Evaluation Board Manual

IDTP95020-EVAL

Features

- Reference design layout for easy system integration
- Low-cost 6-layer PCB with 1 oz. copper traces
- Fully assembled with test points and stand-offs
- User-friendly switches (jumper-free)
- Single input operation with mini-USB
- USB to I²C hardware converter for PC connectivity
- EEPROM to store and load start-up script
- Software tool for full register and settings control
- Optional DC power adapter input for high power applications
- LED status indicators for most inputs and outputs
- Thermal vias below package for improved heat dissipation

Evaluation Kit Contents

- Evaluation board
- 3.7V Li+ battery
- USB type A to mini-USB type B cable
- AC to DC power adapter
- 2pcs 3.5mm male to male stereo cable
- 4Ω portable speaker
- IDTP95020-EVAL evaluation board manual
- IDTP95020 product datasheet
- CD containing:
  - IDTP95020 control software tool
  - Reference layout Gerber Files
  - Reference layout Cadence Allegro board files
  - Electronic copy of IDTP95020 product datasheet
  - Electronic copy of IDTP95020-EVAL manual

Description

The IDTP95020 evaluation board serves to demonstrate the features and performance of the IDTP95020 Audio, Power Management and Control integrated circuit. The intuitive top-level layout and control switches simplify the user experience to emphasize the impressive level of integration and abundance of useful features that this device offers.

The device can be powered and controlled by a single mini-USB input. If more input power is required, a DC input from wall adapter can be connected.

The external EEPROM memory chip is pre-programmed with a basic start-up script that is automatically loaded when power is applied. The device can be reprogrammed to suit the needs of your specific application using the IDTP92020 software tool.

The core layout is a 6-layer reference that can be copied and integrated into a larger system design.

Evaluation Board

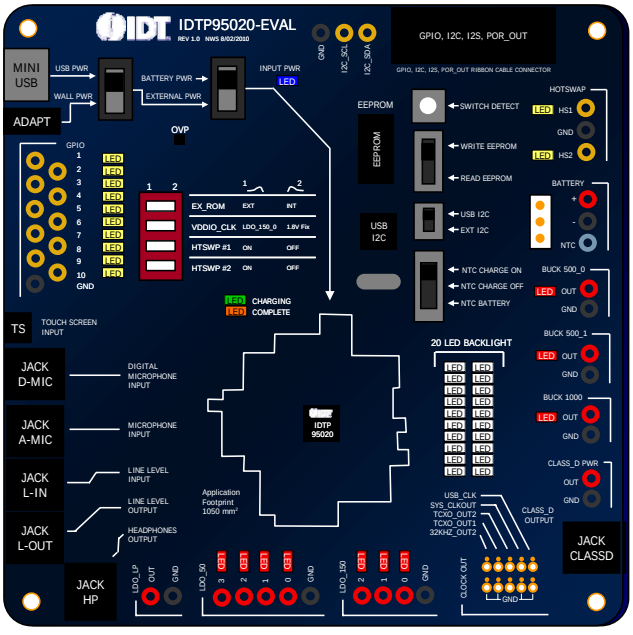

Figure 1. Evaluation Board Illustration Top Layer

© 2019 Renesas Electronics Corporation

Table of Contents

Revision History

October 22, 2010 – Changed R78 and R80 to open.

October 5, 2010 – Updated AC/DC power adapter setting to 4.5V

September 24, 2010 – Updated schematic and BOM for R11, R12, and C77

August 2010 – Initial draft

December 13, 2010 – Add Ordering information.

© 2019 Renesas Electronics Corporation

USAGE GUIDE

This evaluation board is designed to demonstrate the performance and functionality of the IDTP95020 in a lab bench test environment. In most cases, this board can be wired into an existing system for evaluation. For complex or electrically sensitive situations, it is recommended to use the reference layout to integrate this design into your system to eliminate hardware limitations or signal degradation introduced by long leads.

With no inputs, this device can function in its pre-programmed mode of operation using battery power with limited flexibility to change modes using hardware switches. To evaluate the full potential of this device an AC adapter input and PC with USB output is required. Everything you need (except the PC) is included in this evaluation kit.

Quick-Start Guide

Follow these simple steps to power-up and enable the power management features of the IDP95020:

1. Connect the USB cable from PC to the IDTP95020-EVAL board
2. When prompted, install the USB software drivers (first time only)
3. Plug the AC adapter into the wall (120 VAC) and connect the other end (4.5 VDC) into the adapter plug on the IDTP95020-EVAL board.
4. Open the CyrusTool to change register settings and control the device.

Verifying Connectivity

You can verify that the IDTP95020 is properly connected to your computer and able to communicate to the evaluation board by reading the global register setting.

After you open the CyrusTool program, click the 'Read' button on the opening screen. You should see the 'Value' field read 0x55 and there should be no error messages. If this is what you see, then your connection is ready.

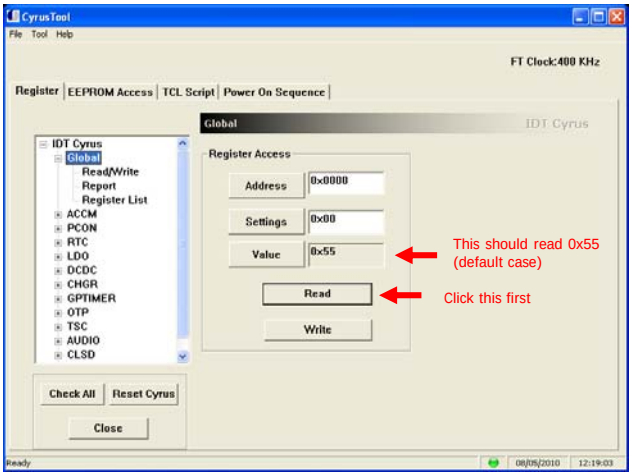

Figure 2. Verifying Connectivity

© 2019 Renesas Electronics Corporation

Factory Settings

The EEPROM on the IDTP95020-EVAL board is pre-programmed with a generic start-up script to facilitate the speedy evaluation of the device. This script will be automatically loaded into the IDTP95020 device registers when power is applied. It will affect which features are enabled and the output voltage settings of each regulator.

The following table shows the default setting:

FEATURE	DEFAULT SETTING
Input current limit	2A
Battery charger	Enabled
Buck_500_0	3.3V
Buck_500_1	3.3V
Buck_1000	3.3V
LDO_50_0	3.3V
LDO_50_1	3.3V
LDO_50_2	3.3V
LDO_50_3	3.3V
LDO_150_0	1.2V
LDO_150_1	3.3V
LDO_150_2	3.3V
Clock & PLL Outputs	Enabled
GPIO 1	Switch detect
GPIO 2	Charger LED1
GPIO 3	Charger LED2
GPIO 4	CHRG_ILIM
GPIO 5	Interrupt output
GPIO 6-10	Off
Analog Microphone Input	Disabled
Digital Microphone Input	Disabled
Line Level Input	Disabled
Line Level Output	Disabled
Headphone Output	Disabled
CLASS_D Output	Disabled
LED Backlight	Disabled
Touchscreen controller	Disabled
ADC Input	Disabled

All of these factory settings can be controlled by changing the register settings of the device while in operation, or by modifying the script file that is loaded into the EEPROM.

Installing the Software Drivers

The first time that you use the IDTP95020-EVAL board, you must install the drivers to communicate with the USB to I²C controller that is located on the evaluation board. The purpose of this controller is to take instructions from the IDTP95020 software tool through the USB connection and convert those instructions to I²C for communication with the IDTP95020 device.

To install the driver, open the IDTP95020-EVAL CD and run the file: **/Software/Drivers/CDM 2.04.06.exe**. This will install the drivers automatically. After the installation process is complete, you may connect the evaluation board to the computer with the USB cable and use the software tool.

Running a TCL Script File

TCL script files are used to modify the embedded microcontroller and register settings while the IDTP95020 is in operation. The IDTP95020-EVAL CD contains some useful scripts to demonstrate some features and functionality of the IDTP95020 device. To run a script file, do the following:

1. Connect the USB cable, open the CyrusTool and navigate to the 'TCL Script' tab
2. Click the 'Add Scripts' button to choose the script file
3. Click the 'Run' button to load the script

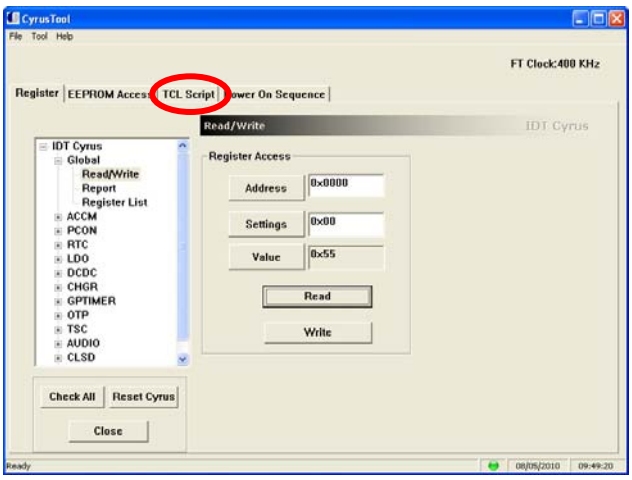

Figure 3. TCL Script Tab

© 2019 Renesas Electronics Corporation

Add or Remove Scripts

Click the 'Add Scripts' button to choose which scripts you want to run. If you add more than one script they will run in sequence.

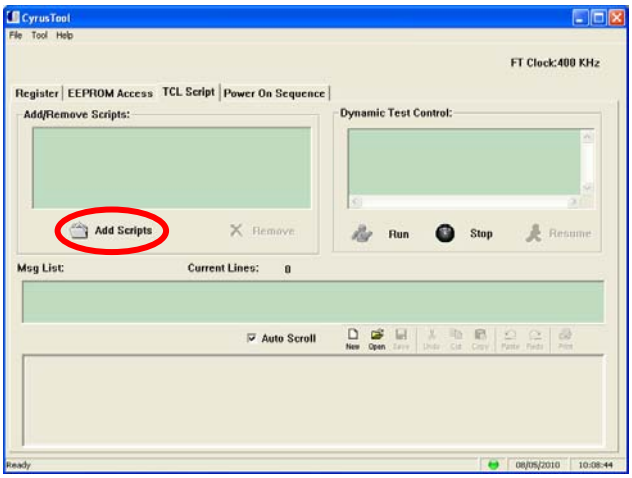

Figure 4. TCL Script Add Script Button

Running The Script

Once you have added the script(s) that you want to run, click the 'Run' button to run the script. You will see the script scrolling in the box at the bottom, and the results of the script in real-time on the box to the right.

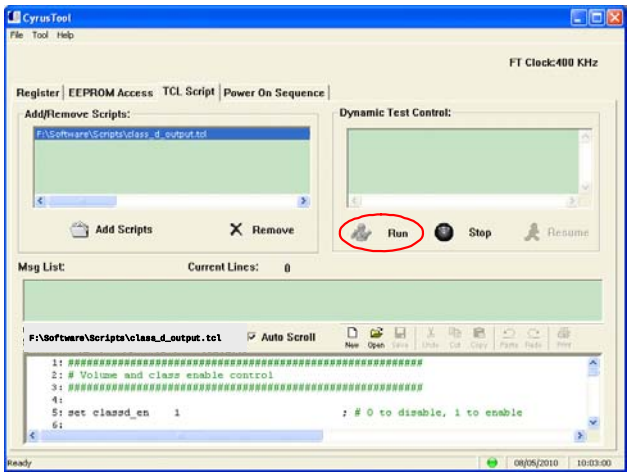

Figure 5. After Adding a TCL Script File

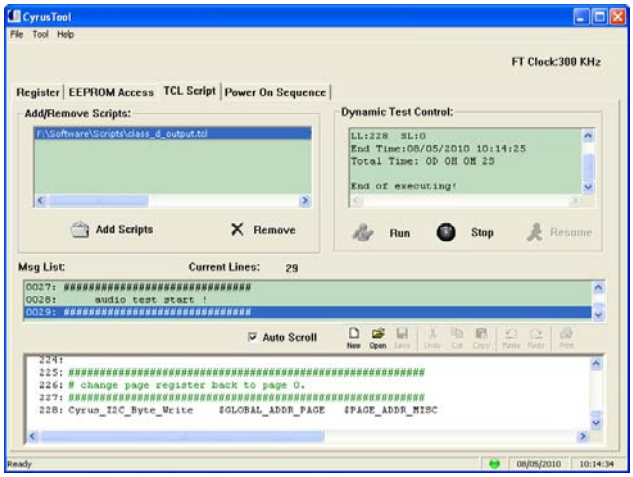

Figure 6. Running the TCL Script File

© 2019 Renesas Electronics Corporation

Creating a Custom Power-On Sequence

The IDTP95020 has the flexibility to run any custom power-on sequence to suit the special needs of your system. The IDTP95020-EVAL CD includes the CyrusTool which will enable you to generate a custom power-on sequence script file using a graphical user interface (GUI).

To create your own power-on sequence, follow these steps:

1. Connect the USB cable, open the CyrusTool and navigate to the 'Power On Sequence' tab
2. Add the elements for the voltages and power-on time delays that you desire
3. Save the script file to a known location
4. Follow-steps to "Programming the EEPROM Script" as described in this document

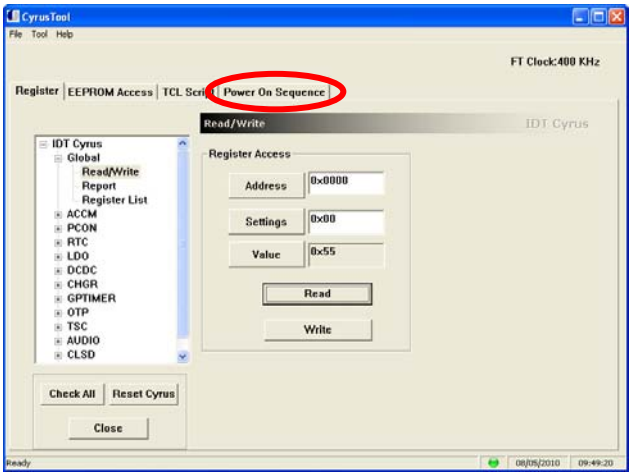

Figure 7. Power On Sequence Tab

Setting the Voltages and Time Delays

Each regulator's output in a power on sequence must have a specified output voltage and time delay. The graph on the left side depicts each regulator as a red circle. The Y-axis is the output voltage level and the X-axis is the time delay from when power is first applied to the device.

Choose the first regulator that you want to use from the 'Element:' drop down menu on the left and press the 'Add' button. This will place the red circle on the graph. You can then drag the circle to the output voltage and time delay that is desired. Alternatively, you can choose the specific voltage and time delay from the drop down menu and input field on the right side. In this case, when the 'Add' button is pressed, the red circle will be placed as specified and not require any further modification.

Follow this process until you have configured all of the regulators that you want to turn on when power is first applied to the device.

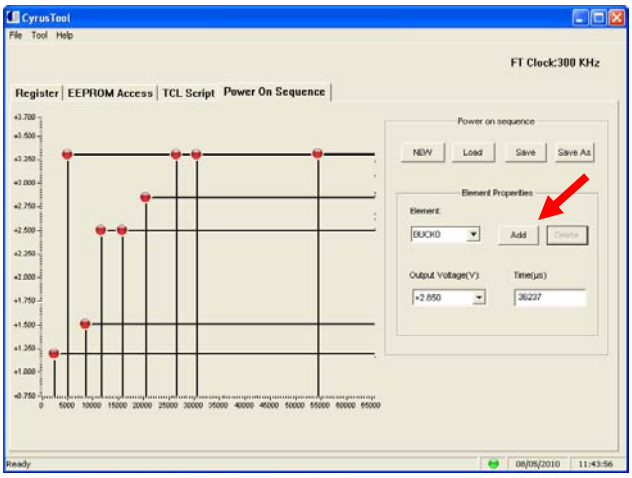

Figure 8. Power On Sequence Showing 9 Regulators

Saving and Loading Your Power On Sequence Script

After you have configured the power on sequence as desired, press the 'Save As' button and choose the location to save your new script file.

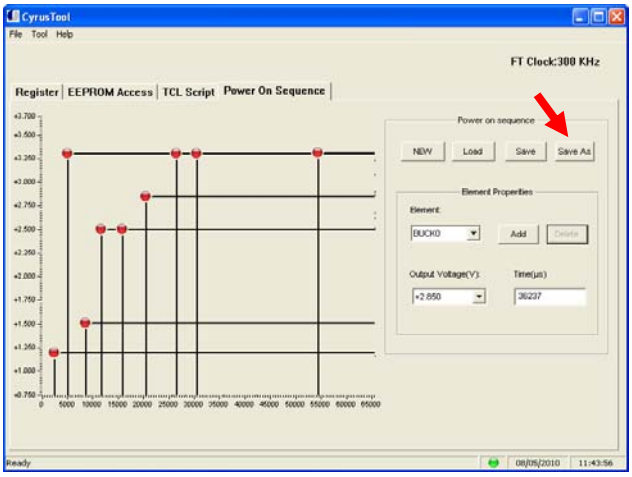

Figure 9. Saving the Power On Sequence

Now that you have created and saved your own custom power on sequence script, you must load it into the EEPROM so that the IDTP95020 device can access it when power is applied. To do this, follow the instructions in the "Programming the EEPROM Script" section.

© 2019 Renesas Electronics Corporation

Programming the EEPROM Script

The IDTP95020-EVAL is equipped with an EEPROM chip that stores an initial start-up script that the IDTP95020 device loads at start-up. In a typical application, the IDTP95020 is configured by the application processor or can be mask programmed with a custom script inside the IDTP95020 device itself.

It is possible to change the default programming of the EEPROM using the IDTP95020 software tool. To load a new script, follow these steps:

1. Change the EEPROM hardware switch to the 'Write EEPROM' position
2. Connect the USB cable, open the CyrusTool and navigate to the 'EEPROM Access' tab
3. Choose the input script file location
4. Choose where to store the binary output file
5. Generate by the binary output file
6. Download the binary file to the EEPROM
7. Return the EEPROM hardware switch back to the 'Read EEPROM' position
8. Reset power to the evaluation board

Change Hardware Switch to 'Write EEPROM'

There is a hardware EEPROM switch on the evaluation board to select whether the EEPROM should be wired to the USB-I²C chip, or to the IDTP95020 device. In the 'Write EEPROM' position, the EEPROM device can be accessed by an external control, such as the computer. In the 'Read EEPROM' position, the IDTP95020 device can load the start-up script during start-up or reset. Thus, you must manually slide the hardware switch to the 'Write EEPROM' position when attempting to modify the script file that is loaded in the EEPROM.

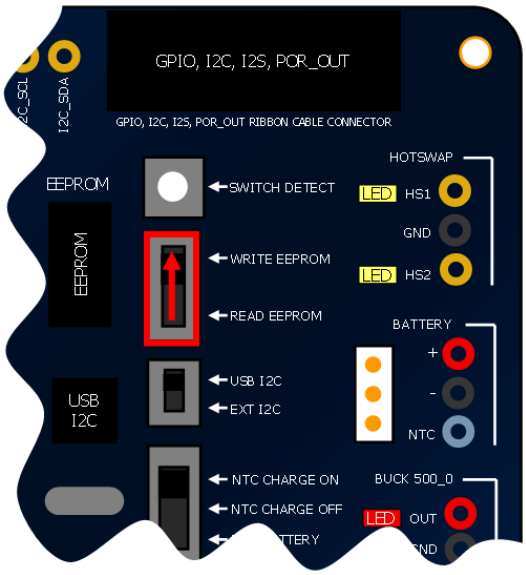

Figure 10. EEPROM Hardware Switch to Write Mode

Navigate to the EEPROM Access Tab

Open the 'CyrusTool.exe' file located on the CD in the **/Software** directory and navigate to the 'EEPROM Access' tab. Make sure that the USB cable is connected from the computer to the evaluation board. If it is not connected, the program will alert "Device Not Found" and ask if you if want to enter simulation mode. If this happens, choose 'No', connect the cable, and reopen the program.

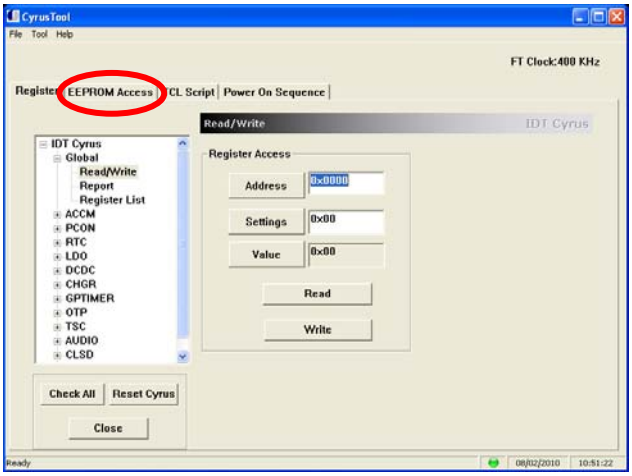

Figure 11. Navigating to the EEPROM Access Tab

© 2019 Renesas Electronics Corporation

Generating the Binary File

The EEPROM chip requires a binary (.BIN) file be loaded. The IDTP95020 software tool has a function to convert a .TXT script file into a .BIN file.

Put the location of the .TXT script file in the 'Input File:' field. Then, put the location where you want the .BIN file to be stored after it is generated in the 'Output File:' field. Finally, click the 'Generate' button to create the .BIN file.

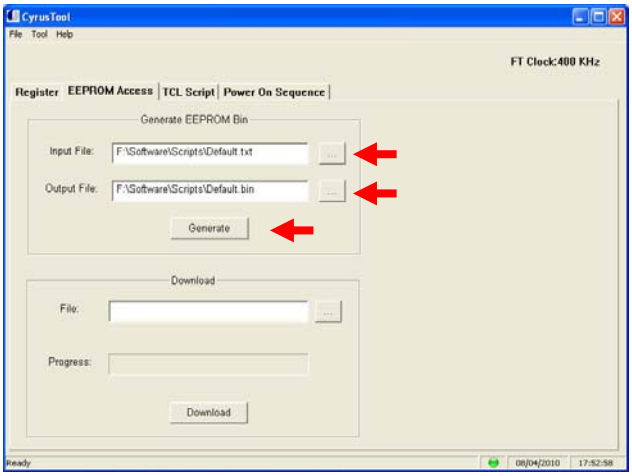

Figure 12. Generating the Binary File

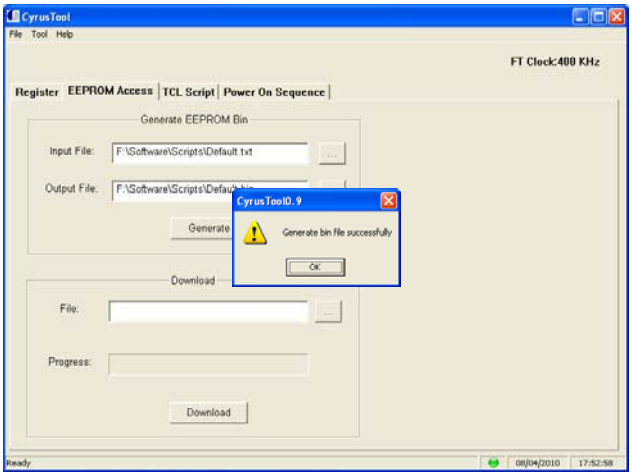

Figure 13. Success Message for Generating the Binary File

Downloading the Binary File to EEPROM

After creating the binary file, the software tool will assume that you want to load the binary file that you just created, and thus, automatically put the path of your new binary file in the 'File:' field. If you want to use a different binary file, you can choose a new path here.

Click the 'Download' button to download the file to the EEPROM.

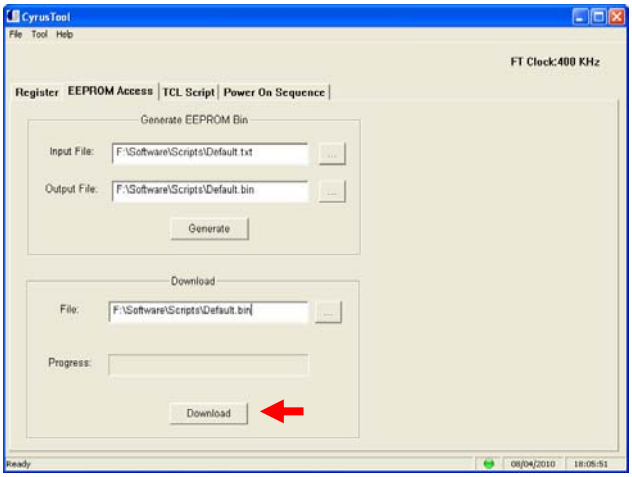

Figure 14. Downloading the Binary File to the EEPROM

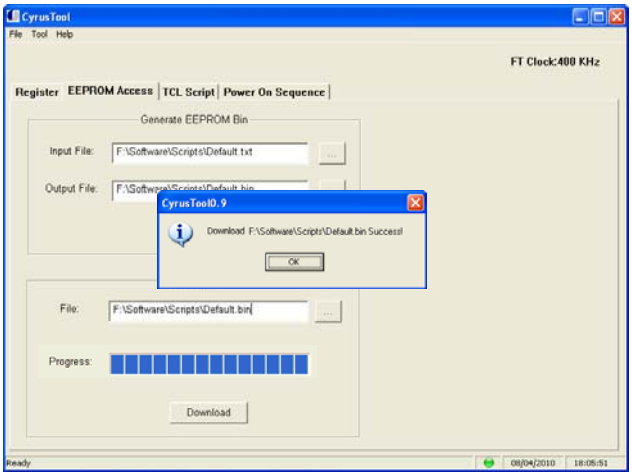

Figure 15. Success Downloading the Binary File to the EEPROM

© 2019 Renesas Electronics Corporation

Change Hardware Switch to 'Read EEPROM'

There is a hardware EEPROM switch on the evaluation board to select whether the EEPROM should be wired to the USB-I²C chip, or to the IDTP95020 device. In the 'Write EEPROM' position, the EEPROM device can be accessed by an external control, such as the computer. In the 'Read EEPROM' position, the IDTP95020 device can load the start-up script during start-up or reset. Thus, you must manually slide the hardware switch back to the 'Read EEPROM' position so that the IDTP95020 device can load the new script at startup, as shown in Figure 16.

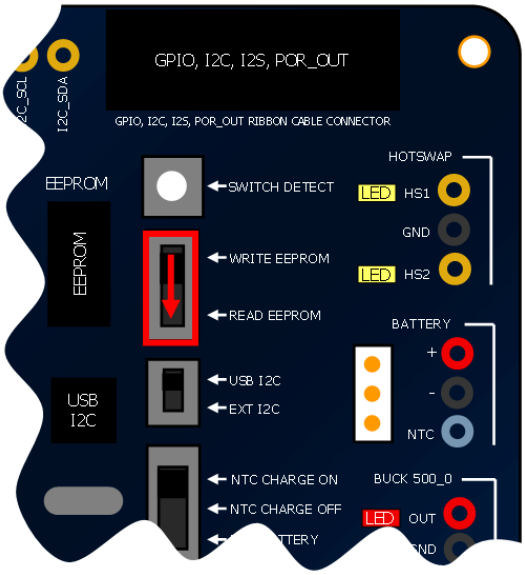

Figure 16. EEPROM Hardware Switch to Read Mode

Changing Register Settings

While there are several demonstration scripts included on the IDTP95020-EVAL CD in the **/Software/Scripts** directory, it is often useful to change the individual register bits to further evaluate the capabilities of the IDTP95020 device. To change the register bits, follow these steps:

1. Connect the USB cable and open the CyrusTool. By default, you will be in the 'Register' tab.
2. Select the 'Register List' of the block you want to modify.
3. Click the 'Detail' button of the register you want to modify.
4. Click the 'Read' button.
5. Change the bits as desired.
6. Click the 'Write' button.

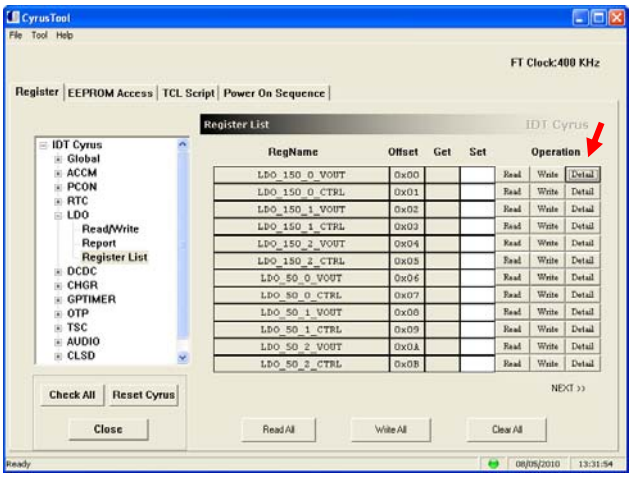

Figure 17. Click the 'Detail' Button to Modify the Register Setting

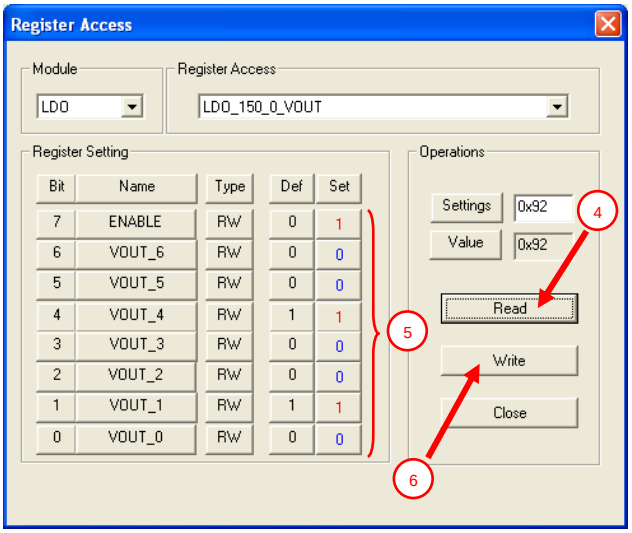

Figure 18. Changing the Register Setting

After pressing the 'Write' button, your changes will take effect immediately. To confirm that your changes were applied, you can press the 'Read' button again. This will read the register setting which should be the same as what you just wrote.

For advanced users, you may also change the register settings by entering the hexadecimal code into the 'Settings' field. Furthermore, you can do this from the CyrusTool home screen by entering the register address and hexadecimal code. This will eliminate the need to navigate to the different registers.

© 2019 Renesas Electronics Corporation

Manually Enabling and Setting the DC DC Regulators

The five switching regulators and seven LDO regulators have each have a global and local disable bit. Both bits must be high for each regulator to be enabled.

For example, to enable the LDO_150_0 regulator check the Global >> LDO_GLOBAL_EN register and make sure that the LDO_150_0_EN bit is high (global enable).

Then, navigate to LDO >> LDO_150_0_VOUT and make sure that the ENABLE bit is high (local enable).

At this same register, you can modify the other 7 bits to change the output voltage. For example, for 2.5V output setting enter 1000110b for bits [6:0].

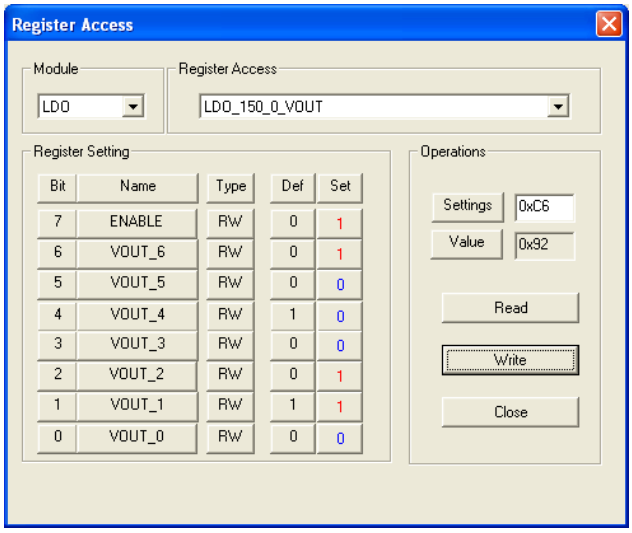

Figure 19. LDO_150_0 2.5V Output Voltage Setting

Follow similar steps to enable and change the other buck switching regulators Buck_500_0, Buck_500_1, and Buck_1000. For example, modify the registers:

- Global >> DCDC_GLOBAL_EN
- DCDC >> BUCK_500_0_VOUT

External I²C Input Switch

This evaluation board provides three options to control the IDTP95020 I²C: using your computer's USB cable, an external ribbon cable, or test points.

To control the device from an external source connected to the ribbon cable or I²C test points, slide the switch down to the 'EXT I2C' setting as shown in Figure 20.

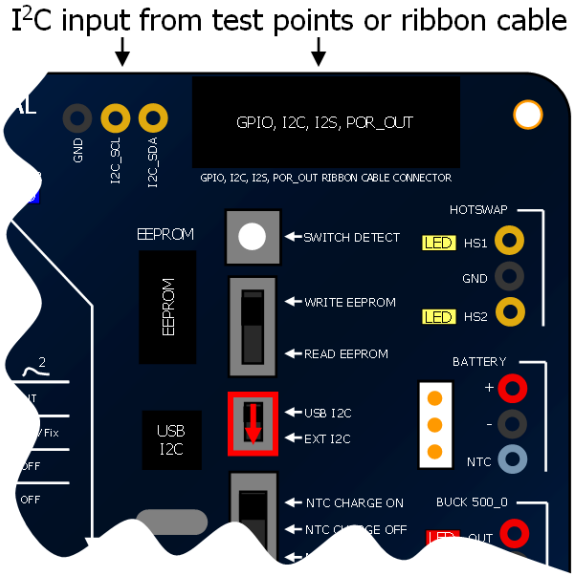

Figure 20. External I²C Input Switch

© 2019 Renesas Electronics Corporation

Setting the Battery NTC Mode

There are three modes for the battery temperature sensing (NTC) function.

NTC Charge ON

This mode will pull the CHRG_NTC pin low thus disabling the temperature protection feature. In other words, the battery charger will not be affected by temperature.

NTC Charge OFF

This mode will pull the CHRG_NTC to CHRG_VNTC, thus mimicking a too-cold condition. This will shut down the battery charger.

NTC Battery

This mode will use the actual battery NTC that is connected to the NTC test point or NTC pin of the three-pin battery connector.

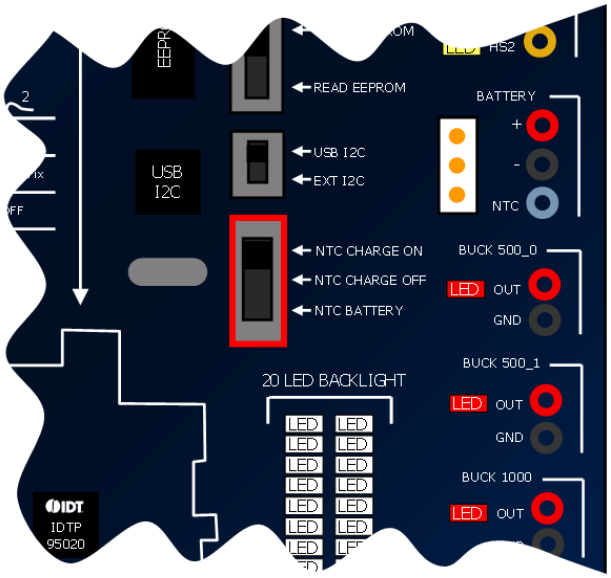

Figure 21. Battery NTC Mode

Four-Switch Dip Switch

The four-switch dip switch offers control for the EX_ROM pin, the VDDIO_CLK pin, and both hotswap channels.

EX_ROM Switch

This switch will pull the EX_ROM pin high or low. The purpose is to choose whether the IDTP95020 device should read the start-up script from its internal ROM, or retrieve it from the external EEPROM chip. The default setting for demonstration purposes is to put the switch in position #1, 'EXT'.

VDDIO_CLK Switch

This switch will choose where to connect the VDDIO_CLK pin on the IDTP95020 device. Position #1 will use the LDO_150_0 output as the supply. Position #2 will use the fixed 1.8V supply.

HOTSWP #1 and HOTSWP #2 Switches

These switches toggle the HSCTRL1 and HSCTRL2 pins on the IDTP95020 device. Position #1 will enable the hotswap output. Position #2 will disable it. The supply comes from Buck_500_0. The outputs are accessible by the yellow hotswap test points on the right-top of the evaluation board.

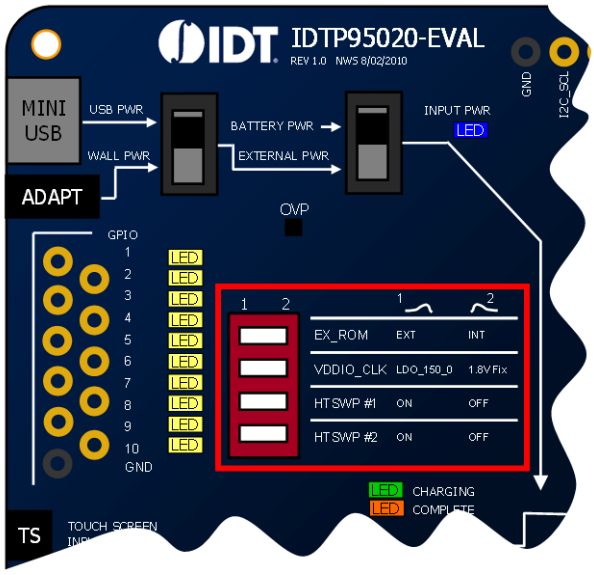

Figure 22. Four-Switch Dip Switch

© 2019 Renesas Electronics Corporation

Clock Outputs

The IDTP95020 evaluation board has probe points for the various clock signal outputs. Each of the five outputs have a small probe-hole and larger through-hole for each signal and ground. The small holes are used for probe points, while the larger holes can be populated by a standard 10-pin ribbon connector.

Refer to the IDTP95020 datasheet for information to enable and disable the various clock outputs.

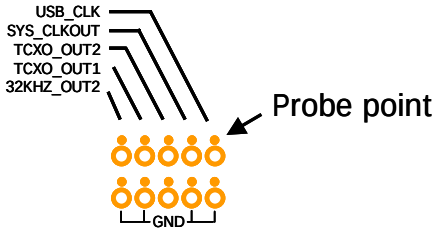

Figure 23. Clock Outputs

AC to DC Wall Adapter

The AC to DC wall adapter has a dial to select the output voltage. It is recommended to use the 4.5V setting for most applications. At very high loads, it is possible that the poor load regulation of the adapter may cause the voltage at the board to be <4.2V, which will cause the IDTP95020 device to shutdown. In this case, it's possible to use the 6V setting, but the on-board over-voltage protection (OVP) chip may interfere.

If you need more input power, you may disconnect the plug head from the AC adapter cable and use the two pins to connect your power supply leads.

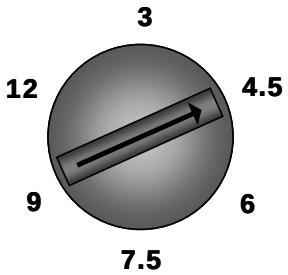

Figure 24. Recommended 4.5V Wall Adapter Setting

LED Backlight

The IDTP95020 is equipped with 20 white LEDs to simulate an LED backlight application. To demonstrate this feature, follow these steps:

1. Connect USB and Adapter to the board
2. Run the **led_backlight_50.bin** script

You will need to connect your USB cable so you can run the led backlight script. The adapter is recommended to provide the maximum power for the highest brightness setting.

Run the script located on the IDTP95020 CD at location **/Software/Scripts/led_backlight_50.bin**. This script will program the LED backlight to 50% brightness. For 100% brightness, use **/Software/Scripts/led_backlight_100.bin.** Refer to the "Running a TCL Script File" section for more details.

Manually Enabling and Setting the LED Backlight

As described in the "Changing Register Settings" section, you can manually enable and program the LED Backlight by changing the register settings. First, make sure the Global Enable bit is high, then change the local enable bit high. This will enable the LED backlight. To modify the brightness, change the DCDC >> LED_BOOST_IOUT register setting.

© 2019 Renesas Electronics Corporation

Audio Output (CLASS_D)

The IDTP95020 will take an audio input from your PC (or other audio source) and output that sound through the CLASS_D audio amplifier to drive the 4Ω notebook speaker.

To use the CLASS_D audio amplifier, follow these steps:

1. Connect USB and Adapter to the board
2. Connect audio cable from PC to board
3. Connect audio cable from board to speaker
4. Run the **audio_output_gain12.bin** script

You will need to connect your USB cable so you can run the audio script. The adapter is recommended to provide the maximum power for the best audio performance.

Connect the 3.5mm audio cable from your PC's audio output port to the Line Level Input jack on the IDTP95020 evaluation board. Since the purpose of the CLASS_D is to drive the output speaker, you can use any low-power input, such as your portable MP3 player. Then, connect the CLASS_D Output to the speaker using the other 3.5mm audio cable. Refer to Figure 25 for an illustration.

Run the script located on the IDTP95020 CD at location **/Software/Scripts/audio_output_gain12.bin**. Refer to the "Running a TCL Script File" section for more details.

Headphones Output

After following the steps above, you may connect headphones to the headphone jack located on the bottom-left of the board. You will hear the audio output simultaneously with the CLASS_D Output.

Line Level Output

After following the steps above, you may use the Line Level Output as a repeater of your original input signal. It is located on the left-bottom of the board. This is a low-power output that can be connected to a different buffered input.

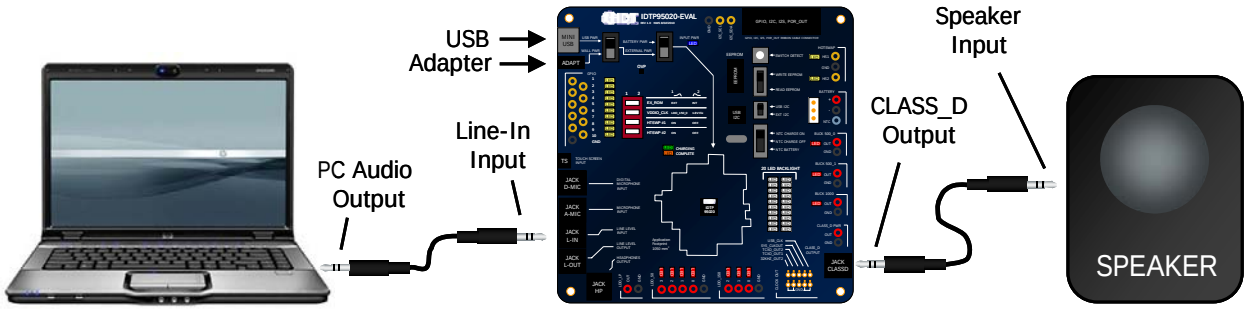

Figure 25. CLASS_D Output Connection

 © 2019 Renesas Electronics Corporation

SCHEMATIC

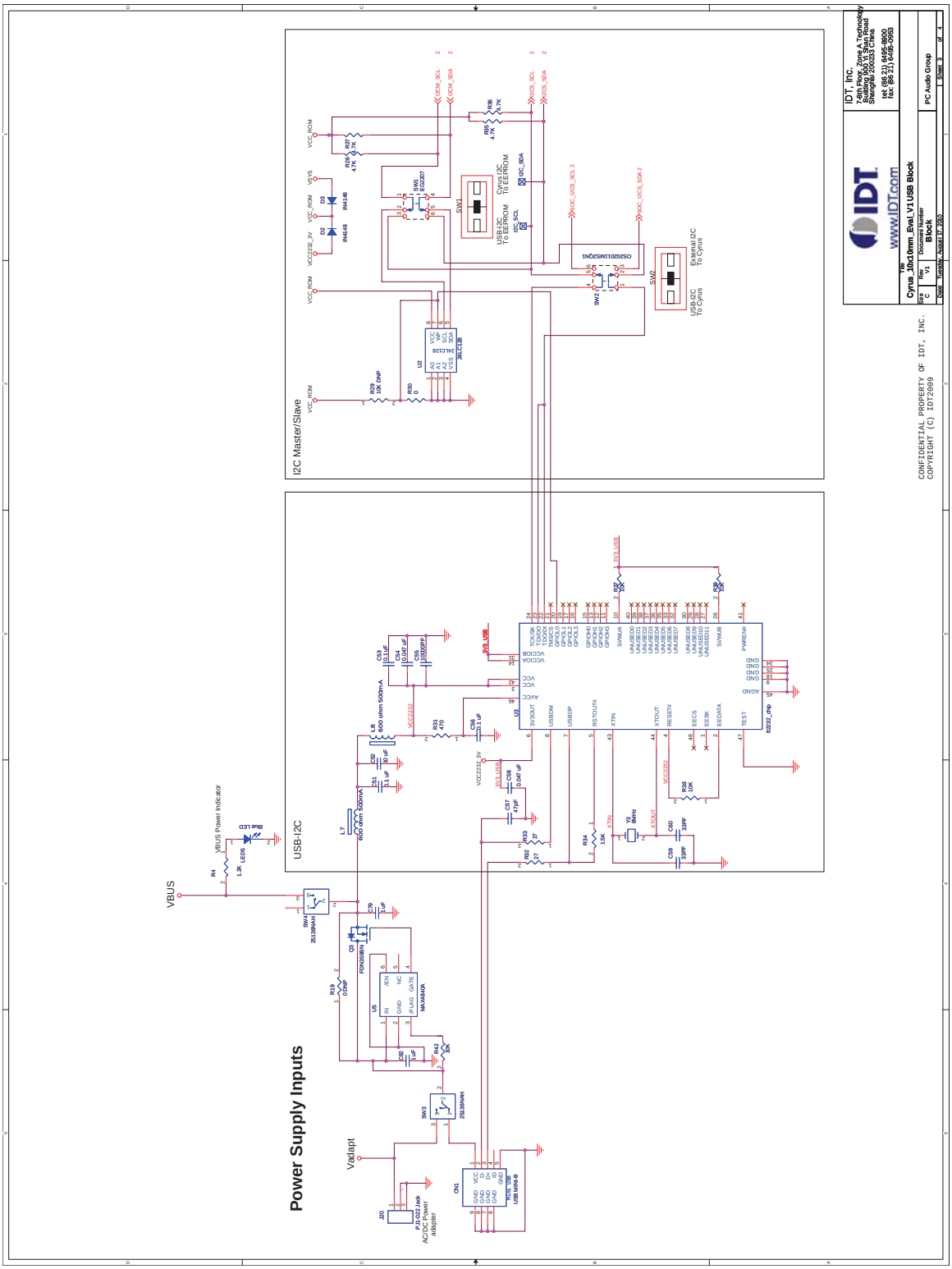

Figure 26. Board Schematic Page 1

 © 2019 Renesas Electronics Corporation

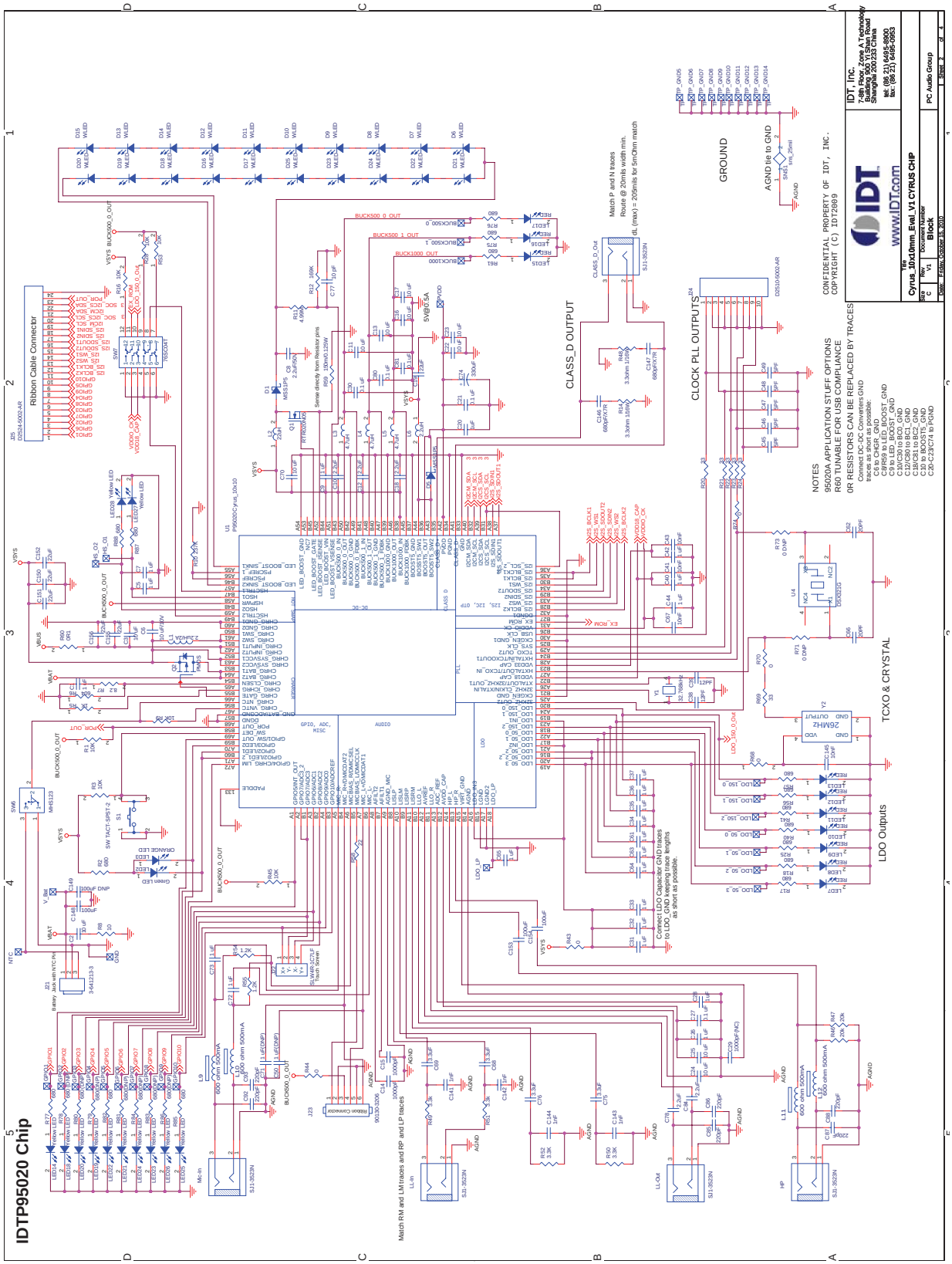

Figure 27. Board Schematic Page 2

© 2019 Renesas Electronics Corporation

COMPONENT MAP

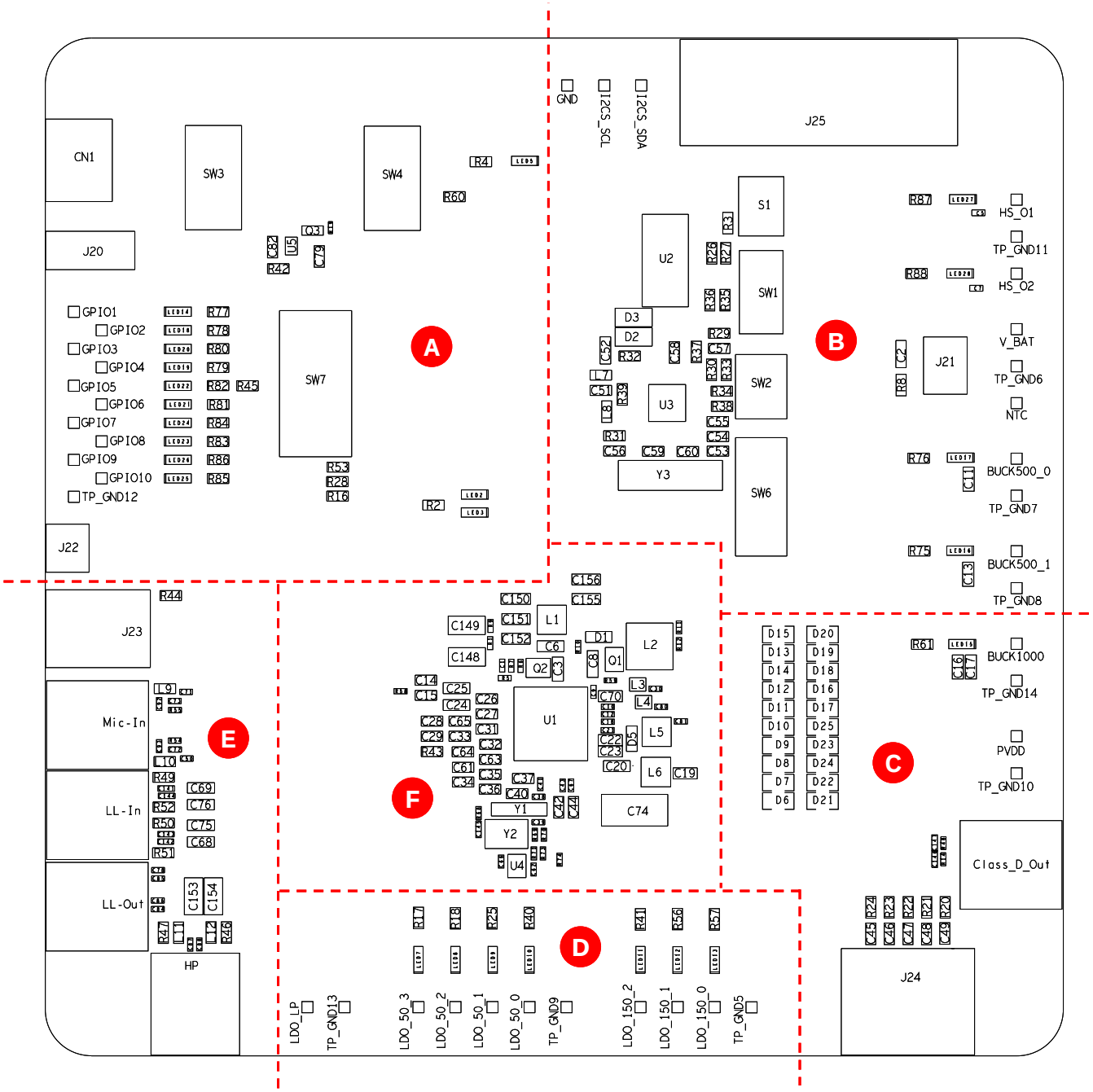

Figure 28. Component Map

© 2019 Renesas Electronics Corporation

SYMBOL	VALUE	DESCRIPTION	PART NUMBER	LOCATION
BUCK1000	Red TP	Buck1000 output	5010 (red)	C
BUCK500_0	Red TP	Buck500_0 output	5010 (red)	B
BUCK500_1	Red TP	Buck500_1 output	5010 (red)	B
C1	1µF	Input current limit sense filter capacitor for CHRG_CLSEN pin	GRM155R61A105KE15D	F
C10	2.2µF	Buck_500_0 input supply capacitor	C0402X5R6R3-225MNP	F
C11	10µF	Buck_500_0 output load capacitor	GRM188R60J106ME47D	B
C12	2.2µF	Buck_500_1 input supply capacitor	C0402X5R6R3-225MNP	F
C13	10µF	Buck_500_1 output load capacitor	GRM188R60J106ME47D	B
C14	1000pF	AFILT2 filter capacitor	ECJ-1VC1H102J	F
C141	1nF	Line-level Input filter capacitor	C0402C102K5RACTU	E
C142	1nF	Line-level Input filter capacitor	C0402C102K5RACTU	E
C143	1nF	Line-level Input filter capacitor	C0402C102K5RACTU	E
C144	1nF	Line-level Input filter capacitor	C0402C102K5RACTU	E
C145	10nF	26MHz TCXO input supply capacitor	GRM155R71H103KA88D	F
C146	680pF	Class_D Output filter capacitor	C1005X7R1H681K	C
C147	680pF	Class_D Output filter capacitor	C1005X7R1H681K	C
C148	100uF	Electronic load stabilization capacitor	C1206C107M9PACTU	F
C149	OPEN (100uF)	Electronic load stabilization capacitor	C1206C107M9PACTU	F
C15	1000pF	AFILT1 filter capacitor	ECJ-1VC1H102J	F
C150	22uF	Pre-DCDC output capacitor for VSYS	C0805C226M9PACTU	F
C151	22uF	Pre-DCDC output capacitor for VSYS	C0805C226M9PACTU	F
C152	22uF	Pre-DCDC output capacitor for VSYS	C0805C226M9PACTU	F
C153	100uF	Headphones ac coupling capacitor	C1206C107M9PACTU	E
C154	100uF	Headphones ac coupling capacitor	C1206C107M9PACTU	E
C155	22uF	Pre-DCDC input capacitor for VBUS	C0805C226M9PACTU	F
C156	22uF	Pre-DCDC input capacitor for VBUS	C0805C226M9PACTU	F
C16	10µF	Buck_1000 output load capacitor	GRM188R60J106ME47D	C
C17	10µF	Buck_1000 output load capacitor	GRM188R60J106ME47D	C
C18	2.2µF	Buck_1000 input supply capacitor	C0402X5R6R3-225MNP	F
C19	10µF	Boost5 input load capacitor	GRM188R60J106ME47D	F
C2	10µF	Electronic load stabilization capacitor	C0805X5R100-106KNE	B
C20	1µF	Class_D input supply filter capacitor	T491C105K050AT	F
C21	0.1µF	Class_D input supply filter capacitor		F
C22	10µF	Boost5 output load capacitor	GRM188R60J106ME47D	F
C23	10µF	Boost5 output load capacitor	GRM188R60J106ME47D	F
C24	10µF	AVREF decoupling capacitor	C0805X5R100-106KNE	F
C25	10µF	AVDD input supply capacitor	C0805X5R100-106KNE	F
C26	1µF	AVDD_CAP filter capacitor	C0603X7R100-105KN	F
C27	0.1µF	AVDD_CAP filter capacitor	TMK107BJ104KA-T	F
C28	1µF	ADC_REF filter capacitor	C0603X7R100-105KN	F
C29	OPEN (1000pF)	VIRT_GND filter capacitor	ECJ-1VC1H102J	F
C3	10µF	Pre-DCDC input decoupling capacitor	GRM188R60J106ME47D	F
C30	0.1µF	Buck_500_0 output decoupling capacitor	ECJ-1VB1C104K	F
C31	1µF	LDO_IN1 input capacitor	C0603X7R100-105KN	F
C32	1µF	LDO_IN2 input capacitor	C0603X7R100-105KN	F
C33	1µF	LDO_IN3 input capacitor	C0603X7R100-105KN	F
C34	1µF	LDO_50_0 output capacitor	C0603X7R100-105KN	F

© 2019 Renesas Electronics Corporation

SYMBOL	VALUE	DESCRIPTION	PART NUMBER	LOCATION
C35	1µF	LDO_150_2 output capacitor	C0603X7R100-105KN	F
C36	1µF	LDO_150_1 output capacitor	C0603X7R100-105KN	F
C37	1µF	LDO_150_0 output capacitor	C0603X7R100-105KN	F
C38	12pF	32kHz crystal filter capacitor	C0402C120J5GACTU	F
C39	12pF	32kHz crystal filter capacitor	C0402C120J5GACTU	F
C40	1µF	VDD18_CAP filter capacitor	C0603X7R100-105KN	F
C41	10nF	VDD18_CAP filter capacitor	GRM155R71H103KA88D	F
C42	1µF	VDD33_CAP filter capacitor	C0603X7R100-105KN	F
C43	10nF	VDD33_CAP filter capacitor	GRM155R71H103KA88D	F
C44	1µF	VDDIO_CK filter capacitor	C0603X7R100-105KN	F
C45	5pF	32KHZ_OUT_2 clock output filter capacitor	ECJ-1VC1H050C	C
C46	5pF	TCXO_OUT1 clock output filter capacitor	ECJ-1VC1H050C	C
C47	5pF	TCXO_OUT2 clock output filter capacitor	ECJ-1VC1H050C	C
C48	5pF	SYSCLK_OUT clock output filter capacitor	ECJ-1VC1H050C	C
C49	5pF	USB_CLK clock output filter capacitor	ECJ-1VC1H050C	C
C5	1µF	Hotswap #1 output load capacitor	C0402X5R100-105KNE	B
C50	OPEN (1µF)	MIC R+ biasing capacitor	C0402X5R100-105KNE	E
C51	0.1µF	USB to I²C chip input supply filter capacitor	TMK107BJ104KA-T	B
C52	10µF	USB to I²C chip input supply filter capacitor	C0805X5R100-106KNE	B
C53	0.1µF	USB to I²C chip input supply filter capacitor	TMK107BJ104KA-T	B
C54	47nF	USB to I²C chip input supply filter capacitor	C0603X7R160-473KNP	B
C55	10nF	USB to I²C chip input supply filter capacitor	GRM155R71H103KA88D	B
C56	0.1µF	USB to I²C chip input supply filter capacitor	TMK107BJ104KA-T	B
C57	47pF	USB to I²C USB D- filter capacitor	ECJ-1VC1H470J	B
C58	47nF	USB to I²C chip filter capacitor	C0603X7R160-473KNP	B
C59	33pF	USB to I²C 6MHz crystal filter capacitor	ECJ-1VC1H330J	B
C6	10µF	Pre-DCDC output decoupling capacitor	C0805X5R100-106KNE	F
C60	33pF	USB to I²C 6MHz crystal filter capacitor	ECJ-1VC1H330J	B
C61	1µF	LDO_50_1 output capacitor	C0603X7R100-105KN	F
C62	20pF	12MHz crystal filter capacitor	C1005C0G1H200J	F
C63	1µF	LDO_50_2 output capacitor	C0603X7R100-105KN	F
C64	1µF	LDO_50_3 output capacitor	C0603X7R100-105KN	F
C65	1µF	LDO_LP output / filter capacitor	C0603X7R100-105KN	F
C66	20pF	12MHz crystal filter capacitor	C1005C0G1H200J	F
C67	10nF	VDDIO_CK filter capacitor	GRM155R71H103KA88D	F
C68	3.3µF	Line-level Input ac coupling capacitor	ECJ-2YB0J335K	E
C69	3.3µF	Line-level Input ac coupling capacitor	ECJ-2YB0J335K	E
C7	1µF	Hotswap #2 output load capacitor	C0402X5R100-105KNE	B
C70	10µF	LED_Boost input supply capacitor	GRM188R60J106ME47D	F
C71	OPEN (1µF)	MIC L+ biasing capacitor	C0402X5R100-105KNE	E
C72	1µF	Analog microphone ac coupling capacitors	C0402X5R100-105KNE	E
C73	1µF	Analog microphone ac coupling capacitors	C0402X5R100-105KNE	E
C74	330µF	Class_D supply input load capacitor	TPSD337M006R0045	B
C75	3.3µF	Line-level Input ac coupling capacitor	ECJ-2YB0J335K	E
C76	3.3µF	Line-level Input ac coupling capacitor	ECJ-2YB0J335K	E
C77	10pF	LED_Boost OVP feedback noise decoupling capacitor	GRM1555C1H100JZ01D	F (stack R12)
C78	2.2µF	Line-level out AC coupling capacitor	C1005X5R0J225M	E
C79	1µF	OVP protection switch output capacitor	C0603X7R100-105KN	A

© 2019 Renesas Electronics Corporation

SYMBOL	VALUE	DESCRIPTION	PART NUMBER	LOCATION
C8	1uF / 50V	LED_Boost output capacitor	GRM21BR71H105KA12L	F
C80	0.1µF	Buck_500_1 output decoupling capacitor	ECJ-1VB1C104K	F
C81	0.1µF	Buck_1000 output decoupling capacitor	ECJ-1VB1C104K	F
C82	1µF	OVP protection switch input capacitor	C0603X7R100-105KN	A
C84	2.2µF	Line-level out AC coupling capacitor	C1005X5R0J225M	E
C85	220pF	Line-level output filter capacitor	GRM155R71H221KA01D	E
C86	220pF	Line-level output filter capacitor	GRM155R71H221KA01D	E
C87	220pF	Headphones output filter capacitor	GRM155R71H221KA01D	E
C88	220pF	Headphones output filter capacitor	GRM155R71H221KA01D	E
C9	1µF	LED_Boost input supply capacitor	C0402X5R100-105KNE	F
C92	220pF	Analog microphone input filter capacitor	GRM155R71H221KA01D	E
C93	220pF	Analog microphone input filter capacitor	GRM155R71H221KA01D	E
CLASS_D_OUT		Class_D 3.5mm output jack	SJ1-3523N	C
CN1		Mini-USB input connector jack	1734035-2	A
D1	Schottky diode	LED_Boost rectification Schottky diode	MSS1P5-E3/89A	F
D10	White LED	White LED for backlight	LTW-170TK	C
D11	White LED	White LED for backlight	LTW-170TK	C
D12	White LED	White LED for backlight	LTW-170TK	C
D13	White LED	White LED for backlight	LTW-170TK	C
D14	White LED	White LED for backlight	LTW-170TK	C
D15	White LED	White LED for backlight	LTW-170TK	C
D16	White LED	White LED for backlight	LTW-170TK	C
D17	White LED	White LED for backlight	LTW-170TK	C
D18	White LED	White LED for backlight	LTW-170TK	C
D19	White LED	White LED for backlight	LTW-170TK	C
D2	Signal diode	VCC_ROM supply diode	1N4148W	B
D20	White LED	White LED for backlight	LTW-170TK	C
D21	White LED	White LED for backlight	LTW-170TK	C
D22	White LED	White LED for backlight	LTW-170TK	C
D23	White LED	White LED for backlight	LTW-170TK	C
D24	White LED	White LED for backlight	LTW-170TK	C
D25	White LED	White LED for backlight	LTW-170TK	C
D3	Signal diode	VCC_ROM supply diode	1N4148W	B
D5	Schottky diode	Boost5 over-voltage protection Schottky diode	MSS1P5-E3/89A	F
D6	White LED	White LED for backlight	LTW-170TK	C
D7	White LED	White LED for backlight	LTW-170TK	C
D8	White LED	White LED for backlight	LTW-170TK	C
D9	White LED	White LED for backlight	LTW-170TK	C
GND	Black TP	I²CS input ground	5011 (black)	B
GPIO1	Yellow TP	GPIO1 input or output	5014 (yellow)	A
GPIO10	Yellow TP	GPIO10 input or output	5014 (yellow)	A
GPIO2	Yellow TP	GPIO2 input or output C1005X5R0J225M	5014 (yellow)	A
GPIO3	Yellow TP	GPIO3 input or output	5014 (yellow)	A
GPIO4	Yellow TP	GPIO4 input or output	5014 (yellow)	A
GPIO5	Yellow TP	GPIO5 input or output	5014 (yellow)	A
GPIO6	Yellow TP	GPIO6 input or output	5014 (yellow)	A
GPIO7	Yellow TP	GPIO7 input or output	5014 (yellow)	A
GPIO8	Yellow TP	GPIO8 input or output	5014 (yellow)	A

© 2019 Renesas Electronics Corporation

SYMBOL	VALUE	DESCRIPTION	PART NUMBER	LOCATION
GPIO9	Yellow TP	GPIO9 input or output	5014 (yellow)	A
HP		Headphones 3.5mm output jack	SJ1-3523N	E
HS_O1	Yellow TP	Hotswap #1 output	5014 (yellow)	B
HS_O2	Yellow TP	Hotswap #2 output	5014 (yellow)	B
I2CS_SCL	Yellow TP	Clock input for I²C control	5014 (yellow)	B
I2CS_SDA	Yellow TP	Data input for I²C control	5014 (yellow)	B
J20		DC power input jack, from adapter	PJ1-022	A
J21		Three-terminal Li-Ion battery connector	3-641213-3	B
J22		Touch-screen 4-pin flex cable connector	HLW4R-2C7LF	A
J23		Digital microphone 6-pin ribbon connector	90130-3206	E
J24	OPEN	Clock outputs 10-pin ribbon connector	D2510-5002-AR	C
J25		GPIO, I²C, I²S, POR_OUT 24-pin ribbon connector	D2524-5002-AR	B
L1	2.2uH / 2A	Pre-DCDC inductor	MLPS-4018-2R2M	F
L10	600Ω / 500mA	Analog Microphone Input ferrite chip	MMZ1608Y601B	E
L11	600Ω / 500mA	Headphones Output ferrite chip	MMZ1608Y601B	E
L12	600Ω / 500mA	Headphones Output ferrite chip	MMZ1608Y601B	E
L2	22uH	LED_Boost inductor	B82462G4223M	F
L3	4.7uH	Boost_500_0 inductor	GMPI-201610-4R7M	F
L4	4.7uH	Boost_500_1 inductor	GMPI-201610-4R7M	F
L5	4.7uH	Buck_1000 inductor	MLPS-4018-4R7M	F
L6	2.2uH	Boost5 inductor	CDRH3D23HPNP-2R2PC	F
L7	600Ω / 500mA	Ferrite chip for USB to I²C chip	MMZ1608Y601B	B
L8	600Ω / 500mA	Ferrite chip for USB to I²C chip	MMZ1608Y601B	B
L9	600Ω / 500mA	Analog Microphone Input ferrite chip	MMZ1608Y601B	E
LDO_150_0	Red TP	LDO_150_0 output	5010 (red)	D
LDO_150_1	Red TP	LDO_150_1 output	5010 (red)	D
LDO_150_2	Red TP	LDO_150_2 output	5010 (red)	D
LDO_50_0	Red TP	LDO_50_0 output	5010 (red)	D
LDO_50_1	Red TP	LDO_50_1 output	5010 (red)	D
LDO_50_2	Red TP	LDO_50_2 output	5010 (red)	D
LDO_50_3	Red TP	LDO_50_3 output	5010 (red)	D
LDO_LP	Red TP	LDO_LP output	5010 (red)	D
LED10	Red LED	LDO_50_0 output voltage indicator	LTST-C170CKT	D
LED11	Red LED	LDO_150_2 output voltage indicator	LTST-C170CKT	D
LED12	Red LED	LDO_150_1 output voltage indicator	LTST-C170CKT	D
LED13	Red LED	LDO_150_0 output voltage indicator	LTST-C170CKT	D
LED14	Yellow LED	GPIO1 output voltage indicator	LTST-C170YKT	A
LED15	Red LED	Buck_1000 output voltage indicator	LTST-C170CKT	C
LED16	Red LED	Buck_500_1 output voltage indicator	LTST-C170CKT	B
LED17	Red LED	Buck_500_0 output voltage indicator	LTST-C170CKT	B
LED18	Yellow LED	GPIO2 output voltage indicator	LTST-C170YKT	A
LED19	Yellow LED	GPIO4 output voltage indicator	LTST-C170YKT	A
LED2	Green LED	Charging-in-progress indicator LED	LTST-C170KGKT	A
LED20	Yellow LED	GPIO3 output voltage indicator	LTST-C170YKT	A
LED21	Yellow LED	GPIO6 output voltage indicator	LTST-C170YKT	A
LED22	Yellow LED	GPIO5 output voltage indicator	LTST-C170YKT	A
LED23	Yellow LED	GPIO8 output voltage indicator	LTST-C170YKT	A
LED24	Yellow LED	GPIO7 output voltage indicator	LTST-C170YKT	A

© 2019 Renesas Electronics Corporation

SYMBOL	VALUE	DESCRIPTION	PART NUMBER	LOCATION
LED25	Yellow LED	GPIO10 output voltage indicator	LTST-C170YKT	A
LED26	Yellow LED	GPIO9 output voltage indicator	LTST-C170YKT	A
LED27	Yellow LED	Hotswap #1 output voltage indicator	LTST-C170YKT	B
LED28	Yellow LED	Hotswap #2 output voltage indicator	LTST-C170YKT	B
LED3	Orange LED	Charging completed indicator LED	LTST-C171AKT	A
LED5	Blue LED	Input power indicator LED	LTST-C170TBKT	A
LED7	Red LED	LDO_50_3 output voltage indicator	LTST-C170CKT	D
LED8	Red LED	LDO_50_2 output voltage indicator	LTST-C170CKT	D
LED9	Red LED	LDO_50_1 output voltage indicator	LTST-C170CKT	D
LL-IN		Line-level In 3.5mm input jack	SJ1-3523N	E
LL-OUT		Line-level Out 3.5mm output jack	SJ1-3523N	E
MIC-IN		Analog Microphone 3.5mm input jack	SJ1-3523N	E
NTC	Gray TP	Thermistor input from battery pack	5128 (gray)	B
PVDD	Red TP	Class_D power input (or Boost5 output)	5010 (red)	C
Q1		LED_Boost NMOS switching FET	RTR020N05TL	F
Q2		Charger ideal diode for connecting battery to VSYS	Si2333DS	F
Q3		Over-voltage protection pass FET	FDN359BN	A
R1	10kΩ	POR_OUT pull up resistor	ERJ-2GEJ103X	F
R10	237kΩ	PSCREF resistor to ground	ERJ-2RKF2373X	F
R11	4.99MΩ	LED_Boost over-voltage protection setting resistor	CRCW04024M99FKED	F
R12	169kΩ	LED_Boost over-voltage protection setting resistor	ERJ-2RKF1693X	F
R14	3.3Ω	Class_D output filter resistor	RL0510S-3R3-F	C
R16	10kΩ	SW7 pull up resistor	ERJ-3EKF1002V	A
R17	680Ω	LED7 current limiting resistor	ERJ-3GEYJ681V	D
R18	680Ω	LED8 current limiting resistor	ERJ-3GEYJ681V	D
R19	OPEN (0Ω)	Over-voltage protection chip bypass resistor	CRCW04020000Z0ED	A
R2	680Ω	LED2 & LED3 current limiting resistor	ERJ-3GEYJ681V	A
R20	33Ω	USB_CLK filter resistor	ERJ-3GEYJ330V	C
R21	33Ω	SYSCLK_OUT filter resistor	ERJ-3GEYJ330V	C
R22	33Ω	TCXO_OUT2 filter resistor	ERJ-3GEYJ330V	C
R23	33Ω	TCXO_OUT1 filter resistor	ERJ-3GEYJ330V	C
R24	33Ω	32KHZ_OUT2 filter resistor	ERJ-3GEYJ330V	C
R25	680Ω	LED9 current limiting resistor	ERJ-3GEYJ681V	D
R26	4.7kΩ	I²CM_SCL pull up resistor	ERJ-3GEYJ472V	B
R27	4.7kΩ	I²CM_SDA pull up resistor	ERJ-3GEYJ472V	B
R28	10kΩ	SW7 pull up resistor	ERJ-3EKF1002V	A
R29	OPEN (10kΩ)	EEPROM write protect pull up resistor	ERJ-3EKF1002V	B
R3	10kΩ	SW_DET pull up resistor	ERJ-3EKF1002V	B
R30	0Ω	EEPROM write protect pull down resistor	ERJ-3GEY0R00V	B
R31	470Ω	USB to I²C chip supply filter resistor	ERJ-3GEYJ471V	B
R32	27Ω	USB to I²C chip USBDP series resistor	ERJ-3GEYJ270V	B
R33	27Ω	USB to I²C chip USBDM series resistor	ERJ-3GEYJ270V	B
R34	1.5kΩ	USB to I²C chip RSTOUT# to USBDP resistor	ERJ-3GEYJ152V	B
R35	4.7kΩ	I²CS_SCL pull up resistor	ERJ-3GEYJ472V	B
R36	4.7kΩ	I²CS_SDA pull up resistor	ERJ-3GEYJ472V	B
R37	10kΩ	USB to I²C chip pull up resistor	ERJ-3EKF1002V	B

© 2019 Renesas Electronics Corporation

SYMBOL	VALUE	DESCRIPTION	PART NUMBER	LOCATION
R38	10kΩ	USB to I²C chip pull up resistor	ERJ-3EKF1002V	B
R39	10kΩ	USB to I²C chip pull up resistor	ERJ-3EKF1002V	B
R4	1.2kΩ	LED5 current limiting resistor	ERJ-3EKF1201V	A
R40	680Ω	LED10 current limiting resistor	ERJ-3GEYJ681V	D
R41	680Ω	LED11 current limiting resistor	ERJ-3GEYJ681V	D
R42	10kΩ	Over-voltage chip /FLAG pull up resistor	ERJ-3EKF1002V	A
R43	0Ω	LDO input to VSYS jumper resistor	ERJ-3GEY0R00V	F
R44	0Ω	Digital microphone Buck_500_0 supply jumper resistor	ERJ-3GEY0R00V	E
R45	10kΩ	GPIO5 pull up resistor	ERJ-3EKF1002V	A
R46	0Ω	Headphones biasing resistor	ERJ-3GEY0R00V	E
R47	0Ω	Headphones biasing resistor	ERJ-3GEY0R00V	E
R48	3.3Ω	Class_D output filter resistor	RL0510S-3R3-F	C
R49	0Ω	Line-level In series resistor	ERJ-3GEY0R00V	E
R5	1kΩ	Battery charge current setting resistor	CRCW04021K00FKED	F
R51	0Ω	Line-level In series resistor	ERJ-3GEY0R00V	E
R53	10kΩ	SW7 pull up resistor	ERJ-3EKF1002V	A
R54	1.2kΩ	Analog microphone input biasing resistor	ERJ-2RKF1201X	E
R55	1.2kΩ	Analog microphone input biasing resistor	ERJ-2RKF1201X	E
R56	680Ω	LED12 current limiting resistor	ERJ-3GEYJ681V	D
R57	680Ω	LED13 current limiting resistor	ERJ-3GEYJ681V	D
R58	22Ω	Analog microphone input biasing resistor	ERJ-2RKF22R0X	F
R59	150mΩ	LED_Boost current sense resistor	SR731ETTPR150F	F
R6	604Ω	Input current limit sense resistor for CHRG_CLSEN pin	ERJ-2RKF6040X	F
R60	0.1Ω	Pre-DCDC input series resistor	SR731JTTDR100F	A
R61	680Ω	LED15 current limiting resistor	ERJ-3GEYJ681V	C
R68	0Ω	26MHz TCXO LDO_50_3 supply jumper resistor	CRCW04020000Z0ED	F
R69	33Ω	26MHz TCXO output series resistor	ERJ-2RKF33R0X	F
R7	8.2Ω	Input current limit sense resistor for CHRG_CLSEN pin	ERJ-2GEJ8R2X	F
R70	0Ω	26MHz TCXO output jumper resistor	CRCW04020000Z0ED	F
R71	OPEN (0Ω)	12MHz crystal jumper resistor	CRCW04020000Z0ED	F
R73	OPEN (0Ω)	12MHz crystal jumper resistor	CRCW04020000Z0ED	F
R74	0Ω	12MHz crystal jumper resistor to disconnect the TCXO_OUT1 wire	CRCW04020000Z0ED	F
R75	680Ω	LED16 current limiting resistor	ERJ-3GEYJ681V	B
R76	680Ω	LED17 current limiting resistor	ERJ-3GEYJ681V	B
R77	680Ω	LED14 current limiting resistor	ERJ-3GEYJ681V	A
R78	OPEN (680Ω)	LED18 current limiting resistor	ERJ-3GEYJ681V	A
R79	OPEN (680Ω)	LED19 current limiting resistor	ERJ-3GEYJ681V	A
R8	10Ω	Electronic load stabilization resistor	ERJ-3GEYJ100V	B
R80	OPEN (680Ω)	LED20 current limiting resistor	ERJ-3GEYJ681V	A
R81	OPEN (680Ω)	LED21 current limiting resistor	ERJ-3GEYJ681V	A
R82	680Ω	LED22 current limiting resistor	ERJ-3GEYJ681V	A
R83	OPEN (680Ω)	LED23 current limiting resistor	ERJ-3GEYJ681V	A
R84	OPEN (680Ω)	LED24 current limiting resistor	ERJ-3GEYJ681V	A
R85	680Ω	LED25 current limiting resistor	ERJ-3GEYJ681V	A

© 2019 Renesas Electronics Corporation

SYMBOL	VALUE	DESCRIPTION	PART NUMBER	LOCATION
R86	OPEN (680Ω)	LED26 current limiting resistor	ERJ-3GEYJ681V	A
R87	680Ω	LED27 current limiting resistor	ERJ-3GEYJ681V	B
R88	680Ω	LED28 current limiting resistor	ERJ-3GEYJ681V	B
R9	10kΩ	CHRG_NTC pull up resistor to CHRG_VNTC	ERJ-2GEJ103X	F
S1	Push-button	SW_DET push button pull-up switch	B3F-1000	B
SNS1		Trace-jumper to separate audio ground from system ground	N/A	F (bottom)
SW1	2-slider	EEPROM I²C path selection switch	EG2207	B
SW2	2-slider	I²C communication input selection switch	OS202011MS2QN1	B
SW3	2-slider	USB or adapter power selection switch	25136NAH	A
SW4	2-slider	Battery power or external power selection switch	25136NAH	A
SW6	3-slider	Battery NTC selection switch	MHS123	B
SW7	4-dip	EX_ROM, VDDIO_CK, and Hotswap selection switch	76SC04T	A
TP_GND10	Black TP	Class_D power ground return	5011(black)	C
TP_GND11	Black TP	Hotswap ground return	5011(black)	B
TP_GND12	Black TP	GPIO ground return	5011(black)	A
TP_GND13	Black TP	LDO_LP ground return	5011(black)	D
TP_GND14	Black TP	Buck1000 ground return	5011(black)	C
TP_GND5	Black TP	LDO_150_x ground return	5011(black)	D
TP_GND6	Black TP	Battery negative terminal input	5011(black)	B
TP_GND7	Black TP	Buck500_0 ground return	5011(black)	B
TP_GND8	Black TP	Buck500_1 ground return	5011(black)	B
TP_GND9	Black TP	LDO_50_x ground return	5011(black)	D
U1		Audio, Power Management and Control IC	IDTP95020	F
U2		EEPROM IC	24LC128	B
U3		USb to I²C converter IC	FT2232C	B
U4		12MHz crystal	DSX321G-12.000MHz	F
U5		Over voltage protection IC	MAX4840A	A
V_BAT	Red TP	Battery positive terminal input	5010 (red)	B
Y1		32.768kHz crystal	CC5V-T1A 32.768KHZ	F
Y2		26MHz TCXO IC	KT3225R26000ZAW28TMA	F
Y3		6MHz crystal	ECS-60-32-5P-TR	B

© 2019 Renesas Electronics Corporation

ORDERING GUIDE

Table 1. Ordering Summary

PART NUMBER	MARKING	PRICE	AMBIENT TEMP. RANGE	SHIPPING CARRIER	QUANTITY
IDTP95020-EVAL	IDTP95020-EVAL	$249.00	0°C to +70°C	Box 14”x10”x2”	1

NOTES:

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers who are designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only to develop an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third-party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising from your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.01)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit www.renesas.com/contact-us/.

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

© 2026 Renesas Electronics Corporation. All rights reserved.