

Product Group: SG2 Programmable Relay
 Number: AN-SG2-022

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Title: Mathematical Instructions

Summary: We will define and demonstrate the Add/Subtract and the Multiply/Divide mathematical instructions.

We will be using the SG2 Client V3.4 in conjunction with Windows 7. Examples will be shown using the Ladder Logic program with the SG2-12HR-D model.

Add/Subtract Procedure:

The Add/Subtract instruction will allow for an Addition to and/or a Subtraction from a selected or set value.

1.0 Using the SG2 Client software, duplicate the program as shown in Figure 1 below.

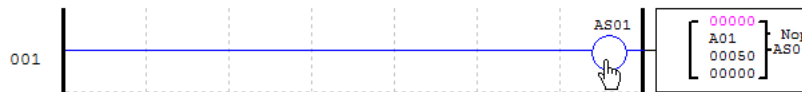



Figure 1

2.0 The Add/Subtract edit Contact/Coil window opens when Add/Subtract coil using  in the bottom toolbar, AS01 is placed in the last column of a rung of the Ladder Logic program.

2.1 Select Add/Subtract Coil Number:

31 Add/Subtract instructions are available.

2.2 Select Preset Type for Variable 1 (V1):

13 preset types available.

Select Preset V1:

Range -32768 to 32767 (Numeric Constant Type Only)

2.3 Select Preset Type for Variable 2 (V2):

V2 is the Addition Operator

Select Preset V2:

Range -32768 to 32767 (Numeric Constant Type Only)

2.4 Select Preset Type for Variable 3 (V3):

V3 is the Subtraction Operator

Select Preset V3:

Range -32768 to 32767 (Numeric Constant Type Only)

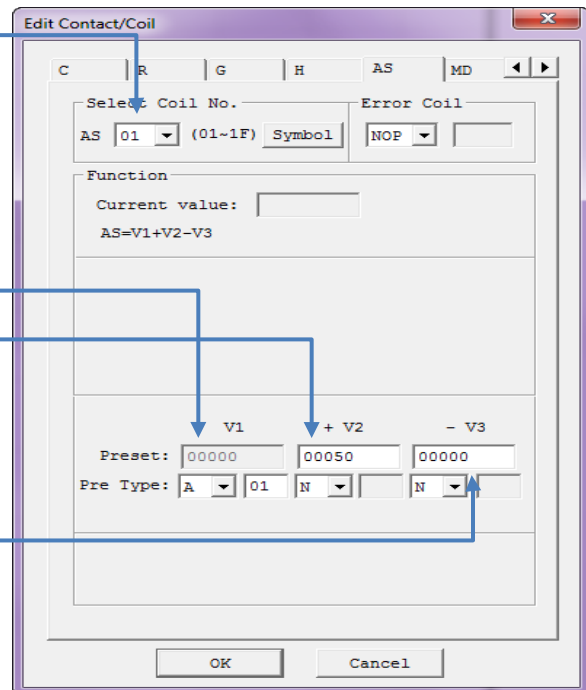


Figure 2

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Preset Type Abbreviations

There are 13 preset types available for use as variables (V1, V2, and V3) when using mathematical instructions within the SG2. Their abbreviations are listed below.

N – Numeric Constant	AT – Temperature Input	PI – PID
V – Expand Output	AQ – Analog Output	MX – Multiplexer
A – Analog Input	DR – Data Register	AR – Analog Ramp
T – Timer	AS – Add/Subtract	
C – Counter	MD – Multiply/Divide	

Example 1: Addition Instruction

For this example we are simulating a +1.5°C correction for the Temperature Expansion Module AT01 temperature input. We are using a numeric constant for V2 of 00015 as there is an implied decimal point after the first digit (0001.5). When the AT01 has a raw temperature reading of 26.5°C, shown as 00265, the AS01 instruction adds 1.5 to the AT01 raw temperature value giving us a final temperature value of 28.0°C, shown as 00280 in Figure 3 below.

$$V1 (\text{Temperature Input } 26.5^{\circ}\text{C}) + V2 (1.5) - V3 (00000) = 28.0$$

1. Select Coil: Set to AS01
2. Preset V1: N/A Preset Type V1: Set to AT01 (Temperature Input)
3. Preset V2: Set to 1.5 (shown as 00015) Preset Type V2: Set to N (Numeric Constant)
4. Preset V3: Set to 0 (shown as 00000) Preset Type V3: Set to N (Numeric Constant)
5. Run Simulation: Adjust AT1 in the AT Tool window to see how the output value change

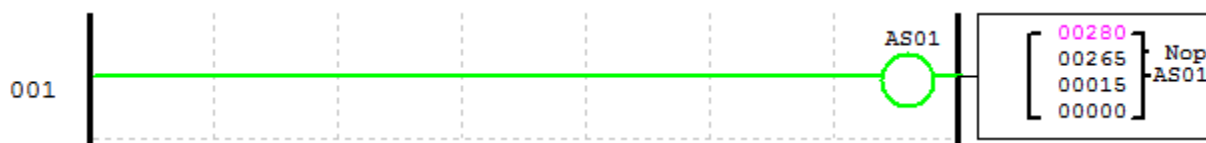


Figure 3

Coil Values Display

Figure 4 shows the series of numbers and their meanings in the SG2 Client Software when a coil is added. The Calculated Value is the number returned after all mathematical instructions are complete.

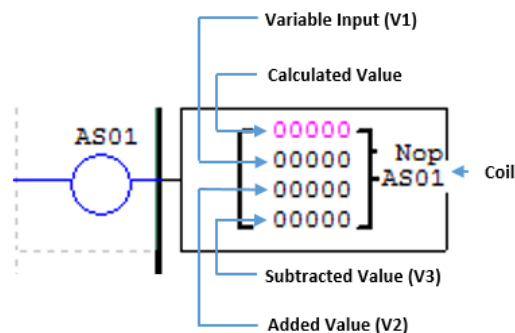


Figure 4

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Example 2: Subtraction Instruction

For this example, we are simulating a - 0.3°C correction for the Temperature Expansion Module AT01 temperature input. We are using a numeric constant for V3 of 00003 as there is an implied decimal point after the first digit (0000.3). When the AT01 has a raw temperature reading of 23.3°C, shown as 00233, the AS01 instruction subtracts 0.3 from the AT01 raw temperature value giving us a final temperature value of 23.0°C, shown as 00230 in Figure 4 below.

$$V1 (\text{Temperature Input } 23.3^{\circ}\text{C}) + V2 (00000) - V3 (.3) = 23.0$$

1. Select Coil: Set to AS01
2. Preset V1: N/A Preset Type V1: Set to AT01 (Temperature Input)
3. Preset V2: Set to 0 (shown as 00000) Preset Type V2: Set to N (Numeric Constant)
4. Preset V3: Set to 3 (shown as 00003) Preset Type V3: Set to N (Numeric Constant)
5. Run Simulation: Adjust AT1 in the AT Tool window to see how the output value changes.

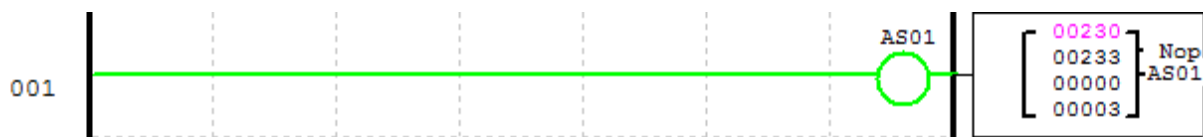


Figure 5

Multiply/Divide Procedure:

The Multiply/Divide instruction will allow for a Multiplication of and/or a Division of a number from a selected or set value.

3.0 Using the SG2 Client software, duplicate the program as shown in Figure 5 below.

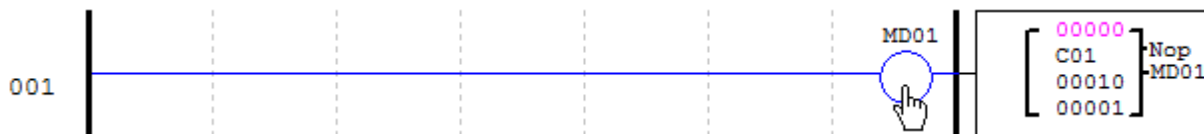


Figure 6

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4.0 The Multiply/Divide edit Contact/Coil window opens when the Multiply/Divide coil MD01 is placed in the last column of a rung of the Ladder Logic program.

4.1 Select Multiply/Divide Coil Number:

31 Multiply/Divide instructions are available.

4.2 Select Preset Type for Variable 1 (V1):

13 preset types available.

Select Preset V1:

Range -32768 to 32767 (Numeric Constant Type only)

4.3 Select Preset Type for Variable 2 (V2):

V2 is the Multiplication Operator

Select Preset V2:

Range -32768 to 32767 (Numeric Constant Type only)

4.4 Select Preset Type for Variable 3 (V3):

V3 is the Division Operator

Select Preset V3:

Range -32768 to 32767 (Numeric Constant Type only)

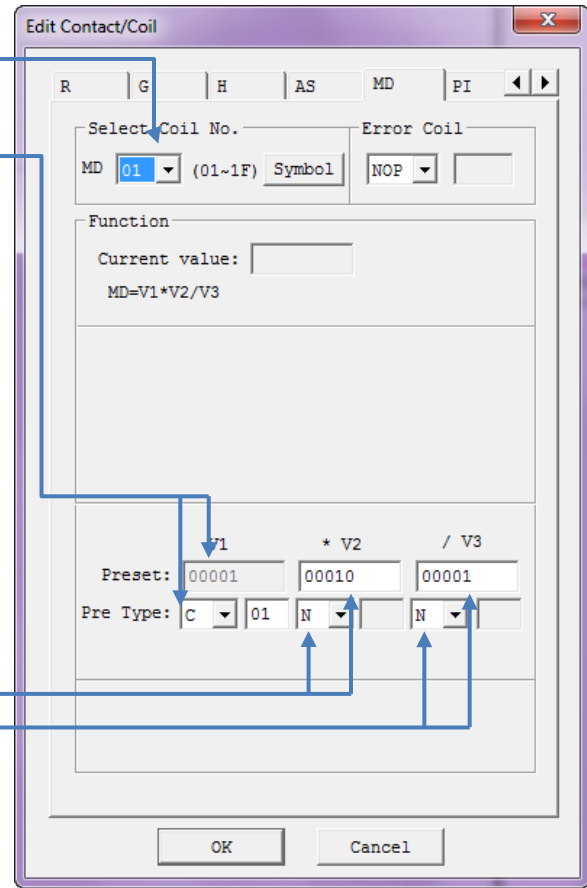


Figure 7

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Example 1: Multiplication Instruction

For this example, we are obtaining a total count of material that is packaged. Each box that is counted (C01 Value) has a total of 10 Pieces of material inside. We use the Multiply/Divide (MD01) instruction to take the value of C01 and multiply that number by 10, giving us the total material that is packaged.

$$V1 \text{ (Counter input is 10)} * V2 \text{ (10)} / V3 \text{ (1)} = 100$$

1. Select Coil: Set to MD01
2. Preset V1: N/A Preset Type V1: Set to C01.
3. Preset V2: Set to 10 (shown as 00010) Preset Type V2: Set to N (Numeric Constant)
4. Preset V3: Set to 1 (shown as 00001) Preset Type V3: Set to N (Numeric Constant)



Figure 8

Example 2: Division Instruction example

For this example, we know that for every 10 pieces of material that needs to be packaged we need 1 box. We use the Multiply/Divide (MD01) instruction to take the total amount of material to be packaged and divide that number by 10, giving us the number of boxes needed to package the material.

$$V1 \text{ (Counter input is 10)} * V2 \text{ (1)} / V3 \text{ (10)} = 1$$

1. Select Coil: Set to MD01
2. Preset V1: N/A Preset Type V1: Set to C01
3. Preset V2: Set to 1 (shown as 00001) Preset Type V2: Set to N (Numeric Constant)
4. Preset V3: Set to 10 (shown as 00010) Preset Type V3: Set to N (Numeric Constant)



Figure 9

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