JUMO Safety Manual for RTD Temperature Probes and Thermocouples for Connection to JUMO dTRANS T06 Ex Type 707075

with Safety Integrity Level (SIL) and Performance Level (PL) classification

Safety Manual

90000002T99Z001K000

V2.00/EN/00740824/2025-09-29

Safety Manual for Temperature Probes for Connection to JUMO dTRANS T06 Type 707075 with Functional Safety

application

T06 Type 707075 Ex with SIL classification.
It is only valid together with the manufacturer's declaration issued for the temperature probe (shown on page 10) in combination with a JUMO dTRANS T06 Type 707075

JUMO temperature probes from the following data sheet product groups can be connected:

901820 and 901821
902820 and 902821
903520 and 903525
903710 and 903720

The operating manual 70707500T90Z00XK000 is also applicable.

Area of application

This combination enables safe temperature measurement in line with the functional safety specified in the safety levels SIL 2 or Performance Level b or c in accordance with the standards

- -DIN EN 61508 Part 1 to 7 "Functional safety of electrical/electronic/programmable electronic safety-related systems"
- -DIN EN ISO 13849 -1 "Safety of machinery - Safety-related parts of control systems" Evidence of conformity with the SIL and PL is provided by the TÜV report SEBS-A.20140509.0933409.

Terms and abbreviations in accordance with DIN EN 60730-2-9:

Safety feature	Requirement
Modes of operation and software class in accordance with DIN EN 60730-2-9	System 2K
	Only in the case of redundancy 2N
	Software class C

Terms and abbreviations in accordance with DIN EN 61508 and DIN EN 61511

Name	Description
Actuator	Part of a safety-related system that intervenes in the process in order to achieve a safe state.
EUC	Equipment Under Control Device, machine, apparatus, or unit used for production, shaping of materials, transportation, or medical or other purposes.
E/E/PE	Electrical/Electronic/Programmable Electronic (E/E/EP): based on electrical (E) and/or electronic (E), and/or programmable electronic (PE) technology.
Failure	The end of the capability of a functional unit to carry out a requested function.
Diagnostic Coverage	Partial reduction in the probability of dangerous hardware failures due to the use of automatic diagnostic tests.
Fault	Abnormal state that may result in a reduction or the loss of the capability of a functional unit to carry out a requested function.
Functional Safety	A part of overall safety related to the EUC and EUC control system that depends on the E/E/PE safety-related system, other technology safety-related systems, and external risk reduction facilities working correctly.

Name	Description
Functional Unit	Unit consisting of hardware or software, or both, which is suitable for performing a defined task.
Dangerous Failure	Failure that has the potential to put the safety-related system into a dangerous or inoperative state.
Safe Failure	Failure that does not have the potential to put the safety-related system into a dangerous or inoperative state.
Hazard	Potential source of damage
Safety	Absense of unacceptable risks
Safety Function	Function that is performed by an E/E/PE safety-related system, other technology safety-related systems, or external risk reduction facilities with the aim of achieving or maintaining a safe state for the EUC, while taking into consideration a defined dangerous event.
Safety Integrity	Probability of a safety-related system performing the requested safety function within a specified time frame under all specified conditions and in line with requirements.
Safety Integrity Level (SIL)	One of four discrete levels to specify the requirements for the safety integrity of safety functions which are assigned to the E/E/PE safety-related system; SIL 4 corresponds to the highest level of safety integrity; SIL 1 the lowest.
Safety-Related System	System that: - performs the required safety functions necessary to achieve or maintain a safe state for the EUC, and - is intended to achieve the necessary safety integrity for the requested safety functions either on its own or with other E/E/PE safety-related systems, other technology safety-related systems, and external risk reduction facilities
Safety Instrumented System (SIS)	Safety instrumented system used to perform one or more safety instrumented functions. An SIS consists of one or more sensors, a logic system, and one or more actuators.
Lambda: λ	Failure rate [FIT]
Lambda **D**angerous: λ_D	Dangerous failure rate
Lambda **D**angerous **D**etect: λ_{DD}	Detected dangerous failure rate
Lambda **D**angerous **U**ndetect: λ_{DU}	Undetected dangerous failure rate
Lambda: λ_S	Safe failure rate
Lambda: λ_{SD}	Detected safe failure rate
Lambda: λ_{SU}	Undetected safe failure rate
BPCS	Basic Process Control System
DC	**D**iagnostic **C**overage
FIT	**F**ailure **I**n **Ti**me (1×10^{-9} per h)
HFT	**H**ardware **F**ailure **T**olerance
PFD	**P**robability of **F**ailure on **D**emand
PFD_{avg}	**P**robability of **F**ailure on **D**emand average
PFH	**P**robability of dangerous **F**ailure per **H**our
PTC	**P**roof **T**est **C**overage
MooN	Architecture with M out of N voting, i.e. N indicates how often the safety function has been executed, and M indicates how many channels need to be operating correctly.

MRT	Mean Repair Time
$MTTF_D$	Mean Time To Failure (Dangerous)
MTTR	Mean Time To Restoration
SFF	Safe Failure Fraction
SIL	Safety Integrity Level
SC	Systematic Capability
PTC	Proof Test Coverage
T_i	Proof Test intervall

Terms and abbreviations in accordance with DIN EN ISO 13849:

Symbol or abbreviation	**Description**
PL (a, b, c, d, e)	Denotation of Performance Level
B, 1, 2, 3, 4	Denotation of categories
B_{10d}	Number of cycles at which 10 % of the components of a sample fail dangerously for wearing pneumatic or electromechanical components (mean time to dangerous failure)
Cat.	Category
CCF	**C**ommon **C**ause **F**ailure. Modeled by what is known as the beta factor.
DC	**D**iagnostic **C**overage
DC_{avg}	**D**iagnostic **C**overage **av**era**g**e
MTTF	Mean Time To Failure
$MTTF_c$	Mean Time To Critical Failure
$MTTF_d$	Mean Time to Dangerous Failure
PL	Performance Level
PLC	Programmable Logic Controller
PL_{low}	Lowest Performance Level of an SRP/CS in an SRP/CS combination
PL_f	Required Performance Level
T_M	Length of operation, anticipated period of use (**M**ission **T**ime)
T_{10d} value	Guide value for a preventative replacement (10 % of the B_{10d} value). At this value, approx. 63 % of all components have already failed dangerously. In such cases, the standard DIN EN ISO 13849-1:2006 recommends replacement.

Further abbreviations and terms are outlined in IEC 61508-4.

Safety requirements

Failure tolerances for a safety function, depending on the SIL class (IEC 61508-1, 7.6.2)

Safety Integrity Level	**Operating mode with low demand mode**	**Operating mode with high demand mode**
SIL	PFD	PFH
4	$\geq 10^{-5}$ to $< 10^{-4}$	$\geq 10^{-9}$ to $< 10^{-8}$
3	$\geq 10^{-4}$ to $< 10^{-3}$	$\geq 10^{-8}$ to $< 10^{-7}$
2	$\geq 10^{-3}$ to $< 10^{-2}$	$\geq 10^{-7}$ to $< 10^{-6}$
1	$\geq 10^{-2}$ to $< 10^{-1}$	$\geq 10^{-6}$ to $< 10^{-5}$

Safety Manual for Temperature Probes for Connection to JUMO dTRANS T06 Type 707075 with Functional Safety

Safety integrity of the hardware for type-B safety-related sub-systems
(IEC 61508-2, 7.4.3)

Proportion of safe failures	**Fault tolerance**		
SFF	**HFT = 0**	**HFT = 1**	**HFT = 2**
< 60 %	-	SIL 1	SIL 2
60 % to < 90 %	SIL 1	SIL 2	SIL 3
90 % to < 99 %	SIL 2	SIL 3	(SIL 4)
≥ 99 %	SIL 3	(SIL 4)	(SIL 4)

Qualitative requirements for RTD temperature probes

The platinum RTD temperature probes meet the requirements of the standard DIN EN 60751.

Qualitative requirements for thermocouples

The thermocouples meet the requirements of the standard DIN EN 60584.
The temperature probes are developed and manufactured in a production process which is certified to ISO 9001.

Permissible versions

Only temperature probes which **do not** contain a **transmitter** are permitted.
Please ensure that the following extra codes are **not** contained in the order codes:
/330, /331, /332, /333, /334, /335, /336, /337, /338, /550, /551, /859, /867 and /869.

Reaction time

The information regarding reaction times is based on measurement in accordance with DIN EN 60751 in air at a flow rate of 2 m/s, and water at a flow rate of 0.4 m/s. The corresponding reaction times t_{05} and t_{09} are given. This is the time that the temperature probe needs in order to display 50 % or 90 % of the temperature jump.

The entire reaction time is comprised of the reaction time of the temperature probe and the reaction time of the JUMO dTRANS T06 combined and can be found in the operating manual of the JUMO dTRANS T06 (chapter on "Technical Data").

Guide values for temperature probes depending on the external diameter

Diameter/mm	Air		Water	
	t_{05}/s	t_{09}/s	t_{05}/s	t_{09}/s
< 2 mm	10	25	1	3
< 3 mm	15	50	3	7
< 6 mm	40	140	6	18
< 9 mm	85	300	20	55
< 12 mm	210	750	50	140

Note: These are typical values from the standard design (for example, in accordance with DIN 43772) and should be used as guide values.

Before using the temperature probe together with the JUMO dTRANS T06, the user must check whether the complete reaction time for the application can ensure safe switch-off of the entire system. Furthermore, the fault tolerance time of the JUMO dTRANS T06 must be observed.

Overheating resistance

Based on the maximum operating temperature of the respective temperature probe, a 10 % overheating resistance must be taken into account.

For example:

- maximum operating temperature of the temperature probe 400 °C
- 10 % overheating resistance = 40 °C
- maximum operating temperature for safety function 400 °C – 40 °C = 360 °C

The failure rates are calculated based on JUMO's existing experience in the field and the analyses of data collected annually from complaints statistics, as well as the Exida failure model.

Explanation of probe types and failure models

The letter a (highlighted in blue) indicates the JUMO failure model; the letters b to i denote the Exida failure model. The number 1 denotes an RTD temperature probe; the number 2 indicates a thermocouple

Variant	Failure model	Probe type
Variant 1a	JUMO	RTD temperature probe with manufacturer's declaration from JUMO.
Variant 1b	Exida	RTD Close Coupled Low Stress, 2-wire and 3-wire technology
Variant 1c	Exida	RTD Close Coupled Low Stress, 4-wire technology
Variant 1d	Exida	RTD Close Coupled High Stress, 2-wire and 3-wire technology
Variant 1e	Exida	RTD Close Coupled High Stress, 4-wire technology
Variant 1f	Exida	RTD Extension Wire Low Stress, 2-wire and 3-wire technology
Variant 1g	Exida	RTD Extension Wire Low Stress, 4-wire technology
Variant 1h	Exida	RTD Extension Wire High Stress, 2-wire and 3-wire technology
Variant 1i	Exida	RTD Extension Wire High Stress, 4-wire technology
Variant 2a	JUMO	Double thermocouples with manufacturer's declaration from JUMO.
Variant 2b	Exida	Double thermocouple Close Coupled, Low Stress
Variant 2c	Exida	Double thermocouple Close Coupled, High Stress
Variant 2d	Exida	Double thermocouple Extension Wire, Low Stress
Variant 2e	Exida	Double thermocouple Extension Wire, High Stress

The following definition applies here for Low Stress, High Stress, Close Coupled, and Extension Wire:

Low Stress	< 2/3 utilization of the maximum admissible probe acceleration
High Stress	> 2/3 utilization of the maximum admissible probe acceleration
Close Coupled	< 30 cm (from sensor to transmitter) or connection of a head transmitter within a protection fitting (head-mounted)
Extension Wire	> 30 cm (from sensor to transmitter) or connection outside the terminal head, e.g. DIN-rail device.

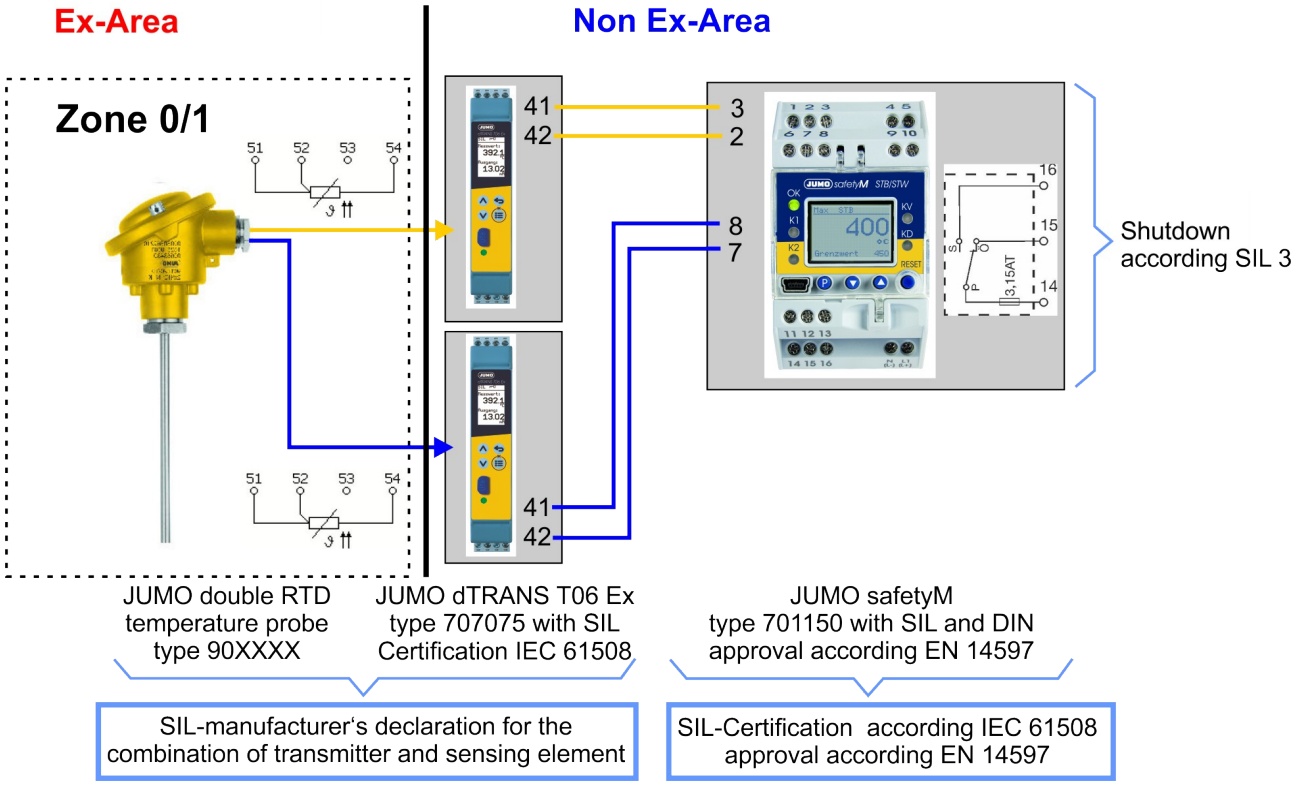
This table shows the maximum achievable SIL and PL.

Device variant DC 24V RTD temperature probes	**PFH** [1/h]	**PFD_{avg}**	**PTC C**	**SFF**	**SIL**	**$MTTF_d$** [years]	**DC_{avg}** [%]	**PL**
Variant 1a	3.23×10^{-7}	5.16×10^{-3}	72	91	2	33	91	c
Variant 1b	1.70×10^{-7}	4.39×10^{-3}	48	93	2	45	93	c
Variant 1c	1.69×10^{-7}	4.38×10^{-3}	48	93	2	45	93	c
Variant 1d	2.68×10^{-7}	4.89×10^{-3}	67	92	2	33	92	c
Variant 1e	2.49×10^{-7}	4.81×10^{-3}	65	93	2	33	93	c
Variant 1f	2.19×10^{-7}	4.63×10^{-3}	60	93	2	39	93	c
Variant 1g	2.10×10^{-7}	4.60×10^{-3}	58	93	2	38	93	c
Variant 1h	1.251×10^{-6}	9.83×10^{-3}	93	90	1	10	90	b
Variant 1i	1.079×10^{-6}	9.14×10^{-3}	92	91	1	9	91	b

Device variant DC 24V Double thermocouples	**PFH** [1/h]	**PFD_{avg}**	**PTC C**	**SFF**	**SIL**	**$MTTF_d$** [years]	**DC_{avg}** [%]	**PL**
Variant 2a	2.24×10^{-7}	4.69×10^{-3}	61	94	2	33	94	c
Variant 2b	1.66×10^{-7}	4.37×10^{-3}	47	94	2	44	94	c
Variant 2c	1.94×10^{-7}	4.63×10^{-3}	55	96	2	25	96	c
Variant 2d	1.99×10^{-7}	4.58×10^{-3}	56	94	2	33	94	c
Variant 2e	8.55×10^{-7}	8.82×10^{-3}	90	96	2	5	96	a

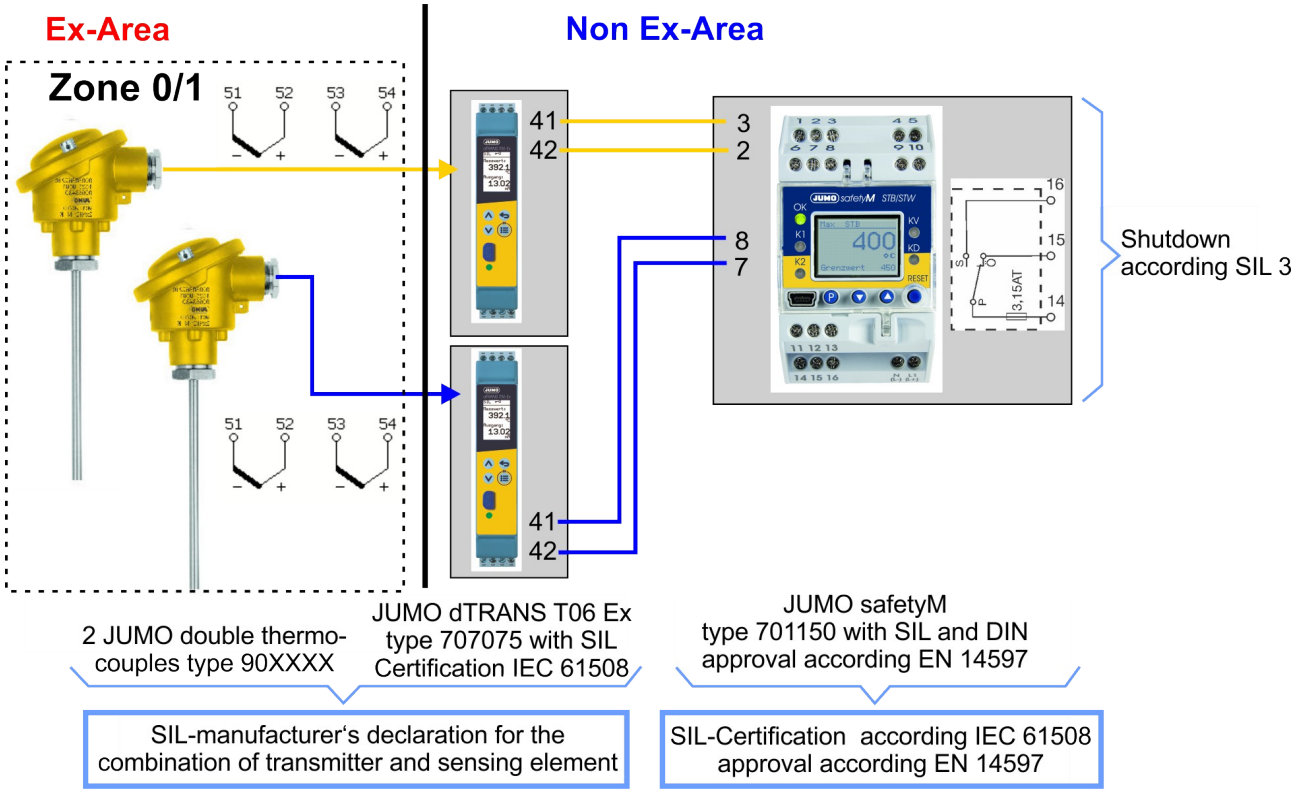
Example application of redundant use with a double RTD temperature probe with a three-wire circuit:

SIL measurement chain



Example application of redundant use with two double thermocouples:

SIL measurement chain



Recommended tests for temperature probes

In order to ensure safe and reliable operation of the temperature probes, the following service and maintenance work must be carried out (including at start-up):

At stipulated intervals, the following tests are recommended:

As indicated in the table below, the insulation resistance of the measuring circuit should be measured against the protection fitting (for thermocouples: only for the insulated measuring circuit; in the case of several measuring circuits the insulation test should also be carried out between the individual measuring circuits). The minimum insulation resistance at room temperature should be 100 MΩ at DC 100 V.

- Damage and corrosion of and signs of wear to temperature probe protection tubes
- Clear assignment of probe with the associated protection tube/protection sleeve by checking the installation depth
- Corrosion and correct position of contacts and terminals of cable connections
- Seals of terminal heads and cable ducts
- Interruption by "tapping", "shaking", etc. on the temperature probe/measuring insert

As the maximum operating temperature has an impact on the drift behavior, the temperature probes should be recalibrated or replaced at specified intervals to ensure reliable and precise measurement of temperature.

The test intervals are listed in the following table:

Maximum operating temperature	Pt RTD temperature probe	Thermocouples
200 °C	5 years	5 years
550 °C	2 years	5 years
700 °C	1 year	2 years
1000 °C		Non-precious metal 1 year
		Precious metal 2 years
1500 °C		1 year

The testing intervals stipulated here are suggestions which should be adapted according to the particular conditions at the location where they are used, and may have to be shortened by the user.

JUMO GmbH & Co KG
Moritz-Juchheim-Straße 1
36039 Fulda

Telefon: +49 661 6003-0
E-Mail: mail@jumo.net
Internet: www.jumo.net

Herstellererklärung
Manufacturer's declaration

Für das folgende Produkt *For the following product*

Gegenstand *Object*	**Widerstandsthermometer** Resistance Thermometer
Hersteller *Manufacturer*	**JUMO GmbH & Co KG , 36093 Fulda, Germany**
Typ *Type*	**902820../659** **in Kombination mit / in combination with** **dTRANS T06 Ex Typ 707075**
Teilenummer *Part number*	**000xxxxxx**
QW- Nummer *Quality number*	**15-04-01**
Fabrikationsnummer *serial number*	**02002xxx**

erklären wir als Hersteller, dass die folgende Kombination aus dem oben genannten Temperaturfühler zusammen mit dem Messumformer "707075" in einer sicherheitsrelevanten Anwendung **Sicherheitsstufe SIL 2 / PL c** die Anforderungen der Funktionalen Sicherheit erfüllt und eingesetzt werden darf. Voraussetzung ist die Beachtung der Bedingungen der mathematischen Berechnung und Konfiguration und der Inbetriebsetzung und die Sicherheitshinweise aus dem **Sicherheitshandbuch** (90000002T99Z000K000) **und der Betriebsanleitung** (70707500T90Z000K000).

we declare as manufacturer, that the following combination of above-mentioned temperature probe and the temperature transmitter "707075" in a safety-relevant application of **security level SIL 2 / PL c** fulfills the requirements of the Functional Safety and can be used. Requirement is the attention of the conditions, the mathematics calculation and configuration, and of the starting and the safety instructions given in the **safety manuals** (90000002T99Z001K000) **and the instruction manual** (70707500T90Z001K000)

Diese Bescheinigung darf nur unverändert weiterverbreitet werden.
This certificate may only be reproduced in unchanged form.

Datum
Date

25.11.2020

Stempel / *stamp*

JUMO GmbH & Co. KG
Moritz-Juchheim-Straße 1 36039 Fulda, Germany
Tel.: +49 661 6003-0 Fax: +49 661 6003-500
mail@jumo.net www.jumo.net

Im Auftrag
by order
Qualitätsdepartment

Dieses Dokument ist ohne Unterschrift gültig
This certificate will be valid without sign

VL „SIL Herstellererklärung" Version: dTRANS T06

JUMO GmbH & Co. KG

Moritz-Juchheim-Straße 1
36039 Fulda, Germany

Phone: +49 661 6003-727
Fax: +49 661 6003-508
E-mail: mail@jumo.net
Internet: www.jumo.net

Technical Support Germany:

Phone: +49 661 6003-9135
Fax: +49 661 6003-881899
E-mail: support@jumo.net

Shipping address:
Mackenrodtstraße 14
36039 Fulda, Germany

Postal address:
36035 Fulda, Germany

JUMO Mess- und Regelgeräte Ges.m.b.H

Pfarrgasse 48
1230 Vienna, Austria

Phone: +43 1 610610
Fax: +43 1 6106140
E-mail: info.at@jumo.at
Internet: www.jumo.at

Technical Support Austria:

Phone: +43 1 610610
Fax: +43 1 6106140
E-mail: info@jumo.at

JUMO Mess- und Regeltechnik AG

Laubisrütistrasse 70
8712 Stäfa, Switzerland

Phone: +41 44 928 24 44
Fax: +41 44 928 24 48
E-mail: info@jumo.ch
Internet: www.jumo.ch

Technical Support Switzerland:

Phone: +41 44 928 24 44
Fax: +41 44 928 24 48
E-mail: info@jumo.ch

JUMO Automation S.P.R.L. / P.G.M.B.H. / B.V.B.A.
Industriestraße 18
4700 Eupen, Belgium

Phone: +32 87 59 53 00
Fax: +32 87 74 02 03
E-mail: info@jumo.be
Internet: www.jumo.be