EVBUM2706/D

LC823455 Evaluation Board User's Manual

ON Semiconductor®

www.onsemi.com

EVAL BOARD USER'S MANUAL

Overview

This document describes the hardware board of the LC823455 evaluation kit to help you understand the functions and schematics of the board. The block diagrams help you understand large scale schematics. Illustrations with detailed explanations help you learn the functions, and how to use and operate this board. This document applies to the users of this evaluation board as well as designers who plan to use the LC823455 to custom design a board.

Handling Precautions for This Board

This board includes many ESD sensitive electronic devices.

The following items are required to handle this board:

- Use this board in the ESD Protected Area (EPA).
- Remove the ESD bag in the EPA.
- Remove static from your body when using the board.
- When not in use, store the evaluation board in the ESD bag.
- Do not apply excess or reverse voltage to any terminals on this board.

Features

Flexible Development and Evaluation Board

- Header pins to access almost pins of LC823455
- Header pins to connect user's power supply or PMIC
- Universal area to add user's circuits or connectors
- Connectors to add ARDUINO shield or Pmod module

Three Types of Power Supply Input Connectors

- Micro USB connector (for USB bus−powered operation)
- Industrial standard, 5.5 mm/2.1 mm DC Jack
- JST XH 2-pin connector (for connecting battery)

Single 5 V Supply Operation by Onboard Regulators

- PMIC for LC823455

DCDC: 1.0 V/1.1 V/1.8 V, LDO: 1.0 V/1.5 V/1.8 V/3.3 V

- RTC Power Supply

Dedicated Low Iq LDOs, 0.8 V and 1.0 V

- General-purpose 3.3 V DCDC
- microSD slot dedicated 2.8 V DCDC
- Wi−Fi®/BT dedicated regulators
- ARDUINO shield and Pmod dedicated 3.3 V LDO

Audio I/O

- Dedicated DAMP output terminal for SE and BTL
- Dedicated DAMP LC LPF for SE and BTL
- High−Resolution Audio ready external ADC and DAC
- Dedicated Headphone Amplifier for external DAC
- Volume control for Headphone Amplifier
- 3.5 mm stereo jacks for analog audio I/O
- 2x On−board MEMS digital microphones

USB 2.0 Interface

- Device and Host available
- External boost DCDC for Host and OTG operation
- Insertion/Extraction detection

Storage

- On−board eMMC and serial flash (selectable)
- 1x microSD slot

Wireless Connectivity

- PCI Express® M.2 connector for Wi−Fi/BT module
- Embedded Artists 1MW (Murata) Wi−Fi/BT M.2 module (#EAR00315)

Man−Machine Interface

- 8x Push Switch
- 2x LED (Red & Green)
- 1x Character LCD

Development and Debug Ports

- UART with USB−serial bridge (micro USB connector)
- SWD for Cortex®−M3 (20−pin Box Header)
- JTAG for LPDSP (20−pin Box Header)

Boot Mode Setting

- Easy setting by two rotary switches

© Semiconductor Components Industries, LLC, 2019

December, 2019 − Rev. 0

Publication Order Number:
EVBUM2706/D

Clock

- No external clock source or generator required
- Onboard clock sources:
  - 24 MHz crystal resonator for PLL source
  - 32.768 kHz crystal resonator for RTC
  - 32.768 kHz crystal oscillator for Wi−Fi/BT module

Battery Connectivity

- cell Li−Ion Battery available
- Onboard charger IC
- Battery voltage monitor function

Detailed Explanation for Function Block in This Board

Refer to Figure 1−Figure 6 and schematics for a better understanding of the following explanation.

Battery Monitor

An integrated ADC monitors VBAT voltage. An external resistor divider circuit scales the full−scale level of ADC and input voltage.

Man−Machine Interface

Eight push switches, two LEDs (red, green), and the LCD character display provide man−machine interface function to the user. Software running on the LC823455 assign functions for these switches, LEDs, and the LCD. The red LED is not software−configurable and shows the operating status of LC823455 and is connected to pin “EXTINT2F” of the LC823455. For more information, refer to the LC823455 datasheet description of “EXTINT2F”.

USB 2.0 Interface

Usually, this USB port operates as “Device”.

LC823455 can be operated as “USB Host” by setting of software and U3. In this case, set JP21 to “Host”. JP21 is set to “Device” by default. Refer to related LC823455 documents for details about operating as “USB Host”.

The USB 2.0 port functions as a power supply input when configured as “USB Device”. When the port connects to USB Host equipment, such as a PC, other power supplies are not required.

VBUS in this port connects to pin “KEYINT1” of LC823455 via a resistor divider. RTC functions of LC823455 provide insertion and extraction detection of the USB connector.

Development and Debug Port

The Development and Debug Port is used for software development and debugging. CN601 is an SWD interface connected to the built−in Cortex−M3 to LC823455. CN602 is a JTAG interface linked to the built−in LPDSP. CN1 is connected to UART0 of LC823455 via USB to serial UART IC:FT232, which is industry standard.

RESET/POR

A reset circuit connected to U1 (LC823455), U301 (I/O Expander), and LCD601 (LCD Module) can reset these ICs and the LCD instantaneously. U603 supervises Vdd2 voltage and provides POR (Power On Reset) functions. When U603 detects proper voltage, reset is released.

Two types of Vdd2 (1.8 V and 3.3 V) are available on this evaluation board. Therefore the detection voltage of POR must be set to the proper Vdd2 voltage. JP603 provides this setting. When changing the Vdd2 voltage via SW101, also remember to change the configuration of JP603. Vdd2 and JP603 are set to 1.8 V by default.

CAUTION: The configuration of SW101 and JP603 must be changed only when powered off. When you change these settings, unplug power supply cable from this board or turn off the power supply.

Boot Mode

The circuit to set the boot mode of LC823455 consists of two 4−pole rotary type switches and resistors to fix the logic level. To change the boot mode, set SW611 and SW612 to your desired setting; then, push SW610 to reset and reboot LC823455. After resetting, LC823455 operates in the new mode setting of SW611 and SW612.

A 2.5 mm standard, flat−blade screwdriver (not supplied in the evaluation kit) is required to change the setting of these rotary switches.

The following tables show the relationship between the SW611 and SW612 settings and boot mode (Table 1, Table 2, and Table 3).

Table 1. BOOT MODE SETTING SWITCH AND IPL MODE

SW611	SW612	
BMODE1	BMODE0	IPL Mode
0	0	SPI Boot (USB)
0	1	SPI All Erase
0	2	User Area Boot (SD)
0	3	External ROM Boot
1	0	QSPI Boot (USB)
1	1	Hi−Z
1	2	QSPI All Erase
1	3	QSPI Boot (SD)
2	0	User Boot (USB)
2	1	User Area Delete
2	2	SDCH0 All Erase
2	3	User Boot (USB)
3	0	Physical Boot (SD)
3	1	SPI Boot (SD)
3	2	Partition Delete
3	3	Physical Boot (USB)

Table 2. BMODE0, SWITCH POSITION AND TERMINAL

Switch	Position	BMODE0 Terminal
SW612 (BMODE0)	0	Pullup (via 470 kΩ)
	1	Pullup (via 1 kΩ)
	2	Pulldown (via 1 kΩ)
	3	Pulldown (via 470 kΩ)

Table 3. BMODE1, SWITCH POSITION AND TERMINAL

Switch	Position	BMODE1 Terminal
SW611 (BMODE1)	0	Pullup (via 470 kΩ)
	1	Pullup (via 1 kΩ)
	2	Pulldown (via 1 kΩ)
	3	Pulldown (via 470 kΩ)

Wireless Connectivity

The LC823455A provides a PCI Express M.2 Type Key E connector for a Wi−Fi/BT module. The evaluation kit includes an Embedded Artists 1MW (Murata) Wi−Fi/BT M.2 module (Product #EAR00315) attached to the evaluation board as shipped.

The PCI Express M.2 specification standard defines the M.2 module I/O voltage level.

Level shift circuits link U1 and the M.2 connector allowing the M.2 module to be connected to two different Vdd2 voltages (1.8 V and 3.3 V) of U1. The level shift circuits do not require any setting adjustments for Vdd2 setting changes.

The Wi−Fi/BT M.2 module has a pair of PCM I/O interfaces available for master and slave. Therefore, PCM clock direction control is required for the level shift circuit used this interface. JP801 provides this function.

The wireless connectivity section includes two dedicated power supply circuits. For more information, refer to the description of the power supply in this manual.

The Wi−Fi/BT M.2 module includes a PCB trace antenna – external antennas are not required. Do not place obstacles such as metal near the M.2 module, because it weakens the RF waves. For more information about this M.2 module, see the technical documents provided by Embedded Artists.

I/O Expander

An I^2C I/O Expander with 16 GPIOs is used to control the peripheral circuit on the evaluation board. The I^2C I/O Expander is connected to U1's "I2C_1" and operates as a slave device. An external reset pin connects to the onboard reset circuit.

Audio I/O Overview

Audio inputs consist of two MEMS digital microphones and an external 192 kHz stereo audio ADC. Audio outputs include an integrated class D amplifier and an external 384 kHz stereo audio DAC connected to a Headphone Amplifier with a dedicated volume potentiometer.

The external ADC and DAC logic I/O voltage levels can be configured to either 1.8 V or 3.3 V. The logic I/O voltage level settings are set via jumpers JP405 and JP406 (Open: 3.3 V, Closed: 1.8 V). The jumper defaults are 1.8 V logic voltage levels (JP405 and JP406 are both closed via two jumper plugs). Voltage configuration via these jumpers can be changed only when the device is powered off.

The operation voltage of the ADC and DAC is 3.3 V provided from a low−noise LDO regulator (U103). For maximum output power, VBAT is supplied directly to a headphone amplifier (U404).

MEMS Digital Microphones

This board includes two MEMS digital microphones configurated as stereo. The microphones are set to both 1.8 V and 3.3 V logic I/O levels without configurable settings jumpers.

CN405, Analog Audio Input to ADC

This evaluation board includes an onboard−mounted high-resolution audio stereo ADC (U403). A single−ended analog input signal feeds to the ADC via a 3.5 mm stereo jack (CN405, Pink).

The ADC internal register must be set to slave via the I^2C interface to use the converter.

All analog inputs of the ADC are wired on this board. If your application requires another input channel or differential type input, solder the connector or wire to the input terminal on this board.

CN401 and CN402, Integrated Class D Amplifier

The integrated Class D amplifier outputs are the CN401 and CN402 terminals. The amplifier output configuration options are Single-Ended (SE) and Balanced Transless (BTL). The board provides dedicated LC LPF and output terminals for SE and BTL modes.

The BTL output terminal CN401 is a 4−pin XH connector (by JST MFG) that can be connected directly to a single speaker.

The SE output terminal CN402 is a 3.5 mm stereo jack (Black) is used that can be connected directly to stereo headphones.

The SE and BTL modes are configured via the jumpers JP401 and JP402 and an internal register of LC823455.

An internal function register sets the volume adjustments of the integrated Class D amplifier.

External Audio DAC and Headphone Amplifier

The board includes a high-resolution audio analog output (CN403, 3.5 mm stereo jack, Green). When installed, the dedicated amplifier easily drives stereo headphones. This section consists of an audio stereo DAC (U402), a dual potentiometer (VR401), and a stereo headphone amplifier (U404).

To adjust the volume, turn the potentiometer shaft. When the internal register of LC823455 is used to adjust the volume, turn the shaft of potentiometer all the way to the right.

There are no configuration settings required to operate this DAC. The DAC serves as the I2S slave device with no configurable control pins or registers. The DAC XSMT pin, called “DAC_MUTE” in net, and connected to the I/O expander, is not controlled by I/O expander.

Storage

There are two types of onboard solid−state storage (eMMC & serial flash) options connected to the SD0 interface on LC823455.

To choose storage from eMMC and serial flash, set the Storage MUX jumpers JP501−JP506 (signal) and JP507 (power) located at the right side middle section of Figure 5 according to silkscreen printing on the board. The default is eMMC and JP501−JP507 are closed between pin 2 and pin 1.

These storage devices are available at both 1.8 V and 3.3 V logic I/O levels with no user−definable settings.

The evaluation board also includes a MicroSD slot (CN501) connected to the SD1 interface on the LC823455. The power supply voltage of the slot is configurable, either 3.3 V or 2.8 V using JP508. The default is 2.8 V to achieve a low power consumption operation.

I/O signal level of SD1 is configurable as 1.8 V and 2.8 V/3.3 V to the “VddSD1” terminal of U1. The two types of voltage (1.8 V and 2.8 V/3.3 V) connect to VddSD1 via a power MUX U4. The default setting is 2.8 V/3.3 V, as required for initialization. When using 1.8 V as the VddSD1 power supply, the configuration of U4 and register of LC823455 is needed.

U4 is connected to the I^2C I/O expander. Setting U4 is required to access the I/O expander via the I^2C interface. For more information about these settings, refer to AND9964/D: “System Functions User’s Manual for LC823455 Software Development” and TCA6416A (I^2C I/O Expander from Texas Instruments) data sheet.

Detail of Power Supply Input

Refer to Figure 1–Figure 3 block diagrams for detailed schematics.

Power Supply Input and Its Requirements

The board includes three kinds of power input terminals (CN201, CN202, and CN2) connected to the “Diode OR” circuit. The operating voltage range is from 4.4 V to 5.5 V, using a 5 V DC power supply to one of these terminals is typical. When multiple power input terminals are powered, the highest voltage power supply is selected automatically by the “Diode OR” circuit. The board operates with low current consumption of less than 0.1 A, a 0.5 A power supply is sufficient.

CN201

(DC Jack, Polarity: Center Plus, Size: 5.5 x 2.1 mm)

The CN201 power input jack features RVP (Reverse Voltage Protection) and OVP (Over Voltage Protection). This jack accepts a common DC plug often used in small electronic devices, making it suitable for most applications. A wall adaptor that outputs 5 V DC with a DC plug can be used as a power supply. A laboratory-grade DC power supply can also be used.

CN202 (XH Connector by JST MFG., 2-pin Header)

The CN202 power input terminal for connecting a Li−Ion battery has no protection circuit.

CN2 (Micro USB Connector)

USB Host equipment such as a PC or a commercially available USB wall charger can be used as a power supply. The default setting for the port is USB Device via jumper JP21.

U3 (FAN54005)

This IC features a boost converter for OTG and charger for a Li−Ion battery. When LC823455 operates as a “USB Device”, there is no need to use this U3. On the other hand, when LC823455 is used as “USB Host”, operating U3 as a boost converter is required. For more information about FAN54005, refer to the data sheet.

Power Supply for LC823455

This section is a power management circuit for U1 and consists of two DCDC converters and four LDO regulators. In addition to U1, this section provides power to peripheral circuits and external audio converters (ADC and DAC).

U101, DCDC (1.0/1.1 V)

U101 is the core (Vdd1) power supply for LC823455. Two user−selectable output voltage options (1.0 V and 1.1 V) provide optimization of power consumption of LC823455. An I/O expander connected to the I^2C bus sets the output voltage. The default voltage is 1.0 V.

U101, DCDC (1.8 V)

U101 is a general-purpose 1.8 V power supply for digital circuits. The main loads are Vdd2 of LC823455 (set to 1.8 V), SD1 (VddSD1), eMMC I/O, and serial flash.

SW101

Use switch SW101, a DPDT (Double Pole, Double Throw) On−On type switch, to select the Vdd2 power supply source voltage and set the logical level of the Vdd2IO pin of the LC823455. LC823455 provides two user−selectable options on Vdd2 – either 1.8 V or 3.3 V. For more information about Vdd2IO, refer to the LC823455 data sheet.

U103, LDO 3.3 V

The U103 power supply integrates USBPHY with the LC823455 and external audio converters. These loads require a low noise power supply. Therefore, a dedicated LDO is provided.

U104, LDO 1.8 V

The U104 power supply integrates USBPHY and ADC with the LC823455. These loads require a low noise power supply. Therefore, a dedicated LDO is provided.

U105, LDO 1.5 V

The dedicated U105 power supply integrates the digital amplifier to the LC823455. An LDO provides a low noise power supply for high-quality audio. The input of this LDO is selectable. Input sources are VBAT or output of 1.8 V DCDC (U101). The default is DCDC 1.8 V.

U102, LDO 1.0V

The U102 power supply for the clock generator integrates USBPHY to the LC823455. Clock generator circuits require a low noise power supply. Therefore, a dedicated LDO is provided.

U207, DCDC 3.3 V

U207 is a general-purpose 3.3 V power supply for digital circuits. The main loads are Vdd2 of LC823455 (set to 3.3 V), SD1 (VddSD1, microSD slot), eMMC Core and I/O, serial flash, LCD module, and LEDs. When Vdd2 of LC823455 is set to 3.3 V by SW101, this power supply is used.

U208, DCDC 2.8 V

U208 is a dedicated power supply for MicroSD slot and SD1 I/O supply (VddSD1) with an output voltage of 2.8 V. To use a microSD card at a power consumption lower than 3.3 V, configure the voltage via jumper JP508.

Power Supply for SD1

U504, Load SW

U504 is a power switch for the MicroSD slot (CN501). The default setting is “ON” – controlled via an I/O expander (U301).

U4, Power MUX

Multiplexer U4 is used for selecting the VddSD1 power supply source and controlled via an I/O expander (U301). The configuration options are 3.3 V (2.8 V) or 1.8 V. The default setting is 3.3 V (2.8 V). (3.3 V (2.8 V) is required at the initial negotiation between SD card and LC823455. Configuration of the registers of the I/O expander and LC823455 is required to change the VddSD1 voltage.

Power Supply for RTC

U203 and U204, Power Supply for RTC

The RTC dedicated power supply uses low quiescent current type LDO regulators. LC823455 accepts both 0.8 V and 1.0 V as the RTC power supply. Select the RTC supply voltage via jumper JP218. The default is via the 0.8 V LDO.

U205 and U206, Voltage Supervisor for RTC

Two supervisor ICs monitor the RTC voltage. Select the correct voltage via jumper JP218. The default supervisor IC is 0.8 V.

Power Supply for Wi−Fi/BT

U901, U902 and JP901, Dedicated Power Supplies

Two voltage regulators, a DCDC converter (U901) and an LDO regulator (U902), are provided as Wi−Fi/BT dedicated power supply. The default is DCDC (U901) set via jumper JP901. On PCB Rev.2.0, the LDO outputs 0.8 V by PCB design. Therefore, DCDC must be selected.

JP902, External Power Supply Input for M.2 Module

JP902 accepts an external power supply to the M.2 module. However, the default is onboard supply. To connect an external power supply to the M.2 connector, remove the jumper plug on JP902 and connect it to the supply.

R915, Shunt Resistor for Current Measurement

A 10 mΩ shunt resistor measures the current consumption of the M.2 module using an external voltmeter. Connect a voltmeter to JP903 to measure the current consumption of the M.2 module by using a 10 mV/A transfer ratio from current to voltage.

Other Power Supplies

JP203, VBAT Monitor and Divider Circuit

The VBAT Monitor and Divider Circuit connects VBAT voltage to the ADC input pins of U1. This circuit consists of two resistors (R203 and R203). Generally, they are called a resistor divider circuit. This circuit divides the VBAT voltage to supply the proper voltage to the ADC. Note that there is a capacitor (Schematic, Sheet 4/17). For information about the ADC input, refer to LC823455 data sheet and AND9964/D: “System Functions User’s Manual for LC823455 Software Development”.

JP210, Power Supply for LED202

Jumper JP210 connects an LED that indicates the VBAT power supply status to VBAT. Blue LED (LED202) lights indicate a correct voltage. The LED drive circuit does not have a voltage detector. The LED only indicates that a correct VBAT voltage is supplied to the board. If the power consumption of this LED inhibits the evaluation of the board, please remove the jumper plug on JP210.

JP212, Power Supply for Headphone Amplifier (U404)

Jumper JP212 is used when connecting the headphone amplifier power supply for an external audio DAC to VBAT. If not used, remove the jumper plug on JP212.

JP207, Power Supply for ARDUINO Shield and Pmod

Jumper JP207 connects a dedicated power supply for the ARDUINO shield (connected to CN701−CN704) and Pmod (CN705) to VBAT. 5 V in CN701 is connected to VBAT directly. This rail has no regulators. VBAT is supplied via OVP, RVP, or Diode−OR circuit from the power supply connector. If accurate 5 V power is required, supply the correct voltage to the power connector so that VBAT voltage is 5 V. 3.3 V at CN701 and CN705 is supplied from a dedicated LDO regulator (U702). When not using the ARDUINO shield or Pmod, JP207 can be open.

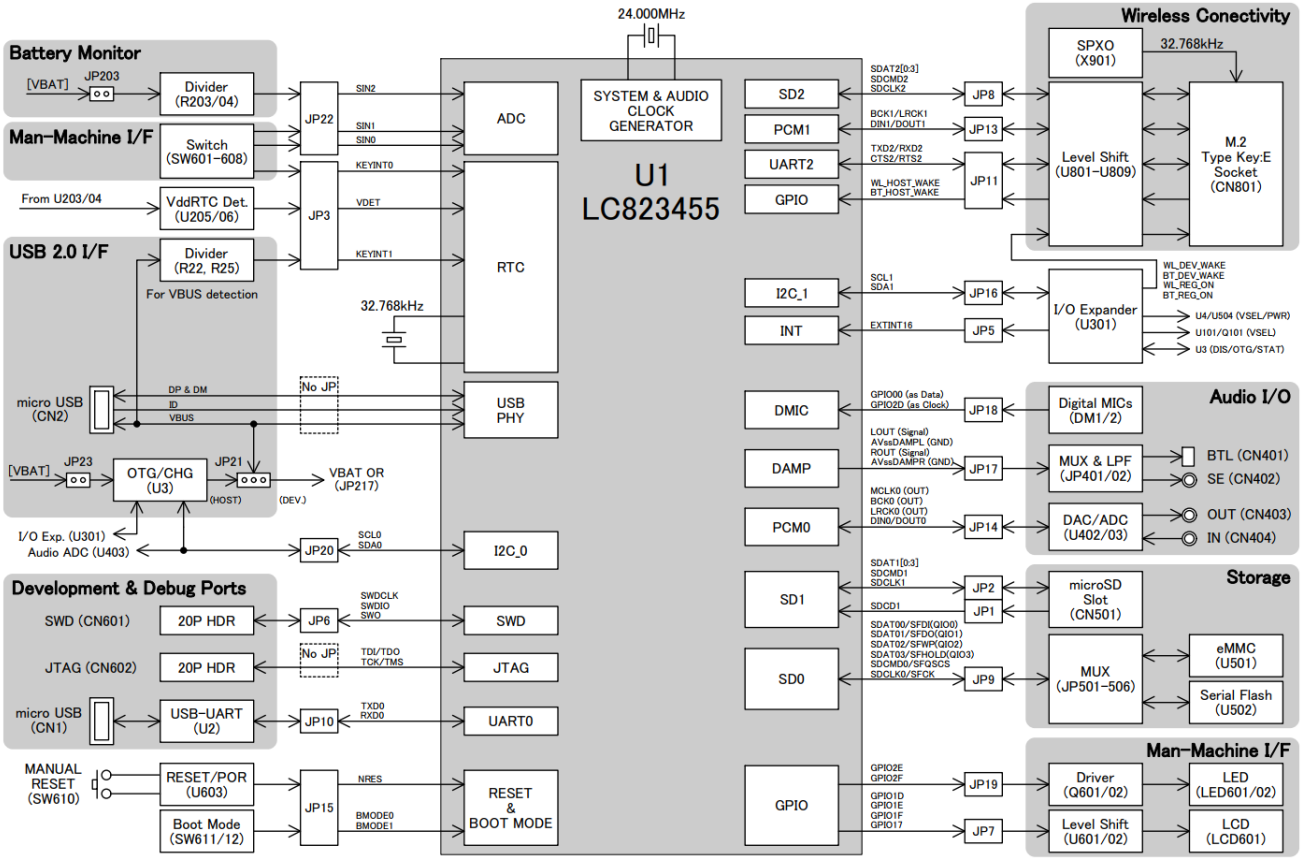


Figure 1. Block Diagram (Signal Only)

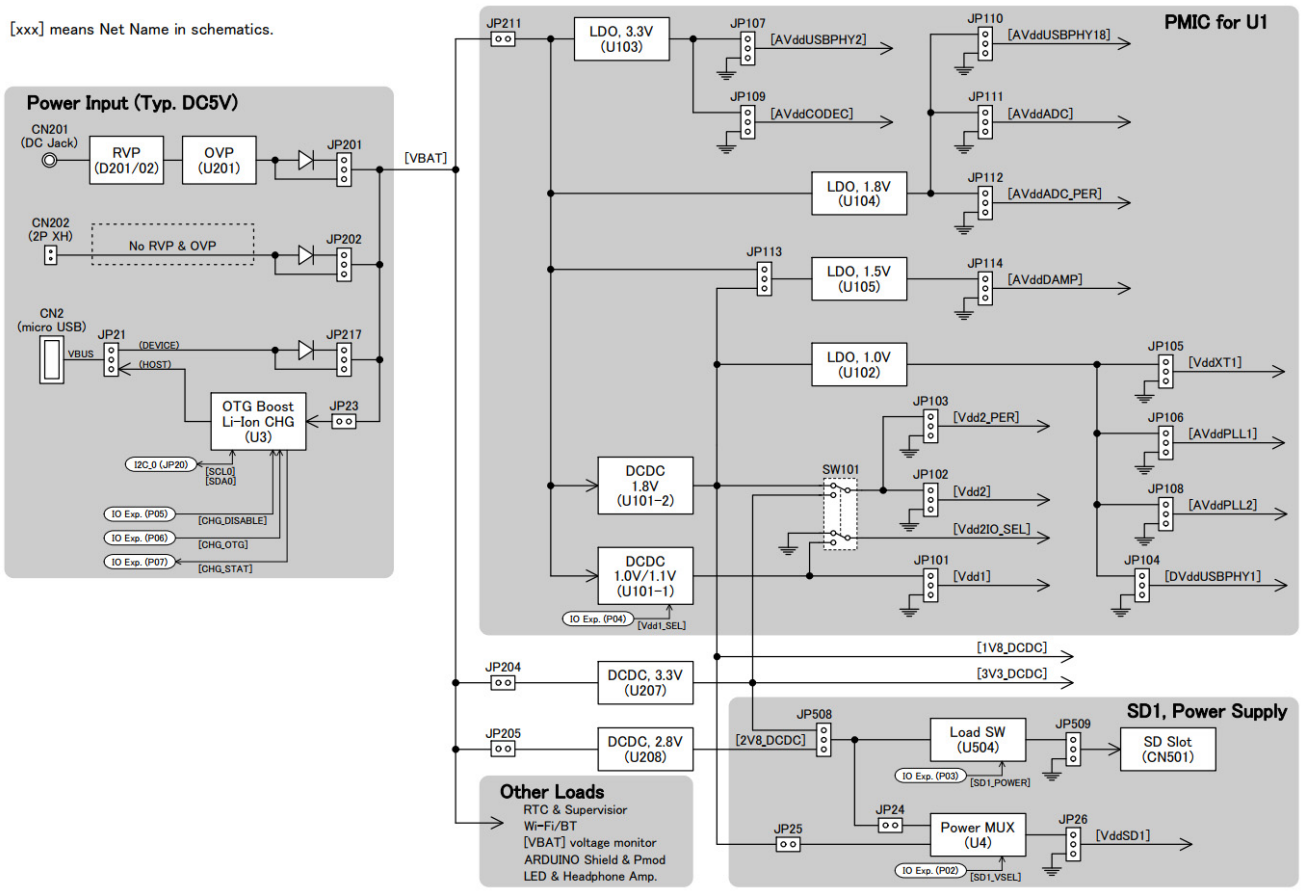


Figure 2. Block Diagram (Power Supply, Main)

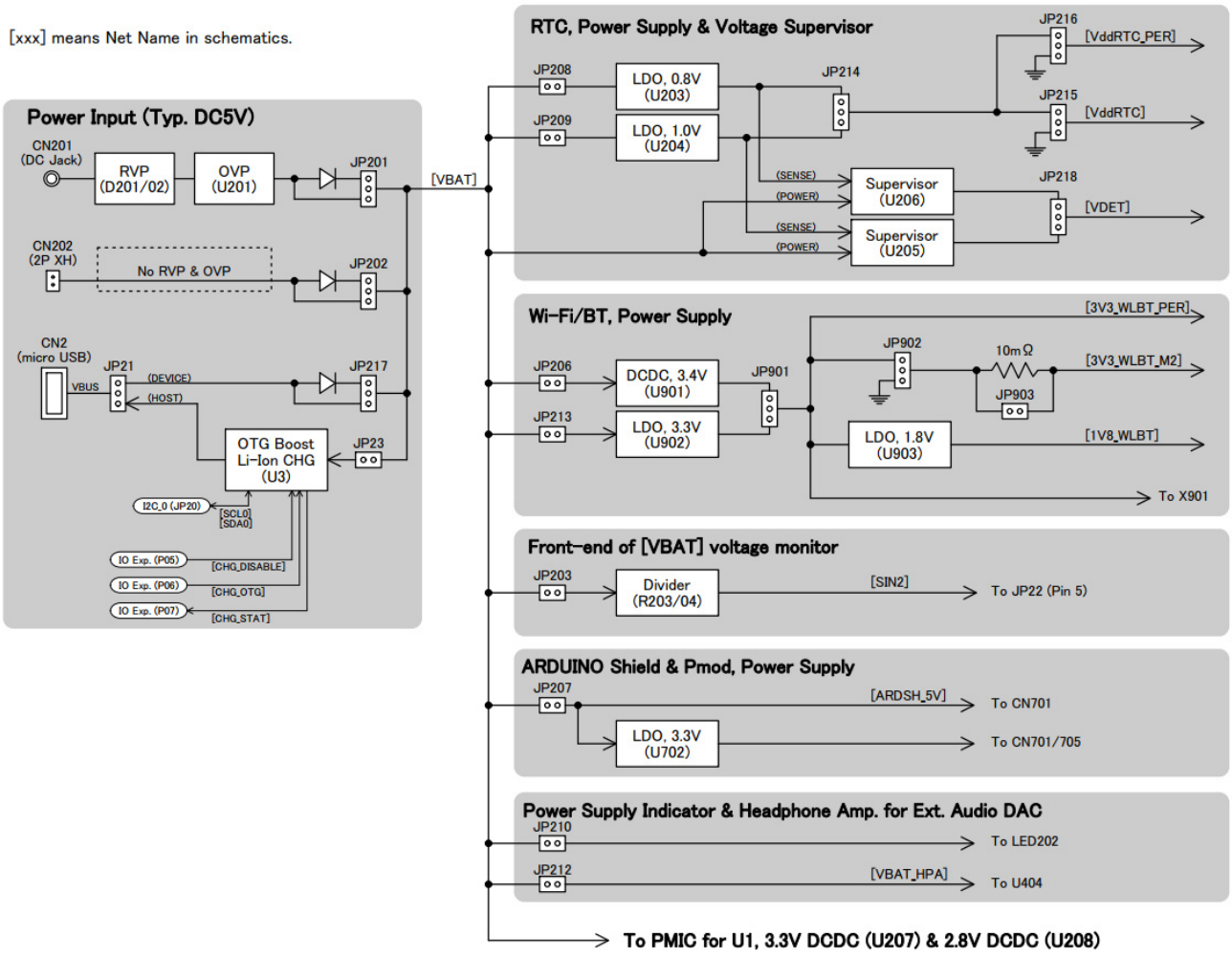


Figure 3. Block Diagram (Power Supply, Sub)

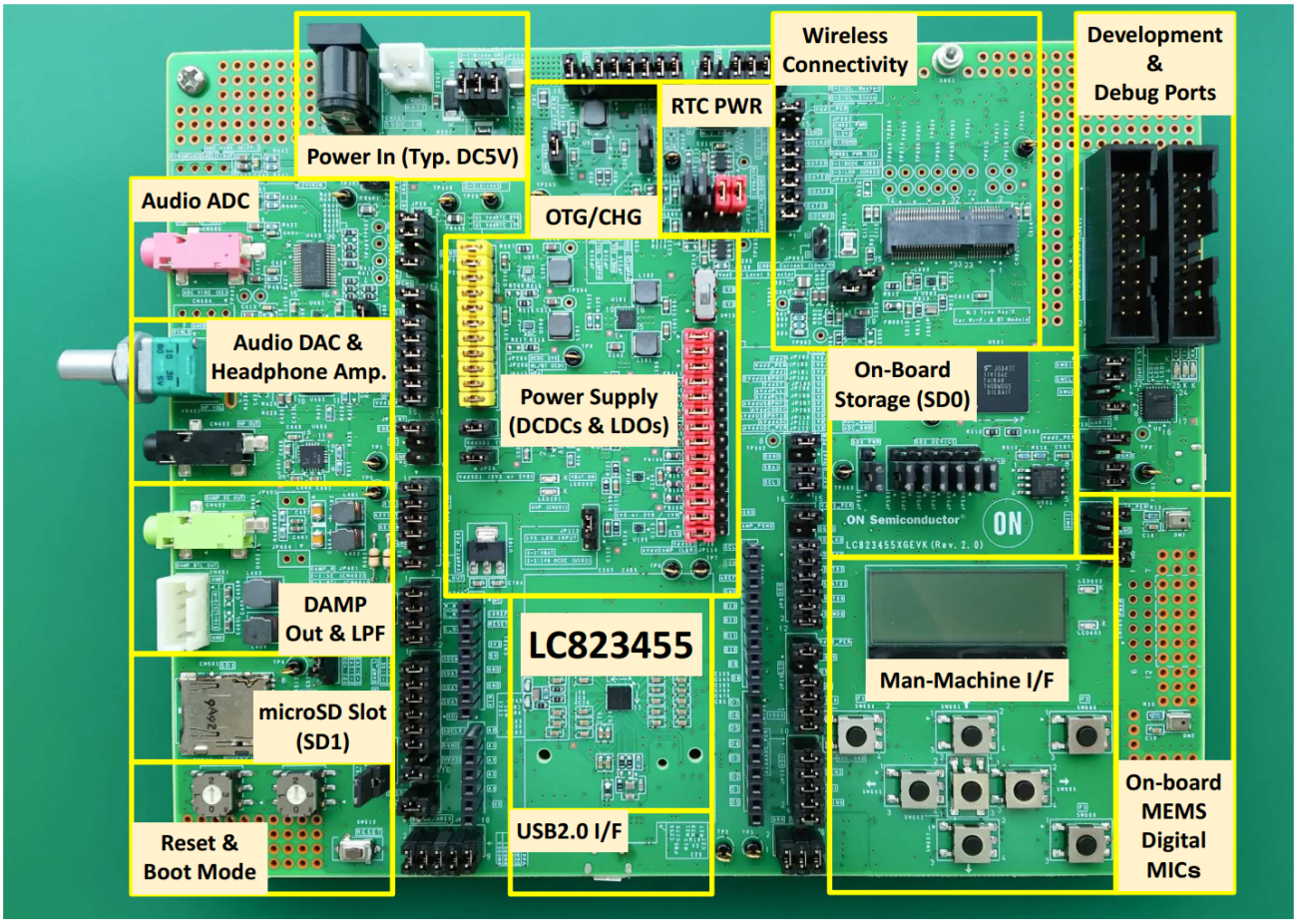


Figure 4. LC823455XGEVK (Function Block)

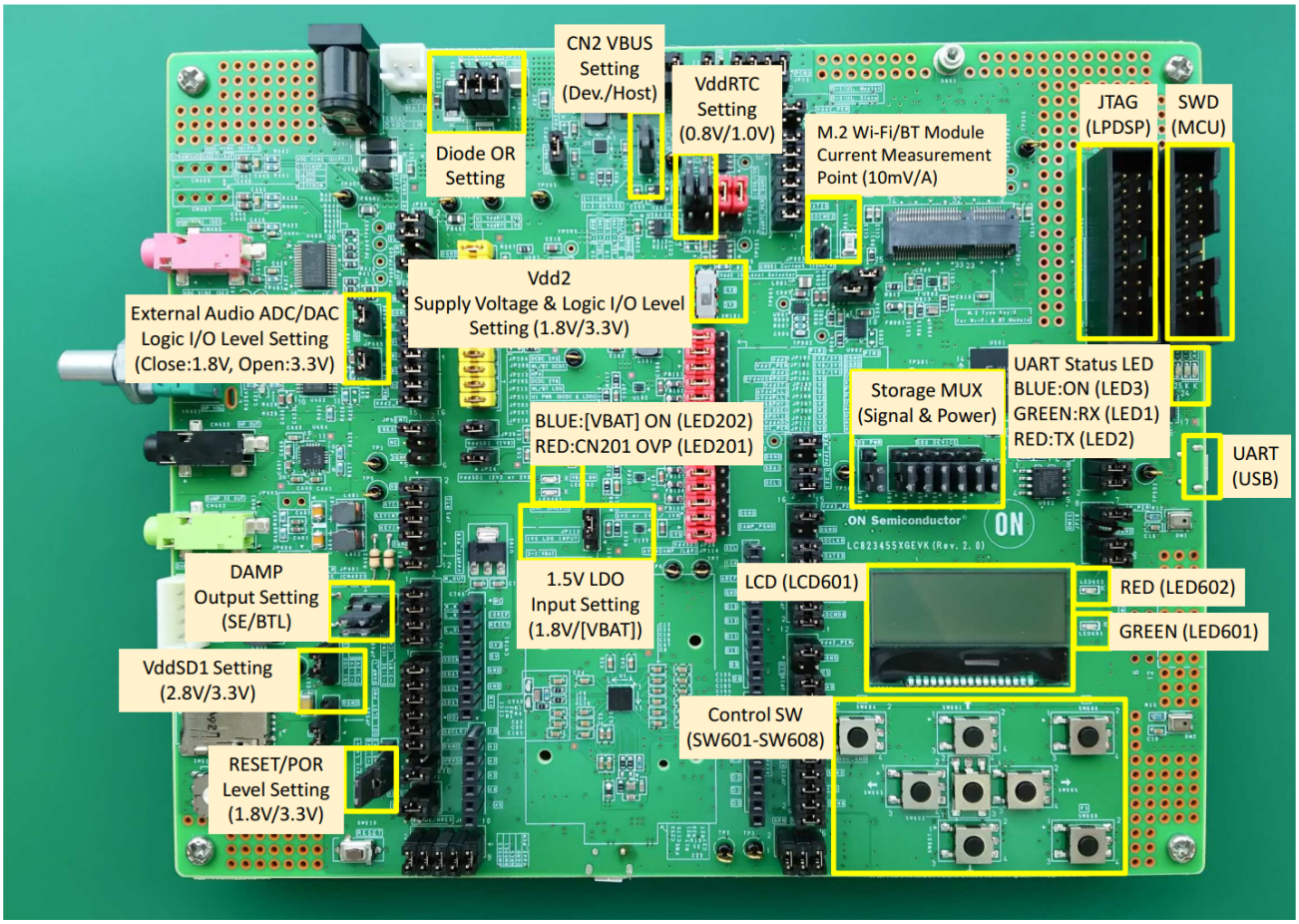


Figure 5. LC823455XGEVK (Detailed, 1/2)

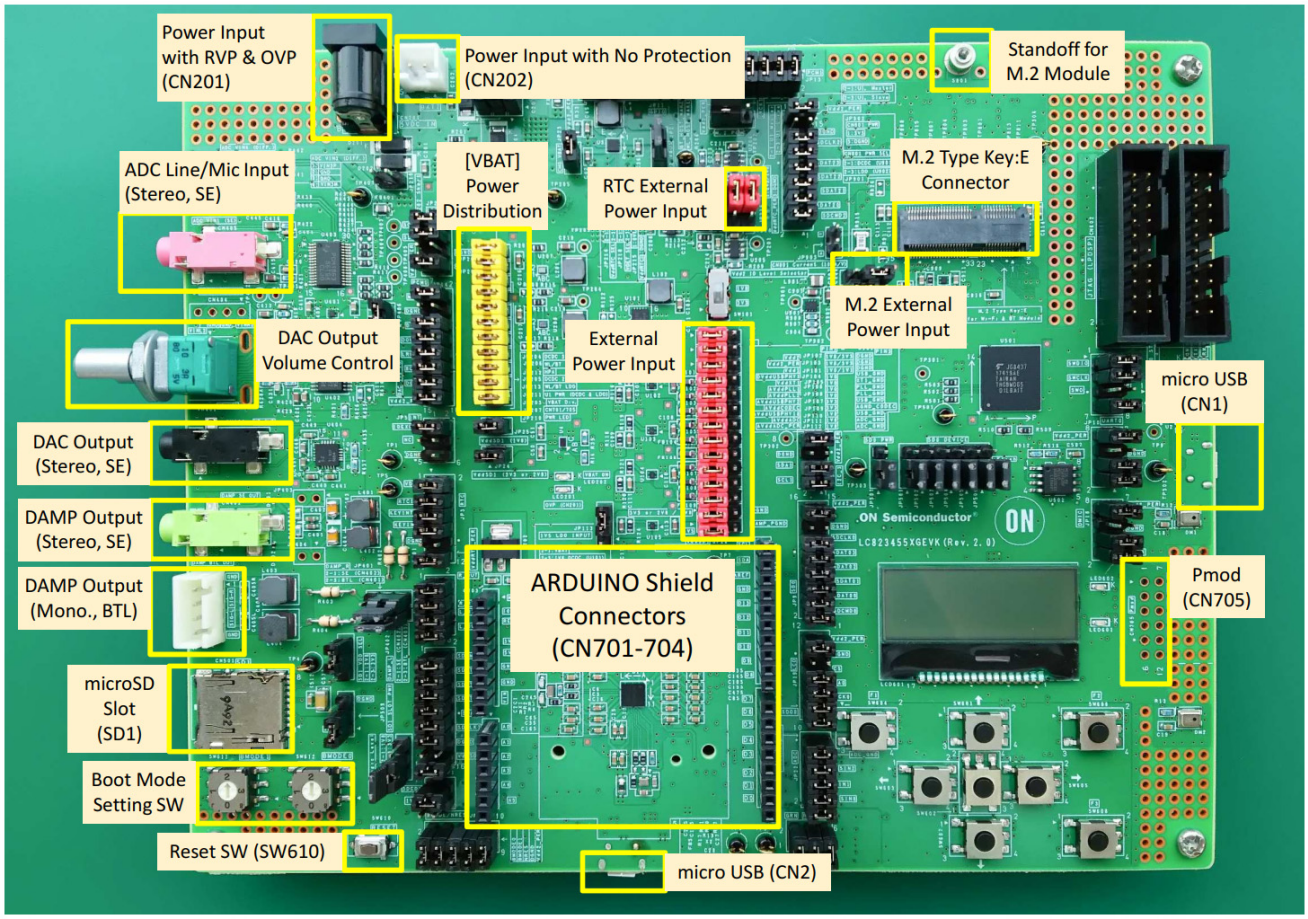


Figure 6. LC823455XGEVK (Detailed, 2/2)

ON Semiconductor is licensed by the Philips Corporation to carry the I²C bus protocol.
Cortex is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.
PCI Express is a registered trademark of PCI−SIG.
Wi−Fi is a registered trademark of Wi−Fi Alliance.
All other brand names and product names appearing in this document are registered trademarks or trademarks of their respective holders.

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

The evaluation board/kit (research and development board/kit) (hereinafter the "board") is not a finished product and is as such not available for sale to consumers. The board is only intended for research, development, demonstration and evaluation purposes and should as such only be used in laboratory/development areas by persons with an engineering/technical training and familiar with the risks associated with handling electrical/mechanical components, systems and subsystems. This person assumes full responsibility/liability for proper and safe handling. Any other use, resale or redistribution for any other purpose is strictly prohibited.

The board is delivered "AS IS" and without warranty of any kind including, but not limited to, that the board is production−worthy, that the functions contained in the board will meet your requirements, or that the operation of the board will be uninterrupted or error free. ON Semiconductor expressly disclaims all warranties, express, implied or otherwise, including without limitation, warranties of fitness for a particular purpose and non−infringement of intellectual property rights.

ON Semiconductor reserves the right to make changes without further notice to any board.

You are responsible for determining whether the board will be suitable for your intended use or application or will achieve your intended results. Prior to using or distributing any systems that have been evaluated, designed or tested using the board, you agree to test and validate your design to confirm the functionality for your application. Any technical, applications or design information or advice, quality characterization, reliability data or other services provided by ON Semiconductor shall not constitute any representation or warranty by ON Semiconductor, and no additional obligations or liabilities shall arise from ON Semiconductor having provided such information or services.

The boards are not designed, intended, or authorized for use in life support systems, or any FDA Class 3 medical devices or medical devices with a similar or equivalent classification in a foreign jurisdiction, or any devices intended for implantation in the human body. Should you purchase or use the board for any such unintended or unauthorized application, you shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the board.

This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and may not meet the technical requirements of these or other related directives.

FCC WARNING − This evaluation board/kit is intended for use for engineering development, demonstration, or evaluation purposes only and is not considered by ON Semiconductor to be a finished end product fit for general consumer use. It may generate, use, or radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment may cause interference with radio communications, in which case the user shall be responsible, at its expense, to take whatever measures may be required to correct this interference.

ON Semiconductor does not convey any license under its patent rights nor the rights of others.

LIMITATIONS OF LIABILITY: ON Semiconductor shall not be liable for any special, consequential, incidental, indirect or punitive damages, including, but not limited to the costs of requalification, delay, loss of profits or goodwill, arising out of or in connection with the board, even if ON Semiconductor is advised of the possibility of such damages. In no event shall ON Semiconductor's aggregate liability from any obligation arising out of or in connection with the board, under any theory of liability, exceed the purchase price paid for the board, if any.

For more information and documentation, please visit www.onsemi.com.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Email Requests to: orderlit@onsemi.com

ON Semiconductor Website: www.onsemi.com

TECHNICAL SUPPORT
North American Technical Support:
Voice Mail: 1 800−282−9855 Toll Free USA/Canada
Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative

◊