

## 14.2 UM161

### 14.2.1 General Information

The UM161 is a universal analog/digital mixed module. It offers very high component density using standard 3.5 mm terminal blocks.

#### Features

- 4 analog inputs  $\pm 10$  V
- 3 analog outputs  $\pm 10$  V
- 14 digital inputs 24 VDC
- 2 digital outputs 24 VDC (can be also used as digital inputs)

#### Features

- 1 potentiometer supply  $\pm 10$  V
- The module is equipped with a comparator function, so that it can react quickly to changing analog inputs.

### 14.2.2 Order Data


Model Number	Short Description	Image
3UM161.6	2005 universal mixed module, 1x4 analog inputs $\pm 10$ V, 14-bit, 1x3 analog outputs $\pm 10$ V, 12-bit, 1x14 digital inputs 24 VDC, 1 ms, 1 digital output 24 VDC, 2 A, 500 $\mu$ s, 1 digital output 24 VDC, 10 mA, 10 $\mu$ s, both outputs can be used as inputs. Order 2 x TB718 terminal blocks separately!	
7TB718.9	Accessory terminal block, 18-pin, screw clamp, 1.5 mm <sup>2</sup>	
7TB718.91	Accessory terminal block, 18-pin, cage clamp, 1.5 mm <sup>2</sup>	
7TB718:90-02	Accessory terminal block, 18-pin, 20 pieces, screw clamp, 1.5 mm <sup>2</sup>	
7TB718:91-02	Accessory terminal block, 18-pin , 20 pieces, cage clamp, 1.5 mm <sup>2</sup>	
Terminal blocks are not included in the delivery.		

Table 298: UM161 order data

## 14.2.3 Technical Data

Product ID	UM161
<b>General Information</b>	
C-UL-US Listed	Yes
B&R ID Code	\$99
Module Type	B&R 2005 I/O module
Slot	
Main Rack	Yes
Expansion Rack	Yes
Power Consumption	
5 V	Max. 2 W
24 V	Max. 4 W (+1.5 W for potentiometer supply)
Total	Max. 6 W
<b>Potentiometer Voltage Outputs</b>	
Number and Type of Potentiometer Voltages	1 Potentiometer supply $\pm 10V$
Electrical Isolation to PLC	Yes
Alignment Precision at 25° C	
Total	$\pm 0.4\%$
Temperature Drift	$\pm 0.5 \text{ mV}/^\circ\text{C}$
Load	4 x 1 k $\Omega$ parallel, total of max. 80 mA
Short Circuit Protection	Yes
<b>Analog Inputs</b>	
Number of Inputs	4 differential inputs
Input Signal	
Nominal	-10 to +10 V
Min./Max.	-20 to +20 V
Digital Converter Resolution	14-bit
Data Format	INT
Input Impedance in Signal Range	
Static	>10 M $\Omega$
Dynamic	3 k $\Omega$ /10 nF
Isolation Voltage between Input and Bus	$\pm 50 \text{ V}$
Cut-off Frequency	8 kHz
Conversion Time	<45 $\mu\text{s}$ for all 4 inputs
Maximum Error at 25° C	
Offset	$\pm 4.5 \text{ mV}$
Gain	$\pm 0.05\%$ <sup>1)</sup>
Linearity Error	$\pm 0.9 \text{ mV}$
Temperature Drift	$\pm 1.5 \text{ mV}/^\circ\text{C}$
<b>Analog Outputs</b>	
Number of Outputs	3 voltage outputs
Output Signal	$\pm 10 \text{ V}$

Table 299: UM161 technical data

<b>Product ID</b>	<b>UM161</b>
Digital Converter Resolution	12-bit
Data Format	INT
Load Impedance	≥1 kΩ
Output Response when Power Supply is Switched On/Off	An enable relay is switched on at a defined value of 0 V, Default setting = 10 kΩ between the output terminals using relay contact
Conversion Time	<45 μs for all 3 outputs
Isolation Voltage between Output and Bus	±50 V
Alignment Precision at 25° C	
Offset	±4.9 mV
Gain	±0.2% <sup>1)</sup>
Linearity Error	±19.6 mV
Temperature Drift	±1.2 mV/°C
<b>Digital inputs</b>	
Number of Inputs	16
Type of Inputs	
Channel 1	16-bit event counter or period measurement
Channel 2	Latch input (Comparator input)
Channels 3 -14	Digital inputs
Channels 15 - 16	Digital outputs (can also be used as digital inputs)
Rated Voltage	
Nominal	+24 VDC
Maximum	+30 VDC
Input Current at Nominal Voltage	Approx. 4mA (IEC 1131-2 type 1)
Switching Threshold	
LOW Range	< 5 V
Switching range	5 to 15 V
HIGH Range	> 15 V
Wiring	Sink or source
Counter Input, Input 1	
Rated Frequency	Max. 10 kHz (symmetrical square wave)
Latch Input, Input 2	
Max. Switching Delay	10 μs
Input Delay, Inputs 3 - 16	
Typical	0.6 ms
Maximum	1 ms
Isolation Voltage between Input and Bus	±50 V
Voltage Monitoring	Supply voltage >18 V
<b>Digital Outputs</b>	
Number and Type of Outputs	2 transistor outputs
Rated Current	
Output 1 (Channel 15)	10 mA
Output 2 (Channel 16)	2 A
Rated Voltage	24 VDC

Table 299: UM161 technical data (cont.)

Product ID	UM161
Switching Voltage Range	18 - 30 VDC
Wiring	Source
Short Circuit Protection	Yes
Overload Protection	Yes
Braking Voltage when Switching Off Inductive Loads	59 V
Switching Delay 0 to 1 Output 1 Output 2	Max. 10 µs Max. 500 µs
Switching Delay 1 to 0 Output 1 Output 2	Max. 10 µs Max. 500 µs
Comparator Output Evaluation Reaction Time	Output 1 can be set by the comparator logic < 50 µs
Mechanical Characteristics	
Dimensions	B&R 2005 single-width

Table 299: UM161 technical data (cont.)

1) Refers to the current measurement value.

### 14.2.4 Status LEDs

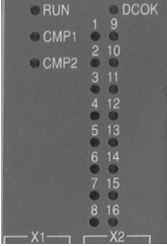
Image	LED	Description
	RUN	Indicates that both the analog/digital converter and digital/analog converter are running.
	DCOK	Lit as long as the supply for the digital inputs is in the defined range (greater than +18 VDC).
	CMP1	Comparator 1 is configured.
	CMP2	Comparator 2 is configured.
	1 - 14	Input state of the corresponding digital inputs.
	15 - 16	Using channels 15 and 16 as digital inputs: Input state of the corresponding digital inputs.
		Using channels 15 and 16 as digital outputs: Control status of the corresponding output. Take note that LEDs are also lit in green in this instance.

Table 300: UM161 status LEDs

### 14.2.5 Connection Elements

Two 18-pin terminal blocks are located next to each other in the lower part of the housing so that all signals can be connected using terminal blocks.

The TB718 terminal blocks are available with screw and cage clamps.

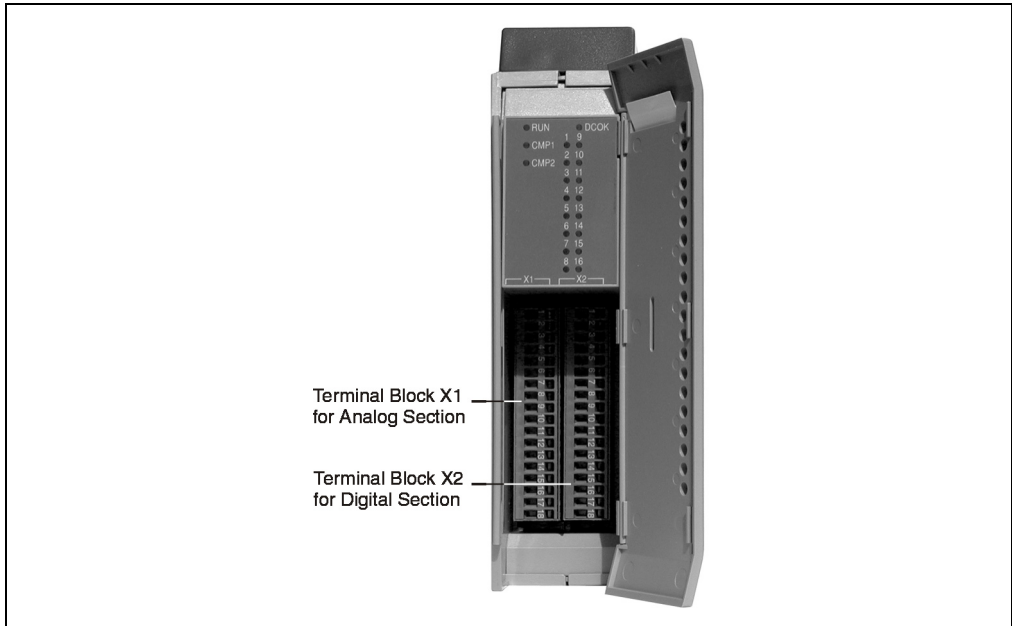


Figure 170: UM161 connection elements

14.2.6 Pin Assignments

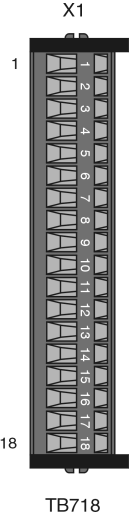
Left 18-pin Terminal Block	Connection	Assignment
	1	Potentiometer voltage +10 V (for channels 1 and 2)
	2	Potentiometer voltage -10 V (for channels 1 and 2)
	3	+ Analog input 1
	4	- Analog input 1
	5	+ Analog input 2
	6	- Analog input 2
	7	Potentiometer voltage +10 V (for channels 3 and 4)
	8	Potentiometer voltage -10 V (for channels 3 and 4)
	9	+ Analog input 3
	10	- Analog input 3
	11	+ Analog input 4
	12	- Analog input 4
	13	+ Analog output 1
	14	- Analog output 1 / GND analog signal
	15	+ Analog output 2
	16	- Analog output 2 / GND analog signal
	17	+ Analog output 3
	18	- Analog output 3 / GND analog signal

Table 301: UM161 pin assignments for terminal block X1

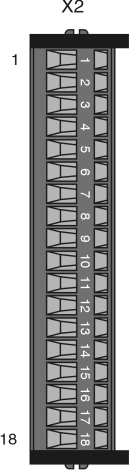
Right 18-pin Terminal Block	Connection	Assignment
 <p data-bbox="308 224 333 240">X2</p> <p data-bbox="258 276 270 292">1</p> <p data-bbox="245 649 270 665">18</p> <p data-bbox="296 711 359 727">TB718</p>	1	Digital input 1 (counter input or period measurement)
	2	Digital input 2 (Latch input)
	3	Digital input 3
	4	Digital input 4
	5	Digital input 5
	6	Digital input 6
	7	Digital input 7
	8	Digital input 8
	9	Digital input 9
	10	Digital input 10
	11	Digital input 11
	12	Digital input 12
	13	Digital input 13
	14	Digital input 14
	15	Digital input 15 or digital output 1 (10 mA)
	16	Digital input 16 or digital output 2 (2 A)
	17	COMs (+24 VDC in sink operation)
	18	COM (GND in sink operation)

Table 302: UM161 pin assignments for terminal block X2

### 14.2.7 Connection Example

#### Analog Inputs/Outputs

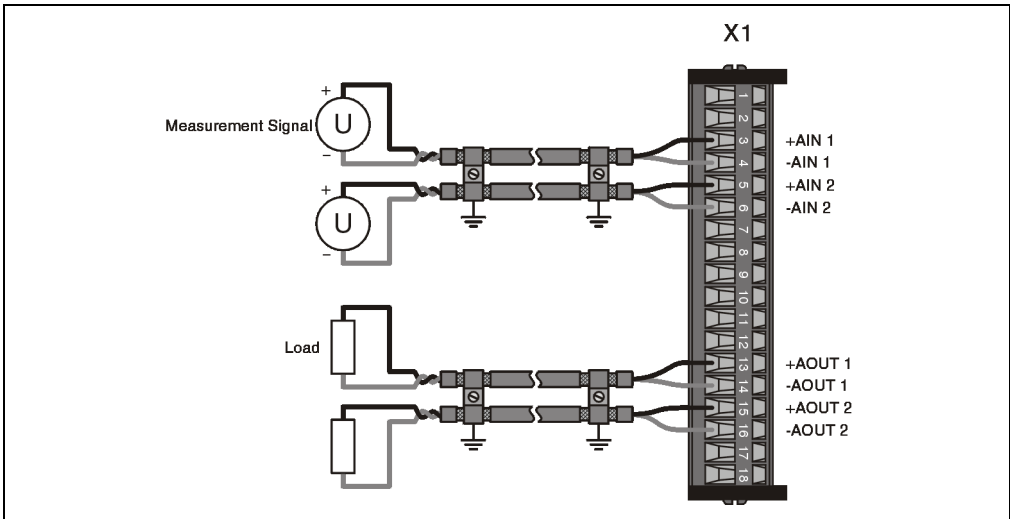


Figure 171: UM161 analog inputs/outputs connection example

#### Potentiometer Connection

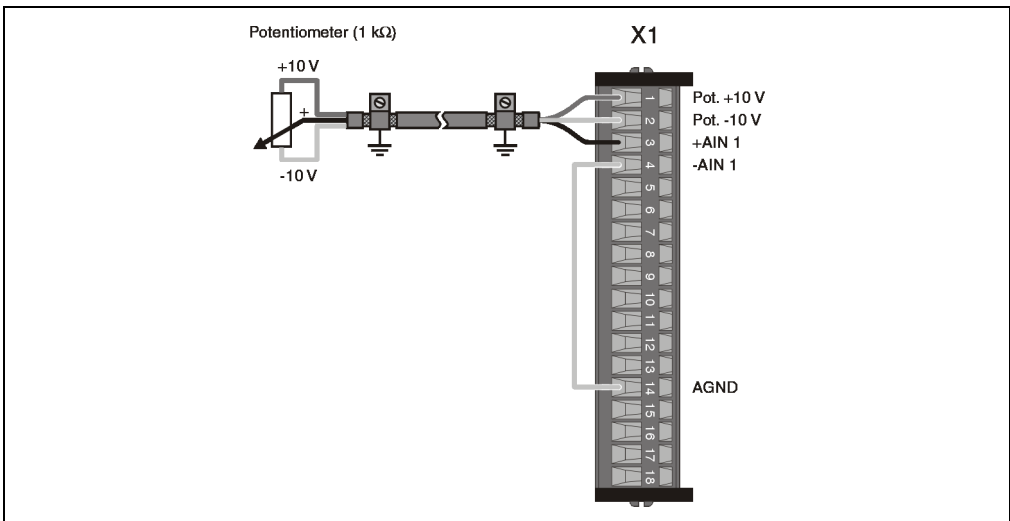


Figure 172: UM161 potentiometer connection example



## Digital Inputs/Outputs

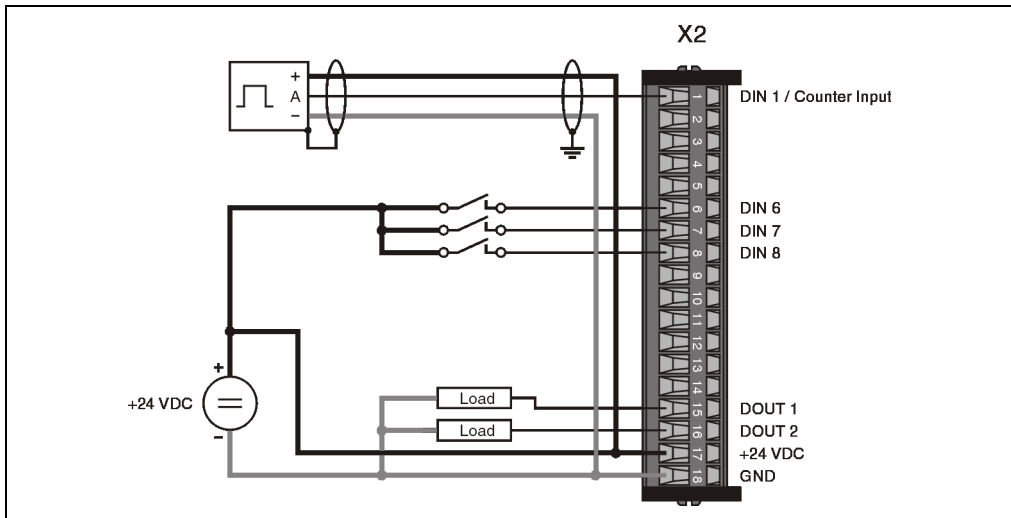


Figure 173: UM161 digital inputs/outputs connection example

### 14.2.8 Input Circuit Diagram

#### Analog Inputs

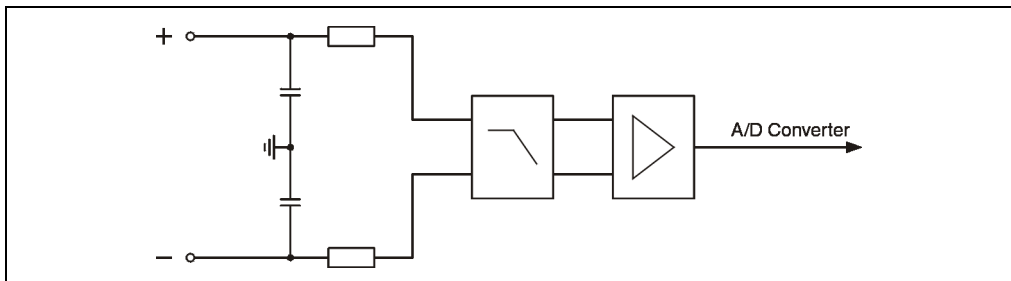


Figure 174: UM161 input circuit diagram analog inputs

## Digital Inputs

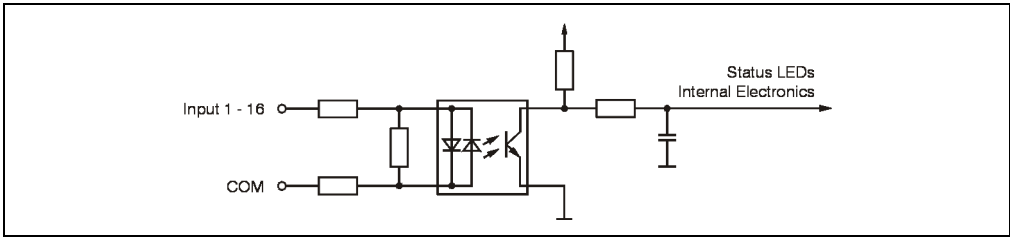


Figure 175: UM161 input circuit diagram digital inputs

## 14.2.9 Output Circuit Diagram

### Analog Outputs

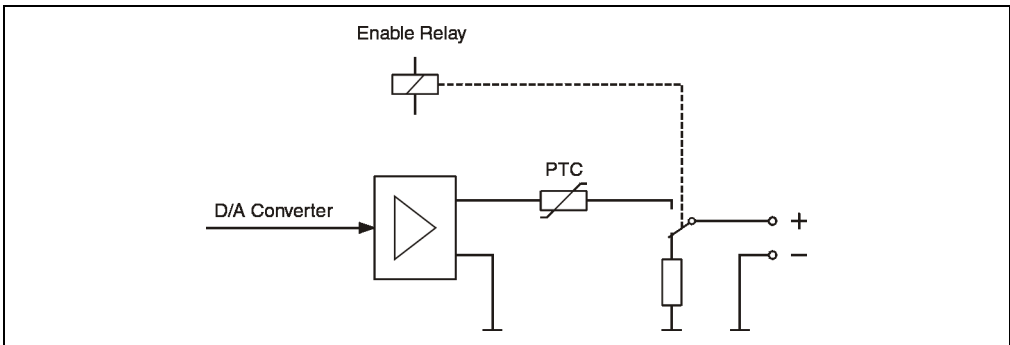


Figure 176: UM161 output circuit diagram analog outputs

### Digital Outputs

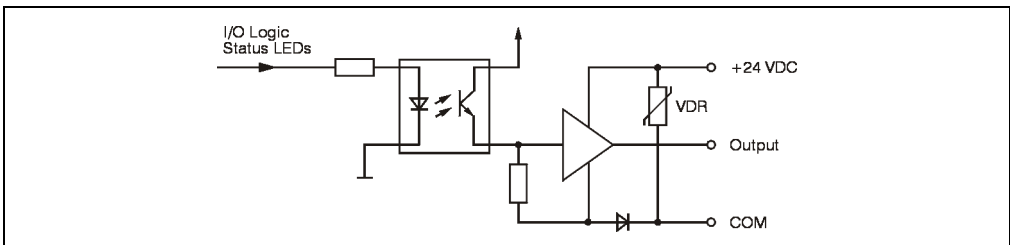


Figure 177: UM161 output circuit diagram digital outputs

### Potentiometer Voltage Outputs

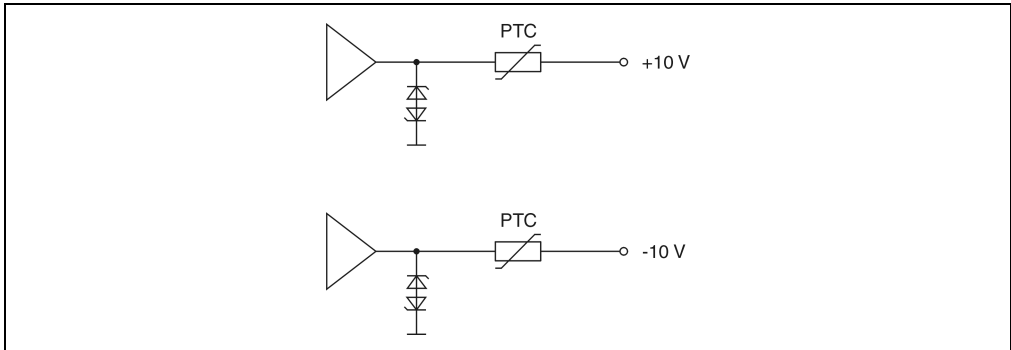


Figure 178: UM161 output circuit diagram potentiometer voltage outputs

### 14.2.10 Relationship between Converter Value and Input / Output Signals

#### Input Voltage $\pm 10$ V

The converter value (INT format) changes in increments of 4 (... , -8, -4, 0, 4, 8, etc.).

Input Voltage	Converter Value	
	Hexadecimal	Decimal
$\leq -10$ V	\$8000	-32768
-1.221 mV	\$FFFC	-4
0 V	\$0000	0
1.221 mV	\$0004	4
$\geq 10$ V	\$7FFC	32764

Table 303: UM161 Relationship between input voltage and converter value

#### Output Voltage $\pm 10$ V

The converter value (INT format) changes in increments of 16 (... , -32, -16, 0, 16, 32, etc.).

Converter Value		Output Voltage
Hexadecimal	Decimal	
$\leq$ \$8080	-32640	-10 V
\$FFF0	-16	-4.902 mV
\$0000	0	0 V
\$0010	16	4.902 mV
$\geq$ \$7F80	32640	10 V

Table 304: UM161 relationship between output voltage and converter value

### 14.2.11 Variable Declarations

The variable declaration is made in B&R Automation Studio™:

Function	Variable Declarations				
	Scope	Data Type	Length	Module Type	Chan.
Single Digital Input (Channel x)	tc_global	BOOL	1	Digit. In	1 ... 16
Single Analog Input (Channel x)	tc_global	INT	1	Analog In	2 ... 5
Comparator 1 Actual Value	tc_global	INT	1	Analog In	6
Comparator 2 Actual Value	tc_global	INT	1	Analog In	7
Event Counter or Period Duration	tc_global	INT	1	Analog In	8
Single digital output (channel x)	tc_global	BOOL	1	Digit. Out	15, 16
Single analog output (channel x)	tc_global	INT	1	Analog Out	2 ... 4
Comparator 1 Comparison Value	tc_global	INT	1	Analog Out	5
Comparator 2 Comparison Value	tc_global	INT	1	Analog Out	6
Comparator 1 Switching Channel	tc_global	INT	1	Analog Out	7
Comparator 2 Switching Channel	tc_global	INT	1	Analog Out	8
Status Register 1: Timestamp for Comparator 1	tc_global	USINT	1	Status In	0
Status Register 2: Timestamp for Comparator 2	tc_global	USINT	1	Status In	1
Status Register 3: Event for Comparator 1	tc_global	USINT	1	Status In	2
Status Register 4: Event for Comparator 2	tc_global	USINT	1	Status In	3
Status Register 5: Timer reference value	tc_global	USINT	1	Status In	6
Mode Register 1: Configuration for Comparator 1	tc_global	USINT	1	Status Out	0
Mode Register 2: Configuration for Comparator 2	tc_global	USINT	1	Status Out	1
Mode Register 3: Acknowledge and Configure Comparator 1 and 2	tc_global	USINT	1	Status Out	3
Mode Register 4: Event counter / period duration	tc_global	USINT	1	Status Out	4

Table 305: UM161 variable declaration

#### Comparator 1 Actual Value

Analog actual value at the time of the comparator event.

#### Comparator 2 Actual Value

Analog actual value at the time of the comparator event.

#### Event counter / period duration

16-bit event counter on digital input 1 or period duration (resolution 10 µs).

### **Comparator 1 Comparison Value**

Determines the comparator threshold for comparator 1.

### **Comparator 2 Comparison Value**

Determines the comparator threshold for comparator 2.

### **Comparator 1 Switching Channel**

After a comparator event, the switching value is output on the corresponding analog output until the event is cleared again.

### **Comparator 2 Switching Channel**

After a comparator event, the switching value is output on the corresponding analog output until the event is cleared again.

### **Status Register 1: Timestamp for Comparator 1**

Timer reference value at the time of the comparator event.

### **Status Register 2: Timestamp for Comparator 2**

Timer reference value at the time of the comparator event.



**Status Register 4: Event for Comparator 2**

Bits 0 - 4 indicate which input the comparator event has triggered. Bit 7 indicates the status of the module supply for the digital component (24 VDC). It has the same status in status registers 3 and 4.

Status Register 4	Bit	Description
	7	0 ..... No supply voltage or supply voltage too low (24 VDC) 1 ..... Supply voltage in the valid range
	6	x
	5	x
	4	0 ..... Comparator 2 not triggered by external latch input 1 ..... Comparator 2 triggered by external latch input
	3	0 ..... Comparator 2 not triggered by analog input 4 1 ..... Comparator 2 triggered by analog input 4
	2	0 ..... Comparator 2 not triggered by analog input 3 1 ..... Comparator 2 triggered by analog input 3
	1	0 ..... Comparator 2 not triggered by analog input 2 1 ..... Comparator 2 triggered by analog input 2
	0	0 ..... Comparator 2 not triggered by analog input 1 1 ..... Comparator 2 triggered by analog input 1
<div style="display: flex; justify-content: space-between; width: 100%;"> <span>7</span> <span>0</span> </div>		

**Status Register 5: Timer reference value**

Free running 8-bit counter. Cycle time 20 μs.

### Mode Register 1: Configuration for Comparator 1

Along with the comparator source, an analog output can also be configured. The switching channel is output immediately by this analog output, when a comparator event occurs. It is also possible to output the switching value on several analog outputs.

Mode Register 1	Bit	Description
	7	0 ..... Switching value 1 not output on analog output 3 1 ..... Switching value 1 output on analog output 3
	6	0 ..... Switching value 1 not output on analog output 2 1 ..... Switching value 1 output on analog output 2
	5	0 ..... Switching value 1 not output on analog output 1 1 ..... Switching value 1 output on analog output 1
	4	0 ..... External latch off 1 ..... External latch triggers comparator 1
	3	0 ..... Comparator 1 analog input 4 off 1 ..... Comparator 1 analog input 4 on
	2	0 ..... Comparator 1 analog input 3 off 1 ..... Comparator 1 analog input 3 on
	1	0 ..... Comparator 1 analog input 2 off 1 ..... Comparator 1 analog input 2 on
	0	0 ..... Comparator 1 analog input 1 off 1 ..... Comparator 1 analog input 1 on



### Mode Register 2: Configuration for Comparator 2

Along with the comparator source, an analog output can also be configured. The switching channel is output immediately by this analog output, when a comparator event occurs. It is also possible to output the switching value on several analog outputs.

Mode Register 2	Bit	Description
	7	0 ..... Switching value 2 not output on analog output 3 1 ..... Switching value 2 output on analog output 3
	6	0 ..... Switching value 2 not output on analog output 2 1 ..... Switching value 2 output on analog output 2
	5	0 ..... Switching value 2 not output on analog output 1 1 ..... Switching value 2 output on analog output 1
	4	0 ..... External latch off 1 ..... External latch triggers comparator 2
	3	0 ..... Comparator 2 analog input 4 off 1 ..... Comparator 2 analog input 4 on
	2	0 ..... Comparator 2 analog input 3 off 1 ..... Comparator 2 analog input 3 on
	1	0 ..... Comparator 2 analog input 2 off 1 ..... Comparator 2 analog input 2 on
	0	0 ..... Comparator 2 analog input 1 off 1 ..... Comparator 2 analog input 1 on

### Mode Register 3: Acknowledge and Configure Comparators 1 and 2

In this register, the digital outputs are configured and the comparator event is acknowledged. The comparator event is reset by writing the bits. That means the analog value is output again on the analog output (no longer the switching value).

Mode Register 3	Bit	Description
	7	0 ..... Comparator 2 not acknowledged 1 ..... Comparator 2 acknowledged
	6	0 ..... Comparator 2 triggers for value > comparison value 1 ..... Comparator 2 triggers for value < comparison value
	5	0 ..... Digital output 14 normal operation 1 ..... Digital output 14 is switched off by comparator event 2
	4	0 ..... Digital output 15 normal operation 1 ..... Digital output 15 is switched on by comparator event 2
	3	0 ..... Comparator 1 not acknowledged 1 ..... Comparator 1 acknowledged
	2	0 ..... Comparator 1 triggers for value > comparison value 1 ..... Comparator 1 triggers for value < comparison value
	1	0 ..... Digital output 14 normal operation 1 ..... Digital output 14 is switched off by comparator event 1
	0	0 ..... Digital output 15 normal operation 1 ..... Digital output 15 is switched on by comparator event 1

### Mode Register 4: Event Counter / Period Duration

The read-out for the digital input 1 can be toggled between event counter and period duration in this register.

Mode Register 4	Bit	Description
	1 - 7	0
	0	0 ..... Period Duration 1 ..... Event Counter