NTE
ELECTRONICS, INC.
44 FARRAND STREET
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NTE16000–ECG thru NTE16022–ECG
Polymeric Positive Temperature Coefficient (PTC) Resettable Fuses

ELECTRICAL CHARACTERISTICS

NTE Type No.	Diag. No.	V max. Volts	I max. Amps	I_{Hold}	I_{Trip}	Initial resistance		1 Hour (R_1) Post–Trip Resistance	Max. Time To Trip at 5*Ih	Tripped Power Dissipation
				Amperes at 23°C		Ohms at 23°C		Ohms at 23°C	Seconds at 23°C	Watts at 23°C
				Hold	Trip	Min.	Max	Max.		
16000–ECG	629	60	40	0.10	0.20	2.50	4.50	7.50	4.0	0.38
16001–ECG	629	60	40	0.17	0.34	2.00	3.20	8.00	3.0	0.48
16002–ECG	629	60	40	0.20	0.40	1.50	2.84	4.40	2.2	0.40
16003–ECG	629	60	40	0.25	0.50	1.00	1.95	3.00	2.5	0.45
16004–ECG	629	60	40	0.30	0.60	0.76	1.36	2.10	3.0	0.50
16005–ECG	629	60	40	0.40	0.80	0.52	0.86	1.29	3.8	0.55
16006–ECG	629	60	40	0.50	1.00	0.41	0.77	1.17	4.0	0.75
16007–ECG	629	60	40	0.65	1.30	0.27	0.48	0.72	5.3	0.90
16008–ECG	629	60	40	0.75	1.50	0.18	0.40	0.60	6.3	0.90
16009–ECG	629	60	40	0.90	1.80	0.14	0.31	0.47	7.2	1.00
16010–ECG	630	30	40	0.90	1.80	0.07	0.12	0.22	5.9	0.60
16011–ECG	629	30	40	1.10	2.20	0.10	0.18	0.27	6.6	0.70
16012–ECG	629	30	40	1.35	2.70	0.065	0.115	0.17	7.3	0.80
16013–ECG	629	30	40	1.60	3.20	0.055	0.105	0.15	8.0	0.90
16014–ECG	629	30	40	1.85	3.70	0.04	0.07	0.11	8.7	1.00
16015–ECG	630	30	40	2.50	5.00	0.025	0.048	0.07	10.3	1.20
16016–ECG	630	30	40	3.00	6.00	0.02	0.05	0.08	10.8	2.00
16017–ECG	630	30	40	4.00	8.00	0.01	0.03	0.05	12.7	2.50
16018–ECG	630	30	40	5.00	10.00	0.01	0.03	0.05	14.5	3.00
16019–ECG	630	30	40	6.00	12.00	0.005	0.02	0.04	16.0	3.50
16020–ECG	630	30	40	7.00	14.00	0.005	0.02	0.03	17.5	3.80
16021–ECG	630	30	40	8.00	16.00	0.005	0.02	0.03	18.8	4.00
16022–ECG	630	30	40	9.00	18.00	0.005	0.01	0.02	*20.0	4.20

* Tested at 40 Amps.

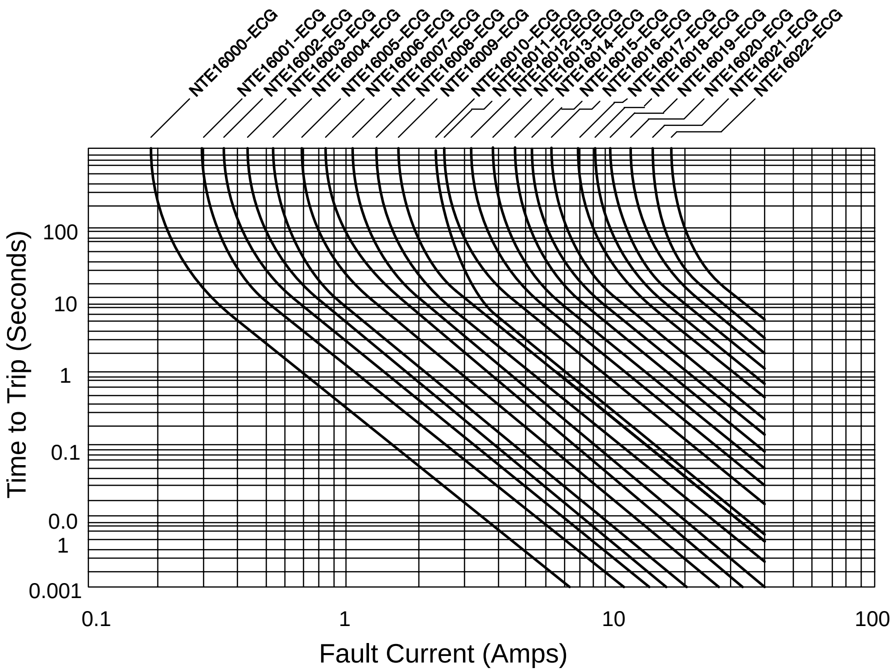
TECHNICAL DATA

Operating/Storage Temperature	–40°C to +85°C	
Maximum Device Surface Temperature in Tripped State	+125°C	
Passive Aging	+85°C, 1000 Hours	±5% Typical Resistance Change
Humidity Aging	+85°C, 85% R.H. 1000 Hours	±5% Typical Resistance Change
Thermal Shock	+125°C/–40°C 10 Times	±10% Typical Resistance Change
Mechanical Shock	MIL–STD–202, Method 213, Condition 1 (100g, 6 Seconds)	No Resistance Change
Solvent Resistance	MIL–STD–202, Method 215	No Change
Vibration	MIL–STD–883C, Method 2007.1, Condition A	No Change

TEST PROCEDURES AND REQUIREMENTS

Test	Test Condition	Accept/Reject Criteria
Visual/Mechanical	Verify Dimensions and Materials	Per PF Physical Description
Resistance	In Still Air @ +23°C	$R_{min} \leq R \leq R_{max}$
Time to Trip	5 Times I_{Hold}, V_{max}, +23°C	T ≤ Max. Time to Trip (Seconds)
Hold Current	30 Min. at I_{Hold}	No trip
Trip Cycle Life	V_{max}, I_{max}, 100 Cycles	No Arcing or Burning
Trip Endurance	V_{max}, 48 Hours	No Arcing or Burning
Solvent Resistance	MIL–STD–202, Method 215	No Change
Vibration	MIL–STD–883C, Method 2007.1, Condition A	No Change

TYPICAL TIME TO TRIP AT +23°



THERMAL DERATING CHART – I_{HOLD} (Amps) *

NTE Type No.	Ambient Operating Temperature								
	–40°C	–20°C	0°C	+23°C	+40°C	+50°C	+60°C	+70°C	+85°C
NTE16000–ECG	0.16	0.14	0.12	0.10	0.08	0.07	0.06	0.05	0.04
NTE16001–ECG	0.26	0.23	0.20	0.17	0.14	0.12	0.11	0.09	0.07
NTE16002–ECG	0.31	0.27	0.24	0.20	0.16	0.14	0.13	0.11	0.08
NTE16003–ECG	0.39	0.34	0.30	0.25	0.20	0.18	0.16	0.14	0.10
NTE16004–ECG	0.47	0.41	0.36	0.30	0.24	0.22	0.19	0.16	0.12
NTE16005–ECG	0.62	0.54	0.48	0.40	0.32	0.29	0.25	0.22	0.16
NTE16006–ECG	0.78	0.68	0.60	0.50	0.41	0.36	0.32	0.27	0.20
NTE16007–ECG	1.01	0.88	0.77	0.65	0.53	0.47	0.41	0.35	0.26
NTE16008–ECG	1.16	1.02	0.89	0.75	0.61	0.54	0.47	0.41	0.30
NTE16009–ECG	1.40	1.22	1.07	0.90	0.73	0.65	0.57	0.49	0.36
NTE16010–ECG	1.40	1.22	1.07	0.90	0.73	0.65	0.57	0.49	0.36
NTE16011–ECG	1.60	1.43	1.27	1.10	0.91	0.85	0.75	0.67	0.57
NTE16012–ECG	1.96	1.76	1.55	1.35	1.12	1.04	0.92	0.82	0.70
NTE16013–ECG	2.32	2.08	1.84	1.60	1.33	1.23	1.09	0.98	0.83
NTE16014–ECG	2.68	2.41	2.13	1.85	1.54	1.42	1.26	1.13	0.96
NTE16015–ECG	3.63	3.25	2.88	2.50	2.08	1.93	1.70	1.53	1.30
NTE16016–ECG	4.35	3.90	3.45	3.00	2.49	2.31	2.04	1.83	1.56
NTE16017–ECG	5.80	5.20	4.60	4.00	3.32	3.08	2.72	2.44	2.08
NTE16018–ECG	7.25	6.50	5.75	5.00	4.15	3.85	3.40	3.05	2.60
NTE16019–ECG	8.70	7.80	6.90	6.00	4.98	4.62	4.08	3.66	3.12
NTE16020–ECG	10.15	9.10	8.05	7.00	5.81	5.39	4.76	4.27	3.64
NTE16021–ECG	11.60	10.40	9.20	8.00	6.64	6.16	5.44	4.88	4.16
NTE16022–ECG	13.05	11.70	10.35	9.00	7.47	6.39	6.12	5.49	4.68

* $I_{Trip} = 2 \bullet I_{Hold}$

DIMENSIONAL OUTLINE DRAWINGS

Diagram 629

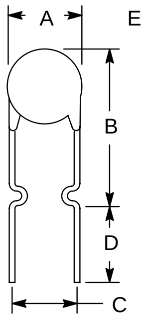
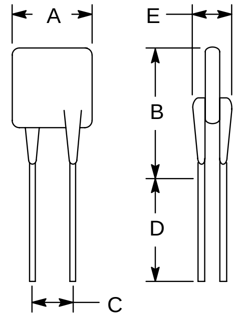


Diagram 630



NOTE: Shape changes from round to square starting with NTE16016–ECG.

PRODUCT DIMENSIONS (Dimensions are in inches(mm))

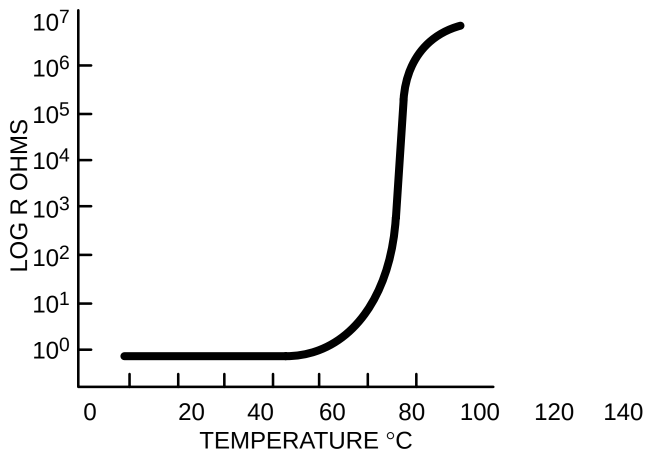
	A	B	C		D	E	Physical Characteristice		
NTE Type No.	**Max.**	**Max.**	**Nom.**	**Tol. ±**	**Min.**	**Max.**	**Diag. No.**	**Lead Dia.**	**Material**
NTE16000–ECG	.290 (7.4)	.500 (12.7)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.122 (3.1)	629	.020 (0.51)	Sn/NiCu
NTE16001–ECG	.290 (7.4)	.500 (12.7)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.122 (3.1)	629	.020 (0.51)	Sn/CuFe
NTE16002–ECG	.290 (7.4)	.500 (12.7)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.122 (3.1)	629	.020 (0.51)	Sn/CuFe
NTE16003–ECG	.290 (7.4)	.500 (12.7)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.122 (3.1)	629	.020 (0.51)	Sn/CuFe
NTE16004–ECG	.290 (7.4)	.530 (13.4)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.122 (3.1)	629	.020 (0.51)	Sn/CuFe
NTE16005–ECG	.290 (7.4)	.540 (13.7)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.122 (3.1)	629	.020 (0.51)	Sn/CuFe
NTE16006–ECG	.310 (7.9)	.540 (13.7)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.122 (3.1)	629	.020 (0.51)	Sn/Cu
NTE16007–ECG	.380 (9.7)	.600 (15.2)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.122 (3.1)	629	.020 (0.51)	Sn/Cu
NTE16008–ECG	.410 (10.4)	.630 (16.0)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.122 (3.1)	629	.020 (0.51)	Sn/Cu
NTE16009–ECG	.460 (11.7)	.660 (16.7)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.122 (3.1)	629	.020 (0.51)	Sn/Cu
NTE16010–ECG	.290 (7.4)	.480 (12.2)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.120 (3.0)	630	.020 (0.51)	Sn/Cu
NTE16011–ECG	.350 (8.9)	.550 (14.0)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.120 (3.0)	629	.020 (0.51)	Sn/Cu
NTE16012–ECG	.350 (8.9)	.750 (18.9)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.120 (3.0)	629	.020 (0.51)	Sn/Cu
NTE16013–ECG	.400 (10.2)	.660 (16.8)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.120 (3.0)	629	.020 (0.51)	Sn/Cu
NTE16014–ECG	.470 (12.0)	.720 (18.4)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.120 (3.0)	629	.020 (0.51)	Sn/Cu
NTE16015–ECG	.470 (12.0)	.720 (18.3)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.120 (3.0)	630	.030 (0.81)	Sn/Cu
NTE16016–ECG	.470 (12.0)	.720 (18.3)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.120 (3.0)	630	.030 (0.81)	Sn/Cu
NTE16017–ECG	.570 (14.4)	.970 (24.8)	.200 (5.1)	.027 (0.7)	.300 (7.6)	.120 (3.0)	630	.030 (0.81)	Sn/Cu
NTE16018–ECG	.690 (17.4)	.980 (24.9)	.400 (10.2)	.027 (0.7)	.300 (7.6)	.120 (3.0)	630	.030 (0.81)	Sn/Cu
NTE16019–ECG	.760 (19.3)	1.260 (31.9)	.400 (10.2)	.027 (0.7)	.300 (7.6)	.120 (3.0)	630	.030 (0.81)	Sn/Cu
NTE16020–ECG	.870 (22.1)	1.170 (29.8)	.400 (10.2)	.027 (0.7)	.300 (7.6)	.120 (3.0)	630	.030 (0.81)	Sn/Cu
NTE16021–ECG	.960 (24.2)	1.300 (32.9)	.400 (10.2)	.027 (0.7)	.300 (7.6)	.120 (3.0)	630	.030 (0.81)	Sn/Cu
NTE16022–ECG	.960 (24.2)	1.300 (32.9)	.400 (10.2)	.027 (0.7)	.300 (7.6)	.120 (3.0)	630	.030 (0.81)	Sn/Cu

RESETTABLE CIRCUIT PROTECTION

When it comes to Polymeric Positive Temperature Coefficient (PPTC) circuit protection, you now have a choice.

Polymeric fuses are made from a conductive plastic formed into thin sheets, with electrodes attached to either side. The conductive plastic is manufactured from a non–conductive crystalline polymer and a highly conductive carbon balck. The electrodes ensure even distribution of power through the device, and provide a surface for leads to be attached or for custom mounting.

The phenomenon that allows conductive plastic materials to be used for resettable overcurrent protection devices is that they exhibit a very large non–linear Positive Temperature Coefficient (PTC) effect when heated. PTC is a characteristic that many materials exhibit whereby resistance increases with temperature. What makes the polymeric conductive plastic material unique is the magnitude of its resistance increase. At a specific transition temperature, the increase is resistance is so great that it is typically expressed on a log scale.



HOW POLYMERIC RESETTABLE OVERCURRENT PROTECTORS WORK

The conductive carbon black filler material in the polymeric device is dispersed in a polymer that has a crystalline structure. The crystalline structure densely packs the carbon particles into its crystalline boundry so they are close enough together to allow current to flow through the polymer insulator via these carbon "chains".

When the conductive plastic material is at normal room temperature, there are numerous carbon chains forming conductive paths through the material.

Under fault conditions, excessive current flows through the polymeric device. I^2R heating causes the conductive plastic material's temperature to rise. As this self heating continues, the material's temperature continues to rise until it exceeds its phase transformation temperature. As the material passes through this phase transformation temperature, the densely packed crystalline polymer matrix changes to an amorphous structure. This phase change is accompanied by a small expansion. As the conductive particles move apart from each other, most of them no longer conduct current and the resistance of the device increases sharply.

The material will stay "hot", remaining in this high resistance state as long as the power is applied. The device will remain latched, providing continuous protection, until the fault is cleared and the power is removed. Reversing the phase transformation allows the carbon chains to re–form as the polymer re–crystallizes. The resistance quickly returns to its original value.

PRODUCT SELECTION

To select the correct polymeric circuit protection device, complete the imformation listed below for application, and then refer to thwe resettable overcurrent protector data sheets.

1. Determine the nromal operating current:
   __________ amps
2. Determine the maximum circuit voltage (V_{max}):
   __________ volts
3. Determine the fault current (I_{max}):
   __________ amps
4. Determine the operating temperature range:
   Minimum Temperature: __________ °C
   Maximum Temperature: __________ °C
5. Select a product family so that the maximum rating for V_{max} and I_{max} is higher than the maximum circuit voltage and fault current in the application.
6. Using the I_{Hold} vs. Temperature Table on the product family data sheet, select the polymeric device at the maximum operating temperature with an I_{Hold} greater than or equal to the normal operating current.
7. Verify that the selected device will trip under fault conditions by checking in the I_{Trip} table that the fault current is greater than I_{Trip} for the selected device, at the lowest operating temperature.
8. Order samples and test in application.

APPLICATIONS

The benefits of polymeric Resettable Overcurrent Protectors are being recognized by more and more design engineers, and new applications are being discovered every day.

The use of polymeric types of devices have been widely accepted in the following applications and industries:

- **Personal computers**
- **Laptop computers**
- **Personal digital assistants**
- **Transformers**
- **Small and medium electric motors**
- **Audio equipment and speakers**
- **Test and measurement equipment**
- **Security and fire alarm systems**
- **Personal care products**
- **Point–of–sale equipment**
- **Industrial controls**
- **Automotive electronics and harness protection**
- **Marine electronics**
- **Battery–operated toys**