# RENESAS

### QCIOT-013-28022POCZ

QCIOT-013 Digital Power Monitor Board

This document provides quick-start instructions for the QCIOT-013 Digital Power Monitor (DPM) Board that include setting up and programming the board.

*Important*: To ensure the QCIOT-013 Digital Power Monitor (DPM) Board is set up correctly, complete the steps in the order listed in *Quick Start Procedure*.

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## 1. Board Information

### 1.1 How to Get the Board

To obtain the QCIOT-013 Digital Power Monitor (DPM) Board (QCIOT-013-28022POCZ), go to the Renesas product page.



### Figure 1. QCIOT-013 Digital Power Monitor Board

Part Number	Description		
QCIOT-013-28022POCZ	QCIOT Digital Power Monitor Pmod Board		

#### 1.2 **Board Contents**

The QCIOT-013 board can measure voltages in the presence of common-mode voltages ranging from 0V to 60V, and it can measure the variable input current and power consumption. The board can also report diagnostics by configuring the fault thresholds of the bus voltage and shunt voltage.



\*Design Detail, usually 0Ω resistors

\*  $R_{sH}$  and  $C_{sH}$  are footprints for optionally mounting on the PMOD. Because these can be large and disipate considerable power, on-board RC is limited in it capabilities.

### Figure 2. QCIOT-013 Digital Power Monitor Board Block Diagram

The setup and configuration for the QCIOT-013 board is comprised of the following required or recommended hardware:

- Renesas Fast Prototyping Board: FPB-RA4E1
- USB micro-B cable (provided with FPB board)
- PC running Windows 10/11 with at least one USB port.
- DC Power supply (0 to 60V output)
- Shunt resistor and load resistor

The following is required or recommended software:

- Renesas Flexible Software Package v4.5.0 platform installation:
  - e<sup>2</sup> studio 2023-01 or later
  - FSP 4.5.0 or later
  - GCC Arm Embedded 10.3.1 (10 2021.10)
- Sample code files (available on the Renesas product page for this device)

# 2. Quick Start Procedure

Complete the following quick-start steps in the order listed.

### 2.1 Install e<sup>2</sup>studio and the Mobile App

Visit the Renesas website for the latest version of the  $e^2$  studio installer. The minimum FSP version supporting the QCIOT-013 board is FSP 4.5.0.

### 2.2 Kit Hardware Connection

Follow these procedures to set up the kit.

- 1. Ensure that the MCU development kit has at least one Type 6A Pmods.
  - a. For FPB-RA4E1, two Pmods, PMOD1 and PMOD2, are available.
  - b. For the kits other than FPB-RA4E1, if no Type 6A Pmod is available, ensure that the kit can use the US082-INTERPEVZ interposer board. Insert the board into the MCU connector before adding any sensor boards.
- 2. Ensure that the Pin 12 of Pmod is 3.3V, which is requested by QCIOT-013.
  - a. For FPB-RA4E1 and FPB-RA6E1, the Pin 12 of Pmod is 5V by default. Short the trace jumper E1 and open E2 to get 3.3V on Pmod1.
  - b. For some evaluation boards, the Pin 12 of Pmod is 3.3V by default. No change needed. Check the user manual before using it.
- 3. Mount the J4, J5, and J6 jumpers on QCIOT-013.
- 4. Connect the terminal of shunt resistor to VINP and VINM of J1 using wires or terminal pins.
  - a. Connect the load in this guide, and if using wires, ensure the wire gauge has sufficient thickness to carry the operating current load.

The Vbus and current load should be from the target-tested system. This guide uses the DC power supply and load resistor to simulate the measured voltage and current.

Renesas recommends the following settings for the board.

Rshunt: 25Ω/0.25W

Rload: 5kΩ/2W

DC power supply: 0 to 60V

Choose a different shunt resistor based on the required load and Vbus voltage. Refer to the *ISL28022 Datasheet* for more details about shunt resistor selection.



Figure 3. Connect the Target System with QCIOT-013

- 5. Plug in the QCIOT-013 Board to PMOD1 connector of FPB4AE1. Be careful to align Pin 1 on the power board and MCU kit.
- 6. Connect the FPB board with the computer using the USB micro-B cable.
- 7. Set the DC Power supply output to 3.3V and turn on the output.
- 8. The kit is now ready for use.



Figure 4. QCIOT-013 Power Monitor Board with FPB-RA4E1 MCU Kit

# 3. Board Test

### 3.1 Program the Renesas Development Board

1. Open the sample project in e<sup>2</sup>studio.

### See Figure 5.



Figure 5. ISL28022 Project Structure

Open the <code>ra\_isl28022\_profile.c</code> file. Verify the ISL28022\_RSHUNT\_OHM\_USER setting. This value should match the shunt resistor you have chosen. In this example, the default  $25\Omega$  resistor is used. If the shunt resistor is different than  $25\Omega$ , change this setting.

h ra_isl2802	2_profile.h $ imes$	
2	* Includes.	
4		
5	<pre>#include "rm_isl28022_api.h"</pre>	
6		
8	* Macro definitions.	
10		
11	#define ISL28022 RSHUNT OHM USER	(25.0f)
12	<pre>//#define ISL28022_RSHUNT_OHM_USER</pre>	(0.05f)
13	<pre>#define ISL28022_VSHUNT_MAX_THRESHOLD_V_USER</pre>	(0.32f)
14	<pre>#define ISL28022_VSHUNT_MIN_THRESHOLD_V_USER</pre>	(-0.32f)
15	<pre>#define ISL28022_VBUS_MAX_THRESHOLD_V_USER</pre>	(60.0f)
16	<pre>#define ISL28022_VBUS_MIN_THRESHOLD_V_USER</pre>	(0.0f)
17	<pre>#define ISL28022_CONFIG_MODE_USER</pre>	RM_ISL28022_MODE_SHUNTANDBUS_CONTINUOUS
18	<pre>#define ISL28022_VBUS_FULL_SCALE_USER</pre>	RM_ISL28022_VBUS_FULLSCALE_60V
19	<pre>#define ISL28022_VSHUNT_FULL_SCALE_USER</pre>	RM_ISL28022_VSHUNT_FULLSCALE_320MV
20	<pre>#define ISL28022_AUX_INT_PIN_EN_USER</pre>	RM_ISL28022_AUXCONTROL_INTERRUPT_PIN_DISABLE
21	<pre>#define ISL28022_AUX_INT_PIN_FORCE_USER</pre>	RM_ISL28022_AUXCONTROL_INTERRUPT_PIN_FORCE_NOACTIVE
22	<pre>#define ISL28022_AUX_EXTCLK_EN_USER</pre>	RM_ISL28022_AUXCONTROL_EXTCLK_DISABLE
23	<pre>#define ISL28022_AUX_EXTCLK_DIV_USER</pre>	RM_ISL28022_AUXCONTROL_EXTCLK_DIV0
24		
25	<pre>/*The following setting is for board best*/</pre>	
26	<pre>#define BOARDTEST_VBUS_TARGET_V_USER</pre>	(3.314f)
27	<pre>#define BOARDTEST_VBUS_TOLERANCE_PERCENT_USER</pre>	(0.01f)
28	<pre>#define BOARDTEST_LOAD_RESISTOR_OHM_USER</pre>	(5000)
29	#define BOARDTEST_CURRENT_TOLERANCE_PERCENT_USER	(0.05f)
30		
31		
22		



### 2. Go to the menu bar and select **Run > Debug Configuration**.



Figure 7. Debug Configuration

- 3. Select Renesas GDB Hardware Debugging > isl28022\_Sandbox\_Debug.
- 4. Click the **Debug** button.

🖻 🕫 📓 🗶 🖻 🎖 👻	Name: ISL28022_Sandbox Debug_Flat						
c C/C++ Application	Main  Debugger Startup Source Common Project:						
C/C++ Remote Application Chrome Debug	ISL28022_Sandbox				Browse.		
😨 Debug Adapter Launcher	C/C++ Application:						
EASE Script	Debug/ISL28022_Sandbox.elf						
GDB Simulator Debugging (RH850 Launch Firefox Debugger	Build (if required) before launching		Variables	Search Project	Browse		
Launch Group	Build Configuration: Use Active						
Renesas GDB Hardware Debugging     ISL28022_Sandbox Debug_Flat     Renesas Simulator Debugging (KX,	Enable auto build     Use workspace settings	O Disable a Configure W	uto build orkspace Settings				
<ul> <li>Running Chrome Debug Instance</li> <li>Running Firefox Debugger</li> <li>Running Node is application</li> </ul>							
,							

Figure 8. Start Debug Mode

After clicking the **Debug** button, the code enters debug mode.

	[ISL28022_Sa	尾 startup.c 🗙 🚺 main.c	isl28022_thr	isl28022_thr	r_ble_gtl_api.c	» <sub>12</sub>	🗆 💕 E	× "7	- 0
III 34 j+ 8	56	<pre>int32_t main(void);</pre>		Contraction of the second s		1.000	~	8 30	54 F.
V C ISL28022 Sandbox Debut	57					1	TO LA		
** * KCU starts executing here out of reset. Main stack pointer is set up already.     ** * KCU starts executing here out of reset. Main stack pointer is set up already.								C: 1/8 OA	£ 0/4
✓ P Thread #1 1 (single ♦)	62 00009ec4	1	/				20	10	
■ Reset_Handler() 63 /* Initialize system using BSP. */							Туре		
🚆 arm-none-eabi-gdb (1	64 00009ec8	SystemInit();						Trace	a Start
📕 Renesas GDB server (H	65	/* Call user annli	cation */					Trace	a Stop
	67 00009ecc	main();	cución: /					S Trace	Record
	68							Event	t Break
	69 00009ed0	<pre>while (1)</pre>						😰 Time	r Start
	70	{ /* Infinite Lo	on #/					👔 Time	r Stop
	72	}	op. /						
	73	}							
	74								
	76	* Default exception h Sweid Default Handlen ()	andler.						
	79 00009ed2	{	0010)						
	80	⊕ /** A error has oc	curred. The user	will need to inv	estigate the cause	. Common proble			
	84 00009ed6	BSP_CFG_HANDLE_UNR	ECOVERABLE_ERROR	(0);			~ <		>
		<				>	Projec	t Saved	Te + +
6	Console III Reg	isters 👔 Problems 🏟 Smart Br	owser 🙀 Debugger	Console 🛹 Search 🗙	🚺 Memory 🛛 👃	1 × 1 = E	P = 🐶	- 🛃 🕺	- 0
R	References to 'ble_thread_create()' (1 match)								
~									
	✓ 🥵 ra_gen								
	✓ 💽 main.c								
	• main	line 108: ble thread create ();							
		Annu Banna Banna Banna A							
<>									

Figure 9. Debug Mode

5. Go to the menu bar, select Renesas Views > Debug > Renesas Debug Virtual Console.



Figure 10. Open Virtual Console

In the bottom panel, the Renesas Debug Virtual Console appears.



Figure 11. Renesas Debug Virtual Console

6. Click I and information appears in the **Renesas Debug Virtual Console** window.

E Console	Problems	Smart Browser	R Debugger Console	🔲 Renesas Debug	Virtual Console	× 🔗 Searc	h 🚺 Memory
**************************************	ing*******	****					
Rshunt	is: 25.10	000hms					
Vshunt Full Scale	is: 0.320	90V					
Vshunt ADC Resolution	is: 32768	3					
Vshunt LSB	is: 0.000	0010V					
Vshunt Max(user)	is: 0.320	0000V					
Vshunt Min(user)	is: -0.32	20000V					
Vbus Full Scale	is: 60.00	900V					
Vbus ADC Resolution	is: 16384	l I					
Vbus LSB	is: 0.004	10V					
Vbus Max(user)	is: 60.00	0000V					
Vbus Min(user)	is: 0.000	0000V					
Current Full Scale	is: 0.012	27A					
Current LSB	is: 0.000	000389069A					
*******************A11	registers*	***********	t				
Configuration	Registe	er(00): 0x591f					
Shunt Voltage	Registe	er(01): 0x0694					
Bus Voltage	Registe	er(02): 0x0cf6					
Power	Registe	er(03): 0x008e					
Current	Registe	er(04): 0x06bf					
Calibration	Registe	er(05): 0x1062					
Shunt Voltage Thresho	ld Registe	er(06): 0x7dfd					
Bus Voltage Threshold	l Registe	er(07): 0xea00					
DCS Interrupt Status	Registe	er(08): 0x0000					
Aux Control	Registe	er(09): 0x0000					
***********************	**********	************					
*******************NEW	READINGS**	*****					
Shunt and Bus Voltage	Continuou	is Mode					
Vshunt val is: 0.016	840V						
Vbus valis: 3.3200V							
Current val is: 0.000671A							
Power val is: 0.002	22W	***					
**************	READINGS**						
Shunt and Bus Voltage	Continuou	is Mode					
vsnunt val is: 0.016	840V						
vous val is: 3.312	20V						
Current val is: 0.000	ALVO						
Power val 15: 0.002	ZW						

Figure 12. Debug Information

# 4. Revision History

Revision	Date	Description
1.00	Mar 25, 2024	Initial release.

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