

AUTOMATED MEASUREMENT SYSTEMS

SYSTEM CALIBRATION INTRODUCTION



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SYSTEM CALIBRATION INTRODUCTION

SYSTEM CALIBRATION

This section contains a unified calibration procedure for the entire System. The unified procedure is based on the calibration procedures given in the standard instruction manuals for the individual instruments in the System. Calibration procedures for optional accessories that have been ordered with the System have been added at the end of the unified procedure.

Any required maintenance should be performed before proceeding with the system calibration. Maintenance information is contained in the maintenance section of the standard instruction manuals.

This system calibration procedure has been arranged in an order which will provide the most concise calibration of the system with a minimum of test equipment. At the beginning of the system calibration procedure is an equipment list which includes the test equipment needed to calibrate the system and a short description of each piece of equipment. This description should aid in choosing suitable options when the suggested equipment is not available.

EQUIPMENT REQUIRED

The following list of equipment is needed to calibrate the entire S-3100 Series Systems. This list is a composite of the lists found at the beginning of each of the standard instruction manual calibration procedures. Some substitutions have been made in the individual lists in order to eliminate duplication of the instrument function or to substitute an instrument of more recent design. Additional recommended calibration equipment is listed as required by the calibration procedure.

1. Test Oscilloscope, Tektronix Type 547. Compatible with Type 1A1 (item 2) and Type W (item 3).
2. Dual Trace Unit, Tektronix Type 1A1, Minimum requirements, Dual Trace Bandwidth DC to 40 MHz with minimum deflection factor 0.005 volts/division.
3. Differential Comparator Unit, Tektronix Type W, compatible with Type 547 Oscilloscope. For voltage comparison and minimum deflection factor measurements. Bandwidth DC to 7 MHz minimum deflection factor 0.001 volts/division.
4. Two 1X probes. Type P6011. Tektronix Part No. 010-0193-00.
5. 10X probe, Type P6010. Tektronix Part No. 010-0288-00.
6. Variable autotransformer: Output voltage variable from 104 to 126 volts AC RMS for 115-volt nominal operation, or from 208 to 252 volts AC RMS for 230-volt nominal operation; output power 210 watts minimum. If the autotransformer does not include a monitor voltmeter, a separate AC voltmeter accurate within $\pm 3\%$ over the operating range listed above is required. General Radio W10MT3W metered Variac autotransformer meets these requirements.
7. Bench multimeter such as Simpson Model 262 or Triplett Model 630 NA. One measurement in the Type 568 requires a meter capability of measuring -3300 Volts accurate to within 1%.
8. Precision differential DC voltmeter accurate within $\pm 0.5\%$; meter resolution, 1 mV; range, 0.001 volt to 250 volts. A meter such as a John Fluke Model 825A is recommended. A 10 k Ω , 1/2 W, $\pm 5\%$ resistor is required to add across the meter input for some measurements.
9. 50 Ω Amplitude Calibrator. Output impedance 50 Ω ; voltage range 0.012 to 1.2 volt square wave; accuracy within $\pm 0.25\%$. Tektronix Calibration Fixture 067-0508-00.
10. Square wave and pulse generator that produces 1 μ s and 10 μ s period square waves with 1.0 volt peak amplitude into 50 Ω with an amplitude accuracy within $\pm 0.5\%$. Also required is a pulse of approximately 0.2 volt into 50 Ω having a X70 ps risetime with a trigger signal available at least 75 ns in advance of the fast pulse. The Tektronix Type 284 meets the above requirements. (If your Type 284 lead-time switch is labeled 5 ns – 50 ns, order modification kit, Tektronix Part No. 040-0487-00.)
11. 50 Ω 2X attenuator with GR874 connectors, such as GR874-G6. Tektronix Part No. 017-0080-00.
12. 50 Ω 5X attenuator with GR874 connectors, such as GR874-G14. Tektronix Part No. 017-0079-00.

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13. 50 Ω coaxial cable with GR874 connectors such as 5 ns signal delay RG58C/U cable, Tektronix Part No. 017-0512-00.

14. 50 Ω coaxial cable, approximately 42 inches long with BNC connectors, for example, RG58C/U, Tektronix Part No. 012-0057-01. (This cable is supplied with the Type 284.)

15. 50 Ω Voltage Pickoff unit, Type VP-2, Tektronix Part No. 017-0077-01. (This part is supplied with the Type S-3.)

16. 50 Ω end-line termination, GR874-W50B, Tektronix Part No. 017-0081-00.

17. Rigid plug-in extender, Tektronix Part No. 067-0590-00. This Calibration Fixture is used to operate the Type 3S6 outside the indicator oscilloscope.

18. Normalizer Head, for loop gain adjustment and to check Digital logic: Tektronix Calibration Fixture 067-0572-00.

19. Circuit card extender, Tektronix Part No. 012-0149-00.

20. Square wave generator with the following output characteristics: amplitude at least 12 volts into 50 Ω ; repetition rate of 50 kHz; risetime 12 ns or less. Tektronix Type 106 Square Wave Generator will meet these requirements.

21. 50 Ω 10X attenuator with BNC connectors, Tektronix Part No. 011-0059-00.

22. Two 50 Ω 10X attenuators, with GR874 connectors, such as GR874-G20. Tektronix Part No. 017-0078-00.

23. Adapters, BNC Male to GR, such as Tektronix Part No. 017-0064-00 and BNC Female to GR, 017-0063-00.

24. DC Bridge for measuring 100 k Ω and 1 M Ω . Accuracy, $\pm 0.025\%$. Maximum DC Bridge volts allowed across 100 k Ω resistor is 100 volts.

25. Two 50 Ω coaxial cables with GR874 connectors such as 20 ns signal delay RG213/U cable, Tektronix Part No. 017-0504-00.

26. A special variable attenuator with GR874 connectors. It consists of a 100 Ω potentiometer across the 50 Ω line, and does not have a guaranteed response. Tektronix Part No. 067-0511-00.

27. One 6 foot Sampling-Head extender (for two heads), Tektronix Part No. 012-0130-00. (Supplied with Type 3S6.)

28. Six circuit board connectors. Tektronix Part No. 388-0805-00. (Accessories included with Type 3S6, 3T6, and rigid extenders.)

29. Time mark generator, Tektronix Type 184. Minimum alternate requirements: time-mark or sine wave period outputs from 0.5 s through 2 ns; accuracy within 0.5%; output amplitude at least 0.3 volt into 50 Ω .

30. Pulse Generator, Tektronix Type 111 recommended. Minimum alternate requirements: positive-going and negative-going pulse outputs; pulse risetime less than 1 ns; pulse duration 2 ns; repetition rate 100 kHz; pulse amplitude at least 2 volts into 50 ohms. The Type 111 has an output pulse amplitude of 10 to 20 volts.

31. Rigid plug-in extender, Tektronix Part No. 067-0591-00. This Calibration Fixture is used to operate the Type 3T6 outside the indicator oscilloscope.

32. Signal delay, coaxial cable. Impedance, 50 ohms; delay 60 ns; GR874 connectors. Tektronix Type 113 Delay Cable.

33. Air Line; 20 cm length, GR874 connectors. Tektronix Part No. 017-0084-00.

34. Coaxial T connector with GR 50-ohm connectors. Tektronix Part No. 017-0069-00.

35. Coaxial T Power Divider with 50-ohm connectors GR-TPD. Tektronix Part No. 017-0082-00.

36. Sine Wave Generator, Tektronix Type 191 Constant Amplitude Signal Generator. Output Frequency variable from 20 MHz through 100 MHz, accuracy within 3%; output amplitude variable from approximately 1 mV to approximately 1 V into 50 ohms.

37. 56-terminal circuit card extender. Tektronix Part No. 012-0078-00.

38. Precision resistors for current range adjustments and load requirements: Tolerance $\pm 0.01\%$; temperature coefficient $5 \text{ PPM}/^\circ\text{C}$; 100Ω 10 W, $1 \text{ k}\Omega$ 1 W, and $10 \text{ k}\Omega$ 100 mW.

39. Test Load. Obtain a 10Ω 5 watt, 10% resistor and two alligator clips. Solder an alligator clip to each lead. This load is used for loading the +5-volt supply.

40. Capacitor: $1 \mu\text{F}$ with more than 100 volts rating.

41. 3 ft. sampling head extender (Tektronix Part No. 012-0124-00).

42. Circuit card extender (Tektronix Part No. 670-1186-00).

43. 7M11 Dual Delay Line. Minimum alternate requirements: Provide 75 ns time delay with input impedance of 50Ω . Required only to check display jitter.

44. Termination. Impedance, 50 ohms; accuracy, $\pm 3\%$; connectors, BNC. Tektronix Part No. 011-0049-00.

45. Cable. Impedance, 50 ohms; type, RG-213/U; length, 5 nanoseconds; connectors, GR874. Tektronix Part No. 017-0502-00.

46. Cable (two). Impedance, 50 ohms; type RG-58A/U; length, 42 inches, connectors, BNC. Tektronix Part No. 012-0057-01.

47. Adapter. Connectors, GR874 to BNC jack. Tektronix Part No. 017-0063-00.

48. 24-terminal connector. Mates with J22, Remote Program connector. Tektronix Part No. 131-0325-00. Following resistors required to check remote programming (1%, fixed).

Resistance	Tektronix Part No.	Power Rating
165Ω	323-0118-00	1/2 watt
499Ω	321-0164-00	1/8 watt
$1 \text{ k}\Omega$	321-0193-00	1/8 watt
$2 \text{ k}\Omega$	321-0222-00	1/8 watt
$90.9 \text{ k}\Omega$	321-0381-00	1/8 watt
$249 \text{ k}\Omega$	321-0423-00	1/8 watt

49. 4-pin connector. Mates with J340, POWER SUPPLY OUTPUT connector. Tektronix Part No. 131-0268-00. Following resistors required to provide load for Programmable Power Supply (10 watt, 5%, fixed).

Resistance	Tektronix Part No.
50Ω	308-0362-00
250Ω	308-0014-00

Performance Check/Calibration

Performance and/or calibration of the instruments making up the S-3130 System should be checked after each 500 hours of operation and at least once every six months to ensure that the instruments are operating correctly. Recalibration of the instruments may be performed periodically as part of a regular preventive maintenance schedule or may be done whenever the need is indicated by the system performance. Whenever defective components are replaced or other electrical repairs made within an instrument, then the performance of the instrument should be checked and recalibration performed as necessary.

When doing a complete calibration of the S-3130 System the best overall performance is obtained if each adjustment in each instrument is made to the exact setting, even if the observed performance is within the allowable tolerance.

A calibration record is included at the break point where the procedure goes from one instrument to the next. These calibration records can be used as a check list to verify correct instrument operation and as a calibration guide for experienced calibrators.

TEST EQUIPMENT USAGE CHART

The Test Equipment Usage Chart lists the equipment required, in abbreviated form, by the same numbers referred to in the Equipment Required paragraph, and shows what equipment is required to calibrate each system instrument.

System Instruments

ITEM	568	R230	3T6	3S6	S-3A	R240	R250	R116	R1140	R1340	286 287 288	R293
1. Type 547	X	X	X	X	X	X	X	X	X	X	X	X
2. Type 1A1		X	X	X	X	X	X		X	X	X	X
3. Type W	X	X	X	X	X							
4. 1X Probe	X	X	X	X	X	X	X	X	X	X		X
5. 10X Probe			X	X	X							
6. Autotrans	X					X	X	X	X	X	X	X
7. Multimeter	X	X	X	X	X	X	X		X	X		X
8. John Fluke 825A	X	X	X			X	X	X	X	X	X	
9. Amp. Cal				X							X	
10. Type 284			X	X	X						X	
11. 2X Atten			X								X ¹	
12. 5X Atten			X								X	
13. Coax 5 ns			X	X	X						X ¹	
14. Coax (BNC)			X	X	X		X	X			X	X
15. VP-2			X	X	X		X	X			X ¹	
16. Termination			X	X	X		X	X			X	
17. Extender Plug-In				X							X	
18. Norm Head				X								
19. Extender Cir. Card			X	X								
20. Type 106 Square Wave Gen				X	X							
21. 10X Atten BNC					X							
22. 10X Atten GR				X								X
23. BNC to GR			X	X	X			X				X
24. DC Bridge				X	X							
25. Coax 20 ns			X	X	X							
26. Variable Atten			X								X	
27. Extender Sampling Head	X	X	X	X	X			X			X	
28. Connector Cir. Board	X	X	X	X	X			X				
29. Time Mark Gen			X					X				
30. Pulse Gen			X									
31. Extender Plug-In			X									
32. Type 113 Delay Cable			X									
33. 20 cm Air Line			X									
34. Coax T			X									

¹S-3150 only.

TEST EQUIPMENT USAGE CHART (cont)

System Instruments

ITEM	568	R230	3T6	3S6	S-3A	R240	R250	R116	R1140	R1340	286 287 288	R293
35. Power Divider			X								X	
36. Type 191			X									
37. Extender Card								X				
38. Precision Resistor											X	
39. Test Load											X	
40. Capacitor											X	
41. Delay Line											X	
42. 3' Extender											X	
43. Card Extender											X	
44. Termination											X	X
45. Coax 50 Ω												X
46. Cable 50 Ω												X
47. Adapter												X
48. 24-Terminal Connector												X
49. 4-Pin Connector												X

