

OPTI-TRIP I RMS

APPLICATION NOTE OT-053090

OPTI-TRIP PICK-UP AND TIME BAND SETTINGS

OPTI-TRIP Model LSI has seven (7) switches for pick-up and time band settings, the Model LSI has five (5).

The following abbreviations are used to identify the trip unit functions:

L = Long Time
S = Short Time
I = Instantaneous
G = Ground Fault

The following notations are used in the trip unit pick-up and time band settings:

X = Times CT Rating
S = Second Delay at 6x (For LT Time Band)
C = Cycles Delay (For GF and ST Time Band)
I²T = Ramp Function

The setting switches have discrete, positive detent positions. A small flat blade screwdriver is required to rotate the switches. The small groove along the switch shaft acts as the switch pointer. Changes to the switch settings can be made while the breaker is in service.

PICK-UP SETTINGS:

The pick-up setting in amps equals the CT current rating times the pick-up setting.

As an example, the primary pick-up currents for 600 amp CT's with the following settings are:

.25x GF pick-up times 600 amp = 150 amp
.5x LT pick-up times 600 amp = 300 amp
6x ST pick-up times 600 amp = 3600 amp
8x I pick-up times 600 amp = 4800 amp

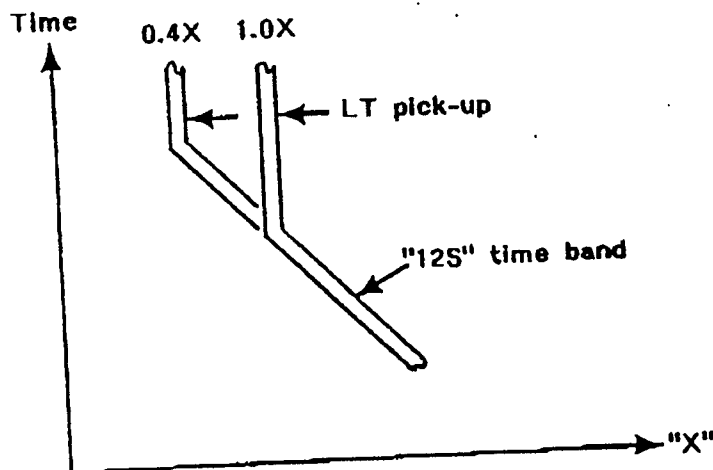
The primary pick-up currents for 1600 amp CT's with the following settings are:

.5x GF pick-up times 1600 amp = 800 amp
1.0x LT pick-up times 1600 amp = 1600 amp
6x ST pick-up times 1600 amp = 9600 amp
10x I pick-up times 1600 amp = 16000 amp

TIME BAND SETTINGS

The time band settings for LT, ST, and GF (I^2T on) are dependent only on the CT rating and not on the corresponding pick-up settings.

As an example:



The proper LT pick-up setting is usually determined by the cable ampacity or the maximum continuous current capacity of the load as required by the NEC or local codes.

The proper time band settings are not so readily determined. A coordination study is usually required to select the time bands that best coordinate with the upstream protective device, as well as the largest down stream protective device.

For a motor load, the time band should allow for motor inrush and acceleration time and still provide locked rotor protection.

Normally, the lower pick-up values will require one of the shorter time bands, and the higher pick-up values will require one of the longer time bands.

TRIP TIME VALUES FOR TESTING:

To determine the LT, ST, and GF trips times for primary injection testing, the following may be helpful:

The trip times for LT, ST (I^2T on) and GF (I^2T on) are a function of:

- 1) Time Band Setting
- 2) CT Rating
- 3) Primary Test Current

Please note that once the proper time band is selected, the pick-up setting does not enter into the trip times. The only exception is that the primary test current must be at least 10% greater than the pick-up setting.

To find the trip time, it is first necessary to calculate the "X" equivalent of the primary test current and then determine the time by calculation, or by using the time-current trip curves.

The "X" value is equal to the primary test current divided by the CT rating.

$$X = \frac{\text{Primary Test Current}}{\text{CT Rating}}$$

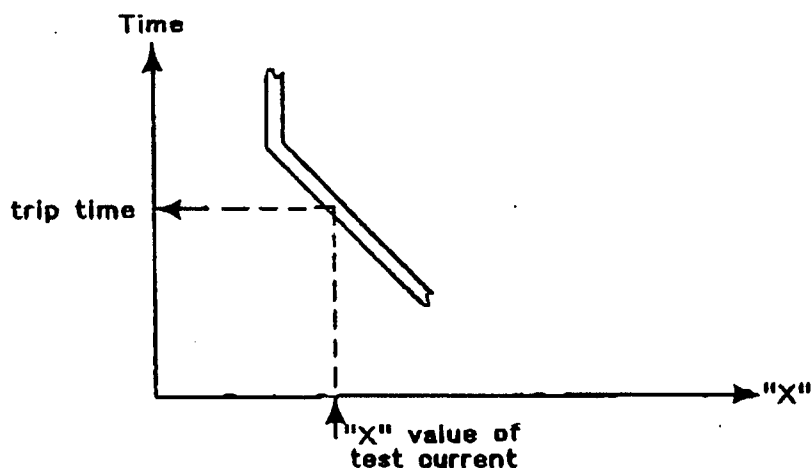
As an example, the "X" value for the following primary test currents and 1600 amp CT's are:

2400 Amp Primary Test Current, $X = 2400/1600 = 1.5$
 4800 Amp Primary Test Current, $X = 4800/1600 = 3.0$
 9600 Amp Primary Test Current, $X = 9600/1600 = 6.0$

For an 800 amp CT with the following primary test currents, the "X" values are:

600 Amp Primary Test Current, $X = 600/800 = 0.75$
 2400 Amp Primary Test Current, $X = 2400/800 = 3.0$
 4800 Amp Primary Test Current, $X = 4800/800 = 6.0$

Once the "X" value of the primary test current is determined, the trip time can be determined graphically from the time-current trip curves as follows:



The trip times can also be determined by calculation using the following equation:

$$T \text{ (sec)} = \frac{\text{Time Band Constant}}{(X)^2}$$

The time band constants are:

GF I^2T : 6C TIME BAND CONSTANT = 0.10
 12C TIME BAND CONSTANT = 0.20
 24C TIME BAND CONSTANT = 0.40
 48C TIME BAND CONSTANT = 0.80

ST I^2T : 6C TIME BAND CONSTANT = 10.0
 12C TIME BAND CONSTANT = 20.0
 24C TIME BAND CONSTANT = 40.0
 48C TIME BAND CONSTANT = 80.0

LT: 3S TIME BAND CONSTANT = 108.
 4.25S TIME BAND CONSTANT = 153.
 6S TIME BAND CONSTANT = 216.
 8.5S TIME BAND CONSTANT = 306.
 12S TIME BAND CONSTANT = 432.
 17S TIME BAND CONSTANT = 612.
 24S TIME BAND CONSTANT = 864.
 34S TIME BAND CONSTANT = 1224.

As an example, the trip times for a 1600 amp CT with the following primary currents and time bands are:

6S LT Time Band, 3200 Amp Primary Current:

$$X = \frac{3200}{1600} = 2 \quad ; \quad T = \frac{216}{(2)^2} = 54 \text{ sec.}$$

12S LT Time Band, 4800 Amp Primary Current:

$$X = \frac{4800}{1600} = 3 \quad ; \quad T = \frac{430}{(3)^2} = 48 \text{ sec.}$$

24C ST Time Band, 9600 Amp Primary Current:

$$X = \frac{9600}{1600} = 6 \quad ; \quad T = \frac{40.0}{(6)^2} = 1.11 \text{ sec.}$$

6C GF Time Band, 6400 Amp Primary Current:

$$X = \frac{640}{1600} = 0.4 \quad ; \quad T = \frac{0.10}{(0.4)^2} = 0.625 \text{ sec.}$$

The above trip times are for the center of the time band. The tolerance for the trip unit is $\pm 10\%$ in the current direction. This corresponds to $\pm 23\%$ in the time direction.