

Chapter 10

07CR42 / 07CT42

07CR42 / 07CT42

This chapter gives you an introduction to the AC 31 automation, from the overall architecture to the operational rules of the 07CR42 and 07CT42 central units.

1. Presentation

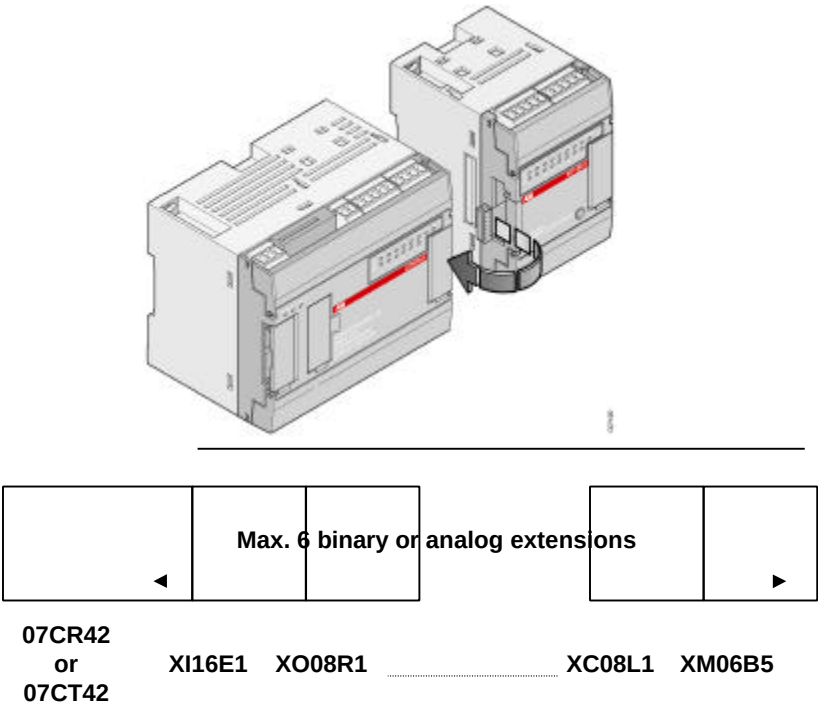
The 07CR42 and 07CT42 central units bring accessibility to beginners and experienced automation users alike, for any application with 14 to 110 inputs / outputs, using the same set of basic components.

It is therefore possible to realize applications throughout a site, a workshop, or a machine where each component (input / output unit, central unit) is close to the sensors / actuators. All information from the sensors is sent after processing by the central unit to the actuators. The following communication interfaces are available, to extend the AC 31's possibilities and integration with the company's other automation systems: MODBUS®, ASCII.

2. General set-up rules

An ABB AC 31 system always includes an AC 31 central unit.

Each 07CR42 and 07CT42 central units incorporate a specific number of binary inputs / outputs and analog inputs. It is possible, to increase the number of inputs / outputs, to add input / output extensions connected directly to the 07CR42 and 07CT42 central units.



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3. References

Products	Description	References
Central units		
07 CR 42 - 24VDC	Extensible stand-alone central unit, with 8 isolated inputs 24 V d.c. and 6 incorporated relay outputs 250 V a.c. / 2 A and 3 analog inputs with 2 voltage inputs +/- 10 V and 1 temperature input RS232 interface for programming or ASCII or MODBUS® communication 24 V d.c. power supply.	1SBP260023R1001
07 CR 42 - 120/230VAC	Extensible stand-alone central unit, with 8 isolated inputs 24 V d.c. and 6 incorporated relay outputs 250 V a.c. / 2 A and 3 analog inputs with 2 voltage inputs +/- 10 V and 1 temperature input RS232 interface for programming or ASCII or MODBUS® communication 24 V d. c. power supply output to power inputs 120 / 230 V a.c. power supply	1SBP260024R1001
07 CT 42 - 24VDC	Extensible stand-alone central unit, with 8 isolated inputs 24 V d.c. and 6 incorporated transistor outputs 24 V d.c. / 0.5 A and 3 analog inputs with 2 voltage inputs +/- 10 V and 1 temperature input RS232 interface for programming or ASCII or MODBUS® communication 24 V d.c. power supply	1SBP260025R1001

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4. Technical specification

4.1. General characteristics

	07 CR 42 24 V d.c.	07 CT 42 24 V d.c.	07 CR 42 120/230 V a.c.
Number of I/O - Incorporated binary inputs - Incorporated binary outputs - Incorporated analog inputs - Analog potentiometers - Maximum number of extension units per central unit - Max. number of binary inputs - Max. number of binary outputs - Max. number of analog inputs - Max. number of analog outputs	8 6 3 2 6 104 54 51 12		
Interfaces - CS 31 interface - Interface for: Programming MODBUS® or ASCII	- no 1 RS 232		
Memory - User program memory size: - without ONLINE - with ONLINE - User program memory and the constants - Data memory - Data backup: - Backup autonomy - Charge time under power	17 000 words (typically: 8.5 kInstructions) 8 000 words (typically: 4 kInstructions) - Flash Eprom - SRAM - yes with battery 20 days at 25°C 100% in 12 h		
Weight	400 g		800 g

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4.2. Functionality and programming

	07 CR 42 24 V d.c.	07 CT 42 24 V d.c.	07 CR 42 120/230 V a.c.
- Execution time for 1kbytes: 100% binary instructions 65% binary, 35 % words - Internal bits - Internal words - Internal double words - Chain steps - Word constants - Double word constants - Timers - Time range - Counters - Counter range - High speed counter function: - Incremental encoder - Stand-alone counter - Interruptions: - by alarm (on rising edge) - cyclic - max length - Command output of step motor with frequency modification (cyclic ratio = 50%) - User program protection in the central unit - Clock Drift (typical)	0.4 ms 1.2 ms 2016 2016 128 2016 496 127 42 simultaneously - from 1 ms to 596 h 30 (24 days + 20 h 30) - unlimited - 32767 to + 32767 1 with max frequency 5 kHz on the I62.00 and I62.01 inputs 2 at 7 kHz on the I62.00 and I62.01 inputs 250 µs delay 2 on the I62.02 and I62.03 inputs 1 (from 1 ms to 2 s) 3 ms 10 Hz to 2.66 kHz - yes with password 4.3 min / month at 25°C		
- Programming software - Programming language - Program execution - Sub-program: - Level - Operation set: - Basic functions - Advanced functions	AC31GRAF under Windows® (IEC 1131-3) FBD/LD : Function blocks and ladder diagrams Quick LD: Ladder diagram IL: Instruction list SFC: Sequential function chart sequential triggered by clock or triggered by alarm (interruptions) 12 1 Boolean, arithmetic, comparison over 80		

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4.3. Power supply

	07 CR 42 24 V d.c.	07 CT 42 24 V d.c.	07 CR 42 120/230 V a.c.
Power supply			
- Power supply voltage:			
Nominal value	24 V d.c.		120 / 230 V a.c.
Admissible range	19.2 to 30 V		97.75 to 126.5 V or 195.5 to 253 V
- Consumption:			
central unit alone typical.	120 mA		60/30 mA
Maximum configuration typical.	400 mA		100 mA
- Polarity reversal protection	yes		no
- 24 V d.c. isolated power for the inputs:	no		yes
Voltage range	-		19.2 to 30 V
Output current	-		400 mA
Short circuit protection	-		yes
- Dissipation	5 W (6 W for 07 CT 42)		10 W

4.4. Incorporated binary inputs

	07 CR 42 24 V d.c.	07 CT 42 24 V d.c.	07 CR 42 120/230 V a.c.
- Number of inputs	8	8	8
- Isolation of inputs / electronic	1500 V a.c.	1500 V a.c.	1500 V a.c.
- Input types	PNP or NPN	PNP or NPN	PNP or NPN
- Input voltage:			
Nominal value	24 V d.c.	24 V d.c.	24 V d.c.
Signal at 0 (IEC 1131-2)	0 to + 5 V	0 to + 5 V	0 to + 5 V
Signal at 1 (IEC 1131-2)	+ 15 to + 30 V	+ 15 to + 30 V	+ 15 to + 30 V
- Input current at 24 V d.c.:			
Inputs I62.02 to I62.07	7 mA	7 mA	7 mA
Inputs I62.00 and I62.01	9 mA	9 mA	9 mA
- Filtering time:			
Standard input	5 ms	5 ms	5 ms
Input with counter configuration	70 µs	70 µs	70 µs
Input with interruption configuration	90 µs	90 µs	90 µs
- Cable length:			
Unshielded (not for the high speed counter inputs)	300 m	300 m	300 m
Shielded	500 m	500 m	500 m
Non standard inputs	50 m	50 m	50 m

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4.5. Incorporated binary outputs

	07 CR 42 24 V d.c.	07 CT 42 24 V d.c.	07 CR 42 120/230 V a.c.
- Number of outputs	6 relays	6 transistors	6 relays
- Isolation of the outputs / electronic	1500 Vrms 1 min	1500 V a.c.	1500 Vrms 1 min
- Total charging current under voltage:			
direct 24 V d.c.			
resistive load / inrush current	2 A / 5 A	1 A for	2 A / 5 A
L / R = 20 ms	2 A	O62.00 and	2 A
L / R = 30 ms	1 A	O62.01 and	1 A
L / R = 40 ms	0.6 A	0.5 A for	0.6 A
L / R = 60 ms	0.35 A	other outputs	0.35 A
alternate 24 to 230 V a.c.	2 A AC-1 0.5 A AC-15	-	2 A AC-1 0.5 A AC-15
- Total charging current	6 x 2 A	4 x 0.5 A + 2 x 1 A	6 x 2 A
- Output leakage current	-	< 200 µA	-
- Output waste voltage	-	0.5 V to 500 mA max.	-
- Minimum cut-off values	10 mA under 12 V d.c.	12 V	10 mA under 12 V d.c.
- Breaking capacity under 120 V a.c. (contact rating code B300) (UL)	2 A		2 A
- Breaking capacity under 250 V a.c. (contact rating code B300) (UL)	2 A (1.5 A according to UL)		2 A (1.5 A according to UL)
- Number of common	2 (2+4)		2 (2+4)
- Switching frequency:			
for resistive loads	< 1 Hz	5 kHz	< 1 Hz
for inductive loads	< 0.2 Hz		< 0.2 Hz
for lamps	< 0.2 Hz		< 0.2 Hz
- Number of switches:			
for AC-1	1 million	-	1 million
for AC-15	100 000	-	100 000
- Short circuit and overload protection	envisage externally	yes: thermic	envisage externally
- Surge voltage protection	envisage externally	yes	envisage externally
- Outputs diagnosis	no	overload and short circuit	no
- Cable length:			
unshielded	150 m	150 m	150 m
shielded	500 m	500 m	500 m

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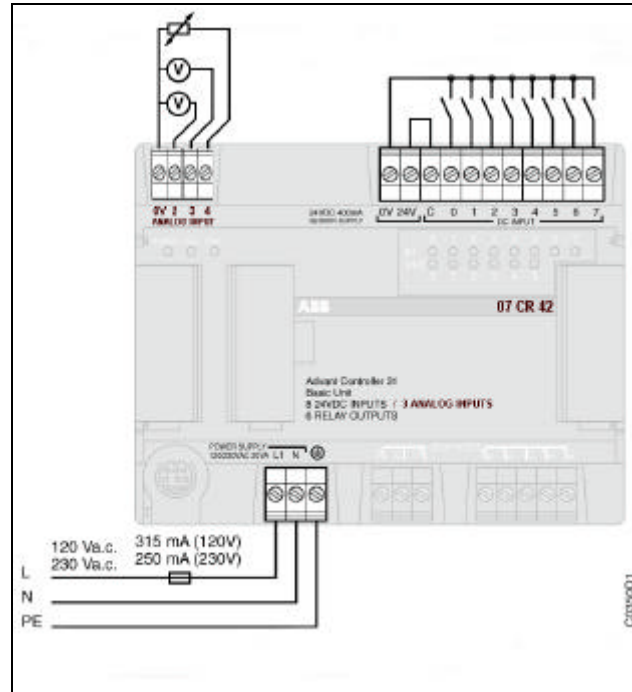
4.6. Incorporated analog inputs

4.6.1. Technical characteristics

	07 CR 42 24 V d.c.	07 CT 42 24 V d.c.	07 CR 42 120/230 V a.c.
- Number of analog inputs:			
Voltage	2	2	2
Temperature	1	1	1

	Voltage	Temperature
- Nominal range:	+/- 10 V	RTD
Maximum values :	+/- 30 V	10Ω up to 7MΩ
- Resolution	11 bits + sign (5 ms)	12 bits
- Min resolution at input (± 1LSB)	+/- 2,5 mV	Pt100 Pt1000 0.6° C 0.3° C
- Full scale precision	≤+/- 1%	≤+/- 2%
- Word value range read by the central unit	+/- 32767	Full scale depends on the type of sensor
- Amplification error between two channels	70 dB	70 dB
- Input impedance	>20 kΩ	>20 kΩ
- Linearization for Pt 100 / Pt 1000		By FKG function block
- Sampling rate	2.5 ms	2.5 ms
- filtering time	0.5 ms	50 ms
- Diagnosis	No	No
- Cable length:	50 m	50 m
shielded	Yes	Yes

4.6.2. Cabling of the analog inputs



Example : connection on 07CR42 120/230 V a.c.

The 3 analog inputs are not electrically isolated.

Warning: the connector for analog inputs is different of connector for binary inputs.

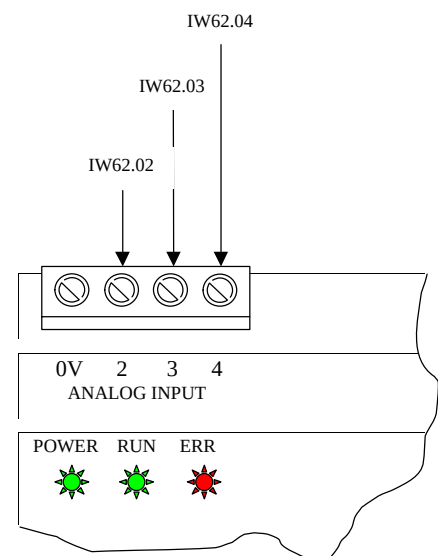
Use rigid or multi-conductor AWG 18 (0.96 mm²) to AWG 14 (1.95 mm²) wires for binary inputs and the rigid or multi-conductor AWG 14 (1.95 mm²) wires for the binary outputs.

And use rigid or multi-conductor AWG 28 (0.08 mm²) to AWG 16 (1.5 mm²) wires for analog inputs.

4.6.3. Addressing of analog inputs

The address 62 is assigned to the analog inputs.

- IW62.02 Voltage format
- IW62.03 Voltage format
- IW62.04 Temperature format



Assignment of the 3 analog inputs

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4.6.4. Voltage format on analog input

The voltage format is only available on the analog inputs IW62.02 and IW62.03
Measuring ranges ± 10 V 11 bits resolution plus sign.

1 LSB = $20 / 2^{12} = 4,88$ mV with minimum value (step 8)

Value = [V (in volt) / 10] * 32767 with value (- 32767 $\leq$ X $\leq$ + 32767)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
- 10	5	2.5	1.25	625	313	156	78	39	20	10	5	0	0	0	0
Sign	V	V	V	mV	mV	mV	mV	mV	mV	mV	mV	0			

Relationship between the measured values and the positions of the bits in the 16-bit word

The value range corresponds to the numbers - 32767.... + 32767

Range overflow: + 32767 , range underflow: -32767

Warning:

Without connection or Open-circuit, the analog value read in the user program is:

= +10800 (+/- 1%) corresponding to around 3.5 volts

Short-circuit : 0 (+/- 1%)

Fast reading with fix frequency, independently of the cycle time, around 2.5 ms

4.6.5. Current format 4 - 20 mA

The analog inputs IW62.02 and IW62.03 can be also configure in current format 4-20 mA in using an external additional resistance in parallel of the analog input.

In the same time, inside user program, it is necessary to use calculation function blocks or directly FKG function blocks (just two couple of points is enough) in order to converter the read analog value in value corresponding to current format.

To choose the right additional resistance, you have first to check the technical data of the current sensor and identify the Max load resistance allowed.

The resistance should be less than 500 Ohms, and according to the value chosen, it is possible to determinate the resolution:

For R = 500 Ohms => dynamic 2/10V resolution around 11 bits

For R = 250 Ohms => dynamic 1/5V resolution around 10 bits

For R= 125 Ohms => dynamic 0.5/2.5V resolution around 9 bits

4.6.6. Temperature format on analog inputs

The analog input IW62.04 can be used with all universal temperature sensors like PT100, PT1000, PTC or others.... The analog input can be configured individually in a lot of different operating temperature modes.

The complete table of corresponding resistance / analog value can be found in § annexes.

The configuration will be performed by FKG function block, this function allows to define a curve by n points (X0 / YO... Xn-1 / Yn-1) and this function block make a linear interpolation between the interpolation points. The resulting curve representing the relationship between X and Y will be the current analog value.

- X will correspond at the current analog value of IW62.04
- Y value according to the table corresponding Resistance / Analog value

(further details can be found inside software manual AC31GRAF - 1SBC006099R1101 – Volume C and Chapter “High order functions”)

4.6.6.1 Configuration for PT100 sensor (Platinum 100 W / 0°C)

$$\text{Value} = (32737 * R) / (R + 768)$$

The measuring range for PT100 is 12 bits,

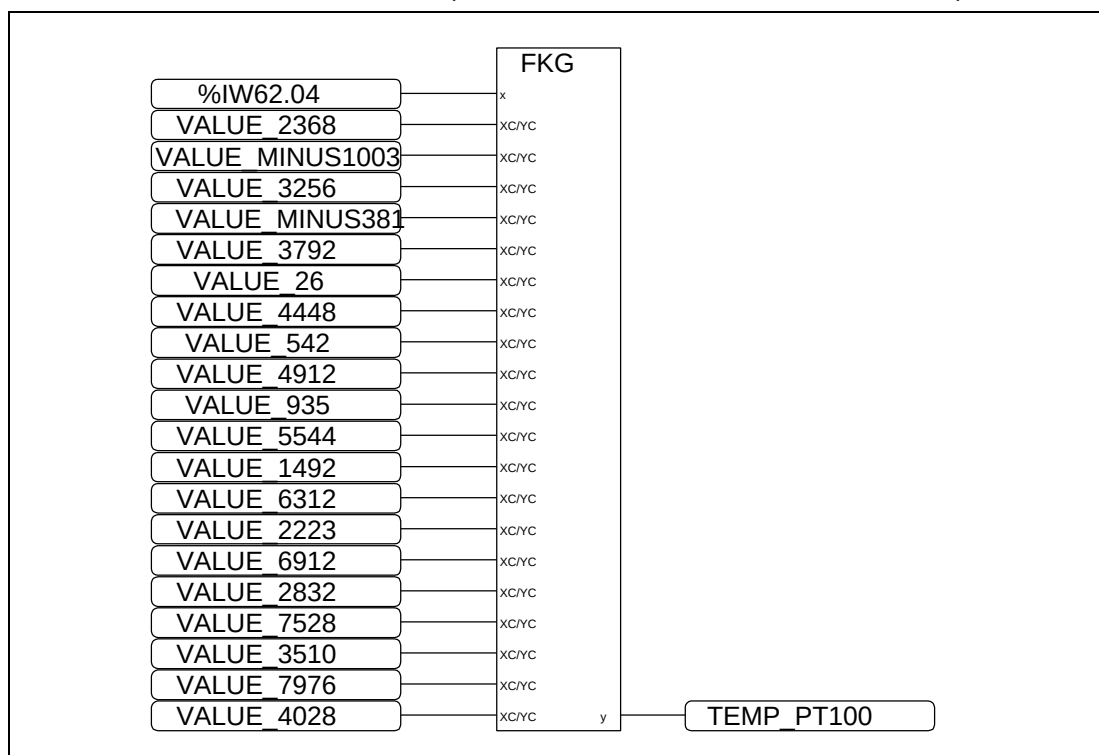
the value range: (-100.3 to +524.4 °C) by FKG function block

range overflow / open-circuit: : +32688,

range underflow / short-circuit of the sensor : 0

Example of configuration PT100 sensor with FKG function block:

Possibility of using only a point everything them 30 °C to assure a precision lower than 0.5 °C for PT100 sensor. (the values can be found in table next § 4.6.6.2.)



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4.6.6.2 Table of corresponding Resistance / Analog value / ° Celsius / ° Fahrenheit for PT100 sensors

R (Ohms)	Value IW	°C / 10	°F / 10
60	2368	-1003	-1485,4
63	2472	-932	-1357,6
66	2584	-858	-1224,4
69	2688	-783	-1089,4
72	2800	-708	-954,4
75	2904	-633	-819,4
78	3008	-558	-684,4
81	3112	-482	-547,6
85	3256	-381	-365,8
89	3392	-280	-184
93	3528	-178	-0,4
95	3592	-128	89,6
97	3664	-77	181,4
99	3728	-25	275
101	3792	26	366,8
103	3864	77	458,6
105	3928	128	550,4
107	3992	180	644
109	4056	231	735,8
111	4128	282	827,6
113	4192	334	921,2
115	4256	386	1014,8
117	4320	439	1110,2
119	4384	490	1202
121	4448	542	1295,6
124	4544	620	1436
127	4632	698	1576,4
130	4728	777	1718,6
133	4824	855	1859
136	4912	935	2003
139	5008	1013	2143,4
142	5096	1092	2285,6
145	5192	1172	2429,6
148	5280	1251	2571,8
151	5368	1331	2715,8
154	5456	1411	2859,8
157	5544	1492	3005,6
160	5632	1572	3149,6
164	5752	1680	3344

R (Ohms)	Value IW	°C / 10	°F / 10
168	5864	1788	3538,4
172	5976	1893	3727,4
176	6088	2002	3923,6
180	6200	2113	4123,4
184	6312	2223	4321,4
188	6424	2333	4519,4
192	6536	2443	4717,4
194	6592	2498	4816,4
196	6640	2555	4919
198	6696	2608	5014,4
200	6752	2664	5115,2
203	6832	2747	5264,6
206	6912	2832	5417,6
209	6992	2915	5567
212	7072	3000	5720
215	7144	3084	5871,2
218	7224	3170	6026
221	7304	3253	6175,4
224	7376	3338	6328,4
227	7456	3423	6481,4
230	7528	3510	6638
233	7608	3595	6791
236	7680	3681	6945,8
239	7752	3767	7100,6
242	7832	3854	7257,2
245	7904	3941	7413,8
248	7976	4028	7570,4
251	8048	4115	7727
254	8120	4203	7885,4
257	8192	4290	8042
260	8264	4380	8204
263	8336	4467	8360,6
266	8408	4556	8520,8
269	8480	4645	8681
273	8568	4763	8893,4
277	8664	4883	9109,4
281	8752	5003	9325,4
285	8848	5123	9541,4
289	8936	5244	9759,2

4.6.6.3 Configuration for PT1000 sensor (Platinum 100 W / 0°C)

$$\text{Value} = (32737 * R) / (R + 768)$$

The measuring range for PT1000 is 12 bits,

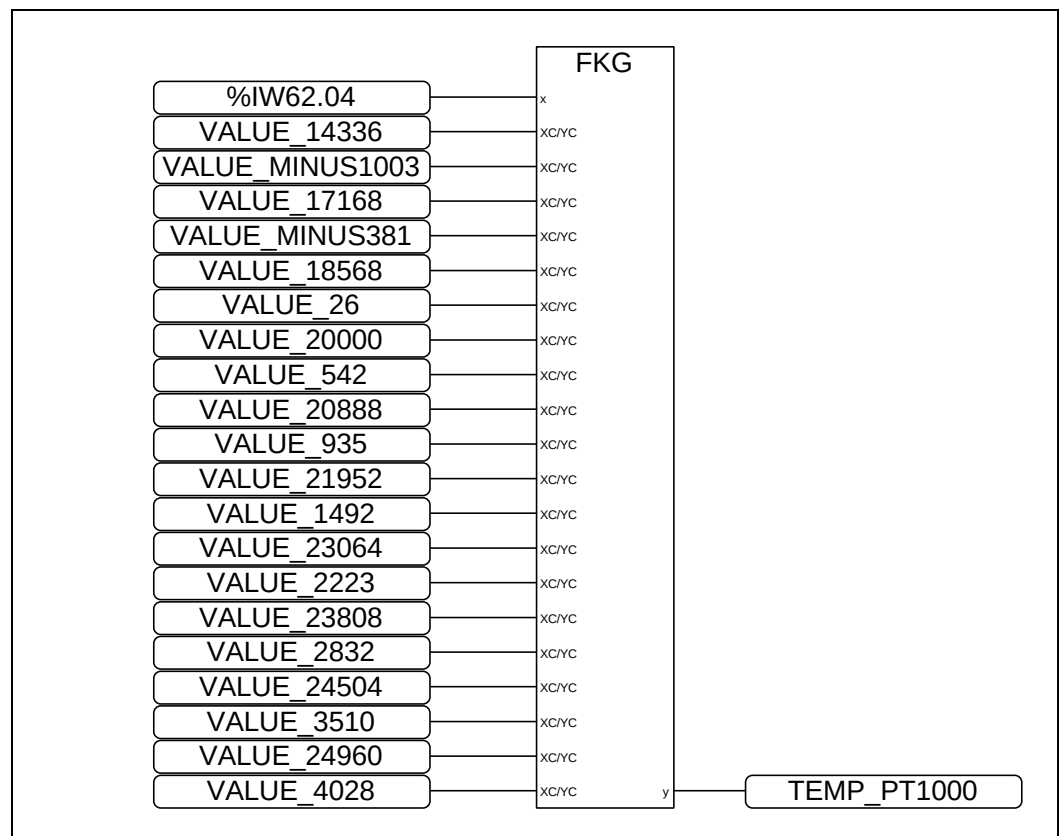
the value range: (-100.3 to +524.4 °C) by FKG function block

range overflow / open-circuit: : +32688,

range underflow / short-circuit of the sensor : 0

Example of configuration PT1000 sensor with FKG function block:

Possibility of using only a point everything them 20 °C to assure a precision lower than 0.3 °C for PT1000 sensor. (the values can be found in table next § 4.6.6.4.)



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4.6.6.4 Table of corresponding Resistance / Analog value / ° Celsius / ° Fahrenheit for PT1000 sensors

R (Ohms)	Value IW	°C / 10	°F / 10
600	14336	-1003	-1485,4
630	14728	-932	-1357,6
660	15104	-858	-1224,4
690	15472	-783	-1089,4
720	15816	-708	-954,4
750	16152	-633	-819,4
780	16472	-558	-684,4
810	16776	-482	-547,6
850	17168	-381	-365,8
890	17544	-280	-184
930	17904	-178	-0,4
950	18072	-128	89,6
970	18240	-77	181,4
990	18408	-25	275
1010	18568	26	366,8
1030	18728	77	458,6
1050	18880	128	550,4
1070	19032	180	644
1090	19176	231	735,8
1110	19320	282	827,6
1130	19464	334	921,2
1150	19600	386	1014,8
1170	19736	439	1110,2
1190	19864	490	1202
1210	20000	542	1295,6
1240	20184	620	1436
1270	20368	698	1576,4
1300	20552	777	1718,6
1330	20720	855	1859
1360	20888	935	2003
1390	21056	1013	2143,4
1420	21216	1092	2285,6
1450	21368	1172	2429,6
1480	21520	1251	2571,8
1510	21664	1331	2715,8
1540	21808	1411	2859,8
1570	21952	1492	3005,6
1600	22088	1572	3149,6
1640	22264	1680	3344

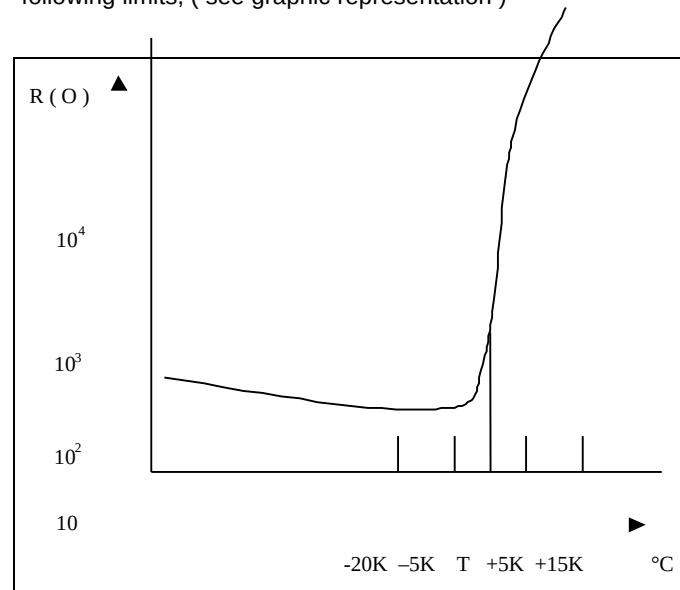
R (Ohms)	Value IW	°C / 10	°F / 10
1680	22432	1788	3538,4
1720	22600	1893	3727,4
1760	22760	2002	3923,6
1800	22912	2113	4123,4
1840	23064	2223	4321,4
1880	23208	2333	4519,4
1920	23352	2443	4717,4
1940	23416	2498	4816,4
1960	23488	2555	4919
1980	23552	2608	5014,4
2000	23616	2664	5115,2
2030	23720	2747	5264,6
2060	23808	2832	5417,6
2090	23904	2915	5567
2120	24000	3000	5720
2150	24088	3084	5871,2
2180	24176	3170	6026
2210	24256	3253	6175,4
2240	24344	3338	6328,4
2270	24424	3423	6481,4
2300	24504	3510	6638
2330	24584	3595	6791
2360	24664	3681	6945,8
2390	24736	3767	7100,6
2420	24816	3854	7257,2
2450	24888	3941	7413,8
2480	24960	4028	7570,4
2510	25032	4115	7727
2540	25096	4203	7885,4
2570	25168	4290	8042
2600	25232	4380	8204
2630	25304	4467	8360,6
2660	25368	4556	8520,8
2690	25432	4645	8681
2730	25512	4763	8893,4
2770	25592	4883	9109,4
2810	25672	5003	9325,4
2850	25752	5123	9541,4
2890	25824	5244	9759,2

4.6.7. configuration with another temperature sensor type

Possibility to use another temperature sensors like PTC, NTC...etc...

The configuration will be performed also by FKG function block, the parameters can be found according to the characteristics temperature sensor type used in the complete table of corresponding resistance / analog value (see in § annexes)

Example with PTC thermistor, thermal machine protection, use to protect electric motors from over temperature. The resistance / temperature characteristics of PTC thermistor is defined by the following limits, (see graphic representation)



Typical characteristics curve $R(^{\circ}\text{C})$ for PTC thermistor

With T = limit to protect electric motor

Example:

- with PTC 80 $T = 80^{\circ}\text{C}$ corresponding to about 1000Ω
- with PTC 120 $T = 120^{\circ}\text{C}$ corresponding to about 1000Ω

Use the corresponding analog value in user program (comparison functions) to realise the protection motor. Possibility also to use several PTC thermistors connected in series and use the additional resistance values of different thermistors before to use the analog value corresponding in the user program.

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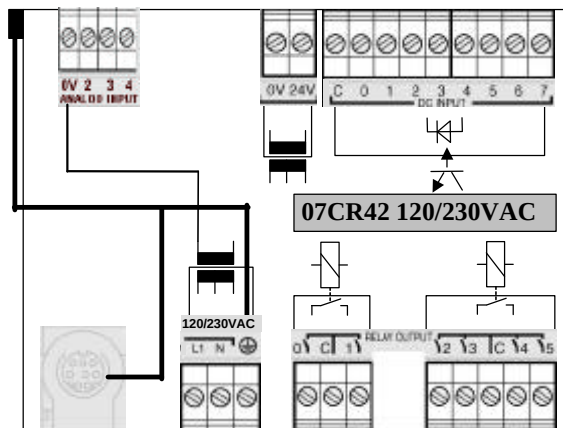
4.6.8. Diagnosis identification

Values for the different version of 42 series of correspondence table between the error and the diagnosis variable values are:

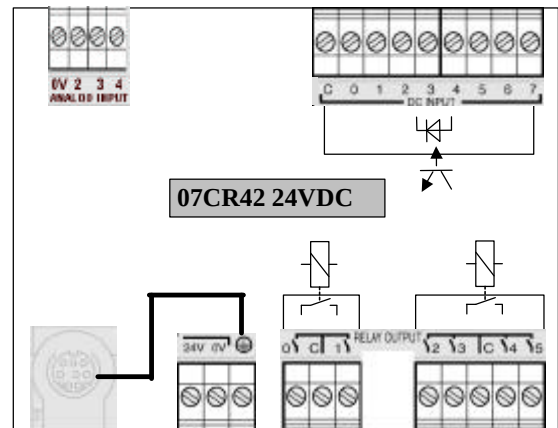
- Unit type: 228 07CR42
- Unit type: 229 07CT42

(further details about diagnosis procedure can be found inside Technical manual AC31 - 1SBC260400R1001 –Chapter 8 “Diagnosis”)

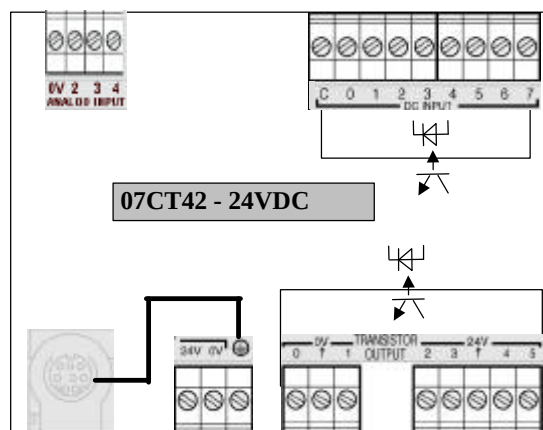
4.6.9. Overview of electrical isolations



Electrical of isolation for 07CR42 – 120/230VAC



Electrical of isolation for 07CR42 – 24VDC



Electrical of isolation for 07CT42 – 24VDC

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4.6.10. Annexes

Complete table of corresponding Resistance / Analog value for only IW62.04

R (Ohms)	Value IW		R (Ohms)	Value IW		R (Ohms)	Value IW
10	416		105	3928		248	7976
11	456		107	3992		251	8048
12	496		109	4056		254	8120
13	544		111	4128		257	8192
14	584		113	4192		260	8264
15	624		115	4256		263	8336
16	664		117	4320		266	8408
17	704		119	4384		269	8480
18	744		121	4448		273	8568
19	784		124	4544		277	8664
20	824		127	4632		281	8752
22	904		130	4728		285	8848
24	984		133	4824		289	8936
26	1064		136	4912		293	9024
28	1144		139	5008		297	9112
30	1224		142	5096		301	9200
33	1344		145	5192		305	9288
34	1384		148	5280		309	9376
35	1424		151	5368		313	9464
36	1456		154	5456		317	9552
37	1496		157	5544		321	9632
38	1536		160	5632		325	9720
39	1576		164	5752		329	9800
40	1616		168	5864		333	9888
42	1688		172	5976		337	9968
44	1768		176	6088		342	10072
46	1840		180	6200		347	10168
48	1920		184	6312		352	10272
50	1992		188	6424		357	10368
52	2072		192	6536		362	10472
54	2144		194	6592		367	10568
56	2216		196	6640		372	10664
58	2288		198	6696		377	10760
60	2368		200	6752		382	10856
63	2472		203	6832		387	10952
66	2584		206	6912		392	11048
69	2688		209	6992		397	11136
72	2800		212	7072		402	11232
75	2904		215	7144		408	11336
78	3008		218	7224		414	11448
81	3112		221	7304		420	11552
85	3256		224	7376		425	11640
89	3392		227	7456		430	11728
93	3528		230	7528		435	11816
95	3592		233	7608		440	11904
97	3664		236	7680		445	11992
99	3728		239	7752		450	12072
101	3792		242	7832		455	12160
103	3864		245	7904		460	12240

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R (Ohms)	Value IW		R (Ohms)	Value IW		R (Ohms)	Value IW
465	12328		1240	20184		2770	25592
470	12408		1270	20368		2810	25672
475	12488		1300	20552		2850	25752
480	12568		1330	20720		2890	25824
485	12648		1360	20888		605	14400
490	12728		1390	21056		612	14496
495	12808		1420	21216		619	14584
500	12888		1450	21368		626	14680
506	12984		1480	21520		633	14768
512	13072		1510	21664		640	14856
518	13168		1540	21808		647	14944
524	13256		1570	21952		654	15032
530	13344		1600	22088		661	15120
536	13432		1640	22264		668	15208
542	13520		1680	22432		676	15304
548	13608		1720	22600		684	15400
554	13696		1760	22760		692	15496
560	13784		1800	22912		700	15584
566	13864		1840	23064		708	15680
572	13952		1880	23208		716	15768
578	14032		1920	23352		724	15864
584	14120		1940	23416		732	15952
591	14216		1960	23488		740	16040
598	14312		1980	23552		748	16128
600	14336		2000	23616		756	16216
630	14728		2030	23720		765	16312
660	15104		2060	23808		774	16408
690	15472		2090	23904		783	16504
720	15816		2120	24000		792	16592
750	16152		2150	24088		801	16688
780	16472		2180	24176		810	16776
810	16776		2210	24256		819	16872
850	17168		2240	24344		828	16960
890	17544		2270	24424		837	17048
930	17904		2300	24504		847	17144
950	18072		2330	24584		857	17240
970	18240		2360	24664		867	17336
990	18408		2390	24736		877	17424
1010	18568		2420	24816		887	17520
1030	18728		2450	24888		897	17608
1050	18880		2480	24960		907	17696
1070	19032		2510	25032		917	17792
1090	19176		2540	25096		928	17888
1110	19320		2570	25168		939	17984
1130	19464		2600	25232		950	18072
1150	19600		2630	25304		961	18168
1170	19736		2660	25368		972	18256
1190	19864		2690	25432		983	18352
1210	20000		2730	25512		994	18440

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R (Ohms)	Value IW		R (Ohms)	Value IW		R (Ohms)	Value IW
1005	18528		1773	22808		3600	26944
1017	18624		1794	22888		3664	27024
1029	18720		1815	22968		3729	27104
1041	18808		1836	23048		3796	27192
1053	18904		1858	23128		3864	27272
1065	18992		1880	23208		3941	27360
1077	19080		1902	23288		4019	27448
1089	19168		1924	23360		4099	27528
1102	19264		1947	23440		4180	27616
1115	19352		1970	23520		4263	27696
1128	19448		1993	23600		4348	27784
1141	19536		2022	23688		4434	27864
1154	19624		2052	23784		4522	27944
1167	19712		2082	23880		4612	28024
1181	19808		2113	23976		4704	28104
1195	19896		2144	24064		4821	28200
1209	19992		2176	24160		4941	28296
1223	20080		2208	24256		5064	28384
1237	20168		2241	24344		5190	28480
1251	20256		2274	24440		5319	28568
1266	20344		2308	24528		5451	28656
1281	20440		2342	24616		5587	28736
1296	20528		2377	24704		5726	28824
1311	20616		2412	24792		5869	28904
1326	20696		2448	24880		6015	28992
1341	20784		2484	24968		6165	29072
1357	20872		2521	25056		6319	29144
1373	20960		2558	25144		6476	29224
1389	21048		2596	25224		6657	29312
1405	21136		2634	25312		6843	29392
1421	21216		2673	25392		7034	29472
1438	21312		2713	25480		7230	29552
1455	21392		2753	25560		7432	29632
1472	21480		2794	25640		7640	29704
1489	21568		2835	25720		7853	29776
1506	21648		2877	25800		8127	29864
1524	21736		2920	25880		8411	29952
1542	21824		2963	25960		8705	30040
1560	21904		3007	26040		9009	30120
1578	21984		3052	26120		9324	30200
1596	22072		3097	26192		9650	30280
1615	22152		3143	26272		10036	30368
1634	22240		3190	26344		10437	30448
1653	22320		3237	26424		10854	30528
1672	22400		3295	26512		11288	30608
1692	22480		3354	26600		11739	30680
1712	22568		3414	26688		12325	30776
1732	22648		3475	26776		12941	30856
1752	22728		3537	26856		13588	30944

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R (Ohms)	Value IW
14267	114136
15265	122120
16333	130664
17476	139808
18699	149592
20007	160056
21407	171256
23119	184952
24968	199744
26965	215720
29391	235128
32330	258640

R (Ohms)	Value IW
35563	284504
40897	327176
47031	376248
54085	432680
64902	519216
77882	623056
93458	747664
112149	897192
134578	1076624
161493	1291944
193791	1550328
232549	1860392

R (Ohms)	Value IW
279058	2232464
390681	3125448
546953	4375624
765734	6125872
1072027	8576216
1500837	12006696
2251255	18010040
3376882	27015056
5065323	40522584
7091452	56731616