TRICOR® TCE 8000

HART® Communication

TRICOR Coriolis Technology

Manual-Version

TCM_COHA_CLASSIC_S_EN_191022_E004

SW-Version

This manual is valid for

Main SW: Mv3.40 and higher

Trademark Information

HART® is a registered trademark of the HART® Communication Foundation, Austin, Texas, USA.

Any use of the term HART® hereafter in this document implies the registered trademark.

The TCE 8000 follows HART® Communication Protocol Revision 7. The TCE 8000 communicates only as a non-bursting slave device and can only be used in a system with a HART® Master Controller.

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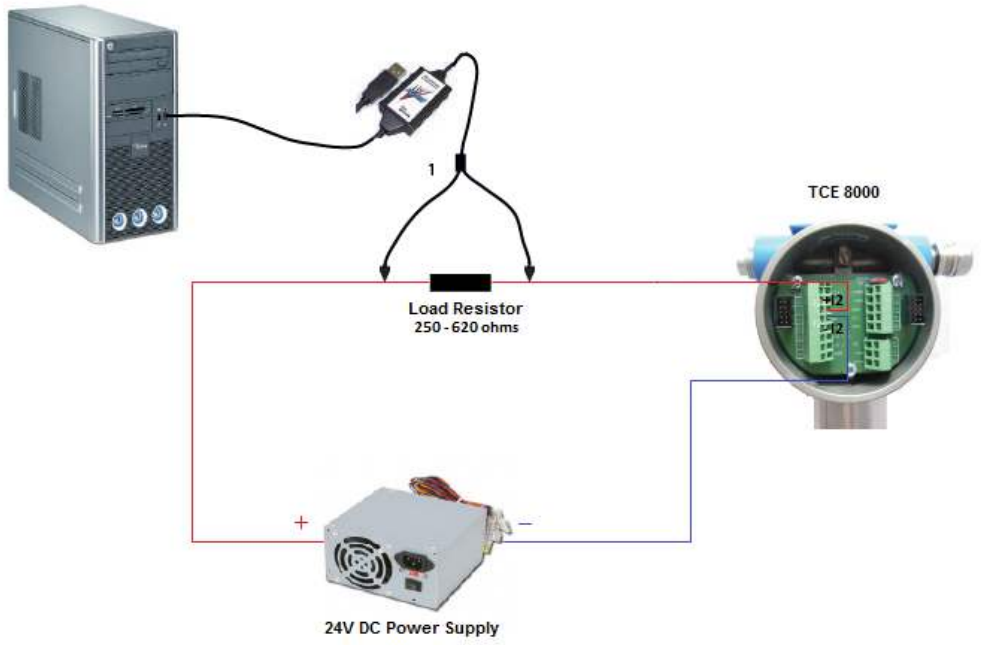
1. Electrical connection for HART®

For the HART® communication the current output Current 2 (terminals 3 and 4) is used.

For communication a small AC current gets modulated on the DC signal current. A load resistor with 250 Ω nominal resistance converts the current into a small voltage. The HART® modem connected across the resistor detects the AC voltage and converts it into the corresponding digital data stream. The communication works over that connection in both directions.



2. Ex installation for HART®

The analog current outputs need an external supply of 24 V DC.

The outputs are designed for a rated voltage of 30 V AC.

The outputs are protected against wrong polarity. Voltages below 30 V (AC or DC) will not damage the outputs nor affect the Ex safety.

Refer to chapter 3.3 of the TRICOR CLASSIC manual for more information regarding Ex installation!

WARNING!

Applying more than 30V (AC or DC) to the analog output terminals will damage the TCE and destroy the protection of the TCM!

WARNING!

If more than 30V have been applied to any of the analog output terminals, the unit must be returned to KEM/AWL for repair as the safety barrier might be destroyed!

3. Communication using HCF Host SDC-625

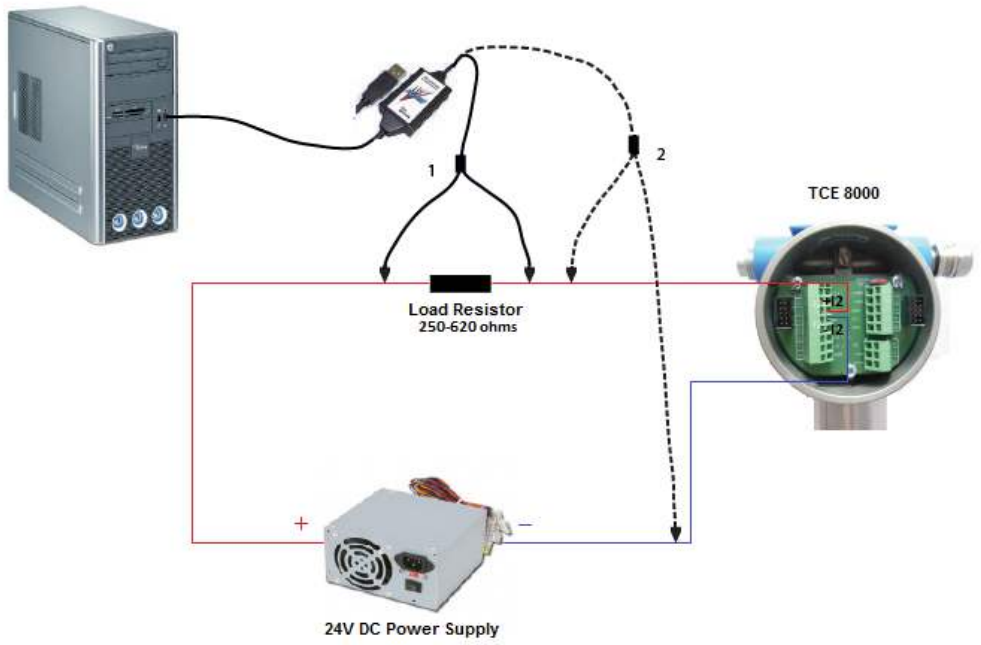
Refer to the manual of your HART® modem for the detailed information about the required load resistor or different electrical connection details.

3.1. HART® modem without built in load resistor

For the HART® communication the current output Current 2/AO2 (terminals 3 and 4) is used.

Connect the analog output Current 2/AO2 as described in chapter 3.3.6 in the TRICOR CLASSIC manual and connect the load resistor in series to the analog output of the TCE 8000.

The minimum value for the load resistor is 250 Ω (determined by the HART® requirements), the maximum value is 620 Ω (determined by the maximum allowed voltage drop).



Connect the test clips of the HART® modem across the load resistor (1). If in a fixed installation a load resistor of the required size is built in, but not accessible, a HART® modem without built in load resistor can be connected across the TCE 8000 (2).

3.2. Device Description

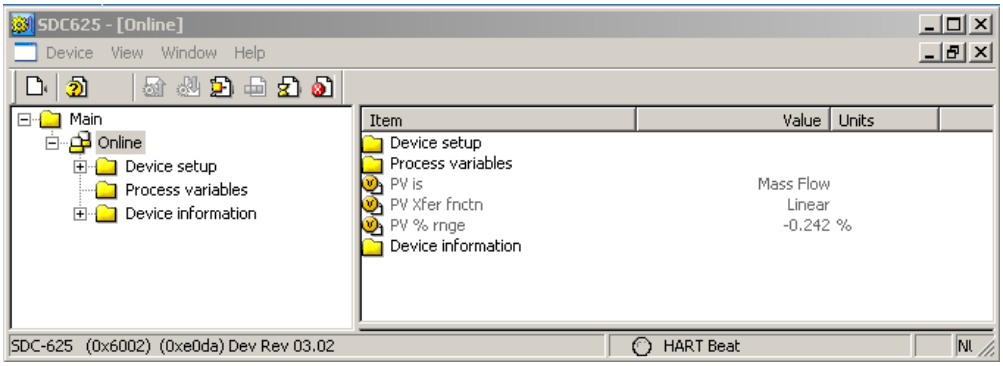
The device description (DD) is a text file that precisely describes TCE 8000 device capabilities for use by the host system. It defines the parameters that are available for building control loops, establishes the arrangement of parameters in a menu structure, and determines how parameters are related to one another. For the DD files please contact KEM or AW-Lake!

- 0302.fm8
- 0302.im8
- 0302.sym

3.3. Control menu overview using the HCF host SDC-625 (Version 3.0.1)

Main Menu

- Device setup
- Process variables -> show available device variables and measured values
- PV is -> the device variable assigned to PV (see Tab. 1 in Appendix for available device variables). The PV or SV assignments can be changed in the menu Device setup -> Analog Outputs -> Config AO1/AO2
- PV Xfer fnctn -> PV transfer function (read only), by default “linear”
- PV % rnge
- Device information

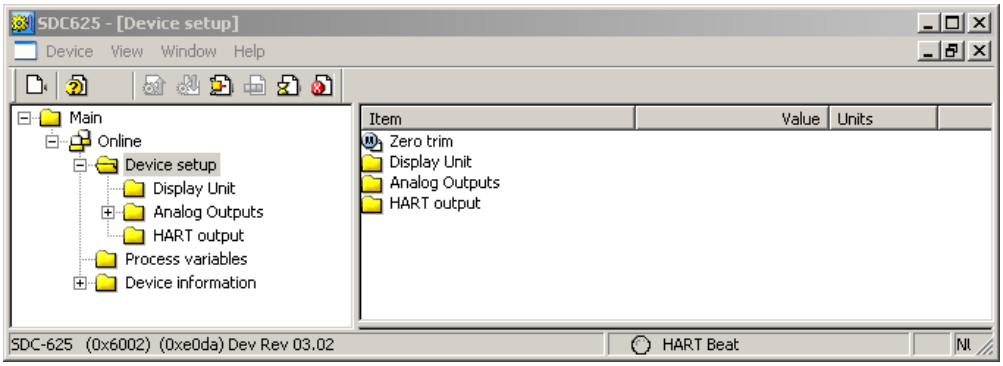


NOTE:

PV (primary variable) is always assigned to physical analog output Current 1 or AO1
SV (secondary variable) to physical analog output Current 2 or AO2

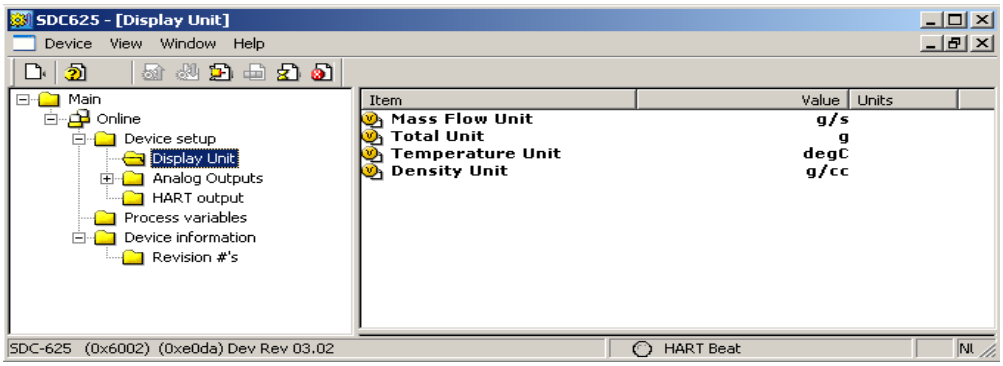
Device Setup

- Zero trim -> activate zero procedure
- Display Units -> show or change the measuring units assigned to device variables
- Analog Outputs -> set up the analog outputs
- HART® output



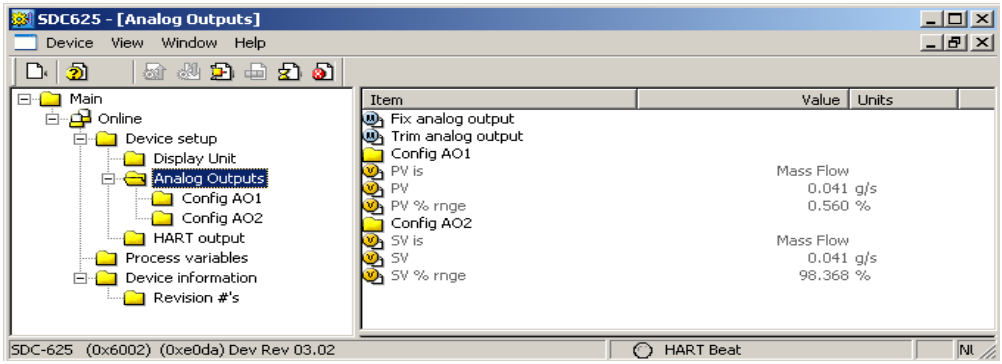
Device Setup -> Display Units (see Tab. 2 in Appendix for available measuring units)

- Mass Flow Units
- Total Units
- Temperature Units
- Density Units



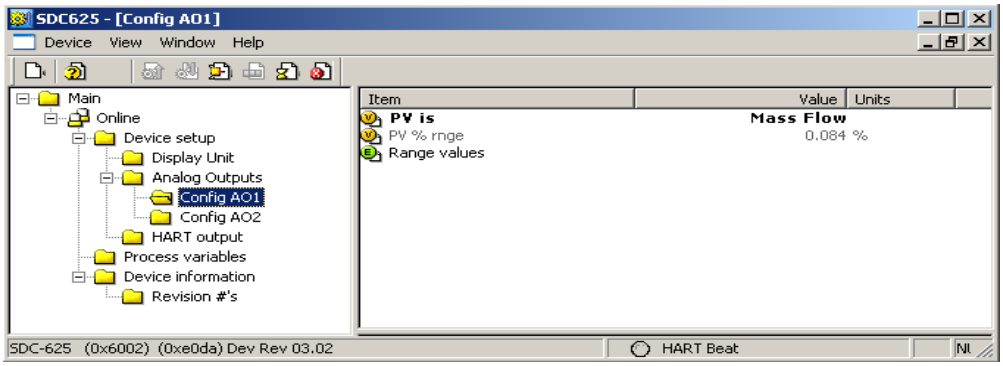
Device Setup (Geräteeinstellung) -> Analog Outputs (Analogausgänge)

- Fix analog output (Analogausgang festlegen) -> die Analogausgänge testen
- Trim analog output (Analogausgang trimmen)
- Config AO1 (Konfig AO1)
- PV is (PV ist) -> Gerätevariable, die der PV zugewiesen wurde
- PV-> gegenwärtiger Wert der PV
- PV % rnge (PV % Bereich)
- Config AO2 (Konfig AO2)
- SV is (SV ist) -> Gerätevariable, die der SV zugewiesen wurde
- SV-> gegenwärtiger Wert der SV
- SV % rnge (SV % Bereich)



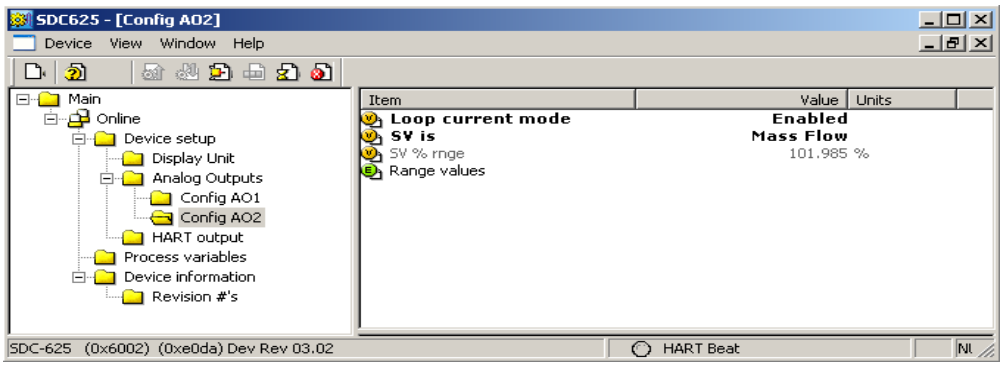
Device Setup (Geräteeinstellung) -> Analog Outputs (Analogausgänge)-> Config AO1 (Konfig AO1)

- PV is (PV ist)
- PV % rnge
- Range values (Bereichswerte) -> Bereichswerte für AO1 (PV Analogkanal) einstellen



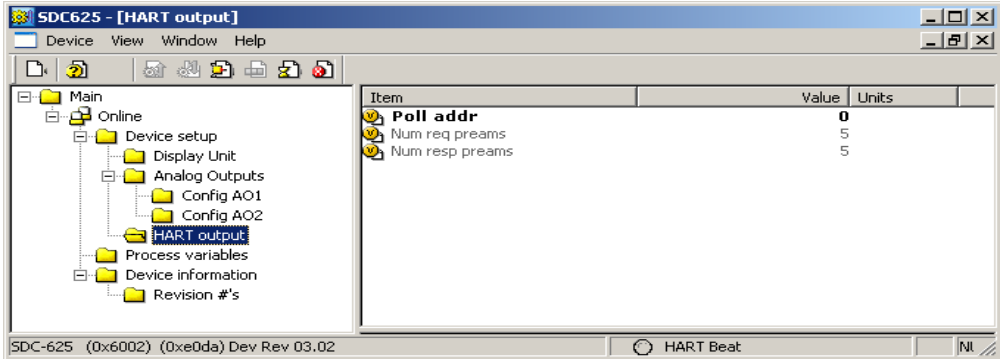
Device Setup -> Analog Outputs -> Config AO2

- Loop current mode -> by default “enabled” because the polling address of the TCE 8000 device is by default “0”. If setting the mode to “disabled” the analog output AO2 (SV analog channel) will be fixed to 4mA (see menu Device Setup -> HART® output -> Polling address for further explanations).
- SV is
- Range values -> set the range values for AO2 (SV analog channel)



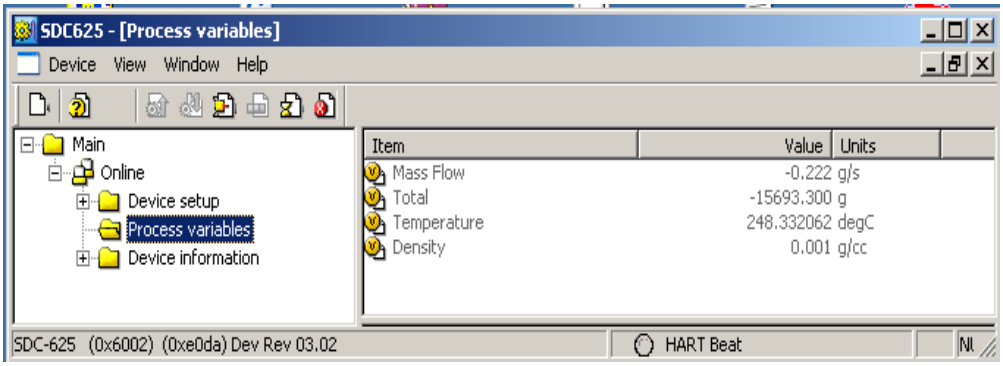
Device Setup -> HART® Output

- Polling address -> by default “0”. If your TCE 8000 device is a part of a HART® network with multiple HART® devices the polling address has to be assigned to a number different from 0. The available address space is 1-63. After the polling address was changed to a number different from 0 the loop current mode will be disabled (see menu Device Setup -> Config Analog Outputs -> Config AO2) so the analog output AO2 (SV analog channel) will be fixed to 4mA.
- If you change the polling address again to 0 you have to enable the loop current mode in the menu Device Setup -> Config Analog Outputs -> Config AO2
- Number of request preambles -> read only
- Number of response preambles -> read only



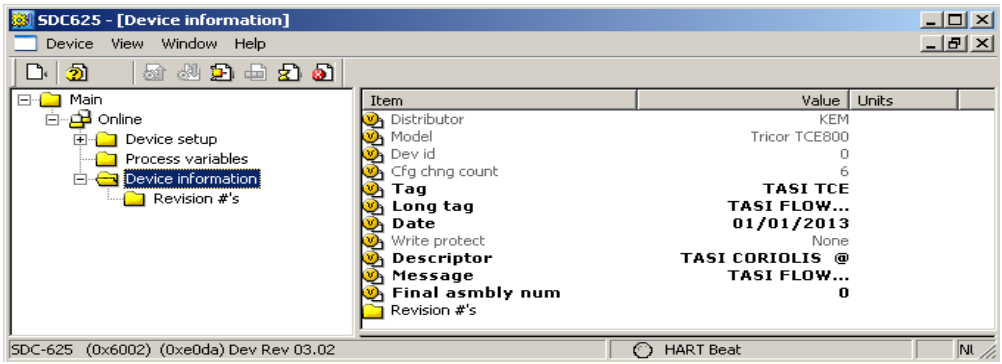
Process Variables (Prozessvariablen – alle verfügbaren Gerätevariablen)

- Mass Flow (Massendurchfluss)
- Total (Gesamtmenge)
- Temperature (Temperatur)
- Density (Dichte)



Device Information (Geräteinformationen)

- Lieferant
- Model (Modell)
- Dev id (Gerätenr.)
- Configuration change counter (Zähler der Konfigurationsänderungen)
- Tag
- Long tag (Langer Tag)
- Date (Datum)
- Write protect (Schreibschutz)
- Descriptor (Deskriptor)
- Message (Meldung)
- Final assembly number (Endfertigungsnummer)
- Revision #'s (Revision(en))



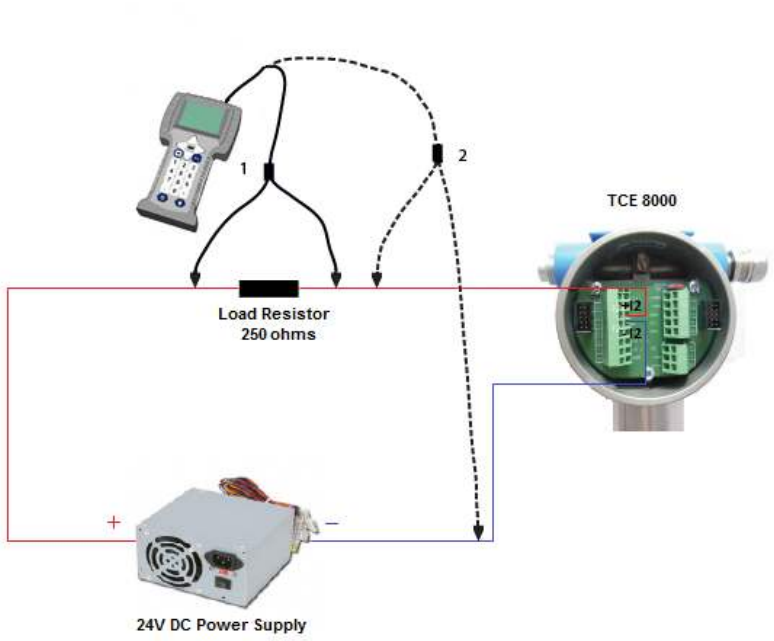
3.4. Emerson 375/475 Field Communicator

3.4.1. Field communicator without built in load resistor

For the HART® communication the current output Current 2/AO2 (terminals 3 and 4) is used.

Connect the analog output Current 2/AO2 as described in chapter 3.2.6 in the TRICOR CLASSIC manual and connect the load resistor in series to the analog output of the TCE 8000.

The minimum value for the load resistor is 250 Ω (determined by the HART® requirements), the maximum value is 620 Ω (determined by the maximum allowed voltage drop).

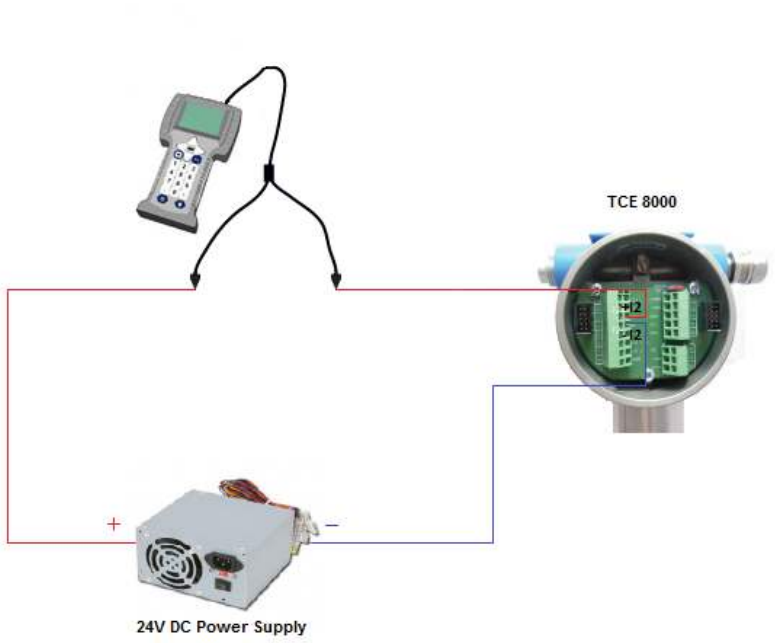


Connect the test clips of the Field Communicator across the load resistor (1).

If in a fixed installation a load resistor of the required size is built in but not accessible a Field Communicator without built in load resistor can be connected across the TCE 8000 (2).

3.4.2. Field communicator with built in load resistor

If a Field Communicator with built in load resistor is used, it must be connected in-line.



Connect the clip of the Field Communicator to the bare end of the wires.

WARNING!

If a Field Communicator with built in load resistor is connected across the TCE 8000 (connection 2 in the upper picture) or directly across the power supply, no HART® communication or current reading is possible and the HART® modem might get damaged!

3.4.3. Device Description

For communicating with Emerson 375 or 475 Field Communicator please use the following DD files:

- 6002E0DA0302.hdd
- 6002E0DA0302.hhd

For the DD files please also contact KEM or AW-Lake! Since TCE 8000 electronics not registered at HCF HART Foundation (registration is pending) yet the DD files are not a part of the available DD files on your Field Communicator. You have to use the “Easy Upgrade Utility” to download our DD files to your Field Communicator!

3.4.4. Control menu overview using the 375/475 Field Communicator

The screen shots below were made from the 475 HART® simulator running on Windows PC.

Start communication:

Continue with “CONT”:

Main menu:

Refer to 3.3 for detailed information to the control menu structure!

After changing the configuration (e.g. measuring units) the following screen will be shown.

Please continue with “YES”:

4. Appendix

4.1. Available HART® Commands

4.1.1. Universal Commands

Command		Data in Request			Data in Reply			
No	Function	Byte	Type	Function	Byte	Type	Value	Function
0	Read Unique Identifier			none	0			expansion code
					1-2	U16	E0DA	device code
					3		5	number of preambles
					4		7	universal command Rev.
					5		3	transmitter specific cmd. rev.
					6		12	SW rev.
					7		1	HW rev.
					8		0	device function flags
					9-11	U24		device ID
					12			number of preambles in response
					13		4	device var. max number
					14-15	U16		config. counter
					16		0	ext. field device status
					17-18	U16	6002	manu. ident. code
					19-20	U16	6002	private label distributor code
					21			device profile
1	Read Primary Variable			none	0			PV units code
					1-4	F		primary variable
2	Read current and percent of range			none	0-3	F		current (mA)
					4-7	F		percent of range
3	Read current and four (predefined) dynamic variables			none	0-3	F		current (mA)
					4			PV units code
					5-8	F		primary variable
					9			SV units code
					10-13	F		secondary variable
					14			TV units code
					15-18	F		third variable
					14			FV units code
					15-18	F		fourth variable
6	Write polling address and loop current mode	0	byte	polling address	0			polling address
		1	byte	loop current mode	1			loop current mode

Command		Data in Request			Data in Reply			
No	Function	Byte	Type	Function	Byte	Type	Value	Function
7	Read loop configuration			none	0 1			polling address loop current mode 0 – disabled (fixed at 4mA) 1 – enabled (reflects PV
8	Read dynamic variable classification			none	0 1 2 3			PV classification SV classification TV classification QV classification
9	Read device variables with status	0 1 2 3	byte byte byte byte	Device var. code 0 Device var. code 1 Device var. code 2 Device var. code 3	0 1 2 3 4-7 8 9-17 18-26 27-35	 F 		extended field device status slot 0: device var. code 0 slot 0: device var. classification slot 0: units code slot 0: device var. value slot 0: device var. status repeat for Slot 1 repeat for Slot 2 repeat for Slot 3
11	Read unique identifier associated with tag	0-5	A	tag	0-21			same as command #0 (tag is 8 char.)
12	Read massage			none	0-23	A		message (32 char.)
13	Read tag, descriptor, data			none	0-5 6-17 18-20	A A D		tag (8 char.) descriptor (16 char.) data
14	Read PV sensor information			none	0-2 3 4-7 8-11 12-15	U24 F F F	1	transducer ser. number (not used in TCE 8000) units code (PV units) upper trans. limit lower trans. limit minimum span
15	Read Output Information			none	0 1 2 3-6 7-10 11-14 15 16 17	 F F F 	FA 0 FB FA 0	alarm select code (not used in TCE 8000) transfer function code (linear) PV/range units code upper range value lower range value damping value(sec.) write protect code private label distributor code PV analog channel flags
16	Read final assembly number			none	0-2	U24		final assembly number

Command		Data in Request			Data in Reply			
No	Function	Byte	Type	Function	Byte	Type	Value	Function
17	Write message	0-23	A	Message	0-23	A		echo command data
18	Write tag, descriptor, data	0-5 6-17 18-20	A A D	Tag Descriptor Date	0-5 6-17 18-20	A A D	0-5 6-17 18-20	echo command data
19	Write final assembly number	0-2	U24	Final assembly number	0-2			echo command data
20	Read long tag			none	0-31			32-char. full ISO latin-1 ASCII
21	Read unique identifier associated with long tag	0-31		Long tag	0-21			same as command #0 (long tag is 32 char.)
22	Write long tag	0-31		Long tag	0-31			echo command data
38	Reset configuration changed flag							
48	Read additional device status							

4.1.2. Common Practice Commands

Command		Data in Request			Data in Reply			
No	Function	Byte	Type	Function	Byte	Type	Value	Function
33	Read transmitter variables (see Tab. 1 in Appendix)	0 1 2 3	B B B B	device variable code for slot 0 (see Tab. 1 in Appendix for device var. assignments) device var. for slot 1 device var. for slot 2 device var. for slot 3	0 1 2-5			slot 0: dev. var. code slot 0: units code slot 0: variable repeat for slot 1 repeat for slot 2 repeat for slot 3
50	Read dynamic variable assignments (see Tab. 1 and 2 in Appendix)			none	0 1 2 3	B B B B		PV transmitter var. code SV transmitter var. code TV transmitter var. code QV transmitter var. code
51	Write dynamic variable assignments (see Tab. 1 and 2 in Appendix)	0 1 2 3	B B B B	PV var. code SV var. code TV var. code QV var. code	0-3			as in command

Command		Data in Request			Data in Reply			
No	Function	Byte	Type	Function	Byte	Type	Value	Function
52	Set transmitter variable zero	0	B	1 for mass or volume batch totals				as in command
53	Write transmitter var. units (see Tab. 1 and 3 in Appendix)	0 1	B B	device var. code device var. units code				as in command
54	Read transmitter var. information	0	B	device var. code				as in command

4.1.3. Common Practice Commands

Befehl		Daten in der Abfrage			Daten in der Antwort			
Nr.	Funktion	Byte	Typ	Funktion	Byte	Typ	Wert	Funktion
129	Read damping value	0	B	device var. code (see device var. assignments)	0 1-4	 F		channel number damping value
140	Read diagnostics			none	0-3 4-7 8-11 12-15 16-19 20-21	F F F F F U16		sensor A voltage [mV] sensor B Voltage [mV] drive Current [mA] sensor Frequency[Hz] zero Offset [µs] error Code
142	Read service parameters			none	0-3 4-7 8-11 12-15	F F F F		low flow cut off in % of f.s. low density cut off in curr. units flow direction 1 - FORWARD -1 - REVERSE K-factor
143	Write service parameters	0-3 4-7 8-11 12-15	F F F F	Low Flow Cut Off Low Density Cut Off Flow Direction K-factor	0-3 4-7 8-11 12-15	F F F F		low flow cut off in % of f.s. low density cut off in curr. units flow direction 1 - FORWARD -1 - REVERSE K-factor
144	Read grand total mass			none	0-3	F		grand total mass in current units
151	Reset batch totals			none				
153	Reset grand totals			none				

4.2. Tables

Device variable code	function
0	Mass flow rate
1	Mass batch total
2	Temperature
3	Density
4	Volume flow rate
5	Volume batch total

Tab. 1: Device variable codes

Dynamic variable	Function by default
PV	Mass flow rate
SV	Mass batch total
TV	Temperature
QV	Density

Tab. 2: Dynamic variable assignments

Use command #50 for reading dynamic variable assignments or command #51 for writing dynamic variable assignments.

NOTE:

If you change the PV from default mode “mass flow” to “volume flow” please change first the meter mode to “VOLUME”. Also by changing PV from “volume flow” to “mass flow” please change first the meter mode back to “MASS”.

Function	Units code (decimal)	Units description
Mass flow rate	70	g/s (default setting)
	71	g/min
	72	g/h
	73	kg/s
	74	kg/min
	75	kg/h
	76	kg/day
	77	mtons/min
	78	mtons/h
	79	mtons/day
	80	lbs/sec
	81	lbs/min

Function	Units code (decimal)	Units description
	82	lbs/h
	83	lbs/day
Mass batch total	60	g (default setting)
	61	kg
	62	mtons
	63	lbs
	125	ounces
Temperature	32	°C (default setting)
	33	°F
	35	Kelvin
Density	91	g/cc (default setting)
	93	lbs/gal
	94	lb/ft3
	96	kg/l
	97	g/l
Volume flow rate	16	gal/min (default setting)
	17	l/min
	18	igal/min
	22	gal/s
	24	l/s
	30	igal/h
	31	igal/day
	132	bbl/s
	133	bbl/min
	134	bbl/h
	135	bbl/day
	136	gal/h
	137	igal/s
	138	l/h
	235	gal/day
Volume batch total	40	gallons (default setting)
	41	liters
	42	imp. gallons
	46	barrels
	124	imp. barrels

Tab. 3: Measuring units

Contact

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