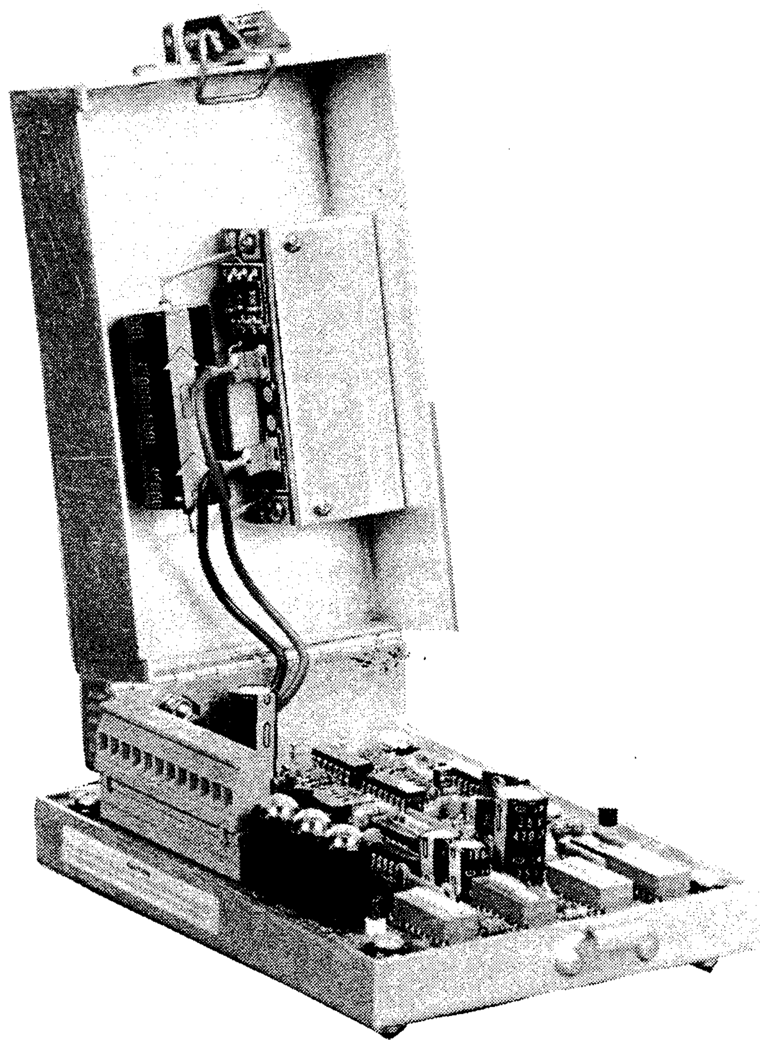
CARRIERE
TECHNICAL INDUSTRIES



FB600E
STATIC RELAY

INSTRUCTION MANUAL

CARRIERE TECHNICAL INDUSTRIES

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*        FB600E         *
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*     STATIC RELAY      *
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*  INSTRUCTION MANUAL   *
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Carriere Technical Industries
Division of Derlan Manufacturing Inc.
5621 Finch Ave. E.
Scarborough, Ont.
Canada M1B 2T9
Tel: (416) 297-8738
Fax: (416) 297-0421

Part No. FB600E-M0-02/91
1601-0007

INTENT

This manual describes the function, operation and use of the Carriere model FB600E Static Trip Relay.

REVISION

Manual Part No.	FB600E Revision
FB600E-M04/86	all Rev. A, B, C, D1, D2, D3, D4
FB600E-M10/87	Rev. D5
FB600E-M011/88	Rev. D5
FB600E-M02/90	Rev. D5
FB600E-M02/91	Rev. D6

FB600E INSTRUCTION MANUAL

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1.0 INTRODUCTION

1.1 PRODUCT DESCRIPTION

The FB600E is a static trip relay used to cause a low voltage breaker to open under fault conditions. Its primary application is as a retrofit to 600 volt breakers for upgrading existing protection. By using special CT's with both 1 amp signal windings and a separate power winding, the FB600E relay requires no control power to operate. An output pulse from the FB600E relay is used to drive an actuator which causes the breaker to trip.

The FB600E will trip on overloads with separately adjustable, instantaneous, short time and long time pickup levels. The short and long delay times are also adjustable. A long time pickup LED is provided to assist in verifying the pickup threshold. To help determine the cause of trip, an indicator is provided for instantaneous, or short time, trip and a separate indicator is used for long time trip. Also included with the FB600E is a ground fault trip and a latched ground fault indicator to diagnose the cause of trip.

1.2 FEATURES

INSTANTANEOUS OVERLOAD

Pickup Level: 2/4/6/8/10/12 times CT rating or defeat
Pickup Time: 50 ms maximum at >150% of pickup setting

SHORT TIME OVERLOAD

Pickup Level: 2.5/3/3.5/4/4.5/5/5.5/6/6.5/7/7.5/8/8.5/9/9.5/10 times CT rating or defeat
Pickup Time: 0.12/0.2/0.4 seconds at >150% of pickup threshold

LONG TIME OVERLOAD

Pickup Level:
0.5/.55/.6/.65/.7/.75/.8/.85/.9/.95/1/1.05/1.1/1.15/1.2/1.25 times CT rating or defeat
Pickup Time: 2.5/5/7.5/10/12.5/15/17.5/20 seconds at 6 times pickup level. Other times vary as current squared. Actual times for any overload condition can be determined from the time/overcurrent curves. (see fig. 3.5)

GROUND FAULT TRIP

Methods of ground fault detection with the FB600E are as follows:

a) Solidly grounded 3 phase, 3 wire systems.
   Residual connection (figure 2.4)
b) Solidly grounded 3 phase, 3 wire systems.
   Zero sequence connection (figure 2.3)
c) Solidly grounded 3 phase, 4 wire systems.
   Residual connection plus an additional CT in the neutral conductor (figure 2.5)
d) Resistance grounded 3 phase, 4 wire systems.
   Use only the zero sequence connection (figure 2.3)

Pickup Level: a) ZERO SEQUENCE (SEPARATE CT)
.1/.2/.3/.4/.5/.6/.7/.8 times G/F CT rating or defeat
or
b) RESIDUAL GROUND FAULT (PHASE CT SECONDARY SENSING)
.1/.2/.3/.4/.5/.6/.7/.8 times phase CT primary rating or defeat

Pickup Time: 0.05 sec minimum/0.12/0.2/0.4 seconds at >150% of pickup threshold

INDICATORS

Long time pickup LED on while long time pickup level exceeded.
Latched instantaneous or short time trip indicator.
Latched long time trip indicator.
Latched ground fault trip indicator

TRIP INDICATORS

Fault indicators are provided to determine the cause of trip. Each indicator remains set after a trip loss of control power. Indicators are automatically reset when a load of >40% of the CT rating is re-applied to the breaker.

Instantaneous/Short Time: set if the instantaneous pickup level has been exceeded for 50 ms maximum or the short time pickup level has been exceeded for the selected delay time.
Long Time: set if the long time or short time pickup level has been exceeded for the selected delay time.
Ground Fault: set if the ground fault pickup level has been exceeded for the selected ground fault delay time.

1.3 ACCURACY

Long Time/Short Time/Instantaneous/Ground Fault pickup level: +/- 10%
Long/Short/Ground Fault trip time: +/-20% at >150% of pickup threshold
Instantaneous trip: 50 ms maximum at >150% of pickup level.

Stated accuracy applies over the full operating range of -25 to +60°C.
CT input is a 50/60Hz sinewave.

1.4 MAXIMUM INPUTS

Phase/Ground Fault CT's: (terminals 1/5, 2/5, 3/5, 4/5)
4 amps input from secondary...continuous
20 times rated current...1 second

1.5 ENVIRONMENT

Operating temperature range: -25°C to +60°C

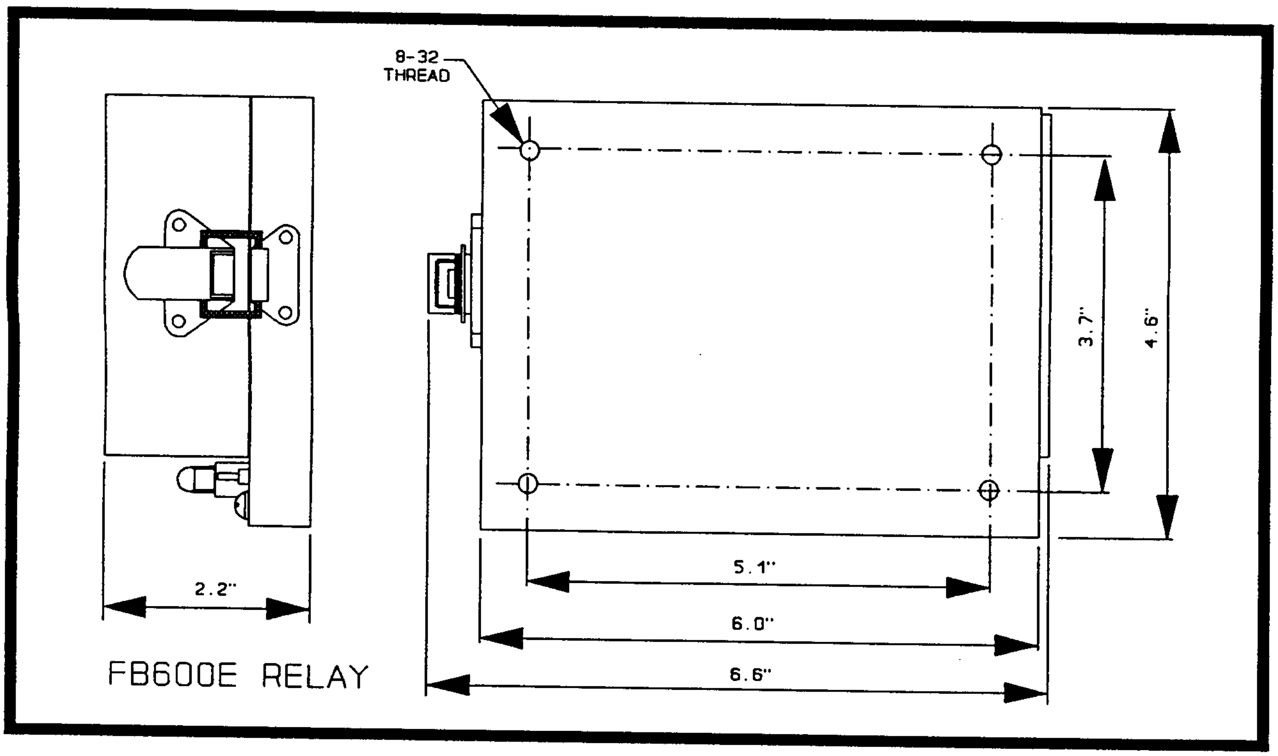
2.0 INSTALLATION

2.1 PHYSICAL DIMENSIONS

The FB600E is housed in a metal chassis with a hinged cover to protect its components yet allow access to the setting selector switches.

Figure 2.1 shows the physical dimensions of the FB600E. Four threaded holes are provided on the base to accept 8-32 x 1/4" screws for mounting the FB600E to the breaker chassis. If this orientation is not convenient other mounting holes must be drilled to suit the mounting scheme.

Figure 2.1 FB600E PHYSICAL DIMENSIONS



2.2 MOUNTING

To allow access to selector switch settings, a hinged cover with a spring release catch is provided. This allows pickup levels and time delays to be quickly set or modified without the need of tools. When mounting the FB600E, provision should be made for the cover to partially open to allow access to the selector switches. The latched trip indicators and external wiring terminals are mounted outside the hinged cover. Orient the relay on the breaker to allow access to the terminal block for relay testing and to ensure that the indicators are visible when the breaker is drawn out.

2.3 EXTERNAL CONNECTIONS

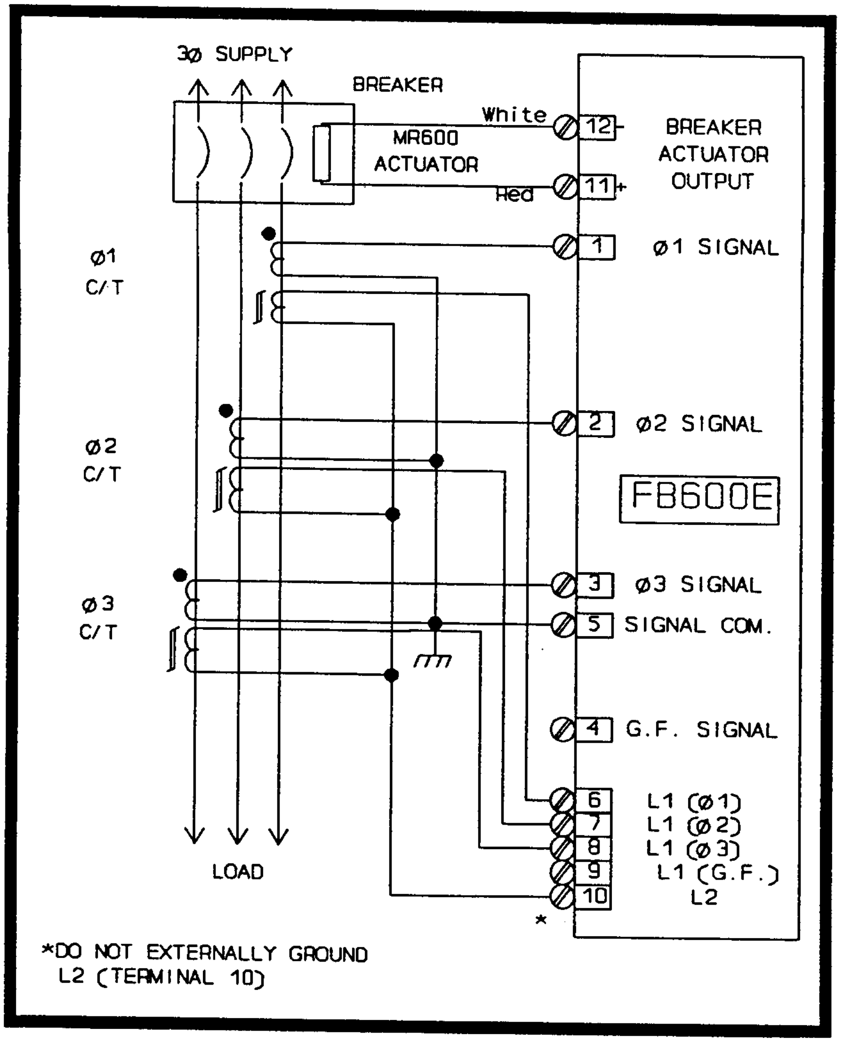
External wiring of the FB600E will depend on the grounding scheme used.

2.3.1 No Ground Fault Detection:

The simplest wiring configuration is the FB600E connected to detect short circuit and overloads but no ground faults as shown in figure 2.2. Each of the specially wound phase current transformers (CT's) has a signal winding and a power winding thus eliminating the need for an external control power source. When a trip condition occurs, a short pulse is provided to the spring loaded actuator which triggers the breaker to open.

The CT signal winding common (terminals) may be externally connected to ground. However, the power winding common terminal (10) and actuator terminals (11, 12) **must not be externally grounded or connected to signal common (5)** on the FB600E or it will not operate correctly.

Fig. 2.2 EXTERNAL WIRING FOR NO GROUND FAULT DETECTION



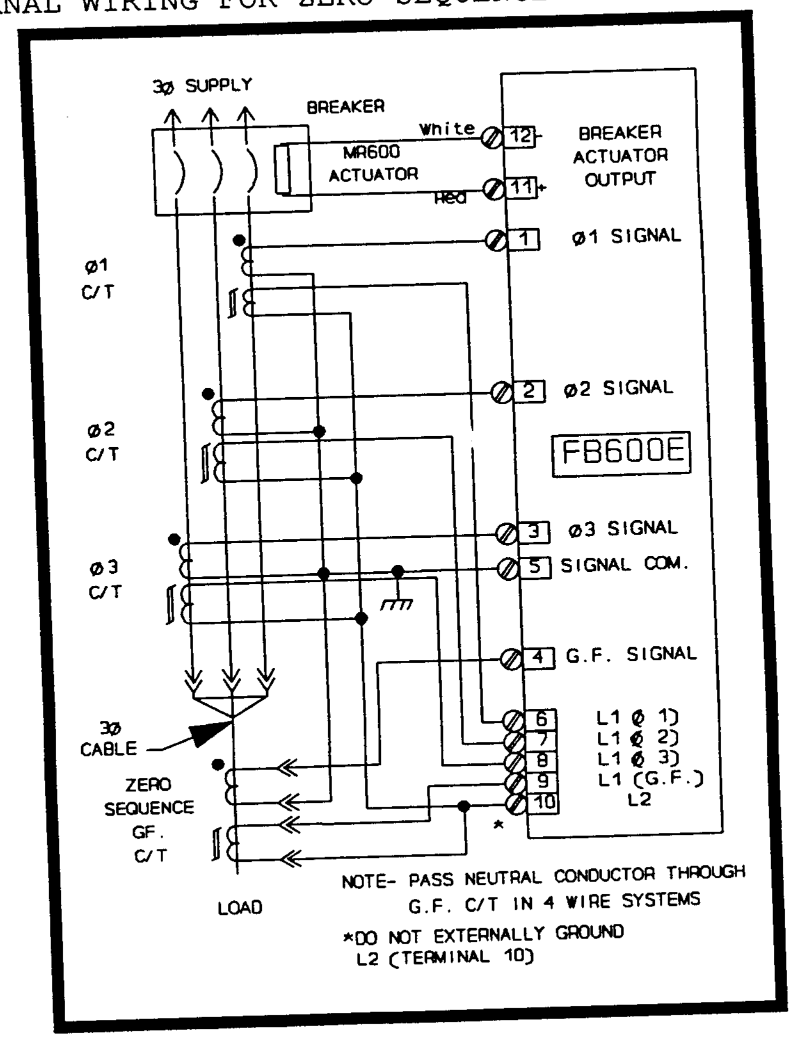
2.3.2 Zero Sequence Ground Fault:

On resistance grounded or solidly grounded 3 wire systems, where the phase conductors run in a cable outside the breaker, the zero sequence ground fault detection scheme can be used (figure 2.3). The cable passes through the window of a separate CT outside the breaker which senses the zero sequence component of the 3 currents. If a ground shield is present in the 3 phase cable, it must pass outside the window of the ground fault sensing CT.

Providing no ground fault is detected, the 3 phase currents instantaneously sum to zero and there is no CT output. Under ground fault conditions, this CT generates a signal and power for the FB600E. The wiring to this external CT is via 4 extra breaker connecting fingers.

The CT signal winding common (terminals) may be externally connected to ground. However, the power winding common terminal (10) and actuator terminals (11, 12) **must not be externally grounded or connected to signal common (5)** on the FB600E or it will not operate correctly.

Fig. 2.3 EXTERNAL WIRING FOR ZERO SEQUENCE GROUND FAULT DETECTION



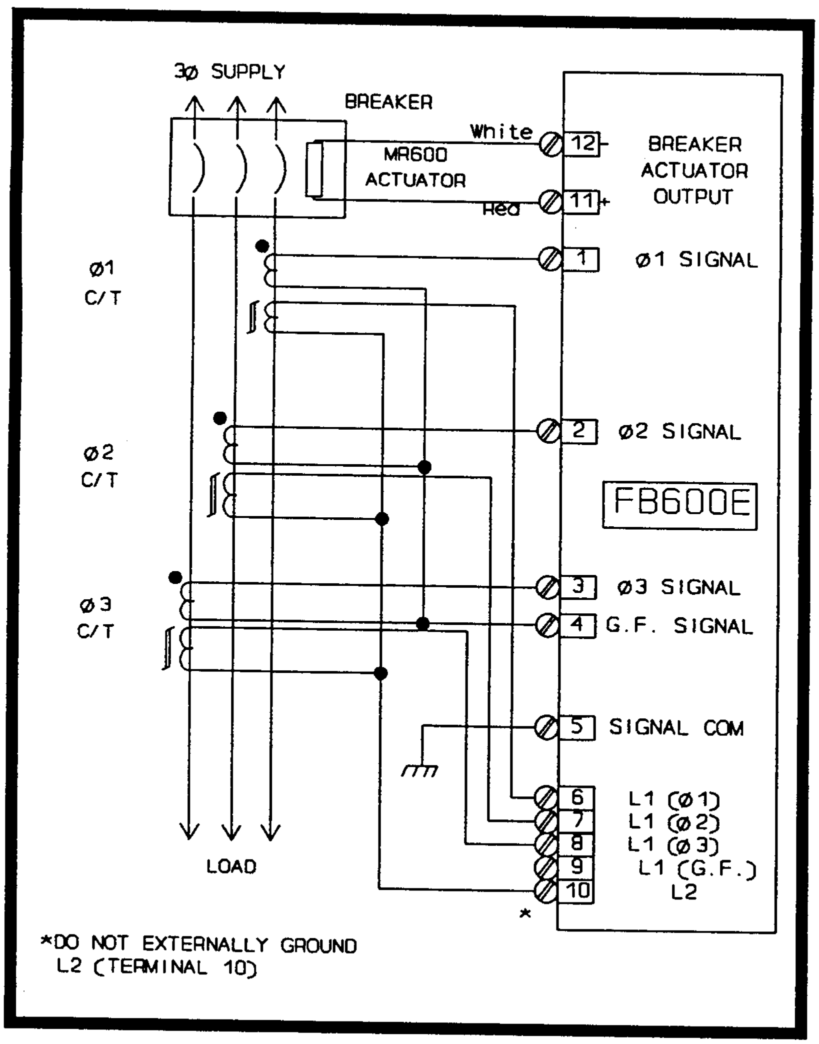
2.3.3 Solidly Grounded 3 Wire System/Residual Ground Fault:

In a 3 wire system where it is inconvenient to run the 3 phases through a separate ground fault CT, the residual or common return current of the 3 phase CT's can be sensed for ground fault detection as in figure 2.4.

Providing no ground fault is present, the 3 primary currents and hence phase CT secondary currents cancel to zero. When a ground fault occurs, the current that is sensed by summing the return current in each CT secondary is no longer zero and the FB600E will trip after the appropriate ground fault pickup level time delay has been exceeded.

The CT signal winding common (terminals) may be externally connected to ground. However, the power winding common terminal (10) and actuator terminals (11, 12) **must not be externally grounded or connected to signal common (5)** on the FB600E or it will not operate correctly.

Fig. 2.4 EXTERNAL WIRING FOR 3 WIRE RESIDUAL GROUND FAULT DETECTION

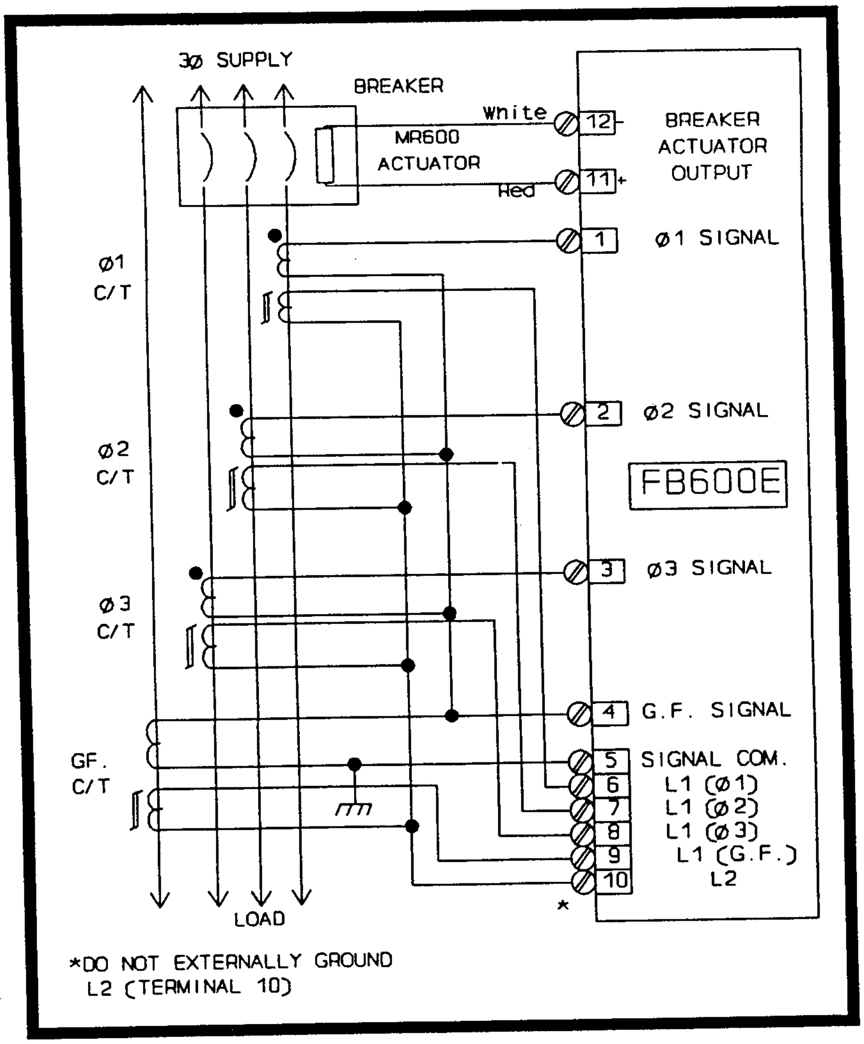


2.3.4 Solidly Grounded 4 Wire/Residual Ground Fault Sensing:

In a 4 wire system where it is inconvenient to run the 3 phases and neutral through a separate ground fault CT the wiring scheme of figure 2.5 can be used. The residual current in the return wire of the 3 phase CT's is sensed. Under unbalanced conditions this current will not be zero even with no ground fault since the residual current will flow in the fourth neutral wire. Consequently, a separate CT of the same ratio as the phase CT is used to sense the neutral current and is connected to exactly cancel the phase CT residual current. Now if a ground fault occurs, the residual current will no longer be cancelled by the neutral wire current and the FB600E will trip when the appropriate pickup level and time delay is obtained.

The CT signal winding common (terminals) may be externally connected to ground. However, the power winding common terminal (10) and actuator terminals (11, 12) **must not be externally grounded or connected to signal common (5)** on the FB600E or it will not operate correctly.

Fig. 2.5 EXTERNAL WIRING FOR 4 WIRE RESIDUAL GROUND FAULT DETECTION



2.4 CURRENT TRANSFORMERS

Any current transformer having both a signal and power winding can be used with the FB600E. Primary current ratios may cover any range typically from 100 to 4000 amps in suitable increments or CT's may have several taps.

A few notes of caution are in order regarding the CT's used in conjunction with the FB600E. These notes are:

(a) The signal winding must have an output of 1 amp at the rated primary current into a nominal resistive burden of 0.5 ohms.

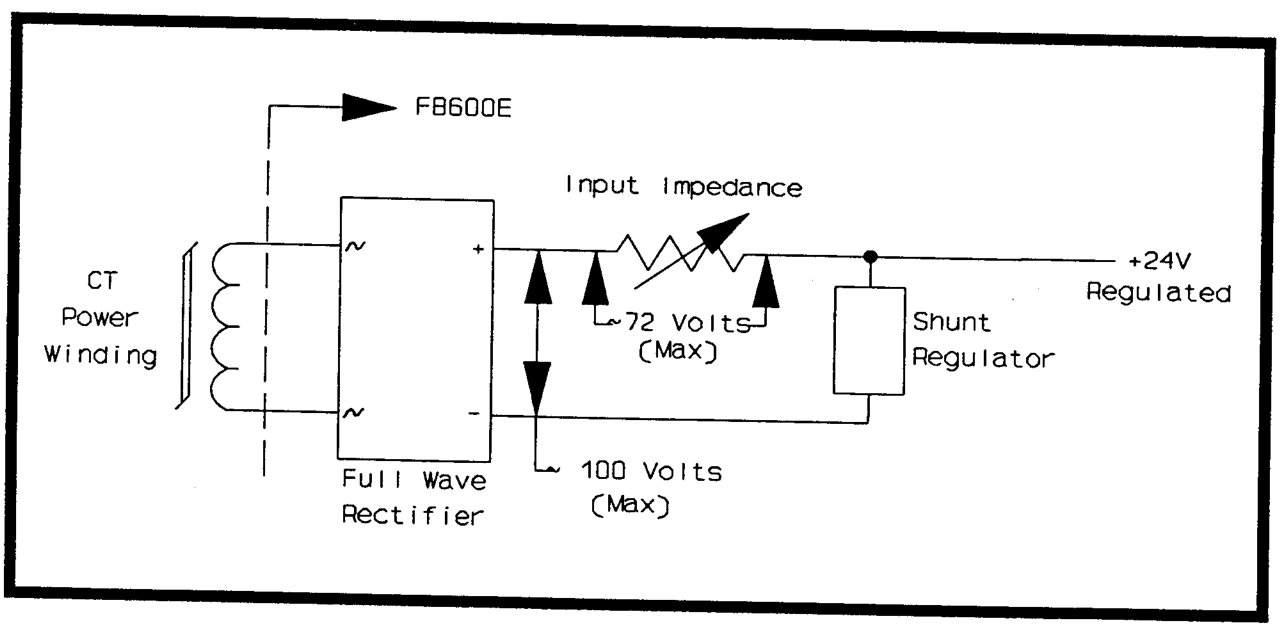
(b) The power winding should saturate below the CT rated amps and provide approximately 10 VA max. The zero sequence ground fault CT is similar to the phase CT.

(c) The FB600E power inputs will increase in burden with increased power input. At the worst case, the FB600E power inputs will burden the power windings to a point where the burden voltage is 100 volts. Figure 2.6 describes the loading on the power windings of the CT's.

(d) If the power windings of the CT's do not limit (or saturate) their power outputs as described in (b), damage to the FB600E may result. Carriere can provide specially designed CT's from stock which will limit output power from the power windings. These Carriere CT's are available in several ratios. Please contact the factory or a Carriere agent for more information.

(e) In order to ensure proper operation of all FB600E functions, the power windings must be able to provide (individually) at least 4.5 VA of power. Carriere CT's provide this power at 0.5 x CT rating.

Fig. 2.6 CT POWER WINDING BURDEN



2.5 ACTUATOR

When a trip condition is detected a pulse of DC current will be supplied to an external actuator. The magnetic field produced causes the spring loaded actuator to move a plunger thus tripping the breaker mechanism. The actuator linkage mechanism used will depend on the type of breaker to which the FB600E is installed.

2.6 SYSTEM GROUNDING

The CT signal windings, power windings and actuator are connected to different points in the circuitry of the FB600E. Using a common external ground for the signal winding common (terminal 5), power winding common (terminal 10) or actuator (11, 12) will cause the FB600E to operate incorrectly. Consequently, only the CT signal winding common should be connected to an external ground as shown in the wiring diagrams of figures 2.2-2.5. The power winding common and actuator are indirectly referenced to ground internally by the circuitry.

3.0 SETUP AND OPERATION

3.1 INSTANTANEOUS TRIP SETTINGS

Instantaneous tripping without any intentional delay is used to provide protection against short circuits. The pickup level is controlled by switches SI1 to SI3 to select a trip level of 2 (curve A) to 12 (curve B) times the CT rating as shown in figure 3.2. Various short circuit pickup levels can be selected according to figure 3.1. This feature may be defeated by setting switch SI8 off.

Fig. 3.2 INSTANTANEOUS TRIP TIME DELAY CURVES

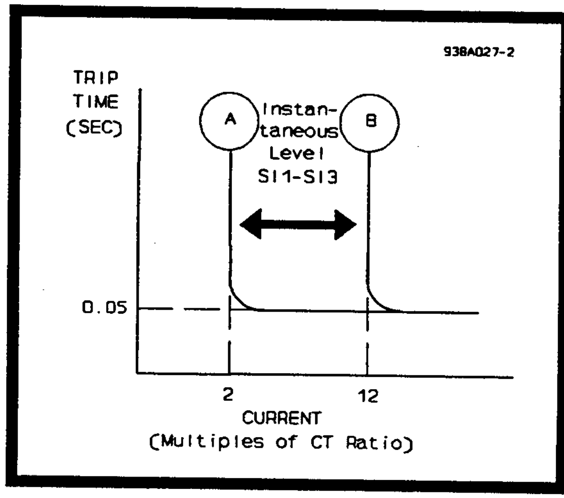


Fig. 3.1 INSTANTANEOUS TRIP SWITCH SETTINGS

INSTANTANEOUS TRIP SWITCH SETTINGS		
FUNCTION	LEVEL	SWITCHES SI 1 2 3 4 5 6 7 8
Instantaneous Pickup Level	2 X CT Rating 4 X CT Rating 6 X CT Rating 8 X CT Rating 10 X CT Rating 12 X CT Rating	1 1 1 - - - - 1 0 1 1 - - - - 1 1 0 1 - - - - 1 0 0 1 - - - - 1 1 1 0 - - - - 1 0 1 0 - - - - 1
Instant. Disable		- - - - - - - 0
0= off 1= on -= no effect	Trip Indicator: Inst./Short Time	

3.2 SHORT TIME OVERLOAD SETTINGS

Short time delay tripping is provided for use in coordinated protection systems to shut down only pickup levels of 2.5-10 times the CT rating and time delays of 0.12 to 0.4 seconds can be selected using switches SS1 to SS8 as shown in figure 3.3. This feature can also be defeated for test purposes by setting SS8 off. The effect of these switches on the time/overcurrent curves is shown in figure 3.4.

Fig. 3.4 SHORT TIME DELAY TIME/OVERCURRENT CURVES

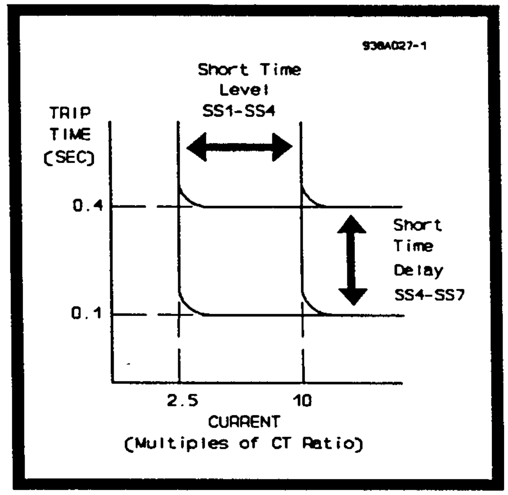


Fig. 3.3 SHORT TIME SWITCH SETTINGS

SHORT TIME DELAY SWITCH SETTINGS		
FUNCTION	LEVEL	SWITCHES SS 1 2 3 4 5 6 7 8
Short Time Pickup	2.5 x CT Rating	1 1 1 1 - - - 1
	3 x CT Rating	0 1 1 1 - - - 1
	3.5 x CT Rating	1 0 1 1 - - - 1
	4 x CT Rating	0 0 1 1 - - - 1
	4.5 x CT Rating	1 1 0 1 - - - 1
	5 x CT Rating	0 1 0 1 - - - 1
	5.5 x CT Rating	1 0 0 1 - - - 1
	6 x CT Rating	0 0 0 1 - - - 1
	6.5 x CT Rating	1 1 1 0 - - - 1
	7 x CT Rating	0 1 1 0 - - - 1
	7.5 x CT Rating	1 0 1 0 - - - 1
	8 x CT Rating	0 0 1 0 - - - 1
	8.5 x CT Rating	1 1 0 0 - - - 1
	9 x CT Rating	0 1 0 0 - - - 1
	9.5 x CT Rating	1 0 0 0 - - - 1
	10 x CT Rating	0 0 0 0 - - - 1
Short Time Delay	0.12 sec. @ >150% pickup level	- - - - 1 0 0 1
	0.2 sec. @ >150% pickup level	- - - - 0 1 0 1
	0.4 sec. @ >150% pickup level	- - - - 0 0 1 1
Short Disable		- - - - - - - 0
0= off 1= on -= no effect		

3.3 LONG TIME SETTINGS

To allow a breaker to protect system components such as transformers, motors, conductors, etc. that fail due to resistive heating, a set of time overcurrent curves that follow a current squared characteristic is provided. When an overcurrent condition persists for a specified length of time the breaker trips and breaks the load. Trip times for various levels of current and curve settings are listed in figure 3.5 for testing convenience. These curves are shown on the time/overcurrent graph of figure 3.10 for coordination purposes.

Fig 3.5 LONG TIME OVERLOAD TRIP TIMES
FB600E LONG TIME PICKUP DELAYS (SECONDS)
CURRENT IN MULTIPLES OF LONG TIME PICKUP

CURVE	ERROR	SL 5-7	12	10	8	7	6	5	4	3	2	1.5	1.25	1.1	1
1	-20%	111	0.50	0.72	1.13	1.47	2.00	2.88	4.50	8.00	18.00	32.00	46.08	59.50	72.00
	0		0.63	0.90	1.41	1.84	2.50	3.60	5.63	10.00	22.50	40.00	57.60	74.38	90.00
	+20%		0.76	1.08	1.69	2.21	3.00	4.32	6.76	12.00	27.00	48.00	69.12	89.26	108.00
2	-20%	011	1.01	1.44	2.26	2.94	4.00	5.76	9.01	16.00	36.00	64.00	92.16	119.01	144.00
	0		1.26	1.80	2.82	3.68	5.00	7.20	11.26	20.00	45.00	80.00	115.20	148.76	180.00
	+20%		1.51	2.16	3.38	4.42	6.00	8.64	13.51	24.00	54.00	96.00	138.24	178.51	216.00
3	-20%	101	1.51	2.16	3.38	4.42	6.00	8.64	13.51	24.00	54.00	96.00	138.24	178.51	216.00
	0		1.89	2.70	4.23	5.52	7.50	10.80	16.89	30.00	67.50	120.00	172.80	223.14	270.00
	+20%		2.27	3.24	5.08	6.62	9.00	12.96	20.27	36.00	81.00	144.00	207.36	267.77	324.00
4	-20%	001	2.02	2.88	4.51	5.89	8.00	11.52	18.02	32.00	72.00	128.00	184.32	238.02	288.00
	0		2.52	3.60	5.64	7.36	10.00	14.40	22.52	40.00	90.00	160.00	230.40	297.52	360.00
	+20%		3.02	4.32	6.77	8.83	12.00	17.28	27.02	48.00	108.00	192.00	276.48	357.02	432.00
5	-20%	110	2.52	3.60	5.64	7.36	10.00	14.40	22.52	40.00	90.00	160.00	230.40	297.52	360.00
	0		3.15	4.50	7.05	9.20	12.50	18.00	28.15	50.00	112.50	200.00	288.00	371.90	450.00
	+20%		3.78	5.40	8.46	11.04	15.00	21.60	33.78	60.00	135.00	240.00	345.60	446.28	540.00
6	-20%	010	3.02	4.32	6.77	8.83	12.00	17.28	27.02	48.00	108.00	192.00	276.48	357.02	432.00
	0		3.78	5.40	8.46	11.04	15.00	21.60	33.78	60.00	135.00	240.00	345.60	446.28	540.00
	+20%		4.54	6.48	10.15	13.25	18.00	25.92	40.54	72.00	162.00	288.00	414.72	535.54	648.00
7	-20%	100	3.53	5.04	7.90	10.30	14.00	20.16	31.53	56.00	126.00	224.00	322.56	416.53	504.00
	0		4.41	6.30	9.87	12.88	17.50	25.20	39.41	70.00	157.50	280.00	403.20	520.66	630.00
	+20%		5.29	7.56	11.84	15.46	21.00	30.24	47.29	84.00	189.00	336.00	483.84	624.79	756.00
8	-20%	000	4.03	5.76	9.02	11.78	16.00	23.04	36.03	64.00	144.00	256.00	386.64	476.03	576.00
	0		5.04	7.20	11.28	14.27	20.00	28.80	45.04	80.00	180.00	320.00	460.80	595.04	720.00
	+20%		6.05	8.64	13.54	17.66	24.00	34.56	54.05	96.00	216.00	384.00	552.96	714.05	864.00

Switches SL1 to SL8 are used to select pickup current levels of 0.5-1.25 times the CT rating and time delays of 2.5-20 seconds (at 6 times the CT rating) as shown in figure 3.6.

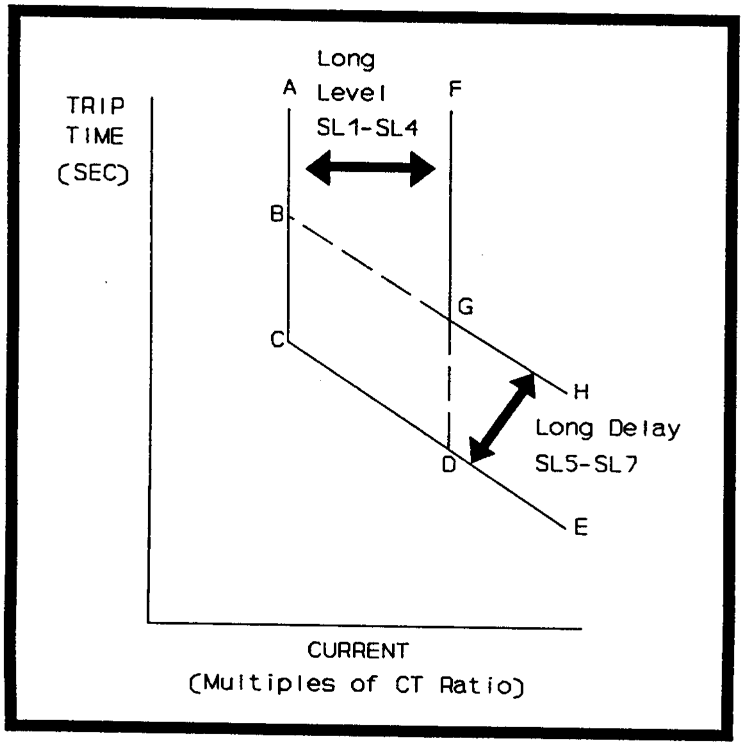
The short time delay and instantaneous trip settings should be selected to ensure that the breaker trips without allowing a continuous current to flow that is greater than 400% of the CT rating (see Maximum Inputs section 2.5). The effect of switches SL1 to SL7 on the time/current curves is shown in figure 3.7.

Fig. 3.6 LONG TIME DELAY SWITCH SETTINGS.

LONG TIME DELAY SWITCH SETTINGS		
FUNCTION	LEVEL	SWITCHES SL- 1 2 3 4 5 6 7 8
Long Time Pickup	0.5 x CT Rating	1 1 1 1 - - - 1
	0.55 x CT Rating	0 1 1 1 - - - 1
	0.60 x CT Rating	1 0 1 1 - - - 1
	0.65 x CT Rating	0 0 1 1 - - - 1
	0.70 x CT Rating	1 1 0 1 - - - 1
	0.75 x CT Rating	0 1 0 1 - - - 1
	0.80 x CT Rating	1 0 0 1 - - - 1
	0.85 x CT Rating	0 0 0 1 - - - 1
	0.90 x CT Rating	1 1 1 0 - - - 1
	0.95 x CT Rating	0 1 1 0 - - - 1
	1.00 x CT Rating	1 0 1 0 - - - 1
	1.05 x CT Rating	0 0 1 0 - - - 1
	1.10 x CT Rating	1 1 0 0 - - - 1
	1.15 x CT Rating	0 1 0 0 - - - 1
	1.20 x CT Rating	1 0 0 0 - - - 1
	1.25 x CT Rating	0 0 0 0 - - - 1
Long Time Delay	2.5 sec. @ 6x Pickup Level	- - - - 1 1 1 1
	5 sec. @ 6x Pickup Level	- - - - 0 1 1 1
	7.5 sec. @ 6x Pickup Level	- - - - 1 0 1 1
	10 sec. @ 6x Pickup Level	- - - - 0 0 1 1
	12.5 sec. @ 6x Pickup Level	- - - - 1 1 0 1
	15 sec. @ 6x Pickup Level	- - - - 0 1 0 1
	17.5 sec. @ 6x Pickup Level	- - - - 1 0 0 1
	20 sec. @ 6x Pickup Level	- - - - 0 0 0 1
Long Time Disable		- - - - - - - 0
0 = off 1 = on - = no effect		

Switches SL1 to SL4 determine the current pickup level required for the breaker to trip. The time to trip will be determined by the amount that the current exceeds the overload level and the curve selected (SL5 to SL7). Long time delay trip can be defeated for test purposes by setting switch SL8 off.

Fig. 3.7 LONG TIME DELAY CURVES



Minimum pickup (0.5 x CT rating) Minimum time (2.5 sec. @ 6x CT pick-up)	curve ABCDE SL8 to SL1: 11111111
Minimum pickup (0.5 x CT rating) Maximum time (20 sec. @ 6x CT pick-up)	curve ABGH SL8 to SL1: 10001111
Maximum pickup (1.25 x CT rating) Minimum time delay (2.5 sec. @ 6x CT pick-up)	curve FGDE SL8 to SL1: 11110000
Maximum pickup (1.25 x CT rating) Maximum time delay (20 sec. @ 6x CT pick-up)	curve FGH SL8 to SL1: 10000000

3.4 GROUND FAULT SETTINGS

Ground fault occurs when moisture, dirt, insulation breakdown or a mechanical short allows current to pass from a phase conductor to the ground. This may result in arcing damage or a fire. Often the ground fault current is below the trip level of the overload settings and separate ground fault protection is necessary to prevent damage.

Separate ground fault levels of 0.1-0.8 times the CT rating and trip times of no intentional delay to 0.4 seconds are provided. Ground fault pickup and delay settings are guaranteed if the power winding(s) of the CT's provide the minimum amount of power required, namely, 0.5 times the CT Phase current rating (see section 2.4). The level settings should be set low enough to provide a trip under ground fault conditions and high enough to prevent nuisance trips under normal conditions. Some ground current will be detected from capacitive currents or CT mismatch and spill currents in residual ground sensing circuits. The level must be set higher than this normally encountered value.

Ground fault time delays are provided for system coordination. Solidly grounded systems will generally require a minimum time delay while longer time delays can be used in resistance grounded systems. Switch settings for various pickup levels and time delays are shown in figure 3.8.

The effect of ground fault pickup level switches SG1 to SG3 and time delay switches SG4-SG7 on the time/current curves is shown in figure 3.9. Ground fault detection is supplied on all FB600E. By setting switch SG8 off this feature can be defeated for test purposes.

Fig. 3.8 GROUND FAULT CURVES

GROUND FAULT SWITCH SETTINGS		
FUNCTION	LEVEL	SWITCHES SG- 1 2 3 4 5 6 7 8
Ground Fault Pickup Level	0.1 x CT Rating 0.2 x CT Rating 0.3 x CT Rating 0.4 x CT Rating 0.5 x CT Rating 0.6 x CT Rating 0.7 x CT Rating 0.8 x CT Rating	1 1 1 - - - - 1 0 1 1 - - - - 1 1 0 1 - - - - 1 0 0 1 - - - - 1 1 1 0 - - - - 1 0 1 0 - - - - 1 1 0 0 - - - - 1 0 0 0 - - - - 1
Ground Fault Time Delay	0.05 sec. @ > 150% Pickup Level 0.12 sec. @ > 150% Pickup Level 0.2 sec. @ > 150% Pickup Level 0.4 sec. @ > 150% Pickup Level	- - - 1 0 0 0 1 - - - 0 1 0 0 1 - - - 0 0 1 0 1 - - - 0 0 0 1 1
G/F Disable		- - - - - - - 0
0 = off 1 = on - = no effect	Trip Indicator: Ground Fault	

Fig. 3.9 GROUND FAULT CURVES

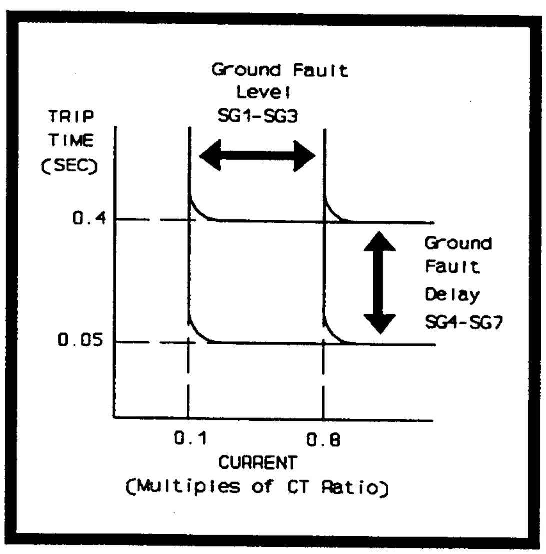
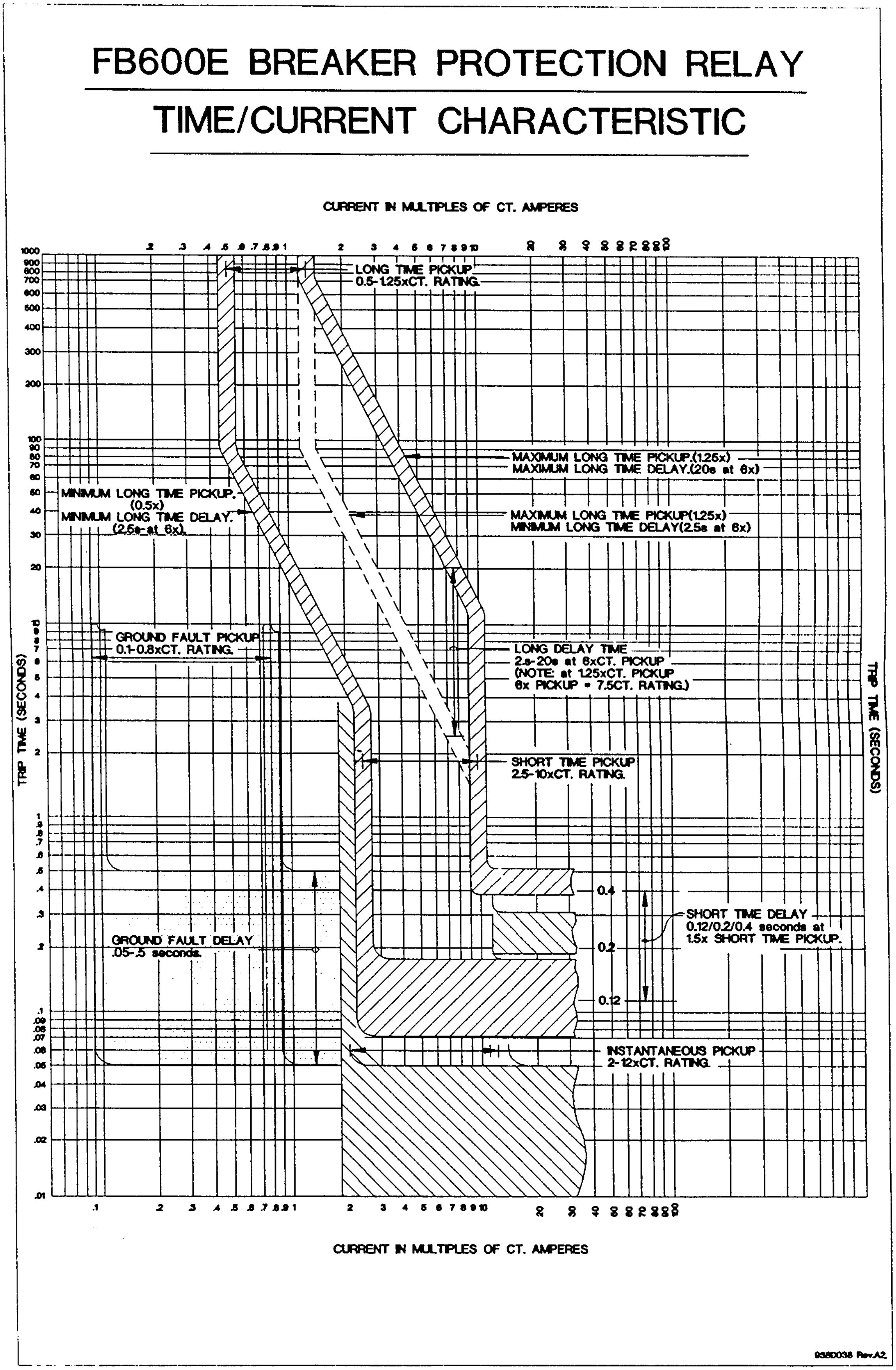


Fig. 3.10 FB600E TIME/CURRENT CHARACTERISTICS



4.0 TESTING

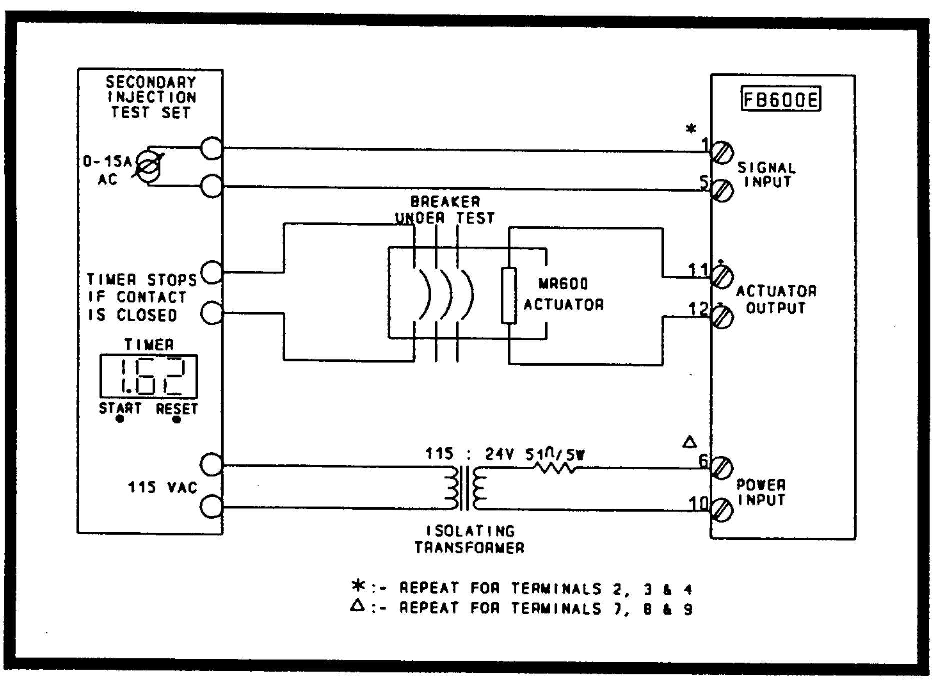
4.1 SECONDARY INJECTION TESTING

A single phase current source of 0-12 amps AC is required to simulate levels of 0-1200% in the phase CT secondary. A mechanical timer or electronic timing device will be required to measure time delays. Power to operate the FB600E is normally derived from the phase current through the power winding of the CT. When doing secondary injection tests this power must be derived from an auxiliary source. Most commercial secondary injection test sets are equipped with these features and can be adapted to testing the FB600E.

The signal common (terminal 5), power common (terminal 10) and actuator output (terminals 11 and 12) are connected to different points within the FB600E. In some commercial secondary injection test sets, the terminals that would normally be connected to these points are tied together as a common ground. Consequently, it is necessary to isolate these points either through the use of an isolating transformer and interface module. A specially designed module for this purpose, model FT1 is available (see figure 4.2).

In the testing setup shown in figure 4.1 an isolating transformer is used for the power supply source. It is necessary to limit the current from the 24 volt transformer using a 51 ohm 5 watt (nominal) resistor. One of the three breaker poles is used as the trip contact to stop the test set timer when the FB600E trips. This adds the trip time of the breaker to the trip time of the FB600E.

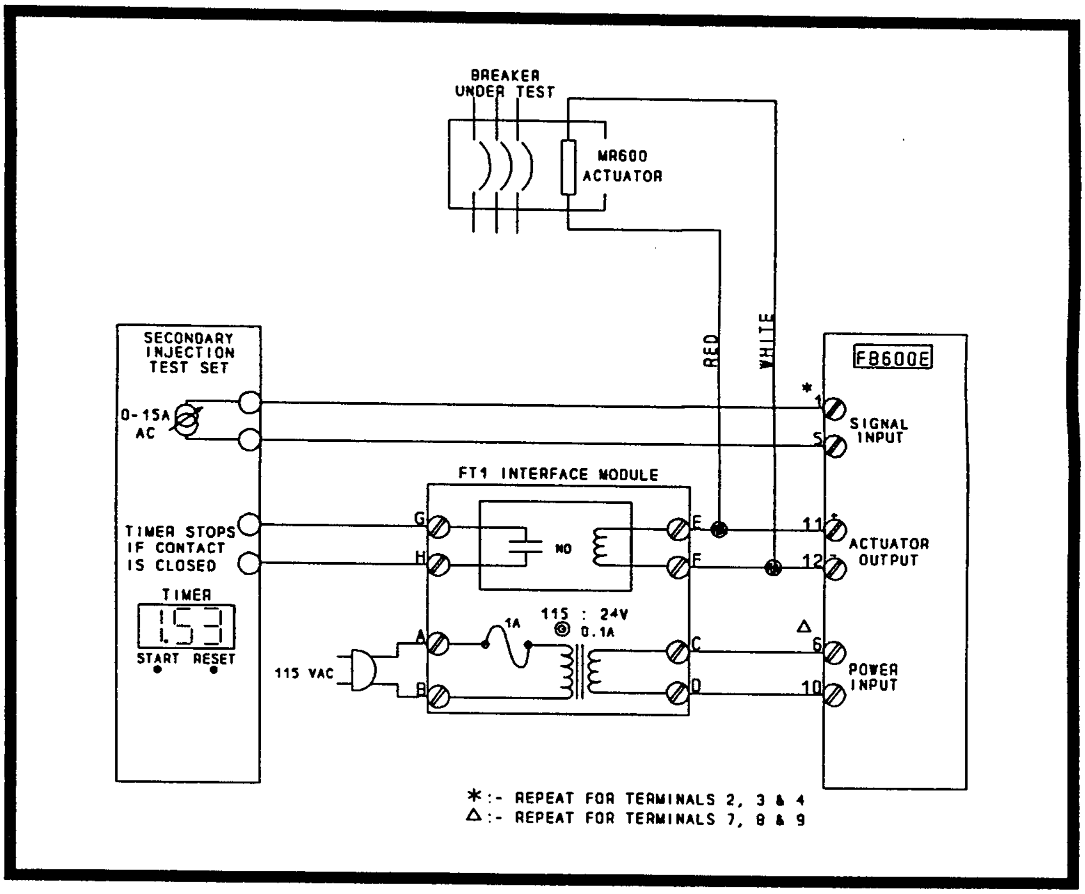
Fig. 4.1.1 SECONDARY INJECTION TESTING USING A BREAKER CONTACT



If an isolating transformer is not available or it is inconvenient to use a breaker pole as a trip contact, an inexpensive isolation module, model FT1, is available. This provides a power source and all the necessary signal isolation for most commercial secondary injection sets. Connections to this module are shown in figure 4.1.2.

Each time the FT1 unit trips, it must be reset before another test can begin. Pressing the reset button also resets the FB600E indicators. The FT1 module power indicator light must be on and the trip light off before doing a timing test. When the FB60E is untripped, the FT1 provides an open contact across terminals G and H. The FT1 should be connected to the secondary injection set so that a contact closure on terminals G and H stops the timer.

Fig. 4.1.2 SECONDARY INJECTION TESTING USING THE FT1 INTERFACE MODULE



One amp phase CT's are used with the FB600E. Consequently, an input current of 1 amp represents an overload of 100%. For example, if the pickup level is set at 0.5 times the CT rating and a current of 1 amp is input, the overload detected is 200%. The current injection device should remove the applied signal input as soon as a trip (actuator output pulse) is obtained. Failure to do this may result in the FB600E indicators resetting or damage to the FB600E circuitry due to the high current that could flow continuously into the low impedance actuator connected to terminals 11 and 12.

4.2 PRIMARY INJECTION TESTING

In order to test all components of the system including the CT's, FB600E, MR600 actuator and breaker, primary injection is needed. Each phase can be tested individually by connecting the primary injection source to the breaker in place of the bus using the wiring configurations of figures 2.2-2.5. If a 3 phase source is not used, it is necessary to defeat the ground fault detection by setting switch SG8 off to prevent nuisance tripping.

The power winding of the phase CT appears as a high impedance to the primary injection source as it goes into saturation. Unless the 3 phase source has a very low output impedance, it cannot drive the CT with a true sinewave and this will cause the signal input to appear distorted. This can be checked by connecting an oscilloscope across the phase signal input (terminals 1 and 5 for phase 1). If the applied signal is an undistorted sinewave then all calibration checks can be made using the primary injection set.

If the sinewave has a flattened zero cross area the current pickup levels will appear to be inaccurate and only functional tests can be performed. For example, the short time and instantaneous time delays can be verified but not the actual pickup level. Calibration of the pickup levels and long time delay should be checked with an undistorted signal using secondary injection while system function can be checked with primary injection testing.

4.3 INSTANTANEOUS TRIP TESTING

Use the switch settings in figure 3.1 to set the desired instantaneous trip level and defeat the other trip functions using figures 3.3, 3.6 and 3.8. Slowly increase the current into one phase using the setup of figure 2.2 until the actuator trips or an output pulse is obtained. The current read by the meter should equal the pickup level +/- 10%.

Increase the current to at least 150% of the pickup value. Remove the current, reset the timer and wait 5 seconds. Apply the full current received after a maximum of 50 ms from the application of current. Repeat these tests for other pickup settings as desired.

4.4 SHORT TIME OVERLOAD TESTING

Use the switch settings in figure 3.3 to set the desired short time pickup level and select the shortest time delay. Defeat the other trip functions using figures 3.1, 3.6 and 3.8.

Slowly increase the current into one phase using the setup of figure 2.2 until the actuator trips or an output pulse is obtained. The current read by the meter should equal the pickup level +/- 10%.

Increase the current to at least 150% of the short time pickup level selected. Remove the current, reset the timer and wait 5 seconds. Apply the full current using a switch. The timer should measure that an output pulse (actuator trip) was produced after the selected time delay +/- 20%. Repeat these tests for other settings as desired.

4.5 LONG TIME OVERLOAD TESTING

Use the switch settings in figure 3.6 to set the desired long time pickup level and time delay curve. Defeat the other trip functions using figures 3.1, 3.3 and 3.8. Note that the maximum continuous current injected into any phase for an extended length of time should not exceed 4 amps or component damage may result.

Slowly increase the current until the long time pickup LED begins to flash. The flashing rate indicates the amount of overload. At the point where the LED first starts to flash, the current measured should equal the pickup level setting +/- 10%.

Increase the current to the degree of overload required. For example, with a pickup level of 1 x the CT rating, 3 amps represents an overload level of 3 times the pickup level. Remove the current and wait 5 seconds. Reset the timer. Apply the full current using a switch and begin timing. The timer should measure an output pulse (actuator trip) after a time delay determined from figure 3.5 for the corresponding settings and level of applied signal. Trip time delay accuracy is +/- 20% of the nominal trip time. Repeat these tests for other settings as desired.

4.6 GROUND FAULT TESTING

Use the switch settings in figure 3.8 to set the desired ground fault pickup level and select the shortest delay time. Connect the input signal to the ground fault terminals 4 and 5 as shown in figures 2.3, 2.4 and 2.5.

Slowly increase the current in one phase until the actuator trips or an output pulse is obtained. The current read by the meter should equal the ground fault pickup level +/- 10%.

Increase the current to at least 150% of the ground fault pickup level selected. Remove the current, reset the timer and wait 5 seconds. Apply the full current using a switch. The timer should measure an output pulse (actuator trip) after the selected time delay +/- 20%. Repeat these tests for other settings as required.

4.7 FINAL SETTING TEST

Once all calibration tests have been completed, set the selector switches in figures 2.2-2.5 to the desired final values. At this time it is advisable to do functional tests of the complete system using primary injection (section 4.2).

FB600E TESTING NOTE

During normal operation, a circuit breaker will not experience any overloads. After an overload trip, the breaker will not have any load applied for a significant period of time while the problem is diagnosed before resetting. The FB600E is designed to withstand any overload experienced during actual operation.

When testing a circuit breaker during commissioning, it is póssible to repeatedly apply large overloads to test a large number of points on the different curves or at different switch settings. This can eventually lead to overheating of the power supply circuit which must dissipate the heat generated from the repeated overloads in this artificial situation. Since this can lead to permanent component damage, allow the FB600E to cool for a short period after each overload test whether primary or secondary injection is used. This should prevent any damage to the unit.

When testing the FB600E with secondary injection an external power supply is required. This power supply must be current limited or the FB600E shunt regulator will be permanently damaged. In addition, some signal isolation is required when commercial test sets are used. An interface module, the FT1, should always be used when secondary injection testing the Carriere model FB600E. This inexpensive module provides the necessary auxiliary power source and signal isolation. Wiring is shown in figure 4.2. Following these precautions should ensure trouble-free testing and operation.

CARRIERE RELAY WARRANTY

Carriere warrants each relay it manufactures to be free from defects in material and workmanship under normal use and service for a period of 24 months from date of installation.

In the event of a failure covered by this warranty, Carriere will undertake to repair or replace the relay providing the warrantor determines that it is defective and it is returned with transportation charges prepaid to an authorized service centre or the factory. Repairs or replacement under this warranty will be made without charge.

This warranty shall not apply to any relay which has been subject to misuse, negligence, accident, incorrect installation or use not in accordance with instructions nor any unit that has been altered outside a Carriere authorized factory outlet.

Carriere is not liable for contingent or consequential damages or expenses sustained as a result of a relay malfunction, incorrect application, settings or adjustment.

FB600E
STATIC RELAY

INSTRUCTION MANUAL

CARRIERE
TECHNICAL INDUSTRIES
DIVISION OF DERLAN MANUFACTURING INC.
5621 FINCH AVE. E.
SCARBOROUGH, ONTARIO
CANADA, M1B 2T9
TEL: (416) 297-8738
FAX: (416) 297-0421

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