9.6 AT610

9.6.1 Technical Data

Module ID	AT610
General	
Model Number	2AT610.6
Description	2010 Analog Input Module, 16 inputs, temperature sensor, Type L/J/K, -200 to +1300 degrees C, Order terminal blocks separately!
C-UL-US Listed	Yes
B&R ID Code	$25
Base Plate Module	BP200, BP201, BP210
Number of Inputs	16 differential inputs for thermocouples
Distribution Group 1 Group 2 Group 3 Group 4	4 groups Channels 1 - 4 Channels 5 - 8 Channels 9 - 12 Channels 13 - 16
Input Signal Nominal Allowed	 -15 to +55 mV -20 to +20 V
Differential Input Resistance	>1 MΩ
Input Filter	Bessel low pass 2nd order, cutoff frequency 8 Hz, Measured using NOTCH characteristic method (according to measurement time)
Common Mode Rejection	80 dB (DC) 75 dB (50 Hz)
Max. Modulation Compared to Ground between 2 Elect. Isolated Groups	 ±50 V ±50 V
Common Mode Control between Two Channels in a Group	±9 V

Module ID	AT610
Electrical Isolation	
Input - PCC	Yes
Group 1 - Group 3	No
Group 2 - Group 4	No
Groups 1+3 - Groups 2+4	Yes
Input - Input (same group)	No
Measurement Procedure	
Conversion Principle	Integrated (voltage / frequency converter)
Measurement Time per Channel	Can be set to 20 msec / 16.67 msec / 10 msec / 8.33 msec (AT610 operation)
Resolution	Internal >14 Bit (23841 internal ADC converter values at 20 msec)[1]
Quantization	
Internal	2.936 µV
Output	0.1 °C (temperature measurement) 2.0 µV (scaled voltage raw value)
Internal Reference Junction	
Temperature Determination	Temperature profile measurement in module with four temperature sensors Reference junction temperature determined for each channel separately
Measurement Precision (natural convection)	Max. ±4 °C over entire environmental temperature range (0 to 60 °C) Typ. +3 °C / -1 °C at 25 °C environmental temperature
Repeat Precision	±0.1 °C
Status Display	
Terminal ok	Red
RUN LED	Green
10 Status LEDs	Yellow
Operating Modes	AT600 compatible (standard setting) AT610
Power Consumption	Max. 8 W
Dimensions (H, W, D) [mm]	285, 40, 185

Operating Mode	AT610			
Set per Group[2]				
Sensor				
Model	FeCuNi	FeCuNi	NiCrNi	Raw Value Measurement
Type	L	J	K	----
Standard	DIN 43710	DIN IEC 584	DIN IEC 584	Scaled to 2 µV
Measurement Voltage Range	-8.15 to 53.14 mV[2]	-7.89 to 54.95 mV[2]	-5.891 to 52.398 mV[2]	-15 to +55 mV
Measurement Range in 0.1 °C Steps	-200.0 to +900.0 °C	-200.0 to +950.0 °C	-200.0 to +1300.0 °C	According to sensor
Linearization	Yes	Yes	Yes	in CPU
Reference Junction Measurement				
Internal	-20 to +90 °C			Can be read
External	-100 to +200 °C (can be set)			----

Conversion Time	
Measurement Time per Conversion	Can be set to 20 msec / 16.67 msec / 10 msec / 8.33 msec
Calculation Time per Channel Pair	6 msec
Measurement Time for Internal Reference Junction	26 msec

Maximum Cycle Time

	50 Hz	60 Hz
8 * (meas. time per conversion + calc. time)	8 * (20 + 6) msec	8 * (16.67 + 6) msec
Reference junction meas. (if activated)	26 msec	26 msec
Results in a cycle time of	234 msec	207.36 msec

Module ID	AT610
Basic Precision at 25 °C	±25 µV (±0.036 %) [3]
Offset Drift	±1.1 µV/°C (±0.0016 %/°C) [4]
Gain Drift	±0.006 %/°C [5]
Repeat Precision (meas. time 20 msec)	±0.008 % [4]
Operating Mode	**AT600**
Sensor Model Type Standard Measurement Range in 0.1 °C Steps Linearization Terminal Temperature Compensation	 FeCuNi L DIN 43710 -50.0 to +750.0 °C Yes -20 to +90 °C from internal reference junction measurement
Conversion Time Measurement Time per Conversion Maximum Cycle Time	 20 msec 235 msec

[1] The internal resolution is different according to the measurement time, but the conversion value is scaled to 20 msec. This means that value changes are avoided when setting measurement times!

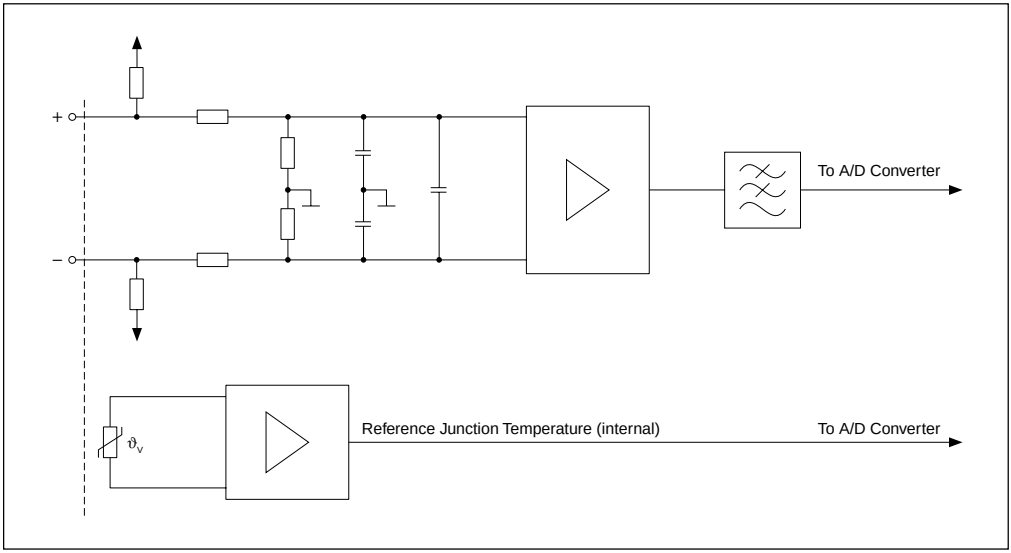
[2] Scaled to 0 °C reference junction temperature.

[3] Without consideration for reference junction measurement errors.

[4] Refers to the measurement range of 70 mV.

[5] Refers to the current measurement value.

9.6.2 Input Circuit



9.6.3 Status LEDs

In the AT600 operating method only the terminal status LED and the RUN LED are active.

—< ●— Indicates the terminal block status i.e when the LED lights no terminal block connected to the module or that the terminal block is not connected properly.

RUN Indicates that the analog/digital converter is running.

60Hz This LED indicates which Enable time is switched on. When this LED is lit, the Enable time is set to 16.67 msec through which 60 Hz mains hum is filtered out. Otherwise a Enable time of 20 msec is selected.
The Enable time is valid for all 16 channels.

Default: 50 Hz; 60Hz LED not lit

τ/2 The LED is indicates that half the Enable time is set.
When this LED lights, the Enable time required is 10 msec or 8.33 msec (independent of whether the 60Hz LED lights or not).

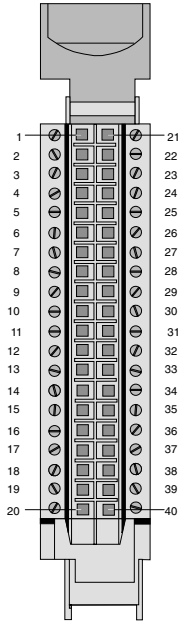
Default: Full Enable time; τ/2 LED not lit

ϑxA/ϑxB These LEDs show the temperature sensor type setting for group x (1 - 4).

Default: Sensor type L; ϑxA/ϑxB LEDs not lit

ϑ4		ϑ3		ϑ2		ϑ1		Sensor Type
B	A	B	A	B	A	B	A	
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	L - Default or false setting in mode register 2
OFF	ON	OFF	ON	OFF	ON	OFF	ON	J
ON	OFF	ON	OFF	ON	OFF	ON	OFF	K
ON	ON	ON	ON	ON	ON	ON	ON	U invalid status (Error)

9.6.4 Terminal Assignments



TB140

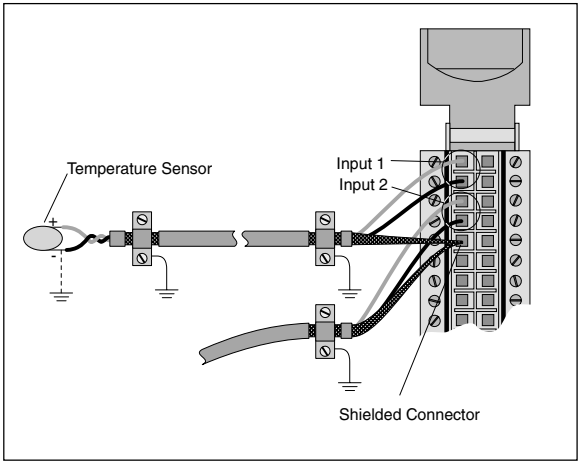
Terminal	Description		Terminal	Description	
1	+ Sensor Input 1	Group 1	21	+ Sensor Input 9	Group 3
2	- Sensor Input 1		22	- Sensor Input 9	
3	+ Sensor Input 2		23	+ Sensor Input 10	
4	- Sensor Input 2		24	- Sensor Input 10	
5	Shield		25	Shield	
6	+ Sensor Input 3		26	+ Sensor Input 11	
7	- Sensor Input 3		27	- Sensor Input 11	
8	+ Sensor Input 4		28	+ Sensor Input 12	
9	- Sensor Input 4		29	- Sensor Input 12	
10	Shield		30	Shield	
11	+ Sensor Input 5	Group 2	31	+ Sensor Input 13	Group 4
12	- Sensor Input 5		32	- Sensor Input 13	
13	+ Sensor Input 6		33	+ Sensor Input 14	
14	- Sensor Input 6		34	- Sensor Input 14	
15	Shield		35	Shield	
16	+ Sensor Input 7		36	+ Sensor Input 15	
17	- Sensor Input 7		37	- Sensor Input 15	
18	+ Sensor Input 8		38	+ Sensor Input 16	
19	- Sensor Input 8		39	- Sensor Input 16	
20	Shield		40	Shield	

Connecting the Signal Cable

Shielded cable must be used for all temperature sensor connections. The shielding is done for two inputs at a time to the shield connection provided on the terminal block. For several thermocouple elements the sensor negative pin is grounded which does not affect the Enables one way or the other.

Open inputs should be closed for grounding reasons.

The eight shielded connections are equally rated and connected through 100 Ω resistors to ground (⏚, i.e contact spring and mounting rail).



Effect of Compensation Cable Lengths

Measurement errors are typically brought about by incorrectly selected cable resistance. With a cable resistance of 40 Ω (that requires a cable length of approx. 40 m) the measurement error amounts to 9 µV (respectively 0.013 % of the measurement range).

9.6.5 Variable Declaration

Operating Mode AT600

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single analog input (channel x)	tc_global	INT16	1	Analog In	1 ... 16
Status register AT600	tc_global	BYTE	1	Status In	0
Enable over range register for inputs 1 to 8	tc_global	BYTE	1	Status In	2
Enable over range register for inputs 9 to 16	tc_global	BYTE	1	Status In	3
Enable under range register for inputs 1 to 8	tc_global	BYTE	1	Status In	4
Enable under range register for inputs 9 to 16	tc_global	BYTE	1	Status In	5
Mode register 1	tc_global	BYTE	1	Status Out	8
Status register 1	tc_global	BYTE	1	Status In	8

Operating Mode AT610

Function	Variable Declaration				
	Scope	Data Type	Length	Module Type	Channel
Single analog input (channel x)	tc_global	INT16	1	Analog In	1 ... 16
Single analog input as standard raw value (channel x)	tc_global	INT16	1	Analog In	33 ... 48
Reference junction temperature in 0,1 °C single steps (channel x)	tc_global	INT16	1	Analog In	49 ... 64
Instruct ext. reference junction temperature in 0.1 °C steps (channel x)	tc_global	INT16	1	Analog Out	1 ... 16
Status register AT600	tc_global	BYTE	1	Status In	0
Modus register 1	tc_global	BYTE	1	Status Out	8
Modus register 2	tc_global	BYTE	1	Status Out	9
Modus register 4	tc_global	BYTE	1	Status Out	11
Status register 1	tc_global	BYTE	1	Status In	8
Status register 2	tc_global	BYTE	1	Status In	9
Status register 4	tc_global	BYTE	1	Status In	11

Operating Mode

The AT600 operating method is set after switching on or after a reset. In this operating status no mode setting except the switching of AT610 in mode register 1 can be carried out.

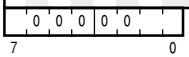
The AT610 module can replace the AT600 temperature input module in the existing application without changing the application program.

When a module is set in the AT610 operating mode, no further mode changes are possible.

Mode Register 1 (AT600 and AT610)

Bits 2 - 6 must always be set to 0 !

MODE REGISTER 1 WRITE	Bit	Description
	7	τ/2 - Half Enable time
	6	0
	5	0
	4	0
	3	0
	2	0
	1	AT610 - Change operating method from AT600 -> AT610
	0	τ - Enable time 16.67 msec



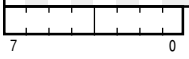
τ 0 ..... Enable time per channel 20 msec (default)
50 Hz mains hum is filtered out
1 ..... Enable time per channel 16.67 msec
60 Hz mains hum is filtered out
No relevance for AT600 operating mode

τ/2 0 ..... Enable time is 20 msec or 16.67 msec dependent on Bit 0 (default).
1 ..... Half Enable time: Enable time is 10 msec or 8.33 msec dependent on Bit 0.
No relevance for AT600 operating mode

AT610 0 ..... Operating mode AT600 (default)
1 ..... Operating mode AT610
Only one change of operating mode is possible.

Mode Register 2 (AT610)

MODE REGISTER 2 WRITE	Bit	Description
	7	ϑ4B - Sensor type for group 4 (channel 13 - 16)
	6	ϑ4A - Sensor type for group 4 (channel 13 - 16)
	5	ϑ3B - Sensor type for group 3 (channel 9 - 12)
	4	ϑ3A - Sensor type for group 3 (channel 9 - 12)
	3	ϑ2B - Sensor type for group 2 (channel 5 - 8)
	2	ϑ2A - Sensor type for group 2 (channel 5 - 8)
	1	ϑ1B - Sensor type for group 1 (channel 1 - 4)
	0	ϑ1A - Sensor type for group 1 (channel 1 - 4)



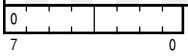
ϑ4		ϑ3		ϑ2		ϑ1		Sensor Type
B	A	B	A	B	A	B	A	
0	0	0	0	0	0	0	0	L (default)
0	1	0	1	0	1	0	1	J
1	0	1	0	1	0	1	0	K
1	1	1	1	1	1	1	1	U invalid sensor type. Distribution: -3276.8

Mode Register 4 (AT610)

Selective switching off of channels (disable) or the compensation temperature reduces the cycle time.

Bit 7 must be set to 0 !

MODE REGISTER 4 WRITE	Bit	Description
	7	0
	6	$COMP_{ext3+4}$ - Compensation temp external groups 3 and 4
	5	$KOMP_{ext1+2}$ - Compensation temp external group 1 and 2
	4	T_{Comp} - Disable update function for internal compensation
	3	C4/8/12/16 - Disable channels 4, 8, 12 and 16
	2	C3/7/11/15 - Disable channels 3, 7, 11 and 15
	1	C2/6/10/14 - Disable channels 2, 6, 10 and 14
	0	C1/5/9/13 - Disable channels 1, 5, 9 and 13



C1/5/9/13
0 ..... Enable channels 1, 5, 9 and 13 (default)
1 ..... Disable channels 1, 5, 9 and 13
The last enabled value is still received

C2/6/10/14
0 ..... Enable channels 2, 6, 10 and 14 (default)
1 ..... Disable channels 2, 6, 10 and 14
The last enabled value is still received

C3/7/11/15
0 ..... Enable channels 3, 7, 11 and 15 (default)
1 ..... Disable channels 3, 7, 11 and 15
The last enabled value is still received

C4/8/12/16
0 ..... Enable channels 4, 8, 12 and 16 (default))
1 ..... Disable 4, 8, 12 and 16
The last enabled value is still received

T_{Comp}
0 ..... The internal compensation temperature (terminal block temperature) is permanently updated (default)
1 ..... The internal compensation temperature is no longer updated. The last enabled value is still received and used for terminal block compensation.

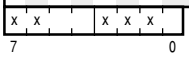
$COMP_{ext\ 1+2}$
0 ..... Internal compensation is updated (terminal block temperature compensation is used- default)
1 ..... External compensation is updated (valid for groups 1 and 2).
When this operating method is selected, firmware does not use the measurement from the modules sensor for compensation. It is set instead of the value given by the user. These values are written in 0.1 °C steps in "Analog Out" channels 1 - 16 in the I/O range.

$COMP_{ext\ 3+4}$
0 ..... Internal compensation is updated (terminal block temperature compensation is used- default)
1 ..... External compensation is active (valid for groups 3 and 4).
When this operating method is selected, firmware does not use the enable from the modules sensor for compensation. It is set instead of the value given by the user. These values are written in 0.1 °C steps in "Analog Out" channels 1 - 16 in the I/O range.

Status Register AT600 Operating Modes (AT600 and AT610)

This Byte includes the status when operating mode AT600 is set. In operating mode AT610, the terminal status can only be evaluated with Bit 0. Bits 4 and 5 are always 0 in At610 mode !

STATUS REGISTER AT600 READ	Bit	Description
	7	x
	6	x
	5	OVR - Measurement Over Range
	4	UNR - Measurement Under Range
	3	x
	2	x
	1	x
	0	FKL - Terminal Status



FKL 0 ..... The terminal block is connected properly.
1 ..... No terminal block is connected.

UNR 0 ..... No Measurement Under-Range. The temperature values of all inputs are above the lower limit of the measurement range (-50 °C).
1 ..... Measurement Under-Range. The temperature values of at least one input is below (-50 °C).
Not applicable for AT600

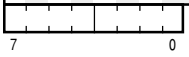
OVR 0 ..... No Measurement Over-Range. The temperature values of all inputs are below the upper limits of the measurement range (750 °C).
1 ..... Measurement Over-Range. The temperature values of at least one input have exceeded (750 °C). An open input or a broken contact will also cause a log. 1 in this bit.
Not applicable for AT600

Measurement Over Range Register for Inputs 1 to 8 (AT600)

Measurement over range: Temperature value ≥ +750.0 °C

In the AT600 operating mode, the respective Bit is set when one of the inputs 1 to 8 has a measurement over range. In AT610 all Bits are always 0!

REGISTER READ	Bit	Description	0	1
	7	Input 8: Measurement Over Range	No	Yes
	6	Input 7: Measurement Over Range	No	Yes
	5	Input 6: Measurement Over Range	No	Yes
	4	Input 5: Measurement Over Range	No	Yes
	3	Input 4: Measurement Over Range	No	Yes
	2	Input 3: Measurement Over Range	No	Yes
	1	Input 2: Measurement Over Range	No	Yes
	0	Input 1: Measurement Over Range	No	Yes

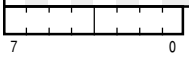


Measurement Over Range Register for Inputs 9 to 16 (AT600)

Measurement over range: Temperature value ≥ +750.0 °C

In the AT600 operating mode, the respective Bit is set when one of the inputs 9 to 16 has a measurement over range. In AT610 all Bits are always 0!

REGISTER READ	Bit	Description	0	1
	7	Input 16: Measurement Over Range	No	Yes
	6	Input 15: Measurement Over Range	No	Yes
	5	Input 14: Measurement Over Range	No	Yes
	4	Input 13: Measurement Over Range	No	Yes
	3	Input 12: Measurement Over Range	No	Yes
	2	Input 11: Measurement Over Range	No	Yes
	1	Input 10: Measurement Over Range	No	Yes
	0	Input 9: Measurement Over Range	No	Yes

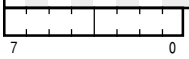


Measurement Under Range Register for Inputs 1 to 8 (AT600)

Measurement over range: Temperature value ≤ -50.0 °C

In the AT600 operating mode, the respective Bit is set when one of the inputs 1 to 8 has a measurement over range. In AT610 all Bits are always 0!

REGISTER READ	Bit	Description	0	1
	7	Input 8: Measurement Under Range	No	Yes
	6	Input 7: Measurement Under Range	No	Yes
	5	Input 6: Measurement Under Range	No	Yes
	4	Input 5: Measurement Under Range	No	Yes
	3	Input 4: Measurement Under Range	No	Yes
	2	Input 3: Measurement Under Range	No	Yes
	1	Input 2: Measurement Under Range	No	Yes
	0	Input 1: Measurement Under Range	No	Yes

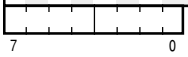


Measurement Under Range Register for Inputs 9 to 16 (AT600)

Measurement under range: Temperature value ≤ -50.0 °C

In the AT600 operating mode, the respective Bit is set when one of the inputs 9 to 16 has a measurement over range. In AT610 all Bits are always 0!

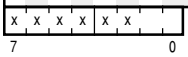
REGISTER	READ	Bit	Description	0	1
		7	Input 16: Measurement Under Range	No	Yes
		6	Input 15: Measurement Under Range	No	Yes
		5	Input 14: Measurement Under Range	No	Yes
		4	Input 13: Measurement Under Range	No	Yes
		3	Input 12: Measurement Under Range	No	Yes
		2	Input 11: Measurement Under Range	No	Yes
		1	Input 10: Measurement Under Range	No	Yes
		0	Input 9: Measurement Under Range	No	Yes



Status Register 1 (AT600 and AT610)

Status register 1 can be evaluated in both operating modes.

STATUS REGISTER 1	READ	Bit	Description
		7	x
		6	x
		5	x
		4	x
		3	x
		2	x
		1	AT610 - AT610 operating mode
		0	IERR - Module error



IERR 0 ..... Data value in the Dual Ported RAM corresponds to the definition.
1 ..... There is an internal error. This means that the data value in the Dual Ported RAM does not correspond to the definition. If this occurs, please contact B&R.

AT610 0 ..... Operating mode AT600
1 ..... Operating mode AT610

Status Registers 2 and 4

The settings for mode registers 2 and 4 are given again in mode registers 2 and 4. The settings become valid when the status register corresponds to the mode register.

Status Register 2 (AT610)

STATUS REGISTER 2 READ	Bit	Description
	7	ϑ4B - Sensor type for group 4 (channel 13 - 16)
	6	ϑ4A - Sensor type for group 4 (channel 13 - 16)
	5	ϑ3B - Sensor type for group 3 (channel 9 - 12)
	4	ϑ3A - Sensor type for group 3 (channel 9 - 12)
	3	ϑ2B - Sensor type for group 2 (channel 5 - 8)
	2	ϑ2A - Sensor type for group 2 (channel 5 - 8)
	1	ϑ1B - Sensor type for group 1 (channel 1 - 4)
	0	ϑ1A - Sensor type for group 1 (channel 1 - 4)

7 0

Status Register 4 (AT610)

STATUS REGISTER 4 READ	Bit	Description
	7	x
	6	$COMP_{ext3+4}$ - Compensation temp. external Groups 3 and 4
	5	$COMP_{ext1+2}$ - Compensation temp. external Groups 1 and 2
	4	T_{Comp} - Disable function for internal compensation update
	3	C4/8/12/16 - Disable channels 4, 8, 12 and 16
	2	C3/7/11/15 - Disable channels 3, 7, 11 and 15
	1	C2/6/10/14 - Disable channels 2, 6, 10 and 14
	0	C1/5/9/13 - Disable channels 1, 5, 9 and 13

x

7 0

9.6.6 AT600 Value Range

Measurement Point Temperature	
Temperature Range	Sensor type L: -500 to +7500 [0.1 °C]
Measurement Under Range	-500
Measurement Over Range	+7500
Sensor Break	+7500
Under Range compensation temperature	-500
Over Range compensation temperature	+7500
General Error	-32768

9.6.7 AT610 Value Range

Measurement Point Temperature	
Temperature Range	Sensor L: -2000 to +9000 [0.1 °C] Sensor J: -2000 to +9500 [0.1 °C] Sensor K: -2000 to +13000 [0.1 °C]
Measurement Under Range	-32767
Measurement Over Range	+32767
Broken Sensor	+32767
Range Exceed Compensation Temperature	-32768
General Error	-32768
ADC Raw Value for Voltage Measurement Range -15 mV to +55 mV	
Thermo Voltage Raw Value	-7500 to +27500 [2 µV]
Measurement Under Range	-32767
Measurement Over Range	+32767
Broken Sensor	+32767
General Error	-32768
Compensation Temperature (Internal or Default)	
Temperature Range	Internal: -200 to +900 [0.1 °C] Default: -1000 to +2000 [0.1 °C]
Measurement Over/Under Range Exceeded	Internal: An over/under range on a measurement point results in -32768 (error value) on all channels Default: An over/under range on a channel results in -32768 reading on that channel
General Error	-32768

9.6.8 Measurement Range Monitoring

1) Reasons for a Measurement Over Range

AT600: Registered value +7500
AT610: Registered value +32767

- ❍ No temperature sensor connected or broken sensor
- ❍ The input voltage brought about by the temperature sensor is bigger than the:
  a) Voltage measurement range
  b) Temperature sensor range

AT600 only

- ❍ Compensation temperature under range

2) Reasons for a Measurement Under Range

AT600: Registered value-500
AT610: Registered value -32767

- ❍ The input voltage brought about by the temperature sensor is smaller than the:
  a) Voltage measurement range
  b) Temperature sensor range

AT600 only

- ❍ Compensation temperature over range

AT610 only

- ❍ A non-permitted temperature sensor is set (see mode register 2)
- ❍ Positive or negative measurement exceeding of the internal or external comparison temperature

3) Short Circuit Monitoring

A short circuit is a valid operating status (0 mV). Therefore, this error status must be confirmed by carrying out a plausibility test in the application program.
B&R recommends carrying out plausibility monitoring through additional logic when 0 °C is also recorded in the application operating range.
Example: When the heating of $\Delta t = n$ sec is turned on, the temperature must increase by 2 °C (experimental value, that can also be determined adaptively).

9.6.9 Installation Instructions

- ❍ Artificial convection reduces the internal compensation temperature by raising the ambient temperature of the AT610 (by approx. ±2 °C).
- ❍ For EMV reasons it is recommended to jumper any open inputs.
- ❍ The AT610 reaches the correct operating temperature for determining the compensation temperature 5 minutes after turning on the controller. The declared measurement precision becomes valid at this point.

9.6.10 Internal Measurement Processing

A scaled raw value is created from the input voltage which has a linear relationship to the input voltage. The thermo element temperature (for the given thermocouple type) is calculated from this raw value, taking the reference junction temperature into consideration. Reference junction compensation and liniarization are carried out internally.

The reference junction temperature is calculated individually for each module channel. The required temperature measurement is carried out using four separate temperature sensors positioned along the terminal block. The reference junction temperature value can be read in the AT610 operating mode.

It is also possible to enter a reference junction temperature value for each channel which is used for the internal reference junction compensation instead of the measured value ("external reference junction"). Operating with external reference junction is only possible in the AT610 operating mode and can be set separately for two groups.

This results in the following special modes of operation

a) A thermo element other than the defined types (J, K, L) is connected. The thermo element temperature is calculated in an application program (main CPU) using the raw value and the reference junction temperature measured on the module (for each channel).

b) It is necessary to install an external reference junction (especially for long cables). However, the thermo element temperature should still be determined on a AT610 module.
The thermo element voltage is connected from the external reference junction to the terminal of the AT610 using copper cable which stores the temperature measured on the external reference junction (e.g. with PT100 - AT300) in the AT610 module's IO area. The AT610 internally calculates the desired thermo element temperature from the measured voltage and the reference junction temperature (per channel).