

Startup Guide

# RZ/T2M Group, RZ/T2L Group, RZ/N2L Group

R12AN0123EJ0502 Rev.5.02 Aug.8, 2024

CN032 AC Servo Solution Startup Guide (for Motion Control Utility)

## Introduction

This startup guide is a quick start guide for CN032 AC Servo Solution Kit by using "Motion Control Utility Tool".

#### <<Caution when handling the solution board>>

Don't touch the board while power is supplied because CN032 AC servo solution board contains high voltage circuits.

## **Target Device**

RZ/T2M Group RZ/T2L Group

RZ/N2L Group

When applying the sample program covered in this startup guide to another microcomputer, modify the program according to the specifications for the target microcomputer and conduct an extensive evaluation of the modified program.

#### **Related Document**

- CN032 AC Servo Solution Controller Board Manual (for RZ/T2M, RZ/N2L)
- CN032 AC Servo Solution Controller Board Manual (for RZ/T2L)
- CN032 AC Servo Solution Inverter Board Manual
- CN032 AC Servo Solution Firmware Manual
- CN032 AC Servo Solution Startup Guide (for EtherCAT)
- CN032 AC Servo Solution Startup Guide (for Motion Utility Control) (this manual)
- RZ/T2M Group User's Manual: Hardware
- RZ/T2L Group User's Manual: Hardware
- RZ/N2L Group User's Manual: Hardware



# RZ/T2M Group, RZ/T2L Group, RZ/N2L Group Startup Guide (for Motion Control Utility)

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# 1. Overview

## 1.1 CN032 AC Servo Solution Overview

This application note is implemented by using the Controller board equipped with Renesas Electronics RZ/T2M, RZ/T2L or RZ/N2L and the Inverter board for 220V AC servo motor.

This solution includes software that runs on the Controller board, PC software, and circuit diagram. Therefore, initial evaluation and advance development of industrial motor equipment development using RZ/T2M, RZ/T2L or RZ/N2L can be easily done.

## **1.2 Connection Configuration**

Figure 1-1 is shown the connection configuration.

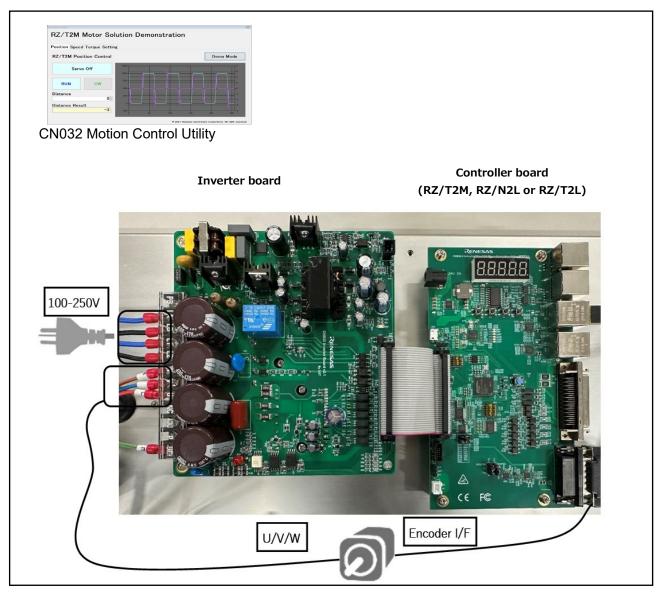


Figure 1-1 Connection Configuration



## 1.3 Connection Equipment

Table 1-1 is shown the connection equipment list.

No.	Item	Model	Spec.
1	220V AC Servo motor	BM0602A1PD-A	200W, 3000rpm
		ZhuHai KaiBang Motor Manufacturing Co. , Ltd.	
2	Encoder	TS5669N140	17/16Bit
		Tamagawa Seiki Co. , Ltd.	
3	Communication with the PC	UART to USB converter	-
4	ICE	- I-jet from IAR Systems - J-Link EDU from Segger	-

#### 1.3.1 220V AC Servo motor



BM0602A1PD-A



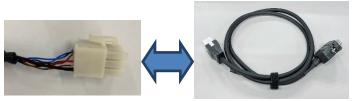
Connecter (motor side)

Conversion cable for connecting to Inverter board

## 1.3.2 Absolute Encoder



TS5669N140



Connecter (encoder side)

Conversion cable for connecting to Inverter board

Cable Color

Yellow/Green

Red

Blue

Brown

Signal

GND(PE)

U

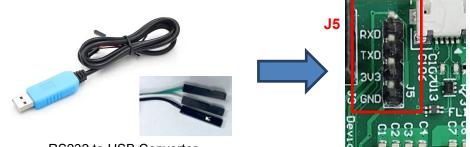
W

V



# 1.3.3 Communication with the PC 1.3.3.1 RS232 to USB

The RS232 to USB Converter is connected to the J5 connector on the controller board. Table 1-2 is shown the connection with controller board.



RS232 to USB Converter

Figure 1-2 Serial connect to host PC

#### Table 1-2 Connection RS232 to USB Converter with Controller board

RS232 to USB converter	J5	Note
TXD(Green)	RXD(J5-1)	
RXD(White)	TXD(J5-2)	
NC	3V3(J5-3)	Connection is not needed
GND(Black)	GND(J5-4)	

## 1.3.3.2 RS485 to USB

The RS485 to USB converter is connected the J6 or J8 of the controller board.



Figure 1-3 Serial connect to host PC

## 1.3.3.3 Selection for RS232 or RS485

RS232 or RS485 can be selected by SW2-1 according to Table 1-3.

#### Table 1-3 Communication selection

	RS232	RS485(default)
SW2-1	ON	OFF



SW2 on the board



## 1.3.4 ICE

ICE is connected to the Controller board (ARM JTAG connector (10 pins)).

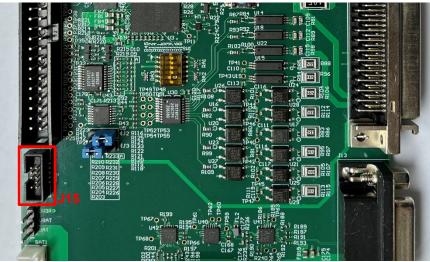


Figure 1-4 Hardware debugger connection



## 1.3.5 Power Supply

Supply 100-250V AC power to Inverter board, and supply 5V from Inverter board to Controller board by cable.

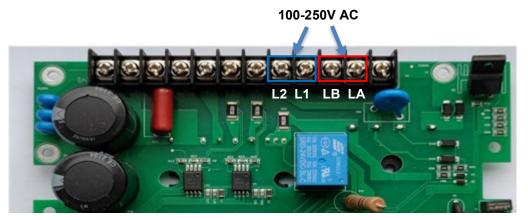


Figure 1-5 Inverter board for 220V Motor

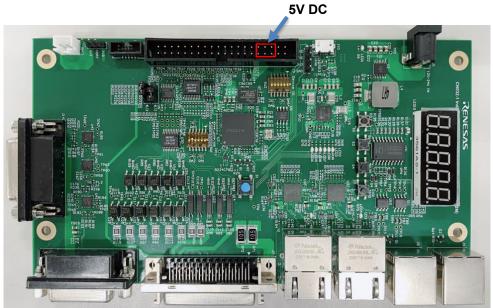


Figure 1-6 Controller board



## 2. Operating Environment

This solution kit is for the environment below.

From this chapter onwards, the procedure for operating the 220V AC servo motor control system with 220V AC power supply is described.

Item		Description				
item		RZ/T2M edition RZ/T2L edition		RZ/N2L edition		
MPU Series		RZ/T2M	RZ/T2L	RZ/N2L		
		Dual Arm Cortex®-R52	Single Arm Cortex®-R52	Single Arm Cortex®-R52		
	Package	R9A07G075M24:	R9A07G074M08:	R9A07G084M04:		
		225-pin FBGA	196- pin FBGA	225-pin FBGA		
Operating f	requency	800MHz	800MHz	400MHz		
Operating n	nodes	xSPI0 boot mode (x1 boot	Serial flash)			
Operating v	voltage	3.3V/1.8V/1.1V				
Power sour board	ce for Inverter	220V AC, 1.5A max. consumption				
Devices		Serial flash memory				
(Functions	to be used on	Manufacturer: Renesas				
the board)		Model: AT25SF128A-SHB-T				
•	development	IAR Systems Embedded Workbench <sup>®</sup> for Arm 9.32.2				
environmen	IT	Renesas Electronics e <sup>2</sup> studio 2023-07				
		Toolchain GNU ARM Embedded 9.3.1 (*1)				
install.	ndix 7.2 on how to	Renesas Electronics FSPSC 2023-07 (*2)				
Flexible Su (FSP)	pport Package	RZT FSP v1.3.0 RZN FSP v1.3.0				
Emulator		Manufactured by IAR Systems				
		I-jet				
		Manufactured by SEGGER				
		J-Link EDU Ver.11.0				
PC Softwar	e	Manufactured by Renesas				
		CN032 Motion Control Utility				

#### Table 2-1 Operating Environment

(\*1) For instructions on how to install the toolchain, refer to Chapter 7.2.2 Toolchain Install

(\*2) FSPSC (FSP Smart Configurator) is a code generation tool for IAR Embedded Workbench.

The Table 2-2 Controller board and inverter board combination shows the combination of the controller board and inverter board. Operation is not guaranteed with any combination other than the following.

#### Table 2-2 Controller board and inverter board combination

No.	Controller board		Inverter board		
		V1.1	V1.2	V2.1	
1	RZ/T2M(v1.1), RZ/N2L(v1.1)	Available	Available	N/A	
2	RZ/T2M(v2.1), RZ/N2L(v2.1)	N/A	N/A	Available	
3	RZ/T2L(v1.0)	Available	Available	N/A	
4	RZ/T2L(v2.0)	N/A	N/A	Available	



The No.2 in Table 2-2 requires Software Package Ver.5.02(r12an0123xx0502-cn032-ac-servo-solution) or later, the No. 4 requires Software Package Ver.5.01(r12an0123xx0501-cn032-ac-servo-solution) or later.

When operating No.1 in Table 2-2 on Software Package Ver.5.02(r12an0123xx0502-cn032-ac-servo-solution) or later, change the mode of P03\_5 to "Disable" in Pin Configurations.

When operating No.3 in Table 2-2 on Software Package Ver.5.01(r12an0123xx0501-cn032-ac-servo-solution) or later, change the mode of P15\_1 to "Disable" in Pin Configurations.

The procedure will be explained using the development environment e<sup>2</sup>studio of No.3 as an example.

陷 Project Explorer 🛛 📄 😫 🍸 🕴 🗖	1 💮 *[CN032_AC_Servo_Solution_CPU0] FSP	Configuration $ imes$			- 8
✓      ✓ CN032_AC_Servo_Solution_CPU0     →	Pin Configuration				Generate Project Content
> 🚑 apl > 🚑 eci	Select Pin Configuration		Expo	ort to CSV file  🚺 Co	nfigure Pin Driver Warnings
> 2 encoder > 2 inc	32_AC_Servo_Solution_CPU0_RZT2M.p	incfg v Manage configurations	V	Generate data: g_b	sp_pin_cfg
> 🧟 lib > 😂 rzt	Pin Selection 📙 🕀 📮	Pin Configuration			😲 Cycle Pin Group
	Type filter text           >          P14           •          P15           •          P15,0           •          P15,0           •          P15,0           •          P15,0           •          P15,7           >          P16           >          P17	Name Symbolic Name Comment Mode Parrup/down Output Type Drive Capacity Region Schmitt Trigger Slew Rate Comment Module name: P15_1 Port Capabilities: P55_14 Port Capabilities: P55_14 Port Capabilities: P15_1 Port Capabili	Value BUF_ENABLE Disabled None CMOS Low Safety None Slow	Link	~ ~ ~
	Printenction         Pin Number           Summary         BSP         Crocks         Pins         Interrupts         E           Problems         Console         X         Proper         Proper           RZ/T FSP         Console         X         Proper		マニュアル 🍣 Call Hierar	chy 🚺 Memory	

Then click "Generate Project Content" button.

*[CN032_AC_Servo_Solution_CPU0] FSP (	Configuration $ imes$			
Pin Configuration				Generate Project Conte
Select Pin Configuration		📑 Expo	rt to CSV file  ፤ Configure	e Pin Driver Warnings
32_AC_Servo_Solution_CPU0_RZT2M.pir	cfg Y Manage configurations	$\checkmark$	Generate data: g_bsp_pin	_cfg
Pin Selection $\exists \exists \exists \exists \exists \exists z \exists z$	Pin Configuration			😲 Cycle Pin Grou
Type filter text	Name Symbolic Name	Value BUF_ENABLE	Link	
> V P07	Comment Mode	Disabled		
> V P09 > V P10	Pull up/down Output Type	None		
> 🛩 P12 > 🛩 P13	Drive Capacity	Low		
> 🗸 P14	Region	Safety		



## 3. Board Setting

## 3.1 Switches

### 3.1.1 Controller board

Table 3-1 is shown the switches setting of the Controller board.

No	SW		Item	Setting	Description
1	SW1	1	MD0	1=ON	xSPI0 boot mode (x1 boot Serial flash)
	(Boot mode) 2		MD1	2=ON	
		3	MD2	3=ON	
		4	MDD	4=ON	JTAG normal mode
		5	MDW	5=OFF	1 wait
		6	No use	-	-
2	SW2	1	RS485/RS232	1=OFF	OFF: RS485 mode
					ON: RS232 mode

## 3.2 Jumpers

#### 3.2.1 Controller board

Table 3-2 is shown the jumpers setting of the Controller board for RZ/T2M, RZ/T2L and RZ/N2L. Table 3-3 is shown the jumpers setting of the Controller board for RZ/T2L.

#### Table 3-2 Jumpers Setting of Controller board for RZ/T2M, RZ/T2L and RZ/N2L

No	JP	Item	Setting	Description
1	J2	PWM signal of V- phase	1-2 short	Select MTU3 output signal
2	J3	PWM signal of W+ phase	2-3 short	Select MTU3 output signal

#### Table 3-3 Jumpers Setting of Controller board for RZ/T2L

No	JP	Item	Setting	Description
1	J14	RXD1/ENCIFDI1 selection	1-2 short	Select RXD1 signal from encoder
2	J15	TXD1/ENCIFDO1 selection	1-2 short	Select TXD1 signal from encoder



## 4. CN032 AC Servo Solution Execution procedure

## 4.1 Precaution before operation

When using this kit, please kindly comply with the following 1 to 3:

- 1. Use stable power supply with current 1[A] limit setting to inverter board.
- Do not use DC12-24[V] power supply jack to controller board.
   %The power of controller is supplied from the inverter board.
- 3. Even after turning off, please do not touch the inverter board when high voltage LED(D27) is on which could be about 3 minutes or more.

If motor malfunctions or makes noise during use, please turn off the power to the inverter board immediately.

If this malfunction symptom continues, please contact our sales office or agency.

## 4.2 AC Servo Solution Starting

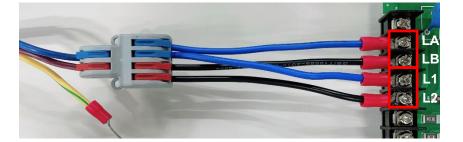
① Connect 220V AC motor to the Inverter board

	Motor	Inverter Board
Connection	W	P4-6
	V	P4-7
	U	P4-8
	GND(PE)	P4-12



Note: silk for U/W on the inverter board (v1.1 only) is wrong printed.

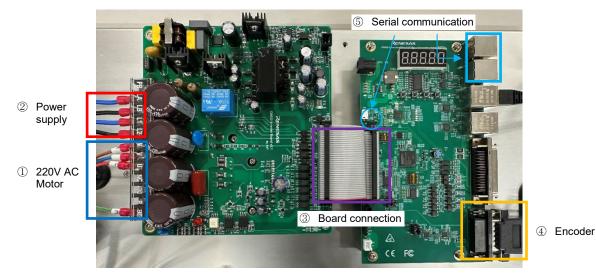
 Connect power supply cable to the Inverter board LA and L1 of P4 are connected to AC 220V + (blue cable).
 LB and L2 of P4 are connected to AC 220V – (black cable).



- ③ Connect between the Controller board and the Inverter board
- ④ Connect the encoder to the Controller board The encoder is connected to the D-Sub15pin connector, and it is connected to the J13 connector of the Controller board.
- Connect the J6 or J8 of the Controller board to PC through RS485 to USB converter. or
   Connect the J5 of the Controller board to PC through RS232 to USB converter.



After connecting steps 1 to 5 above, the boards will look like the figure below.



(6) xSPI0 boot mode setting
 Set SW1 of the Controller board to the following.



Power supply to the Inverter board, and then the red lamp lights up.
 Additionally, the Controller board is supplied 5V DC power from Inverter board and then LED1 lights up.



Power lamp of the Inverter board



Power LED of the controller board

\* : If the program is not stored in the serial Flash ROM, the program is written to the serial Flash ROM. Refer to "7.3 56Program Writing Procedure".



## 4.3 Motion Control Utility Execution

## 4.3.1 Installation

Copy the following ZIP file to any folder (\*) and unzip the zip file. CN032\_Motion\_Utility\_For220V.zip

\* The Motion Control Utility can be used in the Controller board equipped with RZ/T2M, RZ/T2L or RZ/N2L.

\* The folder path name to expand CN032\_Motion\_Utility\_For220V.zip should be alphanumeric characters.

\* About ZIP file detail, refer to "7.1 Package Folder Structure".

## 4.3.2 Demonstration Mode

#### 4.3.2.1 Motor Parameter Setting

The "default.mtr" is for BM0602A1PD-A motor.

#### 4.3.2.2 Starting the CN032 Motion Utility.exe

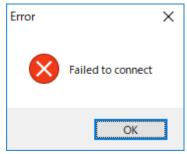
When RS-232 / RS-485 is connected

Select the COM port number and "Demonstration". Push the "OK" button.

🖳 New Conn	ection	-		×
RS232 RS4	22			
Serial Po	t COM1	~		
Mode	O Tuner / Anal			
	<ul> <li>Demonstratio</li> </ul>	ns		
		OK	Cance	el

■RS-422 is not supported

Display the connection error

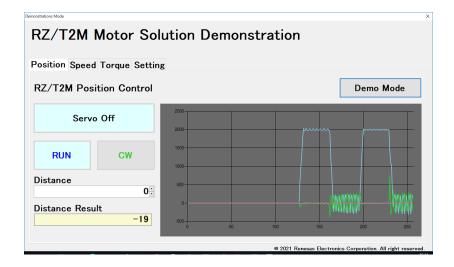


Double-check the CN032 AC Servo Solution connection (refer to "3 Board Setting"), restart the Motion Utility.



#### 4.3.2.3 Demonstrations Mode

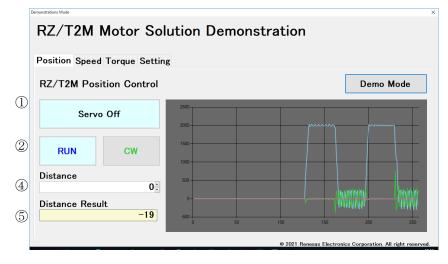
In Demonstrations Mode, it is possible to check the operation of speed control/ torque control / position control. To display with PC/tablet, the scaling of various toolboxes is changed according to the screen size. The speed control/torque/position control screen is switched by tab. "Demo Mode" button is had at each control screen and is controlled automatically by pushing this button.





#### (1) Position Control Screen

Figure 4-1 is shown the Position Control screen.





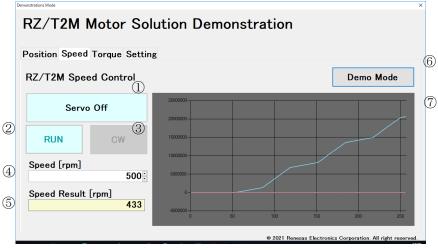
No.	Item	Description
(1)	Servo On/Off	This toggle button is controlled the power supply on/off.
0		When this button is pressed while "Servo On" is displayed, the motor power is turned
		off.
		$\cdot$ When this button is pressed while "Servo Off" is displayed, the motor power is turned on
2	RUN/STOP	This toggle button is started/stopped the position control.
		<ul> <li>When this button is pressed while "RUN" is displayed, the motor rotates to</li> </ul>
		distance(target distance) and stops by applying a torque when reaching the target
		distance. When stopping, this toggle button is displayed "STOP" -> "RUN".
		<ul> <li>When this button is pressed while "STOP" is displayed, the motor stops emergency.</li> </ul>
		When stopping, this toggle button is displayed "STOP" -> "RUN".
3	CW/CCW	This toggle button is controlled the direction of motor rotation.
		<ul> <li>When this button is pressed while "CW" is displayed, the motor rotates forward</li> </ul>
		(clockwise when viewed from the output shaft side).
		· When this button is pressed while "CCW" is displayed, the motor rotates reverse
		(counter clockwise when viewed from the output shaft side).
4	Distance	Target distance is set. 0 to 2000 (1 step) can be set.
		This value cannot be changed while motor rotates.
5	Distance Result	The movement distance (result) is displayed at 100ms intervals.
6	Demo Mode	This toggle button is operated the Position Control automatically.
		When this button is pressed while "Demo Mode" is displayed, the following operations are
		performed.
		1. Start the Position Control toward the target position: 20000.
		2. After 10 seconds, restart toward the certain target distance: 0.
		3. Repeat the above No.1 and No.2.
		When this button is pressed again, the motor stops. While operating Demo Mode, other
		buttons (RUN / STOP button, etc.) cannot be used. If other tab (Torque tab/Speed tab) is
		pressed while operating Demo Mode, Demo Mode is stopped emergency.
$\bigcirc$	Graph	Waveform of current motor position value (Blue), Pos error (Green) and Id/Iq current value
		(Red/Orange) are displayed at 100ms intervals as default.
		The variables and scaling displayed in the graph can be changed. See "5 Variables" for
		variables.

Note: When using UART to RS232 cable, if there are any noise in the waveform displayed in the graph, please use UAER to RS485 cable.



# Speed Control Screen

Figure 4-2 is shown the Speed Control screen.





No.	Item	Description
1	Servo On/Off	This toggle button is controlled the power supply on/off.
٢		• When this button is pressed while "Servo On" is displayed, the motor power is turned
		on.
		When this button is pressed while "Servo Off" is displayed, the motor power is turned
		off.
2	RUN/STOP	This toggle button is started/stopped the speed control.
0		• When this button is pressed while "RUN" is displayed, the motor rotates at speed[rpm]
		(target speed). When rotating, this toggle button is displayed "RUN" -> "STOP".
		• When this button is pressed while "STOP" is displayed, the motor stops emergency.
		When stopping, this toggle button is displayed "STOP" -> "RUN".
3	CW/CCW	This toggle button is controlled the direction of motor rotation.
		<ul> <li>When this button is pressed while "CW" is displayed, the motor rotates forward</li> </ul>
		(clockwise when viewed from the output shaft side).
		When this button is pressed while "CCW" is displayed, the motor rotates reverse
		(counter clockwise when viewed from the output shaft side).
4	Speed[rpm]	Target speed is set. 0 to 2000 [rpm] (1 step) can be set.
		This value can be changed while motor rotates.
5	Speed	The current speed (result) is displayed at 100ms intervals.
	Result[rpm]	
6	Demo Mode	This toggle button is operated the Speed Control automatically.
		When this button is pressed while "Demo Mode" is displayed, the following operations are performed.
		1. Start the Speed Control at the target speed: 500.
		2. After 5 seconds, restart at the certain target speed: 2000.
		3. Repeat the above No.1 and No.2.
		When this button is pressed again, the motor stops. While operating Demo Mode, other
		buttons (RUN / STOP button, etc.) cannot be used. If other tab (Torque tab/Position tab)
		is pressed while operating Demo Mode, Demo Mode is stopped emergency.
$\overline{O}$	Graph	Waveform of current motor position value (Blue), Pos error (Green) and Id/Iq current value
		(Red/Orange) are displayed at 100ms intervals as default.
		The variables and scaling displayed in the graph can be changed. See "5 Variables" for
		variables.



#### (2) Torque Control Screen

Figure 4-3 is shown the Torque Control screen.

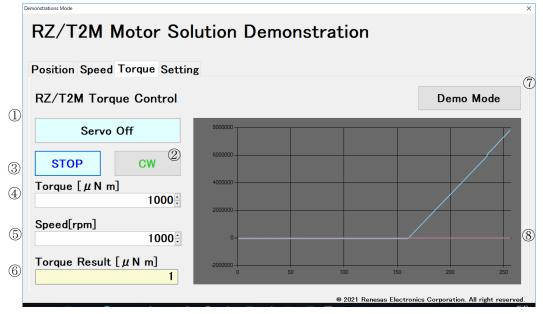


Figure 4-3 Torque Control Screen

No.	Item	Description
1	Servo On/Off	This toggle button is controlled the power supply on/off.
		· When this button is pressed while "Servo On" is displayed, the motor power is turned
		on.
		<ul> <li>When this button is pressed while "Servo Off" is displayed, the motor power is turned</li> </ul>
		off.
2	RUN/STOP	This toggle button is started/stopped the torque control.
		When this button is pressed while "RUN" is displayed, the motor rotates at torque[mNm]
		(target torque). When rotating, this toggle button is displayed "RUN" -> "STOP".
		<ul> <li>When this button is pressed while "STOP" is displayed, the motor stops emergency.</li> </ul>
		When stopping, this toggle button is displayed "STOP" -> "RUN".
3	CW/CCW	This toggle button is controlled the direction of motor rotation.
		<ul> <li>When this button is pressed while "CW" is displayed, the motor rotates forward</li> </ul>
		(clockwise when viewed from the output shaft side).
		<ul> <li>When this button is pressed while "CCW" is displayed, the motor rotates reverse</li> </ul>
		(counter clockwise when viewed from the output shaft side).
4	Torque[uNm]	Target torque is set. 0 to 2000 [uNm] (1 step) can be set.
		This value can be changed while motor rotates.
5	Speed[rpm]	Target speed is set. 0 to 2000 [rpm] (1 step) can be set.
	_	This value can be changed while motor rotates.
6	Torque Result[uNm]	The current torque (result) is displayed at 100ms intervals.
(7)	Demo Mode	This toggle button is operated the Torque Control automatically.
<u> </u>		When this button is pressed while "Demo Mode" is displayed, torque control is started at
		the certain torque.
		When this button is pressed again, the motor stops. While operating Demo Mode, other
		buttons (RUN / STOP button, etc.) cannot be used. If other tab (Position tab/Speed tab) is
		pressed while operating Demo Mode, Demo Mode is stopped emergency.
(8)	Graph	Waveform of current motor position value (Blue), Pos error (Green) and Id/Iq current value
		(Red/Orange) are displayed at 100ms intervals as default.
		The variables and scaling displayed in the graph can be changed. See "5 Variables" for
		variables.



### (3) Setting Screen

Figure 4-4 is shown the setting screen. Contents of Position tab/Speed tab/Torque tab can be configured.

monstrations Mode												×
RZ/T	2M N	lotor So	lu	tion	D	emon	stra	tion				
Position	Speed	Torque Setti	ng									
Graph												
	🛛 Chai	nnel 1					⊠ Char	nnel 2				
	Scale	1	~	Left	~		Scale	1	~	Left	~	
	Data	Position			~		Data	Pos Err			~	
	<sup>⊠</sup> Char	ınel 3					☑ Char	nnel 4				
	Scale	1	~	Left	~		Scale	1	~	Left	~	
	Data	Id Current			~		Data	Iq Current			~	
								© 2021 Renesas Elec	tronic	s Corpora	tion. A	ll right reserved.

Figure 4-4 Setting Screen

#### ∎Graph

No.	Item	Description
1	Channel1~Channel4	The show/hide of Channel1 to Channel4 graphs is set. And the graph display is valid
		when the check box is checked.
2	Scale	Scale is set in 0.125 units. And primary axis (left side) / secondary axis (right side) of
		Y axis is set with "Left" / "Right".
3	Data	The displayed data (variable) is set. Refer to "5 Variables".



#### 4.3.3 Tuner/Analyze Mode

#### 4.3.3.1 CN032 Motion Utility.exe Starting

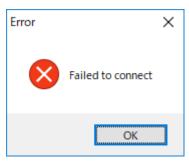
#### ■When RS-232 is connected

Select the COM port number and "Tuner/Analyzer". Push the "OK" button.

🖳 New Connec	tion	-		×
RS232 RS422	2			
Serial Port	COM1	~		
Mode	O.T. (A. 1			
	O Tuner / Anal;	yzer		
	● Demonstratio	ns		
		OK	Cance	el

#### ■RS-422 is not supported

■ Display the connection error



Double-check the CN032 AC Servo Solution connection (refer to "3 Board Setting"), restart the Motion Utility.



#### 4.3.3.2 Position Control Execution

This chapter shows an execution example of Position Control. About detail specification, refer to "4.4 Tuner/Analyzer Mode Specification".

#### (1) Import of the Motor Parameters

Select the [File]>[Import] of the menu and select the motor parameters in the same folder as CN032 Motion Utility.exe.

Motor: BM0602A1PD-A -> default.mtr

#### (2) Power ON

Push the "Power ON" button.

Commands	
Power On	Open Loop Control
Sane On	Voltage [%] 5 🗣 Reverse Forward
Reset Error Flags	
Connection: COM3	

#### (3) Phasing Operation

Select the "Setup" tab, push the "Phase" button.

Motor Phasing		
Phasing Mode	Algorithmic	~
Phasing Time [ms]	100	Phase
Phasinig Output [%]	15	Phase

#### (4) Servo ON

Push the "Servo On" button.

<	Commands Power On Servo On Reset Error Flags	Open Loop Control Voltage [X] 5 🗣 Reverse Forward
	Connection: COM3	



## (5) Position Control

Push the "Cycle Move P1-P2" button. The position of the motor is repeated 0 or 10000.

Setup	Tuning	Motion	Digita	I I/O	Encoder	Limits			
Velo	city Prof	ile							
	Velocity Profile Trapezoidal 🗸								
	Velocit	y [Enc Co	305,2	200	-				
		Velocity	279.4	2					
	Acceleration [EC/s/s] 457,764								
	Decel	eration [E	C/s/s]	457,7	64	-			
- Motio	on Gener	ator							
Tar	get #1	0	÷	Сору	/ Go	to # <u>1</u>			
Tan	get #2	10000	-	Сору	/ Go	to # <u>2</u>			
Di	stance	1000	÷	Rever	se <u>E</u> or	ward			
Pau	se [ms]	2000	θΓ	S	top Cycle				



## 4.4 Tuner/Analyzer Mode Specification

Figure 4-5 is shown the main screen of Tuner/Analyzer mode.

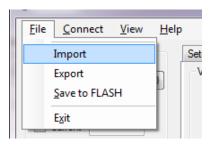
Tuner/Analyzer mode is for the configuration of motor parameter, tuning and diagnostic of the Solution. This mode has a GUI (graphical user interface) that displays various parameters and commands and has a terminal emulator that can read and write variables dynamically. In addition, a Motion Scope is displayed linear graphs of important controller variables.

💀 RZ/T2M Motion Utility	- 0	×
<u>F</u> ile <u>C</u> onnect <u>V</u> iew <u>H</u> elp		
Module ID $\checkmark$	Setup Tuning Motion Digital I/O Encoder L	imits
Firmware Version	Motor Configuration	
Status	Motor Type	$\sim$
Position 0	Pole Pairs Count 1 🕒 Counts/F	hase
Pos Error	Enc Counts/Revolution 1 😫 0	
Voltage	Position Inverted 🛛 🗸	
Index	Encoder Type	$\sim$
Id / Iq	Motor Commutation	
Torque	Commutation Mode	$\sim$
Velocity	Windings Mapping	
Status / Faults / Warnings		
	Motor Phasing	
	Phasing Mode	
	Phasing Time [ms] 100	~
	Phasinig Output [%] 100 Phase	e
Commands Review On		
Power On <u>S</u> TOP	Open Loop Control	
Servo On	Voltage [%] 5 🖨 Reverse Forwar	rd
Reset Error Flags		
Connection: Not Connected		.:

Figure 4-5 Main Screen



## 4.4.1 Menu 4.4.1.1 File



No.	Item	Description
1	Import	Motor parameters are imported. (Extension: *.mtr)
2	Export	Motor parameters are exported. (Extension: *.mtr)
3	Save to Flash	Motor parameters are written to the Flash ROM of the Controller board. (Address (:0xB0000~(ch1 of motor)) of Flash ROM that firmware of the solution is stored. )
		<ul> <li>* Execute when the power is turned off (motor stopped).</li> <li>* After writing the motor parameters, turn off the power of the solution board and restart.</li> </ul>

About motor parameters, refer to "6 Motor Parameters".

## 4.4.1.2 Connect/Disconnect

#### ■Connect

The connection dialog offers entering connection string which describes the communication interface. The string format also defines the type of the communication protocol.

Rew Connection	
RS232 RS422	
Serial Port COM22	<b>-</b>
	OK Cancel

• The RS-232/ RS485 connection is implied by specifying COM followed by a number such as COM5. The baud rate is fixed at 115,200 bps

• The RS-422 connection is not supported.

#### Disconnect

The communication is disconnected. If connecting again, "Connect" is selected.

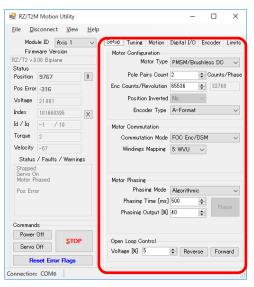


#### 4.4.1.3 View

File	Disconne	ct	Vie	ew Help	
	Module ID	A×	~	Control Panel	
	Firmware V	ersi		Motion Scope	ļ
RZ/T	RZ/T1 v.1.21 Biplane			Terminal	
-Statu Posi	is tion ()			Refresh	

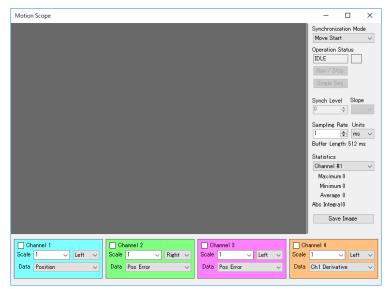
#### Control Panel

Part of the red frame is shown/ hidden.



#### ■Motion Scope

Motion Scope screen is shown/ hidden.





#### ■Terminal

Part of the red frame is shown/ hidden.

RZ/T2M Motion Utility		
Eile Disconnect View Help Module ID Axis 1 V Firmware Version RZ/T2W V.1.00 Firmware Status Position 27736696 0	Setup Tuning Motion Digital I/O Encoder Limits Suspend Polling Motor Configuration Motor Type PMSM/Brushless DC V Pole Pairs Count 2 Counts/Phase	Read Text
Pos Error         0           Voltage         24.096           Index         27710184           Id         1           O         0           Torque         0           Velocity         0           Status         / Faults / Warnings           Stopped	Enc Counts/Revolution [55596 ] [22768] Position Inverted No Encoder Type A-Format Motor Commutation Commutation Mode FOC Enc/DSM Windines Mappine 5: WVU	
Servio Off Motor Phased No Power Pos Error	Motor Phasing Phasing Mode Algorithmic Phasing Time [ms] 500 (*) Phase Phase	
Power On Servo On Reset Error Rags	Open Loop Control Voltage [X] 5 1 Reverse Forward	>

#### ■Refresh

Motor parameters of default (when shipping) are refreshed.

#### 4.4.1.4 Help

#### About





## 4.4.2 Main Screen

💀 RZ/T2M Motion Utility				-		×
<u>File Connect View H</u> elp			Co	ontrol P	anel	
Module ID 🗸 🗸	Setup	Tuning	Motion	Digital I/O	Encoder	Limits
Firmware Version	Moto	r Configu	ration			
Status		M	otor Type			$\sim$
Position 0		Pole Pa	irs Count	t 1	🗢 Counts	s/Phase
Pos Error	Enc C	Dounts/R	evolution	1	<b>\$</b> 0	
Voltage		Position	n Inverted	1	~	
		Enco	der Type			~
×			>p			
Id / Iq	Moto	r Commu	tation			
Torque	C	Commutat	tion Mode			$\sim$
Velocity	1	Windings	Mapping		$\sim$	
Status / Faults / Warnings						
	Moto	r Phasing				
			ing Mode			$\sim$
			Time [ms			ase
	P	'hasinig (	Dutput [%]	100	*	
Commands						
Power On STOP	Onen	Loop Co	ntrol			
Servo On		αe [%] [5		😫 Rever	se For	ward
Reset Error Flags						
Connection: Not Connected						

No.	Item		Description					
1	Module ID		Axis number of motor to be controlled is selected.					
2	Firmware Ve	rsion	Version of the solution firmware Is displayed.					
3	Status	Position	The current coordinates of the motor are displayed. If pushing "0" button, the current coordinates is 0.					
4		Pos Error	The actual coordinates and the distance to the target coordinates are displayed.					
5		Voltage	DC bus voltage is displayed.					
6		Index	The encoder counter value (Position value) (absolute value) is displayed. Every pressing the X button is updated. Incremental encoder is displayed 0.					
7		ld/lq	The current Id/Iq value are displayed.					
8		Torque	The current torque value is displayed.					
9		Velocity	The current speed[rpm] is displayed.					
10		Status/	The current status, faults and warnings are displayed. About detail, refer to					
		Faults/Warnings	"■Status/ Faults/ Warnings".					
11	Commands	Power On	This toggle button is controlled the power supply on/off.					
12		Servo On	This toggle button is controlled the servo on/off.					
13		STOP	This button is stopped the rotation of the motor.					
14		Reset Error Flags	This button is released the status of Faults/Warnings. By releasing the status of Faults/Warnings, "Servo On" button is valid.					



#### Status/ Faults/ Warnings

No.	Indication	Description
1	"Moving"/ "Stopped"	"Moving" or "Stopped" is displayed to 1st line.
		"Moving": The motor is rotating.
		"Stopped": The motor is stopping.
2	"Servo On"/	"Servo On" or "Servo Off" is displayed to 2nd line.
	"Servo Off"	"Servo On": The servo control is started.
		"Servo Off": The servo control is stopped.
3	"Power On" / "Power Off"	"Power On" or "Power Off" is displayed to 3rd line.
		"Power On": Power is turned ON.
		"Power Off": Power is turned OFF.
4	"Motor Phased"/	"Motor Phased" or "Motor Not Phased" is displayed to 4th line.
	"Motor Not Phased"	"Motor Phased": Motor phasing is completed.
		"Motor Not Phased": Motor phasing is not completed.
5	"Position Captured"	The encoder count was acquired.
6	"PVT Buffer Error"	PVT buffer capacity were less than threshold.
7	"Overcurrent"	Over current was detected.
8	"Amplifier Inhibit"	Error by "4.4.3.5(5)Other".
9	"PVT Buffer Empty"	PVT buffer empty were detected.
10	"Overtemperature"	Overheating was detected.
11	"Amplifier Fault"	Fault error from Current Sensor.
12	"Position Error"	The Max Position Error.
13	"Wraparound Error"	Position Counter Wraparound



# 4.4.3 Control Panel

# 4.4.3.1 Setup Tab

🖳 RZ/T2N	1 Motion U	Itility				-		×
<u>F</u> ile <u>D</u> is	connect	<u>V</u> iew	<u>H</u> elp					
Modu	110	is 1	$\sim$	Setup Tuning Motic	on Digital	I/O E	ncoder	Limits
Firmv	ware Versio	on		- Motor Configuration				
RZ/T2 v.0.	.00 Biplane			Motor Ty	pe PMSM	/Brush	less DC	~
Status								
Position	-296		0	Pole Pairs Co		÷	Counts	
Pos Error	287			Enc Counts/Revolut	ion 65536	¢	3276	8
Voltage	21.899			Position Inver	ted No			
Index	10166839	5	X	Encoder Ty	pe A-For	mat		$\sim$
Id / Iq	0 /-3	1		Motor Commutation				
Torque	0			Commutation Mo	ode FOC E	inc/DS	М	~
Velocity	-1			Windings Mappi	ne 5: WVI	U ~	]	
Status	/ Faults /	Warnine	s				_	
Stopped Servo Or	- -							
Motor Ph				Motor Phasing				
Pos Erro	ır.			Phasing Mo	de Algori	thmic		~
				Phasing Time [	ms] 500	-		
				Phasinig Output	[%] 40	÷	Ph	ase
Command	s							
Power	Off	STOP		Open Loop Control				_
Servo Off			Voltage [%] 5	€ B	everse	For	vard	
Re	set Error I	lags		touge bill		overse	TON	varu
Connection:					_	_	_	

#### (1) Motor Configuration

Setup	Tuning	Motion	Digital I/O	Encoder	Limits
Motor	r Configu	ration —			
	Me	otor Type	PMSM/Bru	shless DC	$\sim$
	Pole Pa	irs Count	2	😫 Counts	:/Phase
Enc C	ounts/R	evolution	2000	<b>\$</b> 1000	
	Positior	n Inverted	No	$\sim$	
	Enco	der Type	Incrementa	I	$\sim$

No.	Item	Description
1	Motor Type	Motor type is selected.
		PMSM/Brushless DC (PMSM/ Brushless DC)
2	Pole Pairs Count	Motor pole pairs count is set. (1 to 16 can be selected.)
3	Enc Counts/Revolution	Encoder count for one revolution is set.
4	Counts/Phase	Electrical cycle (= the encoder counts per revolution divided by the number of
		pole pairs) is displayed.
5	Position Inverted	The position feedback can be inverted if needed. This option eliminates the need of changing the wiring of an incremental encoder if the direction motion does not
		correspond to the decoded position.
6	Encoder Type	Encoder Type is selected.
		0: Incremental
		3: FA-Coder



#### (2) Motor Commutation

Commutation Mode	FOC Enc/DSM	~
Windings Mapping	5: WVU $\sim$	

No.	Item	Description	
1	Commutation Mode	Motor commutation mode is set.	
		<ul> <li>"FOC Enc/DSM": Sinusoidal vector control with encoder and Delta Sigma</li> </ul>	
		Modulator	
2	Windings Mapping	Windings Mapping (U/V/W placement.) is selected.	

#### (3) Motor Phasing

Motor Phasing		
Phasing Mode	Algorithmic	~
Phasing Time [ms]	500 🚖	Phase
Phasinig Output [%]	40 🚖	rnase

No.	Item	Description
<u>No.</u> 1	Item Phasing Mode	Description         Phasing mode is selected. About detail, refer to the following "■CN032 AC Servo Solution Firmware Manual".         1. Algorithmic         an algorithm is executed upon power up of the controller. It energizes the windings creating known flux orientation that rotates the motor. After a small delay that allows the motor to settle the motor position is taken as a reference for the pole's orientation.         The advantage of using Algorithmic phasing is it does not need additional hardware and wiring, and its accuracy is pretty good.         The disadvantage is that it executes small (half electrical cycle) but uncontrolled motion upon power up that may not be acceptable.
		<ul> <li>2. Dithering algorithm moves the magnetic flux at various angles and identifies the direction of movement based on the encoder. This algorithm may not be available in all firmware versions.</li> <li>The advantage is of this approach is same as the algorithmic phasing and in addition it minimizes the robot motion to several encoder counts.</li> <li>The disadvantage is its accuracy is affected by the motor load, so it is not applicable to gravity or spring-loaded axes.</li> <li>The phasing process can be initiated at any time by pressing the Phase button.</li> <li>The controller power must be turned on.</li> </ul>
2	Phasing Time [ms]	Phasing time is set. The voltage is applied with magnitude defined by the motor variable motor power for a duration defined in the motor variable phasing time. When Phasing Mode is Hall-Based, this item cannot be selected.
3	Phasing Output [%]	Phasing Output is set. The voltage is applied with magnitude defined by the motor variable motor power for a duration defined in the motor variable phasing time. When Phasing Mode is Hall-Based, this item cannot be selected.
4	Phase Button	Phasing is started.



Phasing Procedure	Description	
Forced Phasing phasing mode == 0	In this mode the firmware forms a voltage vector a known angle. It is formed by applying appropriate PWM duty cycle to each of the three phase outputs.	
pnasing_mote o	The voltage is applied with magnitude defined by the motor variable <b>motor_power</b> for a duration defined in the motor variable <b>phasing_time</b> . These two variables have to be configured so that they will cause the motor to rotate its rotor such that it is oriented along the orientation of the magnetic flux. Once the time expires, the algorithm stores the current position and sets the phase origin 90degrees back from it.	
	This procedure is implemented in the function <b>forced_phasing()</b> in the file <b>m_phasing.c</b>	
	The pros of this function are its simplicity and robustness. The cons are the small move in random direction the motor would make during the procedure execution. Another disadvantage is that the motor should have no static friction or gravity load that would affect the proper rotor orientation.	
Dithering Based Phasing phasing_mode == 2	The dithering algorithm is derived from the Forced phasing algorithm – identifying the rotor position by observing its position after known flux is applied for a certain time.	
	Unlike the Forced phasing algorithm, the Dithering algorithm does not wait for a certain time – instead it monitors the position change of the rotor. Once the motion direction is detected, the flux orientation is changed so that it cause change in the opposite direction. The magnitude of the flux angle changes is gradually reduced until the motion is no longer detected. The end result is motor phasing that only includes small motor vibrations for a short time as part of the phasing.	
	This algorithm has the benefits of the Forced Phasing algorithm but without the drawback of unwanted motion. The cons are the need of carefully tuning the algorithm parameter in order to match the dynamic characteristics of the mechanical system the motor is attached to. The presence of static friction and gravity load are also undesired.	
	The algorithm is implemented by the function <b>dither_phasing()</b> in the file <b>m_phasing.c</b>	

CN032 AC Servo Solution Firmware Manual



## (4) Open Loop Control

Open Loop Control				
Voltage [%]	5	-	Reverse	Forward

No.	Item	Description		
1	Voltage [%]	The voltage (speed) to rotate is set. 1 to 99% can be set. If increasing this value,		
		rotation of motor is fast.		
2	Reverse Button	The motor rotates with Voltage (reverse). Motor reverses while the "Reverse"		
		button is pushed. Motor stops when the "Reverse" button is released.		
3	Forward Button	The motor rotates with Voltage (forward). Motor forwards while the "Forward"		
		button is pushed. Motor stops when the "Forward" button is released.		



## 4.4.3.2 Tuning Tab

Set the position loop, speed loop, and current loop on the Tuning tab.

Setup Tuning	Motion D	igital I/O	Encoder	Limits
-PIDVAFF Reg	ulator / Pos	ition Loop-		
KP	1647 🌲	Vel Fl	F 0	<b>÷</b>
KI	2649 🚖	Acc FF	FO	÷
KD	0 🖨	Bias	0	-
Integral Limit	400 🌲	Limit[%	] 100	<b>*</b>
PID Regulator	/ Speed Lo	ор		
KP	298 韋			
KI	6 🜲			
KD	0 🜲			
Field Oriented	Control / C	Current Loop	)	
KP	47 🌲	🖂 Bipola	r Puls	e
КI	52 🌲	Output [%	] 10	<b></b>
KD	0 🖨	Time [ms	s] 100	-
KD Integral Limit PID Regulator KP KI KD - Field Oriented KP KI	0	Bias Limit∭ op Current Loop ⊡ Bipola Output ∭	r Puls	e e

#### (1) PIDVAFF Regulator/Position Loop

-PIDVAFF Regulator / Position Loop-

KP	1647	-	Vel FF	0	-
KI	2649	-	Acc FF	0	-
KD	0	-	Bias	0	-
Integral Limit	400	•	Limit[%]	100	-

No.	Item	Description
1	KP	Proportional Gain in the position control loop algorithm (0 - 32767).
2	Vel FF	Velocity Feed Forward in the position control loop algorithm (0 - 32767).
3	KI	Integral Gain in the position control loop algorithm (0 - 32767).
4	Acc FF	Acceleration Feed Forward in the position control loop algorithm (0 - 32767).
5	KD	Differential Gain in the position control loop algorithm (0 - 32767).
6	Bias	Value to be added to the output of the PID regulator continuously.
7	Integral Limit	Integral Limit in the position control loop algorithm (0 - 32767).
8	Limit [%]	Motor output limit from the position loop PID regulator (0 - 32767)

■PID regulator of position control

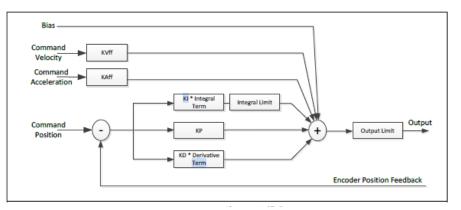


Figure 4-6 PID regulator



#### (2) PID Regulator/Speed Loop

PID Regulator	/ Spee	d Loop
KP	298	<b>÷</b>
KI	6	-
KD	0	-

No.	Item	Description
1	KP	Proportional Gain in the velocity control loop (0 - 32767).
2	KI	Integral Gain in the velocity control loop (0 - 32767).
3	KD	Differential Gain in the velocity control loop (0 - 32767).

#### (3) Field Oriented Control/Current Loop

Field Oriented Control / Current Loop					
KP	47	-	🗹 Bipolar	Pulse	•
KI	52	-	Output [%]	10	-
KD	0	-	Time [ms]	100	-

No.	Item	Description
1	KP	Proportional gain in the Quadrature current control loop (0 - 32767).
2	Bipolar/Pulse Button	When this button is pushed, a pulse of the specified magnitude (Output [%]) for the specified time (Time [ms]) is output. When "Bipolar" is checked, bipolar pulses (positive pulse and negative pulse) are output. When "Bipolar" is not checked, a unipolar pulse (positive pulse) is output.
3	KI	Integral gain in the Quadrature current control loop (0 - 32767).
4	Output [%]	Output voltage set as PWM duty cycle (32767 = 100%). Requires that the servo control is turned off.
5	KD	Differential Gain in the Quadrature current control loop (0 - 32767).
6	Time [ms]	Time of PWM output is set.



#### 4.4.3.3 Motion Tab

Setup	Tuning	Motion	Digita	al I/O	Enco	oder	Limits
Veloc	Velocity Profile						
		Velocity P	rofile	S-C	urve l	Bezie	r 🗸
	Velocity [Enc Counts/s] 3,052					-	
		Velocity	[RPM]	91.56			
	Accel	leration [E	C/s/s	457,7	64		-
	Decel	eration [E0	)/s/s]	457,7	64		÷
	Acc Jerl	< Factor [(	-1000	500			-
[	Dec Jerk	Factor [0	-1000	800			÷
Motic	on Gener	ator					_
Tare	get #1	0	÷	Copy	/	Go t	o # <u>1</u>
Tare	get #2	10000	<b>+</b>	Copy	/	Go t	o # <u>2</u>
Dis	stance	1000	÷	<u>R</u> ever	se	<u>F</u> orv	ward
Paus	e [ms]	500	÷	Cycle	Move	P1	- P2
		Electro	nic Ge	earing			
	IN	1	÷A	xis 1			
	OUT	1	÷ A	xis 2			

#### (1) Velocity Profile

About Velocity Profile, "Trapezoidal", "Spline-Curve", "Bezier-Curve" and "PVT Streaming" are selected.

#### (a) Velocity Profile : Trapezoidal and Spline-Curve

**The Trapezoidal Profile:** The definition of maximum velocity, acceleration and deceleration are set. Note that the motion parameters are maximum values that may not be achievable given the distance to the target position and the abilities of the motor.

**The Spline-Curve Profile:** Provides smooth velocity profile curve and eliminates the vibrations caused by the sudden start and stop of acceleration typical for the Trapezoidal velocity profile. The smooth motion comes at the expense of extended time to execute the same motion.

Velocity Profile		
Velocity Profile	Trapezoidal	$\sim$
Velocity [Enc Counts/s]	3,052	-
Velocity [RPM]	91.56	
Acceleration [EC/s/s]	457,764	<b>*</b>
Deceleration [EC/s/s]	457,764	<b>*</b>

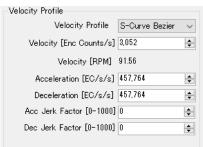
No.	Item	Description
1	Velocity [Enc Counts/s]	Maximum velocity is set.
2	Velocity [rpm]	The value converted the maximum speed to rpm is displayed.
3	Acceleration [EC/s/s]	Maximum acceleration is set.
4	Deceleration [EC/s/s]	Maximum deceleration is set.



#### (b) Velocity Profile : Bezier-Curve

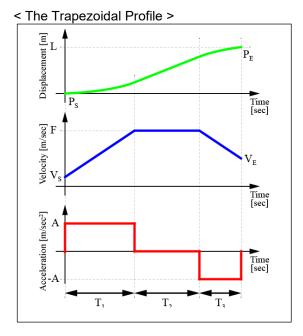
**Bezier-Curve Profile:** Setting of acceleration and deceleration jerk parameters are valid. These values can be set in the range between 0 and 1000 and change the shape of the respective acceleration and deceleration profile phases. The configurable jerk allows tradeoff between the performance and the settle time affected by aggressive deceleration.

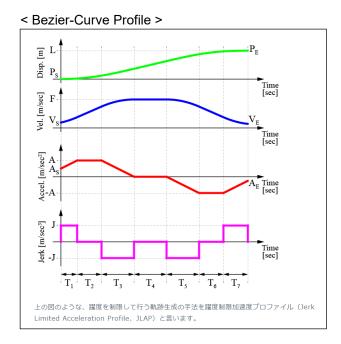
The PVT Streaming Profile is intended to demonstrate the use of PVT mode which employs the host computer as master velocity profile generator. This approach is valuable for the synchronization of multiple axes and complex mechanisms.



No.	Item	Description	
1	Velocity [Enc Counts/s]	Maximum velocity is set.	
2	Velocity [rpm]	The value converted the maximum speed to rpm is displayed.	
3	Acceleration [EC/s/s]	Maximum acceleration is set.	
4	Deceleration [EC/s/s]	Maximum deceleration is set.	
5	Acc Jerk Factor [0-1000]	Acceleration Jerk (0 - 1000) is set.	
6	Dec Jerk Factor [0-1000]	Deceleration Jerk (0 - 1000) is set.	

#### ■References:







## (c) Velocity Profile : PVT Streaming

**PVT Streaming Profile (PVT= position Velocity Time):** Since the communication bandwidth between the host and the controller is inherently limited, the velocity profiles are presented as sets of Position and Velocity over a fixed time slices (typically 5ms to 20ms). Hence the name Position-Velocity-Time for these profile time. The PVT points are streamed to each of the controllers which in turn execute interpolation algorithm to generate the desired position and velocity set-points each microsecond.

Velocity Profile	
Velocity Profile	PVT Streaming $-\sim$
Velocity [Enc Counts/s]	3,052
Velocity [RPM]	91.56
Acceleration [EC/s/s]	457,764 🜲
Deceleration [EC/s/s]	457,764 🚖
Acc Jerk Factor [0-1000]	0
Dec Jerk Factor [0-1000]	0
PVT Time Slice [ms]	1

No.	Item	Description
1	Velocity [Enc Counts/s]	Maximum velocity is set.
2	Velocity [rpm]	The value converted the maximum speed to rpm is displayed.
3	Acceleration [EC/s/s]	Maximum acceleration is set.
4	Deceleration [EC/s/s]	Maximum deceleration is set.
5	Acc Jerk Factor [0-1000]	Acceleration Jerk (0 - 1000) is set.
6	Dec Jerk Factor [0-1000]	Deceleration Jerk (0 - 1000) is set.
7	PVT Time Slice [ms]	PVT Time is set.



### (2) Motion Generator

Motion Gener	rator			
Target #1	0	-	Сору	Go to # <u>1</u>
Target #2	1000	-	Сору	Go to # <u>2</u>
Distance	1000	<b>+</b>	<u>R</u> everse	<u>F</u> orward
Pause [ms]	500	<b>*</b>	Cycle Move	e P1 - P2
IN OUT	Electro	* *	dearing Axis 1 Axis 2	

No.	Item	Description
1	Target #1/ Copy Button/	Position of target #1 is set.
	Go to #1 Button	When pushing "Copy" button, Current position is copied.
		When pushing "Go to #1" button, the motor rotates to the Position of Target #1.
2	Target #2/ Copy Button/	Position of target #2 is set.
	Go to #2 Button	When pushing "Copy" button, Current position is copied.
		When pushing "Go to #2" button, the motor rotates to the Position of Target #2.
3	Distance/ Reserve	Distance (Position) is set.
	Button/ Forward Button	When pushing "Reserve" button, the motor rotates reverse to the "Distance".
		When pushing "Forward" button, the motor rotates forward to the "Distance".
4	Pause [ms]/	When pushing "Cycle Move P1-P2" button, repeat the following.
	Cycle Move P1-P2	① The motor rotates to the Target #1.
	Button	2 Pause
		③ The motor rotates to the Target #2.
		④ Pause
		When pushing "Cycle Move P1-P2" button again, the motor stops.



## 4.4.3.4 Encoder Tab

Setup Tuning M	otion Digital	I/O Encoder
Encoder Type	FA Coder	
Version	1.0	
Encoder ID	N/A	
Status (hex)	0000	Update
Status (text)		
Bit Rate [KHz]	2500	~
EEPROM Addr	0 😫	Read
EEPROM Data	0 ≑	Write

No.	Item	Description
1	Encoder Type	Encoder Type is displayed.
		When customer uses custom encoder, "Custom" is displayed.
2	Version	Encoder version is displayed.
3	Encoder ID	Encoder ID is displayed.
4	Status(hex)	Error Status of Encoder is displayed in 16-bit HEX.
5	Status(text)	Error Status of Encoder is displayed in character.
6	update Button	Error Status of encoder is updated.
7	Bit Rate [kHz]	Bit Rate[kHz] of encoder (Absolute Encoder) is selected.
8	Read Button	The value of the EEPROM address of Absolute Encoder is read.
		When pushing the "Read" button, the value of the "EEPROM Addr" is read and
		the read result is displayed in "EEPROM Data".
9	Write Button	When pushing the "Write" button, the value of the "EEPROM Data" is written to
		address of "EEPROM Addr".

## Encoder Error Status

Bit	Indication
0	Overspeed Error
1	Initialization Error
2	Counting Error
3	Multi-turn Overflow
4	N.C
5	Multi-turn Error
6	Battery Error
7	Battery Alarm
8	EEPROM Busy
9	EEPROM Error
10	N.C
11	N.C
12	N.C
13	N.C
14	N.C
15	N.C

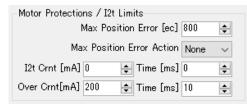


## 4.4.3.5 Limits tab

The follow error detection can be set.

- Motor position deviation
- Overcurrent
- Over voltage of DC bus voltage
- Under voltage of DC bus voltage
- Motor overload pre-detection
- · Motor position error (upper limit / lower limit)
- Motor upper limit speed
- Motor speed deviation
- PVT buffer empty

### (1) Motor Protections/I2t Limits



No.	Item	Description
1	Max Position Error[ec]	Max Position Error is set.
2	Max Position Error Action	<ul> <li>When the position is greater than or equal to the Max Position Error, the action is set.</li> <li>0: "None": No action.</li> <li>1: "Stop": Servo Off</li> <li>2: "Off": Servo Off and Power Off</li> </ul>
3	I2t Crnt[mA]/ Time[ms]	Motor overheating current [mA] and overheating time [ms] are set. This protection is slow because it integrates the square of the current exceeding the nominal over. Once this protection is activated the output current is limited, but the motions is not stopped.
4	Over Crnt[mA]/ Time[ms]	The over current [mA] and the over current detection time [ms] are set.

#### (2) Inverter Limits

Inverter Limits		
Min. Voltage [V]	0.000	* *
Max. Voltage [V]	0.000	-
Overload pre-detect [mA]	0	<b>*</b>

No.	Item	Description
1	Min.Voltage [V]	Under voltage of DC bus voltage is set.
2	Max.Voltage[V]	Over voltage of DC bus voltage is set.
3	Overload pre-detect[mA]	The Overload pre-detect is set.



### (3) Position Control Limits

Position Control Limits			
Minimum Position [EC]	-150000	-	Сору
Maximum Position [EC]	150000	-	Сору

No.	Item	Description
1	Minimum Position [EC]	The lower limit of position error detection is set.
		When pushing "Copy" button, position of "4.4.2 Main Screen" is copied.
2	Maximum Position [EC]	The upper limit of position error detection is set.
		When pushing "Copy" button, position of "4.4.2 Main Screen" is copied.

## (4) Speed Control Limits

Speed Control Limits		
Max Speed [EC/s]	45776	-
Instructed Speed Diff[EC/s]	1526	-

No. Item		Description
1	Max Speed [EC/s]	Max speed is set.
2	Instructed Speed Diff [EC/s]	The motor speed deviation is set.



## (5) Other

PVT Buffer Empty Level	30 🚖	
Error Flags (click to decode)	0x02000000	Read
Error Mask	0x00000000	Edit

No.	Item	Description	
1	PVT Buffer Empty Level	PVT buffer empty level is set.	
2	Error Flags/ Read Button	Current detected Error is displayed. When pushing "Read" button, detected Error is updated. About errors for bits, refer to" ■Error detection setting screen".	
3	Error Mask/ Edit Button	Enables / disables for each error are set. When pushing "Edit" button, Enables / disables for each error can be set.	

#### Error detection setting screen

For items checked in the check box, motor stop when error detection is activated. The item whose item name is bold is the item where the error is currently detected.

Eı	Error Handling Setup 🗴					
	Interlocks					
	Watch Dog Timeout	Abnormal Position				
	CPU Voltage Drop	Position Error				
	Memory Error	Forward Limit Switch Triggered				
	Inverter Under Voltage	Maximum Limit Position				
	Inverter Over Voltage	Reverse Limit Switch Triggered				
	Inverter Over Current	Minimum Limit Position				
	✓ Inverter Fault	Home Procedure Incomplete				
	Motor Over Temperature	Home Procedure Error				
	Inverter Over Temperature	Encoder Not Detected				
	Ground Fault	Invalid Parameter Setting				
	Overload pre-detect	Switch Setting Error				
	Over Speed	PVT Buffer Empty				
	Instructed speed difference					
	Inverter Under Voltage Inverter Over Voltage Inverter Over Voltage Inverter Fault Motor Over Temperature Inverter Over Temperature Ground Fault Overload pre-detect Over Speed	Maximum Limit Position Reverse Limit Switch Triggered Minimum Limit Position Home Procedure Incomplete Home Procedure Error Encoder Not Detected Invalid Parameter Setting Switch Setting Error				

OK Cancel

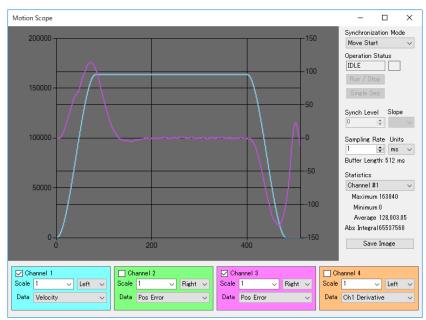
**Bold** font indicates the intrlock condition is TRUE Checked box indicates interlock is enabled

Bit	Item	Bit	Item
0	N.C	16	Forward Limit Switch Triggered
1	N.C	17	Position Error
2	N.C	18	Abnormal Position
3	N.C	19	Instructed speed difference
4	N.C	20	Over Speed
5	N.C	21	Overload pre-detect
6	N.C	22	Ground Fault
7	PVT Buffer Empty	23	Inverter Over Temperature
8	Switch Setting Error	24	Motor Over Temperature
9	Invalid Parameter Setting	25	Inverter Fault
10	Encoder Not Detected	26	Inverter Over Current
11	Home Procedure Error	27	Inverter Over Voltage
12	Home Procedure Incomplete	28	Inverter Under Voltage
13	Minimum Limit Position	29	Memory Error
14	Reverse Limit Switch Triggered	30	CPU Voltage Drop
15	Maximum Limit Position	31	Watch Dog Timeout



## 4.4.4 Motion Scope

The Motion Scope can be resized and positioned independently from the main control window. The Motion Scope has four channels that can be configured to visualize various motion controller variables in line chart form. It is important to note that the data capture always takes place in the motion controller and the Motion Scope only visualizes the result from the data capture. This is done to allow very high rate of data acquisition independent from the communication bandwidth between the controller and the Windows application.



No.	Item	Description
1	Synchronization Mode	Synchronization Mode is selected. Move Start: Waveform data is collected by triggered the start of position control. Move End: Waveform data is collected by triggered the stop of position control. Manual: Waveform data is collected asynchronously with the operation of the motion controller
2	Operation Status	Operation Status is displayed. IDLE: Idle status. The back color of the Status Panel on the right is transparent. TRANSFER: Under collecting waveform data. The back color of the Status Panel on the right is orange. RECORD: Waveform data collection completed. The back color of the Status Panel on the right is red.
3	RUN/STOP Button	Waveform data collection is started / stopped.
4	Single Seq	when pushing "Single Seq" button, waveform data is collected once.
5	Synch Level/Slope	Level and slope (Rising edge / Falling edge) are set. Synchronization Mode: Manual is valid only.
6	Sampling Rate/ Units	Sampling rate is set. Minimum is 50 µs. "Units" is selected µs or ms. The sampling number of waveform data are 512 or less. Ex: When the sampling rate is set to 50 µs, the waveform for 25.6 ms (= 50 µs x 512) is displayed.
7	Statistics	The statistical data (maximum value / minimum value / mean value / integral value of absolute value of sampling data) of the selected channel are displayed.
8	Save Image	Waveform is saved in PNG format or waveform data is saved in CSV format.

The graph can be changed scale by operating the mouse. Zoom in is clicked the corner of the graph and dragged to the desired range. Zoom out is clicked the edge of the scroll bar.



Motion scope can display waveform of 4 channels and show/hide at check box.

🗹 Channel 1	🗹 Channel 2	☑ Channel 3	Channel 4
Scale 1 🗸 Left 🗸	Scale 1 🗸 Right 🗸	Scale 1 🗸 Right 🗸	Scale 1 🗸 Left 🗸
Data Velocity 🗸 🗸	Data Pos Error 🗸 🗸	Data Phase Angle 🔍 🗸	Data Ch1 Derivative 🗸 🗸

No.	Item	Description	
1	Scale	Scale is set at 0.125 units. And primary axis (left side) / secondary axis (right side) of	
		Y axis is set with "Left" / "Right".	
2	Data	Waveform data (variables) is selected. Refer to "5 Variables".	



## 4.4.5 Terminal

The Terminal Emulator allows communicating the motion controllers using ASCII commands. This is helpful when certain command is not available as a button or when the status does not include information about some internal state. The commands are entered at the bottom of the screen and. The Up/Down arrow keys can bring the history of the recently issued commands. (Not supported on RS-422.)

Modu	lle ID Axis 1	~	Setup Tuning Motion Digital I/O Encoder Limits Suspend Polling	Read Text
Firmw IZ/T2M V Status Position Pos Error Voltage Index Id / Iq	vare         Version           1.00         Firmware           27736696         0           24.096         27710184           0         / 0		Motor Configuration Motor Type PMSM/Brushless DO Pole Pairs Count 2 2 Counts/Pha e Enc Counts/Revolution 65536 2 82768 Position Inverted No Encoder Type A-Format	
Velocity	/ Faults / Warni	ngs	Commutation Mode FOC Enc/DSM ∨ Windines Mappine S: WVU ∨	
No Powe Pos Erro	nased er		Motor Phasing Phasing Mode Algorithmic Phasing Time [ms] 500 ♀ Phasinig Output [X] 40 ♀	
Command Power		P	Open Loop Control	
Servo	On set Error Flags		Voltage [X] 5 \$ Reverse Forward <	

No.	Item	Description
1	Suspend Polling	When checking "Suspend Polling", the acquisition of information (Position, DC
		bus voltage value, etc.) from the solution is stopped.
2	Read the text file Button	The text file that the command is written is executed.



# 5. Variables

Table 5-1 is shown the variables that can be displayed in a graph.

No.	Variable	Description
1	Position	Motor Position
2	Velocity	Velocity
3	Acceleration	Acceleration
4	I2t Accumulator	I2t Integral
5	Pos Err	Position Error
6	PID Output	PID Regulator Output Value
7	Id Current	Direct Current
8	Iq Current	Quadrature Current
9	Id Current Err	Direct Current Error
10	Iq Current Err	Quadrature Current Error
11	ADC1 Value	U Phase A/D Converter Value
12	ADC2 Value	V Phase A/D Converter Value
13	ADC3 Value	W Phase A/D Converter Value
14	PVT Points	PVT FIFO Buffer Depth
15	D Voltage	FOC Voltage Output D
16	Q Voltage	FOC Voltage Output Q
17	RT Counter	-
18	Phase Angle	Phase Angle
19	Input Capture	Current C (Input Capture Value)
20	Position Err	Position Error (pos_error detail)
21	Pos Control Integral	Position Control Integral
22	Velocity Err	Velocity Error
23	Vel Control Integral	Velocity Control Integral
24	Id Control Integral	Id Control Integral
25	Iq Control Integral	Iq Control Integral
26	Torque Estimate	Motor Torque Estimate
27	Motor Electric Angle	Motor Electric Angle

### Table 5-1 Variables that can be displayed in a graph



## 6. Motor Parameters

Table 6-1 is shown the Motor Parameters of BM0602A1PD-A.

 Table 6-1 BM0602A1PD-A Motor Parameters

No	Item	Description	BM0602A1PD-A
			Absolute
1	Version Nodeld	N.C N.C	0
2			0 3
3	ModuleType	Module Type 2: Electronic gearing mode is valid	3
		3: Electronic gearing mode is invalid	
4	MotorType	Motor Type	3
4	Motor Type	3 : PMSM/Brushless DC	3
		4 : Induction Motor	
5	EncoderType	Encoder Type	3
		0 : Incremental	
		1 : Endat 2.2	
		2 : BiSS 3 : FA-Coder	
		4 : A-format <sup>™</sup>	
		5 : Hiperface DSL	
		6 : Custom	
		O companying the stars that the	
6	CommutationMode	Communication Mode 4: Sinusoidal vector control with encoder and Delta Sigma Modulator	4
		5: Sinusoidal vector control with encoder and Dena olgina woodlator	
		6: Sinusoidal vector control with CT	
_			10.107
7	PhaseCounts	Electrical cycle (= the encoder counts per revolution divided by the number of pole pairs)	13107
8	EncoderCounts	Encoder count for one revolution	65536
Ũ	Enocaciocanto		00000
9	PolePairs	Motor pole pairs count	5
10	HallInvert	N.C	0
11	PosInvert	CW/ CCW of motor 0: CW, 1: CCW	0
12	PhaseOffset	N.C	0
13	PhaseMap	Windings Mapping (U/V/W placement.)	6
14	PhaseScale	N.C	-5
15	PhasingMode	Phasing Mode	0
		0 : Algorithmic 2 : Dithering	
16	PhasingTime	Phasing Time[ms]	500
17	PhasingPower	Phasing Output[%]	20
18	Ds	Desired position loop cycle time [us]	100 <b>(=62.5us)</b>
19	Кр	Proportional Gain in the position control loop algorithm	1648
20	Ki	Integral Gain in the position control loop algorithm	100
21	Kd	Differential Gain in the position control loop algorithm	0
22		Integral Limit in the position control loop algorithm	1000
23	Vff	Velocity Feed Forward in the position control loop algorithm	0
24	Aff	Acceleration Feed Forward in the position control loop algorithm	0
25	Bias	Value to be added to the output of the PID regulator continuously.	0
25	Dias		0
26	lqkp	Proportional gain in the Quadrature current control loop	7
27	lqki	Integral gain in the Quadrature current control loop	40
27	lgkd	Differential Gain in the Quadrature current control loop	40
	•		
29	Vqkp	Proportional Gain in the velocity control loop	5
30	Vqki	Integral Gain in the velocity control loop	1



No	Item	Description	BM0602A1PD-A
			Absolute
31	Vqkd	Differential Gain in the velocity control loop	0
32	MinVolt	Under voltage of DC bus voltage	2600
33	MaxVolt	Over voltage of DC bus voltage	3000
34	MinPos	The lower limit of position error detection	- 6553600
35	MaxPos	The upper limit of position error detection	6553600
36	MaxVel	Max speed	45776
37	MaxVelDiff	The motor speed deviation	1526
38	MaxTemp	N.C	0
39	OvrCrnt	Overload pre-detect [mA]	1000
40	MinBuffer	PVT buffer empty level	10
41	ErrMask	Error Mask	0
42	Vcomp	N.C	0
43	MaxErr	Max Position Error	16384
44	MaxErrTime	N.C	0
45	MaxOutput	Motor output limit from the position loop PID regulator	100
46	CurrentLimit	The over current [mA]	1000
47	CurrentTime	over current detection time [ms]	10
48	I2TLimit	Motor overheating current [mA]	0
49	I2TTime	Motor overheating time [ms]	0
50	AutoBrake	N.C	0
51	ErrorInputMask	N.C	0
52	HomeFlagMask	Home Mask	0
53	AutoStopMode	Max Position Error Action 0: "None": No action. 1: "Stop": Servo Off 2: "Off": Servo Off and Power Off	0
54	HallShift	N.C	0
55	ApeBaudrate	Bit Rate[kHz] of encoder (Absolute Encoder)	4000
56	GearingIn	Input value of Electronic Gearing function	0
57	GearingOut	Output value of Electronic Gearing function	0



# 7. Appendix

## 7.1 Package Folder Structure

<pre>&lt; r12an0123xxXXX-cn032-ac-servo-solution&gt; *X&gt; </pre>	K: Revision *<>: Folder name
<firmware></firmware>	//CN032 AC Servo Solution Firmware Folder
Common	// Common source file for GCC and EWARM
+Project                                 <gcc></gcc>	//GCC project for RZ/N2L
+- <iccarm>         <rzn2l></rzn2l></iccarm>	//EWARM project for RZ/N2L
Common         +Project	// Common source file for GCC and EWARM
<gcc></gcc>	//GCC project for RZ/T2L
+- <iccarm>     +- <rzt2m></rzt2m></iccarm>	//EWARM project for RZ/T2L
Common       +Project	// Common source file for GCC and EWARM
<gcc></gcc>	//GCC project for RZ/T2M
<pre>    +- <iccarm>     +- <motionutility></motionutility></iccarm></pre>	//EWARM project for RZ/T2M //CN032 Motion Control Utility Folder
+- <document></document>	//Manual, etc Folder
<motor>   <board></board></motor>	//Motor specification Folder //Controller board and Inverter board Folder
r12um0044ejXXXX-rzt2m-rzn2l-cn032-hardware.pdf   r12um0051ejXXXX-rzt2l-cn032-hardware.pdf	//Hardware Manual for RZ/T2M, RZ/N2L //Hardware Manual for RZ/T2L
r12um0055ecXXXX-cn032-inverter.pdf	// Hardware Manual for Inverter board
r11um0169ejXXXX-rzt2m-cn032-firmware.pdf   r12an0123ejXXXX-rzt2m-cn032-startup-tuningtool.pd	//Firmware Manual df//This document
+- r12an0124ejXXXX-rzt2m-cn032-startup-ethercat.pdf	



## 7.2 How to Install Development Environments

### 7.2.1 Development Environments Install

AC Servo Solution Kit (RZ/T2M, RZ/T2L)

Download e2studio or FSPSC for **RZT FSP v1.3.0** from the following web site.

#### Release v1.3.0 · renesas/rzt-fsp · GitHub

Download "setup\_rztfsp\_v1\_3\_0\_e2s\_v2023\_07.exe" for FSP with e2studio installer.

If using IAR, download "setup\_rztfsp\_v1\_3\_0\_rzsc\_v2023\_07.exe" for smart configurator installer.

<pre> \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$</pre>	3.53 MB	Sep 6
<pre> @RZT_FSP_Packs_v1.3.0.exe </pre>	40 MB	Sep 6
<pre></pre>	36.6 MB	Sep 6
Setup_rztfsp_v1_3_0_e2s_v2023-07.exe	1.96 GB	Sep 16
Setup_rztfsp_v1_3_0_rzsc_v2023-07.exe	588 MB	Sep 8
BSource code (zip)		Sep 6
Source code (tar.gz)		Sep 6

#### AC Servo Solution Kit (RZ/N2L)

Download e2studio or FSPSC for RZN FSP v1.3.0 from the following web site.

#### Release v1.3.0 · renesas/rzn-fsp · GitHub

Download "setup\_rznfsp\_v1\_3\_0\_e2s\_v2023\_07.exe" for FSP with e2studio installer.

If using IAR, download "setup\_rznfsp\_v1\_3\_0\_rzsc\_v2023\_07.exe" for smart configurator installer.

<pre> fsp_documentation_v1.3.0.zip </pre>	3.57 MB S	ep 26
<pre> @RZN_FSP_Packs_v1.3.0.exe </pre>	33.4 MB S	ep 26
<pre> @RZN_FSP_Packs_v1.3.0.zip </pre>	30 MB S	ep 26
Setup_rznfsp_v1_3_0_e2s_v2023-07.exe	1.95 GB S	ep 27
Setup_rznfsp_v1_3_0_rzsc_v2023-07.exe	580 MB S	ep 27
Source code (zip)	S	ep 26
Source code (tar.gz)	S	ep 26

If using IAR, download IAR Embedded Workbench<sup>®</sup> for Arm Version 9.32.2 from IAR web site.

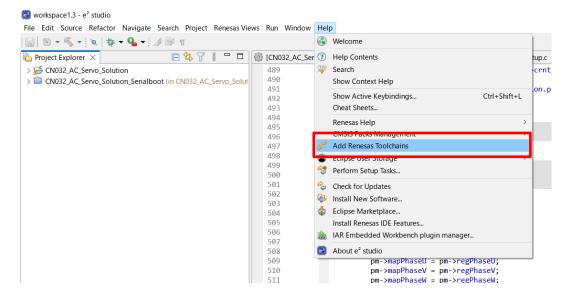
#### Products | IAR Systems



## 7.2.2 Toolchain Install

When using e<sup>2</sup> studio, install the toolchain "GNU ARM Embedded 9.3.1" by following the steps below.

(1) Select the "Add Renesas Toolchains" item from the "Help" menu.



#### (2) Click "Download..." button.

Preferences pe filter text	Renesas Toolchain Management			l × ⇒ +
Device add-ins Suppc ^	Scan for installed toolchains on startup			
Launch Settings Logging	Toolchain Type ✓ ☑ GNU ARM Embedded	Installation Path		
My Renesas Renesas QE	<ul> <li>✓ 12.2.1.arm-12-mpacbti-34</li> <li>✓ 12.2.1.arm-12-24</li> </ul>	C¥Program Files (x86)¥Arm GNU Toolchain arm-none-eabi¥12.2 mpacbti-rel1¥ C¥Renesas¥rzt¥e2studio v2023-07_fsp_v1.3.0¥toolchains¥gcc_arm¥arm-gnu-toolchain-12.2.rel1-mingw-w64-i686-arm-none-eabi¥		
Renesas Toolchain Ma Smart Browser	<ul> <li>✓ 10.3.1.20210824</li> <li>✓ 9.3.1.20200408</li> </ul>	Cx¥Program Files (x86)¥GNU Arm Embedded Toolchain¥10 2021.10¥ Cx¥Program Files (x86)¥GNU Arm Embedded Toolchain¥9 2020-q2-update¥		
Smart Demo > Smart Manual	<ul> <li>✓ 9.2.1.20191025</li> <li>✓ 5.4.1.20160919</li> </ul>	C:¥Renesas¥rzt¥e2studio_v2023-07_fsp_v1.3.0¥toolchains¥gcc_arm¥9_2019q4¥ C:¥Program Files (x86)§KONU Tools ARM Embedded¥54 2016q3¥		
Support Folders Tracealyzer	✓ 4.9.3.20150529      KPIT GNUARM-NONE-EABI Toolchain	C:¥Program Files (x86)¥GNU Tools ARM Embedded¥4.9 2015q3¥		
TraceX Run/Debug	xPack GNU ARM Embedded GCC ARM A-Profile (AArch64 bare-metal)			
Scripting Terminal	10.3.1.20210621	C*Renesas¥rzt¥e2studio_v2023-07_fsp_v1.3.0¥toolchains¥gcc_arm_aarch64¥10.3-2021.07¥gcc-arm-10.3-2021.07-mingw-w64-i686-aa	rch64-none	-elf¥
TextMate Toolchains				
racing /alidation				
Version Control (Team) XML V		Download Scan Add Remove		
>				
2 迠 🛆 🔘		Apply and Clo	se Ca	ancel



(3) Open "GNU ARM Embedded" tab, select "GNU ARM Embedded 9.3.1", and click "Finish" button.

ype filter text		
Name	Version	Description
🗸 🔳 GNU ARM Embedded		GNU ARM Embedded
GNU ARM Embedded 12.2-	12.2.1.arm-12-24	GNU ARM Embedded 12.2-Rel1
GNU ARM Embedded 10.3	10.3.0.202110	GNU ARM Embedded 10.3 2021.10
GNU ARM Embedded 9.3.1	9.3.1.2020q2	GNU ARM Embedded 9.3.1 2020q2
GNU ARM Embedded 9.2.1	9.2.1.2019q4	GNU ARM Imbedded 9.2.1 2019q4
GNU ARM Embedded 6 201	6.0.0.2017q2	GNU ARM Embedded 6 2017q2
LibGen for GNU ARM Embe	1.2023.11	LibGen for GIU ARM Embedded (requires GNU ARM
GCC ARM A-Profile		GCC ARM A-Piofile

\*If you cannot find "GNU ARM Embedded 9.3.1" in the above window, please download "9-2020-q2-update" from the following URL, then restart e<sup>2</sup> studio and try again.

https://developer.arm.com/downloads/-/gnu-rm

arm Developer	Community	Documentation	Downloads	IP Explor
Developing on Arm $\lor$ Architecture and Processors $\lor$ Tools and Software $\lor$				
Overview Arm Ecosystem FVPs				
+ Downloads: 10.3-2021.10 October 21, 2021				
+ Downloads: 10.3-2021.07 July 29, 2021				
+ Downloads: 10-2020-q4-major December 11, 2020				
⊢ Downloads: 9-2020-q2-update June 30, 2020				
+ Downloads: 10-2020-q2-preview June 29, 2020				
+ Downloads: 9-2019-q4-major November 06, 2019				
+ Downloads: 8-2019-q3-update July 10, 2019				



(4) Select language and click "OK" button.

() 0				- 🗆 X
	Install new software			
	Select software to install then click Fi	nish to start downle	oad & installation	
	Name	Version	Description	
	GNU ARM Embedded GNU ARM Embedded 12.2- GNU ARM Embedded 10.3 GNU ARM Embedded 9.3.1 GNU ARM Embedded 9.2.1	10.3.0.202110 9.3.1.2020q2	GNU ARM Embedded GNU ARM Embedded 12.2-Rel1 GNU ARM Embedded 10.3 2021.10 GNU ARM Embedded 9.3.1 2020q2 GNU ARM Embedded 9.3.1 2019q4	
	GNU ARM Embedded 9.2.1 GNU ARM Embedded 6 201 LibGen for GNU ARM Embe	6.0.0.2017q2	GNU ARM Embedded 9.2.1 2019q4 GNU ARM Embedded 6 2017q2 LibGen for GNU ARM Embedded (requ GCC ARM A-Profile	uires GNU ARM
	Install	er Language	×	
	6	Please select	a language.	
		English	×	
			OK Cancel	
	Run toolchain scan after inst		ed manua	ally)
				_
			Finish	Cancel
(5) Click "Next"	button.			
	💽 Install			- 🗆 ×
	Install new software			
	Select software to install then click Fi	nish to start downlo	ad & installation	
		isin to start downing		
	Name	Version	Description	
	✓ ■ GNU ARM Embedded		GNU ARM Embedded	
			GNU ARM Embedded 12.2-Rel1	
	GNU ARM Embedded 10.3	10.3.0.202110	GNU ARM Embedded 10.3 2021.10	
	GNU Arm Embedded	Toolchain 9-2020-c	q2-update —	×
			e to the GNU Arm Embedde in 9-2020-q2-update 9 202 Vizard	
			will guide you through the installation of GNI oolchain 9-2020-q2-update 9 2020.	J Arm
		before start relevant sys	ended that you close all other applications ing Setup. This will make it possible to updat tem files without having to reboot your	te
		computer. Click Next to	o continue.	
	Run tool			
		J.		
			Next > Car	Cancel
	a to display at this time			



 $\Box$   $\times$ 

### (6) After reading click "I Agree" button.

💽 Install

#### Install new software

Select software to install then click Finish to start download & installation

ame	Version	Description	
GNU ARM Embedded		GNU ARM Embedded	
GNU ARM Embedded 12.2-	12.2.1.arm-12-24	GNU ARM Embedded 12.2-Rel1	
GNU ARM Embedded 10.3	10.3.0.202110	GNU ARM Embedded 10.3 2021.10	
G G G GNU Arm Embedded	e terms before install	q2-update — — X	ARM
	ject GNU Binutils ( <u>htt</u>	ement. ps://www.qnu.org/software/binutils/), are/qdb/) under the following license(s).	
Version 3	to copy and distribute	ion, Inc. < <u>http://fsf.org/</u> > e verbatim copies	L
	J Arm Embedded Too	ick I Agree to continue. You must accept the Ichain 9-2020-q2-update 9 2020.	
1401001 C 1110001 0 7 50011 1 210			Cancel



### (7) Click "Install" button.

stall new software Select software to install then click Fi	nish to start downl	oad & installation			
Name	Version	Description			
<ul> <li>GNU ARM Embedded</li> </ul>		GNU ARM Embedded			
GNU ARM Embedded 12.2-	12.2.1.arm-12-24	GNU ARM Embedded 12.2-Rel1			
GNU ARM Embedded 10.3	10.3.0.202110	GNU ARM Embedded 10.3 2021.10			
Choose the folder in whi	ch to install GNU Arm	n Embedded Toolchain 9-2020-q2-update		ARM .	
Setup will install GNU Arr		in 9-2020-q2-update 9 2020 in the follow owse and select another folder. Click Inst			
Setup will install GNU Arr folder. To install in a diff start the installation.	erent folder, dick Bro		tall to		
Setup will install GNU Arr folder. To install in a diff start the installation. Destination Folder Im Files (x86)¥GNU /	erent folder, dick Bro <u>Vm Embedded Toold</u> B	owse and select another folder. Click Inst	tall to		

(8) Installation is complete. Click the "Finish" button.

		1	
Jame	Version	Description	
GNU ARM Embedded		GNU ARM Embedded	
		GNU ARM Embedded 12.2-Rel1	
GNU ARM Embedded 10.3	10.3.0.202110	GNU ARM Embedded 10.3 2021.10	
	Toolcha Setup V	ting the GNU Arm Embedded in 9-2020-q2-update 9 2020 Wizard nbedded Toolchain 9-2020-q2-update 9 2020 has	ARM



## 7.3 Program Writing Procedure

This chapter is shown how to write a program to serial Flash ROM.

## 7.3.1 Power Supply

① xSPI0 boot mode setting Set SW1 of the Controller board to the following.



② Power supply to the Inverter board, and then the red lamp lights up. Additionally, the Controller board is supplied 5V DC power from Inverter board and then LED1 lights up.



Power lamp of the Inverter board



Power LED of the Controller board

## 7.3.2 EWARM

① Select the [All programs] > [IAR EW for Arm x.xx.x] > [IAR EW for Arm x.xx.x] from Windows start menu, start up the IAR Embedded Workbench.

CN032_AC_Servo_Solution_serial_boot - IAR Embedded Workbench	DE - Arm 9.20.2		-		×
File Edit View Project I-jet Tools Window Help					
i 🗅 🖸 🖴 🖨 🕹 X 🛍 ŭ i 5 c i	- < Q > ⇆ HE < 📮 >	e 🖻 🖿 🌒 🚥 🖸 🔹 📜 🚛 📜			
Workspace 👻 🕈 🗙					
Debug ~					
Files       B       CM032_AC_Serve_Solution_serial_boot       HB       CQ_Src       HB       HB					
Debug Log				•	• • ×
Log Fri Jun 03, 2022 15:27:50: IAR Embedded Workbench 9:20 2 Fri Jun 03, 2022 15:27:51: Loading the Het driver	C:\Program Files\IAR Systems\Embedde	d Workbench 9.0\arm\bin\armPROC.dll)			
, Ready			CAP NUM	上書き	



② Select the [File] > [Open Workspace...] and select the project file below. <u>AC Servo Solution Kit (RZ/T2M)</u>

"Software\Firmware\rzt2m\Project\iccarm\CPU0\_serialboot\ CN032\_AC\_Servo\_Solution\_CPU0\_serialboot.eww"

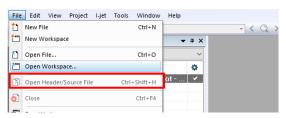
AC Servo Solution Kit (RZ/T2L)

"Software\Firmware\rzt2l\Project\iccarm\serial\_boot\CN032\_AC\_Servo\_Solution\_serialboot.eww"

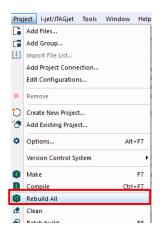
AC Servo Solution Kit (RZ/N2L)

"Software\Firmware\rzn2l\Project\iccarm\serial\_boot\CN032\_AC\_Servo\_Solution\_serialboot.eww"

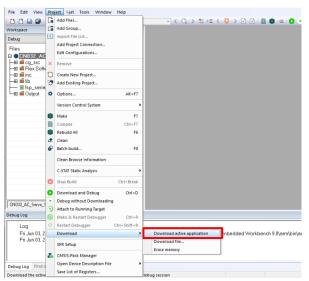
And then open the workspace.



③ Execute build. Select [Project] > [Rebuild All].



④ Select the [Project] > [Download] > [Download active application] to write the program to serial Flash ROM.





## 7.3.3 e2studio

① Import the sample project. After the program is started, by selecting [File]  $\rightarrow$  [Import]  $\rightarrow$  [Existing Projects into Workspace]. Check the "select root directory" and select the folder below.

AC Servo Solution Kit (RZ/T2M)

 $``Software\Firmware\rzt2m\Project\gcc$ 

AC Servo Solution Kit (RZ/T2L)

"Software\Firmware\rzt2l\Project\gcc

AC Servo Solution Kit (RZ/N2L)

"Software\Firmware\rzn2l\Project\gcc

If "Copy projects into workspace" is checked, uncheck it and then selecting [Finish].

Import							×
Import Projects						_	
	ch for existing Eclipse projects.						
• Select root directory:	D:¥r12an0123xxXXXX-cn032-ac	-servo-solution	(Software¥Firmwa	re¥rzt2m¥Project¥	gcc v	Browse	è
O Select archive file:					~	Browse	2
Projects:							
	Solution_CPU0_serialboot (D:¥r1 Solution_CPU0 (D:¥r12an0123xx)					- Ociceei	All
	Solution_CPU1 (D:¥r12an0123xx)						All
						Refres	h
<					>		
Options Search for nested pro	niects						
Copy projects into w	-		Unchec	k			
	d projects upon completion		01101100				
	ready exist in the workspace						
Working sets							
Add project to work	ing sets					New	
Working sets:					· · · ·	Select	
?			< Back	Next >	Finish	Cance	ł

Describe the procedure for AC Servo Solution Kit (RZ/T2M) as example. AC Servo Solution Kit (RZ/T2L, RZ/N2L) can write the program to flash memory using the following procedure.



② Build the "CN032\_AC\_Servo\_Solution\_CPU0\_serialboot" project

In [Project Explorer] view, right click the node of the project to be debugged and select [Build Project].

workspace - e <sup>2</sup> studio						
File Edit Source Refactor Navigate Search Proj	ect	Renesas Views Run Window	Help			
🐔 🗱 🔳 🎋 Debug 🗸 🖻 C	N032_	AC_Servo_Solution_CPU1 D 🗸 🔅	1 📑 🗝 🔛 🔞	🛞 <del>-</del> 🐔 -	- 🗟 🖋 🔂 -	8° - C
₨ ▾ 卷 ➠ ▾ ▥ 🗑 🖏 🍪 🖗 🖢 ▾ 🖗 ▾ !	;- c)	* (> • -> • 📑				
🍋 Project Explorer 🗙 🔲 🖨 🛱	3					
> S CN032_AC_Servo_Solution_CPU0 > CN032_AC_Servo_Solution_CPU0_serialboot [Debus > S CN032_AC_Servo_Solution_CPU1	9	New Go Into	>			
		Open in New Window Show In	Alt+Shift+W >			
		Copy Paste	Ctrl+C Ctrl+V			
	×	Delete Source Move	Delete >			
		Rename	F2			
	24 24	Import Export Renesas FSP Export	,			
[		Build Project				
	£	Refresh Close Project Close Unrelated Projects	F5			

- ③ Press the "RESET" switch of the Controller board
- ④ While the board and J-LINK are connected, start writing to the flash memory in the following order In [Project Explorer] view, right click the node of the CPU0 project to be debugged and select [Debug As]
   → [Debug Configurations].

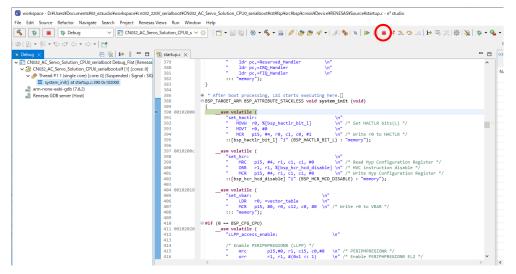
📓 workspace - e² studio						
File Edit Source Refactor Navigate Search Pr	oject					
🐔 🗱 🔳 🎋 Debug 🗸 🖻	CN03	2_AC_Servo_Solution_CPU1 D 🗸 🔅	i 📬 👻 🗐 🦷		9 〒 🗞 〒 🔜 💋 👩 〒 🚳 〒 💽 〒 🮯 후	😂 🛷 👻 🗟 п
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> CN032_AC_Servo_Solution_CPU0						
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	_					
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	Ē	Paste	Ctrl+V			
	×	Delete	Delete			
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		Move				
		Rename	F2			
	2	Import				
	4	Export				
		Renesas FSP Export	>			
		Build Project				
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	·	Close Project				
		Close Unrelated Projects				
		Build Targets	>			
		Index	>			
		Build Configurations	>			
	0	Run As	>			
	脊	Debug As	>	C	1 GDB OpenOCD Hardware Debugging (DSF)	
		Team	>	C *	2 GDB Simulator Debugging (RH850)	
		Compare With	>	C	3 Local C/C++ Application	
		Restore from Local History		C *	4 Renesas GDB Hardware Debugging	ype
		MISRA-C	>	C	5 Renesas Simulator Debugging (RX, RL78)	-
	\$	C/C++ Project Settings	Ctrl+Alt+P		Debug Configurations	
		Renesas C/C++ Project Settings	L	-		



⑤ [Renesas DBG Hardware Debugging] → [CN032\_AC\_Servo\_Solution\_CPU0\_serialboot Debug\_Flat] item, then press [Debug].

Debug Configurations	— 🗆 X
Create, manage, and run configurations	- A
Image: Construction (CPUD, serialboot Debug, Flat         Image: Construction (CPUD, Serialboot (CP	Common Browse Variables Variables Variables Configure Workspace Settings
Filter matched 15 of 17 items	Revert Apply

6 Press the terminate button to stop the debugging window



Press the reset button of the Controller board, and then running the program written to the flash memory



# **Revision History**

		Description	1
Rev.	Date	Page	Summary
1.00	Jun.8, 2022	-	First Edition issued
2.00	Aug.9, 2022	1,4,8,12,	Description for AC Servo Solution (RZ/N2L) added.
		47,50-52	
		9,10	Typo fixed.
3.00	3.00 Sep.30, 2022 1		Caution when handling the solution board added.
		8	RZ/N2L FSP is updated to V1.00.
		47	Package folder structure is changed for firmware Rev3.00.
		49,50	File path is changed for firmware Rev3.00.
4.00	Feb.28, 2023	1,4,14,41,	Description for AC Servo Solution (RZ/T2L) added.
		43,45,47,	
		50,52,53,	
6		59,60	
		6,7	Description of RS485 communication added.
		49	Description of development environment install added.
5.00	Dec.15, 2023	9	Operating Environment table is updated.
		11	Precaution is added.
		49	Development Environment install is updated.
5.01	Jun.18,2024	1	Related Document updated.
		4	Figure 1-1 is updated to the latest AC Servo Solution kit.
		9	Operating Environment table is updated.
		9,10	Controller board and inverter board combination added.
		13	Connection Configuration is updated to the latest AC Servo
			Solution kit.
		51	7.2.2Toolchain Install chapter added.
		58	Description of import the sample project fixed.
5.02	Aug.8,2024	1	Related Document updated.
		9	Controller board and inverter board combination is updated.
		10	Description of change the BUF_ENABLE pin fixed.



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The following usage notes are applicable to all Microprocessing unit and Microcontroller unit products from Renesas. For detailed usage notes on the products covered by this document, refer to the relevant sections of the document as well as any technical updates that have been issued for the products.

1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices.

2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power is supplied until the power is supplied until the power reaches the level at which resetting is specified.

3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5. Clock signals

6.

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between  $V_{IL}$  (Max.) and  $V_{IH}$  (Min.).

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