

TYPE 175

TRANSISTOR-CURVE TRACER HIGH-CURRENT ADAPTER CALIBRATION PROCEDURE

RECOMMENDED EQUIPMENT:

Tektronix Type 575 Transistor-Curve Tracer (calibrated).
Type 175 Switch Checker (or calibrated resistors as listed in the procedure).
Line Voltage Control (20 ampere Variac or equivalent).

SPECIFICATIONS CALLED OUT ARE TEST SPECS.

First, make a visual mechanical inspection. Check for long ends, unsoldered joints, wire dress, loose hardware, etc. Preset front panel controls as follows:

COLLECTOR SWEEP POLARITY - - - - -	minus (-)
PEAK VOLTS RANGE - - - - -	0 - 20
PERCENT OF PEAK VOLTS - - - - -	Full left (CCW)
STEP SELECTOR - - - - -	100 MA/STEP
VERTICAL DISPLAY - - - - -	1 AMP
HORIZONTAL DISPLAY - - - - -	0.1 BASE VOLTS

1. CHECK RESISTANCE TO GROUND OF TRANSFORMER PRIMARIES & LOW VOLTAGE SUPPLIES:

-150 V (14 K), +100 V (11 K), +300 V (inf.), -25 V at C621 (150 Ω), +25 V at C620 (80 Ω). Check R720 (300 Ω ±1%). Check the ZERO VOLTS and ZERO CURRENT switch. Resistance from terminal B to ground in the ZERO CURRENT position should be infinite. Resistance in the ZERO VOLTS position should be zero. Check primaries of all transformers for infinite resistance to ground.

2. ADJUST BASE STEP GENERATOR ZERO ADJ.:

Display a horizontal trace of about six (6) dots by switching:

MODE SWITCH - - - - -	TRANS B
HORIZONTAL DISPLAY - - - - -	0.1 BASE VOLTS
STEP SELECTOR - - - - -	0.1 VOLTS/STEP
STEP ZERO - - - - -	Mid-range
BASE STEP GENERATOR (on 575) - - - -	REPETITIVE

Switch the BASE STEP GENERATOR POLARITY alternately plus (+) and minus (-) while adjusting STEP ZERO ADJ. for symmetrical switching around the first dot.

3. ADJUST BASE STEP GENERATOR ADJ.:

With the same settings as in the last step, move the ZERO CURRENT - ZERO VOLTS switch to ZERO VOLTS and position the spot under the center graticule line. With the +ADJ. move the first dot of the display under the center graticule line.

4. CHECK STEP ZERO CONTROL:

The STEP ZERO control should move the display approximately 0.5 division each side of mid-range. Re-center STEP ZERO control.

5. CHECK BASE STEP GENERATOR POLARITY:

Switch the BASE STEP GENERATOR POLARITY switch from minus (-) to plus (+). In the positive position the display should step to the right and in the negative position, to the left.

6. MEASURE STEP AMPLIFIER IMPEDANCE:

Switch the 175 SWITCH CHECKER to 1 K on the Series Resistance switch and connect it to terminals B and E on the 175 TRANSISTOR TEST PANEL (Transistor A). Obtain one (1) dot per ten (10) major divisions by switching:

STEPS/FAMILY (on 575) - - - - -	MINIMUM (CCW)
REPETITIVE-SINGLE FAMILY (on 575) - -	REPETITIVE
HORIZONTAL DISPLAY - - - - -	.1 BASE VOLTS/DIV
STEP SELECTOR - - - - -	1 MA/STEP
STEP GENERATOR POLARITY - - - - -	plus (+)
TRANSISTOR SELECTOR - - - - -	"A"

Adjust V/STEP on the 175 for exactly one (1) step in ten (10) major divisions on the 575. Now switch BASE STEP GENERATOR POLARITY to minus (-). There must be one (1) step in ten (10) major divisions $\pm 1\%$. If the minus (-) deflection is out of tolerance, change V254 & V264 and recheck plus (+) and minus (-).

Disconnect leads.

7. ADJUST V/STEP ADJ. and CHECK STEP SELECTOR & HORIZONTAL DISPLAY SW (BASE V):

READ ALL OF THIS STEP BEFORE TEST.

Using the cables provided, connect the 175 SWITCH CHECKER VERTICAL COMPARISON switch to the Type 175 as follows:

Cable from "E"	on Sw Checker	to "E" jack on 175 (trans. B)
Cable from "C"	on Sw Checker	to "B" jack on 175
Cable from "V _E "	on Sw Checker	to "V _{CE} EXT. INPUT" (gnd. post)
Cable from "V _C "	on Sw Checker	to <u>white-brown lead at R510 (120 Ω)</u> <u>located on buss strap in 175</u>

Set controls as follows:

STEP SELECTOR - - - - -	50 MA/STEP
HORIZONTAL DISPLAY - - - - -	.1 BASE VOLTS/DIV
STEP GENERATOR - - - - -	plus (+)
175 SWITCH CHECKER - - - - -	2 Ω
STEPS/FAMILY (175)- - - - -	CW

Set V/STEP ADJ. for one (1) dot per major division.

With the SWITCH CHECKER connected the same, check the HORIZONTAL BASE VOLTS and STEP SELECTOR switches, using the settings in the following table (on Page 3). Tolerance $\pm 2\%$.

7. (con'd)

TABLE I

	<u>RESISTOR</u>	<u>STEP SELECTOR</u>	<u>HORIZONTAL DISPLAY</u>	<u>DOTS</u>
1.	100 Ω	1 MA/STEP	.1	1
2.	100 Ω	1 "	.2	2
3.	100 Ω	2 "	.2	1
4.	100 Ω	2 "	.5	5 dots per 2 Divs.
5.	100 Ω	5 "	.5	1
6.	10 Ω	10 "	.1	1
7.	10 Ω	20 "	.2	1
8.	10 Ω	50 "	.5	1
9.	10 Ω	50 "	1.0	2
10.	10 Ω	100 "	1.0	1
11.	10 Ω	100 "	2.0	2
12.	2 Ω	200 "	.5	5 dots in 4 Major Divs.
13.	2 Ω	500 "	1.0	1
Set STEPS/FAMILY CONTROL on 575 to 5 steps (6 dots) & set controls to				
14.	2 Ω	1000 MA/STEP	1.0	1 dot per 2 Divisions
Reset STEPS/FAMILY CONTROL on 575 full CW				
15.	open	.02 VOLTS/STEP	.1	5
16.	open	.05 "	.1	2
17.	open	.1 "	.1	1
18.	open	.2 "	.2	1
19.	open	.5 "	.5	1

If an incorrect display first occurs in the 2nd, 4th, 9th or 11th measurement of the table, the trouble is in the corresponding position of the HORIZONTAL DISPLAY switch. An incorrect display in any of the other measurements indicates that the trouble is in the corresponding position of the STEP SELECTOR switch. If the dots are consistently farther apart in the VOLTS/STEP positions of the STEP SELECTOR switch than in the MA/STEP positions, this indicates that R246 has increased in value or the wiring resistance of the circuit has increased. Conversely, if the dots are consistently closer together in the VOLTS/STEP positions of the STEP SELECTOR switch than in the MA/STEP positions, this indicates that R246 has decreased in value or has become shorted.

8. HORIZONTAL DISPLAY SWITCH (COLLECTOR V_{CE} POSITIONS):

READ ALL OF THIS STEP BEFORE TEST.

After you have verified the accuracy of all of the BASE V_{BE} positions of the HORIZONTAL DISPLAY switch, proceed as follows to check the resistors associated with the COLLECTOR V_{CE} positions of the switch:

1. Set the Transistor Selector switch to TRANSISTOR A, the PEAK VOLTS RANGE switch to 0-20, and the PERCENT OF PEAK VOLTS RANGE control to 0.
2. Set the HORIZONTAL DISPLAY switch to 2 COLLECTOR V_{CE} .
3. Rotate the PERCENT OF PEAK VOLTS RANGE control clockwise until you obtain exactly 10 divisions of horizontal deflection on the screen.
4. Set the HORIZONTAL DISPLAY switch to 5 COLLECTOR V_{CE} . There should be four (4) divisions ($\pm 2\%$) of horizontal deflection on the screen.
5. Return the PERCENT OF PEAK VOLTS RANGE control to 0.
6. Set the PEAK VOLTS RANGE switch to 0-100 and the PERCENT OF PEAK VOLTS RANGE control for exactly ten (10) divisions of horizontal deflection.
7. Set the HORIZONTAL DISPLAY switch to 10 COLLECTOR V_{CE} . There should be five (5) divisions ($\pm 2\%$) of horizontal deflection on the screen.

(The remaining COLLECTOR V_{CE} positions of the HORIZONTAL DISPLAY switch use the same resistors as the BASE V_{BE} positions which were checked previously).

9. VERTICAL DISPLAY SWITCH:

READ ALL OF THIS STEP BEFORE TEST.

In checking the resistances in the VERTICAL DISPLAY switch, the output of the Collector Sweep Circuit is applied across an externally connected resistor at each setting of the VERTICAL DISPLAY SWITCH. The voltage across the resistor is displayed as horizontal deflection and the current through the resistor is displayed as vertical deflection. The slope of the line displayed, as the Collector Sweep Output sweeps between zero and a selected maximum voltage, should indicate the value of the external resistance. Any deviation from the proper slope indicates an off-value current sampling resistor (assuming that the resistances in the HORIZONTAL DISPLAY switch, as measured previously, are all correct).

To check the resistances in the VERTICAL DISPLAY switch, proceed as follows:

1. Set the PERCENT OF PEAK VOLTS RANGE control to 0.
2. Set the COLLECTOR SWEEP POLARITY switch on the Type 175 to plus (+).
3. Connect the resistor designated in Column A of Table II (page 5) between the large C and E terminals on the TRANSISTOR A side of the transistor Test Panel of the Type 175, using the high-current test cables.

9. (con'd)

4. Connect test leads from the ends of the resistor (V_E & V_C) to the V_{CE} EXT. INPUT binding posts on the same side of the Transistor Test Panel.
5. Set the PEAK VOLTS RANGE, VERTICAL DISPLAY and HORIZONTAL DISPLAY switches on the Type 175 to the positions designated on Columns B, C and D of Table II.
6. Adjust the POSITION controls on the Type 575 to position the spot to the lower left corner of the graticule.
7. Set the Transistor Selector switch to TRANSISTOR A.
8. Rotate the PERCENT OF PEAK VOLTS RANGE control clockwise until you obtain the horizontal deflection specified in Column E of Table II. The vertical deflection should be within 2% of that specified in Column F.

NOTE: In the first measurement, you may not be able to obtain the full ten (10) divisions of horizontal deflection before the circuit breaker actuates. However, if the slope of the displayed line is correct, the measurement may be considered to be within tolerance. If the circuit breaker does actuate, return the PERCENT OF PEAK VOLTS RANGE control to 0 and wait one (1) minute for the heating element in the breaker to cool before resetting it.

TABLE II

Return the PERCENT OF PEAK VOLTS RANGE control to 0 after each measurement.

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F</u>
RESISTOR (ohms)	PEAK VOLTS RANGE	VERTICAL DISPLAY (amps)	HORIZONTAL DISPLAY (V_{CE})	HORIZONTAL DEFLECTION	VERTICAL DEFLECTION
0.005	0-20	20.0	0.1	10 Div	10 Div
0.005	0-20	10.0	0.1	5	10
Change to small connectors on 175 and Switch Checker. Use leads with banana plugs on both ends to connect C and E terminals.					
0.05	0-20	5.0	0.2	10	8
0.05	0-20	2.0	0.1	10	10
0.05	0-20	1.0	0.1	5	10
2.0	0-20	0.5	1.0	10	10
10.0	0-20	0.2	2.0	10	10
10.0	0-20	0.1	1.0	10	10
10.0	0-20	0.05	0.5	10	10
10.0	0-20	0.02	0.2	10	10
10.0	0-20	0.01	0.1	10	10
10.0	0-20	0.005	0.1	5	10

9. (con'd)

Continue in like manner down the table, inserting the proper resistor and setting the controls as designated, and check for adequate deflection and proper slope on the Type 575 screen. If vertical deflection is not correct, or if adequate horizontal deflection cannot be obtained, make a note of it (whether greater or less) and go on to the next measurement.

If the slope is correct for the first few measurements in Table II, but is incorrect for the remaining measurements, this indicates that one of the current-sampling resistors has changed in value. It will generally be the resistor associated with the VERTICAL DISPLAY switch position at which the incorrect deflection first occurred as you progressed down the table. If the deflection is greater than specified, the resistor has increased in value; if the deflection is less than specified, the resistor has decreased in value.

Insufficient horizontal deflection in the fifth and/or seventh measurement of the table (.1 and .2 positions of the VERTICAL DISPLAY switch, respectively) indicates that the internal resistance of the Collector Sweep circuit itself has increased beyond its proper value. In this case, check T702 and the associated rectifier diodes as described in the paragraph on Troubleshooting the Collector Sweep Circuit. (Instruction Manual)

10. CHECK BASE STEP GENERATOR SERIES RESISTANCE SWITCH:

With the HORIZONTAL DISPLAY switch set at .1 BASE VOLTS/CM and the STEP SELECTOR at .2 VOLTS/STEP, connect the SERIES RESISTANCE COMPARISON switch (on Switch Checker) between terminals B & E on the 175. Progressively, switch the same resistance in the COMPARISON switch as in the SERIES RESISTANCE. There should always be one (1) Dot/DIV $\pm 3\%$.

11. SET UP A DISPLAY OF AVERAGE COLLECTOR CHARACTERISTICS FOR A TYPE 2N277 TRANSISTOR:

CONTROL

HORIZ. DISPLAY - - - - -	.5 COLLECTOR VOLTS
VERT. DISPLAY - - - - -	1 AMP/DIV
BASE STEP GEN. - - - - -	20 MA/STEP
STEP GEN. POLARITY - - - - -	minus (-)
PERCENT OF PEAK VOLTS - - - - -	25
PEAK VOLTS RANGE - - - - -	0 - 20
COLL. SW. POLARITY - - - - -	minus (-)

Connect a 2N277 to the 175 and display a family of curves.

12. RECHECK CALIBRATION:

- a. Zero Adj.
- b. \pm Adj.
- c. V/Step Adj.

175 SWITCH CHECKER

PARTS LIST:

Quantity	Description	Tek Number
1 ea.	Resistor, .005 Ω .1% 100 w.) Order	
1 ea.	Resistor, .05 Ω .1% 50 w.) Special	
1 ea.	Resistor, WW, 2 Ω .1% 50 w.)-- from --	Tek-made
1 ea.	Resistor, WW, 10 Ω .1% 20 w.) Resistor	
1 ea.	Resistor, mica plate, 100 Ω .1% 2 w.) Dept.	
1 ea.	Switch, 2 pole, 4 position	Special
1 ea.	Switch, 2 pole, 11 position	"
1 ea.	Cable, (10 in., 175-153 w/2 ea. 210-245 terminals)	"
1 ea.	Cable, (5-1/2 in. 175-153 w/2 ea. 210-245 terminals)	"
1 ea.	Chassis, .063 aluminum	"
1 ea.	Strip, ceramic, 3/4 x 2 notches, clip-mounted	124-086
2 ea.	Post, ceramic	129-009
1 ea.	Post, binding, 5-way, black	129-036
1 ea.	Post, binding, 5-way, red	129-055
1 ea.	Base, motor	131-102
1 ea.	Assembly, pilot light	136-028
6 ea.	Jack, banana type, female	136-052
1 ea.	Jack, female, red	136-083
1 ea.	Jack, male, black	136-084
1 ea.	Motor, fan	147-009
1 ea.	Bulb, NE-51	150-003
1 ea.	Fuse, AGC, 1 Amp., Fast-blo	159-022
2 ea.	Spacer,	166-098
2 ea.	Lockwasher, int. #4	210-004
21 ea.	Lockwasher, int. #6	210-006
10 ea.	Lockwasher, int. #8	210-008
6 ea.	Lockwasher, ext. #10	210-009
6 ea.	Lockwasher, int. #10	210-010
8 ea.	Lockwasher, pot, int. 3/8 x 1/2	210-012
5 ea.	Lug, banana, 3/4 long	210-214
6 ea.	Lug, solder, 1/4 in. hole	210-223
2 ea.	Nut, hex, 4-40 x 3/16	210-406
21 ea.	Nut, hex, 6-32 x 1/4	210-407
8 ea.	Nut, hex, 8-32 x 5/16	210-409
1 ea.	Nut, hex, 3/8-32 x 1/2	210-413
1 ea.	Nut, hex, 15/32-32 x 9/16	210-414
5 ea.	Nut, hex, 10-32 x 3/8	210-445
1 ea.	Nut, switch, 15/32-32 x 5/64, 12-sided	210-473
3 ea.	Washer, steel, 10S x 7/16	210-805
1 ea.	Washer, flat, .390 ID x 9/16 OD	210-840
1 ea.	Washer, steel, 1/2 ID x 5/8 OD	210-845
2 ea.	Screw, 4-40 x 3/8 RHS	211-013
6 ea.	Screw, 6-32 x 3/8 Truss	211-537
11 ea.	Screw, 6-32 x 5/16 FH Phillips	211-538
8 ea.	Screw, 6-32 x 5/16 Truss	211-542
2 ea.	Screw, 8-32 x 1-1/2 RHS	212-022
2 ea.	Screw, 8-32 x 1-3/4 FHS	212-041
2 ea.	Screw, 4-40 x 1/4 PHS, thread-cutting	213-035
4 ea.	Screw, 6-32 x 3/8 Truss, thread-cutting	213-041
4 ea.	Screw, 4-40 x 1/4 RH Phillips, thread-cutting	213-044
5 ea.	Screw, hex, 10-32 x 1/2	213-090

PARTS LIST: (continued)

Quantity	Description	Tek Number
1 ea.	Switch, toggle, SPST	260-134
1 ea.	Resistor, prec. 2 Ω 1/2 w. 1%	309-058
1 ea.	Resistor, prec. 20 Ω 1/2 w. 1%	309-064
1 ea.	Resistor, prec. 200 Ω 1/2 w. 1%	309-073
1 ea.	Resistor, prec. 10 Ω 1/2 w. 1%	309-096
1 ea.	Resistor, prec. 100 Ω 1/2 w. 1%	309-112
1 ea.	Resistor, prec. 1 K 1/2 w. 1%	309-115
1 ea.	Resistor, prec. 5 Ω 1/2 w. 1%	309-127
1 ea.	Resistor, prec. 50 Ω 1/2 w. 1%	309-128
1 ea.	Resistor, prec. 500 Ω 1/2 w. 1%	309-179
3 ea.	Resistor, mica plate, 1 Ω 3 w. 1/2%	310-535
1 ea.	Tag, 117 V	334-649
2 ea.	Grommet, rubber, 5/16	348-003
3 ea.	Shockmount	348-008
1 ea.	Assembly, fuse holder	352-002
1 ea.	Ring, fan	354-063
6 ea.	Spacer, nylon	358-042
1 ea.	Spacer, nylon molded	361-008
1 ea.	Knob, black, 1.375 OD x .655	366-042
1 ea.	Knob, black, 1.625 OD x .655	366-060
1 ea.	Blade, fan	369-011
2 ea.	Bar, aluminum	381-084
1 ea.	Plate, fan screen	386-731
1 ea.	Mount, fan motor	426-061
1 ea.	Case Assembly, blank for Type 181, consisting of:	
	2 ea. Subpanel)	
	1 ea. Overlay, rear)---	No #'s*
	1 ea. Overlay, front, etched & anodized)	
*	Special order from Shop per drawings CS208 & CS255	
	2 ea. Rail, bottom frame	122-052
	2 ea. Ring, feature	354-067
	1 ea. Rail, top w/handle	381-128
	2 ea. Panel, side	387-039
	1 ea. Panel, bottom	387-040
1 pr.	Leads, test, consisting of:	
	2 ea. Plug, banana	134-013
	1 ea. Wire, test lead, 36 in. black	175-029
	1 ea. Wire, test lead, 36 in. red	175-030
	1 ea. Cover, red	200-047
	1 ea. Cover, plastic, black (for alligator clip)	200-062
	2 ea. Cover, plastic, black (for banana plug)	200-076
	2 ea. Clip, alligator	344-001
1 pr.	Leads, test, consisting of:	
	4 ea. Plug, banana	134-013
	4 ea. Cover, plastic, black	200-076
	1 ea. Wire, #14 stranded, 36 in. black) Special	
	1 ea. Wire, #14 stranded, 36 in. red) Order	
1 pr.	Leads, test, consisting of:	
	2 ea. Plug, red pin 100 Amp	134-045
	2 ea. Plug, black pin, 100 Amp	134-046
	4 ea. Tube, spacer, brass .375 OD	166-196
	2 ea. Wire, test lead 36 in. yellow	175-153