MM300
IO_A analog module recommendations

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Contents:

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1. INTRODUCTION

The MM300 is a modular motor protection and control system designed specifically for low-voltage motor applications. It was launched to the market in 2007.

The aim of this report is to provide recommendations for the interpretation of the current measurements of the IO_A analog module on slot D.

At the date of this report there are more than 37000 units supplied worldwide and installed in many different applications and countries.

2. MM300 PERFORMANCE

2.1. Hardware

The MM300 is packaged in a modular arrangement.

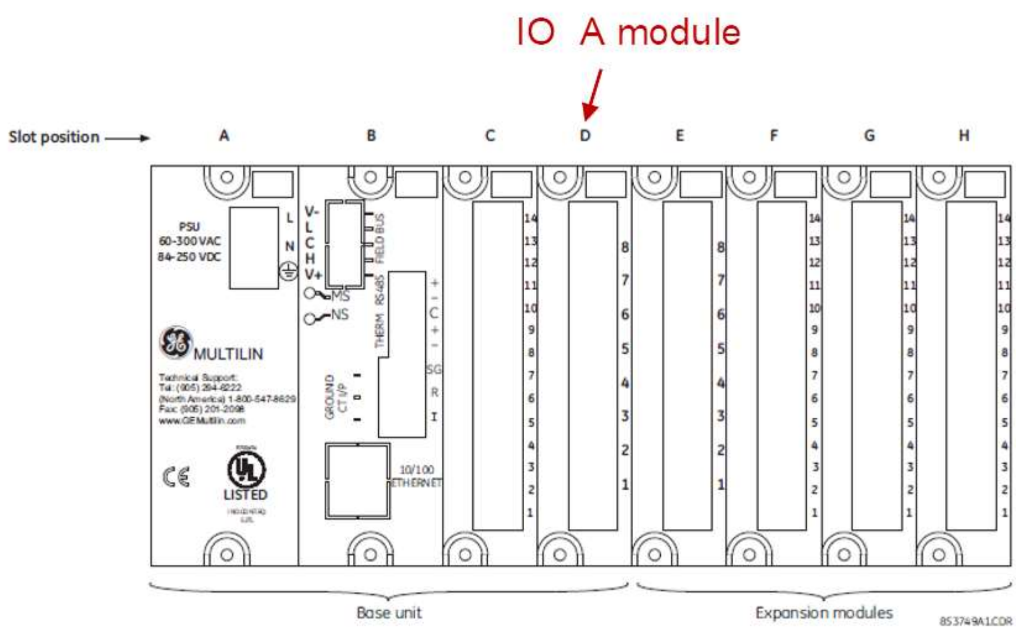

Fig. 1 Relay base and expansion modules.

The base module consists of:

- Slot A: power supply.
- Slot B: CPU and communication module.
- Slot C: IO_C Vac Inputs/Outputs module or IO_E Vdc Inputs/Outputs module.
- **Slot D: IO_A CT module.**

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The expansion module is configurable and different modules can be ordered for slots E, F, G and H:

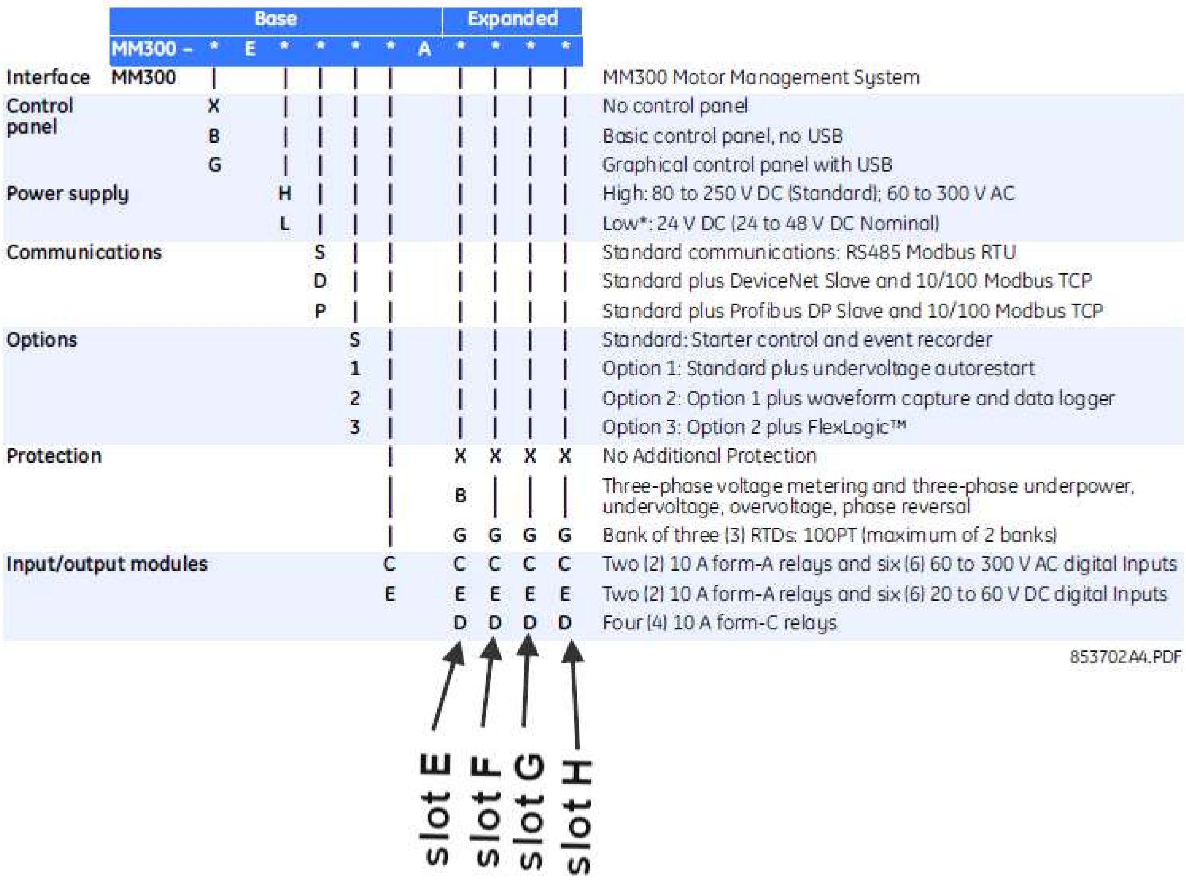

Fig. 2 Expansion modules options.

2.2. Reliability

The MTBF (Mean Time Between Failures) is 505 years as of April 3, 2019 latest recorded figures.

This is equivalent to a failure rate of:

FR = 1 / MTBF = 1 / 505= 0.20 %/year

This performance has been constant since that date due product maturity and our continuous improvement program.

2.3. Warranty

Fig.3 Ten years warranty logo in the web.

GE guaranties all MM300 supplied since October 1st, 2013 for 10 years as the rest of protection and control products that are in active life cycle status.

This warranty includes materials and workmanship when the product is wired, set and connected as per the instruction manual and within the published specifications.

This extended warranty has been possible as a result of many product and process improvements in the last 10 years using modern techniques of product design, manufacturing, components selection and field returns continuous improvement.

To achieve the best performance, cybersecurity, etc. GE publishes periodically new firmware versions with the corresponding release notes that customers may download and upgrade at no charge in the field if they feel the new version provides significant advantages.

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3. IO_A module measurements

3.1. IO_A module specifications

As per the instruction manual MM300REF-AE on page 1-10, the IO_A current measurement module has the following specifications:

PHASE CURRENT INPUTS (INCLUDING RESIDUAL GROUND CURRENT)

Range:	0.2 to 40 A (8 × CT), direct connection up to 5 A FLA
Input type:	Combined 1 A / 5 A
Frequency:	50 or 60 Hz
Accuracy:	ExtCT: ±2% of reading or ±1% of 8× CTPrimary, whichever is greater Direct: ±2% of reading or ±0.1 A, whichever is greater
Withstand (at 5A nominal):	0.2 s at 100× 1.0 s at 50× 2.0 s at 40× continuous at 3× rated current
Burden:	<4 mVA at 1A <0.1 VA at 5 A

Fig.4 Currents inputs specifications.

For example, if CT Primary is 1A and current injected to the relay is 0.5A:

Accuracy will be ±2% of ready or ±1% x 8 x 1A= 0.08A=80mA, whichever is greater.

a) Current read by the relay is 0.49A:

$$\%\varepsilon = \left(\frac{Iread}{Iapplied} - 1\right) x\ 100 = \left(\frac{0.49}{0.5} - 1\right) x\ 100 = 2\% \rightarrow \text{OK}$$

0.5A-0.49A= 0.01 A=10mA < 80mA →OK

b) Current read by the relay is 0.42A:

$$\%\varepsilon = \left(\frac{Iread}{Iapplied} - 1\right) x\ 100 = \left(\frac{0.42}{0.5} - 1\right) x\ 100 = 16\% \rightarrow \text{X}$$

However, 0.5A-0.42A=0.08A= 80mA → OK

Both cases are within expected accuracy.

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In the unbalance protection when configured very sensitive and currents applied are very low or very high, it can lead in unexpected trips due to measurement errors.

The calculation method is as follows:

$$\text{If } I_{AV} \geq I_{FLA}: \quad UB\% = \frac{|I_M - I_{AV}|}{I_{AV}} \times 100\%$$

$$\text{If } I_{AV} \leq I_{FLA}: \quad UB\% = \frac{|I_M - I_{AV}|}{I_{FLA}} \times 100\%$$

Where:
I_{AV} = average phase current
I_M = current in a phase with maximum deviation from I_{AV}
I_{FLA} = MOTOR FULL LOAD CURRENT setpoint

Fig. 5 Current unbalance calculation.

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3.2. Temperature

As the CTs used in the MM300 are small size, they are more sensitive to temperature changes. Temperature influences in the error.

In the MM300 relay, steady state is reached 3 hours after powering on:

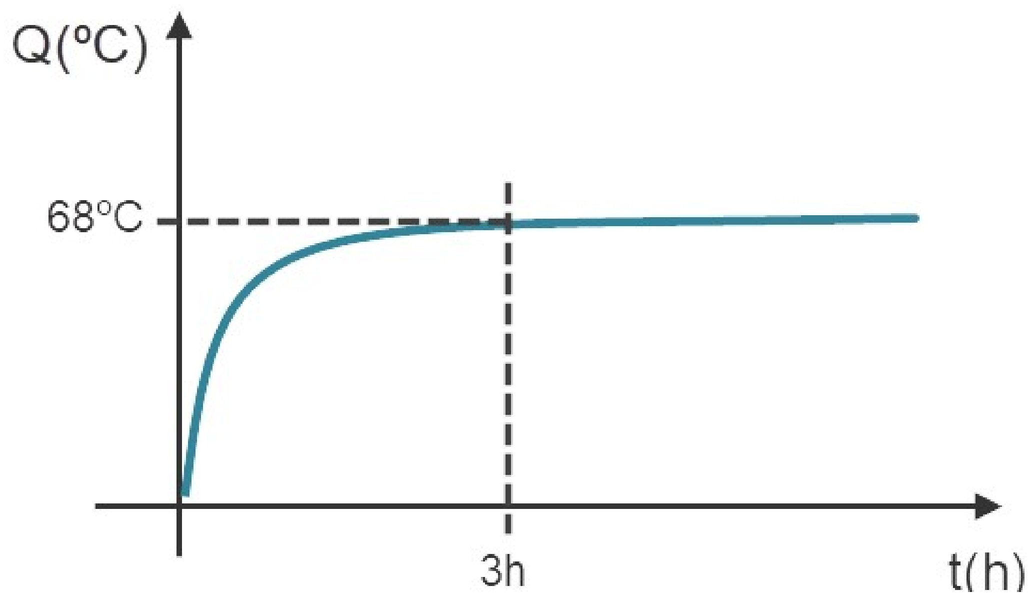

Fig.6 Steady state

It is recommended to test the relays under steady state, if possible, inside the panel.

At factory, relays are calibrated after reaching steady state temperature in order the accuracy to be the highest possible.

During maintenance works, relays measurement test needs to be carried out during steady state.

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3.3. IO_A module replacement

In order to compensate hardware errors, relays are calibrated. The calibration values include two values for offset and another two for the gain, for high and low current values. These values are stored in a calibration file that is recorded in the CPU.

Therefore, if measurement modules are exchanged between two relays, CPU modules need to be also exchanged.

In the example below, CPU_1 contains calibration file of IO_A1 and CPU_2 contains calibration file of IO_A2:

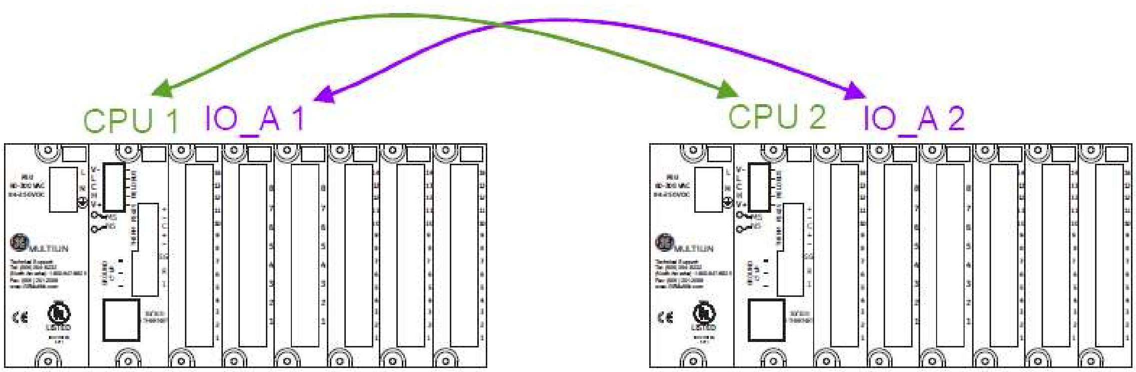

Fig.7 IO_A replacement

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3.4. Low current measurements

The CTs measurement difference is bigger at low and high current levels as show in the graphic below:

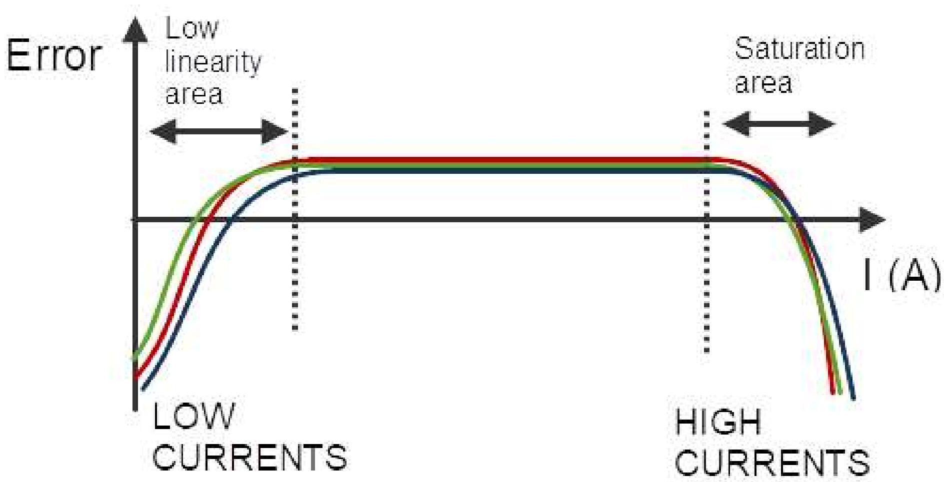

Fig.8 Error at low and high currents.

When low currents are injected to the IO_A current inputs, due to low magnetics flux, there are linearity errors.
And during high currents injection, due to high magnetics flux, there are saturation errors.

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