AX58400 Product Introduction

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1. Introduction

This document provides an overview of AX58400 EtherCAT Slave Controller w/ Dual-Core MCU.

The AX58400 EtherCAT Slave Controller w/ Dual-Core MCU is a System-in-Package (SiP) product based on the STM32H755 microcontroller from STMicroelectronics. AX58400 is equipped with STM32 Dual-Core 32-bit ARM® Cortex®-M7 core with DSP extension runs up to 480 MHz, 32-bit ARM® Cortex®-M4 core with Adaptive Real-Time Accelerator (ST ART Accelerator™) runs up to 240 MHz. AX58400 offers three ADCs, two DACs, two ultra-low power comparators, a low-power RTC, a high-resolution timer, 12 general-purpose 16-bit timers, two PWM timers for motor control, five low-power timers, a true random number generator (RNG), and a cryptographic acceleration cell. The devices support four digital filters for external sigma-delta modulators (DFSDM). Supports additional communication interfaces such as 10/100Mbps Ethernet MAC, USB OTG, Camera I/F, TFT-LCD Controller, JPEG Codec, SPI/UART/I2C/I2S/SAI/CAN/SDMMC/HDMI-CEC, etc.

The AX58400 EtherCAT Slave Controller (ESC) integrates two embedded Fast Ethernet PHYs which can support both copper and fiber Ethernet applications, embedded 9 KB RAM, eight Fieldbus Memory Management Units (FMMUs), eight Sync Managers and 64-bit distributed clock. AX58400 is interoperable with all EtherCAT systems with standard EtherCAT protocols such as CoE, FoE, VoE, etc. and is suitable for motor/motion control, digital I/O control, sensors data acquisition, robotics, EtherCAT IO-Link master, EtherCAT Junction slave module, etc. industrial automation fieldbus applications.

The AX58400 is available in 225LD EHS-TFBGA 13x13 mm, 0.8-mm pitch, supports the RoHS compliant package and industrial grade operating temperature range from -40 to 85°C.

ASIX offers AX58400 evaluation boards, demo kits and free Board Support Package (BSP) which includes reference schematics, PCB design guidelines, hardware/software design guides, software tools, sample firmware sources, etc. for designers to easily design AX58400 EtherCAT slave products.

2. Block Diagram

The following are AX58400 block diagram and major features,

Figure 1. AX58400 Block Diagram

Processor	On-chip Flash (Bytes)	On-chip Data RAM (Bytes)	Ethernet MAC	USB OTG	Graphic	Digital Camera I/F
Dual-Core ARM Cortex-M7/M4 480MHz/240MHz	2M Dual bank	1M	10/100 Mbps (w/ MII/RMII)	2	TFT-LCD	1
ESC Fast Ethernet	**ESC RAM (Kbytes)**	**ESC FMMU**	**ESC Sync Managers**	**ESC Distributed Clock**	**SPI**	**USART/UART/ LPUART**
2 x Internal PHY 1 x MII	9	8	8	64-bit	6	4/4/1
I2C	**I2S**	**SAI**	**SPDIFRX I/F**	**SWPMI I/F**	**Quad-SPI Memory I/F**	**SDMMC Host I/F**
4	3	4	1	1	1	2
HDMI-CEC	**ADC**	**DAC**	**Sigma Delta Modulator**	**Analog Comparator**	**Operational Amplifier**	**Die Temperature Sensor (DTS)**
1	3*16-bit	2*12-bit	1	2	2	1
PWM	**Watchdog Timer**	**RTC**	**Security**	**Cryptographic Accelerator**	**Package/ Size**	**Temperature Range (˚C)**
Yes	Yes	Yes	ROP, PC-ROP, Active tamper, etc.	AES, TDES, HASH, HMAC	EHS-TFBGA-225 13x13 mm 0.8 mm pitch	-40 ~ +85

Figure 2. AX58400 Major Features

3. Target Applications

The following are AX58400 typical target applications.

- Motor/Motion Control
- Digital I/O Control
- Robotics
- Sensors Data Acquisition
- EtherCAT IO-Link Master
- EtherCAT Junction Slave Module
- Communication Module
- Operator HMI Interfaces

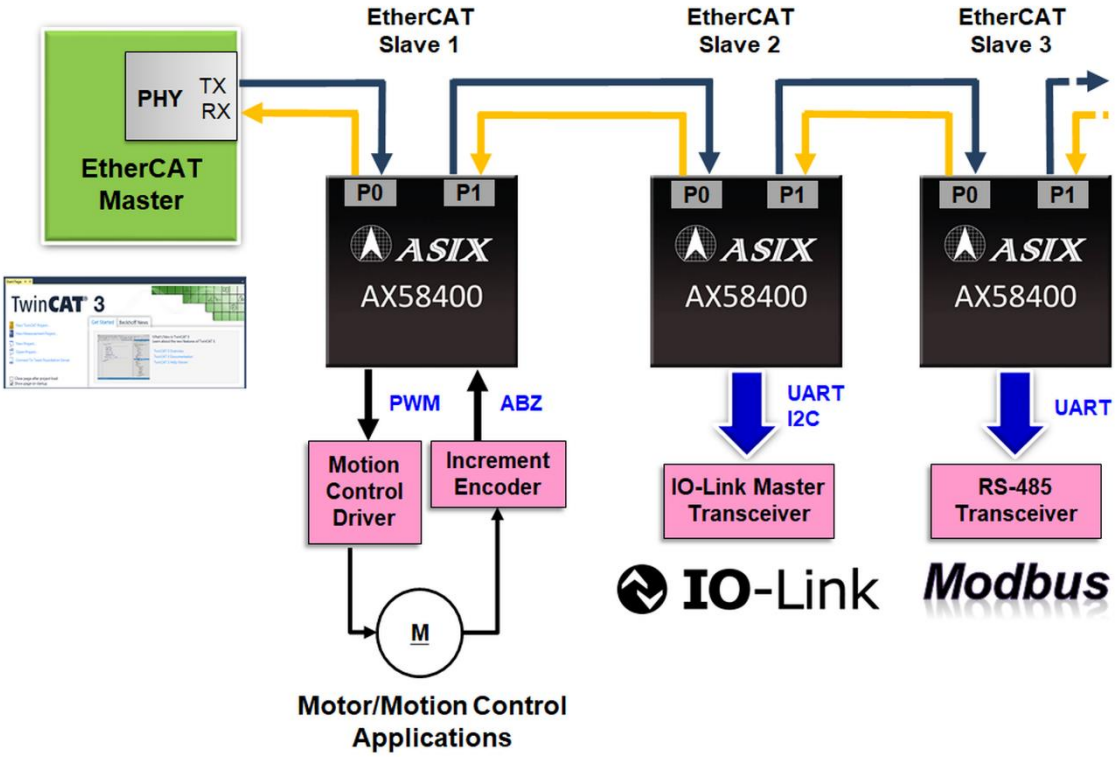

Figure 3. AX58400 Target Applications

4. Order Information

The following are the ordering information of AX58400 silicon and AX58400 boards. Please contact ASIX's Sales (sales@asix.com.tw) for more details.

Part Number	Description
AX58400 BI	225LD EHS-TFBGA RoHS compliant package, temperature range: -40 to 85°C.

AX58400 Boards	Description
AX58400-TSB-1 (GPIO)	This is AX58400 GPIO evaluation board for analog/digital I/O applications.
AX58400-TSB-1 (Motor)	This is AX58400 evaluation board for motor/motion control applications.
AX58400-DMK-ADIO-1	This is AX58400 ADIO demo kit combined AX58400 GPIO evaluation board and AX58400 Analog/Digital I/O expansion board.

Figure 4. Ordering Information

5. AX58400 Evaluation Boards/Demo Kit

ASIX Electronics offers AX58400 GPIO Evaluation Board, AX58400 Motor Evaluation Board and AX58400 ADIO Demo Kit for designers to evaluate AX58400 functionalities on different target applications.

5-1. AX58400 Evaluation Boards

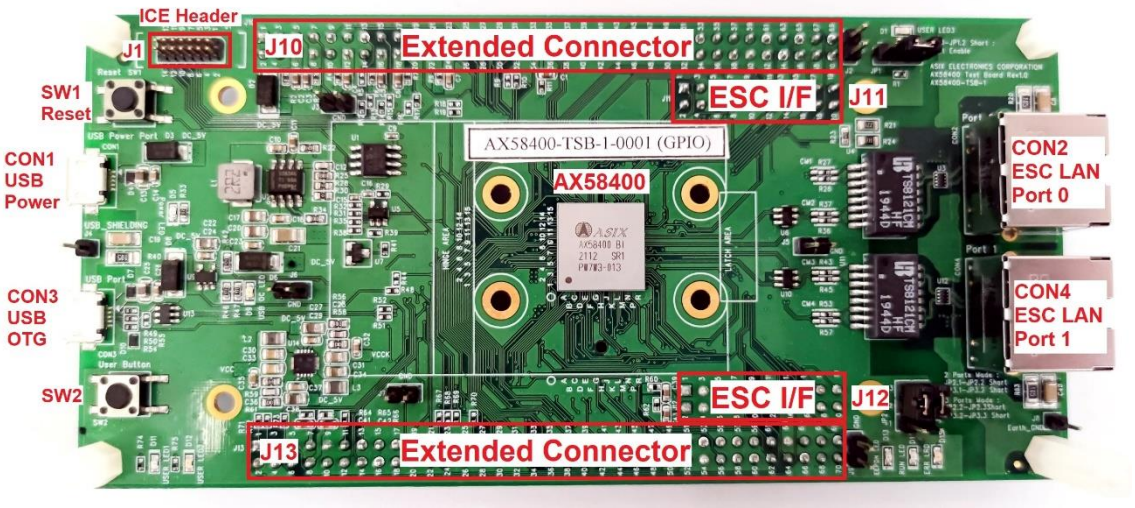

Figure 5. AX58400 GPIO Evaluation Board for Analog/Digital I/O Applications

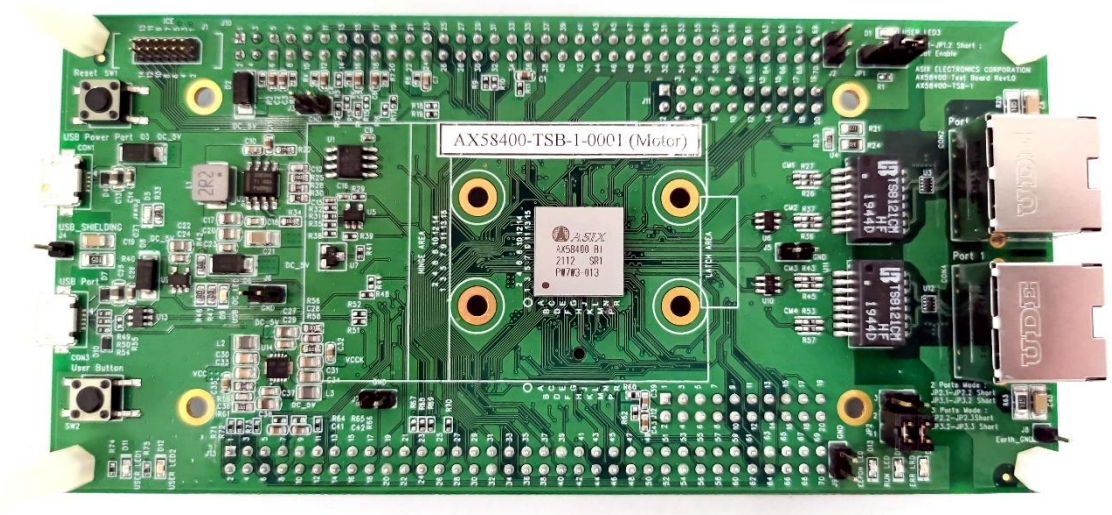

Figure 6. AX58400 Motor Evaluation Board for Motor/Motion Control Applications

The following is the overview of AX58400 GPIO/Motor evaluation boards.

Names	Descriptions
CON1 (USB Power)	Micro-USB 5V power connector Provide alternate 5V power source for AX58400 evaluation board, and provide extra 5V power source for USB OTG port
CON2/CON4 (ESC LAN Port 0/1)	EtherCAT slave LAN port 0 & port 1
CON3 (USB OTG)	USB OTG port connector
SW1	Reset button
SW2	General events trigger button
J10, J13	Extended interface connectors
J11, J12	EtherCAT interface connectors
J1	ICE header

Figure 7. AX58400 Evaluation Boards Overview

5-2. AX58400 ADIO Demo Kit

The AX58400 ADIO demo kit includes AX58400 GPIO Evaluation Board and AX58400 Analog/Digital I/O Expansion Board.

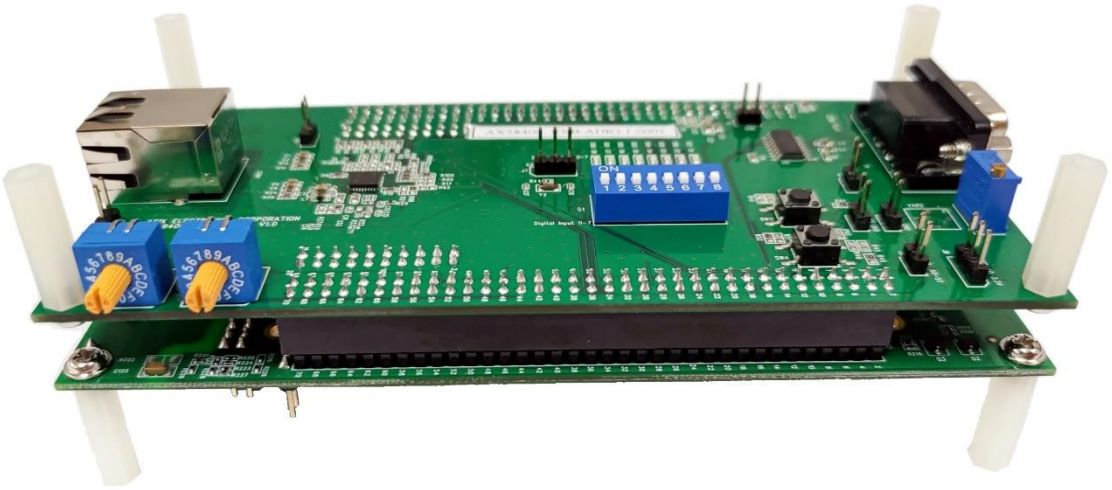

Figure 8. AX58400 ADIO Demo Kit

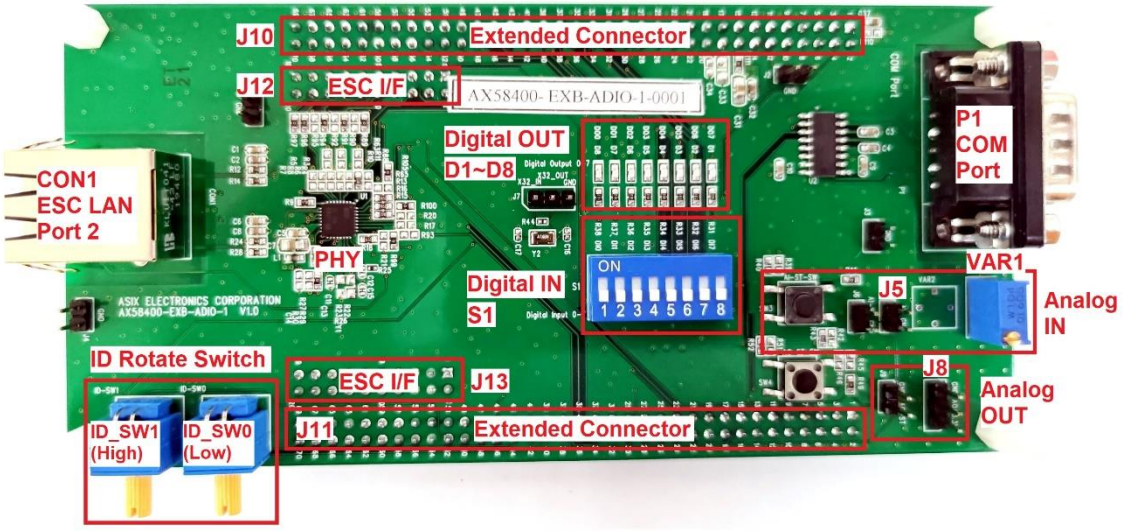

Figure 9. AX58400 Analog/Digital I/O Expansion Board

The following is the overview of AX58400 Analog/Digital I/O Expansion Board. Please refer to Section 5-1 for the overview of AX58400 GPIO Evaluation Board.

Names	Descriptions
CON1 (ESC LAN Port 2)	EtherCAT slave LAN port 2
P1 (COM Port)	COM port for UART debug console
ID_SW0, ID_SW1	16-bit EtherCAT ID rotate switches: ID_SW1 for high-byte ID, ID_SW0 for low-byte ID (Default: set ID_SW1=0, ID_SW0=0)
S1	8-bit DIP switch for Digital Input demo
D1~D8	8 LEDs for Digital Output demo
J5	Analog Input connector
VAR1	Variable 100K ohm resistor for Analog Input demo
J8	Analog Output connector
J10, J11	Extended interface connectors
J12, J13	EtherCAT interface connectors

Figure 10. AX58400 Analog/Digital I/O Expansion Board Overview

6. Software Development Tools

ASIX offers AX58400 Board Support Package (BSP) which include user guide, reference schematic, PCB layout/gerber/BOM files, application design note and software tools/demo sample source/SSC tool configuration import files, etc. Please contact ASIX Sales (Sales@asix.com.tw) for details.

The following are the software tools for developing AX58400 applications.

6-1. ST STM32CubeProgrammer Software

STM32CubeProgrammer (STM32CubeProg) is an all-in-one multi-OS software tool for programming STM32 products. It provides an easy-to-use and efficient environment for reading, writing and verifying device memory through both the debug interface (JTAG and SWD) and the bootloader interface (UART, USB DFU, I2C, SPI, and CAN). Designers can get the **STM32CubeProgrammer Software** from STMicroelectronics' web site (https://www.st.com/en/development-tools/stm32cubeprog.html).

The STLINK-V3MINI is a stand-alone debugging and programming mini probe for STM32 microcontrollers. The JTAG/SWD interfaces are used to communicate with any STM32 microcontroller located on an application board. Designers can get the **STLINK-V3MINI** from STMicroelectronics' web site (https://www.st.com/content/st_com/en/products/development-tools/hardware-development-tools/hardware-development-tools-for-stm32/stlink-v3mini.html).

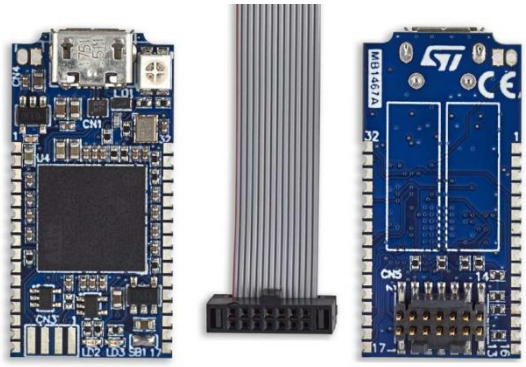

Figure 11. ST STLINK-V3MINI Debugger Board

6-2. ST STM32CubeMX Initialization Code Generator

STM32CubeMX is a graphical tool that allows a very easy configuration of STM32 microcontrollers and microprocessors, as well as the generation of the corresponding initialization C code for the Arm® Cortex®-M core or a partial Linux® Device Tree for Arm® Cortex®-A core), through a step-by-step process. Designers can get the **STM32CubeMX Initialization Code Generator** from STMicroelectronics' web site (https://www.st.com/en/development-tools/stm32cubemx.html).

6-3. ST STM32CubeIDE Development Tool

The STM32CubeIDE is an all-in-one multi-OS development tool, which is part of the STM32Cube software ecosystem. STM32CubeIDE is an advanced C/C++ development platform with peripheral configuration, code generation, code compilation, and debug features for STM32 microcontrollers and microprocessors. It is based on the Eclipse®/CDT framework and GCC toolchain for the development, and GDB for the debugging. Designers can get the **STM32CubeIDE Development Tool** from STMicroelectronics' web site (https://www.st.com/en/development-tools/stm32cubeide.html).

6-4. Arm Keil MDK-ARM uVision5 Development Tool

Arm Keil MDK is the most comprehensive software development solution for Arm-based microcontrollers and includes all components that you need to create, build, and debug embedded applications. Designers can purchase the **Keil MDK-ARM uVision5 Development Tool** from Keil's web site (https://developer.arm.com/tools-and-software/embedded/keil-mdk).

6-5. ETG EtherCAT SSC Tool

Download the EtherCAT Slave Stack Code Tool from ETG website (https://www.ethercat.org/) and extract the downloaded file (e.g. "SSC_V5i11.zip") and run the SSC tool setup (e.g. "EtherCAT Slave Stack Code Tool.exe") to install the EtherCAT Slave Stack Code Tool on Windows platform.

Note please join ETG member (https://www.ethercat.org/en/membership_application.html) firstly before downloading the EtherCAT Slave Stack Code Tool.

6-6. BECKHOFF TwinCAT XAE Tool

Download "TwinCAT 3.1 – eXtended Automation Engineering (XAE) Tool" from Beckhoff website (https://www.beckhoff.com/en-en/support/download-finder/software-and-tools/) and run TwinCAT 3 setup (e.g. "TC31-Full-Setup.3.1.4020.32.exe") to install TwinCAT 3 tool on Windows platform.

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