

Digitally Controlled Potentiometer (DCP)

This digital potentiometer evaluation USB kit provides you with a tool for evaluating the operation of many kinds of different Digitally Controlled Potentiometers (DCPs). It includes a ISLUSB2DCPMBEV1Z interface board also called a motherboard, DCP evaluation software, and a DCP evaluation board also called a DCP Daughter Card. The DCP Evaluation Kit provides a platform for evaluating all functions and features of DCPs and supports I2C, UP/DOWN, and Push Button interfaces. The 2-piece construction (using a motherboard and a daughter card) enables remote control operation of a DCP from PC through the USB port.

Kit Contents

- Interface Board (Motherboard) - ISLUSB2DCPMBEV1Z
- DCP Evaluation board (Daughter Card) - ISL22317

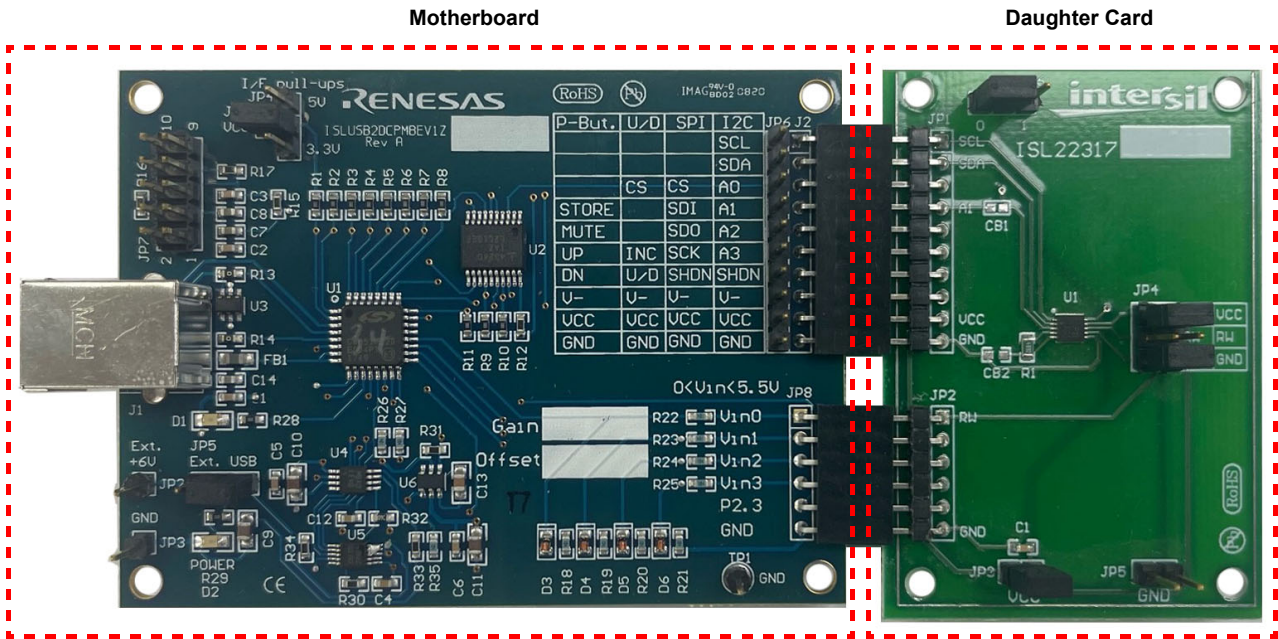


Figure 1. DCP Evaluation Platform

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1. Functional Description

The DCP Evaluation Kit provides a platform for evaluating all functions and features of DCPs and supports I2C, UP/DOWN, and Push Button interfaces. The 2-piece construction (using a motherboard and a daughter card) enables remote control operation of a DCP from PC through the USB port.

1.1 Installation of the DCP Evaluation Software and USB Drivers

The DCP evaluation software and USB drivers have to be installed on a PC running Windows NT/2000/XP/Vista/7/8/10 Operating System before connecting the ISLUSB2DCPMBEV1Z interface board to the USB port.

- The DCP Evaluation software can be downloaded from the [Renesas Website](#).
- Run the Renesas_DCP_Installer_VXXX.exe executable file.
- When the installation wizard appears, click **Next**.
- Click to agree to installation.
- The following windows lets you know that the installation program placed the DCP evaluation software in C:\USERS\PUBLIC\Renesas\DCP_VXXX, and that you can have the installation wizard create a desktop icon for easy access to the software.

After the software has been installed, plug the ISLUSB2DCPMBEV1Z board into the USB port and let Windows set up a driver for the new hardware.

2. Overview and Operation of the DCP Evaluation Platform

2.1 Hardware Overview

2.1.1 ISLUSB2DCPMBEV1Z Interface Board (Motherboard)

The motherboard provides the interface between a PC and DCP evaluation board (daughter card), as shown in [Figure 1](#). A USB cable, with type A and B connectors on each end, is required to plug the board into a PC (schematic of ISLUSB2DCPMBEV1Z board in Appendix A). The ISLUSB2DCPMBEV1Z board is powered from the USB port. It contains a microcontroller (U1) with USB interface (J1) for communicating with the PC, and I/O pin connector (J2) to supply power and communicate with the DCP daughter card.

The mother board also provides power to the daughter card either from the USB port or from an external power supply through the adjustable voltage regulator (U4). An external power supply can be connected to JP2 (+6V) and JP3 (GND) hookup pins. A JP5 jumper allows the selection between USB or external power. An on-board inverter (U6) generates negative voltage from U4 output. Both positive (VCC) and negative (V-) outputs are controlled through the Graphical User Interface (GUI) of the DCP evaluation software.

The U2 MUX minimizes the number of J2 pins by mapping selected interface to the daughter card connectors J2 and JP6. The J2 and JP6 mapping is fully compatible with previous generation of DCP evaluation boards, such as the XLABVIEW01 board. The voltage at VIN0, VIN1, VIN2, and VIN3 pins of JP8 can be measured through the onboard ADC. Usually these inputs are wiper outputs from the daughter card. **Note:** The ADC can measure only positive signals from 0V to 5.5V; negative inputs are blocked out by Schottky diodes D3~D6.

2.1.2 DCP Evaluation Board (Daughter Card)

Each DCP daughter card is different, but typically contains one DCP device, one or two connectors to attach to the mother board, and a DCP terminal header allowing different terminal configurations, such as connection to VCC, GND, V-, or to each other.

The ISL22317 daughter card (shown in [Figure 2](#)) has a JP1 male connector to match with the JP2 female connector of the mother board to provide VCC, V-, GND, and I2C interface signals to the DCP. The JP2 male connector provides wiper outputs back to the mother board through the matching JP8 to be measured and

displayed on the GUI, or measured from the terminal header JP4. The DCP terminals RH, RW, and RL can be left open, or connected to VCC, V-, each other or external circuitry by using jumpers. The VCC power is supplied through the JP3 jumper from the motherboard. The JP3 header also allows measuring power consumption of the DCP by connecting an ammeter between the JP3.1 and JP3.2 pins instead of a jumper, or use an external power supply connected to JP3.2.

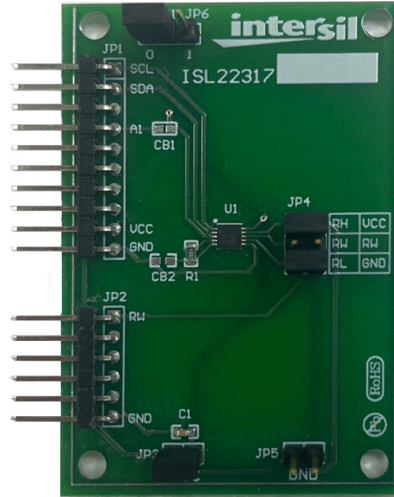
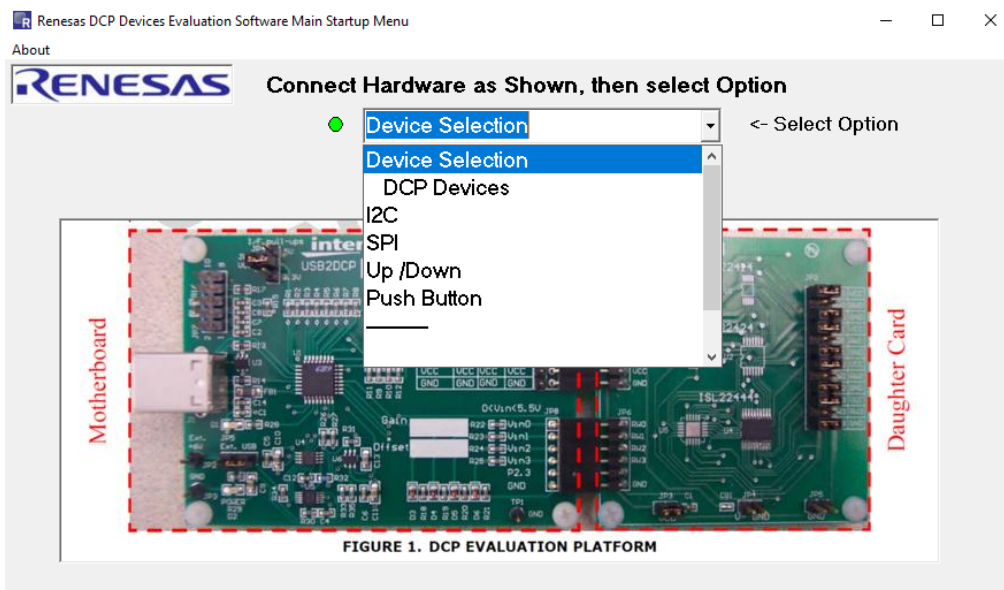


Figure 2. ISL22317 DCP Daughter Card

3. DCP Evaluation Software

3.1 Software Overview

When the DCP evaluation software starts, the **Connect Hardware as Shown, then select Option** window appears and you can select the appropriate interface from a pull-down menu and view an image of the DCP evaluation platform and how it should be connected, as shown in [Figure 3](#) and [Figure 1](#), respectively. Select either **I²C**, **Up/Down**, or **Push Button** interface.



NOTE: Green lights indicate that ISLUSB2DCPMBEV1Z board is attached and communication is established.

Figure 3. DCP Device Selection Window

The product demonstration GUI automatically appears when the interface is selected as shown in [Figure 4](#). It starts up with the **Manual Setup** window, where you can choose items such as a number of taps, number of DCPs in package (such as single, dual, or quad), slave address, address pin settings A0~A4, enable or disable VCC, and V- outputs.

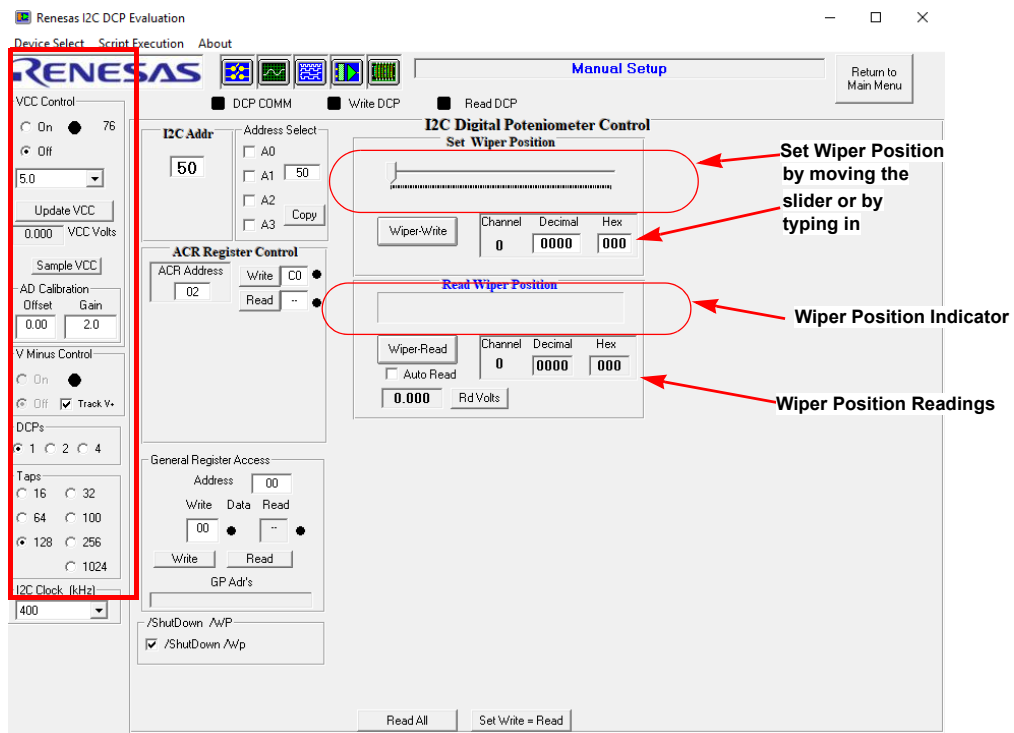


Figure 4. I²C Interface Product Evaluation Window, Manual Setup

There are convenient initial setups available for Renesas supported I²C DCPs from the **Device Select** pull-down menu, located on the menu bar, -> Parameter file as shown in [Figure 5](#).

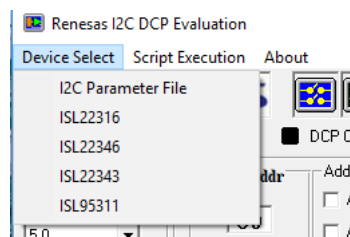


Figure 5. I²C Device Select Pull-Down

All executable functions are separated by individual frames that provide more visibility and convenient. All white text boxes have either a pull-down menu, selectable, or type-in capability. Type-in capability means that you can type in a new value, hit the **Enter** button on the keyboard, or **Write/Read software** button, and this data is executed by the software. Gray boxes are read only.

The interface clock frequency for the I²C interface is selectable from a pull-down menu as well.

3.2 VCC Control

To start communication with the DCP, the on-board voltage regulator has to be turned on. The regulator control (such as VCC Control) is located in the upper left corner of the GUI. There are several VCC options available in the pull-down menu from fixed to user-adjustable. By default, VCC is set to 5V. The negative V- voltage tracks the VCC or can be turned off.

The VCC level is automatically sampled by an on-board Analog-to-Digital Converter (ADC) every time the VCC is turned on or off, or can be manually sampled by pushing the Sample VCC button.

The ADC requires calibration to receive the correct VCC readings. The calibration procedure is shown in the following steps:

1. Set the VCC level to 5.0V. Use an external voltmeter to measure the actual VCC output and record its reading as Measure1. Write down the ADC reading as Read1.
2. Set the VCC level to 3.0V. Write down the voltmeter reading as Measure2 and the ADC reading as Read2.
3. Calculate the ADC Gain using [Equation 1](#).

(EQ. 1)
$$\text{Gain} = 2 \times \frac{\text{Measure1} - \text{Measure2}}{\text{Read1} - \text{Read2}}$$

4. Enter the new Gain value and repeat the measurement starting at Step 1.
5. The ADC Offset = Measure1 - Read1. The calibrated Gain and Offset values can be written down directly on the ISLUSB2DCPMBEV1Z motherboard and should be used for correct readings.

3.3 Set Wiper Position in I²C interfaces

The wiper position can be set by moving the slider or by typing in a hex or decimal value in the corresponding text box, see [Figure 4](#). Software automatically reads back the wiper register if the **Auto Read** box is checked out. Each DCP channel has its own wiper control and read capability. Set the wiper position in the Up/Down and Push-Button Interfaces

3.4 Set Wiper Position in Up/Down and Push-Button Interfaces

To move the wiper in an up or down direction, enter the number of counts in corresponding text box as shown in [Figure 6](#) and push the **Up** or **Down** button.

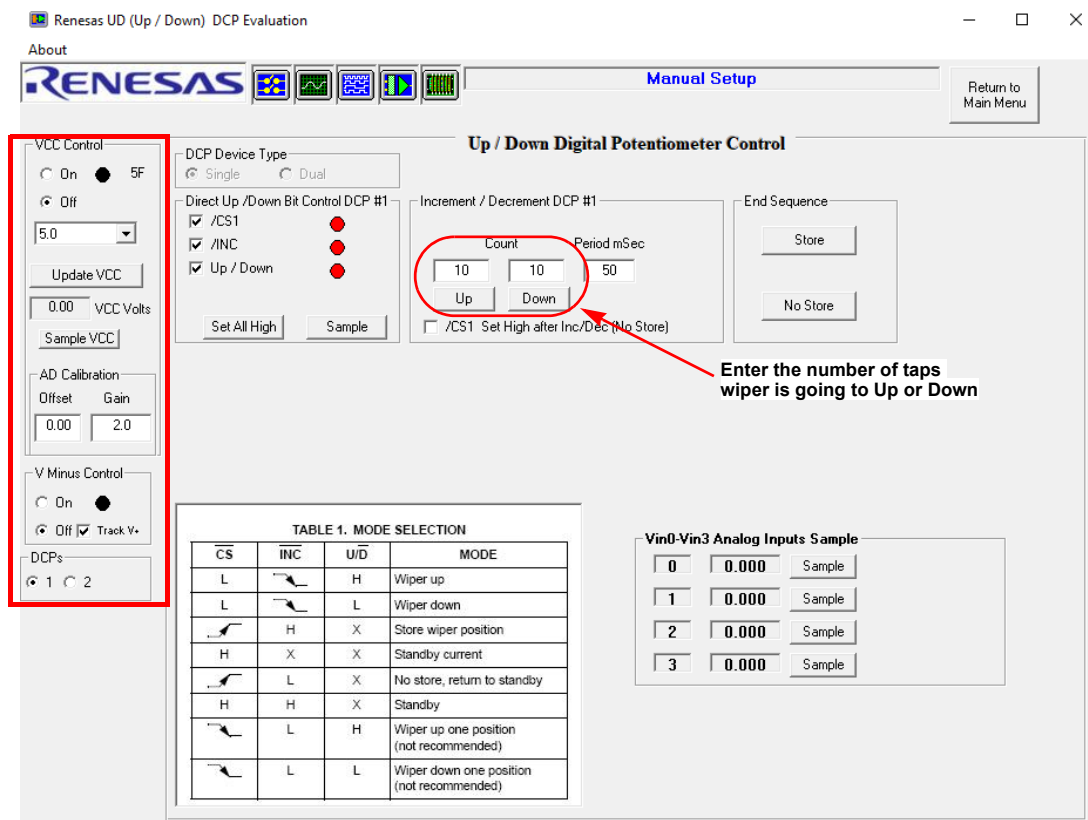


Figure 6. Up/Down Interface Product Evaluation Window

4. Script Execution

The DCP evaluation software allows multiple commands to be executed, which were written in sequence in a script file. A script file is a text file written in Notepad or other simple text editing programs. There are some examples of script files provided for your convenience, that can be opened by following **Script Execution > File > Open Script File** from the menu bar. Script files can be executed only in I²C and SPI interface product windows. Script execution is not supported for Up/Down and Push-button DCPs.

4.1 I²C Script File

The structure of the command line for the I²C interface is a Slave Address followed by a Register Address, Write Data, Read Data, and Comments. The data in the command line is separated by a comma without spacing. All spaces are ignored.

The Slave Address should be written once at the beginning of the command sequence, starting with an acute symbol and letter A. For example, 'AA0 for Address A0 or 'A50 for Address 50. This slave address is used for all lines below in the sequence until the next address line, if a script file is written to communicate with several DCPs on the bus. Comments must start with the number sign (#) followed by any ASCII symbols.

The Write Data or Read Data can be omitted for Read only or Write only operation. For example:

- 00,55, #write 55 to address 0 without reading back
- 00,55,55 #write 55 to address 0, then read back from address 0. The read data is compared with 55
- 00, ,55 #read from address 0 and compare result with 55

The wait command starts with the acute symbol followed by a letter w and a number that represents waiting time before execution of the next command in milliseconds. For example, 'w1000 #delay for 1000ms. The script execution window is shown in [Figure 7](#).

Line	I2C Adr	Reg Adr	Data_Wr	Data_Rd	Act_Rd	Operation	Comment
001	50					NOP	#ISL22317 DCP Step and We
002	50					NOP	#010622 rgrist, ddbromirov
003	50					NOP	Script File has a blank line
004	50					Cmd:Set I2C Adr	# Default Address 50
005	50	02	C0	C0	--	Reg:1 W:1 R:1	# Write to ACR, Set WR activ
006	50	00	7F	7F	--	Reg:1 W:1 R:1	# Write to Wiper set to max ar
007	50					Cmd:Delay :1000: mSec	# Wait one second
008	50	00	00	00	--	Reg:1 W:1 R:1	# Write to Wiper Set to Min ar
009	50					Cmd:Delay :1000: mSec	# Wait one second

Figure 7. ISL22316 Script Execution Example

Successfully executed commands are highlighted by a green color, while non successful command or unexpected returned values are highlighted by a red color. A script file can be executed at once, or put in a loop by pressing the **Run All Steps** or **Loop Count** buttons in the upper right corner of the Script Execution Window. The actual read data can be stored in an updated script file by specifying a path and pressing the **Write to Disk** button.

5. Board Design

5.1 ISLUSB2DCPMBEV1Z

5.1.1 Schematic Diagrams

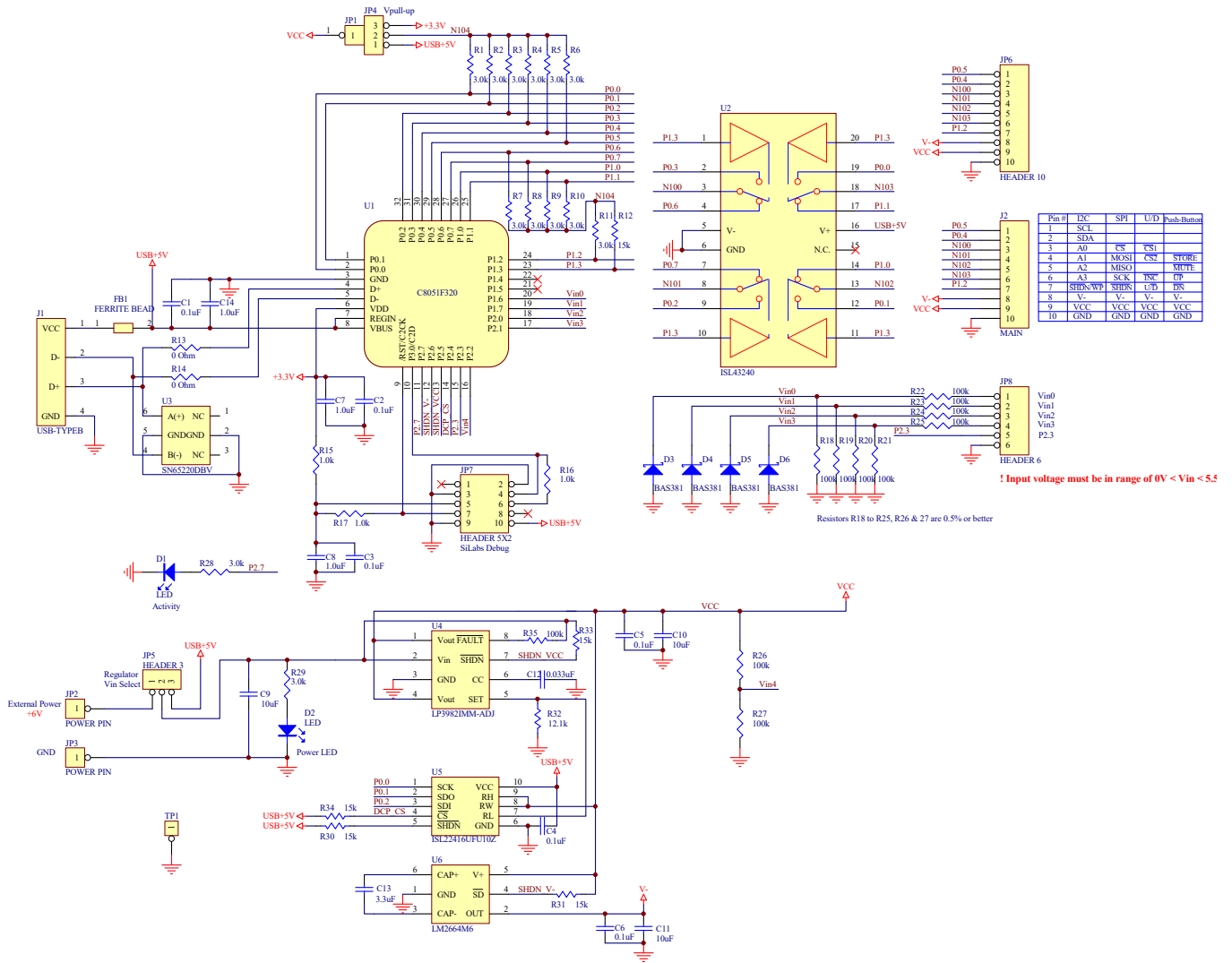


Figure 8. ISLUSB2DCPMBEV1Z Schematic

5.1.2 Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1		PWB-PCB, ISLUSB2DCPMBEV1Z, REVA, ROHS	Imagineering Inc	ISLUSB2DCPMBEV1ZREVAPCB
6	C1, C2, C3, C4, C5, C6	CAP, SMD, 0603, 0.1 μ F, 50V, 10%, X7R, ROHS	AVX	06035C104KAT2A
3	C7, C8, C14	CAP, SMD, 0603, 1 μ F, 50V, 10%, X5R, ROHS	TDK	C1608X5R1H105K
1	C12	CAP, SMD, 0603, 0.033 μ F, 50V, 10%, X7R, ROHS	VENKEL	C0603X7R500-333KNE
3	C9-C11	CAP, SMD, 0805, 10 μ F, 35V, 10%, X5R, ROHS	TDK	C2012X5R1V106K085AC
1	C13	CAP, SMD, 0805, 3.3 μ F, 50V, 10%, X5R, ROHS	TDK	C2012X5R1H335K125AB
1	J1	CONN-USB TYPE B, RECEPTACLE, TH, 4P, R/A, BRD LOCK, 30V, 1.5A, ROHS	MOLEX	67068-9000
1	JP7	CONN-HEADER, 2x5, BRKAWY- 2x36, 2.54mm, ROHS	BERG/FCI	67996-272HLF
4	JP1, JP2, JP3, TP1	CONN-HEADER, 1x1, BREAKAWAY 1x36, 2.54mm, ROHS	BERG/FCI	68000-236HLF
1	JP6	CONN-HEADER, 1x10, BRKAWY 1x36, 2.54mm, ROHS	BERG/FCI	68000-236HLF
2	JP4, JP5	CONN-HEADER, 1x3, BREAKAWY 1X36, 2.54mm, ROHS	BERG/FCI	68000-236HLF
1	JP8	CONN-RECEPTACLE HEADER, TH, 1x6, 2.54mm, R/A, TIN, ROHS	Sullins	PPTC061LGBN-RC
1	J2	CONN-RECEPTACLE, TH, 1x10, 2.54mm, R/A, TIN, ROHS	Sullins	PPTC101LGBN-RC
2	JP1 to JP4-Pin 2, JP5-Pins 2-3	CONN-JUMPER, SHUNT, 2P, 2.54mmPITCH, BLK, 6mm, OPEN, ROHS	Sullins	SPC02SYAN
4	D3-D6	DIODE-SCHOTTKY, SMD, MICROMELF, 40V, 30mA, ROHS	Vishay	BAS381-TR3
2	D1, D2	LED, SMD, 0805, SUPER RED, THIN, 1.8V, 21 MILLICANDELA	Lumex	SML-LXT0805SRW-TR-T
1	FB1	FERRITE-CHIP, SMD, 0805, 33 Ω at 100MHz, 4A, 8m Ω , ROHS	Würth Elektronik	742792012
1	U1	IC-PROG. PID2034_F340_1p0.HEX, USB MCU, 32P, LQFP, 8BIT, ROHS	Silicon Laboratories	C8051F320-GQ

Digitally Controlled Potentiometer (DCP) Evaluation Kit Manual

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1	U5	IC-Digital Potentiometer, 10P, MSOP, ROHS	Renesas	ISL22416UFU10Z
1	U2	IC-QUAD SPDT ANALOG SWITCH, 20P, SSOP, ROHS	Renesas	ISL43240IAZ
1	U6	IC-CMOS VOLTAGE CONVERTER, SMD, 6P, SOT23-6, ROHS	National Semiconductor	LM2664M6/NOPB
1	U4	IC-ADJ. LDO REGULATOR, SMD, 8P, MSOP, 300mA, ROHS	National Semiconductor	LP3982IMM-ADJ/NOPB
1	U3	IC-SINGLE USB PORT TVS, SMD, 6P, SOT-23-6, ROHS	Texas Instruments	SN65220DBVR
2	R13, R14	RES, SMD, 0603, 0Ω, 1/10W, TF, ROHS	Venkel	CR0603-10W-000T
3	R15-R17	RES, SMD, 0603, 1k, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-3EKF1001V
1	R32	RES, SMD, 0603, 12.1k, 1/10W, 1%, TF, ROHS	Venkel	CR0603-10W-1212FT
5	R12, R30, R31, R33, R34	RES, SMD, 0603, 15k, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-3EKF1502V
13	R1-R11, R28, R29	RES, SMD, 0603, 3k, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-073KL
11	R18-R27, R35	RES-AEC-Q200, SMD, 0603, 100k, 1/10W1, 0.5%, ROHS	KOA	RK73H1JT1003D
4	Bottom four corners	BUMPONS, 0.44inWx0.20inH, CYLINDRICAL DOME, BLK, ROHS	3M	SJ-5003 (BLACK)

5.2 ISL22317 DCP Daughter Card

5.2.1 Schematic Drawing

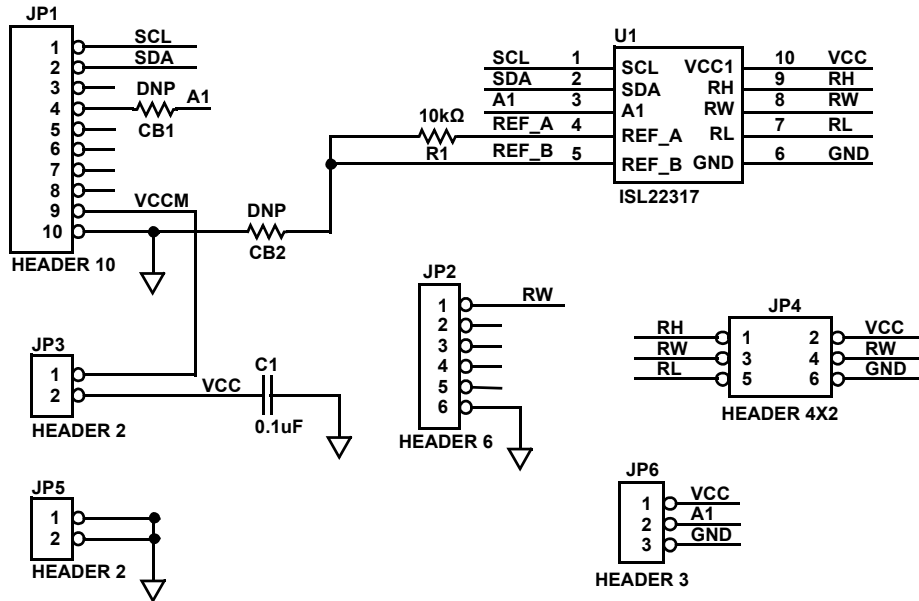


Figure 9. ISL22317 DCP Daughter Card Schematic

5.2.2 Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1	C1	CAP, SMD, 0603, 0.1µF, 50V, 10%, X7R, ROHS	AVX	06035C104KAT2A
1	JP1	CONN-HEADER, 1x10, BRKAWY 1x36, 2.54mm, ROHS	BERG/FCI	6800-236HLF
1	JP2	CONN-HEADER, 1x6, BRKAWY 1x36, 2.54mm, ROHS	BERG/FCI	6800-236HLF
1	JP4	CONN-HEADER, 3x2, BRKAWY 1x36, 2.54mm, ROHS	BERG/FCI	6800-236HLF
1	JP6	CONN-HEADER, 1x3, BRKAWY 1x36, 2.54mm, ROHS	BERG/FCI	6800-236HLF
2	JP3, JP5	CONN-HEADER, 1x2, BRKAWY 1x36, 2.54mm, ROHS	BERG/FCI	6800-236HLF
1	U1	IC-Digital Potentiometer, 10P, TDFN, ROHS	Renesas	ISL22317UFRTZ
1	R1	RES, SMD, 0603, 10k, 1/10W, 1%, TF, ROHS	Generic	Various

6. Ordering Information

Part Number	Description
USB2DCPEVAL	DCP EVK Ordering part

7. Revision History

Revision	Date	Description
2.00	Jan 10, 2022	Applied New Template. Updated Figures 1, 2, and 7. Added ISL22317 information throughout document.
1.00	Aug 20, 2019	Updated the DCP Evaluation Software and USB Drivers section on page 1. Added Figure 3. Updated Figures 4 through 7. Added Revision History. Updated Disclaimer.
0.00	Apr 13, 2010	Initial release

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