FACTORY CALIBRATION PROCEDURE

CONTENTS:

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

Equipment Required

This procedure is company confidential

R116

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.

June 1968

For all serial numbers above 100.

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)

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 50Ω Precision Termination (011-0099-00)
2   50Ω BNC Terminations (011-0049-00)
1   GR 50Ω X10 Attenuator (017-0078-00)
2   BNC to GR Adapters (017-0064-00)
1   5ns Cable (017-0502-00)
2   50Ω BNC cable (012-0057-00)
1   R116 Remote Program Test Fixture (PMIE Dwg #1647-C)
1   1kΩ Termination (PMIE Dwg #1804-B)

c. *Other equipment*

1   20,000Ω/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.

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. In-
struments 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: ±6%
      1μS RANGE: ±4%
     10μS RANGE: ±4%
    100μS RANGE: ±4%
      1mS RANGE: ±4%

20. 10μS DELAY RANGE

*d. DELAY MULTIPLIER ±2%

21. 10nS DELAY RANGE

*b. 50nS Delay ±(2% +10ns)
*c. 500ns Delay ±(2% +10ns)
*d. 10nS DELAY RANGE, – Pulse
    ±(2% +10ns)
*e. 10nS DELAY RANGE, Remote
    ±(4% +10ns)

22. DELAY OR BURST TIME

*b. DELAY or BURST TIME ±(2% +10ns)
*c. DELAY OR BURST TIME ±(4% +10ns)

23. + TRIGGER INPUT

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

24. TRIGGER OUTPUT

a. + PRETRIGGER OUT
    Amplitude: ≥+2V
b. + DELAYED TRIGGER OUT
    Amplitude: ≥+2V

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

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 Slo-Blo

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.

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	

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) ±(2% +50mV)

10. PROGRAM CLAMP

a. Setup
b. Adjust Program Clamp, R54(N)
   Output Level: 0v ±0.8V

11. DC OFFSET ACCURACY

a. Setup
b. Check internal DC OFFSET
   ± (5% +200mV)
c. Check remote DC OFFSET
   ± (7% +200mV)

12. AMPLITUDE ACCURACY

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

13. 1μS & 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 ±4%
h. Check 100nS RISETIME FALLTIME RANGE
   ±4%
i. Check 1μS and 100nS RISETIME FALLTIME
   RANGE, Remote ±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 ±12%
d. Check 10nS RISETIME FALLTIME RANGE
   ±10%
e. Check 10nS RISETIME FALLTIME RANGE,
   Remote ±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 1μS & 100nS WIDTH RANGE ±2%
e. Check WIDTH MULTIPLIER ±2%
f. Adjust 10nS Width, C32(P) ±4%
g. Adjust 50nSEC Width. R523 ±4%
h. Check Remote WIDTH RANGES
   10μS RANGE: ±4%
    1μS RANGE   ±4%
   100nS RANGE: ±4%
   10nS RANGE: ±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 ±2%
e. Adjust 100ns period, C52(B) ±3%
f. Adjust 1μs Period, C55(B) ±2%
g. Check 100μS PERIOD RANGE ±2%
h. Check 10μS PERIOD RANGE ±2%
i. Check Remote PERIOD
   100nS RANGE: ±5%
     1μS RANGE: ±4%
    10μS RANGE: ±4%
   100μS RANGE: ±4%
     1mS RANGE: ±4%

19. DELAY GENERATOR TRIGGER SENSITIVITY

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

20. 10μS DELAY RANGE

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

21. 10nS DELAY RANGE

a. Setup
b. Adjust 50nS Delay, R513 ±(2% +10ns)
c. Adjust 500ns Delay, C32(C)
   ±(2% +10ns)
d. Check 10nS DELAY RANGE, – Pulse
   ±(2% +10ns)
e. Check 10nS DELAY RANGE, Remote
   ±(4% +10ns)

22. DELAY OR BURST TIME

a. Setup
b. Check DELAY or BURST TIME ±(2% +10ns)
c. Check Remote DELAY OR BURST TIME
   ±(4% +10ns)

23. + TRIGGER INPUT

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

24. TRIGGER OUTPUT

a. Check + PRETRIGGER OUT
   Amplitude: $\geq$+2V
b. Check + DELAYED TRIGGER OUT
   Amplitude: $\geq$+2V

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

Location	Ckt No	Description
Front panel	F401	0.6A Slo-Blo
Front panel	F402	0.6A Slo-Blo

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:

BOARD FUNCTION	LETTER DESIGNATION	JACK
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 50Ω cable to a precision 50Ω
termination.

3. RESISTANCE

    *a. Check Remote Program Input
       Resistance*

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

	Approximate Resistance		
	+ Lead	− Lead	Meter
Pin	to gnd	to gnd	range
1	800Ω	2.3kΩ	ΩX1k
2	850Ω	2.4kΩ	ΩX1k
3	140Ω	330Ω	ΩX100
4	80Ω	80Ω	ΩX100
5 thru 17	inf	inf	ΩX1k
18	6.5kΩ	inf	ΩX1k
19	40kΩ	inf	ΩX1k
20 thru 27	inf	inf	ΩX1k
28	33kΩ	44kΩ	ΩX1k
29	21kΩ	44kΩ	ΩX1k
30	21kΩ	44kΩ	ΩX1k
31	inf	12kΩ	ΩX1k
32	5kΩ	inf	ΩX1k
33	19kΩ	13kΩ	ΩX1k
34	2.7kΩ	2.3kΩ	ΩX1k
35	inf	inf	ΩX1k
36	0Ω	0Ω	ΩX1k

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, ap-
   proximately 80Ω. Change the com-
   mon meter lead to signal ground,
   Pin 1 of J9 and measure power
   supply resistance as follows, with
   meter range at ΩX100.

   ### Approximate Resistance

Test Point	Supply	+ meter lead to gnd	- meter lead to gnd
J9 Pin 2	-27V	500Ω	375Ω
J9 Pin 3	-6V	530Ω	340Ω
J9 Pin 4	+25V	130Ω	130Ω
J9 Pin 26	+ 7V	220Ω	260Ω
J7 Pin 8	+12.4V	500Ω	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 ± INPUT to J9
   pin 4. Set the DCVB to measure +25V.

5. <u>CAUTION</u> Do not short signal
   ground to chassis.

   A capital letter following the
   schematic number of an adjust-
   ment indicates the etched cir-
   cuit card on which the adjust-
   ment 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 vol-
    tages 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:

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

b. Noise on the power supply sig-
nals can be reduced by setting
the TYPE R116 TRIGGER SOURCE to
EXTERNAL or MANUAL. Return the
switch to INTERNAL after check-
ing 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
    50Ω cable and 50Ω 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

    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 ad-
    just R544 to position pulse base
    to noted position.

8.   + PULSE DC LEVEL AND AMPLITUDE CAL

    a. Setup

TYPE R116

PROGRAM	REMOTE
REMOTE PROGRAMMER	
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 gratiucle
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 mav 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 Amp-
lifier) 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 amp-
    litudes (AMPLITUDE 1V X2) will be
    within limits.

9e.   It may be necessary to readjust
    R85 (F), R532, and/or R42(M) to es-
    tablish + 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

    <u>TYPE R116</u>

    PROGRAM   REMOTE
    POLARITY   +

    <u>TYPE W</u>

    V_C RANGE   0
    INPUT ATTEN   100

    b. Adjust Program Clamp, R54(N)
        Output Level: 0v ±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

    <u>TYPE W</u>
    MILLIVOLTS/CM   20
    INPUT ATTEN   10
    COMPARISON VOLTAGE 5-0-0
    V_C RANGE   –1.1

    b. Check internal DC OFFSET
        ±(5% +200mV)

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: ±*(2% +50mV)*
  .5V Range: ±*(2% +25mV)*
  .2V Range: ±*(2% +15mV)*

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	±1.25cm
.5V	10	10	10	5-0-0	±1.25cm
.2V	10	10	5	2-0-0	±1.1cm
.2V	2	1	10	4-0-0	±2.3cm
.5V	2	10	2	1-0-0	±2.25cm
1V	2	10	5	2-0-0	±1.8cm

c. *Check AMPLITUDE MULTIPLIER*
   ±*(2% +50mV)*

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	±1.8cm
3	5	3-0-0	±2.2cm
4	5	4-0-0	±2.6cm
5	10	5-0-0	±1.5cm
6	10	6-0-0	±1.7cm
7	10	7-0-0	±1.9cm
8	10	8-0-0	±2.1cm
9	10	9-0-0	±2.3cm
10	10	10-0-0	±2.5cm

12. (cont'd)

    d. Check - Pulse amplitude
       1V Range: ±(2% +50mV)
      .5V Range: ±(2% +25mV)
      .2V Range: ±(2% +15mV)

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: ±(4% +50mV)
     5V Range: ±(4% +25mV)
    .2V Range: ±(4% +15mV)

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 com-
bination 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	±2.25cm
.5V	10	10	10	5-0-0	±2.25cm
.2V	10	10	5	2-0-0	±1.9cm
.2V	2	1	10	4-0-0	±3.1cm
.5V	2	10	2	1-0-0	±3.3cm
1V	2	10	5	2-0-0	±2.6cm

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

13. 1μS & 100nS RISETIME AND FALLTIME

    a. Setup

TYPE R116

TRIGGER SOURCE	INTERNAL
RISETIME FALLTIME RANGE	1μS
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 = 1μS
      MULT = 10
    AMPLTIUDE
      MULTIPLIER 10

Risetime = 1μs X10 X10 = 100μs

13a.   (cont'd)

R116 Remote Programmer

DC OFFSET	0
RISETIME FALLTIME RANGE	1µS
RISETIME MULT	10
FALLTIME MULT	10

TYPE 547

B TIME/CM	.5mSEC

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	10µS

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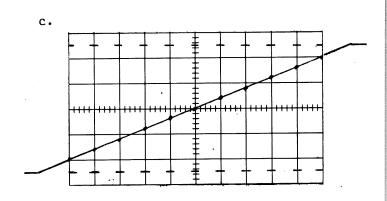2 through 50Ω cable and 50Ω termination.

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.

    d. Adjust T_f Timing, R54(F)

Change the TYPE 547 TRIGGERING SLOPE
to -, and TRIGGERING LEVEL to posi-
tion start of the display to the
first vertical graticule line ex-
actly 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
1µS. 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.
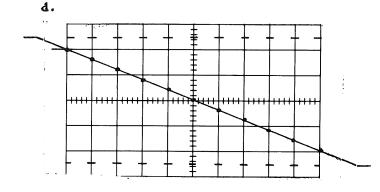
    f. Adjust Falltime Mult Cal, R554

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 nec-
essary.

    g. Check RISETIME MULT and
        FALLTIME MULT   ±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 RISETIME MULT	FALLTIME MULT	TYPE 184 MARKER SELECTOR	TYPE 547 SET B TIME/CM & VARIABLE for	B TRIGGERING SLOPE
1	1	1μS	10 marks/10cm	+
1	1	1μS	10 marks/10cm	−
2	2	1μS	20 marks/10cm	+
2	2	1μS	20 marks/10cm	−
3	3	10μS	3 marks/10cm	+
3	3	10μS	3 marks/10cm	−
4	4	10μS	4 marks/10cm	+
4	4	10μS	4 marks/10cm	−
5	5	10μS	5 marks/10cm	+
5	5	10μS	5 marks/10cm	−
6	6	10μS	6 marks/10cm	+
6	6	10μS	6 marks/10cm	−
7	7	10μS	7 marks/10cm	+
7	7	10μS	7 marks/10cm	−
8	8	10μS	8 marks/10cm	+
8	8	10μS	8 marks/10cm	−
9	9	10μS	9 marks/10cm	+
9	9	10μS	9 marks/10cm	−
10	10	10μS	10 marks/10cm	+
10	10	10μS	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 ±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	1μSEC	+
10	10	1μSEC	−
1	1	.1μSEC	+
1	1	.1μSEC	−

Switch POLARITY to − and repeat for
− Pulse.

13. (cont'd)

i. Check 1µS and 100nS RISETIME
FALLTIME RANGE , Remote ±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	.1µSEC	+
100nS	1	1	.1µSEC	−
100nS	10	10	1µSEC	+
100nS	10	10	1µSEC	−
1µS	1	1	1µSEC	+
1µS	1	1	1µSEC	−
1µS	10	10	10µSEC	+
1µS	10	10	10µSEC	−

Return R116 PROGRAM to INT.

14. 1nS & 10nS RISETIME AND FALLTIME RANGE

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

a. Setup

TYPE R116

PERIOD	10µS X1
DELAY OR BURST TIME	10nS X5
WIDTH	100nS X50
RISETIME-FALLTIME RANGE	1nS
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): ±10%

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.

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.

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 ±12%

Change the PROGRAM to REMOTE. Repeat
step 14b.

d. *Check 10nS RISETIME FALLTIME RANGE:*
    ±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 1μs 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 ±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	100μS X1
DELAY OR BURST TIME	1μS X5
WIDTH	100nS (MULTIPLIER cw)
PROGRAM	INT
RISETIME FALLTIME RANGE	1nS
RISETIME MULT	1
FALLTIME MULT	1

TYPE 547

B TIME/CM	2μSEC
B TRIGGERING SLOPE	+

15. Apply R116 PULSE OUTPUT to
1A1 through 50Ω 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(O) (Delay Generator Trig
Sens) to obtain a stable delayed
pulse.

16. PULSE WIDTH

  a. Setup

  <ins>TYPE R116</ins>

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

  <ins>TYPE 547</ins>

B TIME/CM	20µSEC

  <ins>TYPE 1A1</ins>

MODE	ALT

  <ins>TYPE 184</ins>

MARKER SELECTOR	5µS

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 50Ω 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 10µSEC.
Adjust R522 for a pulse 50µs wide
using the 50µs time marks as a
reference.

Change the TYPE 547 SWEEP MAGNI-
FIER 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 50µS. Adjust R41(P)
for same result as in step 16b

Repeat steps 16b and c as necessary.

d. *Check 1µS & 100nS WIDTH RANGE*
    ±2%

Change R116 PERIOD to 100µS X1
and WIDTH to 1µS X5, TYPE 547 B
TIME/CM to 1µSEC, and TYPE 184
MARKER SELECTOR to 1µS. Check
for pulse width of 5µs, ±2%. Change
R116 WIDTH to 1µS X50, TYPE 547 B
TIME/CM to 10µSEC, and check for
pulse width of 50µs, ±2%.

Change R116 PERIOD to 10µS X1 and
WIDTH to 100nS X5, TYPE 547 B TIME/CM
to .1µSEC, and TYPE 184 MARKER
SELECTOR to .1nS. Check for pulse
width of 500ns, ±2%. Change R116
WIDTH to 100nS X50, TYPE 547 B TIME/
CM to 1µSEC, and check for pulse
width of 5µs, ±2%.

Repeat this step for - Pulse.

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

16. (cont'd)

  e. *Check WIDTH MULTIPLIER*
    ±2%

Change R116 PERIOD to 1mS X1, WIDTH
to 10µS X5, and check accuracy of
+ Pulse width for each WIDTH MULTI-
PLIER setting indicated in the fol-
lowing table:

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

  f. *Adjust 10nS Width, C32(P)*
    ±4%

Change the R116 PERIOD RANGE to
1µS and WIDTH to 10nS X50. Change
the TYPE 184 MARKER SELECTOR to
50nS. Change the TYPE 547 B TIME/
CM to .1µSEC. 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 ±4%*

Change the R116 WIDTH to 10nS X5,
the TYPE 184 MARKER SELECTOR to
10nS, and the TYPE 547 SWEEP MAGNI-
FIER 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*
    10µS Range: ±4%
     1µS Range: ±4%
    100nS Range: ±4%
    10nS Range: 6%

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

h. Greater resolution may be ob-
  tained using TYPE 547 SWEEP
  MAGNIFIER.

16h. (cont'd)

R116 PERIOD	Remote Programmer WIDTH	TYPE 547 B TIME/CM	TYPE 184 MARKER SELECTOR
1µS X1	10nS X5	.1µSEC	50nS
10µS X1	10nS X50	.1µSEC	50nS
10µS X1	100nS X5	.1µSEC	50nS
10µS X1	100nS X50	1µSEC	.5µS
10µS X1	1µS X5	1µSEC	.5µS
100µS X1	1µS X50	10µSEC	5µS
100µS X1	10µS X5	10µSEC	5µS
1mS X1	10µS X50	.1mSEC	50µS

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

  Apply R116 PULSE OUTPUT through
  a 5ns cable and GR 50Ω 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 amp-
litude, then change A mVolts/
DIV to 20. Position the top of the
display to graticule center with
DC OFFSET ±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 ±1V and check
the bottom of the waveform for over-
shoot 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
±1V.

Adjust C82(M) for optimum level.
Position the bottom of the wave-
form to graticule center with DC
OFFSET ±1V and check the bottom of
the waveform for aberrations not to
exceed ±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

   <u>TYPE R116</u>

PERIOD	1mS X1
WIDTH	10nS X50

   <u>TYPE 547</u>

B TIME/CM	1mSEC
SWEEP MAGNIFIER	OFF

   <u>TYPE 184</u>

MARKER SELECTOR	1mS

   b.   Adjust Period Mult Cal, R502

Adjust R502 to superimpose pulse
on time marks.

   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 PERIOD MULTIPLIER	TYPE 184 MARKER SELECTOR	TYPE 547 SET B TIME/CM & VARIABLE for
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

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

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: ±5%
          1μS RANGE: ±4%
       10μS RANGE: ±4%
     100μS RANGE: ±4%
       1mS RANGE: ±4%

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

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

19. DELAY GENERATOR TRIGGER SENSITIVITY

    a.   *Setup*

    TYPE R116

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

    TYPE 547

B TIME/CM	1μS
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 100μS, 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.   10μS DELAY RANGE

    a. Setup

TYPE R116

PERIOD	1mS X2
DELAY OR	
BURST TIME	10μS X5
WIDTH	1μS X5

TYPE 547

B TIME/CM	5μSEC

TYPE 1A1

MODE	ALT

TYPE 184

MARKER SELECTOR	50μS

    b. Adjust Delay or Burst Time
       Mult Cal, R512

Adjust R512 for a pulse delay
of 50μs.

    c. Adjust Delay Timing, R41(0)

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

    d. Check DELAY MULTIPLIER ±2%

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

R116 DELAY MULTIPLIER	TYPE 547 SET B TIME/CM & VARIABLE FOR
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	1μS X5
DELAY OR BURST TIME	10nS X15
WIDTH	10nS X5

TYPE 3T2

RANGE	1μS
TIME MAGNIFIER	X5

    b. *Adjust 50nS Delay, R513:*
       ±(2% +10ns)

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

    c. *Adjust 500n Delay, C32(C)*
       ±(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*
       ±(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*
       ±(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 50Ω 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*
    ± (2% +10ns)

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

R116 PERIOD	R116 DELAY OR BURST TIME	R116 WIDTH	TYPE 184 MARKER SELECTOR	TYPE 547 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*
    ± (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   100µS X1
DELAY OR
    BURST TIME   10µS X25
WIDTH   10µS 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 Frequency	Min P-P Trigger Ampl	Max P-P Trigger Ampl	R116 PERIOD	R116 DELAY	R116 WIDTH
Check in	SINGLE,	DLY'D SINGLE,	DOUBLE,	& BURST	MODES:
1kHz	4V	40V	100µS X1	10µS X25	10µS X5
10kHz	4V	40V	10µS X1	1µS X25	1µS X5
100kHz	4V	40V	1µS X1	100nS X25	100nS X5
1MHz	4V	40V	100nS X1	10nS X25	10nS X5

Check in SINGLE MODE:

Trigger Frequency	Min P-P Trigger Ampl	Max P-P Trigger Ampl	R116 PERIOD	R116 DELAY	R116 WIDTH
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 100µS X1,
DELAY to 10µS X25, WIDTH to 10µS
X5, and check for stable manual
triggering in all modes except
GATED OUTPUT.

24. TRIGGER OUTPUT

a. *Check + PRETRIGGER OUT*
   Amplitude: >+2V

Connect + PRETRIGGER OUT through a
50Ω 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: ≥+2V

Move the 50Ω cable and 1k termina-
tion 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	100µS X1
WIDTH	10µS 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