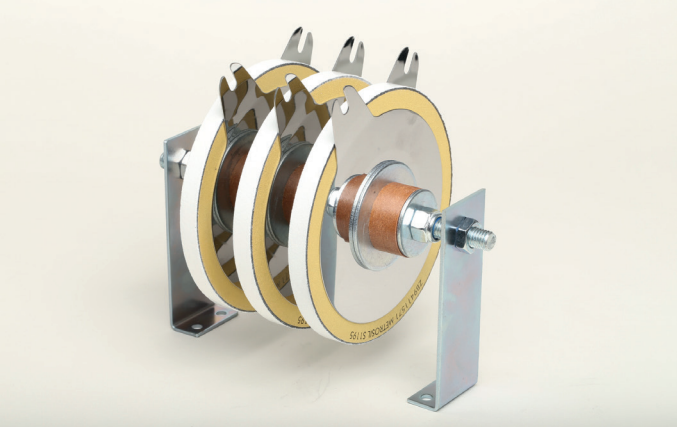
METROSIL®
PROTECTION BUILT-IN

METROSIL 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 fault conditions. M&I Materials Ltd supply a wide variety of Metrosils to provide such protection. This datasheet will help you specify the correct Metrosil device for your relay. First you will need the following information:

1. CT rating
1A or 5A are the most common values.

2. Relay Setting Voltage
Also called the **Stabilisation Voltage**, this is the voltage (across the stabilising resistor + the relay), above which the relay will trigger.

3. Maximum Secondary Internal Fault Current
This is the highest possible current on the secondary that occurs during a fault on the primary. This can be determined from the primary fault current and the CT ratio, and is typically less than 150 Arms.

4. Maximum Allowable Voltage on the Secondary Under Fault Conditions
During a fault, the Metrosil will automatically limit any overvoltage. Typically this is between 1 – 3.5 kVpeak under clamping conditions.

5. Maximum Allowable Current Through the Relay Metrosil at the Setting Voltage
During normal operation, the relay Metrosil leaks a small amount of current. As the Metrosil is in parallel with the relay, it is important to account for the leakage so the relay operates at the correct voltage/current.

6. Fault Current Duration
Also called **Fault Clearing Time**. On some relay protection schemes, there may be a longer delay between the fault and the relay operating. If this time is longer than 0.5s, the Metrosil will need to be de-rated.

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 maximum internal secondary fault currents of up to 50Arms (typically 1A CTs) table 1 applies (see page 3).

For maximum internal secondary fault currents of up to 150Arms (typically 5A CTs), table 2 applies (see page 3).

The distinction between 1A and 5A devices is based on typical fault current requirements. It is acceptable to use a 1A Metrosil device with a 5A CT or vice versa, so long as the rated secondary fault current is not exceeded and all other parameters are appropriate.

Step 2 - **Identify the Metrosil type**

From the 'Typical Relay Setting Voltage' range and 'Rated Maximum Current' , identify the recommended Metrosil Type from either Table 1 or Table 2 using columns 2 and 5.

Find a relay setting voltage that is close to what you require. If your setting voltage is lower than the example voltages given, the corresponding leakage current will be lower through that device.

If required, these values can be more accurately determined in steps 3 and 4. For a 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 1 or 2, 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

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PROTECTION BUILT-IN

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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 that does not exceed the maximum allowable voltage of the relay system.

This can be done either directly from tables 1 or 2, column 6 - Or, calculated from Equation 2, using the **maximum** value of C for the Metrosil type identified and a value of 0.25 for β

Equation 1 - For applied sinusoidal voltages:-

$$I_{rms} = 0.52\left(\frac{V_{rms}\sqrt{2}}{C}\right)^{\frac{1}{\beta}}$$

Use minimum C value and β of 0.25.

Equation 2 - For applied sinusoidal currents:-

$$V_{peak} = 1.09C(I_{rms})^{\beta}$$

Use maximum C value and β of 0.25.

Step 5 - **Fault Clearance Time**

If your fault duration is longer than 0.5s, use tables 1 or 2, columns 7, 8 and 9, to check that the fault time of the system is within the short time current rating for the specified Metrosil type.

Operating conditions for the majority of high impedance relays offered by M&I Materials Ltd are given within this data sheet. Where your condition requirements are not covered, M&I Materials can recommend other Metrosils. VI curves are available on request.

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

Metrosil Type Single Pole(S1) Three Pole (S3/I)	Typical Relay Setting Voltages	Maximum Leakage Current Through the Metrosil at Relay Setting Voltage	Value of C Min/Max	Rated Maximum Current	Protection Voltage at the Peak of Rated Fault Current	Short Time Current Rating			Maximum Continuous Voltage Rating
						1 sec	2 sec	3 sec	
	Vrms	mArms	Vdc	Arms	Vpk	Arms			Vrms
256/R4/600A/S1 802/600A/S3/I	125	19	405/495	50	1435	45	30	22	200
	175	73							
	185	90							
1088/R2/600A/S1 1195/R1/600A/S3/I	300	30	810/990	50	2870	39	30	17	350
	325	50							
6315/R0/600A/S1 6324/R0/600A/S3/I	400	55	990/1210	50	3500*	46	26	19	425

Table 1 - Leakage Current, Protection Voltage and Short Time Currents for 1A Relay Metrosils with Maximum Internal Secondary Fault Current of 50Arms. All properties quoted in this table are typical values and do not constitute a specification.

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PROTECTION BUILT-IN

METROSIL FOR HIGH IMPEDANCE RELAYS

Metrosil Type	Typical Relay Setting Voltage	Maximum Leakage Current Through the Metrosil at Relay Setting Voltage	Value of C Min/Max	Rated Maximum Current	Protection Voltage at the Peak of Rated Fault Current	Short Time Current Rating			Maximum Continuous Voltage Rating
						1 sec	2 sec	3 sec	
	Vrms	mArms	Vdc	Arms	Vpk	Arms			Vrms
1213/R2/600A/S1	200	35	540/640	50	1730	50	30	20	220
1214/R2/600A/S1	250	40	670/800	50	2120	50	25	18	290
	275	50							
1223/R1/600A/S1	300	50	740/800	50	2400	40	20	15	330
1217/R2/600A/S2/P	200	70	470/540	100	1730	100	60	45	230
1215/R2/600A/S2/P	250	75	570/670	100	2120	90	50	35	290
	275	100							
1196/R3/600A/S2/P	300	100	620/740	100	2400	80	45	30	330
1219/R2/600A/S3/P	200	100	430/500	150	1730	150	85	60	220
1220/R2/600A/S3/P	250	100	520/620	150	2120	135	75	55	265
1221/R0/600A/S3/P	275	100	570/670	150	2200	125	70	50	290
1222/R2/600A/S3/P	300	100	620/740	150	2600	115	65	40	330

Table 2 - Leakage Current, Protection Voltage and Short Time Currents for 5A Relay Metrosils (*typical values that do not constitute a specification*).

Metrosil Type	Rated Energy Absorption	Short Time Power Rating			Power Dissipation
		1 sec	2 sec	3 sec	
	kJ	kW			W
256/R4/600A/S1 & 802/600A/S3/I	20	53	26	17	20
1088/R2/600A/S1 & 1195/R1/600A/S3/I	33	88	44	29	20
6315/R0/600A/S1 & 6324/R0/600A/S3/I	50	77	39	25	20
1213/R2/600A/S1	33	50	27	16	20
1214/R2/600A/S1	33	85	42	28	20
1223/R1/600A/S1	33	88	44	29	20
1217/R2/600A/S2/P	66	176	88	59	40
1215/R2/600A/S2/P	66	176	88	59	40
1196/R3/600A/S2/P	66	176	88	59	40
1219/R2/600A/S3/P	99	220	110	73	60
1220/R2/600A/S3/P	99	155	74	50	60
1221/R0/600A/S3/P	99	220	110	73	60
1222/R2/600A/S3/P	99	220	110	73	60

Table 3 - Energy and power ratings for Metrosil relay protection devices (*typical values that do not constitute a specification*).

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METROSIL FOR HIGH IMPEDANCE RELAYS

ENERGY AND POWER RATINGS

Table 3 displays the rated energy absorption for each device (or each phase of a three phase device), along with the short time Power rating. Finally the power dissipation represents the cooling rate of a Metrosil device after a surge event, provided it is installed with adequate space and airflow.

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 apply:-

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

DESIGN AND DIMENSIONS

CAD drawings showing the design and dimensions of a stud mount and bracket mount, 600A/S1 and 600A/S3/P relay Metrosil are shown below. Other drawings are available on request.

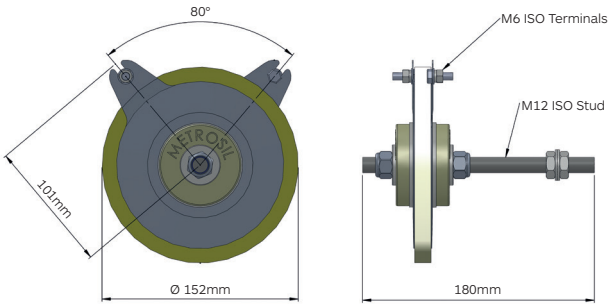

Diagram 1 - 600A/S1 Stud Mounted Relay Metrosil
(standard S1 is stud mounted, no brackets)

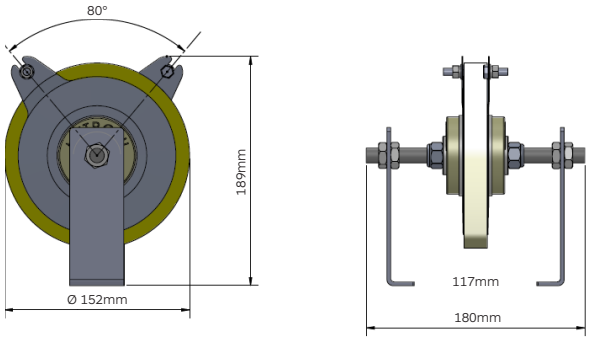

Diagram 2 - 600A/S1/2B Bracket Mounted Relay Metrosil
(2B = 2 brackets)

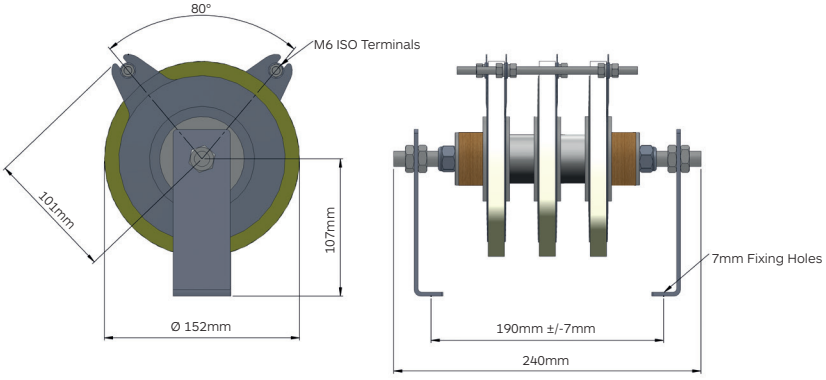

Diagram 3 - 600A/S3/P/2B Bracket Mounted Relay Metrosil (2B = 2 brackets)

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