User Manual

Type 301

Signal Converter Universal Input

(TC / RTD / mV / mA / V / Potentiometer)

This Manual is applicable to µDin 301 with
Firmware release 1.6 and to µDin 301 Configuration Software V2.2

ELCON INSTRUMENTS
INTRINSIC SAFETY and ex SPECIALISTS

ELCON INSTRUMENTS SRL - Italy - HEAD OFFICE - Via delle Industrie, 4 - 20050 Mezzago (MI) P.O. Box 14 - 20050 Mezzago (MI)
Phone ++39 039 6292 1 - General fax ++39 039 6292 240 - Sales fax ++39 039 6292 290 - E-mail: info@elconinst.com - website: www.elconinst.com

ELCON INSTRUMENTS - Asia - Pacific - Suite 5003 Bayside Plaza - 376-380 Bay Street - Brighton - Le - Sands - Sydney, N.S.W. 2216, Australia
Phone ++61 2 9556 1188 - ++61 2 9556 1499 - Fax ++61 2 9556 3400

ELCON INSTRUMENTS INC. - U.S.A. - 5834 Peachtree Corners East, - Suite A - Norcross (Atlanta) Georgia 30092
Phone ++1 770 4463 872 - Fax ++1 770 4470 329 - Toll Free ++1 800 2535 266

ELCON INTRINSIC SAFETY LTD. - United Kingdom - Heighington Lane - Newton Aycliffe - Co Durham - DL5 6XZ
Phone ++44 1325 314 455 - Fax ++44 1325 314 456

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1. OVERVIEW

The µD301 unit is a versatile, microprocessor based device intended to interface with the ***low-level sensors*** located within an hazardous area. The input value is available in safe area both in analog (current loop) and in digital (RS-232 serial line) form. The analog output is isolated from the power supply (24 Vdc) and is updated each 100 ms.

The followings ***sensor types*** are supported:

- Thermocouple sensors: (S, R, B, E, J, K, T, N, L)
- RTD temperature sensors: (Pt100, Pt50, Pt10, Ni100, Cu100, Cu50, Cu10, Pt100 and Pt50 and Pt10 GOST; 2/3/4 wires)
- Current-output devices: (+/- 20 mA, passive input)
- Voltage-output devices: (+/- 100 mV and +/- 10 V ranges)
- Potentiometric sensors: (from 200 ohm to 10 Kohm)

Note: Underlined RTD sensor types may be selected only with the µD301 configuration software.

Sensors can works within the following ***operating limits***:

• Thermocouple	S	-50	+1750	°C	
• Thermocouple	R	-50	+1750	°C	
• Thermocouple	B	+0	+1800	°C	
• Thermocouple	E	-200	+1000	°C	
• Thermocouple	J	-200	+750	°C	
• Thermocouple	K	-200	+1300	°C	
• Thermocouple	T	-200	+400	°C	
• Thermocouple	N	-200	+1300	°C	
• Thermocouple	L	-200	+800	°C	
• Pt100, Pt50, Pt10 RTD	(DIN 43760)	-200	+850	°C	(α = 0.3850)
• Ni100 RTD		-60	+180	°C	(α = 0.6170)
• Pt100, Pt50, Pt10 RTD	(GOST P 50353-92)	-200	+1100	°C	(α = 0.3910)
• Cu100, Cu50, Cu10 RTD		-200	+200	°C	(α = 0.4280)
• Current - mA		-20	+20	mA	
• Voltage - mV		-100	+100	mV	
• Voltage - Volt		-10	+10	V	
• Potentiometer		0	100	%	

Note: Use of the Thermocouple B in the 0 +50°C range is not recommended due to low emission and likely reduced accuracy.

The input ***operating range*** is defined by a zero value and a span value with dip switches while with configuration software is defined by zero value and max value. The operating range can be set either through dip-switches or by serial line use. The operating range must always be within the allowed sensor operating limits. The input zero is usually associated with a 4 mA output, while zero+span is associated with 20 mA output. To avoid accuracy limitations, it is recommended not to set the ***span*** below the specified minimum limits.

The input operating range is normally set via dip-switches with reference to a ***°C table***. It is however possible to select an ***°F table***, obtained by conversion and truncation to 0 of the less significant digit. When you set the opera-

ting range by the serial line any difference between the °C and °F settings disappears, because the zero and span values can be precisely set to any desired temperature.

The ***output range*** can be set to either 0-20 mA or 4-20 mA; by serial line use only, it is also possible to set the reverse scale of the analog output.

2. INTERNAL PROCESSING

The unit is ***microprocessor based*** and most functions are under direct software control. The microprocessor includes an EEPROM area (non volatile memory) intended to store in a permanent way both calibration and configuration information.

The ***input stage*** can accept low-level signals in the +/-120 mV range, and also interface with the internal cold junction compensator (CJC) temperature sensor. The CJC sensor is located near the thermocouple input terminal blocks and it is measured every 4 seconds.

The ***analog to digital*** conversion is based on a proprietary sigma-delta technique featuring both high resolution (17 bits) and good noise immunity. The conversion time of ***100 ms*** enables high noise rejection at both 50 and 60 Hz mains frequency.

All ***calibrations*** are implemented at the digital level. A set of offset and gain correction parameters is stored in EEPROM at factory-calibration time. Each type of sensor is individually calibrated. No end-user calibration is therefore required.

All temperature sensors are fully ***linearized***. A digital, table-based technique is used to guarantee a negligible linearization error. After linearization (and CJC, when applicable) a typical temperature resolution of ***0.1 °C*** is achieved. A new output value is available every 100 ms.

The ***digital to analog*** conversion is based on a mark-space technique providing a 13 bit equivalent resolution. The analog output is calibrated by the microprocessor following the same approach as for the input sensors.

3. SPECIAL FUNCTIONS

We have an ***overrange*** situation when the input signal exceeds the selected operating range. When in an overrange situation, the analog output signal still follows the input. The output range is however limited to 0-24 mA, with a reduced accuracy above 20 mA and below 4 mA.

We have an ***overload*** situation when the input signal exceeds the sensor operating limits. When in an overload situation, the analog output goes to the specified burn-out state. For sensors not supporting burn-out detection, the output goes either near 0 mA or 24 mA.

We have a ***burn-out*** situation when a thermocouple or RTD connection is broken. The burn-out condition is verified each 4 s (TC) and each 0.1 s (RTD). The average burn-out detection time is 2.3 s (TC) and 0.1 s (RTD). The average burn-out recovery time is 3.7 s (TC) and 0.6 s (RTD).

When burn-out occurs, the output can be configured for one out of three ***sensor error actions***:
- upscale to (24 mA) (high mode)
- down-scale (0 mA) (low mode)
- frozen to the last valid value (hold mode)

If an exceedingly high input rate of change is detected, the related value is discarded as invalid. For example, a J thermocouple at 100 °C is not allowed to change at a rate higher than 180 °C/s. This is a form of ***digital filtering*** which cancels errors due to strong electromagnetic interference.
It is possible, by serial line use only, to configure the analog output in such a way as to associate the zero input value with 20 mA and the end of scale input value with 0 or 4 mA. In this way, we get a ***reverse output*** mode, in which the output decreases when the input signal increases.
The µD301 configuration software is required for this option.

4. CONFIGURATION OPTIONS

Available ***dip-switch*** configuration options:
- Input operating range (default: zero = 0 °C, span = 500 °C)
- Output operating range (default: 4-20 mA)
- Sensor type (default: K thermocouple)
- Sensor error action (default: upscale burnout)
- °C / °F mode (default: °C)
- HW selections (default: normal)

No unit power-down is required to operate switches.
The ***°F mode*** sets the tables for input operating range configuration in °F units.
The other options for ***HW selections*** are "3 wire RTD" and "potentiometer" sensors.

Available ***serial line*** configuration options (µD301 configuration software required):
- Input operating range (any value within the allowed range can be selected)
- Output operating range (any value within the allowed range can be selected)
- Sensor type (any dip-switch selection and other types, see note above)
- Sensor error action (upscale, downscale or frozen analog output value)
- "Reverse" analog output mode.
- CJC temperature forced to a fixed value.

Note: You may configure the RTD Pt50, Pt10, Cu100, Cu50, Cu10, Pt100 and Pt50 and P10 GOST sensor type, only by the µD301 configuration software.

Note: You must configure the sensor type with the dip-switches on the uDIN 301 to the disable position, in order to have a permanent selection otherwise any selection will be lost when power goes off.

Warning: It is not possible to set some configuration parameters through the dip-switches and some others through the serial line.

Warning: If you set the CJC to a fixed temperature or you set the reverse output mode selection through the serial line while operating in permanent mode, the selection will be valid even if the µD301 will be configured with dip-switches later.

5. FAULT LED SIGNALLING

- The red LED in a ***fast blinking*** status (200 ms "on" / 200 ms "off") indicates a severe internal error. If this happens frequently, the unit is faulty and must be returned to one of the Elcon Instruments facility or Rep. The blinking continues for one minute after error detection.

- The red LED in a ***slow blinking*** status (2 s "on" / 1 s "off") indicates a problem with the serial line, which could result from its improper connection or usage. The unit is most likely not faulty. The blinking continues for 20 seconds after error detection.

- The red LED in a ***fixed on*** status indicates a configuration error, an overload situation or a burn-out condition, The unit is not faulty. The LED goes off when the error disappears.

6. START-UP PROCEDURE

- Verify that the available ***supply voltage*** is within specifications.
- Verify that the ***dip-switches*** are set according to the "default" status.
- Connect the supply voltage (terminals 7 & 8).
  - both the green and the red LED should be "on" (a burn-out condition is present).
- Connect a jumper on the TC input (terminal 11 & 12)
  - wait for 4 s to enable burn-out recovery, and the red LED should go off.
- If any of the above conditions do not occur the unit may be faulty, but first check the power supply voltage and available current.
- Remove the power supply and TC input connections.

7. CONFIGURATION PROCEDURE (DIP-SWITCHES)

- Set ***all the dip-switches*** as required by the application.
- Connect the selected ***input sensor*** (see applicable diagrams).
- Verify and connect the supply voltage (terminals 7 & 8). If the ***red LED*** is ON or blinking:
  - a wrong input sensor type or connection could be present.
  - the selected input sensor type could be wrong.
  - the selected operating range could be wrong.
  - an input overload or burn-out condition could be present.
- If required, you can change the dip-switches setting ***without removing*** the supply voltage.
- Verify that the analog ***output value*** is in line with the input status; when required, simulate an ***input burn-out*** condition and verify that the analog output behaves as required.

8. CONFIGURATION PROCEDURE (SERIAL LINE)

- Set the ***HW selection*** dip switch (SW3) as required by the application.
- Set the ***Sensor type*** dip switch (SW2A) on the ***switches disable*** status. This disables the configurations defined by the "span", "zero" and "options" dip-switches and substitutes them with what is currently specified in the unit non volatile memory.
- Verify and connect the supply voltage (terminals 7 & 8).
- Connect the ***communication cable*** between a PC RS232 serial port (9 pin connector) and the serial line connector on the unit.
- Use the ***µD 301 Configurator*** to set all the configuration parameters as required by the application. All modified parameters are permanently stored in the unit non-volatile memory.
- If, during the serial line configuration procedure, the ***red LED*** is "slow blinking", check that the communication cable connection and the PC serial line port are working properly.
- Connect the selected input sensor (see applicable diagrams). If the ***red LED*** is on or blinking:
  - a wrong input sensor type or connection could be present.
  - the selected input sensor type could be wrong.
  - an input overload or burn-out condition could be present.
  - the selected span value could be too small.
  - the selected operating range could be outside the sensor operating limit.
- Use the unit ***without changing*** the "sensor type" dip switch status.

Note: When 2 wire RTD operation is required , you need to connect a jumper on the terminal block to get the equivalent 3-wire connection.

9. µD301 CONFIGURATOR (CONFIGURATION SOFTWARE)

• INTRODUCTION

The ***µD301 Configurator*** (that can be ordered to ELCON as "CONF1") is a 32-bit Windows®95 application that allows an easy unit configuration via a standard RS-232 serial line. The program provides an intuitive user interface and can be used to set in a simple way, just with a click of the mouse, all the required configuration parameters.

Minimum requirements of your PC are:

- processor 486
- 8 MB Ram
- 2.5 MB of hard disk space free
- a free serial port

• INSTALLATION

Before you install the "µD301 Configurator", we strongly recommend that you close any application you may be running because Setup will not be able to install system files or update shared files if they are in use.
The installation program is contained into 2 diskettes of 1.44 Mbyte each, insert the first one in the floppy disk drive, run the SETUP.EXE program and follow the given instructions. The program will occupy around 2.5 Mbyte on the hard disk of your computer.
The use of the standard ***communication cable*** (included in the "CONF1" package) is recommended to avoid pro-

blems. If you are interested in building your own cable, the following explanation will help you: the cable has 2 different connectors for the PC and for the µD301. On the PC side there is a standard D-25 (or D-9) female connector while on the barrier side there is a Terminal Block 3 poles 90° female (Phoenix 18 03 58 1 [Type MC 1.5/3-ST-3.81]).

In the following table is shown the RS-232 signals used for the connection and the relationship between the PC connector pins and the µD301 terminal block poles.

Look out! On the connector on the PC side the RTS signal must be connected to the CTS signal, i.e. for D9 connect pins 7&8, for D25 connect pins 4&5.

RS-232 signals	*PC D-9*	*PC D-25*	*µD301*
Transmit Data (TxD)	*pin 3*	*pin 2*	*Rx pole*
Receive Data (RxD)	*pin 2*	*pin 3*	*Tx pole*
Request To Send (RTS)	*pin 7*	*pin 4*	
Clear to Send (CTS)	*pin 8*	*pin 5*	
Signal Ground	*pin 5*	*pin 7*	*GND pole*

• OPERATION

On start-up, the program does not connect with the µD301 unit automatically, in order to let the user perform any required preliminary test and adjustment such as the selection of the communication port. The program address by default the COM2 serial port, but is possible to select a different port simply selecting between COM1, COM2, COM3 and COM4 from the port selection list of the configuration program. The selection is automatically saved so that next time you start the program the port selected will be restored.

When you are ready to communicate with the unit, press the button called ***Connect***.

Of course, if you select a port that is not present or is not available (e.g. in use by mouse) on your PC, when you try to connect to µD301 a message box will display you that the selection is not allowed and the connection fails. In this case you have to change the selection of the communication port and retry again. If the message box do not appear, but the connection fails, probably you have selected an available, but wrong, port or something else is wrong (e.g. connecting cable, µD301 turned off ...).

If the connection has been completed successfully, the message ***Connection OK*** appears in the "State" frame. Additionally, also some information appears both about the firmware revision and about the type of configuration you are going to do, "Volatile" or "Permanent". If you read the ***Volatile*** indication, this means that the ***sensor type*** dip switch has not been set on the "switches disable" status. If this is the case, any configuration parameter you set is temporary and will be lost at power-down.

Before starting the configuration program check out in the 'Control Panel' of Windows 95 of your PC, if the 'Decimal point separator' of the 'International settings' program, in the 'Number' subfolder, is set to the dot character "."
If not, you must change it from your actual selection into the dot character and then press 'Apply' otherwise a message box will tell you to do so.
At the end, when you have finished to use the configuration program you may change back the selection to the previous one.
When the connection is achieved, the current set-up of the unit is shown and, according to the specific parameter, only logically relevant items can be changed. For instance, if the selected sensor is an RTD, you will see the refe-

rence junction (CJC) information, but you will not be able to change it. Then, if you change sensor to TC the CJC options become active and you can change them.
To have a simple but immediate check of the correct working of the device you may see the current input and output value, with a reduced resolution, expressed the former in the current sensor selected unit and the latter in steps of 1/10 of mA. If the input value is invalid or not applicable a red message will tell you the kind of problem with that sensor.
Remember that when you change ''Range limits'' or ''Reference Junction Fixed value'' you must press ''ENTER'' to send the change to µD301. In all other cases each change is automatically updated and sent to µD301.

Warning: avoid to change the position of any unit dip-switch while using the µD301 Configurator.

When the unit has been configured to your requirements, select the ***Disconnect*** button and, if you don't have any additional unit to configure, the ***Exit*** button.

Warning: the µD301 Configurator doesn't check that the selected input or output operating range is ''legal'' that is to say, within the allowed or suggested limits.

10. APPENDIX A

How to know the µD301 configuration software version.

The configuration software version is displayed into the title of the running window program from program release 2.0 and above, so if you do not see any version number it means that you have installed the 1.03 version. It is suggested that that you upgrade your configuration software to the newest version.

µD301configuration software version history

1.03 First release.
2.0 Added the selection of the thermocouple 'L' for µD301 301 with firmware V1.3 and above.
2.1 Added the selection of the Comm Port within the program window.
2.2 Added the selection of RTD Pt50, Pt10, Cu100, Cu50, Cu10, Pt100 GOST, Pt50 GOST and Pt10 GOST for µD301 301 with firmware V1.6 and above. Added two boxes in the program window that display when the program is connected to a µD301 301 device, both the corrected input value and the calculated analog output value to help and check field sensor installation.

How to know the µD301 firmware version.

The µD301 firmware version is written on a label attached onto the device box from version 1.6 and above. For all the versions it is possible to know the firmware version using the configuration program, in fact when you connect a device to the PC the firmware version is automatically displayed in the status window.

µD301 firmware version history

1.2 First release.
1.3 Added thermocouple 'L'.
1.4 Software improvements.
1.5 Software improvements.
1.6 Added RTD Pt50, Pt10, Cu100, Cu50, Cu10, Pt100 GOST, Pt50 GOST and Pt10 GOST selectable only with µD301 configuration software.