

Accelerate Development of Robust Network Communications with CANopen and CANopen FD

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SECURE CONNECTIONS
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PUBLIC

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THE MCUXPRESSO ECOSYSTEM



- > **Core Technologies from NXP**
 - MCUXpresso IDE
 - MCUXpresso SDK
 - MCUXpresso Config Tools
 - MCUXpresso Secure Provisioning Tool
- > **Enabling Software Technologies**
 - Run time software libraries and middleware
 - Enable customers to focus on differentiation
 - From NXP and partners
- > **Enabling Tools Technologies**
 - Partner IDEs
 - Debug Probes
 - Development Boards
 - From NXP and partners

MCUXPRESSO SDK

SOFTWARE FRAMEWORK AND DRIVERS



Architecture:

- CMSIS-CORE compatible
- Single driver for each peripheral
- Transactional APIs w/ optional DMA support for communication peripherals

Reference Software:

- Peripheral driver usage examples
- Application demos
- FreeRTOS usage demos
- IoT connectivity examples

Integrated RTOS:

- Amazon FreeRTOS
- RTOS-native driver wrappers

License:

- BSD 3-clause for startup, drivers, USB stack
- All code Black Duck scanned

Enabling Technologies:

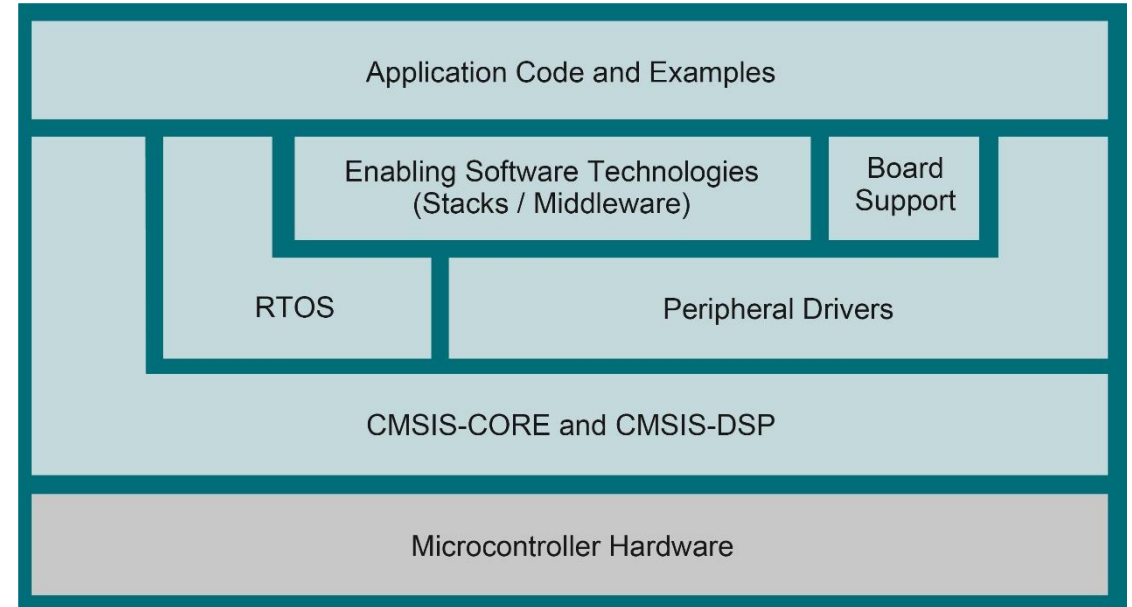
- Wired and wireless connectivity
- Graphics/HMI
- Motor Control
- ML/AI
- Cloud connectivity
- Storage
- ...and more

Toolchains:

- MCUXpresso IDE
- IAR®, ARM® Keil®, GCC w/ Cmake

Quality:

- Production-grade software
- MISRA 2004 compliance
- Checked with Coverity® static analysis tools





NXP has partnered with EmSA to offer CANopen as an Enabling Software Technology. **Fully integrated** CANopen Libraries based on MicroCANopen Plus v7.0 are available in MCUXpresso SDK v2.7.



Libraries

A limited version of MicroCANopen Plus is included in MCUXpresso SDK for select devices in library form:

- i.MX RT1050
- i.MX RT1060
- i.MX RT1064
- i.MX RT1020
- LPC54628
- LPC54618
- LPC54608
- LPC54S018
- [LPC551x/S1x](#) (coming soon)



Examples

Examples are available to help you get started with your CAN application.

1. CANopen Generic I/O example (CiA 401)
2. CANopen Manager example



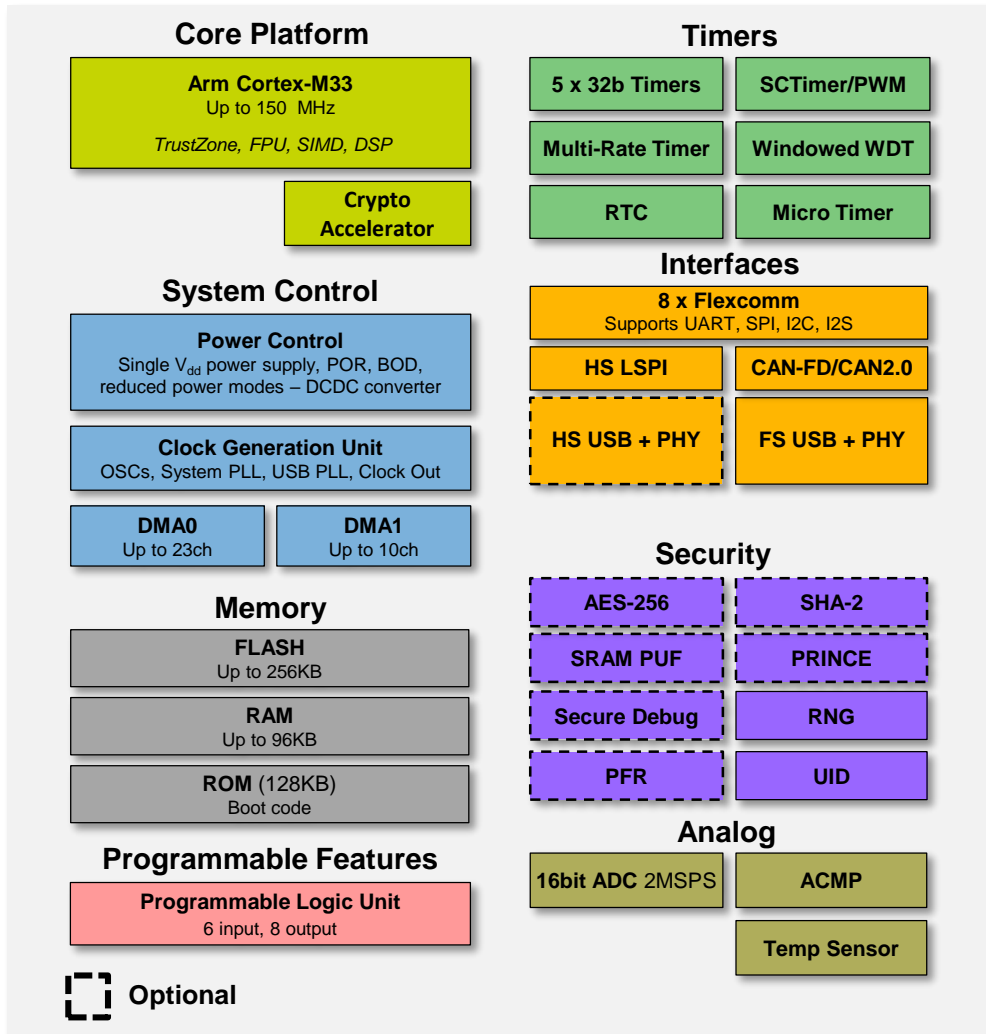
CANopen Architect Software

Go beyond the examples and seamlessly transition from evaluation to full production software development.

CANopen Architecture software is available as a free download to help you easily generate custom configurations.

LPC551X/S1X MCU FAMILY BLOCK DIAGRAM

- High Efficiency Cortex-M33
- Advanced Security
- CAN-FD and USB HS
- 10K RSL – \$0.97-\$1.80



Core Platform

- Up to 150MHz Cortex-M33
- Multilayer Bus Matrix

Memory

- Up to 256KB FLASH
- Up to 96KB RAM
- 128KB ROM

Timers

- 5 x 32b Timers
- SCTimer/PWM
- Multi-Rate Timer
- Windowed Watchdog Timer
- RTC
- Micro Timer

Interfaces

- USB High-speed (H/D) w/ on-chip HS PHY
- USB Full-speed (H/D), Crystal-less
- 1 x High-Speed SPI up to 50MHz
- 8 x Flexcomms support up to 8x SPI, 8x I2C, 8x UART, 4x I²S channels (total 8 instances)
- CAN-FD (CAN 2.0 on LPC5512)

Advanced Security

- TrustZone-M
- Protected Flash Region (PFR)
- AES-256 HW Encryption/Decryption Engine
- SHA-2
- CASPER Co-Processor for Assymmetric cryptography
- SRAM PUF for Key Generation support
- PRINCE – Real-time Encrypt/Decrypt for flash data
- Secure debug authentication
- RNG

Analog

- 1 16b ADC, up to 10 ch, 2MSPS
- Analog Comparator
- Temperature Sensor

Packages

- HLQFP100
- VFBGA98
- HTQFP64

Other

- Buck DC-DC
- Operating voltage: 1.8 to 3.6V
- Temperature range: -40 to 105 °C

LPC551X/S1X TARGET APPLICATIONS

Target Applications



Industrial & Building Automation

- Remote IO and Sensor Nodes
- Elevators and Lifts
- Smart Lighting and Utilities



Consumer Products

- Gaming and PC Peripherals
- Vehicle/Asset Tracking Systems
- Cordless Power Tools and Appliances



Smart Home

- Secure/Biometric Access Control
- Security Systems
- Sensor Nodes

Benefits

Industrial & Building Automation

- 150Mhz Cortex-M33 & package flexibility for compact design
- High precision & High Speed ADC
- CAN-FD for an upgrade from CAN2.0

Consumer

- HS/FS USB with PHY built-in for BOM cost saving
- High-Speed SPI for efficient module interface
- Secure boot supports FW update
- Large SRAM for easy FW development
- Low power consumption

Smart Home & Sensor Node

- Trust Zone for memory protection
- PRINCE for real-time de-/encryption for embedded flash
- Built-in SRAM PUF for key storage

MCUXpresso Software and Tools

UNIFIED SUITE OF
TOOLS FOR EASY
DEVELOPMENT
WITH NXP MCUs



MCUXPRESSO SOFTWARE AND TOOLS ADDITIONAL WEB RESOURCES



MCUXpresso Software and Tools Overview Page:
<https://www.nxp.com/mcuxpresso>

MCUXpresso Software and Tools Community Site:
<https://community.nxp.com/community/mcuxpresso>



[Website /
Community](#)



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Support devices

[Supported Devices Table \(Community Doc\)](#)

CAN (FD) overview

[Wired Communications on NXP MCUs](#)





CANopen (FD) hands-on with NXP's MCUXpresso SDK

www.em-sa.com/nxp



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PREREQUISITES: SOFTWARE & “HOW TO”

NXP's MCUXpresso SDK

- Check introductory videos and webinars www.em-sa.com/video
- SDK Builder at mcuxpresso.nxp.com
- EmSA CANopen Libraries included for selected NXP MCUs

EmSA's CANopen (FD)

- Check introductory videos and webinars www.em-sa.com/video
- CANopen Configuration: CANopen Architect Mini www.em-sa.com/nxp
- CANopen Monitor: for example CANopen Magic Lite

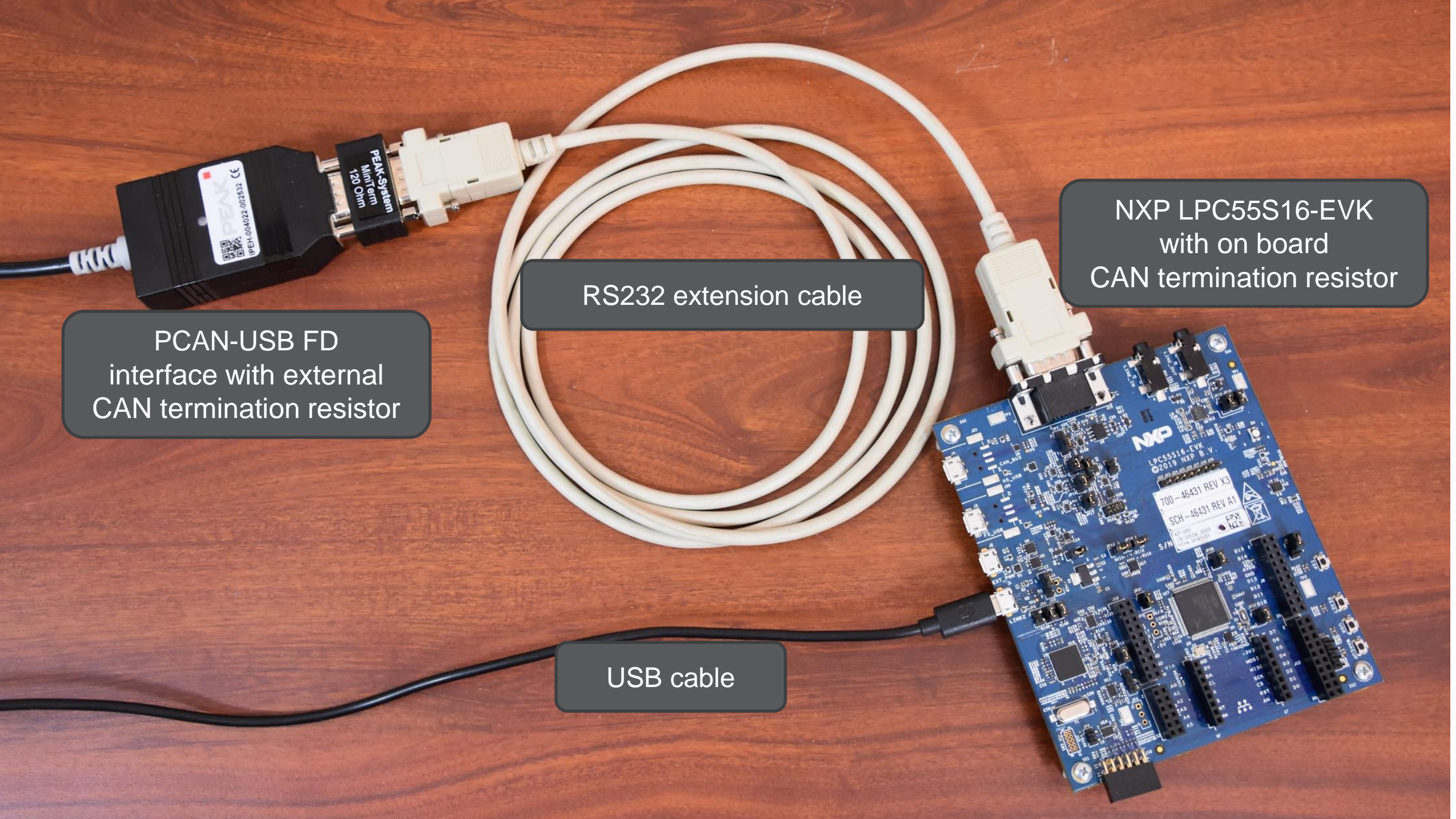
PREREQUISITES: HARDWARE

NXP
LPC55S16-EVK

- Runs the CANopen FD example which we will modify/enhance during this session

CAN FD interface

- For example PCAN-USB FD



PCAN-USB FD interface with external CAN termination resistor

RS232 extension cable

USB cable

NXP LPC55S16-EVK with on board CAN termination resistor

GET SW FROM SDK BUILDER



🏠 SDK Dashboard

GENERAL

📌 Select Board

🔍 Explore

ADMINISTRATION

🔔 Notifications

⚙️ Preferences

DOWNLOADS

📁 MCUXpresso IDE

⚙️ MCUXpresso Config Tools

📁 Offline data

SDK Builder

Generate a downloadable SDK archive for use with desktop MCUXpresso Tools.

Developer Environment Settings

Selections here will impact files and examples projects included in the SDK and Generated Projects

SDK Version

2.7.0 2019-12-19

Toolchain / IDE

All toolchains

Host OS

Windows

Search Name, Category, or Description...

Select All

Unselect All

☑	Name	Category	Description	Dependencies
<input checked="" type="checkbox"/>	CMSIS DSP Library		CMSIS DSP Software Library	
<input type="checkbox"/>	AWS IoT	Middleware	AWS IoT	
<input checked="" type="checkbox"/>	canopen	Middleware	CANopen Stack - MicroCANopen Plus	
<input type="checkbox"/>	Embedded Wizard	Middleware	Embedded Wizard GUI	



Hardware Details

Board: LPCXpresso54608
Device: LPC54608
Core Type / Max Freq: Cortex-M4F / 180MHz
Device Memory Size: 512 KB Flash, 192 KB RAM

SDK Details

SDK Version: 2.7.0 (released 2019-12-19)
Host OS: Windows
Toolchain: All Toolchains
Middleware: CMSIS DSP Library, canopen, mbedtls, sdmmc stack

CANOPEN (FD) BASICS: OBJECT DICTIONARY

- Object Dictionary
 - Each CANopen (FD) node has one
 - Contains all parameters (config & data) that can be communicated



Node ID 5

Name	Index	Sub	Typ	Data
Device Type	1000h	0	U32	00000191h
Heartbeat	1017h	0	U16	500
Serial Nr	1018h	4	U32	010E4FF1h
Digital In 1	6000h	1	U8	5Ah

CANOPEN (FD) BASICS: (U)SDO & PDO



(U)SDO Communication

- (Universal) Service Data Object
- Access to one OD entry in one node (request/response)



PDO Communication

- Process Data Object
- Group multiple OD entries into one message (multicast/broadcast)

HANDS-ON SESSION LPC55S16-EVK

•CANopen Device Demo

-Replace process data

- Receive PDO 1:
single command byte for switching operating mode
- Transmit PDO 1:
three analog 16bit values from accelerometer
- Transmit PDO 2:
32bit loop counter for diagnostics

-String manipulation

- Uses 128char string buffer
- Show use of data sizes bigger than 32bit
- Changes with operating mode switch



Hands-on using:
MCUXpresso SDK
CANopen Architect Mini
CANopen Magic Lite



www.em-sa.com/nxp
www.em-sa.com/video

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