



2V68-S User Guide

CT Supervision And Shorting Relay

RMS Mors Smitt

Advanced Protection Devices



User Guide

2V68-S User Guide

About This Manual

This User Guide covers all 2V68-S relays manufactured from January 2025. Earlier relays do not necessarily incorporate all the features described. Our policy of continuous development means that extra features & functionality may have been added.

The 2V68-S User Guide is designed as a generic document to describe the common operating parameters for all relays built on this platform.

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Documentation

Technical Bulletin

The detailed technical attributes, functional description & performance specifications for the 2V68-S are described in the product Technical Bulletin.

The order of precedence for product information is as follows:

- Technical Bulletin
- User Guide

User Guide

This User Guide covers all 2V68-S relay versions & describes the generic features & attributes common across all versions.

Different relay versions are required to cater for varying customer requirements such as auxiliary voltage range, I/O configuration, case style, relay functionality etc.

The product ordering code described in the Technical Bulletin is used to generate a unique version of the relay specification.

Introduction

Application

The 2V68 is a three phase monitoring device designed to provide continuous supervision of the CT summation circuit in high impedance type protection schemes. The relay will detect open circuited CT wiring as well as open circuited main current transformers.

The relay provides three (3) latching N/O alarm output contacts to signal faults. Three (3) additional N/O latching output contacts are provided for an integral summation circuit CT shorting facility.

The 2V68 type relays have a setting range of 2-14V adjusted on a per phase basis from calibrated potentiometers at the front panel. The relay is continuously rated at 300V RMS & no external components are required.

An optional harmonic filter is available to reject 2nd, 3rd, 4th and 5th harmonics to reduce the effect of switching transients.

The AC input voltage is continuously monitored and when it exceeds the pre-set level, latching contacts are actuated after a three (3) second time delay. An optional adjustable time delay setting version is also available.

General Safety Precautions Working With Current Transformer Circuits

The secondary circuit of a live CT must not be open circuited.

Non-observance of this precaution can result in injury to personnel or damage to equipment.

Relay Operator Interface

Voltage Setting Dials

The adjustable voltage setting for each phase is set via front panel rotary dials. The setting range is from 2 – 14 Vac.

Optional Time Delay Setting Dial

The 2V68-S comes standard with a fixed 3 sec operate time delay. The optional adjustable time delay model provides a time delay setting dial that may be set from 3 – 20 sec.

Power Indication

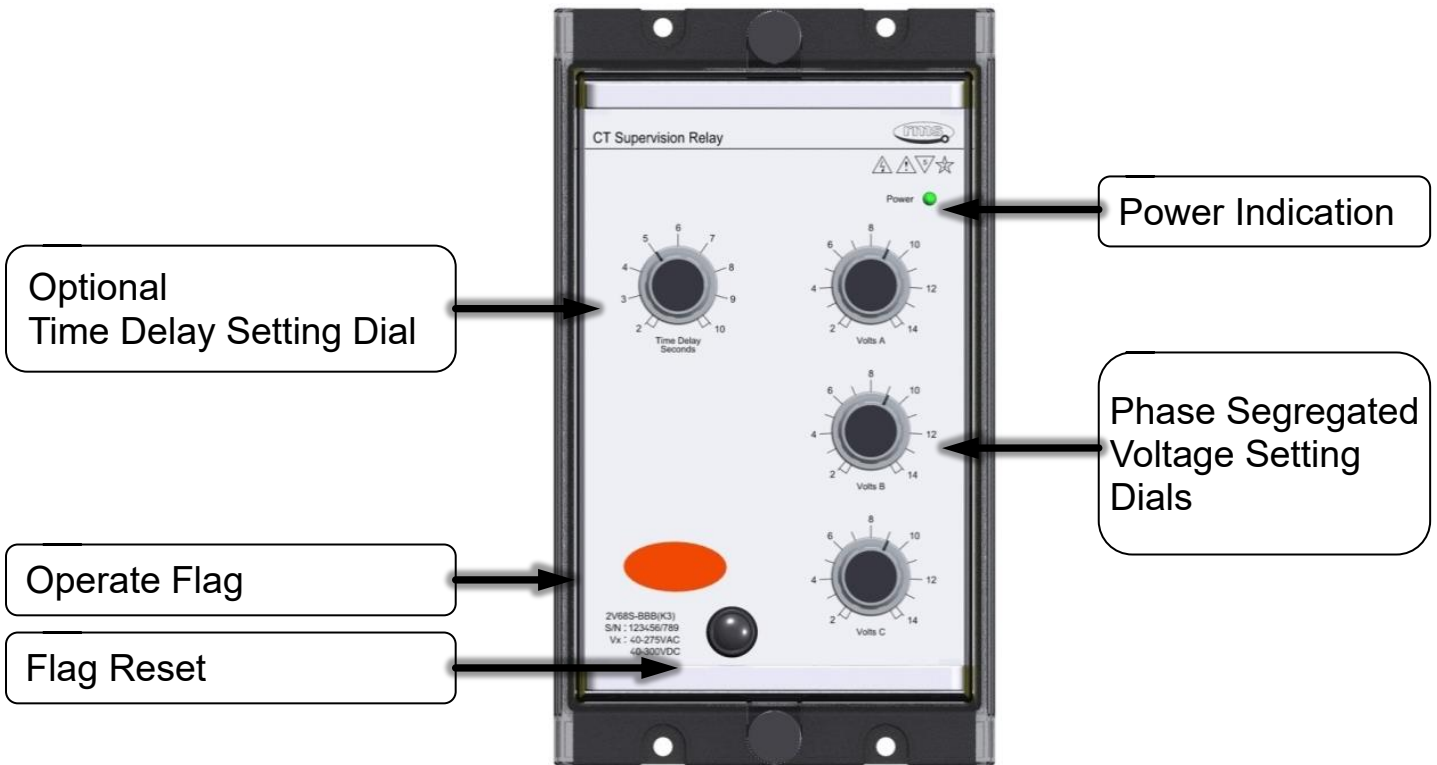
The green power LED indicates the presence of an auxiliary supply to the relay.

Flag Indicator

A hand reset mechanical flag is provided to indicate operation of the relay and a potential open circuit in the CT summation.

Flag Reset

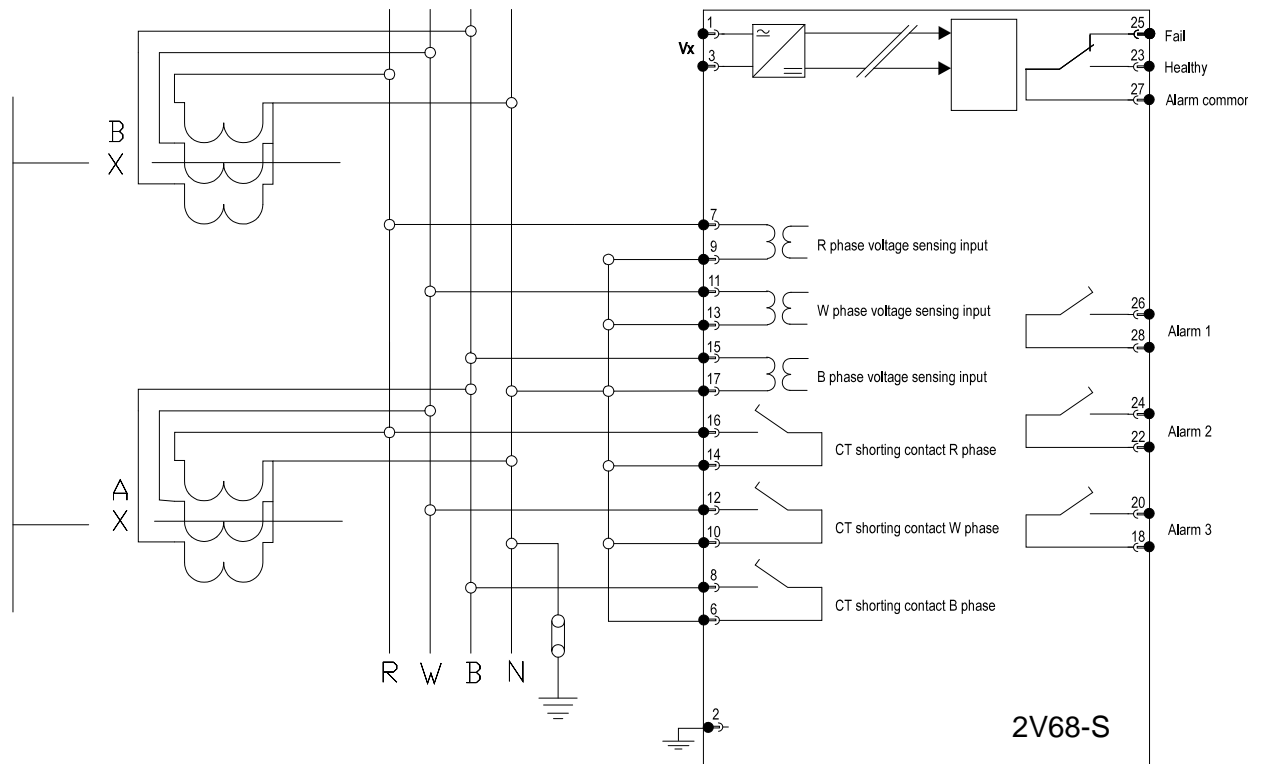
Hand reset push button for the latched output contacts and the mechanical flag.



2V68-S Front Fascia

Scheme Wiring and Installation

2V68-S Connection diagram



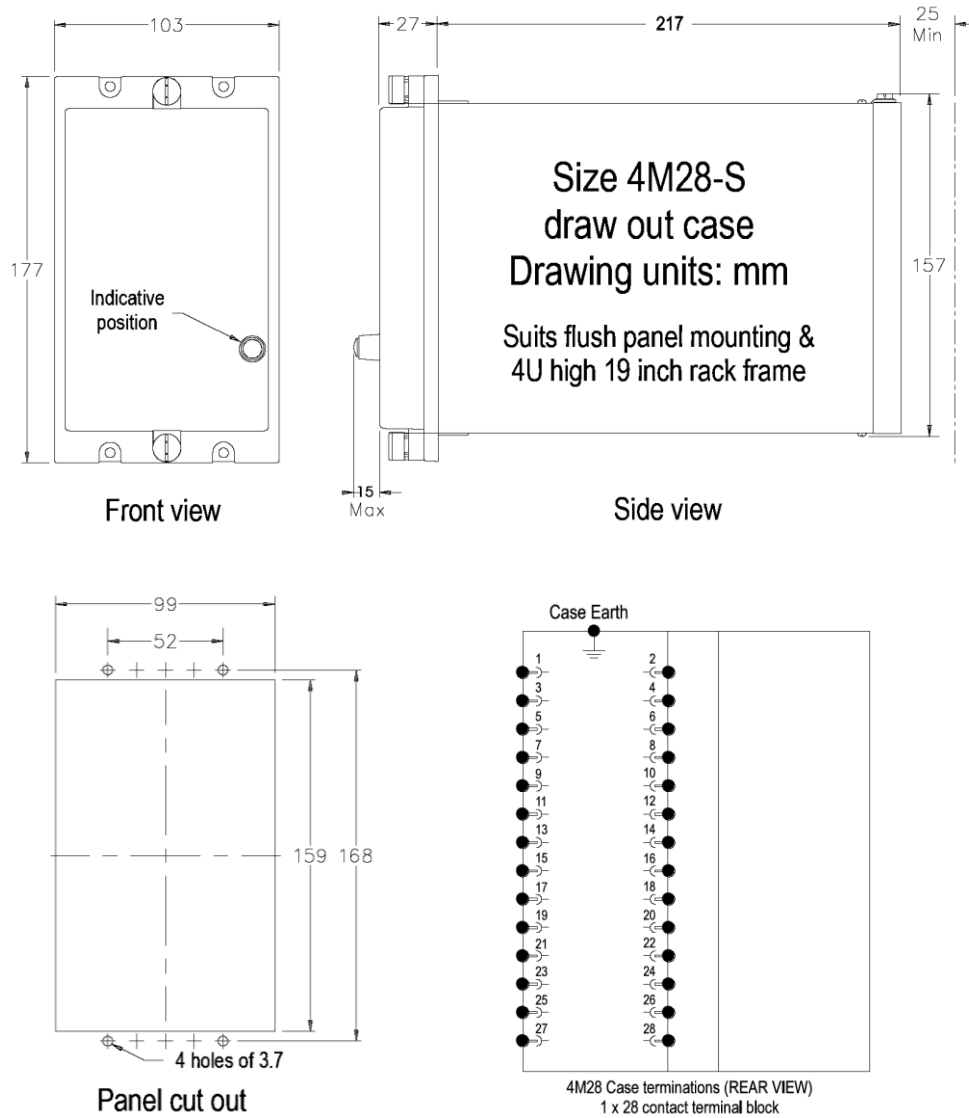
The connection diagram shows typical relay connections of the relay supervision inputs to a CT summation circuit :

Terminals 7-9	: R phase
Terminals 11-13	: W phase
Terminals 15-17	: B phase

Also shown are connections of the CT shorting contacts of the 2V68-S to the CT summation circuit, shorting is provided to the CT summation neutral point :

Terminals 16-14	: R phase
Terminals 12-10	: W phase
Terminals 8-6	: B phase

Terminal Layout and Relay Dimensions



All dimensions are in mm.

The module may be either flush panel mounted or alternatively mounted on a 4U high 19 inch rack frame.

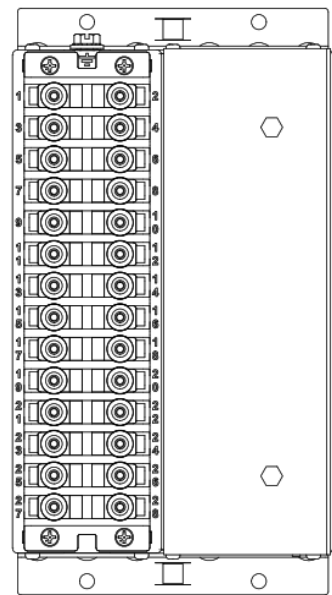
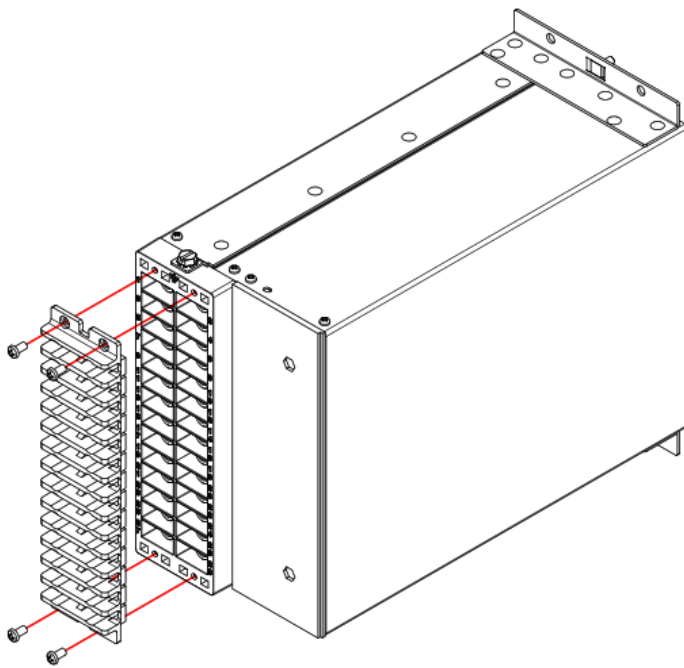
The relay terminal numbers are as viewed from the rear of the relay. M4 screw terminals are provided for relay wiring.

IP2X Terminal Covers

The relay may be ordered with IP2X terminal covers to provide IP2X protection of the case terminals.

Alternatively separate IP2X terminal cover kits are available to provide IP2X protection of the case terminals.

The covers are fitted to the terminal block prior to cable termination.

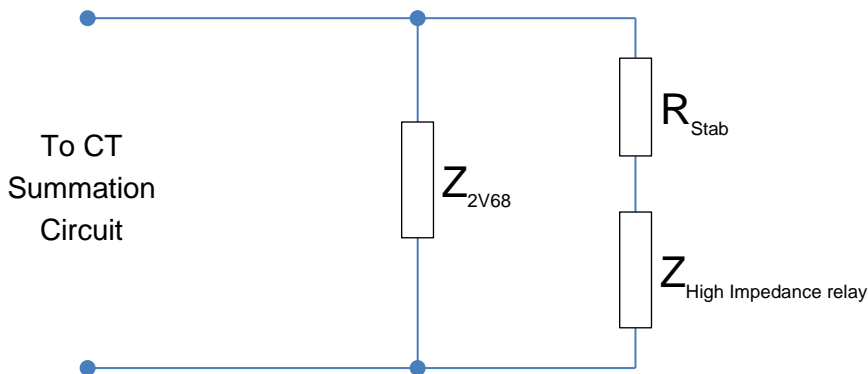


4M28-S Case with IP2X cover

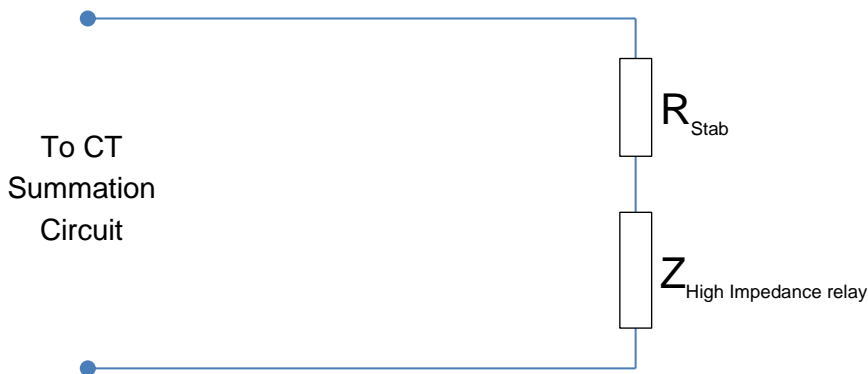
Relay Settings

Setting Assumptions

The 2V68-S is a voltage detection relay used to monitor the shunt voltage across the stabilising resistor in series with a current operated High Impedance relay. The equivalent circuit presented to the CT summation circuit is shown below (one phase shown only for clarity).



Given that $Z_{2V68} \gg (R_{Stab} + Z_{High Impedance Relay})$, the equivalent circuit then simplifies to :



In the event of a CT secondary becoming open-circuit or the CT wiring being broken, a resultant current spill will flow into the stabilising resistor and the high impedance relay. The current spill will develop a voltage across the stabilising resistance and the high impedance relay.

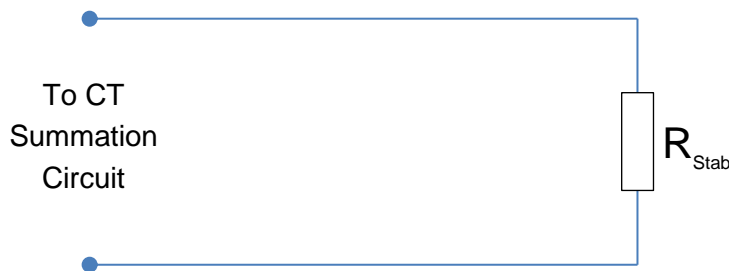
It should be noted that the supervision principle requires some load current to be flowing for a spill current to be developed on the occurrence of an open circuit. Inevitably there will be situations where, for part of the time, particularly under light loading conditions the supervision relay would not operate on the occurrence of an open circuit in the secondary circuit due to there being insufficient spill current developed.

A variable load profile would however cause the eventual operation of the CT supervision relay as the spill current increased.

Given the low incidence of open circuits in CT secondary wiring coupled with the coincident low probability of a busbar fault, the abovementioned limitation of the CT supervision scheme is generally accepted.

Voltage Setting Criteria

Typically in a high impedance scheme $R_{Stab} \gg Z_{High\ Impedance\ Relay}$, a good approximation of the equivalent circuit is :



Therefore the developed voltage across the 2V68 relay will be $R_{Stab} \times I_{spill}$

The voltage setting on the 2V68 is made as sensitive as possible subject to the following criteria :

$$V_{set} > 2 \times R_{Stab} \times I_{spill\ due\ to\ CT\ error\ at\ Full\ Load} \quad (\text{Criteria 1})$$

&

$$V_{set} < 0.5 \times R_{Stab} \times I_{set} \quad (\text{where } I_{set} \text{ is the High Impedance relay current setting}) \quad (\text{Criteria 2})$$

Without information on the amount of spill current due to CT error at Full Load the following voltage setting may be trialled :

$$V_{set} = 0.1 \times R_{Stab} \times I_{set} \quad (\text{where } I_{set} \text{ is the High Impedance relay current setting}) \quad (\text{Equation 1})$$

With this setting, on site adjustment may be required if the supervision scheme operates due to load only.

Sample Setting Calculation Method 1

The following sample setting calculation is based on the following High Impedance Protection Settings :

$$R_{\text{Stab}} = 200 \Omega$$

$$I_{\text{set}} = 400 \text{ mA}$$

$$I_{\text{spill due to CT error at Full Load}} = 5 \text{ mA}$$

To satisfy Criteria 1

$$V_{\text{set}} > 2 \times R_{\text{Stab}} \times I_{\text{spill due to CT error at Full Load}}$$

$$V_{\text{set}} > 2 \times 200 \Omega \times 5 \text{ mA}$$

$$V_{\text{set}} > 2 \text{ V}$$

To satisfy Criteria 2

$$V_{\text{set}} < 0.5 \times R_{\text{Stab}} \times I_{\text{set}}$$

$$V_{\text{set}} < 0.5 \times 200 \Omega \times 400 \text{ mA}$$

$$V_{\text{set}} < 40 \text{ V}$$

We can choose

$$V_{\text{set}} = 2 \text{ V} \quad \text{which satisfies both Criteria 1 and Criteria 2.}$$

The standard time delay of 3 sec will be suitable for most circumstances.

Where a longer time delay is called for the adjustable time delay option may be specified to allow a time delay setting range of 3 – 20 sec.

Sample Setting Calculation Method 2

Without information on the CT error at Full Load and based on the above High Impedance Protection Settings we can use Criteria 3 to determine our voltage setting :

$$R_{\text{Stab}} = 200 \Omega$$

$$I_{\text{set}} = 400 \text{ mA}$$

According to Criteria 3

$$V_{\text{set}} = 0.1 \times R_{\text{Stab}} \times I_{\text{set}}$$

$$V_{\text{set}} = 0.1 \times 200 \Omega \times 400 \text{ mA}$$

$$V_{\text{set}} = 8 \text{ V}$$

The standard time delay of 3 sec will be suitable for most circumstances.

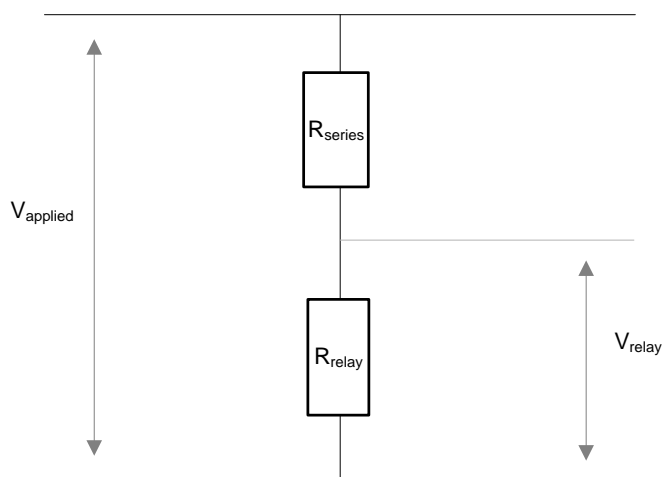
Where a longer time delay is called for the adjustable time delay option may be specified to allow a time delay setting range of 3 – 20 sec.

Application Of External Resistors For Elevated Voltage Settings

Where the required voltage setting needs to be greater than 14V an external resistor in series with the 2V68 relay may be applied.

By using a voltage divider calculation at a given relay setting voltage and the required applied voltage for operation, a suitable series resistor value can be determined.

The equivalent circuit would be :



The following derivation would then yield :

$$\frac{V_{applied}}{R_{series} + R_{relay}} = \frac{V_{relay}}{R_{relay}}$$

$$R_{series} = \left(\frac{V_{applied}}{V_{relay}} - 1 \right) \times R_{relay}$$

$$R_{series} = \left(\frac{V_{applied}}{V_{relay}} - 1 \right) \times 30k\Omega$$

$$\text{for } 2 \text{ Volt} \leq V_{relay} \leq 14 \text{ Volt}$$

(Equation 2)

Note that the effective applied voltage for the relay to operate would be subject to the tolerances of the chosen series resistor and the relay input impedance, so at best say +/- 10%.

The relay must be capable of sustaining the temporary shunt voltage during a fault condition and the continuous shunt voltage at the chosen relay setting. In practice the power dissipation is low due to the overall shunt impedance and usually results in a power dissipation of < 20 W.

Sample Setting Calculation For Elevated Voltage Settings

Assume that the calculated operate voltage needs to be :

40 V

With the relay set at say 14V

Using equation 2

$$R_{series} = \left(\frac{V_{applied}}{V_{relay}} - 1 \right) \times 30k\Omega$$

$$R_{series} = \left(\frac{40 V}{14 V} - 1 \right) \times 30k\Omega$$

$$R_{series} = 56 k\Omega , 20 W \text{ power rating.}$$

Commissioning

Commissioning Preliminaries

Carefully examine the module to ensure that no damage has occurred during transit. Check that the model number and rating information are correct.

Insulation

The relay, and its associated wiring, may be insulation tested between:

- all electrically isolated circuits
- all circuits and earth

An electronic or brushless insulation tester should be used, having a dc voltage not exceeding 1000V. Accessible terminals of the same circuit should first be strapped together. Deliberate circuit earthing links, removed for the tests, subsequently must be replaced.

Site Commissioning Verification Checklist

Observe all site specific standard safety procedures.

System Power Up

Item	Description	Complete
1	Confirm all necessary primary equipment isolations	
2	Confirm all necessary secondary equipment isolations	
3	Check panel installation of the 2V68-S monitor	
4	Check for correct case earthing	
5	Check the 2V68-S is wired to the protection design schematic	
6	Confirm Fail alarm relay is closed (Terminals 25 and 27)	
7	Apply correct Auxiliary voltage to power up the 2V68-S	
8	Observe that the green power LED remains illuminated solid	
9	Confirm Fail alarm relay is open (Terminals 25 and 27)	

Voltage Setting Check

Item	Description	Complete
1	Apply an AC test voltage to inputs 7 and 9 (R phase voltage sensing input) that is greater than the setting applied to the front dial	
2	Confirm operation of the relay after the nominal 3 sec delay or as per the optional time delay setting	
3	Confirm Relay flag has dropped, Alarm outputs 1 – 3 have operated and the CT shorting contacts for R, W and B phase have all operated	
4	Remove the AC test voltage and confirm that the Relay flag remains in the operated position, the Alarm output contacts 1 – 3 are latched and the CT shorting contacts for R, W and B phase are latched	
5	Depress the Relay reset push button and confirm that Alarm and CT shorting contacts reset to the open position and the operate flag is reset	
6	Repeat items 1 through 5 with the test voltage instead applied to inputs 11 and 13 (B phase voltage sensing input) in place of R phase	
7	Repeat items 1 through 5 with the test voltage instead applied to inputs 15 and 17 (C phase voltage sensing input) in place of R phase	