TEK OPERATORS MANUAL

PRODUCT GROUP 42
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7A42 Logic Triggered Vertical Amplifier

Please check for change information at the rear of this manual.

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RELATED DOCUMENTATION

For information on related 7A42 documentation refer to General Information, Section 1 of this manual under Technical Manuals and Standard Accessories.

LIST OF ILLUSTRATIONS

LIST OF TABLES

OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and sevicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

TERMS

IN THIS MANUAL

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

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

AS MARKED ON EQUIPMENT

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS

IN THIS MANUAL


Static-Sensitive Devices


This symbol indicates where applicable cautionary or other information is to be found.

AS MARKED ON EQUIPMENT


DANGER—High voltage.


Protective ground (earth) terminal.


ATTENTION—refer to manual.

WARNINGS

POWER SOURCE

This product is intended to operate in a mainframe connected to a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the mainframe power cord is essential for safe operation.

GROUNDING THE PRODUCT

This product is grounded through the grounding connector of the mainframe power cord. To avoid electrical shock, plug the mainframe power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective-ground connection by way of the grounding conductor in the mainframe power cord is essential for safe operation.

DANGER ARISING FROM LOSS OF GROUND

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating), can render an electrical shock.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERES

To avoid explosion, do not operate this product in an atmosphere of explosive gasses.

DO NOT OPERATE PLUG-IN UNIT WITHOUT COVERS

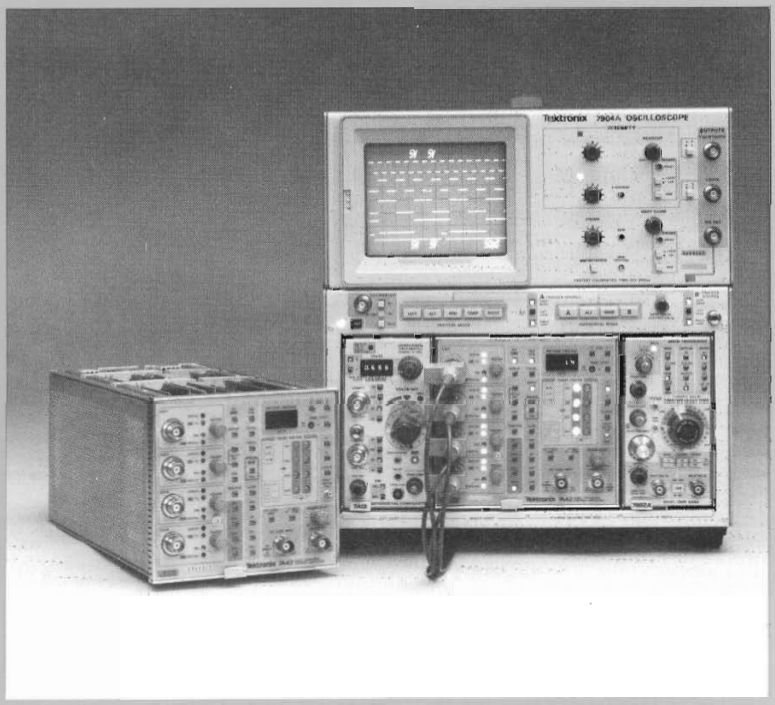
To avoid personal injury, do not operate this product without covers or panels installed. Do not apply power to the plug-in via a plug-in extender.

DESCRIPTION

The 7A42 Logic Triggered Vertical Amplifier is a four channel, wide bandwidth, plug-in unit, compatible with Tektronix 7000-series Oscilloscopes. It was specifically designed to display and make measurements on digital logic signals in the TTL, ECL and CMOS logic families. While the display output from the 7A42 is analog, the trigger output is digital and is comprised of a user selectable Boolean function of the four input channels. A fifth TRIGGER VIEW trace depicts either the trigger function output or the external clock input.

SECTION ONE
GENERAL INFORMATION

1



Shown above is the Tektronix 7A42, 7A13, and 7B92A installed in a Tektronix 7904A Oscilloscope.

The 7904A is a general purpose, real-time 7000-series mainframe, featuring a 300 MHz system bandwidth with the 7A42.

SECTION 1 CONTENTS

GENERAL INFORMATION

This section contains a basic content description of both the Operators and Service manuals, information on instrument installation, power requirements, packaging for shipment, Standard Accessories, Optional Accessories, Specifications and a dimensional drawing of the 7A42. The specification portion consists of three tables: Electrical, Environmental, and Physical Characteristics.

COLOR USED IN THIS MANUAL

Red, green and yellow color is used in this manual to visually correlate the front-panel indicators and markings to the descriptions of the text.

TECHNICAL MANUALS

An operators and two service manuals are supplied with your 7A42 as standard accessories. The following information outlines the content of these manuals.

Operators Manual

The Operators Manual is divided into the following four sections:

Section 1—GENERAL INFORMATION contains content descriptions of the Operators and Service manuals, instrument description, mainframe and plug-in compatibility, packaging instructions and instrument specifications.

Section 2—OPERATING INSTRUCTIONS contains a block diagram description, a front-panel drawing and brief description of controls, connectors and indicators. Get-Acquainted Exercises provide a basic operating procedure for the first-time user followed by a systematic demonstration of all front-panel controls. A detailed description of all front-panel controls is also given in this section.

Section 3—APPLICATIONS gives examples of how to use the 7A42 to make some difficult measurements.

Section 4—INSTRUMENT OPTIONS contains a description of available options.

Service Manual

WARNING

The following service instructions are for use by qualified personnel only. To avoid personal injury, do not perform any service other than that contained in the operating instructions unless you are qualified to do so. Refer to Operators Safety Summary and Service Safety Summary prior to performing any service.

The service manual is divided into 2 volumes. Volume 1 contains the following:

Section 1—GENERAL INFORMATION contains content descriptions of the Operators and Service manuals, mainframe and plug-in compatibility, packaging instructions and instrument specifications.

Section 2—THEORY OF OPERATION contains basic and general circuit analysis that is useful for servicing the instrument.

Section 3—MAINTENANCE describes preventive maintenance procedures, conventional troubleshooting and diagnostic troubleshooting procedures with detailed instructions for replacing assemblies, subassemblies, and individual components.

Section 4—CHECKS AND ADJUSTMENT contains procedures to check the operational performance and electrical characteristics of the instrument. Procedures also include methods for adjustment of the instrument to meet specifications.

Section 5—INSTRUMENT OPTIONS contains a description of available options.

Section 6—REPLACEABLE ELECTRICAL PARTS contains information necessary to order replaceable parts and assemblies related to the electrical functions of the instrument.

Section 7—DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS includes detailed circuit schematics, locations of assembled boards within the instrument, voltage and waveform information and circuit board component locators.

Section 8—REPLACEABLE MECHANICAL PARTS includes information necessary to order replaceable mechanical parts and shows exploded drawings which identify assemblies.

Volume 2 of the service manual contains signature analysis tables to be used with the diagnostic information provided in the Maintenance section of the Volume 1 service manual.

INSTALLATION

INITIAL INSPECTION

This instrument was inspected both mechanically and electrically before shipment. It should be free of mars or scratches and should meet or exceed all electrical specifications. To confirm this, inspect the instrument for physical damage incurred in transit and check the basic instrument functions by performing the Get-Acquainted Exercises in Section 2, Operating Instructions. Qualified service personnel can verify Performance Requirements by referring to the Checks and Adjustment section of the service manual. If there is damage or deficiency, contact your local Tektronix Field Office or representative.

OPERATING TEMPERATURE

The 7A42 can be operated where the ambient air temperature is from 0° to +50° C and can be stored in ambient temperatures from −55° to +75° C. After storage at temperatures outside the operating limits, allow the chassis temperature to reach operating limits before applying power.

INSTALLING THE 7A42 IN THE MAINFRAME

The 7A42 is designed to operate in the two center or the two left most plug-in compartments of a Tektronix 7000-series oscilloscope mainframe.

NOTE

Switch off the mainframe power before installing or removing the 7A42.

To install the 7A42 in the mainframe, align the grooves in the top and bottom of the instrument with the guides at the top and bottom of the plug-in compartment. Then push the 7A42 in until its front panel is flush with the front panel of the mainframe.

To remove the 7A42 from its host mainframe, pull the release latch (see Fig. 1-1) to disengage the unit from the mainframe, then pull the 7A42 straight out from the plug-in compartment leaving the mainframe on the bench.

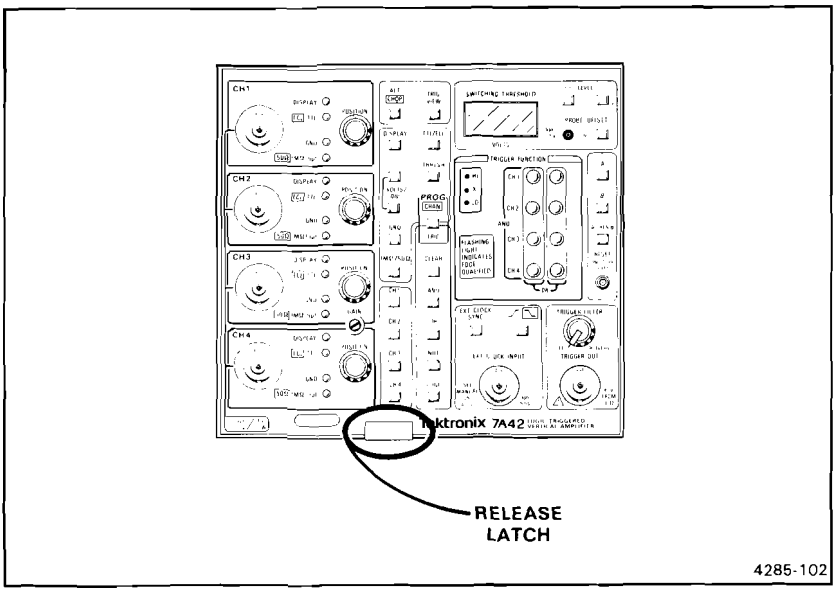


Figure 1-1. 7A42 release latch.

MAINFRAME COMPATIBILITY

The 7A42 is compatible with all Tektronix 7000 series mainframes. In four-wide plug-in compartment mainframes, it can be installed in either the two leftmost or two centermost plug-in compartments. When used in the two leftmost compartments, select the Left Vertical Mode to display the analog signals. The associated time base plug-in Trigger Source should be Left Vertical with the time-base trigger controls set to Auto or Norm, Dc, Internal, Slope to +, with the Level control centered. The A Then B Gate Output can be picked off from the RIGHT VERTICAL TRIGGER SOURCE by a 7D11 or 7D15 from either horizontal compartment. In three-wide plug-in compartment mainframes, the 7A42 must be used in the two leftmost compartments in a similar way.

When the 7A42 is installed in the center two plug-in compartments of a four compartment mainframe; set the mainframe Vertical Mode and Trigger Source to Right Vertical. The mainframe A Then B Gate Output can not be used in this configuration, however, the A Then B Gate is still available at the front-panel TRIGGER OUT bnc connector.

Since all analog channels are sent out the 7A42's left interface connector, it cannot use the full capabilities of a dual beam oscilloscope such as the 7844, R7844, and the 7612D. However, it has full compatibility with these mainframes in a single beam configuration.

Since the 7A42 uses the mainframe crt readout to display the channel volts per division and error warning messages, the 7A42 is not recommended for use in mainframes without readout.

If the 7A42 is used with two time-base units in a four compartment mainframe where Chop has been selected as the Horizontal Mode, and if exactly four traces are to be displayed by the 7A42, two of the traces may synchronize to one time base while the other two traces synchronize to the other time base. To prevent this from happening, one trace should be removed, or a fifth trace should be added to the mainframe crt display (even if it is positioned off screen so it cannot be seen). With one, two, three, or five traces, the channel display will not synchronize to the horizontal chop frequency.

The 7A42 is compatible with the 7854 Oscilloscope mainframe when the 7854 is operated in real-time. However, when the 7854 is operated in digital storage, and waveform and readout acquisition is desired, the 7A42-7854 mode should be selected, via an internal jumper; refer qualified service personnel to the 7A42 Service manual. Once the 7A42-7854 mode has been selected, proper readout and waveform acquisition can be guaranteed with the following 7A42 display conditions:

1. Any single channel displayed alone (CH1, CH2, CH3, CH4, or TRIG VIEW).
2. Channels 1 and 2 only displayed together, ALT display mode selected.
3. Channels 3 and 4 only displayed together, ALT display mode selected.

Refer to the Applications section in this manual for further information.

PACKAGING FOR SHIPMENT

If this instrument is to be shipped by commercial transportation, we recommend that the instrument be packaged in the original manner. The carton and packaging material in which your instrument was shipped should be saved and used for this purpose.

NOTE

Package and ship Plug-Ins and Mainframes separately.

If this instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag to the instrument showing the following: Owner of the instrument (with address), the name of a person at your firm who can be contacted, complete instrument type and serial number, and a description of the service required.

If the original package is unfit for use or not available, package the instrument as follows:

1. Obtain a corrugated cardboard shipping carton having inside dimensions at least six inches greater than the instrument dimensions; refer to Table 1-1 for carton test strength requirements.

2. Enclose the instrument with polyethylene sheeting or equivalent to protect the finish of the instrument.

3. Cushion the instrument on all sides by tightly packaging dunnage or urethane foam between the carton and the instrument, allowing three inches of packaging on each side.

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

5. Mark the address of the Tektronix Service Center and your return address on the carton in one or more prominent locations.

TABLE 1-1
Shipping Carton Test Strength

Gross Weight (lb)	Carton Test Strength (lb)
0	200
10-30	275
30-120	375
120-140	500

SPECIFICATION

The electrical characteristics listed in Table 1-2 apply when the following conditions are met: (1) Adjustment of the instrument must have taken place at an ambient temperature between +20° and +30° C, (2) the instrument is allowed a 20-minute warm-up period, (3) specifications are valid at an ambient temperature of 0° to +50° C, unless otherwise stated, (4) the instrument must be in an environment that meets the limits described in Table 1-3, (5) the instrument must be operated in a calibrated 7000-series mainframe.

Any applicable conditions not listed above may be stated as part of the characteristic. Environmental characteristics are listed in Table 1-3 and Physical characteristics are listed in Table 1-4.

TABLE 1-2
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
DISPLAY		
Deflection Factor		
Calibrated Range at Input BNC Connector		
TTL (CMOS) Family	0.1, 0.2, 0.5 V/div.	
ECL Family	20, 50, 100 mV/div.	
Calibrated Range through a 10X Probe		
TTL (CMOS) Family		1, 2, 5 V/div.
ECL Family		0.2, 0.5, 1 V/div.
Channel to Channel Gain Match	Within 2% in ECL Logic Family, 20 mV/div, 1 Megohm input impedance.	

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
DISPLAY (CONT)		
Deflection Factor (cont)		
Gain Ratio Accuracy within the same Channel	Within 2% of indicated deflection factor relative to ECL Logic Family, 20 mV/div, 1 Megohm input impedance.	
GAIN Range		Permits adjustment of deflection factor for calibrated operation with any calibrated 7000-series mainframe. Adjustable at least +4% to -4% from calibrated setting.
Frequency Response		
Bandwidth	350 MHz in 7104, 0° - 35°C mainframe ambient temperature. Refer to Tektronix Product Catalog 7000-Series Oscilloscope System Specification for system bandwidths.	
Input Signal Dynamic Range		
Maximum Signal Voltage at tip of 10X Probe		
TTL (CMOS) Family		±30 V.
ECL Family		±6 V.
Output Dynamic Range		Limited to the CRT display area. Mainframe Vertical Trace Separation should not be used to bring an off-screen signal onto screen.

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
DISPLAY (CONT)		
Maximum Input Voltage		
1 Megohm		25 V (dc + peak ac) 36 MHz or less, derated linearly to 3 V (peak ac) at 300 Mhz.
50 Ohm		5 V RMS during any 1 ms time interval. Active internal protection opens all inputs if overvoltage is applied to any channel.
50-Ohm Input Protection Reaction Time		
Maximum time to open input with applied overvoltage of:		
10 V DC	10 seconds.	
15 V DC	1 second.	
20 V DC	0.5 second.	
Input Characteristics		
Input Coupling		
DC		Incoming signal is dc-coupled to the amplifier.
GND		A grounded input is actually open at the input BNC, (i.e., 1 Megohm or 50 Ohm termination is disconnected). Internally, the amplifier input is grounded to provide a zero-volt input reference.

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
DISPLAY (CONT)		
Input Characteristics (cont)		
High Impedance	1 Megohm ±1%, in parallel with approximately 15 pF.	
Low Impedance	50 ohms ±1 ohm at dc.	
VSWR		≤1.15:1, dc to 300 MHz.
VOLTS/DIV Shift	0.2 divisions or less shift when VOLTS/DIV is changed in either TTL or ECL Families or between Families.	
POSITION Range		At least +7 divisions to −7 divisions but less than +9 divisions to −9 divisions from graticule center with gain calibrated.
Displayed Noise		Grounded input at maximum sensitivity, 7A42 triggered on another channel, tested at 1 ms/div and 10 ns/div, not more than 0.02 divisions RMS, as measured in a 7854.
DC Drift		
Drift with Time		Not more than 0.2 divisions in any 10 minutes after twenty minute warm-up (ambient temperature and line voltage constant).

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
DISPLAY (CONT)		
DC Drift (cont)		
Drift with Temperature		Not more than 0.2 divisions for 10° C ambient change (line voltage constant).
Differential Delay Between Any Two Channels, set to Same Logic Family and VOLTS/DIV	200 ps maximum.	
Plug-in Delay Time		Typically 25 ns from channel input to A11 and B11 of mainframe interface connector.
Channel to Channel Crosstalk		Typically less than 0.05 divisions with logic signal inputs applied through a 10X probe.
Chop Frequency		See mainframe manual for specifications.
TRIG VIEW or External Clock View		
Amplitude	0.35 divs ±0.1 div.	
Position		Baseline to be set 3 divisions (±0.5 divisions) below graticule center. Internally adjustable approximately ±4 divisions from graticule center. Refer qualified service personnel to service manual.

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
DISPLAY (CONT)		
TRIG VIEW or External Clock View (cont)		
Risetime		2 ns or less.
Time Coincidence with Channel Display		
TRIG VIEW	Within 3 ns.	
External Clock View	Within 5 ns.	
Readout		Displayed on crt, see detailed operating information.
TRIGGER		
SWITCHING THRESHOLD		
Voltage Range		
At Input BNC		
TTL (CMOS) Family	+1.28 V to -1.27 V.	
ECL Family	+256 mV to -254 mV.	
At tip of 10X probe with readout compensation		
TTL (CMOS) Family		+12.8 V to -12.7 V.
ECL Family		+2.56 V to -2.54 V.

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
TRIGGER (CONT)		
SWITCHING THRESHOLD (cont)		
Resolution		
At tip of 10X probe with readout compensation		
TTL (CMOS) Family		100 mV.
ECL Family		20 mV.
Accuracy, at Center Value of Hysteresis Window		
At Input BNC		
TTL (CMOS) Family	±5 mV ±2% of setting.	
ECL Family	±1 mV ±2% of setting.	
At tip of 10X probe with readout compensation		
TTL (CMOS) Family		±50 mV ±2% of setting.
ECL Family		±10 mV ±2% of setting.
Hysteresis, Centered at Threshold, 50kz~		
At Input BNC		
TTL (CMOS) Family	40 mV +20%, -50%.	
ECL Family	8 mV +20%, - 50%.	

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
TRIGGER (CONT)		
SWITCHING THRESHOLD (cont)		
Hysteresis, Centered at Threshold (cont)		
At tip of 10X probe with readout compensation		
TTL (CMOS) Family		400 mV +20%, −50%.
ECL Family		80 mV +20%, −50%.
Presets		
At tip of 10X probe with readout compensation		
TTL (CMOS) Family		+1.4 V.
ECL Family		−1.30 V.
PROBE OFFSET Activated		0 V.
TIP (PROBE OFFSET) Input		
Maximum Voltage Range	+5.10 V to −5.10 V, dc only.	
Input Resistance		≥100 KΩ.
DVM Resolution		20 mV.
DVM Accuracy	±20 mV ±2% of reading.	

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
TRIGGER (CONT)		
TRIGGER FILTER		
Range	Off, or adjustable from <15 ns to >300 ns.	The trigger filter cannot be activated if the EXT CLOCK is turned on, nor will it operate with any trigger function that contains an edge sensitive channel.
Match, Function A to Function B	Within 20%, at maximum setting.	
⚠ EXT CLOCK Input		
Maximum Voltage Range		+5V to −5V (DC + peak AC)
Threshold		Two EXT CLOCK INPUT modes are available, TTL or ECL; for selection of either mode refer qualified service personnel to 7A42 Service Manual.
TTL Level		
Logic Zero	≤0.8 V.	
Logic One	≥2 V.	
ECL Level		
Logic Zero	≤−1.5 V.	
Logic One	≥−1.1 V.	

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
TRIGGER (CONT)		
EXT CLOCK Input (cont)		
Input Impedance		The EXT CLOCK INPUT may be connected directly to the clock source, or through a 1X probe (TTL only). The EXT CLOCK Input is not compatible with a 10X probe.
TTL Level		Approximately 10K ohm in parallel with approximately 55 pF, terminated to +5 V.
ECL Level		Approximately 50 ohms, terminated to -2 V.
Minimum Input Slew Rate		
TTL Level		None.
ECL Level		100 mV/ns.
Pulse Width		
TTL Level	20 ns minimum.	Either pulse transition selected.
ECL Level	5 ns minimum.	Leading pulse transition selected.
	10 ns minimum.	Trailing pulse transition selected.
Set-up Time	10 ns minimum.	Time that level sensitive channels must be valid before EXT CLOCK INPUT transition.

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
TRIGGER (CONT)		
EXT CLOCK Input (cont)		
Hold Time	10 ns minimum.	Time that level sensitive channels must remain valid after EXT CLOCK INPUT transition.
Channel EDGE Sensitivity		
Set-up Time, Channel to Channel	5 ns minimum.	Time that level sensitive portion of trigger function must be true before EDGE sensitive channel transition.
Hold Time, Channel to Channel	5 ns minimum.	Time that level sensitive portion of trigger function must remain true after EDGE sensitive channel transition.
Set-up Time, EDGE Sensitive Channel	10 ns minimum.	Time that level of EDGE sensitive channel must be stable before transition.
Hold Time, EDGE Sensitive Channel	5 ns minimum.	Time that level of EDGE sensitive channel must remain stable after transition.
Mainframe Trigger Output		
Amplitude, 1 MHz square wave		300 mV ±50 mV p-p differential, into A13 and B13 of main interface connection on left side of plug-in.

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
TRIGGER (CONT)		
Mainframe Trigger Output (cont)		
Centering, 1 MHz square wave		Mean value of square wave within one division of graticule center.
Risetime, 10% to 60%		2 ns ±1 ns.
Falltime, 90% to 40%		2 ns ±1ns.
⚠ TRIGGER OUT Connector		
Output Voltage		
Logic Zero	≤0.2 V into 50 ohm load.	
Logic One	≥0.8 V into 50 ohm load.	
Output Impedance		Approximately 50 ohms.
Toggle Frequency	125 MHz maximum.	A Mode or B Mode, with displayed input signal of 60mV p-p in ECL or 300mV p-p in TTL Logic Family, centered at threshold.
Propagation Delay		
Channel Input to Trigger Output		25 ns or less.
Differential Propagation Delay from Channel Input to Trigger Output through any Trigger Function		5 ns or less.

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
TRIGGER (CONT)		
TRIGGER OUT Connector (cont)		
Propagation Delay (cont)		
A THEN B Mode		
Time Between A and B	5 ns minimum.	Minimum set-up time from event A to event B to insure that trigger output occurs with event B.
Time From B to A	5 ns minimum.	Minimum time after event B to next event A to insure proper arming.
Event Duration		Minimum time to insure proper arming and triggering.
Event A	5 ns minimum.	
Event B	5 ns minimum.	
Front-Panel A THEN B Gate Output		The front-panel A THEN B Gate Output is active only if selected and in the A THEN B mode; refer qualified service personnel to 7A42 Service Manual for selection.
Voltage		
Logic Zero		≤0.2 V into 50 ohm load.
Logic One		≥0.8 V into 50 ohm load.
Output Impedance		Approximately 50 ohms.

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
TRIGGER (CONT)		
TRIGGER OUT Connector (cont)		
A THEN B GATE TRIGGER OUT (cont)		
Timing		
Time from Event A Recognition to Rising Edge of Gate	25 ns or less.	
Mainframe A THEN B Gate Output		Active only in A THEN B Mode.
Amplitude, 1 MHz Square Wave		300 mV ±50 mV p-p differential, into A13 and B13 of main interface connector on right side of plug-in.
Centering, 1 MHz Square Wave		Mean value of square wave within one division of graticule center.
Risetime, 10% to 60%		2 ns ±1 ns.
Falltime, 90% to 40%		2 ns ±1 ns.
Timing		
Time from Event A Recognition to Rising Edge (50% point) of Gate Output		Approximately 15 ns.
Time from Event B Recognition to Falling Edge (50% point) of Gate Output		Approximately 15 ns.

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
TRIGGER (CONT)		
Mainframe A THEN B Gate Output (cont)		
Pulse Width		
Gate Output width, Measured at the 50% Points	Greater than the time between event A and event B by 5 ns ±2 ns.	
RESET Input		
Maximum Input Voltage		+5 V to -5 V (DC + peak AC).
Input Impedance		Approximately 50 ohms.
Levels		
Logic Zero	≤0.2 V.	
Logic One	≥0.8 V.	
Pulse Width	100 ns minimum.	
Timing, Post-RESET Inhibit Time to Next Trigger	10 ns minimum.	Time from falling edge of RESET to next recognizable event.
Response Time	RESET pulse must lead or be coincident with event recognition, to inhibit trigger output. Event recognition must lead the RESET pulse by 10 ns to guarantee trigger output.	

TABLE 1-2 (CONT)
Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
BATTERY BACK-UP		
Ni-Cad Battery (3.75 V)		Provides power to preserve front-panel control status a minimum of 200 hours while main power is off. Battery requires about 24 hours to fully charge from discharged condition.

TABLE 1-3
Environmental Characteristics

Characteristics	Information
Temperature (External Ambient Mainframe) Temperature	
Operating	0 to +40° C in 7403N/7603 without fan (fan kit is available). 0 to +50° C in other 7000-series mainframes.
Storage	-55° C to +75° C.
Altitude	
Operating	15,000 feet (4.6 Km).
Nonoperating	To 50,000 feet (15.2 Km).
EMC	Tested to MIL-T-28800C, MIL-STD-461A (excluding RE-01).
Vibration	
Operating and Nonoperating	Tested to MIL-T-28800C, SECT. 4.5.5.3.1 Type III, Class 5.
Shock	Tested to MIL-T-28800C, SECT. 4.5.5.4.1 Type III, Class 5.

TABLE 1-3 (CONT)
Environmental Characteristics

Characteristics	Information
Bench Handling	Tested to MIL-T-28800C, SECT. 4.5.5.4.3 Type III, Class 5.
Transportation	National Safe Transit Association, Preshipment Test Procedure.
Vibration and Bounce (packaged product)	NSTA, PROJECT 1 A-B-1.
Drop (packaged product)	NSTA, PROJECT 1 A-B-2.

TABLE 1-4
Physical Characteristics

Characteristics	Information
Net Weight	Approximately 6.2 lb, 2.8 Kg.
Dimensions	See dimensional drawing Figure 1-2.

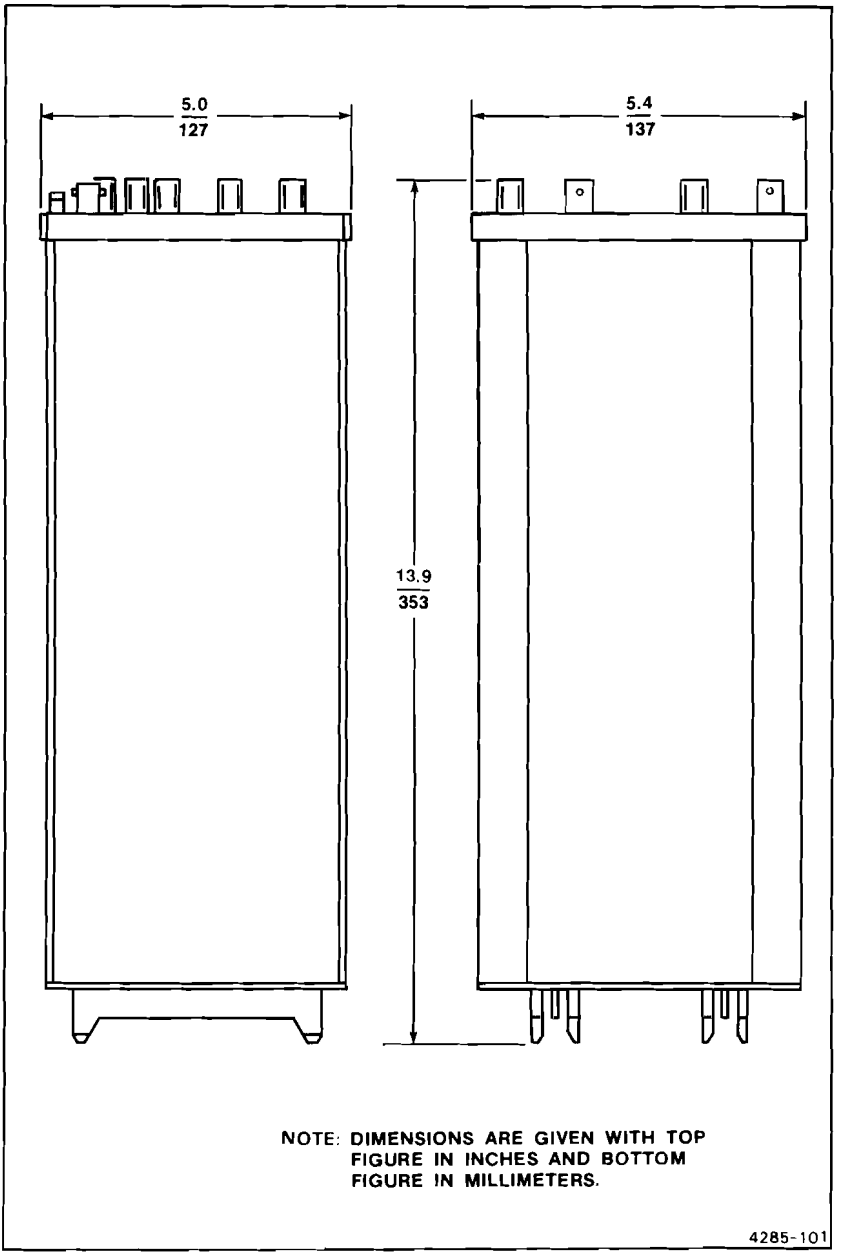


Figure 1-2. 7A42 dimensional drawing.

STANDARD ACCESSORIES

1 ea.....Operators Manual
1 ea..... Service Manual (Volume 1)
1 ea..... Service Manual (Volume 2)
1 ea.....SMB to BNC Cable

For part numbers, refer to the tabbed Accessories page at the rear of the 7A42 Service (Volume 1) manual.

OPTIONAL ACCESSORIES (not included)

The following accessories have been selected from our catalog specifically for your instrument. They are listed as a convenience to help you meet your measurement needs. For detailed information and prices, refer to a Tektronix Products Catalog or contact your local Tektronix Field Representatives.

PROBES

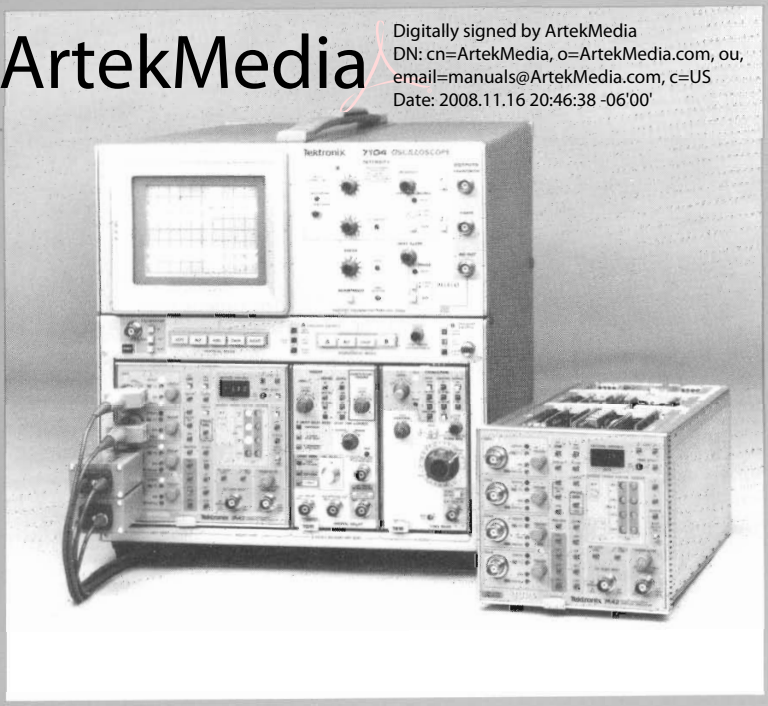
The P6131 10X passive probe (10 Megohm, 10.8 pF) has a 1.3 meter cable, a narrow barrel and variety of probe tips (hooks, IC grabbers, and ground leads) available.

The P6230 is an active 450 ohm variable bias/offset probe, which is an excellent ECL logic probe due to its low capacitances and minimal loading (because of the variable bias/offset feature). The 7A42's PROBE OFFSET feature is designed to work with the P6230. The P6131 accessories will also fit the P6230. (See ECL Probing Techniques in the Application section of this manual.)

Passive probes such as the P6131, require low-frequency compensation into the inputs of the 7A42, as with any vertical amplifier. The mainframe calibrator provides a signal suitable for making this adjustment. For optimum high-frequency performance, the probe high-frequency compensation should also be adjusted directly into the 7A42 inputs. See the probe manual for instructions to perform this adjustment.

SECTION TWO
OPERATING INSTRUCTIONS

2



Shown above is the Tektronix 7A42, 7D11, and 7B10 installed in a Tektronix 7104 mainframe.

The fast writing rate of the 7104 microchannel plate crt permits clear viewing of low-duty-cycle or single-shot pulses under normal lighting conditions even at the fastest sweep speeds.

The 7D11 Digital Delay plug-in unit enhances the trigger capabilities of the 7A42. In the 7D11 delay-by-time mode, the oscilloscope trigger can be inhibited during or after a time interval initiated by the 7A42. In the delay-by-events mode, the 7D11 allows a triggered sweep only after the n^{th} occurrence of a particular digital event.

SECTION 2 CONTENTS

OPERATING INSTRUCTIONS

This section will familiarize you with the capabilities and operation of the 7A42. A thorough understanding of this information will remove later uncertainty when operating your 7A42.

OPERATION

For operation, your 7A42 Logic Triggered Vertical Amplifier must be properly installed in a Tektronix 7000-series mainframe. Installation is explained in the General Information section of this manual.

SIMPLIFIED BLOCK DIAGRAM OF THE 7A42

The 7A42 has six basic functional blocks of circuitry: Attenuators, Amplifiers, Channel Switching, Trigger Threshold Generators, Trigger Comparators and Trigger Logic (see Fig. 2-1).

Each channel (CH1 through CH4) has its own Attenuator, Amplifier, Trigger Threshold Generator, and Trigger Comparator. Impedance matching (50Ω/1MΩ) and gain switching (VOLTS/DIV) are accomplished by the Attenuator. There are two signal outputs from each Attenuator, one signal is applied to the Trigger Comparator and the other to the Amplifier, for each channel.

The Amplifiers provide the signal gain necessary to drive the vertical amplifiers within the host oscilloscope mainframe. The Channel Switching stage provides vertical signal processing to display the channel traces and the Trigger View trace on the mainframe crt. This is accomplished by either chopping between the channels selected for display or by displaying them alternately after each sweep of the time base.

The Trigger Comparator compares the signal from the Attenuator with the voltage of the Trigger Threshold Generator. When the signal from the Attenuator exceeds the Threshold Voltage, the Trigger Comparator produces an output which is applied to the Trigger Logic stage.

The Trigger Logic stage accepts logic levels from the Comparator and compares them with the programmed logic level, of each channel. When the applied input signal(s) conform to the programmed trigger logic conditions, a trigger pulse is produced. The Trigger Logic conditions are user programmed from the front-panel.

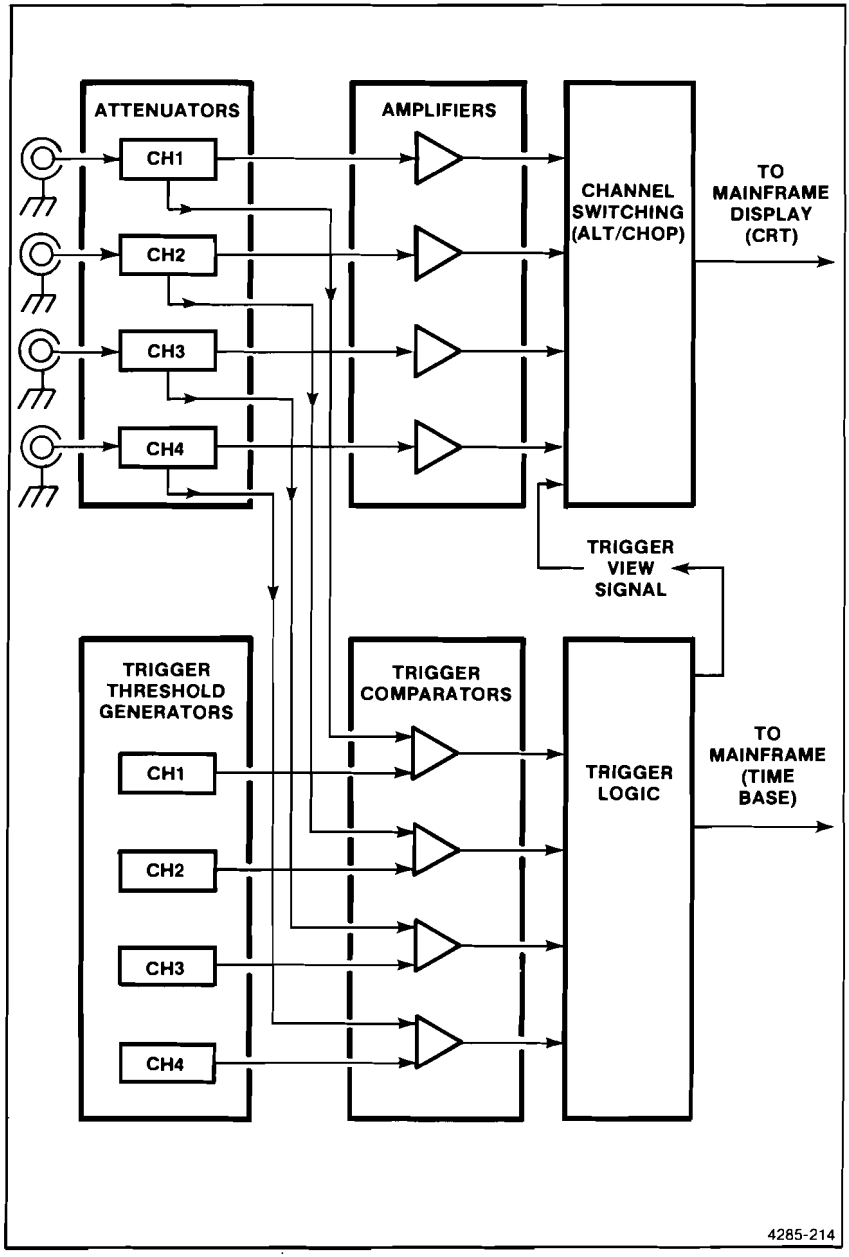


Figure 2-1. Simplified block diagram of the 7A42.

BOOLEAN ALGEBRA FOR 7A42 USE

The basis of digital electronics is the binary number system; ones and zeroes, highs and lows. The most common digital circuit components, inverters and gates, operate on the principles of Boolean algebra. Boolean algebra is a binary algebra with many characteristics similar or analogous to the ordinary algebra we use. Expressions in both algebras consist of variables, constants, and operators.

The 7A42 provides oscilloscope triggering on Boolean or logical combinations of the input signals. The input channels are the variables in the Boolean trigger equation, and the 7A42 supplies the operators as programmed by the user.

The following is a brief review of the basics of Boolean algebra and an introduction to how they apply to the 7A42.

Definition of Boolean logic functions:

1. The dot (•) is used to indicate the AND logical operator. The AND function of two or more variables is sometimes referred to as a product. It is the Boolean equivalent of ordinary multiplication. In some Boolean expressions the dot may be omitted, i.e., A•B=AB.

2. The plus sign (+), indicates the OR logical operator, which is sometimes referred to as a sum (the Boolean equivalent of addition). The AND function has mathematical hierarchy over the OR function as multiplication has over addition, thus the expression W•X+Y•Z would be evaluated as if it were written (W•X)+(Y•Z).

3. A bar over a constant or variable is used to indicate the NOT logical operator. Other words that are sometimes used to describe this operation are invert or complement; $\overline{X}$ is the inverse or complement of X.

4. A common Boolean function comprised of AND, OR, and invert operators is the EXCLUSIVE-OR function, symbolized by a plus sign with a circle around it (⊕). The EXCLUSIVE-OR of variables X and Y is $X•\overline{Y}+\overline{X}•Y$.

The AND, OR, NOT, and XOR (EXCLUSIVE-OR) logic functions are defined in Figure 2-1 for the constants 0 (false) and 1 (true).

AND	OR	NOT	XOR
0•0=0	0+0=0	$\overline{0}$=1	0 ⊕ 0=0
0•1=0	0+1=1	$\overline{1}$=0	0 ⊕ 1=1
1•0=0	1+0=1		1 ⊕ 0=1
1•1=1	1+1=1		1 ⊕ 1=0

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Figure 2-2. Definition of the Boolean AND, OR, NOT and XOR (EXCLUSIVE-OR) logic functions.

5. The following two expressions, known as DeMorgan's Theorem, shows the relationship of the AND, OR and NOT (invert) logic functions to one another. With the use of the invert function, the AND function can be expressed in terms of OR function, and vise versa.

$$X \bullet Y = \overline{(\overline{X} + \overline{Y})}$$

$$X + Y = \overline{(\overline{X} \bullet \overline{Y})}$$

6. AND functions and OR functions can be combined together in one of two equivalent notations, called sum of products and product of sums. The 7A42 trigger function uses the sum of products notation, that is, the OR of two AND functions. DeMorgan's Theorem can be used to convert from one notation to another. An example of the sum of products notation as it relates to the 7A42 is:

$$(CH1 \bullet CH2) + (CH3 \bullet CH4)$$

where CH1, CH2, CH3, and CH4 are the Boolean variables, the two quantities in parantheses (AND functions) are called products, and the two products are "ORed" together to form a sum. Each 7A42 trigger function can consist of up to two products of the four input channels summed together. The products may be formed in any combination from one or all of the input channels. The analog channel input signals become Boolean variables when they are compared to a threshold voltage. If the signal is higher than the threshold, it is true; if lower, it is false. The Boolean variables may be programmed into the trigger function in either their non-inverted (high) or inverted (low) form. A channel input which is not part of the trigger function is considered a "don't care".

Figure 2-3 shows two examples of a user programmed trigger function. In each example, the trigger function is comprised of a logical contribution of input channels 1 through 4.

NOTE

Logic symbols used in the following functional tables are of the positive logic convention and are defined as follows:

H = high level (true or logic "1")

L = low level (false or logic "0")

↑ = transition from low to high level

↓ = transition from high to low level

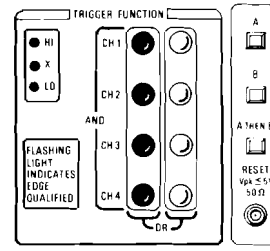
X = irrelevant (any input, including transitions)

⎍ = one high-level pulse

Function f = CH1•CH2•CH3•CH4
Keystroke sequence: CH1 AND CH 2 AND CH3 AND CH4

CH1	CH2	CH3	CH4	Function f
L	L	L	L	L
L	L	L	H	L
L	L	H	L	L
L	L	H	H	L
L	H	L	L	L
L	H	L	H	L
L	H	H	L	L
L	H	H	H	L
H	L	L	L	L
H	L	L	H	L
H	L	H	L	L
H	L	H	H	L
H	H	L	L	L
H	H	L	H	L
H	H	H	L	L
H	H	H	H	H

Front-panel TRIGGER FUNCTION display.



Function g = $\overline{CH1}$•$\overline{CH2}$•CH3•CH4
Keystroke sequence: NOT CH1 AND NOT CH2 AND CH3 AND CH4

CH1	CH2	CH3	CH4	Function g
L	L	L	L	L
L	L	L	H	L
L	L	H	L	L
L	L	H	H	H
L	H	L	L	L
L	H	L	H	L
L	H	H	L	L
L	H	H	H	L
H	L	L	L	L
H	L	L	H	L
H	L	H	L	L
H	L	H	H	L
H	H	L	L	L
H	H	L	H	L
H	H	H	L	L
H	H	H	H	L

Front-panel TRIGGER FUNCTION display.

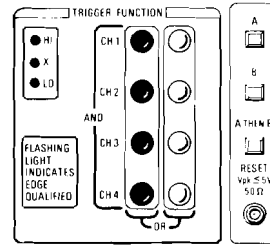


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Figure 2-3. Examples of products of Channel 1 through 4.

Function f = CH1•CH2•CH3•CH4

CH1	CH2	CH3	CH4	Function f
L	L	L	L	L
L	L	L	H	L
L	L	H	L	L
L	L	H	H	L
L	H	L	L	L
L	H	L	H	L
L	H	H	L	L
L	H	H	H	L
H	L	L	L	L
H	L	L	H	L
H	L	H	L	L
H	L	H	H	L
H	H	L	L	L
H	H	L	H	L
H	H	H	L	L
H	H	H	H	H

Function g = $\overline{CH1}$•$\overline{CH2}$•CH3•CH4

CH1	CH2	CH3	CH4	Function g
L	L	L	L	L
L	L	L	H	L
L	L	H	L	L
L	L	H	H	H
L	H	L	L	L
L	H	L	H	L
L	H	H	L	L
L	H	H	H	L
H	L	L	L	L
H	L	L	H	L
H	L	H	L	L
H	L	H	H	L
H	H	L	L	L
H	H	L	H	L
H	H	H	L	L
H	H	H	H	L

OR

Function f + g = (CH1•CH2•CH3•CH4) + ($\overline{CH1}$•$\overline{CH2}$•CH3•CH4)
Keystroke sequence: CH1 AND CH2 AND CH3 AND CH4 OR → NOT CH1 AND NOT CH2 AND CH3 AND CH4

Function f	Function g	Function f + g
L	L	L
L	H	H
H	L	H

Front-panel TRIGGER FUNCTION display.

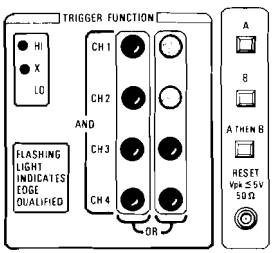

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Figure 2-4. Function f and g OR'ed together.

If the first example of Figure 2-3 (function *f*) were programmed into the first column (product) of the 7A42 TRIGGER FUNCTION display and the second example of Figure 2-3 (function *g*) into the second, the TRIGGER FUNCTION would be the sum of the two products as shown in Figure 2-4.

The 7A42 has a feature called EDGE sensitivity. Though a departure from pure Boolean logic, this feature adds additional triggering flexibility by allowing the synthesis of additional digital circuit components such as flip-flops. Any product (AND function) in the trigger function can be programmed to have a single rising or falling EDGE-sensitive channel. That EDGE-sensitive channel will then qualify the product only at the selected (rising or falling) EDGE-sensitive channel transition. Figure 2-5 shows a simple example of a product consisting of CH1 and CH2, where CH2 is selected to be rising-edge sensitive.

Function *f* = CH1•↑CH2
Keystroke sequence: CH1 AND EDGE CH2

CH1	CH2	Function *f*
L	L	L
L	↑	L
L	H	L
L	↓	L
H	L	L
H	↑	⎍
H	H	L
H	↓	L

Front-panel TRIGGER FUNCTION display.

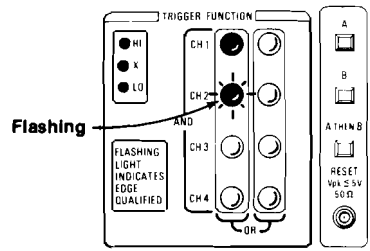

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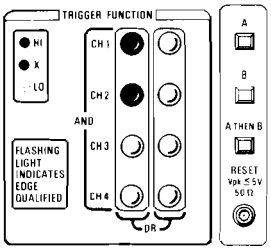
Figure 2-5. Example of EDGE Qualified TRIGGER FUNCTION.

Another 7A42 feature is nested triggering. One Boolean function programmed into the 7A42's "function A" can be set to arm the trigger circuitry, after which another Boolean function programmed into "function B" can become the trigger event. Without being previously armed by function A going true, an occurrence of function B will not cause a trigger output pulse. Figure 2-6 illustrates the A THEN B nested triggering mode.

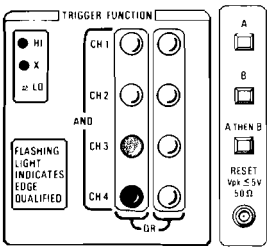
TRIGGER FUNCTION A
f_a = **CH1•CH2**
Keystroke sequence:
CH1 AND CH2

Front-panel TRIGGER FUNCTION A display.



TRIGGER FUNCTION B
f_b = **$\overline{\text{CH3}}$•CH4**
Keystroke sequence:
NOT CH3 AND CH4

Front-panel TRIGGER FUNCTION B display.



CH1	CH2	CH3	CH4	f_a
L	L	X	X	L
L	H	X	X	L
H	L	X	X	L
H	H	X	X	H

THEN

CH1	CH2	CH3	CH4	f_b
X	X	L	L	L
X	X	L	H	H
X	X	H	L	L
X	X	H	H	L

RETURN

NESTED TRIGGER Out

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Figure 2-6. Example of A THEN B Nested Triggering.

CONTROLS, CONNECTORS, AND INDICATORS

All controls, connectors, and indicators required for the normal operation of the 7A42 Logic Triggered Vertical Amplifer unit are located on the front panel. Figure 2-7 shows an exploded front panel and gives a brief functional description of each control, connector, and indicator.

Foldout for Front-panel controls, connectors, and indicators Figure 2-7

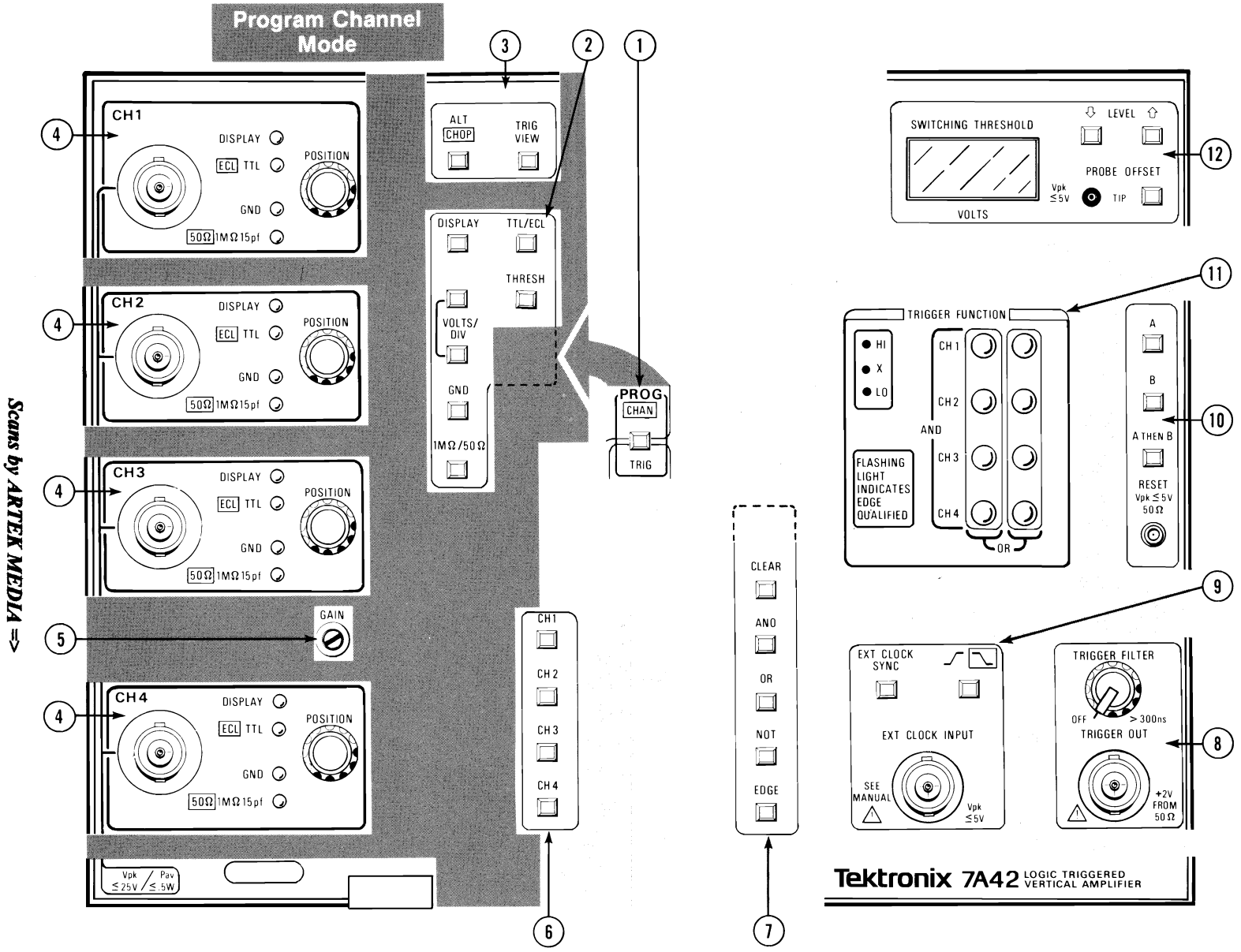

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Figure 2-7. 7A42 controls, connectors, and indicators.

(1) **PROG CHAN or TRIG**—Pushbutton selects one of two modes; when light is on, those controls associated with programming the TRIGGER FUNCTION are operable (see **6**, **7** and **10**). When light is out, those controls associated with CH1, CH2, CH3, CH4 setup conditions are operable (see **6** and **2**).

(2) **DISPLAY**—Pushbutton turns on or off the display of the incoming signal selected by controls listed under number **6**[1]. Nondisplayed channels may still contribute to the TRIGGER FUNCTION.

VOLTS/DIV—Two pushbutton switches increase or decrease vertical deflection factor of the channel selected by controls listed under number **6**[1].

GND—Pushbutton grounds the selected channel amplifier input and disconnects the incoming signal, of the channel selected by controls listed under number **6**[1].

1MΩ/50Ω—Pushbutton switch selects input impedance to be either one megohm or 50 ohms of the channel selected by controls listed under number **6**[1].

TTL/ECL—Pushbutton switch selects the deflection factor range and preset threshold to be compatible with either TTL or ECL logic families of the channel selected by controls listed under number **6**[1].

THRESH—Pushbutton switch activates the LEVEL pushbuttons and SWITCHING THRESHOLD VOLTS display, allowing operator to set the threshold voltage of the channel selected by controls listed under number **6**[1].

(3) **ALT/CHOP**—Pushbutton switch, determines whether the displayed channel(s) are displayed alternately, after each sweep of the time base, or are displayed simultaneously in a chopped mode.

TRIG VIEW—Pushbutton to display TRIGGER FUNCTION output signal or EXT CLOCK signal on crt.

[1]**PROG CHAN/TRIG must be set to CHAN.**

(4) The following controls, connectors, and indicators are common to CH1, CH2, CH3, and CH4.

Input Connector—Bnc for signal connection.

POSITION—Vertically positions the incoming signal. Clockwise rotation moves displayed trace upward.

DISPLAY—When DISPLAY indicator light is on, channel is selected for display.

ECL/TTL—When indicator light is on the preset threshold voltage and range of deflection factors are compatible with TTL logic levels; when off they are compatible with ECL Logic levels.

GND—When indicator light is on, the amplifier input is grounded and the input signal is electrically disconnected from the amplifier.

50Ω/1MΩ—When indicator light is on, the input impedance is one megohm, 15 picofarads; when off, input impedance is 50Ω.

(5) **GAIN**—Screwdriver control adjusts display gain of channels CH1, CH2, CH3, and CH4.

(6) **CH1, CH2, CH3, and CH4**—Operate in either the PROG CHAN or the PROG TRIG modes. In the PROG CHAN mode the self-cancelling pushbutton switches determine which channel is affected by the controls listed under number **2**[1]. In the PROG TRIG mode the CH1 through CH4 pushbutton switches determine which channel is programmed into the TRIGGER FUNCTION, as selected by the controls listed under number **10**[2].

(7) **CLEAR**—Pushbutton switch clears the programmed TRIGGER FUNCTION selected by the controls listed under **10**[2].

AND, OR, NOT—Pushbutton switches used with controls listed under number **6** to program the TRIGGER FUNCTION selected by the controls listed under **10**[2].

EDGE—Pushbutton selects edge sensitivity for the channel being programmed into the TRIGGER FUNCTION[2].

[1]**PROG CHAN/TRIG must be set to CHAN.**
[2]**PROG CHAN/TRIG must be set to TRIG.**

(8) **TRIGGER FILTER**—Variable control sets minimum duration of TRIGGER FUNCTION output before it is sent to the time base or TRIGGER OUTput connector.

TRIGGER OUT—Provides a front-panel output of the trigger signal.

(9) **EXT CLOCK INPUT**—Provides external clock input for synchronizing triggers to an external clock signal source (EXT CLOCK SYNC light must be on).

EXT CLOCK SYNC—Pushbutton switch allows an external clock to qualify the TRIGGER FUNCTION.

⌐⌙—Pushbutton switch selects positive going or negative going edge of the external clock signal which qualifies TRIGGER FUNCTION.

(10) **A, B, A THEN B**—Two independent TRIGGER FUNCTION programs are available (A and B). The A THEN B is a nested combination where A must occur to arm triggering before B is allowed to produce a trigger output.

RESET—External input to disable the TRIGGER FUNCTION output and disarm the A THEN B nested triggering; no arming or triggering can occur while a high level is applied.

(11) **TRIGGER FUNCTION**—LED display indicates the Boolean function which will produce a TRIGGER FUNCTION output. Number **6**, **7**, and **10** controls are used to program TRIGGER FUNCTION lights[2].

(12) **SWITCHING THRESHOLD VOLTS**—LED display indicates threshold voltage of the channel selected by controls listed under number **6** or displays probe offset[3].

LEVEL—Two pushbutton switches set threshold voltage of channel selected by the controls listed under number **6**[3].

PROBE OFFSET—Measures offset voltage of probe connected to the channel selected by controls listed under number **6**[3].

[1]**PROG CHAN/TRIG must be set to CHAN.**
[2]**PROG CHAN/TRIG must be set to TRIG.**
[3]**PROG CHAN/TRIG must be set to CHAN, and THRESH must be active.**

GET-ACQUAINTED EXERCISES

These Get-Acquainted Exercises will help you become familiar with the operation of your 7A42 and at the same time, check basic instrument operation. The Get-Acquainted Exercises are divided into three parts: Exercise 1—Preliminary Set Up and Initialization, Exercise 2—Obtaining a Triggered Display, and Exercise 3—Logic Triggering.

NOTE

When power is applied to the 7A42 an automatic self test will be performed. After the self test is complete the display 7A42 TEST COMPLETE will appear on the crt for approximately 1 second. If a 7A42 TEST BUSY message remains in the crt display, see the discussion Self-Test Failure Messages, in this section under Detailed Operating Information.

EXERCISE 1
PRELIMINARY SET UP AND INITIALIZATION

This exercise describes proper installation of the 7A42 into a compatible oscilloscope mainframe, exercises the self-test sequence and initializes the front-panel control settings.

PRELIMINARY SET UP

Perform the following procedure to install and power up the 7A42.

a. Install the 7A42 in the left two vertical compartments of a Tektronix 7000-series oscilloscope mainframe (e.g., 7104, 7904A).

b. Set the oscilloscope Vertical Mode to Left.

c. Install a time-base unit in one of the two horizontal compartments and set the oscilloscope mainframe Horizontal Mode for the appropriate time base (A or B).

d. Set the time-base triggering to +Slope, Auto Mode with DC Coupling from the Internal Source and the Level control to midrange.

e. Set the time-base Time/Division to 1 millisecond.

f. Set the appropriate oscilloscope mainframe Trigger Source (A or B) to Left Vert.

g. Turn the oscillsocope mainframe Power on.

NOTE

Bold numbers are used as an aid to perform these exercises. The number refers an instruction to an illustration. The same numbers can be found in both the text and corresponding illustrations, with an arrow pointing to a control, indicator or crt display that has been mentioned in the text.

INITIALIZATION

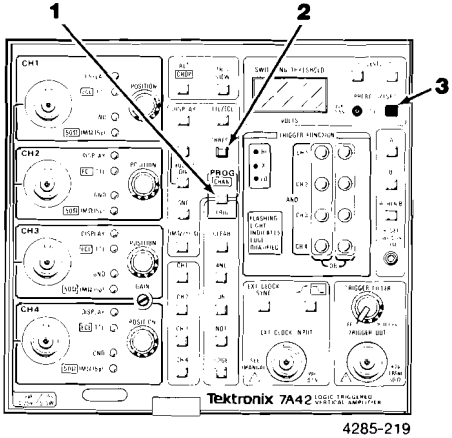
After completion of the 7A42 installation and power-up self-test sequence the next step is to initialize the 7A42 front-panel settings.

To initialize the 7A42 front-panel controls to a known state, perform the following procedure:

a. Set the PROG pushbutton **1** to the CHAN mode (pushbutton light out).

b. Press the THRESH pushbutton **2** so that the pushbutton light is on (Threshold Mode).

c. Press the PROBE OFFSET pushbutton **3** until it illuminates red (Acquire Mode).



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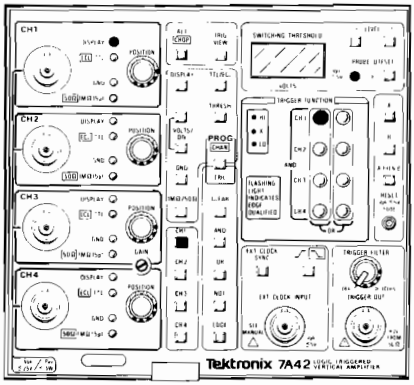
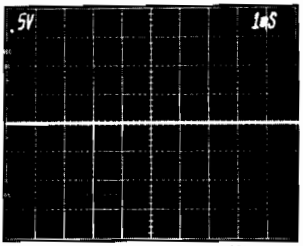
d. Turn the oscilloscope mainframe Power off and then on again.

e. After the self test is completed, the 7A42 front-panel status indicators and control lights should be as shown below.





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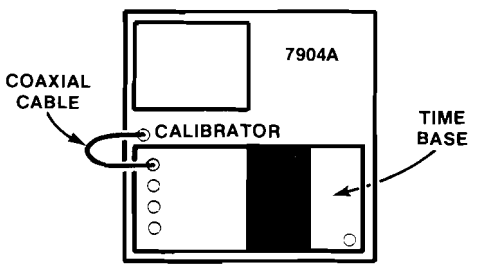
EXERCISE 2
OBTAINING A TRIGGERED DISPLAY

This exercise demonstrates basic triggering from a single oscilloscope calibrator signal. A demonstration of the 7A42 front-panel GAIN adjustment and how to obtain a triggered display on each of the four channels is also given.

NOTE

If continuing from Exercise 1, proceed with Exercise 2. If not, first perform Exercise 1 then proceed.

Now that the 7A42 is properly installed and initialized, begin this exercise by performing the setup conditions as shown below:

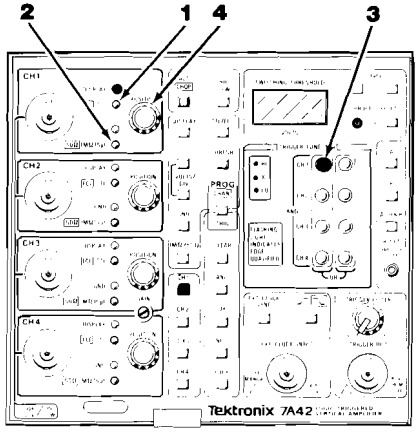


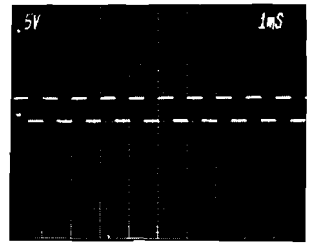
CALIBRATOR ..... 0.4 V 1kHz
TIME BASE
TIME/DIV ..... 1 mS
TRIGGERING
MODE ..... AUTO
COUPLING ..... DC
SOURCE ..... INT
SLOPE ..... POSITIVE
LEVEL ..... CENTERED
B DELAY MODE ..... INDEPENDENT
MAG X1
HOLDOFF ..... MIN

4285-220

As can be seen from the CH1 status indicators, CH1 has been previously initialized to TTL **1** and 1 MΩ 15 pf input **2**. Observe that the TRIGGER FUNCTION has been set to trigger on a HI level of CH1 **3**.

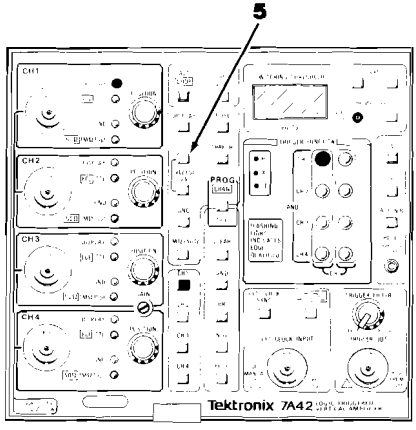
Rotate the CH1 POSITION control **4** to move the triggered display to the center of the crt.

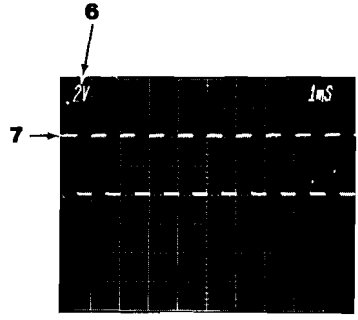




4285-221

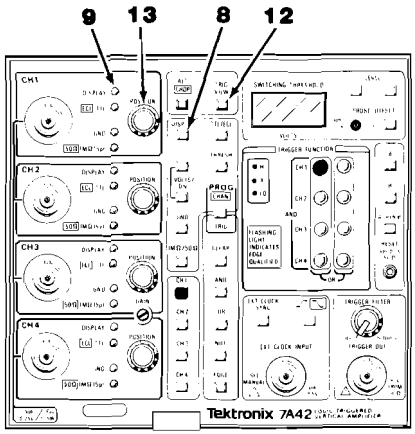
Press the upper VOLTS/DIV pushbutton **5** once to obtain a 0.2 V deflection factor as displayed on the crt readout **6**. Note that the CH1 waveform amplitude increased **7**.

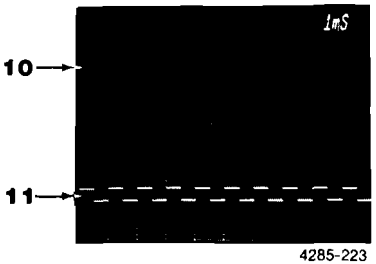




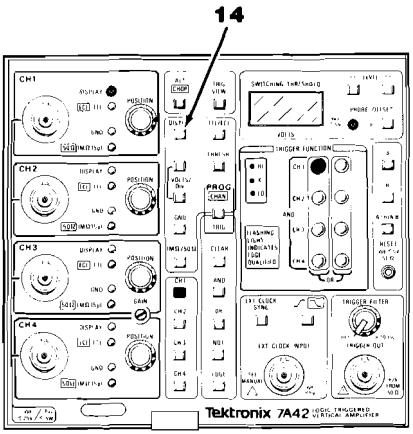
4285-222

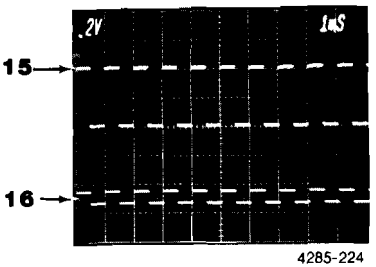
Now press the DISPLAY pushbutton **8**, note that the CH1 DISPLAY indicator **9** extinguishes and that the channel 1 waveform **10** is no longer displayed on the crt. The trigger view trace **11** is now displayed at the bottom of the crt (TRIG VIEW pushbutton is illuminated **12**). Rotate the CH1 POSITION control **13** and notice that it has no affect on the trigger view display **11**. Set the CH1 POSITION control **13** to midrange.



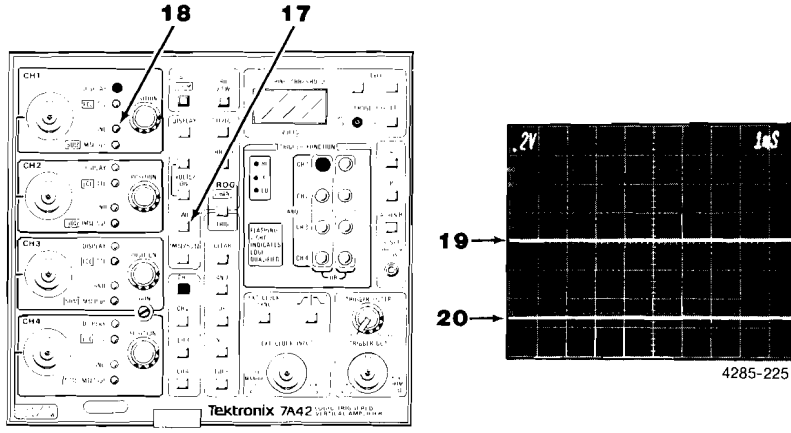


Press the DISPLAY pushbutton **14** and observe that the CH1 trace **15** is again displayed and that the TRIG VIEW trace **16** remains displayed at the bottom of the crt.

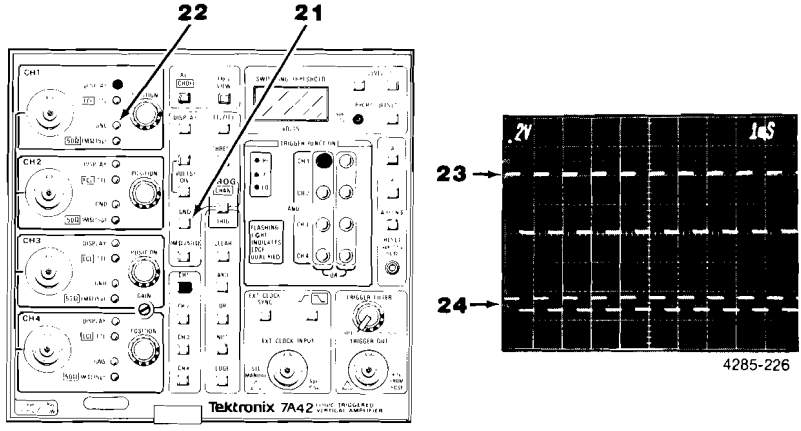




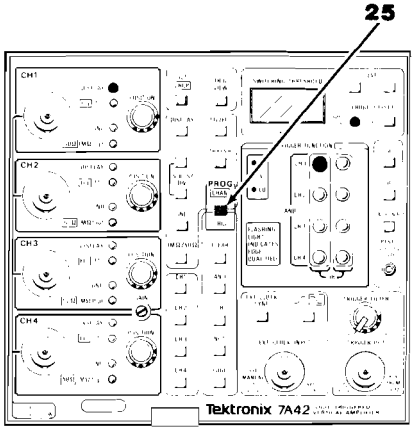
Press the GND pushbutton **17**. Notice that the CH1 GND indicator **18** is illuminated and that the CH1 waveform **19** and TRIG VIEW waveform **20** are replaced by a baseline trace (the CH1 input is now referenced to ground).

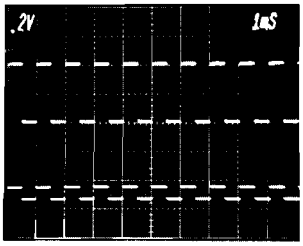


Press the GND pushbutton **21** again. The CH1 GND indicator **22** is now extinguished and the baseline traces are replaced by the CH1 waveform **23** and the trigger view waveform **24**.



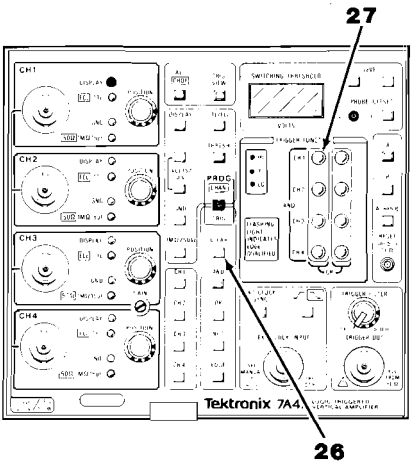
Press the PROG pushbutton **25**. The pushbutton light is now green which indicates that the PROG TRIG (Program Trigger) mode has been selected.

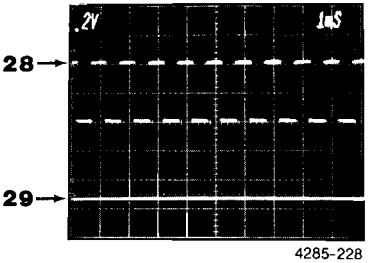




4285-227

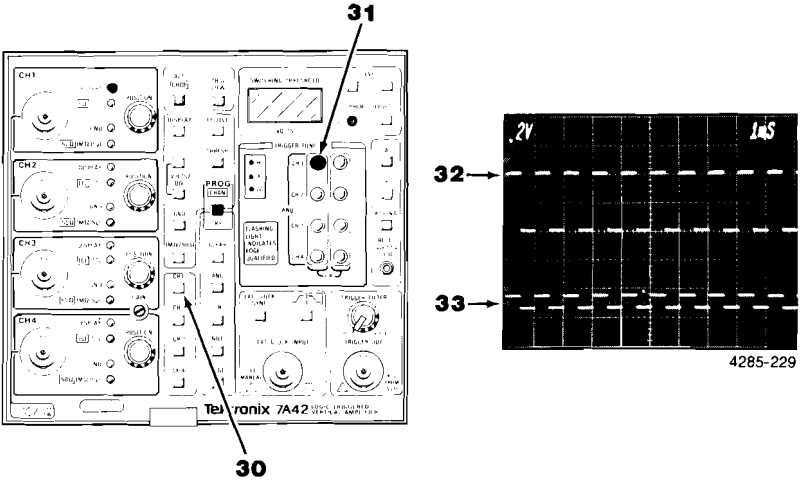
Press the CLEAR pushbutton **26** and notice that the CH1 TRIGGER FUNCTION indicator **27** extinguishes, the CH1 display **28** free-runs (is not triggered), and the TRIG VIEW waveform **29** disappears. This happens because there is no trigger function programmed so the time-base unit does not receive a trigger signal.



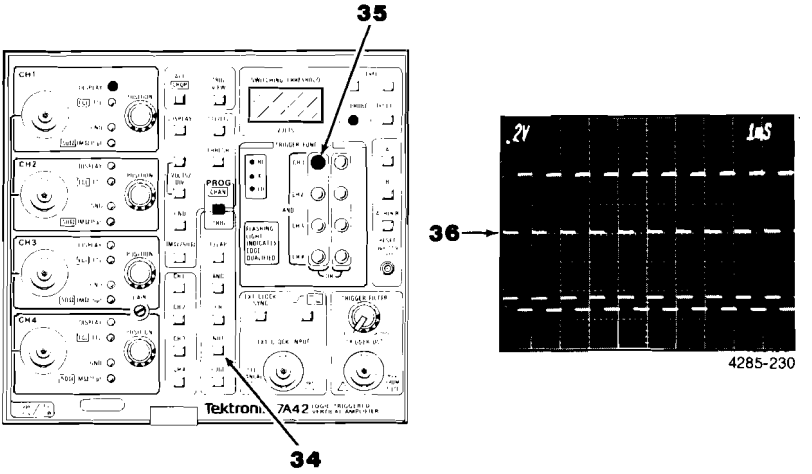


4285-228

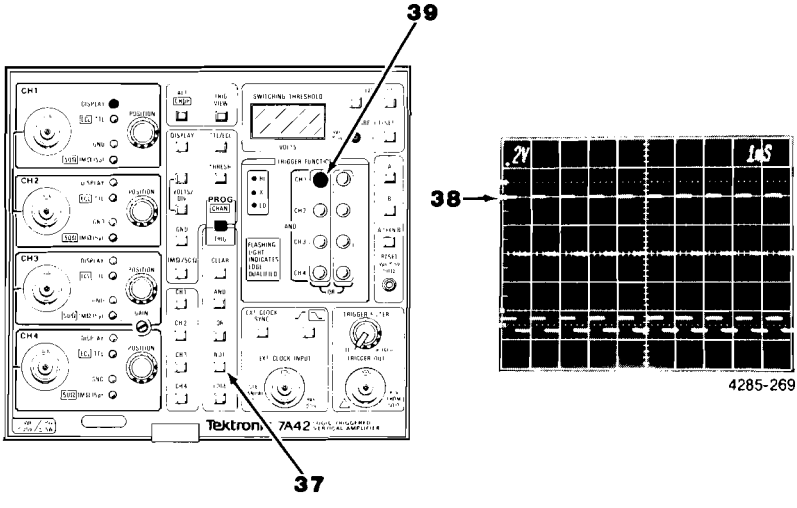
Press the CH1 pushbutton **30**. The CH1 TRIGGER FUNCTION indicator **31** is now red (indicating an active HI trigger level). Both the CH1 waveform **32** and the TRIG VIEW waveform **33** are again triggered.



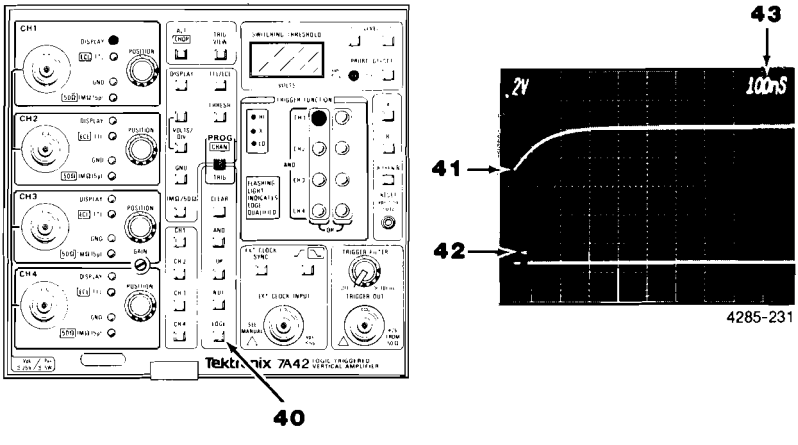
Press the NOT pushbutton **34**. Notice that the CH1 TRIGGER FUNCTION light **35** is now green, and that the CH1 display **36** is triggered on the LO level of the CH1 signal. The TRIG VIEW display is HI (true) when CH1 is LO (false).



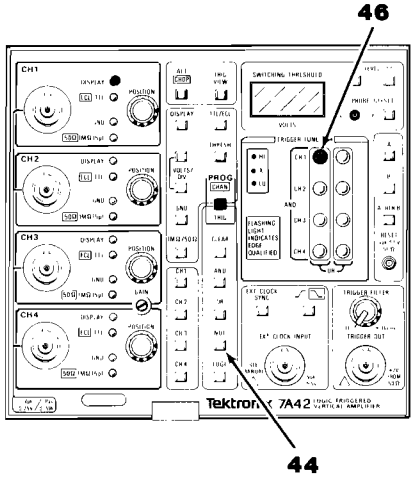
Press the NOT pushbutton **37**. Notice that the display is triggered on the CH1 HI level **38**, and the CH1 TRIGGER FUNCTION indicator is red **39** (two presses of the NOT pushbutton cancel each other).



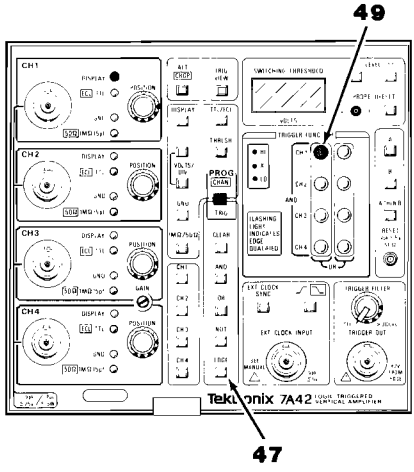
Set the time-base Time/Division to 100 ns and rotate the oscilloscope Intensity control clockwise to view the trace. Press the EDGE pushbutton **40**. Notice that the CH1 TRIGGER FUNCTION light is flashing (to indicate edge qualified triggering) and that the display is triggered on the rising edge of CH1 **41**. A slight adjustment of the time-base Trigger Level control may be necessary to obtain a triggered display. Notice that a narrow TRIG VIEW pulse **42** corresponding to the rising edge of the CH1 waveform can be observed with the time-base Time/Div control set to 100 ns/div **43**.



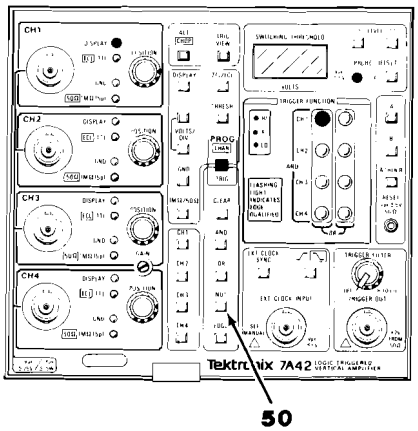
Press the NOT pushbutton **44**, the display is now triggered on the falling edge of CH1 **45** and the CH1 TRIGGER FUNCTION indicator **46** is now flashing green.

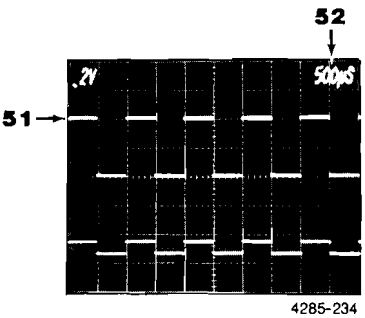


Press the EDGE pushbutton **47**, the display is now triggered on the LO level of CH1 **48**. The CH1 TRIGGER FUNCTION indicator **49** is no longer flashing (two presses of the EDGE pushbutton cancel one another).

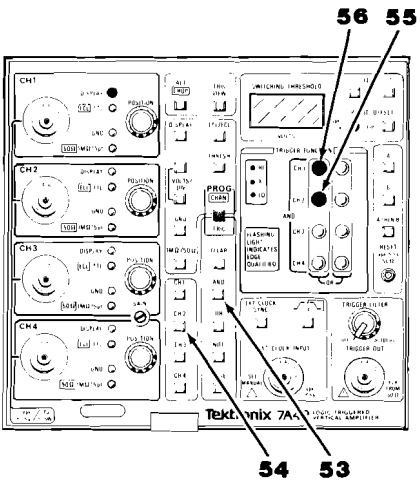


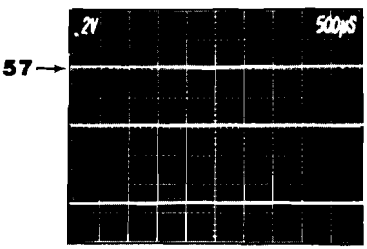
Press the NOT pushbutton **50** to return the display triggering to the HI level of CH1 **51**. Set the time-base Time/Div control to 500 μs **52**.



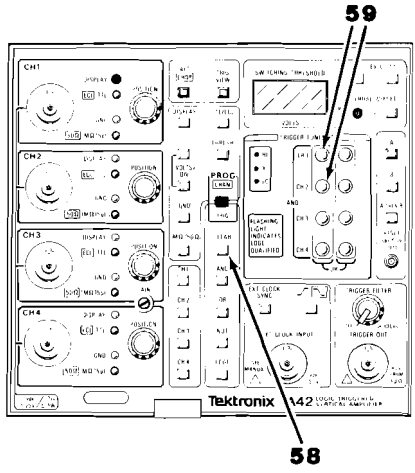


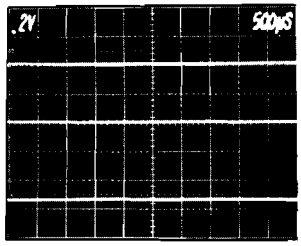
Press the AND pushbutton **53**, then press the CH2 pushbutton **54** and notice that the CH2 TRIGGER FUNCTION indicator **55** illuminates red (CH1 **56** remains red). Notice also that the CH1 display is not triggered **57**. This is because the TRIGGER FUNCTION requirements (CH1 AND CH2 simultaneously HI) are not met and therefore the time-base unit does not receive a trigger signal.





Press the CLEAR pushbutton **58** (the CH1 and CH2 TRIGGER FUNCTION indicators **59** extinguish).

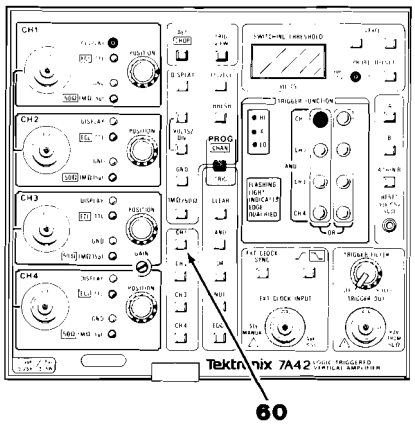


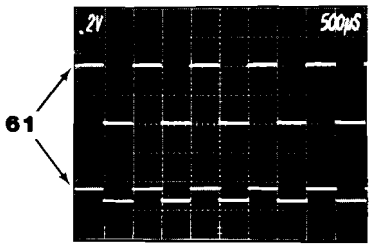


4285-236

Press the CH1 pushbutton **60**.

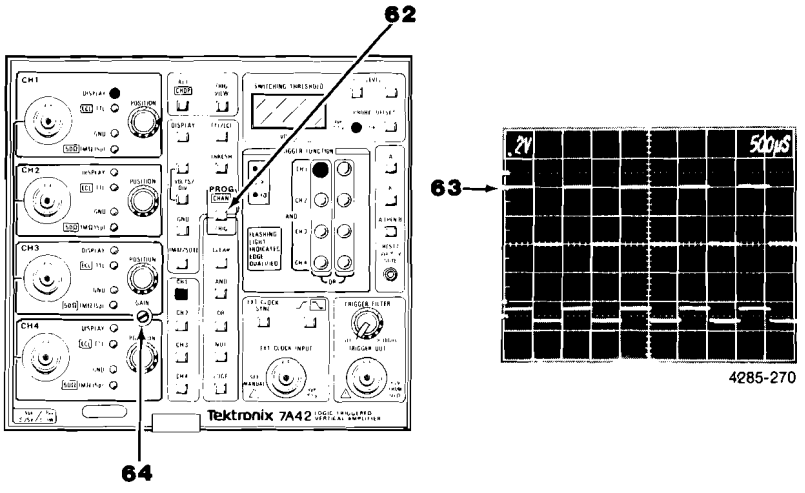
The TRIGGER FUNCTION requirements are now met and the CH1 display is again triggered **61**.



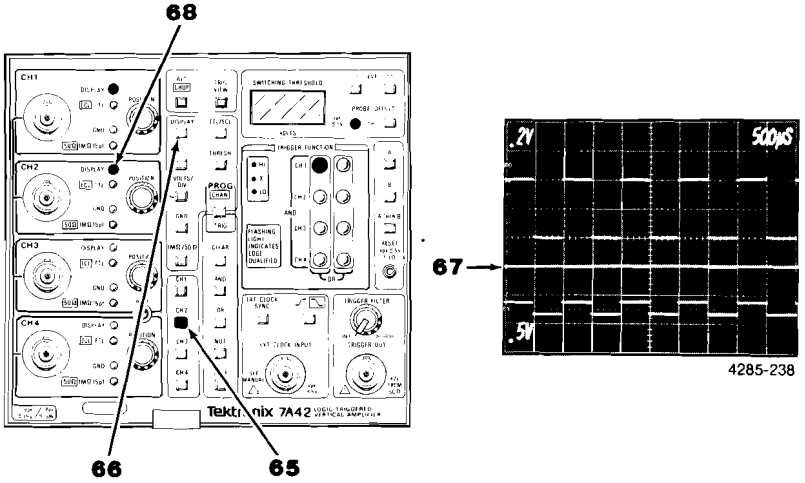


4285-237

Press the PROG pushbutton **62** for the PROG CHAN mode (pushbutton light out). Check the CH1 display for a 2 division square-wave signal **63**. If necessary adjust the 7A42 GAIN **64** (front-panel screwdriver adjustment) for exactly 2 divisions of display (position display as necessary).



Select CH2 for display by first pressing the CH2 pushbutton **65** and then pressing the DISPLAY pushbutton **66**. Observe the CH2 base-line trace **67** (position as necessary). The CH2 DISPLAY indicator **68** is illuminated red.

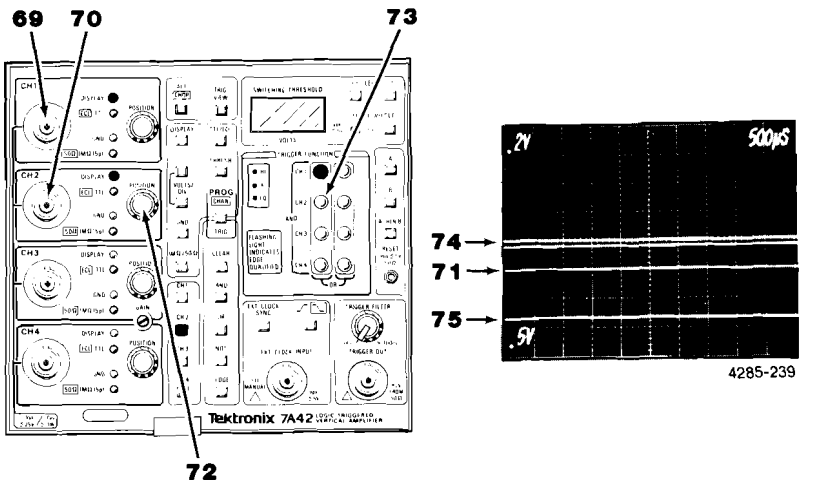


Move the oscilloscope calibrator signal from the CH1 input connector **69** to the CH2 input connector **70**.

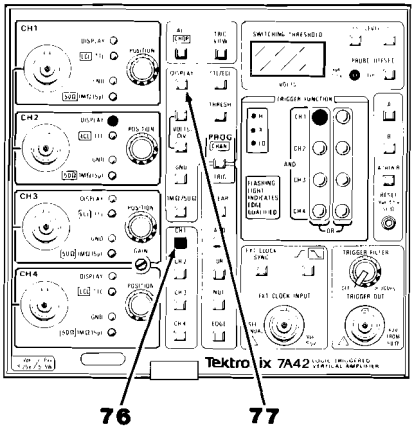
Notice that the square-wave display **71** is free-running (not triggered). Rotate the CH2 POSITION control **72** and notice that the square wave is displayed on CH2. The CH2 display **72** is free-running because there is no TRIGGER FUNCTION **73** selected for CH2 and therefore the time-base unit does not receive a trigger signal.

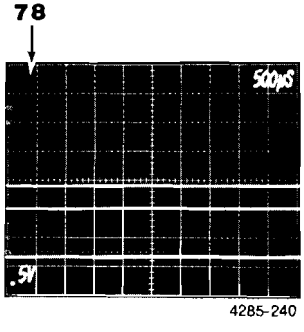
A base-line trace is now displayed **74** for CH1. The base-line trace is displayed on the crt because there is no longer a signal applied to the CH1 input connector.

Observe that the TRIG VIEW trace waveform is no longer displayed **75**, because there is no longer a true TRIGGER FUNCTION, and therefore the time-base unit does not receive a trigger signal.



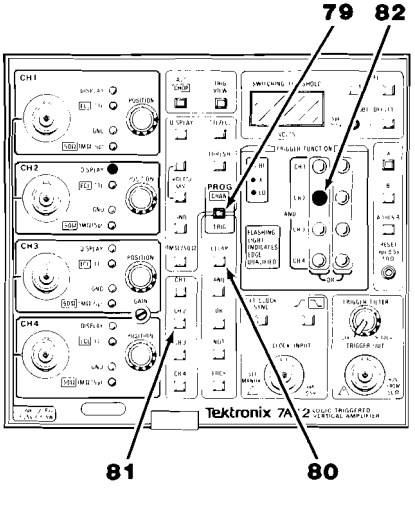
To remove the CH1 trace from the crt display first press the CH1 pushbutton **76** and then press the DISPLAY pushbutton **77**. Observe that the CH1 trace and deflection factor readout **78** are no longer displayed.

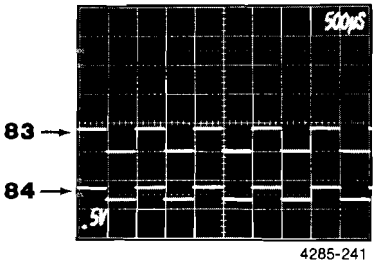




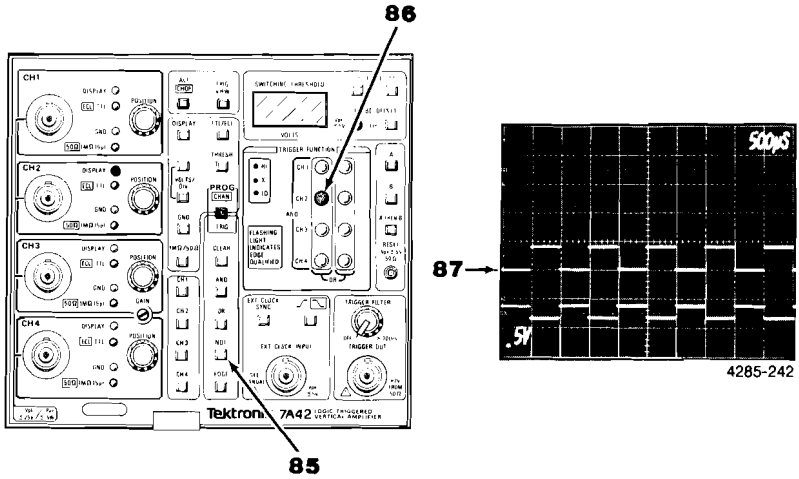
To set the TRIGGER FUNCTION requirements for CH2 first, select the Program Trigger mode by pressing the PROG pushbutton **79** so that it is lit green. Press the CLEAR pushbutton **80**, and then the CH2 pushbutton **81**.

Notice that the only TRIGGER FUNCTION indicator illuminated is CH2 **82** and that the CH2 display **83** is triggered. The TRIG VIEW waveform is also displayed **84**.

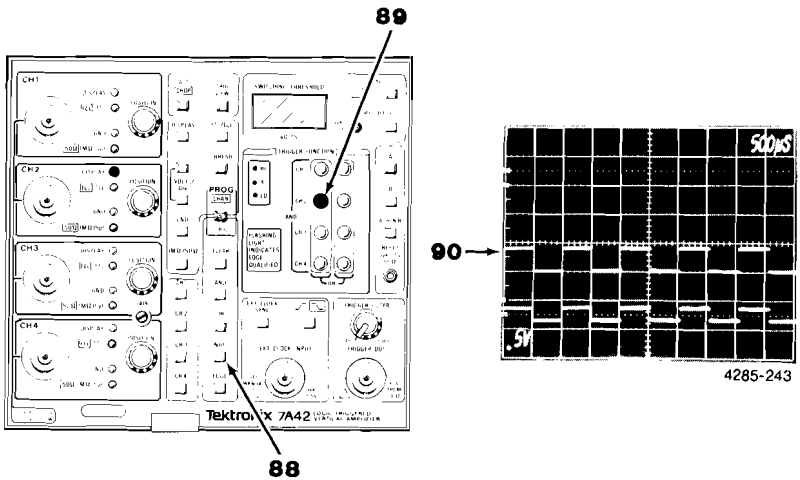




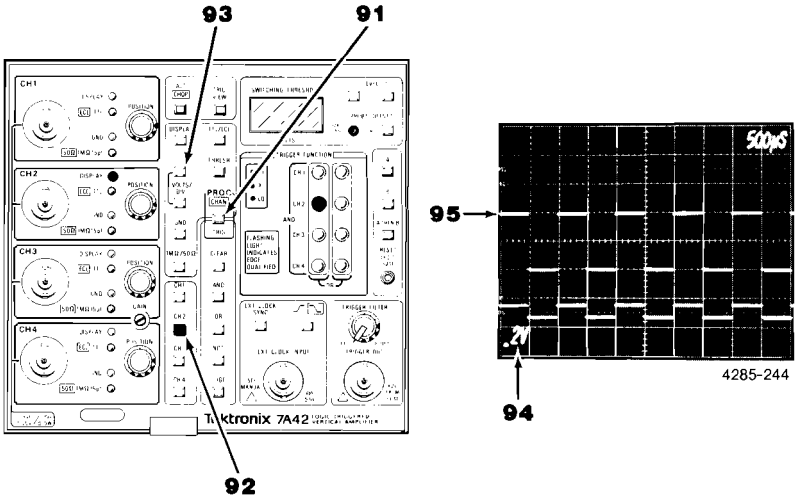
Press the NOT pushbutton **85** and notice that the TRIGGER FUNCTION CH2 indicator **86** is green (green TRIGGER FUNCTION indicator denotes an active LO trigger level). Notice that the CH2 display **87** is triggered on the LO level of the calibrator signal.



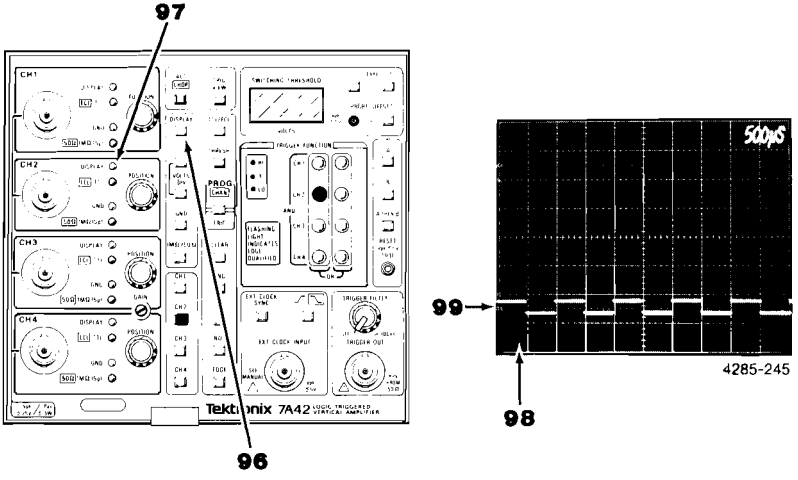
Press the NOT pushbutton **88** again and observe that the TRIGGER FUNCTION CH2 indicator **89** is red and that the channel 2 display **90** is triggered on the HI level of the calibrator signal.



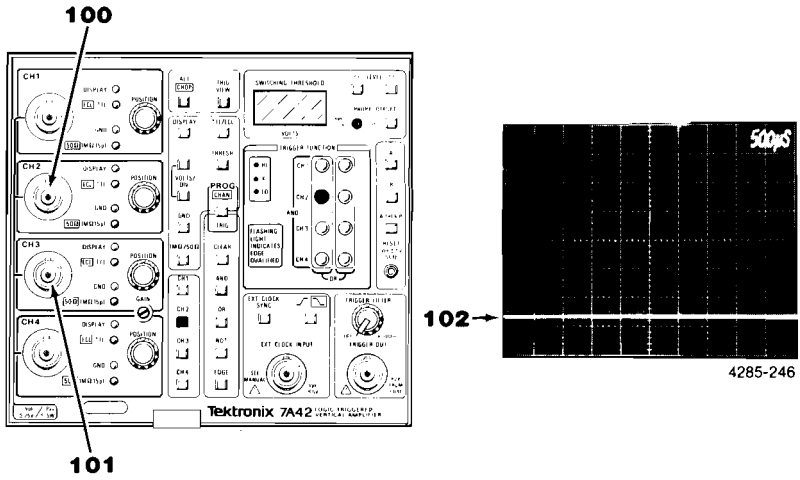
To set the vertical deflection factor of CH2, select the Program Channel Mode by pressing the PROG pushbutton **91** so that the pushbutton light is extinguished, then press the CH2 pushbutton **92**. Press the upper VOLTS/DIV pushbutton **93** once for a deflection factor of 0.2V as displayed on the crt readout **94**. Check the CH2 display for a 2 division square-wave display **95**.



To remove the CH2 display from the crt press the DISPLAY pushbutton **96**. Notice that the CH2 DISPLAY indicator **97** extinguishes and the CH2 deflection factor readout **98** is no longer displayed. Also notice that the TRIG VIEW trace **99** indicates that a trigger is still being produced. This is because even though CH2 is not displayed, the signal is still applied to the TRIGGER FUNCTION circuitry.

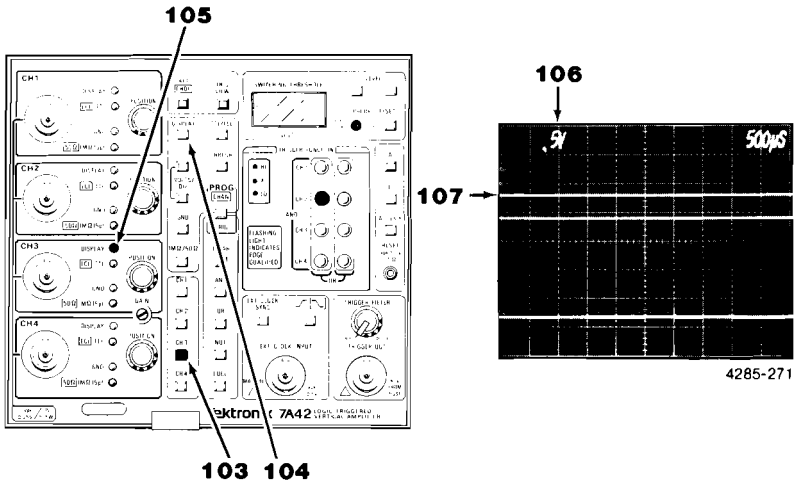


Move the oscilloscope calibrator signal from the CH2 input connector **100** to the CH3 input connector **101**. Notice that the TRIG VIEW waveform **102** is no longer displayed.

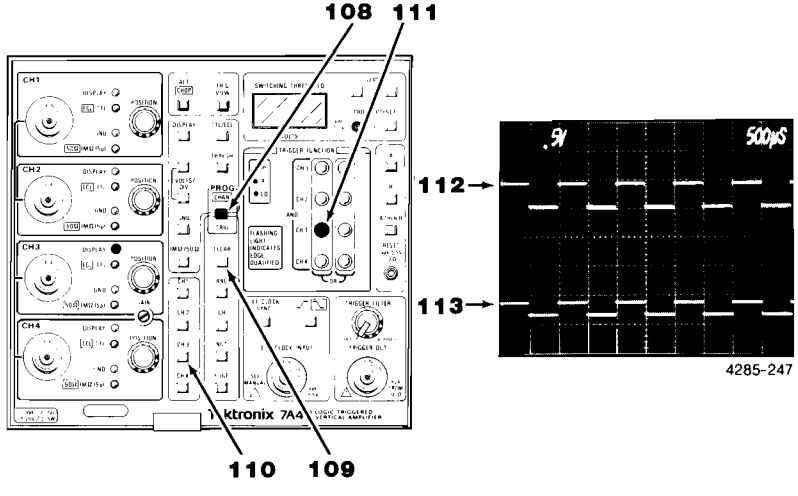


Select CH3 for display by first pressing the CH3 pushbutton **103** and then the DISPLAY pushbutton **104**.

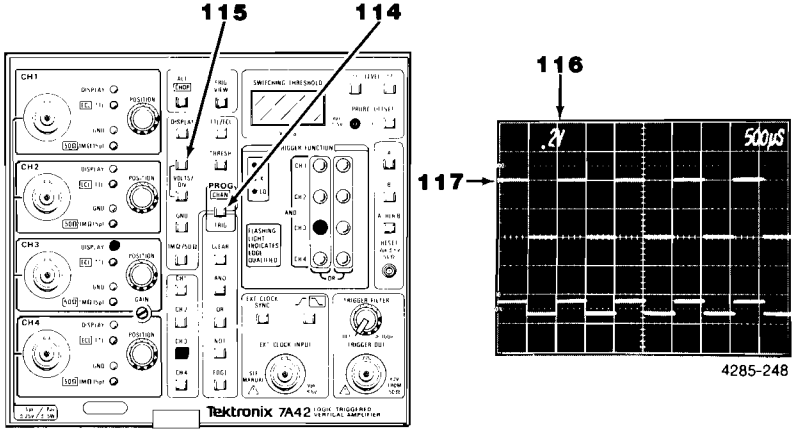
Notice that the CH3 DISPLAY indicator **105** is illuminated (red) and that the CH3 deflection factor readout **106** is displayed on the crt. Observe that the CH3 display **107** is not triggered. This happens because no TRIGGER FUNCTION requirements are programmed for CH3.



To set TRIGGER FUNCTION requirements for CH3, select the Program Trigger mode by pressing the PROG pushbutton **108** so that the pushbutton light is green. Remove the CH2 TRIGGER FUNCTION by pressing the CLEAR pushbutton **109**. Now, press the CH3 pushbutton **110**. Notice that the CH3 TRIGGER FUNCTION indicator **111** illuminates red. Notice that the CH3 display **112** is triggered, and that a TRIG VIEW signal **113** is displayed.



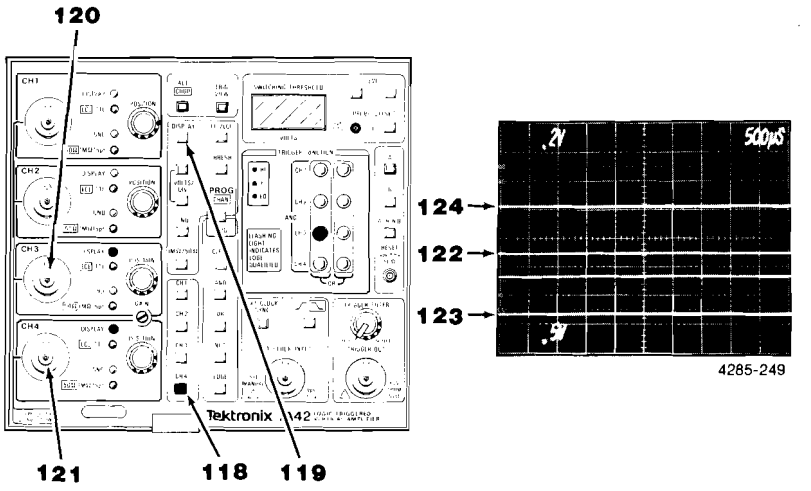
Change the vertical deflection factor of CH3 by selecting the Program Channel mode (press the PROG pushbutton **114** so that the pushbutton light is extinguished). Press the upper VOLTS/DIV pushbutton **115** once so that 0.2V is displayed on the crt readout **116**. Check the CH3 trace **117** for a 2 division display.



To display Channel 4, press the CH4 pushbutton **118** and then press the DISPLAY pushbutton **119**.

Move the oscilloscope calibrator signal from the CH3 input connector **120** to the CH4 input connector **121**.

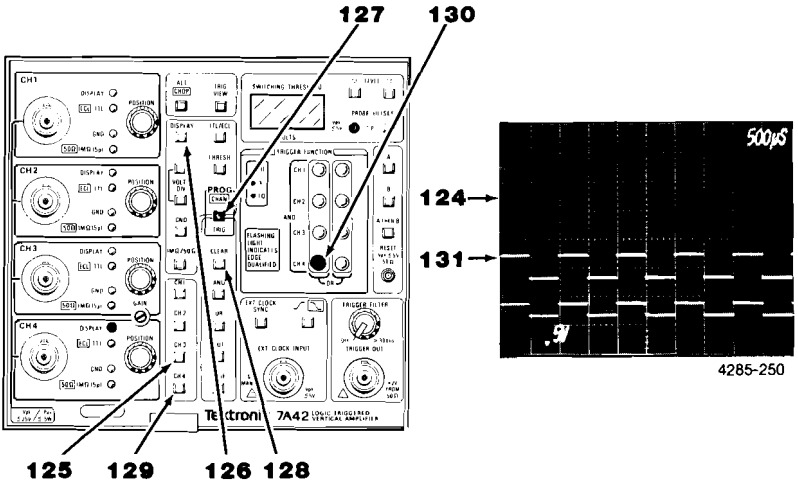
Observe that the channel 4 display **122** is not triggered. The CH4 display is not triggered because no TRIGGER FUNCTION requirements have been selected for CH4 and therefore no signal is displayed on the TRIG VIEW trace **123**. Notice that because there is no longer a signal applied to CH3, there is no longer a signal displayed on the CH3 trace **124**.



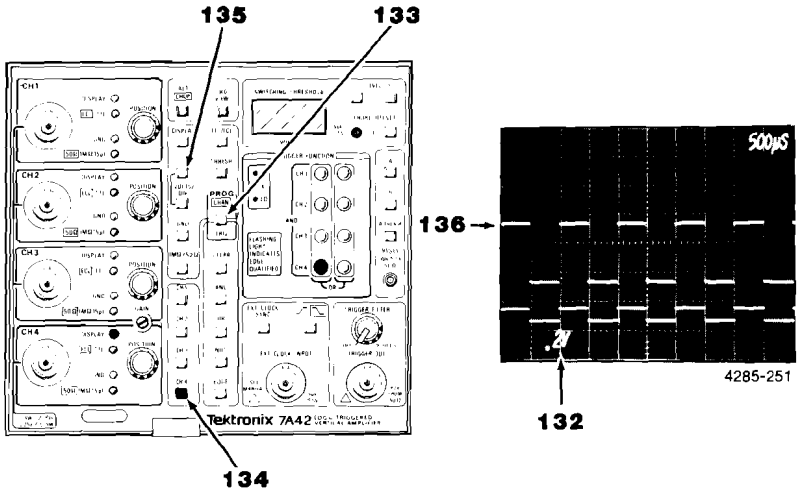
To remove the CH3 trace **124** from the crt display, first press the CH3 pushbutton **125** and then press the DISPLAY pushbutton **126**.

To set TRIGGER FUNCTION requirements for CH4 press the PROG pushbutton **127** (Program Trigger mode). Then remove the CH3 TRIGGER FUNCTION by pressing the CLEAR pushbutton **128**. Now press the CH4 pushbutton **129**.

Notice the the CH4 TRIGGER FUNCTION indicator **130** is red (HI) and that the CH4 square-wave display is triggered **131**.



To change the CH4 vertical deflection factor **132**, press the PROG pushbutton **133** so that the light is extinguished. Press the CH4 pushbutton **134**, and then press the upper VOLTS/DIV pushbutton **135** once for 0.2V as displayed on the crt readout **132**. Check the CH4 display **136** for a waveform 2 divisions in amplitude.



EXERCISE 3
LOGIC TRIGGERING

Exercise 3 demonstrates the use of the 7A42 TRIGGER FUNCTION feature, using two of the four input channels (CH1 and CH4). CH1 and CH4 were arbitrarily selected; we could have selected any two of the four input channels.

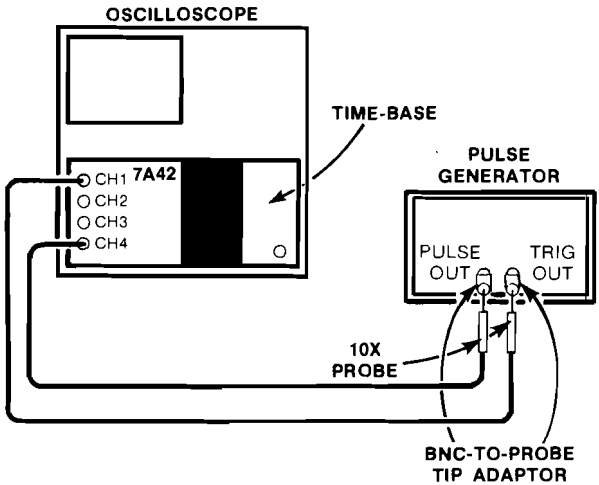
The equipment listed below was used to develop this exercise. Other equipment may be substituted, for instance: any Tektronix 7000-series time base or oscilloscope; any Tektronix 10X voltage probe; and any pulse generator with both a trigger output and a delayable pulse output, capable of producing zero to 2 volts from the trigger out and 5 volts from the pulse out.

Oscilloscope ..... Tektronix 7904A, one required.
Time Base ..... Tektronix 7B10, one required.
Subminiature probe
tip-to-bnc adapter ..... Tektronix Part 013-0195-00, two required.
Probe ..... Tektronix P6131, two required.
Pulse Generator ..... Tektronix PG508 installed in a Tektronix TM503, one each required.

NOTE

First repeat Exercise 1, then proceed.

Perform the following setup:



OSCILLOSCOPE
- POWER ..... ON
- VERTICAL MODE ..... LEFT
- HORIZONTAL MODE ..... B
- B TRIGGER SOURCE ..... LEFT VERT

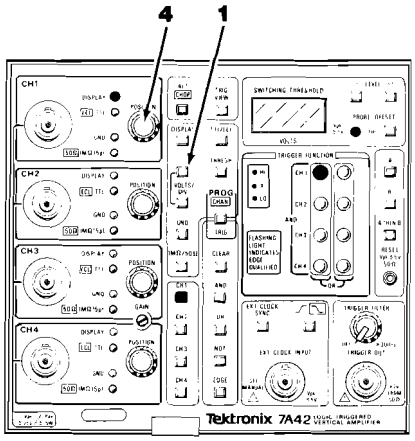
PULSE GENERATOR
- PERIOD ..... 2 μS
- DELAY ..... 0.1 μS
- VARIABLE DELAY ..... CAL
- DURATION ..... 0.1 μS
- VARIABLE DURATION ..... CAL
- TRANSITION TIME ..... 5 nS
- TRIGGERING ..... FREERUN
- MODE ..... DELAYED

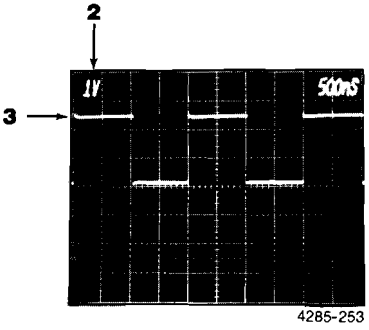
TIME BASE
- TIME/DIV ..... 500 nS/DIV
- TRIGGERING
  - MODE ..... AUTO
  - COUPLING ..... DC
  - SOURCE ..... INTERNAL
  - LEVEL ..... CENTERED
  - SLOPE ..... POSITIVE
  - B DELAY MODE ..... INDEPENDENT
  - MAG X1
  - HOLDOFF ..... MIN

4285-252

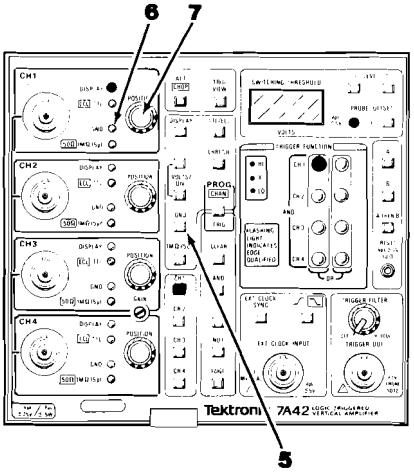
Press the 7A42 upper VOLTS/DIV pushbutton **1** twice for a 1V per division deflection factor, as shown on the Channel 1 crt readout **2**.

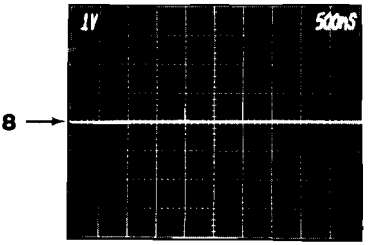
Use the CH1 POSITION control **4** as necessary to move the square wave **3** (approximately 2.5 divisions in amplitude) so that it can be viewed on the crt,



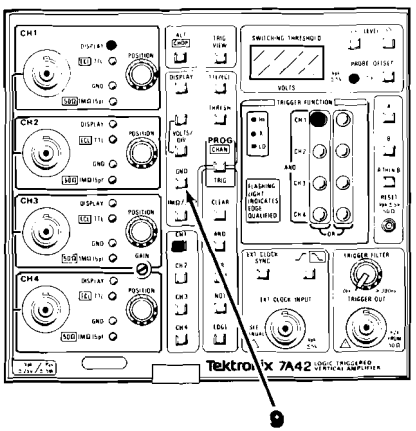


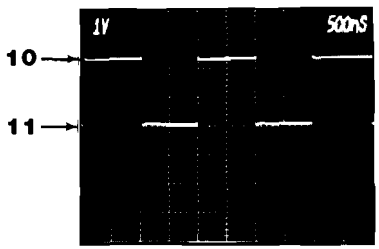
Press the GND pushbutton **5** and notice that the CH1 GND indicator **6** is now illuminated. Use the CH1 POSITION control **7** to move the displayed trace to the graticule center line **8**.





Press the CH1 GND pushbutton **9** and notice that the 2.5 division square wave **10** is displayed with its LO level near the ground reference **11**.



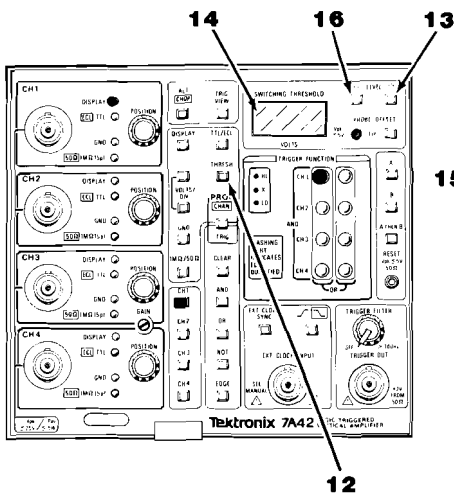


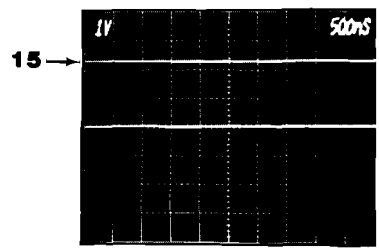
4285-255

Press the THRESH pushbutton **12** (pushbutton light on).

Press and hold the 7A42 ⇳LEVEL control **13** and notice that the SWITCHING THRESHOLD display **14** increases from the default setting of 1.4 V. Notice that when the SWITCHING THRESHOLD display reaches about 2.5 volts (the amplitude of the displayed square-wave signal **15**) the displayed signal free-runs (is not triggered).

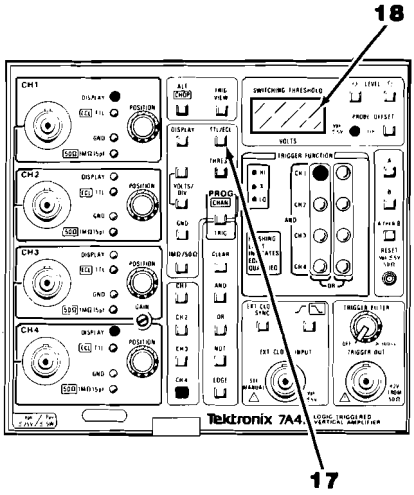
Press and hold the ⇳LEVEL pushbutton **16** until the display is again triggered.

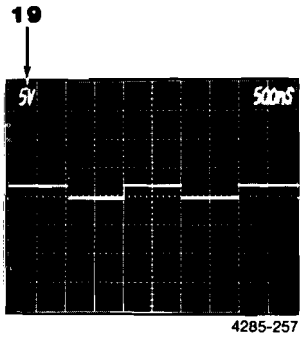




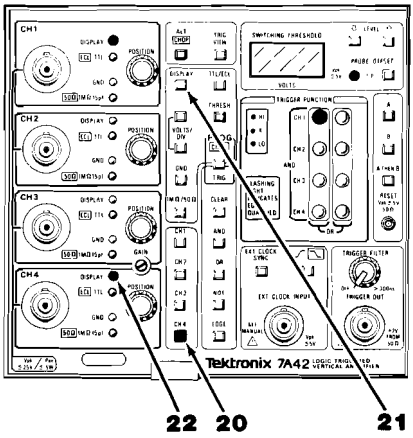
4285-256

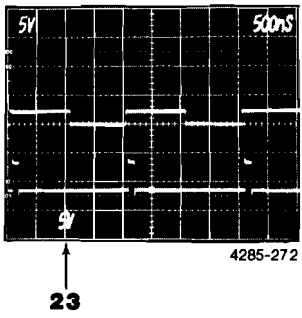
Press the TTL/ECL pushbutton **17** twice and notice that the SWITCHING THRESHOLD display **18** defaults to 1.4 V. The CH1 deflection factor also defaults to 5 V/division **19** (the minimum display size available).



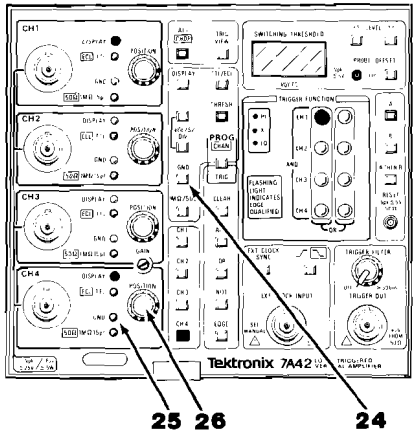


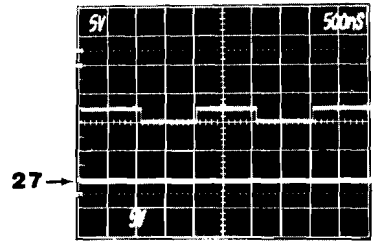
Press the CH4 pushbutton **20**, then press the DISPLAY pushbutton **21**. Notice that the CH4 pushbutton **20** and the CH4 DISPLAY status lights **22** are now illuminated red. Notice that the CH4 deflection factor readout **23** is now displayed.





Press the GND pushbutton **24** and notice that the CH4 GND indicator **25** is illuminated and that a baseline trace is displayed for CH4. Use the CH4 POSITION control **26** to move the CH4 trace to the second horizontal graticule line up from the bottom of the crt **27**. This is the CH4 *ground reference*.





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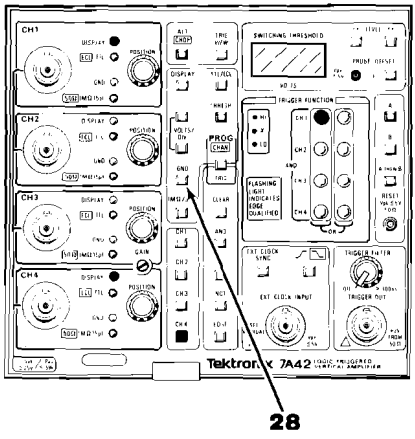
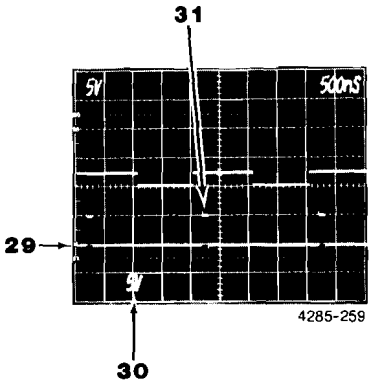
Press the GND pushbutton **28** again and notice that the CH4 waveform is again displayed **29**. Notice that CH4 is set for 5 V/div **30**.

Set the pulse generator amplitude controls so that the most positive output level is 1 division **31** above the ground reference and the most negative level is at the ground reference **29**.





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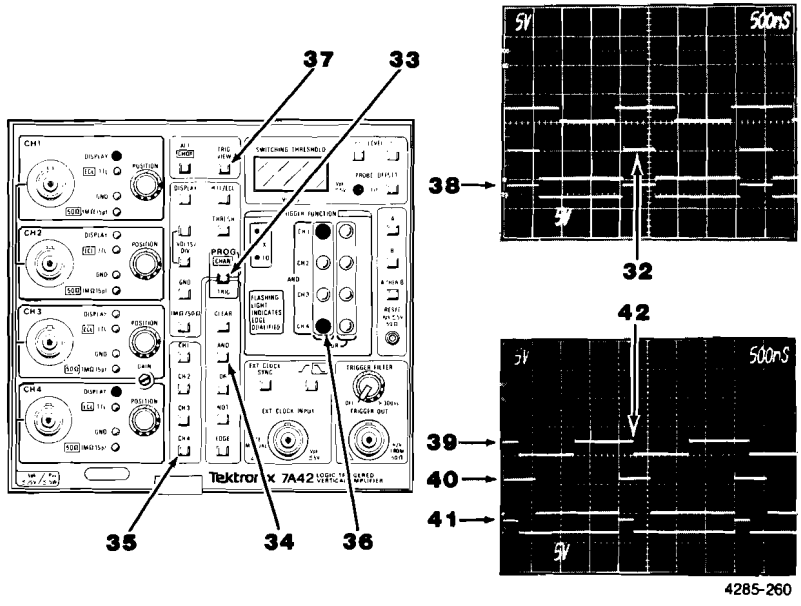
Set the pulse generator Variable Duration control to display a 500 ns wide pulse on the CH4 display **32**.

Press the PROG pushbutton **33** so that it is illuminated green (Program Trigger mode). Now press the AND pushbutton **34** then the CH4 pushbutton **35** and notice that the CH4 TRIGGER FUNCTION indicator **36** is red, indicating active HI level sensitivity for CH4.

Press the TRIG VIEW pushbutton **37** and notice that the TRIG VIEW trace **38** is now displayed at the bottom of the crt.

Change the timing relationship of the CH1 and CH4 displays by varying the pulse generator Variable Delay control. Notice that during the time that the CH1 **39** and the CH4 **40** displayed waveforms are both HI, that the TRIG VIEW display is HI **41**. Set the pulse generator Variable Delay control so the falling edge of the CH1 signal occurs while the CH4 signal is HI **42**.



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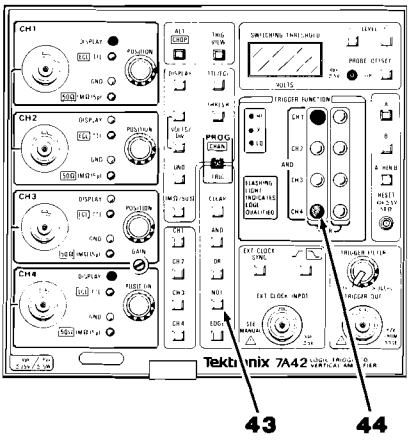
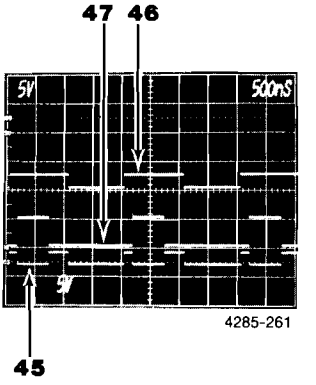
Press the NOT pushbutton **43** and notice that the CH4 TRIGGER FUNCTION indicator **44** changes to green (active LO). Now the 7A42 will produce a trigger when CH1 is HI and CH4 is LO.

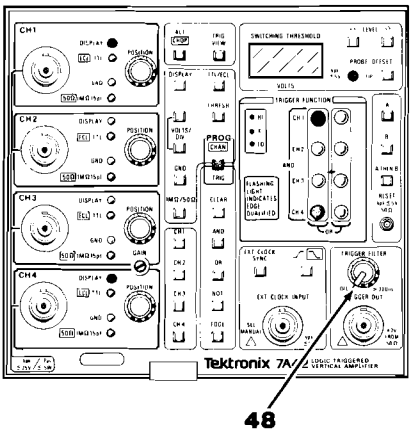
Observe that the TRIG VIEW trace is HI **45** when the CH1 display is HI **46** and the CH4 display is LO **47**. Now adjust the pulse generator Variable Delay control so the HI level of the CH4 signal occurs entirely within the time that the CH1 signal

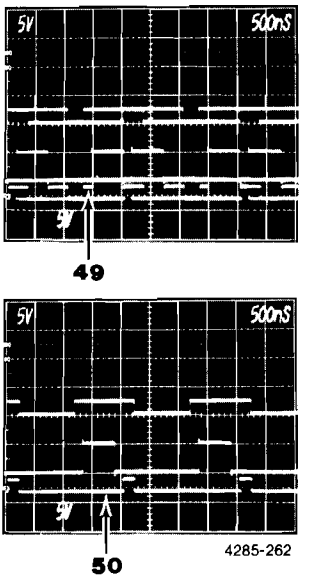
is HI. An adjustment of the time-base Holdoff control may be necessary for obtaining a stable display.





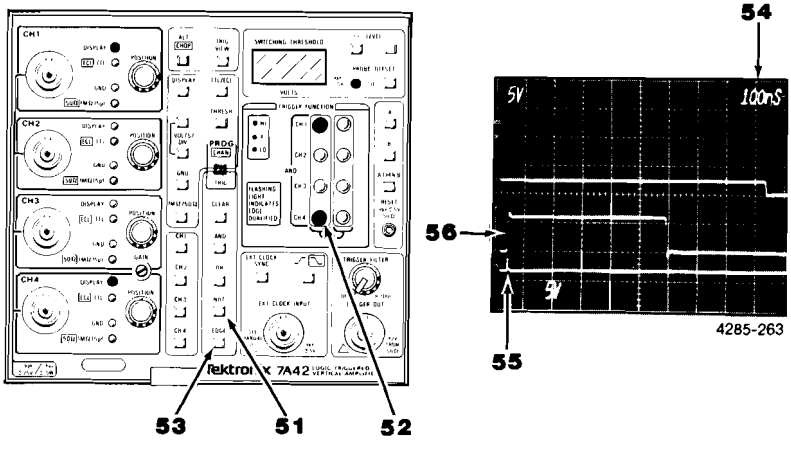
Set the time-base Holdoff control so that the display is double triggered. A stable trace can now be obtained by using the 7A42 TRIGGER FILTER control. Rotate the TRIGGER FILTER control **48** clockwise until the narrower of the two TRIGGER VIEW pulses **49** disappears **50**. Now vary the time-base Holdoff control and notice that the display **50** is always stable. Return the TRIGGER FILTER control to the OFF (counterclockwise detent) position.



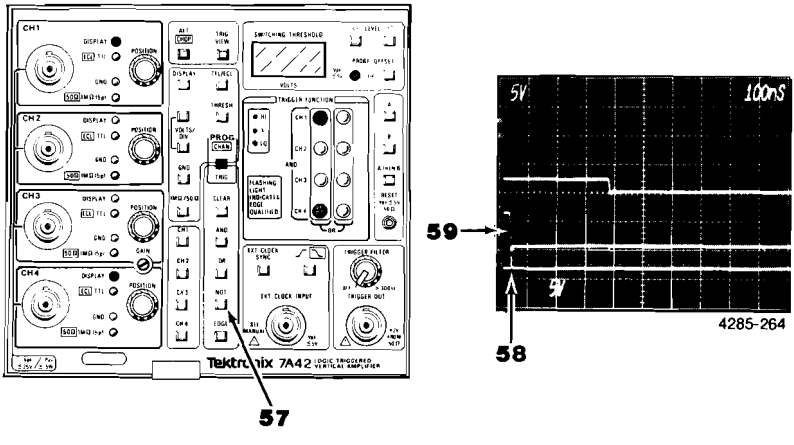


Press the NOT pushbutton **51** and notice that the CH4 TRIGGER FUNCTION indicator **52** is red (active HI).

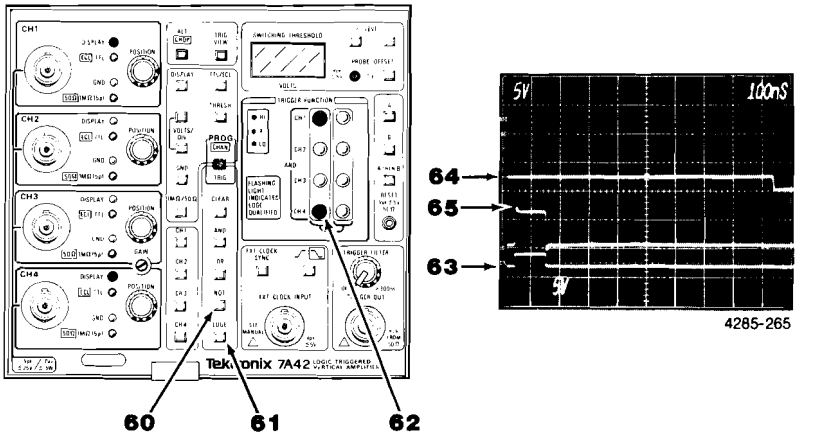
Press the EDGE pushbutton **53**. Notice that the CH4 TRIGGER FUNCTION indicator **52** is flashing to indicate EDGE qualified triggering. Set the time-base Time/Div to 100 ns **54**. Notice that the TRIG VIEW display has a narrow pulse **55** coincident with the rising edge **56** of the CH4 display.



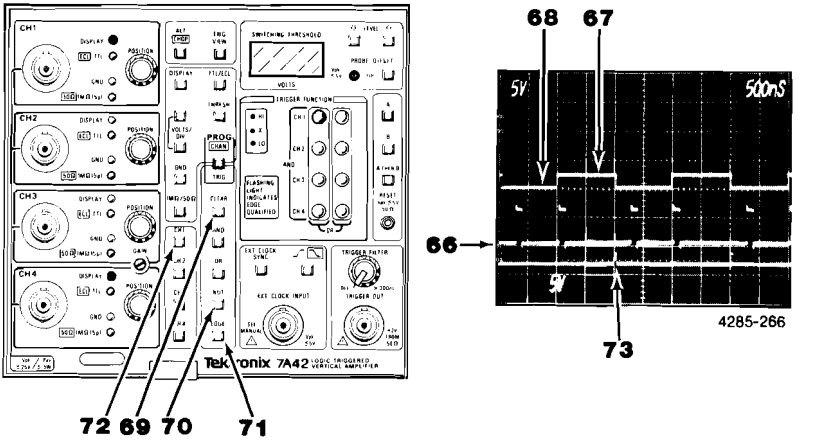
Press the NOT pushbutton **57**. Observe that the displayed TRIG VIEW pulse **58** now corresponds with the falling edge of the CH4 waveform **59**. Adjust the pulse generator Variable Duration control and notice that the CH4 display becomes untriggered when the programmed trigger condition no longer exists (CH1 AND NOT CH4 EDGE).



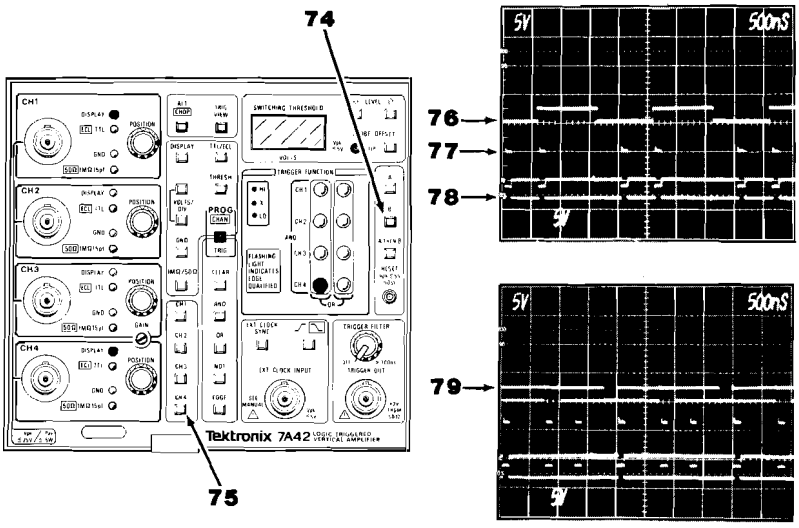
Press the NOT pushbutton **60** and the EDGE pushbutton **61**. Notice that the CH4 TRIGGER FUNCTION indicator has stopped flashing **62** (steady red) and that the TRIG VIEW display **63** is HI during the time that CH1 **64** and CH4 **65** are both HI. Set the pulse generator Variable Duration control for a CH4 pulse width of 100 ns (CAL position).



Set the time-base Time/Div control to 500 ns. Set the pulse generator to Both Paired by pressing both the Delayed and Undelayed pushbuttons together. Set the pulse generator Variable Delay control so that one of the pulses in the CH4 display **66** occurs while the CH1 display is HI **67** and the other occurs while CH1 display is LO **68**. Press the CLEAR pushbutton **69**, the NOT pushbutton **70**, the EDGE pushbutton **71** and the CH1 pushbutton **72**. Notice that TRIGGER FUNCTION A is the falling transition of CH1 **73**.



Press the B pushbutton **74** and then the CH4 pushbutton **75**. Adjust the time-base Holdoff control for a stable display. Vary the pulse generator Delay control and notice that a trigger is displayed on the TRIG VIEW trace **76** while the CH4 pulse **77** is HI, regardless of the CH1 signal **78** being HI or LO. Set the pulse generator Variable Delay control so that one of the CH4 pulses is centered during the time that the CH1 signal is LO. Now adjust the time-base Holdoff control for an unstable display **79**.



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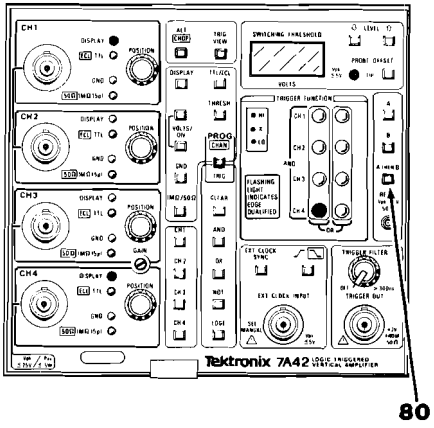
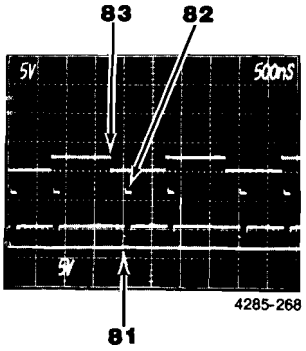
Press the A THEN B pushbutton **80** and while varying the pulse generator Delay control, notice that a trigger occurs on the TRIG VIEW trace **81** only on the leading edge of the first CH4 pulse **82** following the falling edge of the CH1 trace **83**. The display remains stable regardless of the setting of the time-base Holdoff control.





DETAILED OPERATING INFORMATION

Detailed information concerning the controls and operation of the 7A42 is given in the following pages.

SELF-TEST

NOTE

Disconnect any cables from the RESET, EXT CLOCK, and TIP inputs while Self Test is in progress (an external impedance on these connectors may cause a Self Test failure).

When power is applied to the 7A42 an internal self-test sequence is automatically performed. While the self-test sequence is in progress the mainframe crt readout shows 7A42 TEST BUSY, see Figure 2-8. When the self-test sequence is finished, the message 7A42 TEST COMPLETE appears momentarily on the mainframe oscilloscope crt, as shown in Figure 2-9. During the self-test sequence some of the

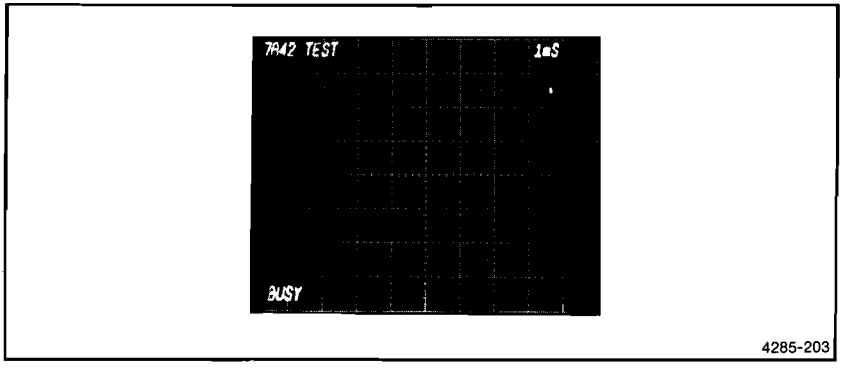


Figure 2-8. Self-test in progress.

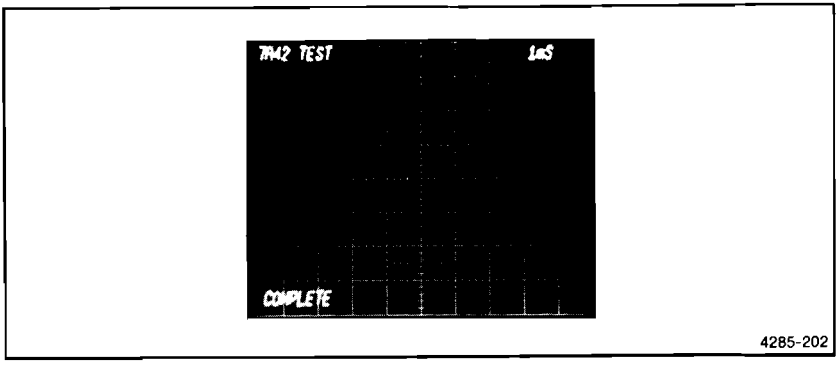


Figure 2-9. Self-test finished.

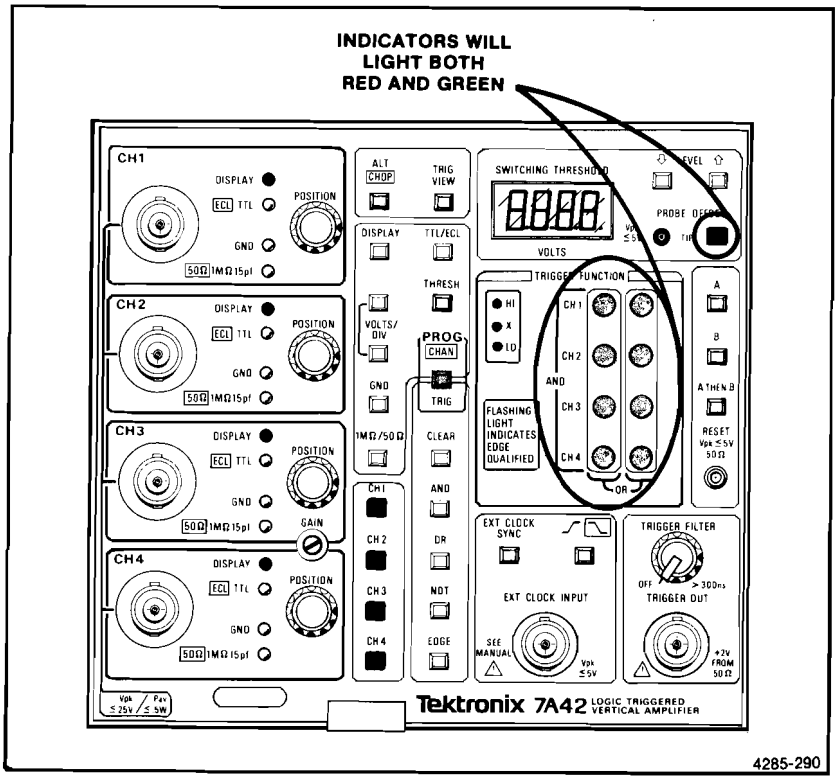


Figure 2-10. 7A42 front-panel drawing showing pushbuttons and indicators that are illuminated during the self-test sequence.

front-panel pushbuttons and all of the indicators are momentarily illuminated to verify their operation. Figure 2-10 shows which ones should light.

The SWITCHING THESHOLD VOLTS indicator will display 8.8.8.8. during the first part of the self-test sequence to verify that all segments operate. If there are no self test failures, the Firmware Version number will then be displayed for a few seconds before the self test is completed.

Self-test failures are indicated by three different methods: 1. on the mainframe crt, 2. on the 7A42 SWITCHING THRESHOLD display, and 3. on the TRIGGER FUNCTION indicators. Figure 2-11 illustrates a typical self-test failure, indicated by the three display methods. Displaying the self-test failure messages in three different ways increases the chance that the failure message will be displayed, even if the failure affects the operation of two of the three display methods.

The TRIGGER FUNCTION display indicates a self-test failure with the color red and self-test passed with the color green. If a failure occurs, the self-test sequence will stop.

The SWITCHING THRESHOLD VOLTS indicator and mainframe crt readout display indicate a self-test failure with a numeric code. All of the self-test code numbers are listed in Table 2-1, along with the nature of the failure and an explanation of the severity of the failure. The severity information is helpful in determining if the 7A42 can still be used for the intended purpose or whether repair is necessary. To continue the self-test sequence, press any of the 7A42 front-panel pushbuttons.

NOTE

There should be no connections to the RESET EXT CLOCK, and TIP inputs during the time Self Test is running.

NOTE

Before the 7A42 Self Test feature can verify that the 7A42 readout circuitry is operating properly, mainframe crt readout system must be set to the "Freerun" (non-Gated) mode.

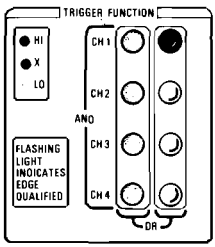
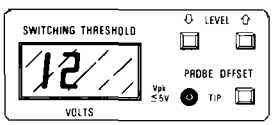
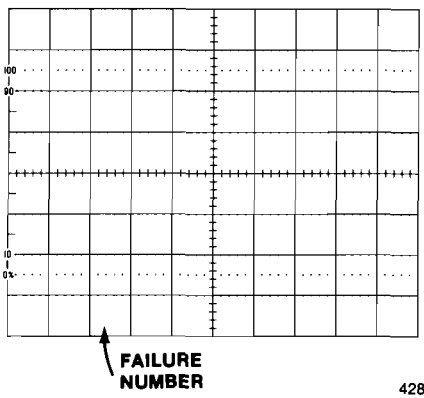
DISPLAY MEDIA	TYPICAL DISPLAY
TRIGGER FUNCTION LEDS **GREEN = TEST PASSED** **RED = TEST FAILED**	
SWITCHING THRESHOLD VOLTAGE MONITOR (Numeric Display)	
CRT READOUT (Numeric Display) **NOTE: During some self tests, the crt readout is unstable; this condition is normal.**	

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Figure 2-11. Typical self-test failure display.

TABLE 2-1
7A42 Self-Test Failure Messages

TRIGGER FUNCTION (LED display)		SWITCHING THRESHOLD VOLTS and crt readout display		Severity of failure; functional usability of instrument
Indication	**Test**	**Indication**	**Test**	
CH1, first column.	ROM	01 to 04	ROM	Possible loss of front-panel control; repair before use.
CH2, first column.	RAM	05 to 06	RAM	
CH3, first column	Micro-processor control logic.	07 to 09	Micro-processor control logic.	
CH4, first column.	PROBE OFFSET	10	PROBE OFFSET	Avoid use of probe offset feature. 7A42 otherwise fully functional. Repair when convenient.
CH1, second column.	Crt display and readout.	11	Crt trace display.	Channels 1 through 4 may not be displayable. Repair before use.
		12,13	Crt readout.	Crt readout may not be functioning. Cause could be lack of mainframe readout. Repair when convenient.
CH2, second column.	Trigger	14	Trigger control.	Some or all trigger functions may not be operational. Repair before use.
		15	Trigger logic.	Some channels may not trigger properly. Repair before use.

TABLE 2-1 (CONT)
7A42 Self-Test Failure Messages

TRIGGER FUNCTION (LED display)		SWITCHING THRESHOLD VOLTS and crt readout display		Severity of failure; functional usability of instrument
Indication	**Test**	**Indication**	**Test**	
CH2, second column (cont)	Trigger (cont)	23	Boolean logic.	Some trigger functions may not be operational. Repair before use.
		26	A THEN B	Avoid use of A THEN B mode. Repair when convenient.
CH3, second column.	Edge detectors	34	Edge detectors.	Avoid use of Edge-qualified triggering mode and external clock. Repair when convenient.
CH4, second column.	EXT CLOCK	70	EXT CLOCK	Avoid use of external clock. Repair when convenient.

FRONT-PANEL INITIALIZATION

While getting acquainted with the 7A42, it might be desirable to begin operation with the front-panel controls set to a known state (initialized). The front panel will initialize to the control settings listed in Table 2-2 and as shown in Figure 2-12. To initialize the 7A42 front-panel control settings, see Exercise 1 in the Get-Acquainted Exercises of this section.

BATTERY BACKUP

Upon completion of the self-test sequence, the 7A42 battery backup feature restores the 7A42 front-panel control settings to the same settings that were present when the power was turned off.

TABLE 2-2
7A42 Front-Panel Control Settings When Initialized

Control	Control Setting
PROG CHAN/TRIG	Program Channel (light off)
Programmable Channel	CH1 only
DISPLAY	CH1 only
VOLTS/DIV (CH1 through CH4)	Preset to 0.5 V/Div at bnc input
TTL/ECL (CH1 through CH4)	TTL
GND (CH1 through CH4)	Ungrounded
1MΩ/50Ω (CH1 through CH4)	1MΩ
ALT/CHOP	ALT
TRIG VIEW	Off
SWITCHING THRESHOLD voltage (CH1 though CH4)	Preset TTL (+1.4V); display off
THRESH	Off
PROBE OFFSET	Off
A TRIGGER FUNCTION	CH1 (HI)
B TRIGGER FUNCTION	Cleared
TRIGGER MODE	
TRIGGER FUNCTION	A
A THEN B	Off
EXT CLK SYNC	Off
External Clock Slope	Off

NOTE

Controls not listed above are not preset.

The battery-backup feature can be defeated if so desired; refer qualified service personnel to the 7A42 Service Manual. If the battery-backup feature has been disabled, the 7A42 front-panel control settings will return, at power up, to the settings listed in Table 2-2, and as shown in Figure 2-12.

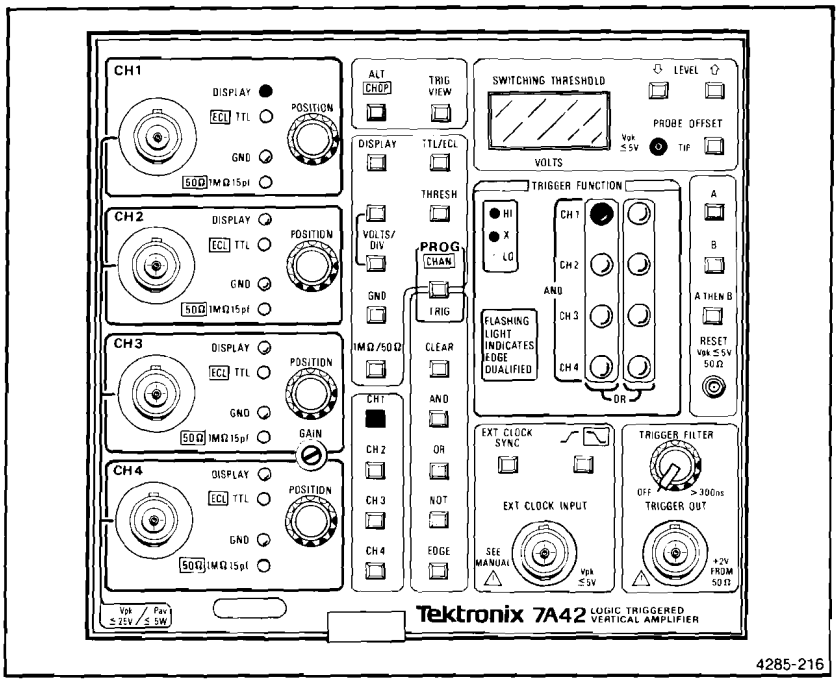


Figure 2-12. 7A42 front-panel control lights when initialized.

OPERATOR MESSAGES

Operator Messages occur under several operating conditions and are accompanied by an audible beep. When they occur, the mainframe readout will display a mnemonic at the top of the crt and a number code at the bottom. The mnemonic is an abbreviated explanation of the operating condition which caused the message to be displayed. The code number references the message to Table 2-3 which gives a more complete explanation of the operating condition.

NOTE

The audible beep can be turned off; refer qualified service personnel to the 7A42 Service Manual (Volume 1).

TABLE 2-3
7A42 Operator Message Summary

Code	Mnemonic	Description and Corrective Action
1	OVERLOAD	A channel input is overloaded. Remove the overvoltage and unground the channels to continue operation.
2	OFFSET ACQ	A key was pressed while Probe Offset acquisition was in progress. Push PROBE OFFSET once to lock in acquired value, or twice to turn PROBE OFFSET off, before continuing operation.
3	PUSH PROG	Key(s) pressed is/are active only in PROG CHAN mode. To use key, first press PROG CHAN.
4	PUSH PROG	Key(s) pressed is/are active only in PROG TRIG mode. To use key, first press PROG TRIG.
5	AND/OR REQ	While programming a trigger function, a CH1, CH2, CH3, CH4, NOT, or EDGE was pressed when an AND or an OR key was expected.
6	CH KEY REQ	While programming a trigger function, two Boolean operator keys (AND or OR) were pressed without pressing a channel key (CH1, CH2, CH3, or CH4) in between. Channel keys and Boolean operator keys should be pressed alternately, e.g., CH1 AND NOT CH2 OR CH3 EDGE.
7	OR IS FULL	The OR key was pressed again. Only one TRIGGER FUNCTION OR is allowed.
8	EXTCLK ON	The EDGE key was pressed while in the EXT CLOCK SYNC mode. The selection of an EDGE sensitive channel and the EXT CLOCK SYNC mode are mutually exclusive. If EDGE sensitivity is desired, first turn off the EXT CLOCK SYNC mode.
9	EXTCLK REQ	The EXT CLOCK slope key was pressed when the EXT CLOCK SYNC button was turned off. The EXT CLOCK SYNC slope key is operational only when the EXT CLOCK SYNC button is turned on.
10	EDGE IS ON	The EXT CLOCK SYNC key was pressed when one of the trigger functions (either A, B, or both) already have an EDGE sensitive channel. Channel EDGE sensitivity and EXT CLOCK are mutually exclusive. If EXT CLOCK SYNC operation is desired, first CLEAR the channel EDGE sensitive trigger function.

TABLE 2-3 (CONT)
7A42 Operator Message Summary

Code	Mnemonic	Description and Corrective Action
11	THRESH REQ	Either a LEVEL key or the PROBE OFFSET key was pressed without pressing the THRESH key first. The THRESH key must be lit to change a threshold level or acquire a probe offset.
12	NO FUNC A	The A THEN B key was pressed without having programmed function A; or while in A THEN B mode function A was CLEARed. Both trigger functions (A and B) must be programmed for proper A THEN B operation. Program function A; then proceed.
13	NO FUNC B	The A THEN B button was pressed without having programmed function B; or while in A THEN B mode function B was CLEARed. Both trigger functions (A and B) must be programmed for proper A THEN B operation. Program function B; then continue.

WARNING BEEPS: Although no messages are displayed, short warning beeps are issued to indicate "out of range." A beep will sound when the VOLTS/DIV keys are pushed beyond the available selections or when the variable threshold level reaches its limits.

NOTE

The audible beep can be turned off; refer qualified Service Personnel to the 7A42 Service Manual (Volume 1).

SIGNAL CONNECTIONS

Generally, probes offer the most convenient means of connecting input signals to the instrument. They are shielded to prevent electromagnetic interference. The 10X probe offers a high input impedance to minimize circuit loading when measurements are made; signal amplitude is attenuated by a factor of 10 by the probe, so the scale-factor readout is switched to indicate the correct scale factor.

The limited TTL/ECL VOLTS/DIV ranges require that attenuation be used to obtain useful signal levels at the 7A42 channel inputs. Ten times probes are recommended on the channel inputs to attenuate TTL and ECL signals; otherwise 10X attenuators should be used. When 10X probes are used the VOLTS/DIV and SWITCHING THRESHOLD are automatically compensated to reflect the characteristics at the probe tip.

RECOMMENDED PROBES

The Tektronix P6131 and P6230 probes are recommended for use with the 7A42. The Tektronix P6131 is a 10X passive probe with 10 megohm at 10.8 picofarads. A variety of probe tips (hooks, IC grabber and ground leads) are available with this probe.

The Tektronix P6230 is an active 450 ohm bias/offset probe which is especially useful with ECL logic circuits due to its minimal circuit loading characteristics. For information on how to use the P6230 probe, refer to the Application section in this manual.

Probe Compensation

Maladjustment of probe compensation is one source of measurement error. Most 10X passive high impedance probes are equipped with a compensation adjustment. To ensure optimum measurement accuracy, always compensate the oscilloscope probe before making measurements. Refer to the probe instruction manual for probe adjustment procedure.

For optimum 7A42/P6131 performance the P6131 should be high-frequency compensated while connected to the 7A42; see the P6131 probe manual for high-frequency compensation adjustment procedure.

COAXIAL CABLES

Although the 7A42 input channel VOLT/DIV ranges are intended to be used with 10X probes, coaxial cables may be used for signal connections. When coaxial cables are used a 10X attenuator must be used to reduce TTL/ECL signals to usable levels. When 10X attenuators are used the VOLTS/DIV and SWITCHING THRESHOLD readings are not automatically compensated and will indicate values a factor of 10 lower than actual.

Cables also may be used to connect signals to the input connectors, but they may have considerable effect on the accuracy of the displayed waveform. To maintain the original frequency characteristics of an applied signal, use only low-loss, 50 ohm, high-quality coaxial cable. Cables should be terminated into 50 ohms. The 7A42 has an internal 50 ohm termination for each input channel which can be selected from the front-panel.

CRT READOUT

Figures 2-13 and 2-14 show the 7A42 scale factor readout location. Figure 2-14 was taken with X10 probes attached to the channel inputs. Figure 2-13 was taken without probes attached to the channel inputs and without changing the channel VOLTS/DIV settings from those of Figure 2-14.

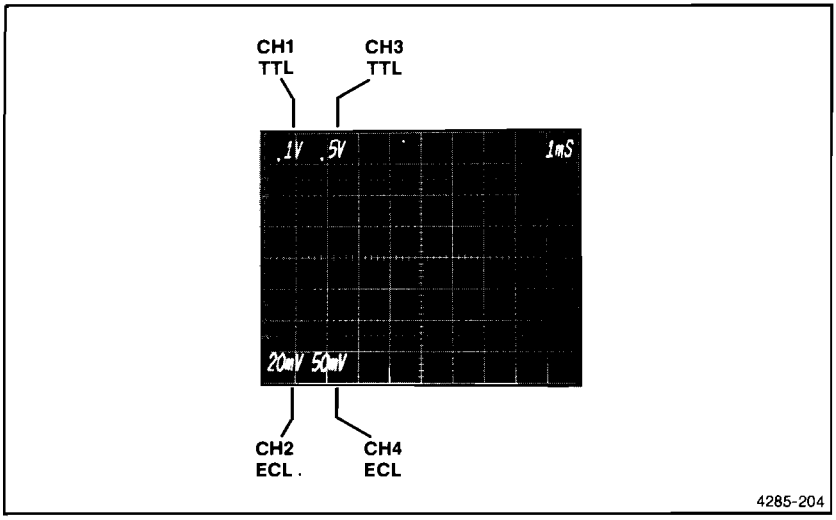


Figure 2-13. Channel readout display.

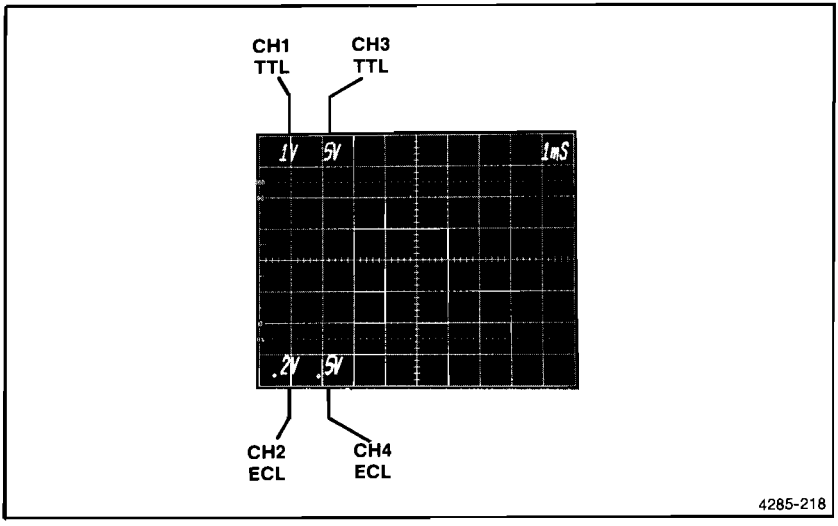


Figure 2-14. Channel readout display with 10X probes attached to inputs of CH1, CH2, CH3, and CH4.

NOTE

The front-panel controls, indicators and connectors drawing, Figure 2-7 in this section of the manual, can be unfolded and referred to while reading the following text.

POSITION

A POSITION control is provided for each of the four channels. The control vertically positions the displayed trace on the host mainframe crt (clockwise rotation moves the trace upward).

GAIN

This screwdriver control adjusts the 7A42 display output (of all four channels) to match the vertical gain tolerance of any Tektronix 7000-series mainframe.

STATUS INDICATORS (CH1, CH2, CH3, CH4)

Each channel has four status indicators (DISPLAY, ECL/TTL, GND and 50Ω/1MΩ). These indicators show the status of each individual channel. A description of each indicator is given below.

DISPLAY

When the DISPLAY indicator is lit, the associated channel is displayed on the mainframe crt. If the indicator is extinguished, any signal applied to the channel input will still be routed to the TRIGGER FUNCTION circuitry, providing the GND indicator is not lit.

ECL/TTL

When the ECL/TTL indicator is lit, the channel threshold voltage range and deflection factors match the voltage levels and signal amplitudes of the TTL logic family. When the indicator is extinguished the threshold voltage range and deflection factors are in accord with the ECL logic family.

GND

When the GND indicator is lit, the input to the selected channel amplifier is grounded and the signal path from the front-panel bnc connector to the amplifier is open. An external signal applied to this channel is not terminated (it is open). Grounded channel traces are still displayed to enable the ground reference position to be established.

50Ω/1MΩ

When the 50Ω/1MΩ indicator is lit, the input impedance of the associated channel is one megohm. When the indicator is extinguished the input impedance is 50 ohms.

ALT/CHOP

The ALT/CHOP pushbutton selects either alternate or chopped as the display mode (for all channels). When the ALT/CHOP indicator is lit, the channels selected for display are alternately displayed on the mainframe oscilloscope crt after each sweep of the time base. When the ALT/CHOP indicator is extinguished, the display is electronically switched between channels at about a one-megahertz rate. In general, the ALT mode provides the best display at sweep rates of 100 microseconds/division and faster while the CHOP mode provides the best display at sweep rates slower than about 200 microseconds/division or whenever multiple single-shot signals are to be photographed.

TRIGGER FUNCTION

The two-color TRIGGER FUNCTION indicators display the Boolean trigger function. The color red indicates a HI (logic 1, or higher than threshold voltage) condition. Green indicates LO (logic Ø, or lower than threshold voltage) condition. An indicator that is not lit represents the X (don't care) condition. A red flashing or green flashing indicator signifies that the channel is edge sensitive (rising, red; or falling, green) as opposed to being level sensitive.

The TRIGGER FUNCTION indicators are arranged in two columns of four each. Each column represents a logical AND function, (a Boolean product of the four input channels). After the AND functions are performed, the columns are ORed together to form the complete Boolean TRIGGER FUNCTION. Thus each TRIGGER FUNCTION is equivalent to two four-bit word recognizers ORed together.

There is one exception to this convention. While an extinguished indicator represents the "don't care" condition, an entire column that is not lit is considered to be inactive. If an unlit column were interpreted as a don't care, that column ORed with any other column would always be true.

A TRIGGER FUNCTION AND B TRIGGER FUNCTION

There are two separate TRIGGER FUNCTIONS available, A and B. They are identical; either may be used. One pushbutton will always be lit to indicate which function is displayed by the TRIGGER FUNCTION indicators and therefore, the function that will produce the trigger output. The other function is stored in memory and may be called up by pressing that pushbutton. The programming or clearing of the function displayed will not affect the other function.

A THEN B NESTED TRIGGERING

One level of nested triggering is available when this mode is used. The trigger output to the mainframe time base occurs only after the triggering is first armed by the occurrence of function A. The trigger output then takes place with the next occurrence of function B. After this cycle, the 7A42 will begin to look for another occurrence of function A, to begin the next nested trigger cycle.

TRIG VIEW

The TRIG VIEW trace provides a visible replica of the trigger output signal as it is processed by the 7A42 according to the programmed TRIGGER FUNCTION. This trigger signal is also sent to the time base. When the EXT CLOCK SYNC pushbutton switch is lit, the TRIG VIEW trace displays the external clock input signal.

The TRIG VIEW trace is normally located near the bottom of the crt display. There is an internal provision for repositioning the trace; to reposition the TRIG VIEW trace refer qualified service personnel to the 7A42 Service Manual. If all of the channel displays are turned off the TRIG VIEW trace will be on and cannot be turned off.

TRIGGER FILTER

The TRIGGER FILTER control provides a selectable amount of delay between the time that the TRIGGER FUNCTION is recognized as true, and the time that the Trigger Output is sent to the time base to trigger the sweep. Thus the TRIGGER FILTER will inhibit trigger events that are shorter in duration than those for which the control is set. A longer trigger event will pass through the TRIGGER FILTER and can cause a triggered sweep as well as a signal at the front-panel TRIG OUT connector. The TRIGGER FILTER control can be used only with level-sensitive trigger functions (it is inactive with any TRIGGER FUNCTION that contains an edge-sensitive channel). The TRIGGER FILTER operates independently on TRIGGER FUNCTION A and TRIGGER FUNCTION B. In the A THEN B mode, the TRIGGER FILTER may be inactive on function A because of an edge sensitive channel, while at the same time be active on function B. The TRIGGER FILTER is not active when in the EXT CLOCK SYNC mode or when the control is in the counterclockwise detent (OFF) position.

EXT CLOCK SYNC

The EXT CLK SYNC pushbutton allows the 7A42 to be used in a synchronous mode of operation. The trigger output (in either A, B, or A THEN B mode) will occur only on the selected edge of an external clock signal, providing the TRIGGER FUNCTION is also true at that time. If TRIG VIEW is selected, a replica of the external clock input signal having a fixed amplitude and position will be displayed on the TRIG VIEW trace.

SLOPE SELECT

Either the rising or falling edge of an external clock signal can be used to qualify the TRIGGER FUNCTION. When the Slope Select pushbutton is lit the TRIGGER FUNCTION is qualified on the rising transition of the external clock signal.

EXT CLOCK INPUT

The EXT CLOCK INPUT is directly compatible with either TTL or ECL logic families. The instrument is shipped from the factory in the TTL mode. To determine which mode is selected (ECL or TTL), proceed as follows:

1. Remove any input signal from the EXT CLOCK INPUT.
2. Press the PROG pushbutton so that it is lit green.
3. Press the CLEAR pushbutton, to eliminate any existing TRIGGER FUNCTION.
4. Press the TRIG VIEW pushbutton so that the pushbutton light is on and the trigger view trace is displayed on the mainframe crt.
5. Observe the trigger view trace as the EXT CLOCK SYNC pushbutton is pressed.

If the trigger view trace moves upward approximately half a division (when the EXT CLOCK SYNC push-button is lit) the selected mode is TTL. If the trigger View trace does not shift, the mode is ECL. To select the ECL mode refer qualified service personnel to the 7A42 Service Manual. The EXT CLOCK INPUT can be used with a 1X probe in TTL mode, or can be directly connected to the logic circuit in either TTL or ECL mode; 10X probes should not be used with this input.

RESET INPUT

The RESET INPUT allows the operator to apply a signal to inhibit the trigger output. Applying a positive 0.8 volt level to the RESET input will prevent the programmed TRIGGER FUNCTION from being recognized as true. The result is that no trigger output signal will occur until the reset voltage is removed.

If the A THEN B nested-trigger mode is selected, TRIGGER FUNCTION A has occurred, and TRIGGER FUNCTION B has not occurred; the RESET signal will reset function A (the armed condition) as well as inhibit function B. Therefore, the RESET input can be used to enhance the A THEN B nested trigger operation by providing an "A THEN B unless RESET" feature.

TRIGGER OUT

The TRIGGER OUT bnc connector is a trigger output signal source. This signal can be used to synchronize other equipment with the 7A42 TRIGGER FUNCTION. The output of the TRIGGER FUNCTION is determined by the setting of the A, B, or A THEN B pushbuttons, the programming of the A and B functions, and the channel input signals. Timing diagrams for a typical set of conditions are shown in Figures 2-15 and 2-16.

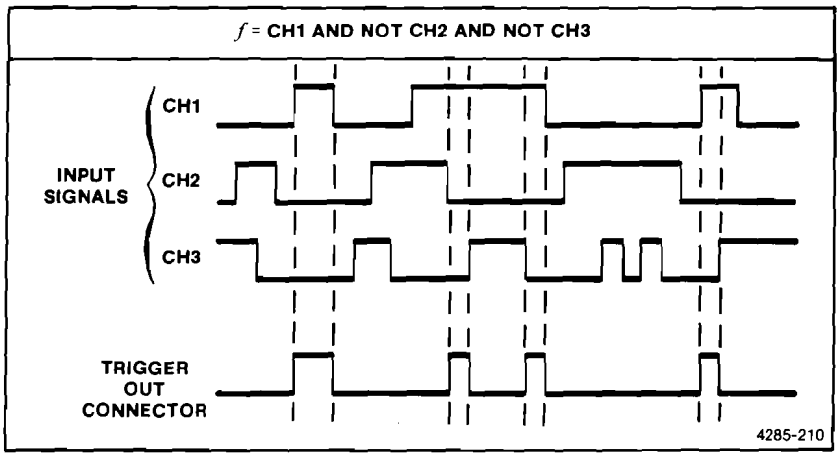


Figure 2-15. Timing diagram showing the relationship of the TRIGGER OUT waveform to the input signals.

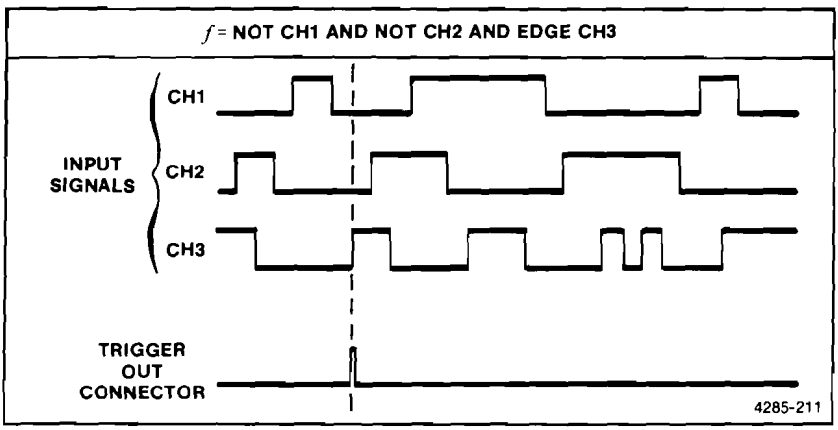


Figure 2-16. Timing diagram depecting the TRIGGER OUT waveform, as a result of the TRIGGER FUNCTION reacting to the input signals.

Two modes of operation can be selected for the TRIGGER Out connector; Normal, and A THEN B Gate. In Normal Mode, the A THEN B Trigger Out is a pulse, regardless of the duration of Trigger Function B. A typical timing diagram depicting the Normal and A THEN B Gate modes, is shown in Figure 2-17. For selection of either mode refer qualified service personnel to the 7A42 Service Manual. The TRIGGER OUT signal levels are compatible with the RESET input levels.

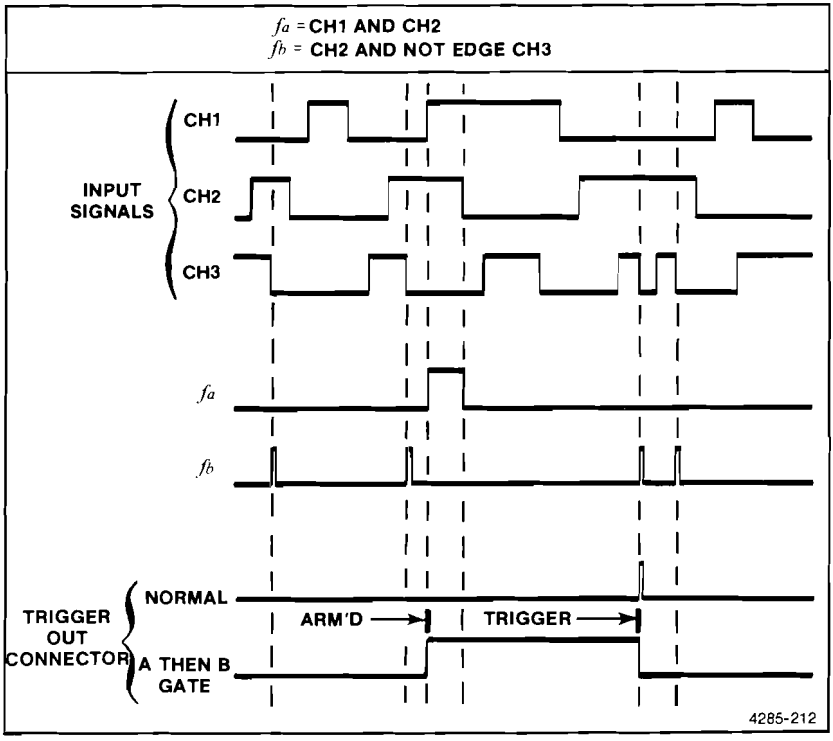


Figure 2-17. Example of A THEN B, level and EDGE sensitive TRIGGER FUNCTION, showing the Normal and A THEN B Gate waveform alternatives.

PROG CHAN/TRIG

The PROG CHAN/TRIG pushbutton selects one of two modes, PROG CHAN (program channel) or PROG TRIG (program trigger). In the PROG CHAN mode the DISPLAY, VOLTS/DIV, GND, 1MΩ/50Ω, TTL/ECL, and THRESH pushbuttons are activated. These controls are used with the CH1, CH2, CH3 and CH4 pushbuttons to individually set the channel status. In the PROG TRIG mode CLEAR, AND, OR, NOT, and EDGE pushbutton controls are activated and are used with the CH1, CH2, CH3, and CH4 pushbutton controls to program a Boolean equation into the A TRIGGER FUNCTION or B TRIGGER FUNCTION. The following text discusses first the PROG CHAN controls and then the PROG TRIG controls.

PROGRAM CHANNEL MODE

The TTL/ECL, VOLTS/DIV, GND, 1MΩ/50Ω, and DISPLAY, controls are active in the PROG CHAN mode. These controls are used with the CH1, CH2, CH3, and CH4 pushbuttons to set the status of each channel.

CH1, CH2, CH3, CH4. In the PROG CHAN mode the CH1, CH2, CH3, and CH4 pushbuttons are used to select and indicate the channel which will respond to the TTL/ECL, VOLTS/DIV, GND, 1MΩ/50Ω, DISPLAY and THRESH pushbutton controls.

DISPLAY. The DISPLAY pushbutton turns the selected channel display on or off. In the off position the trace is removed from the crt display. However, the signal applied to that channel is still routed to the TRIGGER FUNCTION circuitry, providing the channel GND indicator is not lit.

TTL/ECL. The TTL/ECL pushbutton offers a threshold range and selection of display sensitivities appropriate for either TTL or ECL logic families.

VOLTS/DIV. The VOLTS/DIV pushbuttons set the scale factor of the selected channel. The scale factor is displayed on the mainframe crt readout; refer to CRT Readout in this section. Three sensitivities are available in each logic family; see Table 2-4. To increase the sensitivity (display size) press the upper button.

TABLE 2-4
Channel Volts/Division Ranges

Logic Family	At The BNC	Through a 10X Probe
TTL (CMOS)	.1, .2, .5 V/Div	1, 2, 5 V/Div
ECL	20, 50, 100 mV/Div	.2, .5, 1 V/Div

GND. The GND pushbutton connects the selected channel amplifier input to ground as a reference for trace positioning. However, the incoming signal is not grounded; it is disconnected from the amplifier input.

1MΩ/50Ω. The 1MΩ/50Ω pushbutton selects the input impedance of the selected channel. The available impedances are 1 megohm in parallel with about 15 pF, or 50 ohms.

THRESH. Each of the four input channels have two possible preset threshold voltages, +1.4 volts for the TTL mode and -1.30 volts for the ECL mode. In addition, these threshold voltages can be altered using the LEVEL⇧ or LEVEL⇩ pushbuttons. The SWITCHING THRESHOLD VOLTS display will indicate the threshold voltage present at each of the channel inputs. To turn the SWITCHING THRESHOLD VOLTS display on, press the THRESH pushbutton (the light should be on).

The SWITCHING THRESHOLD VOLTS display corresponds to the channel pushbutton that is lit (CH1, CH2, CH3, or CH4). While the button is lit, the actual threshold voltage for the channel is indicated in the seven-segment LED display. For each logic family there are internally preset thresholds that can be altered by pressing either the LEVEL⇧ or LEVEL⇩ button. A single push changes the threshold by one increment. When either LEVEL button is held down the rate

accelerates. Each channel's threshold level is maintained when THRESH is pushed again to turn off the seven-segment display and button light. However, for a particular channel, the variable setting (if any) will be cancelled (reverts to the preset value) when the TTL/ECL selection is changed.

PROBE OFFSET. The PROBE OFFSET control provides a means of acquiring the offset voltage introduced into the signal path by the P6230 (450 ohm) active probe. In order to minimize circuit loading, it is desirable to set the probe offset/bias near the logic zero level or the termination voltage of the ECL circuit being probed. To acquire the PROBE OFFSET, THRESH must be selected and the channel (1 through 4) to which the P6230 is connected must be selected. When the PROBE OFFSET pushbutton is pressed it will light red, and the SWITCHING THRESHOLD VOLTS display becomes a DVM that reads the amount of probe offset. To measure and acquire the probe offset voltage, touch the probe tip to the front-panel jack labeled TIP, then set the offset adjustment on the probe case to the voltage desired. While still holding the probe tip to the TIP jack, push the PROBE OFFSET button once again to acquire this offset measurement into the 7A42. The probe offset button will now light green and the probe tip may now be removed. The offset measurement remains in the display which is again indicating the SWITCHING THRESHOLD voltage. At this point, the SWITCHING THRESHOLD can be adjusted to any other value (independent of the probe offset) by using the LEVEL buttons. Pressing the PROBE OFFSET button once more turns off the lit button, clears the acquired offset measurement, and reestablishes the preset threshold. The 7A42 PROBE OFFSET feature is appropriate for use only with the P6230 probe.

The acquired PROBE OFFSET voltage, whether zero or otherwise, is maintained when the THRESH button is turned off or while threshold information of another channel is being displayed. That value is also maintained if the logic family is changed; the switching threshold reverts to the probe offset voltage. If a channel has a non-zero offset, the PROBE OFFSET button will be lit green when that channel is selected (PROG CHAN mode) as a reminder of the offset status.

LEVEL. The LEVEL⇧ and LEVEL⇩ controls are used to set the threshold voltage of each channel to a value other than the preset threshold voltage. These controls are active only in the PROG CHAN mode and when the THRESH pushbutton switch is lit.

When either the LEVEL⇧ or LEVEL⇩ button is held, the variable threshold changes at an accelerating rate, pausing momentarily at the preset value. (There will be no pause if a probe offset has been acquired for the channel.)

The SWITCHING THRESHOLD VOLTS display indicates the preset threshold voltage or the variable threshold voltage set by the LEVEL and LEVEL controls, The CH1, CH2, CH3, and CH4 pushbuttons indicate which channel's threshold voltage is being monitored.

When using the P6230, remember the first step is to acquire the probe offset value into the 7A42. Next set the Switching Threshold Voltage with the LEVEL buttons to

a value appropriate for the logic family under test. The Switching Threshold Voltage at the probe tip is indicated in the numerical display.

PROGRAM TRIGGER MODE

The CH1, CH2, CH3, CH4, CLEAR, AND, OR, NOT, and EDGE pushbuttons are active in the PROG TRIG mode. These controls are explained next.

CH1, CH2, CH3, and CH4. The CH1, CH2, CH3, and CH4 pushbutton switches are used with the AND, OR and NOT pushbuttons to program the TRIGGER FUNCTION, (e.g., keystroke sequence; CH1 AND CH2 AND CH3 OR CH4).

AND. The AND pushbutton enters the logical AND operator into the Boolean TRIGGER FUNCTION. AND serves as a delimiter for the CH1 through CH4, NOT, and EDGE pushbuttons.

OR. The OR pushbutton enters the logical OR operator into the Boolean TRIGGER FUNCTION. OR also serves as a delimiter for the CH1 through CH4, NOT, and EDGE pushbuttons.

CLEAR. The CLEAR pushbutton erases the TRIGGER FUNCTION program currently displayed by the TRIGGER FUNCTION indicators. The other stored TRIGGER FUNCTION program remains unaffected by the CLEAR operation (see A, B and A THEN B).

NOT. The NOT pushbutton is used to negate a variable in the Boolean TRIGGER FUNCTION. For example, if CH1 is entered into the TRIGGER FUNCTION display (that is, CH1 is an active HI, red), pressing the NOT key will change it to an active LO (green). Successively pressing the NOT key will alternately change the CH1 indicator from HI to LO; this sequence will continue until a delimiter is entered (AND or OR).

EDGE. The EDGE pushbutton is used to change a level sensitive variable in a Boolean TRIGGER FUNCTION from level to edge sensitive. The NOT pushbutton is used with the EDGE pushbutton to select falling edge sensitivity. For example, the keystroke sequence CH1 EDGE programs the 7A42 to trigger on the rising transition of CH1; the keystroke sequence CH3 NOT EDGE sets it to trigger on the falling transition of CH3. Pressing the EDGE key twice charges the channel to edge-sensitive and back to level-sensitive, similar to the operation of the NOT key.

The 7A42 allows one independent EDGE-sensitive channel per product in each TRIGGER FUNCTION (A and B).

NOTE

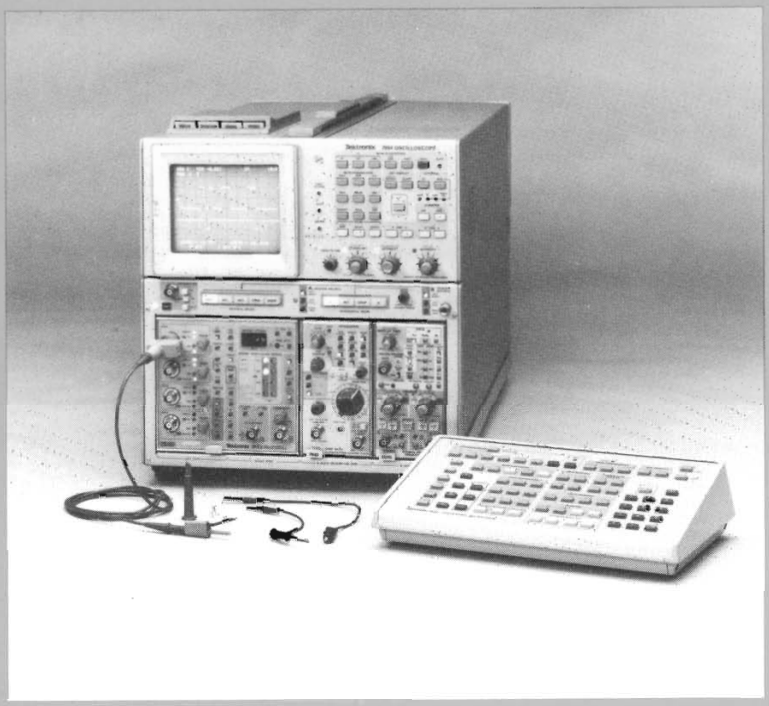
The channel (CH1, CH2, CH3 or CH4), EDGE, and NOT keys can be entered in any order. For instance, the keystroke sequences CH1 NOT EDGE, NOT CH1 EDGE, and EDGE NOT CH1 are equivalent.

If the product already contains one edge-sensitive channel at the time a second edge-sensitive channel is entered into the same product, the last entered channel will

receive the edge-sensitive status. The previous edge-sensitive channel will become level-sensitive only. This is because only one edge-sensitive channel per product is allowed. If the last entered channel is converted back to level-sensitive, the previous edge-sensitive channel will again become edge-sensitive.

SECTION THREE
APPLICATIONS

3



Shown above is the Tektronix 7A42, 7B87, and 7D15 installed in a Tektronix 7854 Oscilloscope.

The 7854 is a programmable waveform-processing oscilloscope that enables signal averaging, cursor measurements, and single-key waveform parameter measurements to save time and improve both accuracy and resolution.

When gated by the 7A42, the 7D15 Universal Counter/Timer can provide a numerical readout of the time, or number of clock cycles, between two independent digital events. It can also measure and display the duration, period, or frequency of a digital event.

SECTION 3 CONTENTS

APPLICATIONS

In this section we give some examples of how your 7A42 Logic Triggered Vertical Amplifier can be used in specific applications. These applications provide sufficient detail for you to adapt them to other related applications. Contact your Tektronix Field Office or representative for assistance in making measurements that are not described in this manual.

APPLICATION 1
DISPLAYING FOUR CHANNELS OF DATA WITH THE 7A42

High-speed delay comparisons and timing measurements on data lines are often difficult to accomplish with a high degree of accuracy. However, with less than 200 picoseconds time delay between any of the four input channels, the 7A42 makes these measurements with ease and confidence.

For example, the combinational triggering functions provided on the 7A42 front panel make it a simple matter to look at any count of a four-bit counter. A master clock signal can be connected to the 7A42 EXT CLOCK INPUT and displayed on the Trigger View trace.

MEASUREMENT TECHNIQUE

Figure 3-1 illustrates an example of viewing the output of a counter when the countdown reaches a value of decimal "10," where the LSB is displayed on the CH1 trace and the MSB is displayed on the CH4 trace. To accomplish this, enter the 7A42 Trigger Function: NOT CH1 AND CH2 AND NOT CH3 AND CH4.

The 7A42 can store and recall two independent trigger functions; function "A" and function "B." To enter these two trigger functions press the A pushbutton, enter the first Boolean trigger function equation, push the B pushbutton and enter the second Boolean trigger function equation. Either function may be recalled by merely selecting Trigger Function A or Trigger Function B. When the input signals satisfy the programmed logic function, the 7A42 will generate a trigger. The trigger can be routed externally to other measurement devices and/or internally through the 7000-series mainframe trigger path to a time base or special-purpose plug-in unit, in either horizontal compartment. No external connection to the time base is necessary to provide a triggered display on the oscilloscope crt.

The Trigger View trace enables you to see the state of the programmed trigger function in addition to the selected channel displays; see Figure 3-2. The Trigger

View trace is a representation of the trigger signal output, in the form of a small signal at the bottom of the crt. This signal is sent to the time base and to the front-panel TRIGGER OUT connector (if the External Clock Sync mode is not in use). The time registration accuracy of the Trigger View trace with the channel display(s) makes it useful in verifying when the programmed trigger condition indeed exists. The Trigger View trace can also be used to measure how long the trigger function is true.

Viewing The Master Clock Line

The Trigger View trace can display a fifth channel of data such as the master clock; see Figure 3-3. Applying the master clock signal to the EXT CLOCK INPUT

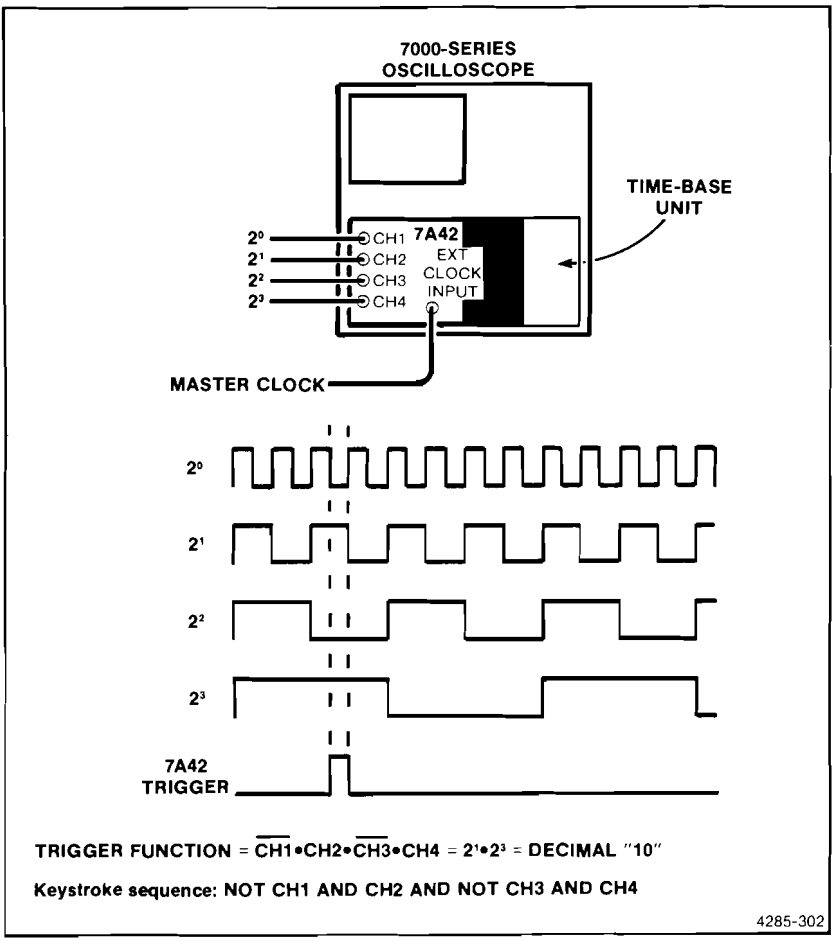


Figure 3-1. Triggering on the decimal "10" event.

enables the user to: 1) Qualify the Trigger Function on a positive or negative transition of the external clock input signal and 2) display that clock signal by selecting the Trigger View trace.

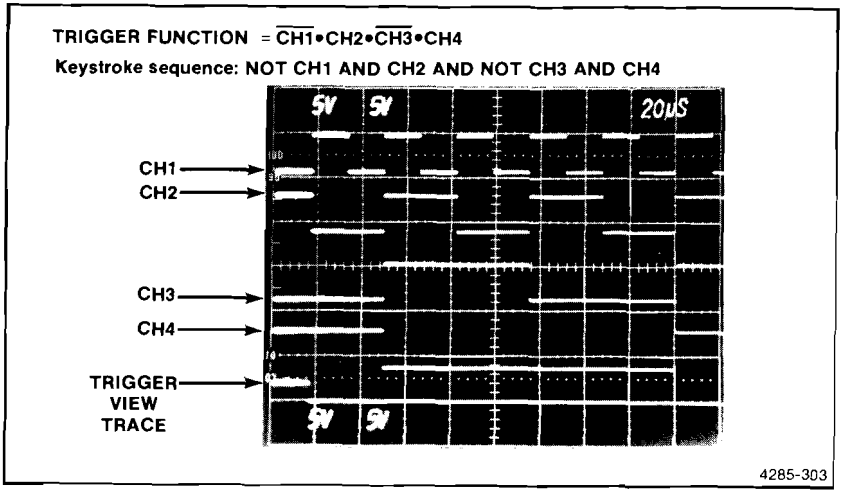


Figure 3-2. Display of four channels with TRIG VIEW trace.

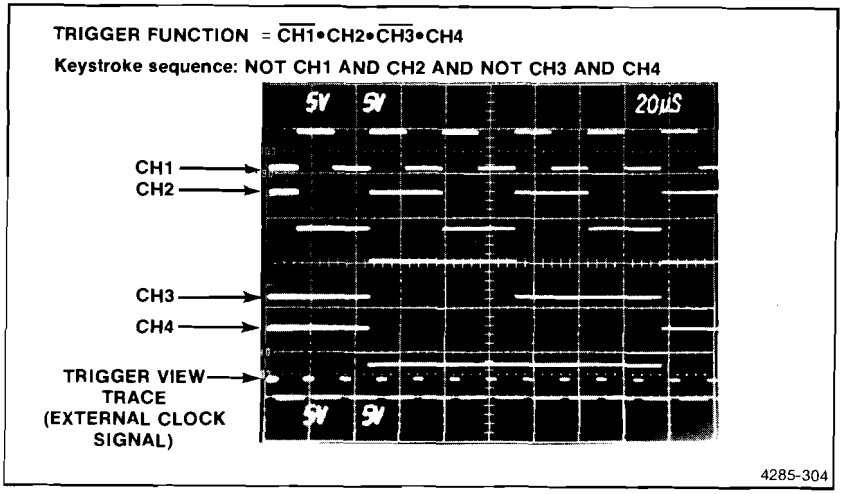


Figure 3-3. Four channel display with an external clock signal displayed on the TRIG VIEW trace.

APPLICATION 2
SOLVING ABNORMAL PULSE PROBLEMS WITH THE 7A42

Defective gates or timing errors in a logic system can produce low amplitude pulses which are not recognizable as valid logic levels. These abnormalities can introduce errors in the performance of a digital system which are very difficult to trace and locate.

To an ordinary oscilloscope triggering system, one pulse in a pulse train looks like any other. The oscilloscope can only recognize a pulse which has a higher-than-normal amplitude. A low-amplitude pulse can be difficult, if not impossible, to detect. Low amplitude pulses, or half-logic levels, can be detected by means of the 7A42 variable threshold feature. Each of the four channels can have a distinct threshold recognition level for a high- or low-logic level.

The 7A42 features an automatic preset TTL or ECL threshold level. If a variable threshold is needed, enter the Program Channel mode, turn the threshold monitor on, and select the channel whose threshold is to be varied. The LEVEL⇧ and LEVEL⇩ controls can then be used to set the desired threshold voltage. The threshold voltage for each channel can, in turn, be set individually in this manner.

MEASUREMENT TECHNIQUE

When one wants to trigger on a pulse that is somewhere in the TTL threshold region (+0.8V and +2.0V), a problem arises because the pulse is too low to be recognized as a TTL high level and too high to be recognized as a TTL low level; see Figure 3-4.

To locate and trigger on a TTL low amplitude pulse, connect the CH1 and CH2 probes to the same point on the signal under test and establish a dual threshold to bracket the suspected amplitude of the pulse as follows:

1. Set the CH1 SWITCHING THRESHOLD voltage for +2.0V and the CH2 SWITCHING THRESHOLD readout voltage for +0.8V.

2. Enter keystroke sequence NOT CH1 AND CH2. The 7A42 will monitor the data line looking for a pulse which is less than +2.0V (NOT CH1) and greater than +0.8V (AND CH2) in amplitude.

The time base should be set to Auto trigger and +Slope so that it will trigger on the positive slope of the signal from the dc coupled internal source. Because the same signal is present on CH1 and CH2, only one channel need be displayed. Even though only one channel is displayed, both CH1 and CH2 will contribute to the trigger function.

Because valid logic signal transitions also cross the voltage window between the CH1 and CH2 thresholds, trigger outputs may occur when the signals pass through this transition region. The 7A42 TRIGGER FILTER control can be used to

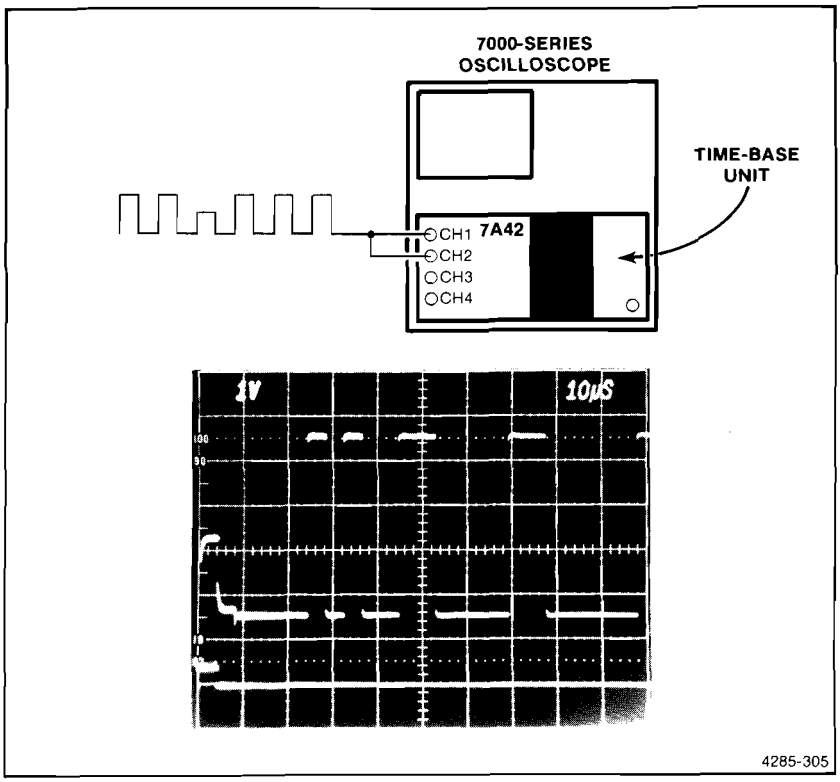


Figure 3-4. Triggering on a low-amplitude pulse.

prevent triggering on these normal transitions, and at the same time allow the low amplitude pulse of a slightly longer duration to be detected.

APPLICATION 3
ADDING EDGE SENSITIVITY TO YOUR TRIGGER FUNCTION

When developing a microprocessor based system, it is important to ensure that data being "read" from or "written" into memory remains stable at specified times. The 7A42 Logic Triggered Vertical Amplifier can monitor these data lines and trigger on an error condition by means of its level and edge sensitive Trigger Function features.

In addition to recognizing logic high and low levels, the 7A42 can incorporate one edge sensitive channel into each product (AND function). Because each Trigger Function (A or B) can contain two products, two independent Edge operators per Trigger Function are available. Edge-sensitive triggering can monitor data lines and check to ensure that the data remains stable.

MEASUREMENT TECHNIQUE

Figure 3-5 illustrates the timing requirements of a typical microprocessor read cycle. The Data bus may change states during the first 200 nanoseconds of the cycle but must remain stable during the final 100 nanoseconds while the

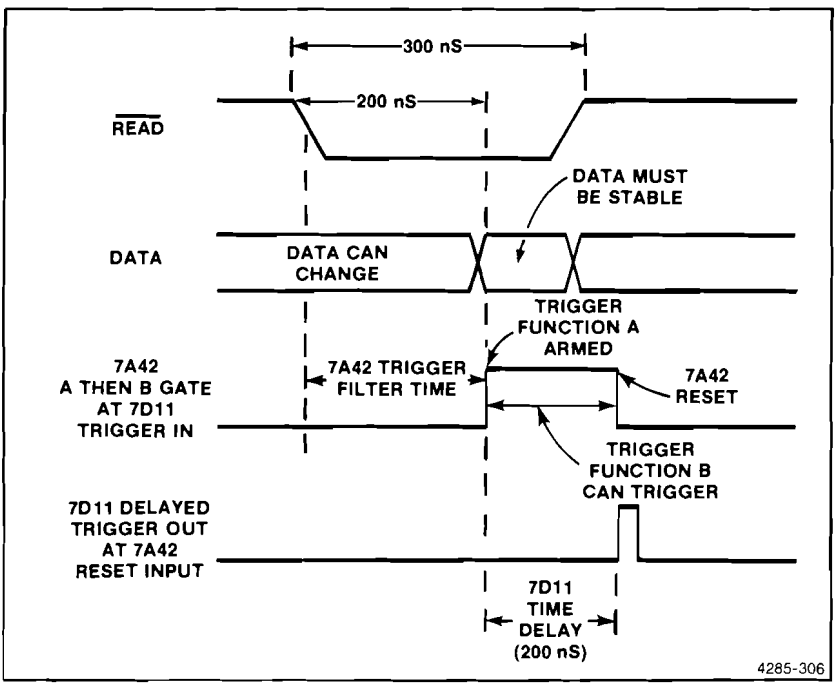


Figure 3-5. Timing diagram of a typical microprocessor read cycle.

microprocessor is actually latching the data in. The 7A42's A THEN B mode will be used to create a "nested" trigger function. Trigger Function A must first arm the 7A42 before the next occurrence of Trigger Function B will generate a trigger output signal. In this application, Trigger Function A looks for a low level on the read strobe, but will not arm the trigger until the time selected by the TRIGGER FILTER control has elapsed. Trigger Function B will then await any transition on the data line during the remainder of the strobe pulse. The 7D11 Digital Delay unit can be used to reset the Trigger Function if the error condition does not occur on a given read cycle.

For this measurement, only two of the 7A42 input channels need be used. CH1 can be connected to the memory "Read" line and CH2 can monitor the "Data" line. The 7A42 will "babysit" these lines and trigger on any occurrence of either an invalid positive or negative transition on the Data line during a Read operation. If the 7A42 produces no trigger signal the stability of the design can be assured. If a trigger does occur, the 7A42 will display the error condition. Timing problems that recur at very slow repetition rates, and happen rarely or at random can be viewed using a storage oscilloscope. A fast-writing-rate real-time oscilloscope can also be used with a camera to record the event.

Figure 3-6 shows how to set up the measurement and Figure 3-7 shows the display. The 7A42 has captured a data line transition 10 nanoseconds before the end of the read cycle during the time that data should remain stable. Notice that no trigger pulse (TRIG VIEW) corresponds to the falling data transition that occurrs 140 nanoseconds into the next read cycle, because that data transition falls within the time that the data may still change. Trigger Function A arms when a low level Read strobe occurs after the TRIGGER FILTER control time has elapsed. Trigger Function B causes a trigger if, during the remainder of the low level Read strobe, either a positive or a negative transition of the data line occurs.

The variable TRIGGER FILTER control should be used to prevent arming before the time window of the actual "Read" operation. The TRIGGER FILTER control can be set to prevent arming of the 7A42 for up to 300 nanoseconds. For example, with the TRIGGER FILTER control set for approximately 200 nanoseconds, the "Read" line must remain low longer than 200 nanoseconds in order for Trigger Function A to be armed. To set the TRIGGER FILTER control for 200 nanoseconds, select Trigger Function A with the TRIGGER FILTER control turned off (fully counterclockwise). Note the pulse width of the Read strobe. Now turn the TRIGGER FILTER control clockwise until the width of the Read strobe is shortened by 200 nanoseconds. The triggering is now at that point of the Read cycle after which the Data lines must remain stable. The TRIGGER FILTER control will operate only on Function A, because Function B will contain an edge sensitive channel. (The Trigger Filter responds only to level-sensitive Trigger Functions.)

The 7D11 is used in the delay by time mode. It begins counting when Function A is recognized and times out shortly after the end of the Read strobe. A positive transition on the 7A42's A THEN B Gate out will start the 7D11's count. The 7D11 receives this gate signal internally through the 7000-series main interface. At the end of its programmed time interval, the 7D11 resets the 7A42. This enables the 7A42 to prepare for the next event even if Trigger Function B is never recognized.

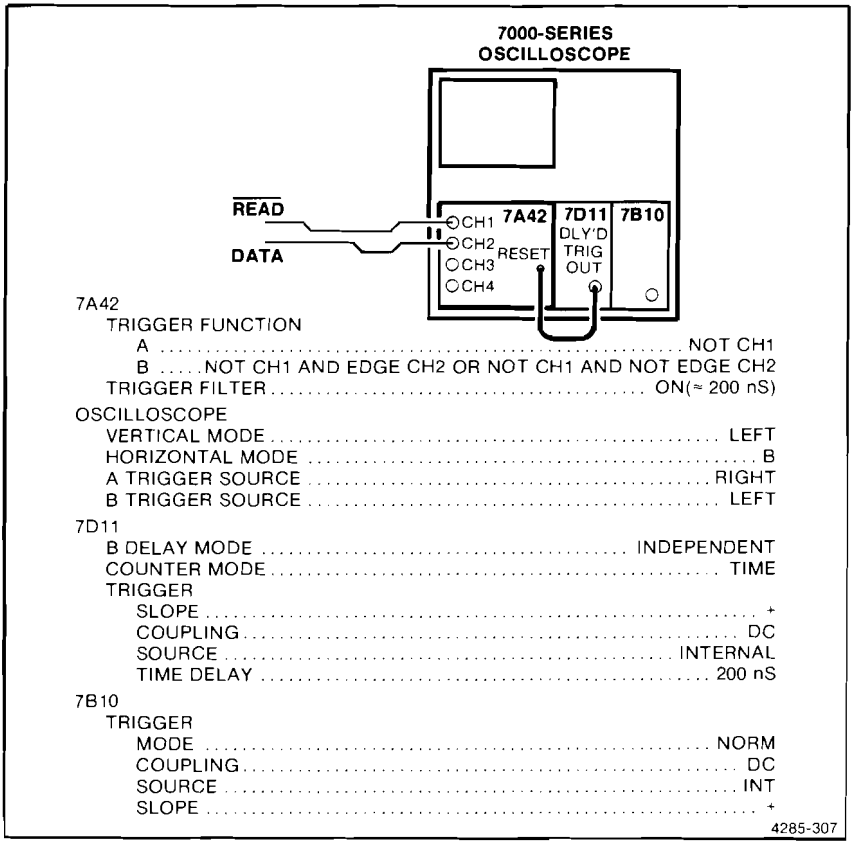


Figure 3-6. Set up to monitor invalid data transitions.

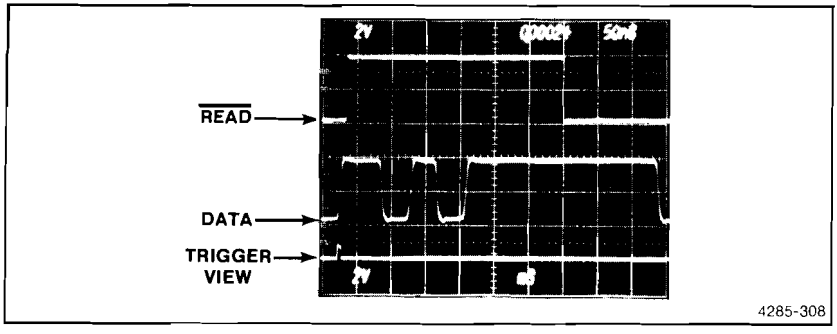
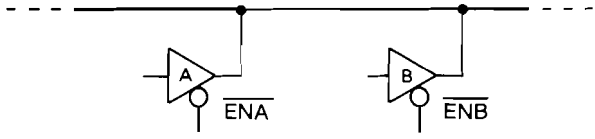


Figure 3-7. The 7A42 captures a positive transition of data during the time data should be stable.

APPLICATION 4
DETECTING AND DISPLAYING BUS CONTENTION

In bus-oriented systems, one problem which is difficult to detect with either an oscilloscope or a logic analyzer is that of bus contention. Bus contention arises when more than one component attempts to drive a common bus at the same time.

Consider the simple circuit shown below. Three-state bus drivers A and B both connect to the same line of a data bus. If both drivers are enabled at the same time, due to a circuit fault or poor design, their outputs will contend with each other if they are attempting to establish high and low levels simultaneously. In this situation, an invalid logic level could exist and improper data could be transferred.

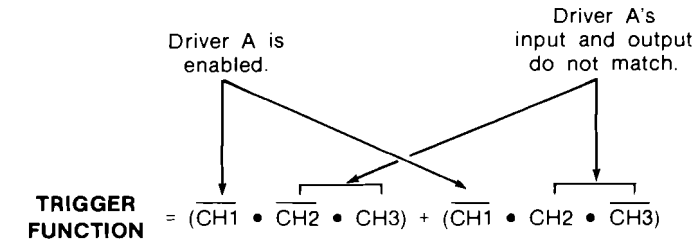


Bus contention can also create a substantial power supply glitch. This fault condition is very difficult to detect with an ordinary oscilloscope due to the aperiodic nature of bus activity. Also, the level and slope triggering system of a conventional oscilloscope provides no way of recognizing this type of condition.

MEASUREMENT TECHNIQUE

The 7A42 enables one to easily detect and trigger on a bus contention condition in order to trace the source of the error and isolate the problem. When driver A is enabled (CH1 low) the signal at the input of driver A (CH2) should match the signal on the bus line (CH3) except for an instant of time equal to driver A's propagation delay.

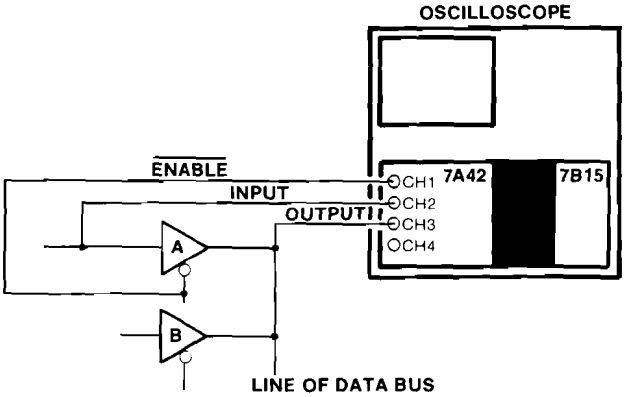
Set the 7A42 to trigger when the above condition is not met; that is, when the input and output do not match. At this time some other driver on the bus is overpowering driver A's output. The drivers propagation delay causes a mismatch that can be ignored by using the TRIGGER FILTER Control.



Connect channels 1, 2, and 3 to a suspected bus driver as shown in Figure 3-8.

TRIGGER FUNCTION = $(\overline{CH1} \bullet \overline{CH2} \bullet CH3) + (\overline{CH1} \bullet CH2 \bullet \overline{CH3})$

Keystroke sequence: NOT CH1 AND NOT CH2 AND CH3 OR NOT CH1 AND CH2 AND NOT CH3



MAINFRAME
- VERTICAL MODE ..... LEFT
- HORIZONTAL MODE ..... B
- B TRIGGER SOURCE ..... LEFT

7B15
- TRIGGER
  - MODE ..... NORMAL
  - SOURCE ..... INT
  - COUPLING ..... DC
  - SLOPE ..... POSITIVE

7A42
- TRIGGER FILTER ..... On ≈ 9 o'clock

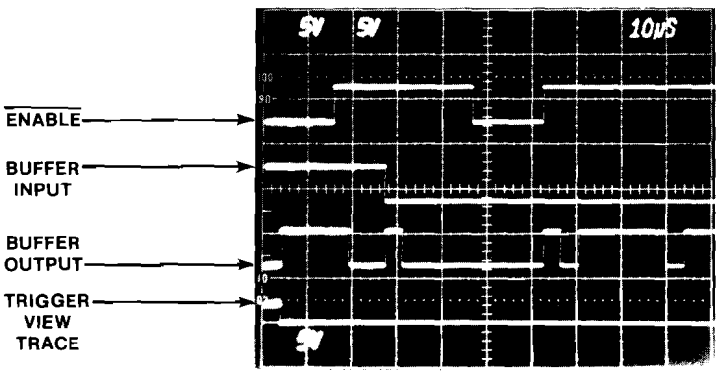


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Figure 3-8. Bus contention measurement set up.

APPLICATION 5
ENHANCED NESTED TRIGGERING USING THE 7D15 225 MHz UNIVERSAL COUNTER/TIMER

The use of an oscilloscope to trigger on (and display) an event is helpful when trying to solve a problem. Sometimes, however, a visual representation does not provide enough information to deal with the problem. Additional data showing how much time has elapsed between occurrences of the event, how many clock cycles separate the events, and how many repetitions of the event occur in a given time interval can aid troubleshooting and reduce design time.

Combining the nested triggering ability of the 7A42 with time, frequency, and events measurement capabilities of the 7D15 225 MHz Universal Counter/Timer, provides a powerful design evaluation and troubleshooting tool. Using the 7A42's A THEN B Gate signal to gate the counting and timing system in the 7D15 allows a variety of difficult measurements. The 7D15 can measure the width of the 7A42's A THEN B Gate to determine how much time elapsed between Trigger Function A and Trigger Function B. The 7D15 will also function as a gated-events counter capable of counting the number of cycles between Trigger Function A and Trigger Function B, or as an events counter to provide a total count of trigger events over an extended period of time (e.g., reliability testing).

EVENTS COUNTING

No matter what mode of operation the 7A42 is in, the 7D15 can count the number of triggers generated by the 7A42 over a predefined period. No external connections are necessary to accomplish this. With the 7A42 occupying the two leftmost compartments and the 7D15 occupying the horizontal "A" compartment, 7A42 trigger signals are sent directly to the counter along the 7000-Series mainframe trigger path. To count the number of errors occurring in a digital system, make the necessary connections of the data lines to the 7A42's input channels, program the trigger function to recognize the error condition, and set the 7D15 as follows:

7D15 Settings:
- Mode ..... Frequency B
- Storage ..... Off
- Gate ..... On
- Trigger B
  - Source ..... Trigger Source
  - Slope ..... +
  - Coupling ..... DC
  - Level ..... Preset

Mainframe Settings:
- A Trigger Source ..... Left Vertical

The 7D15 will keep a running count of the number of triggers generated by the 7A42 and display the total on the mainframe crt.

COUNTING CLOCK CYCLES BETWEEN EVENTS

The 7A42's Trigger Function A and Trigger Function B can be programmed to recognize two independent events, and the 7D15 will count the number of clock cycles occurring between the two events. The 7A42's A THEN B Gate out is sent to the 7D15 via the 7000-series mainframe trigger path. This gate tells the 7D15 to count clocks on its "B" input while the A THEN B Gate is high. To begin, you must program the 7A42's Trigger Function. Start with Function A which will arm the 7A42 and cause the A THEN B Gate to go high when recognized. Then enter Function B which, when recognized, will cause the 7A42 to generate a trigger and send the A THEN B Gate low. Make the proper connections from the unit under test to the 7A42's input channels, set each channel for the desired logic family, impedance, threshold, and display characteristics, and enter the following 7D15 and mainframe settings:

7D15 Settings:

Connect clock signal from the unit under test to the 7D15 B input.

Gate	CH A Gate
Mode	Freq B
Display Time	0.1 sec
Storage	Off
Trigger A	
Source	Trigger Source
Slope	+
Coupling	DC
Level	Preset
Trigger B	
Source	Input B
Slope	As needed (clock polarity)
Coupling	As needed
Level	As needed (clock threshold)
Sensitivity	As needed

Mainframe Settings:

Set the Trigger Source for the compartment containing the 7D15 to Right Vertical.

MEASURING TIME FROM FUNCTION A TO FUNCTION B

The 7D15's accurate internal clock can be used to determine the elapsed time from recognition of Function A to recognition of Function B. The width of the 7A42's A THEN B gate out represents this time and can be measured by the 7D15 with no external connections. The 7D15 will receive this gate from the mainframe's trigger path, measure its width, and display the results of the measurement on the crt readout. For further information, refer to Mainframe A THEN B Gate Out Pulse Width in section 1 of this manual under specifications.

7D15 Settings:

- Gate ..... Normal
- Mode ..... TIM Width A
- Averg X10
- Clock ..... 10 ns
- Trigger A
  - Source ..... Trigger Source
  - Slope ..... +
  - Coupling ..... DC
  - Level ..... Preset

Mainframe Settings:

Set the Trigger Source for the compartment containing the 7D15 to Right Vertical.

APPLICATION 6
OFFSET PROBING TECHNIQUES FOR HIGH SPEED LOGIC SYSTEMS

Probing high-speed circuits with high impedance probes can cause ringing at high frequencies and significant degradation of rise and fall times. The 7A42 Logic Triggered Vertical Amplifier - P6230 Variable Bias/Offset Probe combination enables probing high-speed ECL logic with minimum circuit loading.

The P6230 Variable Bias/Offset Probe is a 10X, 450 ohm device. The bias voltage at the probe tip is continuously variable from -5V to +5V. It also features a built-in, 50-ohm termination resistor that can be switched in for use with 1 megohm amplifiers. This 50-ohm termination will be switched out in this application in favor of the 7A42's internal 50 ohm terminator. A variety of grounding schemes are possible with the P6230, including a low-inductance ground lead, and a printed-circuit-board adaptor. Ground leads should be as short as possible to minimize ringing. The low capacitance of the probe makes it advantageous for probing transmission line circuits. A high-fidelity signal representation is possible with less sensitivity to the length of the ground lead than with higher capacitance probes.

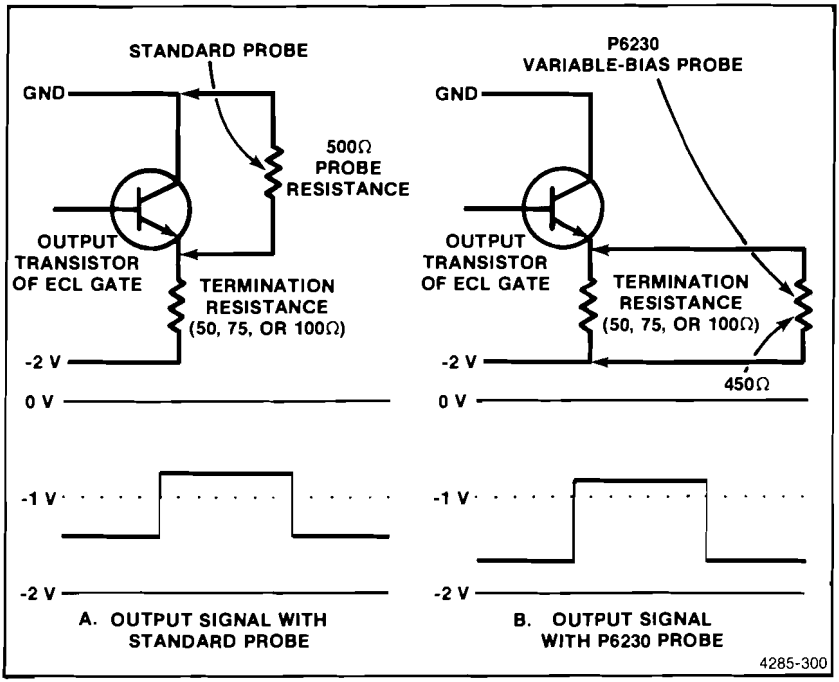

Figure 3-9. Standard 500-ohm probe forms voltage divider with termination resistor.

PROBING ECL CIRCUITS

ECL circuits are commonly operated with a -5.2 V and zero-volt Vee and Vcc supplies. For this configuration, a high logic level becomes -0.8V and a low logic level becomes -1.7V. The output of an ECL gate is the emitter of an NPN transistor (emitter follower stage) whose collector is connected to ground. The output of the gate must be pulled down to a negative supply with an external resistor to enable proper logic levels to exist. Transmission lines are often used to connect gates; the pull-down resistor can also terminate the transmission lines which often connect gates. This termination is usually 50, 75, or 100 ohms connected to a -2V supply.

To probe ECL, a 500 Ω 10X passive probe would be an attractive choice because of its very low input capacitance. However this probe's resistance, 500 Ω to ground, would form a voltage divider with the gate's output termination resistor. Figure 3-9 shows an ECL emitter-follower output stage being probed a) by a standard 500 Ω probe, and b) by the P6230 Variable Bias/Offset Probe. The divider can shift the ECL output signal levels with the low level affected most. The dc operating point of the gate output transistor is substantially altered when the standard probe is part of the circuit, as illustrated in Figure 3-9.

The P6230 solves this problem by providing a bias voltage at the probe tip (see Fig. 3-10). For ECL circuit probing, set the probe tip offset to the ECL low level or to the -2V termination voltage. The effect of the probe's resistance on the gate's termination resistance will be minimized. Figure 3-11 shows two superimposed waveforms. Waveform B was taken using a -2 volt bias offset. Waveform A was taken with no offset. Notice the reduced level shift and faster negative transition of waveform B.

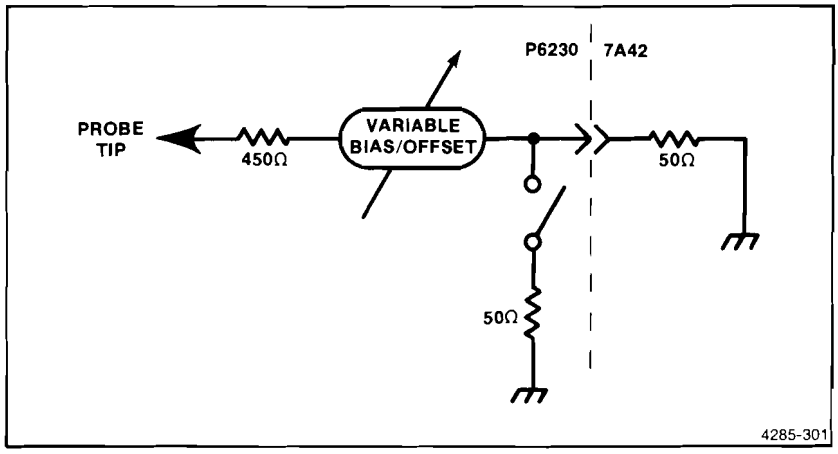

Figure 3-10. Simplified diagram of the P6230 Variable Bias/Offset probe.

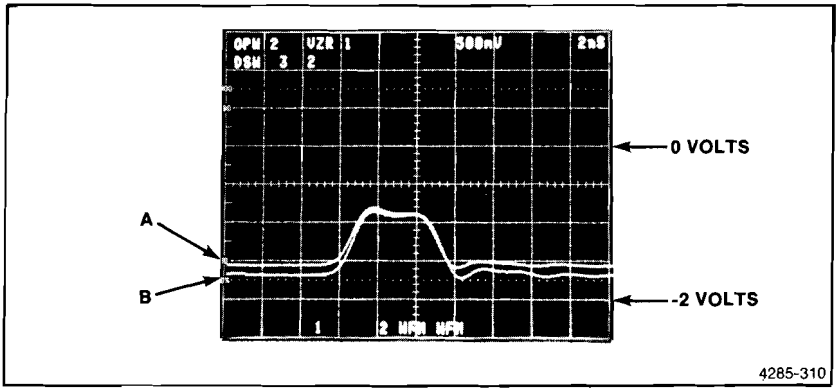

Figure 3-11. Two ECL level waveforms, A without bias offset, B with a -2 volt bias offset.

7A42 PROBE OFFSET FEATURE

The 7A42 features a built-in digital voltmeter which was designed to accommodate the P6230 Variable Bias/Offset Probe. Pressing the 7A42's PROBE OFFSET pushbutton while in the program channel mode with the SWITCHING THRESHOLD VOLTS monitor turned on, will cause the button to light red. This red light indicates that the digital voltmeter is enabled and ready to measure the probe offset. Place the tip of the probe into the 7A42's PROBE TIP jack and set the probe offset to the desired voltage. While holding the probe tip in the jack, push the PROBE OFFSET button again until it lights green. The offset for that particular channel has now been measured, acquired, and will be compensated for automatically when setting the threshold for that channel. In other words, the user, having acquired the probe offset for a particular channel, need not take that offset into account when setting the logic threshold for that channel.

When using the P6230, remember the first step is to acquire the probe offset value into the 7A42. Next set the Switching Threshold Voltage with the LEVEL buttons to a value appropriate for the logic family under test. The Switching Threshold Voltage at the probe tip is indicated in the numerical display.

APPLICATION 7
USING THE 7A42 WITH THE 7854

The TEKTRONIX 7854 is a waveform-processing oscilloscope. It combines the high performance of a 7000-series real-time mainframe with digital storage and extensive processing capability.

7A42 measurements with the 7854 are more accurate and faster than with a conventional oscilloscope. The 7854 digitizes signals in up to 1,024 point records with 10 bit (0.01 division) vertical resolution. Single and dual cursors enable precise time and amplitude measurements. Single keystrokes instantly calculate the most common waveform and pulse parameters (e.g., risetime, delay, peak-to-peak, etc). Signal averaging will recover the true signal from noisy obscurity.

Up to 16 waveforms (40 with Option 2D) can be stored and recalled for later measurement or comparison.

To digitize with the 7854 and 7A42, first ensure that the 7A42 is in the proper operational mode for the 7854. There is an internal jumper that must be properly positioned by qualified service personnel as detailed in the 7A42 Service Manual. This ensures that readout and waveform acquisition will be consistent.

Valid display conditions for digitizing are:

1. Any single channel displayed alone (CH1, CH2, CH3, CH4, or TRIG VIEW).

2. Channels 1 and 2 only displayed together, ALT display mode selected.

3. Channels 3 and 4 only displayed together, ALT display mode selected.

Other channel combinations should be avoided for 7854 acquisitions. Only a single channel can be displayed when signal averaging. Single channels displayed alone will always be acquired as the 0WFM. Channels 1 and 2 (or 3 and 4) will always be acquired as 0WFM and 1WFM respectively. Trigger view may be acquired alone, but it will be assigned the default vertical deflection factor of unity (1/division).

You may notice the readout format change as channels are displayed or removed from the display. For example, .1V may become 100 mV. This is normal for a 7A42 in the "7854 operational mode," and does not affect measurements.

APPLICATION 8
USING THE 7A42 WITH THE 7104

The TEKTRONIX 7104 Oscilloscope is a one gigahertz mainframe that is an ideal companion to the 7A42 Logic Triggered Vertical Amplifier. The bandwidth of the 7104 accommodates the full specified 7A42 system bandwidth of 350 MHz for high speed logic.

An equally impressive capability is the fast writing rate of the 7104 microchannel plate crt. At fast sweep rates the 7104 trace is much brighter than conventional oscilloscopes. High transition pulses at low-speed duty cycles can be easily seen under normal lighting conditions without the annoying baseline blooming as on conventional oscilloscopes.

The 7104's crt brightness is particularly useful with the 7A42. High-speed pulses are immediately apparent. Trigger combinations that are seldom realized will still result in a bright, usable display.

Additionally, the 7104 is useful in conjunction with the 7A42 trigger view feature, where conventional oscilloscopes would have difficulty displaying an "Edge-Qualified" trigger function at slow speeds.

SECTION FOUR
INSTRUMENT OPTIONS

No options existed for the 7A42 at the time of this printing. Information about any subsequent options will be included in the CHANGE INFORMATION section at the back of this manual.

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7A42 Operator Messages

Code	Mnemonic	Description and Corrective Action
1	**OVERLOAD**	A channel input is overloaded. Remove the overvoltage and unground the channels to continue operation.
2	**OFFSET ACQ**	A key was pressed while Probe Offset acquisition was in progress. Push PROBE OFFSET once to lock in acquired value, or twice to turn PROBE OFFSET off, before continuing operation.
3	**PUSH PROG**	Key(s) pressed is/are active only in PROG CHAN mode. To use key, first press PROG CHAN.
4	**PUSH PROG**	Key(s) pressed is/are active only in PROG TRIG mode. To use key, first press PROG TRIG.
5	**AND/OR REQ**	While programming a trigger function, a CH1, CH2, CH3, CH4, NOT, or EDGE was pressed when an AND or an OR key was expected.
6	**CH KEY REQ**	While programming a trigger function, two Boolean operator keys (AND or OR) were pressed without pressing a channel key (CH1, CH2, CH3, or CH4) in between. Channel keys and Boolean operator keys should be pressed alternately, e.g., CH1 AND NOT CH2 OR CH3 EDGE.
7	**OR IS FULL**	The OR key was pressed again. Only one TRIGGER FUNCTION OR is allowed.
8	**EXTCLK ON**	The EDGE key was pressed while in the EXT CLOCK SYNC mode. The selection of an EDGE sensitive channel and the EXT CLOCK SYNC mode are mutually exclusive. If EDGE sensitivity is desired, first turn off the EXT CLOCK SYNC mode.
9	**EXTCLK REQ**	The EXT CLOCK slope key was pressed when the EXT CLOCK SYNC button was turned off. The EXT CLOCK SYNC slope key is operational only when the EXT CLOCK SYNC button is turned on.
10	**EDGE IS ON**	The EXT CLOCK SYNC key was pressed when one of the trigger functions (either A, B, or both) already have an EDGE sensitive channel. Channel EDGE sensitivity and EXT CLOCK are mutually exclusive. If EXT CLOCK SYNC operation is desired, first CLEAR the channel EDGE sensitive trigger function.
11	**THRESH REQ**	Either a LEVEL key or the PROBE OFFSET key was pressed without pressing the THRESH key first. The THRESH key must be lit to change a threshold level or acquire a probe offset.
12	**NO FUNC A**	The A THEN B key was pressed without having programmed function A; or while in A THEN B mode function A was CLEARed. Both trigger functions (A and B) must be programmed for proper A THEN B operation. Program function A; then proceed.
13	**NO FUNC B**	The A THEN B button was pressed without having programmed function B; or while in A THEN B mode function B was CLEARed. Both trigger functions (A and B) must be programmed for proper A THEN B operation. Program function B; then continue.

WARNING BEEPS: Although no messages are displayed, short warning beeps are issued to indicate "out of range." A beep will sound when the VOLTS/DIV keys are pushed beyond the available selections or when the variable threshold level reaches its limits.

NOTE

The audible beep can be turned off; refer qualified Service Personnel to the 7A42 Service Manual (Volume 1).