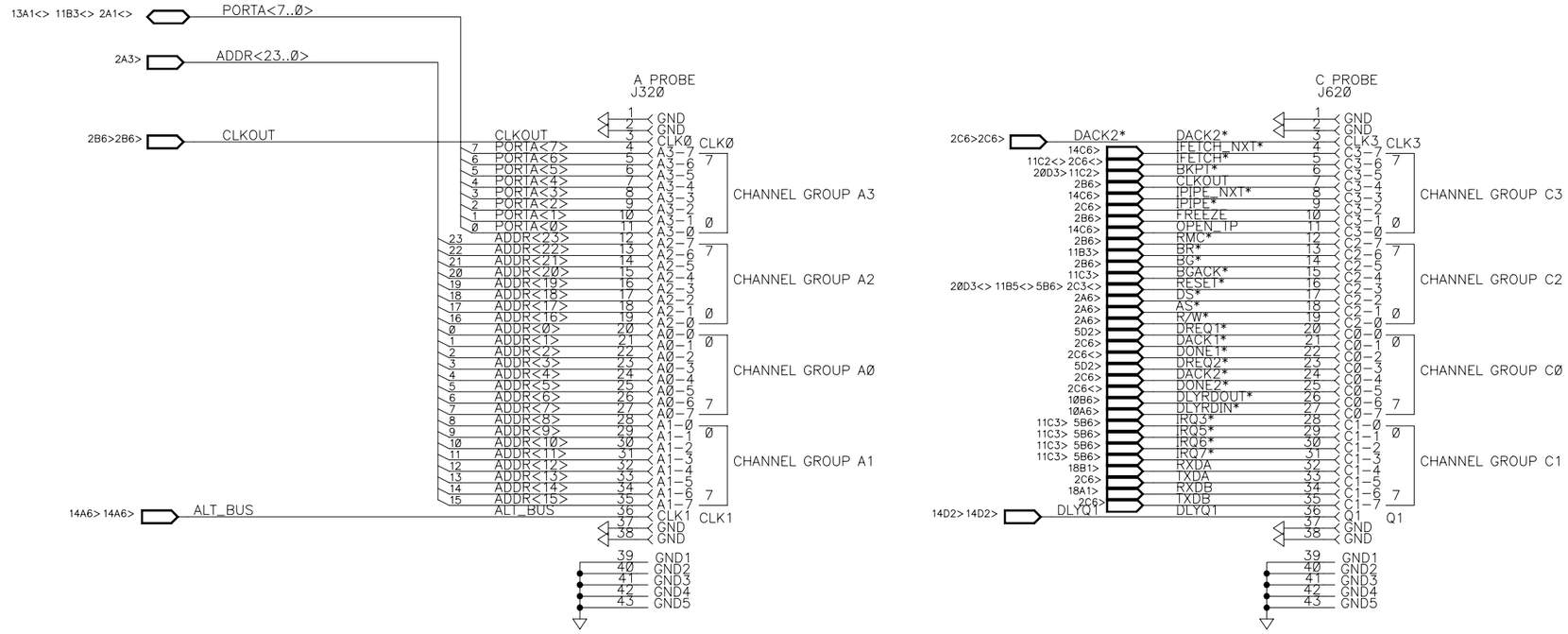
NOTES:

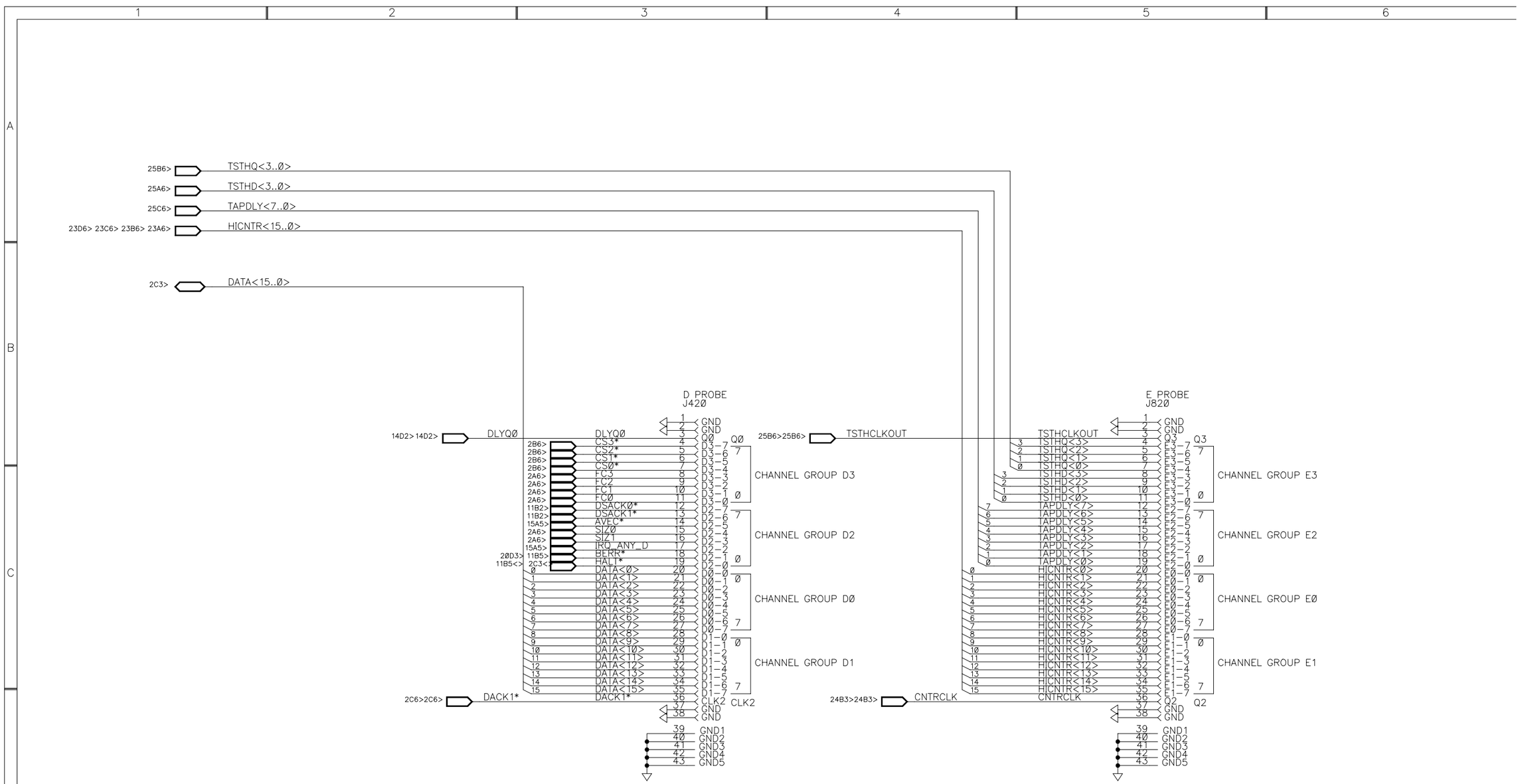
(1) : J110 NOT INSTALLED

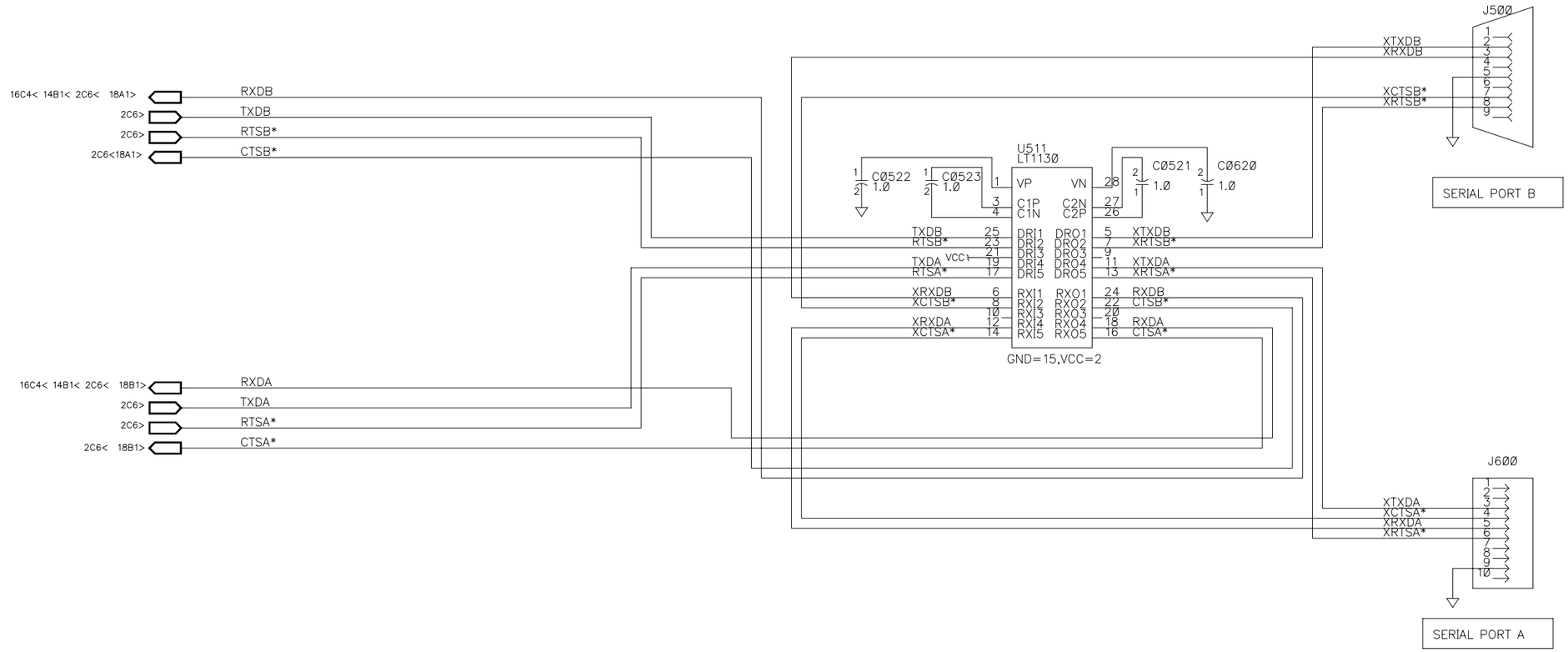

16B1<> 11B3<> 2A1<>
PORTA<7..Ø>
2A3>
ADDR<23..Ø>
J73Ø
Ø ADDR<Ø> A Ø
1 ADDR<1> A1
2 ADDR<2> A2
3 ADDR<3> A3
4 ADDR<4> A4
5 ADDR<5> A5
6 ADDR<6> A6
7 ADDR<7> A7
Ø
CHANNEL GROUP AØ CONNECTOR
7
J53Ø
16 ADDR<16> A16
17 ADDR<17> A17
18 ADDR<18> A18
19 ADDR<19> A19
2Ø ADDR<2Ø> A2Ø
21 ADDR<21> A21
22 ADDR<22> A22
23 ADDR<23> A23
Ø
CHANNEL GROUP A2 CONNECTOR
7
J63Ø
8 ADDR<8> A8
9 ADDR<9> A9
1Ø ADDR<1Ø> A1Ø
11 ADDR<11> A11
12 ADDR<12> A12
13 ADDR<13> A13
14 ADDR<14> A14
15 ADDR<15> A15
Ø
CHANNEL GROUP A1 CONNECTOR
7
J43Ø
Ø PORTA<Ø> A24
1 PORTA<1> A25
2 PORTA<2> A26
3 PORTA<3> A27
4 PORTA<4> A28
5 PORTA<5> A29
6 PORTA<6> A3Ø
7 PORTA<7> A31
Ø
CHANNEL GROUP A3 CONNECTOR
7
J531
14A6> ALT_BUS CK1
CLOCK CK1 CONNECTOR
J33Ø
2B6> CLKOUT CKØ
CLOCK CKØ CONNECTOR

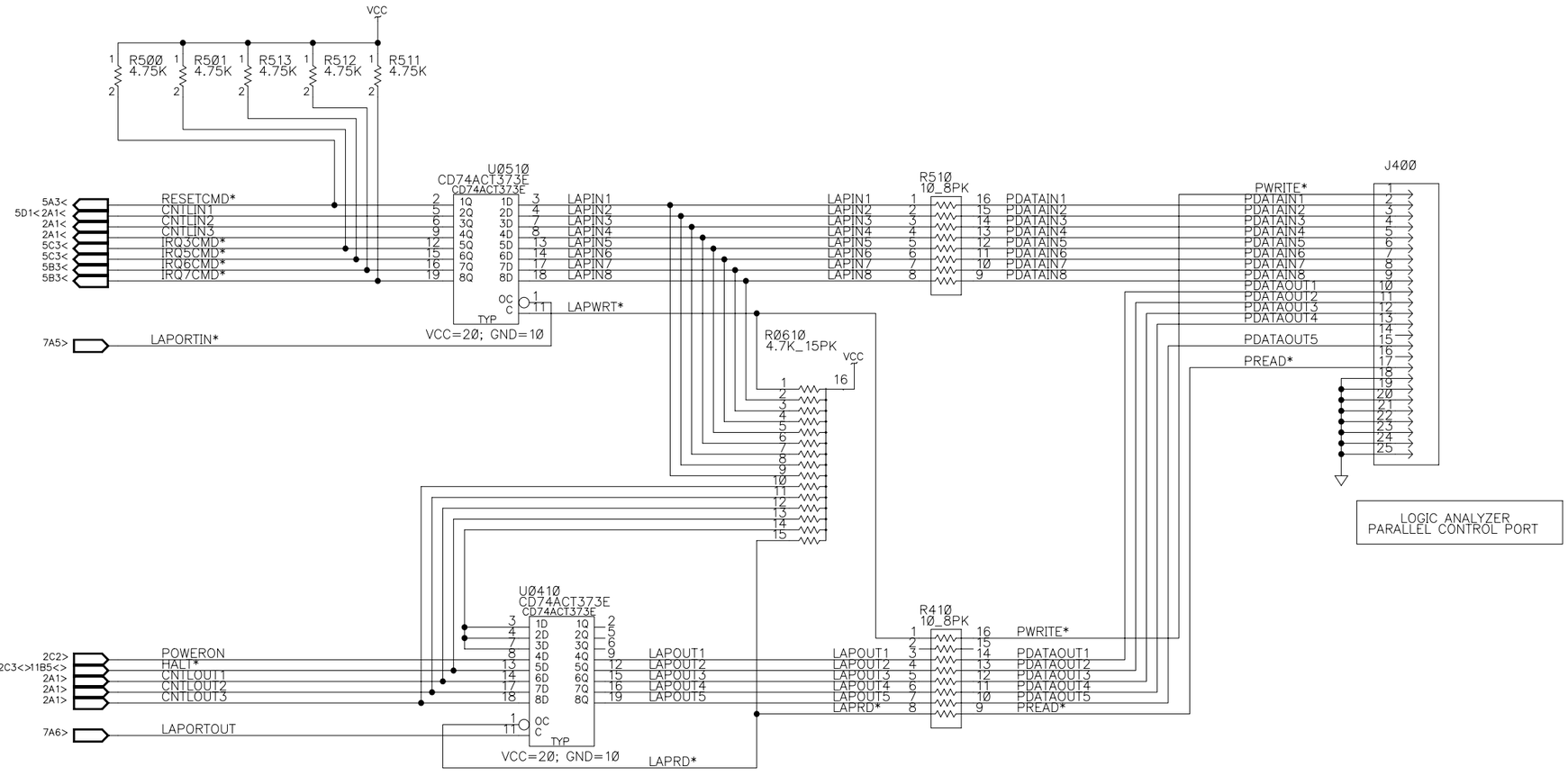

J750
5D2> DREQ1* C0
2C6<> DONE1* C1
5D2> DREQ2* C2
2C6<> DONE2* C3
2C2> TOUT1 C4
2C2> TOUT2 C5
10A6> DLYRDIN* C6
10B6> DLYRDOUT* C7
0
7
CHANNEL GROUP C0 CONNECTOR
J650
11C3> 5B6> IRQ3* C8
11C3> 5B6> IRQ5* C9
11C3> 5B6> IRQ6* C10
11C3> 5B6> IRQ7* C11
18B1> RXDA C12
2C6> TXDA C13
18A1> RXDB C14
2C6> TXDB C15
0
7
CHANNEL GROUP C1 CONNECTOR
J551
14D2> DLYQ1
QUALIFIER Q1 CONNECTOR
U471
CD74HCT32E
2D4> EXTAL
VCC=14; GND=7
R730
0 OHMS
DLYQ0
15D4< 17B2<
R760
0 OHMS
DLYQ1
14C1< 16C4<
VCC
R562
8.25K
U564
74HCT20N
BG*
BGACK*
VCC=14; GND=7
U0573
74HCT04N
10 ALT_BUS
13C2< 16C1<
VCC=14; GND=7
J550
2A6> R/W*
2A6> AS*
2A6> DS*
11B5<> 5B6> 2C3<> 20D3<> RESET*
11C3> BGACK*
2B6> BG*
11B3> BR*
2B6> RMC*
R/W~
AS~
DS~
RESET~
BGACK~
BG~
BR~
RMC~
0
7
CHANNEL GROUP C2 CONNECTOR
TP5
R550 (1)
0 OHMS
J450
2B6> FREEZE
2C6> IPIPE*
2B6> CLKOUT
20D3> 11C2> BKPT*
11C2<> 2C6<> IFETCH*
OPEN_TP
IPIPE_NXT*
IFETCH_NXT*
IPIPE_NET~
IFETCH~
0
7
CHANNEL GROUP C3 CONNECTOR
14C6> 16B4< 14C6> 16B4<
J350
2C6> DACK2*
CK3
CLOCK CK3 CONNECTOR
NOTES:
(1) : R550 NOT INSTALLED

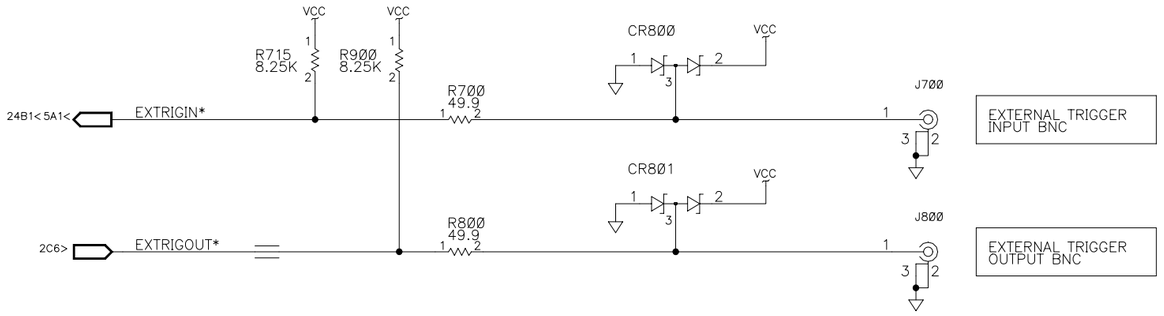

2B3> DATA<15..Ø>
J74Ø
CHANNEL GROUP DØ CONNECTOR
J64Ø
CHANNEL GROUP D1 CONNECTOR
J541
CLOCK CK2 CONNECTOR
U564 74HCT2ØN
11C3> 5B6> IRQ7*
11C3> 5B6> IRQ6*
11C3> 5B6> IRQ5*
11C3> 5B6> IRQ3*
VCC=14; GND=7
IRQ_ANY_D
AVEC*
15A5> 17C3< 15A5> 17C3<
15A5> 17C3< 15A5> 17C3< 15A5> 17C3<
J54Ø
11B5<> 2C3<> 11B5<> 2C3<> HALT*
20D3> 11B5> 20D3> 11B5> BERR*
2A6>2A6> SIZ1
2A6>2A6> SIZØ
2B6> CSØ*
11B2> 11B2> DSACK1*
11B2> 11B2> DSACKØ*
CHANNEL GROUP D2 CONNECTOR
J44Ø
2A6>2A6> FCØ
2A6>2A6> FC1
2A6>2A6> FC2
2A6>2A6> FC3
2B6>2B6> CSØ*
2B6>2B6> CS1*
2B6>2B6> CS2*
2B6>2B6> CS3*
CHANNEL GROUP D3 CONNECTOR
J34Ø
14D2> 14D2> DLYQØ
QUALIFIER QØ CONNECTOR


13A1<> 11B3<> 2A1<>
PORTA<7..0>
2A3>
ADDR<23..0>
2B6>2B6>
CLKOUT
A PROBE
J32Ø
CLKOUT
PORTA<7>
PORTA<6>
PORTA<5>
PORTA<4>
PORTA<3>
PORTA<2>
PORTA<1>
PORTA<Ø>
CLKØ
CHANNEL GROUP A3
ADDR<23>
ADDR<22>
ADDR<21>
ADDR<20>
ADDR<19>
ADDR<18>
ADDR<17>
ADDR<16>
CHANNEL GROUP A2
ADDR<Ø>
ADDR<1>
ADDR<2>
ADDR<3>
ADDR<4>
ADDR<5>
ADDR<6>
ADDR<7>
CHANNEL GROUP AØ
ADDR<8>
ADDR<9>
ADDR<10>
ADDR<11>
ADDR<12>
ADDR<13>
ADDR<14>
ADDR<15>
CHANNEL GROUP A1
14A6> 14A6>
ALT_BUS
ALT_BUS
CLK1
CLK1
GND
GND
GND1
GND2
GND3
GND4
GND5
2C6>2C6>
DACK2*
C PROBE
J62Ø
DACK2*
IFETCH_NXT*
IFETCH*
BKPT*
CLKOUT
IPIPE_NXT*
IPIPE*
FREEZE
OPEN_IP
RMC*
BR*
BG*
BGACK*
RESET*
DS*
AS*
R/W*
DREQ1*
DACK1*
DONE1*
DREQ2*
DACK2*
DONE2*
DLYRDOUT*
DLYRDIN*
IRQ5*
IRQ6*
IRQ7*
RXDA
TXDA
RXDB
TXDB
CLK3
CHANNEL GROUP C3
CHANNEL GROUP C2
CHANNEL GROUP CØ
CHANNEL GROUP C1
14D2> 14D2>
DLYQ1
DLYQ1
Q1
Q1
GND
GND
GND1
GND2
GND3
GND4
GND5

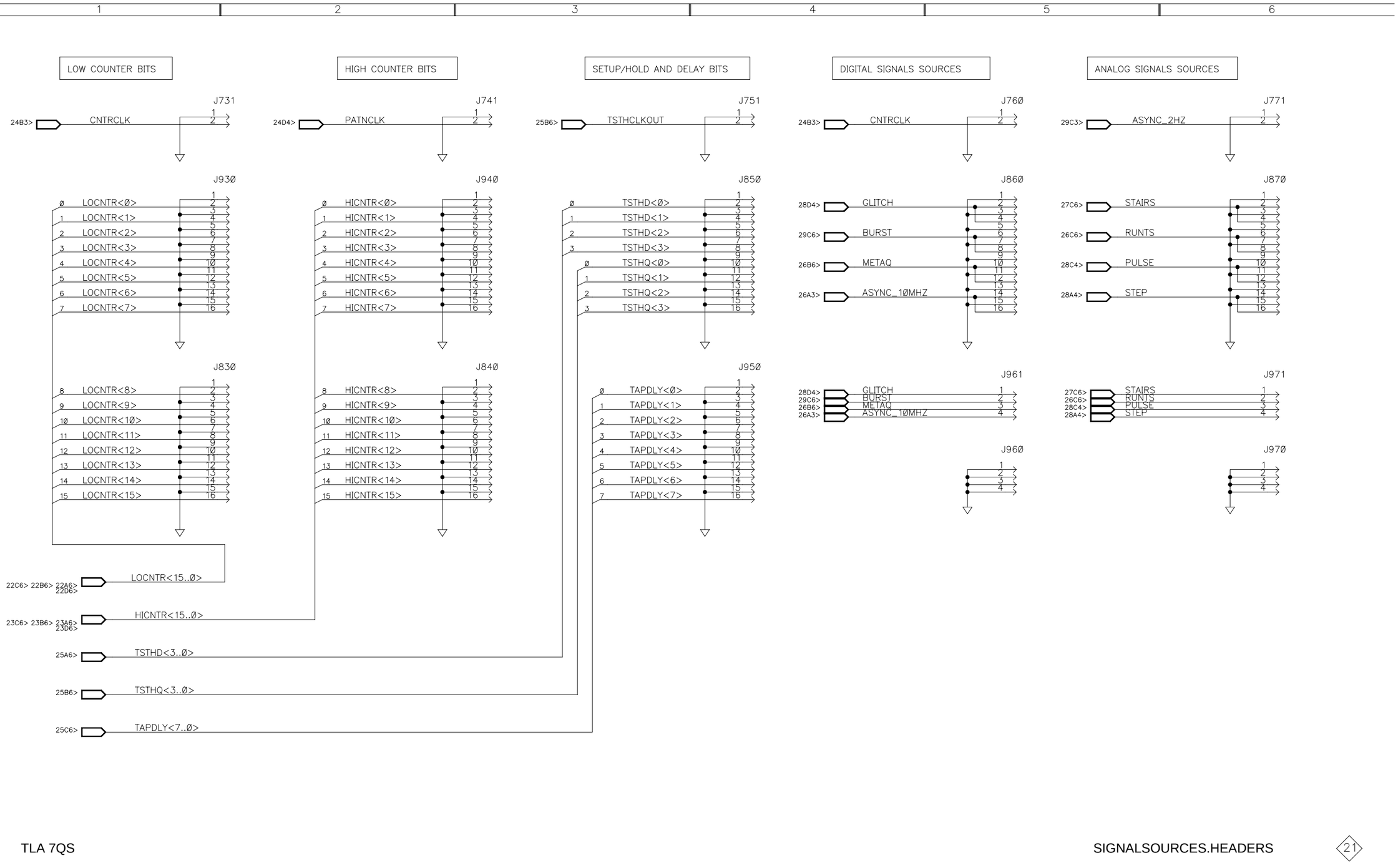

25B6> TSTHQ<3..Ø>
25A6> TSTHD<3..Ø>
25C6> TAPDLY<7..Ø>
23D6> 23C6> 23B6> 23A6> HICNTR<15..Ø>
2C3> DATA<15..Ø>
D_PROBE
J42Ø
E_PROBE
J82Ø
14D2> 14D2> DLYQØ
25B6>25B6> TSTHCLKOUT
2B6> CS3*
2B6> CS2*
2B6> CS1*
2B6> CSØ*
2A6> FC3
2A6> FC2
2A6> FC1
2A6> FCØ
11B2> USACKØ*
11B2> USACK1*
15A5> AVEC*
2A6> SIZØ
2A6> SIZ1
15A5> IRQ_ANY_D
2ØD3> 11B5> BERR*
2C3> 11B5<> HALT*
DATA<Ø>
DATA<1>
DATA<2>
DATA<3>
DATA<4>
DATA<5>
DATA<6>
DATA<7>
DATA<8>
DATA<9>
DATA<1Ø>
DATA<11>
DATA<12>
DATA<13>
DATA<14>
DATA<15>
2C6>2C6> DACK1*
CHANNEL GROUP D3
CHANNEL GROUP D2
CHANNEL GROUP DØ
CHANNEL GROUP D1
CHANNEL GROUP E3
CHANNEL GROUP E2
CHANNEL GROUP EØ
CHANNEL GROUP E1
24B3>24B3> CNTRCLK
GND
GND1
GND2
GND3
GND4
GND5
CLK2
Q2
Q3
QØ

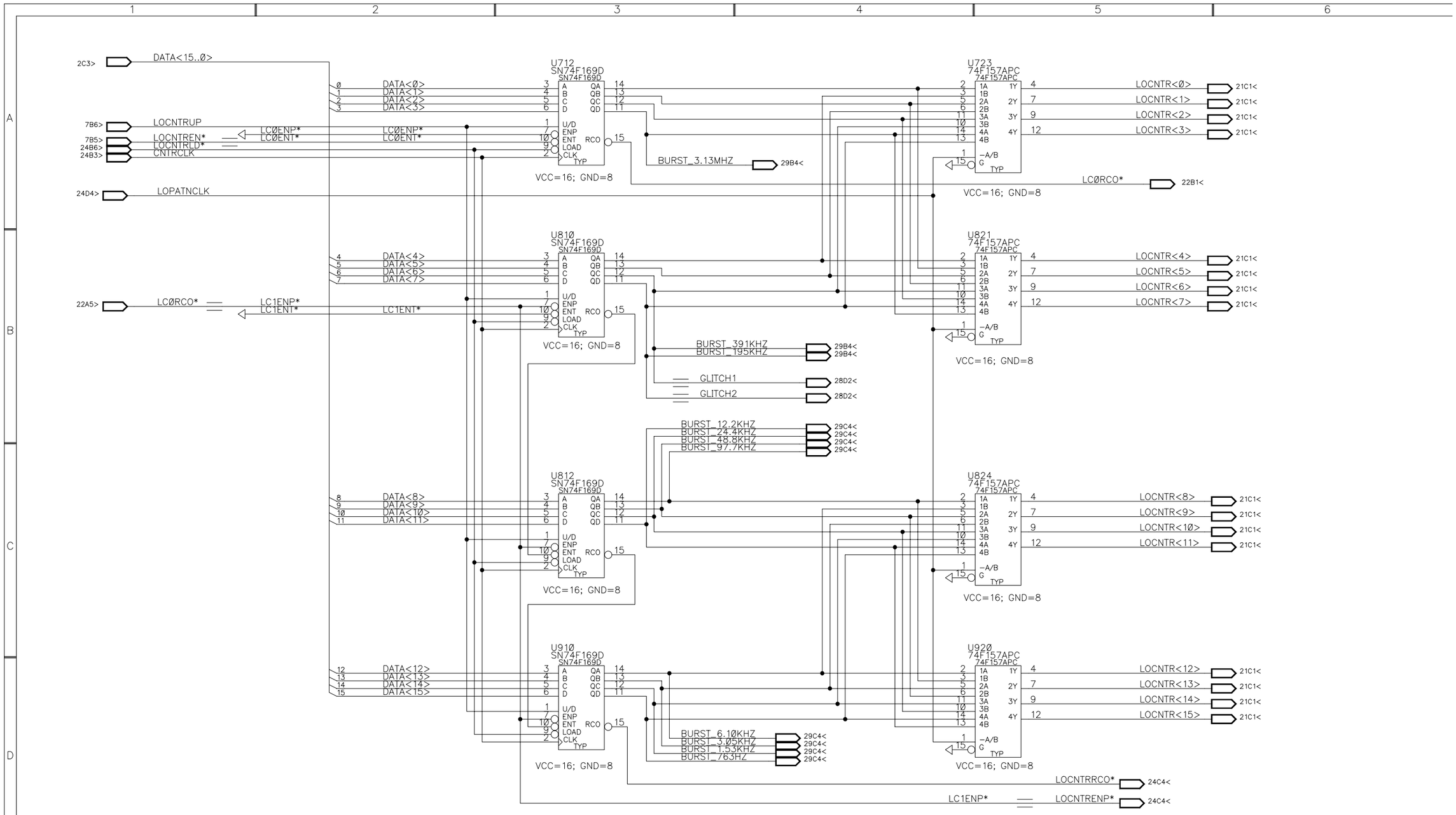

J500
XTXDB
XRXDB
XCTSB*
XRTSB*
SERIAL PORT B
U511
LT1130
C0522
C0523
C0521
C0620
1.0
VP
VN
C1P
C1N
C2N
C2P
TXDB
RTSB*
TXDA
RTSA*
XRXDB
XCTSB*
XRXDA
XCTSA*
VCC
DRI1
DRI2
DRI3
DRI4
DRI5
DRO1
DRO2
DRO3
DRO4
DRO5
RXI1
RXI2
RXI3
RXI4
RXI5
RXO1
RXO2
RXO3
RXO4
RXO5
XTXDB
XRTSB*
XTXDA
XRTSA*
RXDB
CTSB*
RXDA
CTSA*
GND=15,VCC=2
16C4< 14B1< 2C6< 18A1>
2C6>
2C6<18A1>
16C4< 14B1< 2C6< 18B1>
2C6< 18B1>
J600
XTXDA
XCTSA*
XRXDA
XRTSA*
SERIAL PORT A

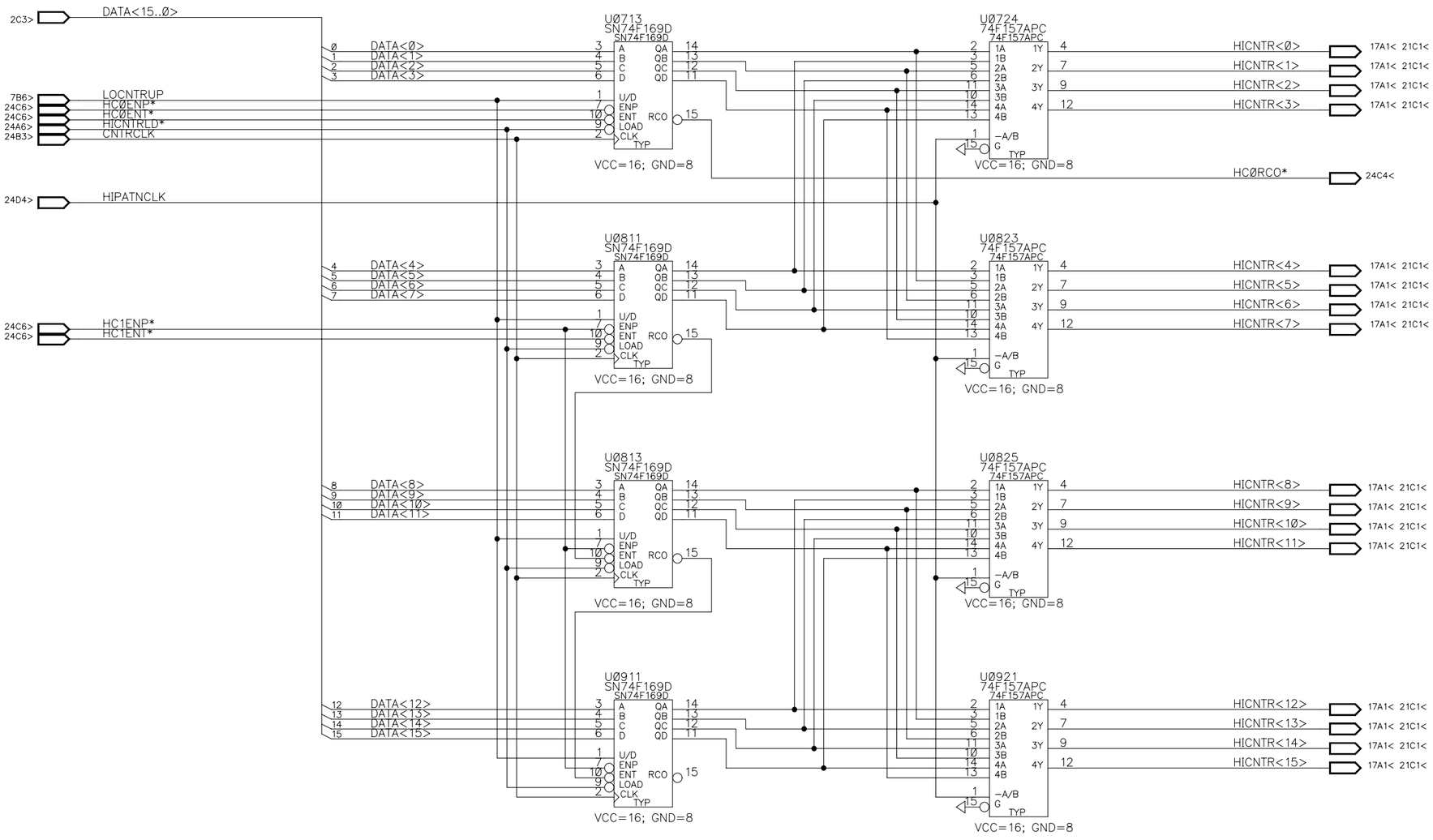

VCC
R500 4.75K
R501 4.75K
R513 4.75K
R512 4.75K
R511 4.75K
U0510
CD74ACT373E
RESETCMD*
CNTLIN1
CNTLIN2
CNTLIN3
IRQ3CMD*
IRQ5CMD*
IRQ6CMD*
IRQ7CMD*
LAPORTIN*
LAPWRT*
VCC=20; GND=10
R510
10_8PK
LAPIN1
LAPIN2
LAPIN3
LAPIN4
LAPIN5
LAPIN6
LAPIN7
LAPIN8
PDATAIN1
PDATAIN2
PDATAIN3
PDATAIN4
PDATAIN5
PDATAIN6
PDATAIN7
PDATAIN8
J400
PWRITE*
PDATAOUT1
PDATAOUT2
PDATAOUT3
PDATAOUT4
PDATAOUT5
PREAD*
LOGIC ANALYZER
PARALLEL CONTROL PORT
R0610
4.7K_15PK
U0410
CD74ACT373E
POWERON
HALT*
CNTLOUT1
CNTLOUT2
CNTLOUT3
LAPORTOUT
LAPOUT1
LAPOUT2
LAPOUT3
LAPOUT4
LAPOUT5
LAPRD*
VCC=20; GND=10
R410
10_8PK

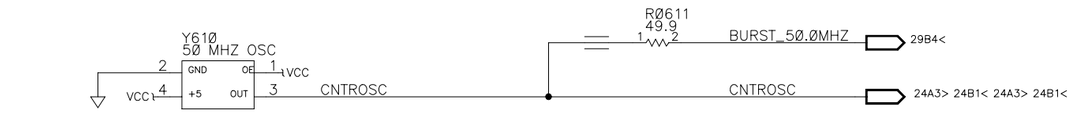


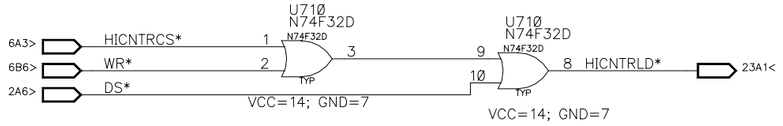
NOTES:
(1): J601 NOT INSTALLED

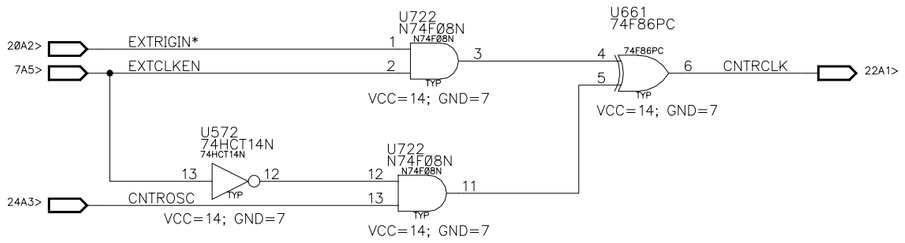

LOW COUNTER BITS
HIGH COUNTER BITS
SETUP/HOLD AND DELAY BITS
DIGITAL SIGNALS SOURCES
ANALOG SIGNALS SOURCES
J731
24B3> CNTRCLK
J741
24D4> PATNCLK
J751
25B6> TSTHCLKOUT
J760
24B3> CNTRCLK
J771
29C3> ASYNC_2HZ
J930
0 LOCNTR<0>
1 LOCNTR<1>
2 LOCNTR<2>
3 LOCNTR<3>
4 LOCNTR<4>
5 LOCNTR<5>
6 LOCNTR<6>
7 LOCNTR<7>
J940
0 HICNTR<0>
1 HICNTR<1>
2 HICNTR<2>
3 HICNTR<3>
4 HICNTR<4>
5 HICNTR<5>
6 HICNTR<6>
7 HICNTR<7>
J850
0 TSTHD<0>
1 TSTHD<1>
2 TSTHD<2>
3 TSTHD<3>
0 TSTHQ<0>
1 TSTHQ<1>
2 TSTHQ<2>
3 TSTHQ<3>
J860
28D4> GLITCH
29C6> BURST
26B6> METAQ
26A3> ASYNC_10MHZ
J870
27C6> STAIRS
26C6> RUNTS
28C4> PULSE
28A4> STEP
J830
8 LOCNTR<8>
9 LOCNTR<9>
10 LOCNTR<10>
11 LOCNTR<11>
12 LOCNTR<12>
13 LOCNTR<13>
14 LOCNTR<14>
15 LOCNTR<15>
J840
8 HICNTR<8>
9 HICNTR<9>
10 HICNTR<10>
11 HICNTR<11>
12 HICNTR<12>
13 HICNTR<13>
14 HICNTR<14>
15 HICNTR<15>
J950
0 TAPDLY<0>
1 TAPDLY<1>
2 TAPDLY<2>
3 TAPDLY<3>
4 TAPDLY<4>
5 TAPDLY<5>
6 TAPDLY<6>
7 TAPDLY<7>
J961
28D4> GLITCH
29C6> BURST
26B6> METAQ
26A3> ASYNC_10MHZ
J971
27C6> STAIRS
26C6> RUNTS
28C4> PULSE
28A4> STEP
J960
J970
22C6> 22B6> 22A6> 22D6> LOCNTR<15..0>
23C6> 23B6> 23A6> 23D6> HICNTR<15..0>
25A6> TSTHD<3..0>
25B6> TSTHQ<3..0>
25C6> TAPDLY<7..0>

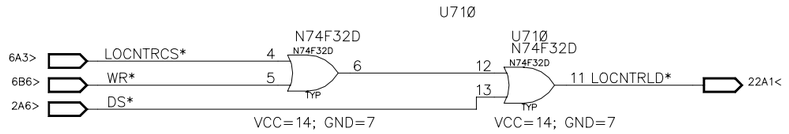

2C3> DATA<15..Ø>
7B6> LOCNTRUP
7B5> LOCNTREN*
24B6> LOCNTRLD*
24B3> CNTRCLK
24D4> LOPATNCLK
22A5> LCØRCO*
LCØENP*
LCØENT*
LC1ENP*
LC1ENT*
DATA<Ø> DATA<1> DATA<2> DATA<3>
DATA<4> DATA<5> DATA<6> DATA<7>
DATA<8> DATA<9> DATA<10> DATA<11>
DATA<12> DATA<13> DATA<14> DATA<15>
U712
SN74F169D
U810
U812
U910
U723
74F157APC
U821
U824
U920
A B C D QA QB QC QD U/D ENP ENT LOAD CLK RCO TYP
1A 1B 2A 2B 3A 3B 4A 4B 1Y 2Y 3Y 4Y -A/B G
VCC=16; GND=8
BURST_3.13MHZ 29B4<
BURST_391KHZ 29B4<
BURST_195KHZ 29B4<
GLITCH1 28D2<
GLITCH2 28D2<
BURST_12.2KHZ 29C4<
BURST_24.4KHZ 29C4<
BURST_48.8KHZ 29C4<
BURST_97.7KHZ 29C4<
BURST_6.1ØKHZ 29C4<
BURST_3.Ø5KHZ 29C4<
BURST_1.53KHZ 29C4<
BURST_763HZ 29C4<
LCØRCO* 22B1<
LOCNTR<Ø> LOCNTR<1> LOCNTR<2> LOCNTR<3>
LOCNTR<4> LOCNTR<5> LOCNTR<6> LOCNTR<7>
LOCNTR<8> LOCNTR<9> LOCNTR<10> LOCNTR<11>
LOCNTR<12> LOCNTR<13> LOCNTR<14> LOCNTR<15>
21C1<
LOCNTRRCO* 24C4<
LC1ENP* LOCNTRENP* 24C4<

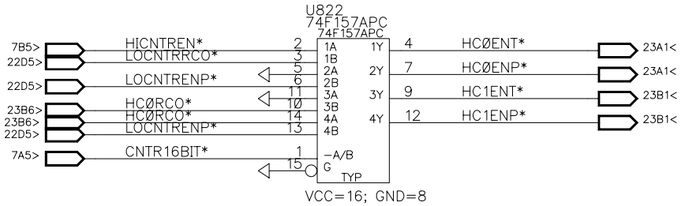

DATA<15..Ø>
2C3>
LOCNTRUP
HCØENP*
HCØENT*
HICNTRLD*
CNTRCLK
7B6>
24C6>
24C6>
24A6>
24B3>
HIPATNCLK
24D4>
HC1ENP*
HC1ENT*
24C6>
24C6>
DATA<8>
DATA<9>
DATA<10>
DATA<11>
DATA<12>
DATA<13>
DATA<14>
DATA<15>
U0713
SN74F169D
U0811
SN74F169D
U0813
SN74F169D
U0911
SN74F169D
A
B
C
QA
QB
QC
QD
U/D
ENP
ENT
LOAD
CLK
RCO
TYP
VCC=16; GND=8
U0724
74F157APC
U0823
74F157APC
U0825
74F157APC
U0921
74F157APC
1A
1B
2A
2B
3A
3B
4A
4B
1Y
2Y
3Y
4Y
–A/B
G
HICNTR<Ø>
HICNTR<1>
HICNTR<2>
HICNTR<3>
HICNTR<4>
HICNTR<5>
HICNTR<6>
HICNTR<7>
HICNTR<8>
HICNTR<9>
HICNTR<10>
HICNTR<11>
HICNTR<12>
HICNTR<13>
HICNTR<14>
HICNTR<15>
17A1< 21C1<
HCØRCO*
24C4<

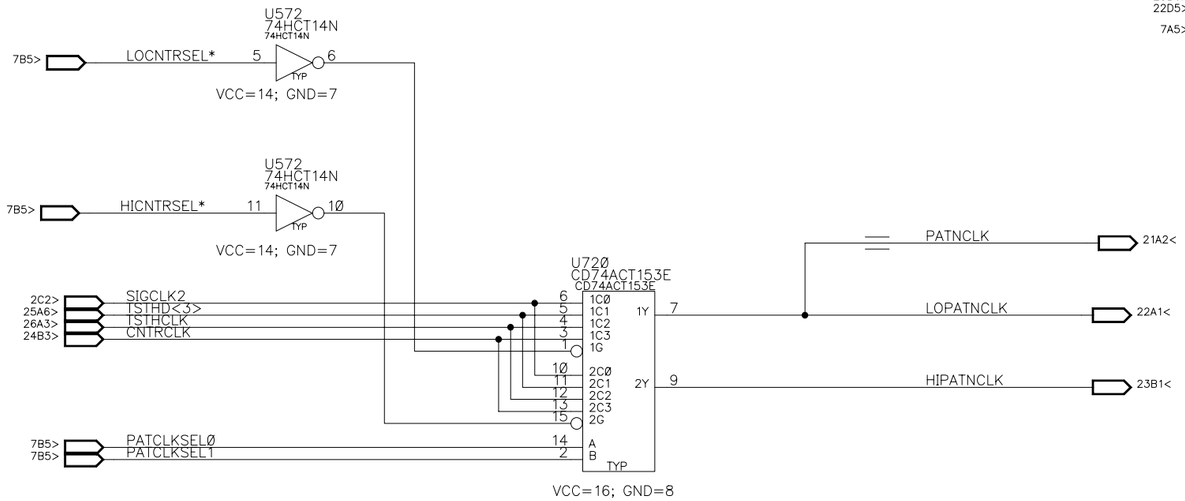

Y610
50 MHZ OSC
GND
OE
VCC
+5
OUT
CNTROSC
R0611
49.9
BURST_50.0MHZ
29B4<
CNTROSC
24A3> 24B1< 24A3> 24B1<

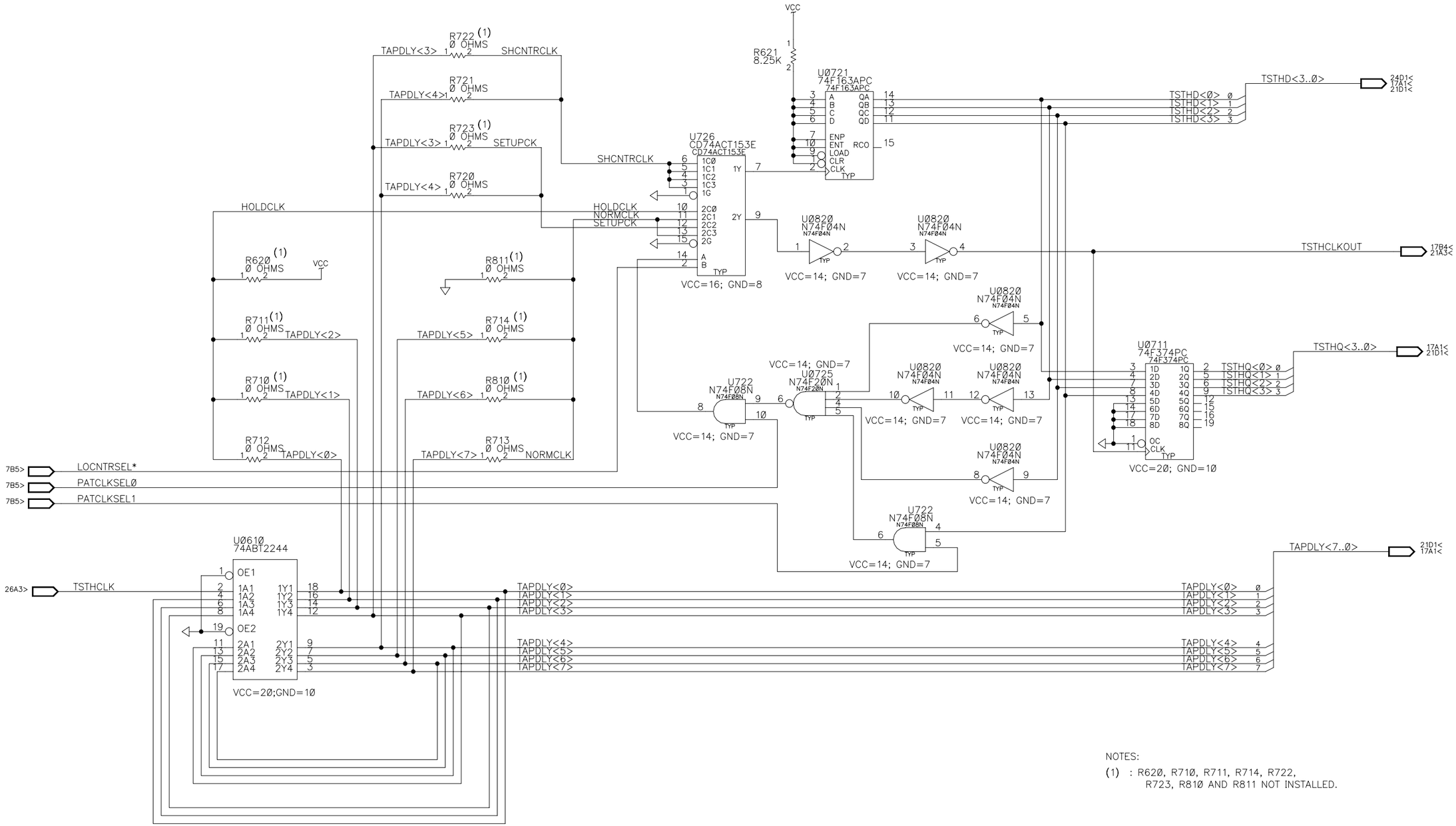

U710
N74F32D
6A3>
HICNTRCS*
6B6>
WR*
2A6>
DS*
VCC=14; GND=7
U710
N74F32D
23A1<
VCC=14; GND=7


U722
N74F08N
20A2>
EXTRIGIN*
7A5>
EXTCLKEN
VCC=14; GND=7
U661
74F86PC
CNTRCLK
22A1>
VCC=14; GND=7
U572
74HCT14N
24A3>
CNTROSC
VCC=14; GND=7
U722
N74F08N
VCC=14; GND=7


U710
6A3>
LOCNTRCS*
6B6>
WR*
2A6>
DS*
N74F32D
VCC=14; GND=7
U710
N74F32D
11 LOCNTRLD*
22A1<
VCC=14; GND=7

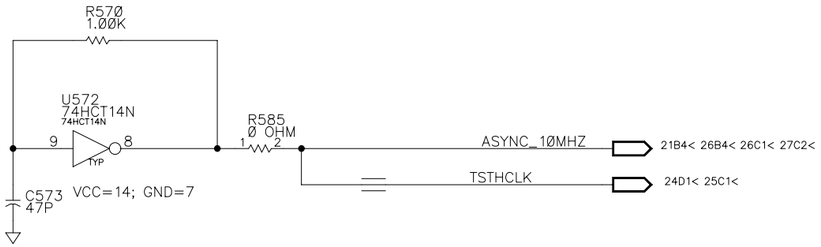

U822
74F157APC
7B5>
HICNTREN*
22D5>
LOCNTRRCO*
22D5>
LOCNTRENP*
23B6>
HCØRCO*
23B6>
HCØRCO*
22D5>
LOCNTRENP*
7A5>
CNTR16BIT*
1A
1B
2A
2B
3A
3B
4A
4B
−A/B
G
1Y
2Y
3Y
4Y
HCØENT*
HCØENP*
HC1ENT*
HC1ENP*
23A1<
23A1<
23B1<
23B1<
TYP
VCC=16; GND=8

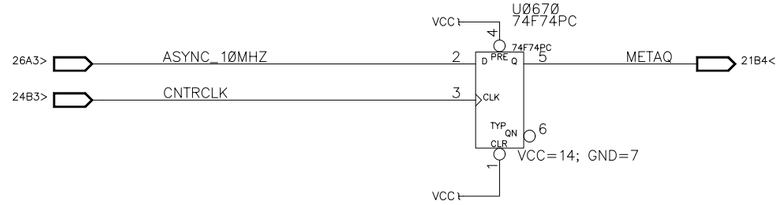

U572
74HCT14N
7B5>
LOCNTRSEL*
VCC=14; GND=7
U572
74HCT14N
7B5>
HICNTRSEL*
VCC=14; GND=7
U720
CD74ACT153E
2C2>
SIGCLK2
25A6>
TSTHD<3>
26A3>
TSTHCLK
24B3>
CNTRCLK
1C0
1C1
1C2
1C3
1G
2C0
2C1
2C2
2C3
2G
1Y
2Y
PATNCLK
21A2<
LOPATNCLK
22A1<
HIPATNCLK
23B1<
7B5>
PATCLKSEL0
7B5>
PATCLKSEL1
A
B
TYP
VCC=16; GND=8

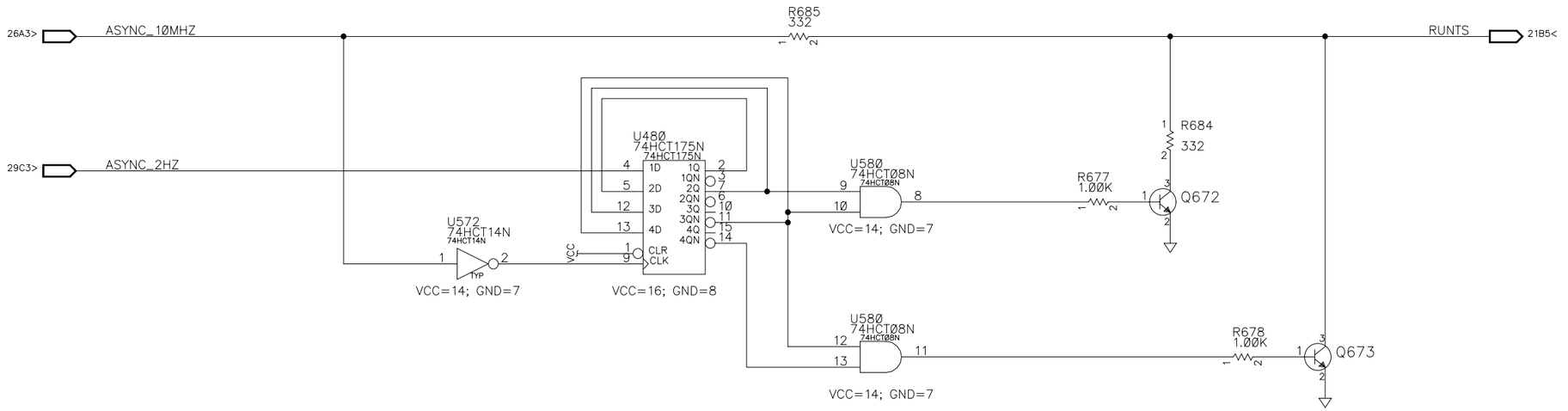


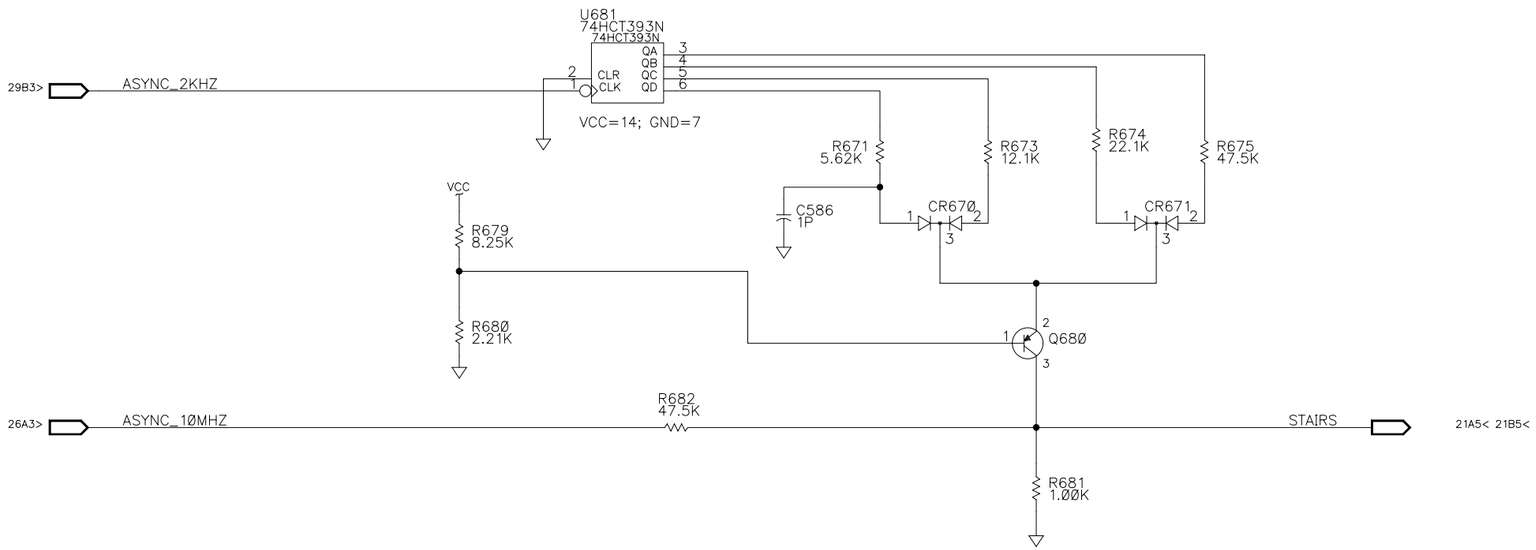
NOTES:

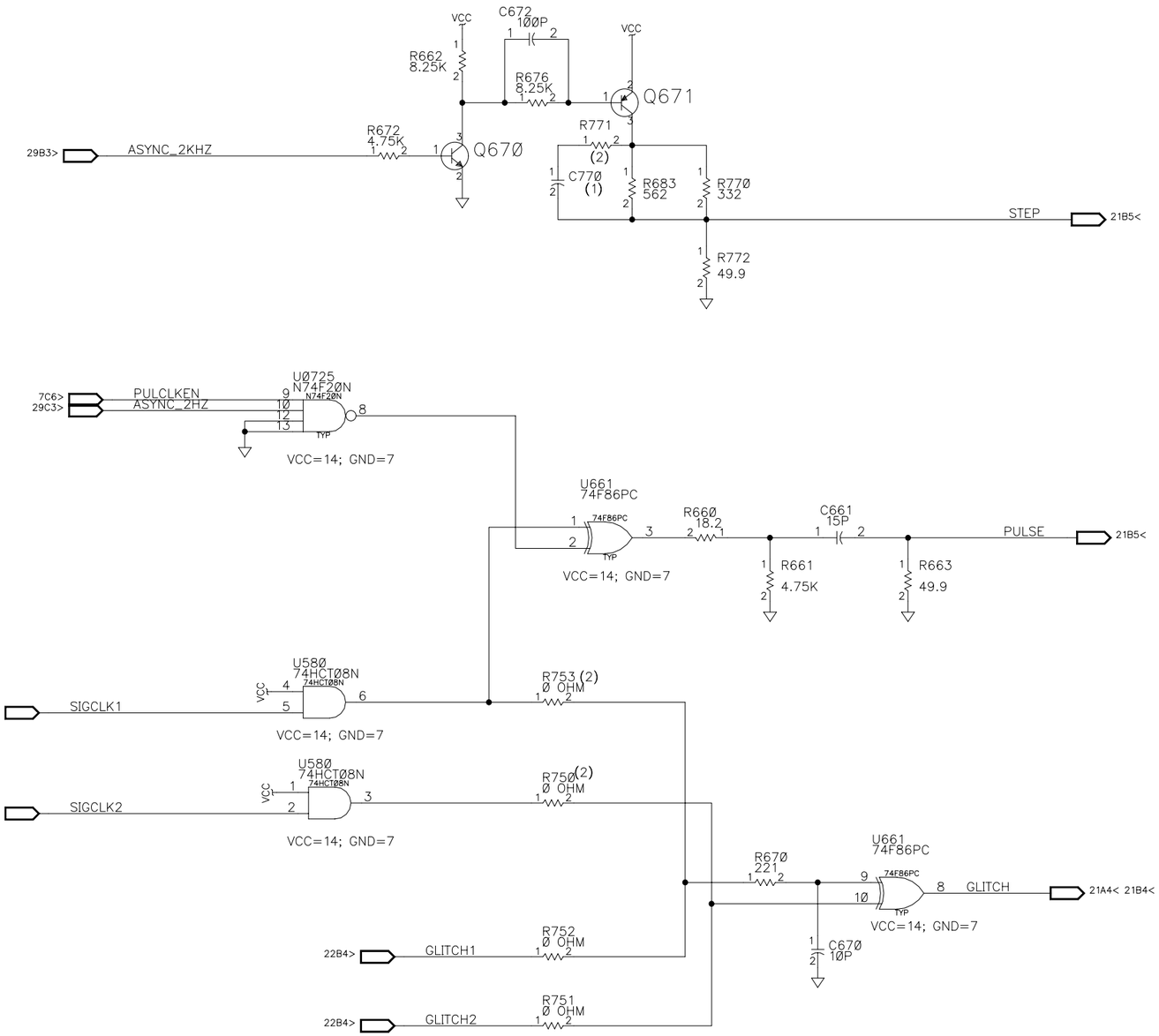
(1) : R62Ø, R71Ø, R711, R714, R722, R723, R81Ø AND R811 NOT INSTALLED.


R570
1.00K
U572
74HCT14N
74HCT14N
9
8
TYP
R585
0 OHM
1
2
ASYNC_10MHZ
21B4< 26B4< 26C1< 27C2<
TSTHCLK
24D1< 25C1<
C573
47P
VCC=14; GND=7


U0670
74F74PC
VCC
4
74F74PC
26A3>
ASYNC_10MHZ
2
D
PRE
Q
5
METAQ
21B4<
24B3>
CNTRCLK
3
CLK
TYP
ON
6
CLR
VCC=14; GND=7
1
VCC

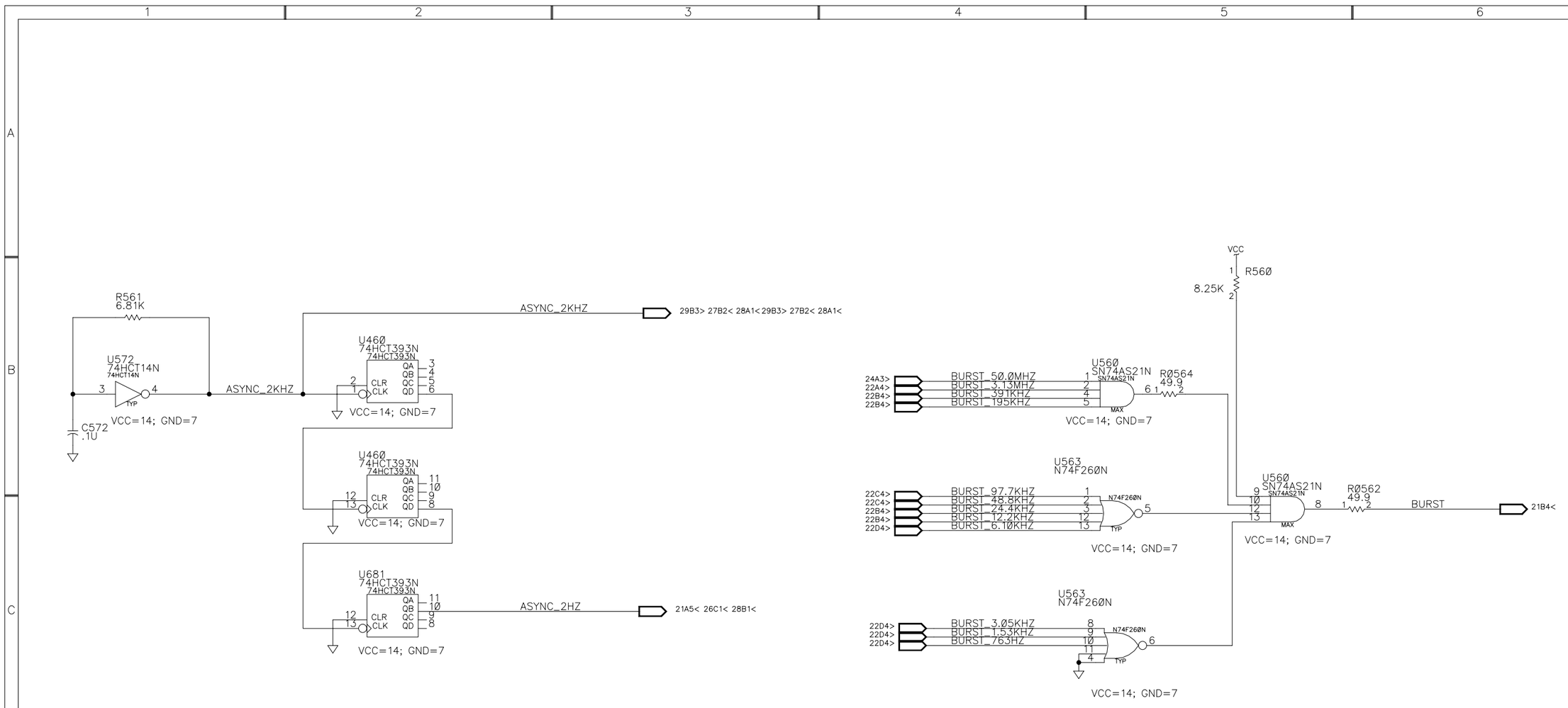

R685
332
26A3>
ASYNC_10MHZ
RUNTS
21B5<
U480
74HCT175N
74HCT175N
29C3>
ASYNC_2HZ
4
1D
1Q
2
1QN
3
5
2D
2Q
7
2QN
6
12
3D
3Q
10
3QN
11
13
4D
4Q
15
4QN
14
1
CLR
9
CLK
U572
74HCT14N
74HCT14N
1
2
TYP
VCC=14; GND=7
VCC=16; GND=8
U580
74HCT08N
74HCT08N
9
8
10
VCC=14; GND=7
R677
1.00K
1
2
R684
332
Q672
U580
74HCT08N
74HCT08N
12
11
13
VCC=14; GND=7
R678
1.00K
Q673

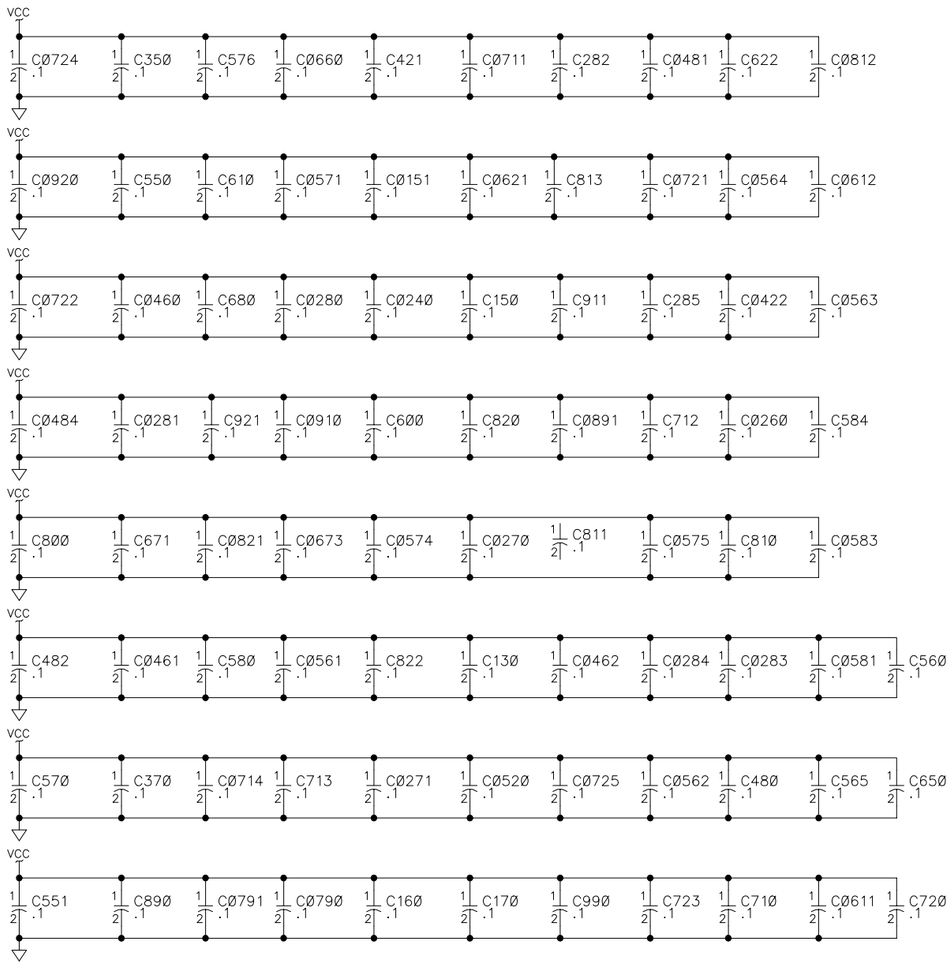

U681
74HCT393N
74HCT393N
QA
QB
QC
QD
CLR
CLK
VCC=14; GND=7
29B3>
ASYNC_2KHZ
R671
5.62K
R673
12.1K
R674
22.1K
R675
47.5K
C586
1P
CR670
CR671
VCC
R679
8.25K
R680
2.21K
Q680
R682
47.5K
26A3>
ASYNC_10MHZ
STAIRS
21A5< 21B5<
R681
1.00K



NOTES:

(1) : C770 NOT INSTALLED
(2) : R750, R753 AND R771 NOT INSTALLED


R561
6.81K
U572
74HCT14N
74HCT14N
3
4
1YP
ASYNC_2KHZ
C572
.1U
VCC=14; GND=7
U460
74HCT393N
74HCT393N
QA
QB
QC
QD
CLR
CLK
2
1
3
4
5
6
VCC=14; GND=7
ASYNC_2KHZ
29B3> 27B2< 28A1< 29B3> 27B2< 28A1<
U460
74HCT393N
74HCT393N
12
13
11
10
9
8
VCC=14; GND=7
U681
74HCT393N
74HCT393N
ASYNC_2HZ
21A5< 26C1< 28B1<
VCC=14; GND=7
VCC
R560
8.25K
1
2
U560
SN74AS21N
SN74AS21N
24A3>
22A4>
22B4>
22B4>
BURST_50.0MHZ
BURST_3.13MHZ
BURST_391KHZ
BURST_195KHZ
1
2
4
5
MAX
R0564
49.9
6
1
2
VCC=14; GND=7
U563
N74F260N
22C4>
22C4>
22B4>
22B4>
22D4>
BURST_97.7KHZ
BURST_48.8KHZ
BURST_24.4KHZ
BURST_12.2KHZ
BURST_6.10KHZ
1
2
3
12
13
N74F260N
5
TYP
VCC=14; GND=7
U560
SN74AS21N
SN74AS21N
9
10
12
13
8
MAX
R0562
49.9
1
2
BURST
21B4<
VCC=14; GND=7
U563
N74F260N
22D4>
22D4>
22D4>
BURST_3.05KHZ
BURST_1.53KHZ
BURST_763HZ
8
9
10
11
4
N74F260N
6
TYP
VCC=14; GND=7


VCC
C0724 C350 C576 C0660 C421 C0711 C282 C0481 C622 C0812
VCC
C0920 C550 C610 C0571 C0151 C0621 C813 C0721 C0564 C0612
VCC
C0722 C0460 C680 C0280 C0240 C150 C911 C285 C0422 C0563
VCC
C0484 C0281 C921 C0910 C600 C820 C0891 C712 C0260 C584
VCC
C800 C671 C0821 C0673 C0574 C0270 C811 C0575 C810 C0583
VCC
C482 C0461 C580 C0561 C822 C130 C0462 C0284 C0283 C0581 C560
VCC
C570 C370 C0714 C713 C0271 C0520 C0725 C0562 C480 C565 C650
VCC
C551 C890 C0791 C0790 C160 C170 C990 C723 C710 C0611 C720

Replaceable Mechanical Parts

This section contains a list of the replaceable mechanical components for the TLA 7QS training board. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available through your local Tektronix field office or representative.

Changes to Tektronix products are sometimes made to accommodate improved components as they become available and to give you the benefit of the latest improvements. Therefore, when ordering parts, it is important to include the following information in your order:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If you order a part that has been replaced with a different or improved part, your local Tektronix field office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

Using the Replaceable Mechanical Parts List

The tabular information in the Replaceable Mechanical Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find all of the information you need for ordering replacement parts. The following table describes the content of each column in the parts list.

Parts list column descriptions

Column	Column name	Description
1	Figure & index number	Items in this section are referenced by figure and index numbers to the exploded view illustrations that follow.
2	Tektronix part number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entries indicates the part is good for all serial numbers.
5	Qty	This indicates the quantity of parts used.
6	Name & description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.
7	Mfr. code	This indicates the code of the actual manufacturer of the part.
8	Mfr. part number	This indicates the actual manufacturer's or vendor's part number.

Abbreviations Abbreviations conform to American National Standard ANSI Y1.1–1972.

Chassis Parts Chassis-mounted parts and cable assemblies are located at the end of the Replaceable Electrical Parts List.

Mfr. Code to Manufacturer Cross Index The table titled Manufacturers Cross Index shows codes, names, and addresses of manufacturers or vendors of components listed in the parts list.

Manufacturers cross index

Mfr. code	Manufacturer	Address	City, state, zip code
00779	AMP INC.	CUSTOMER SERVICE DEPT PO BOX 3608	HARRISBURG, PA 17105–3608
04426	ITW SWITCHES	AN ILLINOIS TOOL WORKS CO. 6615 W. IRVING PARK RD.	CHICAGO, IL 60634
06090	RAYCHEM CORP	300 CONSTITUTION DR	MENLO PARK, CA 94025–1111
0KB01	STAUFFER SUPPLY CO	810 SE SHERMAN	PORTLAND, OR 97214–4657
22526	BERG ELECTRONICS INC	825 OLD TRAIL ROAD	ETTERS, PA 17319
31918	ITT SWITCH PRODUCTS	8081 WALLACE RD	EDEN PRAIRIE, MN 55344–8798
50434	HEWLETT PACKARD	370 W TRIMBLE ROAD	SAN JOSE, CA 95131–1008
53387	3M COMPANY	ELECTRONICS PRODUCTS DIV 3M AUSTIN CENTER	AUSTIN, TX 78769–2963
60381	PRECISION INTERCONNECT CORP.	16640 SW 72ND AVE	PORTLAND, OR 97224
62712	SEIKO INSTRUMENTS USA INC	ELECTRONIC COMPONENTS DIV 2990 W LOMITA BLVD	TORRANCE, CA 90505
63058	BERG ELECTRONICS INC.	MCKENZIE SOCKET DIV 910 PAGE AVE	FREMONT, CA 94538–7340
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD PO BOX 76500	COLD SPRINGS, KY 41076
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077–0001
85480	BRADY USA	NAMEPLATE DIVISION P O BOX 571 346 ELIZABETH BRADY RD	HILLSBOROUGH, NC 27278
TK0435	LEWIS SCREW CO.	4300 SOUTH RACINE AVENUE	CHICAGO, IL 60609
TK2449	SINGATRON ENTERPRISE CO LTD	13925 MAGNOLIA AVE	CHINO, CA 91710
TK2597	MERIX CORP	1521 POPLAR LANE	FOREST GROVE, OR 97116

Replaceable parts list

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
8–1–1	671–3684–00			1	CIRCUIT BOARD:LA QUICKSTART	80009	671–3684–00
–	334–5026–00			1	MARKER,IDENT:MKD BLANK	85480	ORDER BY DESCR
–2	150–1137–00			2	DIODE,OPTO:LED,BAR GRAPH ARRAY, MULTICOLOR, 10–ELEMENT	50434	HDSP–4836
–3	131–6226–00			4	CONN,HDR:PCB,MALE,STR,1 X 4,0.2 CTR,0.0.166 MLG,0.03 DIA X 0.0.115 TAIL,0.021 DIA,GOLDUS (J960, J961, J970, J971)	63058	SST63150–001
–4	129–1404–00			4	SPACER,POST:0.375 L,2–56 INT & EXT THD,0.187 HEX	0KB01	129–1404–00
–5	211–0022–00			4	SCREW,MACHINE:2–56 X 0.188,PNH,STL CD PL, POZ	TK0435	ORDER BY DESCR
–6	260–2072–00			5	SWITCH,PUSH:SPST,10MA,35VDC,MOMENTARY	31918	D60101
–7	333–4223–00			1	FRONT PANEL:FRONT PANEL,0.048 CRS,TLA7QS	80009	333–4223–00
–8	119–3130–00			1	DISPLAY,MODULE:LCD,16 CHARACTERS X 2 LINES,5 X 7 DOT MATRIX	62712	M16320A
–9	131–4866–00			1	CONN,BOX:PCB,FEMALE,STR,2 X 7,0.1 CTR,0.325 H X 0.125 TAIL,30 GOLD	53387	929852–01–07–30
–10	131–0608–00			14	CONN,TERMINAL:PRESSFIT/PCB,MALE,STR,0.025 SQ,0.248 MLG X 0.137 TAIL,50 GOLD,PHZ BRZ,W/FERRULE	22526	48283–018
–11	131–5267–00			4	CONN,HDR:PCB,MALE,STR,2 X 40,0.1 CTR,0.235 MLG X 0.110 TAIL,30GOLD, HIGH TEMP (J430, J440, J450, J530, J540, J550, J630, J640, J650, J730, J740, J750, J830, J840, J850, J860, J870, J930, J940, J950)	00779	104326–4
–12	131–4917–00			11	CONN,HDR:PCB,MALE,STR,1 X 2,0.1 CTR,0.235 MLG X 0.110 TAIL,30 GOLD (J330, J340, J350, J531, J541, J551, J731, J741, J751, J760, J771)	00779	104350–1
–13	105–1089–00			4	LATCH ASSY:LATCH HOUSING ASSY,VERTICAL MOUNT,0.48 H X 1.24 L,W/PCB SINGLE CLIP	60381	105–1089–00
–14	131–3692–00			1	CONN,DIN:PCB,MALE,RTANG,3 X 32,0.1CTR (J180)	00779	536416–5
–15	131–6134–00			4	CONN,PLUG:SMD,MICTOR,PCB,FEMALE,STR,38 POS,0.025 CTR,0.245 H,GOLD (J320, J420, J620, J820)	00779	767004–1
–16	260–0960–01			1	SWITCH,SLIDE:DPST,ALT MAKE/BREAK,FORM Z,0.5A,175VAC,75VDC,CHASSIS MNT	04426	023–021–304
–17	159–5008–00			1	FUSE,THRM,CHIP:SELF RESETTING FUSE,1.5A HOLD,3.0A TRIP AT 20 DEG C,30V MAX	06090	SMD150–2
–18	150–1132–00			1	DIODE,OPTO:LED,GRN,569MCD,10.6MCD AT 10MA,40 DEG VIEW ANGL,HLMP–3568,T–1 3/4	50434	HLMP–3568
–19	131–5527–00			1	JACK,POWER DC:PCB,MALE,RTANG,2MM PIN (J111)	TK2449	DJ–005–A

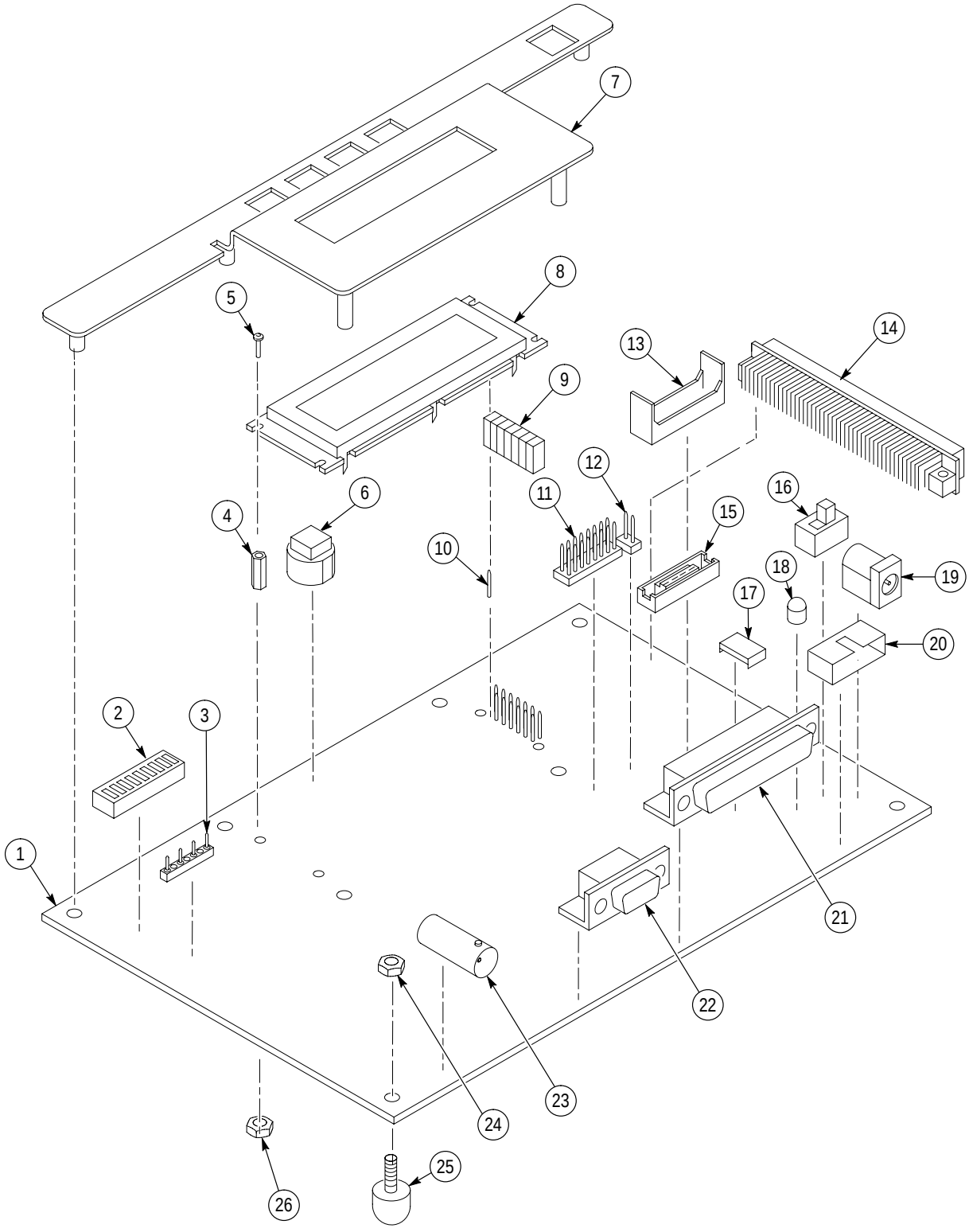


Figure 8–1: Exploded view

Replaceable parts list (Cont.)

Fig. & index number	Tektronix part number	Serial no. effective	Serial no. discont'd	Qty	Name & description	Mfr. code	Mfr. part number
8–1–20	131–3358–00			2	CONN,HDR:PCB,MALE,RTANG,2 X 5,0.1 CTR,0.390 MLG X 0.112 TAIL,0.33 H,SHRD/4 SIDES,MIL PLZ (J200, J600)	53387	2510–5002UB
–21	131–3395–00			1	CONN,DSUB:PCB,MALE,RTANG,25 POS,0.318 MLG X 0.125 TAIL,30 GOLD,W/4–40 THD INSERTS (J400)	00779	747842–4
–22	131–3925–00			1	CONN,DSUB:PCB,FEMALE,RTANG,9 POS,0.112 CTR,0.318 MLG X 0.125 TAIL,4–40 THD INSERT (J500)	00779	747844–4
–23	131–5999–00			2	CONN,RF:BNC,FEMALE,50 OHM,RTANG (J700, J800)	00779	414373–1
–24	210–0407–00			2	NUT,PLAIN,HEX:6–32 X 0.25,BRS CD PL	73743	3038–402
–25	348–0048–00			8	FOOT,CAMERA:BLACK VINYL W/6–32 STUD	80009	348–0048–00
–26	210–0405–00			4	NUT,PLAIN,HEX:2–56 X 0.188,BRS CD PL	73743	12157–50
					STANDARD ACCESSORIES		
–	119–4812–01			1	POWER ADAPTER, NORTH AMERICAN, 12V 1.0A,UNREG,120VAC 60HZ	0GV90	WD1E1000C12CP/CK
–	119–4813–01			1	POWER ADAPTER, UNIVERSAL EUROPEAN, 12W,12V 1.0A,UNREG,220VAC 50HZ (OPTION A1)	0GV90	WD13E1000C12CP/CK
–	119–4922–01			1	POWER ADAPTER, UK, 12W,12V 1.0A,UNREG, 240VAC 50HZ (OPTION A2)	0GV90	WD35E1000C12CP/CK
–	119–4923–01			1	POWER ADAPTER, JAPAN; 12W,12V 1.0A,UNREG, 100VAC 50HZ (OPTION A6)	0GV90	WD35E1000C12CP/CK
–	070–9717–XX			1	MANUAL,TECH:TRAINING,TLA 7QS QUICKSTART	80009	070–9717–XX
					OPTIONAL ACCESSORIES		
–	070–9716–XX			1	MANUAL,TECH:TECHNICAL REFERENCE,TLA 7QS QUICKSTART	80009	070–9716–XX
–	020–2211–XX			1	KIT:TECHNICAL REFERENCE,TLA 7QS (INLUDES TLA 7QS QUICKSTART TRAINING MANUAL AND SOFTWARE, TLA 7QS TECHNICAL REFERENCE MANUAL AND SOFTWARE)	80009	020–2211–XX

Appendix A: Source Code

This appendix contains information on the source code available with the standard training board as it is shipped from the factory.

System Source Code Files

Table A–1 lists some of the system source code files available with the TLA 7QS software. The files are contained on the floppy disk that accompanies this manual.

Several of the C source code files have corresponding include files. The files with the .s extensions are 68340 assembly language files. The Mongoose.a file is a precompiled object file that implements the ROM portion of the SDS target monitor.

Table A–1: TLA 7QS System software files

File	Description
Count.c, Count.h	Counter and pattern generator routines
Cyclewai.c, Cyclewai.h	Show cycles and wait state routines
Data.c, Data.h	Some variable storage and retrieval routines
Diags.c, Diags.h	TLA 7QS QuickStart diagnostic routines
Driver.c, Driver.h	Implementation file for low-level drivers
Flash.c	Flash EErom erase and burn routines
Led.c	An adaptation of the Stop Lites program
Lites.c	An adaptation of the Lites program
Main.c	Main routine and initialization
Menu.c, Menu.h	Menu initialization and selection routines
Mongoose.h	Include file for project globals
Pgmdelay.c	Programmable delay line routines
Queue.c, Queue.h	An adaptation of the Stop Lites program
Sethold.c	A setup and hold routine
Stoplite.c, Stoplite.h	An adaptation of the Stop Lites program
Rs232.s	Assembly language to configure 68340 serial ports
Start.s	Assembly language startup code for the 68340 family to initialize RAM

Table A–1: TLA 7QS System software files (Cont.)

File	Description
Timer.s	Assembly language to configure the 68340 timers
Mongoose.a	Precompiled ROM portion of the SDS target monitor
Mongoose.obj	Firmware object file

Sample programs

The following programs are included with this manual to provide examples of creating user programs to work with the training board. The following three programs are working programs. Use them as guidelines to create your own programs.

User.c

The User.c file is a sample C program that will display a character string on the display of the training board.

```
/*****************************************************************
 * File:     User.c
 * Purpose: This file contains an example of how to add a menu
 * item to the user flash ROM of the QuickStart board. This
 * example will print the message "Time to switch" on the LCD and
 * wait for a key stroke. It will then return control to the
 * main menu.
 * Note:
 * For this example, the QuickStart source code and required
 * include files are located in the directory ..\revb02. This
 * path must be modified if your files are in a different
 * location.
*****************************************************************/

#include "..\revb02\mongoose.h" /*mongoose project definitions */
#include "..\revb02\menu.h"    /* menu structure definitions */
#include "..\revb02\driver.h"  /* low-level driver definitions */
#include "string.h"

/* forward declarations */
void user1(int);

/* confidence word to indicate that user flash is valid */
const unsigned short userword = 0xABBA;

/* This is our menu entry */
const MENU   userTest1 = { "USER 1", 3, 35, user1, 0 };
```

```
/* string variable that will hold our string */
char string[80];

/*************************************************************
 * a dummy function is used since the first function uses a
 * different return from subroutine mechanism.
*************************************************************/

void
dummy()

{
}

/*************************************************************
 * This is our example routine. It will write the string to the
 * first row  and column of the LCD display.
*************************************************************/

void
user1(int testnum)

{
            /* build our display string */
            strcpy(string, "Time to switch");

            /* print our string at row 0, col 0 */
            LCDprintXY(0, 0, string);

            /* wait for the user to press a key */
            while (currentState != KEYSTOP)
                        ;
}
```

build.bat This build.bat file is an MSDOS batch file that will compile, link and prepare for download the sample C program named User.c.

```
cc68000 -f -L const=user_word -L const=user_const -L \
        string=user_string -L code=user_code user.c -o user.o
linker  user.o mongoose.obj -f combine.spc -o user.out
down    -d mot user.out -d mot -o user.txt -w 0x200000,0x40000
```

combine.spc

This combine.spc file is a linker specification file that will map partitions and regions to specific memory locations that match the requirements for the training board. For more information, refer to the SDS Linker documentation.

```
/*************************************************************\
* This is an example linker specification file to be used to
* combine the monitor and a target program together into a single
* object file.
\*************************************************************/
partition {
    overlay {
              VTBL_ADDR = $;
              region {} vector          [ size = 256 ];
              region {} data            [ roundsize=4 ];
              region {} ram           [ addr=0x1000,roundsize=4 ];
              region {} malloc          [ size=0x1000 ];
              region {} stack           [ size=0x4000 ];
              STKTOP = $;
              region {} usr_ram         [ roundsize=4 ];
              region {} mon_sram        [ roundsize=4 ];
              region {} mon_coproc0     [ size =   0 ];
              region {} mon_coproc1     [ size = 260 ];
              region {} mon_coproc2     [ size =   0 ];
              region {} mon_coproc3     [ size =   0 ];
              region {} mon_coproc4     [ size =   0 ];
              region {} mon_coproc5     [ size =   0 ];
              region {} mon_coproc6     [ size =   0 ];
              region {} mon_coproc7     [ size =   0 ];
              COP_END = $;
              region {} mon_buffer      [ align=4 ];
              region {} mon_stack       [ size = 0x110 ];
              MON_STACKTOP = $;
    } oram;
} RAM ;

partition {
    overlay {
              region {}  user_word [absaddr=0x200000];
              region {}  user_const;
              region {}  user_string;
              region {}  user_code;
    } oflash;
} FLASH [ addr = 0x00200000 ];
```

```
partition {
    overlay {
              region {}  reset;
    } oreset;
} RESET [ addr = 0x00600000 ];

partition {
    overlay {
              TEXT_START = $;
              region {}  usr_reset;
              region {}  usr_code;       CODE_END = $;
              region {}  mon_exec;       EXEC_END = $;
              region {}  mon_except;     EXCP_END = $;
              TEXT_END = $;
              region {}  usr_const       [ roundsize=4 ];
              region {}  usr_string      [ roundsize=4 ];
              region {}  code;
              region {}  const           [ roundsize=4 ];
              region {}  string          [ roundsize=4 ];
              DATA = $;
    } orom;
} ROM ;

partition {
    overlay {
              region {} system_valid;
    } ocon;
} CON [ addr = 0x0060fff0 ];
```