



METROSIL CURRENT TRANSFORMER PROTECTION UNITS

Introduction

One of the major operational hazards which may be encountered with a current transformer (CT) involves the secondary circuit being left in an open circuit condition, whilst the primary is still energised. Open circuit conditions can occur inadvertently through routine maintenance of the burden or damage to the leads of the secondary circuit. High voltage transients may be generated in these situations and damage the CT winding insulation; possibly rendering it inoperable. In addition, these transients can cause high eddy currents in the CT core. These may be detrimental to the magnetising characteristics of the CT and result in errors in the measurement accuracy.

A Metrosil Current Transformer Protection Unit (CTPU) provides protection against potential CT operation hazards. It is designed to permanently connect across the terminals of the CT and operate without the need for user intervention.

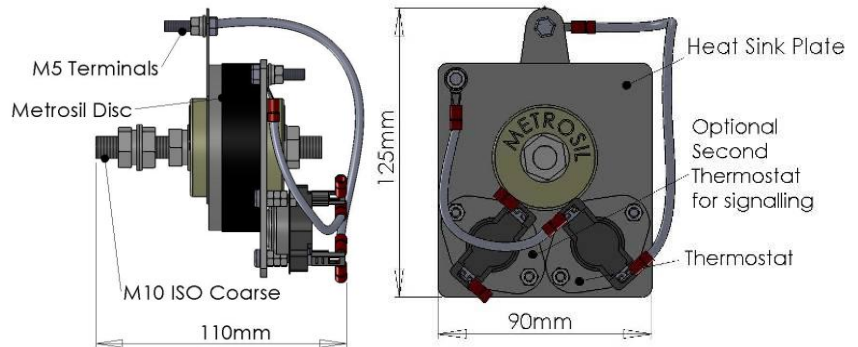
Construction and Operation of a Metrosil CTPU

Figure 1 shows the construction and dimensions of a single pole Metrosil CTPU. A varistor disc is connected in parallel with a thermostatic switch mounted on a heat sink plate.

Under normal working or fault conditions, with the burden connected, the varistor is subjected to an applied voltage. It acts as a passive load and draws little current, thus preventing inaccuracies in the measurement of the CT. During open circuit conditions, the varistor is subjected to an applied current and acts as an active load, limiting the voltage across the CT terminals and preventing any damage.

The thermostatic switch manages the thermal cycling within the Metrosil CTPU when the CT is in an open circuit condition. A second thermostatic switch can be mounted on the heat sink plate for remote monitoring.

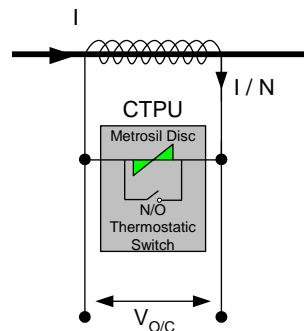
Figure 1 - Construction and Typical Dimensions of a Single Pole CTPU



Connection of the Metrosil CTPU

Figure 2 illustrates how a Metrosil CTPU should be connected across the secondary winding of a CT in parallel with the burden. It is advisable to locate the Metrosil CTPU as close to the CT as possible to prevent it being inadvertently detached during maintenance.

Figure 2 - Electrical Connection of the Metrosil CTPU



A Metrosil CTPU can be constructed in both single and three pole varieties for convenience of installation.

The procedure for choosing the correct Metrosil CTPU is shown on pages 2 and 3.

Protection of CTs and Relays

Metrosil CTPUs protect CTs from damage under open circuit conditions. They do not protect relay or CT systems from overvoltages created due to high secondary fault currents.

For protection of high impedance relay systems against overvoltages during fault conditions, please refer to our Metrosil Relay data sheet.

For assistance in using Metrosil CTPUs in conjunction with Metrosil Relays for High Impedance Relay Systems, please contact the Metrosil team.



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Choosing the Correct Metrosil CTPU

There are 6 standard Metrosil CTPU types which can accommodate a wide range of burdens and operating conditions. These are referenced by either a letter or a number.

For simplicity the procedure for selecting the correct Metrosil CTPU has been broken down into the following 5 steps:-

- **Step 1** - Identify the relevant table for the application

For metering applications refer to Table 1. For protection applications refer to Table 2.

- **Step 2** - Select the Metrosil CTPU type

For metering applications, using Table 1, select the Metrosil CTPU according to the CT Rated Secondary Current and the CT Burden of the system.

For protection applications, using Table 2, select the Metrosil CTPU according to the CT Rated Secondary Current, the Maximum Fault Current as a Multiple of Rated Current and the CT Burden of the system.

- **Step 3** - Check the leakage current through the Metrosil CTPU with the burden connected

Using Table 3, refer to the Metrosil CTPU derived from steps 1 and 2 above. Identify the secondary voltage that appears across the CT under normal operation and cross check that the leakage current will not affect the measurement accuracy. In addition, check that this current can flow for an infinite time.

Next refer to the secondary voltage that appears across the CT under fault conditions and cross check that the higher level of leakage current will still not affect the measurement accuracy.

Parameters for choosing the correct Metrosil CTPU Type

Table 1 – Metrosil CTPU Types for Metering CT Applications

| CT Rated Secondary Current (Amps) | CT Burden (VA) | | | |
|-----------------------------------|----------------|----|----|------|
| | 5 | 10 | 15 | 30 |
| 5 | A | A | A | A |
| 1 | A | B | B | C |
| 0.5 | B | C | C | 3166 |

Note - It is assumed that the CT and the Metrosil CTPU will not be expected to maintain the metering accuracy above twice full load current

Table 2 - Metrosil CTPU Types for Protection CT Applications

| CT Rated Secondary Current (Amps) | Maximum Fault Current as Multiple of Rated Current | CT Burden (VA) | | | |
|-----------------------------------|--|----------------|------|------|------|
| | | 5 | 10 | 15 | 30 |
| 5 | x 5 | A | A | A | A |
| | x 10 | A | A | A | B |
| | x 15 | A | A | A | B |
| | x 20 | A | A | B | B |
| 1 | x 5 | A | B | B | C |
| | x 10 | B | B | C | 3140 |
| | x 15 | B | C | 3166 | 3140 |
| | x 20 | B | C | 3140 | 3134 |
| 0.5 | x 5 | B | 3166 | 3166 | 3140 |
| | x 10 | C | 3140 | 3140 | 3134 |
| | x 15 | C | 3140 | 3140 | |
| | x 20 | 3166 | 3140 | 3134 | |

Note - It is assumed that the measurement error is not greater than 1% at indicated multiple of rated current

In this case the current must be able to flow for a period of time greater than the maximum fault duration.

Table 3 is for selection purposes only and is not representative of the specification of the CTPU type.

If the values and times are acceptable proceed to step 4. If they are outside of the requirements please contact the Metrosil team.

- **Step 4** - Check the peak voltage which the CTPU limits the open circuited system to

Use Table 4 to check that the chosen Metrosil CTPU will limit the voltage to a level that will not damage the CT.

- **Step 5** - Confirm if a second thermostatic switch is required

Specify whether a second thermostatic switch is required for remote monitoring/signalling purposes.



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Table 3 – Simulated Leakage Current through Metrosil CTPU types with the CT Burden Connected

Values contained in the table are for selection purposes only

| Secondary Voltage Across Terminals (Vrms) | Metrosil CTPU Types | | | | | | | | | | | |
|---|---------------------|-----|-------|-----|------|-----|------|-----|------|-----|------|-----|
| | A | | B | | C | | 3166 | | 3140 | | 3134 | |
| | mA | Sec | mA | Sec | mA | Sec | mA | Sec | mA | Sec | mA | Sec |
| 10 | <1 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ |
| 20 | 14 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ |
| 30 | 110 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ |
| 40 | 350 | ∞ | 2 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ |
| 50 | 1350 | ∞ | 6 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ |
| 75 | 2600 | 19 | 50 | ∞ | 1.5 | ∞ | <1 | ∞ | <1 | ∞ | <1 | ∞ |
| 100 | | | 160 | ∞ | 6 | ∞ | 1.5 | ∞ | <1 | ∞ | <1 | ∞ |
| 150 | | | 1350 | 30 | 43 | ∞ | 11 | ∞ | <1 | ∞ | <1 | ∞ |
| 200 | | | 12200 | 4 | 160 | 215 | 50 | ∞ | 1.2 | ∞ | <1 | ∞ |
| 250 | | | | | 900 | 50 | 180 | ∞ | 4 | ∞ | <1 | ∞ |
| 300 | | | | | 2500 | 15 | 500 | 75 | 9 | ∞ | 1 | ∞ |
| 350 | | | | | 5800 | 5.5 | 1200 | 27 | 20 | ∞ | 1.5 | ∞ |
| 400 | | | | | | | 2500 | 11 | 37 | ∞ | 3 | ∞ |
| 500 | | | | | | | | | 150 | 162 | 7 | ∞ |
| 600 | | | | | | | | | 400 | 49 | 17 | ∞ |
| 700 | | | | | | | | | 950 | 17 | 33 | ∞ |
| 800 | | | | | | | | | 2050 | 7.5 | 70 | 235 |
| 900 | | | | | | | | | 3900 | 3 | 130 | 116 |
| 1000 | | | | | | | | | | | 220 | 61 |
| 1100 | | | | | | | | | | | 360 | 34 |
| 1200 | | | | | | | | | | | 550 | 20 |
| 1400 | | | | | | | | | | | 1200 | 6 |
| 1600 | | | | | | | | | | | 2350 | 3 |
| 1800 | | | | | | | | | | | 4200 | 2 |
| 2000 | | | | | | | | | | | 7100 | 1 |



Leakage current which can be continuously dissipated

Leakage current which can be dissipated for the time period indicated

Note - Table 3 assumes a maximum ambient temperature of 40°C

Table 4 – Typical Peak Voltage across the Open Circuited CT with the CTPU Connected

| Secondary Load Current (Arms) | Metrosil CTPU Specification | | | | | |
|-------------------------------|-----------------------------|-----|-----|------|------|------|
| | A | B | C | 3166 | 3140 | 3134 |
| 5 | 140 | 420 | 845 | 1134 | | |
| 1 | 95 | 286 | 574 | 758 | 1648 | 2856 |
| 0.5 | 81 | 242 | 486 | 638 | 1386 | 2402 |