

User Manual DA9168 Performance Board UM-PM-051

Abstract

This document describes the hardware and software used to evaluate the DA9168. It is applicable to the DA9168-03-A1 performance board.



DA9168 Performance Board

Contents

Ab	stract			1
1	Term	s and De	finitions	4
2	Refer	ences		4
3	Intro	duction		5
4	DA91	68 Perfo	mance Board Hardware	5
	4.1		umper Positions and Connector Definitions	
	4.2		Module	
5	Basic	: Operatio	on	10
	5.1	-	Fast Charge Mode	
	5.2	Starting I	Reverse Boost Mode	10
	5.3	Signal M	onitoring	11
	5.4	Fault Ind	icators	11
	5.5	Interrupt	Signals	12
6	DA91	68 Perfor	mance Board Software	13
	6.1	SmartCa	nvas GUI Installation	13
		6.1.1	SmartCanvas GUI Installation Step-by-Step Guide	13
	6.2	Initial I ² C	-USB Connection	16
7	Smar	tCanvas	Software	17
	7.1	Register	Controls	17
	7.2	Table Vie	ew Tab	18
	7.3	Control V	Vindows	18
		7.3.1	Communication	18
		7.3.2	Enable/Disable Polling	
		7.3.3	I/O	19
		7.3.4	Raw I/O	19
		7.3.5	File I/O	
		7.3.6	Info	
	7.4		ms	
		7.4.1	File -> Open Python Script	
		7.4.2	File -> Run Python Script	
		7.4.3	Tools -> Model IO	
		7.4.4	Tools -> Scan I2C	
		7.4.5	Tools -> Custom Tabs	
		7.4.6	Search -> Find Register	
		7.4.7	View	
8	-		File	
	8.1	-	ster Text File Format	
Re	vision	History.		24



Figures

Figure 1: DA9168 Performance Board Overview	. 5
Figure 2: DA9168 Performance Board Default Jumper Position	. 6
Figure 3: I ² C-USB Module	. 9
Figure 4: Enable Fast Charge Mode	10
Figure 5: Enable Reverse Boost Mode	10
Figure 6: System Events Tab	11
Figure 7: Interrupt Mask Tab	12
Figure 8: System Status Tab	12
Figure 9: GUI Setup License Agreement	13
Figure 10: GUI Setup Destination Location	14
Figure 11: GUI Setup Shortcuts Location	14
Figure 12: GUI Setup Create Shortcut	15
Figure 13: GUI Setup Installation	15
Figure 14: GUI Setup Finish and Launch	16
Figure 15: Main Interface	17
Figure 16: Table View	18
Figure 17: Communication Control	18
Figure 18: Polling	19
Figure 19: I/O	19
Figure 20: Raw I/O	19
Figure 21: File I/O	19
Figure 22: Info	20
Figure 23: Model IO	21
Figure 24: Scan I2C	21
Figure 25: Custom Tabs	22
Figure 26: Find Register	22
Figure 27: Register Dump (.txt File) Example	23

Tables

Table 1: Header and Switch Definitions	6
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DA9168 Performance Board

1 Terms and Definitions

GPIO	General purpose input / output
GUI	Graphical user interface
lOs	Inputs / outputs
OTP	One time programmable
MUX	Multiplexer
PC	Personal computer
PCB	Printed circuit board
SAM3U	I ² C-USB interface (Microchip [®] Arm [®] -based ATSAM3U4E [®] microcontroller)
SCH	Schematic
GND	Ground
USB	Universal serial bus

2 References

- [1] DA9168, Datasheet, Dialog Semiconductor.
- [2] DA9168-03-A1_sch.pdf, Dialog Semiconductor.
- [3] DA9168-03-A1_pcb.pdf, Dialog Semiconductor.



3 Introduction

The DA9168 performance board enables the measurement, evaluation, and programming of the DA9168 device.

Dialog's control software SmartCanvas[™], uses a graphical user interface (GUI) to control DA9168 via the USB port of a PC. The I²C-USB connector is on the bottom side of the performance board.

The board has jumper links to provide access to alternative configurations and measurement test points.

4 DA9168 Performance Board Hardware

The DA9168 performance board functionality is organized in seven discrete sections, see Figure 1.

- 1. VBUS input section: Power supply and USB power supply connectors.
- 2. VSYS output section.
- 3. VBAT input/output section.
- 4. VOUT1 and VOUT2 outputs section.
- 5. REFLDO output section.
- 6. GPIOs network section.
- 7. GPIOs signal monitors section.



Figure 1: DA9168 Performance Board Overview

User Manual	Revision 3	03-Aug-2022



4.1 Default Jumper Positions and Connector Definitions

DA9168 performance board default jumper connections are shown as Figure 2.



Figure 2: DA9168 Performance Board Default Jumper Position

Table 1: Header and Switch Definitions

Note: Default jumper positions are indicated in **bold**.

Reference Designator	Position	Function
J1	n/a	Micro USB-2.0 connector
J2	n/a	VIN power
J3	n/a	VSYS load
J4	n/a	VOUT1 load
J5	n/a	VOUT2 load
J6	n/a	VREFLDO load
J7	n/a	VMID load
J8	1	VSYS load voltage sense
10	2	VSYS load GND sense
J9	1-2	Connects VIN to VBUS
J10	1-2	VIN_USB to VBUS

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Revision 3



DA9168 Performance Board

Reference Designator	Position	Function
11.1	1	VIN power sense
J11	2	VIN GND sense
J12	1-2	Connects TMP_SNS network to TMP_SNS pin
J13	1-2	Reserved
J14	1-2	CHG_EN_N pull-down connector
J15	1-2	TMP_SNS pull-up connector
J16	1-2	Reserved
J17	1-2	Reserved
J18	n/a	VIN GND
J19	n/a	VSYS GND
100	1-2/3	Connects VBAT_SNS and VBAT
J20	4	AGND
J21	n/a	VBUS line transient connector
J22	n/a	VSYS load transient connector
J23	n/a	VOUT1 load transient connector
J24	n/a	VOUT2 load transient connector
J25	n/a	VMID load transient connector
	1	VSYS output voltage sense
J26	2	VSYS GND voltage sense
(VSYS Kelvin sensing)	3	VSYS load
	4	VSYS GND
	1	VOUT1 output voltage sense
J27	2	VOUT1 GND voltage sense
13 14 15 16 17 18 19 20 21 22 23 24 25 26 //SYS Kelvin sensing) 27 /OUT1 Kelvin sensing) 28 /OUT2 Kelvin sensing) 29 REFLDO Kelvin sensing) 30 /BAT Kelvin sensing) 31	3	VOUT1 load
	4	VOUT1 GND
	1	VOUT2 output voltage sense
J28	2	VOUT2 GND voltage sense
(VOUT2 Kelvin sensing)	3	VOUT2 load
	4	VOUT2 GND
	1	REFLDO output voltage sense
J29	2	REFLDO GND voltage sense
(REFLDO Kelvin sensing)	3	REFLDO load
	4	REFLDO GND
	1	VBAT voltage sense
J30	2	VBAT GND voltage sense
(VBAT Kelvin sensing)	3	VBAT load
	4	VBAT GND
J31	1	VMID output voltage sense
(VMID Kelvin sensing)	2	VMID GND voltage sense

User Manual

Revision 3

03-Aug-2022



Reference Designator	Position	Function
	3	VMID load
	4	VMID GND
	1	VBUS voltage sense
J32	2	VBUS GND voltage sense
(VBUS Kelvin sensing)	3	VBUS load
	4	VBUS GND
J33	n/a	I ² C-USB module connector
J34	1-10	GPIOs signal monitor
J35	1-10	GPIOs signal monitor
J36	1-2	ILIMIT pull-up connector
550	2-3	ILIMIT pull-down connector
J37	1-2	ILIMIT pull-up connector
337	3-4	ILIMIT weak pull-down connector
120	1-2	EN pull-up connector
J38	2-3	EN pull-down connector
120	1	Connects to real battery positive
J39	2	Connects to real battery GND
J40	1-2	INT_N pull-up connector
J41	1	Device C1 pin (VBAT) voltage sense
	2	VBAT GND voltage sense
J42	1	Device C2 pin (VSYS) voltage sense
	2	VSYS GND voltage sense
J43	1-2	CHG_EN_N pull-up connector
S1	n/a	RIN_N reset push button



4.2 I²C-USB Module

The DA9168 performance board uses an I²C-USB module (Figure 3) for the I²C communication. This I²C-USB module integrates a Microchip[®] Arm[®]-based ATSAM3U4E[®] (SAM3U) microcontroller.

Note: The SAM3U microcontroller VDDIO voltage is fixed at 3.3 V; therefore, the I²C-USB module only supports 3.3 V level I²C communication.



Figure 3: I²C-USB Module



5 Basic Operation

5.1 Starting Fast Charge Mode

Before starting Fast Charge mode, confirm the jumper connections are correct; VBUS and VBAT voltage level:

- VBUS voltage is higher than VINDPM, typical setting is 5.0 V
- VBAT voltage is higher than fast charge voltage threshold, typical setting is 3.7 V

Once power is applied, OTP registers are loaded and I²C communication is available.

Set register CHG_EN (0x16[0]) to high. DA9168 enters Fast Charge mode.

DA9168								
EUNCTIO	NAL REGISTERS		Table View					
Charger	Charger Settings							
ਤੱ	PMC_CHG_00		PMC_CHG_01		PMC_CHG_02		PMC_CHG_03	
	CHG_VRCHG	100	CHG_TMR_SAFE	5 🗸	CHG_RANGE_TERM	5-20 mA, in 5	CHG_RANGE	Fast-charge 20 mA
	CHG_TMR_HALF_EN	Enable	CHG_TMR_PRE	30 🗸	CHG_RANGE_PRE	5-15 mA, in 5	CHG_ICHG	CHG_RANGE = 0 : V
	CHG_TMR_EN	Enable	CHG_TOPOFF	Disable TOPOFF	CHG_ITERM	CHG_RANGE = 0 : V		
	CHG_TERM_EN	Enable			CHG_IPRE	CHG_RANGE = 0 : V		
	CHG_EN	Enable						
	0x0016	0x0F	0x0017	0x00	0x0018	0x0F ÷	0x0019	0x19
	PMC_CHG_04		PMC_CHG_05		PMC_CHG_06			
	CHG_VBATREG	4.20 🗸	TS_VBATREG_SHIFT	100	TS_ICHG	CHG_RANGE = 0 : V		
			CHG_TS_WARM_V	Disable				
			CHG_TS_COOL_I	Disable				
	0x001A	0x17 *	0x001B	0x00 -	0x001C	0x0C		

Figure 4: Enable Fast Charge Mode

5.2 Starting Reverse Boost Mode

To enable DA9168 Reverse Boost mode, confirm the following conditions:

- VBUS power supply is disconnected
- VBAT voltage is higher than reverse boost voltage threshold, typical setting is 3.7 V
- Bits BOOST_VOUT(0x14[3:0]) setting is 0.5 V higher than VBAT

Set register BOOST_EN (0x13[0]) to high. DA9168 enters Reverse Boost mode.

DA9168								
EUNCTIO	NAL REGISTERS	CHARGER LDO	Table View					
System	System settings							
ەن _	PMC_SYS_00		PMC_SYS_01		PMC_SYS_02		PMC_SYS_03	
	E_RD_CLR_DIS	Low	ILIMIT_EN	No IINDPM update	BTS_VBAT_RATE	50 ms	SYS_WAIT	1 🗸
	VSYS_MIN	3.7 🗸	IINDPM	0.1 🗸	BTS_VBAT_EN	Disable	WD_TMR	160 🗸
	VINDPM	4.2 🗸			BTS_VBUS_RATE	50 ms	WD_EN	No action
					BTS_VBUS_EN	Disable	RST_TMR	12 🗸
					VBAT_DEB	100 🗸	RST_REG	No action
					VBUS_DEB	100 🗸		
	0x000F	0x38	0x0010	0x00	0x0011	0x0A	0x0012	0x34
	PMC_SYS_04		PMC_SYS_05		PMC_SYS_06			
	SEQ_BOOST	BOOST_EN is set w	BOOST_ILIM	1.0 🗸	RIN_N_SHIP_EXIT_TMR	20 ms		
	DLOAD_VMID_SEL	30 🗸	BOOST_VOUT	5.0 🗸	VBUS_OVSEL	5.8 🗸		
	DLOAD_VMID_EN	Disable			HIZ_MODE	VBUS when available		
	REV_VBUS_EN	Disable			SHIP_DLY	10 🗸		
	BOOST_EN	Enable			SHIP_MODE	No action		
	0x0013	0x39	0x0014	0x9A ÷	0x0015	0x06 ÷		

Figure 5: Enable Reverse Boost Mode



DA9168 Performance Board

5.3 Signal Monitoring

The Kelvin sensing method is used on the DA9168 performance board to improve the measurement accuracy. On J26, J27, J28, J29, J30, J31, and J32, header pins 1 and 2 are used as voltage sensing pins, while pins 3 and 4 can be used for measuring the current flows.

- J41 monitors the DA9168 C1(VBAT) pin voltage directly
- J42 monitors the DA9168 C2(VSYS) pin voltage directly

🚹 CAUTION

Apply high current to J26, J27, J28, J29, J30, J31, J32, J41 and J42 headers pin 1 and 2 may cause the voltage sensing traces to burn out.

Other signals:

- switching node is monitored at TP4
- VBTS signal is monitored at TP3
- GPIO signals are monitored at J34 and J35 headers

5.4 Fault Indicators

Faults are indicated in the System Events tab in the SmartCanvas GUI.

	NAL REGISTERS SYSTEM	I CHARGER LDO	Table View					
System Status	PMC_EVENT_00		PMC_EVENT_01		PMC_EVENT_02		PMC_EVENT_03	
γste	E_VBUS_VINDPM	VBUS not in VINDPM	E_VBUS_OV	VBUS not in OV	E_TSD_CRIT	Below	E_CHG_SLEEP	VBUS lower
	E_VBUS_IINDPM	VBUS not in IINDPM	E_VMID_OV	VMID not in OV	E_TSD_WARN	Below	E_CHG_SPLMT	VBAT fet not
System Events	E_VMID_OC	VMID not in OC	E_VSYS_OV	VSYS not in OV	E_WD_TIMER	Watch-dog timer not	E_CHG_TIMER	Charge timer not
E E	E_VBAT_OC	VBAT not in OC	E_VBAT_OV	VBAT not in OV	E_TS_HOT	Battery temp sens	E_CHG_TRICKLE	Charger not in trickle
Syste	E_VBUS_OK	VBUS not OK	E_VBUS_UV	VBUS not in UV	E_TS_WARM	Battery temp sens	E_CHG_PRE	Charger not
	E_VMID_OK	VMID not OK	E_VMID_UV	VMID not in UV	E_TS_COOL	Battery temp sens	E_CHG_CC	Charger not
mas	E_VSYS_OK	VSYS not OK	E_VSYS_UV	VSYS not in UV	E_TS_COLD	Battery temp sens	E_CHG_CV	Charger not
븉	E_VBAT_OK	VBAT not OK	E_VBAT_UV	VBAT not in UV	E_TS_OFF	Battery temp sens	E_CHG_DONE	Charge termination
Interrupt mask	0x0005	0x00	0x0006	0x00 +	0x0007	0x00 +	0x0008	0x00 +
	PMC_EVENT_04							
	E_REF_OC	REF not in OC						
	E_LDO2_IMON1	LDO2 not in IMON1						
	E_LDO2_IMON2	LDO2 not in IMON2						
	E_LDO2_OC	LDO2 not in OC						
	E_LDO1_IMON1	LDO1 not in IMON1						
	E_LDO1_IMON2	LDO1 not in IMON2						
	E_LDO1_OC	LDO1 not in OC						
	0x0009	0x00						

Figure 6: System Events Tab

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5.5 Interrupt Signals

DA9168 interrupt signals are masked in the Interrupt Mask tab.

DA9168 EUNCTIO		M CHARGER LDO	Table View					
System Events System Status	Interrupt mask bits PMC_MASK_00 M_VBUS_VINDPM M_VBUS_UINDPM M_VHID_OC M_VBAT_OC M_VBUS_OK M_VHID_OK	Masked Masked Masked Masked Masked	PMC_MASK_01 M_VBUS_OV M_VMID_OV M_VSS_OV M_VBAT_OV M_VBUS_UV M_VBUS_UV	Masked Masked Masked Masked Masked	PMC_MASK_02 M_TSD_CRIT M_TSD_WARN M_WD_TIMER M_TS_HOT M_TS_WARM M_TS_COOL	Masked Masked Masked Masked Masked	PMC_MASK_03 M_CHG_SLEEP M_CHG_SPLMT M_CHG_TIMER M_CHG_TRICKLE M_CHG_PRE M_CHG_CC	Masked Masked Masked Masked Masked
Interrupt mask	M_VSYS_OK M_VSYS_OK M_VBAT_OK 0x000A PMC_MASK_04	Masked Masked 0xFF	M_VSYS_UV M_VBAT_UV Ox000B	Masked Masked 0xFF	M_TS_COLD M_TS_OFF 0x000C	Masked Masked 0xFF +	M_CHG_CV M_CHG_DONE 0x000D	Masked Masked 0xFF
	M_REF_OC M_LDO2_IMON1 M_LDO2_IMON2 M_LDO2_OC M_LDO1_IMON1	Masked Masked Masked Masked Masked						
	M_LDO1_IMON2 M_LDO1_OC 0x000E	Masked Masked						

Figure 7: Interrupt Mask Tab

Note: A masked fault is still indicated as high in the read-only registers 0x0000 to 0x0004 in the **System Status** tab.

TIONAL REGISTERS							
PMC_STATUS_00		PMC_STATUS_01		PMC_STATUS_0	2	PMC_STATUS_03	
S_VBUS_VINDPM	VBUS not in VINDPM	S_VBUS_OV	VBUS not in OV	S_TSD_CRIT	Below	S_CHG_SLEEP	VBUS low
S_VBUS_IINDPM	VBUS not in IINDPM	S_VMID_OV	VMID not in OV	S_TSD_WARN	Below	S_CHG_SPLMT	VBAT fet n
S_VMID_OC	VMID not in OC	S_VSYS_OV	VSYS not in OV	S_WD_TIMER	Watch-dog timer not	S_CHG_TIMER	Charge time
S_VBAT_OC	VBAT not in OC	S_VBAT_OV	VBAT not in OV	S_TS_HOT	Battery temp sens	S_CHG_TRICKLE	Charger not in
S_VBUS_OK	VBUS OK	S_VBUS_UV	VBUS not in UV	S_TS_WARM	Battery temp sens	S_CHG_PRE	Charger n
S_VMID_OK	VMID not OK	S_VMID_UV	VMID not in UV	S_TS_COOL	Battery temp sens	S_CHG_CC	Charger n
S_VSYS_OK	VSYS not OK	S_VSYS_UV	VSYS in UV	S_TS_COLD	Battery temp sens	S_CHG_CV	Charger n
S_VBAT_OK	VBAT OK	S_VBAT_UV	VBAT not in UV	S_TS_OFF	Battery temp sens	S_CHG_DONE	Charge termin
0x0000	0x09	0x0001	0x02	0x0002	0x00	0x0003	0x00
PMC_STATUS_04							
S_REF_OC	REF not in OC						
S_LDO2_IMON1	LDO2 not in IMON1						
S_LDO2_IMON2	LDO2 not in IMON2						
S_LDO2_OC	LDO2 not in OC						
S_LDO1_IMON1	LDO1 not in IMON1						
S_LDO1_IMON2	LDO1 not in IMON2						
S LDO1 OC	LDO1 not in OC						



User	Manual
USCI	Manual



6 DA9168 Performance Board Software

The board is controlled using the <u>SmartCanvas</u> software graphical user interface (GUI), which requires a PC operating Windows[®] 2000/XP/Vista/7/10 with a USB1.1 or USB2 interface. The GUI allows the user to:

- configure the DA9168 device
- perform write and read operations to all control registers
- monitor the device status, including faults

6.1 SmartCanvas GUI Installation

The files required to install the software are available on the supplied USB drive. To install the DA9168 SmartCanvas software:

- 1. Run setup_DA9168_GUI_0.0.0.3.exe. The program default install location is: C:\Dialog Semiconductor\Power Management\DA9168 GUI.
- On completion, plug in the performance board I²C-USB and apply power to VBUS or VBAT. The software must be started after the I²C-USB is plugged in, otherwise communication with the board may fail.
 - a. For first time users, Windows should detect the attached USB device. If this is not the case, it may be necessary to install the driver by navigating to the required driver file in the USB driver directory, see Section 6.2. For guaranteed operation, it is recommended that a PC reboot be carried out after installing the driver.
- 3. Once installation is complete, run the DA9168 SmartCanvas software: DA9168 GUI.exe.

6.1.1 SmartCanvas GUI Installation Step-by-Step Guide

🙀 Setup - DA9168 GUI 0.0.0.3 —	×
License Agreement Please read the following important information before continuing.	
Please read the following License Agreement. You must accept the terms of this agreement before continuing with the installation.	
Dialog Smart Canvas Software Package Licensing Agreement	^
THIS LICENSING AGREEMENT REGULATES YOUR USE OF THE SOFTWARE PRODUCTS DESCRIBED HEREIN AND PROVIDED BY DIALOG SEMICONDUCTOR (UK) LTD (記LOG+ .	
IF YOU (INDIVIDUAL OR LEGAL ENTITY, ALSO REFERRED TO AS GIOENSEE- HEREIN) HAVE ALREADY SIGNED OR ASSENTED TO BE BOUND DV (NOTURE CONTINUES LIGHTIONIC) CONFIDENTIAL WITH DESCRIPTION TO THE	~
• I accept the agreement	
O I <u>d</u> o not accept the agreement	
Next >	ancel

Figure 9: GUI Setup License Agreement

4. Select I accept the agreement then click Next.





👸 Setup - DA9168 GUI 0.0.0.3	_		×
Select Destination Location Where should DA9168 GUI be installed?			
Setup will install DA9168 GUI into the following folder.			
To continue, click Next. If you would like to select a different folder,	click Bro	owse.	
C:¥Dialog Semiconductor¥Power Management¥DA9168 GUI	В	owse	
At least 145.8 MB of free disk space is required.			
< <u>B</u> ack <u>N</u> ext	>	Ca	ncel

Figure 10: GUI Setup Destination Location

5. Click Next.

🖟 Setup - DA9168 GUI 0.0.0.3		-	-		\times
Select Start Menu Folder Where should Setup place the program's sh	nortcuts?				
Setup will create the program's sh	ortcuts in the foll	owing Start I	Menu fi	older.	
To continue, click Next. If you would like to	select a differen	t folder, click	Brows	e.	
Dialog Semiconductor¥Power Management	¥DA9168 GUI		B <u>r</u> ow	se	
	< <u>B</u> ack	<u>N</u> ext >		Cance	el

Figure 11: GUI Setup Shortcuts Location

6. Click Next.

14 of 26





🔂 Setup - DA9168 GUI 0.0.0.3		_		×
Select Additional Tasks Which additional tasks should be performed?			Q	
Select the additional tasks you would like Setup then click Next.	o to perform v	vhile installing [0A9168 GU	Ι,
Additional shortcuts:				
Create a desktop shortcut				
	< <u>B</u> ack	<u>N</u> ext >	Car	icel

Figure 12: GUI Setup Create Shortcut

7. Select the Create a desktop shortcut check box and click Next.

🔀 Setup - DA9168 GUI 0.0.0.3	-		×
Ready to Install Setup is now ready to begin installing DA9168 GUI on your computer.			
Click Install to continue with the installation, or click Back if you want t change any settings.	to review	or or	
Destination location: C:¥Dialog Semiconductor¥Power Management¥DA9168 GUI		1	
Start Menu folder: Dialog Semiconductor¥Power Management¥DA9168 GUI			
Additional tasks: Additional shortcuts: Create a desktop shortcut			
<		>	/
< <u>B</u> ack Insta	all	Ca	ncel

Figure 13: GUI Setup Installation

8. Click Install.



🛃 Setup - DA9168 GUI 0.0.0.3	– 🗆 ×
	Completing the DA9168 GUI Setup Wizard
	Setup has finished installing DA9168 GUI on your computer. The application may be launched by selecting the installed shortcuts.
	Click Finish to exit Setup.
	Launch DA9168 GUI
R	
	Einish

Figure 14: GUI Setup Finish and Launch

9. Click Finish.

Once the installation is complete, a PC restart may be required.

When the software is installed, insert the I²C-USB cable before applying power. The DA9168 SmartCanvas software can be started after power up.

6.2 Initial I²C-USB Connection

On connecting the I²C-USB to the PC for the first time, the SAM3U USB driver requests driver updating/installation from the Windows operating system. On Windows 7/10 32-bit operating systems the driver usually installs automatically. On Windows 7/10 64-bit machines it is common for the complete driver installation to fail. If this happens you must install the driver manually by following these steps:

- 1. Control Panel \rightarrow Devices and Printers (double-click device with yellow exclamation sign).
- 2. Update Driver.
- 3. Browse my computer for driver software.
- 4. Select the Driver folder location: C:\Dialog Semiconductor\Power Management\DA9168 GUI\driver.
- 5. If Windows warns about the driver, select **Install anyway**.
- 6. Remove the I²C-USB cable then reinsert it into the performance board.

7 SmartCanvas Software

Run the DA9168 SmartCanvas software by clicking the shortcut on the appropriate item in the Start menu (All Programs \rightarrow Dialog Semiconductor \rightarrow Power Management \rightarrow DA9168 GUI). The main GUI interface is displayed, see Figure 15.

The minimum recommended setting for the PC display size is 1024x768 pixels. Font size on the PC display should be Normal (95 dpi).

NOTE

It is important to note that a display size other than the recommended setting affects the way in which the panels appear.

7.1 Register Controls

Device registers are displayed as a group of controls. Selected bit ranges within a register make up a control. Register data is always a standard bit width dictated by the device register map, but a control can be anything from 1-bit to the full register data width.

Registers are grouped together on tabs to assist with identification of device function or registers of the same type.

S DA916										- σ ×
Eile Ior	ls <u>S</u> earch ⊻iew <u>H</u> el	p								Control ×
DA9168										CONUS A
EUNCTI	INAL REGISTERS	1 QHARGER LDO	Table View							S smartcanvas
8	Charger Settings									Sinarccantas
Charge	PMC_CHG_00		PMC_CHG_01		PMC_CHG_02		PMC_CHG_03			Communication
	CHG_VRCHG	100	CHG_TMR_SAFE	5 🗸	CHG_RANGE_TERM	5-20 mA, in 5	CHG_RANGE	Fast-charge		US8 connection
	CHG_TMR_HALF_EN CHG_TMR_EN	Enable	CHG_TMR_PRE CHG_TOPOFF	30 V Disable TOPOFF V	CHG_RANGE_PRE CHG_ITERM	5+15 mA, in 5	CHG_TCHG	CHG_RANGE	-01 -	
	CHG_TERM_EN	Enable	CHS_TOPOPP	Usable TOPOPP	CHG_IPRE	CHG_RANGE = 0 : V				DA9168 Device Communication
	CHG_EN	Disable				(Reconnect to device
	0x0016	CxOE 🗄	0x0017	0x00	0x0018	Ox0F	0x0019	0x19		Raw I/O Bus Interface DA9168 I2C
	PMC_CHG_04		PMC_CHG_05		PMC_CHG_06					Bus Interface DA9168 I2C Slave Address 0x00
	CHG_VBATREG	4.20 🗸	TS_VBATREG_SHIFT	100	TS_JCHG	CHG_RANGE = 0 : V				Reg. Address 0x00
			CHG_TS_WARM_V CHG_TS_COOL_I	Disable						Send Data 0x00
	0x001A	0x17			0x001C	0x0C				Read Data 0x00
										Advanced Mode
										Poling
										Disabled Disabled Poll All Registers Poll Visible Only
										C1/0
										Read All Registers (exd. Event)
										Read Event Registers
										File 10
										Save Load File Format: Address Name
										Chip ID
										Read Chip ID
				Status				×	Info	VUSB Interface Info
Cons	le Log								Ditfield Info	ULI DI Version: 1.19 USB Device: 0
									Bitfield: T5_VBATREG_SHEFT Register: PMC_CHG_05 (0x1b)	SAM3U FW Version: 1.11 VCS FW Dev, Version: 69888
	Clear	Mark 1	Save to file	Filter (reg expr)	1º		Log level: Info	×	Bit: [2] Access: R/W	PPGA Version: 15.255
									POR: 0	
									Current Value: 0 Enumerated Value: 100	
									Chandel Blocks:	
									PMC: TS_VBATREG_SHIPT	
									Description: Battery voltage regulation setting down-shift during TS event (miV).	

Figure 15: Main Interface



7.2 Table View Tab

The **Table View** tab shows the complete register map, see Figure 16. From this tab all the registers can be set or read back. Clicking on any of the bit groups on the map allows access to the full control settings. These controls read and write the same value elsewhere on the interface.

19168 Jools Search Yiew Hel 9168	p										- 0 Centrol
NCTIONAL REGISTERS	1 QHARGER	LDO Table View									Ssmart canvas
	Data	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	9	
x0000: PMC_STATUS_00		S_VBUS_VINDPM: 0x00	S_VBUS_IINDPM: 0x00	S_VMID_OC: 0x00	S_VEAT_OC: 0x00	S_VBUS_OK: Ex01	S_VMID_OK: 0x00	S_VSYS_OK: 0x00	S_VEAT_OK: Ex01		Communication USB connection
0001: PMC_STATUS_01	x02	S_VBUS_OV: 0x00	S_VMID_OV: 0x00	S_VSYS_OV: 0x00	S_VBAT_OV: 0x00	S_VBUS_UV: 0x00	S_VMID_UV: 0x00	S_VSYS_UV: 0x01	S_VEAT_UV: 0x00		Use connection
0002: PMC_STATUS_02	x00	S_TSD_CRIT: 0x00	S_TSD_WARN: 0x00	S_WD_TIMER: 0x00	S_TS_HOT: 0x00	S_TS_WARM: 0x00	S_TS_COOL: 0x00	S_TS_COLD: 0x00	S_TS_OFF: 0x00		DA9168 Device Communication
0003: PMC_STATUS_03	x00	S_CH0_SLEEP: 0x00	S_CHO_SPLMT: 0x00	S_CHS_TIMER: 0x00	S_CHG_TRICKLE: 0x00	S_CHG_PRE: 0x00	S_CH0_CC: 0x00	\$_CH0_CV: 0x00	S_CH0_DONE: 0x00		Reconnect to device
004: PMC_STATUS_04	x00	unused	S_REF_OC: 0x00	S_LDO2_IMON1: 0x00	S_LDO2_IMON2: 0x00	5_LD02_0C: 0x00	S_LDO1_IMON1: 0x00	S_LDO1_IMON2: 0x00	8_LD01_0C: 0x00		Raw I/O Bus Interface DA9168 I2C
005: PMC_EVENT_00	x00	E_VBUS_VINDPM: 0x00	E_VBUS_IINDPM: 0x00	E_VMD_OC: 0x00	E_VBAT_OC: 0x00	E_VBUS_OK: 0x00	E_VMD_OK: 0x00	E_VSYS_OK: 0x00	E_VBAT_OK: 0x00		Slave Address 0xD0
0006: PMC_EVENT_01	x00 🗄	E_VBUS_OV: 0x00	E_VMID_OV: 0x00	E_VSYS_OV: 0x00	E_VBAT_OV: 0x00	E_VBUS_UV: 0x00	E_VMID_UV: 0x00	E_VSYS_UV: 0x00	E_VBAT_UV: 0x00		Reg. Address 0x00
0007: PMC_EVENT_02	x00 🗄	E_TSD_CIRIT: 0x00	E_TSD_WARN: 0x00	E_WD_TIMER: 0x00	E_TS_HOT: 0x00	E_TS_WARM: 0x00	E_TS_COOL: 0x00	E_TS_COLD: 0x00	E_TS_OFF: 0x00		Send Data 0x00 Read Data 0x00
0008: PMC_EVENT_03	x00	E_CHG_SLEEP: 0x00	E_CHG_SPLMT 0x00	E_CHG_TIMER: 0x00	E_CHG_TRICKLE: 0x00	E_CHG_PRE: 0x00	E_CHG_CC: 0x00	E_CHG_CV: 0x00	E_CHG_DONE: 0x00		Read Data 0x00
0009: PMC_EVENT_04	x00 🗄		E_REF_OC: 0x00	E_LD02_IMON1: 0x00	E_LD02_IM0N2: 0x00	E_LD02_0C: 0x00	E_LDO1_IMON1: 0x00	E_LD01_IM0N2: 0x00	E_LD01_0C: 0x00		Poling
000A: PMC_MASK_00	wff 🗄	M_VBUS_VINOPM 0x01	M_VBUS_IINDPM: 0x01	M_VMD_OC: 6x01	M_VEAT_OC: 0x01	M_VBUS_OK: 0x01	M_VMID_OK: 0x01	M_VSYS_OK: 0x01	M_VEAT_OK: Gu01		Disabled Pol Al Registers Pol Visible C
008: PMC_MASK_01	aff 🗄	M_VBUS_OV: 0x01	M_VMID_OV: Ge01	M_VSYS_OV: BuD1	M_VEAT_OV: 0x01	M_VBUS_UV: 6x01	M_VMID_UV: 0x01	M_VSYS_UV: Ga01	M_VEAT_UV: Gut1		-10
000C: PMC_MASK_02	NFF 🗄	M_TSD_CRIT: 0x01	M_TSD_WARN: Beb1	M_WD_TIMER: 0x01	M_TS_HOT: 0x01	M_TS_WARM: Ex01	M_TS_COOL: 0x01	M_TS_COLD: 0x01	M_TS_OFF: Ex01		Read All Registers (excl. Event)
000D: PMC_MASK_03	NFF 🗄	M_CHG_SLEEP: 0x01	M_CHG_SPLME 0x01	M_CHG_TIMER: 6v01	M_CHG_TRICKLE: 0x01	M_CHG_PRE: 0x01	M_CH6_CC: 0x01	M_CHG_CV: 0x01	M_CHG_DONE: Ev01		Read Event Registers
000E: PMC_MASK_04	x7F 🗄	unused	M_REF_OC: Bed1	M_LD02_INON1: 6x01	M_LDO2_BMON2: 0x01	M_LD02_OC: 6x01	M_LDO1_MON1: 0x01	M_LDO1_IMON2: 0x01	M_LD01_0C: Ge01		File 10 Load
00F: PMC_SYS_00	x38 ÷		E_RD_CLR_DIS: 0x00	VSYI	MIN: i03		VIN	DPM: i08			File Format: 🔿 Address 🌑 Nam
010: PMC_SYS_01	x00 ÷	un.	used	LIMIT_EN: 0x00			IINDPM: 0x00				Chip ID
0011: PMC_SYS_02	x0A ÷	BTS_VBAT_RATE: 0x00	BTS_VBAT_EN: 0x00	BTS_VBUS_RATE: 0x00	BTS_VBUS_EN: 0x00	VBA	T_DEB: Ix12	VBU	5_DEB: x12		
0012: PMC_SYS_03	x34 ÷	SYS,		WD.	TMR: 03	WD_EN 0x00	RST	TMR:	RST_REQ: 0x00		
0013: PMC_SYS_04	x38 🗄		ised	SEQ_BOOST: Ex01	DLOAD_V	MID_SEL: 03	DLOAD_VMID_EN: 0x00	REV_VBUS_EN: 0x00	BOOST_EN: 0x00		Read Chip ID
											USB Interface Info
				Status				×	Bitfield Info	Info	 Interface: Dialog USB-IO ULI DI Version: 1.19
nsole Log			_				_		Bitfield: CHG_VBATR Register: PMC_CHG	REG (0x1a)	USB Device: 0 SAM3U FW Version: 1.11 VCS FW Dev. Version: 69888
Clear	Mark	Save to file		Filter (reg expr):			Log level: Info	×	Bits: [5:0] Access: R/W POR: 23		PPGA Version: 15.255
									Current Value: 23 Enumerated Value: 4	4.20	
									Chipmodel Blocks: PMC: CHG_VBATR	REG	
									Description:		
									Battery voltage regi 10 mV step.	ulation setting (V).	

Figure 16: Table View

7.3 Control Windows

All dockable control windows, either on the right or bottom of the main window add additional functionality or monitoring to the GUI. The windows can be undocked by clicking on and dragging the title bar of that window and can be placed anywhere on the screen.

7.3.1 Communication

The **Communication** window has indicators to show when the SAM3U I²C-USB module is plugged in and when I²C communication is possible; the currently active I²C-USB device number is also shown, see Figure 17. Most of the time the communication link automatically connects if the I²C-USB is active and the device is powered up. On rare occasions, sequence of events may prevent recognition of the active communication link, pressing the **Reconnect to device** button recovers the link.

Control	×
Smart canvas	
Communication	n.
USB connection	
OA9168 Device Communication	
Reconnect to device]

Figure 17: Communication Control



DA9168 Performance Board

7.3.2 Enable/Disable Polling

The **Enable/Disable Polling** button enables or disables polling of the device registers and the refreshing of the registers controls on the GUI interface, see Figure 18.

Dis	abled
O Poll All Registers	Poll Visible Only

Figure 18: Polling

The **Enable/Disable Polling** button also allows the polling rate to be changed. There is an option to poll all or just the visible registers; however, selecting **Poll Visible Only** may have adverse effects on the functionality of the automation controls and is therefore not recommended.

7.3.3 I/O

The I/O update actions are as follows:

- Read All Register (excl. Event) even if the hardware device is not being actively polled then all the registers can be polled once by pressing this button.
- **Read Event Registers** all event registers can be polled once by pressing this button.

_I/0	
	Read All Registers (excl. Event)
	Read Event Registers

Figure 19: I/O

7.3.4 Raw I/O

The **Raw I/O** control sends the entered device address, register address and data on the I²C communications interface, see Figure 20. If the information sent is not valid then the I²C message returns NACK and an error message is displayed in the **Status** window. Data from an individual address can also be READ from this window.

Raw I/O	
Bus Interface	DA9168 I2C 🔍
Slave Address	0xD0
Reg. Address	0x00
Send Data	0x00
Read Data	0x00
Advanced Mode	

Figure 20: Raw I/O

The optional **Advanced Mode** allows control of the I²C frequency.

7.3.5 File I/O

The **File I/O** control **Load** button allows formatted text files to be loaded into the device registers, which is then be reflected on the **Registers** display of the GUI interface, see Figure 21.

1	File IO			
	Save		Load	
	File Format:	O Addre	ess 🔘 Name	

Figure 21: File I/O

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User	Manual	



DA9168 Performance Board

The **Save** button saves the register values displayed on the GUI interface. If saving with the extension .txt or .csv, one of the **File Format** radio buttons can be selected to save by either register name or register address.

A predefined automated sequence is present in this window. This single-shot button allows a separate script to be loaded as required.

7.3.6 Info

The **Info** window displays a description of an interface control including: name, parent register and the bits to which this control corresponds, current value, whether it is read only or R/W, and finally a description of each possible setting, see Figure 22.

For long descriptions the window may either be undocked and made larger; or docked at the lefthand side of the main window.

nfo	x
Bitfield Info	
bitfield: S_REF_OC Register: PMC_STATUS_04 (0x4) Bit: [6] Access: R POR: 0	
Current Value: 0 Enumerated Value: REF not in OC	
Chipmodel Blocks: PMC: S_REF_OC	
Description: REF OC Status	

Figure 22: Info

7.4 Menu Items

There are several menu items found on the top line of the interface, which allows the selection of enhanced functionality. These are not required in most cases of interface use.

7.4.1 File -> Open Python Script

The **Open Python script** option in the **File** menu opens a Python[®] script selected in the pop-up window.

7.4.2 File -> Run Python Script

The **Run Python script** option in the **File** menu runs the Python script selected in the pop-up window.

User Manual



7.4.3 Tools -> Model IO

The Model IO option in the Tools menu allows access to all registers at a glance, see Figure 23.

🐒 Model IO Viewer	– 🗆 X		
ModelIO			
DA9168	V		
PMC_STATUS_00	V		
PMC_STATUS_00			
S_VBUS_VINDPM	VBUS not in VINDPM		
S_VBUS_IINDPM	VBUS not in IINDPM		
S_VMID_OC	VMID not in OC		
S_VBAT_OC	VBAT not in OC		
S_VBUS_OK	VBUS OK		
S_VMID_OK	VMID not OK		
S_VSYS_OK	VSYS not OK		
S_VBAT_OK	VBAT not OK		
0x0000	0x08		

Figure 23: Model IO

7.4.4 Tools -> Scan I2C

The **Scan I2C** option in the **Tools** menu allows the scan of all slave devices on the I^2C bus, see Figure 24.

💟 I2C Bus Scan	_	×
Scan	52 %	
I2C channel 0: slaves found I2C channel 1: slaves found		
Last Error: ('USB-Lab_IO ER LOW (extra info: I2C slave		is

Figure 24: Scan I2C

User	Manua	
0301	manua	



7.4.5 Tools -> Custom Tabs

The **Custom Tabs** option in the **Tools** menu allows customized tabs to be created by dragging register widgets to the **Custom Tabs** control window, see Figure 25.

Custom Tabs	- 🗆 X
Import Tabs ODA9168 Custom Tab	b-falx coupt coupt
DA0165 Outom Tab Test Test Default PMC_SYS_00 E.O.O. VIDS/MN 3.7 VIDD/MN 4.2 Ox000F 0x.38	Test FMC_SVS_D4 SEQ.BOOT BOOT_BI set we DOAD_MED_SL 30 DOAD_MED_SL 30 DOAD_MED_SL 30 DOAD_MED_SL 30 DOAD_MED_SL 30 DOAD_MED_SL 30 DOAD_MED_SL 0 BOOT_BN Deable DOOT_BN Deable DOOT_ST_N Deable

Figure 25: Custom Tabs

7.4.6 Search -> Find Register

The **Find Register** option in the **Search** menu searches by name, or number, or by a particular text term contained within the GUI, see Figure 26. An entry made in the **Search Name** box searches register names and display the instances found in the right-hand side list box. If the **All Text** radio button is selected all entries containing the written text are identified and listed.

Search			x
Search Controls	Name	Address	
PMC_CHG_00 Find	1 PMC_CHG_00	0x0016	
Register O Controls O All Text			
Search Address			
0x Find			
Results			
Prev Next			
Advanced search			

Figure 26: Find Register

If the **Advanced Search** checkbox has been selected, selecting **Reg expr** allows a search based upon Python regular expression functions.

7.4.7 View

The View menu reopens the docking windows if they have been previously closed.

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8 Register Text File

The DA9168 SmartCanvas software can save and load a text file containing command codes representing the register addresses and data. This file is principally used to save and load setup data but may also be used to perform a small degree of automation.

The use of the **Save** button in the **File I/O** control transfers register contents to the user's software. This is a register dump of the entire device. If the **Name** radial button is selected instead of **Address**, then register names rather than register addresses are saved in the text file.

8.1 I²C Register Text File Format

The following formats are used for both read and write in the text file:

- WRITE: writes to the device: WRITE [device name] [register address] [register data value].
- READ: reads from the device: READ [device name] [register address]. The result of the read is passed to a **File Readback Values** pop-up window.
- DELAY: implements a time delay specified in milliseconds: DELAY [time in milliseconds] no time suffix required.
- USBIO: controls the SAM3U USB device IOs: USBIO [USB IO pin index] [output value] USB device output value = 0 or 1.
- ACTION: pauses the file being loaded until the pop-up message dialogue has been acknowledged: ACTION [text message].

Numbers are always expressed in Hex, separated by tabs. The use of 0x in front of the hex value is mandatory. Inline comments (lines beginning with //) are permitted in the file. The data is processed in the order written and written directly to the specified device.

For example:

WRITE DA9168_I2C 0x0016 0x0E WRITE DA9168_I2C PMC_CHG_00 0x0E READ DA9168_I2C 0x0016 READ DA9168_I2C PMC_CHG_00 DELAY 1000 // delay is 1000 ms or 1 s USBIO 0 1 // "0" refers to the index number for the USB IO pin on the "USB_Ports" tab. ACTION Please press the OK button to continue.

DA9168 File IO 15-06-2020 15-54-12 - Notepad			-	×
<u>File Edit Format View H</u> elp				
CONFIG DA9168_I2C slave=0xD0 bus=I2C addrBytes=1 dataBytes=1 freq=4	00000 chan=0			
READ DA9168_I2C PMC_STATUS_00 0x00				
DELAY 1000				
WRITE DA9168_I2C PMC_STATUS_01 0x00				
WRITE DA9168_I2C PMC_STATUS_02 0x00				
WRITE DA9168_I2C PMC_STATUS_03 0x00				
WRITE DA9168_I2C PMC_STATUS_04 0x00				
WRITE DA9168_I2C PMC_EVENT_00 0x00				
WRITE DA9168_I2C PMC_EVENT_01 0x00				
ACTION				
WRITE DA9168_I2C PMC_EVENT_02 0x00				
WRITE DA9168_I2C PMC_EVENT_03 0x00				
WRITE DA9168_I2C PMC_EVENT_04 0x00				
WRITE DA9168_I2C PMC_MASK_00 0xFF				
WRITE DA9168_I2C PMC_MASK_01 0xFF				
WRITE DA9168_I2C PMC_MASK_02 0xFF				
WRITE DA9168_I2C PMC_MASK_03 0xFF				
WRITE DA9168_I2C PMC_MASK_04 0x7F				
WRITE DA9168_I2C PMC_SYS_00 0x38				
WRITE DA9168_I2C PMC_SYS_01 0x00				
WRITE DA9168_I2C PMC_SYS_02 0x0A				
WRITE DA9168_I2C PMC_SYS_03 0x34				
WRITE DA9168_I2C PMC_SYS_04 0x38				
WRITE DA9168_I2C PMC_SYS_05 0x9A				
WRITE DA9168_I2C PMC_SYS_06 0x06				
WRITE DA9168_I2C PMC_CHG_00 0x0E				
WRITE DA9168_I2C PMC_CHG_01 0x00				
WRITE DA9168_I2C PMC_CHG_02 0x0F				
WRITE DA9168_I2C PMC_CHG_03 0x19				
WRITE DA9168_I2C PMC_CHG_04 0x17				
WRITE DA9168_I2C PMC_CHG_05 0x00				
WRITE DA9168_I2C PMC_CHG_06 0x0C				
WRITE DA9168_I2C PMC_LDO_00 0x44				
<				>
	Windows (CRLF)	Ln 9, Col 35	100%	

Figure 27: Register Dump (.txt File) Example

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0301	manual



Revision History

Revision	Date	Description
3	03-Aug-2022	File was rebranded with new logo, copyright and disclaimer
2	17-Aug-2020	Minor spelling corrections and clarification of Caution in Section 5.3.
1	03-July-2020	Initial version

User Manual



DA9168 Performance Board

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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(Rev.1.0 Mar 2020)

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