

FACTORY CALIBRATION PROCEDURE

CONTENTS:

This is the guide for calibrating new instruments in Product Manufacturing. The procedure consists of 4 sections:

Equipment Required

Factory Test Limits - Factory Test Limits are limits an instrument must meet before leaving Manufacturing. These limits are often more stringent than advertised performance requirements. This is to insure that the instrument will meet advertised requirements after shipment, allows for individual differences in test equipment used, and (or) allows for changes in environmental conditions.

Short Form Procedure - The Short Form Procedure has the same sequence of steps and the same limits on checks or adjustments as the Main Procedure.

Main Procedure - The Main Procedure gives more detailed instructions for the calibration of the instrument. This procedure may require that some checks and adjustments be made so that performance is better than that required by the Factory Test Limits. This insures the Factory Test Limits will be met when side panels are added, permits some normal variation in test equipment and plug-in scopes, etc.

Abbreviations in this procedure will be found listed in TEKTRONIX STANDARD A-100. Definitions of terms used in this procedure may be found in TEKTRONIX STANDARD A-101.

In this procedure, all front panel control labels and Tektronix instrument names are in capital letters (VOLT/DIV, etc). Internal adjustment labels are capitalized only (Gain Adj, etc).

CHANGE INFORMATION:

This procedure has been prepared by Product Manufacturing Staff Engineering. For information on changes made to this procedure, to make suggestions for changing this procedure, or to order additional copies: please contact PMSE, 39-307. (CS)

*This procedure is
company confidential*

R116

June 1968

For all serial
numbers above 1000.



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PMSE

COMPANY CONFIDENTIAL

EQUIPMENT REQUIRED:

The following equipment is necessary to complete this procedure:

a. TEKTRONIX Instruments

- 1 TYPE 547 OSCILLOSCOPE
- 1 TYPE 1A1 DUAL-TRACE PLUG-IN UNIT
- *1 TYPE W PLUG-IN UNIT
- 1 TYPE 561A OSCILLOSCOPE
- 1 TYPE 3S1 DUAL-TRACE SAMPLING UNIT
- 1 TYPE 3T2 RANDOM SAMPLING SWEEP
- *1 TYPE 184 TIME-MARK GENERATOR
- 1 TYPE 191 CONSTANT AMPLITUDE SIGNAL GENERATOR
- 2 TYPE P6028 PROBES
- 1 TYPE 76TU LINE VOLTAGE CONTROL UNIT

b. Test Fixtures and Accessories

- 1 DC Voltage Bridge (DCVB) (067-0543-99)
- 1 STANDARD AMPLITUDE CALIBRATOR (SAC) (067-0502-00)
- 1 SINE-WAVE GENERATOR (067-0542-99)
- *1 50 Ω Precision Termination (011-0099-00)
- 2 50 Ω BNC Terminations (011-0049-00)
- 1 GR 50 Ω X10 Attenuator (017-0078-00)
- 2 BNC to GR Adapters (017-0064-00)
- 1 5ns Cable (017-0502-00)
- 2 50 Ω BNC cable (012-0057-00)
- 1 R116 Remote Program Test Fixture (PMIE Dwg #1647-C)
- 1 1k Ω Termination (PMIE Dwg #1804-B)

c. Other equipment

- 1 20,000 Ω /VDC Multimeter

* Equipment must be traceable to NBS for certification of measurement characteristics.

Substitute test equipment may be used. The Plant Staff Engineer must approve any substitutions. All equipment listed must perform within its manufacturer's specifications, unless otherwise stated.

FACTORY TEST LIMITS

QUALIFICATION

Factory Test Limits are qualified by the conditions specified in the main body of the Factory Calibration Procedure. The numbers and letters to the left of the limits correspond to the procedure steps where the check or adjustment is made. Steps without Factory Test Limits (set-ups, presets, etc.) are not listed. Instruments may not meet Factory Test Limits if calibration or checkout methods and test equipment differ substantially from those in this procedure.

5. POWER SUPPLIES

- c. Power Supply accuracy and ripple, 94.5VAC to 137.5VAC line

Supply	Voltage Limit	Ripple Limit
+25V	±0.25V	<15mV
-27V	±0.6V	<15mV
-6V	±0.5V	<30mV
+7V	±1V	<50mV
-13.5V	±2V	<20mV
+12.4V	±1V	
+9.5V	±0.7V	

10. PROGRAM CLAMP

- b. Program Clamp
(Output Level: 0V ±0.8V)

11. DC OFFSET ACCURACY

- b. Internal DC OFFSET ±(5% +200mV)
c. Remote DC OFFSET ±(7% +200mV)

12. AMPLITUDE ACCURACY

- *b. + Pulse amplitude
1V Range: ±(2% +50mV)
.5V Range: ±(2% +25mV)
.2V Range: ±(2% +15mV)
*c. AMPLITUDE MULTIPLIER
±(2% +50mV)
*d. - Pulse amplitude
1V Range: ±(2% +50mV)
.5V Range: ±(2% +25mV)
.2V Range: ±(2% +15mV)

- *e. Remote amplitude
1V Range: ±(4% +50mV)
.5V Range: ±(4% +25mV)
.2V Range: ±(4% +15mV)

13. 1μS & 100nS RISETIME AND FALLTIME

- g. RISETIME MULT and FALLTIME MULT ±4%
h. 100nS RISETIME FALLTIME RANGE ±4%
i. 1μS and 100nS RISETIME FALLTIME RANGE, Remote ±6%

14. 1nS & 10nS RISETIME AND FALLTIME RANGE

- b. 1nS RISETIME FALLTIME RANGE ±10%
c. 1nS RISETIME FALLTIME RANGE, Remote ±12%
d. 10nS RISETIME FALLTIME RANGE, ±10%
e. 10nS RISETIME FALLTIME RANGE, Remote ±12%

16. PULSE WIDTH

- *d. 1μS & 100nS WIDTH RANGE ±3%
*e. WIDTH MULTIPLIER ±3%
*f. 10nS Width ±5%
*g. 50nSEC Width ±5%
*h. Remote WIDTH RANGES
10μS RANGE: ±5%
1μS RANGE: ±5%
100nS RANGE: ±5%
10nS RANGE: ±7%

17. PULSE ABERRATIONS

- b. + Pulse Overshoot +3%, -3%, total 3% P-P
c. + Pulse level +3%, -3%, total 3% P-P
d. - Pulse aberrations +3%, -3%, total 3% P-P
e. Pulse aberrations, REMOTE POLARITY +5%, -5%, total 5% P-P

18. PULSE PERIOD

- *d. PERIOD MULTIPLIER ±2%
*e. 100ns Period ±4%
*f. 1μS Period ±2%
*g. 100μS PERIOD RANGE ±2%
*h. 10μS PERIOD RANGE ±2%

i. Remote PERIOD

- 100nS RANGE: $\pm 6\%$
- 1 μ S RANGE: $\pm 4\%$
- 10 μ S RANGE: $\pm 4\%$
- 100 μ S RANGE: $\pm 4\%$
- 1mS RANGE: $\pm 4\%$

20. 10 μ S DELAY RANGE

- *d. DELAY MULTIPLIER $\pm 2\%$

21. 10nS DELAY RANGE

- *b. 50nS Delay $\pm(2\% + 10\text{ns})$
- *c. 500ns Delay $\pm(2\% + 10\text{ns})$
- *d. 10nS DELAY RANGE, - Pulse
 $\pm(2\% + 10\text{ns})$
- *e. 10nS DELAY RANGE, Remote
 $\pm(4\% + 10\text{ns})$

22. DELAY OR BURST TIME

- *b. DELAY or BURST TIME $\pm(2\% + 10\text{ns})$
- *c. DELAY OR BURST TIME $\pm(4\% + 10\text{ns})$

23. + TRIGGER INPUT

- b. EXTERNAL triggering with sinewave
Stable triggering at:
1kHz with $\geq 4\text{V}$ to $\leq 40\text{V}$ P-P
10kHz with $\geq 4\text{V}$ to $\leq 40\text{V}$ P-P
100kHz with $\geq 4\text{V}$ to $\leq 40\text{V}$ P-P
1MHz with $\geq 4\text{V}$ to $\leq 40\text{V}$ P-P
5MHz with $\geq 4\text{V}$ to $\leq 10\text{V}$ P-P
10MHz with ≥ 6 to $\leq 8\text{V}$ P-P
- c. Manual trigger
Stable triggering in all modes
except GATED OUTPUT

24. TRIGGER OUTPUT

- a. + PRETRIGGER OUT
Amplitude: $\geq +2\text{V}$
- b. + DELAYED TRIGGER OUT
Amplitude: $\geq +2\text{V}$

25. GATED OUTPUT MODE

- b. GATED OUTPUT MODE
Gated output with +2V to +10V
+GATE IN
- c. REMOTE GATED OUTPUT MODE
Gated output with +2V to +10V
+GATED IN

*Indicates measurement characteristics;
test equipment used must be traceable
to NBS for instrument certification.

THE END

SHORT FORM PROCEDURE

Factory Test Limits are limits an instrument must meet before it leaves Manufacturing; therefore, it must be possible to inspect to these limits. Because of normal variations in test equipment and plug-in scopes, addition of side panels, etc, it is necessary to set up some circuits so their performance is better than required by Factory Test Limits. Therefore, the instructions given in the Factory Calibration Procedure may call for checks or adjustments which result in less error than that allowed by the Factory Test Limits.

1. FUSES F401 & F402 0.6A S10-B10

2. PRESETS

- a. Preset TYPE R116 controls
- b. Preset TYPE R116 internal adjustments
- c. Preset R116 Remote Program Test Fixture controls
- d. Preset TYPE 547 controls
- e. Preset TYPE W controls

3. RESISTANCE

- a. Check Remote Program Input Resistance
- b. Check Power Supply resistance

4. LINE VOLTAGE SELECTOR

5. POWER SUPPLIES

- a. Setup
- b. Adjust +25V, R14 (I)

- c. Check power supply accuracy and ripple, 94.5VAC to 137.5VAC line.

<u>Supply</u>	<u>Voltage Limit</u>	<u>Ripple Limit</u>
+25V	$\pm 0.25V$	$\leq 15mV$
-27V	$\pm 0.6V$	$\leq 15mV$
-6V	$\pm 0.5V$	$\leq 30mV$
+7V	$\pm 1V$	$\leq 50mV$
-13.5V	$\pm 2V$	$\leq 20mV$
+12.4V	$\pm 1V$	
+9.5V	$\pm 0.7V$	

6. DC OFFSET RANGE CAL

- a. Setup
- b. Preset + Offset Zero, R466
- c. Adjust Offset Range, R32(N)

7. DC OFFSET CAL

- a. Setup
- b. Adjust DC Offset Cal, R544

8. + PULSE DC LEVEL AND AMPLITUDE CAL

- a. Setup
- b. Adjust Baseline Clamp, R25 (M)
- c. Adjust + Offset Zero, R466
- d. Adjust Range Cal, R85 (F)
- e. Adjust Amplitude Mult Cal, R532

9. - PULSE DC LEVEL AND AMPLITUDE CAL

- a. Setup
- b. Adjust - Offset Zero, R476
- c. Adjust - DC Level, R34(M)
- d. Adjust - Amplitude, R42(M)
- e. Check -2V (AMPLITUDE 1V X2)
 $\pm(2\% + 50mV)$

10. PROGRAM CLAMP

- a. Setup
- b. Adjust Program Clamp, R54(N)
Output Level: 0v $\pm 0.8V$

11. DC OFFSET ACCURACY

- a. Setup
- b. Check internal DC OFFSET
 $\pm (5\% + 200\text{mV})$
- c. Check remote DC OFFSET
 $\pm (7\% + 200\text{mV})$

12. AMPLITUDE ACCURACY

- a. Setup
- b. Check + Pulse amplitude
 - 1V Range: $\pm (2\% + 50\text{mV})$
 - .5V Range: $\pm (2\% + 25\text{mV})$
 - .2V Range: $\pm (2\% + 15\text{mV})$
- c. Check AMPLITUDE MULTIPLIER
 $\pm (2\% + 50\text{mV})$
- d. Check - Pulse amplitude
 - 1V Range: $\pm (2\% + 50\text{mV})$
 - .5V Range: $\pm (2\% + 25\text{mV})$
 - .2V Range: $\pm (2\% + 15\text{mV})$
- e. Check Remote amplitude
 - 1V Range: $\pm (4\% + 50\text{mV})$
 - .5V Range: $\pm (4\% + 25\text{mV})$
 - .2V Range: $\pm (4\% + 15\text{mV})$

13. $1\mu\text{S}$ & 100nS RISETIME AND FALLTIME

- a. Setup
- b. Adjust T_r centering and T_f centering,
R32(F) and R42(F)
- c. Adjust T_r Timing, R64(F)
- d. Adjust T_f Timing, R54(F)
- e. Adjust Risetime Mult Cal, R564
- f. Adjust Falltime Mult Cal, R554
- g. Check RISETIME MULT and FALLTIME
MULT $\pm 4\%$
- h. Check 100nS RISETIME FALLTIME RANGE
 $\pm 4\%$
- i. Check $1\mu\text{S}$ and 100nS RISETIME FALLTIME
RANGE, Remote $\pm 6\%$

14. 1nS & 10nS RISETIME AND FALLTIME RANGE

- a. Setup
- b. Adjust 1nS RISETIME FALLTIME RANGE,
C72(F)
- c. Check 1nS RISETIME FALLTIME RANGE,
Remote $\pm 12\%$
- d. Check 10nS RISETIME FALLTIME RANGE
 $\pm 10\%$
- e. Check 10nS RISETIME FALLTIME RANGE,
Remote $\pm 12\%$

15. WIDTH GENERATOR TRIGGER SENSITIVITY

- a. Setup
- b. Adjust Trig Sens, R22(P)

16. PULSE WIDTH

- a. Setup
- b. Adjust Width Mult Cal, R522
- c. Adjust Width Timing, R41 (P)
- d. Check $1\mu\text{S}$ & 100nS WIDTH RANGE $\pm 2\%$
- e. Check WIDTH MULTIPLIER $\pm 2\%$
- f. Adjust 10nS Width, C32(P) $\pm 4\%$
- g. Adjust 50nSEC Width. R523 $\pm 4\%$
- h. Check Remote WIDTH RANGES
 - $10\mu\text{S}$ RANGE: $\pm 4\%$
 - $1\mu\text{S}$ RANGE $\pm 4\%$
 - 100nS RANGE: $\pm 4\%$
 - 10nS RANGE: $\pm 6\%$

17. PULSE ABERRATIONS

- a. Setup
- b. Adjust + Pulse Overshoot, C50(M)
 $+3\%$, -3% , total 3% P-P
- c. Adjust + Pulse level, C82(M)
 $+3\%$, -3% , total 3% P-P
- d. Check - Pulse aberrations:
 $+3\%$, -3% , total 3% P-P
- e. Check pulse aberrations,
REMOTE POLARITY $+5\%$, -5% , total
5% P-P

18. PULSE PERIOD

- a. Setup
- b. Adjust Period Mult Cal, R502
- c. Adjust Period timing, R34(B)
- d. Check PERIOD MULTIPLIER $\pm 2\%$
- e. Adjust 100ns period, C52(B) $\pm 3\%$
- f. Adjust $1\mu\text{S}$ Period, C55(B) $\pm 2\%$
- g. Check $100\mu\text{S}$ PERIOD RANGE $\pm 2\%$
- h. Check $10\mu\text{S}$ PERIOD RANGE $\pm 2\%$
- i. Check Remote PERIOD
 - 100nS RANGE: $\pm 5\%$
 - $1\mu\text{S}$ RANGE: $\pm 4\%$
 - $10\mu\text{S}$ RANGE: $\pm 4\%$
 - $100\mu\text{S}$ RANGE: $\pm 4\%$
 - 1mS RANGE: $\pm 4\%$

19. DELAY GENERATOR TRIGGER SENSITIVITY

- a. Setup
- b. Adjust Trig Sens, R22(C)

20. 10 μ S DELAY RANGE

- a. Setup
- b. Adjust Delay or Burst Time Mult Cal, R512
- c. Adjust Delay Timing, R41(O)
- d. Check DELAY MULTIPLIER $\pm 2\%$

21. 10nS DELAY RANGE

- a. Setup
- b. Adjust 50nS Delay, R513 $\pm(2\% + 10\text{ns})$
- c. Adjust 500ns Delay, C32(C) $\pm(2\% + 10\text{ns})$
- d. Check 10nS DELAY RANGE, - Pulse $\pm(2\% + 10\text{ns})$
- e. Check 10nS DELAY RANGE, Remote $\pm(4\% + 10\text{ns})$

22. DELAY OR BURST TIME

- a. Setup
- b. Check DELAY or BURST TIME $\pm(2\% + 10\text{ns})$
- c. Check Remote DELAY OR BURST TIME $\pm(4\% + 10\text{ns})$

23. + TRIGGER INPUT

- a. Setup
- b. Check EXTERNAL triggering with sinewave
Stable triggering at:
1kHz with $>4\text{V}$ to $<40\text{V}$ P-P
10kHz with $>4\text{V}$ to $<40\text{V}$ P-P
100kHz with $>4\text{V}$ to $<40\text{V}$ P-P
1MHz with $>4\text{V}$ to $<40\text{V}$ P-P
5MHz with $>4\text{V}$ to $<10\text{V}$ P-P
10MHz with >6 to $<8\text{V}$ P-P
- c. Check Manual trigger
Stable triggering in all modes except GATED OUTPUT

24. TRIGGER OUTPUT

- a. Check + PRETRIGGER OUT
Amplitude: $>+2\text{V}$
- b. Check + DELAYED TRIGGER OUT
Amplitude: $>+2\text{V}$

25. GATED OUTPUT MODE

- a. Setup
- b. Check GATED OUTPUT MODE
Gated output with +2V to +10V + GATE IN
- c. Check REMOTE GATED OUTPUT MODE
Gated output with +2V to +10V + GATE IN

THE END

1. FUSES

<u>Location</u>	<u>Ckt No</u>	<u>Description</u>
Front panel	F401	0.6A S1o-B1o
Front panel	F402	0.6A S1o-B1o

2. PRESETS*a. Preset TYPE R116 controls*

TRIGGER SOURCE	INTERNAL
MODE	SINGLE
PERIOD	1mS X1
DELAY OR	
BURST TIME	10μS X5
WIDTH	10μS X50
AMPLITUDE	1V X10
PROGRAM	REMOTE
DC OFFSET	0
RISETIME FALLTIME	
RANGE	1μS
RISETIME MULT	cw
FALLTIME MULT	cw
POLARITY	+
POWER	OFF
LINE VOLTAGE	
SELECTOR	115V (Rear Panel)

b. Preset TYPE R116 internal adjustments

Set all TYPE R116 internal adjustments to midrange.

c. Preset R116 Remote Program Test Fixture controls

TRIGGER SOURCE	INTERNAL
MODE	SINGLE
PERIOD	1mS X1
DELAY OR	
BURST TIME	10μS X5
WIDTH	10μS X50
AMPLITUDE	1V X10
DC OFFSET	0
RISETIME	
FALLTIME	
RANGE	1μS
RISETIME MULT	X10
FALLTIME MULT	X10
POLARITY	+

2. RANGE and MULTIPLIER settings will be described with single notation. For example, a PERIOD RANGE of 1mS and PERIOD MULTIPLIER of 10 will be written: PERIOD 1mS X10.

Circuit board designations and jacks are shown in the following table:

<u>BOARD FUNCTION</u>	<u>LETTER DESIGNATION</u>	<u>JACK</u>
Function		
Program #2	K	J1
Period		
Generator	B	J2
Delay		
Generator	O	J3
Function		
Program #1	L	J4
Width		
Generator	P	J5
Pulse Shape		
Generator	F	J6
Output		
Amplifier	M	J7
Attenuator	N	J8
Power Supply	I	J9

2. (cont'd)

d. Preset TYPE 547 controls

HORIZONTAL DISPLAY B
 B TRIGGERING
 MODE AUTO STABILITY
 SLOPE +
 COUPLING AC
 SOURCE NORM INT
 B TIME/CM .2mS
 TIME/CM VARIABLE CALIBRATED

e. Preset TYPE W controls

V_C RANGE 0
 COMPARISON VOLTAGE 5-0-0
 DISPLAY A-B
 INPUT ATTEN 1
 A & B INPUT AC
 MILLIVOLTS/CM 10
 VARIABLE CALIB

Connect R116 PULSE OUTPUT through
 a 50 Ω cable to a precision 50 Ω
 termination.

3. RESISTANCE

*a. Check Remote Program Input
Resistance*

Check resistance between J10 and
 chassis ground as in the following
 table:

Pin	Approximate Resistance		
	+ Lead to gnd	- Lead to gnd	Meter range
1	800 Ω	2.3k Ω	Ω X1k
2	850 Ω	2.4k Ω	Ω X1k
3	140 Ω	330 Ω	Ω X100
4	80 Ω	80 Ω	Ω X100
5 thru 17	inf	inf	Ω X1k
18	6.5k Ω	inf	Ω X1k
19	40k Ω	inf	Ω X1k
20 thru 27	inf	inf	Ω X1k
28	33k Ω	44k Ω	Ω X1k
29	21k Ω	44k Ω	Ω X1k
30	21k Ω	44k Ω	Ω X1k
31	inf	12k Ω	Ω X1k
32	5k Ω	inf	Ω X1k
33	19k Ω	13k Ω	Ω X1k
34	2.7k Ω	2.3k Ω	Ω X1k
35	inf	inf	Ω X1k
36	0 Ω	0 Ω	Ω X1k

- a. R116 Remote Programmer is not
 connected to TYPE R116.

3. (cont'd)

b. Check Power Supply resistance

Measure the resistance from Q423 emitter to chassis ground, approximately 80Ω . Change the common meter lead to signal ground, Pin 1 of J9 and measure power supply resistance as follows, with meter range at $\Omega \times 100$.

Approximate Resistance

<u>Test Point</u>	<u>Supply</u>	<u>+ meter lead to gnd</u>	<u>- meter lead to gnd</u>
J9 Pin 2	-27V	500 Ω	375 Ω
J9 Pin 3	-6V	530 Ω	340 Ω
J9 Pin 4	+25V	130 Ω	130 Ω
J9 Pin 26	+7V	220 Ω	260 Ω
J7 Pin 8	+12.4V	500 Ω	1.3k

Connect R116 Remote Programmer to J10 on TYPE R116.

4. LINE VOLTAGE SELECTOR

Set the multimeter to a range suitable to measure 35VAC. Connect the multimeter leads to T401 terminals 10 & 11 and set TYPE R116 POWER on. Measure and note the AC Voltage. Change the Line Voltage Selector to 230V. Check that the voltage at T401 terminals 10 & 11 is approximately one half that previously measured. Change the Line Voltage Selector to 115V.

5. POWER SUPPLIES*a. Setup*

Connect two X1 probes to TYPE W INPUTS and connect one of the probes to TYPE R116 J9 pin 1 (signal ground). Connect the DCVB COMMON to J9 Pin 1, and the other TYPE W Probe and DCVB \pm INPUT to J9 pin 4. Set the DCVB to measure +25V.

5. CAUTION Do not short signal ground to chassis.

A capital letter following the schematic number of an adjustment indicates the etched circuit card on which the adjustment is located.

5. (cont'd)

b. *Adjust +25V, R14 (I)*

Adjust R14 (I) for a null on the DCVB.

c. *Check power supply voltages, accuracy and ripple*

Check accuracy of power supply voltages with the DCVB and ripple with the TYPE W and TYPE 547. Check ripple and accuracy from 94.5 VAC line to 137.5 VAC line as in the following table:

<u>Supply</u>	<u>Test Point</u>	<u>Voltage Limit</u>	<u>Ripple Limit</u>
+25V	J9 Pin 4	$\pm 0.25V$	$< 15mV$
-27V	J9 Pin 2	$\pm 0.6V$	$< 15mV$
-6V	J9 Pin 3	$\pm 0.5V$	$< 30mV$
+7V	J9 Pin 26	$\pm 1V$	$< 50mV$
-13.5V	Chassis ground	$\pm 2V$	$< 20mV$
+12.4V	J7 Pin 8	$\pm 1V$	
+9.5V	Q423 Emitter	$\pm 0.7V$	

b. Noise on the power supply signals can be reduced by setting the TYPE R116 TRIGGER SOURCE to EXTERNAL or MANUAL. Return the switch to INTERNAL after checking power supplies.

c. -13.5V (-VARIABLE) is measured with R116 DC OFFSET adjusted for OUTPUT PULSE baseline of 0V.

+9.5V is measured to chassis ground.

All other supplies are measured to signal ground.

6. DC OFFSET RANGE CAL

a. *Setup*TYPE R116

POLARITY REMOTE PROGRAM

TYPE W

DISPLAY A- V_C
 INPUT A DC
 INPUT ATTEN 10
 V_C RANGE 0
 MILLIVOLTS/CM 50
 COMPARISON VOLTAGE 5-0-0

TYPE 547

B TIME/CM .2mSEC
 B TRIGGER SOURCE NORM

Connect R116 PULSE OUTPUT through a 50 Ω cable and 50 Ω precision termination to TYPE W A INPUT.

6. (cont'd)

b. Preset +Offset Zero R466

Establish test scope graticule center at zero volts by setting the TYPE W INPUT A to GND and positioning the trace to graticule center. Change the TYPE W INPUT A to DC. Set the Remote Programmer DC OFFSET to 0, POLARITY to +, and adjust R466 to place the baseline of the pulse at test scope graticule center.

c. Adjust Offset Range, R32(N)

Change the Remote Programmer OFFSET to -5V and TYPE W V_C RANGE to -1.1. Adjust Offset Range, R32(N), to place the pulse baseline at graticule center. Return Remote Programmer OFFSET to 0.

7. DC OFFSET CAL*a. Setup*TYPE R116

PROGRAM	REMOTE
POLARITY	+

TYPE W

V_C RANGE	0
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b. Adjust DC Offset Cal, R544

Check that the DC OFFSET knob is positioned to the center of pot rotation. Set the DC OFFSET to 0. Note position of pulse baseline. Change R116 PROGRAM to INT and adjust R544 to position pulse base to noted position.

8. + PULSE DC LEVEL AND AMPLITUDE CAL*a. Setup*TYPE R116

PROGRAM	REMOTE
<u>REMOTE PROGRAMMER</u>	

OFFSET	0
--------	---

TYPE W

INPUT ATTEN	100
-------------	-----

MILLIVOLTS/CM	10
---------------	----

Remove DC Offset: Disconnect
9-60 wire from pin on strip near
L484.

b. Adjust Baseline Clamp, R25(M)

Adjust R25(M) for a pulse baseline
1.6cm above graticule center (+1.6V).
Replace DC Offset.

c. Adjust + Offset Zero, R466

Adjust R466 for a pulse baseline
at zero volts.

d. Adjust Range Cal, R85(F)

Set TYPE W INPUT ATTEN to 10,
COMPARISON VOLTAGE to 1-0-0, and
V_C RANGE to +11. Adjust R85(F) for
pulse top at graticule center
(+10V amplitude).

e. Adjust Amplitude Mult Cal, R532

Set TYPE W V_C RANGE to ± 1.1 and
COMPARISON VOLTAGE to 2-0-0; set
R116 AMPLITUDE to 1V X2. Adjust
R532 for pulse top at graticule
center (+2V amplitude). Return
R116 AMPLITUDE to 1V X10.

Recheck step 8d.

8. Establish test scope graticule center at zero volts prior to each adjustment or check:

Set TYPE W V_C RANGE to 0, INPUT A to GND, and position trace to graticule center. Return INPUT A and V_C RANGE to original positions.

- d. In some cases it may be necessary to adjust R85(F) for a +10.1V pulse amplitude, so + Pulse and - Pulse 1V X2 AMPLITUDE will be within limits.

9. - PULSE DC LEVEL AND AMPLITUDE CAL

*a. Setup*TYPE R116

POLARITY

-

TYPE W

INPUT ATTEN

100

 V_C RANGE

-1.1

COMPARISON VOLTAGE

1-1-6

Connect emitter of Q53 (Output Amplifier) to signal ground: connect a lead from signal ground (Pin 1 & A, J7) to bottom end of R53 (1.1K, 2W resistor on Output Amplifier board).

b. Adjust - Offset Zero, R476

Adjust R476 for a trace at graticule center (-11.6VDC). Remove lead between signal ground and R53.

c. Adjust -DC Level, R34(M)

Set TYPE W V_C RANGE to 0, and INPUT ATTEN to 10. Adjust R34(M) for pulse baseline at graticule center.

d. Adjust - Amplitude, R42(M)

Set TYPE W COMPARISON VOLTAGE to 1-0-0, and V_C RANGE to -11. Adjust R42(M) for top of pulse at graticule center (-10V amplitude).

*e. Check -2V (AMPLITUDE 1V X2)
±(2% +50mV)*

Set TYPE W V_C RANGE to -1.1 and COMPARISON VOLTAGE to 2-0-0, and R116 AMPLITUDE to 1V X2. Check that top of pulse is within 0.9cm of graticule center.

Recheck step 9c.

9. Establish test scope graticule center at zero volts prior to each adjustment or check.

d. It may be necessary to adjust R42(M) for a -9.9V pulse amplitude, so both 2V + Pulse and - Pulse amplitudes (AMPLITUDE 1V X2) will be within limits.

9e. It may be necessary to readjust R85 (F), R532, and/or R42(M) to establish + Pulse and - Pulse, 10V and 2V (AMPLITUDE 1V X2) amplitude accuracy. If this is done, the following steps should be rechecked: 8d, 8e, 9c, 9d, and 9e.

10. PROGRAM CLAMP*a. Setup*TYPE R116

PROGRAM	REMOTE
POLARITY	+

TYPE W

V _C RANGE	0
INPUT ATTEN	100

*b. Adjust Program Clamp, R54(N)
Output Level: 0v \pm 0.8V*

Remove the R116 Remote Programmer plug from J10 of the TYPE R116. Adjust R54(N) to position the trace to 0V. Change R116 POLARITY to - and check that trace is within 0.8V of ground; it may be necessary to readjust R54(N) to clamp both + and - POLARITY outputs within limits. Return R116 POLARITY to +. Replace the R116 Remote Programmer plug in J10, and return the R116 PROGRAM to INTERNAL.

- b. With Remote Programmer plug removed, and R116 PROGRAM in REMOTE, check that there are no spikes on the trace; if there are spikes, select Q13 in Output Amplifier.

11. DC OFFSET ACCURACY*a. Setup*TYPE W

MILLIVOLTS/CM	20
INPUT ATTEN	10
COMPARISON VOLTAGE	5-0-0
V _C RANGE	-1.1

*b. Check internal DC OFFSET
 $\pm(5\% + 200\text{mV})$*

Check + Pulse DC OFFSET accuracy indicated in the following table; pulse baseline must be at graticule center or within limit shown:

11. Establish test scope graticule center at zero volts prior to each check.

11b. (cont'd)

R116 DC OFFSET	TYPE W COMPARISON VOLTAGE	TYPE W V _C RANGE	MAXIMUM ERROR OF PULSE BASELINE MILLIVOLTS	CM
-5	5-0-0	-1.1	±450	±2.25
-4	4-0-0	-1.1	±400	±2.00
-3	3-0-0	-1.1	±350	±1.75
-2	2-0-0	-1.1	±300	±1.50
-1	1-0-0	-1.1	±250	±1.25
0	1-0-0	0	±200	±1.00
+1	1-0-0	+1.1	±250	±1.25
+2	2-0-0	+1.1	±300	±1.50
+3	3-0-0	+1.1	±350	±1.75
+4	4-0-0	+1.1	±400	±2.00
+5	5-0-0	+1.1	±450	±2.25

Set R116 POLARITY to -, and check - Pulse DC OFFSET accuracy as indicated in the table above.

c. Check remote DC OFFSET
±(7% +200mV)

Set TYPE W MILLIVOLTS/CM to 50, R116 PROGRAM to REMOTE, Remote Programmer OFFSET to +5, and check that both + Pulse and - Pulse baselines are within 1.1cm of graticule center.

Change Remote Programmer OFFSET to -5, TYPE W V_C RANGE to -1.1, and check that both + Pulse and - Pulse baselines are within 1.1cm of graticule center.

Set TYPE W V_C RANGE to 0, MILLIVOLTS/CM to 20, and Remote Programmer OFFSET to 0, and check that baselines of both + Pulse and - Pulse are within 1.0cm of graticule center.

12. AMPLITUDE ACCURACY

a. Setup

TYPE R116

AMPLITUDE	1V X10
POLARITY	+
PROGRAM	INT
DC OFFSET	0

TYPE W

COMPARISON	
VOLTAGE	10-0-0

12 (cont'd)

b. Check +Pulse amplitude

1V Range: $\pm(2\% + 50\text{mV})$
 .5V Range: $\pm(2\% + 25\text{mV})$
 .2V Range: $\pm(2\% + 15\text{mV})$

For each AMPLITUDE RANGE and MULTIPLIER combination in the following table, position pulse baseline to graticule center, change TYPE W V_C RANGE to +1.1, and check that pulse top is at graticule center, or within limit shown.

R116 AMPLITUDE RANGE	MULTIPLIER	INPUT ATTEN	MILLI-VOLTS/CM	V_C	Maximum Error of Pulse Top
1V	10	10	20	10-0-0	$\pm 1.25\text{cm}$
.5V	10	10	10	5-0-0	$\pm 1.25\text{cm}$
.2V	10	10	5	2-0-0	$\pm 1.1\text{cm}$
.2V	2	1	10	4-0-0	$\pm 2.3\text{cm}$
.5V	2	10	2	1-0-0	$\pm 2.25\text{cm}$
1V	2	10	5	2-0-0	$\pm 1.8\text{cm}$

c. Check AMPLITUDE MULTIPLIER
 $\pm(2\% + 50\text{mV})$

Check pulse amplitude for each AMPLITUDE MULTIPLIER setting (1V RANGE) in the following table. Check that pulse top is at graticule center or within limit shown; prior to each check, establish pulse baseline at graticule center with TYPE W V_C RANGE at 0.

R116 AMPLITUDE MULTIPLIER	TYPE W MILLIVOLTS/CM	V_C	Maximum Error of Pulse Top
2	5	2-0-0	$\pm 1.8\text{cm}$
3	5	3-0-0	$\pm 2.2\text{cm}$
4	5	4-0-0	$\pm 2.6\text{cm}$
5	10	5-0-0	$\pm 1.5\text{cm}$
6	10	6-0-0	$\pm 1.7\text{cm}$
7	10	7-0-0	$\pm 1.9\text{cm}$
8	10	8-0-0	$\pm 2.1\text{cm}$
9	10	9-0-0	$\pm 2.3\text{cm}$
10	10	10-0-0	$\pm 2.5\text{cm}$

12. (cont'd)

d. Check - Pulse amplitude

1V Range: $\pm(2\% + 50\text{mV})$.5V Range: $\pm(2\% + 25\text{mV})$.2V Range: $\pm(2\% + 15\text{mV})$

Change the R116 POLARITY to - and AMPLITUDE to 1V X10, and the TYPE W V_C RANGE to 0. Position the pulse baseline to graticule center. Change TYPE W V_C RANGE to -1.1 and check the accuracy of the - pulse as in step 12b.

e. Check Remote amplitude

1V Range: $\pm(4\% + 50\text{mV})$.5V Range: $\pm(4\% + 25\text{mV})$.2V Range: $\pm(4\% + 15\text{mV})$

Change the R116 AMPLITUDE to REMOTE and POLARITY to REMOTE PROGRAM. Using R116 Remote Programmer, check + and - Pulse amplitude accuracy for each RANGE and MULTIPLIER combination in the following table:

R116 RANGE	AMPLITUDE MULTIPLIER	INPUT ATTEN	MILLI- VOLTS/CM	V_C	Maximum Error of Pulse Top
1V	10	10	20	10-0-0	$\pm 2.25\text{cm}$
.5V	10	10	10	5-0-0	$\pm 2.25\text{cm}$
.2V	10	10	5	2-0-0	$\pm 1.9\text{cm}$
.2V	2	1	10	4-0-0	$\pm 3.1\text{cm}$
.5V	2	10	2	1-0-0	$\pm 3.3\text{cm}$
1V	2	10	5	2-0-0	$\pm 2.6\text{cm}$

Replace the test scope TYPE W with a TYPE 1A1.

13. $1\mu\text{S}$ & 100nS RISETIME AND FALLTIME

a. Setup

TYPE R116

TRIGGER SOURCE	INTERNAL
RISETIME FALLTIME	
RANGE	$1\mu\text{S}$
RISETIME MULT	1
FALLTIME MULT	1
PROGRAM	INT
POLARITY	+
AMPLITUDE	1V X10

13. Risetime and falltime are products of RISETIME FALLTIME RANGE and MULT settings, and AMPLITUDE MULTIPLIER settings.

Example:

RISETIME FALLTIME
RANGE = $1\mu\text{S}$
MULT = 10
AMPLITUDE
MULTIPLIER 10

Risetime = $1\mu\text{S} \times 10 \times 10 = 100\mu\text{S}$

13a. (cont'd)

R116 Remote Programmer

DC OFFSET	0
RISETIME FALLTIME	
RANGE	1 μ S
RISETIME MULT	10
FALLTIME MULT	10

TYPE 547

B TIME/CM	.5mSEC
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TYPE 1A1

CHANNEL 1 VOLTS/CM	2
CHANNEL 2 VOLTS/CM	.5
VARIABLE VOLTS/CM	CALIB
MODE	CH 2
INPUT SELECTOR	DC

TYPE 184

MARKER SELECTOR	10 μ S
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Connect R116 PULSE OUTPUT to 1A1
INPUT 1 through 50 Ω cable and 50 Ω
precision termination. Apply 10 μ S
markers from TYPE 184 and 1A1 INPUT
2 through 50 Ω cable and 50 Ω termination.

b. *Adjust T_r centering and T_f centering,
R32(F) and R42(F)*

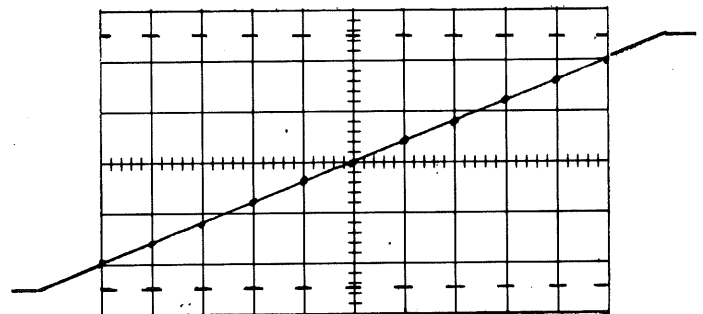
Connect VOM (3VDC Range) between base of
Q14 and base of Q34 (Pulse Shape Generator).
Adjust R32(F) for 0V.

Connect VOM (3VDC Range) between base of
Q24 and base of Q44. Adjust R42(F) for
0v.

c. *Adjust T_r Timing, R64(F)*

Adjust the TYPE 547 B TIME/CM and
VARIABLE to obtain exactly 10 time
marks in 10cm. Return TYPE 1A1
MODE to CH 1. Center the display
above and below the center hori-
zontal graticule line. Adjust the
TYPE 547 B TRIGGERING LEVEL to
position the start of the display
to the first vertical graticule
line exactly 2cm below the center
horizontal graticule line. Adjust
R64(F) so the display crosses the
last vertical graticule line ex-
actly 2cm above the center hori-
zontal graticule line.

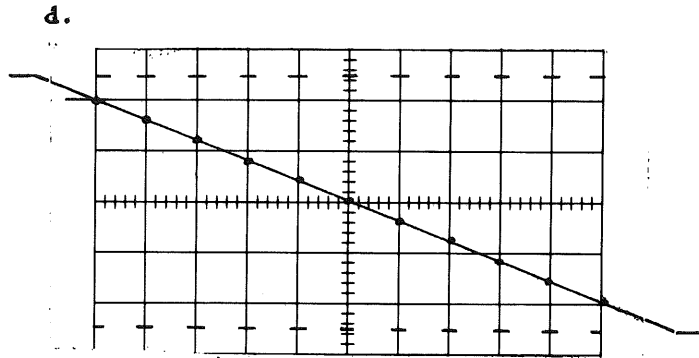
c.



13. (cont'd)

d. Adjust T_f Timing, R54(F)

Change the TYPE 547 TRIGGERING SLOPE to -, and TRIGGERING LEVEL to position start of the display to the first vertical graticule line exactly 2cm above the center horizontal graticule line. Adjust R54(F) as in step 13c, except for a negative slope.

*e. Adjust Risetime Mult Cal, R564*

Change the R116 Remote Programmer RISETIME MULT and FALLTIME MULT to 1, and TYPE 184 MARKER SELECTOR to μ S. Change TYPE 1A1 MODE to CH 2. Adjust TYPE 547 B TIME/CM and VARIABLE to obtain exactly 10 markers in 10cm. Return TYPE 1A1 MODE to CH 1. Adjust R564 for the same result as in step 13c.

f. Adjust Falltime Mult Cal, R554

Change the TYPE 547 TRIGGERING SLOPE to -. Adjust R554 for the same result as in step 13d.

Repeat steps 13c, d, e and f as necessary.

g. Check RISETIME MULT and FALLTIME MULT $\pm 4\%$

Check that RISETIME MULT and FALLTIME MULT knobs are aligned with 1 at ccw end of rotation. Set TYPE R116 PROGRAM to INT.

Check accuracy of RISETIME MULT and FALLTIME MULT settings indicated in the following table. Prior to each check, select the proper markers and adjust the TYPE 547 B TIME/CM and VARIABLE as indicated.

13g. (cont'd)

TYPE R116		TYPE 184	TYPE 547	
RISETIME MULT	FALLTIME MULT	MARKER SELECTOR	SET B TIME/CM & VARIABLE for	B TRIGGERING SLOPE
1	1	1 μ S	10 marks/10cm	+
1	1	1 μ S	10 marks/10cm	-
2	2	1 μ S	20 marks/10cm	+
2	2	1 μ S	20 marks/10cm	-
3	3	10 μ S	3 marks/10cm	+
3	3	10 μ S	3 marks/10cm	-
4	4	10 μ S	4 marks/10cm	+
4	4	10 μ S	4 marks/10cm	-
5	5	10 μ S	5 marks/10cm	+
5	5	10 μ S	5 marks/10cm	-
6	6	10 μ S	6 marks/10cm	+
6	6	10 μ S	6 marks/10cm	-
7	7	10 μ S	7 marks/10cm	+
7	7	10 μ S	7 marks/10cm	-
8	8	10 μ S	8 marks/10cm	+
8	8	10 μ S	8 marks/10cm	-
9	9	10 μ S	9 marks/10cm	+
9	9	10 μ S	9 marks/10cm	-
10	10	10 μ S	10 marks/10cm	+
10	10	10 μ S	10 marks/10cm	-

Change R116 POLARITY to - and repeat for RISETIME MULT and FALLTIME MULT settings of 1 and 10. Return POLARITY to +.

h. Check 100ns RISETIME FALLTIME RANGE $\pm 4\%$

Change RISETIME FALLTIME RANGE to 100ns and check t_r and t_f indicated in the following table:

RISETIME MULT	FALLTIME MULT	B TIME/CM	TRIGGERING SLOPE
10	10	1 μ SEC	+
10	10	1 μ SEC	-
1	1	.1 μ SEC	+
1	1	.1 μ SEC	-

Switch POLARITY to - and repeat for - Pulse.

13. (cont'd)

- i. Check $1\mu\text{S}$ and 100nS RISETIME
FALLTIME RANGE, Remote $\pm 6\%$

Change R116 PROGRAM to REMOTE,
POLARITY to +, and check t_r and t_f
indicated in the following table:

R116 Remote Programmer			TYPE 547	
RISETIME FALLTIME RANGE	RISETIME MULT	FALLTIME MULT	B TIME/CM	TRIGGERING SLOPE
100nS	1	1	.1 μSEC	+
100nS	1	1	.1 μSEC	-
100nS	10	10	1 μSEC	+
100nS	10	10	1 μSEC	-
1 μS	1	1	1 μSEC	+
1 μS	1	1	1 μSEC	-
1 μS	10	10	10 μSEC	+
1 μS	10	10	10 μSEC	-

Return R116 PROGRAM to INT.

14. 1nS & 10nS RISETIME AND FALLTIME RANGE

- a. Setup

TYPE R116

PERIOD 10 μS X1
DELAY OR
BURST TIME 10nS X5
WIDTH 100nS X50
RISETIME-FALLTIME
RANGE nS
RISETIME MULT 1
FALLTIME MULT 1
AMPLITUDE 1V X10

TYPE 3S1

A mVolts/Div 200

TYPE 3T2

RANGE 100nS
TIME MAGNIFIER X10

- b. Adjust 1nS RISETIME FALLTIME
RANGE, C72(F): $\pm 10\%$

Adjust TYPE 3S1 mVOLTS/DIV VARIABLE
for exactly 5 div of display amp-
litude. Measure risetime from the
10% amplitude point to the 90%
amplitude point. Adjust C72(F) for 10ns
 t_r . Change TYPE 3T2 POLARITY to -,
and check for 10ns t_f . Repeat for
- Pulse.

14. Use sampling system for this
step. Apply R116 PULSE OUTPUT
through 5ns cable to GR 50 Ω
X10 Attenuator and TYPE 3S1
A INPUT.

- b,c. Check and note errors in TYPE
3T2. These errors must be taken
into account in checking 1ns and
10ns risetime and falltime accuracy.

14b. (cont'd)

Change RISETIME MULT and FALLTIME MULT to 10 and check for 100ns t_r and t_f of both - Pulse and + Pulse. Return RISETIME MULT and FALLTIME MULT to 1.

c. Check 1nS RISETIME FALLTIME RANGE,
Remote $\pm 12\%$

Change the PROGRAM to REMOTE. Repeat step 14b.

d. Check 10nS RISETIME FALLTIME RANGE:
 $\pm 10\%$

Change RISETIME FALLTIME RANGE to 10nS, and PROGRAM to INT. Measure risetime from the 10% amplitude point to the 90% amplitude point. Check for a t_r and t_f of 100ns. Repeat for - Pulse.

Change RISETIME and FALLTIME MULT to 10 and check for 1 μ s t_r and t_f of both - Pulse and + Pulse. Return RISETIME MULT and FALLTIME MULT to 1.

e. Check 10nS RISETIME FALLTIME RANGE,
Remote $\pm 12\%$

Change the PROGRAM to REMOTE. Set the Remote Programmer RISETIME FALLTIME RANGE to 10nS X1. Repeat step 14d. Return PROGRAM to INT.

15. WIDTH GENERATOR TRIGGER SENSITIVITY

a. Setup

TYPE R116

TRIGGER SOURCE	INTERNAL
MODE	SINGLE
PERIOD	100 μ s X1
DELAY OR	
BURST TIME	1 μ s X5
WIDTH	100ns (MULTIPLIER cw)
PROGRAM	INT
RISETIME FALLTIME	
RANGE	1nS
RISETIME MULT	1
FALLTIME MULT	1

TYPE 547

B TIME/CM	2 μ SEC
B TRIGGERING SLOPE	+

15. Apply R116 PULSE OUTPUT to 1A1 through 50 Ω Precision Termination.

15. (cont'd)

b. Adjust Trig Sens, R22(P)

Turn R22(P) full cw, then ccw until one stable pulse appears on test scope. Change R116 WIDTH RANGE to 10nS, and check for one stable pulse; if display is not stable, turn R22(P) ccw until it is. Note position of R22(P).

Change R116 WIDTH to 100nS X5, MODE to DOUBLE, and TRIGGER SOURCE to EXTERNAL or MANUAL. Trigger R116 manually, and turn R22(P) ccw until double pulses disappear; turn R22(P) cw until two stable pulses appear. Note position of R22 (P).

Center R22(P) between the two noted positions.

- b. It may be necessary to adjust R22(0) (Delay Generator Trig Sens) to obtain a stable delayed pulse.

16. PULSE WIDTH*a. Setup*TYPE R116

MODE	SINGLE
TRIGGER SOURCE	INTERNAL
PERIOD	1mS X1
DELAY OR	
BURST TIME	10nS X10
WIDTH	10μS X5
AMPLITUDE	1V X10
POLARITY	+
RISETIME FALLTIME	
RANGE	1nS
RISETIME MULT	1
FALLTIME MULT	1

TYPE 547

B TIME/CM	20μSEC
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TYPE 1A1

MODE	ALT
------	-----

TYPE 184

MARKER SELECTOR	5μS
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16a. (cont'd)

Connect TYPE 184 MARKER OUTPUT to TYPE 1A1 INPUT 2. Set CHANNEL 2 VOLTS/CM for a 5cm display of time markers. Apply R116 PULSE OUTPUT through 50 Ω termination to type 1A1 INPUT 1. Adjust B TRIGGERING LEVEL for a stable display.

b. Adjust Width Mult Cal, R522

Change TYPE 547 B TIME/CM to 10 μ SEC. Adjust R522 for a pulse 50 μ s wide using the 50 μ s time marks as a reference.

Change the TYPE 547 SWEEP MAGNIFIER to X10. Check the accuracy of the pulse width at the 50% amplitude points.

c. Adjust Width Timing, R41(P)

Change the R116 WIDTH MULTIPLIER to 50. Change TYPE 547 B TIME/CM to .1mSEC and TYPE 184 MARKER SELECTOR to 50 μ S. Adjust R41(P) for same result as in step 16b

Repeat steps 16b and c as necessary.

d. Check 1 μ S & 100ns WIDTH RANGE $\pm 2\%$

Change R116 PERIOD to 100 μ S X1 and WIDTH to 1 μ S X5, TYPE 547 B TIME/CM to 1 μ SEC, and TYPE 184 MARKER SELECTOR to 1 μ S. Check for pulse width of 5 μ s, $\pm 2\%$. Change R116 WIDTH to 1 μ S X50, TYPE 547 B TIME/CM to 10 μ SEC, and check for pulse width of 50 μ s, $\pm 2\%$.

Change R116 PERIOD to 10 μ S X1 and WIDTH to 100ns X5, TYPE 547 B TIME/CM to .1 μ SEC, and TYPE 184 MARKER SELECTOR to .1ns. Check for pulse width of 500ns, $\pm 2\%$. Change R116 WIDTH to 100ns X50, TYPE 547 B TIME/CM to 1 μ SEC, and check for pulse width of 5 μ s, $\pm 2\%$.

Repeat this step for - Pulse.

d. It may be necessary to readjust R522 to bring both 1 μ S X5 and 100ns X5 WIDTH RANGES within limits. If this is done, recheck steps 16c and d.

16. (cont'd)

e. Check WIDTH MULTIPLIER
 $\pm 2\%$

Change R116 PERIOD to 1mS X1, WIDTH to 10 μ S X5, and check accuracy of + Pulse width for each WIDTH MULTIPLIER setting indicated in the following table:

R116 WIDTH MULTIPLIER	TYPE 547 B TIME/CM	TYPE 184 MARKER SELECTOR
5	10 μ SEC	5 μ S
10	20 μ SEC	10 μ S
15	20 μ SEC	10 μ S
20	20 μ SEC	10 μ S
25	50 μ SEC	50 μ S
30	50 μ SEC	50 μ S
35	50 μ SEC	50 μ S
40	50 μ SEC	50 μ S
45	50 μ SEC	50 μ S
50	.1mSEC	50 μ S

f. Adjust 10nS Width, C32(P)
 $\pm 4\%$

Change the R116 PERIOD RANGE to 1 μ S and WIDTH to 10nS X50. Change the TYPE 184 MARKER SELECTOR to 50nS. Change the TYPE 547 B TIME/CM to .1 μ SEC. Adjust C32(P) for a pulse 500ns wide, using the 50nS time marks as a reference. Change the TYPE 547 SWEEP MAGNIFIER to X10 and check the pulse width at the 50% amplitude points. Repeat for - Pulse.

g. Adjust 50nSEC Width, R523 $\pm 4\%$

Change the R116 WIDTH to 10nS X5, the TYPE 184 MARKER SELECTOR to 10nS, and the TYPE 547 SWEEP MAGNIFIER to X10. Adjust R523 for a pulse width of 50nS. Repeat for - Pulse.

Repeat steps 16 f and g as necessary.

h. Check Remote WIDTH RANGES

10 μ S Range: $\pm 4\%$
 1 μ S Range: $\pm 4\%$
 100nS Range: $\pm 4\%$
 10nS Range: 6%

h. Greater resolution may be obtained using TYPE 547 SWEEP MAGNIFIER.

Change R116 WIDTH RANGE to REMOTE, and check pulse width for each WIDTH RANGE in the following table:

16h. (cont'd)

R116	Remote Programmer	TYPE 547	TYPE 184 MARKER
<u>PERIOD</u>	<u>WIDTH</u>	<u>B TIME/CM</u>	<u>SELECTOR</u>
1 μ S X1	10nS X5	.1 μ SEC	50nS
10 μ S X1	10nS X50	.1 μ SEC	50nS
10 μ S X1	100nS X5	.1 μ SEC	50nS
10 μ S X1	100nS X50	1 μ SEC	.5 μ S
10 μ S X1	1 μ S X5	1 μ SEC	.5 μ S
100 μ S X1	1 μ S X50	10 μ SEC	5 μ S
100 μ S X1	10 μ S X5	10 μ SEC	5 μ S
1mS X1	10 μ S X50	.1mSEC	50 μ S

17. PULSE ABERRATIONS*a. Setup*TYPE R116

PERIOD	100nS X3
DELAY OR	
BURST TIME	10nS X5
WIDTH	10nS X5
RISETIME FALLTIME	1nS X1

TYPE 3S1

MODE	CHANNEL A
SMOOTH NORMAL	NORMAL
A mVOLTS/DIV	200
INVERT NORM	NORM
HORIZ PLUG-IN	SAMPLING 3T SERIES

TYPE 3T2

RANGE	1 μ S
TIME MAGNIFIER	X10
DISPLAY MODE	NORMAL
DISPLAY MAG	X1

Apply R116 PULSE OUTPUT through
a 5nS cable and GR 50 Ω X10 atten-
uator to TYPE 3S1 A INPUT.

17. (cont'd)

- b. *Adjust + Pulse Overshoot, C50(M)*
+3%, -3%, total 3% P-P

Check for 5div of display amplitude, then change A mVolts/DIV to 20. Position the top of the display to graticule center with DC OFFSET $\pm 1V$ and adjust C50(M) for optimum risetime, with overshoot less than 3% (1.5div). Position the bottom of the display to graticule center with DC OFFSET $\pm 1V$ and check the bottom of the waveform for overshoot less than 3% (1.5div).

- c. *Adjust + Pulse level, C82(M)*
+3%, -3%, total 3% P-P

Position the top of waveform to graticule center with DC OFFSET $\pm 1V$.

Adjust C82(M) for optimum level. Position the bottom of the waveform to graticule center with DC OFFSET $\pm 1V$ and check the bottom of the waveform for aberrations not to exceed $\pm 3\%$ (1.5div).

- d. *Check - Pulse aberrations*
+3%, -3%, total 3% P-P

Change the R116 POLARITY to - and repeat steps 17b and c for negative pulses.

- e. *Check pulse aberrations, REMOTE POLARITY*
+5%, -5%, total 5% P-P

Change POLARITY to REMOTE PROGRAM. Check pulse aberrations on both + and - positions of the Remote Programmer POLARITY switch.

Recheck Step 14.

Recheck Step 16f and g.

18. PULSE PERIOD*a. Setup*TYPE R116

PERIOD 1mS X1
 WIDTH 10nS X50

TYPE 547

B TIME/CM 1mSEC
 SWEEP MAGNIFIER OFF

TYPE 184

MARKER SELECTOR 1mS

b. Adjust Period Mult Cal, R502

Adjust R502 to superimpose pulse
 on time marks.

b. Greater resolution may be obtained
 by changing the test scope SWEEP
 MAGNIFIER to X10.

c. Adjust Period timing, R34(B)

Change the R116 PERIOD MULTIPLIER
 to 10, TYPE 547 B TIME/CM to 10mSEC
 and TYPE 184 MARKER SELECTOR to 10mS.
 Adjust R34(B) for the same result as
 in step 18b. Repeat steps 18b and c.

d. Check PERIOD MULTIPLIER

±2%

Change the R116 PERIOD to 100μS X1,
 TYPE 547 B TIME/CM to 10μSEC and
 TYPE 184 MARKER SELECTOR to 10μS.
 Check pulse period accuracy for each
 MULTIPLIER setting in the following
 table. Prior to each check, select
 the proper markers and adjust the TIME/
 CM and VARIABLE as indicated. Pulse
 period must be within 2% of dial
 indication (10cm ±0.2cm).

R116	TYPE 184	TYPE 547
PERIOD	MARKER	SET B TIME/CM
<u>MULTIPLIER</u>	<u>SELECTOR</u>	<u>& VARIABLE for</u>
1	10μS	10 marks/10cm
2	10μS	20 marks/10cm
3	.1mS	3 marks/10cm
4	.1mS	4 marks/10cm
5	.1mS	5 marks/10cm
6	.1mS	6 marks/10cm
7	.1mS	7 marks/10cm
8	.1mS	8 marks/10cm
9	.1mS	9 marks/10cm
10	.1mS	10 marks/10cm

18. (cont'd)

*e. Adjust 100ns period, C52(B)
±3%*

Change the R116 PERIOD to 100nS X1, WIDTH to 10nS X5, TYPE 547 B TIME/CM to .1μSEC and TYPE 184 MARKER SELECTOR to .1μS. Adjust C52(B) for a pulse period of 100ns. Change PERIOD to 100nS X10 and check for 1μs pulse period. Repeat for - Pulse.

f. Adjust 1μs Period, C55(B): ±2%

Change the R116 PERIOD to 1μS x1, TYPE 547 B TIME/CM to 1μSEC and TYPE 814 MARKER SELECTOR to 1μS. Adjust C55(B) for a pulse period of 1μs. Change PERIOD to 1μS X10 and check for a 10μs pulse period. Repeat for - Pulse.

g. Check 100μS PERIOD RANGE ±2%

Change R116 PERIOD to 100μS X1 and WIDTH to 1μS X5, TYPE 547 B TIME/CM to 10μSEC, and TYPE 184 MARKER SELECTOR to .1mS. Check for pulse period of 100μs.

Change R116 PERIOD to 100μS X10, TYPE 547 B TIME/CM to .1mSEC, and check for a 1μs pulse period.

Repeat for - Pulse.

h. Check 10μS PERIOD RANGE ±2%

Change R116 PERIOD to 10μS x1, TYPE 547 B TIME/CM to 1μSEC, and TYPE 184 MARKER SELECTOR to 10μS. Check for pulse period of 10μs.

Change R116 PERIOD to 10μS x10, TYPE 547 B TIME/CM to 10μSEC, and check for a 100μs pulse period. Repeat for - Pulse.

18. (cont'd)

i. Check Remote PERIOD

100nS RANGE: $\pm 5\%$ 1 μ S RANGE: $\pm 4\%$ 10 μ S RANGE: $\pm 4\%$ 100 μ S RANGE: $\pm 4\%$ 1mS RANGE: $\pm 4\%$

Change R116 PERIOD to REMOTE, and check pulse period accuracy for each REMOTE PERIOD RANGE and MULTIPLIER combination in the following table:

Remote Programmer PERIOD	R116 WIDTH	TYPE 547 B TIME/CM	TYPE 184 MARKER SELECTOR
100nS X1	10nS X5	.1 μ SEC	.1 μ S
100nS X10	10nS X5	.1 μ SEC	.1 μ S
1 μ S X1	100nS X5	.1 μ SEC	.1 μ S
1 μ S X10	100nS X5	1 μ SEC	10 μ S
10 μ S X1	100nS X5	1 μ SEC	10 μ S
10 μ S X10	100nS X5	10 μ SEC	10 μ S
100 μ S X1	100nS X5	10 μ SEC	10 μ S
100 μ S X10	1 μ S X5	.1mSEC	1mS
1mS X1	1 μ S X5	.1mSEC	1mS
1mS X10	1 μ S X5	1mSEC	1mS

19. DELAY GENERATOR TRIGGER SENSITIVITY

a. Setup

TYPE R116

PERIOD 10 μ S X1
 WIDTH 10nS X5
 DELAY OR BURST
 TIME RANGE 10nS
 MULTIPLIER full cw
 MODE DOUBLE

TYPE 547

B TIME/CM 1 μ S
 TYPE 1A1 CH 1

b. Adjust Trig Sens, R22(C)

Rotate R22(C) fully cw, then ccw just to the point where stable double pulses are displayed. Change PERIOD to 100 μ S, then 1mS and readjust R22(C) as necessary to display stable pulses on all three PERIOD ranges.

b. R116 OUTPUT must be stable as DELAY MULTIPLIER is turned ccw to 15.

20. 10 μ S DELAY RANGE*a. Setup*TYPE R116

PERIOD	1mS X2
DELAY OR	
BURST TIME	10 μ S X5
WIDTH	1 μ S X5

TYPE 547

B TIME/CM	5 μ SEC
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TYPE 1A1

MODE	ALT
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TYPE 184

MARKER SELECTOR	50 μ S
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*b. Adjust Delay or Burst Time
Mult Cal, R512*

Adjust R512 for a pulse delay
of 50 μ s.

c. Adjust Delay Timing, R41(0)

Change the R116 DELAY to 10 μ S X50,
and the TYPE 547 B TIME/CM to 50 μ SEC.
Adjust R41(0) for a 500 μ s pulse delay.
Repeat steps 20b and c as necessary.

d. Check DELAY MULTIPLIER $\pm 2\%$

With DELAY RANGE at 10 μ S, check pulse
delay accuracy for each DELAY MULTIPLIER
setting in the following table. Apply
50 μ s markers, and adjust the TIME/CM
and VARIABLE as indicated. Pulse delay
must be within 2% of dial indication
(10cm ± 0.2 cm).

<u>R116</u>	<u>TYPE 547</u>
<u>DELAY</u>	<u>SET B TIME/CM</u>
<u>MULTIPLIER</u>	<u>& VARIABLE FOR</u>
50	10 marks/10cm
45	9 marks/10cm
40	8 marks/10cm
35	7 marks/10cm
30	6 marks/10cm
25	5 marks/10cm
20	4 marks/10cm
15	3 marks/10cm
10	2 marks/10cm
5	1 mark/10cm

21. 10nS DELAY RANGE*a. Setup*TYPE R116

PERIOD	1 μ S X5
DELAY OR	
BURST TIME	10nS X15
WIDTH	10nS X5

TYPE 3T2

RANGE	1 μ S
TIME MAGNIFIER	X5

b. Adjust 50nS Delay, R513:
 $\pm(2\% +10ns)$

Center the display vertically. Adjust R513 for a pulse delay of 150ns.

c. Adjust 500n Delay, C32(C)
 $\pm(2\% +10ns)$

Change the R116 DELAY to 10nS X50, and TYPE 3T2 TIME MAGNIFIER to X1. Center the display vertically, and adjust C32(C) for a 500ns pulse delay. Repeat 21b and 21c as necessary.

d. Check 10nS DELAY RANGE, - Pulse
 $\pm(2\% +10ns)$

Change R116 POLARITY to -, TYPE 3T2 POLARITY to -, and center display vertically. Check for a pulse delay of 500ns.

Change R116 DELAY to 10nS X15, TYPE 3T2 TIME MAGNIFIER to X5, and check for a 150ns pulse delay. Return R116 and TYPE 3T2 POLARITY to +.

e. Check 10nS DELAY RANGE, Remote
 $\pm(4\% +10ns)$

Change the R116 DELAY to REMOTE, the Remote Programmer DELAY to 10nS X15, and check for a pulse delay of 150ns.

Change Remote Programmer Delay to 10nS X50, and check for a 500ns pulse delay.

Repeat with R116 POLARITY in -.

21. The sampling system is useful for this step. Apply R116 PULSE OUTPUT through 5ns cable to GR 50 Ω X10 Attenuator and TYPE 3S1 A INPUT.

d. It may be necessary to readjust R513 or C32(C) to bring - Pulse delay accuracy within limits. If this is done, recheck + Pulse delay accuracy (steps 21b and 21c).

22. DELAY OR BURST TIME*a. Setup*TYPE R116

PERIOD 1mS X3
 DELAY OR
 BURST TIME 10μS X50
 WIDTH 1μS X5

TYPE 547

B TIME/CM 5μSEC

TYPE 1A1

MODE ALT

TYPE 184

MARKER SELECTOR 50μS

Apply R116 pulse to TYPE 1A1 INPUT
 2, and TYPE 184 markers to TYPE
 1A1 INPUT 1.

b. Check DELAY or BURST TIME
 $\pm (2\% + 10ns)$

Check pulse delay accuracy for each
 combination of DELAY or BURST TIME
 RANGE and MULTIPLIER in the following
 table:

R116	R116		TYPE 184	
PERIOD	DELAY OR	R116	MARKER	TYPE 547
	BURST TIME	WIDTH	SELECTOR	B TIME/CM
1mS X3	10μS X50	1μS X5	50μS	50μSEC
100μS X3	10μS X5	1μS X5	5μS	5μSEC
100μS X3	1μS X50	1μS X 5	5μS	5μSEC
100μS X3	1μS X5	100nS X5	.5μS	.5μSEC
100μS X3	100nS X50	100nS X5	.5μS	.5μSEC
10μS X3	100nS X5	10nS X5	.5μS	.1μSEC

Change R116 POLARITY to -, and repeat
 for - Pulse. Return POLARITY to +.

c. Check DELAY OR BURST TIME
 $\pm (4\% + 10ns)$

Change R116 DELAY OR BURST TIME to
 REMOTE, and repeat step 22b.

23. + TRIGGER INPUT*a. Setup*TYPE R116

TRIGGER SOURCE	EXTERNAL OR MANUAL
PERIOD	100 μ S X1
DELAY OR	
BURST TIME	10 μ S X25
WIDTH	10 μ S X5

*b. Check EXTERNAL triggering with
sinewave*

Check for proper R116 output with
sine-wave triggers listed in the
following table applied to R116 + TRIGGER INPUT:

Trigger	Min P-P Trigger	Max P-P Trigger	R116 PERIOD	R116 DELAY	R116 WIDTH
Frequency	Ampl	Ampl			
Check in	SINGLE, DLY'D SINGLE, DOUBLE, & BURST MODES:				
1kHz	4V	40V	100 μ S X1	10 μ S X25	10 μ S X5
10kHz	4V	40V	10 μ S X1	1 μ S X25	1 μ S X5
100kHz	4V	40V	1 μ S X1	100nS X25	100nS X5
1MHz	4V	40V	100nS X1	10nS X25	10nS X5

Check in SINGLE MODE:

5MHz	4V	10V			10nS X5
10MHz	6V	8V			10nS X5

*c. Check Manual trigger
Stable triggering in all modes
except GATED OUTPUT*

Change R116 PERIOD to 100 μ S X1,
DELAY to 10 μ S X25, WIDTH to 10 μ S
X5, and check for stable manual
triggering in all modes except
GATED OUTPUT.

24. TRIGGER OUTPUT*a. Check + PRETRIGGER OUT
Amplitude: \geq +2V*

Connect + PRETRIGGER OUT through a
50 Ω cable and 1k termination to
TYPE 1A1 INPUT 1. Check for triggers
at least +2V in amplitude with PERIOD
at 100nS X1.

24. (cont'd)

- b. *Check + DELAYED TRIGGER OUT*
Amplitude: $\geq +2V$

Move the 50 Ω cable and 1k termination from + PRETRIGGER OUT to + DELAYED TRIGGER OUT. Check for triggers at least +2V in amplitude with PERIOD at 100nS X1 and DELAY at 10nS X5.

25. GATED OUTPUT MODE

- a. *Setup*

TYPE R116

PERIOD	100 μ S X1
WIDTH	10 μ S X5
MODE	GATED OUTPUT

Apply 2V square-wave from TYPE 547 AMPLITUDE CALIBRATOR to R116 + GATE IN.

- b. *Check GATED OUTPUT MODE*
Gated output with +2V to +10V
+GATE IN

Check R116 output for pulses gated by the calibrator signal.

Apply +10V Square-wave to +GATE IN and repeat.

- c. *Check REMOTE GATED OUTPUT MODE*
Gated output with +2V to +10V
+GATE IN

Change the R116 MODE to REMOTE, and Remote Programmer MODE to GATED OUTPUT. Repeat step 25b.

THE END