

Functions for  
Analog Module RMC12.2  
User's Manual

**SYSTEM200**

**Title** Functions for Analog Module RMC12.2

**Type of document** User's Manual

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**Purpose of the document** This document describes the utilization of the functions for the RMC12.2-2E-1A analog module.

**Configuration control**

Documentation identification of previous releases	Release date	Comment
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# 1 General

## 1.1 Overview of the Available Functions

The following functions are provided for the RMC12.2-2E-1A analog module:

- Voltage measurement 'VLT\_MEAS' up to ±10 V
- Current measurement 'AMP\_MEAS' up to ±20 mA
- Resistance measurement 'RES\_MEAS' up to 2000Ω
- Temperature measurement 'TMP1MEAS' from -100°C to +850°C using a Pt100 element
- Voltage and current output 'AN\_OUT' up to ±10 V or +20 mA

## 1.2 Address Assignments of the Registers

Each analog value of the two channels that is digitized by the analog module is provided as a 16-bit input word. Figure 1-1 shows the allocation of the channels to the absolute addresses. The variables of the two input words and the variable of the OUT0 output word must be declared as INTEGER type in the declaration editor. For this purpose, the INT type must be entered in the TYPE column (see Chapter 3 Typical Program).

Word M	Word M+1	IBS word
Analog value <b>channel 1</b> (%IW*.4)	Analog value <b>channel 2</b> (%IW*.6)	IN register
Output word <b>OUT 0</b> (QW*.0)	Parameter word <b>OUT 1</b> (%QW*.2)	OUT register

Figure 1-1: Address assignments of the registers

### 1.3 Selecting the Measuring Ranges

The measuring ranges of the two analog input channels are set through two bits, named RANGE\_0 and RANGE\_1. Figure 1-2 shows the allocation to the absolute addresses of the output word.

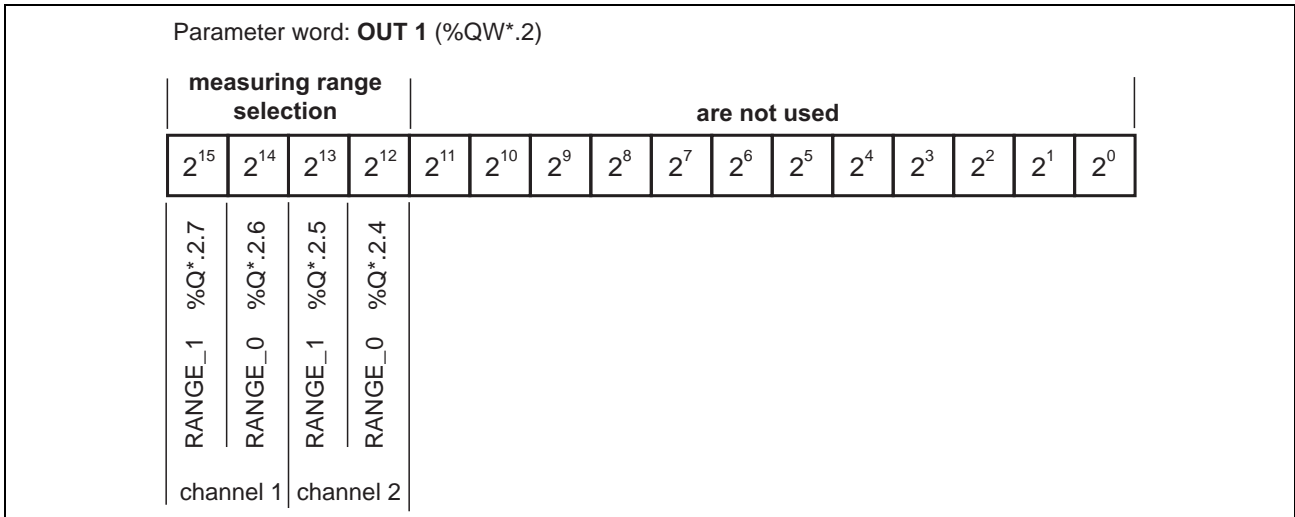


Figure 1-2: Selecting the measuring ranges

Using the RANGE\_0 and RANGE\_1 bits, the following ranges can be selected:

Meas. range	Channel 1		Channel 2		Voltage	Current	Resistance	Temperature
	RANGE_1 %Q*.2.7	RANGE_0 %Q*.2.6	RANGE_1 %Q*.2.5	RANGE_0 %Q*.2.4				
I	0	0	0	0	± 0.5 V	---	200 Ω	-100 °C ... +266 °C
II	0	1	0	1	± 1.0 V	---	400 Ω	-100 °C ... +850 °C
III	1	0	1	0	± 5.0 V	± 20 mA	2000 Ω	---
IV	1	1	1	1	± 10.0 V	---	---	---

Figure 1-3: Overview of the selectable measuring ranges

## 2 Functions

The resolution specified for the functions is derived from the minimum increment of the analog module. Measuring inaccuracies caused by the measuring setup cannot be specified.

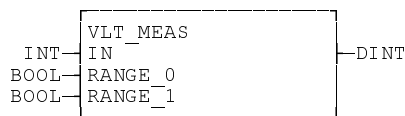
### 2.1 Voltage Measurement 'VLT\_MEAS'

In conjunction with the RMC12.2-2E-1A analog module, this function permits voltages up to ±10 V to be measured. The resolution is specified in Figure 2-4. The measuring range is selected via the two Boolean inputs RANGE\_0 and RANGE\_1. The analog value of the INT type is applied to the IN input. The function's output variable contains the measured voltage value of the DINT type. Its unit depends on the selected range (see Figure 2-4).

**Error variables** The error variables are set as follows if an illegal value is applied to the IN input:

```
ErrorFlg:    TRUE
ErrorNr:     1
ErrorTyp:    -240
```

In this case, the measured value is set to 0.



```
IN      (INT) : Analog value channel 1 or 2
RANGE_0 (BOOL): Least significant bit of the measuring range
RANGE_1 (BOOL): Most significant bit of the measuring range
```

Measuring range	Voltage range	Resolution	Unit of meas. value
I	± 0.5 V	250 µV	[10 µV]
II	± 1.0 V	500 µV	[100 µV]
III	± 5.0 V	2.5 mV	[100 µV]
IV	± 10.0 V	5 mV	[1 mV]

Figure 2-4: Resolution and unit of the measured value as a function of the measuring range

### 2.2 Current Measurement 'AMP\_MEAS'

In conjunction with the RMC12.2-2E-1A analog module, this function permits currents up to ±20 mA to be measured. The resolution is 10µA. The analog value of the INT type is applied to the IN input. The function's output variable contains the measured current value of the INT type. The unit of the measured value is 1µA; the channel's measuring range must be set to '±20 mA' (measuring range III).

**Error variables** The error variables are set as follows if an illegal value is applied to the IN input:

ErrorFlg: TRUE  
 ErrorNr: 1  
 ErrorTyp: -246

In this case, the measured value is set to 0.



IN (INT): Analog value channel 1 or 2

Measuring range	Current range	Resolution	Unit of meas. value
III	±20 mA	10 µA	1 µA

Figure 2-5: Resolution and unit of measured value

## 2.3 Resistance Measurement 'RES\_MEAS'

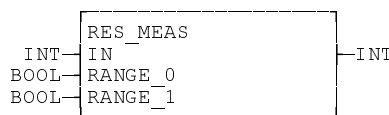
In conjunction with the RMC12.2-2E-1A analog module, this function permits resistance up to 2000Ω to be measured. The resolution is specified in Figure 2-6. The measuring range is selected via the two Boolean inputs RANGE\_0 and RANGE\_1. The analog value of the INT type is applied to the IN input. The function's output variable contains the measured resistance value of the INT type. Its unit depends on the selected range (see Figure 2-6).

**Error variables** The error variables are set as follows if an illegal value is applied to the IN input:

ErrorFlg: TRUE  
 ErrorNr: 1  
 ErrorTyp: -247

In this case, the resistance value is set to -1.

If measuring range IV (RANGE\_0 and RANGE\_1 are TRUE) has been selected, the resistance value is set to -2, and the error variables are set as specified above.



IN (INT): Analog value channel 1 or 2  
 RANGE\_0 (BOOL): Least significant bit of the measuring range  
 RANGE\_1 (BOOL): Most significant bit of the measuring range

Measuring range	Resistance range	Resolution	Unit of meas. value
I	200 Ω	100 mΩ	100 mΩ
II	400 Ω	200 mΩ	100 mΩ
III	2000 Ω	1 Ω	1 Ω

Figure 2-6: Resolution and unit of the measured value as a function of the measuring range



## 2.4 Temperature Measurement 'TMP1MEAS'

In conjunction with a Pt100 element connected to the RMC12.2-2E-1A analog module, this function permits temperatures to be measured in the range between -100°C and +850°C.

The implemented characteristic curve is the one of a platinum resistance thermometer that, according to EN 60751, describes the correlation between temperature  $T$  and electrical resistance  $R_T$  as follows:

- for the range -100°C ... 0°C:

$$R_T = 100\Omega [1 + AT + BT^2 + C(T - 100^\circ\text{C})T^3]$$

- for the range 0°C ... 850°C:

$$R_T = 100\Omega (1 + AT + BT^2)$$

The following constants are used here:

$$A = 3.9083E-3 \text{ } ^\circ\text{C}^{-1}, B = -5.775E-7 \text{ } ^\circ\text{C}^{-2}, C = -4.183E-12 \text{ } ^\circ\text{C}^{-4}$$

Figure 2-7 shows the resolution as a function of the selected measuring range. The measuring range is selected via the two Boolean inputs RANGE\_0 and RANGE\_1. The analog value of the INT type is applied to the IN input. The function's output variable contains the measured temperature value of the INT type. Its unit depends on the selected range (see Figure 2-7).

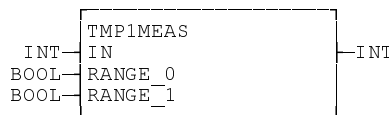
**Error variables**

The error variables are set as follows if an illegal (negative) value is applied to the IN input:

```
ErrorFlg:    TRUE
ErrorNr:     1
ErrorTyp:    -248
```

In this case, the temperature value is -10000.

If an illegal measuring range (III or IV) has been selected, the temperature value is set to -20000, and the error variables assume the values that are specified above.



```
IN      (INT) : Analog value channel 1 or 2
RANGE_0 (BOOL): Least significant bit of the measuring range
RANGE_1 (BOOL): Most significant bit of the measuring range
```

Measuring range	Temperature range	Resolution	Unit of meas. value
I	-100 °C ... +266 °C	0.5 °C	0.1 °C
II	-100 °C ... +850 °C	1 °C	1 °C

Figure 2-7: Resolution and unit of the measured value as a function of the measuring range

## 2.5 Voltage and Current Output 'AN\_OUT'

This function permits voltages up to  $\pm 10V$  and currents up to  $+20\text{ mA}$  to be provided at the analog output of the RMC12.2-2E-1A analog module. The minimum increment is  $4.88\text{ mV}$  or  $9.77\mu\text{A}$ , respectively. The function's variable value must be copied to the OUT0 output word (see Chapter 3 Typical Program). The SCALE input is used as scaling factor. For voltage output, this factor should be set to 10, 100, 1000 or 10000, and for current output to 20, 200, 2000 or 20000. The value at the OUT input will then represent the analog output value. The analog initial value is calculated as follows:

$$\text{Output voltage} = \frac{OUT}{SCALE} \cdot 10V$$

$$\text{Output current} = \frac{OUT}{SCALE} \cdot 20\text{mA}$$

Example: For an output voltage of  $1.6\text{ V}$ , the input variables can have the following values assigned:

OUT:                   160  
SCALE :                1000

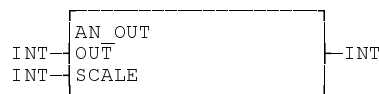
Proportionally to the output voltage  $0 \dots +10\text{ V}$ , a current of  $0 \dots +20\text{ mA}$  is provided at the current output. The resulting current in our example is  $3.2\text{ mA}$ .

### Error variables

If '0' is assigned to the SCALE input or is the amount of the OUT value greater than the SCALE value, the error variables will be set as follows:

ErrorFig:            TRUE  
ErrorNr:             1  
ErrorTyp:            -249

In this case, the function's output variable assumes the value of  $16\#0000$ . This corresponds to an output value of  $0\text{ V}$  or  $0\text{ mA}$ .



OUT (INT):            Output value  
SCALE (INT):         Scaling factor corresponds to  $+10V$  or  $+20\text{ mA}$

### 3 Typical Program

The following measurements are made in conjunction with the RMC12.2-2E-1A analog module:

- Channel 1: Voltage measurement in the range of ±10 Volt
- Channel 2: Temperature measurement in the range of +300...+400°C

In addition, a current of 10 mA is provided at the analog output.

```
Ring module 1 - IBM1 (Interbus-S master)
No. log. Ident User ID Bytes 1 2
no. code
1 1 * $0008 RMK12.*-IBS-BKL .....
2 2 $02BF RMC12.*-2E-1A QQQQIIII .....
1: RMK12.*-IBS-BKL ..... INDRAMAT RECO bus terminal
2: RMC12.*-2E-1A ..... INDRAMAT analog module
```

```
Identifier AT TYPE Comment
PROGRAM EXAMPLE
VAR_INPUT
analog_1 %IW2.4 INT (*measured value analog input 1 *)
analog_2 %IW2.6 INT (*measured value analog input 2 *)
END_VAR

VAR_OUTPUT
output %QW2.0 INT (*analog value, output word OUT0 *)
ch2_r0 %Q2.2.4 (*least sign. bit meas. range ch.2*)
ch2_r1 %Q2.2.5 (*most sign. bit meas. range ch. 2*)
ch1_r0 %Q2.2.6 (*least sign. bit meas. range ch.1*)
ch1_r1 %Q2.2.7 (*most sign. bit meas. range ch. 1*)
END_VAR

VAR
temp INT (*measured temperature value *)
voltage DINT (*measured voltage value *)
END_VAR
```

```
(*Voltage measurement +/-10 Volt at analog input 1*)
VLT_MEAS
analog_1 IN
ch1_r0 RANGE_0
ch1_r1 RANGE_1
voltage

vlt_meas voltage measurement..... VLT_MEAS
analog_1 Measured value channel ..... %IW2.4... INT
ch1_r0.. Measuring range channel 1, low bit... %Q2.2.6... BOOL
ch1_r1.. Measuring range channel 1, high bit.. %Q2.2.7... BOOL
```

```
(*Temperature measurement at analog input 2*)
TMP1MEAS
analog_2 IN
ch2_r0 RANGE_0
ch2_r1 RANGE_1
temp

tmp1meas Temperature measurement using Pt100..... TMP1MEAS
analog_2 Measured value channel 2..... %IW2.6... INT
temp... Measured temperature value..... INT
ch2_r0.. Measuring range channel 2, low bit... %Q2.2.4... BOOL
ch2_r1.. Measuring range channel 2, high bit.. %Q2.2.5... BOOL
```

```
(*10 mA current output at analog output*)
AN_OUT
10000 OUT
20000 SCALE
output

an_out.. Analog value output..... AN_OUT
10000... Analog value..... ANY_IN
output.. Output word OUT0..... %QW2.0... INT
20000... Scaling factor corresponds to 20mA... ANY_IN
```



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