

## Northeast Frontier Railway

Signal & Telecommunication Department

### Technical Circular No. 02/2016

Sub: Use of Resettable fuse (Polymeric Positive Temperature Coefficient Device) PPTC in reducing signal failures during lightening/surge.

Ref : - 1. CSE Eastern Railway letter no. SG.219/9/1 dated 12.09.2011.  
 2. CSTE N.F. Railway letter no. N/229/2/543 dated 07.05.2013.  
 3. CSE West Central Railway letter no. WCR/N-HQ/110/Signal Policy/Sig-32 Pt.VII dated 07.11.2013.  
 4. RDSO letter no. STS/E/Fuses/Vol- IX dated 24.03.2014.

- 1.0. Polymeric Positive Temperature Coefficient device (PPTC), commonly known as resettable fuse is a passive electronic component used to protect against over current faults in electronic circuits. They are actually non-linear thermistors, however, cycle back to a conductive state after the current is removed, acting more like circuit breakers, allowing circuit to function again without opening chassis or replacing anything.
- 2.0 These devices exhibit a low resistance state when the current through them is within limit. When the current flowing through the device (which has a small resistance in the ON state) exceeds the current limit, the PPTC device warms up above a threshold temperature and the electrical resistance of the PPTC device suddenly increases several orders of magnitude to a "tripped" state where the resistance becomes very high, greatly reducing the current.
  - 2.1. Due to self-resetting feature, these fuses may be useful in selected signaling applications to avoid incidental fuse blowing cases due to fault currents of transient nature.
  - 2.2. A lot of signal failures happen mainly due to ND type fuses blowing off specially at the time of lightning in track feed, TPR, NWKR & RWKR circuit etc. Blowing off fuses without lightning indicates cable defect also.
- 3.0. Parameters of resettable fuses are as below:
  1. Hold Current (  $I_{hold}$  ) – Maximum current device will face without tripping at 23 degree Celsius still air .
  2. Trip Current (  $I_{trip}$  ) - Maximum current at which device will trip at 23 degree Celsius still air.
  3. Maximum Voltage Rating (  $V_{max}$  ) – Maximum Voltage device can withstand without damage at rated current (  $I_{max}$  ).
  4. Maximum Fault Current Rating (  $I_{max}$  ) – Maximum fault current device can withstand without damage at rated voltage (  $V_{max}$  ).
  5. Power Dissipation (  $p_d$  ) – Power dissipated from device when in tripped state at 23 degree Celsius still air.

- 6. Minimum Resistance (Rmin) – Minimum resistance of device in initial (unsoldered) state.
- 7. Maximum Resistance (Rmax) – Maximum resistance of device at 23 degree Celsius measured one hour after tripping.
- 8. Maximum Time of Trip (Sec) - (at 5 times of hold current generally).

3.1. There are different maximum voltage rating poly fuses are available like 30V, 60V, 70V, 350V and 600V. Track feed voltage is maximum 10V. So, resettable fuses of maximum voltage rating 30V can be used in place ND type fuses (6 Amp) at track feed end. In all other circuits nominal operating voltage is 24V or 60V depending upon metal to carbon and metal to metal installations. So, in metal to metal installation, maximum voltage rating of resettable fuses to be used should be 72V and metal to carbon installation, it should be 60V. Resettable fuses to be used in place of existing fuses.

3.2. However, there is a warning for using these resettable fuses. These fuses even in tripped state remain HOT, i.e. conduct partially. Operation beyond the specified maximum rating or improper use may result in damage and possible electrical arcing or flame. **So, it should not be at all used inside the relay room, Equipment room and battery room. It can be used in location huts and location boxes only.**

3.3. So, following types of resettable fuses may be used.

	Track feed 6 Amp ND type fuse	24V DC circuit 2 Amp ND type fuse	60V DC circuit 2 Amp ND type fuse	Signal Lighting
Hold(Amp) Current	2.5	1.1	1.1	1.1
Trip (Amp) Current	5.0	2.2	2.2	2.2
Maximum (Amp) current	40.0	40.0	40	8
Rated (Vdc) Voltage	30.0	60.0	72	120(AC/DC)
Typical (W) Power	1.2	1.5	1.5	2.28
Max time (Sec) to trip	10.3	8.2	8.2	8.2
Rmin at 23° C (Ohm)	0.020	0.150	0.15	0.15
Rmax at 23° C 1 hour after tripping	0.070	0.380	0.38	0.38

\* Where no fuse is provided at track feed end, 6 Amp ND type fuse or PPTC fuse as per above table to be used. The fuse shall be connected between variable resistance and track in positive path.

3.4. Following should be considered before selecting a particular device.

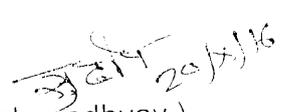
\*These components are available from a no. of foreign manufactures. Only those components from reputed manufactures which are recognized by Underwriters Laboratories to UL thermistor standard 1434 and having UL recognition with valid UL file no. should be used. UL recognition (UL file no.) for a component may be verified from website [www.ul.com](http://www.ul.com). Some manufacturers for these products as per information gathered are LITTLEFUSE, FUZETEC, TYCO, BOURN, RAYCHEM etc.

- The fuse should have an insulating coating of flame retardant epoxy to meet UL-94, VO requirement.
  - Only Radial Leaded fuses should be used.
  - Working temperature range. -40° C to 85° C
  - Lead and Halogen free (desirable).
  - The leads should be tin plated copper.
- Fixing :-
1. Suitable Copper lugs should be well crimped to the leads using proper crimping tool. With these lugs, PPTC fuse will fit nicely onto the ARA terminals. The crimped area may also be filled by solder for better connection, or
  2. 16 / 0.2 flexible wire should be properly soldered to the leads and to be connected to terminals.

\*Products with clear marking over them as per manufacturer's catalog must be used.

\*As the current rating of these devices is affected considerably due to change in ambient temperature and these fuses have significant temperature de-rating as compared to NDT fuses, these fuses may be used only at places where the ambient temperature varies within 10 degree to 35 degree throughout the year.

This has the approval of CSTE.

  
(Sudip Mukhopadhyay )  
Chief Signal Engineer  
For General Manager (S&T)

Date :20-10-2016

No.N/229/2/574

1. CSTE/PL,CSE,CCE,CSTE/CON-I & II.
2. DRM/KIR,APDJ,RNY,LMG,TSK.
3. Sr.DSTE/KIR,APDJ,RNY,MLG,LMG,TSK.
4. All S&T Officers at HQ.
5. Principal,STTC/PNO.
6. Technical Circular file. No N/245/1/5 Pt-III.