



Powerful Processors – Easy to Use™

HEW Target Server Demo Kit

User's Manual

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1.0 Preface

1.1. Cautions

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2.0 Introduction

The Renesas HEW Target Server (HTS) Demo Kit is a low-cost development environment for evaluating M16C family microcontrollers (MCU) and Renesas software development tools.

The kit comes with a complete software development tool chain for Renesas MCUs, including High-performance Embedded Workshop (HEW), which consists of Integrated Development Environment (IDE), Graphical User Interface (GUI) and Software Debugger; NC30WA C-compiler, assembler and linker; and Flash Development Toolkit (FDT) programming software.

The HTS Demo Kit features on-board in-circuit debugging and programming support, eliminating the need for an external In-Circuit Debug (ICD) unit. All that is required for in-circuit debugging and programming with the HTS Demo Kit is a USB connection to a PC and the included development tool software.

A real-time, source-level debug environment is implemented using the HEW software debug interface in conjunction with the HTS Demo Kit board. The Flash Development Toolkit Programmer software allows in-system programming of the HTS Demo Kit board's M16C/26A Flash MCU.

The HTS Demo Kit board features an M16C/26A group MCU, switch, LEDs, photo sensor, serial external Flash and audio amplifier circuit for user experiments. Example application code and peripheral device initialization code are provided on CD-ROM.

This manual provides the technical details of the HTS Demo Kit hardware. The Quick Start Guide provides details on the software installation and usage of the debugging environment.

3.0 Contents of Product Package

This section describes the contents of the HTS Demo Kit product package. When unpacking your HTS Demo Kit, please check to see that all items listed below are included.

3.1. HTS Demo Kit Item List

Table 3-1 lists the items included in the HTS Demo Kit.

Table 3-1 HTS Demo Kit Item List

Item Name	Quantity	Remarks
HTS Demo Kit board	1	M16C based board with integrated in-circuit debugging and programming support
3' Mini USB Cable	1	Connects HTS Demo Kit board to Host PC
CD-ROM	1	Auto-install program HEW (IDE & debugger) NC30WA (C-compiler, assembler, and linker) Flash Development Toolkit Programming Software USB drivers Manuals Tutorials Sample programs

3.1.1. CD-ROM

The CD-ROM contains the electronic manuals and software necessary for developing programs. Your computer must have a web browser — like Mozilla Firefox, Netscape® Browser or Microsoft® Internet Explorer — to view the help files, and Adobe® Acrobat® Reader® to view the manuals.

Insert the enclosed CD into your computer and the installer should auto-start. The installer program will create the `C:\Workspace` folder on your machine. HEW and Flash Development Toolkit programming software are installed in the `C:\Program Files\Renesas` folder by default.

If the installer program does not start, browse to the CD's root folder and double-click on `HTSdemoKit-installer.exe` to start the installation.

See the QuickStart Guide for more details.

4.0 Limited Guarantee and Support

Renesas Technology America, Inc., warrants the HTS Demo Kit to be free from component or assembly defects for a period of 180 days from the date of purchase. Settlement is limited to repair or replacement of the product only. Renesas Technology America, Inc., does not assume any liability arising out of the application or use of any product, circuit or procedure described herein. No other liability or warranty applies, expressed or implied. Software warranty is limited to replacement of the CD only. While every attempt has been made to ensure accurate documentation, Renesas Technology America, Inc., cannot be held responsible for errors or omissions, and reserves the right to make changes without prior notice.

Support for the HTS Demo Kit is provided via the following channels:

1. HEW Target Server Contest website: <http://www.RenesasInteractive.com\HTScontest2008>
2. Renesas website: <http://www.America.Renesas.com/HTS>
3. Online User Forums , FAQs, technical papers, downloads and more at <http://renesasrulz.com>
4. Renesas Technical Support Center, email at techsupport.rta@renesas.com

General information on Renesas Microcontrollers can be found at the following URL:
<http://www.renesas.com>

5.0 System Connectivity

The following lists the hardware and software products required for using the HTS Demo Kit.

- Host Computer (supplied by user)
- HTS Demo Kit Board
- Mini USB cable
- Software Tools (HEW IDE, NC30 Compiler/Linker, Flash Development Toolkit Programmer)
- Optional Hardware: User supplied Stereo Headphones or amplified speaker(s).

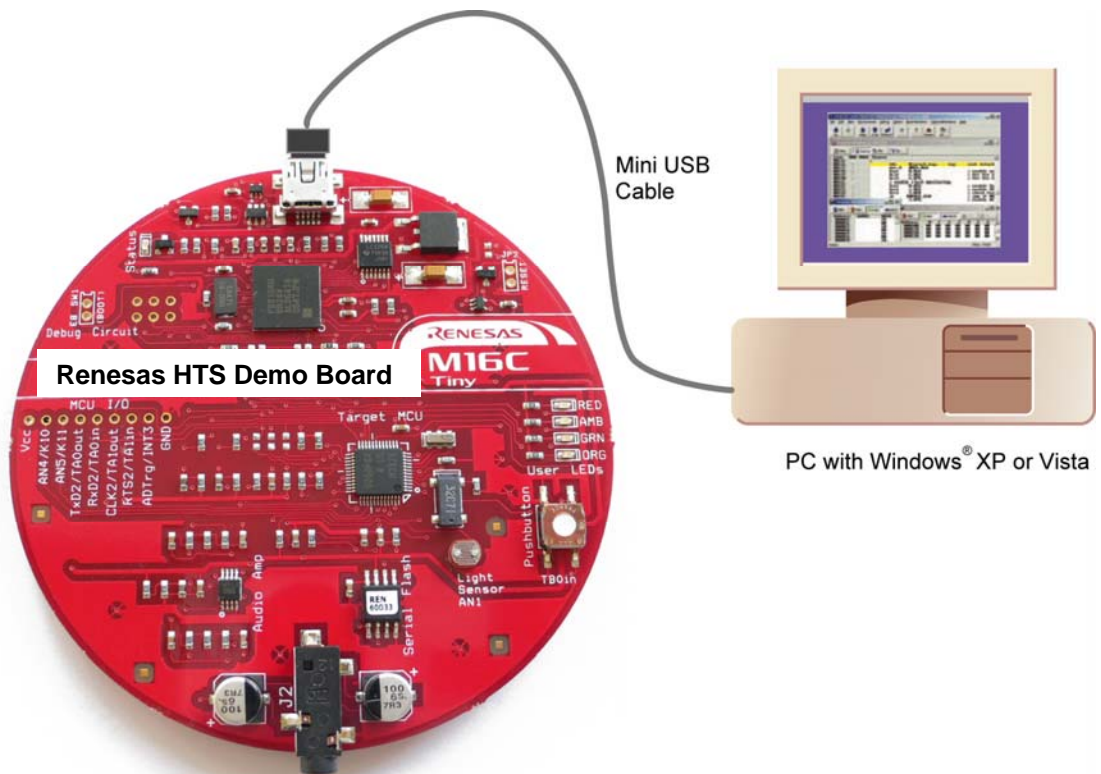


Figure 5-1: HTS Demo Kit Connectivity

5.1. Host Computer Requirements

The minimum requirement to be able to use the software that comes with the HTS Demo Kit is a PC with a USB port and Microsoft Windows XP or Vista.

5.2. HTS Demo Kit Board

The HTS Demo Kit board provides an evaluation and development environment for the M16C family MCUs. See section “6.0 Hardware” for more details.

5.3. Software Development Tools

The installer program installs all the development tools. For details on installation, see the QuickStart Guide. A brief description of all the included tools follows. Please refer to the individual tool manuals for detailed information.

5.3.1. HEW (High-performance Embedded Workshop)

HEW provides a Graphical User Interface (GUI) that integrates the software development tools and includes the C-compiler, assembler, linker, debugger and editor.

5.3.2. NC30WA Evaluation Version C Compiler

The evaluation version of the M3T-NC30WA C-compiler is provided with the same functionality as the commercial version except that link size will be restricted to 64 kBytes after 60 days from when you begin using the compiler. Contact your local sales representative if you wish to purchase a full license.

5.3.3. HEW Debug Interface

HEW communicates with a kernel (i.e. a ROM monitor program) on the target MCU through the ICD. This debug interface provides a highly efficient evaluation environment. Features include:

- Source-level debugging for assembly and C language
- Single-step command (unlimited breakpoints)
- Run command with 6 breakpoints* for the M16C/26A
- RAM monitor function
- C variable “watch” window

**Note: The number of breakpoints will vary depending on the M16C Flash MCU used.*

5.3.4. Flash Development Toolkit

The Flash Development Toolkit Programmer application provides In-System Programming capability for the starter kit or any target board using an M16C family Flash MCU (e.g. R8C, M16C, M32C). Please see the Flash Development Toolkit User Guide for more details.

6.0 Hardware

6.1. HTS Demo Kit Board

Figure 6-1 shows the HTS Demo Kit Board with major components identified.

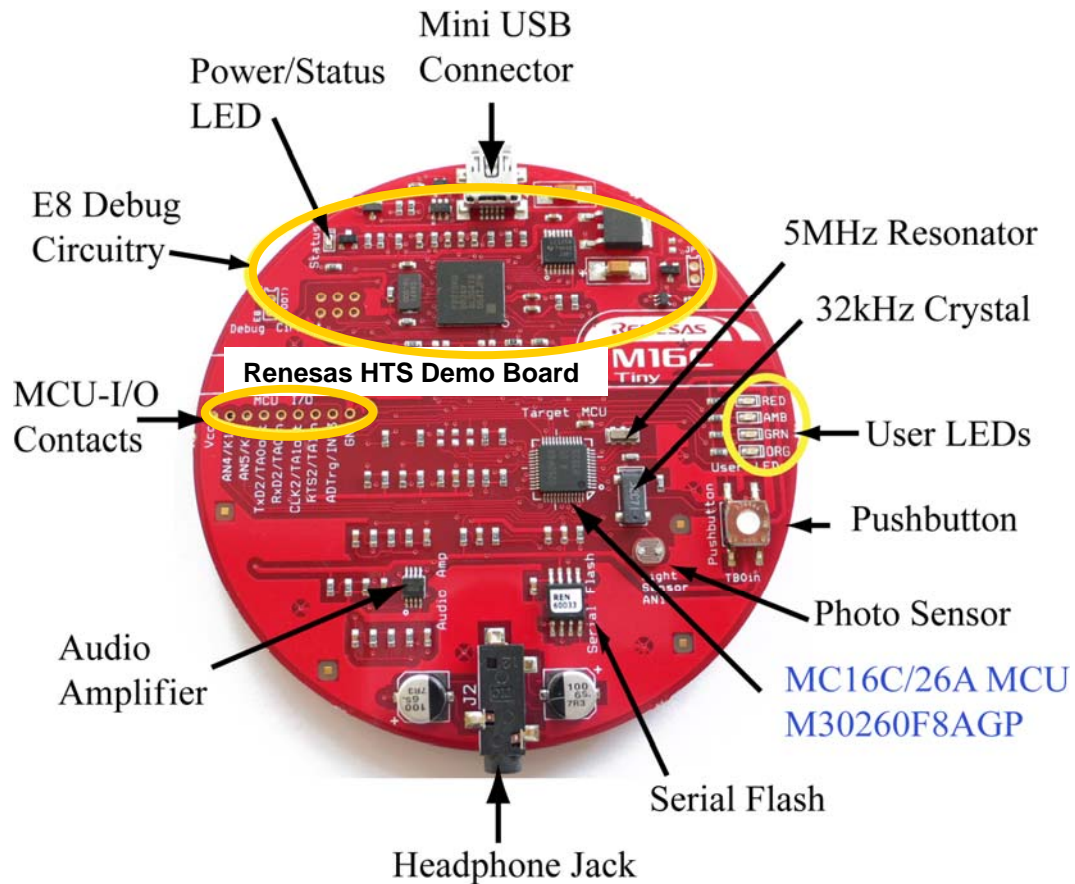


Figure 6-1: HTS Demo Kit Board

6.2. HTS Demo Kit Board Block Diagram

The HTS Demo Kit board incorporates an M30260F8AGP (48-pin QFP) from the M16C/26A group of microcontrollers, designated as U6. Figure 5-2 shows the HTS Demo Kit block diagram.

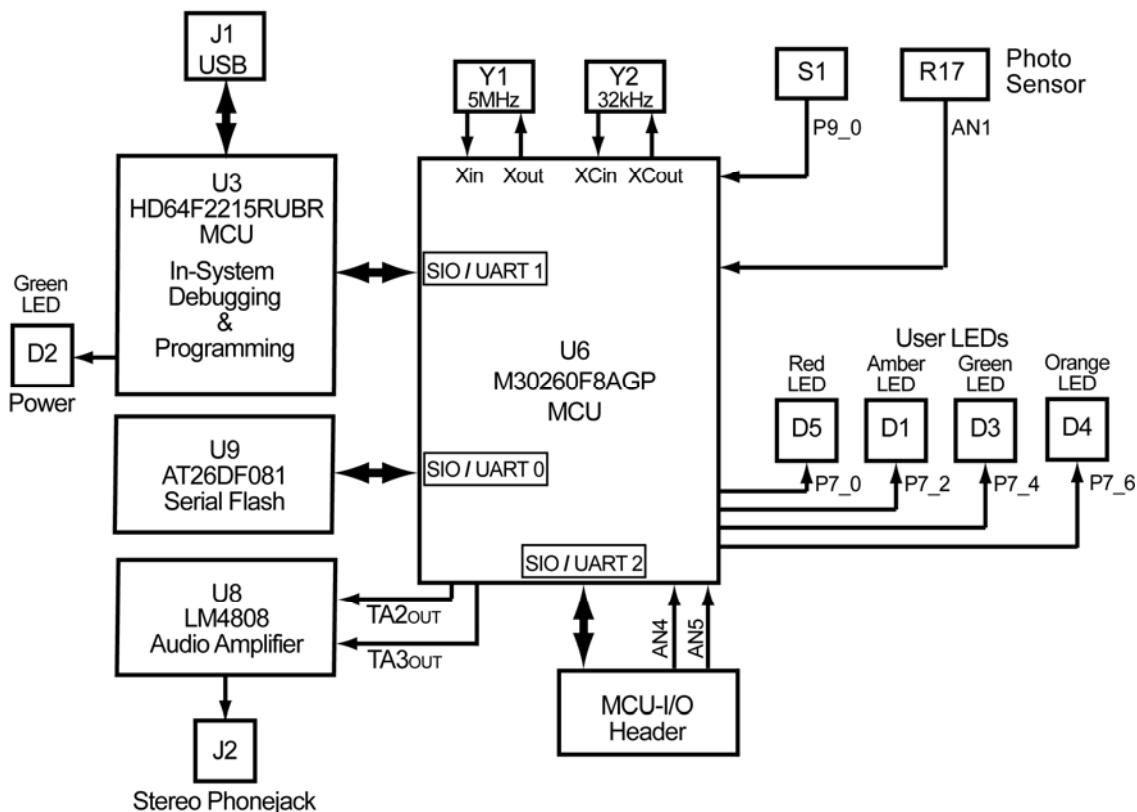


Figure 6-2: HTS Demo Kit Block Diagram

6.3. M16C/26A Group of MCUs

The M16C/26A group of 16-bit single-chip Flash microcontrollers (MCU) is part of the M16C/Tiny family and utilizes an M16C/60 series CPU core. The hardware and software manuals for the M16C/26A group of microcontrollers can be found in the C:\Program Files\Renesas\Hew\Manuals\Renesas\PDFs folder on your PC, from the Start menu (Start > Programs > Renesas > HTS Demo Kit), or from the HEW Manual Navigator after HTS Demo Kit software installation.

7.0 System Operation & Limitations

The HTS Demo Kit board provides sophisticated debugging features at a low cost via its on-board in-circuit debugging and programming circuitry (ICD).

For M16C boards without on-board debugging/programming circuitry, Renesas offers the functionally equivalent, standalone E8 in-circuit debugger/programmer. You can find detailed information on the E8 and its functionality in the E8 Emulator User's Manual, which you can view via the HEW Manual Navigator.

The HTS Demo Kit board does have some limitations when used with the HEW software debugger and the board's ICD circuit. Section 6.1 introduces the kernel (ROM monitor) program and its purpose. The limitations when this kernel is running with the user program are listed in Table 7-1.

Table 7-1: System Limitations when Debugging

Item	Please Refer To
User Limitations	7.2 Pin and Peripheral Limitations
	7.3 Memory Map
	7.4 Register Operation Limitations
	7.5 Limitations on Interrupts – Vectors that Reside in the Hardware Vector Table
Debugger Limitations	7.6 Stop or Wait Mode Limitations The kernel cannot be run in STOP or WAIT modes. Do not use these modes when debugging your program
	7.7 User Program's Real-Time Capability

7.1. Kernel (ROM Monitor) Introduction

During debug, a small program called a kernel is uploaded to the M16C/26A (M30260F8AGP) MCU. The kernel communicates with HEW through the ICD portion of the HTS Demo Kit board regarding MCU status during user code debugging operations.

There are no special steps required in the user program to make use of the ICD portion. The operation of the kernel is transparent to the user, but there are some limitations. These are discussed from section 7.2 onward.

After starting a HEW debug session, the ICD uploads the kernel to the M16C/26A if it does not already exist (e.g. on a blank device or a device that was programmed with the Flash Development Toolkit Programmer). After downloading the kernel, the M16C/26A is ready to download user code.

Connecting the HTS Demo Kit board without starting HEW will not affect the signal lines connected between the ICD MCU (HD64F2215RUBR) and the M16C/26A; the ICD MCU keeps the signal lines in high-impedance state. The ICD MCU only drives the pins after HEW or the Flash Development Toolkit software attempts to connect.

After completing program debug and verification with HEW, you can create an image of your code in Intel (.hex) or Motorola (.mot) file formats. This image can be programmed into the M16C/26A using the Flash Development Toolkit programming software. This procedure erases the kernel and leaves only the user program.

7.2. Pin and Peripheral Limitations

SIO/UART1 pins are used for communication between the M16C/26A kernel on the HTS Demo Kit board and the board's ICD MCU (HD64F2215RUBR). Do not connect these pins to any other circuit, as SIO/UART1 cannot be used in the user program while using the Debugger.

7.3. Memory Map

The amount and locations of memory used by the kernel on the HTS Demo Kit board's M16C/26A MCU are shown in Figure 7-1.

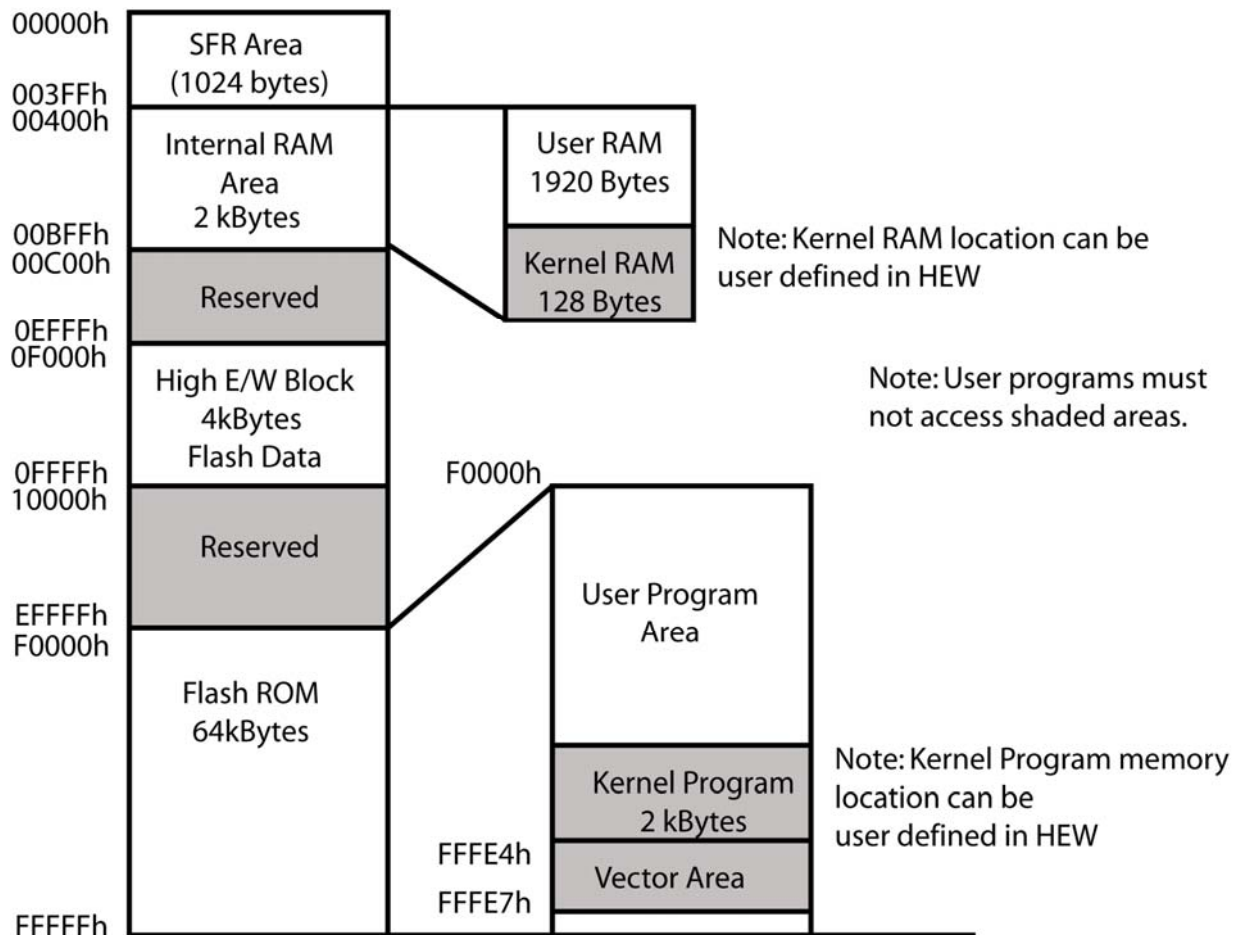


Figure 7-1: M30260F8AGP Memory Map with the Kernel Program

When the High-performance Embedded Workshop is used in 'Download emulator firmware' mode, a dialog box is displayed that allows you to place the kernel anywhere in the available user RAM and Flash ROM. Specify an area that is not used by your application software.

When the High-performance Embedded Workshop is started in 'Does not download emulator firmware' mode, the program area for the emulator kernel cannot be changed, because the previous setting remains effective. When you need to change the program area for the emulator kernel, restart the High-performance Embedded Workshop in 'Download emulator firmware' mode.

7.4. Register Operation Limitations

Table 6-2 lists the limitations on register operation. The registers are inhibited from any modification. If register contents are modified in any way, kernel operation cannot be guaranteed.

Table 7-2: Limitations on Register Operation

Register Name	Restriction
User and Interrupt Stack Pointers	RAM memory range 0B80H – 0BFFH is used by the kernel. Do not set stacks in this area.
UART1 Transmit/Receive Mode Register UART1 Transmit/Receive Control Register 0 UART1 Transmit/Receive Control Register 1	Do not change.
UART1 Interrupt Control Register 0	Do not change.
UART Transmit/Receive Control Register 2	Do not change bits 0 and 2.
UART1 Transmit Buffer Register	Do not write to this register.
UART1 Receive Buffer Register	Do not read this register.
Port 6 and Port 6 DDR	To prevent changes on P6_4 data and direction, use read-modify-write only instructions (BSET, BCLR, AND, OR, etc.).

7.5. Limitations on Interrupts – Vectors that Reside in the Hardware Vector Table

Table 7-3 lists the limitations on hardware interrupt (i.e. fixed) vector addresses.

Table 7-3: Interrupt Vector Addresses

Interrupt Cause	M16C/26A Vector Address	Kit Specification
Undefined	FFFDCh ~ FFFDFh	User available
Overflow	FFFE0h ~ FFFE3h	User available
BRK Instruction	FFFE4h ~ FFFE7h	User inhibited
Address Match	FFFE8h ~ FFFEBh	User inhibited
Single-step	FFFECh ~ FFFEFh	User inhibited
Watchdog Timer	FFFF0h ~ FFFF3h	User available (Note 1)
DBC	FFFF4h ~ FFFF7h	User inhibited
NMI	FFFF8h ~ FFFFBh	User available
RESET	FFFFCh ~ FFFFFh	Reset vector (Note 2)

NOTES:

(1) The Watchdog Timer vector is shared with the oscillation stop and voltage detection interrupts. The vector is available for oscillation stop and voltage detection interrupts, but you must avoid using the vector for watchdog timer interrupts.

(2) The kernel transparently relocates the Reset vector to FFFD8h.

7.6. Stop or Wait Mode Limitations

The kernel cannot be run in STOP or WAIT modes. Do not use these modes when debugging your program.

7.7. User Program's Real-Time Capability (Very Important – Please Read)

Please be aware that while the kernel is in a "STOP" state, the hardware peripherals will continue to run. Therefore, interrupts may not be serviced properly. In addition, the watchdog timer will not be serviced and will likely time out if active.

When RAM Windows or Variable Watch Windows are refreshed, significant target processing time is consumed during which user application code is **not** executed. Use caution in using refreshing windows, as it affects the real-time behavior of your application code.

7.8. Performing Debug Using Symbols

Normally when a new project is created using HEW, debugging symbols are enabled. If you are unable to view the source properly during debug, add the debug option [-g] in HEW before compiling the programs. To enable the [-g] option, perform the following:

- Open the workspace and project in HEW.
- Select 'Renesas M16C Standard Toolchain' from the Options pull-down menu.
- Click on the [Link] tab.
- Select 'Output' under the 'Category' list box.
- Click on the checkbox for [-g] 'Outputs source debug information...'
- Click on the <OK> button

For more information, see the HEW user's manual.

8.0 HTS Demo Kit Board Specifications

8.1. Hardware Specifications

Table 8-1 lists the specifications of the HTS Demo Kit Board.

Table 8-1: HTS Demo Kit Board Specifications

Item	Specification
MCU	M30260F8AGP
Clocks	Main Clock: 5 MHz resonator, PLL, or ring oscillator Sub Clock: 32.768 kHz crystal
Memory	RAM: 2kB (1920 Bytes user available due to kernel) High E/W Data Block: 2kB × 2 Flash ROM: 62kB (63,744 Bytes) [U9]: AT26DF081A 8-Megabit Serial Flash, connected to UART0/SIO
Connectors	[E8_SW1]: 2-pin solder pads to mount Boot Mode header. [MCU_IO]: 9-pin single row solder pads to access selected MCU pins [J1]: Mini USB connector for connection of board to PC [J2]: Stereo Phone jack, connected to board's audio amplifier
Switches	[S1]: Pushbutton (connected to P9_0/TB0in)
LEDs	[D1] (Amber): AMB User LED, connected to P7_2 [D2] (Green): Debugger Status/Power [D3] (Green): GRN User LED, connected to P7_4 [D4] (Orange): ORG User LED, connected to P7_6 [D5] (Red): RED User LED, connected to P7_0
Photo Sensor	[R17]: Connected to AN1 analog input
Audio Amplifier	[U8]: LM4808 Stereo Amplifier, connected to PWM Timer outputs TA2out and TA3out

8.2. HTS Demo Kit Status LED

The green Status LED (D2) indicates operating status of the HTS Demo Kit board. The board's HD64F2215RUBRHP MCU that controls the In-Circuit Debugging and Programming functionality of the board also controls the LED. The LED is on when the board is connected to a USB port and receives power.

8.3. Power Supply Requirements

The HTS Demo Kit Board is powered by the USB bus. It will draw about 50mA with no LEDs on.

8.4. Power-Up Behavior

The audio example tutorial code is pre-programmed into the Renesas M16C/26A microcontroller. If connected to a computer's USB port, without having installed the required Renesas software tools and drivers, the board's RED and AMB user LED's will flash in an alternating pattern. The green Status LED and the GRN and ORG user LEDs will be on.

The RED and AMB LED's blinking frequency will vary with the light intensity measured by the board's photo sensor.

8.5. Operating Environment

Table 8-2 lists the environmental conditions for using and storing the HTS Demo Kit board. Store the board in a conductive bag inside the original factory packaging.

Table 8-2: Operating and Storage Environments

Environmental Condition	Ambient Temperature	Ambient Humidity
Operating	0 to 55°C (No corrosive gas allowed)	30 to 80% (non-condensing)
Storage	-30 to 75°C (No corrosive gas allowed)	30 to 80% (non-condensing)

Appendix A. Expansion Headers

The M30260F8AGP MCU on the HTS Demo Kit target board is housed in a 48-pin QFP package. Pin 1 of the package is identified by the number '1' on the board's top silkscreen. The MCU_I/O solder pads, located below the "Renesas HTS Demo Board" sticker, provide access to some of the MCU's pins. You can use MCU_I/O as test points to check MCU signals or, by mounting your own header, to connect your own external circuitry. The silkscreen identifying the connectors is at the top of the HTS Demo Kit board. The following table shows the mapping of MCU_I/O solder pads to MCU pins and signal names.

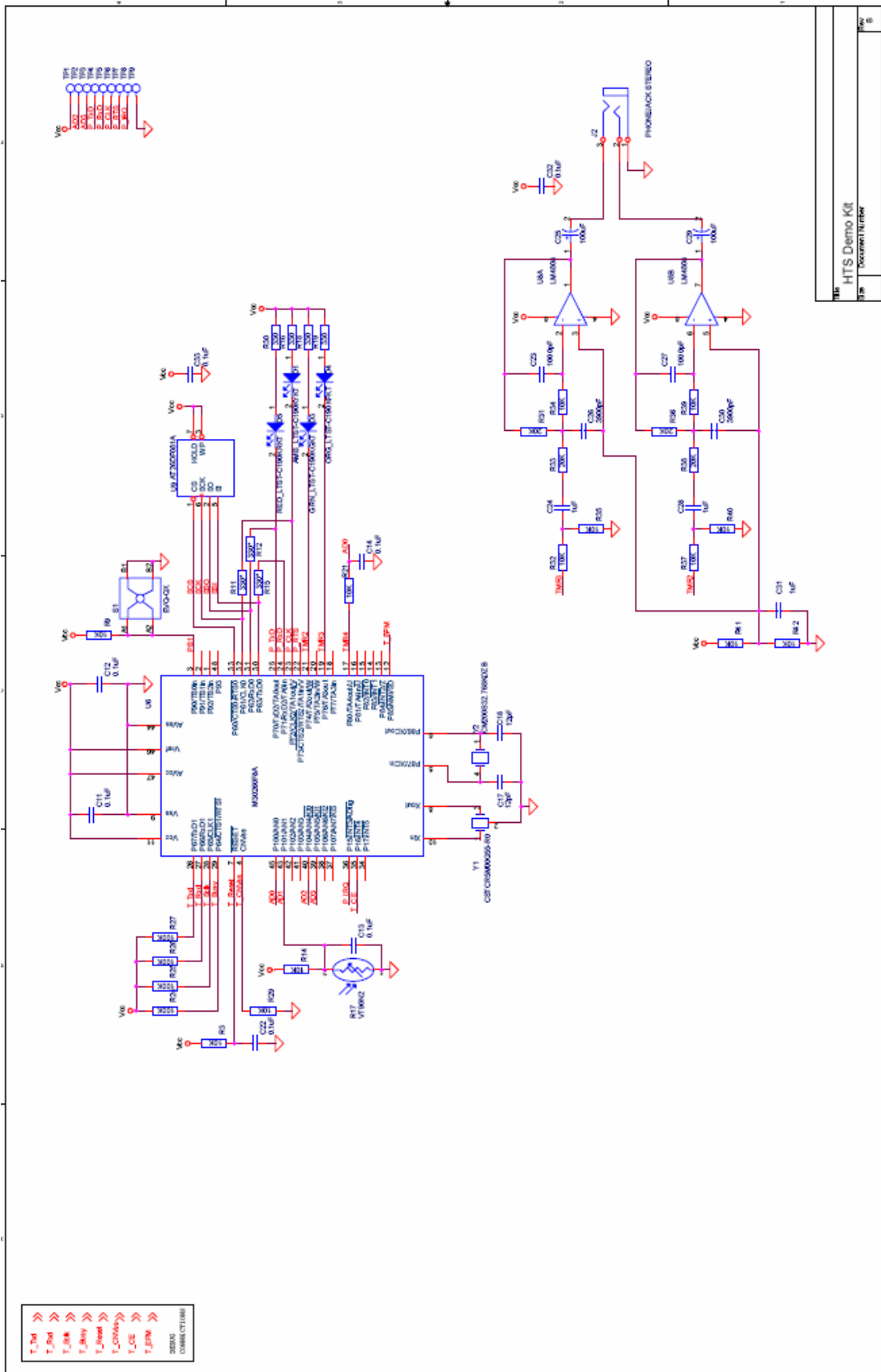
MCU_I/O Pin	48 QFP MCU Pin	MCU Function
Vcc	11,46,47	V_{CC} , V_{REF} , AV_{CC}
AN4	40	$P10_4/AN_4/KI_0$
AN5	39	$P10_5/AN_5/KI_1$
TxD2	25	$P7_0/TxD_2/TA0_{OUT}$
RxD2	24	$P7_1/RxD_2/TA0_{IN}$
CLK2	23	$P7_2/CLK_2/TA1_{OUT}/V$
RTS2	22	$P7_3/CTS_2/RTS_2/TA1_{IN}/\bar{V}$
ADTrg	36	$P1_5/INT_3/AD_{TRG}/IDV$
GND	9,44	V_{SS}/AV_{SS}

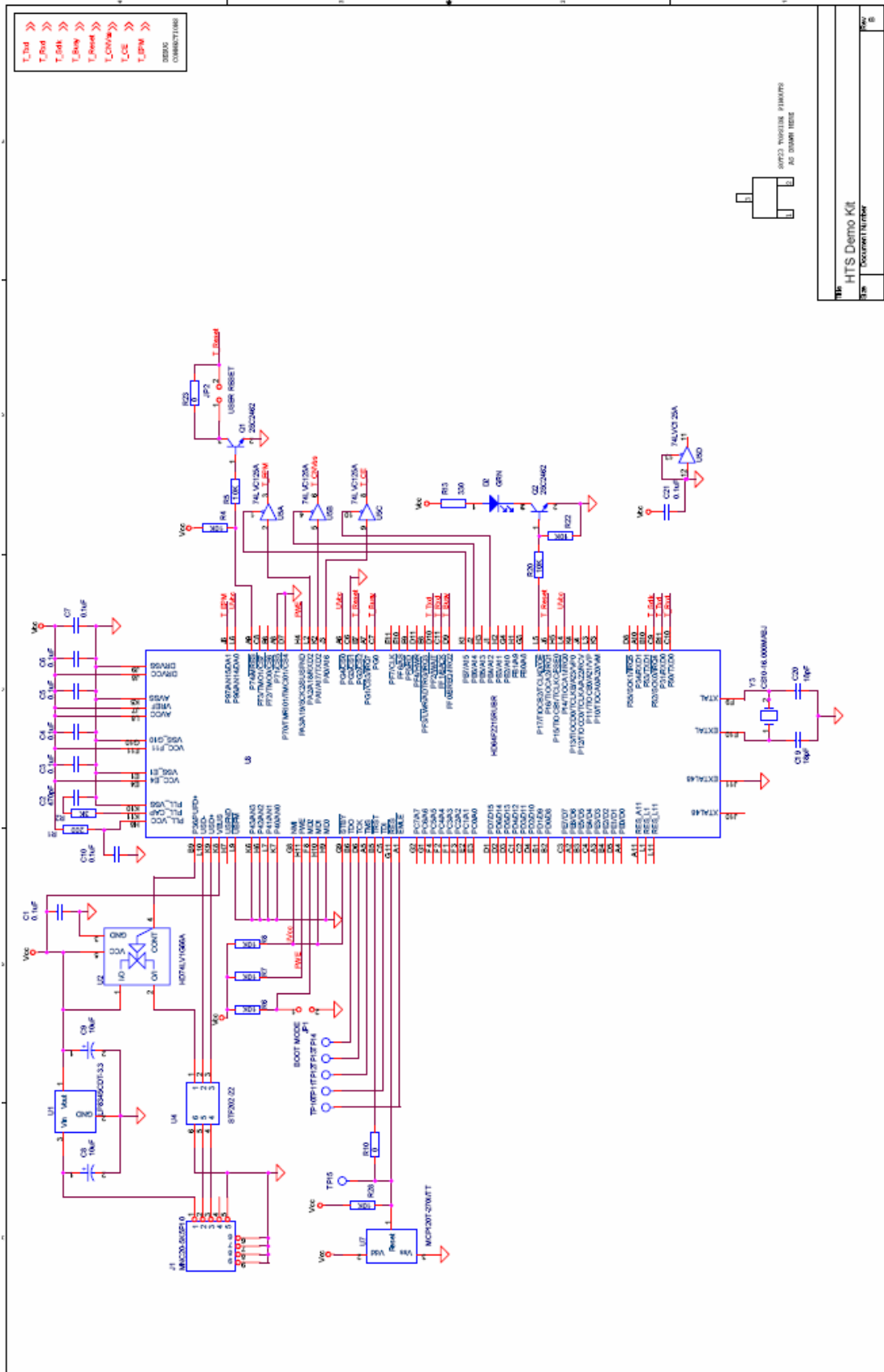
Appendix B. Board Schematic & BOM

The circuit board schematic and Bill-Of-Materials (BOM) are available as separate PDF documents. They can be viewed via Start > Programs > Renesas > HTS Demo Kit, or by browsing to the folder C:\Program Files\Renesas\Hew\HTS Demo Kit\Docs and opening the files:

HTSdemoKit_RevB.pdf

HTSdemoKit_BOM_RevB.pdf





Appendix C. HTS Demo Kit Printed Circuit Board

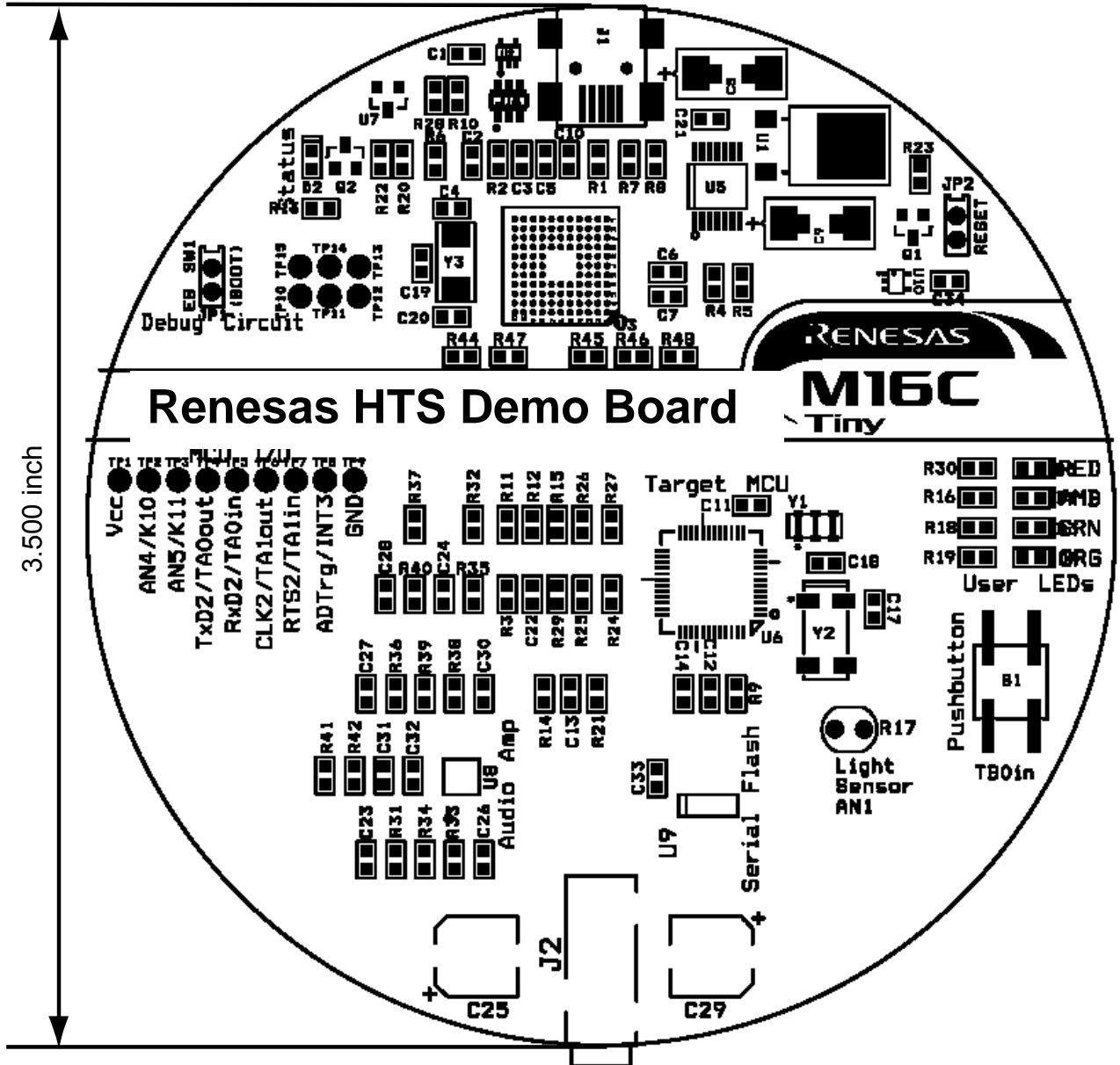


Figure E-1: PCB Top View

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