

Digitally Controlled Potentiometer (DCP) Evaluation USB Kit

Evaluation Kit

AN1555
Rev.1.00
Aug 20, 2019

Introduction

The 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 USB2DCP 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, SPI, 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.

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 USB2DCP interface board to the USB port.

- The DCP Evaluation software can be downloaded from the [Renesas](http://www.renesas.com) 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 USB2DCP board into the USB port and let Windows set up a driver for the new hardware.

Overview and Operation of the DCP Evaluation Platform

Hardware Overview

USB2DCP 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 USB2DCP board in Appendix A). The USB2DCP 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.

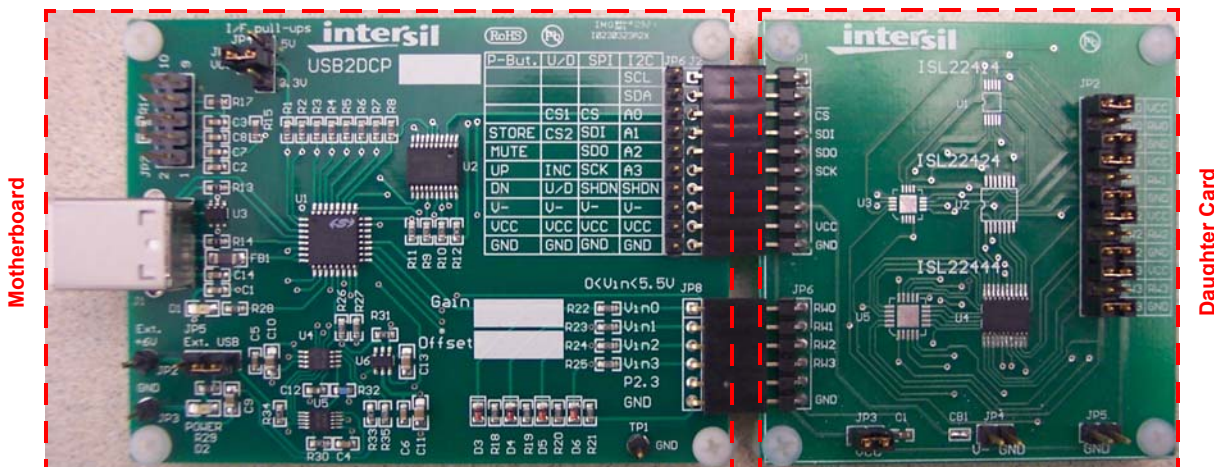


FIGURE 1. DCP EVALUATION PLATFORM

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.

For example, the ISL223x3 daughter card (shown in [Figure 2](#)) has a JP1 male connector to match with the J2 female connector of the mother board to provide VCC, V-, GND, and I²C interface signals to the DCP. The JP6 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 JP2. The DCP terminals RHi, RWi, and RLi 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. An external negative power supply can be used by connecting to JP4 header. In this case, the CB1 shunt should be removed from the board.

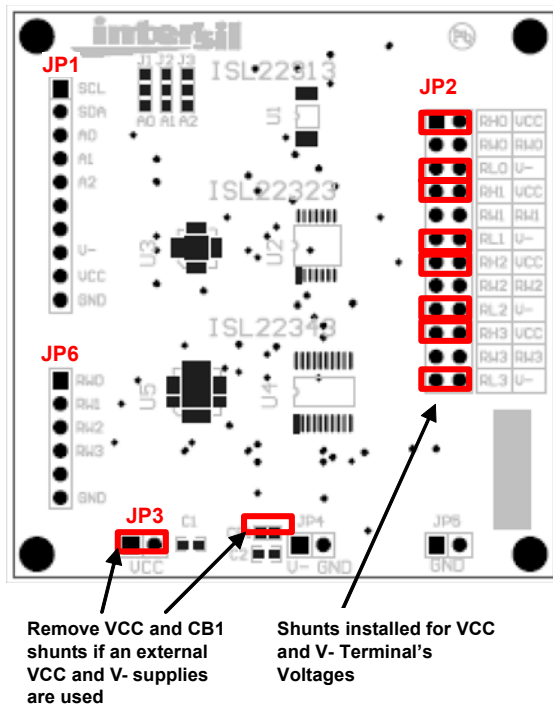


FIGURE 2. ISL223x3 DCP DAUGHTER CARD

DCP Evaluation Software

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 4 on page 3](#) and [Figure 1 on page 1](#), respectively. Select either **I²C**, **SPI**, **Up/Down**, or **Push Button** interface.

The product demonstration GUI automatically appears when the interface is selected as shown in [Figure 5 on page 3](#). 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.

There are convenient initial setups available for Renesas supported I²C and SPI DCPs from the **Device Select** pull-down menu, located on the menu bar, -> Parameter file as shown in [Figure 3](#).

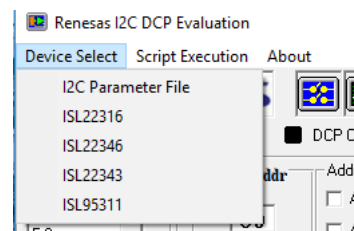


FIGURE 3. I²C and SPI DEVICE SELECT PULL-DOWN

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 and SPI interfaces is selectable from a pull-down menu as well.

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.

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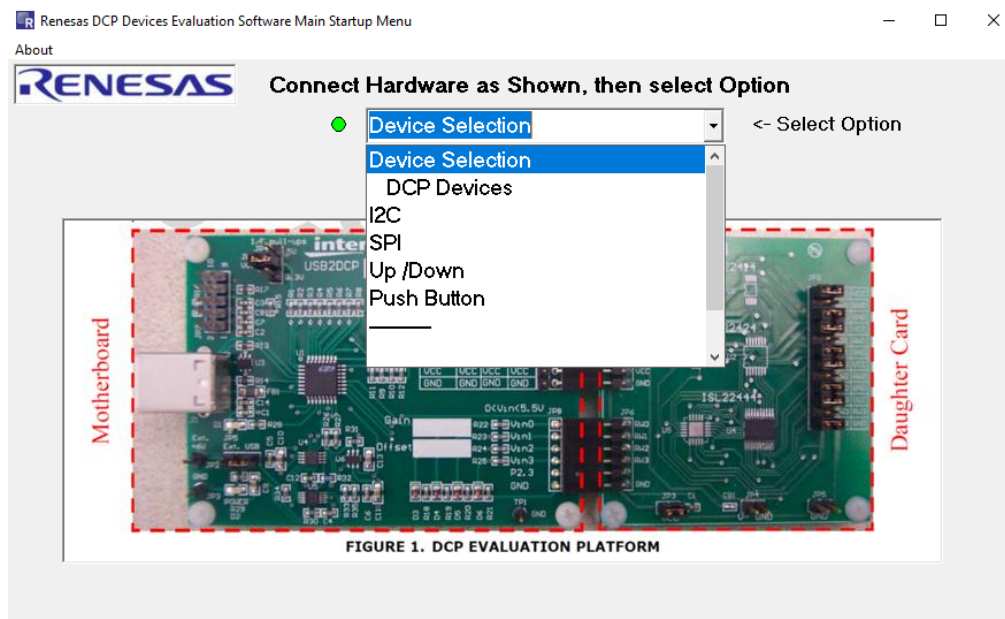
2. Set the VCC level to 3.0V. Write down the voltmeter reading as Measure2 and the ADC reading as Read2.

3. Calculate the ADC Gain as

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

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 USB2DCP motherboard and should be used for correct readings.



NOTE: Green lights indicate that USB2DCP board is attached and communication is established.

FIGURE 4. DCP DEVICE SELECTION WINDOW

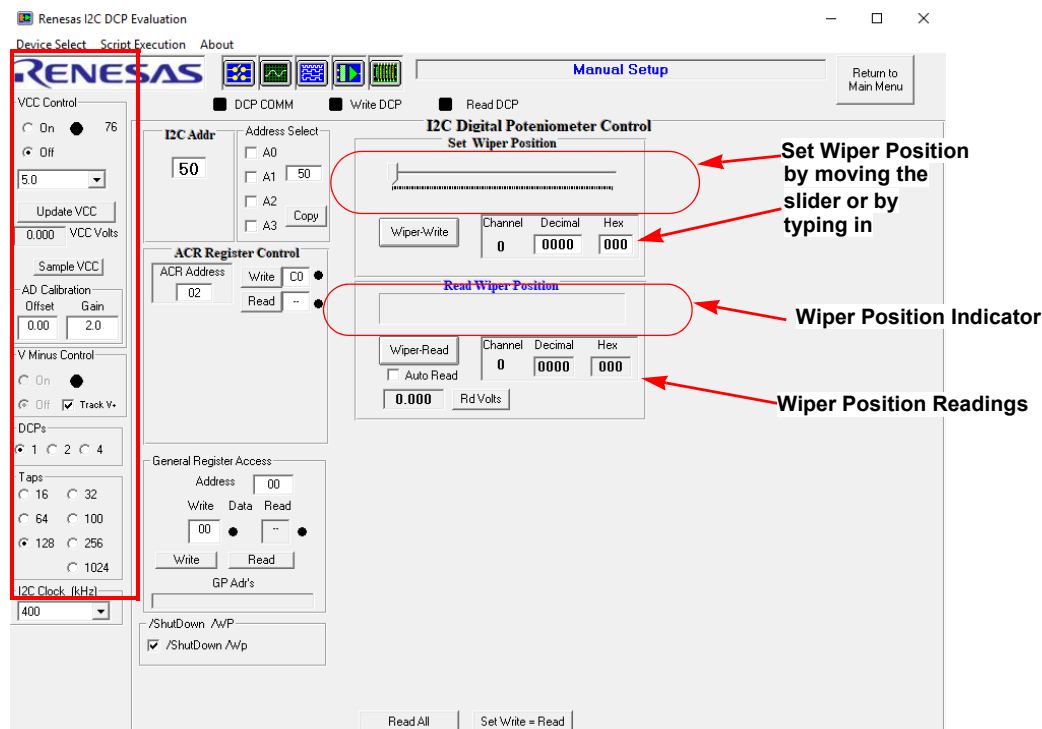


FIGURE 5. I²C INTERFACE PRODUCT EVALUATION WINDOW, MANUAL SETUP

Set Wiper Position in I²C and SPI 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 5 on page 3](#). 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

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.

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.

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.

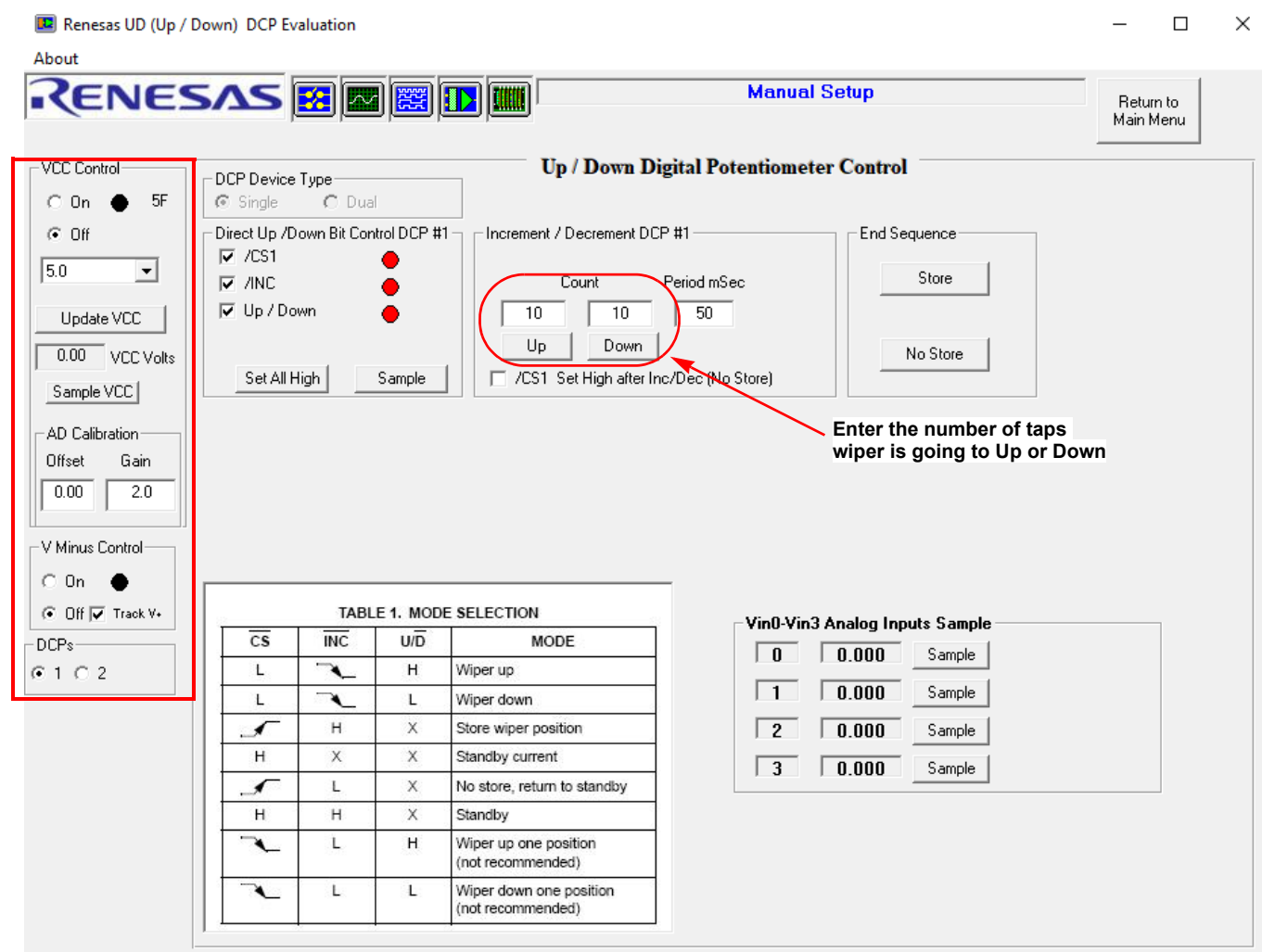


FIGURE 6. UP/DOWN INTERFACE PRODUCT EVALUATION WINDOW

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 will be 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](#).

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.

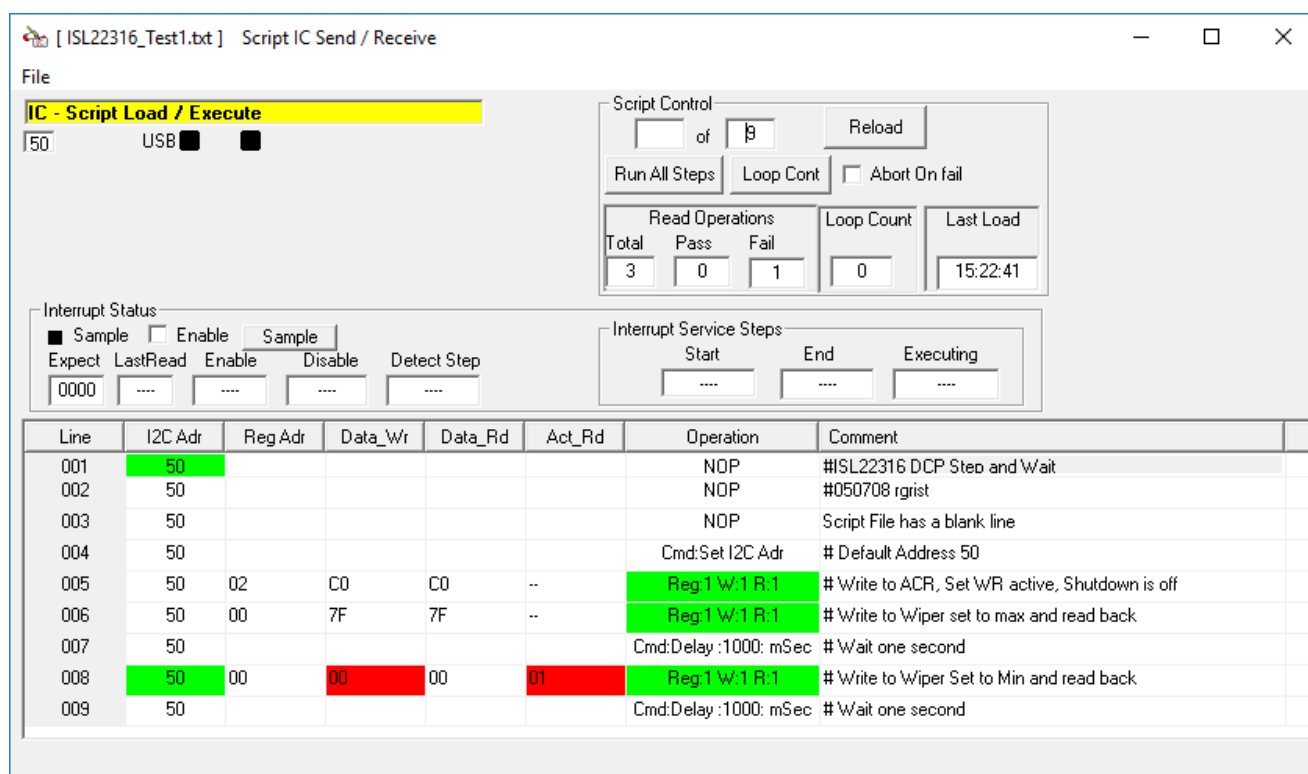


FIGURE 7. THE ISL22316 SCRIPT EXECUTION EXAMPLE

SPI Script File

The structure of the command line for SPI interface is slightly different than for I²C. The first executable command should be an acute symbol followed by letters SPIO (such as 'SPIO'). All the following commands start with the comma followed by data bytes. The total number of data bytes is limited to 32 for this application. Comments must start with the number sign (#) followed by any ASCII symbols. The acute symbol followed by the ENDM ('ENDM') indicates the end of the script.

Command Examples for ISL224x4 Family (2 byte Write, 4 byte Read operation), see [Figure 8](#).

- ,60C0 #Write C0h into the ACR register to set volatile #operation
- ,C05A #Write 5Ah into reg. 0
- ,80000000, XXXXX5A #Read from reg. 0 and compare #with the anticipated data of 5Ah.

where the X symbol represents ignored by test.

Command Examples for ISL224x6 Family (3 byte Write, 3 byte Read operation) are as follows:

- ,50C8C0 #Write C0h into the ACR register, reg. 8, to set #volatile operation
- ,50C07F # Write 7Fh into reg. 0
- ,50B000,XXXX7F #Read back from reg. 0 and compare with #the anticipated data of 7Fh

The script file can be used for programming DCPs in daisy chain configuration. The DCP Evaluation software supports up to eight daisy chained devices. The example of daisy chain programming is shown in [Figure 9](#).

Note: Not all SPI DCPs have daisy chain capability.

Line	I2C Adr	Reg Adr	Data_Wr	Data_Rd	Act_Rd	Operation	Comment
001	50					NOP	#ISL224x4 DCP Step NV write & Wait
002	50					NOP	#102809 ykurtsevov
003	SPI					Cmd:Set SPI Comm	
004	50					NOP	Script File has a blank line
005	50	60C0				W:2	No Internal Register# Write to ACR - Set Volatile, Shutdown is
006	50					NOP	Script File has a blank line
007	50	C0FF				W:2	No Internal Register# Set Wiper to Max (FFh)
008	50	80000000	XXXX80FF	--		W:4 R:4	No Internal Register# Read back data XXXXXXFF from reg.0
009	50					NOP	Script File has a blank line
010	50	C000				W:2	No Internal Register# Set Wiper to Min (00h)
011	50	80000000	XXXX8000	--		W:4 R:4	No Internal Register# Read back data XXXXXX00 from reg.0
012	50					NOP	Script File has a blank line
013	50	C05A				W:2	No Internal Register# write 5Ah to reg.0
014	50	80000000	XXXX805A	--		W:4 R:4	No Internal Register# Read back data XXXXXX5A from reg.0
015	50					NOP	Script File has a blank line
016	50	6040				W:2	No Internal Register# Write to ACR - Set Non-volatile, shutdown
017	50					NOP	Script File has a blank line
018	50	C455				W:2	No Internal Register# Write 55h to NV reg.4
019	50					Cmd:Delay:100: mSec	# Wait 100 msec
020	50					NOP	Script File has a blank line
021	50	84000000	XXXX8455	--		W:4 R:4	No Internal Register# Read back data XXXXXX55 from NV reg
022	50					NOP	Script File has a blank line
023	50	60C0				W:2	No Internal Register# Write to ACR - Set Volatile, Shutdown is
024	50					Cmd: End Main	

FIGURE 8. THE ISL224X4 SCRIPT EXECUTION EXAMPLE

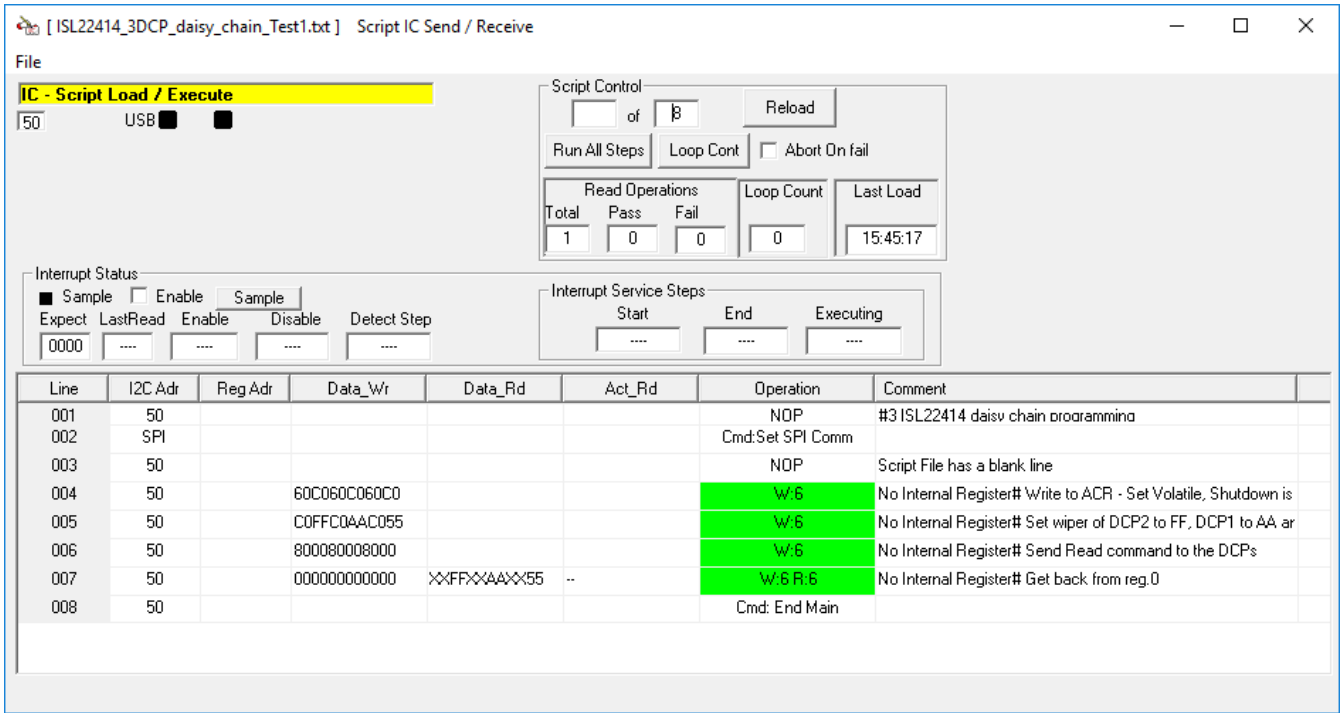
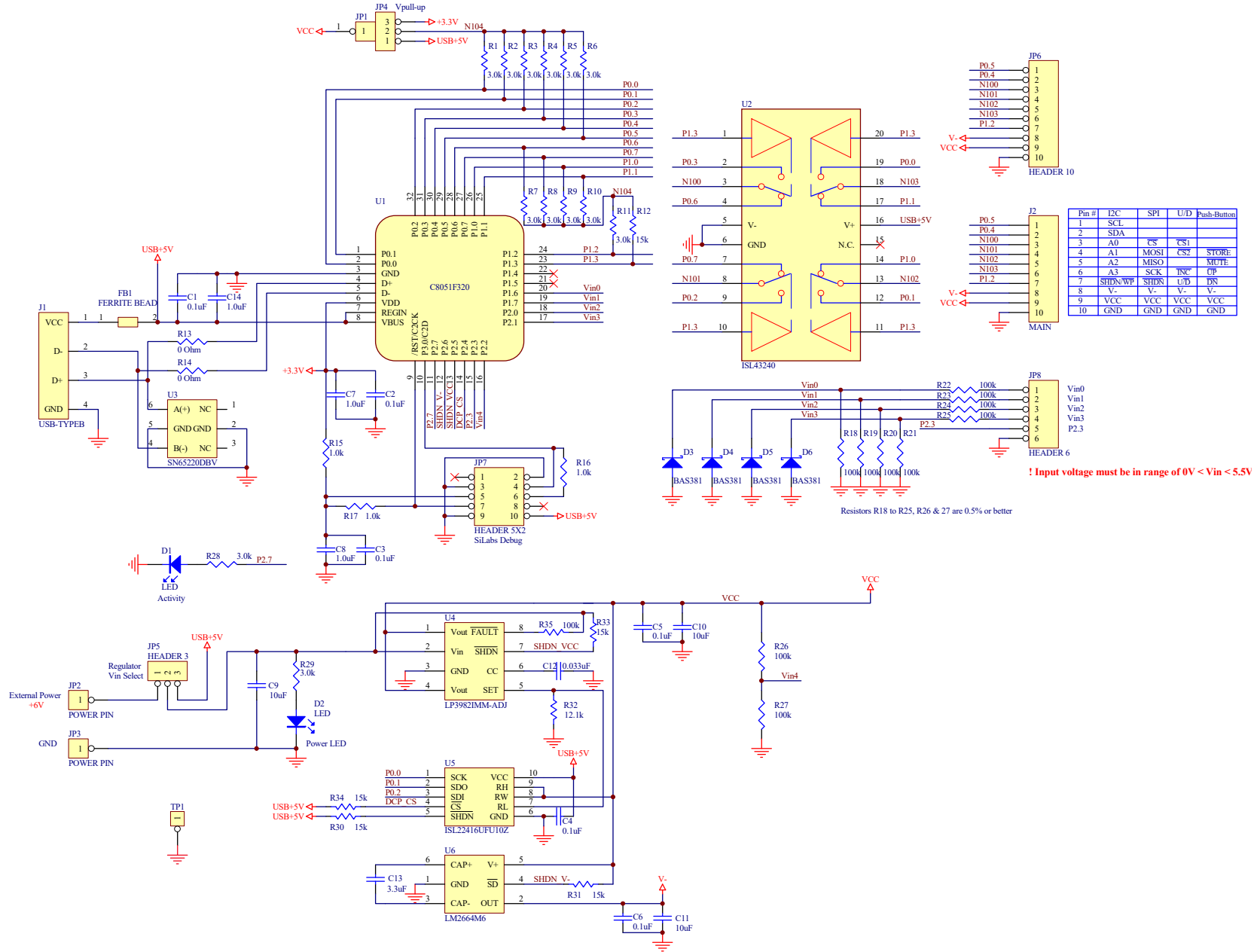


FIGURE 9. THE THREE DAISY CHAINED ISL22414 PROGRAMMING EXAMPLE

Appendix A

USB2DCP Board Schematic



Revision History

DATE	REVISION	CHANGE
Aug 20, 2019	AN1555.1	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.

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(Rev.4.0-1 November 2017)

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