# RENESAS

### **Description**

The AS025-HVPAK Motor Driver Pmod<sup>™</sup> - Stepper Motor board combines a highly integrated HVPAK ™ IC, Current monitor, and protection function. The board can provide a quick configuration of Stepper motor. The board will be configured with one of the Quick connect boards on PMOD6A architecture. The motors like Stepper motor with direction and Step with Full steps/micro-steps are easily configurable. This will reduce the development and turnaround time of any customer.

### **Kit Contents**

AS025-HVPAK STM CONTROL BOARD

### **Features**

- It will be suitable for a quick connect platform using the • Pmod<sup>™</sup> architecture.
- The same can be used as standalone development solution for HVPAK<sup>™</sup> motor driver.
- The system solution can be extended for 1 Stepper motor . driver.
- External current protection circuit provided using ISL28025 for . additional system level hard reset and protection.
- I2C gives options for multiple dynamic configurations like • Direction, Steps, Mode etc.

**Evaluation Board** 



Figure 1: AS025-HVPAK

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### AS025-HVPAK Overview

The AS025-HVPAK Motor Driver Pmod<sup>™</sup> - Stepper Motor board combines a highly integrated HVPAK <sup>™</sup> IC. This design can provide Quick configuration with Stepper motor. ISL28025 is used to provide external current and voltage protection for the circuit. Design has low idle current consumption in combination with a compact size. Speed, direction control options provided using I2C.

The block diagram below highlights the main parts of the system:



The building blocks of the AS025-HVPAK and their functionality are listed below:

- 1. <u>SLG47105:</u> HVPAK<sup>™</sup> Programmable Mixed-Signal Matrix with Four Outputs with Operating Voltage up to 13.2 V and up to 2 A Current per Output. SLG47105 has Full H-Bridge and Independent Half-Bridge Control.
- <u>RAA214250</u>: The RAA214250 is a low-dropout linear voltage regulator that operates from 2.5V to 20V and provide up to 500mA of output current with a typical dropout of 269mV. The output voltage is adjustable with external feedback resistors anywhere from 1.224V to 18V.
- 3. <u>ISL28025</u>: Precision Digital Power Monitor with Real Time Alerts. The ISL28025 is a bidirectional high-side and low-side digital current sense and voltage monitor with a serial interface. The device monitors power supply current and voltage, which provides digital results along with calculated power.

### Hardware Overview

The following block diagrams have specific applications explained below.

1. Power monitor Alert

The internal comparators of the ISL28025 can be configured to monitor the input supply voltage for undervoltage and overvoltage conditions. The comparator can signal the microcontroller to perform an action. A sense resistor, R1 & R2, is used to monitor the current delivered to the circuit load. The sense resistor is connected between the FB (feedback) and the VOUT pin of the ISL28025.



### 2. LDO:

The RAA214250 output voltage (VOUT) used to programmed down to 3.3 V from12 v input using the feedback (FB) resistors, R4 and R5 and Low Dropout of 269mV at 500mA. RAA21450 has feature as short circuit current limit protection with fold-back at higher input voltage.



#### 3. SLG47105V (HVPAK IC):

SLG47105 V provides Independent half-bridge control which allows dual bidirectional or four unidirectional motor operations. Build-in overcurrent and over-temperature protection reduces design complexity and enables higher system reliability, Flexible motor control with a programmable current sense comparator for current limiting or programmable overcurrent protection and R10, R13 used to limit the current. Low power consumption of Analog and Digital allows doing more in one IC. Smaller board space/smaller form factors; Constant motor speed with the variable Vin.



#### 4. Pmod:

This interface conforms to the I2C specification, with an optional interrupt and reset pin plus some optional control signals. If these optional pins are not used, they will have no connection. The pull-up resistors used to provide the logic high level for SCL and SDA are provided on the modules and can be attached to or detached from the bus via onboard jumpers. Pull-ups on INT and RESET, if used, are also provided on the module, and can be attached or detached from the bus via onboard jumpers to enable daisy chaining.

An optional passthrough female Pmod connector may be added to the Pmod opposite to the side with the male connector. This connector may be a six-pin or 12-pin connector, though it should be considered that extra control signals, such as those on the lower row on a 12-pin connector, may not be appropriate for a pass-through connector due to the potential signal conflict if other modules in a daisy chain also used these control signal pins.



5. LED: LEDs are used for power on indication and 3.3 v output indication.

#### Description of LEDs:

LED Color	Reference Designator Function			
Green	D1	Power up		
Yellow	D2	3.3 v output indication		

![](_page_6_Figure_9.jpeg)

#### 6. Arduino connectors:

Near the center of the system control and ecosystem access is an Arduino uno R3 compatible connector interface.

Connector	Pin No.	Arduino Connection description				
	J-24-1	IO8/GPIO/CLKOUT				
	J-24-2	IO9/GPIO/PWM(GTIOC7B)				
	J-24-3	IO10/SSLA0/CTS_RTS9/PWM(GTIOC4A)				
	J-24-4	IO11/MOSIA/TXD9/PWM(GPIOC5A)				
	J-24-5	IO12/MISOA/RXD9/PWM(GTIOC5B)				
IOH	J-24-6	IO13/RSPCKA/SCK9/PWM(GTIOC4B)				
	J-24-7	GND				
	J-24-8	AREF				
	J-24-9	SDA1				
	J-24-10	SCL				
	J-23-1	IO0/RXD7				
	J-23-2	IO1/TXD7				
	J-23-3	IO2/IRQ13-DS/AN009				
	J-23-4	IO3/IRQ3/PWM/(GTIOC3A)				
IOL	J-23-5	IO4/GPIO/PWM/(GTIOC2A)				
	J-23-6	IO5/GPIO/PWM/(GTIOC2B)				
	J-23-7	IO6/GPIO/PWM/(GTIOC6B)				
	J-23-8	IO7/GPIO/PWM/(GTIOC7A)				
	J_18-1	VIN				
	J_18-2	GND				
	J_18-3	GND				
POWER	J_18-4	5v				
(J18)	J_18-5	3.3V				
	J_18-6	RESET				
	J_18-7	IOREF				
	J_18-8	NC				
	J_19_1	AD0/AN000				
	J_19_2	AD1/AN001				
AD	J_19_3	AD2/AN003				
(J19)	J_19_4	AD3/AN007				
	J_19_5	AD4/DAC/AN012				
	J 19 6	AD5/DAC/AN013				

![](_page_8_Figure_2.jpeg)

### **Software Overview**

### **Debugging using CS+**

1. RL78/F14 can be programmed and debugged using CS+. Below are the steps to debug RL78/F14 using CS+. Open the RL78/F14 project in CS+ by double clicking the xxx.mtpj.

Name	Status	Date modified	<ul> <li>Туре</li> </ul>	Size
DefaultBuild	$\odot$	11/27/2023 6:48 PM	File folder	
HV_PAK_Motor_Control	$\odot$	11/27/2023 6:54 PM	File folder	
C function.html	$\odot$	6/15/2023 10:15 AM	Microsoft Edge HT	216 KB
💽 macro.html	$\odot$	6/15/2023 10:15 AM	Microsoft Edge HT	43 KB
my_iic_test.a5085270.mtud	$\odot$	6/20/2023 9:59 AM	MTUD File	307 KB
my_iic_test.a5111502.mtud	$\odot$	11/23/2023 6:37 PM	MTUD File	147 KB
my_iic_test.a5136132.mtud	$\odot$	6/26/2023 10:15 PM	MTUD File	293 KB
my_iic_test.a5141759.mtud	$\odot$	11/28/2023 10:58 AM	MTUD File	309 KB
my_iic_test.mtpj	0	11/27/2023 6:54 PM	MTPJ File	438 KB
📔 r_cg_cgc.c	Ø	6/19/2023 2:58 PM	C File	5 KB
i_cg_cgc.h	$\odot$	6/19/2023 2:58 PM	H File	13 KB
r_cg_cgc_user.c	$\odot$	6/19/2023 2:58 PM	C File	4 KB
r_cg_macrodriver.h	$\odot$	6/19/2023 2:58 PM	H File	5 KB
r_cg_port.c	$\odot$	6/19/2023 2:58 PM	C File	5 KB
r_cg_port.h	$\odot$	6/19/2023 2:58 PM	H File	18 KB
r_cg_port_user.c	$\odot$	6/19/2023 2:58 PM	C File	4 KB
r_cg_serial.c	$\odot$	9/25/2023 2:47 PM	C File	16 KB
r_cg_serial.h	$\odot$	6/19/2023 2:58 PM	H File	25 KB
r_cg_serial_user.c	$\odot$	11/22/2023 1:27 PM	C File	15 KB
r_cg_timer.c	$\odot$	6/19/2023 2:58 PM	C File	8 KB
r_cg_timer.h	$\odot$	6/19/2023 2:58 PM	H File	71 KB
r_cg_timer_user.c	$\odot$	6/19/2023 2:58 PM	C File	5 KB
r_cg_userdefine.h	$\odot$	11/24/2023 3:28 PM	H File	4 KB
Y_main.c	Ø	11/24/2023 2:13 PM	C File	6 KB
r curteminit c	$\odot$	6/19/2023 2:58 PM	C File	5 KB

2. Once the project opens, click on build icon (marked as 1 in Figure: 10), or press F7 to build the project. Once build is successful, click on download icon (marked as 2 in Figure: 10), or press F6 to download the project.

The curt view Project build bebug foor	
👯 Start 🚽 🗄 🕼 👗 🕹 🖸 🖸 🤊	(*) 옮겼 철 책, my_iic_tx_end 💌 100% 💌 🔯 100 PefaultBuild 🔍 🕵 100 🖓 100 🛞 🖄 100 🖉 🖓
- 🗠 🕾 🖧 🍪 🗖 🖻 💣 🍏 🖻	
Project Tree 🏾 🗘 🗙	Property of psn_motor_control.c of r_main.c
2 0 2 2	201501-0. OL OLIMATING
□ my iic test (Project)	
R5F10PPJ (Microcontroller)	
Pin Configurator (Design Tool)	67 unsigned char my motor mode selection[] = "\n\rReady to set motor parameters for selected mode:";
Code Generator (Design Tool)	68
- CA78KOR (Build Tool)	69
RL/8 E1(Serial) (Debug Tool)	70 // Mode User Input
Program Analyzer (Analyze Tool)	72 unsigned char my introl3 buff[] = "\n\r \n\r - Enter step mode full (Fullstep=1, Microstep=0) -\n\r";
E Statun	73 unsigned char my motor mode[] = "\n\r Mode Entered is : ";
Code Generator	74 unsigned char my_motor_full_mode[] = "\n\r Motor is runing in full mode \n\r";
	75 unsigned char my motor Micro step mode[] = "\n\r Motor is runing in micro step mode \n\r";
c r systeminit.c	76 unsigned char my introit buff[] = "\n\rEnter S for microstepping !!!(h\r"; 27 unsigned char my introit buff[] = "\n\rEnter S for microstepping !!!(h\r";
r_cq_cqc.c	
r_cg_cgc_user.c	79 //***********************************
r_cg_port.c	80
r_cg_port_user.c	<pre>unsigned char my_intro8_buff[] = "\n\r \n\r - Enter Motor Direction (1=CW, 0=CCW) -\n\r";</pre>
-g_ r_cg_serial.c	83 unsigned char my motor direction[] = "\n\r Selected Direction is ; ":
- g_ r_cg_serial_user.c	84
r_cg_macrodriver.h	85 //***********************************
r_cg_userderine.n	
r cg port h	ss unsigned char my_htroid_burr(] = "(h'r (h'r - inter step frequency_(100 to 700) -(h'r"; //stepper motor
r co serial b	89 unsigned char my motor frequency[] = "\n\r step frequency Entered is : ";
C r cq timer.c	00
E s ca times was s	

3. Once download is successful CS+ will open debug window as below:

![](_page_10_Figure_3.jpeg)

4. Once the download is completed click on Execute command as highlighted in Figure:12.

🙉 Start   🚚 🗐 🎒 💥 🐚 📸 🦃	Window H	Help ∰a @a⊾ my_i	ic_tx_er	nd 💌 100% 💌 💀 👦 DefaultBuild 🔍 🤸 👦 🗣 🐂 📵 💽 🐂 🗫 🚛 🔩 💑
	p			Executes the program from the current position. (F5)
ject Tree # >	C Ph Dies	ecomble1	nen m	oder control e 🕅 Property 🕅 r main c
0 2 2	0.00		pan_n	en Comerce Tropeny Tropeny Tropeny
my iic test (Project)	33 B	8 🖒 🖓	<b>•</b> •••	olumns*
RSE10PPI (Microcontroller)	Line	Address	ı (r	
Pin Configurator (Design Tool)	67			<pre>void initial_hv_pak_setup(void);</pre>
Code Generator (Design Tool)	68			/* End user code. Do not edit comment generated here */
A CA78KOR (Build Tool)	70			Vold R MAIN_OBERINIC(Vold);
RI 78 F1/Serial) (Debug Tool)	71			
Program Analyzer (Analyze Tool)	72			/* Function Name: main
File	73			* Description : This function implements main function.
Build tool generated filer	74			* Arguments : None
Startup	75			* Return Value : None
Code Conceptor	76			L ************************************
	77			void main (void)
<u>r_main.c</u>	78		1.	
	/9	00082	14	K MAIN (Serihit();
	81			/- Start user code, bo not eart comment generated here -/
	82			
r_cg_port.c	83	00d86	1	display init();
r_cg_port_user.c	84			
r_cg_serial.c	85			
r_cg_serial_user.c	86			// START: TEST FUNCTION
r_cg_macrodriver.h	87			\$1f0
r_cg_userdefine.h	88			
r_cg_cgc.h	89			//initiai_nv_pak_setup();
- Rai r ca port.h	1 50			I I I I I I I I I I I I I I I I I I I

5. After Execute Command, use TTL to USB Adapter and Tera-term terminal software to give serial commands to the device. Select the Serial Port and navigate to Serial Port and specify the baud rate setting as 19200.

○ T CP/IP	Host:	myhost.exam	nple.com	$\sim$
	Service:	<ul> <li>✓ History</li> <li>○ Telnet</li> <li>● SSH</li> <li>○ Other</li> </ul>	TCP port#: 22 SSH version: SSH2 IP version: AUTC	: ~ ) ~
● Serial	Port:	COM9: Silico	n Labs CP210x USB to U	IAF ~

Tera Term: Serial port setup and	nd connection X
Port:	COM9 V New setting
Speed:	
Data:	8 bit ~ Cancel
Parity:	none v
Stop bits:	1 bit ~ Help
Flow control:	none v
Transm 0 Device Friendly Na Device Instance II Device Manufactu Provider Name: Si Driver Date: 5-23-2 Driver Version: 6.7	nit delay msec/char 0 msec/line lame: Silicon Labs CP210x USB to UART Bridge D: USB\VID_10C4&PID_EA60\0001 urer: Silicon Labs Silicon Laboratories Inc. 2018 7.6.2130
	Figure 14: COM Port Settings

### **HVPAK Pin Configurations**

### 1. Pin Configurations:

Table 1: Motor control Method:

MOTOP Control mode	I2C_Write Data							
MOTOR Control mode	No.	Address Byte [hex]	Write Data [hex]	Function				
PINs Control: MODE SLEEP DIRECTION STEP	1	0xF5	0x01	I2C reset with reloading NVM into Data register (soft reset)				
	1	0x15	0xA3					
	2	0x18	0xE3					
	3	0x27	0xE3					
	4	0x28	0x78					
I2C Control: I2C_MODE I2C_SLEEP I2C_DIRECTION STEP Frequency	5	0x2D	0x60					
	6	0x2E	0x98					
	7	0x30	0xC5					
	8	0x31	0xA8	12C Control decign setting				
	9	0x34	0x25	120 Control design setting				
	10	0x35	0x52					
	11	0x36	0x14					
	12	0x38	0x88					
	13	0x42	0xE3					
	14	0x70	0x8E					
	15	0x71	0x6F	1				
	16	0x7F	0xC7					

Table 2: Chip I2C Address

HEX	BIN	DEC
0x08	0001000	8

#### 2. I2C STEP frequency setting:

# STEP frequency [Hz] = 100 000Hz / (Counter Data [dec] + 1) Where Counter Data is from 1 to 65535

#### 3. Step Mode

The step mode is selected by applying logic high and low voltages to the MODE PIN or Register in Table 3.

#### Table 3: Stepping Format

MODE	STEP MODE
0	Full step with 71% current
1	16 micro steps per step

Table 4: I2C Control Registers

Address Byte	Register Bit	Block	Function	Default
	reg<608>	Virtual Input <0>	I2C_Reset	0
	reg<609>	Virtual Input <1>	I2C_SLEEP	0
0x4C	reg<610>	Virtual Input <2>	I2C_MODE	0
	reg<611>	Virtual Input <3>	I2C_DIRECTION	0
	reg<615:612>	Virtual Inputs <47>	Х	0000
0x7F	reg<1031·1016>	CNT0/LDY0 (16bits) Counter Data	Counter Data: from 1 to 65535	0xC7
0x80			STEP Frequency [Hz] = 100000Hz / (Counter Data + 1)	0x00

### **Go Configuration Block Design and Firmware Flashing Steps**

Connect SLG47105 chip using socket to programming board and design block using go configure GUI and flash firmware to us as Stepper motor controller.

- 1. Design block for Stepper motor
  - 1. Open GO configure GUI to design block.
  - 2. Add PWM block for duty control.
  - 3. Add Enable disable function block for reset functionality.
  - 4. Add Step Control Block for Full/Micro Step Control of Stepper Motor.

![](_page_14_Figure_9.jpeg)

- 2. Follow below settings for configure HVPAK (SLG47105) as Stepper Motor controller.
  - 1. Place Unprogrammed SLG47105 chip into socket.
  - 2. Connect Board and socket using USB & power up the board.
  - 3. Design blocks using go configure GUI.
  - 4. Press debug button to run program.
  - 5. Press program from debugging control panel.
  - 6. Confirm Configuration.

![](_page_15_Figure_9.jpeg)

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-mar-indutter ≟ Ground @ -	Brite Orband +	[ IDC Reset
* Sources	rating another farm	Read
Current Source     Diodes		Project Data
-DH-PN Junction		Stop All
-Di-Zener		26 28 30 52 25 27 29 31
* Brushed DC Motors		TP Map
(₩ Portecap 17/05-210E 1 (₩ Crouxet 527200		
Maxim DCX 8M     Maxim DCX 18     DO		
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a minos a pixos		
mingort model (*) X famove model	Pic., Deliver Are -	00
Properties Schematic Library	- E ta X =	
Rules Checker output Time Event Rule	Not	13-80
10:35:48 Q Note: Disable UC if there is no intended usage. SDA and SCL are always active if UC macrocell is enabled.	There is no introded UC sage, prevent fails command inputs by disabling the UC macrocent.	
G Refresh 100 OF Checking is done with: 0 fails, 0 warnings and 1 note.		
	Debugging controls	
	Debugging Controls	
	Debugging Controls	
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	Change platform	
	Debugging Controls       GreenPAK Advanced	
	Oebugging Controls       GreenPAK Advanced     Change platform       Development Platform     Import configuration	
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	Debugging Controls       GreenPAK Advanced Development Platform     Change platform       Import configuration     Import configuration	
	Debugging Controls         GreenPAK Advanced       Change platform         Development Platform       Import configuration         Device:       Onboard       Il2C Reset	
	Debugging Controls         GreenPAK Advanced         Development Platform         Import configuration         Device:       Onboard	
	Debugging Controls         GreenPAK Advanced       Change platform         Development Platform       Import configuration         Device:       Onboard         Read	
	Debugging Controls         GreenPAK Advanced       Change platform         Development Platform       Import configuration         Device:       Onboard       Il2C Reset         Read       Read	
	Debugging Controls         Import configuration         Device:       Onboard         Import configuration         Import configuration         Read         Emulation       Test Mode	
	Debugging Controls         GreenPAK Advanced       Change platform         Development Platform       Import configuration         Device:       Onboard       Il2C Reset         Read       Read         Emulation       Test Mode       Program	
	Debugging Controls         GreenPAK Advanced       Change platform         Development Platform       Import configuration         Device:       Onboard       I2C Reset         Read       Program         Emulation       Test Mode       Program	
	Debugging Controls         GreenPAK Advanced       Change platform         Development Platform       Import configuration         Device:       Onboard       I2C Reset         Emulation       Test Mode       Program         Project Data       Project Data	
	GreenPAK Advanced   Development Platform   Import configuration     Device:   Onboard     IZC Reset     Read   Emulation     Test Mode   Project Data	
	GreenPAK Advanced   Development Platform   Import configuration     Device:   Onboard     IZC Reset     Read   Emulation   Test Mode   Program   Project Data	
	GreenPAK Advanced   Development Platform   Import configuration     Device:   Onboard   Import configuration     Import configuration     Read   Emulation   Test Mode   Project Data     Start All     Pause All     Stop All	
	Debugging Controls         GreenPAK Advanced       Change platform         Development Platform       Import configuration         Device:       Onboard       I2C Reset         Emulation       Test Mode       Program         Project Data       Start All       Pause All	
	GreenPAK Advanced   Development Platform   Import configuration     Device:   Onboard     IzC Reset     Read   Emulation   Test Mode   Project Data     Start All   Pause All   Stop All	
	Debugging Controls         GreenPAK Advanced Development Platform       Change platform         Import configuration       Import configuration         Device:       Onboard       I2C Reset         Emulation       Test Mode       Program         Project Data       Start All       Pause All         Start All       Pause All       Stop All         2       4       8       10       12       14       16       18       20       Vb       22       24       28       30       32         Va       3       5       7       9       C       13       15       17       19       21       23       25       27       29       31	
	Debugging Controls         Change platform         Change platform         Import configuration         Device: Onboard       I2C Reset         Read         Emulation       Test Mode       Program         Start All       Pause All       Stop All         2       4       6       8       10       12       14       16       18       20       Vb       22       24       26       28       30       32         Va       3       7       9       Gl	
	Debugging Controls         Change platform         Change platform         Import configuration         Pevice: Onboard       I I2C Reset         Read         Emulation       Test Mode       Program         Start All       Pause All       Stop All         2       4       6       8       10       12       14       16       18       20       Vb       22       24       26       28       30       32         Va       3       5       7       9       13       15       17       19       21       23       25       27       29       31	
	Debugging Controls         Change platform         Development Platform       Import configuration         Device:       Onboard       I2C Reset         Emulation       Test Mode       Program         Project Data       Start All       Pause All         Start All       Pause All       Stop All         2       4       6       10       12       14       16       18       20       Vb       22       24       26       28       30       32         Va       3       5       7       9       G       13       15       17       19       21       23       25       27       29       31         Int. VDD       Ext. VDD       ON       OFE       TP Map       TP	
	Debugging Controls         Change platform         Device Onboard         I I2C Reset         Read         Project Data         Start All       Pause All       Stop All         I I2C Reset         Project Data         Start All       Pause All       Stop All         Int. VDD       Ext. VDD       ON       OFF       TP Map	
	Debugging Controls         Change platform       Import configuration         Device:       Onboard       I2C Reset         Project       Read         Emulation       Test Mode       Program         Project Data       Start All       Pause All       Stop All         2       4       6       10       12       14       16       18       20       Vb       22       24       26       28       30       32         Va       3       5       7       9       6       13       15       17       19       21       23       25       27       29       11         Int. VDD       Ext. VDD       ON       OFF       TP Map       IEDs ON       IEDs ON       IEDs ON       IEDs OFF	
	Debugging Controls         Change platform         Change platform         Import configuration         Device: Onboard       I2C Reset         Read         Emulation       Test Mode       Program         Project Data         Start All       Pause All       Stop All         2       4       6       8       10       12       14       16       18       20       Vb       22       24       26       28       30       32         Va       3       5       7       9       G       13       15       17       19       21       23       25       27       29       31         Int. VDD       ON       OFF         LEDs ON       LEDs OFF	
	Debugging Controls         Change platform         Change platform         Import configuration         Device: Onboard       I2C Reset         Read         Emulation       Test Mode       Program         Project Data       Project Data         Start All       Pause All       Stop All         2       4       6       10       12       14       16       18       20 Vb       22       24       26       28       30       32         Va       3       5       7       9       G       13       15       17       19       21       23       25       27       29       31         Int. VDD       Ext. VDD       ON       OFF       TP Map       LEDs ON       LEDs OFF	
	Debugging Controls         Change platform         Import configuration         Device: Onboard       I2C Reset         Read         Emulation       Test Mode       Program         Project Data       Project Data         Start All       Pause All       Stop All         Q       4       6       10       12       14       16       18       20       Vb       22       24       26       30       32         Va       3       5       7       9       G       13       15       17       19       21       23       25       27       29       31         Int. VDD       ON       OFF       TP Map       LEDs ON       LEDs OFF	
	Debugging Controls         Change platform         Change platform         Import configuration         Device: Onboard       I2C Reset         Read         Emulation       Test Mode       Program         Project Data         Start All       Pause All       Stop All         2       4       6       10       12       14       16       18       20       Vb       22       24       26       28       30       32         Int. VDD       DN       OFF       TP Map         LEDs ON       LEDs OFF	
	Debugging Controls         GreenPAK Advanced Development Platform       Change platform         Import configuration       Import configuration         Device:       Onboard       I2C Reset         Emulation       Test Mode       Program         Project Data       Start All       Pause All         Start All       Pause All       Stop All         2       4       6       10         12       4       6       10         13       5       7       9         15       17       19       21       23       25         10       ON       OFF       TP Map       LEDs ON       LEDs OFF	

### **Test Setup**

Method 1: I2C Configuration (In this method the board is fully functional using software mode.)

Follow these procedures to set up the kit as shown in Figure 13

- 1. Connect AS025-HVPAK board with the RL78/F14 EVK board. The RL78/F14 and AS025-HVPAK board are communicated by I2C communication.
- 2. Connect 12V DC supply to jumper J4 of AS025-HVPAK board.
- 3. Connect the E1 emulator to build and debug the project.
- 4. Connect the USB to TTL converter to give the user commands.
- 5. Open the Tera term software and give the commands for Stepper Motor Run Mode either Full Step/Micro Step as 0 0r 1, Motor Direction, Stepper Motor Step Frequency, and to Enable the Motor.
- 6. After the user specifies the commands, the motor runs with the specified commands given to it.
- 7. The serial commands are shown in Figure: 14 and Figure: 15.

![](_page_17_Figure_12.jpeg)

🔟 COM6 - Tera Term VT	<del>87</del> 8.	×
File Edit Setup Control Window Help		
/* Welcome to HVPAK Demo*/		^
/* stpeer Motor Control*/		
/*SET stepper Motor Run Mode(Fullstep = 0 ,Microstep = 1)*/		
nitializing HVPAK for Full Step Mode		
nitializing HVPAK for Full Step Mode is completed		
- Enter Motor Direction <1=CW, Ø=CCW> -		
- Enter step frequency_(100 to 700) -		
Please press 1 for confirm the frequency number		
Enable Motor? 1/0		
Motor_IS_RUNNING?!!		

Steps to enter commands in Tera Term to Run the Stepper Motor in Full Step Mode.

- 1. Enter Stepper Motor Run Mode Full Step/Micro Step. Give command as 0 to run the Motor in Full Step Mode.
- 2. The HVPAK will initialize the Motor to Full Step Mode.
- 3. Enter Motor Direction as 1 to Clockwise and 0 for Counterclockwise.
- 4. Enter Motor Step Frequency from 100 to 700 Hz. (Note: Step Frequency range depends on the type of Stepper Motor. We are using 17PM-K210-10V Stepper Motor.)
- 5. Press 1 to confirm the Step frequency entered.
- 6. Press 1 to Enable the Motor.

![](_page_18_Figure_10.jpeg)

Steps to enter commands in Tera Term to Disable/Stop the Motor or to Update the Step Frequency.

- 1. Enter 0 to Disable the Motor.
- 2. Enter 2 to update the Step Frequency.

![](_page_19_Figure_2.jpeg)

![](_page_19_Figure_3.jpeg)

Steps to enter commands in Tera Term to Run the Motor in Micro step Mode.

- 1. Enter Stepper Motor Run Mode Full Step/Micro Step. Give command as 1 to run the Motor in Micro Step Mode.
- 2. The HVPAK will initialize the Motor to Micro Step Mode.
- 3. Enter Motor Direction as 1 to Clockwise and 0 for Counterclockwise.
- 4. Enter Motor Step Frequency from 100 to 700 Hz. (Note: Step Frequency range depends on the type of Stepper Motor. We are using 17PM-K210-10V Stepper Motor.)

- 5. Press 1 to confirm the Step frequency entered.
- 6. Press 1 to Enable the Motor.

![](_page_20_Figure_4.jpeg)

Steps to enter commands in Tera Term to Disable/Stop the Motor or to Update the Step Frequency.

- 1. Enter 0 to Disable the Motor.
- 2. Enter 2 to update the Step Frequency.

![](_page_20_Figure_8.jpeg)

#### RENESAS

**Method 2**: Pin Configuration Method: (In this method the board is fully functional using external input without software. External Inputs: Function Generator and DC Source)

Follow these procedures to set up the kit as shown in Figure 16.

- 1. Connect 12V DC supply to jumper J4 of AS025-HVPAK board.
- 2. Connect Stepper motor to connectors J7 and J8.
- 3. Connect Waveform generator and provide the PWM signal to 9 of Pmod connector, i.e., J3 connector. Pin 9 of Pmod Interface are used for Frequency control of the motor.
- 4. Pin 8 of Pmod interface connector J3 are used for Mode Control of Stepper motor. The motor will run in Full Step Mode for Low Signal, and it will run in Micro Step Mode for High Signal. For Micro Step Control provide 3V supply from the DC Source.
- 5. Pin 7 of Pmod interface connector J3 are used for Direction Control of Stepper motor. To control the direction of Stepper Motor, provide 3V from the DC Source.

![](_page_21_Figure_9.jpeg)

## **AS025-HVPAK Application Schematic**

![](_page_22_Figure_3.jpeg)

Figure 25: Schematic

# **Bill of Materials (BOM)**

#### Table 5. AS025-HVPAK BOM

Quantity	Designator	Description	Manufacturer	Manufacturer Part #
1		6 Position Receptacle Connector 0.100" (2.54mm) Through Hole	Samtec	SSQ-106-03-G-S
	AD1	Gold		
0		Capacitor, 22pF, 25V, SM 0603	Kemet	CU603C220K3GACTU
5	C2, C7, C9, C11, C16	CAP ALUM 10UF 20% 25V SMD	Panasonic	EEE-1EA100SR
3	C3, C8, C12	1 µF ±10% 25V Ceramic Capacitor X7R 0603 (1608 Metric)	Yageo	CC0603KRX7R8BB105
1	C4	Multilayer Ceramic Capacitors 4.7µF ±10% 16V X5R SMD 0603	TDK Corporation	C1608X5R1C475K080AC
1	C5	10 µF ±10% 16V Ceramic Capacitor X5R 0603 (1608 Metric)	Yageo	CC0603KRX5R7BB106
0	C6, C13	10 µF ±10% 16V Ceramic Capacitor X5R 0603 (1608 Metric)	Yageo	CC0603KRX5R7BB106
3	C10, C15, C18	0.1 µF ±10% 16V Ceramic Capacitor X7R 0603 (1608 Metric)	YAGEO	CC0603KPX7R7BB104
2	C14, C17	0.1 µF ±10% 25V Ceramic Capacitor X7R 0603 (1608 Metric)	YAGEO	CC0603KPX7R8BB104
1	D1	LED GREEN CLEAR 0603 SMD	Wurth Electronics	150060GS75000
1	D2	LED RED DIFFUSED 0603 SMD	Würth Elektronik	150060YS55040
1	D3	LED RED CLEAR 0603 SMD	Wurth Electronics	150060RS75000
1	IC1	Digital Power Monitors Precision Digital Power Monitor with Real Time Alerts	Renesas Electronics	ISL28025FR12Z
1	IOH1	10 Position Receptacle Connector 0.100" (2.54mm) Through Hole Gold	Samtec	SSQ-110-03-G-S
1	IOL1	8 Position Receptacle Connector 0.100" (2.54mm) Through Hole Gold	Samtec	SSQ-108-03-G-S
1	J1	Connector Header Through Hole 3 position 0.100" (2.54mm)	FCI	77311-818-03LF
1	J2	12 Position Receptacle Connector 0.100" (2.54mm) Through Hole, Right Angle Gold	Würth Elektronik	SSW-106-02-F-D-RA
1	J3	Connector Header Through Hole, Right Angle 12 position 0.100" (2.54mm)	Würth Elektronik	61301221021
3	J4, J7, J8	Series 101 - 5.00 mm Horizontal Entry Modular with Pressure Clamp WR-TBL, 2 pin	Wurth Elektronik	691101710002
4	J5, J6, J9, J10	CONN HEADER VERT 2POS 1.27 MM	Samtec Inc.	FTS-102-01-L-S
1	POWER1	8 Position Receptacle Connector 0.100" (2.54mm) Through Hole Gold	Samtec	SSQ-108-03-G-S
2	R1, R2	220 mOhms ±1% 0.333W, 1/3W Chip Resistor 0805 (2012 Metric) Automotive AEC-Q200, Current Sense Thick Film	Panasonic	ERJ-6DSFR10V
4	R3, R7, R8, R9	Chip Resistor, 10 KOhm, +/- 1%, 01 W, -55 to 155 degC, 0603 (1608 Metric)	Yageo	RC0603FR-0710KL
2	R4, R17	Chip Resistor, 100 KOhm, +/- 1%, 0.1 W, -55 to 155 degC, 0603 (1608 Metric)	Yageo	RC0603FR-07100KL
1	R5	RES SMD 57.6K OHM 1% 1/10W 0603	Yageo	RT0603FRE0759KL
1	R6	1.82 kOhms ±1% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Moisture Resistant Thick Film	YAGEO	RC0603FR-071K82L
2	R10, R13	Chip Resistor, 1 Ohm, +/- 1%, 125 mW, -55 to 155 degC, 0805 (2012 Metric), RoHS, Tape and Reel	Yageo	RC0805FR-071RL
0	R11, R12, R14, R15	Chip Resistor, 1 Ohm, +/- 1%, 125 mW, -55 to 155 degC, 0805 (2012 Metric), RoHS, Tape and Reel	Yageo	RC0805FR-071RL
2	R16, R18	300 Ohms ±1% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Moisture Resistant Thick Film	Yageo	RC0603FR-07300RL
1	U1	GreenPAK Programmable Mixed-Signal Matrix	Renesas Electronics	SLG47105V
1	U2	500mA 20V Wide Input Voltage Range LDO Linear Regulator	Renesas Electronics	RAA2142504GSP#HA0

### **Board Layout**

![](_page_24_Figure_3.jpeg)

#### Int1 (GND) (Scale 1:1)

![](_page_24_Figure_5.jpeg)

Int2 (PWR) (Scale 1:1)

![](_page_24_Picture_7.jpeg)

Figure 26: Board Layout- 2 Layer

# **Ordering Information**

Orderable Part Number[a]	Description	
AS025HVPAKSTM-POCZ	AS025-HVPAK: Stepper Motor Driver Pmod™	

# **Revision History**

Revision Date	Description of Change
Nov 25, 2023	Initial release.