Bus Differential Relays

M-HIB3 High Impedance Biased Differential Relay

The M-HIB3 High Impedance Biased Differential relay is a member of Cooper Power Systems' Edison® Line of microprocessor based protection relay. The M-HIB3 offers the following features:

- Low-set percentage biased differential elements for each phase (87B).

- Adjustable second harmonic restraint.

- High-set differential element with DC offset restraint. Typical trip time of under 1 cycle.

- Two definite time overcurrent elements (50) for through faults.

- Breaker fail protection (50BF)

- Real-time measurements.

- Two, externally triggerable, 16-cycle oscillographic captures.

The M-HIB3 also shares the following features common to all Edison relays:

- Simple five-button man machine interface (MMI) allows access to all functions, settings, and stored data without the need for a computer.

- Draw-out design permits relay testing without disturbing connections to case.

- Modbus communication protocol and RS485 terminal on rear.

- Programmable reset characteristics.

- Dedicated power supply/relay fail output contacts.

- Cumulative trip counters.
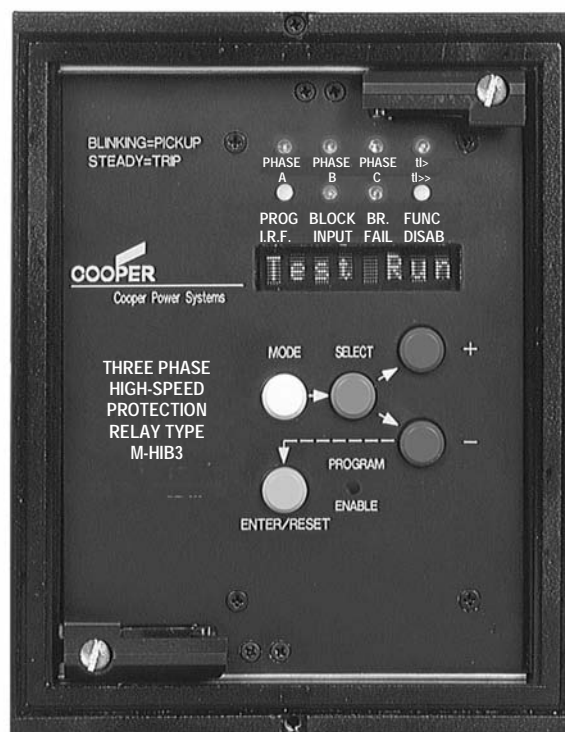
- Auto-ranging power supplies.

- UL Listed

PROTECTION ELEMENTS
Low Set Differential Element (87-L)

Each phase is provided with its own differential element having a characteristic as shown in Figure 2. The relay internally calculates the RMS value of the differential current

FIGURE 1
Front View of the M-HIB3 High Impedance Biased Differential Relay

compensated for any CT ratio and phase angle mismatch. The minimum differential current required for operation is adjustable between 0.1 and 1.0 pu of the rated CT current. This setting is fixed up to 0.5 pu of the machine's rated current. Above 0.5 pu compensation of the set point is required for CT saturation which may occur at higher current levels. The slope of the first sloping portion of the characteristic is adjustable from 10% to 50%, and applies from 0.5 pu to 2.5 pu of the rated current. Above 2.5pu the slope of the differential element is fixed at 100%. This element will typically operate in less than 30msec

If a transformer is included in the differential circuit, significant 2nd harmonic current may flow during transformer energization that may result in false trips. This requires the relay to suppress its response to the 2nd harmonic component of current.

The M-HIB3 allows for adjustment of the 2nd harmonic restraint over the range of 0.1 to 1.0 pu of the rated CT current. Harmonic restraint may be disabled.

High Set Differential Element (87-H)

An instantaneous (high set) differential element is provided to quickly operate in the event of severe internal faults. To effectively eliminate the effects of dc offsets and harmonics, the relay trips on the sensing of sequential positive and negative peak currents whose magnitude exceeds the high set trip level. Due to the operational nature of the element, no harmonic programmable harmonic restraint elements are provided. This element will typically operate in less than 1 cycle.

Overcurrent Protection (50)

Two definite time delay phase overcurrent element are provided for through fault overcurrent protection.

Breaker Fail (50BF)

A programmable time delay is set equal to the breaker clearing time. If the fault is not cleared (i.e., the trip element has not dropped out), before this timer expires, a breaker fail is indicated. The breaker fail function may be assigned to operate one or more of the output relays.

EVENT RECORDS

The M-HIB3 records for the five most recent protective element trips the values of the three-phase differential, the three-phase through currents, and the cause of the trip.

Triggered Oscillographic Capture

The M-HIB3 captures a 16 cycle[1] oscillographic record of the six input current waveforms. The record is triggered by the trip of any protective element, by external signal (dry input) or by Modbus command. Oscillography data must be retrieved by Modbus. The Edison relay interface software, EdisonCom, provides the ability to retrieve and view the oscillographic record.

MEASUREMENTS

Each M-HIB3 provides the following real time measurements:

- Fundamental frequency value of each phase's differential current.
- RMS current of each phase's through current.

The maximum values of these measurements are also recorded. The maximum values reset any time the breaker is closed. All measurements are accessible on the relay's front display and via Modbus.

Trip Counters

A counter is maintained for each protective element which tallies the

cumulative total number of trips each element has experienced.

TARGETS

Eight bright LED targets are provided as follows:

- One for each phase differential element (87)
- One to indicate high set differential operation.
- One to indicate that either of the overcurrent elements (50) have operated.
- One to indicate breaker fail. (50BF)
- One to indicate if the relay is receiving an external blocking signal.
- An LED to indicate when the relay is in programming mode (flashing) and relay or power supply failure (ON).

RESET CHARACTERISTICS

The output relays may be programmed to reset in one of two manners.

- Instantaneously upon the input or calculated quantities dropping below the pickup value.
- Manual reset (by front panel or computer command) only.

TIME SYNCHRONIZATION

The M-HIB3's clock can be set manually, by software or by an external synchronization pulse. The pulse may be set to arrive at fixed 5, 10, 15, 30, or 60-minute intervals. Time clock resolution is 10msec. The time clock feature may also be disabled.

OUTPUT ELEMENTS

The following functions may be programmed to operate one or more of the output relays.

- Low set differential trip.
- High set differential trip.
- Low set overcurrent pick-up.
- Low set overcurrent trip.
- High set overcurrent pick-up.
- High set overcurrent trip.
- Breaker fail.

DIAGNOSTICS

Complete memory and circuit diagnostics are run upon powering the relay. The revision level of the firmware is displayed at this time.
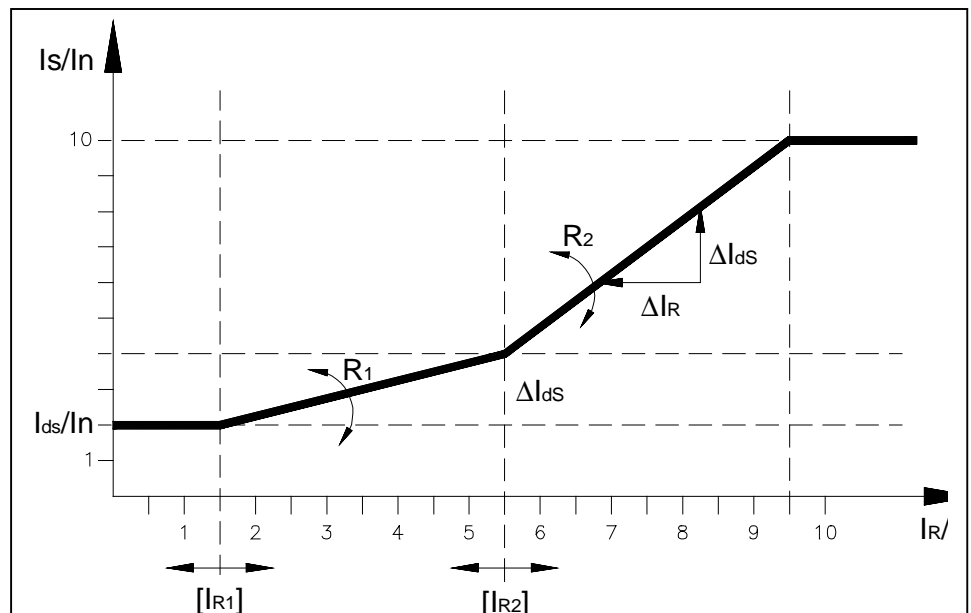
---

[1] 8 pre-fault and 8-post fault cycles.

FIGURE 7: Dual Slope Bias Characteristic of the M-HIB3 Differential relay

Table 1: Functional Specifications

Nominal system frequency setting range	50 or 60 Hz
Rated primary CT current	1 – 9999A in 1A steps
Basic minimum pick-up level if the low set differential element	0.1 - 1.0pu of rated CT current in 0.01pu steps or Disable
First zone bias slope	10 – 50% in 1% steps
2nd Harmonic restraint level for low set differential element	0.1 – 1.0 pu of measured differential current in 0.01 pu steps or Disable
Minimum pick-up level if the high set differential element	0.5 – 9.0pu of rated CT current in 0.1pu steps or Disable
Pick up level of low and high set overcurrent elements	0.5 – 8.0 pu of rated current in 0.1 pu steps or Disable
Time delay range for low and high set overcurrent elements	0.05 – 3.0 seconds in 0.01sec steps
Breaker fail time delay range	0.05 – 1.00 seconds in 0.01 second steps
Minimum pick-up level for CT supervision element	0.1 – 1.0 pu in 0.01 pu steps or Disable
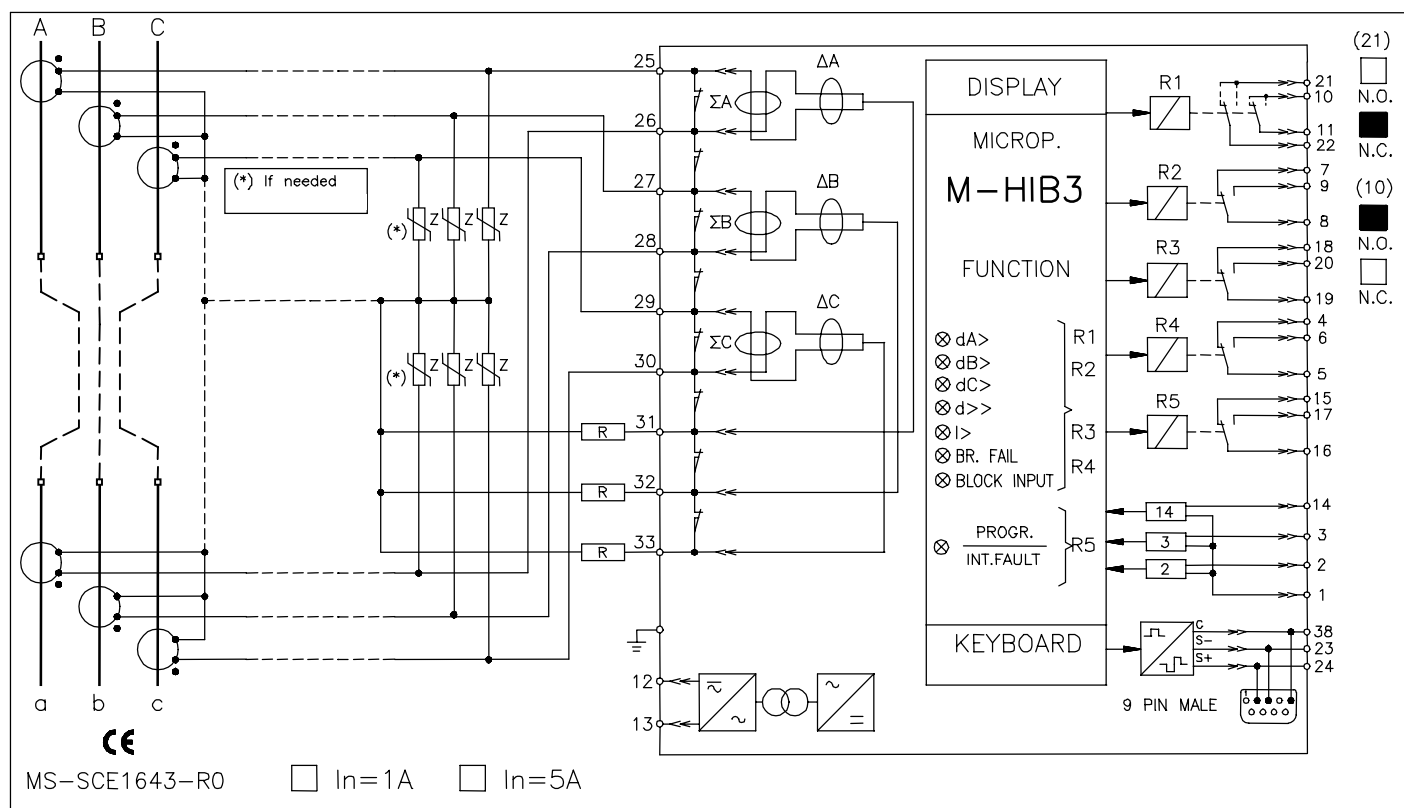
FIGURE 8 - Wiring Diagram for the M-HIB3 Relay

NOTE: All CTs must be of the same CT ratio.

ORDERING INFORMATION

Construct the catalog numbers from Table 2:

Table 2

Base Relay Model	Power Supply		CT Input Range (Asec)	Case Style	
	Code	Description		Code	Description
PRMHIB3J	L	24-110V AC/DC	1	S	Single Case
	H	90-220V AC/DC	5		

Example: PRMHIB3J5LS is a M-HIB3 relay with a 24-110V power supply and 5A nominal CT inputs.

COOPER Power Systems