**Overview**

PROFINET® is becoming the leading industrial Ethernet protocol in automation due to its high-speed, deterministic communications, and enterprise connectivity; however, as the world's most popular fieldbus, PROFINIBUS®'s importance and usage will continue for many years due to legacy investment protection. Recognizing the hybrid attribute in process plants, this TI Design presents an integral solution for the migration of existing fieldbus technology into the real-time Ethernet network, which is based on the programmable real-time unit and industrial communication subsystem (PRU-ICSS) of TI's Sitara™ AM57x processor. The TI Design demonstrates PROFINIBUS master and PROFINET IRT device on AM572x with protocol stacks simultaneously running on an ARM® Cortex®-A15 core while an entire PROFINET switch and PROFINIBUS frame handler are executed on the two PRU-ICSSes respectively. The migration scheme is generally also suitable for other fieldbus and industrial protocols.

**Features**

- **PROFINIBUS:**
  - Cyclic PROFINIBUS-DP (DPV0) and Enhancements to DP (DPV1) for Acyclic Services
  - Transmission Speed: 9.6 Kbaud to 12 Mbaud
- **PROFINET IRT:**
  - Conformance Classes A, B, and C Functionality
  - Minimum Cycle Time of 250 µs
- **PROFINIBUS Master and PROFINET IRT Device Simultaneously Supported**
- **Simplified Protocol Translation Between PROFINIBUS and PROFINET IRT**
- **Leverage PRU-ICSS Industrial Software for Sitara Processors Built on top of Processor-SDK-RTOS**
- **Tested on TMDXIDK5728 Board and Includes Documentation, Software, Demonstration Application, and Hardware Design Files**

**Applications**

- Factory Automation & Controls: PLC, DCS & PAC: Communication Module
- Factory Automation & Controls: PLC, DCS & PAC: CPU (PLC Controller)

**Resources**

- **TIDEP-0075** Design Folder
- **AM572x** Product Folder
- **TMDXIDK5728** Tools Folder
- **PRU-ICSS-INDUSTRIAL-SW** Tools Folder
- **PROCESSOR-SDK** Tools Folder

**ASK Our E2E Experts**
1 System Overview

PROFIBUS (process fieldbus) is a standard for automation technology, which was first developed in 1989 in Germany. Today, there are over 35 million PROFIBUS nodes installed. The PROFIBUS industrial field bus is used to connect controllers to remote input and output units, sensors, actuators, and internetworking components. The applications where PROFIBUS is deployed include factory automation, drives and motion control, process automation, and safety-critical applications[1].

PROFINET is a real-time Ethernet standard for the high-speed, deterministic communications required for a wide range of industrial applications including factory automation, process automation, and building automation. Originally developed under the leadership of Siemens Gmbh as a network extension to the popular PROFIBUS fieldbus technology, PROFINET is now supported by PROFIBUS and PROFINET International, the largest fieldbus organization in the world. Standard Ethernet is not efficient for the small amounts of data exchange that are typical in factory automation, for example, and the lack of determinism means Ethernet cannot support the real-time operation necessary for motor drive control and other industrial real-time applications. PROFINET is a leading example of solving these challenges so that Ethernet can be adapted for real-time industrial applications, such as those found in factory automation environments.[2].

PROFINET encompasses many features from PROFIBUS. PROFINET's unprecedented performance and enterprise-wide connectivity help realize great operational benefits and compelling business advantages. Market research indicates there is high level of usage of PROFIBUS and the market is starting to transition to PROFINET. While PROFIBUS and PROFINET remain popular in the market, new PROFINET installations are now overtaking PROFIBUS installations. However, the transition is likely to be a gradual process due to legacy investment protection and conservative nature of manufacturing industry, especially for process and factory automation. Current installations in factories and plants include many end nodes communicating over PROFIBUS including PLCs, motion controllers, HMIs, drives, and IO modules. As manufacturers look to include newer PROFINET-enabled equipment in their factories, they will need to bridge the new PROFINET networks to the older PROFIBUS networks in a seamless way. Industry 4.0 gateways, communications modules, or PLCs and other equipment capable of communicating over both protocols will be critical to helping overcome this change.

In this TI Design, an integrated approach for the migration of existing fieldbus technology PROFIBUS into the real time Ethernet network PROFINET, which is based on PRU-ICSS industrial software for the Sitara processors AM572x is proposed and implemented. The PRU-ICSS industrial software packages are built to use on top of Processor-SDK-RTOS, a unified software development platform, and provide optimized PRU-ICSS firmware, a corresponding PRU-ICSS driver for the ARM processor and example applications to enable real-time industrial communications for TI Sitara processors.

1.1 System Description

This TI Design leverages the PROFIBUS master example and PROFINET IRT device example provided in PRU-ICSS industrial software for Sitara processors. The design integrates and prioritizes the tasks of each protocol and manages cache and interrupt resources to allow two protocols run simultaneously. In addition, a simplified protocol translation scheme is implemented to make a seamless connection within a distributed heterogeneous industrial enterprise environment possible.

PROFIBUS master frames exchanged with AM335x ICE slave are processed by PRU-ICSS1.

PROFINET IRT device packets transferred with the master programmable logic controller (PLC) (Siemens S7-1500) PROFINET controller are processed by PRU-ICSS2.

The two protocol stacks run simultaneously on one Cortex-A15 processor and are translated on the host processor.
1.2 **Key System Specifications**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROFIBUS services</td>
<td>Cyclic PROFIBUS-DP (DPV0) and enhancements to DP (DPV1) for acyclic services</td>
</tr>
<tr>
<td>PROFIBUS transmission speed</td>
<td>9.6 Kbaud to 12 Mbaud</td>
</tr>
<tr>
<td>PROFINET IRT conformance</td>
<td>Class A, B, and C</td>
</tr>
<tr>
<td>PROFINET IRT minimum cycle time</td>
<td>250 µs</td>
</tr>
<tr>
<td>Protocol translation</td>
<td>PROFIBUS and PROFINET</td>
</tr>
</tbody>
</table>

1.3 **Block Diagram**

The system block diagram (Figure 1) illustrates the multiprotocol setup on AM572x and communication with respective master and slave devices.

![System Block Diagram](image)

**Figure 1. System Block Diagram**

1.4 **Design Considerations**

- PROFIBUS protocol implementation
- PROFINET IRT protocol implementation
- Protocol integration and translation
  - Tasks and priorities
  - DDR cache-ability
  - Interrupt mapping
1.5 **Highlighted Products**

1.5.1 **AM572x**

The AM572x Sitara ARM processor is built to meet the complex processing needs of modern embedded industrial products. The AM572x provides high-processing performance through the flexibility of a fully-integrated mixed processor solution with two ARM Cortex-A15 cores, two ARM Cortex-M4 cores, and two TI C66x digital signal processor (DSP) cores as well as two industrial communication subsystems (PRU-ICSS), which can be used for real-time communications and IO applications, such as PROFINET, PROFIBUS, EtherCAT®, and more.

![Figure 2. AM572x Architecture](image_url)
1.5.2 PRU-ICSS

The PRU-ICSS consists of:
- Two 32-bit load and store RISC CPU cores:
  - Programmable real-time units (PRUs): PRU0 and PRU1
- Data RAMs per PRU core
- Instruction RAMs per PRU core
- Shared RAM
- Peripheral modules
- Interrupt controller (PRUSS_INTC)

The programmable nature of the PRU cores, along with their access to pins, events, and all device resources, provides flexibility in implementing fast real-time responses, specialized data handling operations, custom peripheral interfaces, and in offloading tasks from the other processor cores of the device. The PRU cores are programmed with a small, deterministic instruction set. Each PRU can operate independently or in coordination with each other and can also work in coordination with the device-level host CPU. This interaction between processors is determined by the nature of the firmware loaded into the PRU’s instruction memory.

**Figure 3. AM572x PRU-ICSS Architecture**
Among the interfaces supported by the PRU-ICSS are real-time industrial protocols used in master and slave mode, such as:

- EtherCAT
- PROFINET
- EtherNet/IP™
- Ethernet POWERLINK
- SERCOS III
- HSR and PRP
- EnDat 2.2

More details about the processor features refer to AM572x Sitara™ Processors Silicon Revision 2.0, 1.1[1].

1.6 System Design Theory

The PRU-ICSS industrial software for Sitara processors provides the foundation for the multiprotocol integration and data translation. The software includes firmware for the protocols, drivers, hardware initialization routines, adaptation layer for the stack API, protocol stack, and the application itself. (Disclaimer: The protocol stacks are from third-party vendors and validated on Sitara devices. The copy of the stack libraries included is solely for evaluation, development and test purposes).

To integrate the PROFINET and PROFIBUS from two separate TI-RTOS Code Composer Studio™ (CCS) projects in the PRU-ICSS industrial software package, a few aspects need to be taken into consideration. These include memory management, cache-ability, interrupt mapping, and real-time task scheduling and synchronization.

The protocol translation is implemented through buffer lists. Each protocol owns a buffer list with a length field as flag to indicate data availability while the other protocol polls the field. The timing of data transfer is controlled by the application that aligns with each protocol’s internal state machine.

The data initially is from dp_input buffer from the PROFIBUS slave application then received by the PROFIBUS master stack from the GetProcessData() API through PRU-ICSS1 and stored in the PROFIBUS data buffer in DDR. The PROFINET device polls the PROFIBUS data buffer and sends it to the PROFINET controller. A move module is added in the PROFINET controller, which will route the data back to the PROFINET device. Once the PROFINET device receives the data from the PROFINET controller, the PROFINET device stores the data into shared data buffer. PROFIBUS sends the data from the PROFINET data buffer to slave through PutProcessData(). Finally, the data received in Output_buffer of PROFIBUS slave is transmitted to the universal asynchronous receiver-transmitter (UART) console.
Figure 4 shows the protocol translation scheme.
1.6.1 PROFIBUS® Implementation on AM572x

The PROFIBUS software components comprise the integrated PROFIBUS solution:
- Microcode that implements FDL functionality in the PRU
- PROFIBUS-DP protocol that runs on the ARM MPU
- Industrial application

Figure 5 shows the PROFIBUS component software architecture.

The PROFIBUS real-time frame handler (fieldbus data link or FDL) is encapsulated in the PRU-ICSS1. The PRUs implement real-time PROFIBUS message transmission, frame validation, and communication with the ARM processor. Interrupts are used to communicate with the ARM where the PROFIBUS stack (layer seven, DP-protocol) and the industrial application are run. All process data handling like cyclic, acyclic, and service access point (SAP) between the PROFIBUS stack on ARM and the PRU is through the internal memory. One of the PRUs controls the integrated on-chip UART that is designated for PROFIBUS communication at up to 12-Mbaud data rate. The industrial application and the PROFIBUS DP-protocol (layer seven) are operated on the ARM. The solution can be completed with an RS-485 transceiver suitable for harsh environments, such as TI’s ISO 1176T PROFIBUS transceiver[1].
1.6.2 PROFINET® IRT Implementation on AM572x

The PROFINET slave software components comprise the integrated PROFINET solution:
- Microcode that implements layer two functionality in the device's PRU
- PROFINET slave stack that runs on the ARM processor
- Industrial application

Figure 6 shows the PROFINET software architecture.

The PROFINET slave layer two functionalities are implemented in PRU-ICSS2.

CPM and PPM processing CPM frames are parsed by the PRU-ICSS firmware to check whether the host processor should be notified. Firmware stores the CPM frame in predefined buffer so that data is completely ready for host consumption before it is interrupted.

PPM frames for all the active IOCRs are generated or produced by the firmware running on PRUs. At the start of every phase, firmware determines which PPM frames must be transmitted in that particular phase, and the firmware transmits them out without any interference from host.
Data hold timer (DHT) is implemented in the PRU firmware, and whenever the DHT expires, an interrupt is raised to the ARM processor running the PROFINET stack.

To reduce the number of DCP identify request frames reaching the ARM processor, DCP identify filter is implemented in the PRU firmware to filter out all the DCP identify frames which are not meant for the host.

A two-port, cut-through switch is integrated in PROFINET firmware. The switch handles the non-real-time traffic and can be interfaced with PROFINET, TCP, and IP stacks running on the host[2][3].

1.6.3 Protocol Integration and Translation

1.6.3.1 Key PROFIBUS® and PROFINET® APIs, Global Variables, and Buffers

The following high-level APIs are listed to provide an overview of PROFIBUS and PROFINET stack functionality.

PROFIBUS:

• Get the process data of required length from the given offset.
  
  – short GetProcessData (short DataOffset, short DataLen, BYTE *ProcessDataPtr, short UserLock);

• Put the process data of required length from the given offset.
  
  – short PutProcessData (short DataOffset, short DataLen, BYTE *ProcessDataPtr, short UserLock);

• Transfer the process data.
  
  – short TransferProcessData (TPDTransferPrm* PDPrm);

PROFINET:

• Stack input data buffer.
  
  – APP_BYTE gbyInput_Data[MAX_DATA_FRAME_IO];

• Stack output data buffer.
  
  – APP_BYTE gbyOutputData[MAX_DATA_FRAME_IO];

• Stack AR status information.
  
  – APP_BYTE gbyOutputAPDU[MAX_ARD_PER_DEVICE];

• Stack user ALARM flag.
  
  – volatile unsigned char appAlarmActive;

PROFIBUS data are processed in tasks – appInData and appOutData with same priority level 2.

Task_Params_init(&taskParams);
taskParams.priority = 2;
taskParams.instance->name = "appInData";
taskParams.stackSize = 2048;
Task_create(appInData; &taskParas, NULL);
Task_Params_init(&taskParams);
taskParams.priority = 2;
taskParams.instance->name = "appOutData";
taskParams.stackSize = 2048;
Task_create(appInData; &taskParas, NULL);
1.6.3.2 Tasks and Priorities

PROFIBUS example main function is integrated into PROFINET project as a subfunction, and the tasks in each protocol are reprioritized to ensure the functions are performed in required process time and critical functions can preempt lower priority threads.

Table 2. System Tasks and Priorities

<table>
<thead>
<tr>
<th>PROTOCOLS</th>
<th>TASKS</th>
<th>PRIORITY</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROFINET</td>
<td>taskLedBlink</td>
<td>2</td>
<td>To control LED blink</td>
</tr>
<tr>
<td>PROFINET</td>
<td>applnData</td>
<td>2</td>
<td>To get input data from PROFIBUS master and forward to PROFINET controller</td>
</tr>
<tr>
<td>PROFINET</td>
<td>appOutData</td>
<td>2</td>
<td>To send data received from PROFINET controller to PROFIBUS master</td>
</tr>
<tr>
<td>PROFINET</td>
<td>taskPruss</td>
<td>3</td>
<td>To initialize all software components and run the stack</td>
</tr>
<tr>
<td>PROFINET</td>
<td>RxTask</td>
<td>10</td>
<td>To get packets from ICSS_EMAC and process</td>
</tr>
<tr>
<td>PROFIBUS</td>
<td>Uarttask</td>
<td>1</td>
<td>To check the keyboard input for UART key driven menu</td>
</tr>
<tr>
<td>PROFIBUS</td>
<td>mainTask</td>
<td>2</td>
<td>To initialize PROFIBUS and handle input and output</td>
</tr>
</tbody>
</table>

1.6.3.3 DDR Cache-ability

PROFIBUS requires 1-MB memory DDR region to be uncached for PRU driver memory mapping. The DDR memory cache-ability is configured in am572x_app.cfg file, where serval memory sections with various cache-ability attributes will be defined. The following is the code snippet for uncached DDR memory region:

```c
Mmu.initDescAttrsMeta(attrs0);
attrs0.type = Mmu.DescriptorType_BLOCK; // BLOCK descriptor
attrs0.shareable = 2; // shareable
attrs0.attrIndx = 1; // Non-cache, device memory
// Set the descriptor for each entry in the address range
for (var i = 0x90000000; i < 0xA0000000; i = i + 0x00200000) {
    // Each 'BLOCK' descriptor entry spans a 2MB address range
    Mmu.setSecondLevelDescMeta(i, i, attrs0);
}
```

1.6.3.4 Interrupt Mapping

AM572x has a large number of interrupts to service the requirements of the device's many peripherals and subsystems. The MPU, DSP (x2), IPU (x2), EVE (x4), and PRU-ICSS (x2) subsystems are capable of servicing these interrupts through their integrated interrupt controllers. In addition, each processor's interrupt controller is preceded by an interrupt controller crossbar (IRQ_CROSSBAR) that provides flexibility in mapping the device interrupts to processor interrupt inputs. The IRQ_CROSSBAR module is controlled by registers in the CTRL_MODULE_CORE submodule. The IRQ_CROSSBAR is able to map any of its input signals to any of its outputs. Each output of the IRQ_CROSSBAR module is connected only to one interrupt line of certain interrupt controller (INTC). Thus, the device IRQs are mapped to the device INTCs through the IRQ_CROSSBAR.

By default, CTRL_CORE_MPU_IRQ_120_121 is configured in both PROFIBUS on PRU-ICSS instance one and PROFINET on PRU-ICSS instance two from crossbar. To get the two protocols concurrently run, PROFIBUS interrupt is remapped through CTRL_CORE_MPU_IRQ_118_119 while PROFINET interrupt mapping remains in CTRL_CORE_MPU_IRQ_120_121.

```c
#define INTERRUPT_MAP_TO_CHANNEL3 119+32
#define INTERRUPT_MAP_TO_CHANNEL2 118+32
```
1.6.3.5 Protocol Translation

The protocol translation is implemented at the application level.

Two buffer lists PnetGbyInput_Data and PbusInputData are created to exchange the process data from each protocol, thus perform protocol translation.

```c
struct buffer_list {
    uint8_t *address;
    uint32_t length;
};

APP_BYTE PnetGbyInput_Data[NUM_PN_BUFS][MAX_DATA_FRAME_IO]; /* buffer list for PROFINET slave inputs */
BYTE PbusInputData[NUM_PB_BUFS][MAX_DATA_LEN]; /* buffer list for PROFIBUS master inputs */
```

The buffer lists are updated whenever new data is received or transmitted in each protocol. Followed by GetProcessData() in PROFIBUS, PbusInputData is filled by new data received from PROFIBUS slave and indicates its ready for sending to PROFINET device; meanwhile prior to PutProcessData(), the data received from the PROFINET controller is put into the PROFIBUS output data buffer and then the data ready indicator is cleared. Likewise in PROFINET, PnetGbyInput_Data is filled by new data received from the PROFINET controller and is indicated as ready for sending to PROFIBUS master in appInData task. Meanwhile, data received from PROFIBUS master is sent to PROFINET controller and the data ready indicator is cleared.

The buffer list update is processed in critical section to avoid concurrent accesses to the shared resources that lead to unexpected or erroneous behavior. To ensure exclusive use of critical sections, a synchronization mechanism is implemented at the entry and exit of the buffer list update. The buffer list is a circular buffer and updated in a wraparound manner. Each buffer list is tracked by its read and write index to ensure valid data access.

2 Getting Started Hardware and Software

2.1 Hardware

Required hardware includes:
1. AM572x IDK
2. AM3359 ICE v2
3. Siemens S7-1500 PLC
4. PROFIBUS connector or cable
5. Ethernet cables
6. Two 1GB+ SD card
7. 5-V DC power supply
8. 24-V DC power supply
9. Two mini USB cables
10. XDS-560M JTAG emulator (optional)
2.1.1 Hardware Connections

Figure 7 shows the system setup diagram.

The AM572x industrial development kit (IDK) is a development platform for evaluating the industrial communication and control capabilities of Sitara AM572x processors for applications in factory automation, drives, robotics, grid infrastructure, and more.

Note the power supply for the AM572x IDK is 5-V DC while other Sitara EVMs may use 12-V DC.

The FTDI USB port is used as UART console port (baud 115200, 8N1). XDS560-M JTAG emulator is optional as the image can be booted up from SD card.

The AM3359 industrial communications engine (ICE) is a development platform targeted for systems that specifically focus on the industrial communications capabilities of the Sitara AM335x ARM Cortex-A8 processors. The AM335x ARM Cortex-A8 processors also integrate the PRU-ICSS, which is discussed in detail in the beginning of this guide for AM572x processors. Unlike AM57x, the AM335x processors only have one instance of the PRU-ICSS, so they are able to support one industrial protocol at a time (PROFIBUS or Ethernet-based protocols are both supported for AM335x). AM335x enables low-footprint designs with minimal external components and with best-in-class, low-power performance.

Siemens S7-1500 PLC provides PROFINET IO (two-port switch) as standard interface.
2.2 Software

Required software includes:
1. CCS Linux version 6.1.2
2. Processor SDK RTOS 2.0.2.11
3. PRU-ICSS industrial software for Sitara processors 1.0.0.0
   • PRU-ICSS-PROFINET-SLAVE
   • PRU-ICSS-PROFIBUS-MASTER
4. ProfibusMaster_ProfinetSlave_01.00.00.00
5. SYSBIOSSDK-IND-SITARA 02_01_03_02
6. TIA Portal v13+

2.2.1 Install Code Composer Studio™
CCS version 6.1.2 is available at the Download CCS Wiki page.

2.2.2 Install Processor SDK RTOS
Processor SDK TI-RTOS is available at PROCESSOR-SDK-RTOS-AM7X 02_00_02_11.

2.2.3 Install PRU-ICSS Industrial Software
PRU-ICSS industrial software is available at PRU-ICSS-INDUSTRIAL-SW.
1. Install PROFIBUS master from PRU-ICSS-PROFIBUS-MASTER.
2. Install PROFINET slave from PRU_ICSS_PROFINET_Slave.

2.2.4 Install and Build ProfibusMaster_ProfinetSlave CCS Project
1. Download ProfibusMaster_ProfinetSlave_01.00.00.00 from http://git.ti.com. Note the future releases of Processor SDK RTOS will include the software.
2. Copy ProfibusMaster_ProfinetSlave_01.00.00.00\profibus_master_update\Profibus_AM57x_bsp.c to PRU-ICSS-Profibus_Master_01.00.00.00\examples\profibus_master directory.
3. Copy ProfibusMaster_ProfinetSlave_01.00.00.00\profibus_master_update\swpruss.h to PRU-ICSS-
   Profibus_Master_01.00.00.00\protocols\profibus_master\include\directory.
4. Import ProfibusMaster_ProfinetSlave_01.00.00.00 to CCS and build.
5. Follow Processor SDK RTOS BOOT AM57x Wiki page to create a bootable image, and copy to the SD card. A JTAG emulator may also be used to download the
   ProfibusMaster_ProfinetSlave_01.00.00.00.out from
   ProfibusMaster_ProfinetSlave_01.00.00.00\Release.

2.2.5 Install TIA Portal for Siemens S7-1500 PLC Configuration
TIA Portal software from Siemens is used to configure S7-1500 PROFINET PLC. A trial version and service pack is available at:
• SIMATIC STEP 7 (TIA Portal) V13 TRIAL Download
• Service Pack 1 for SIMATIC STEP 7 V13 including PLCSIM (TIA Portal)
Refer to the Getting Started SIMATIC S7-1500 TIA Portal guide.

2.2.6 Install PROFIBUS® Slave Prebuilt Image for AM3359 ICEv2 Board
Install SYSBIOSSDK-IND-SITARA 02_01_03_02. The PROFIBUS slave prebuilt image is available in the software from SYSBIOSSDK-IND-SITARA.
3 Test Setup

Figure 8 shows the hardware connection diagram to setup the test environment.

3.1 Setup PROFINET® Slave on AM3359 ICE v2 Board

Follow the Wiki pages below to set up PROFINET slave on AM3359 ICE v2 board with the prebuilt image installed in section 2.2.6

- SYSBIOS Industrial SDK 02.01.03 User Guide Wiki page
- PROFINET DP slave demo setup on AM335x Wiki page

**NOTE:** Set jumpers between pins 2 and 3 on J18 and J19 to select ICSS mode. Set jumper on J7, J8 (pin 1 and 2), and J10. Remove jumper on J6.

3.2 Configure Siemens S7-1500 PLC

Refer to the System overview SIMATIC S7-1500 for S7-1500 PLC setup details.

**NOTE:** Because PROFINET uses TCP/IP for configuration, parametrization, and diagnostics, an IP address needs to be programmed in the PLC. For real-time data process, PROFINET uses physical MAC address for more deterministic performance.
In addition, a MOVE module is added into the PROFINET communication path between controller and device.

![MOVE Module in TIA Portal](image)

Figure 9. MOVE Module in TIA Portal

The PROFINET device description file (GSDML-V2.31-MOLEX_TI-AM57xxProfinet_SDK-20150723.xml) is under PRU-ICSS-Profinet_Slave_01.00.00.00\examples\profinet_slave\GSD.

### 3.3 Demonstration

1. Power on PROFIBUS slave: AM3359 ICE v2.
2. Power on AM572x IDK with image loaded from JTAG emulator or SD card. Figure 10 shows the UART console log when the board is booted up from SD card. Wait until PROFINET connection is established then press any key to continue.

![AM572x SD Boot Log](image)

Figure 10. AM572x SD Boot Log
3. Check PROFINET connection status change from TIA Portal. Figure 11 shows the PROFINET controller offline before the communication is established between PROFINET controller and device.

Figure 11. PROFINET® Controller Offline

Figure 12 shows PROFINET controller online after the communication is established between PROFINET controller and device.

Figure 12. PROFINET® Controller Online
4. Configure PROFIBUS master.
   Figure 13 shows how to configure PROFIBUS master.
   • Select baud rate, 1 through 8.
   • Enter 1 for number of slave station.
   • Enter 9 for slave station address.

![Figure 13. Configure PROFIBUS® Master on AM572x](image-url)
5. Check PROFIBUS state change: Slave in state DataExchange.

![Figure 14. PROFIBUS® Master State](image-url)
6. Turn on **monitoring** of programmable module: MOVE and check the data update in both input and output.

![Figure 15. MOVE Monitoring in PROFINET® Controller](image)

7. Verify the received data update in PROFIBUS slave on AM3359 ICE v2.

![Figure 16. PROFIBUS® Slave Data Update](image)
4 Design Files

4.1 Bill of Materials
To download the Bill of Materials (BOM) for each board, see the design files at TIDEP-0075.

4.2 Software Files
To download the Assembly Drawings for each board, see the design files at TIDEP-0075.

5 Related Documentation

1. Texas Instruments, AM572x Sitara™ Processors Silicon Revision 2.0, 1.1, Technical Reference Manual (SPRUHZ6)
2. Texas Instruments, PROFINET on TI's Sitara™ AM335x processors, Marketing White Papers (SPRY252)
3. Texas Instruments, Certified PROFINET IRT v2.3 Device With 1-GHz ARM Application Processor, TI Design (TIDUAK0)
4. Texas Instruments, PROFIBUS on Sitara Processors, Marketing White Papers (SPRY155)

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6 About the Author

GARRETT DING is a software applications engineer for the embedded processing group at Texas Instruments, where he is responsible for developing reference design solutions and providing technical support to customers for the industrial segment. Garrett earned his Master of Science in Electrical Engineering (MSEE) from NanJing University of Science and Technology, China.

ELLEN KOU is a product marketing manager at Texas Instruments, where she is responsible for applications of ARM processors in industrial automation market segments. Ellen earned her Master of Engineering in Electrical Engineering (MEn) from Texas A&M University in College Station, Texas.
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