Special documentation

Special documentation for EtherCAT® specifications, model WUD-2x-E EN

EtherCAT® Conformance tested

Ultra high purity transducer, with display, EtherCAT, models WUD-20-E, WUD-25-E, WUD-26-E

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Contents

1. Introduction

1.1 General information

Further information:

- Website:	www.wika.de / www.wika.com
- Contact: tel.:	+49 9372 132-0
	info@wika.de
- Data sheet:	PE 87.12
- Additional information:	WUD-2x-E EtherCAT
- Test report:	online at portal.wika.com/serial/
	Via QR code on the product la
- Declaration of conformity:	online at www.wika.com
- Tapped holes for process connections:	technical information IN 00.14

1.2 List of abbreviations

CDP	Common Device Profile; Basic profile for the semiconductor industry
DS	Data Sheet
ESI	EtherCAT Subdevice Information; Instrument description file in XML format
ESM	EtherCAT State Machine
ETG	EtherCAT Technology Group
FoE	File transfer over EtherCAT
INIT	Initialisation
L/A	Link/Activity; network status indicators
MDP	Modular Device Profile
OD	Object Dictionary
OP	Operational
PDO	Process Data Object; cyclic process data
SDP	Specific Device Profile; Addition to CDP for special instrument types
SI	Subindex

1.3 Instrument description

The WUD-2x-E model is a compact ultra high purity transducer for high-accuracy pressure measurement in the semiconductor industry. It is the first transducer to use the SDP 5003.2080 and offers maximum security of investment. Due to minimal signal noise, the sensor provides precise measured values in the long term. Thanks to active temperature compensation, even with high temperature fluctuations. Measured values can be viewed on the display.

The EtherCAT conformity is confirmed by an external test house. The WUD-2x-E thus meets the requirements of the semiconductor industry for an EtherCAT instrument.

1.4 General functions

1.4.1 I/O, controls, display

- Device „ID“ – manual setting of the device ID
- SET – short press of the button: selection of the pressure unit *
  – long press of the button: display rotates 180°
- Link / Activity – LED display of network activity
- RUN / ERR – LED display of EtherCAT status
- bar / psia / MPa – pressure unit displayed at the moment***
- Display – 4-digit segment display
- M8 3-pin – power supply
- RJ45 – signal output

* Value indicated on the display is independent from the unit set on the EtherCAT master!
** If none of the bar/ psia / MPa LEDs are lit, the customer-specific pressure unit is displayed.

1.4.2 EtherCAT indicators

The EtherCAT indicators are EtherCAT-specific in accordance with ETG1300 and provide information about the status of the instrument and network. They are helpful for fault finding.

The green **Link/Activity** (L/A) LEDs indicate the status of the network. Each port has its own integrated LED.
The following information can be read:

LED behaviour	Condition	Link	Activity
On	Port open	Yes	No
Flickering	Port open	Yes	Yes
Off	Port closed	No	(not applicable)

The **RUN** LED displays the status of the EtherCAT State Machine (ESM).
The following information can be read:

Indicator states	Slave state	Description
Off	Initialisation	The device is in state INIT
Blinking	Pre-operational	The device is in state PRE-OP
Single flash	Safe operation	The device is in state SAFE-OP
On	Operational	The device is in state OP
Flickering	Bootstrap	The device is in boot. Firmware download is in progress.

The red **Error (ERR)** LED indicates different errors.
If several errors occur at the same time, only the first error is displayed.
The following error can be read:

ERR state	Error name	Description	Example
Off	No error	The EtherCAT communication of the device is in working condition	
Double flash	Process data watchdog timeout / EtherCAT watchdog timeout	An application watchdog timeout has occurred.	Sync manager watchdog timeout
Single flash	Local error	Slave device application has changed the EtherCAT state autonomously, due to local error	Device changes its EtherCAT state from Op to SafeOpError due to a synchronisation error
Blinking	Invalid configuration	General configuration error	State change commanded by master is impossible due to object settings
On	Application controller error	A critical communication or application controller error has occurred	Application controller is not responding anymore (PDI watchdog timeout detected by ESC)

1.4.3 EtherCAT objects

All mandatory (m) objects from 5003.1 and 5003.2080 are implemented.
A complete overview with a description can be viewed in the associated Object Dictionary (OD) on request.

2. Installation

The instrument does not have any switching outputs, even if the mandatory objects 0xF641 "Trip Point Output All" and PDO 0xBFE Subindex (SI) 0x02 suggest this. These are set to 0 by the instrument and cannot be changed.
In addition, the following optional (o) objects have been added:

Index (object)	Subindex (SI) (entry)	Name	Additional information
0x3000	0x01	ETCU	Manufacturer output; Reserved for future use
0x4002	0x01-0x07	Production data	Manufacturer-specific area; read only (RO)
0x5002		Gauge model	Read only (RO) True (1) = absolute pressure instrument False (0) = gauge pressure instrument
0x6000	0x0E	TxPdoState	Is set if the device is not in any error condition
0x6000	0x11	Sensor value	The corrected, converted, calibrated final analogue input value of the sensor
0x6002	0x01	Reading valid	
0x6002	0x02	Overrange exceeded	Is set if value exceeds range
0x6002	0x03	Underrange exceeded	Is set if value falls below range
0x9000	0x01	Accumulated zero offset	Accumulated value that differs from factory settings after every digital offset
0x9000	0x03	Highest precision measurement value	Upper range value
0x9000	0x04	Lowest precision measurement value	Lower range value
0x9002	0x03	Sensor temperature	Temperature in °C; Measurement is close to the sensor (medium).
0xF382		Active manufacturer warning details	Reserved for future use
0xF390		Active manufacturer error details	Reserved for future use
0xF840	0x03	Data units enum	Differs from standard. Manufacturer area used. These units are not absolute or relative. For interpretation, note the index 0x5002. Supported units: 0x80 bar bar 0x81 psi pounds per square inch 0x82 MPa megapascal 0x83 torr torr
0xF940	0x03	Access rights	0: User 1: Reserved 2: Superuser (manufacturer only)
0xF9F7		Total time powered	This is the cumulative amount of time the device has been powered on, in seconds.
0xFB40	0x01-0x03	Zero adjust	Further description in chapter 3.4

The instrument can have additional online objects. These are not operated.

2. Installation

2.1 General information

The mounting, dismounting, installation, parameterisation and maintenance of the transducer in industrial environments absolutely requires suitably skilled personnel in accordance with the operating instructions.

2. Installation

The performance limits in accordance with the specifications in “chapter 8” of the operating instructions must be observed.

Prior to starting any work, read the operating instructions! Keep for later use!

You can find further help in the ETG.1600 “Installation Guideline”.

2.2 Electrical connection

Shielding and grounding
Include the transducer in the equipotential bonding via the process connection or connect it to ground (earth). It must be ensured by a sufficiently dimensioned parallel grounding that no compensating currents flow via the communication cable shielding.

Warning!
Physical injuries and damage to property and the environment
The instrument shield does not act as a protective conductor for protection of personnel, rather as a functional ground in order to shield the instrument from electromagnetic fields.

Information
Only use shielded communication cables and connection elements, at least CAT6 or higher.

Information
Within the instrument there is a low-impedance connection between the shielding of the communication line and the process connection.

Pin assignment
→ For pin assignments, see product label

Information
The pin assignment on the product label refers only to the M8 3-pin for power supply.
For the pin assignment of the RJ45, see data sheet PE 87.12.

Voltage supply
→ For auxiliary power, see product label

2.3 Mechanical connection

→ For information on tapped holes and welding sockets, see technical information IN 00.14 at www.wika.com

3. Commissioning

3.1 Notes on the ESI file

The ESI file is a instrument description file of the EtherCAT system with the extension .xml, which must be loaded into the corresponding folder of the configuration software for use. Using TwinCAT as an example: "C:\TwinCAT\3.1\Config\Io\EtherCAT"

The ESI file provides additional information about the instrument as well as predefined configurations for simplified integration of the instrument.

Information
The ESI file can be found on the product details page at www.wika.com under the designation "WIKA_Industrial_Pressure_Transducers.xml".

The different models and versions differ in the attributes “ProductCode” and the “RevisionNo”. The ESI file available on the website always contains all instruments and versions of this class, with the assignment being carried out automatically by the configuration software.

Because no device descriptions may appear twice, in order to ensure a clear assignment, the filename is retained and the old file is replaced with the new one. The “FileVersion” attribute exists within the file for versioning.

If the ESI file is not used, the following configurations must be carried out manually in the configuration software:

- Mailbox response time to at least 5 s
- For the slot configuration, select the VPG module once

3.2 Operation of EtherCAT

The WUD-2x-E can be parameterised and the EtherCAT main device can be operated with any approved EtherCAT configuration tool.
Although the instrument was developed for the semiconductor industry and the profiles that apply to it (CDP and SDP), it can also be used in the general MDP profile without any problems.
In addition, there are no restrictions when used with other EtherCAT instruments.
Thanks to the CDP/SDP, it is uniformly equipped with the most-important functions and parameters in terms of operation.

3.2.1 PDO mapping

The following PDO mappings are available:

Object	Name	Rx/ Tx	Mapped object	Mapped name	Information
0x1600	Default RxPDO mapping	Rx			Not available
0x1601	User RxPDO mapping	Rx			16 configurable PDOs
0x17FE	Default device RxPDO mapping	Rx			Not available
0x17FF:01	User device RxPDO mapping	Rx	0x3000:01	ETCU	Default: USINT
0x17FF	User device RxPDO mapping	Rx			15 configurable PDOs
0x1A00:01	Default TxPDO mapping	Tx	0x6002:01	Reading valid	Default; Bool
0x1A00:02	Default TxPDO mapping	Tx	0x6002:02	Overrange exceeded	Default; Bool
0x1A00:03	Default TxPDO mapping	Tx	0x6002:03	Underrange exceeded	Default; Bool
0x1A00:05	Default TxPDO mapping	Tx	0x6000:11	Sensor value	Default; REAL
0x1A01	User TxPDO mapping	Tx			16 configurable PDOs
0x1BFE	Default device TxPDO mapping	Tx	0xF380	Active exception status	Default
0x1BFE	Default device TxPDO mapping	Tx	0xF641:01	Trip point output all instances	Default; UDINT; not used
0x1BFF	User device TxPDO mapping	Tx			16 configurable PDOs

3.2.2 Commands

3.2.2.1 Zero adjust 0xFB40

SI 0x01 WR command (array of byte):

Byte 0 = Command, which type of zero point adjustment should be carried out.

0: Zero adjustment with no offset

1: Zero adjustment with zero offset

2: Zero adjustment with target offset

Byte 1 = Which module should run this command. A 0 must be entered here because the WUD-2x-E is a single device.

Byte 2 - 5 = Offset value in REAL data format

SI 0x02 RO status (USINT):

0 - 3 = Command run with or without error.

255 = Command is still executing.

SI 0x03 RO response (array of byte):

Byte 0 = such as SI 0x02

Byte 1 = reserved

Byte 2 = Result of the command

More-detailed description in chapter 3.4 Zero point adjustment.

3.2.2.2 Device reset command 0xFBF0

SI 0x01 WR command (array of byte[6]):

Device default reset = 0x 74 65 73 65 72 00

Factory reset = 0x 74 65 73 65 72 66 resets the instrument to the as-delivered condition.

SI 0x02 RO status (USINT):

0 = Default value, if no reset has yet been carried out

2 = last command finished, error, no response

255 = Command is still executing

SI 0x03 RO response (array of byte[2]):

Byte 0 = See subindex 1

Byte 1 = Unused

3.2.2.3 Exception reset command 0xFBF1

SI 0x01 WR command (array of byte[5]):

Latched exception reset = 0x 74 65 73 65 72

SI 0x02 RO status (USINT):

0 = last command finished, no error, no response

2 = last command finished, error, no response

255 = Command is still executing

SI 0x03 RO response (array of byte[2]):

Byte 0 = See subindex 2

Byte 1 = Unused

3.2.2.4 Store parameters command 0xFBF2: Instrument saves parameter automatically!

SI 0x01 WR command (array of byte[4]):

Read bit 1 = 1 : Instrument saves non-volatile parameters automatically

3.2.2.5 Calculate checksum 0xFBF3: Instrument saves parameter automatically!

SI 0x01 WR command (array of byte[4]):

Read: bit 0 = 1 : Instrument offers checksum for non-volatile parameters

bit 1 = 1 : CRC-32 available

Write: bit 0 = 1 or bit 1 = 1 : calculate CRC-32

SI 0x02 RO status (USINT):

0 = Default value, if the command has not yet been run

1 = Last command finished, no error, repeat possible

2 = Last command finished, error, no response

255 = Command is carried out

SI 0x03 RO response (array of byte [4]):

Byte 0 = See subindex 2

Byte 1 = Unused

3.2.2.6 Load parameters command 0xFBF4: Instrument saves parameter automatically!

SI 0x01 WR command (array of byte [4]):

Read bit 1 = 1 : Instrument saves non-volatile parameters automatically

3.2.3 Setting the pressure units

The units can be changed and changes affect the display of the sensor values and the pressure range.
The default setting of the unit can be read in object 0x4002 SI 0x05.
Contrary to the standard of the SDP 2080, the WUD-2x-E uses the “Manufacturer Units” value range, which makes no statement as to whether it is a relative measuring instrument or an absolute measuring instrument.
For interpretation, the “Gauge type” (relative/absolute) can be read in object 0x5002.
The units can be set/read in object 0xF840, either as a hexadecimal value in SI 0x01 “Data units” or as a literal selection in SI 0x03 “Data units enum”.

The selection is between:

0x80	bar	bar
0x81	psi	pounds per square inch
0x82	MPa	megapascal
0x8x	xxx	one additional customer-specific unit (e.g. 0x83 torr)

3.3 Firmware update

The firmware update conforms to “EtherCAT semiconductor device profile” ETG.5003.2 “Firmware update”.
Basically, two files are required for the implementation.

- WIKA_WUD2xE_updtXX.bin is the actual update file, where XX represents the version. No password is required.
- WIKA_WUD2xE_updtXX.md5 is the associated checksum file for checking the integrity of the update file, with XX representing the version.

In addition, the associated ESI file should be saved in the appropriate directory of the configuration tool. If the ESI file is not used, the “Mailbox response timeout” must be set to at least 5 s before the update.

Information:
It is essential to ensure a constant power supply throughout the update process, as a power failure can damage the instrument!

Implementation steps:

1. Set the mailbox response timeout to at least 5 s with the configuration tool or save the ESI file in the appropriate directory of the configuration tool.
2. Put the instrument in the “Boot” state.
3. FoE download of the WIKA_WUD2xE_updtXX.bin file (no password)
4. Set the instrument to the “Init” state (starts the internal update procedure, various status changes are possible and associated error messages are normal)
5. Wait approx. 3 to 4 minutes. The instrument goes through its internal update process and performs several reboots.
6. The instrument is ready for use again.

Whether the update was successful can be checked in the online object dictionary in objects 0x100A “manufacturer software version” or 0x100B “manufacturer bootloader version”. Here, the value should have changed, if there was a different version on the instrument beforehand.
If the value has not changed as expected, the update can be repeated.
The latest ESI file should be in the configuration tool directory.
The instrument should be reloaded from the configuration tool so that the changes can also be recognised/used by the configuration tool.

3.4 Zero point setting

Depending on the instrument version, the zero point can be set mechanically on the instrument **or** electronically via EtherCAT. The mechanical adjustment cannot be recorded electronically and therefore the zero point setting should generally be carried out **only** mechanically or **only** electronically with corresponding instrument variants.

3.4.1 Mechanical zero point setting

An adjustment can only be carried out with the appropriate instrument version.
The instrument version is marked with a vertical zero on the product label and the potentiometer is visible above.

→ For more information on mechanical zero point setting, see “Instruction manual WUD-2x-E” at www.wika.com.

3.4.2 Electronic zero point setting via EtherCAT

Accumulated changes in the zero point setting are only possible within a tolerance range of ±3.5 % of the full scale value. The accumulated offset can be seen in object 0x9000 SI 0x01.
All pressure-related values refer to the set, active unit.

The zero point adjustment is carried out via the object 0xFB40 “Zero adjust”.

Subindex 0x01 “Command” is a three-part 6-byte array, with which you have three different options for performing an adjustment.

CMD	Byte 0	Byte 1	Byte 2-5	Name	Description
0	00	00	00 00 00 00	Zero adjustment with no offset	After “Zero adjust” the output pressure value is defined by a vendor-specific “zero value” (Individual factory value).
1	01	00	00 00 00 00	Zero adjustment with zero offset	After “Zero adjust” the output value of the gauge is “0”.
2	02	00	xx xx xx xx Offset value Format Real (IEEE754 single precision/big-endian)	Zero adjustment with target offset	After “Zero adjust” the output value is identical to the offset value sent by this command. This command is for adjustment with a pressure reference not equal to zero.

Subindex 0x02 “RO status” (USINT): Displays the status of the last command.

0 = Last command completed, no errors, no reply available

1 = Last command completed, no errors, reply available

2 = Last command completed, errors present, no reply available

3 = Last command completed, errors present, reply available

255 = Command is executing

Subindex 0x03 “RO response“ (array of 3 bytes): Displays the response of the last command

Byte 0 = see SI 0x02

Byte 1 = reserved

Byte 2 = Result of the command

0: Zeroing successful
1: Zeroing failed: out of range
2: Zeroing failed: cumulative out of range
3: Zeroing failed: measurement invalid
254: No previous “Zero adjust” command issued

4. Troubleshooting

4.1 Exceptions

The exceptions function is useful for quick error detection and error handling. They are divided into active errors that are currently pending on the instrument and stored errors. The “Active exception status” 0xF380 is an overview of the active errors and is also reflected in the cyclic process data 0x1BFE SI 0x01. The entries can be masked with the desired masks 0xF3A1-4 so that only the errors relevant to the customer are displayed. The following interpretations of the values are implemented:

0xF380 “Active exception status” (USINT)
Bit 0: Device warning
Bit 1: Manufacturer warning (reserved)
Bit 2: Device error
Bit 3: Manufacturer error (reserved)

Based on this information, the detailed error analysis can be carried out.

Object	Name	Value	Description	Remedial action
0xF381	Active device warning details	Bit 0: Not at temperature	The sensor temperature is out of its specification	Change the ambient or medium temperature to meet the specification
		Bit 1: Electronics warning		Reset or powercycle the device. If the warning is still there, replace the device.
0xF383	Active device error details	Bit 0: Sensor failure	Sensor is broken or communication to EtherCAT module interrupted	Reset or powercycle the device. If the error is still there, replace the device.
		Bit 1: Electronics failure		Reset or powercycle the device. If the error is still there, replace the device.
		Bit 2: Electronics overheating	Internal electronics temperature is too hot for reliable operation	Decrease the ambient or medium temperature and ensure sufficient ventilation

The “Latched xxx” objects 0xF390 - 0xF394 are the exact stored equivalents of the active faults described above. These remain stored until the “Exception reset command” 0xFBF1 (see 3.2.2.3) deletes them completely.

4.2 Error codes

Error pattern	Corrective actions
The device is dark: Neither the display nor any other LEDs are lit	- Check voltage supply - Check wiring and pin assignment - If the power consumption exceeds 2 W, it could be an incorrect pin assignment or the instrument is defective → replace the instrument
Display shows “8888”	- Carry out a power cycle - Display remains unchanged → Replace instrument
No reaction in EtherCAT	- Check “Exceptions” - Carry out a reset - Carry out a power cycle - Replace instrument

5. Document revision

1.0

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