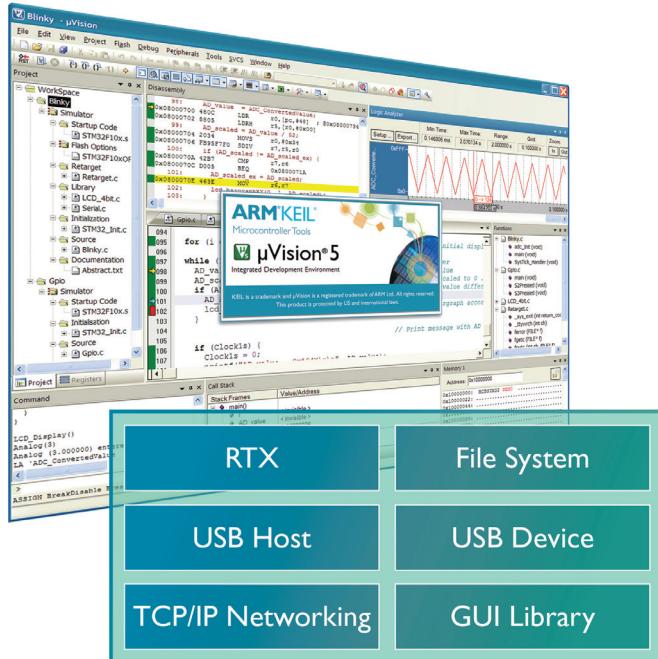


MDK-ARM Version 5

Microcontroller Development Kit

ARM KEIL®
Microcontroller Tools



Keil® MDK (Microcontroller Development Kit) the complete software development environment for ARM processor-based microcontrollers.

- Out-of-the box support for over 1000 ARM® processor-based microcontrollers
- Software Packs with ready-to-use CMSIS and middleware components
- Numerous example projects and templates
- Powerful μVision® IDE, debugger and simulation environment
- On-the-fly application analysis records full instruction trace with the ULINKpro™ Debug Adapter
- Complete Code Coverage information about your program's execution.
- Execution Profiler and Performance Analyzer for analyzing and optimizing your code.
- CMSIS-RTOS RTX real-time operating system with full debugger support.
- Complete and comprehensive middleware including TCP/IP Networking, File Systems and USB.
- Industry-leading ARM C/C++ Compiler with advanced processor-specific optimizations and MicroLib.
- Editor with Code Completion and Dynamic Syntax Checking.

ULINK Debug Adapters

The ULINK™ family of USB Debug Adapters connect a PC's USB port to a target system (via JTAG or SWD), allowing developers to debug and analyze embedded programs executed on target hardware.

The ULINKpro provides unique streaming trace directly to a PC, enabling advanced analysis of your applications such as Execution Profiling and Code Coverage.



Features	ULINK ^{pro}	ULINK2
Run Control debug (ARM Cortex®-M series)	Yes	Yes
Memory + Breakpoint (while running)	Yes	Yes
Data Trace (Cortex-M3 and Cortex-M4)	Yes	Yes
Instruction Trace (Cortex-M3 and Cortex-M4)	Yes	-
Performance		
JTAG Clock speed	50MHz	10MHz
Memory read/write	1MByte/s	25KByte/s
Data Trace streaming (UART mode)	-	1Mbit/s
Data Trace streaming (Manchester mode)	100Mbit/s	-
ETM Trace streaming	800Mbit/s	
Analysis Tools		
Logic Analyzer	Yes	Yes
Performance Analyzer	Yes	-
Execution Profiler	Yes	-
Code Coverage	Yes	-

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ARM®

MDK-Professional Middleware Components

Middleware Pack

Today's microcontroller devices offer a wide range of communication interfaces to meet any embedded design requirement. However, implementing these interfaces presents software developers with real challenges. Middleware components are essential for developers to make efficient use of the device capabilities.

MDK-Professional includes a number of royalty-free, tightly coupled middleware components which enable developers to more easily implement complex communication interfaces in their applications. Middleware components include:

- Graphical User Interface
- USB Host and Device
- TCP/IP Networking Suite
- File System



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All middleware components are specifically designed and optimized for ARM processor-based MCU devices. The libraries are seamlessly integrated with the µVision environment and offer a modular design with well documented APIs.

Graphical User Interface (GUI)

The GUI Library is a fully featured graphics suite that makes it possible to add graphical user interfaces to embedded applications. It supports a large number of displays and includes tools for rapid GUI creation.

- Supports monochrome, grayscale and color LCDs
- Drivers for many displays and display controllers included
- Window Manager for handling multiple windows
- Many widget-like buttons, checkboxes and icons available
- Skinning support for a custom look and feel
- Optimized for speed and size
- Wide range of examples for evaluation boards.



USB Host and Device

MDK-Professional provides USB Host and USB Device support for embedded systems.

The USB Device interface uses standard device driver classes that are available with all modern operating systems. Host driver development is not required. The USB Device interface uses a generic software layer using RTX Kernel features.

TCP/IP Networking Suite

The TCP/IP library is a full networking suite optimized for ARM and Cortex-M processor-based MCUs. It has a small code footprint, and delivers excellent performance.

The suite provides comprehensive support for transmission protocols such as TCP/IP and UDP, as well as application level services and clients including HTTP, Telnet, SMTP, SNMP, and FTP. It provides all the features required for modern networking communication in embedded systems.



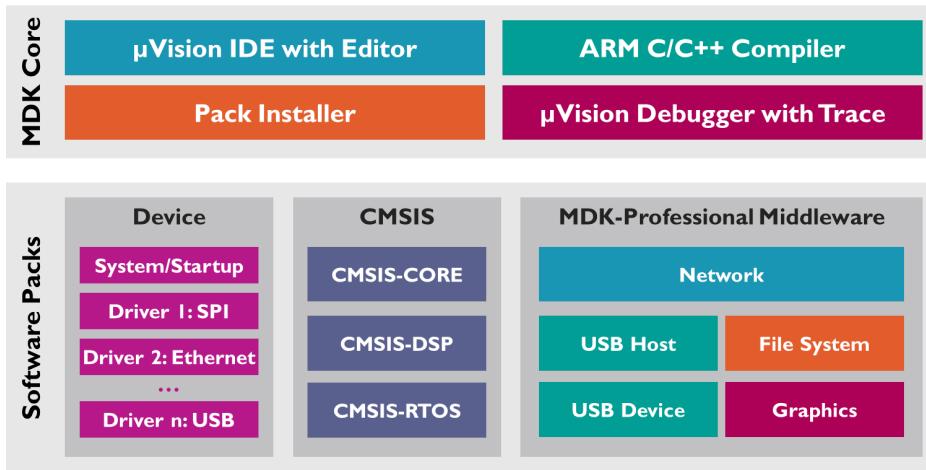
MDK Middleware components allow you to develop robust applications using a wide variety of communication protocols.

File System

The Flash File System allows your embedded applications to create, save, read, and modify files in a wide range of standard storage devices. The Flash File System offers:

- Standard ANSI C File I/O application interface
- NOR and NAND Flash support
- RAM, ROM, and SD/SDHC/MMC/eMMC Memory Cards
- FAT12, FAT16, and FAT32 formats
- SD/MMC card file-caching
- Reentrant and thread-safe operation
- Simultaneous access to multiple storage devices.

MDK-ARM Microcontroller Development Kit



MDK-ARM Core

The MDK-ARM Core contains all the development tools. MDK-ARM is easy to use, yet powerful enough for the most demanding embedded applications.

Software Packs

Software Packs are added on-demand using the Pack Installer. Software Packs contain device support, CMSIS, and middleware components that are essential for efficient software development

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Product Edition	Professional	Standard	Cortex-M	Lite
μVision®				
IDE with Editor, Pack Installer	✓	✓	✓	✓
Debugger	✓	✓	✓	32 KB
ARM Compiler				
C/C++ Compilation Tools	✓	✓	✓	32 KB
Compiler Qualification Kit*	✓			
Extended Compiler Maintenance*	✓			
Device Support				
Cortex®-M	✓	✓	✓	✓
SecurCore® (SC000, SC300)	✓	✓		✓
ARM7™, ARM9™, Cortex®-R4	✓	✓		✓
RTOS and Middleware				
CMSIS-RTOS RTX (with full source)	✓	✓	✓	✓
Middleware Libraries	✓			

*The ARM C/C++ Compiler fulfils the requirements for Safety Critical Applications and is TÜV certified.



www.keil.com/safety



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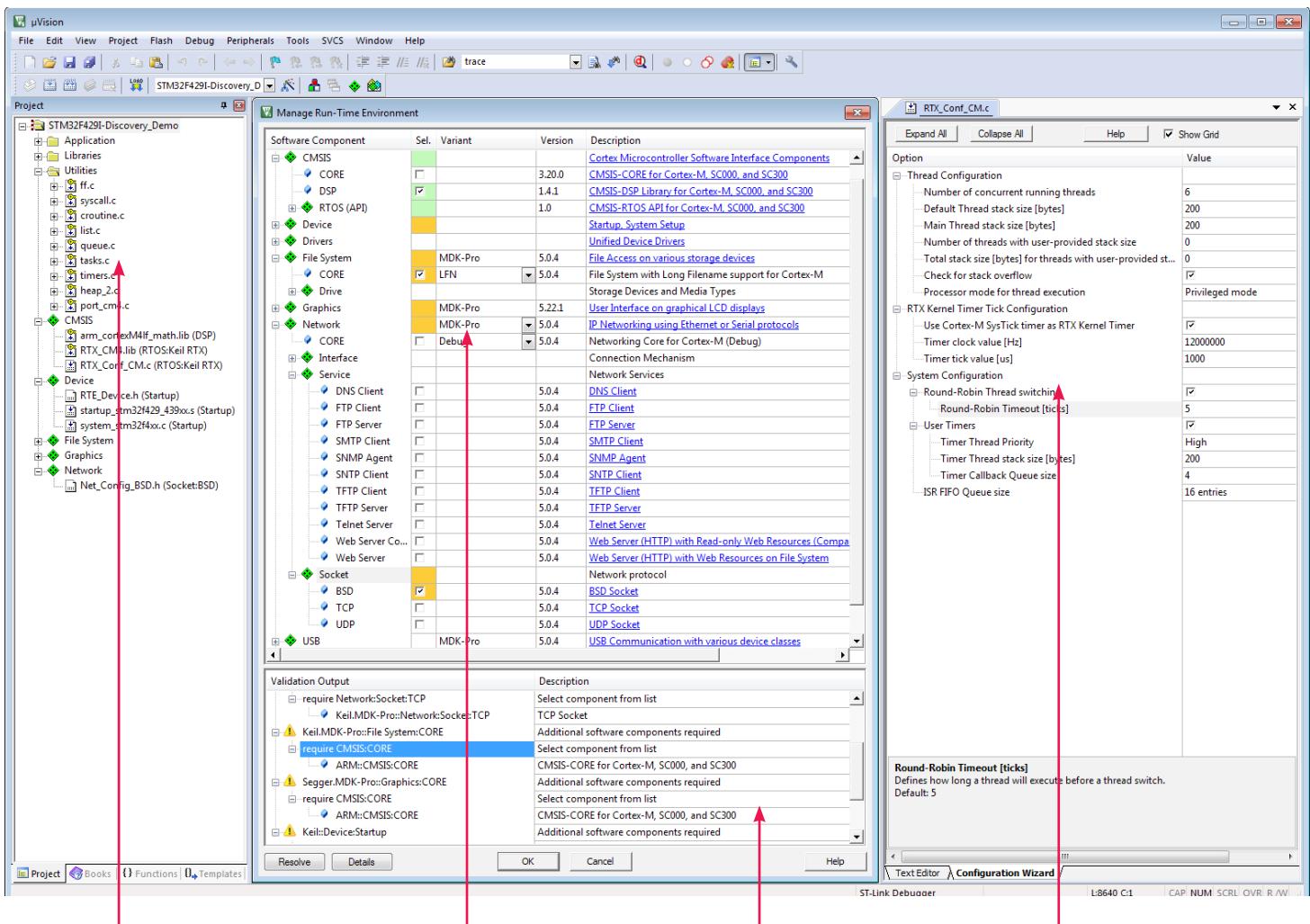
Program examples and detailed technical information are available from your distributor and our web site (www.keil.com).

Create

MDK Core & Software Packs

MDK Version 5 is now split into the MDK Core and Software Packs which makes new device support and middleware updates independent from the toolchain. The MDK Core contains all development tools including IDE, Compiler, and Debugger. Software Packs contain device support, CMSIS, and middleware and are installed and updated on demand using the Pack Installer.

Software Packs contain software components that collect libraries, source modules, configuration and header files, and documentation. Software components are generic and support a wide range of devices and applications. The Software Pack structure allows integration of 3rd-party software components.



The **Project Window** shows application source files of selected software components.

Create the **Run-Time Environment** from Software Packs with pre-built software components.

Device Database®

When you create a project and select a target device from the integrated Device Database µVision pre-configures the development tools for you and shows only options that are relevant for the selected device.

Run-Time Environment

The Run-Time Environment window shows all software components that are compatible with the selected device. Choose from these pre-built software components to accelerate your project development. Just select components you need for your application and µVision creates the required run-time environment for you.

The **Configuration Wizard** simplifies the setup for selected software components.

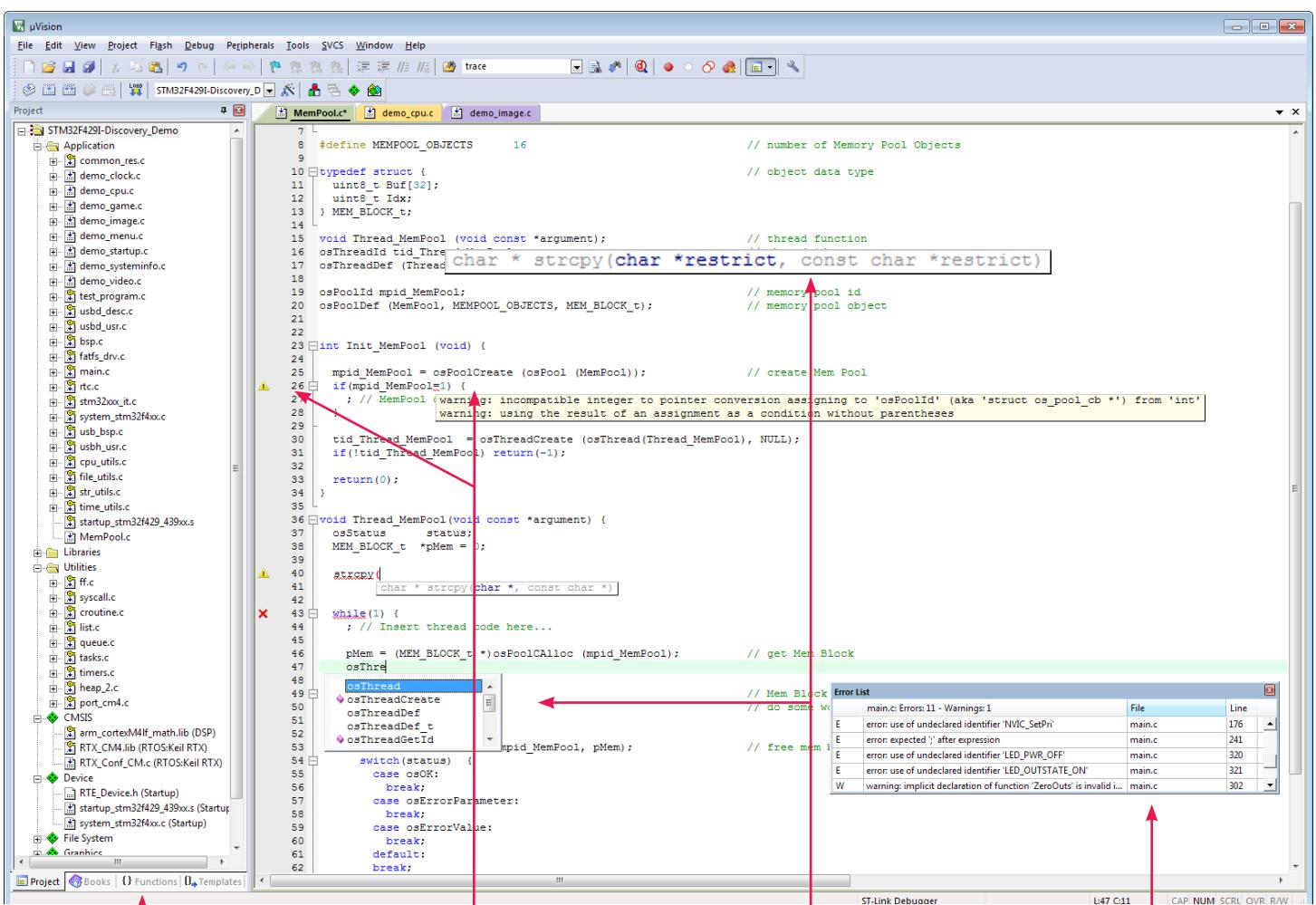
Develop

μVision IDE

μVision integrates a robust editor, project manager and build facility for efficient software development. The flexible window management system supports multiple screens and enables you to drag and drop individual windows anywhere on the visual surface.

Project Targets

Projects support multiple targets that contain the same file groups and Software Components. Project targets ease configuration management and may be used to generate debug and release builds or adaptations for different hardware platforms.



The Functions window gives fast access to functions for each C/C++ source code module.

Dynamic Syntax Checking
shows syntax violations and reduces edit, compile, correction cycles.

While typing code the editor shows **Function Parameters** and the **Code Completion** list.

The **Error List** window summarizes all potential syntax errors and warnings in the current module.

Verify

μVision Debugger

The μVision Debugger provides a single environment in which you may test, verify, and optimize your application code. The debugger includes traditional features like simple and complex breakpoints, watch windows, and execution control and provides full visibility to device peripherals.

RTOS Awareness

The RTX real-time operating system is fully integrated into the debugger making it easy to monitor thread status and kernel activity in the RTX Task and System window. The RTOS Event Viewer displays thread activity and allows identification of thread priority issues in your application.

Integrated Analysis Tools

When using ULINKpro with Streaming Trace, advanced analysis tools show how your program is performing. Code Coverage provides detailed execution statistics for certification testing and validation. The Performance Analyzer with execution profiler helps you to identify and optimize hot-spots in your application code.

Code and Data Trace

Code and data trace can be captured on many Cortex-M series processor-based devices using Streaming Trace with ETM or Trace Buffering with ETB or MTB. Trace can help you to find complex timing problems or sporadic software issues.

The screenshot shows the μVision Debugger interface with several windows open:

- System Viewer:** Shows peripheral registers like SPIB, DR, CRCPR, RXCCR, TXCCR, and I2SCFGR with their current values.
- Performance Analyzer:** Displays a table of function calls and their execution times, highlighting a call to SPI3_TransferByte taking 84.113s.
- Logic Analyzer:** Shows waveforms for TouchPhysX and TouchPhysY signals over time.
- Call Stack + Locals:** Shows the call stack and local variable values for the current function.
- Code View:** Displays the assembly code for the GUIDEMO_ColorBar.c file.
- Watch Windows:** Multiple windows showing variable values for GUIDEMO_Main, Framework_Props, and aColorFrame.

Annotations at the bottom explain the features:

- The System Viewer** provides detailed information for each microcontroller peripheral.
- Execution timing** is summarized in the **Performance Analyzer** and detailed even for code statements.
- The Logic Analyzer** shows variable and signal changes as state diagram or as graphical analogue output.
- Multiple Watch Windows** show selected variables and structures with the option to modify values.