METROSIL®

Metrosils for High Impedance Relays

Introduction

In some applications of high impedance relays, a non-linear Metrosil resistor is required to limit the current transformer (CT) secondary voltage to a safe level during maximum internal fault conditions.

M&I Materials Limited supply a wide variety of Metrosils designed for the protection of high impedance relays.

Correct Metrosil selection ensures that the system is held to a safe clamping voltage under fault conditions, whilst having negligible effect on the measurement accuracy of the relay.

Choosing the correct Metrosil

The procedure for selecting the correct relay Metrosil type is broken down into the following 5 step process:-

- **Step 1 :** Identify the relevant tables for the application

For a 1A CT with maximum internal secondary fault currents of up to 50Arms, tables 1 and 2 apply.

For a 5A CT with maximum internal secondary fault currents of between 50 and 150A rms tables 3 and 4 apply.

- **Step 2 :** Identify the Metrosil type code

Using the maximum relay setting voltage and maximum internal secondary fault current, identify the recommended Metrosil type code from tables 1 or 3.

For 1A CT decide if a single pole or a triple pole (3-phase) Metrosil type is required.

- **Step 3 :** Check the maximum permissible leakage

At the relay setting voltage, check that the maximum leakage current, for the identified Metrosil type, is within the permissible limits of the relay system. This can be done either:-

directly from tables 2 or 4, column 3

Or

calculated from equation 1, using the **minimum** value of C for the Metrosil type identified and a value of 0.25 for β

- **Step 4 :** Check the maximum protection voltage

For a maximum secondary internal fault current condition, check that the identified Metrosil type will limit the voltage to a level which does not exceed the maximum permissible voltage of the relay system. This can be done either:-

directly from tables 2 or 4, column 5

Or

calculated from equation 2, using the **maximum** value of C for the Metrosil type identified and a value of 0.25 for β

- **Step 5 :** Check the fault time

Using tables 2 or 4, columns 6, 7 and 8, check that the fault time of the system is within the short time current rating for the specified Metrosil type.

Equation 1 - For applied sinusoidal voltages:-

$$Irms = 0.52\left(\frac{Vrms\sqrt{2}}{C}\right)^{\frac{1}{\beta}}$$

Use minimum C value and β of 0.25

Equation 2 - For applied sinusoidal currents:-

$$Vpeak = 1.09C(Irms)^{\beta}$$

Use maximum C value and β of 0.25

Operating conditions for the majority of high impedance relays offered by M&I Materials Ltd are given within this leaflet.

Where your condition requirements are not covered, M&I Materials are pleased to recommend other Metrosils.

To take advantage of this service please supply the following information:-

- Nominal rating of the CT (1A, 5A)
- Relay setting voltage (across the relay and stabilising resistor)
- Maximum permissible leakage current at relay setting voltage
- Maximum secondary internal fault current
- Maximum permissible clamping voltage under fault conditions
- Maximum fault time duration, if > 0.5 seconds
- CT Ratio, particularly the secondary rating

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Mounting of Relay Metrosils

The method of mounting Metrosil relay units will depend on local conditions and available space. To avoid overheating, the following general recommendations may be of help:-

- Multiple disc Metrosil units should be mounted with the M12 stud and brackets horizontal so that the orientation of the discs is vertical
- There should be approximately 40mm clearance all round the Metrosil unit(s) and live metalwork
- Where many Metrosils are installed, avoid locating them directly above each other
- Free airflow over the Metrosil must be available

Table 1 – Identification of Metrosil Type for Relays on 1A CTs

Maximum Relay Setting Voltage V_{rms}	Maximum Internal Secondary Fault Current $50A_{rms}$	
	Single Pole Relay	**Triple Pole Relay**
125	600-A/S1/256	600-A/S3/I/802
175		
185		
300	600-A/S1/1088	600-A/S3/I/1195
325		
400	600-A/S1/6315	600-A/S3/I/6324

Table 2 – Leakage Current, Protection Voltage and Short Time Currents for 1A Relay Metrosils with Maximum Internal Secondary Fault Current of $50A_{rms}$

Metrosil Type Single Pole(S1) Three Pole (S3/I)	Maximum Relay Setting Voltage	Typical Metrosil Leakage Current at Maximum Relay Setting Voltage	Value of C in Equations	Maximum Protection Voltage at the peak of $50A_{rms}$	Short Time Current Rating			Maximum Continuous Voltage Rating
					1 sec	**2 sec**	**3 sec**	
	V_{rms}	**mA_{rms}**		**V_{pk}**	**A_{rms}**	**A_{rms}**	**A_{rms}**	**V_{rms}**
600-A/S1/256 600-A/S3/I/802	125	19	405/495	1435	45	30	22	200
	175	73						
	185	90						
600-A/S1/1088 600-A/S3/I/1195	300	30	810/990	2870	39	30	17	350
	325	50						
600-A/S1/6315 600-A/S3/I/6324	400	55	990/1210	3500*	46	26	19	425

*600A-A/S1/6315 will hold to $3400V_{pk}$ at peak of $46A_{rms}$ and $3000V_{pk}$ at peak of $30A_{rms}$

All properties quoted in this table are typical values and do not constitute a specification

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Table 3 – Identification of Metrosil Type for Relays on 5A CTs

	Maximum Internal Secondary Fault Current A_{rms}		
Maximum Relay Setting Voltage V_{rms}	**50**	**100**	**150**
200	600A/S1/1213	600A/S2/P/1217	600A/S3/P/1219
250	600A/S1/1214	600A/S2/P/1215	600A/S3/P/1220
275			600A/S3/P/1221
300	600A/S1/1223	600A/S2/P/1196	600A/S3/P/1222

Definition of Metrosil nomenclature

- 600A reference to the disc diameter
- S1 single Metrosil disc units
- S2 2 Metrosil disc units
- S3 3 Metrosil disc units
- I discs electrically insulated
- P discs connected in parallel

Table 4 **– Leakage Current, Protection Voltage and Short Time Currents for 5A Relay Metrosils with Maximum Internal Secondary Fault Current of 150A_{rms}**

Metrosil Type	Maximum Relay Setting Voltage	Typical Metrosil Leakage Current at Maximum Relay Setting Voltage	Value of C in Equations	Maximum Protection Voltage at the peak of Fault Current	Short Time Current Rating			Maximum Continuous Voltage Rating
					1 sec	**2 sec**	**3 sec**	
	V_{rms}	**mA_{rms}**		**V_{pk}**	**A_{rms}**	**A_{rms}**	**A_{rms}**	**V_{rms}**
600-A/S1/1213	200	35	540/640	1730	50	30	20	220
600A/S1/1214	250	40	670/800	2120	50	25	18	290
	275	50						
600-A/S1/1223	300	50	740/800	2400	40	20	15	330
600-A/S2/P/1217	200	70	470/540	1730	100	60	45	230
600-A/S2/P/1215	250	75	570/670	2120	90	50	35	290
	275	100						
600-A/S2/P/1196	300	100	620/740	2400	80	45	30	330
600-A/S3/P1219	200	100	430/500	1730	150	85	60	220
600-A/S3/P/1220	250	100	520/620	2120	135	75	55	265
600-A/S3/P/1221	275	100	570/670	2200	125	70	50	290
600-A/S3/P/1222	300	100	620/740	2600	115	65	40	330

All properties quoted in this table are typical values and do not constitute a specification

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Design and Dimensions

CAD drawings showing the design and dimensions of a 600A/S1, 600A/S3/I and 600A/S3/P relay Metrosil are show below.

Drawings of a 600A/S1 relay Metrosil with 2 brackets and a 600A/S2/P relay Metrosil are available on request. Please contact the Metrosil team.

Diagram 1 **– 600A/S1 Relay Metrosil**

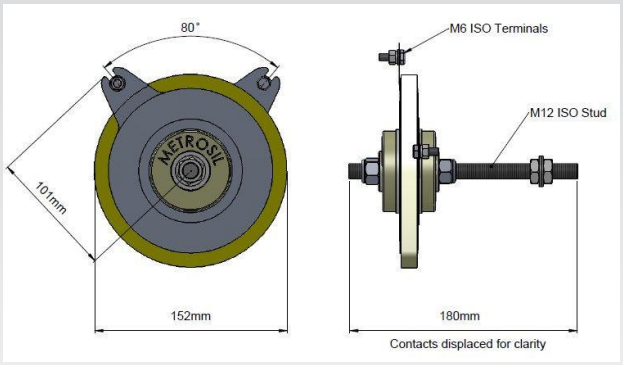

Diagram 2 **– 600A/S3/I Relay Metrosil**

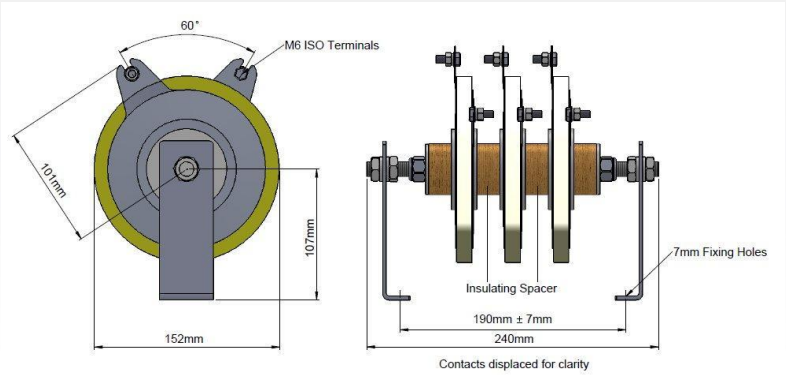

Diagram 3 **– 600A/S3/P Relay Metrosil**