

## Application Note DK9222-0212-0061

IP67

### Keywords

EtherCAT Box modules

IP67

EP6002

Short circuit test

RS422

RS485

Without Com Lib

Program Example

TwinCAT

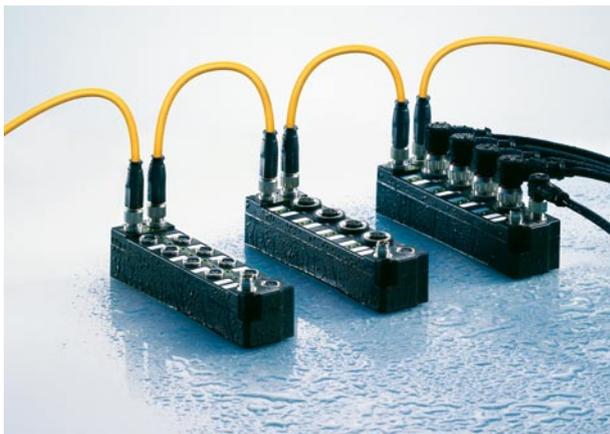
Source code

# EtherCAT Box EP6002 | Hardware configuration and software parameters for diagnostic tests

**This application example describes the hardware principles of RS485 communication via the serial EP6002 interface in the IP67-capable EtherCAT Box, with particular reference to the TwinCAT program example DK9221-1211-0061\_TwinCAT-Sample.zip. The example program describes the sending and receiving of data without an additional library and also contains a diagnostic test for the RS485 connection.**

## The IP 67 I/O system from Beckhoff

The Beckhoff EtherCAT Box delivers EtherCAT technology without requiring a control cabinet. All modules from the IP-67 series feature an integrated direct EtherCAT interface, so that the high performance is retained right down to each module (no sub bus). This opens up new options in the IP-67 world: fast process data communication with eXtreme Fast Control technology (XFC), high-precision measurement and integrated drive functions directly in the field. With dimensions of only 126 x 30/60 x 26.5 mm (H x W x D) the modules are exceptionally small and are therefore particularly suitable for applications where available space is at a minimum.



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#### EP6002-0002 | 2-channel serial interface for RS232 or RS422/RS485

The EP6002 interface module enables IP 67-compliant connection of devices with serial interfaces to EtherCAT networks, whereby each channel can optionally be used for RS232 or RS422/RS485 communication.

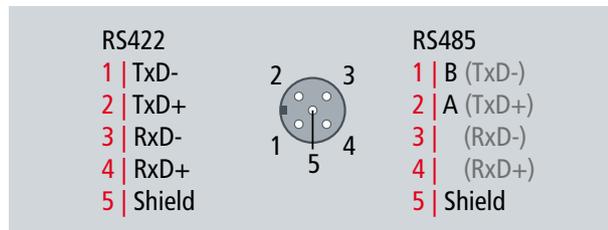


Fig. 1 Pin assignment for the EP6002 EtherCAT Box

In RS485 bus mode, a diagnosis of the communication connection is realised with an external bridge and suitable parameterisation of the software (requires firmware version 03). The RS485 interface of the EtherCAT Box monitors the send data via an external bridge. The controller synchronises the monitored and sent data. The active serial communication channel operates independent of the higher-level bus system in full duplex mode with up to 115.2 kbaud, with 864 bytes being available as a receive buffer and 128 bytes as a send buffer.

#### Standardisation of serial interfaces

Various interface standards have been defined for serial data transfer, which have different names in different countries. For example, RS485 is a universal name for the transfer mode EIA/TIA-485. Other identifiers for the same technology are TIA-485, ANSI/EIA-485 or ANSI/EIA/TIA-485. The commonly used designations RS232, RS422 and RS485 are used in this documentation, although they are not referred to as such in the standard.

#### RS422

With RS422 the data exchange between devices takes place via a peer-to-peer connection. The communication is either 1:1 between two devices or 1:n between several devices. In contrast to RS232, an RS422 sender can send to several RS422 recipients, although RS422 does not enable „genuine“ bidirectional communication between all devices. Full duplex mode requires four lines. RS422 is based on the transfer of differential voltages, so that superimposed common-mode noise does not lead to corruption of the wanted signal. With twisted pair, screened cables, distances of up to 1,200 m and transfer rates of up to 115.2 kbaud can be realised.

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### RS422 | EP6002 Hardware

Sockets 2 or 4 should be used for a communication connection via RS422. The connection shown in Fig. 2 is full-duplex capable. No external bridge is required.

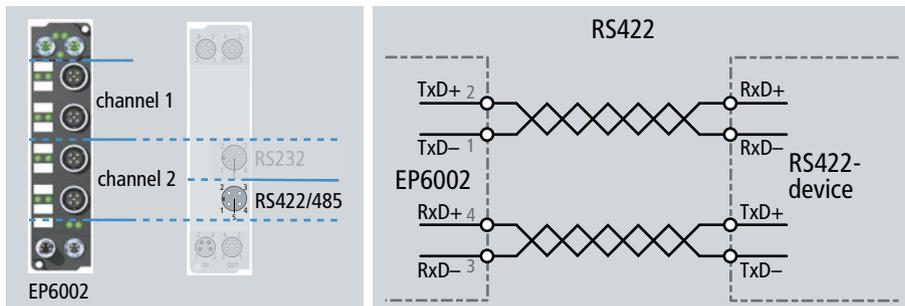


Fig. 2 Connection of an RS422 device to the EP6002

### RS485

Although the electrical specifications for RS485 and RS422 are almost identical, the two transfer modes are not 100% compatible. In contrast to RS422, RS485 can be used to establish „genuine“ multipoint connections with up to 32 devices via a 2-wire line. In RS485 mode the EP6002 EtherCAT Box from Beckhoff enables monitoring of the sent data for simple, yet effective diagnostics of the RS485 bus communication..

### RS485 without monitoring | EP6002 hardware without external bridge

Since the connection cabling is not specified consistently in the various standards, it is important to refer to the documented pinout when connecting different devices. For the EP6002 EtherCAT Box the lower M12 connection of the respective channel should be used for communication via RS485. The 2-wire line is connected to pin 1 and pin 2 (see Fig. 2). The RS485 connections of a device are usually referred to as A and B.

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### RS485 monitoring | EP6002 hardware with external bridge

For active „monitoring“ connect pins 1/3 and 2/4 via an external bridge (see Fig. 3). This activates the second driver stage of the EP6002.

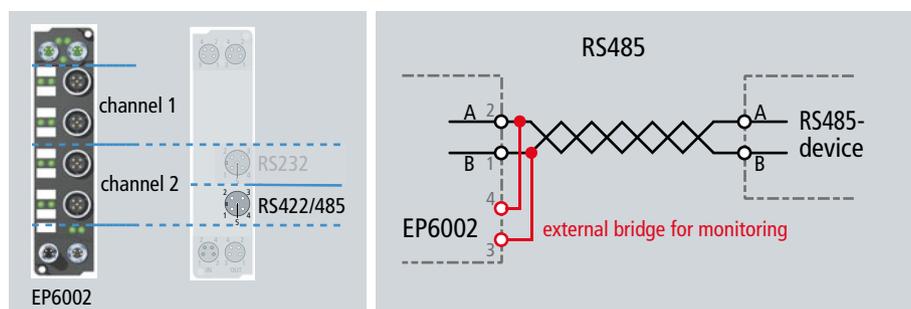


Fig. 3 Two-wire RS485 bus, full duplex

### TwinCAT | EP6002 CoE object directory

The following CoE objects influence the transmission type:

- Object **F800:0n** „Interface Type Ch n“
- Object **80n0:07** „Enable point to point connection (RS422) Channel n“
- Object **80n0:06** „Enable half duplex channel n“

F800:0n	80n0:07	80n0:06	bridge	wire	function
0	X	X	–	3	RS232
1	0	0	external	2	RS485 with echo
1	0	1	internal	2	RS485 without echo
1	1	X	–	4	RS422 full-duplex
		x = no influence			n = Channel 1 or 2

Fig. 4 Logic states of the corresponding bits of the CoE object directory for realising the required transfer

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## TwinCAT program example: Sending and receiving without additional library, integrated diagnostic test

The programming example "DK9221-1211-0061\_TwinCAT-Demo.zip" illustrates the sending and receiving of data via a RS485 route between an EP6002-0002 EtherCAT Box and any RS485 end device without using the TwinCAT PLC Serial Communication Library. In addition it contains an integrated diagnostic test for the RS485 connection through synchronisation of the sent and received string.

```
(*
This example shows how to use the EP6002-0002 for transmitting and receiving via an RS485 connection. If
the box is configured correctly this code checks for a short circuit on an RS485 bus. It simply controls
the loopback.

The following settings have to be made:
- F800-01. "Interface Type Ch. 1" has to be set to RS485/422
- 8000-06. "Enable half duplex" has to be cleared
- 8000-07. "Enable point to point connection" has to be cleared
- The junctions Rx+ and Tx+ have to be connected externally
- The junctions Rx- and Tx- have to be connected externally
*)

IF NOT bInitialized THEN                                (* Box has not been initialized yet *)
  (* Initialize the box *)
  IF state <> 16#0008 THEN
    VisuButtonText := 'Box not in OP';
  ELSE
    VisuButtonText := 'Initializing...';
    CASE iniState OF
      0:
        OutputData.CnSt := 16#04;                        (* Request initialization by setting the "Init :
        WaitTmr(IN := TRUE, PT := t#1s);                 (* Wait for 1 second for example just to make t
        IF WaitTmr.Q THEN
          iniState := iniState + 1;
          WaitTmr(IN := FALSE);
        END_IF;
      1:
        IF InputData.CnSt = 16#04 THEN                   (* Wait for "Init accepted" bit*)
          iniState := iniState + 1;
        END_IF;
      2:
        OutputData.CnSt := 16#00;                        (* Acknowledge initialization *)
          iniState := iniState + 1;
      3:
        IF InputData.CnSt = 16#00 THEN                   (* Wait for init procedure to be acknowledged b
          iniState := 0;
          bInitialized := TRUE;
        END_IF;
    END_CASE;
  END_IF;
ELSE                                                    (* Box has already been initialized *)
  (* Reset test when device is not in OP state *)
  IF state <> 16#0008 THEN                                (* Check for OP state *)
    (* Box is not in OP *)
    bStart := 0;                                        (* The test is not running *)
    WaitTmr(IN := FALSE);                               (* Reset the timer *)
    VisuBgColor := 16#FFFFFF;                           (* white *)
    VisuButtonText := 'Box not in OP';                  (* Feedback to the user *)
    OutputData.CnSt := 0;                               (* Reset all variables to *)
    TxCnt := 0;
    RxCnt := 0;
    FOR z := 0 TO 255 DO
      RcvBuffer[z] := 0;
    END_FOR;
    bInitialized := FALSE;
  ELSE

```

Fig. 5 Screenshot of TwinCAT program example "diagnostic test"

The required I/O configuration takes place in the TwinCAT System Manager. During the hardware configuration make sure that the bridges are set correctly at the EP6002. Once the source code has been adapted to the specific situation, the RS485 test can begin by starting the program and clicking "Press button to start". During the test the message "Performing loopback test..." is displayed. The program checks whether the sent data match the data received after two seconds. If they match, the program displays a "Passed!" message (green), if not, a "Failed!" message appears in red.

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- 2-channel serial interface, RS232, RS422/RS485 [www.beckhoff.com/EP6002](http://www.beckhoff.com/EP6002)
- EtherCAT Extends its Reach into the IP 67 World [www.beckhoff.com/EtherCAT-Box](http://www.beckhoff.com/EtherCAT-Box)
- EtherCAT [www.beckhoff.com/EtherCAT](http://www.beckhoff.com/EtherCAT)

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