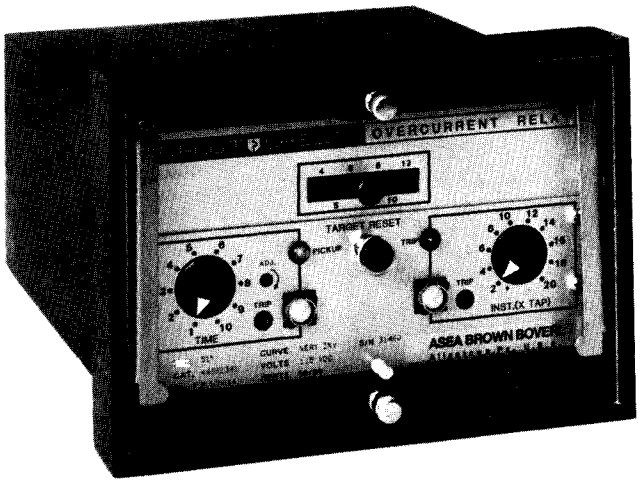
IB 7.2.1.7-14
Issue B
with Addendum A

INSTRUCTIONS

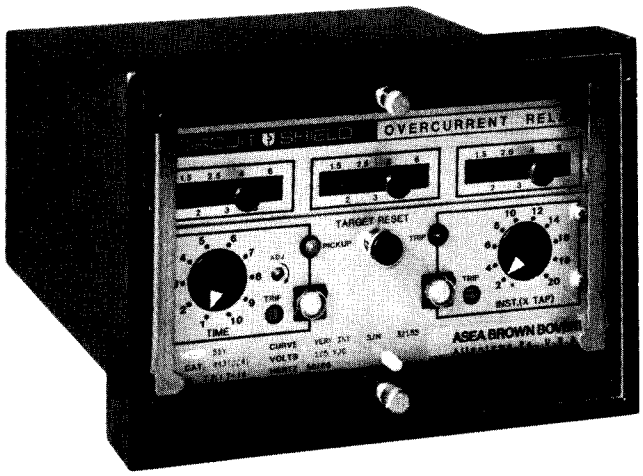
Time-Overcurrent Relay

CIRCUIT SHIELD ®

TYPE 51 with Contact Output
Catalog Series: 243 and 443
Single-Phase, Two-Phase, Three-Phase



Single-Phase



Three-Phase

ABB POWER T&D COMPANY INC.
ALLENTOWN, PENNSYLVANIA

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INTRODUCTION

These instructions contain the information required to properly install, operate, and test the ABB Circuit-Shield Type 51 solid-state time-overcurrent relay, catalog series 243 with contact output. (ABB Type 51 relays with thyristor [SCR] output, catalog series 223 or 423 are covered by instruction book IB 7.2.1.7-1).

These relays are housed in a semi-flush drawout relay case suitable for conventional panel mounting. All connections to the relay are made at terminals at the rear of the case which are clearly numbered.

All user adjustments are located on the front panel behind a clear plastic cover. Target indicators are also mounted on the front panel and are reset by means of a pushbutton which extends through the cover.

PRECAUTIONS

The following precautions should be observed when applying these relays:

1. Incorrect wiring may result in damage. Be sure wiring agrees with connection diagram for the particular relay before the relay is energized.

2. Apply only the rated control voltage marked on the relay front panel.

3. Trip circuit must be interrupted by an auxiliary ("a") contact on the breaker.

4. When testing, be sure to interrupt test current immediately upon relay operation.

5. Do not apply high voltage tests to solid-state relays. If a control wiring insulation test is required, withdraw the circuit board from the case before applying test voltage.

6. Be sure to note the use of links or connections to terminals 9-10-11 described under CONNECTIONS on page 3 to insure proper operation of the relay.

7. Only the lower circuit board of the 243 series relay is removable. The board should insert smoothly. Do not use force.

8. Note that removal of a tap block pin is equivilent to setting the highest tap. (Continuity of the CT circuit is not broken when the pin is removed.)

9. Follow test instructions to verify that the relay is in proper working order. CAUTION: since troubleshooting entails working with energized equipment, caution should be taken to avoid personal shock. Only competent technicians familiar with good safety practices should service these devices.

PLACING THE RELAY INTO SERVICE

1. RECEIVING, HANDLING, STORAGE

Upon receipt of the relay (when not included as part of a switchboard) examine for shipping damage. If damage or loss is evident file a claim at once and promptly notify ABB Asea Brown Boveri. Keep the unit clean and dry and use normal care in handling to avoid mechanical damage.

2. INSTALLATION

MOUNTING: the outline dimensions and panel drilling are given in Figure 1.

CONNECTIONS:

Typical connections are shown in Figure 2. Do not use this relay in capacitor trip applications. If a capacitor trip unit is to be used for tripping power, refer to catalog series 223- units.

For the TIME function to be operable, terminals 10 and 11 must be shorted externally. A link is provided on the relay to accomplish this. The TIME function can be controlled, such as in directional sshemes, by discarding the link and connecting a supervisory contact to terminals 10 and 11.

For the INSTANTANEOUS function to be operable, terminals 9 and 10 must be shorted externally. A link is provided on the relay to accomplish this. The INST function can be controlled by discarding the link and connecting a supervisory contact to terminals 9 and 10.

The relay has a metal front panel which is connected through the printed circuit board and connector wiring to the terminal marked "G". This terminal should be wired to ground.

3. SETTINGS

PICKUP CURRENT TAPS: A tap block for each phase provides for 7 pickup settings which are marked in CT secondary amperes. When the pin is removed, that phase switches to the highest setting. The pin may be moved with the relay in service.

TIME DIAL: One of ten time-current curves is selected by the switch on the left side of the front panel. Refer to the Time-current Characteristic Curve for the particular unit. Note: a screwdriver adjusted vernier (ADJ) is provided to obtain a continuous time adjustment between the discrete switch positions. With the vernier fully counterclockwise, the time corresponds to the switch position. As the vernier is turned clockwise the time increases. Operating times should be verified by test when the vernier is used.

INSTANTANEOUS: Instantaneous pickup is selected by the dial on the right side of the front panel. The adjustment is continuous. The dial is calibrated in multiples of the Time Pickup Tap Setting. For example, if the Pickup Tap is set at 6 amperes and the INST dial is set at 8, the instantaneous pickup is 6 X 8 = 48 amperes.

INDICATORS: Operation targets are provided for the TIME and INST functions. These targets are actuated by the flow of trip circuit current to the trip coil of the circuit breaker or lock-out relay. A minimum of 1 ampere is required to obtain target operation. The targets must be manually reset. Control power must be available to reset the targets. PHASE targets are available as an optional feature.

Light emitting diode (led) indicators are provided to assist in testing. A yellow led lights when the current reaches the TIME pickup value. A red led lights when a tripping output is obtained.

APPLICATION DATA - ABB Circuit-Shield Type 51

The Type 51 series of overcurrent relays provide phase-to-phase or phase-to-ground overcurrent protection. They are designed to be operated by standard 5 ampere secondary current transformers and dc control power from a station battery. Catalog series 243 units provide contact output. For thyristor (SCR) output refer to catalog series 423 units, covered in IB 7.2.1.7-1.

Models are available to provide eight different time-current characteristic curves. Transparent curves are available on request.

These relays include switched-mode power supply circuitry which supplies 24Vdc to the internal circuits of the relay. Some audible noise may be heard from the switched-mode supply within the relay.

Certain models are rated for use on a 120 Vac control supply. Although operation from a station battery is usually preferred for overall reliability, there are applications such as motor starters where an ac control supply does not jeopardize the overall reliability of the scheme.

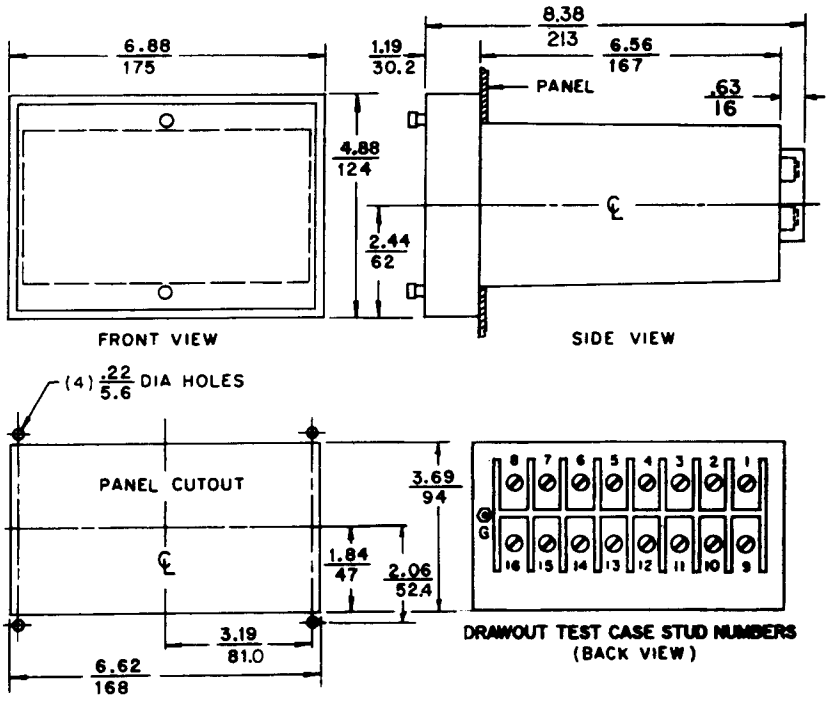


Figure 1

Relay Outline

Dimensions are
Inches
---
mm

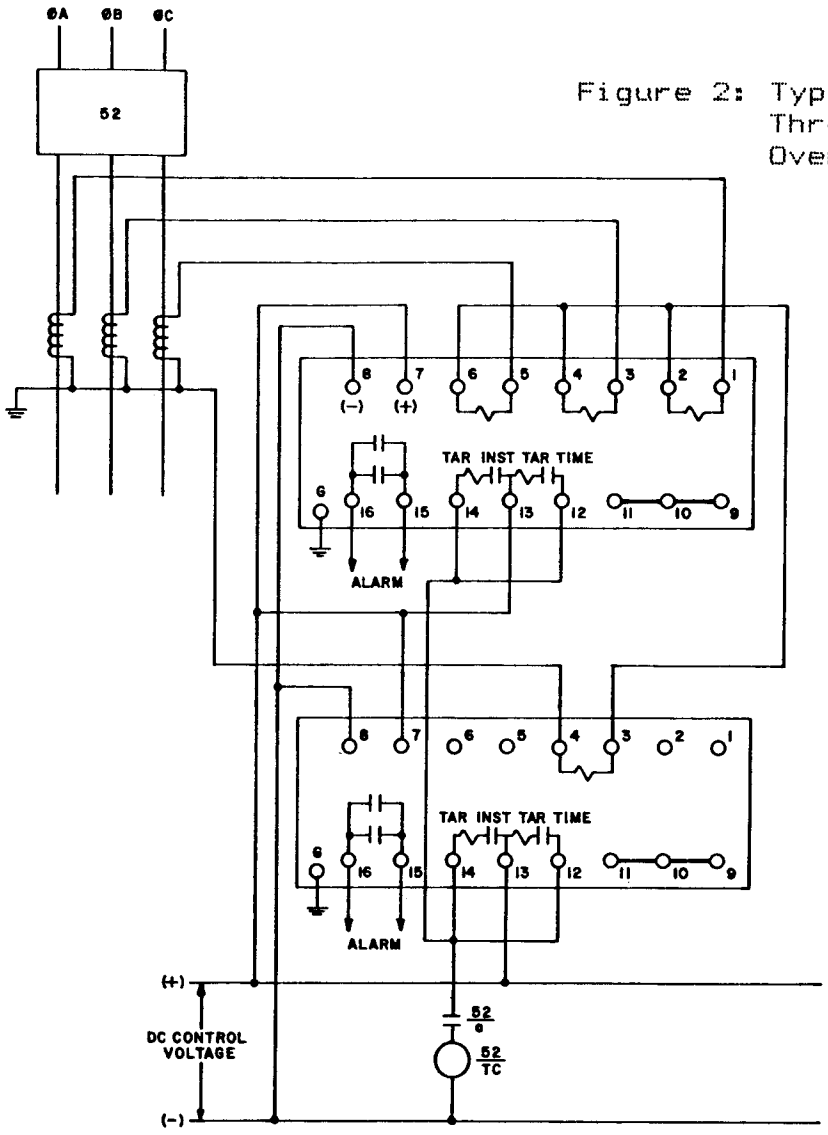


Figure 2: Typical Connections for Three-Phase and Ground Overcurrent Protection

RATINGS

TEMPERATURE

Nominal .....25°C ambient
Additional ±5% tolerance .....−15°C to +55°C
Must operate .....−30°C to +70°C

FREQUENCY

Nominal .....60 Hertz
Additional ±5% tolerance .....+1 to −3 Hertz

INPUT CIRCUIT

Phase one (1) current — terminals 1 and 2.
Phase two (2) current — terminals 3 and 4.
Phase three (3) current — terminals 5 and 6.

The current input for single-phase relays is made at terminals 3 and 4.

Each input current is fed to a tapped transformer primary. The secondary winding produces a voltage across a burden resistor. This voltage is rectified and supplied to the static circuitry.

The pickup of the static circuit is adjusted to the desired pickup current by tap selection of the transformer primary turns.

These overcurrent relays are offered with the following pickup ranges:

Range	Taps ‡
0.1-0.5	0.1, 0.15, 0.2, 0.25, 0.3, 0.4, 0.5
0.5-2.0	0.5, 0.6, 0.8, 1.0, 1.2, 1.5, 2.0
1.5-6.0	1.5, 2.0, 2.5, 3, 4, 5, 6
2.5-5	2,5, 2.8, 3.1, 3.5, 4.0, 4.5, 5.0
2.5-10	2.5, 3.75, 5, 6.3, 7.5, 8.6, 10
4-12	4, 5, 6, 7, 8, 10, 12

‡ When tap plug is removed, affected phase reverts to the maximum pickup.

INPUT CURRENT RATINGS

Time	Tap Range, A	Input Current, 1 Ø or 3 Ø (CT Secondary Amperes)
1 Second	0.1 - 0.5 0.5 - 2.0 1.5 - 6.0 2.5 - 5.0 2.5 - 10	300 multiples of pickup tap setting or 235 A rms, whichever is less.
	4 - 12	300 multiples of pickup tap setting or 390 A rms, whichever is less.
Continuous	All Ranges	1.5 multiples of pickup tap setting.

BURDEN

The burden of the Circuit Shield overcurrent relay is very low, allowing the use of current transformers which would give unsatisfactory performance if they were driving electro-mechanical relays.

Because the input characteristic of the Circuit Shield relay is nonlinear, an impedance cannot be specified, however, the burden voltage across the relay current input terminals can be readily calculated for any given value of current transformer secondary current:

TAP (AMPS)	R_{DC} OHMS
0.5	.092
0.6	.078
0.8	.065
1.0	.055
1.2	.048
1.5	.040
2.0	.032
1.5	.042
2.0	.034
2.5	.038
3.0	.026
4.0	.022
5.0	.020
6.0	.0185
4	.020
5	.020
6	.0185
7	.0175
8	.017
10	.0165
12	.0165

$$V = \frac{1.0}{I_T} + I_S \times R$$

V = burden voltage (volts)
I_S = current transformer secondary current (amperes)
I_T = relay pickup current tap setting (amperes)
R = D.C. resistance of relay input circuit (ohms) (select from table)

NOTES:

1. for units with 0.1 to 0.5A tap range, the Is x R term is negligible.
2. for units with 2 to 5A tap range, use values shown for 1.5 to 6A unit.

FREQUENCY RATING

Type 51 series relays with a nameplate rating of 50/60 Hz. are suitable for operation at either frequency; however, the time current curves in this book apply only to 60 Hz. operation. To determine the operating time for 50 Hz. applications use the correction factors shown below.

Important: relays which have a nameplate rating of just 50 Hz. will perform per the printed curves when operated at 50 Hz. Do not use the correction factor table for these relays.

For 50/60Hz units used at 50Hz:

60Hz Multiple	50Hz Multiple
1	1
2	2
3	3.2
4	4.4
5	5.6
8	9.2
10	11.6
15	17.6
20	23.6
40	48.4

Example: find the operating time for 4 multiples of current from the 60Hz curve. Plot this time at 4.4 multiples to obtain the 50Hz curve. Do this for all values of interest.

Note therefore that operation at 50Hz is slightly slower than the curve shows for 60Hz operation.

TOLERANCES

Time Pickup.....+/-5%

Time Delay.....+/-10%

Inst. Pickup.....+/-10%

CONTROL VOLTAGE BURDEN

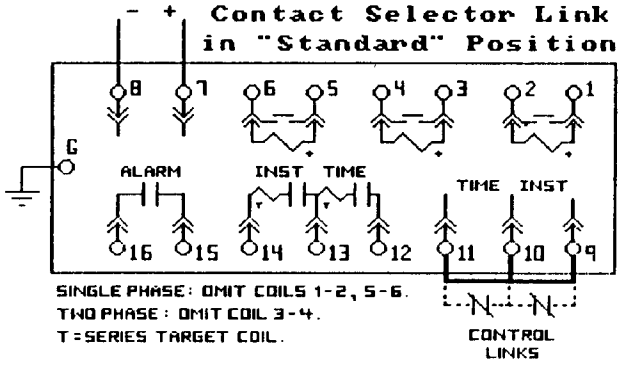
0.6 watts nominal standby,
2.5 watts maximum drain.

CONTACT RATINGS

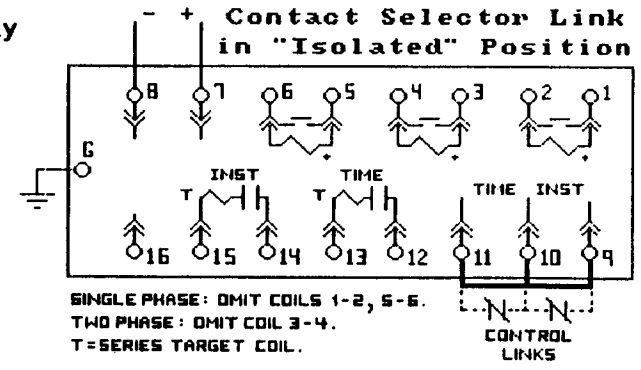
at 125 Vdc:
30 A tripping,
5 A continuous,
0.3A break inductive.

SERIES TARGET COIL

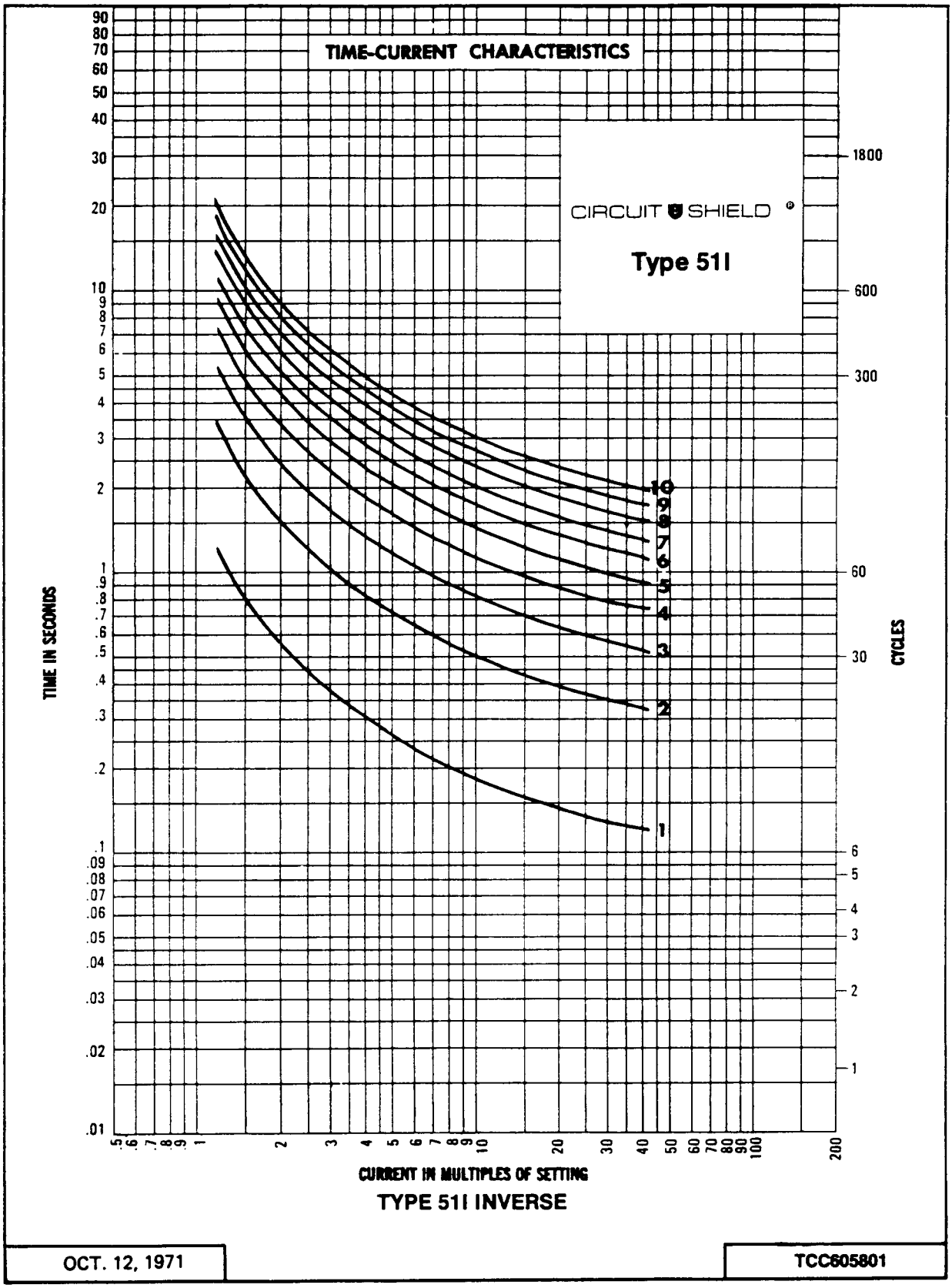
Rated 30 A tripping;
1 A minimum trip circuit current required to set the targets.

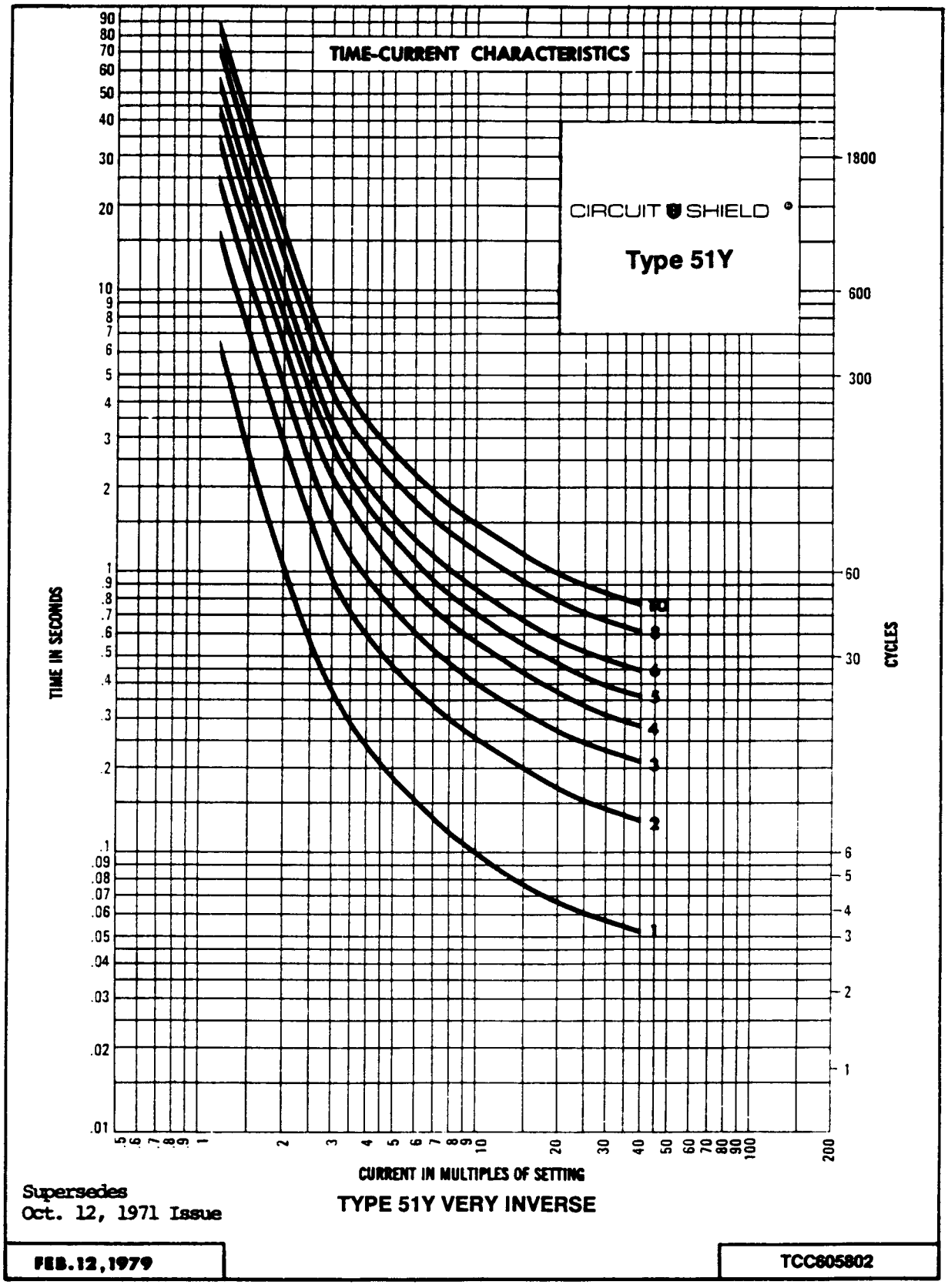


16D443A Type 51
Time-Overcurrent Relay
Contact Output
Drawout Test Case



OVERCURRENT RELAY





Supersedes
Oct. 12, 1971 Issue

TYPE 51Y VERY INVERSE

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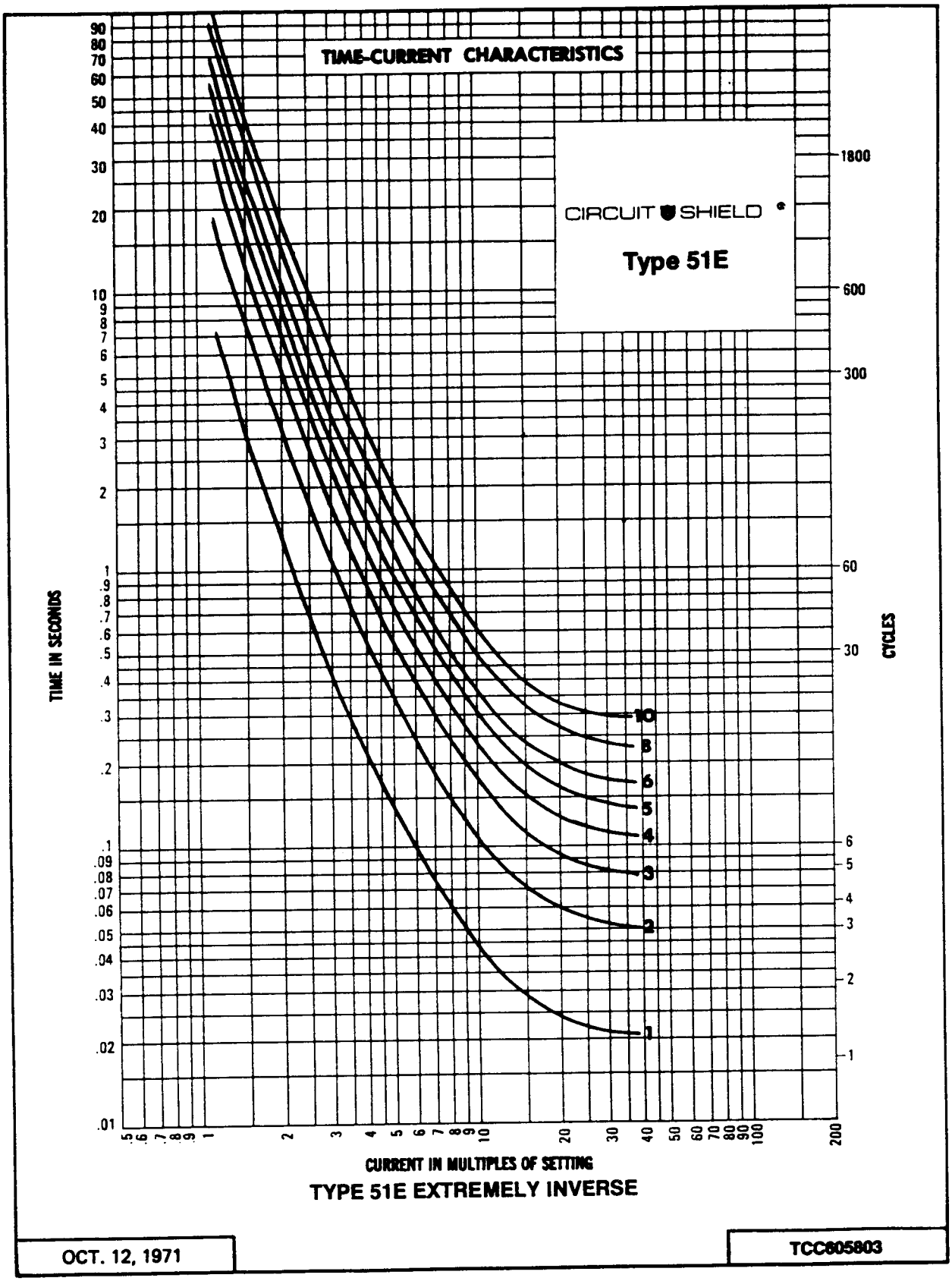


For additional time-current curves, turn to page 15.

TESTING

1. MAINTENANCE AND RENEWAL PARTS

No routine maintenance is required on these relays. Follow test instructions to verify that the relay is in proper working order. We recommend that an inoperative relay be returned to the factory for repair; however, a schematic diagram will be provided on request for those who wish to attempt repairs.

CAUTION: since troubleshooting entails working with energized equipment, caution should be taken to avoid personal shock. Only competent technicians familiar with good safety practices should service these devices.

Renewal parts, such as the output relay and target head assembly are available from the factory. Contact your nearest sales office for quotations. Also available are circuit card extenders which may be useful when troubleshooting. These relays use the 18 pt. extender, catalog 200X0018.

Drawout circuit boards of the same catalog number are interchangeable. The board is removed by using the metal pull knobs on the front panel. The circuit board is identified by the catalog number and serial number on the front panel of the relay. The circuit board may be removed with the unit in service without opening the CT circuits or causing an incorrect operation.

Catalog series 243- units are NOT interchangible with series 223- units. Catalog series 243- can NOT be tested with the type X51C test accessory.

2. HIGH POTENTIAL TESTS

High voltage insulation tests are not recommended. These tests have been applied at the factory. If a control wiring insulation test is required, withdraw the drawout card from the case before applying test voltage.

3. BUILT-IN TEST FUNCTION

A built-in test function is provided for convenience in running a trip test on the relay and associated trip circuits.

CAUTION: tests should be made with the main circuit de-energized. If tests must be run on an energized circuit, take all necessary precautions.

Test buttons labelled TRIP are provided for both the TIME and INST functions. When the button is pressed an overcurrent condition is simulated. The relay should trip immediately when the inst. trip button is actuated. When the time trip button is actuated, the pickup light should come on, and the relay will time out and trip. The button must be held for the time delay period. The simulated test current is approximately equal to a value of 2 times the pickup setting.

3. ACCEPTANCE TESTS

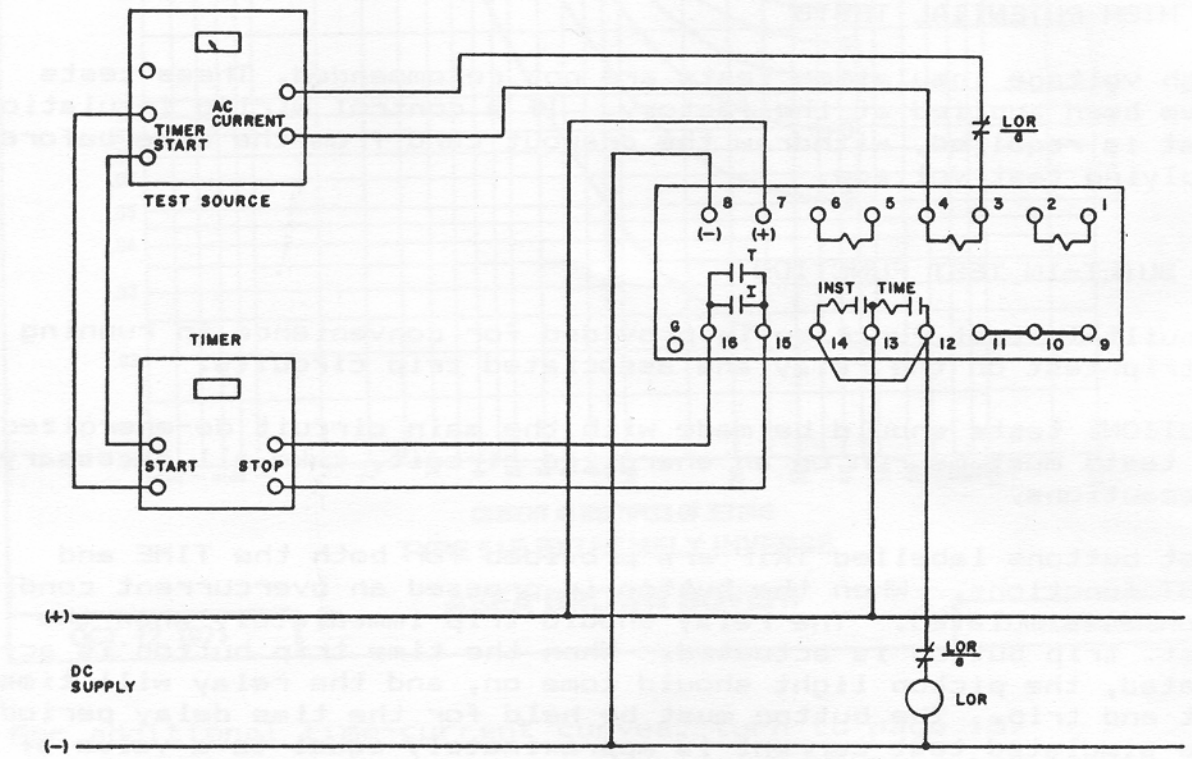
A typical test circuit is shown in figure 4. Apply control voltage to match the relay nameplate rating. The Time pickup current can be determined by increasing the input current until the pickup indicator (yellow led) lights. Operating time can be checked by presetting the current to 3 times the pickup tap. Apply current to relay and measure time to output contact closure. A red led indicator is provided to indicate output contact closure.

NOTE: many test sources have limited capacity and do not properly simulate CT secondary current. See APPENDIX A for correction factors to be used with some of the more common test sources. Other test points on the curve may be checked as the user desires. Operating time should be within +/-10% of the value read from the time-current curve for the particular unit. If the actual settings to be used are known, the vernier adjustment (ADJ) can be used to obtain the desired operating time.

To check INST pickup current, apply test current and increase rapidly until the relay operates. Operating current should be within +/-10% of the setting. Note: APPENDIX A correction factors must be considered for this test as the effect of limited sources is greater at higher currents. Be sure to interrupt test current as soon as the relay operates. In Fig. 4 a contact of the lockout relay performs this function. Do not apply high current tests in rapid succession due to thermal heating effects.

The lockout relay coil will draw sufficient current to actuate the targets of the Type 51 relay.

Figure 4: Typical Test Circuit



APPENDIX A

CIRCUIT-SHIELD TEST TABLES

NOTE: You need not use these tables if you desire to make the standard receiving calibration check described under calibration testing.

When testing protective relays with test sources of limited capacity the accuracy of test results is affected by the wave shape of the test current. Where extremely accurate calibration test are desired, the attached test Tables prepared under laboratory conditions with standard CIRCUIT-SHIELD relays can be used:

Table 1 — Resistance Testing
("STATES" resistance bank #33560.R)

Table 2 — Reactance Testing
("G.E." reactor, #6054975)

Table 3 — MULTI-AMP Unit (SR-51 test set)

Note that the test current wave distortion is more apparent at the low current tap setting (highest relay burden) and at high current multiples (lowest test source impedances).

CIRCUIT-SHIELD solid-state overcurrent relays have been designed with a low burden characteristic. This relay burden is such that the primary current transformer will not saturate at high fault current values if the CT is selected so that its saturation point is above one multiple of the relay pickup setting. This is accomplished by a specially designed input transformer in the relay which saturates at just above pickup current. In addition to improving the accuracy performance of the primary current transformer, this feature also effectively prevents internal solid-state components from being subjected to high currents and voltages under fault conditions.

CONSULT FACTORY FOR TEST CURRENT CORRECTIONS TO BE USED FOR TEST SETS NOT LISTED IN THIS APPENDIX.

TABLE 1
CIRCUIT-SHIELD OVERCURRENT RELAY
TEST CURRENT CORRECTION — RESISTANCE TESTING
120 VOLT SOURCE (FIXED)

(STATES #33560.R)

TEST CURRENT MULT.	0.5-2 AMP TAP RANGE							1.5-6 AMP TAP RANGE				4-12 AMP TAP RANGE				
	0.5	0.6	0.8	1.0	1.2	1.5	2.0	2.5	3	4	5	6	7	8	10	12
PICKUP	0.50	0.60	0.80	1.00	1.20	1.50	2.00	2.50	3.00	4.00	5.00	6.00	7.00	8.00	10.00	12.00
2X	1.02	1.22	1.62	2.02	2.42	3.02	4.02	5.02	6.02	8.02	10.00	12.00	14.00	16.00	20.00	24.00
3X	1.56	1.86	2.46	3.06	3.65	4.55	6.05	7.55	9.05	12.10	15.10	18.10	21.10	24.10	30.10	36.10
4X	2.12	2.51	3.31	4.11	4.91	6.11	8.11	10.10	12.10	16.10	20.10	24.10	28.10	32.11	40.10	48.10
5X	2.70	3.19	4.19	5.19	6.19	7.68	10.20	12.70	15.20	20.20	25.20	30.20	35.20	40.20	50.20	60.18
6X	3.30	3.89	5.09	6.28	7.48	9.28	12.30	15.30	18.30	24.30	30.30	36.30	42.30	48.30		
8X	4.57	5.36	6.94	8.53	10.10	12.50	16.50	20.50	24.50	32.50	40.50	48.50	56.50			
10X	5.95	6.92	8.88	10.90	12.90	15.80	20.80	25.80	30.80	40.81	50.80					
15X	9.94	11.30	14.20	17.10	20.00	24.50	31.90	39.40	46.90							
20X	14.90	16.50	20.10	23.90	27.80	33.70	43.60	53.50								

This table lists corrected test currents for one (1) to twenty (20) multiples of each tap setting available on CIRCUIT-SHIELD relays. These test currents cause the relay to produce the trip time corresponding to current transformer (CT) operation, as will be encountered in actual service.

TABLE 2

CIRCUIT-SHIELD OVERCURRENT RELAY
TEST CURRENT CORRECTION — REACTANCE TESTING
120 VOLT SOURCE (ADJUSTABLE)

(G.E. REACTOR #6054975)

TEST CURRENT MULT.	0.5	0.6	X_S=24 Ω 0.8	1.0	1.2	1.5	2.0	X_S=12 Ω 2.5	3	4	5	X_S=6 Ω 6	7	8	X_S=3 Ω 10	12
PICKUP	0.50	0.60	0.80	1.00	1.20	1.50	2.00	2.50	3.00	4.00	5.00	6.00	7.00	8.00	10.00	12.00
2X	1.08	1.21	1.61	2.00	2.40	3.00	4.00	5.00	6.00	8.00	10.00	12.00	14.00	16.00	20.00	24.00
3X	1.52	1.81	2.41	3.00	3.60	4.50	6.00	7.50	9.00	12.00	15.00	18.00	21.00	24.00	30.00	36.00
4X	2.05	2.41	3.20	4.00	4.80	6.00	8.00	10.00	12.00	16.00	20.00	24.00	28.00	32.00	40.00	48.00
5X	2.55	3.04	4.00	5.00	6.01	7.50	10.00	12.50	15.00	20.00	25.00	30.00	35.00	40.00	50.00	60.00
6X	3.06	3.64	4.90	6.00	7.20	9.05	12.05	15.00	18.00	24.00	30.25	36.00	42.00	48.00	60.00	72.00
8X	4.06	4.90	6.55	8.05	9.75	12.15	16.05	20.10	24.30	32.40	41.00	49.00	56.00	64.00	80.00	
10X	5.35	6.35	8.25	10.40	12.30	15.25	20.50	25.50	31.00	41.50	51.50	62.50	71.50	80.00		
15X	7.85	9.55	12.40	15.50	18.90	22.70	30.45	40.00	47.00	61.80	78.00					X_S=0.5 Ω
20X	10.70	13.20	16.60	22.00	25.00	31.25	46.50	63.00	67.00							

0.5-2 AMP TAP RANGE
1.5-6 AMP TAP RANGE
4-12 AMP TAP RANGE

This table lists corrected test currents for one (1) to twenty (20) multiples of each tap setting available on CIRCUIT-SHIELD relays. These test currents cause the relay to produce the trip time corresponding to current transformer (CT) operation, as will be encountered in actual service.

When using a tapped reactance in series with a variable voltage source to test CIRCUIT-SHIELD relays, the desired test current should be set using the largest possible reactance, as indicated in the chart above for a 120 Vac source.

TABLE 3

For specific test instructions using MULTI-AMP SR-51 Test Set see page 15.

CIRCUIT-SHIELD OVERCURRENT RELAY
TEST CURRENT CORRECTION — MULTI-AMP TEST SET

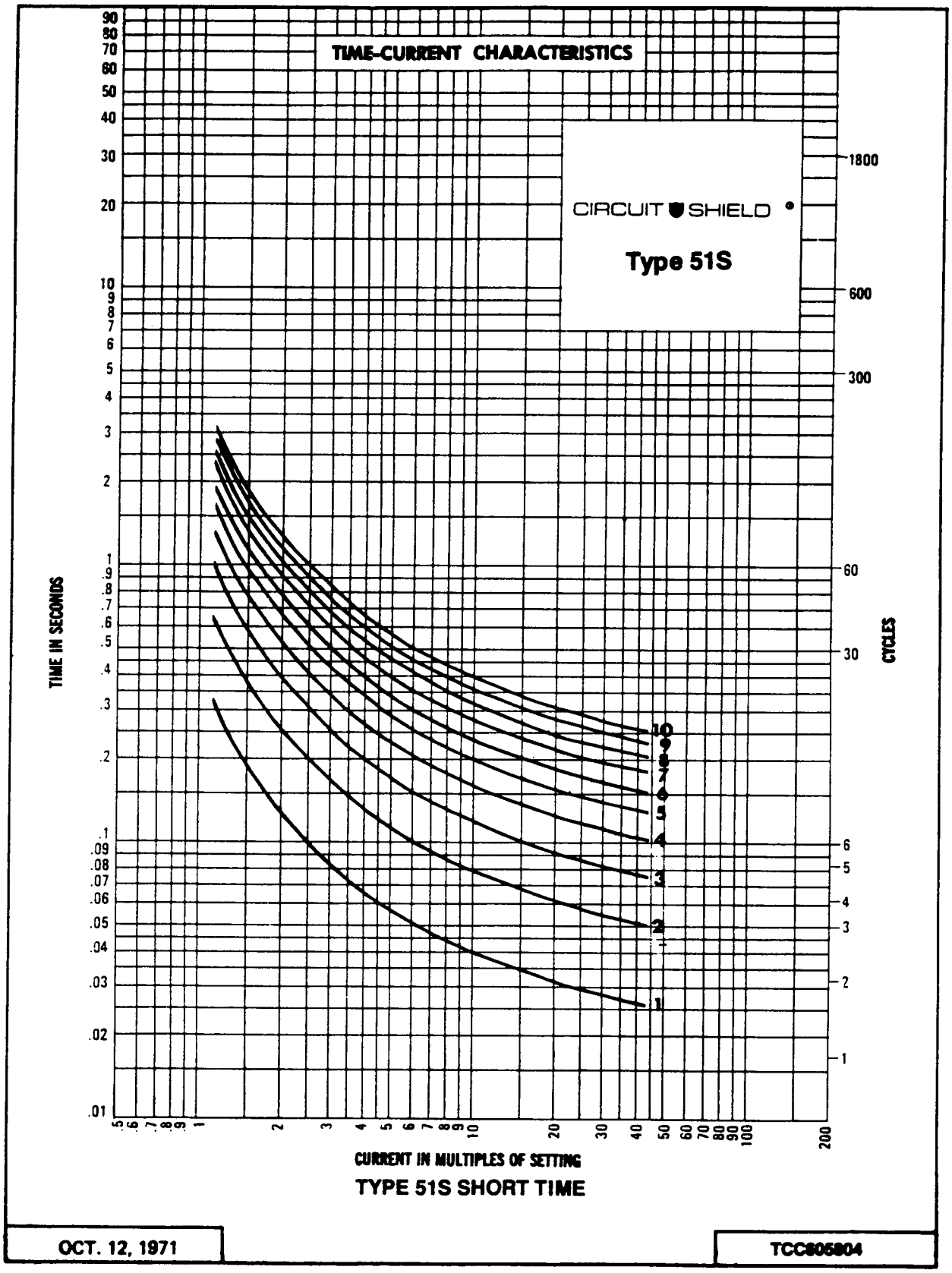
(MULTI-AMP SR-51, SR-76)

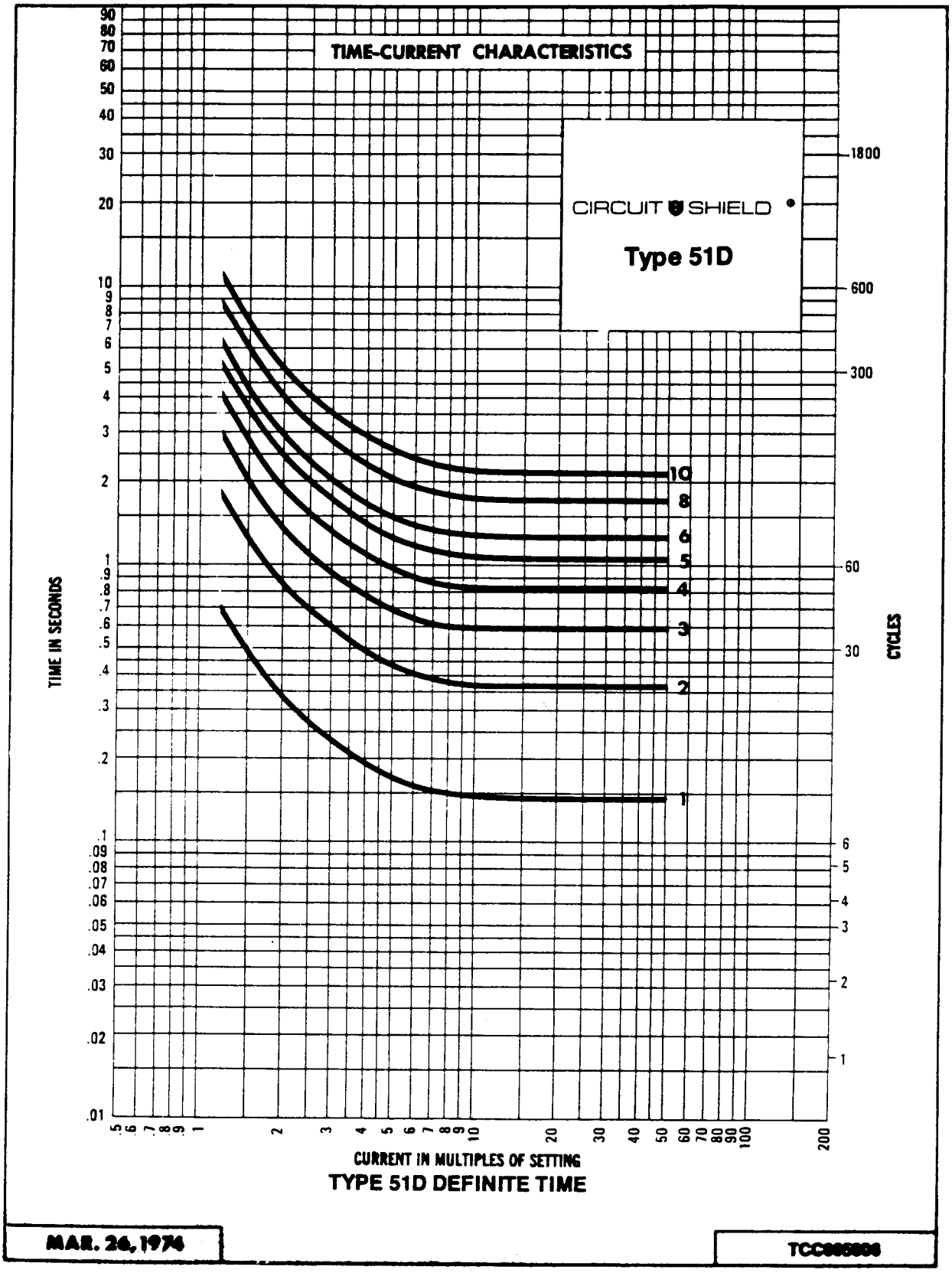
80 VOLT TAP: use data to left of bold line.
40 VOLT TAP: use data to right of bold line.

TEST CURRENT MULT.	0.5	0.6	0.5-2 AMP TAP RANGE 0.8	1.0	1.2	1.5	2.0	1.5-6 AMP TAP RANGE 2.5	3	4	5	4-12 AMP TAP RANGE 6	7	8	10	12
PICKUP	0.50	0.60	0.80	1.00	1.20	1.50	2.00	2.50	3.00	4.00	5.00	6.00	7.00	8.00	10.00	12.00
2X	1.55	1.58	1.87	2.25	2.59	3.15	4.10	5.05	6.10	8.10	10.00	12.00	14.20	16.00	20.00	24.30
3X	3.35	3.34	3.49	3.85	4.29	5.01	6.40	7.80	9.40	12.30	15.30	18.30	21.30	24.30	30.20	36.50
4X	5.10	4.89	5.09	5.45	6.00	6.90	8.70	10.40	12.30	16.50	20.40	24.50	28.50	32.00	40.50	48.80
5X	6.78	6.50	6.60	7.00	7.70	8.81	11.00	13.30	16.00	20.80	25.50	30.80	35.60	41.20	51.00	62.00
6X	8.10	7.90	7.95	8.50	9.30	10.50	13.30	16.00	19.00	25.00	30.60	37.00	44.20	49.50	61.80	74.00
8X	10.80	10.40	10.60	11.30	12.40	14.30	17.80	21.80	25.20	33.00	41.50	51.50	59.50	65.50		
10X	13.30	12.90	13.30	14.00	15.60	18.00	22.30	27.00	31.00	40.90	55.00	65.00	75.00	82.00		
15X	18.80	18.70	18.60	20.50	22.50	25.00	32.00	39.00	52.00	65.00	79.00				40 VOLT TAP	
20X	24.00	24.30	24.00	26.00	29.50	32.50	42.00	61.00	70.00	85.00						

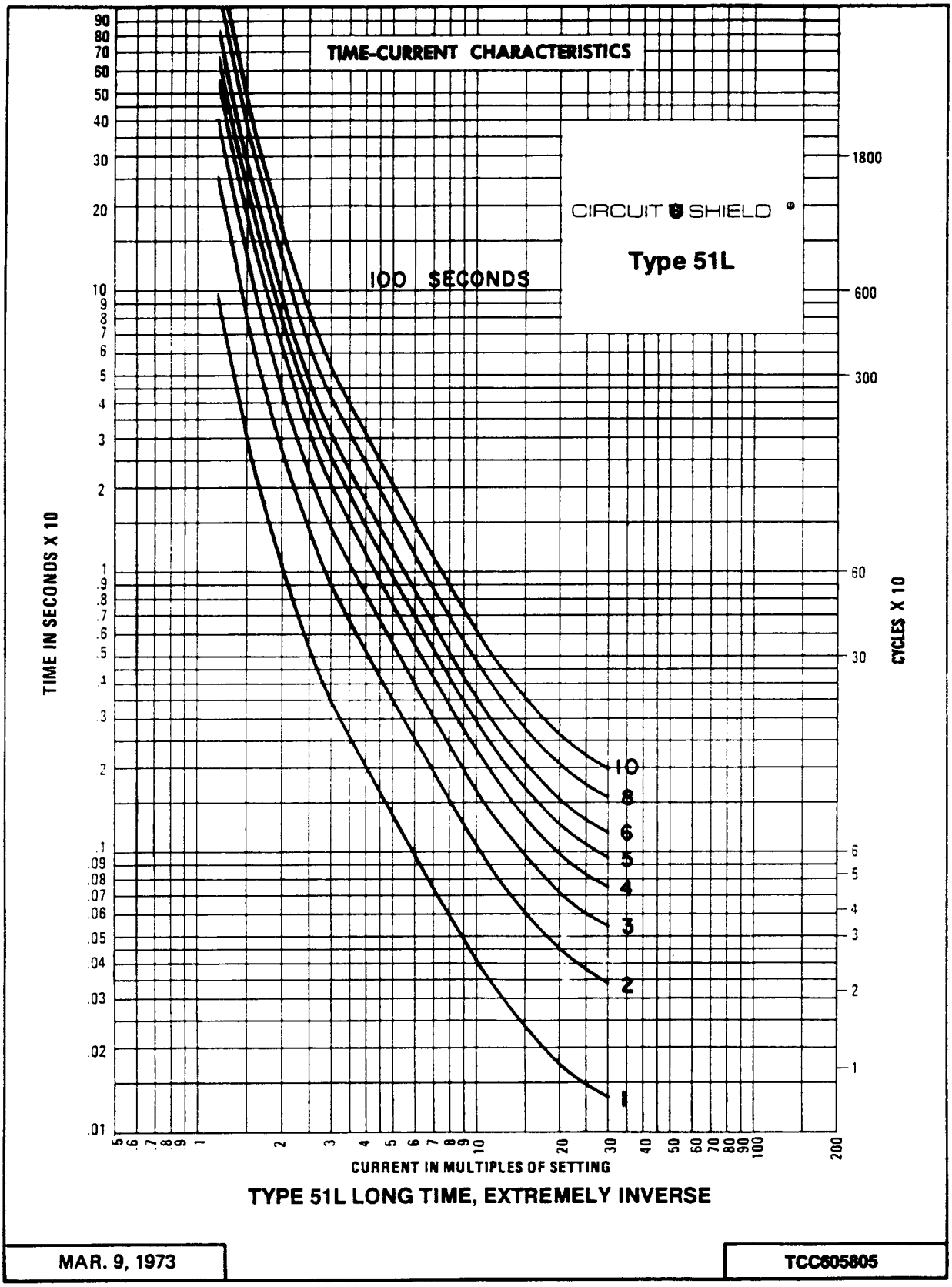
This table lists corrected test currents for one (1) to twenty (20) multiples of each tap setting available on CIRCUIT-SHIELD relays. These test currents cause the relay to produce the trip time corresponding to current transformer (CT) operation, as will be encountered in actual service.

The SR-51, which operates from a 120 Vac source, uses a transformer with step down taps to produce a wide range of currents useful in general relay testing. Since the series impedance of the transformer provides a fixed source impedance, a variable autotransformer is used to adjust the level of input current. This fixed source impedance is in general not large enough compared to the non-linear relay impedance to guarantee sine wave test current.


TIME-CURRENT CHARACTERISTICS
CIRCUIT SHIELD
Type 51S
TIME IN SECONDS
CYCLES
CURRENT IN MULTIPLES OF SETTING
TYPE 51S SHORT TIME
OCT. 12, 1971
TCC805804

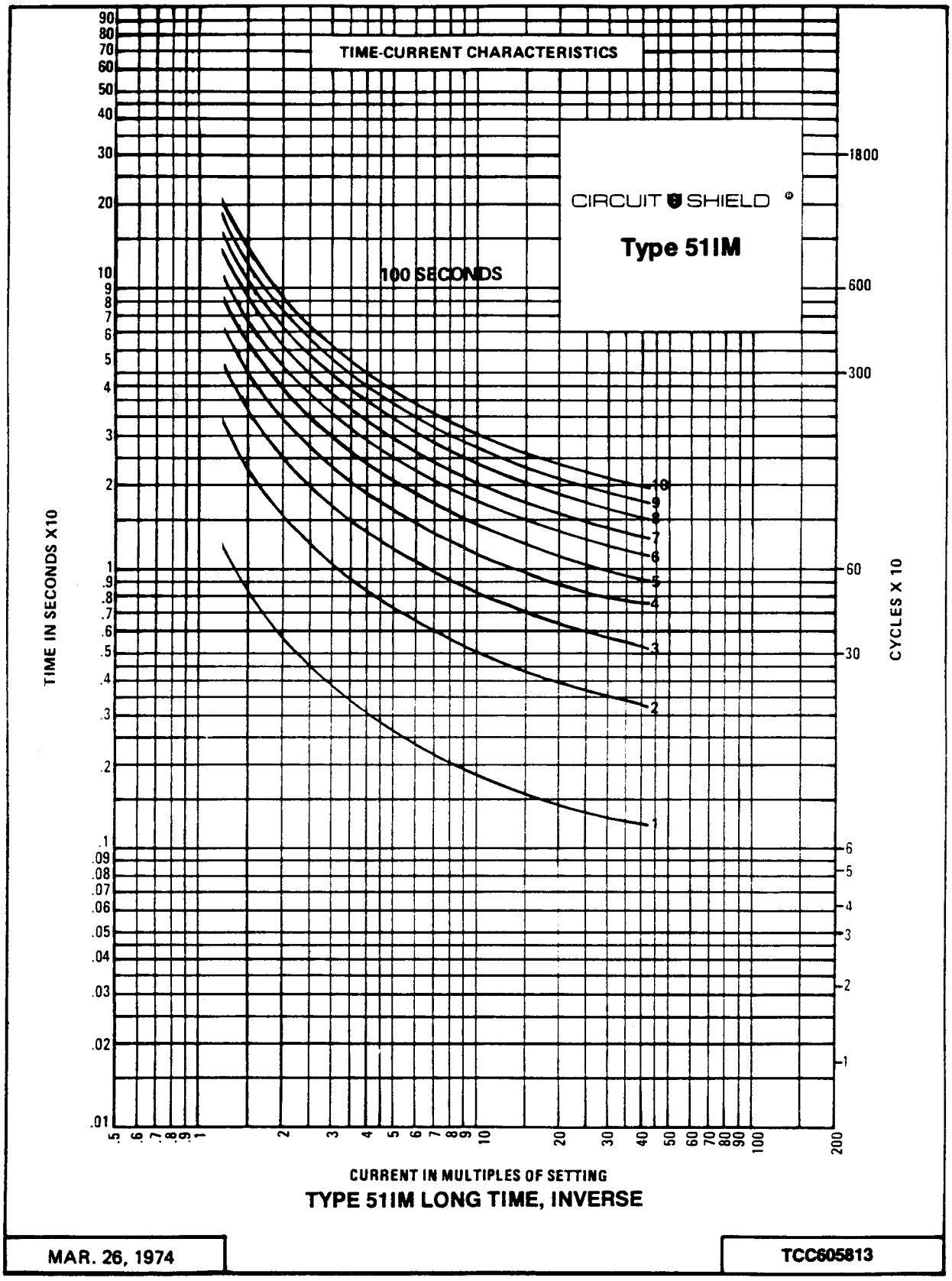


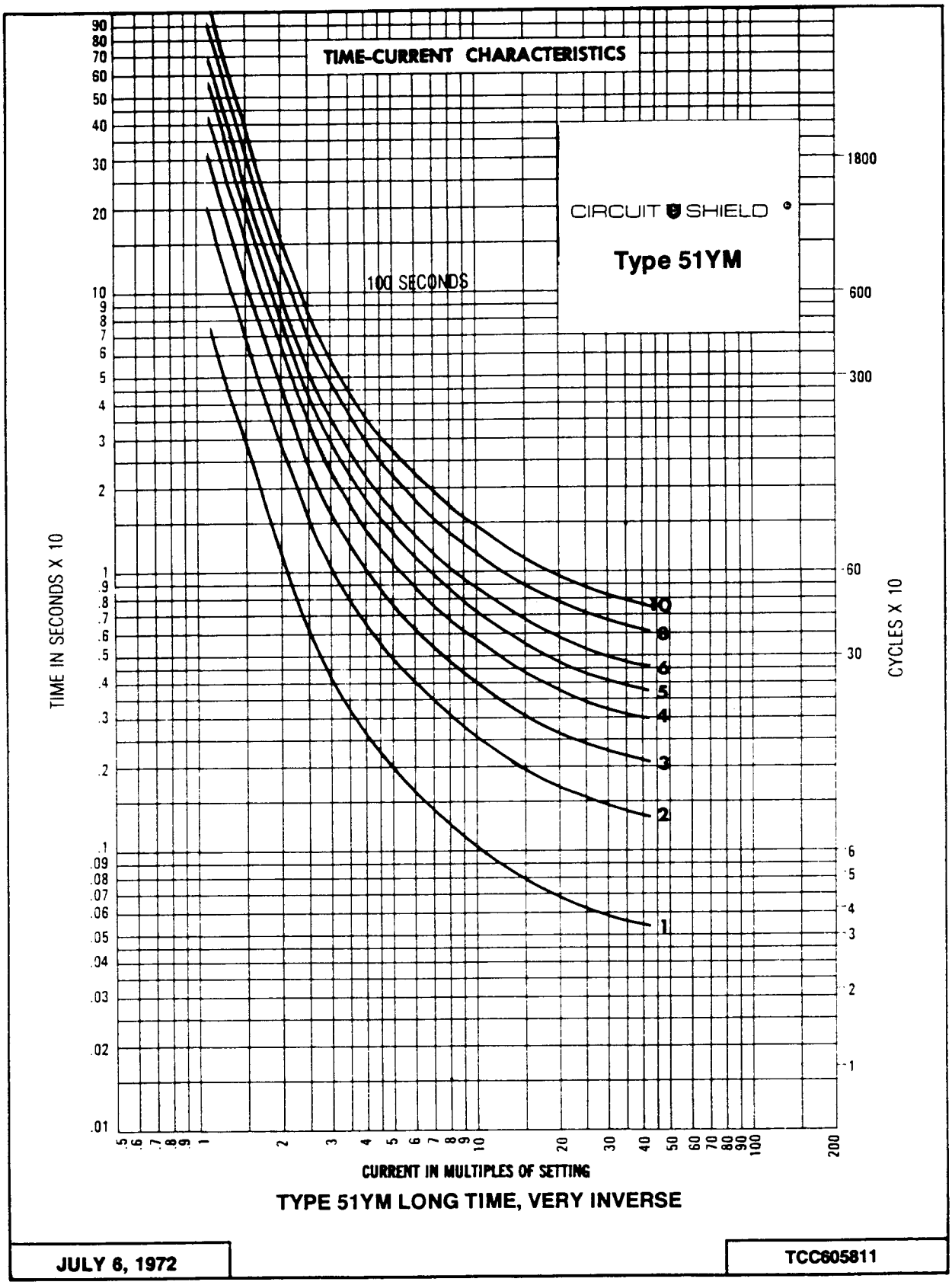
TYPE 51D DEFINITE TIME



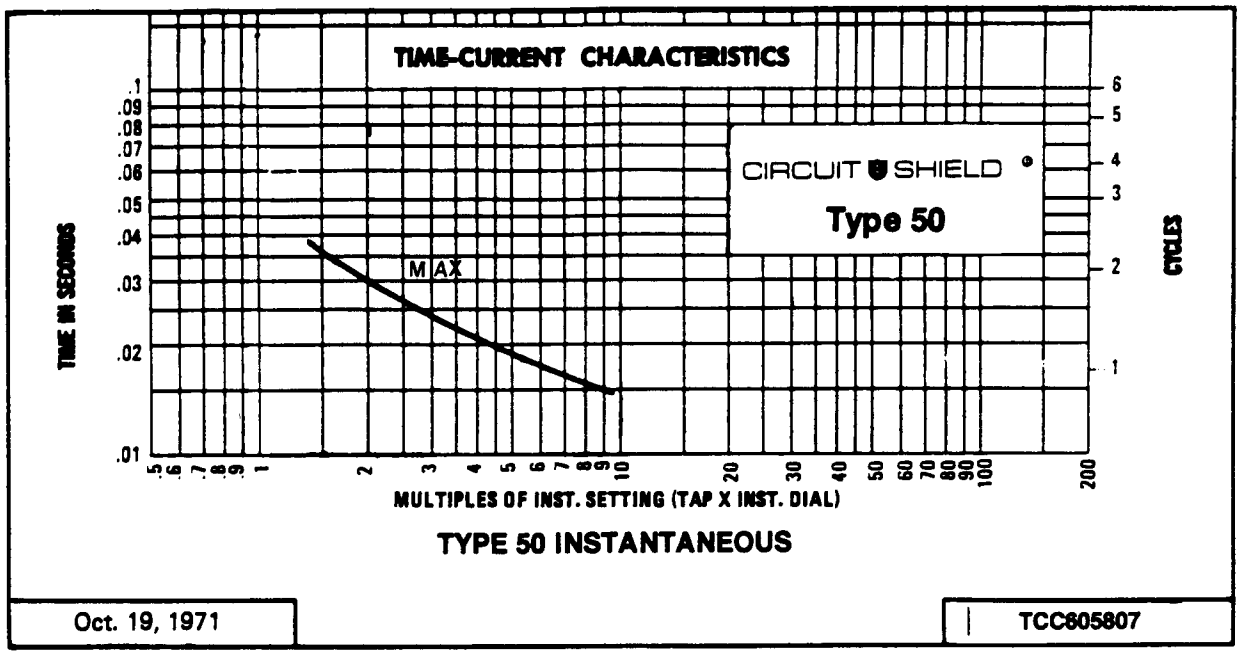
TYPE 51L LONG TIME, EXTREMELY INVERSE

MAR. 9, 1973 TCC805805

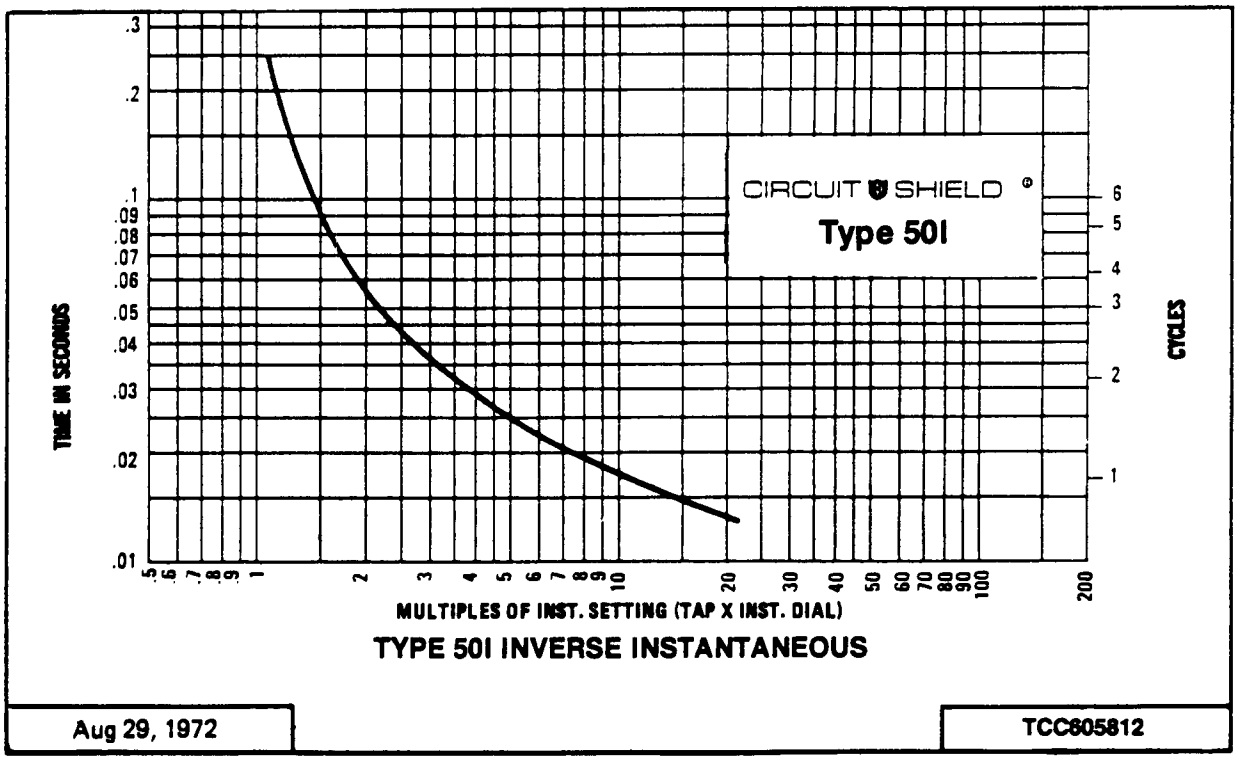

TIME-CURRENT CHARACTERISTICS
CIRCUIT SHIELD
Type 51IM
100 SECONDS
TIME IN SECONDS X10
CYCLES X 10
CURRENT IN MULTIPLES OF SETTING
TYPE 51IM LONG TIME, INVERSE
MAR. 26, 1974
TCC605813



TYPE 51YM LONG TIME, VERY INVERSE



TYPE 50 INSTANTANEOUS



TYPE 50I INVERSE INSTANTANEOUS

Catalog Series 443 Drawout Test Case

INTRODUCTION:

This addendum is an important supplement to the instruction book IB 7.2.1.7-14 that follows.

Circuit-Shield Type 51 Time-Overcurrent Relays with catalog numbers starting with "443" are totally drawout. Current transformer secondary shorting is accomplished by a direct acting spring and blade assembly upon removal of the relay from its case.

MOUNTING:
443 series units have the same dimensions and mounting as the 243 series. The outline and panel drilling are shown in Fig 1.

CONNECTIONS:
443 series units have the same internal and external connection diagrams as the 243 series units.

The selection of the output contact configuration is made by the positioning of a movable link on the inside surface of the vertical rear backplane circuit board. The relay must be withdrawn from its case to inspect this link. The positions of the link are labelled "STANDARD" for the stanAard configuration and "ISOLATED" for the alternate configuration. Refer to the internal connection diagrams on page 7.

TESTING:
The drawout assembly of 443 series units accepts standard banana plug connectors to make the test connections. The ac current connections are made to the vertical posts, and all other connections are made on the rear backplane board. The backplane board is marked to assist the technician in identifying the connection points. Note that jumpers are required from 9 to 10 to complete the Instantaneous torque-control circuit, and from 10 to 11 to complete the Time circuit.

To separate the upper and lower board assemblies, remove the thumbscrews holding the handle assemblies in place and withdraw the lower circuit board forward from its connector. (Note: newer units will also require the removal of (2) screws from the rear underside of the lower circuit board.)

TEST PLUG:
A test plug assembly is available to gain access to the external switchboard wiring connected to the relay case, including the ct secondary circuits. The Type 51 uses catalog 400X0001. Refer to instruction book IB 7.7.1.7-8 for details on its use.