CANopen Protocol Software IXXAT

Quick Start Guide for I/F/I Advanced CAN Evaluation Kit on DBC3C40 Development Board

Version: 1.0
Date: 2010-02-09
Doc. No: WP112-0010

Contents

1 Introduction

The CANopen I/O application demonstrates the IXXAT CANopen Protocol Software for the I/F/I Advanced CAN Module [1] on a DBC3C40 development board by devboards GmbH [2]. The DBC3C40 development board features the EP3C40F484C7N Altera Cyclone III FPGA [3]. The example application is based on the Advanced CAN Module reference design as provided by I/F/I.

2 System Requirements

The CANopen example application requires following components:

- DBC3C40 development board by devboards GmbH
- USB-Blaster by Altera Corporation
- I/F/I CAN reference design for the Cyclone III EP3C40
- Quartus II EDS, NIOS II Eclipse Platform
- CAN interface with a CAN/CANopen bus monitor, for example CAN-to-USB compact and MiniMon V3 or canAnalyser V2.7 by IXXAT Automation GmbH

3 Content of the Evaluation Kit

The IXXAT CANopen slave example for the I/F/I Advanced CAN Module for the Altera Cyclone III FPGA is shipped as compressed ZIP archive. The archive file contains the reference design as provided by I/F/I, an

executable SlaveDemo.elf, corresponding CANopen device description file both in EDS and XDD format according to CiA 306 and CiA 311, and batch files to program the files to the DBC3C40 board and to start a console to which the standard output of the CANopen slave is redirected.

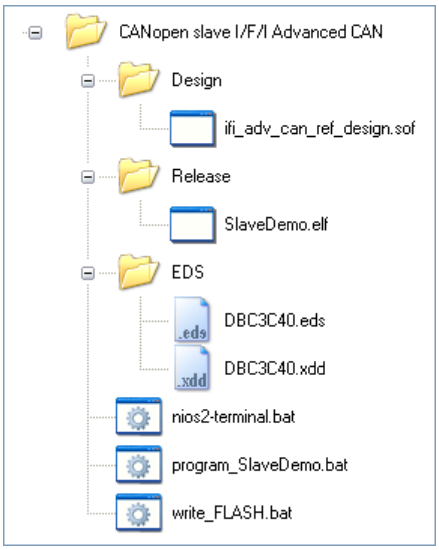

Figure 1: Content of the CANopen I/F/I advanced CAN evaluation kit

4 How to start the Example

1. Set up the hardware:
   - Connect the Altera USB Blaster to the JTAG connector of the DBC3C40 development board
   - Use a suitable adapter to connect the CAN bus to the CAN header P5 on the DBC3C40 board
   - Power up the development board
2. Start a suitable CAN analyzer tool. Set the bit rate to 125 Kbit/s.
3. Use the provided script “program_SlaveDemo.bat” to download and program the reference design and the CANopen example application on the evaluation board (Figure 2).

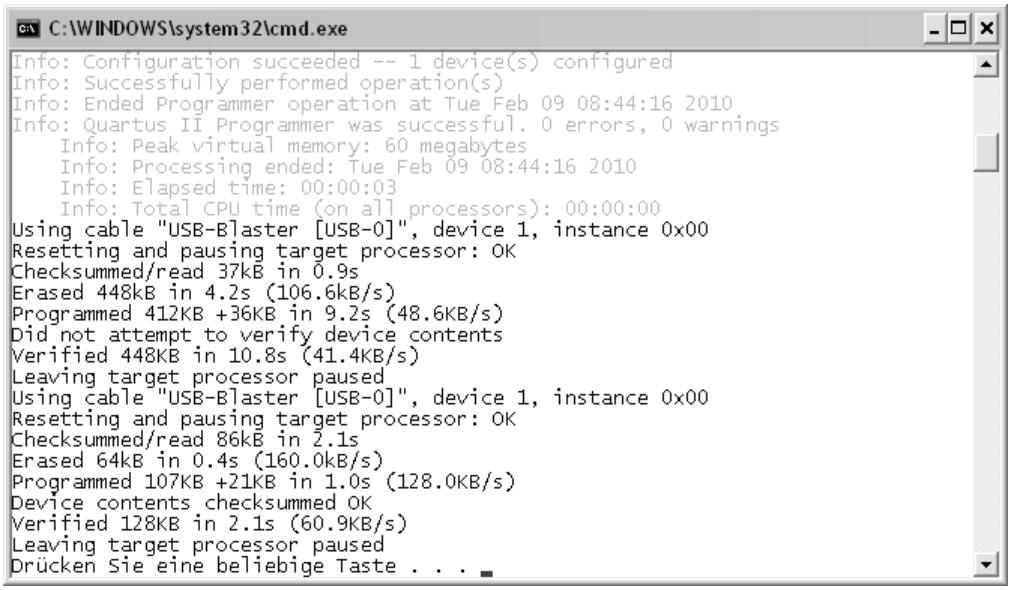

Figure 2: Download and programming of the CANopen example application

4. Reset the evaluation board (power-off/power-on cycle). The example application transmit a CANopen NMT boot-up message to the CAN bus (Figure 3). Make sure that a CAN analyzer tool is started as described in step 2.

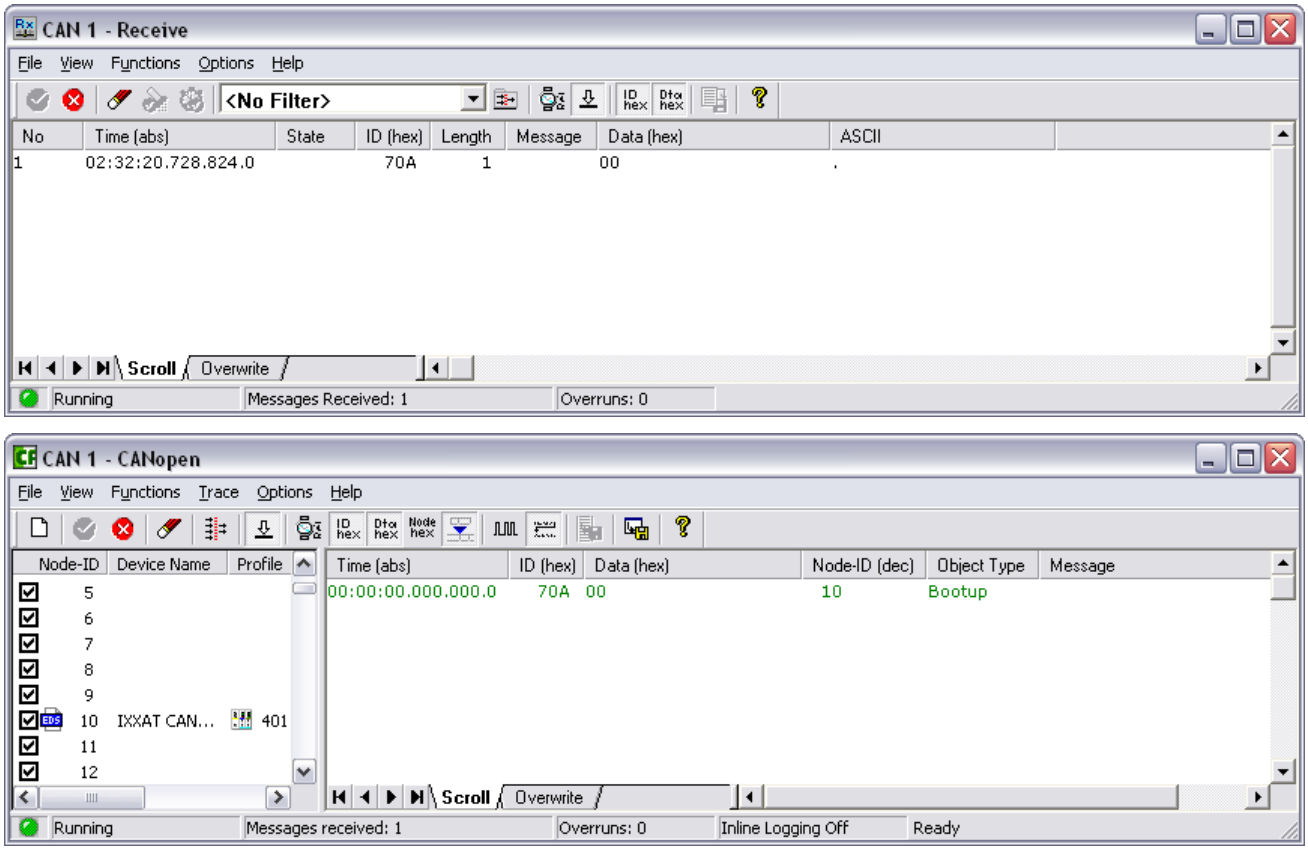

Figure 3: NMT boot-up message of the CANopen example application
Upper image: raw data as transmitted on the CAN bus
Lower image: interpreted data as displayed in the CANopen Module for canAnalyser V2.7 by IXXAT Automation GmbH

5. Start the script “nios2-terminal.bat”. The standard output that is redirected to the terminal provides basic information with usage hints and internal messages on operations performed by the CANopen Protocol Software (Figure 4).

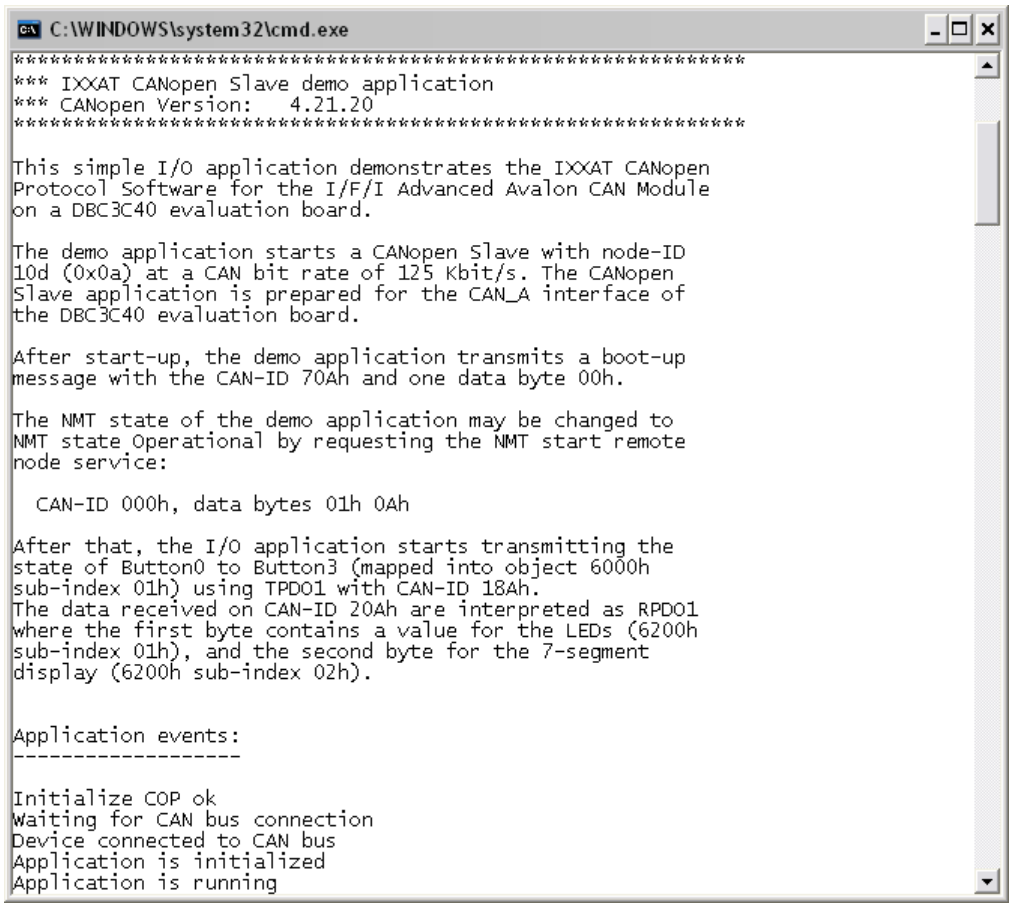

Figure 4: NIOS II terminal with output of the example application

5 Description of the implemented Functionality

The IXXAT CANopen Protocol Software example application for the I/F/I Advanced CAN Module for Altera Cyclone III FPGAs implements a simple I/O device according to CiA 401 CANopen device profile for generic I/O modules. The application starts with the CANopen slave device with node-ID 10_d at a CAN bit rate of 125 Kbit/s.

The following features are implemented:

- 2 × SDO server
- 2 × RPDO
- 2 × TPDO
- Node guarding
- Producer heartbeat time
- Consumer heartbeat time
- Error behavior
- Digital inputs (mapped onto user buttons)
- Digital outputs (mapped to LED and 7-segment elements)

The default PDO mapping for RPDO1 includes objects 6200_h sub-index 01_h (LED, D21:bit 0, D22:bit 1, D23:bit 2, D24:bit 3, D17:bit 4, D18:bit 5, D19:bit 6, D20:bit 7) and 6200_h sub-index 02_h (7-segment element, U24).

The default PDO mapping for TPDO1 includes objects 6000_h sub-index 01_h (user buttons, P25:bit 0, P24:bit 1, P28:bit 2, P26:bit 3).

6 Examples

6.1 Manipulating the 7-segment element by SDO download

As described in the previous section the input data for the 7-Segment element is provided via object 6200_h sub-index 02_h. To manipulate the 3-Segment element CANopen SDO protocols can be used as described below (Figure 5).

Transmit the following message from a suitable CAN tool:

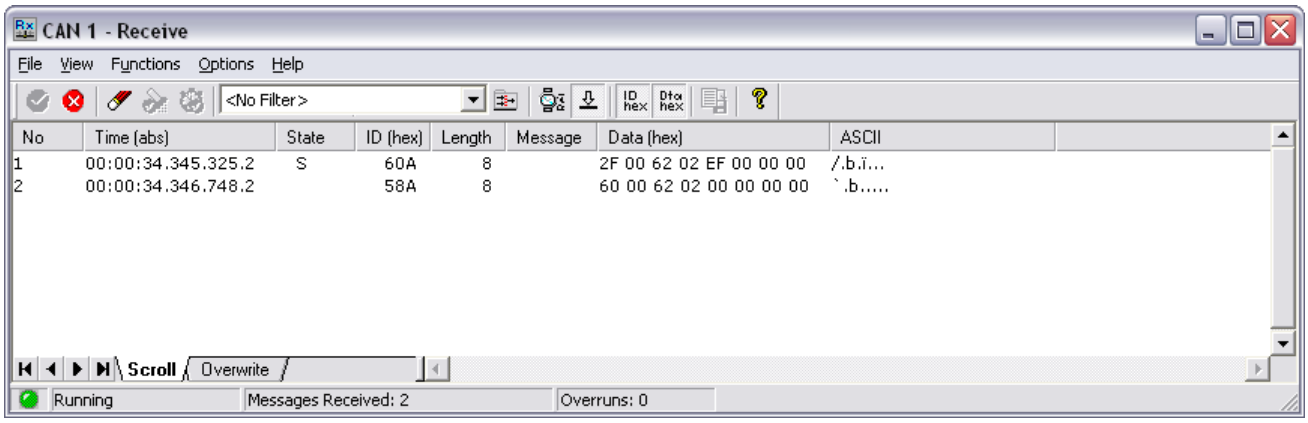

Figure 5: SDO download to node-ID 10_d, object 6200h sub-index 02_h, data EF_h

CAN frame 1 uses the expedited SDO download protocol with CAN-ID $60A_h$ to write one data byte to the referenced application object. The response frame 2 with CAN-ID $58A_h$ confirms the download request. The 7-segment element will display a value EF_h

6.2 Manipulating the LEDs and 7-segment using PDO write protocols

To use PDO protocols the CANopen slave device has to be transferred into NMT state Operational (Figure 6). This is achieved transmitting a NMT start remote node command (CAN frame 1). Upon entering NMT state Operational the CANopen slave device will transmit once all its TPDO with transmission type 255 (frame 2). Following this you may transmit a PDO (PDO1) with CAN-ID $20A_h$ from your CAN tool containing two data bytes (frame 3). LEDs D21, D23, D17, and D19 will be switched on, the 7-segment element will display FE_h.

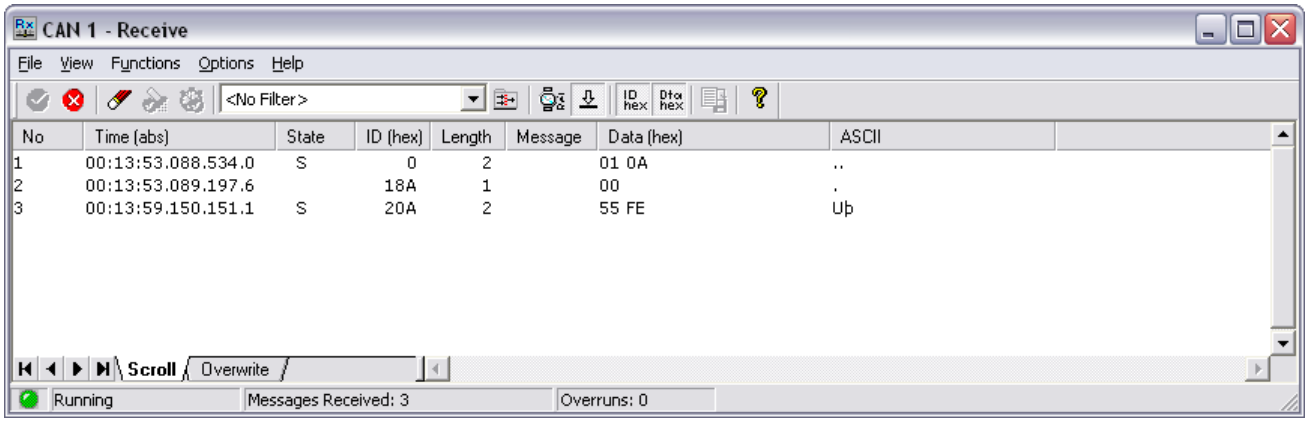

Figure 6: PDO write to node-ID 10_d. Data are mapped onto object 6200_h sub-index 01_h (LEDs), and 6200_h sub-index 02_h (7-segment element)

The examples above can be reproduced with any CAN tool supporting manual configuration and transmission of CAN frames. For a further evaluation of the CANopen slave shipped with the evaluation kit and the possibilities of the CANopen protocol it is recommended to purchase commercial tools such as the IXXAT canAnalyser (Figure 3, Figure 5, and Figure 6) or the IXXAT CANopen Device Manager (Figure 7).

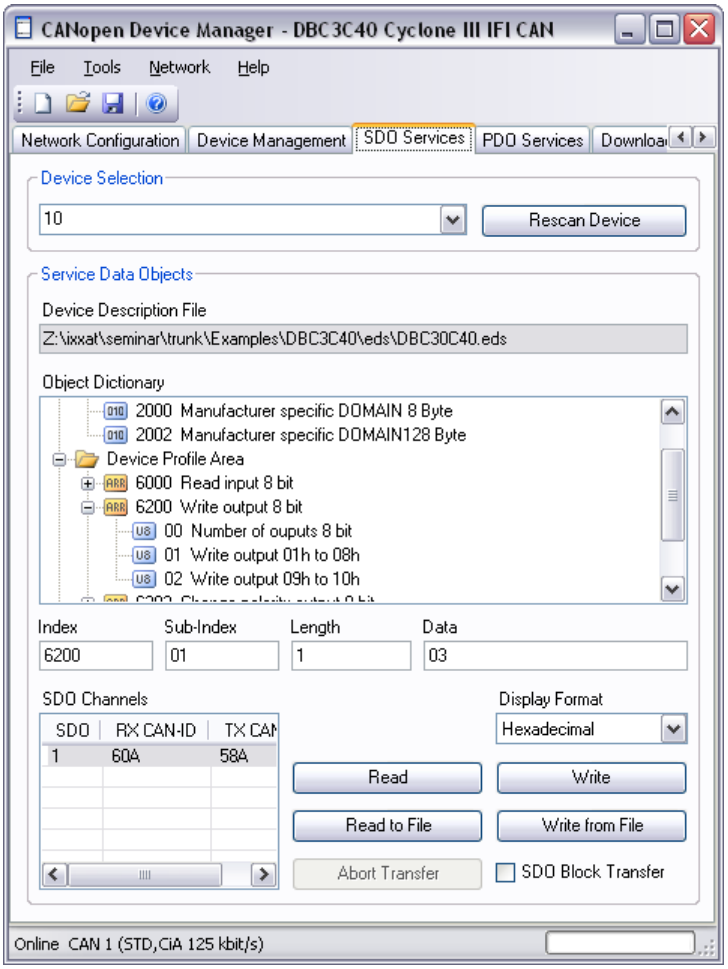

Figure 7: CANopen Device Manager, object dictionary access based on the interpreted device description file shipped with the evaluation kit

7 Order Numbers

1.02.0122.61680	CANopen Slave Protocol Software for I/F/I Advanced CAN Module
1.02.0124.61680	CANopen Master/Slave Protocol Software for I/F/I Advanced CAN Module
1.02.0157.00000	CANopen Device Manager
1.02.0133.00000	canAnalyser
1.02.0145.00000	CANopen Module for canAnalyser

For order numbers for the I/F/I Advanced CAN Module contact the supplier of the IP-core directly [1].

8 References

[1] I/FI Ingenieurbüro für IC-Technologie, http://www.ifi-pld.com/, http://www.ifi-pld.com/IP/Advanced_CAN/advanced_can.html

[2] devboards GmbH, http://www.devboards.de/

[3] Altera Corporation, http://www.altera.com/

[4] IXXAT Automation GmbH, http://www.ixxat.com/
USB-to-CAN compact, http://www.ixxat.com/usb-to-can-compact-interface_en.html
IXXAT CANopen Device Manager http://www.ixxat.com/canopen_device_manager_en.html
IXXAT canAnalyser, http://www.ixxat.com/cananalyser_en.html

9 Contact Information

IXXAT Automation GmbH	IXXAT Inc.	Others
Leibnizstr. 15 88250 Weingarten Germany	120 Bedford Center Road Bedford, NH 03110 USA	For a list of international distributors please consult the IXXAT web page under:
Tel.: +49-(0)7 51 / 5 61 46-0 Fax: +49-(0)7 51 / 5 61 46-29	Phone: +1-603-471-0800 Fax: +1-603-471-0880	www.ixxat.de | contact | distributors
E-Mail: info@ixxat.de Internet: www.ixxat.de	E-mail: sales@ixxat.com Internet: www.ixxat.com	