User manual

DA9155M Getting Started with Evaluation Board

UM-PM-010

Abstract

This document describes the hardware and software used by Dialog Semiconductor to test and evaluate the DA9155M slave battery charger.

The hardware solution is based on PCB numbered 287-06-A.

The software uses a PC operating Windows 2000/XP/Vista/Windows 7 ™ with USB (1.1, 2.0 or 3.0) interface.

The software permits configuration of the device using one pre-defined templates, read and operations to all control registers while monitoring device status.

The section 'Quick Start Tutorial' provides an abbreviated quick start guide with a practical configuration example on how to run the evaluation kit.

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1 Terms and definitions

DAI	Digital Audio Interface
DIO	Digital Input/Output
DUT	Device Under Test
GPIO	General Purpose Input Output
GUI	Graphical User Interface
I2C/SPI	Inter-Integrated Circuit/Serial Peripheral Interface
OS	Operating System
PCB	Printed Circuit Board
SPI	Serial Peripheral Interface
SMU	Source Meter Unit
USB	Universal Serial Bus
PCB	Printed Circuit Board

2 References

[1] DA9155M, Data sheet, Dialog Semiconductor
[2] UG-179-070-D, Digital I/O Board User Guide, Dialog Semiconductor
[3] AN-PM-058 DA9155M PCB Layout Recommendation Application Note, Dialog Semiconductor
[4] 287-06-A00_SCH, DA9155M Performance Board Schematic, Dialog Semiconductor
[5] 287-06-A_PCB, DA9155M Performance Board Layout, Dialog Semiconductor

3 Introduction

The DA9155M Performance Board is designed evaluate the DA9155M slave battery charger. The optimised board layout enables testing at full-rated power and measurement of efficiency, current accuracy, transient response, and thermal performance.

The performance board includes an interface connector to the communication board referred as the Digital I/O (DIO) board. This DIO board connects the DA9155M to a computer via USB-to-I2C, for status monitoring and control using the DA9155M Graphical User Interface (GUI).

This document provides an overview of the development board, hardware configuration, and GUI installation process. The goal of this user manual is to provide the details required to get started with the evaluation of the DA9155M.

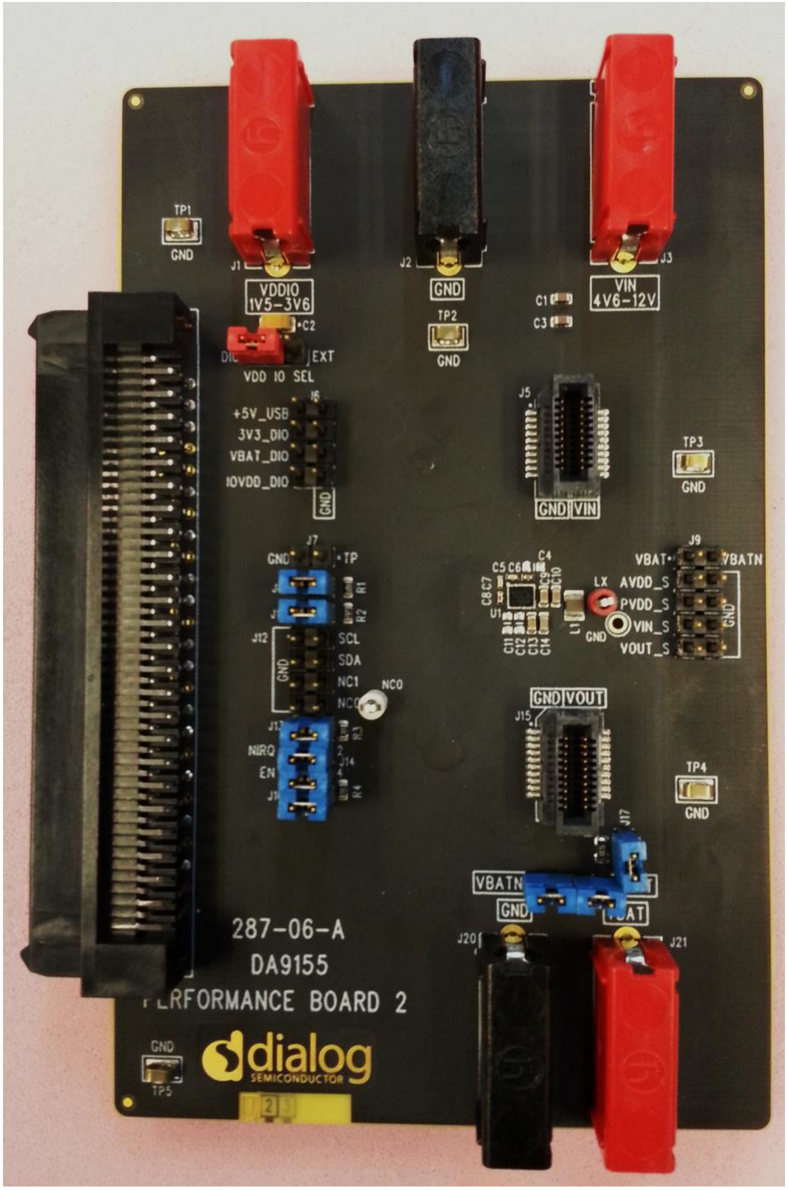


Figure 1: DA9155M Performance Board (top view)

4 Board recommended operating conditions

Table 1 lists the recommended operating conditions of the DA9155M Performance board. Stressing the board beyond these ratings may cause permanent damage to the board.

Table 1: DA9155M Performance Board recommended operating conditions

Parameter	Symbol	Min	Max	Unit
Storage temperature		-60	+150	°C
Operating temperature	T_A	-40	+85	°C
Input voltage	V_{IN}	4.3	13.4	V
Supply voltage IO	V_{DDIO}	1.5	3.6	V
Battery voltage	V_{BAT}	0	4.5	V
Battery current	I_{BAT}	0	3	A
Digital I/O (EN, SCL, SDA, nIRQ)		0	0.7 x VDDIO	

5 DA9155M Performance Board Hardware

The DA9155M board functional overview is shown in Figure 2. The board functionality can be broken down into the following functions:

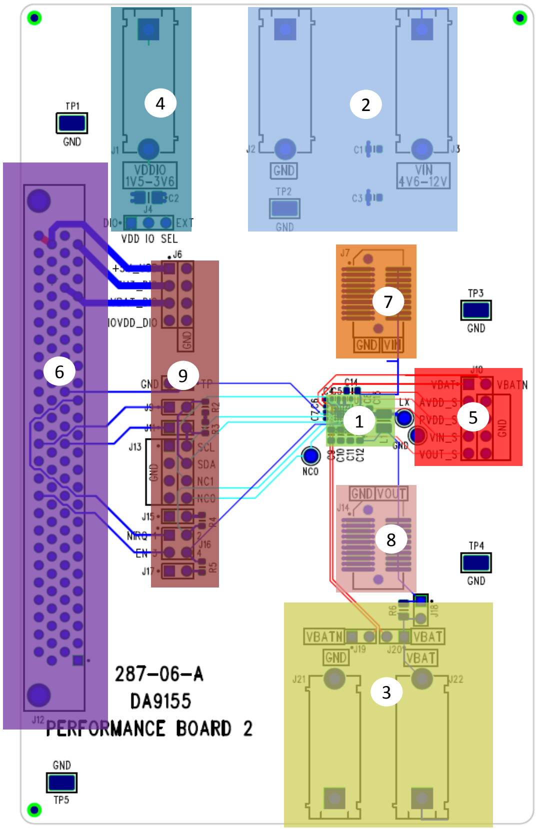


Figure 2: Functional overview

Table 2: DA9155M Performance Board overview and descriptions

Section No.	Function Description
1	Device Under Test (DUT) DA9155M slave charger
2	Input Voltage (VIN) terminals
3	Battery Output (VBAT) terminals and battery current sense resistor
4	VDDIO supply selector (DIO vs External)
5	DA9155M multi-test point J10 connector header
6	Digital I/O interface connector
7	Line transient injection point
8	Load transient injection point
9	Digital I/O board connectivity selector (signals SCL, SDA, Enable, nIRQ, TP)

5.1 DA9155M Slave charger layout

The placement guidelines for PCB layout and trace interconnectivity for the main power components are shown in the PCB layout section of the DA9155M Datasheet [Ref 1] and also shown in Figure 3 below. The same layout guidelines were followed and implemented for the DA9155M Performance Board, with the exception of the footprint for additional output capacitors are included in the board for experimentation purposes.

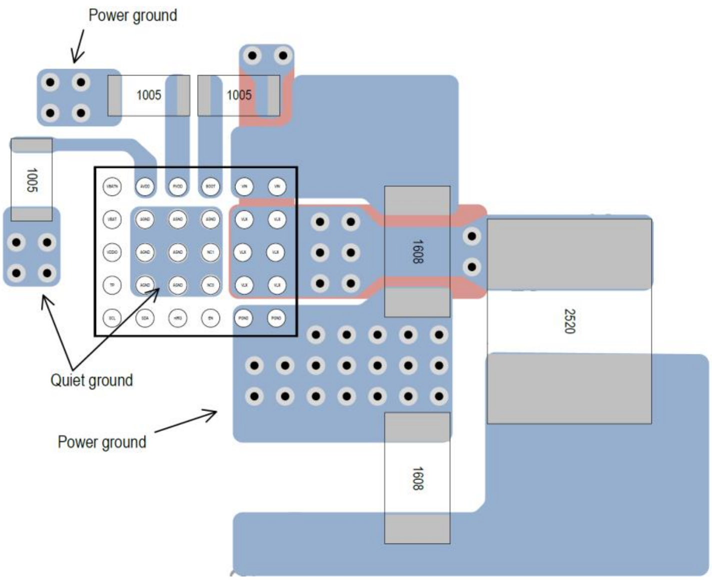


Figure 3: PCB Layout for DA9155M

It is important to follow the recommended layout guidelines in order to achieve the best efficiency performance and noise immunity. Particular attention should be paid to the layout of the input capacitor, inductor and output capacitors, highlighted in Figure 4. From this figure it can be seen that that the Power Ground ensures that there is the minimal path impedance between the capacitors and the DA9155M PGND terminals. The layout engineer should review the DA9155M PCB Layout Recommendations Application Note, see [Ref 3]

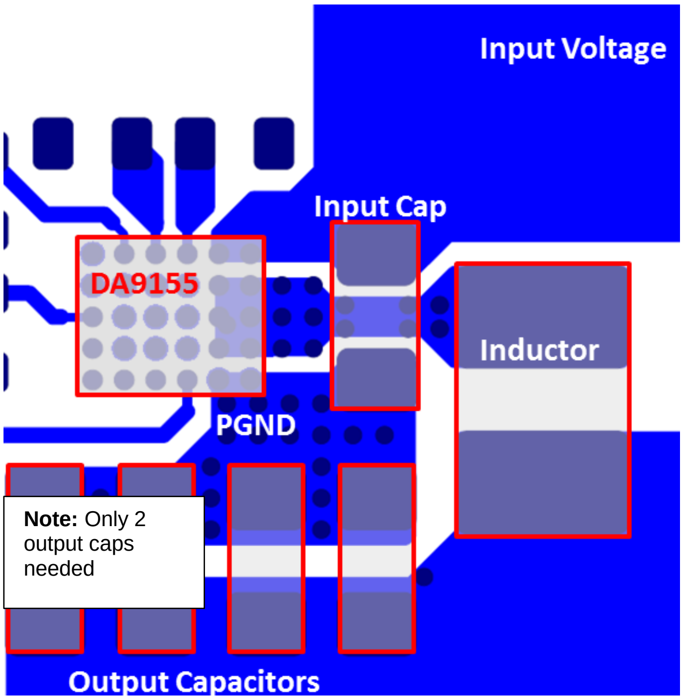


Figure 4: DA9155M Performance Board Layout

5.2 Slave charger multi-test point J10 connector

The multi-test point connector is shown in Figure 5. This connector provides the user access to the various nodes of the DUT. This connector is only capable of "sensing" voltages and should not be used for delivering current/voltage to and from the DUT, as the PCB traces can be fused by excessive current.

The signals available on this header are:

- Battery voltage VBAT sense (using battery Kelvin connection)
- Voltage of the AVDD supply
- Voltage of the PVDD supply
- Input voltage VIN sense
- Output voltage VOUT (measured at DA9155M output capacitor node)

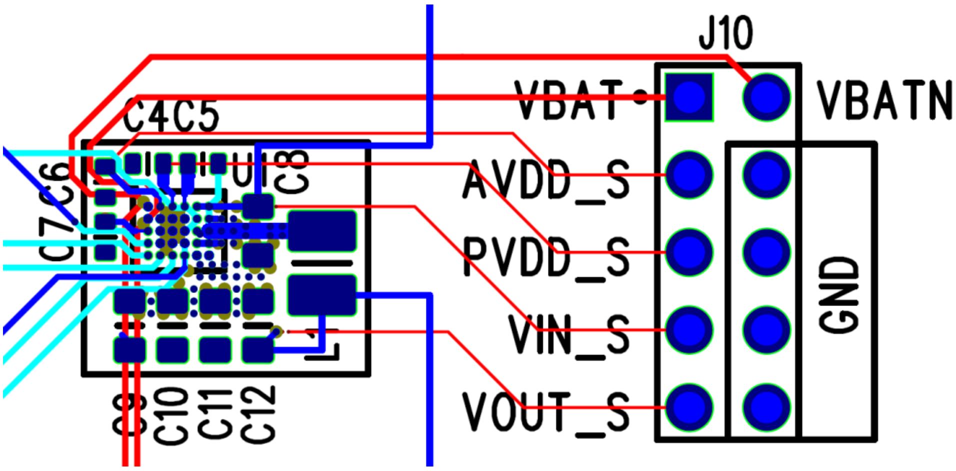
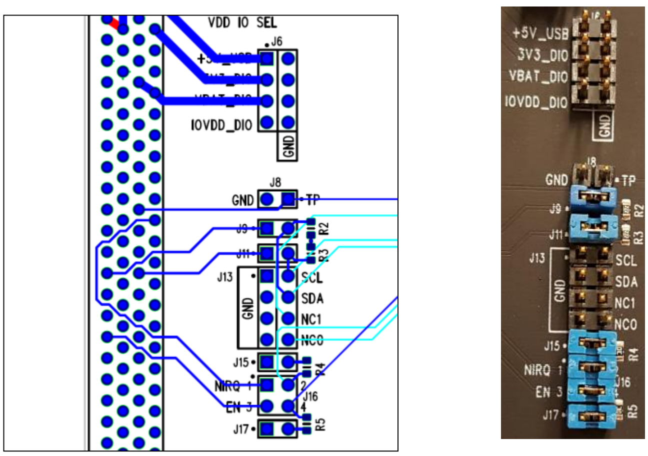


Figure 5: Test point J10 header

5.3 Digital I/O board connectivity headers

The DIO interface connectors select the signals from the DIO board to the DUT board and also provide test point terminals to monitor the different voltage rails of the DIO board. The jumpers shown in **Figure 6** below indicate the default jumper selection for the digital signals SCL, SDA, Enable, nIRQ and TP.



(a) (b)

Figure 6: DIO connectivity headers (a) Layout view (b) Default jumper settings

5.4 Transient injection points

The two injection points are connected to the input voltage and output voltage (J5 and J15). These can be used to measure the line and load transient response of the DUT. Special transient injection boards are available (P/N 44-179-168-03-A and 44-179-168-03-B Hammer2 board), but these are not supplied as part of the standard DA9155M Performance Board kit. Please contact Dialog Semiconductor for more information on how to obtain one of the transient injection boards.

5.5 Connectivity

To evaluate the features of the DA9155M slave charger, it is necessary to connect the DUT to a computer to perform status monitoring and configure the device. The DA9155M Performance Board uses the DIO board as an interface to convert the USB datalink to I^2C bus on the DUT.

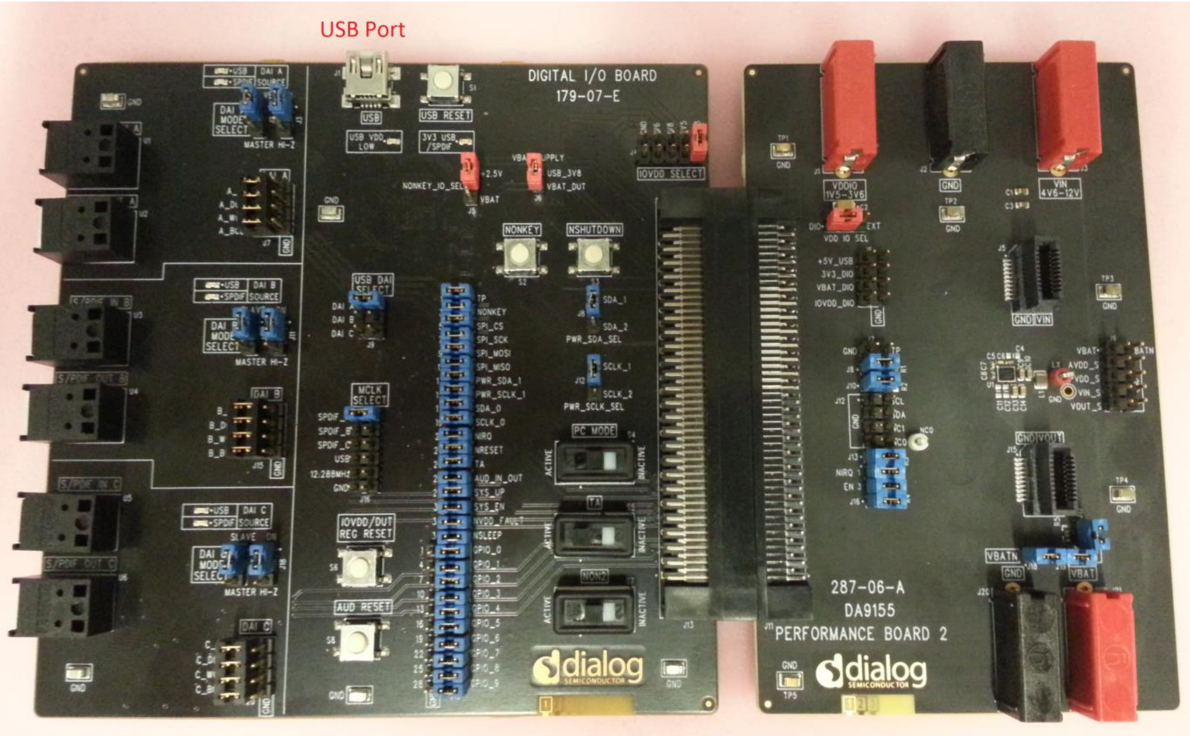


Figure 7: DIO and DA9155M Performance board

The configuration settings for the DIO board are shown in Figure 7. Ensure these settings match the board under test. For additional information, schematics, and configuration, see the Digital I/O Board User guide [Ref 2]

6 Hardware requirements

The hardware included in the list below can be substituted by equivalent hardware.

Table 3: List of hardware

Item #	Description	Manufacturer	Comments
1	DA9155M Performance Board	Dialog Semiconductor	
2	Digital I/O Board	Dialog Semiconductor	
3	USB Cable	N/A	Type-A Male to Mini Type-B Male
4	Keithley 2308 Battery Emulator	Keithley	Dual output SMU, Output #1: Connected to VBAT **(1)** and Output #2: Connected to VIN

Note 1 This SMU must be capable of sourcing and sinking current (simulate a battery).

6.1 Input voltage supply

The DA9155M Performance Board is a slave battery charger; this means that the input voltage must be present in order to enable the DUT. For the initial setup, and example in this document, this is set to 9 V DC and the current limited to 3 A.

6.2 Battery voltage

The VBAT terminals must be connected to a battery and the battery voltage must be within the DA9155M under- and overvoltage limits. Otherwise the DUT will enter into a fault condition and the charging mode will not be enabled until the fault is removed and the fault status registers (Event_A and Event_B) are cleared, see the DA9155M Datasheet [Ref 1] for more details on the DUT power modes and/or fault detection.

Before connecting a standard DC power supply to the VBAT terminals, ensure that the DC power supply is able to source and sink current. Once the DA9155M charger is enabled, current needs to flow into the VBAT supply. Failure to do so could damage the DC power supply and/or the DA9155M Performance Board.

In the hardware list Table 3, the Keithley 2308 Battery Emulator Output #1 is connected to the VBAT terminals. The battery emulator was selected because it is able to sink/source up to 5 A of current and the input impedance can be programmed between 0 Ω and 1 Ω, in 10 mΩ steps.

There are three options that can be connected to the VBAT terminals:

- Li-Ion battery, the voltage must be within the under- and overvoltage limits as configured in DA9155M settings (VBAT_UV and VBAT_OV registers)
- Source Meter Unit capable of sourcing and sinking current, such as the Keithley 2308.
- Power supply connected in parallel to a resistive or electronic load. The user must ensure that the current load is greater than the current supplied by DA9155M, defined by the BUCK_IOUT register. For example: Power supply output set to 4 V, electronic load set to 1 A and DA9155M set to 500 mA.

7 DA9155M Performance Board Graphical User Interface

The user can explore all the features of the DA9155M with the Graphical User Interface (GUI) using the I^2C interface. This includes changing the control settings and monitoring the status/fault of the DUT.

The user must be aware that the GUI is non-invasive, meaning:

- It will not modify registers contents without user interaction
- I^2C periodic communication stops when the “Polling Enabled” button is set to “Polling Disabled”

7.1 Software installation

When the supplied media is inserted into the computer the installation begins automatically. If the installation does not start automatically, run the program file ‘setup_DA9155M_Evaluation_GUI_AB.0_0_xx.exe’ from the ‘Software’ directory on the media. An automated script installs the program on your PC, and by default, the directory C:\Dialog Semiconductor\Power Management\DA9155M_Evaluation GUI is used.

To install the software:

1. Run setup_DA9155M_Evaluation_GUI_AB.0_0_xx.exe and click the ‘Next’ button

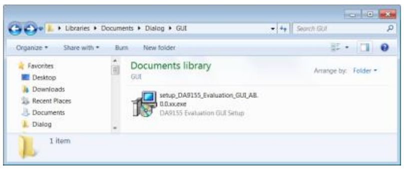
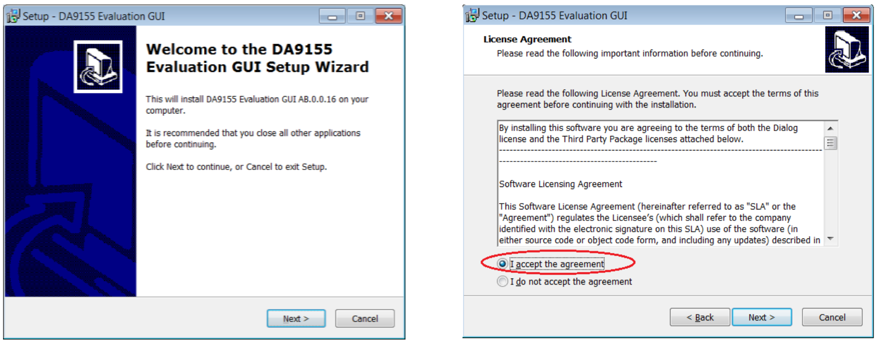


Figure 8: DA9155M Evaluation GUI Installation File

2. Accept the license agreement and click ‘Next’



(a) (b)

Figure 9: DA9155M GUI Software Licensing and Installation

3. Choose the installation path using ‘Browse’ or leave the default path and click ‘Next’

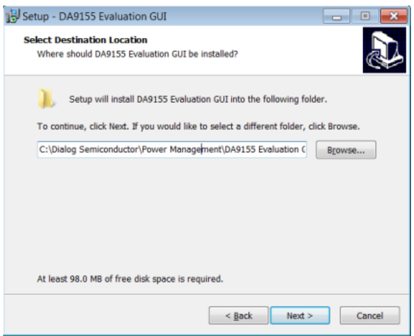


Figure 10: DA9155M GUI Installation Path

4. Choose the ‘Start Menu Folder’ using ‘Browse…’ or leave the default folder and click ‘Next’
5. Check ‘Create a desktop icon’ to access the software directly from the desktop and click ‘Next’
6. Review installation information and click ‘Next’
7. Check ‘Launch DA9155M GUI’ to launch the GUI immediately after installation and click ‘Finish’

Once connected, the hardware will be detected and the drivers will install automatically. In some operating systems the driver installer window may pop up: accept the recommended settings.

7.2 GUI overview

The GUI is laid out in a modular way, where the sections are grouped by functionality. This means that some sections or ‘smartcanvas’ modules are used to display device status (for example, VBAT Under Voltage) and other modules are used to control the behaviour of the DUT (for example, output current).

This section gives an overview of the GUI functions and references the GUI sections as shown in Figure 11.

Figure 11: GUI Overview Screen

Smartcanvas section 1: Right after the GUI is initialized the “I2C comms” and “USB Connected” indicators should be shown in green, see Figure 12. If either one of these indicators is not green communication has not being established between the DA9155M and the GUI. It is possible to verify this by disabling the VBAT and the input voltage of the performance board, and then the green light should be disabled. Once power is re-enabled, press the “Reconnect to device” button to ensure the communication link is active.

The Enable/Disable Polling enables the GUI to perform periodic updates (once per second) of all the DUT registers and all the control/status registers will be updated with the read-back data.

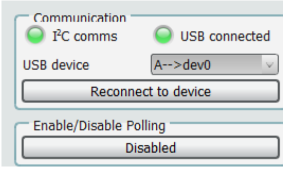


Figure 12: Active Communication Indicator

Smartcanvas section 2: This module will show the performance board status information and will define whether the GUI displayed registers are automatically or manually updated. In order to enable the automatic updates, enable the “Auto Status On” button, see Figure 13. Alternatively, the user might opt to perform a single GUI register refresh/read-back by pressing the “Single Update” button and keeping the “Auto Status Disabled”. The “Read All Registers” button will update all registers including those not displayed in the active GUI screen.

It is recommended to disable “Auto Status On” if other I^2C devices in addition to the DIO and DA9155M are connected to the communication interface, particularly if another I^2C master is connected, as this could create conflict in the communication link. If this is the case, the “Single Update” can be pressed whenever the GUI needs updating.

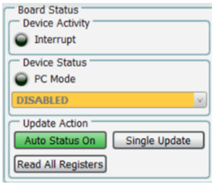


Figure 13: Board Status Indicator

Smartcanvas section 3: This section of the GUI provides the user with “Status and Events” information and can be used to “Mask” events from generating nIRQ flags or events. Figure 14 shows all events are masked or ignored as a default setting.

Event_A and Event_B registers display the status of all specific events, as described in the DA9155M datasheet [REF 1]. For example, if the battery voltage drops below the E_VIN_UV and the M_VIN_UV is unmasked, the S_VIN_UV bit is enabled and this will be displayed in the GUI, ensure the “Auto Status ON” button is active. When the event is “Unmasked” a nIRQ flag is generated and the nIRQ pin is set low after the event occurs.

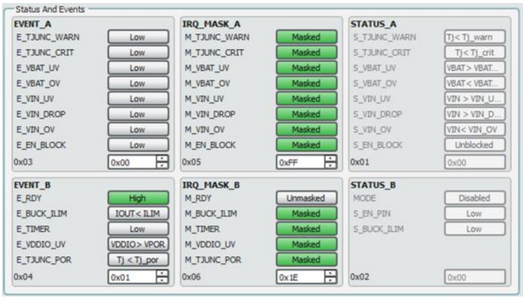


Figure 14: Status and Events shown in GUI

Smartcanvas section 4: This section of the GUI is used to modify specific control registers of the DA9155M as defined in the Datasheet [Ref 1]. For example, the user is able to change the under-voltage (VBAT_UV) level or the specific DUT temperature for generating a warning.

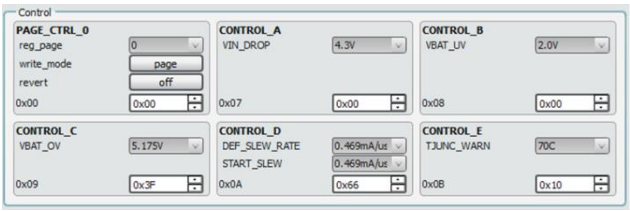


Figure 15: Control Registers in GUI

Smartcanvas section 5: This section of the GUI controls three of the most important registers of the DA9155M: These are the Buck Enable (BUCK_EN), Buck Current Limit (BUCK_ILIM), and Buck Output Current (BUCK_IOUT) registers.

The BUCK_EN will only enable the converter if there are no faults/events present, (EVENT_A = EVENT_B = 0x00). It is best practice to press the "Clear Events" button before enabling the Buck.

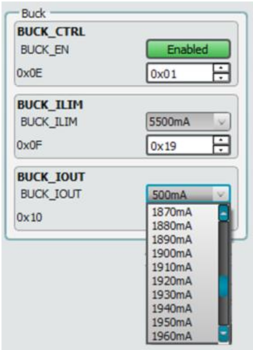


Figure 16: Buck converter control registers

Smartcanvas section 6: In this section of the GUI the following information about the DUT is displayed: I^2C address, REVID, Oscillator Frequency, Timer_A, Timer_B, and page control registers. Review the DA9155M Datasheet for specific functionality of each of the registers in this section.

Smartcanvas section 7: This section of the GUI is used to manually Read/Write data to the I^2C bus, by specifying the Device I^2C address, Register Address, and the data package to read or write. The GUI will not perform any data manipulation or validation to the data written or read.

File I/O is used to save all DA9155M registers to a file. This feature is helpful when used after the "Read All Registers", as it will capture a snap shot of the device under specific test conditions.

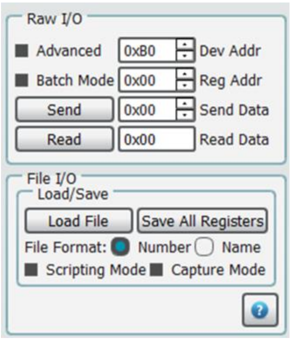


Figure 17: Raw I/O and File I/O GUI Controls

Smartcanvas section 8: The Table View tab displays the DA9155M Registers in a table format and captures the status of all the registers in a compact form. The register values are also editable in the Table View.

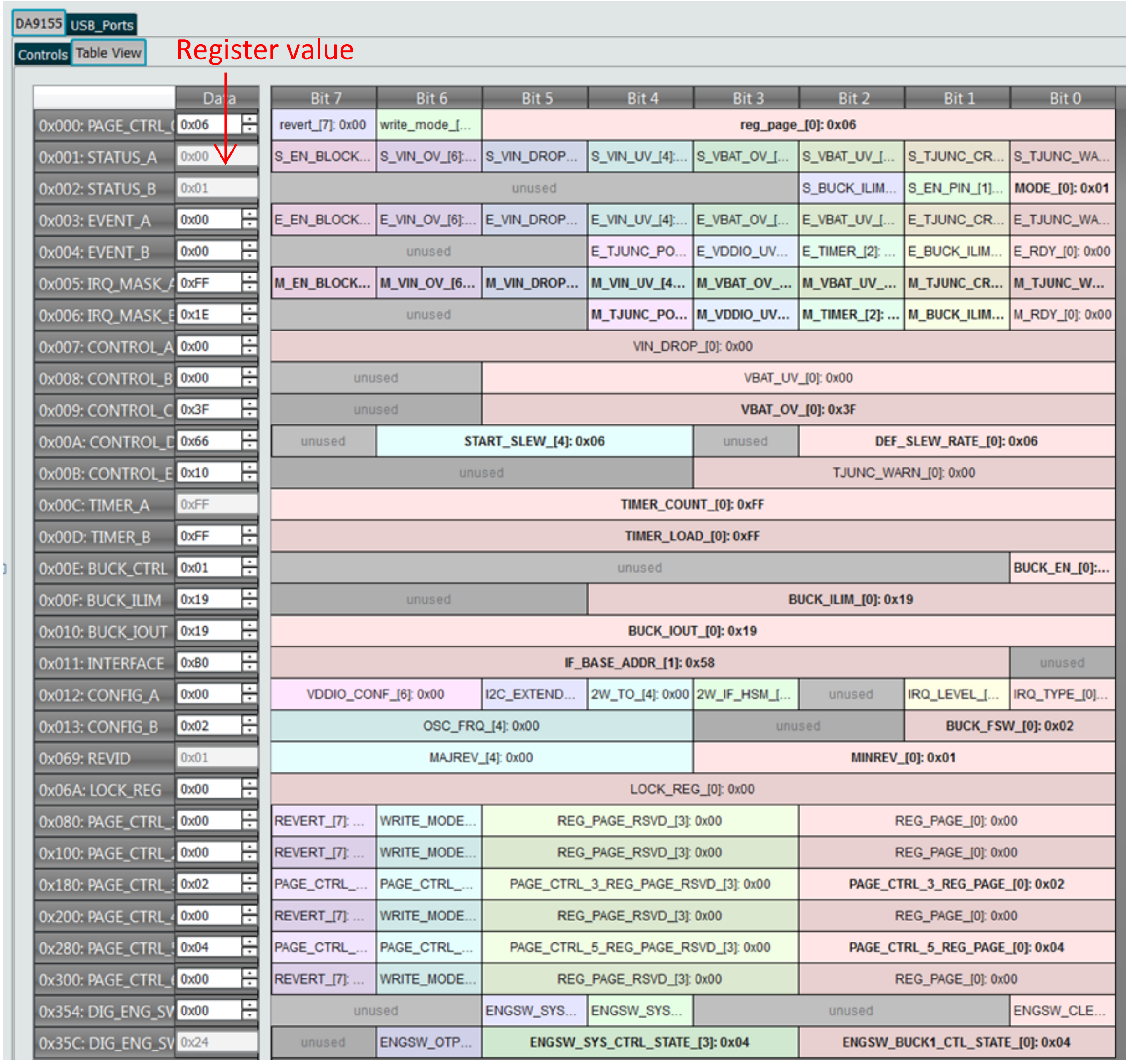


Figure 18: DA9155M GUI using the Table View

8 Quick start tutorial guide

This section of the document provides the steps required to power up the board. Assumed that the GUI is installed and the DIO board is configured as in Figure 7.

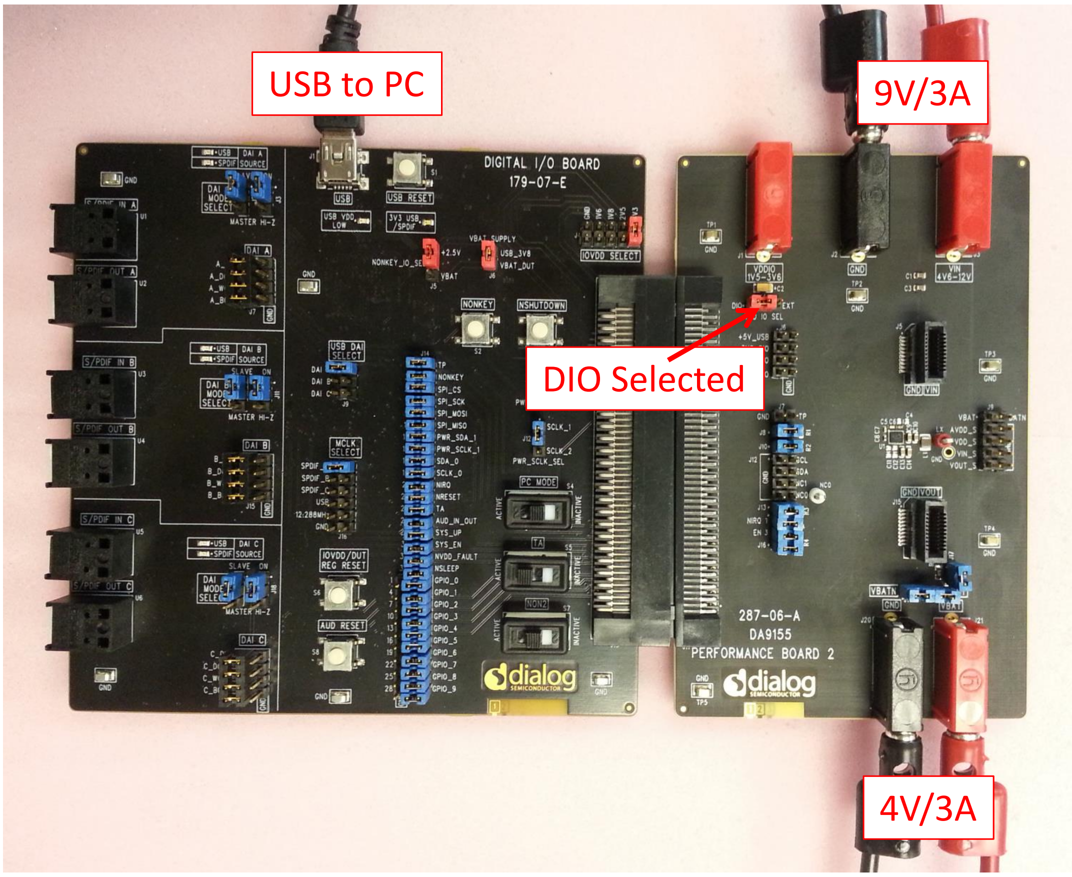


Figure 19: DA9155M Performance Board Full Setup

1. Set the Input Voltage: The input voltage is set to 9 V with a 3 A current limit, (the current limit can be changed later, and this is only a practical starting point). Also, since the Keithley 2308 is a dual output supply, Output #2 of this instrument can be connected to the input voltage terminals.
2. Set the VBAT Voltage: The VBAT terminals should be connected to the Keithley 2308 (battery emulator) Output #1 set to 4 V and current limited to 3 A. As mentioned in the “Battery voltage” section, if a real battery is to be connected, ensure the voltage is within the under- and overvoltage limits.
3. Set the VDDIO Voltage: The VDDIO voltage will be supplied by the DIO board, by selecting the VDDIO SEL jumper as shown in Figure 19, where header J4, is configured to short position pin 1 and 2 (the two closest to the interface connector).
4. Connect the USB cable: If not already so, connect the USB cable from the DIO port to the computer host computer.
5. Using the GUI: At this point the hardware setup is completed and the DA9155M GUI can be initialized. Once the GUI is done loading check the Active Communication Indicator, see Figure 12.
   a. Before the Buck converter is enabled, press the ‘Clear Events’ button.

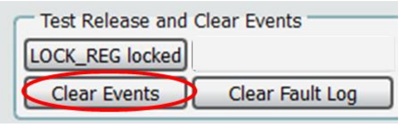


Figure 20: Clear Events button

   b. Select the desired Buck output current from the drop-down

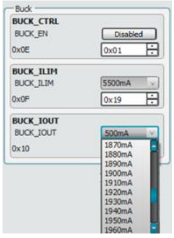


Figure 21: Configure the output current

c. Click the BUCK_EN 'Disabled' button to enable the converter

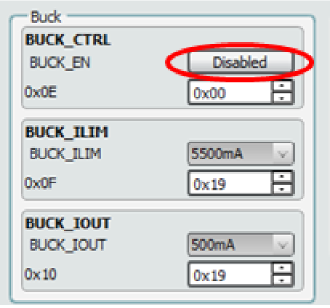


Figure 22: Enable Buck converter button

At this point the Buck converter should be enabled and performance evaluation can begin.

Revision history

Revision	Date	Description
0.2	27-10-2015	Initial draft
1.0	10-11-2015	Initial release
Change details:		

Status definitions

Status	Definition
DRAFT	The content of this document is under review and subject to formal approval, which may result in modifications or additions.
APPROVED or unmarked	The content of this document has been approved for publication.

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RoHS Compliance

Dialog Semiconductor complies to European Directive 2001/95/EC and from 2 January 2013 onwards to European Directive 2011/65/EU concerning Restriction of Hazardous Substances (RoHS/RoHS2).
Dialog Semiconductor's statement on RoHS can be found on the customer portal https://support.diasemi.com/. RoHS certificates from our suppliers are available on request.

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