PXR 10 SKM time-current curve (TCC) settings

Overview

The PXR 10 electronic trip unit available for Power Defense™ circuit breakers is cost-effective and designed to provide a high level of TCC-shaping flexibility with a minimal number of adjustments. This application paper will help the user understand the way SKM software accurately models the PXR 10 and available TCC options.
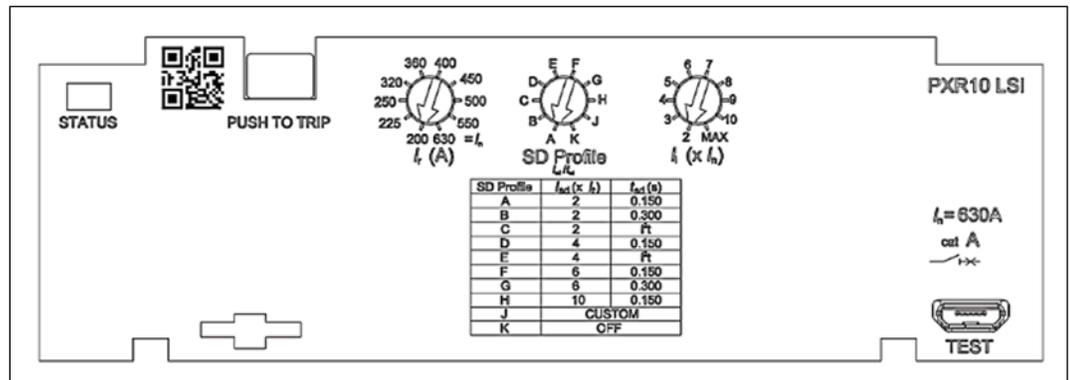
PXR 10 trip unit

The UL® Listed PXR 10 trip unit is only available in an LSI (long time short time instantaneous) version. Ground fault protection is not available. LI (long time instantaneous) versions of the PXR 10 are only available for IEC rated breakers. However, the LSI version has the same curve shaping capability as the LI version when using Profile K as detailed below.

PXR 10 trip units have three dial adjustments to make trip unit adjustment quick and easy.

Note: All PXR 10 adjustments are the same for the PD-2 (225 A) frame, PD-3 (400/600 A) frame, or the PD-4 (800 A) frame. Only the I_r (continuous current) rating range changes for the specific frame and current sensor selected.

Eaton's published time current curves for all Power Defense frames and trip unit types can be found at:

Power Defense Circuit Breakers | Molded Case Circuit Breakers | Eaton

Figure 1. PRX 10 trip unit with LSI protection

I_r — Sets the continuous current rating of the breaker.

SD profile — This one setting dictates both the Short Time Pick-up (I_{sd}) and the Short Time Delay (t_{sd}) per **Table 1 on Page 2**. The pick-up is in multiples of I_r (i.e., continuous current rating).

I_i — Sets the instantaneous pick-up. The instantaneous pick-up is in multiples of I_n (i.e., the current sensor value).

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Table 1. SD profile settings

The SD profile settings of **A** through **H**, and **J** include a wide variety of short time pick-up (I_{sd}) and time delay (t_{sd}) values with both flat response or I^2t response.

Profile	I_{sd} (n x I_r)	t_{sd} (s)
A	2	0.150
B	2	0.300
C	2	I^2t
D	4	0.150
E	4	I^2t
F	6	0.150
G	6	0.300
H	8	0.150
J	10	0.300
K	OFF	
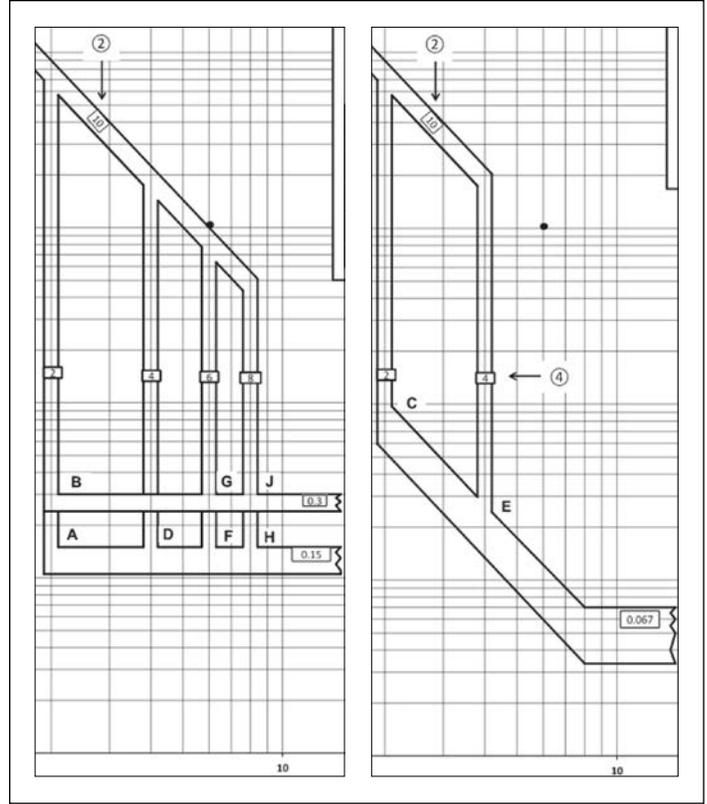
Figure 2. Flat response SD profiles (left) and I^2t response SD profiles (right)

SD Profile K — Short Delay OFF

The SD Profile K gives a simple way to turn an LSI curve shape into an LI curve shape by eliminating the t_{sd} short time delay. This curve shape can be very useful as the tight tolerances and 10 possible adjustments of the I_i instantaneous allow very tight coordination between numerous overcurrent devices. With Profile K, the Long Delay Time portion of the curve continues until the I_i Instantaneous Pick-up setting is chosen as shown in the time current curve example in **Figure 3**.
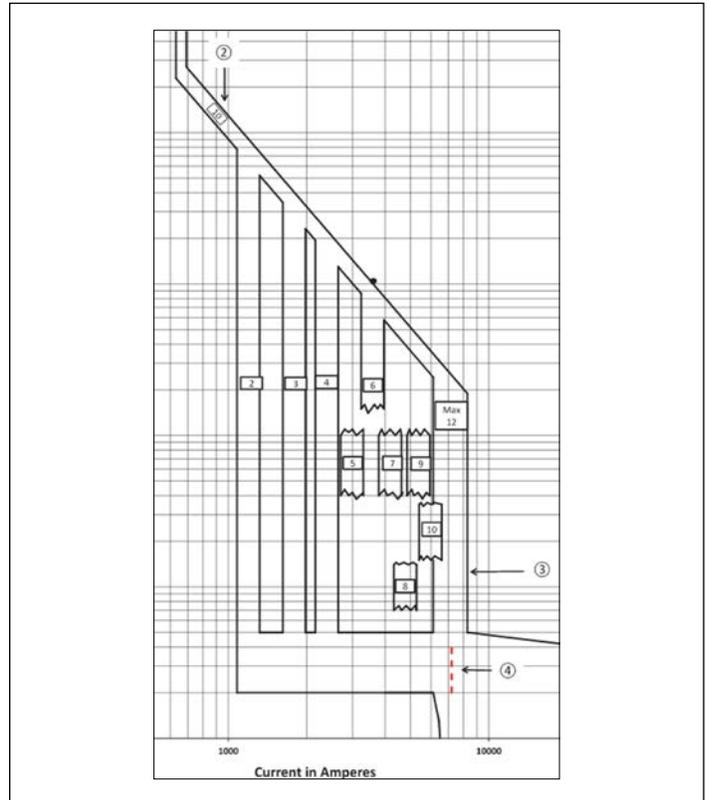

Figure 3. SD Profile K

I$_i$ (Instantaneous) setting

The Instantaneous setting is adjustable from 2x to a maximum pick-up value determined by specific breaker frame and breaker sensor rating. The instantaneous pick-up is in multiples of **I$_n$** (i.e., the current sensor value). Each Power Defense circuit breaker also includes a fixed Instantaneous Override for each specific breaker frame and breaker sensor rating. Below is an example of the adjustable Instantaneous (**I$_i$**) and fixed Instantaneous Override for a 600 A PD-3 frame Power Defense circuit breaker.

Note: The Instantaneous Pick-up (**I$_i$**) takes precedence over the SD profile pick-up rating. For example, on a 600 A breaker (I$_r$ = I$_n$ = 600 A), if the SD profile was set to Profile H (I$_{sd}$ = 8x x I$_r$ = 4800 A) but the **I$_i$** Instantaneous setting is set to 2x (2 x I$_n$ = 1200 A), the breaker will trip instantaneously at currents above 1200 A (without the 150 msec short delay t$_{sd}$. The SKM model takes this into account and will correctly show the breaker response based on the chosen settings as detailed below.
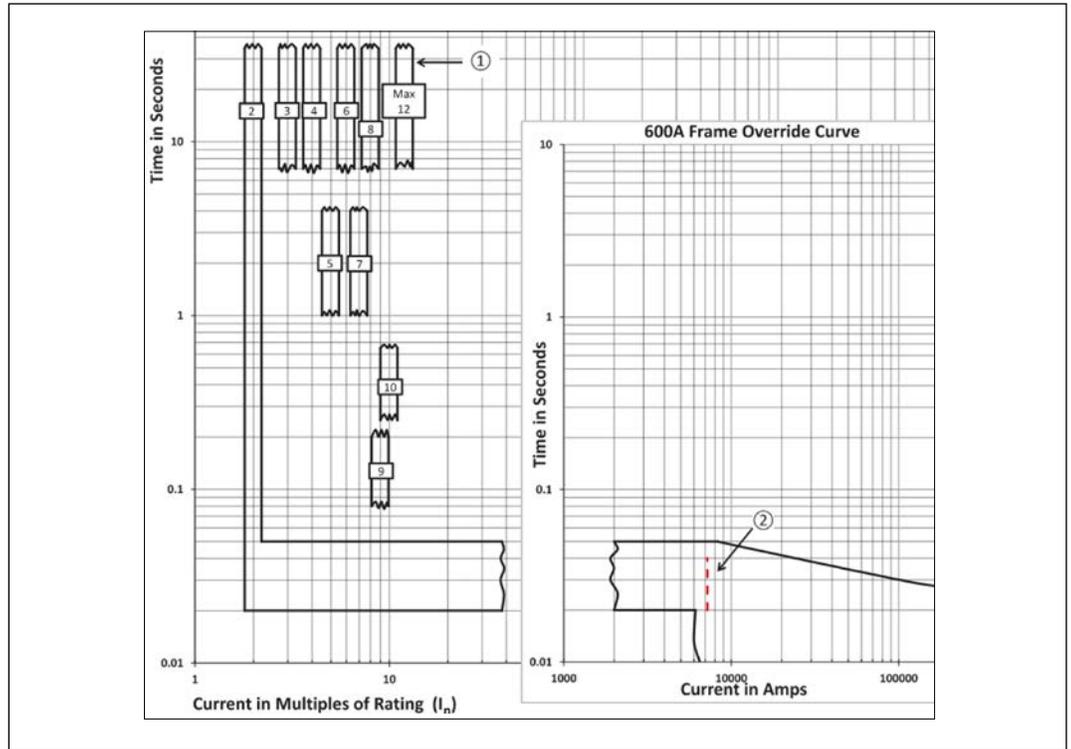

Figure 4. I$_i$ (Instantaneous) setting

SKM modeling of PXR 10 trip units

Models for all Power Defense circuit breakers with thermal-magnetic and PXR electronic trip units (i.e., Static Trip) are available in the SKM library under EATON. If your library does not include these devices, you will need to go to www.skm.com to download the latest device libraries.
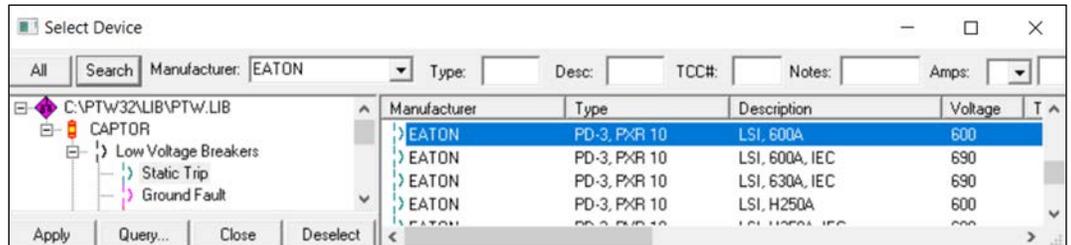

Figure 5. Selecting the PD frame

1. After selecting the appropriate PD frame, PXR 10 LSI trip unit, and sensor rating (listed in the description column), use the Frame drop-down to select the appropriate voltage and interrupting rating of your specific breaker. The sensor and plug selections should already be populated based on the breaker you selected.
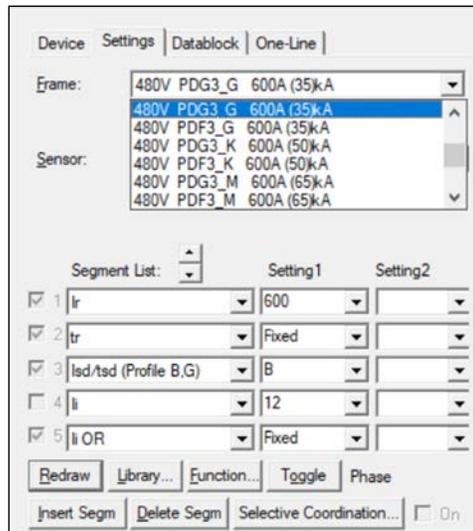

Figure 6. Selecting the voltage and interrupting rating

2. You will want to next select the I_r (continuous current) rating using the Setting1 drop-down next to the I_r selection in the segment list. The second segment in the list, t_r (long delay time) setting, is fixed for the PXR 10.
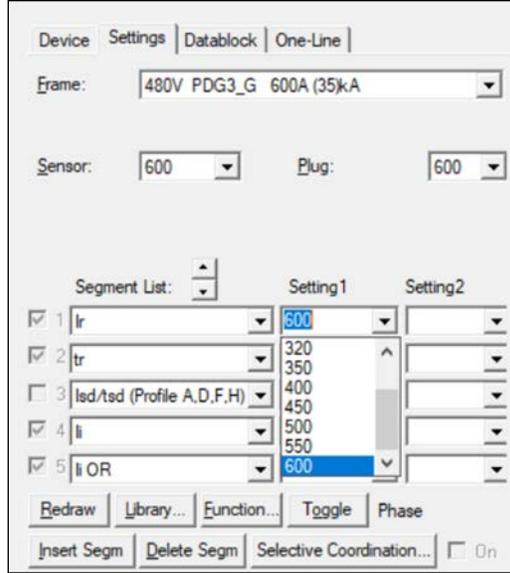

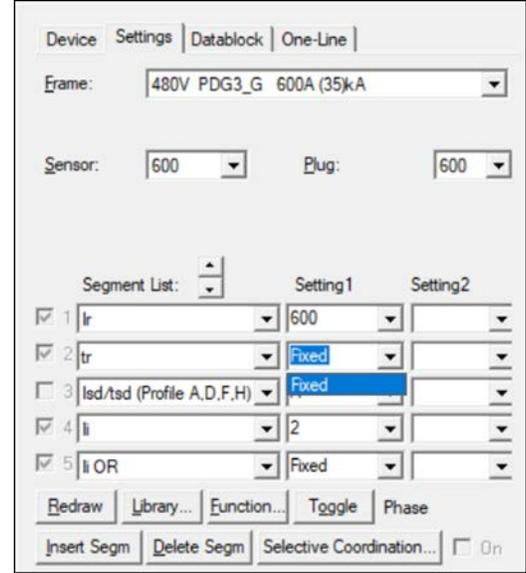**Figure 7. Selecting the I_r (continuous current) rating**

Figure 8. Selecting the t_r (long delay time) rating

3. **SD profile selection** — Next, you want to select what SD profile type you plan on using. From the chart of available profiles below, you can see that there are profile options with different types of **t_{sd}** short delay curve shapes — Flat (0.150 or 0.300 sec), I²t, or OFF.

Table 2. SD profile selections

Profile	I_{sd} (n x I_r)	t_{sd} (s)
A	2	0.150
B	2	0.300
C	2	I²t
D	4	0.150
E	4	I²t
F	6	0.150
G	6	0.300
H	8	0.150
J	10	0.300
K	OFF	

a. **"Flat" response Profiles A, B, D, F, G, H** [see (b) for details for Profile J] — Selecting any of these profiles in the drop-down sets both the Short Delay Pick-up (**I_{sd}**) and the Short Delay Time (**t_{sd}**). Next, set the Instantaneous Pick-up (**I_i**).
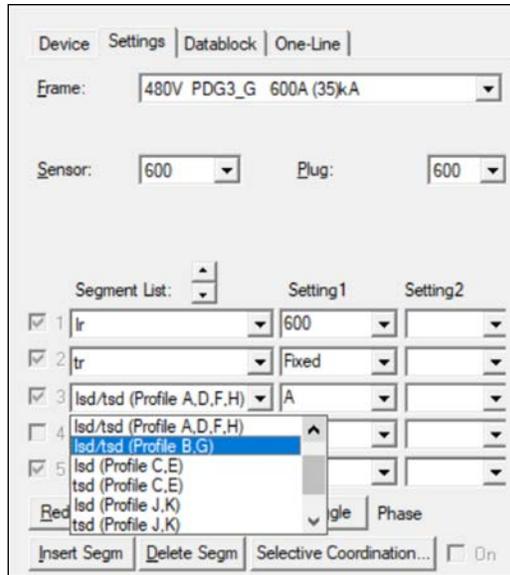

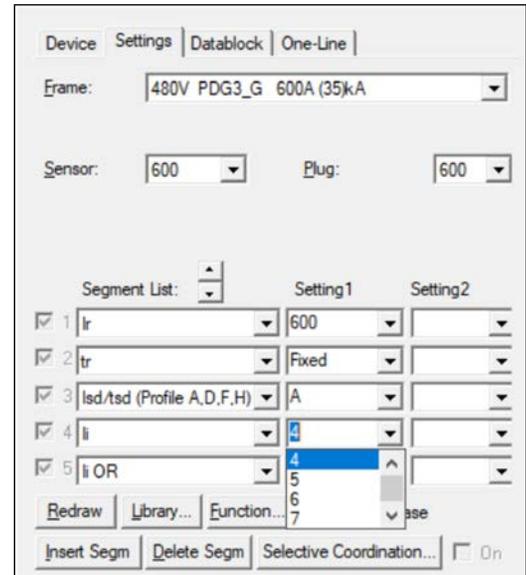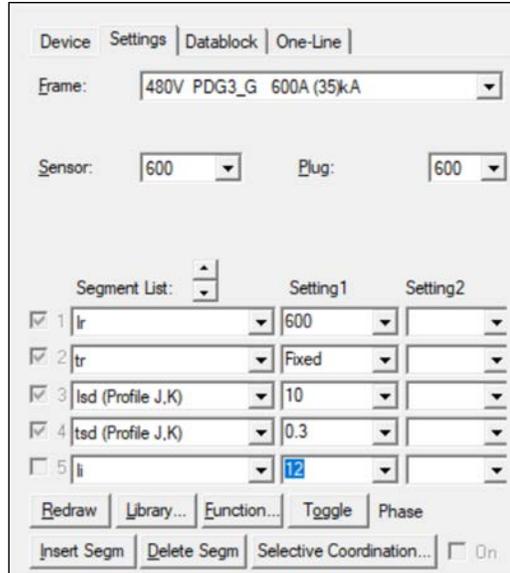**Figure 9. Setting the Short Delay Pickup (I_{sd}) and the Short Delay Time (t_{sd})**
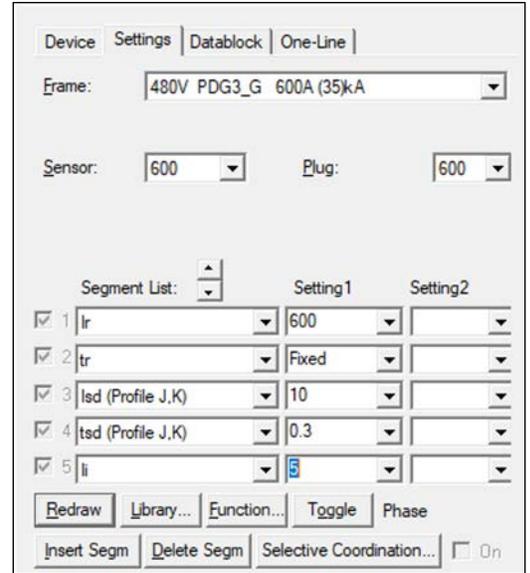

Figure 10. Setting Instantaneous Pick-up (I_i)

Note: The Instantaneous Pick-up (I_i) needs to be set higher than the Short Delay Pick-up (I_{sd}) in order to see the Short Delay Time (t_{sd}). If the Instantaneous Pick-up (I_i) is equal to or less than the Short Delay Pick-up (I_{sd}), it is equivalent to turning the Short Delay Time (t_{sd}) off so the breaker curve is that of an LI breaker. If this is the desired curve shape, Profile K should be used as described in **Step d** on **Page 8**.

b. **"Flat" response Profile J** — Profile J has a default Short Delay Pick-up (I_{sd}) of 10x and Short Delay Time (t_{sd}) of 300 msec. The breaker will provide this response by simply setting the profile dial on the breaker face to J. To model in SKM, select the I_{sd} (Profile J, K) selection for Segment 3 with a setting of 10 and the t_{sd} (Profile J, K) selection for Segment 4 with a setting of 0.3. Next, set Segment 5 to Instantaneous Pick-up (I_i) and Segment 6 to I_i Instantaneous Override (OR).

Figure 11. Segments 3 and 4— I_{sd} setting 10 and t_{sd} setting 0.3

Figure 12. Setting Segment 5 to Instantaneous Pick-up (I_i)
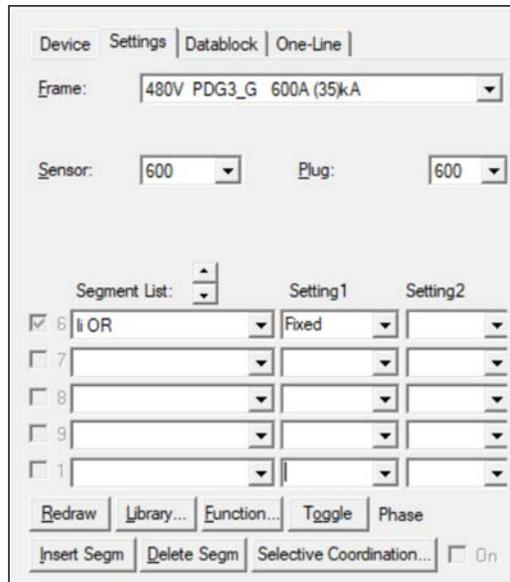
Figure 13. Setting Segment 6 to I_i Instantaneous Override (OR)

Note: The Instantaneous Pick-up (I_i) needs to be set higher than the Short Delay Pick-up (I_{sd}) in order to see the Short Delay Time (t_{sd}). If the Instantaneous Pick-up (I_i) is equal to or less than the Short Delay Pick-up (I_{sd}), it is equivalent to turning the Short Delay Time (t_{sd}) OFF, so the breaker curve is that of an LI breaker. If this is the desired curve shape, Profile K should be used as described in **Step d** on **Page 8**.

Customizing Profile J — Profile J also has the ability to be customized to any available Short Delay Pick-up (I_{sd}) and Short Delay Time (t_{sd}) setting. Using a custom Profile J setting requires using the Power Xpert Protection Manager (PXPM) configuration software to program the breaker. Without using the PXPM software, the Profile J setting on the breaker has the default Short Delay Pick-up (I_{sd}) of 10x and Short Delay Time (t_{sd}) of 300 msec.

To model a custom Profile J in SKM, simply follow the same instructions in (b) but set the I_{sd} (Profile J, K) and tsd (Profile J, K) settings to the custom values you programmed into the breaker.
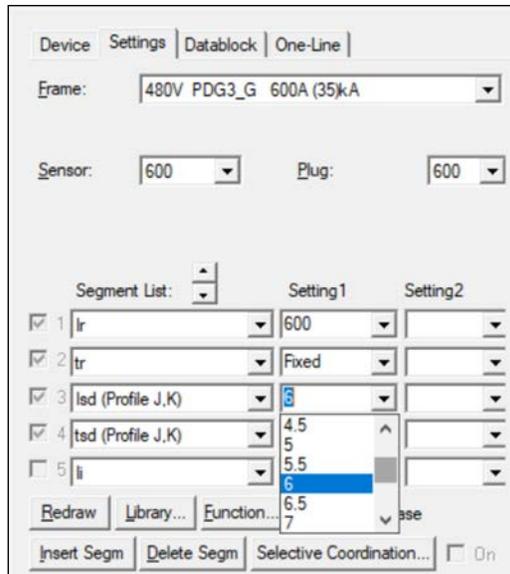
Figure 14. Setting the Short Delay Pickup (I_{sd}) to a custom value
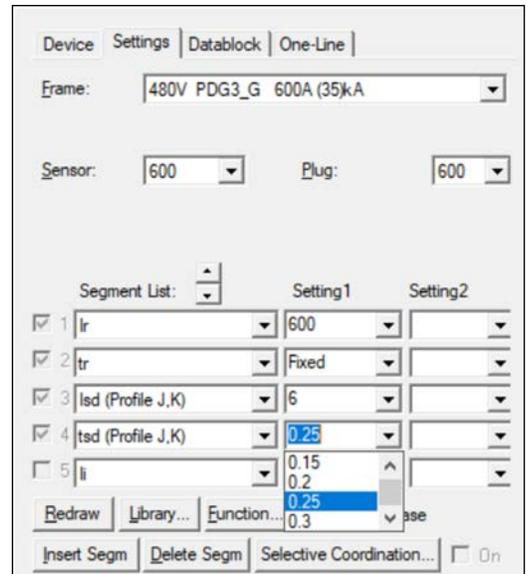
Figure 15. Setting the Short Delay Time (t_{sd}) to a custom value

c. **I²t Response Profiles C and E** — Profiles C and E give an I²t slope response for the Short Delay Pick-up (**I$_{sd}$**) and the Short Delay Time (**t$_{sd}$**). This can be helpful when coordinating with fuses or certain motor inrush profiles. To model in SKM, select the I$_{sd}$ (Profile C, E) selection for Segment 3 with a setting of the desired C or E Profile. Select the t$_{sd}$ (Profile J, K) selection for Segment 4. Next, set Segment 5 to Instantaneous Pick-up (**I$_i$**) and Segment 6 to I$_i$ Instantaneous Override (OR).
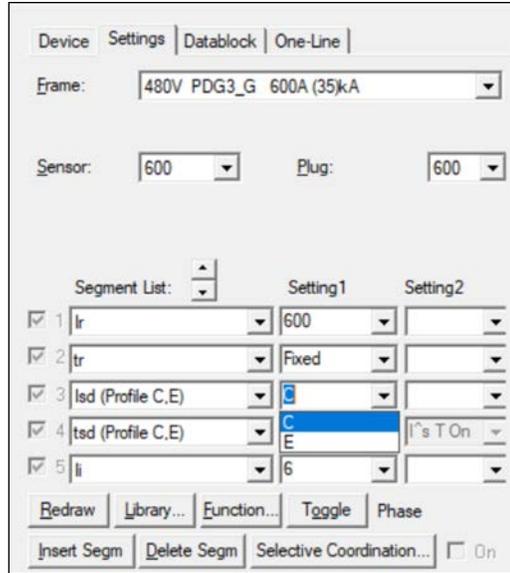
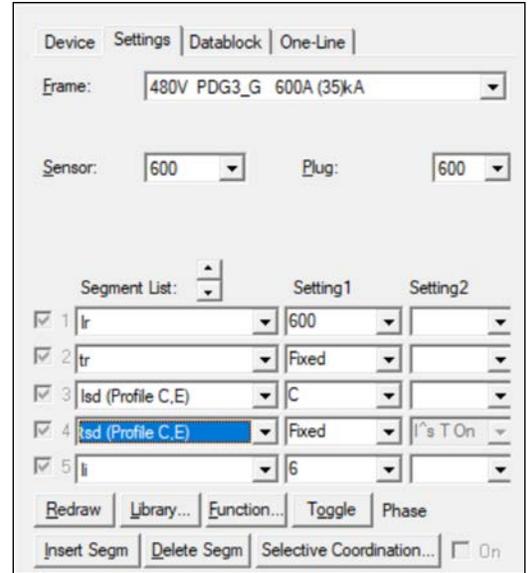**Figure 16. Select the I$_{sd}$ (Profile C, E) selection for Segment 3**

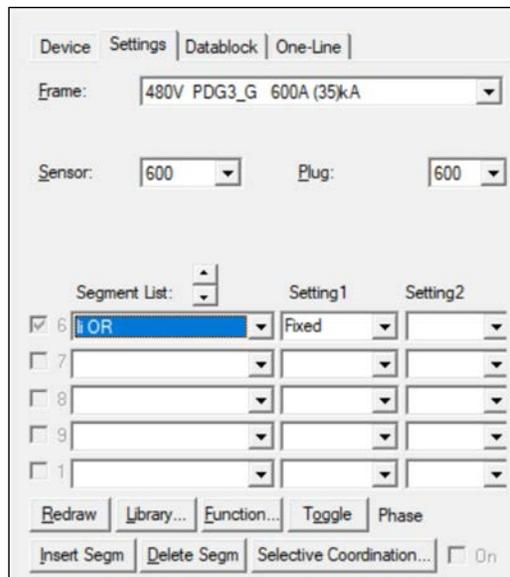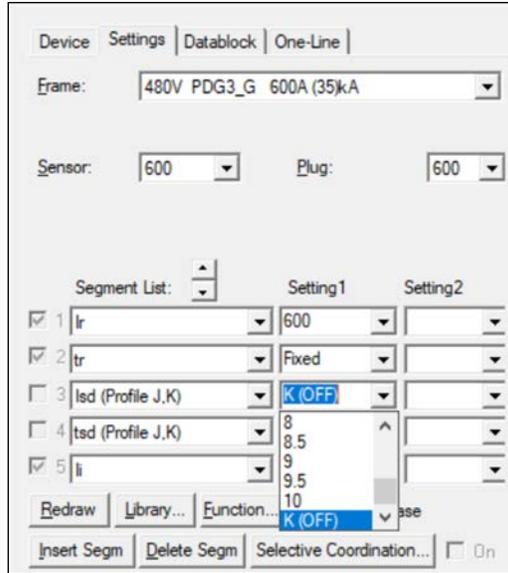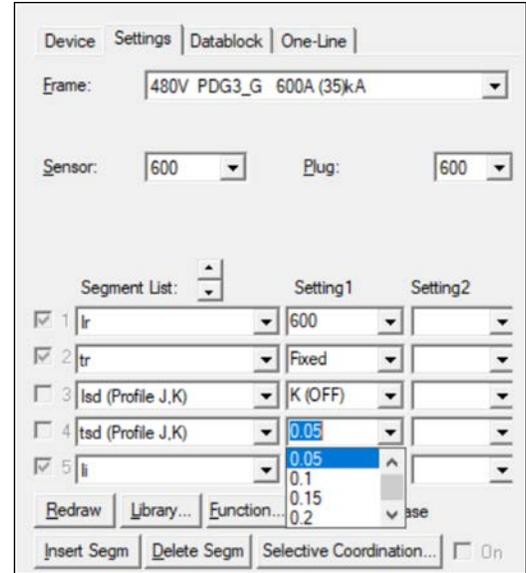**Figure 17. Select the t$_{sd}$ (Profile J, K) selection for Segment 4**

Figure 18. Setting Segment 6 to I$_i$ Instantaneous Override (OR)

d. **Profile K (Short Delay OFF — aka LI response)** — Profile K can be used to turn off Short Delay Pick-up (I_{sd}) and the Short Delay Time (t_{sd}) to give an LI breaker response. This curve shape can be very useful as the tight tolerances and 10 possible adjustments of the I_i instantaneous allow very tight coordination between numerous overcurrent devices. To model in SKM, select the I_{sd} (Profile J, K) selection for Segment 3 with a setting of K (OFF) and the t_{sd} (Profile J, K) selection for Segment 4 with a setting of 0.05. Next, set Segment 5 to Instantaneous Pick-up (I_i) with desired Instantaneous setting and Segment 6 to I_i Instantaneous Override (OR).
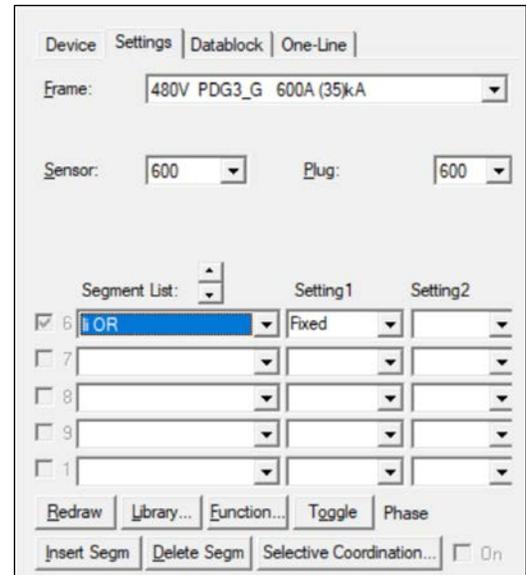

Figure 19. Select the I_{sd} (Profile J, K) selection for Segment 3 with a K (OFF) setting

Figure 20. Select the t_{sd} (Profile J, K) selection for Segment 4 with a setting of 0.05
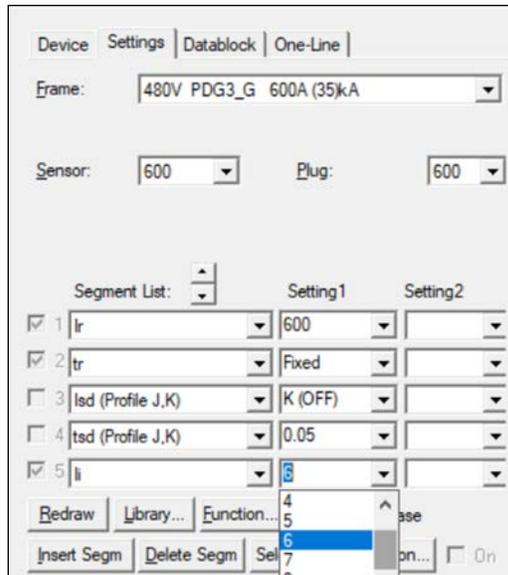
Figure 21. Setting Segment 5 to I_i with desired Instantaneous setting

Figure 22. Setting Segment 6 to I_i Instantaneous Override (OR)