Sitara Linux Software Developer's Guide

NOTE - This Software Developer's Guide (SDG) currently supports the SDK 5.04.01.00 release coming April 16, 2012.
For the SDG specific to your SDK release, please refer to Archived SDGs under Reference_Documentation.

Welcome to the Sitara Linux Software Developer's Guide

Thank you for choosing to evaluate one of our Sitara ARM microprocessors [1]. Please *bookmark* this page and refer back to it as needed. It is designed to quickly provide the information you need most while evaluating the AMx microprocessor. We are always striving to improve this product. Please let us know if you have **ideas or suggestions.**

## Supported Platforms & Version Information

The following Sitara ARM microprocessors are supported with this SDK version.

Platforms	SDK	PSP	Kernel	U-Boot	Toolchain	Release Date
BeagleBone	5.04	04.06.00.07	3.2	2011.09	gcc4.5.3	Mar 2012
AM335xEVM	5.04	04.06.00.07	3.2	2011.09	gcc4.5.3	Mar 2012
Beagleboard-xM	5.04	-	3.0.8	2011.09	gcc4.5.3	Mar 2012
AM37xEVM	5.04	04.02.00.07	2.6.37	2011.09	gcc4.5.3	Mar 2012
AM35xEVM	5.04	04.02.00.07	2.6.37	2011.09	gcc4.5.3	Mar 2012
AM180xEVM	5.04	03.21.00.04	2.6.37	2010.12	gcc4.5.3	Mar 2012

Linux Software Stack

The following software stack illustrates at a high level the various components provided with the Sitara Linux SDK.

NOTE - Availability of certain applications are platform dependent and clarified in the associated User Guides below.
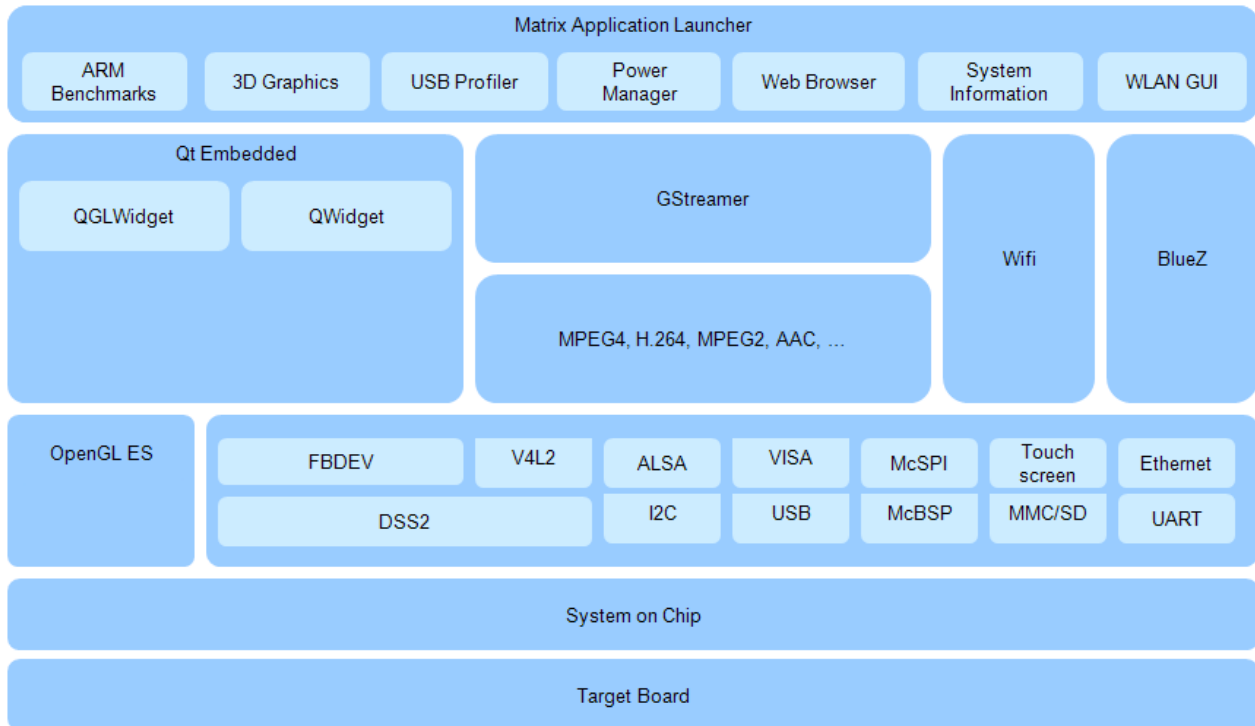
EVM Hardware Overview

Details for various hardware platforms supported by this Sitara Linux SDK are provided before.

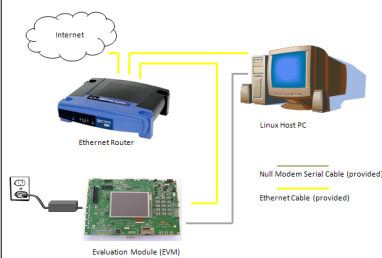| Platform	Document	EVM Provider
AM335xEVM	**Hardware User's Guide** [2]	**www.ti.com** [3]
BeagleBone	**Hardware User's Guide (Rev A3)** [4]	**Beagleboard.org** [5]
Beagleboard-xM	**Hardware User's Guide** [6]	**Beagleboard.org** [5]
AM37xEVM	**Hardware User's Guide** [7]	**Mistral** [8]
AM35xEVM	**Hardware User's Guide** [9]	**Logic** [10]
AM180xEVM	**Hardware User's Guide** [11]	**Logic** [10]

Start your Linux Development

Before using the Sitara Linux SDK you must have a Linux development environment. Linux development environments vary, so we recommend the following for ease of use and consistency when working together. The next few steps will assist you in the setup & configuration of your Linux host based on the physical setup shown below.
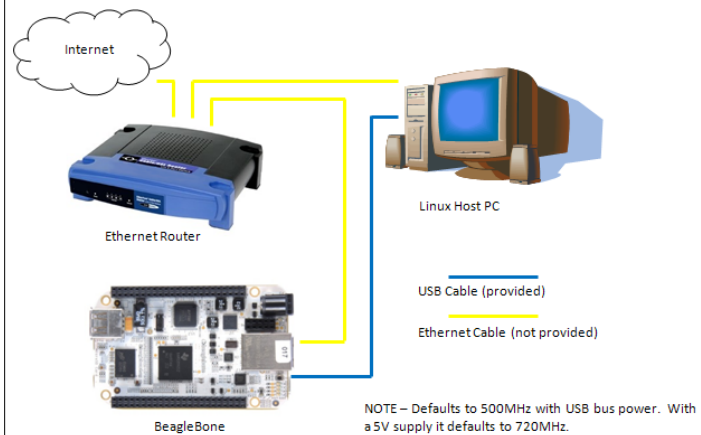
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1. Configure a Linux Host - If you already have a Linux host machine, go to Step 2. If you do not have a Linux host machine, you can configure a Linux host machine on your Windows PC using a virtual machine.

- **Build a Ubuntu 10.04 LTS Linux host with VMware on WinXP (preferred)**
- **Build a Ubuntu 10.04 LTS Linux host with VirtualBox on WinXP**

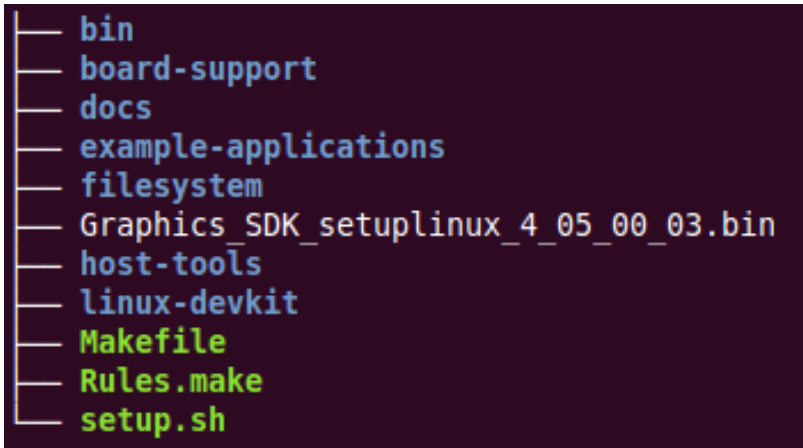| For standard EVMs: 2. Configure your development environment	For Beaglebone: 2. Configure your development environment
3. Install the SDK - Within your Linux host machine, **Install the Sitara SDK**	**3. Run the START_HERE Script** - When Beaglebone boots, a START_HERE directory will display on your Linux host desktop. To start your evalaution and development using the BeagleBone, **Run the START_HERE.sh script** **NOTE:** The START_HERE.sh script will run the setup.sh script. For Beaglebone boards before rev A5 the setup.sh script will attempt to install a udev rule to load the ftdi_sio module with the proper parameters to recognize the Beaglebone. If you experience difficulty with the Beaglebone being recognized you can load the module manually by doing: • sudo rmmod ftdi_sio • sudo modprobe ftdi_sio vendor=0x0403 product=0xa6d0
4. Run the Setup Script - Once the SDK has been installed, **Run the Setup.sh Script** to guide you through the remaining development environment configuration.	**NOTE:** If using a VMWare image you will likely need to import the beaglebone into the VMWare image as a mass storage device using the instructions **here**

SDK Directory Structure Overview

The Sitara Linux SDK contains the following top-level directories and files

```
├── bin
├── board-support
├── docs
├── example-applications
├── filesystem
├── Graphics_SDK_setuplinux_4_05_00_03.bin
├── host-tools
├── linux-devkit
├── Makefile
├── Rules.make
└── setup.sh
```

These directories contain the code and tools used to develop for Sitara devices.

- **bin** - Contains the helper scripts for configuring the host system and target device. Most of these scripts are used by the setup.sh script.
- **board-support** - Contains the SDK components that need to be modified when porting to a custom platform. This includes the kernel and boot loaders as well as any out of tree drivers.
- **docs** - Contains various SDK documentation such as the software manifest and additional user's guide. This is also the location where you can find the *training* directory with the device training materials.
- **example-applications** - Contains the sources for the TI provided example applications seen during the out-of-box demonstration.
- **filesystem** - Contains the reference file systems. These include the smaller base file system as well as the full-featured SDK file system.
- **host-tools** - Contains the host side tools such as pinmux and flash tool.
- **linux-devkit** - Contains the cross-compile toolchain and libraries to speed development for the target device.
- Graphics_SDK_setuplinux_<version>.bin - This is the installer for the graphics SDK. The graphics SDK components are used by the Sitara Linux SDK to provide additional demos as well as integrated with the pre-built Qt libraries to accelerate various Qt functions.
- **Makefile** - Provides build targets for many of the SDK components from the top-level of the SDK.
- **Rules.make** - Sets default values used by the top-level Makefile as well as sub-component Makefiles
- **setup.sh** - Configures the users host system as well as the target system for development

Example Applications User's Guides

There are a number of Example Applications provided within the Sitara Linux SDK. Below are the applications available on each platform and the User's Guides associated with each component.

NOTE: The example applications below assume that you are using the default pinmux/profile configuration that the board ships with, unless otherwise noted in the individual application's User's Guide

Applications available by development platform

Applications	AM335x	BeagleBone	AM180x	AM35x	AM37x	Beagleboard-xM	Users Guide	Description
Matrix GUI	X	X	X	X	X	X	**Matrix User's Guide**	Provides an overview and details of the graphical user interface (GUI) implementation of the application launcher provided in the Sitara Linux SDK
Power & Clocks	X	X			X	X	**Power Management User's Guide**	Provides details of power applications integrated into the Matrix GUI, along with helpful command line equivalents.
Multimedia	X			X	X	X	**Multimedia User's Guide**	Provides details on implementing ARM/Neon based multimedia using GStreamer pipelines and FFMPEG open source codecs.
Camera					X		**Camera User's Guide**	Provides details on how to support smart sensor camera sensor using the Media Controller Framework
USB Profiler	X	X	X	X	X	X	NA	
ARM Benchmarks	X	X	X	X	X	X	NA	
Oprofile	X	X	X	X	X	X	**Oprofile User's Guide**	Provides applications which show how Oprofile can be used for debugging and understanding system performance.
Display	X			X	X		NA	
Cryptography	X	X	X	X	X	X	**Cryptography User's Guide**	Provide details on how to implement cryptography through use of OpenSSL and various example applications.
PRU			X				NA	
WLAN and Bluetooth	X		X		X		**Open Source Wireless Connectivity WLAN/Bluetooth User's Guide**	Provides details on how to enable the WL1271 daughtercard which is connected to the EVM
QT Demos	X	X	X	X	X	X	NA	
Web Browser	X	X	X	X	X	X	NA	
System Settings	X	X	X	X	X	X	NA	

Bootloaders - How to Build & Install

The following provides instructions on how to build and install uboot and MLO. Additional reference documentation is also provided.

- **Building & Installing Uboot & MLO**

Kernel - How to Configure, Build & Install

The following provides instructions on how to configure, build and install the Linux kernel. Additional reference documentation is also provided.

- **Build, Configure and Install the Linux Kernel**

Host Side Development Tools

There are number of host side development tools provided in the Sitara Linux SDK to ease your development. See the appropriate User's Guide below for more information.

Host Tools for Target Development

These are tools that will assist in cross-compiling code for the target device or making images to run on the target device

Top-Level Makefile

The Sitara Linux SDK contains a top-level Makefile in the root of the SDK tree that can be used to rebuild many of the example applications and board support packages. See the **Sitara Linux SDK Top-Level Makefile** page for more information on using this Makefile.

GCC Cross-Compile Toolchain

Starting with version 05.xx of the Sitara Linux SDK there is now a GCC cross-compile toolchain available within the SDK in the linux-devkit directory. For details on using this toolchain please see the **Sitara Linux SDK GCC Toolchain** page.

create-sdcard.sh script

Starting with version 05.04 of the Sitara Linux SDK there is now a shell script available called **create-sdcard.sh** which can be used to create an SD card image for booting the various Sitara EVMs. For details on using this script please see the **Sitara Linux SDK create SD card script** page.

Code Composer Studio v5 User's Guide

Code Composer Studio v5 - a full featured, Eclipse based IDE that includes the Remote System Explorer plugin. CCSv5 can be used for both application development & debug using gdbserver and kernel debug using an XDSv100 JTAG emulator.

- **Code Composer Studio v5 (CCSv5)**

For detailed instructions based on the Beagebone on how to do Linux debugging with CCSv5 see:

- **Linux Debug in CCSv5**

Host tools for Target Configuration

These tools are intended to be run on the host and assist in configuring the target device

Pin Mux Utility User's Guide

Pin Mux Utility - a graphical utility designed to ease the pin mux configuration effort by highlighting pinmux conflicts, configuring the IO and outputting the required source code.

- **AM35x/AM37x/AM335x Pin Mux Utility User's Guide**
- **AM180x Pin Setup Tool User's Guide**

Flash Tool User's Guide

Flash Tool - a graphical utility design to easily support new memory configurations and HW flashing typically through UART & USB for the EVM or custom hardware

- Currently for AM335x Flash programming is handled using U-Boot. Details can be found in the **AM335x U-Boot User's Guide**
- **AM35x/AM37x Flash Tool User's Guide**
- **AM180x Flash Tool User's Guide**

Training Documentation

Training presenatations are now included in the Sitara Linux SDK. Once installed simply locate the docs/training directory within the SDK. Presentations included:

Training Module	Description
Introduction to Linux	Introduces the community-based Linux ecosystem on TI platforms. What will be covered are the components that make up the ecosystem such as the boot loader, Linux kernel, device drivers, user application layer and the relationship between them.
Linux Boot Process	Looks at all aspects of the boot process from power up to running user a application beginning with ROM boot loader progressing through secondary program loader, u-boot, kernel and finishing with user-level initialization.
Introduction to Sitara Linux SDK	Learn about the various components that make up the ARM MPU Linux software development kit including the out-of-box application launcher, the CCS IDE, example applications. In addition, host tools such as the pin-mux utility and the flash tool will be introduced. All these components are packaged into a single easy to use installer from TI.com
Code Composer Studio v5	Covers what the Eclipse-based Code Composer Studio is, how to use it for embedded Linux application development, debugging and additional plug-ins that are provided
Power Management	Discusses how to improve product power performance by minimizing power consumption and guaranteeing system performance. In addition, power management techniques enabled via the Linux SDK will be discussed
Cryptography	Covers cryptography basics and explore cryptographic functions enabled via open source projects. In addition, cryptographic hardware acceleration access and Linux SDK example applications will be discussed.
Board Port	Discusses the fundamentals necessary to port a TI Linux-based EVM platform to a custom target platform. Introduces the necessary steps needed to port the following components: secondary program loader, u-boot and Linux kernel.
ARM Multimedia	Introduces open-source based multimedia codecs for the ARM Cortex-A8. In addition, look at the capability of the NEON coprocessor to accelerate multimedia. Plus, introduces GStreamer, an open-source pipeline-based framework that enables access for multimedia through FFMPEG/libav support on the ARM. GStreamer will be illustrated with Linux SDK examples.
GUI Development	Learn how to develop a GUI quickly with the Linux SDK. Learn background information on QT. Learn how to use the SDK to get started developing a GUI. Learn about QT Creator and all the QT toolset.
Oprofile	Introduces the Opensource tool Oprofile. When is it useful during the development cycle. Introduce some of the more popular features. Cover both modes of operation, internal HW counters or timer interrupts. Cover internal operation details. Also point out use cases where Oprofile may not be useful.

Other How Tos

This section provides how-to articles on additional setups and configurations you may find useful in your development.

- **Creating a HelloWorld CCS Project**
- **How to utilize Error Correction (ECC)**
- **How to Recalibrate the Touchscreen**
- **AMSDK File System Optimization/Customization**
- **How to Develop with 3D Graphics**
- **How to Connect to an EVM via Telnet**
- **How to Setup a Samba Server**
- **Understanding the Boot Sequence**
- **How to Move Files From Host to Target**
- **How to Flash the Linux System to NAND from U-boot**
- **How to use a Mouse instead of the Touchscreen with Matrix**
- **How to enable DVI display**

Reference Documentation

'Archived - Software Developer's Guide'

- **Sitara SDK 5.04.00.00 - Software Developer's Guide (archived)** [12]
- **Sitara SDK 5.03.03.00 - Software Developer's Guide (archived)** [13]
- **Sitara SDK 5.03.02.00 - Software Developer's Guide (archived)** [13]
- **Sitara SDK 5.03.01.00 - Software Developer's Guide (archived)** [14]
- **Sitara SDK 5.03.00.00 - Software Developer's Guide (archived)** [15]
- **Sitara SDK 5.02.00.00 - Software Developer's Guide (archived)** [16]
- **Sitara SDK 4.01 - Software Developer's Guide (archived)** [17]
- **Sitara SDK 4.00 - Software Developer's Guide (archived)** [18]

Release Notes

- **Sitara SDK Release Notes**
- **WLAN/BT Release Notes & Downloads**

Graphics

- **Graphics SDK Getting Started Guide**
  - **Graphics SDK Quick installation and user guide**
- **Graphics SDK 4.06.00.01 Release Notes**
- **SGX Debugging Tips and FAQ**
- **Qt Tips**

AM335x PSP Documentation

- **AM335x PSP 04.06.00.07 Features and Performance Guide**
- **AM335x PSP 04.06.00.07 Release Notes**
- **AM335x PSP 04.06.00.06 Features and Performance Guide**
- **AM335x PSP 04.06.00.06 Release Notes**
- **AM335x PSP 04.06.00.03 Features and Performance Guide**
- **AM335x PSP 04.06.00.03 Release Notes**
- **AM335x PSP User's Guide**

AM35x/AM37x PSP Documentation

- **AM35x-AM37-PSP 04.02.00.07 Feature Performance Guide**
- **AM35x-AM37-PSP 04.02.00.07 Release Notes**
- **AM35x-AM37-PSP 04.02.00.07 User's Guide**

AM180X PSP Documentation

- **AM180x-PSP 03.21.00.04 Feature Performance Guide**
- **AM180x-PSP 03.21.00.04 Release Notes**
- **AM180x-PSP 03.21.00.04 User's Guide**

QT Documentation

- **QT Reference Documentation** [19]

GPLv3 Disclaimer

There are GPLv3 licensed software components contained within the Sitara Linux SDK on both the target and the host. The software manifest (software_manifest.htm) for the Siatara Linux SDK is located in the docs/ directory of the installed SDK. All GPLv3 components for both target and host are contained in the SDK directory.

These GPLv3 components are provided for development purposes only and may be removed for production solutions.

How to Identify the GPLv3 components

To idenitfy the GPLv3 components installed on the target file system, **run the gplv3-notice script** located on the target file system located here: ***/etc/init.d/gplv3-notice***

The gplv3-notice script will list all Sitara Linux SDK built shipped installed packages. If you installed addtional GPLv3 components this script may not identify them until the next target reboot.

How to Remove Target side GPLv3 Components

The gplv3-notice script also outputs how to remove the packages. To remove individual packages from the target development file system, use the opkg remove command which is: ***opkg remove <package>***

Software Updates

We are continually improving the quality and content of the software we provide in the EVM. Updates to the SDK may be obtained at **Software Updates** [20] as they become available.

Technical Support

- **E2E Support Forums** [21] - an active community of TIers and other customer like you already using the AM37x EVM. You may find your question has already been answer with a quick Search of the Forums. If not, a quick post will likely provide you the answers you need. Support@ti.com - a support email list you may submit your question to.
- **support@ti.com** [22]

Want to Contribute?

We are always striving to improve this Sitara Linux SDK. Please let us know if you have ideas or suggestions. The sections below will give you ideas on how to best contribute to the SDK and PSP Linux kernel.

SDK Contributions

All Sitara Linux SDK contributions can be sent to the sdk_feedback@list.ti.com [23] mailing list. This covers submitting bug fixes, new features, or any other feedback to components provided with the Sitara Linux SDK including, but not limited to:

- u-boot
- target file system
- Host Tools
- Scripts
- Example Applications
- Documentation

Some general guidelines to help us with your feedback are:

- **Documentation**
  - Provide the URL of the document being discussed
  - Describe the section in question
  - If you have suggestions on the change requested please include them
- **Source Code/Scripts/Makefiles**
  - Provide the location of the source code being discussed within the SDK
  - If possible provide a patch as this is easier to determine the changes being proposed and helps us to make sure you get credit for your work
- **Tools**
  - Provide the version of the tool
  - If possible give screen captures or step-by-step instructions for reproducing any issues

Following the above guidelines will help to streamline the communication, but we would like to get your feedback no matter what.

PSP Linux Kernel Contributions

For information on how to contribute to the PSP Linux kernel please see the **Contributing to the Linux PSP** page.

References

[1] http://www.ti.com/lsds/ti/dsp/arm.page
[2] http://processors.wiki.ti.com/index.php/AM335x_General_Purpose_EVM_HW_User_Guide
[3] http://www.ti.com
[4] http://beagleboard.org/static/beaglebone/a3/Docs/Hardware/BONE_SRM.pdf
[5] http://www.beagleboard.org
[6] http://beagleboard.org/static/BBxMSRM_latest.pdf
[7] http://www.mistralsolutions.com/assets/downloads/AM37x_EVM.php
[8] http://www.mistralsolutions.com/
[9] http://www.logicpd.com/products/development-kits/zoom-am3517-evm-development-kit#tabs-som-4
[10] http://www.logicpd.com/
[11] http://www.logicpd.com/products/development-kits/zoom-am1808-evm-development-kit#tabs-som-4
[12] http://processors.wiki.ti.com/index.php?title=Sitara_Linux_Software_Developer%E2%80%99s_Guide&oldid=102587
[13] http://processors.wiki.ti.com/index.php?title=Sitara_Linux_Software_Developer%E2%80%99s_Guide&oldid=94632
[14] http://processors.wiki.ti.com/index.php?title=Sitara_Linux_Software_Developer%E2%80%99s_Guide&oldid=88367

[15] http://processors.wiki.ti.com/index.php?title=Sitara_Linux_Software_Developer%E2%80%99s_Guide&oldid=85314

[16] http://processors.wiki.ti.com/index.php?title=Sitara_Linux_Software_Developer%E2%80%99s_Guide&oldid=78069

[17] http://processors.wiki.ti.com/index.php?title=Sitara_Linux_Software_Developer%E2%80%99s_Guide&oldid=62247

[18] http://processors.wiki.ti.com/index.php?title=Sitara_Linux_Software_Developer%E2%80%99s_Guide&oldid=43627

[19] http://doc.qt.nokia.com/4.6/index.html

[20] http://www.ti.com/sitara

[21] http://e2e.ti.com/support/dsp/sitara_arm174_microprocessors/default.aspx

[22] mailto:support@ti.com

[23] mailto:sdk_feedback@list.ti.com

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