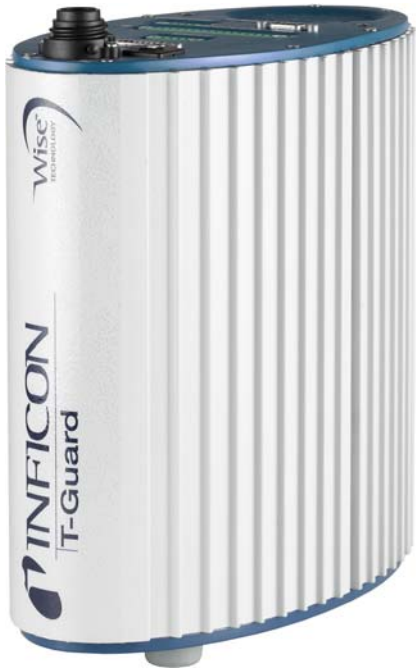
I N T E R F A C E D E S C R I P T I O N

jins85e1-d (1101)



Catalog-No.

540-001
540-002

from Software Version 1.5

T-Guard™

Leak Detection Sensor

INFICON

Table of Contents

(1101)

jins85e1- IVZ.fm

1 General

1.1 Serial RS232 and Field Bus Interfaces

This Interface Description explains how to configure, operate and control T-Guard™ Leak Detection Sensor via serial RS232 or field bus (e.g. Profibus).

For using the field bus module nothing has to be changed in the T-Guard menu.

Field Bus is only available with units already having a field bus interface module.

It is not possible to add field bus to a non-field-bus T-Guard unit.

Other field buses like BACnet MSTP, CANopen, CC-Link, ControlNet, CompoNet, DeviceNet, Modbus-RTU, BACnet/IP, EtherCAT, EtherNet/IP, Modbus-TCP, Profinet IO and SERCOS III are available on request.

When using the RS232 interface, you can choose between three protocols under:

Main Menu → Settings → Interfaces → RS232 Protocol

Choices are: ASCII, Binary and Printer Auto.

- The RS232 binary interface communication protocol is optimized for fast and secure communication between T-Guard™ Leak Detection Sensor and a PC or PLC.
- The RS232 ASCII interface communication protocol is easy to implement and readable by human beings. It is possible to “talk” to T-Guard™ Leak Detection Sensor with a terminal program like Hyperterm (refer to Chapter 3).
- The RS232 “Printer Auto” sends date, time, name of the parameter set, operation mode, leak rate, trigger 1 and trigger 2, if enabled, after every measurement. For example: `20.09.2009 09:20:09 14 LITERS ACCUMULATION 2.00E-5 mbarl/ TRIG1: 3.00E-04`

1.2 RS232 Interface Connecting Cable

The RS232 interface is wired as data communication equipment (DCE).
T-Guard™ Leak Detection Sensor provides a 9-way sub-D socket for the connector.
The signals are assigned as follows:

Pin	Name	Signal
2	RxD	Receive data (T-Guard™ → PC)
3	TxD	Transmit data (PC → T-Guard™)
5	GND	Reference Ground

The other pins are not being used.

The levels on the RS232 interface are defined as follows:

Level	Low (L)	High (H)
Voltage Range	-3 V … -25 V	3 V … 25 V
Logic State	logical 1	logical 0
Level Designation	Mark	Space

Physical Assignment

You can use a standard RS232 cable (straight-through connecting cable, RxD and TxD not crossed, no Null Modem Cable). The RS232 hardware handshake must be switched off in your software program. If you cannot switch off the hardware handshake, an RS232 cable wired as follows may be used:

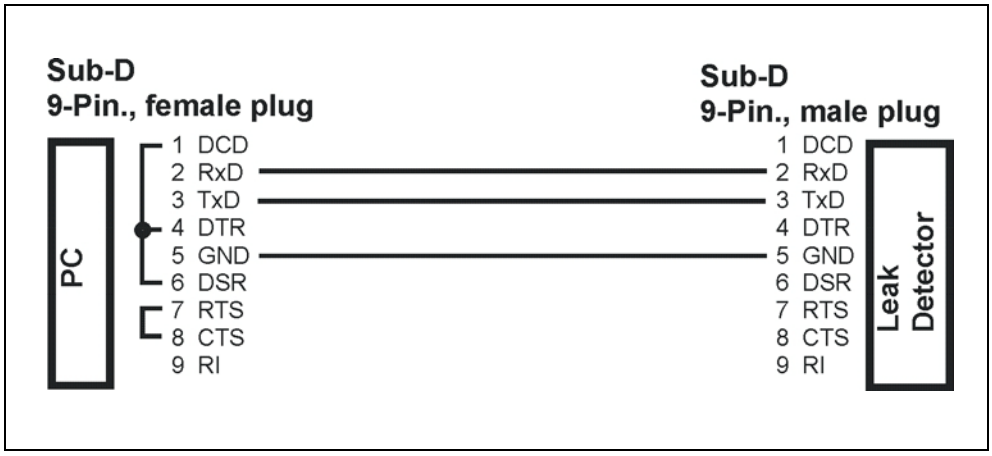


Fig. 1-1 Physical assignment of the RS232 cable to work around hardware handshake.

2 RS232 ASCII Interface Protocol

The RS232 ASCII protocol is similar to the SCPI, a standard protocol widely used for measurement equipment.

2.1 Communication Parameters

Data Format	
baudrate	19,200 or 9,600
data bits	8
parity	none
stop bits	1
flow control	none

2.2 Command Format

In ASCII mode any command starts with " * " (ASCII code 42 dec) and is finished with CR+LF. There is no differentiation between upper and lower case. A blank is required between the command and the parameter, no other blanks are allowed.

There is a short and an extended form of the command. Either the short or the extended command must be used, no other abbreviations are allowed. Command words have to be separated by a colon.
In chapter 2.3 „List of ASCII Commands" short and extended command are specified by upper and lower case. Example: "* STATus" means that the extended command version is "* STATUS" and the short command version is "* STAT".
A command can be composed of up to three words. Parameters have to be separated by commas.

Each command is answered with „OK" or „EXX" (in case of an error). For a list of all error message see section 2.3.1. The transmission can be cancelled with ESC (ASCII code 27dec), ^C (ASCII code 3 dec) or ^X (ASCII code 24 dec).

Some commands can be used as queries, some can be used to set parameters and some can be used for both. A query is marked by a " ? " (ASCII code 63 dec) after the command, for setting data the command has to be followed by the parameter.

Parameters can be boolean or numerical:

<b> Boolean 0 / 1 or OFF / ON Or ENAble / DISAble

<No> Numeric representation format: integer, real (15.6) or exponential (4.5E-7)
Format: [space] [sign] [ddd] [.] [ddd] [e[sign]ddd] (d: digit)

Notice Always use a point as the decimal marker. If a comma is used during numerical data entry, the conversion of the number is cancelled at this point and only the integer part of the number will be used.

The following table lists all commands available in the ASCII mode.

Notice After sending a command from the PC to the leak detector, the PC must wait for the answer from the leak detector before sending a new command. The PC should wait at least 1500 ms for the answer before retrying.

Notice A blank is required between the command and the parameter, no other blanks are allowed. Replace blanks in names by underscores.

2.3 List of ASCII Commands

Command word1	Command word2	Command word3	Parameter	Statement	Read Set	Example	Response
*CAL				only external calibration possible	–		
	:START				S	*CAL:START	OK
	:LEAKrate		<value>	leak rate of test leak	R S	*CAL:LEAK? *CAL:LEAK 2.4E-5	1.20E-5 OK
	:UNIT			unit of test leak	–		
			MBAR*L/S		R S	*CAL:UNIT? *CAL:UNIT MBAR*L/S	mbar*l/s OK
			PA*M3/S		R/S	*CAL:UNIT PA*M3/S	OK
			SCCM		R/S	*CAL:UNIT SCCM	OK
			TORR*L/S		R/S	*CAL:UNIT TORR*L/S	OK
	:QUIT			acknowledge (confirm) after calibration	S	*CAL:QUIT	OK
	:ESC			escape after calibration	S	*CAL:ESC	OK
	:FACtor			calibration factor (values only available after a finished calibration)	–		
		:NEW		actual calibration factor (only available directly after a calibration)	R	*CAL:FAC:NEW?	0.576
		:OLD		last calibration factor	R	*CAL:FAC:OLD?	0.974
	:PRESsure			pressure at the Wise Technology^{TM} Sensor	–		
		:NEW		actual calibration	R	*CAL:PRES:NEW?	271
		:OLD		last calibration	R	*CAL:PRES:OLD?	263
	:StartProof			starts proof function	S		

Command word1	Command word2	Command word3	Parameter	Statement	Read/ Set	Example	Response
*CAL	:STATus			status plain text	–		
				T<20 MIN, CONFIRM	R		
				CAL RUNNING, WAIT	R		
				CAL FINISHED, CONFIRM	R		
				CAL FINISHED	R		
				PROOF RUNNING, WAIT	R		
				PROOF RUNNING	R		
				PROOF FINISHED, CONFIRM	R		
				AIR STABLE, CONFIRM	R		
				NO CAL RUNNING	R	*CAL:STAT?	NO CAL RUNNING
*CLS				clear errors and warnings, E10 if there is none	S	*CLS	OK

*CONFig				read or write parameter	–		
	:AccVol			accumulation volume in chosen unit (0.01.. 10000 liters and equivalent)	S R	*CONF:AV 1.2 *CONF:AV?	OK 1.2
	:CALAccess		<b>	permit calibration (on / off)	S R	*CONF:CALA ON *CONF:CALA?	OK ON
	:CALFac		<value>	calibration factor (0.1 .. 10)	S R	*CONF:CALF 1.1 *CONF:CALF?	OK 1.1
	:CarFlow		<value>	carrier gas flow in chosen unit (*CONF:UNIT:FU?)	S R	*CONF:CF 1000 *CONF:CF?	OK 1000
	:CONTRAST			0 .. 99	R/S	*CONF:CONTRAST 15	OK
	:CONTROL			control location (local = keyboard; RS232 = Interface)	–		
			<value>	RS232, LOCAL/RS232; ALL	R/S	*CONF:CONTROL RS232	OK
	CopyParaSET		M,N	M is the source and N the destination They can be d,0..3,11..35 d means default (not as destination) 0 is the actual parameter set 1..3 are internally stored 11..35 are stored on the optional I·Stick	S S	*CONF:CPSET 1,0 *CONF:CPSET 33,1	OK OK

Command word1	Command word2	Command word3	Parameter	Statement	Read/ Set	Example	Response
*CONFig	:HEPERcent		<value>	Helium percentage 10 .. 100%	S R	*CONF:HEPER 25 *CONF:HEPER?	OK 25
	:LANGuage			english, german, espanol, portuguese, katakana, italiano et francais	–		
			<value>	ENGlish; DEUtsch; ESPanol, PORTuguese, KATakana, ITAliano, FRAncais	S R	*CONF:LANG ENG *CONF:LANG?	OK ENG
	:MODE			changing the operation mode resets the time settings to automatic	–		
			<value>	ACCUMULATE; CARGAS; CONTMODE	S R	*CONF:MODE CARGAS *CONF:MODE?	OK CARGAS
	:NAME			name of the current parameter set (replace space by underscore)	S R	*CONF:NAME 15_L *CONF:NAME?	OK 15_L
	:PLCINLINK			PLC input link for one pin	–		
		:<no.>		pin number = 1 .. 6	R/S		
			<value>	values for PLC input functions:	R/S		
				NOt_used	R/S		
				START INV_START	S R	*CONF:PLCINLINK:2 START *CONF:PLCINLINK:2?	OK START
				STOP INV_STOP	R/S		
				START/STOP INV_START/STOP	R/S		
				CAL INV_CAL	R/S		
				CLEAR INV_CLEAR	R/S		
				READY INV_READY	R/S		
				STANDBY INV_STANDBY	R/S		
				PROOF INV_PROOF	R/S		
				PURGE INV_PURGE	R/S		
				GROSS INV_GROSS	R/S		

Command word1	Command word2	Command word3	Parameter	Statement	Read/ Set	Example	Response
*CONFig	:PLCOUTLINK			PLC output link for one pin	–		
		:<no.>		pin number = 8 .. 15	R/S		
			<value>	values for PLC output functions:	R/S		
				OPEN	S R	*CONF:PLCOUTLINK:9 OPEN *CONF:PLCOUTLINK:9?	OK OPEN
				CLOSE TRIGGER_1 INV_TRIGGER_1 TRIGGER_2 INV_TRIGGER_2 READY INV_READY CYCLE_ACTIVE INV_CYCLE_ACTIVE STANDBY INV_STANDBY ERROR INV_ERROR WARNING INV_WARNING ERR_WARN INV_ERR_WARN CAL_ACTIV INV_CAL_ACTIV MEASURE INV_MEASURE GROSS INV_GROSS CONTROL_OUT_FUNC_GR_LEAK CONTROL_OUT_FUNC_INV_GR_LEAK	R/S R/S R/S R/S R/S R/S R/S R/S R/S R/S R/S R/S R/S R/S R/S		
	:PROOFleak			read/set proof leak rate	S R	*CONF:PROOF 6E-6 *CONF:PROOF?	OK 6.00E-6
			<value>	value = MBAR*L/S, PA*M3/S, SCCM, TORR*L/S	S R	*CONF:PROOF:MBAR*L/S 1.5E-5 *CONF:PROOF:MBAR*L/S?	OK 1.50E-5

Command word1	Command word2	Command word3	Parameter	Statement	Read/ Set	Example	Response
*CONFig	:RECorder			read/write proof leak	–		
		:LINK1_2		analog output 1:	–		
			<para>	para = OFF, P1, MANT, EXP, LR_LIN, LR_LOG, CUR_LIN, CUR_LOG	S R	*CONF:REC:LINK1_2 EXP *CONF:REC:LINK1_2?	OK EXP
		:LINK3_4		analog output 2:	–		
			<para>	para = OFF, P1, MANT, EXP, LR_LIN, LR_LOG, CUR_LIN, CUR_LOG	S R	*CONF:REC:LINK3_4 MANT *CONF:REC:LINK3_4?	OK MANT
		:SCALE1_2		ascent for logarithmic analog output 1..2:	–		
			<para>	para = 0.5V/DEC, 1V/DEC, 2V/DEC, 2.5V/DEC, 3V/DEC, 5V/DEC, 10V/DEC	S R	*CONF:REC:SCALE1_2 1V/DEC *CONF:REC:SCALE1_2?	OK 1V/DEC
		:SCALE3_4		ascent for logarithmic analog output 3..4:	–		
			<para>	para = 0.5V/DEC, 1V/DEC, 2V/DEC, 2.5V/DEC, 3V/DEC, 5V/DEC, 10V/DEC	S R	*CONF:REC:SCALE3_4 2V/DEC *CONF:REC:SCALE3_4?	OK 2V/DEC
		:upperEXP1_2		max. value for analog output 1..2			
			<value>	-1 .. -5 = 10 $^{-1}$ mbarl/s .. 10 $^{-5}$ mbarl/s respectively 10 $^{-7}$ A .. 10 $^{-11}$ A	S R	*CONF:REC:EXP1_2 -4 *CONF:REC:EXP1_2?	OK -4
		:upperEXP3_4		max. value for analog output 3..4	–		
			<value>	-1 .. -5 = 10 $^{-1}$ mbarl/s .. 10 $^{-5}$ mbarl/s respectively 10 $^{-7}$ A .. 10 $^{-11}$ A	S R	*CONF:REC:EXP3_4 -1 *CONF:REC:EXP3_4?	OK -1
	:PRESSHigh			read/write upper pressure limit in mbar	–		
			<value>		S R	*CONF:PRESSH 370 *CONF:PRESSH?	OK 370
	:PRESSLow			read/write lower pressure limit in mbar	–		
			<value>		S R	*CONF:PRESSL 180 *CONF:PRESSL?	OK 180
	:STANDBYDel			setting for standby delay:	–		
			<value>	00:30≙30 s; 01:00≙1 min; 02:00≙2 min; 05:00≙5 min; 10:00≙10 min; 30:00≙39 min; 60:00≙1 h; 0 = off	S S R	*CONF:STANDBYD OFF *CONF:STANDBYD 01:00 *CONF:STANDBYD?	OK OK 01:00

Command word1	Command word2	Command word3	Parameter	Statement	Read/ Set	Example	Response
*CONFig	:TIME	:AUTo	<b>	automatic setting of times	–		
				b: enable = 1; disable = 0	S R	*CONF:TIME:AUT 1 *CONF:TIME:AUT?	OK ENABLED
		:AUToPurge		automatic purge in accumulation mode	–		
			<b>	b: enable = 1; disable = 0	S R	*CONF:TIME:AUTP 1 *CONF:TIME:AUTP?	OK ENABLED
		:MEASure		total measurement time	–		
			<value>	value = 0 .. 300 sec	S R	*CONF:TIME:MEAS 23.3 *CONF:TIME:MEAS?	OK 23.3
		:PURGE		purge time in accumulation mode	–		
			<value>	value = 1.. 50 sec	S R	*CONF:TIME:PURGE 1 *CONF:TIME:PURGE?	OK 1.0
		:WaitPurge		waiting time before automatic purge in accumulation mode	–		
			<value>	value = 0 .. 300 sec	S R	*CONF:TIME:WP 1 *CONF:TIME:WP?	OK 1.0

Command word1	Command word2	Command word3	Parameter	Statement	Read/ Set	Example	Response
*CONFig	:TLRate			read / write test leak rate in current unit	S R	*CONF:TLR 3.7E-4 *CONF:TLR?	OK 3.70E-4
		:MBAR*L/S	<value>	read / write test leak rate in mbar*l/s	S R	*CONF:TLR:MBAR*L/S 3.5E-4 *CONF:TLR:MBAR*L/S?	OK 3.50E-4
		:PA*M3/S	<value>	read / write test leak rate in Pa*m^3/s	R/S		
		:SCCM	<value>	read / write test leak rate in sccm	R/S		
		:TORR*L/S	<value>	read / write test leak rate in Torr*l/s	R/S		
	:TRIGger1			read / write trigger 1 in current unit	–		
		:MBAR*L/S	<value>	read / write trigger 1 in mbar*l/s	S R	*CONF:TRIG1:MBAR*L/S 5.5E-5 *CONF:TRIG1:MBAR*L/S?	OK 5.50E-5
		:PA*M3/S	<value>	read / write trigger 1 in Pa*m^3/s	R/S		
		:SCCM	<value>	read / write trigger 1 in sccm	R/S		
		:TORR*L/S	<value>	read / write trigger 1 in Torr*l/s	R/S		
	:TRIG2ON		<b>	enable/disable trigger 2 with „ON“ or „OFF“	S R	*CONF:TRIG2ON ON *CONF:TRIG2ON?	OK ON
	:TRIGger2			read / write trigger 2 in current unit	–		
		:MBAR*L/S	<value>	read / write trigger 2 in mbar*l/s	S R	*CONF:TRIG2:MBAR*L/S 5.5E-5 *CONF:TRIG2:MBAR*L/S?	OK 5.50E-5
		:PA*M3/S	<value>	read / write trigger 2 in Pa*m^3/s	R/S		
		:SCCM	<value>	read / write trigger 2 in sccm	R/S		
		:TORR*L/S	<value>	read / write trigger 2 in Torr*l/s	R/S		

Command word1	Command word2	Command word3	Parameter	Statement	Read/ Set	Example	Response
*CONFig	:UNIT	:FlowUnit		unit of the carrier gas flow	–		
			<unit>	unit = sccm or l/s	S R	*CONF:UNIT:FU sccm *CONF:UNIT:FU?	OK sccm
		:LR		leak rate unit	–		
			<unit>	unit = SCCM; MBAR*L/S; PA*M3/S; ATM*CC/S; TORR*L/S	S R	*CONF:UNIT:LR TORR*L/S *CONF:UNIT:LR?	OK Torr*l/s
		:Pressure		pressure unit	–		
			<unit>	unit = MBAR; PA; ATM; TORR	S R	*CONF:UNIT:P MBAR *CONF:INIT:P?	OK mbar
		:TLUnit		unit of the external test leak	–		
			<unit>	unit = SCCM; MBAR*L/S; PA*M3/S; ATM*CC/S; TORR*L/S			
		:VolUnit		unit of the free accumulation volume	–		
			<unit>	unit = LITER; CUBICIN; CUBICFT; CCM	S R	*CONF:UNIT:VU CCM *CONF:UNIT:VU?	OK CCM
*END				interrupt or stop measurement and switch to READY	S		
*GROSS				switch to gross mode (only in cont. mode)	–		
			<b>	b = on or off	S R	*GROSS ON *GROSS?	OK ON
*HOUR	:DATE			read / write date			
			<value>	value = dd.mm.yyyy	R/S	*HOUR:DATE?	03.02.2009
	:DEVICE			total operation time of T-Guard	R	*HOUR:DEVICE?	2039.1h
	:SINCE			time after switch on (12:23; hh:mm)	R	*HOUR:SINCE?	00:40 hh:mm
	:TIME			read/write time (real clock time)	–		

Command word1	Command word2	Command word3	Parameter	Statement	Read Set	Example	Response
*IDN				identification of the unit	–		
	:DEVice			name of the unit	R	*IDN:DEV?	T-Guard
	:VERsion			Software version	R	*IDN:VER?	1.30.00
	:SERial			serial number of the unit	R	*IDN:SER?	<11 digits>
	:WiseSerial			serial number of the WISE Technology™ Sensor	R	*IDN:WS?	<11 digits>
*PURGE				Purge the measurement line with valves in GROSS configuration, may stop with Warning 45.	--		
	:START			Start Purge	S	*PURGE:START	OK
	:STOP			Stop Purge	S	*PURGE:STOP	OK
*MEASure					–		
	:Pressure				–		
		:FOREline:		pre-vacuum pressure (in actual unit)	R	*MEAS:P:FORE?	268
	:FILTER			filtered sensor current	R	*MEAS:FILTER?	2.16E-10 A
	:TEMPeratur	:Electronic		temperature of the electronics inside the unit (in °C)	R	*MEAS:TEMP:E	41.5
*READ				read leak rate in set unit (if there is no valid value the result is 1.0, without unit)	R	*READ?	2.50E-4 mbar*l/s
			<unit>	unit = sccm; mbar*l/s; Pa*m3/s; atm*cc/s; Torr*l/s (if there is no valid value the result is 1.0, without unit)	R R	*READ mbar*l/s? *READ Pa*m3/s?	2.50E-4 mbar*l/s 2.50E-5 Pa*m3/s
*STANDBY				valves V1, V2 and V3 are closed; sensor operates at low pressure	S	*STANDBY	OK
	:STOP			Stops Standby. Puts back valves in previous position.	S	*STANDBY:STOP	OK
*START				start measurement (and wake up from standby if necessary)	S	*START	OK

Command word1	Command word2	Command word3	Parameter	Statement	Read / Set	Example	Response
*STATus				read status of the unit deprecated! Use STAT:MEAS instead!	R		
				INIT, START, MEAS, CAL, ERROR, ADJUST, STANDBY, OVERRANGE			
	:BackGND			report helium background quality Possible values = OK, Moderate, Bad	R	*STAT:BGND?	OK
	:CALHist			calibration history	–		
			<no>	no = 1 .. 12	R	*STAT:CALH 2	02.03.09 10:42 ACCUMULATION.0.31
	:CALMode			mode of the calibration	R		
				<no>	R		
				PROOF	R		
				EXTERNAL	R		
				NO CAL		*STAT:CALM?	NO CAL
	:ERRor			read error	R	*STAT:ERR?	NO ERROR/WARNING
	:ERRorHist		<no>	read error history (no =1 .. 12)	R	*STAT:ERRH 1?	20.09.09 09:20:29 W81
	:TRIGger		<no>	read settings of trigger (no = 1 .. 2) Possible values = ON, OFF, GROSSLEAK1, GROSSLEAK2, NO VALUE, DISABLED GROSSLEAK1 means leak rate is >5x highest Trigger, GROSSLEAK2 means leak rate is >100x highest Trig.	R		
	:VALve			read settings of the valves, 0 = closed; 1 = open 010=STANDBY, 110=READY, 011=FINE, 101=GROSS, 100=CONTAMINATED	R	*STAT:VAL?	VALVE 110
	:MEAS			actual status of the measurement (status not listed here is displayed as a number, see section 4.2.1, command 44 „Get Status“.)	R		
			<value>	value = INIT, STARTSTANDBY, STANDBY, CONTAMIN, STARTACC, GROSS1ACC, FINE1, WAITACC, FINE2, GROSS2ACC, READY, STARTCAR, GROSSCAR, FINECAR, CALCCAR, REFCAR, WAITPURGE, PURGE		*STAT:MEAS?	READY
*STOP				stop measurement	S		

2.3.1 Error Messages

The following error messages may be received from T-Guard:

Error number	Error message	Statement
OK	ERR_OK	command executed
E01	ERR_CMD_START	wrong command start (no " * ")
E02	ERR_ERR_BLANK	illegal blank
E03	ERR_CMD_WORD_1	command word 1 illegal
E04	ERR_CMD_WORD_2	command word 2 illegal
E05	ERR_CMD_WORD_3	command word 3 illegal
E06	ERR_DISABLED	control via RS232 not enabled
E07	ERR_ARGUMENT	argument wrong
E08	ERR_NO_DATA	no data available
E09	ERR_OVERFLOW	buffer overflow
E10	ERR_INVALID	command currently invalid
E11	ERR_NO_QUERY	no query allowed
E12	ERR_QUERY	only query allowed
E13	ERR_NOT_IMPLEMENTED	not yet implemented

2.4 Examples of programming

Every command must be terminated by the two bytes
Carriage Return (CR, ASCII 13, \r) and Line Feed (LF, ASCII 10, \n), in this order.
The response you receive from T-Guard will also be terminated like this.

Command sent to T-Guard	Response received from T-Guard	Content
*STAT:MEAS?	READY	status of the unit
*STATUS:MEAS?	READY	status of the unit
*READ?	1.00E-2 mbar*l/s	leak rate in chosen unit of measurement
*READ:SCCM?	0.6 sccm	leak rate in different unit of measurement
*START	OK	start measurement
*CONF:AV?	2	request value of volume
*CONF:AV 5	OK	set volume

2.4.1 Accumulation Mode

2.4.1.1 Performing a calibration

Every command must be terminated by the two bytes
Carriage Return (CR, ASCII 13, \r) and Line Feed (LF, ASCII 10, \n), in this order.
The response you receive from T-Guard will also be terminated like this.

Command sent to T-Guard	Response received from HLD5000	Content
*STAT:MEAS?	READY	status of the unit
*CONF:MODE ACCUMULATE	OK	switch to accumulation mode
*CAL:STAT?	NO CAL RUNNING	no calibration running
*CONF:TRIG2ON OFF	OK	turn off trigger 2
*CONF:TIME:AUT ON	OK	turn on automatic times
*CONF:UNIT:VU LITER	OK	set volume unit to liters
*CONF:AV 10	OK	set free volume to 10
*CONF:TRIG1:MBAR*L/S 1E-3	OK	set trigger 1 to 1E-3 mbar*l/s
*CONF:TLR:MBAR*L/S 8E-4	OK	set test leak rate to 8E-4 mbar*l/s
*CAL:START	OK	start calibration measurement
*CAL:STAT?	CAL RUNNING, WAIT	calibration running
*CAL:STAT?	CAL FINISHED, CONFIRM	calibration finished
*STAT:ERR?	NO ERROR/WARNING	no errors
*CAL:FAC:OLD?	1.017	read old calibration factor
*CAL:FAC:NEW?	1.098	read new calibration factor
*CAL:QUIT	OK	confirm calibration

2.4.1.2 Measurement Cycle

Every command must be terminated by the two bytes
Carriage Return (CR, ASCII 13, \r) and Line Feed (LF, ASCII 10, \n), in this order.
The response you receive from T-Guard will also be terminated like this.

Command sent to T-Guard	Response received from HLD5000	Content
*STAT?	MEAS	status of the unit
*STAT:MEAS?	READY	last measurement finished
*CONF:MODE ACCUMULATE	OK	switch to accumulation mode
*CONF:TRIG2ON OFF	OK	turn off trigger 2
*CONF:TIME:AUT ON	OK	turn on automatic times
*CONF:UNIT:VU LITER	OK	set volume unit to liters
*CONF:AV 10	OK	set free volume to 10
*CONF:TRIG1:MBAR*L/S 5E-4	OK	set trigger 1 to 5E-4 mbar*l/s
*START	OK	start measurement
*STAT:MEAS?	GROSS1ACC	first gross measurement
*STAT:MEAS?	FINE1	first fine measurement
*STAT:MEAS?	WAITACC	accumulating
*READ?	1.0	leak rate not valid
*STAT:MEAS?	GROSS2ACC	second gross measurement
*STAT:MEAS?	FINE2	second fine measurement
*STAT:MEAS?	READY	measurement finished
*STAT:ERR?	NO ERROR/WARNING	no errors
*READ?	2.30E-4	leak rate

2.4.2 Carrier Gas Mode

2.4.2.1 Performing a calibration

Every command must be terminated by the two bytes
Carriage Return (CR, ASCII 13, \r) and Line Feed (LF, ASCII 10, \n), in this order.
The response you receive from T-Guard will also be terminated like this.

Command sent to T-Guard	Response received from HLD5000	Content
*STAT:MEAS?	READY	status of the unit
*CONF:MODE CARGAS	OK	switch to carrier gas mode
*CAL:STAT?	NO CAL RUNNING	no calibration running
*CONF:TRIG2ON OFF	OK	turn off trigger 2
*CONF:TIME:AUT ON	OK	turn on automatic times
*CONF:UNIT:FU SCCM	OK	set flow unit to sccm
*CONF:CF 30000	OK	set carrier gas flow to 30000
*CONF:TRIG1:MBAR*L/S 1E-3	OK	set trigger 1 to 1E-3 mbar*l/s
*CONF:TIME:MEAS?	5.0	read measurement time
*CONF:TLR:MBAR*L/S 8E-4	OK	set test leak rate to 8E-4 mbar*l/s
*CAL:START	OK	start calibration measurement
*CAL:STAT?	CAL RUNNING, WAIT	calibration running
*CAL:STAT?	CAL FINISHED, CONFIRM	calibration finished
*STAT:ERR?	NO ERROR/WARNING	no errors
*CAL:FAC:OLD?	1.017	read old calibration factor
*CAL:FAC:NEW?	1.098	read new calibration factor
*CAL:QUIT	OK	confirm calibration

2.4.2.2 Measurement Cycle

Every command must be terminated by the two bytes
Carriage Return (CR, ASCII 13, \r) and Line Feed (LF, ASCII 10, \n), in this order.
The response you receive from T-Guard will also be terminated like this.

Command sent to T-Guard	Response received from HLD5000	Content
*STAT?	MEAS	status of the unit
*STAT:MEAS?	READY	last measurement finished
*CONF:MODE CARGAS	OK	switch to carrier gas mode
*CONF:TRIG2ON OFF	OK	turn off trigger 2
*CONF:TIME:AUT ON	OK	turn on automatic times
*CONF:UNIT:FU SCCM	OK	set flow unit to sccm
*CONF:CF 30000	OK	set carrier gas flow to 30000
*CONF:TRIG1:MBAR*L/S 1E-3	OK	set trigger 1 to 1E-3 mbar*l/s
*CONF:TIME:MEAS?	5.0	read measurement time
*START	OK	start measurement
*STAT:MEAS?	READY	measurement finished
*STAT:ERR?	NO ERROR/WARNING	no errors
*READ?	2.30E-4	leak rate

3 Using Hyperterm for the ASCII Protocol

3.1 Communication Parameters

Data Format	
Bits per second	19200 or 9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

3.2 Settings for Hyperterm

This section describes which settings one should choose to talk to T-Guard™ Leak Detection Sensor via Hyperterm. You can start Hyperterm in Windows by clicking:

Start → Run …

And typing:

hypertrm

and hitting the Enter key.

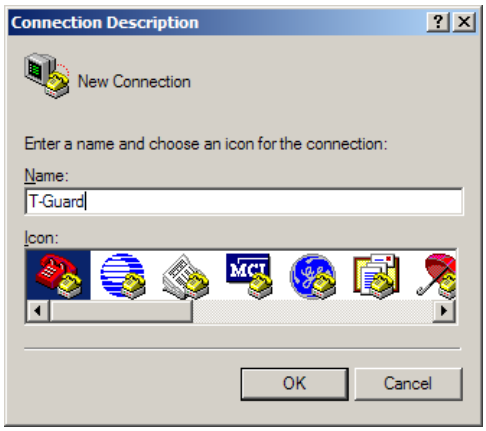


Fig. 3-2 Choose any name for the connection

Fig. 3-3 Choose the serial port to which T-Guard™ Leak Detection Sensor is connected via the RS232 cable.

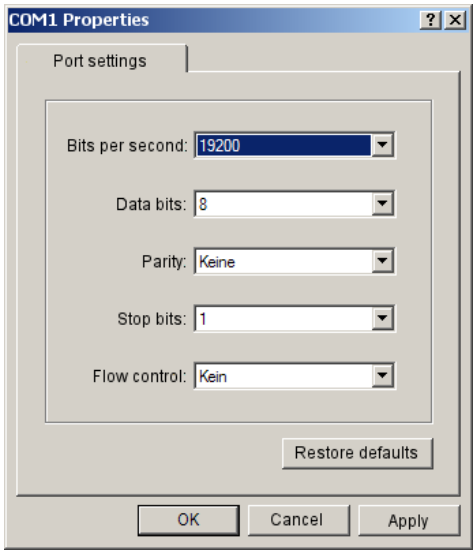


Fig. 3-4 Choose these settings for the connection.

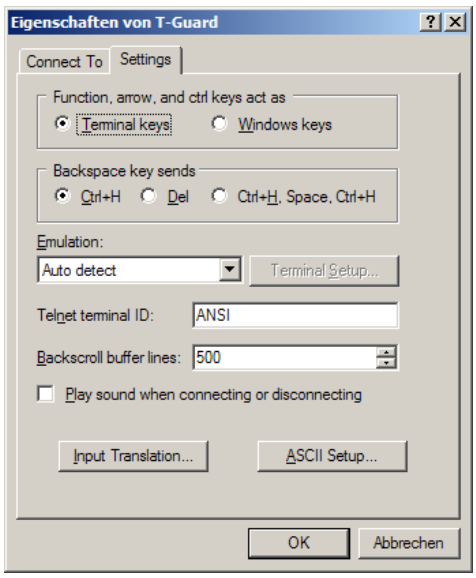


Fig. 3-5 You do not have change anything in this window. Click on “ASCII Setup”.

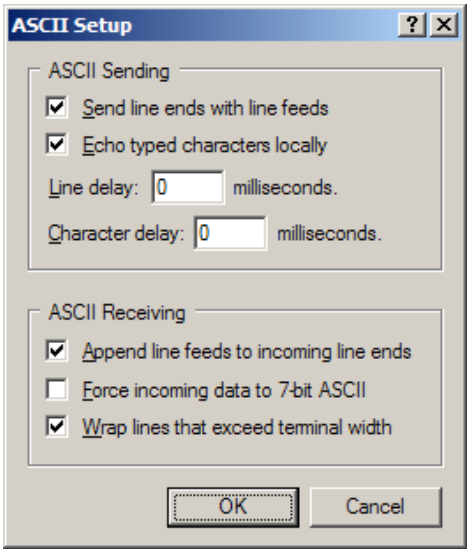


Fig. 3-6 This is a convenient ASCII setup.

Now you can type:

*stat?

After hitting the Enter-Key you will get an answer.

Also see section 2.4: Examples.

4 RS232 Binary Interface Protocol

The binary protocol is machine readable, secure and fast. INFICON also uses this for analysis in its quality control and trouble shooting during manufacturing and service.

4.1 Communication Parameters

Data Format	
baudrate	19,200
float	4 Bytes, IEEE754 (± 10±38), 3 Byte Mantissa, 1 Byte Exponent/Sign
unsigned long int [ul int]:	4 Bytes, integer without algebraic sign MSB … LSB (0 … 4294967295)
unsigned short int [usint]:	2 Bytes, integer without algebraic sign MSB … LSB (0 … 65535)
signed short int	2 Bytes, integer with algebraic sign MSB … LSB (-32768 … 32767)
unsigned char [uchar]:	1 Byte, integer without algebraic sign (0 … 255)
unsigned char [uchar]:	1 Byte, character ASCII Code (0 … 255)
stop bit	1 stop bit

4.2 Binary Command Format

When using the binary protocol the command sent to T-Guard™ Leak Detection Sensor always starts with STX (0x05).

It is followed by a byte which indicates the length of the telegram (including start byte and checksum). The next byte is the command number. The command byte may be followed by additional information (parameter and/or data). Please refer to "Command List Binary Mode" (section 4.2.1) for detailed information about command number, parameter and data format. Every telegram ends with a checksum. The checksum is the sum of all bytes, excluding the checksum byte, modulo 256 (decimal).

T-Guard™ Leak Detection Sensor replies to every valid command with an acknowledgement. All answers start with the length byte followed by the command number, additional data (optional) and the checksum.

In case of an error, T-Guard™ Leak Detection Sensor answers with an error byte instead of the command number (refer to "Error Messages Binary Mode" in section 4.3).

The time out to receive data between 2 signs is 1000 ms.

Tip: When programming in LabView™, you want to turn off the usage of termination characters in the VISA serial module. Otherwise a value of 10 will not show up.

4.2.1 Command List Binary Mode

Tip: Often used commands are **bold**

No.	Name	Description	Parameter	Data
2	**Get vacuum pressure**	Fore vacuum pressure	Byte 0: unit 0=mbar 1=Pa 2=atm 3=Torr	Pressure [float]
5	Get Device ID	Device type		40=T-Guard
8	Get Version	Software version		Byte 0=main version Byte 1=sub version
10	Get Valves	Valves status		Unsigned int. V1 0x0100 (normally closed) V2 0x0200 (normally open) V3 0x0400 (normally open) *which means:* 0=READY 3=GROSS 4=CONTAMINATION 5=FINE 6=STANDBY
16	Get Contrast	Display contrast		Byte 0
38	Get Min Since Start	Uptime		Bytes 0..3: time in minutes [ulint]
44	**Get Status**	Gets status		1=StartStandby 2=Standby 3=Contaminated 4=RunUp 5=StartAccumulation 8=NoPurge 10=AccGross1 20=AccFine1 25=AccWait 30=AccFine2 32=AccGross2 36=WaitPurge 38=Purge 40=Ready 50=CGStart 55=CGGross 65=CGFine 70=CGRef 150=CMStart 155=CMGross 160=CMFine 165=CMStop
52	**START**	Starts measurement		
53	**STOP**	Stops measurement		
54	**Get Cal State**	Gets calibration state		0=No Cal Running 1=Cal Running

No.	Name	Description	Parameter	Data
55	**Start Cal**	Performs calibration, no need to confirm afterwards. Please check new calibration factor separately.		
56	Get Trigger	Trigger value	Byte 0: 1=Trigger 1 2=Trigger 2 Byte 1: 1=sccm 3=mbar l/s 4=Pa m³/s 5=atm cc/s 6=Torr l/s	Leak Rate [float]
57	**Set Trigger**	Trigger value	Byte 0: **1=Trigger 1** 2=Trigger 2 Byte 1: 1=sccm 3=mbar l/s 4=Pa m³/s 5=atm cc/s 6=Torr l/s Bytes 2..5: [float]	
58	Get Mode	Operation mode		Bit 0..6 : 0=accumulation 1=carrier gas 3=cont. mode Bit 7 : 0=automatic times
59	**Set Mode**	Operation mode	Byte 0 : 0=accumulation 1=carrier gas 3=cont. mode	
62	**Get Error Code**	Read which error occurred		error code number [uchar], see the corresponding chapter "Errors and Warnings" in the Technical Handbook.
63	**Clear Error**	Acknowledge and clear errors		
64	GetMinSinceStart	Time since power on		Bytes 0..3: time in minutes [ulint]
66	Get Test Leak	Test leak value for calibration	Byte 0: 0=test leak 1=proof leak Byte 1: 3=mbar l/s 4=Pa m³/s 6=Torr l/s	Leak Rate [float]

No.	Name	Description	Parameter	Data
67	**Set Test Leak**	Test leak value for calibration	Byte 0: 0=test leak 1=proof leak Byte 1: 3=mbar l/s 4=Pa m³/s 6=Torr l/s Bytes 4..7: [float]	
68	Get Run Hours Basic	Uptime Basic		Bytes 0..3: Time in 0.1hs [ulint]
70	Get Serial Number	Serial number of device		Bytes 0..10: Number (ASCII; 0x20..0x7F)
72	**Get Mode**	Operation mode		Byte 0: 1=Run up 2=Measure 6=Standby
74	Get Press Limit Low/ High	Get pressure limits	Byte 0: 0=Low 1=High Byte 1: 0=mbar 1=Pa 2=atm 3=PSI 4=Torr	Pressure Limit [float]
75	Set Press Limit Low/ High	Set pressure limits	Byte 0: 0=Low 1=High Byte 1: 0=mbar 1=Pa 2=atm 3=PSI 4=Torr Byte 2..5: [float]	
78	Get Cal Fac	Get calibration factor		Factor [float]
79	**Set Cal Fac**	Set calibration factor	Factor [float]	
90	Get Program Version	Software version		Byte 0: Main Version Byte 1: Sub Version Byte 2: Debug Version
97	**Get Filtered Ion Current**			Current in Amps [float]
98	Get Unfiltered Ion Current			Current in Amps [float]
99	**Get Leak Rate**	Leak rate	Byte 0: 3=mbar l/s 4=Pa m³/s 6=Torr l/s	Leak Rate [float] is 1 if no value available

No.	Name	Description	Parameter	Data
116	**Get Times**	Measurement times	Byte 0: 0=TGross 1=TFine **2=TMeas** 3=TPurge 4=WaitPurge	Time in seconds [float]
117	**Set Times**	Measurement times	Byte 0: **2=TMeas** 3=TPurge 4=WaitPurge Bytes 1..4: Seconds [float]	
118	Proof	Start and confirm Proof	Byte 0: 1=Start Proof 2=Confirm Proof	
121	Set Date Time	Sets date or time	Byte 0: 0=DATE 1=TIME	Bytes 0..2: Day, month, two-digit-year for DATE, Hours, minutes, seconds for TIME
122	Get Control Location	Gets actual control location		1=LOCAL 2=RS232 3=LOCAL/RS232 4=PLC 5=LOCAL/PLC 7=ALL
123	Set Control Location	Sets actual control location	Byte 0: 1=LOCAL 2=RS232 3=LOCAL/RS232 4=PLC 5=LOCAL/PLC 7=ALL (RS232 cannot switch off itself)	
134	Set Lang	Display language	Byte 0: 0=english 1=german 2=french 3=italian 4=portuguese 5=spanish 6=katakana	
135	Get Lang	Display language		Byte 0: 0=english 1=german 2=french 3=italian 4=portuguese 5=spanish 6=katakana
136	Get Date	Date		Bytes 0..2: Day, month, year
137	Get Time	Time		Bytes 0..2: Hours, minutes, seconds

No.	Name	Description	Parameter	Data
140	Get Background	Background Info from Display Unit		0=OK 1=moderate 2=bad
144	GetCalEnable			0 = disabled 1 = enabled
145	SetCalEnable		Byte0: 0 = disable 1 = enable	
152	Get Stat	Gets status	1=Trigger Status	Bit0 (1)=Trigger1 has been exceeded Bit1 (2)=Trigger2 has been exceeded Bit4 (16)=Leak Rate is >5x highest Trigger Bit5 (32)=Leak Rate is >100x highest Trigger
154	Get Trigger2 ON	Read if Trigger 2 is enabled		0=off 1=on
155	**Set Trigger2 ON**	Enable Trigger 2	**0=off** 1=on	
156	CopyParaSet	Copies parameter set from Byte0 to Byte1	Byte0: 68=default 0=current set 1..3=internal 11..35=I·Stick Byte1: 0=current set 1..3=internal 11..35=I·Stick	
160	Get Acc Vol	Get accumulation volume	Byte 0: 0=liters 1=cu feet 2=cu inches 3=ccm	Value [float]
161	**Set Acc Vol**	Set accumulation volume	Byte 0: 0=liters 1=cu feet 2=cu inches 3=ccm Bytes 1..4: Value [float]	
162	Get Car Flow	Get total carrier gas flow	Byte 0: 0=sccm 1=liters/s	Value [float]
163	**Set Car Flow**	Set total carrier gas flow	Byte 0: 0=sccm 1=liters/s Bytes 1..4: Value [float]	
174	Get Gross	Read if Gross is active (in Cont. Mode only)		0=off 1=on
175	Set Gross	Set GROSS mode (in Cont. Mode only)	Byte 0: 0=off 1=on	

No.	Name	Description	Parameter	Data
176	Get Standby Delay	Read Standby delay time		0=10 s 1=30 s 2=1 min 3=2 min 4=5 min 5=10 min 6=30 min 7=60 min 8=off
177	Set Standby Delay	Set Standby delay time	Byte 0: 0=10 s 1=30 s 2=1 min 3=2 min 4=5 min 5=10 min 6=30 min 7=60 min 8=off	
187	Get IO Ports Out	IO Port (output)		Byte0, Bit0 Pin 8 Byte0, Bit1 Pin 9 Byte0, Bit2 Pin 10 Byte0, Bit3 Pin 11 Byte0, Bit4 Pin 12 Byte0, Bit5 Pin 13 Byte0, Bit6 Pin 14 Byte0, Bit7 Pin 15
188	Get IO Ports In	IO Port (input)		Byte0, Bit0=Pin1 Byte0, Bit1=Pin2 Byte0, Bit2=Pin3 Byte0, Bit3=Pin4 Byte0, Bit4=Pin5 Byte0, Bit5=Pin6
189	**Start Standby or Purge**		Byte0: 1= Start Standby 2= Stop Standby 3= Start Purge 4= Stop Purge	
190	**Get Times Auto**		Byte 0: 0=Auto Times 1=Auto Purge	0=off 1=on
191	**Set Times Auto**		Byte 0: 0=Auto Times 1=Auto Purge Byte 1: 0=off 1=on	
194	Get Value		Byte 0: 0=He Percentage	Value [uchar]
195	Set Value		Byte 0: 0=He Percentage Byte 1: 10..100 [uchar]	

4.3 Error Messages Binary Mode

No.	Name	Explanation
231	RS232disabled	Control location is not RS232
232	RS232Invalid	Command currently not allowed (i.e. CAL when running up)
234	RS232PW2disable	Password disabled (for INFICON service only)
235	RS232CmdFailed	Execution of command failed
240	RS232Cmd	Command does not exist
243	RS232Len	Number or length of parameter wrong
244	RS232Para	Parameter not in valid range
252	RS232Start	First byte was not 0x05
253	RS232Checksum	Transmitted and calculated checksum differ
254	RS232Timeout	Time out (Command transmission did not finish within 500 ms)
255	RS232Buffer	Overflow in command receive buffer

5 Profibus-DP Protocol

5.1 Preface

In order to use Profibus-DP with T-Guard, you must have ordered a T-Guard in the Profibus version (Cat. No. 540-002). It is not possible to add the Profibus option to Cat. No. 540-001.

When setting up the Profibus communication you need to use the GSD file provided by INFICON.

5.2 Process Data Mapping for Cyclic Data Transfer

5.2.1 Read Process Data (PLC-> Leak Detector)

This data is sent periodically from the programmable logic controller to the leak detector:

Byte	Bit	Name	Meaning	Similar to PLC Input	Similar to RS232 ASCII cmd.
0	0	not used			
	1	not used			
	2	CLEAR	Transition 0->1:Clears errors and warnings	CLEAR	*CLS
	3	not used			
	4	CAL	Transition 0->1: Start calibration	CAL	*CAL:START
	5	PROOF	Transition 0->1: Start proof	PROOF	
	6	STOP	Transition 0->1: Stop	STOP	*STOP
	7	START	Transition 0->1: Start	START	*START
1	0	PURGE_STOP	Transition 0->1 = Stop purging the measurement line		*PURGE:STOP
	1	PURGE_START	Transition 0->1 = Start purging the measurement line	PURGE	*PURGE:START
	2	not used			
	3	not used			
	4	STANDBY	Transition 0->1: Switch to stand-by	STANDBY	*STANDBY
	5	GROSS/FINE	Switch between GROSS and FINE (in Cont. Mode only)	GROSS/FINE	*GROSS ON
	6	READY	Transition 0->1: Wake up leak detector from stand-by mode	READY	*STANDBY:STOP
	7	not used			

Notice The Profibus-DP protocol is subject to change.
If you are using this protocol, please ask INFICON for an update.

5.2.2 Write Process Data (Leak Detector -> PLC)

This data is sent periodically from the leak detector to the programmable logic controller:

Byte	Bit	Name	Meaning	Similar to PLC Output	Similar to RS232 ASCII cmd.
0	0	Error	1=Yes, 0=No	ERROR	
	1	Warning	1=Yes, 0=No	WARNING	
	2 3 4	CAL Status	0=NO CAL RUNNING 1=T<20 MIN, CONFIRM 2=CAL RUNNING, WAIT 3=CAL FINISHED 4=CAL FINISHED, CONFIRM 5=PROOF RUNNING, WAIT 6=PROOF FINISHED 7=PROOF FINISHED, CONFIRM		*CAL:STATUS?
	5	Purge	0=inactive 1=active		
	6 7	Background	0 = good 1 = medium 2 = bad		
1	0 1 2 3 4 5 6 7	State	Device state (see "44 Get Status" in the binary protocol)	READY, CYCLE_ACTIVE, STANDBY, MEASURE, GROSS	*STATUS:MEAS?
2 3 4 5		Leak rate (mbar*l/s)	Actual leak rate in mbar*l/s	Recorder output (LR_LIN, LR_LOG...)	*READ?
6 7 8 9		Pressure	Pressure in mbar	Recorder output (P1)	*MEAS:P:FORE?
10 11 12 13		Sensor current	Sensor current in A	Recorder output (CUR_LIN, CUR_LOG)	*MEAS:FILTER?
14		Error / warning code	Error / warning code		*STATUS:ERROR?

5.3 Acyclic Data Transfer

Important Note:

If you want to use acyclic data transfer with Profibus, you must use a Profibus master which supports DPV1 data transfers.

A Profibus master which supports DPV0 only, can only use cyclic data transfer.

5.3.1 Addressing Rules for Acyclic Access

Fieldbus	Rule
Profibus	ADI = slot * 255 + index +1 slot = (ADI-1) / 255 index = (ADI-1) MOD 255

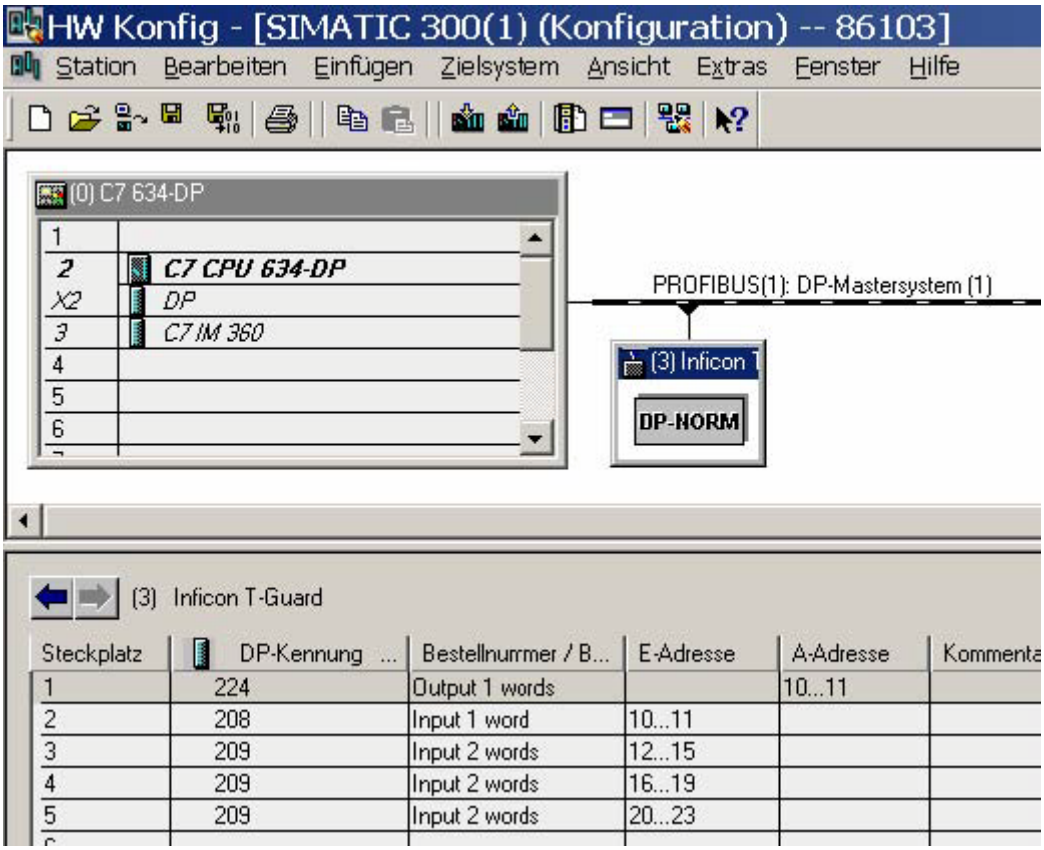
5.3.2 Application Data Instances

The ADI number is equivalent to the command number in the RS232 binary protocol.

Please refer to section 4.2.1 Command List Binary Mode for further description of the commands.

							Profibus	
ADI	Name	Data type	Get	Set	Min.	Max.	Slot	Index
2	Pressure	FLOAT	X				0	1
5	Device ID	UINT8	X				0	4
8	Hardware Version	UINT16	X				0	7
16	LCD contrast	UINT8	X	X			0	15
36	Cal. Factors	FLOAT[7]	X	X			0	35
38	Min. since start	UINT32	X				0	37
43	Offset current	FLOAT	X				0	42
44	State	UINT8	X				0	43
54	Cal. state	UINT8	X				0	53
56	Trigger [mbar*l/s]	FLOAT[2]	X	X			0	55
62	Error Code	UINT8	X				0	61
66	Test leak leak rate [mbar*l/s]	FLOAT	X	X			0	65
67	Proof leak leak rate [mbar*l/s]	FLOAT	X	X			0	66
68	Operation hours [0.1h]	UINT32	X				0	67
70	Serial No.	CHAR[11]	X				0	69
72	State	UINT8	X				0	71
74	Pressure limit Low/High [mbar]	FLOAT[2]	X	X			0	73
77	Serial no. WISE sensor	CHAR[15]	X				0	76
78	Calibration factor	FLOAT	X	X			0	77
97	Ion current	FLOAT	X				0	96
98	Unfiltered ion current	FLOAT	X				0	97
99	Leak rate [mbar*l/s]	FLOAT	X				0	98
112	Valves	UINT16	X				0	111
116	Times	FLOAT[5]	X	X			0	115
122	Control location	UINT8	X	X			0	121
134	Language	UINT8	X	X			0	133
136	Date	UINT8[3]	X				0	135
137	Time	UINT8[3]	X				0	136
154	Trigger 2 enable	UINT8	X	X			0	153
159	WISE load	FLOAT	X				0	158
160	Accumulation volume [l]	FLOAT	X	X			0	159
162	Carrier gas flow [sccm]	FLOAT	X	X			0	161
174	Gross mode	UINT8	X	X			0	173
176	Standby delay time	UINT8	X	X			0	175
187	IO port output	UINT8	X				0	186
188	IO port input	UINT8	X				0	187
190	Auto times	UINT8	X	X			0	189
191	Auto purge	UINT8	X	X			0	190
192	Serial no. analog board	CHAR[15]	X				0	191
194	He concentration	UINT8	X	X			0	193
201	Control word	UINT16		X			0	200
202	Status word	UINT16	X				0	201

5.4 Hardware Configuration



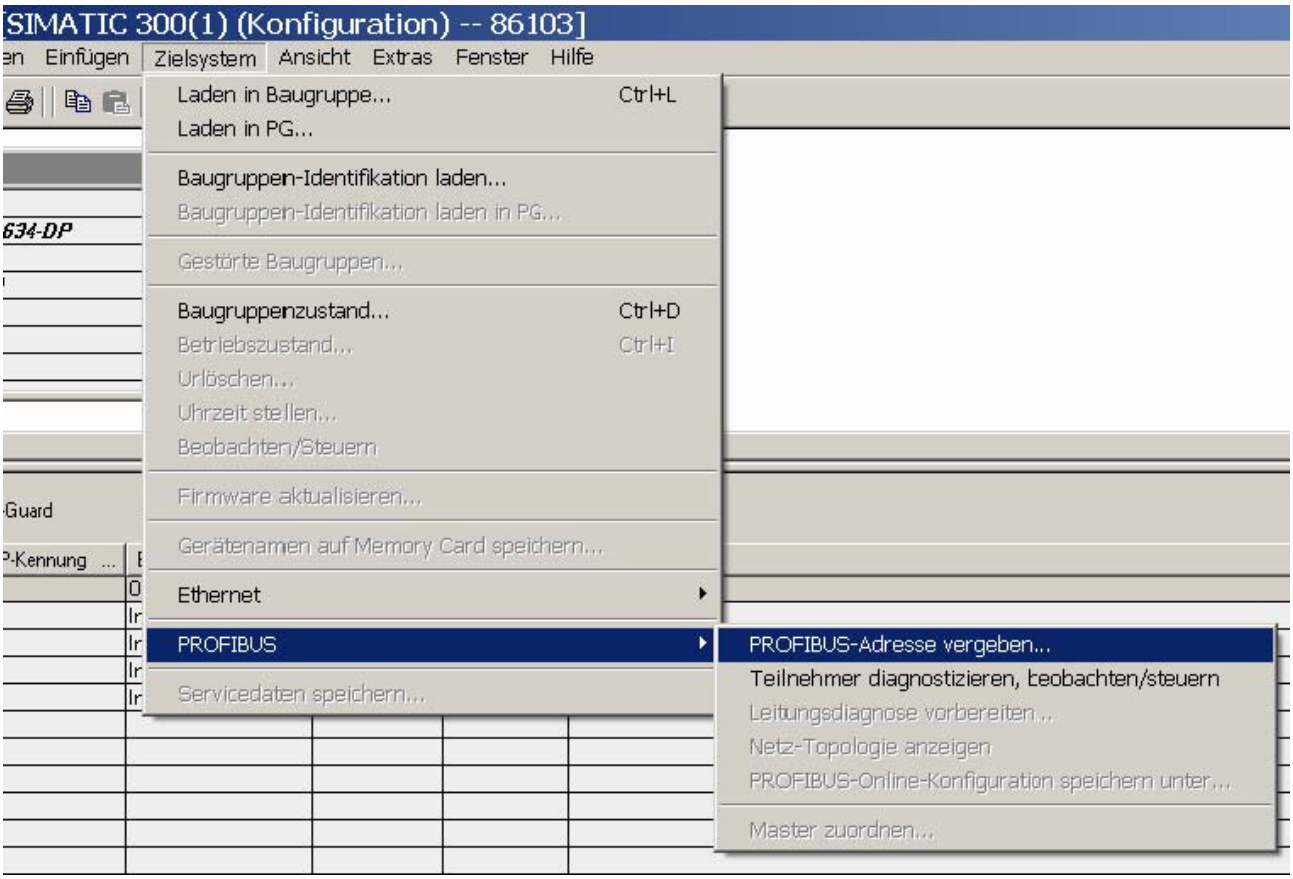
Important Note:

Sequence of the data words (slots) must be:

- **Output at first, inputs at second.**

- One or two words are accessible at once.
- Output and inputs must have the same memory start address.

5.4.1 Assignment of the Profibus Address



The Profibus address has to be assigned with the hardware configuration tool.

After downloading the configuration to the PLC system, the address of the T-Guard™ Profibus Client can be chosen like shown above.

5.4.2 Diagnosis with the T-Guard™ Info Menu

The current state of the T-Guard™ Profibus client is to be seen in the menu:

„Menu - Info - Internal data (Page 8, Info Fieldbus)“

The „State“ has the value „Process_Active (4)“, if the communication has been established.

The „Device Address“ shows the current Profibus address of the T-Guard™ client.

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