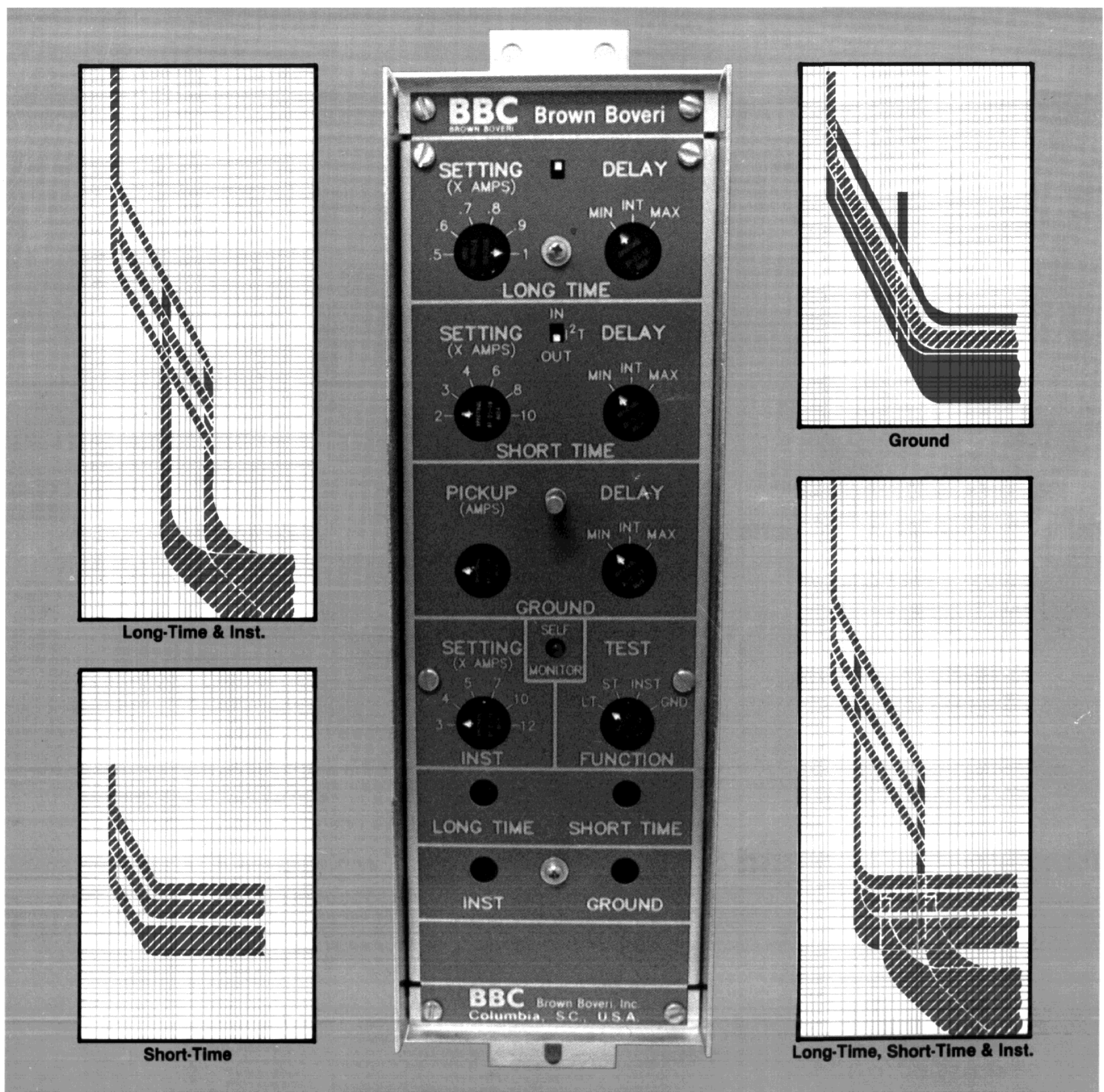


MICRO Power-Shield® Digital Microprocessor Solid-State Trip System

Bulletin A 6.1.1-1A



MICRO Power-Shield...

Digital microprocessor technology for modern electrical power system protection

Six Basic Combinations

MICRO Power-Shield is a state-of-the-art, solid state trip system consisting of the unique and exclusive MICRO Power-Shield (MPS) microprocessor trip unit, an all new magnetic latch, new interconnecting wiring harness, and the time proven existing LK sensors especially designed as an integral component of the entire LK family of low voltage power circuit breakers.

Solid-state trip systems have been supplied on I-T-E low voltage power circuit breakers since 1968. This operating experience and current microprocessor technology have been incorporated into the design and manufacture of the

MICRO Power-Shield tripping system featured on all LK circuit breakers to better protect power systems in the event of overloads or faults.

The completely self-powered MICRO Power-Shield system takes tripping energy from the primary current flowing through the circuit breaker without need for an additional power supply.

The tripping system includes the MICRO Power-Shield trip unit, current sensors, magnetic latch and an interconnecting wiring harness. Current sensors are integrally mounted on each phase of the circuit breaker and supply

the current signal to the MICRO Power-Shield trip unit. This current has a value directly proportional to the current flowing in the primary circuit. If the current value flowing in the primary exceeds the settings for a given time interval, the trip unit sends a signal to the magnetic latch which trips the circuit breaker.

The MICRO Power-Shield is available in six basic combinations (see Table 1) that provide long-time, short-time, instantaneous and ground protective functions. Selection is based on the protection and coordination requirements of the particular system.

Table 1 — Available Trip Units

Type MPS	Trip Functions				Time-Current Curves (Overcurrent, Ground, & I ² t)
	Long-Time Delay	Short-Time Delay	Inst. Setting	Ground Delay	
MPS-3	X	—	X	—	TD-9601
MPS-3G	X	—	X	X	TD-9601 & 9603
MPS-4	X	X	—	—	TD-9602 & 9604
MPS-4G	X	X	—	X	TD-9602, 9603, 9604
MPS-5	X	X	X	—	TD-9602 & 9604
MPS-5G	X	X	X	X	TD-9602, 9603, 9604

Ampere Ratings and Settings

The MICRO Power-Shield trip unit provides a full range of settings for precise protection and coordination. All settings are visible through a transparent cover with a sealable feature that inhibits tampering. Settings that remain stable over long operating periods are readily made with positive detent selector switches. For available settings see Table 2. The exclusive ampere range selector switch doubles the adjustment settings of the basic protective elements: long-time, short-time and

instantaneous. The ampere range selector switch, while providing a broader range of coverage, reduces the required number of different sensors. Only nine sensor ratings are required for long-time settings ranging from 50 to 4200 amperes.

All Model-2A LK low voltage circuit breakers utilize type MPS trip units. Unlike other trip units, above unity or above margin settings, such as 110%, are not required to assure that the LK circuit breaker will carry 100% of its sensor rating

continuously. This is accomplished by the microprocessor beginning the time delay and trip functions only after 100% of the threshold value has been exceeded. This exclusive feature of the microprocessor assures users full utilization of their investment for its intended purpose. Other trip units require selective override switching to ensure coordination. The MPS trip unit allows the LK circuit breaker to completely coordinate with downstream devices without the need for override circuitry.

Table 2 — Sensor Ampere Ratings and Settings

Sensor Rating	Ampere Selector	Long-Time	Short-Time	Inst.	Ground Amps	Circuit Breaker
200 800	200-100 800-400	0.5	2	3	100	LK8
		0.6	3	4	200	LKE8
		0.7	4	5	300	LKD8
		0.8	6	7	600	LK16
		0.9	8	10	900	LKE16
		1.0	10	12	1200	LKD16
1600 2000	800-1600 1000-2000	0.5	2	3	300	LK16
		0.6	3	4	400	LKE16
		0.7	4	5	600	LKD16
		0.8	6	7	800	LKD16
		0.9	8	10	1000	LK20
		1.0	10	12	1200	
2500	1250-2500	0.5	2	3	300	LK25
		0.6	3	4	400	LKE25
		0.7	4	5	600	LK32
		0.8	6	7	800	LKE32
		0.9	8	10	1000	LK42
		1.0	10	12	1200	LKE42
3000 3200 4000 4200	1500-3000 1600-3200 2000-4000 2100-4200	0.5	2	3	500	LK25
		0.6	3	4	600	LKE25
		0.7	4	5	800	LK30,32
		0.8	6	7	900	LKE30,32
		0.9	8	10	1000	LK40,42
		1.0	10	12	1200	LKE40,42

A portable test set is available for field testing. A function switch is provided on the front panel of the MICRO Power-Shield trip unit to facilitate testing. The "test function" switch defeats all trip elements except the one selected for test purposes.

A transparent cover protects the MICRO Power-Shield trip unit and may be sealed to inhibit unauthorized changes of rotary switch settings.

The short time element is furnished with an I²t "IN-OUT" selector. This provides for shaping the time-current characteristic curve in the short-time delay area, from a sharp knee (I²t "OUT"), to a ramp function (I²t "IN").

The ground fault elements include an I²t characteristic that is a permanent feature. The unique circuitry of the MPS trip unit responds to low level arcing faults by summing the erratic currents associated with arcing.

Each MICRO Power-Shield trip unit is completely tested before shipment. There are no electro-mechanical devices to readjust after shipment. Only the required settings need be made prior to placing the unit in service.

MICRO Power-Shield trip unit time delay operating characteristics for the various trip elements are given on the time-current curves referenced in Table 1. Specific time delay settings for the various MPS trip elements are given in Table 3.

Table 3 — Time Delay Settings

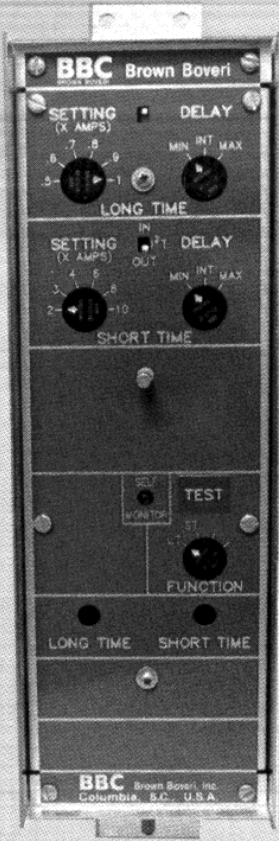
Type MPS	Trip Function	Time Delay Band	Time Delay
③MPS-3 & 3G MPS-4 & 4G ③MPS-5 & 5G	Long-Time	Maximum Intermediate Minimum	15.0 Seconds ① 5.0 Seconds ① 2.0 Seconds ①
MPS-4 & 4G ③MPS-5 & 5G	Short-Time	Maximum Intermediate Minimum	0.35 Seconds ② 0.20 Seconds ② 0.08 Seconds ②
③ MPS-3G MPS-4G ③MPS-5G	Ground	Maximum Intermediate Minimum	0.35 Seconds ② 0.20 Seconds ② 0.05 Seconds ②

① Measured at six times range selector ampere setting at the lower limit of the time delay band.
② Measured at the lower limit of the maximum, intermediate, minimum short-time and ground time delay bands at any point above threshold.
③ Includes adjustable threshold instantaneous trip function.

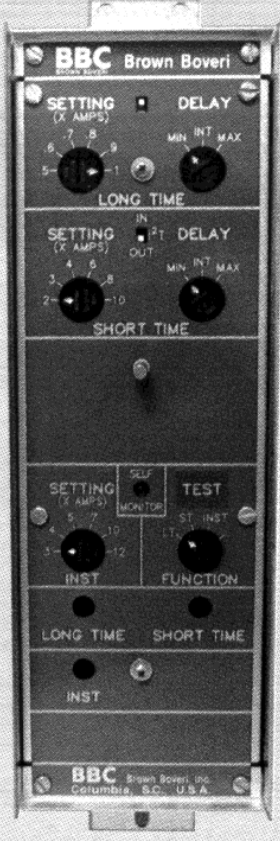
Available Trip Units



Type MPS-3
Long-Time and
Instantaneous



Type MPS-4
Long-Time and
Short-Time



Type MPS-5
Long-Time,
Short-Time and
Instantaneous



Type MPS-3G
Long-Time,
Instantaneous
and Ground



Type MPS-4G
Long-Time,
Short-Time and
Ground



Type MPS-5G
Long-Time,
Short-Time,
Instantaneous
and Ground

Standard Features

Standard features available on the MICRO Power-Shield include all of the standard features and many of the features that were offered as optional on previous solid-state trip devices.

- State-of-the-art microprocessor/ solid-state reliability.
- Transparent protective cover allows inspection and inhibits tampering.
- Independently adjustable, six position trip settings for all trip elements.
- Independently adjustable, three position time delay bands for long-time, short-time and ground.
- Flexible settings for precise system protection and coordination.
- Testing function selector switch.

- True 100% current carrying capability of the long-time setting values.
- Narrow long-time threshold setting tolerance band width (– 0, + 10%).
- Narrow long-time delay bands for precise time delayed response.
- Selectable time-current characteristics.
- Short-time I²t (IN/OUT) selector.
- Shaped instantaneous characteristic for optimum coordination.
- Interchangeability to serve any frame size LK, LKE and LKD circuit breaker.
- Microprocessor self-monitor indicator.

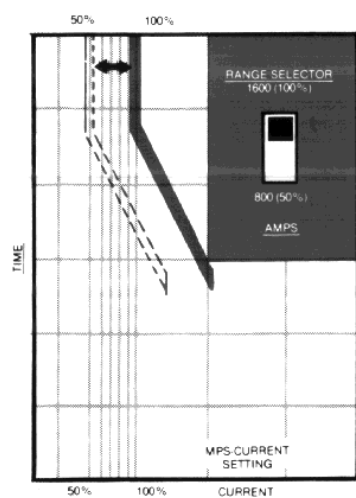
- Target indication for each trip function.
- Target retention despite shock, vibration or loss of control power.
- Targets are reset automatically.
- Double sensor ratings via a two position ampere range selector.
- Seal feature to inhibit unauthorized cover removal and setting changes.
- Completely self-powered (additional power source unnecessary).
- Convenient mounting location on LK circuit breaker front panel.
- Ground current arcing fault summing characteristic.
- Ground current I²t characteristic.

Table 4 — Available Features

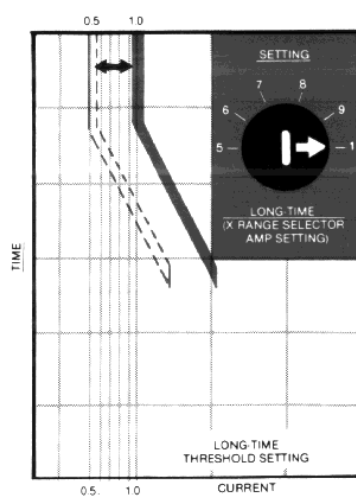
Feature	MPS-3	MPS-3G	MPS-4	MPS-4G	MPS-5	MPS-5G
2 Position Ampere Range Selector	S	S	S	S	S	S
6 Adjustable Long-Time Settings	S	S	S	S	S	S
3 Adjustable Long-Time Delay Bands	S	S	S	S	S	S
6 Adjustable Short-Time Settings	NA	NA	S	S	S	S
3 Adjustable Short-Time Delay Bands	NA	NA	S	S	S	S
6 Adjustable Ground Settings	NA	S	NA	S	NA	S
3 Adjustable Ground Delay Bands	NA	S	NA	S	NA	S
6 Adjustable Instantaneous Settings	S	S	NA	NA	S	S
Target Indication For Each Element	S	S	S	S	S	S
Automatic Target Reset	S	S	S	S	S	S
Test Function Switch For Each Element	S	S	S	S	S	S
Test Set Provisions (Type 606)	O	O	O	O	O	O
Load Alarm Contact *	O	O	O	O	O	O
Ground Alarm Contact *	NA	O	NA	O	NA	O
Ground Current Summing	NA	S	NA	S	NA	S
Short-Time I ² t (IN/OUT)	NA	NA	S	S	S	S
Self Monitor LED	S	S	S	S	S	S

* — Requires an External Source of Control Power NA — Not Available S — Standard Feature O — Optional

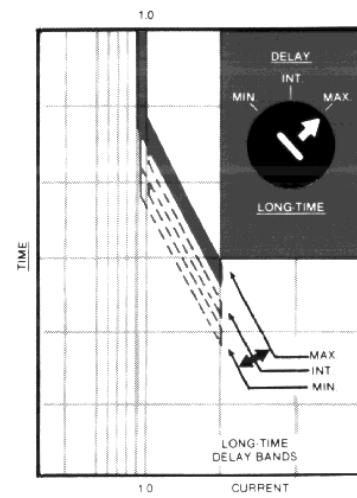
Functions



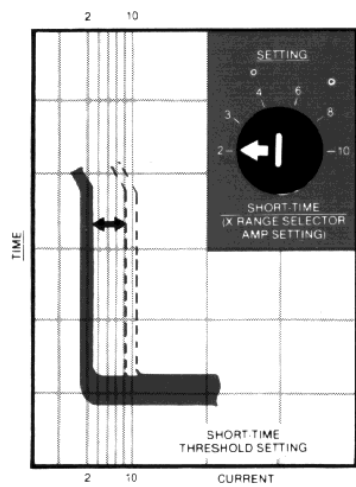
Range Selector (Standard)
Two position ampere range selector switch provides for current setting equal to 100% or 50% of the sensor current rating.



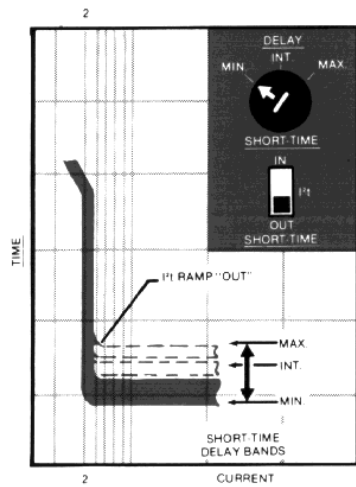
Long-Time Setting (Standard)
Six position long-time setting selector switch provides long-time settings at any of six multiples of the (100% or 50%) range selector ampere setting.



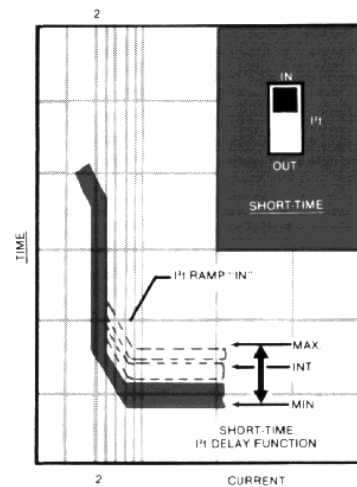
Long-Time Delay (Standard)
Three position long-time delay selector switch varies the long-time delay band setting. Minimum, intermediate and maximum delay bands are provided.



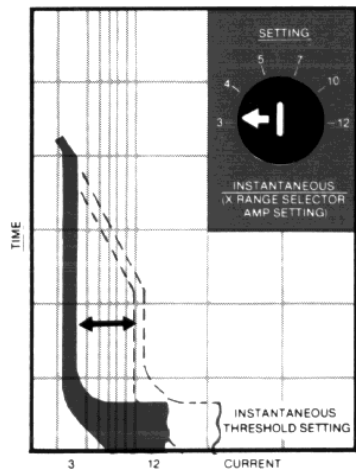
Short-Time Setting (Optional)
Six position short-time setting selector switch provides short-time settings at any of six multiples of the (100% or 50%) range selector ampere settings.



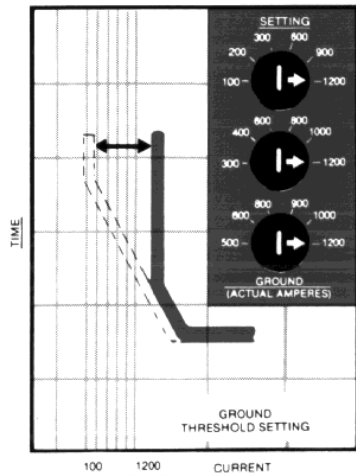
Short-Time Delay (Standard with Short-Time Option)
Three position short-time delay selector switch varies the short-time delay band setting. Minimum, intermediate and maximum delay bands are provided.



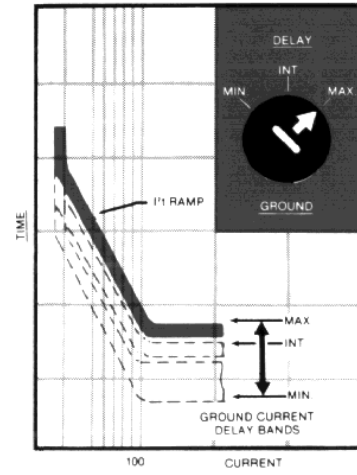
Short-Time I²t Selector (Standard with Short-Time Option)
Short-time I²t switch provides for an I²t ramp function at the knee of the short-time characteristic curves.



Instantaneous Setting (Optional)
Instantaneous threshold setting determines the current level at which the circuit breaker will trip without intentional time delay.

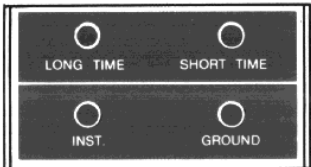


Ground Current Setting (Optional)
Ground current threshold settings are given in actual ampere values with three ranges available. The six position ground setting selector switch provides for ground settings from 100 to 1200A, 300 to 1200A or 500 to 1200A (Refer to Table 2).



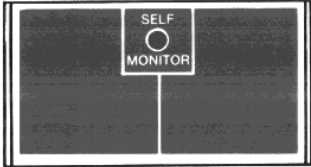
Ground Delay (Standard with Ground Option)
Three position ground delay selector switch varies the minimum, intermediate and maximum delay bands settings. Also included is an I²t ramp function to improve overall selectivity for ground fault protection.

Trip Target Indicator



Target indicators are provided with each trip element as a standard feature. This includes long-time, short-time, instantaneous and ground. Target indication is retained and not affected by shock, vibration or loss of control power. Reset is accomplished automatically within ten (10) seconds after reclosing the circuit breaker. If another trip is initiated target reset will occur instantaneously and a new target will display which protective element responded.

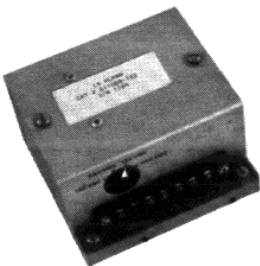
Self Monitor LED



A self monitoring indicating light is provided as a standard feature on all MPS trip units. A self monitor function continuously checks the operating condition of the micro-processor and displays proper operation in the form of a red LED (light emitting diode) mounted on the MPS front panel. The red LED will blink approximately one time per second when activated by primary current flowing through the circuit breaker. The blinking red LED indicates proper operation of the microprocessor.

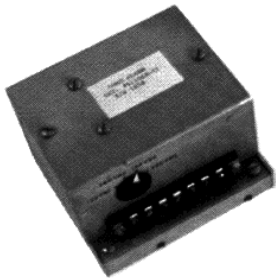
**Accessories
Optional**

Ground Alarm Contact



This feature provides a momentary contact closure when a ground trip operation occurs. This contact is brought out to terminals where a remote alarm circuit may be connected. This contact is suitably rated for use with a remote mounted annunciator. The contact rating at 125 Vdc is 30A momentary, 5A continuous and 0.3A inductive break.

Load Alarm Contact



A load alarm contact is available with a normally open contact that closes when the primary current exceeds the long-time threshold setting. This contact remains closed until the breaker trips. The load alarm contact is brought out to terminals where a remote alarm circuit may be connected. This contact is rated at 125 Vdc, 30A momentary, 5A continuous and 0.3A inductive break.

Type 606 Test Set



A compact, portable test set is available to test all MICRO Power-Shield, type MPS trip units on-site. With the LK circuit breaker drawn out to the "test" position or removed to a worktable, the Type-606 test set verifies the operation of the MICRO Power-Shield trip system in accordance with the settings selected and the characteristics desired. This includes long-time threshold and delay, short-time threshold and delay, ground threshold and delay, and instantaneous threshold.

MICRO Power-Shield Solid-State Trip System

MICRO Power-Shield Trip Unit (MPS-5G shown)

Wiring Harness

Magnetic Latch Unit

Phase Sensor (3-req'd)

Additional Information

Bulletin 6.1.1-1

I-T-E Type LK Low Voltage AC
Power Circuit Breakers

Bulletin 3.1.1-1

Secondary Unit Substations with
I-T-E Type LK Power Switchgear

Bulletin IB 6.1.1.7-1

LK Power Circuit Breaker
Installation & Maintenance
Instructions

Bulletin RP 6.1.1-8

LK Power Circuit Breaker Renewal
Parts

Bulletin IB 6.1.1.7-3

Micro Power-Shield Type-606 Test
Set

TD-9601

Time-Current Characteristic Curves
for Type MPS-3 (Long-Time &
Instantaneous)

TD-9602

Time-Current Characteristic Curves
for Type MPS-4 (Long-Time & Short-
Time) and Type MPS-5 (Long-Time,
Short-Time & Instantaneous)

TD-9603

Ground Time-Current Characteristic
Curves for MPS-3G, MPS-4G &
MPS-5G

TD-9604

Short-Time I^2t Time-Current
Characteristic Curves for MPS-4,
MPS-4G, MPS-5 & MPS-5G