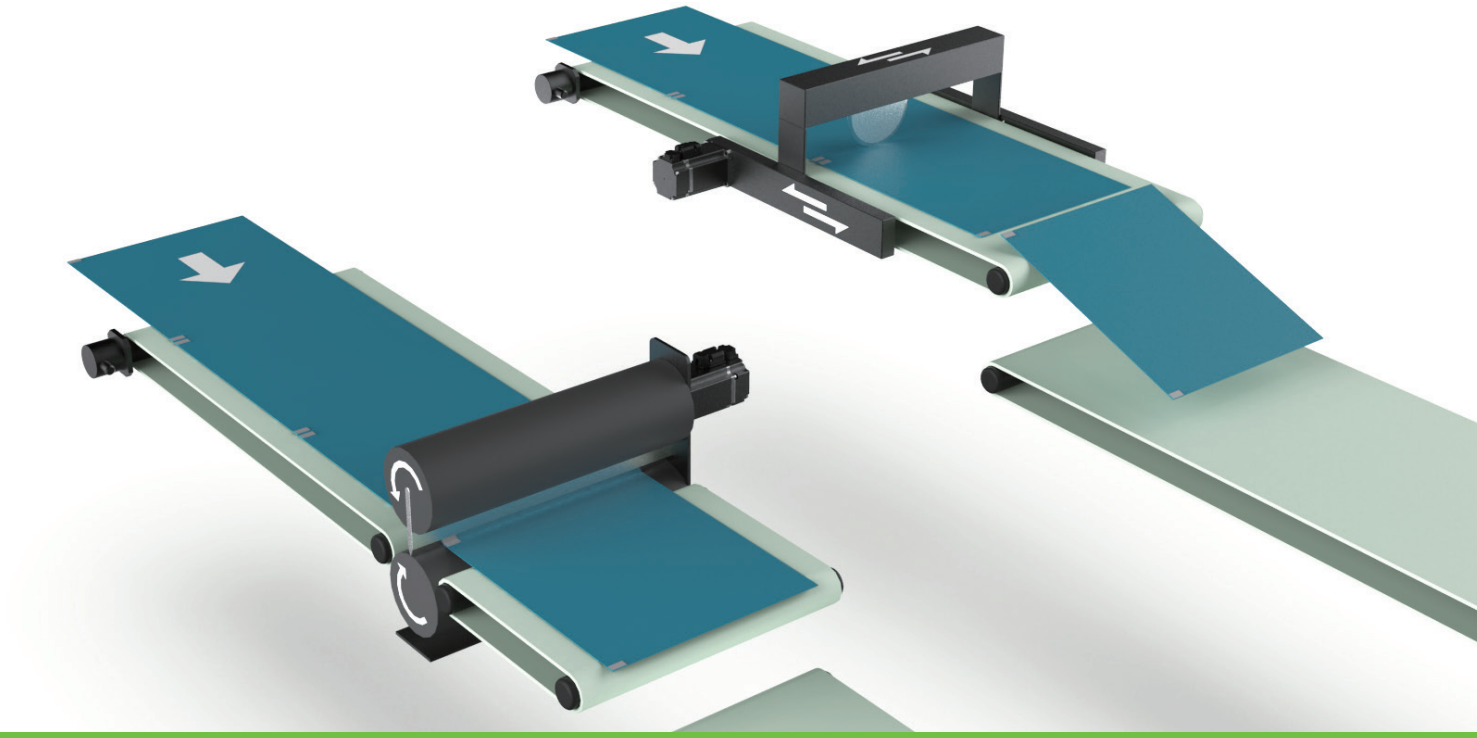
HIWIN® MIKROSYSTEM



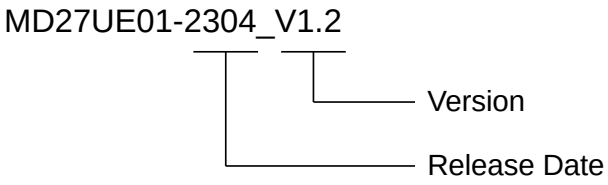
E Series Servo Drive

Electronic Cam Control System
User Manual

www.hiwinmikro.tw
MD27UE01-2304_V1.2

Revision History

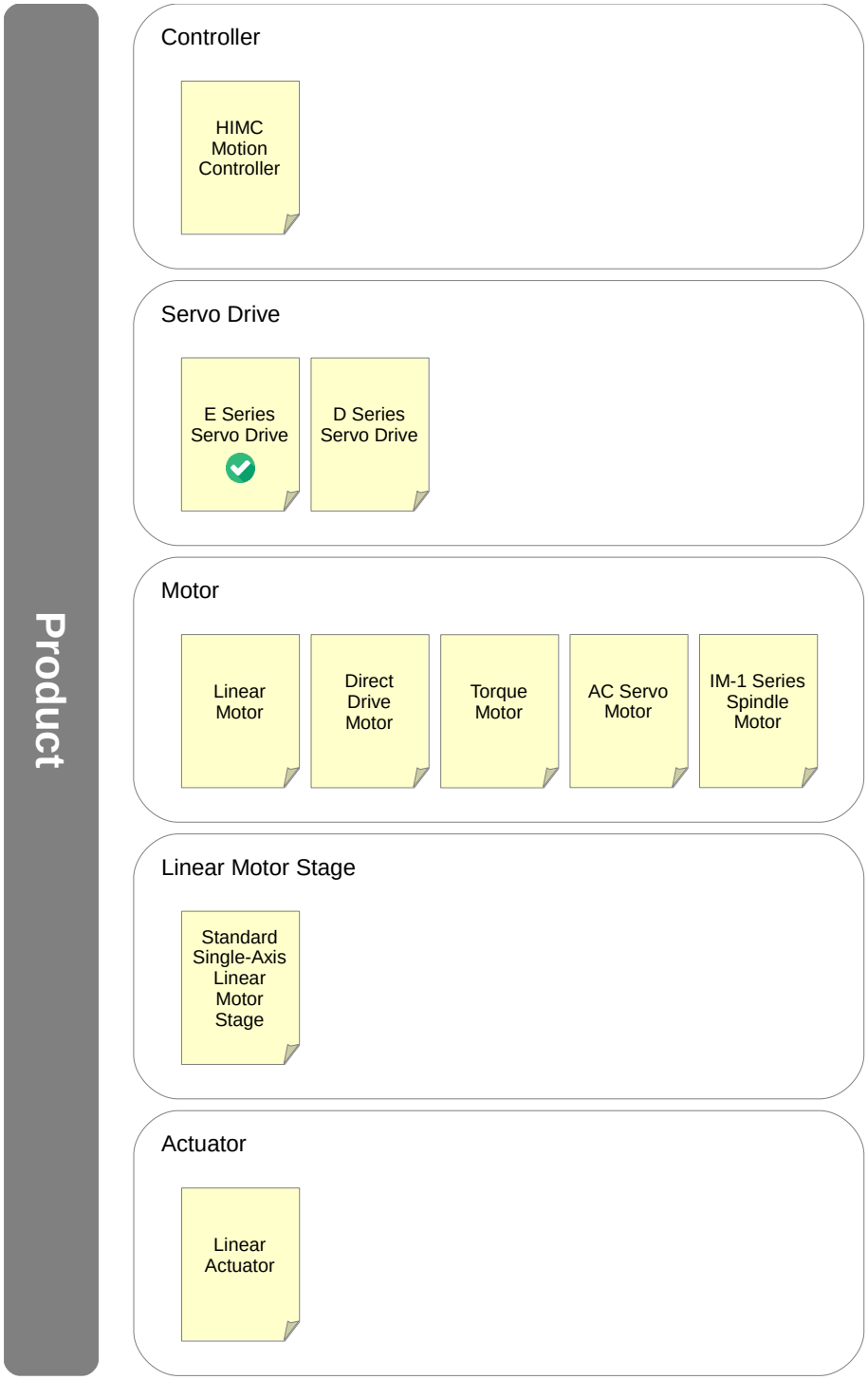
The version of the manual is also indicated on the bottom of the front cover.



Release Date	Version	Applicable Product	Revision Contents
Apr. 25th, 2023	1.2	E1 series servo drive E2 series servo drive	1. Update manual's name. 2. Add the information related to E2 series servo drive: servo drive firmware version, applicable model, hardware configuration for communication. 3. Update section 4.3 **Relevant alarms**.
Mar. 8th, 2022	1.1	E1 series servo drive	Update servo drive firmware version.
Mar. 8th, 2022	1.0	E1 series servo drive	First edition.

Related Documents

The figure and table of the documents related to the product are shown below. Refer to these documents as required.



Product		Doc. Name		Doc. No.	Content
Controller	HIMC Motion Controller	HIMC Installation Guide		MH07UE01-□□□□	Provides detailed information on installing and connecting HIMC motion controller.
		HIMC iA Studio User Guide		MH01UE01-□□□□	Provides detailed information on the human machine interface operation of HIMC motion controller.
		HIMC Modbus TCP User Guide		MH02UE01-□□□□	Provides detailed information on the way Modbus TCP communication protocol applied to HIMC motion controller.
		HIMC HMPL User Guide		MH06UE01-□□□□	Provides detailed information on HMPL library of HIMC motion controller.
		HIMC API Reference Guide		MH05UE01-□□□□	Provides detailed information on API library of HIMC motion controller.
		HIOM Installation Guide		MH03UE01-□□□□	Provides detailed information on installing and connecting HIOM (HIWIN mega-ulink IO module).
		ETA3 Installation Guide		MH09UE01-□□□□	Provides detailed information on installing and connecting ETA3 (HIMC remote module).
Servo Drive	E Series Servo Drive	Technical Manuals	E1 Series Servo Drive User Manual	MD09UE01-□□□□	Provides detailed information on selecting, installing, connecting, setting, performing test run for, tuning, and monitoring E1 series servo drive.
			E2 Series Servo Drive User Manual	MD28UE01-□□□□	Provides detailed information on selecting, installing, connecting, setting, performing test run for, tuning, and monitoring E2 series servo drive.
			E Series Servo Drive Thunder Software Operation Manual	MD12UE01-□□□□	Provides detailed information on the human machine interface operation of E series servo drive.
			E Series Servo Drive Gantry Control System User Manual	MD22UE01-□□□□	Provides detailed information on the usage of E series servo drive gantry control system.
			E Series Servo Drive Electronic Cam Control System User Manual	MD27UE01-□□□□	Provides detailed information on the usage of E series servo drive electronic cam control system.
			E Series Servo Drive Multi-Motion Function User Manual	MD32UE01-□□□□	Provides detailed information on the usage of E series servo drive multi-motion function.
			MPI Library Reference Manual	MD19UE01-□□□□	Provides detailed information on MPI library of E series servo drive and D series servo drive.
			MPI Examples	MD18UE01-□□□□	Provides detailed information on MPI examples of E series servo drive and D series servo drive.
			API Library Reference Manual for Servo Drives	MD23UE01-□□□□	Provides detailed information on API library of E series servo drive and D series servo drive.
			PDL Examples for E Series Servo Drive	MD25UE01-□□□□	Provides detailed information on PDL examples of E series servo drive.
		Communication Manuals	E Series Servo Drive EtherCAT(CoE) Communications Command Manual	MD08UE01-□□□□	Provides detailed information on the way EtherCAT communication protocol applied to E series servo drive.
			E1 Series Servo Drive MECHATROLINK-III Communication Command Manual	MD24UE01-□□□□	Provides detailed information on the way MECHATROLINK-III communication protocol applied to E1 series servo drive.
			E1 Series Servo Drive PROFINET Communication Command Manual	MD02UE01-□□□□	Provides detailed information on the way PROFINET communication protocol applied to E1 series servo drive.

Product		Doc. Name		Doc. No.	Content
		Application Manuals	E2 Series Servo Drive Replacement Guide	MD34UE01-□□□□	Provides detailed information on the way of replacing E1 series servo drive and D1 series servo drive with E2 series servo drive.
			Application Note E1 PROFINET Drive Complete Setup with Siemens TIA Portal	MD30UE01-□□□□	Provides detailed information on the operation of PLC software TIA Portal when E1 PROFINET drive is used with Siemens S7 series PLC.
			Application Note E1 MECHATROLINK-III Drive Complete Setup with YASKAWA MPE720	MD31UE01-□□□□	Provides detailed information on the operation of machine controller software MPE720 when E1 MECHATROLINK-III drive is used with YASKAWA MP3000 series machine controller.
			Function Blocks Application Manual E Series EtherCAT Drive with OMRON Sysmac Studio	MD35UE01-□□□□	Provides detailed information on the usage of application function blocks when E series EtherCAT drive is used with OMRON Sysmac Studio.
			Function Blocks Application Manual E Series EtherCAT Drive with KEYENCE KV STUDIO	MD36UE01-□□□□	Provides detailed information on the usage of application function blocks when E series EtherCAT drive is used with KEYENCE KV STUDIO.
Servo Drive	D Series Servo Drive	D1 Servo Drive User Manual		MD20UE01-□□□□	Provides detailed information on selecting, installing, connecting, setting, performing test run for, tuning, and monitoring D1 servo drive.
		D2 Series Servo Drive User Manual		MD07UE01-□□□□	Provides detailed information on selecting, installing, connecting, setting, performing test run for, tuning, and monitoring D2T servo drive.
		D2T-LM Series Servo Drive User Manual		MD11UE01-□□□□	Provides detailed information on selecting, installing, connecting, setting, performing test run for, tuning, and monitoring D2T-LM servo drive.
		MPI Library Reference Manual		MD19UE01-□□□□	Provides detailed information on MPI library of E series servo drive and D series servo drive.
		MPI Examples		MD18UE01-□□□□	Provides detailed information on MPI examples of E series servo drive and D series servo drive.
		API Library Reference Manual for Servo Drives		MD23UE01-□□□□	Provides detailed information on API library of E series servo drive and D series servo drive.
		PDL Examples for D-series Drives User Manual		MD13UE01-□□□□	Provides detailed information on PDL examples of D series servo drive.
Motor	Linear Motor	Linear Motor User Manual		MP99UE01-□□□□	Provides detailed information on selecting, installing, and connecting linear motor.
	Direct Drive Motor	DMN Series Direct Drive Motor User Manual		MR01UE01-□□□□	Provides detailed information on selecting, installing, and connecting DMN series direct drive motor.
		DMT Series Direct Drive Motor User Manual		MR03UE01-□□□□	Provides detailed information on selecting, installing, and connecting DMT series direct drive motor.
		DMY Series Direct Drive Motor User Manual		MR04UE01-□□□□	Provides detailed information on selecting, installing, and connecting DMY series direct drive motor.
		DMS Series Direct Drive Motor User Manual		MR05UE01-□□□□	Provides detailed information on selecting, installing, and connecting DMS series direct drive motor.
		DMR Series Direct Drive Motor User Manual		MR06UE01-□□□□	Provides detailed information on selecting, installing, and connecting DMR series direct drive motor.

Product		Doc. Name	Doc. No.	Content
	Torque Motor	Torque Motor User Manual	MW99UE01-□□□□	Provides detailed information on selecting, installing, and connecting torque motor.
	AC Servo Motor	AC Servo Motor User Manual	MC03UE01-□□□□	Provides detailed information on selecting, installing, and connecting AC servo motor.
	IM-1 Series Spindle Motor	IM-1 Series Spindle Motor User Manual	MS01UE01-□□□□	Provides detailed information on selecting and installing IM-1 series spindle motor.
Linear Motor Stage	Standard Single-Axis Linear Motor Stage	Standard Single-Axis Linear Motor Stage User Manual	MM06UE01-□□□□	Provides detailed information on selecting, installing, and connecting standard single-axis linear motor stage.
Actuator	Linear Actuator	Linear Actuator User Manual	MA99UE01-□□□□	Provides detailed information on selecting, installing, and connecting linear actuator.

Firmware Change History

Refer to “E1 Series Servo Drive User Manual” and “E2 Series Servo Drive User Manual” for the information of servo drive firmware version.

■ E1 series servo drive

Servo Drive Firmware Version	Revision Contents related to Electronic Cam Function
2.8.8	Support electronic cam control system.

■ E2 series servo drive

Servo Drive Firmware Version	Revision Contents related to Electronic Cam Function
3.9.10	Support electronic cam control system.

Table of Contents

1. Servo drive specification

Select the model based on electronic cam control mode. Table 1.1 is for E1 series servo drive and Table 1.2 is for E2 series servo drive.

Table 1.1

Type	Control Interface	Model	Applicable Electronic Cam Control Mode
Standard	Voltage command and pulse	ED1S-VN-□□□□-01-□□	Pulse input mode
		ED1S-VG-□□□□-01-□□	Group communication mode Pulse input mode

Table 1.2

Type	Control Interface	Model	Applicable Electronic Cam Control Mode
Standard	Voltage command and pulse	ED2S-V0-□□□-1-C-□□	Group communication mode Pulse input mode

Note:

Fieldbus servo drive is not supported.

2. Introduction for electronic cam

Mechanical cam exists in the physical mechanical structure, and its shape is designed based on requirement. When the profile needs to be adjusted or modified, mechanical cam must be redesigned and processed, which is time-consuming and inconvenient. Instead, electronic cam plans the profile via software. It can flexibly design and adjust the profile. Without the physical cam mechanical structure, it can also overcome the limitation of the physical mechanical cam shape, as Figure 2.1 shows. The differences between mechanical cam and electronic cam are listed in Table 2.1.

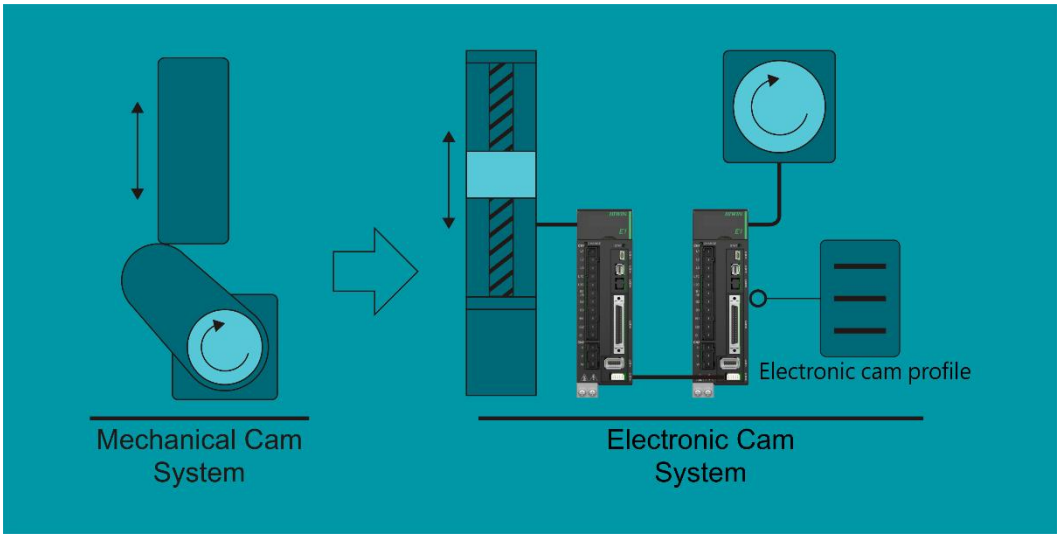


Figure 2.1 (Take E1 series servo drive as an example)

Table 2.1

Performance	Mechanical Cam	Electronic Cam
Spatiality	Take up large space	No physical mechanical cam, space-saving
Planning	The longer the travel distance, the bigger the cam	No space limit, the travel distance will not be influenced
Convenience	Not easy to modify the cam profile	Modified via software, high flexibility
Accuracy	The commands are accurate in a stable environment	The delay error of servo and communication must be considered

Cam mainly plans the profile relatively followed by master axis and slave axis. The typical applications are flying shear - linear and flying shear - rotary, as Figure 2.2 shows. Generally, master axis is defined as material feeder, and slave axis is defined as cutting axis.

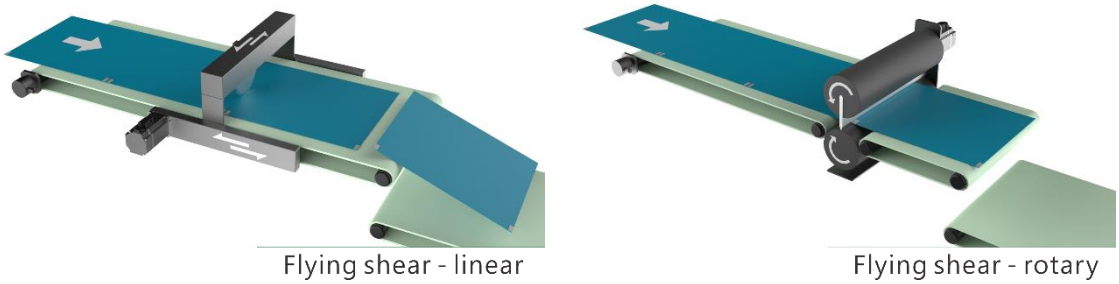


Figure 2.2

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3. Setting procedure

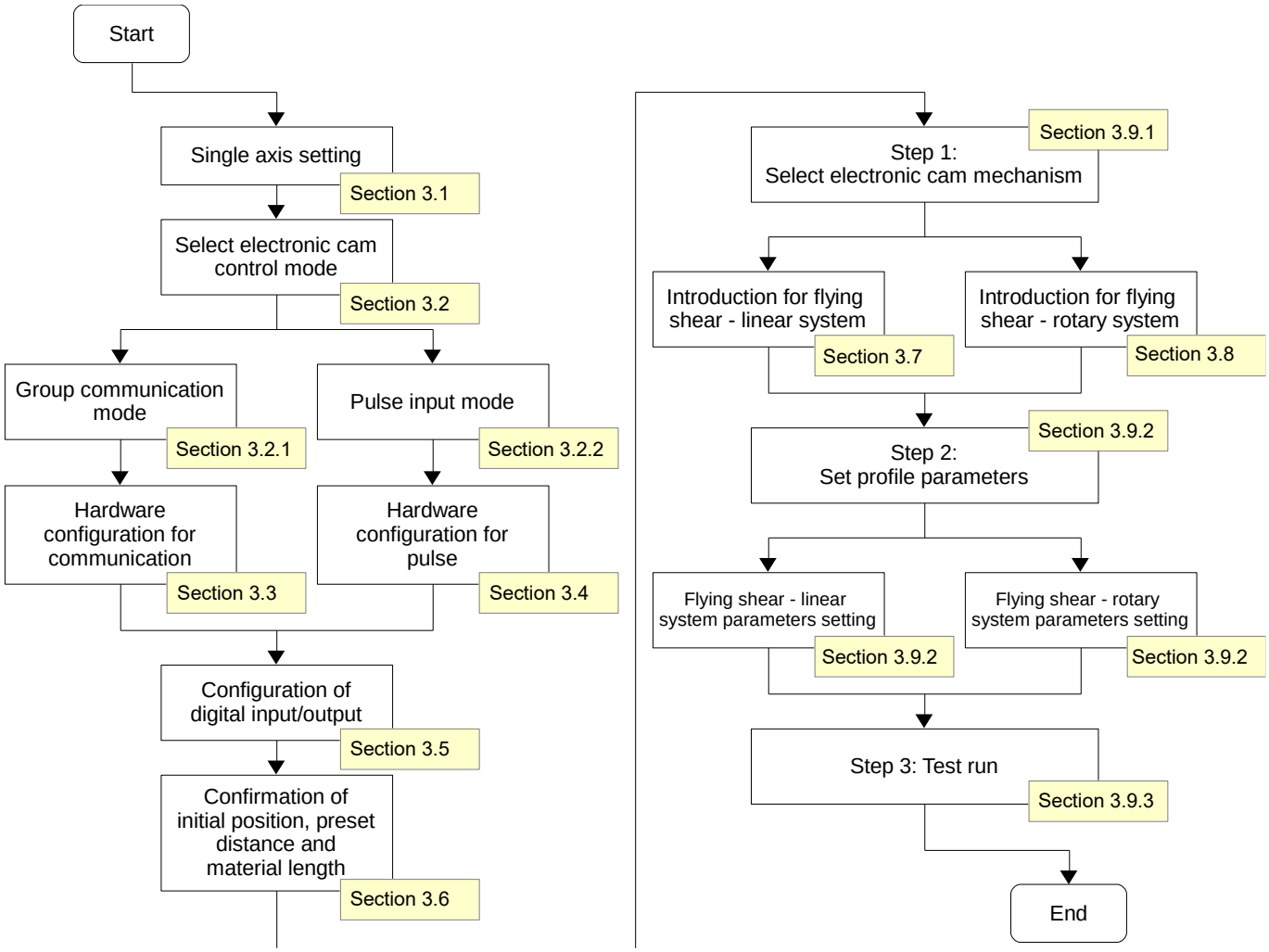


Figure 3.1 Overview of setting procedure

Refer to Figure 3.1 and the corresponding sections for the setting procedure and the description of electronic cam control system. Before setting, ensure hardware and software configuration fits the following requirements, or it may cause danger to the stage.

- ✓ Same firmware version (when group communication mode is used)
- ✓ Slave axis (cutting axis) is set to position mode (Pt000 = t.□□1□).
- ✓ Single axis may be driven during the process of single axis setting; therefore, to avoid causing danger to the stage, ensure the range of motion for master axis (material feeder) will not be influenced by that for slave axis (cutting axis).

3.1 Single axis setting

Respectively execute single-axis initialization based on “E Series Servo Drive Thunder Software Operation Manual”. The setting steps are given below.

- To use electronic cam control mode – Group communication mode
  1. Connect to master (material feeder) servo drive and execute single-axis initialization.
  2. Record the positive moving direction of master (material feeder) motor.
  3. Connect to slave (cutting axis) servo drive and execute single-axis initialization.
  4. Record the positive moving direction of slave (cutting axis) motor, which should be the same as the material feeding direction of master (material feeder) motor. If the directions are different, users can change Pt000.0.

- To use electronic cam control mode – Pulse input mode
  1. Connect to slave (cutting axis) servo drive and execute single-axis initialization.
  2. Record the positive moving direction of slave (cutting axis) motor, which should be the same as the material feeding direction of master (material feeder) motor with external pulses. If the directions are different, users can change Pt000.0.

3.2 Select electronic cam control mode

E series servo drive provides two electronic cam control modes, group communication mode and pulse input mode. The differences between them are listed in Table 3.2.1.

Table 3.2.1

	Group communication mode	Pulse input mode
Requirement of master axis (material feeder)	E series servo drive	E series servo drive or other brand servo drive
Way to group axes	Via the group communication of E series servo drive	Via the hardware wiring configuration of master axis' (material feeder's) encoder output and slave axis' (cutting axis') pulse input
Limit of number of axes	2 axes	No limit
Status monitor	The two axes can monitor each other's servo drive status.	The axes cannot get one another's servo drive status.
Alarm	If an alarm occurs on one axis, the other one will also trigger an alarm to decelerate and stop.	If an alarm occurs on one axis, other axes will maintain current status. Only when they receive the disabled signal, they will decelerate and stop.

3.2.1 Group communication mode

All the functions of group communication mode are based on the group communication of E series servo drive. Therefore, users must use two E series servo drives and establish the communication system. The setting procedure is shown below.

1. Set group communication mode.
   Respectively connect to the two servo drives and set Pt003 = t.□□□1 based on Table 3.2.1.1. After sending the parameter to servo drive, power cycle servo drive to make it become effective.

Table 3.2.1.1

Parameter		Description	Effective	Category
Pt003	t.□□□0 (Default)	Gantry control mode	After power on	Setup
	t.□□□1	Electronic cam control mode (Group communication mode)		
	t.□□□2	2D dynamic error compensation control mode (Apply to GT model)		
	t.□□□3	Electronic cam control mode (Pulse input mode)		

2. Build up the relationship of master axis (material feeder) and slave axis (cutting axis).
   (1) Connect to master (material feeder) servo drive in Figure 3.2.1.1 and set Pt00D = t.□□□1 based on Table 3.2.1.2 (define it as master axis - material feeder). After sending the parameter to servo drive, power cycle servo drive to make it become effective.
   (2) Connect to slave (cutting axis) servo drive in Figure 3.2.1.1 and set Pt00D = t.□□□0 based on Table 3.2.1.2 (define it as slave axis - cutting axis). After sending the parameter to servo drive, power cycle servo drive to make it become effective.

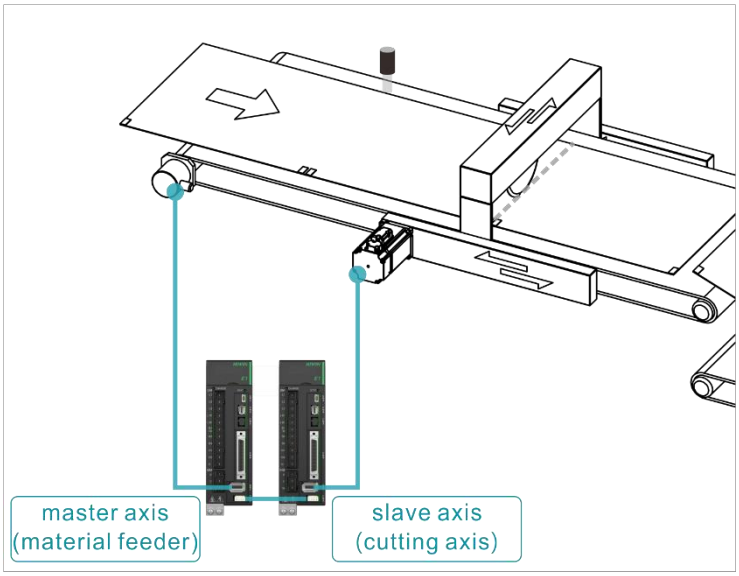


Figure 3.2.1.1 (Take E1 series servo drive as an example)

Table 3.2.1.2

Parameter		Description	Effective	Category
Pt00D	t.□□□0	Slave axis in group communication. (Define it as cutting axis in electronic cam control system)	After power on	Setup
	t.□□□1	Master axis in group communication. (Define it as material feeder in electronic cam control system)		
	t.□□□2 (Default)	No group communication.		

3. Open **Interface signal monitor** window in Thunder main window of any axis to ensure the communication is established, as the red frame in Figure 3.2.1.2 shows.

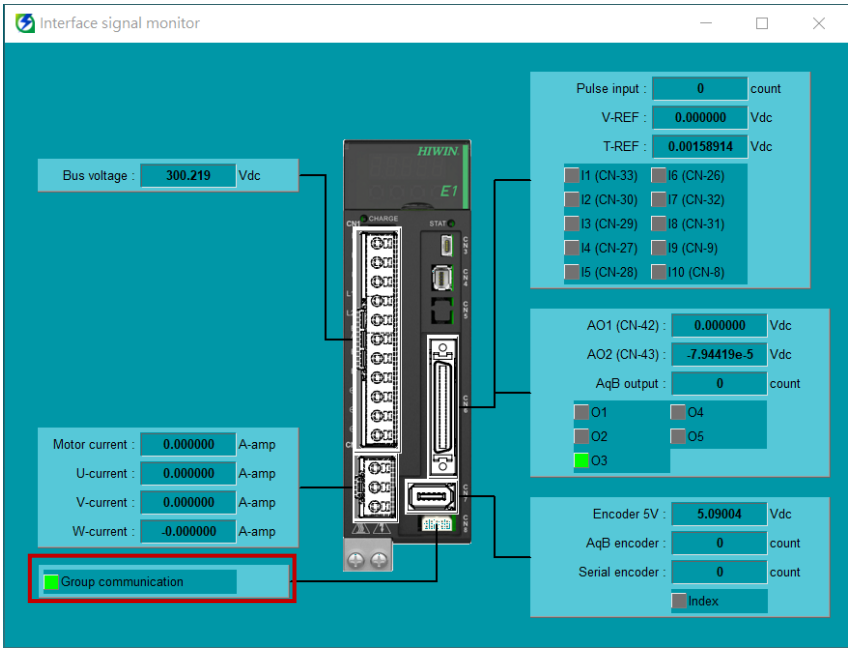


Figure 3.2.1.2 (Take E1 series servo drive as an example)

Note: When group communication mode is used and communication system is established, alarm AL.FC0 or AL.FC1 may be triggered if users power off any of the axes. Refer to chapter 4 for cause, confirmation method and corrective action.

3.2.2 Pulse input mode

Slave axis (cutting axis) of pulse input mode receives external pulses as signal sources of master axis (material feeder). The setting procedure is shown below.

1. Set pulse input mode.
   Connect to slave (cutting axis) servo drive in Figure 3.2.2.1 and set Pt003 = t.□□□3 based on Table 3.2.1.1. After sending the parameter to servo drive, power cycle servo drive to make it become effective.

2. Build up slave axis (cutting axis).
   Connect to slave (cutting axis) servo drive in Figure 3.2.2.1 and set Pt00D = t.□□□0 based on Table 3.2.1.2 (define it as cutting axis). After sending the parameter to servo drive, power cycle servo drive to make it become effective.

3. Set Pt200 based on the encoder format. For example, if the encoder format is AqB, set Pt200 = t.□□□4 (Differential pulse signal with 90 degrees phase difference). After sending the parameter to servo drive, power cycle servo drive to make it become effective.

4. Ensure the pulse relationship of master axis (material feeder) and slave axis (cutting axis).
   Move master axis (material feeder) for a short distance. Open **Interface signal monitor** window in Thunder main window of slave axis (cutting axis) to check if the value of the input column for pulse command, the accumulated direction and the ratio are correct.

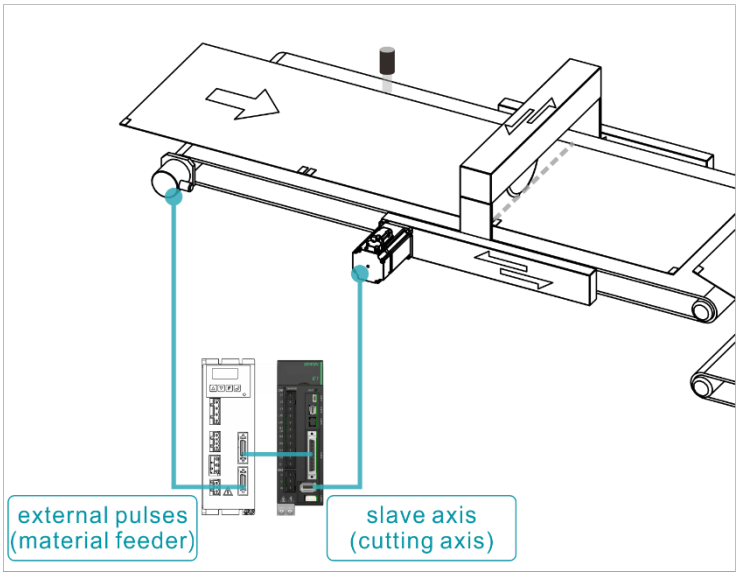


Figure 3.2.2.1 (Take E1 series servo drive as an example)

3.3 Hardware configuration for communication

■ E1 series servo drive

When group communication mode is used, connect two servo drives via CN8 with the communication cable, as Figure 3.3.1 shows. The specification of servo drive communication cable is given in Figure 3.3.2 and Table 3.3.1.

Standard

Figure 3.3.1 CN8 position

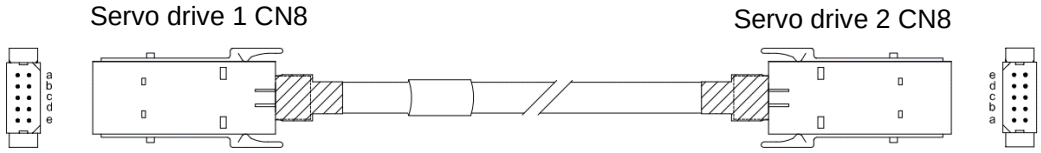


Figure 3.3.2 Servo drive communication cable (for gantry control system)

Table 3.3.1 Communication cable for gantry function

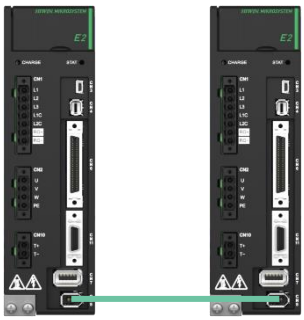
Name	HIWIN Part Number	Description
Servo drive communication cable	HE00EJ6DD000	Connect two servo drives which both support gantry function via CN8. (0.5 m)

Note:

The way for group communication mode to group axes is the same as that of gantry function. Therefore, they use the same servo drive communication cable.

■ E2 series servo drive

When group communication mode is used, connect two servo drives via CN8 with the communication cable, as Figure 3.3.3 shows. The specification of servo drive communication cable is given in Figure 3.3.4 and Table 3.3.2.



Standard

Figure 3.3.3 CN8 position

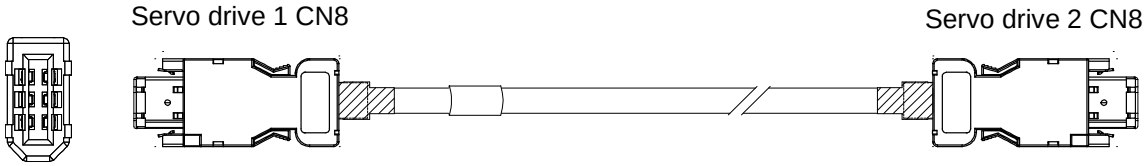


Figure 3.3.4 Servo drive communication cable (for gantry control system)

Table 3.3.2 Communication cable for gantry function

Name	HIWIN Part Number	Description
Servo drive communication cable	HE00EK5DB800	Connect two servo drives which both support gantry function via CN8. (0.5 m)

Note:

The way for group communication mode to group axes is the same as that of gantry function. Therefore, they use the same servo drive communication cable.

3.4 Hardware configuration for pulse

When pulse input mode is used, connect the encoder output pin of master (material feeder) servo drive to the pulse input pin of salve (cutting axis) servo drive.

If E series servo drive is used as master axis (material feeder), its encoder output pin can simultaneously connect to the pulse input pin of multiple salve axes (cutting axes), as Figure 3.4.1 shows. As master axis (material feeder), E series servo drive can set the resolution of one revolution of motor to Pt212 (refer to section 8.6 in “E1 Series Servo Drive User Manual” and section 8.6 in “E2 Series Servo Drive User Manual”). By doing so, master axis (material feeder) will send pulse signals to salve axis (cutting axis) according to the encoder output ratio.

Besides, other brand servo drive or frequency converter can also be used as master (material feeder) servo drive. Just connect its encoder output pin to the pulse input pin of salve (cutting axis) servo drive, and ensure the ratio and the direction are correct.

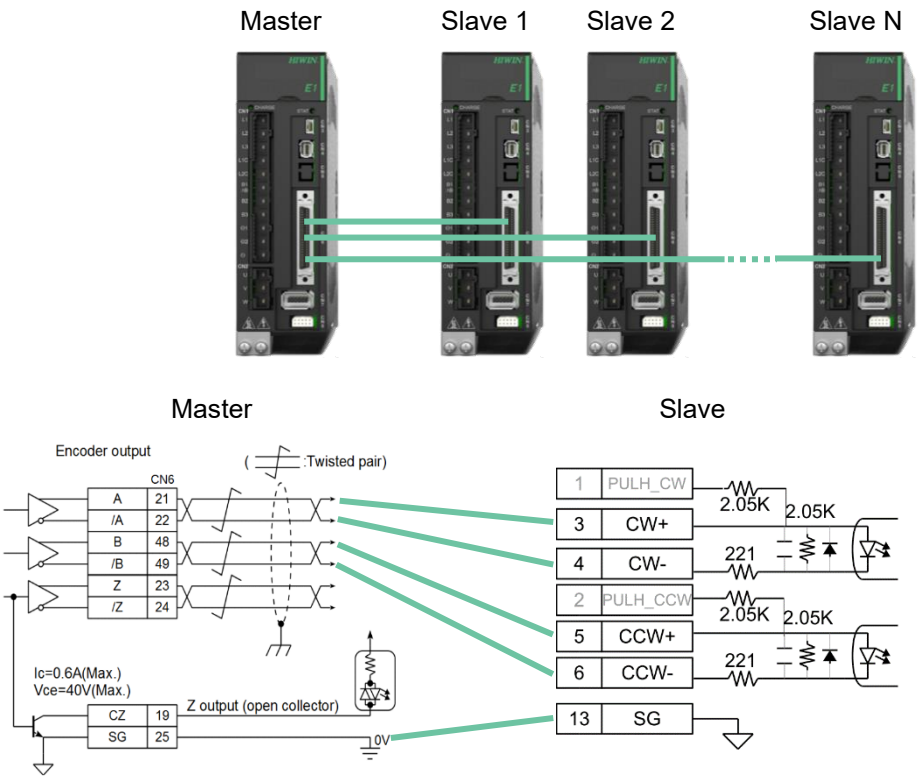


Figure 3.4.1 Wiring diagram for pulse input mode (Take E1 series servo drive as an example)

Note:

If there is a limit for encoder output bandwidth of master axis (material feeder), users can set ECAM_PulseGain of slave axis (cutting axis) to adjust the receiving ratio. Based on the formula “Resolution of master axis (material feeder) = Pt212 x ECAM_PulseGain”, users must set the correct Pt212 in master axis (material feeder) and the correct

ECAM_PulseGain in slave axis (cutting axis). Otherwise, slave axis (cutting axis) cannot receive the correct pulse signals. For example, take E series servo drive as master axis (material feeder), its resolution of motor is 8,388,608 count/rev. Therefore, Pt212 in master axis (material feeder) can be set as 4,194,304, and ECAM_PulseGain in slave axis (cutting axis) can be set as 2. Go to **Others** tab in Thunder “Parameters Setup” window to set ECAM_PulseGain. Its value (int type) will become effective after power on.

3.5 Configuration of digital input/output signal

Configuration of digital input signal:

- Mark input (MARK) signal
  To detect the material on master axis (material feeder), the flying shear - linear or flying shear - rotary function of E series servo drive must be used with MARK sensor. Therefore, MARK sensor must be configured to the digital input signal “MARK” of slave axis (cutting axis). Refer to section 8.1.1 in “E1 Series Servo Drive User Manual” and section 8.1.1 in “E2 Series Servo Drive User Manual” for the setting of digital input signal allocation.

- Electronic cam input (ECAM) signal
  Flying shear - linear or flying shear - rotary function is activated by external trigger signal. Therefore, external trigger signal must be configured to the digital input signal “ECAM” of slave axis (cutting axis). Refer to section 8.1.1 in “E1 Series Servo Drive User Manual” and section 8.1.1 in “E2 Series Servo Drive User Manual” for the setting of digital input signal allocation.

Configuration of digital output signal:

- Electronic cam synchronous area output (ZONE) signal
  When slave axis (cutting axis) and master axis (material feeder) are in sync (same velocity), slave axis (cutting axis) will output a digital output signal “ZONE” to make the tool prepare for cutting. Refer to section 8.1.2 in “E1 Series Servo Drive User Manual” and section 8.1.2 in “E2 Series Servo Drive User Manual” for the setting of digital output signal allocation.

3.6 Confirmation of initial position, preset distance and material length

Before activating electronic cam control system, users must confirm and record the initial position of slave axis (cutting axis), the preset distance and the material length. The descriptions are given below.

■ Flying shear - linear system

Record the initial position, the preset distance and the material length based on the on-site mechanism of flying shear - linear system, as Figure 3.6.1 shows.

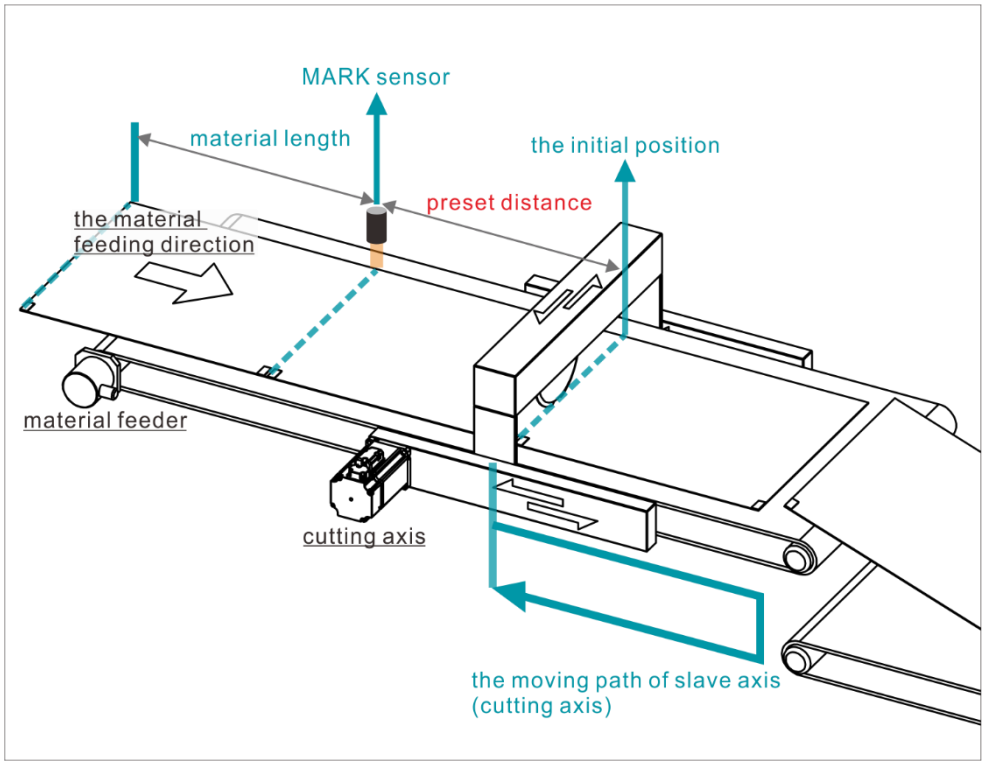


Figure 3.6.1

➢ Confirmation of initial position:

After executing the homing of slave axis (cutting axis) via Thunder, move slave axis (cutting axis) to the desired initial position, that is the initial position of flying shear - linear system. When electronic cam control system is activated, slave axis (cutting axis) needs to get back to the initial position first. Therefore, based on the actual situation, users can set homing method and perform home offset with Pt704 and Pt70A = t.□□1□ to make the motor complete homing and move to the initial position. For example, with homing method 1 or 2, move slave axis (cutting axis) to the desired initial position after Index signal is found. Record the feedback position and set it to Pt704. Then, set Pt70A = t.□□1□ to make it become effective. By doing so, when the next homing is executed, the completed position will go to the desired initial position of flying shear - linear system. Refer to section 8.11 in “E1 Series Servo Drive User Manual” and section 8.11 in “E2 Series Servo Drive User Manual” for the details of homing.

- Confirmation and record of preset distance:
  With “Test Run” window in Thunder, after moving master axis (material feeder) to make its material mark stay at the position of MARK sensor and record its feedback position, move master axis (material feeder) to make its material mark stay at the initial position of slave axis (cutting axis) and record its feedback position. The distance between the two feedback positions multiplied by (Pt20E/Pt210) converting to “count” is the preset distance.

  Note:
  Due to the measurement error, there might be a deviation during the actual execution of flying shear - linear. To solve it, users can slightly adjust (increase or decrease) the preset distance.

- Confirmation and record of material length:
  The distance between the two marks on the material of master axis (material feeder) is the material period (unit: count) and the material length (unit: um). The period and the length of material are in a corresponding and interdependent relationship. Users can measure the actual distance of the two marks with measurement tool and record the length with the unit “um”. Then, convert it to the “count” value of material period. For example, take E series servo drive as master axis (material feeder), its resolution of motor is 8,388,608 count/rev, and the roll axis’ diameter of master axis (material feeder) is 30,000 um. If the material length is 500,000 um, the “count” value of material period is $\frac{8{,}388{,}608*500{,}000}{\mathrm{PI}*30{,}000}$.

  Note:
  The “count” value of material period must be smaller than that of preset distance.

■ Flying shear - rotary system

Record the initial position, the preset distance and the material length based on the on-site mechanism of flying shear - rotary system, as Figure 3.6.2 shows. The initial position depends on the number of tools, as Figure 3.6.3 shows.

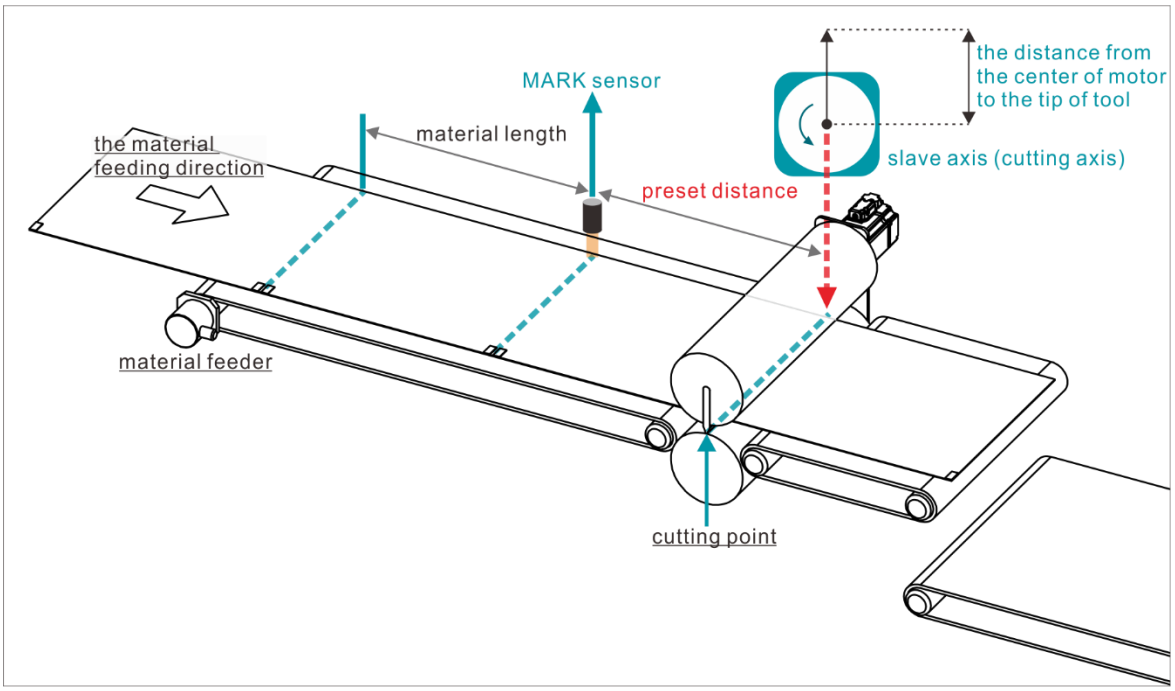


Figure 3.6.2

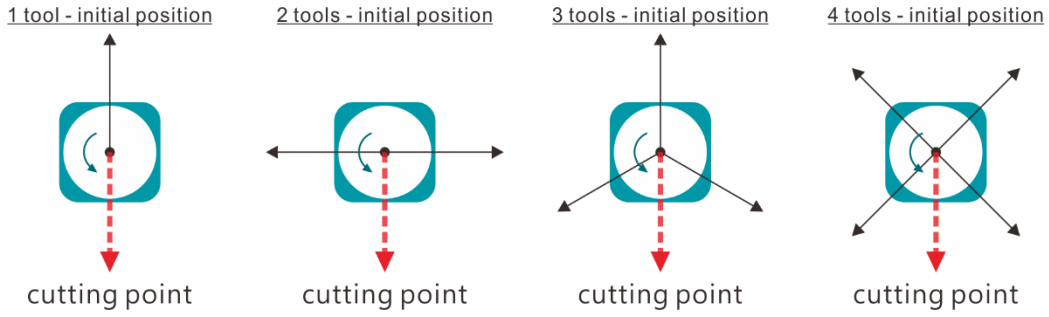


Figure 3.6.3

➢ Confirmation of initial position:

Same as flying shear - linear system.

➢ Confirmation and record of preset distance:

With Thunder “Test Run” window, after moving master axis (material feeder) to make its material mark stay at the position of MARK sensor and record its feedback position, move master axis (material feeder) to make its material mark stay at the cutting point of slave axis (cutting axis) and record its feedback position. The distance between the two feedback positions multiplied by (Pt20E/Pt210) converting to “count” is the preset distance.

Note:

Due to the measurement error, there might be a deviation during the actual execution of flying shear - rotary. To solve it, users can slightly adjust (increase or decrease) the preset distance.

- Confirmation and record of material length:
  Same as flying shear - linear system.

3.7 Introduction for flying shear - linear system

Refer to Figure 3.6.1 for the structure of flying shear - linear system.
After flying shear - linear procedure is activated, make master axis (material feeder) operate with constant velocity and slave axis (cutting axis) back to the initial position. After slave axis (cutting axis) gets back to the initial position, if the material on master axis (material feeder) passes MARK sensor, slave axis (cutting axis) will be triggered to start calculating the profile of flying shear - linear. After the material reaches the initial position, slave axis (cutting axis) will execute the moving forward section of flying shear - linear profile, maintain the same velocity with master axis (material feeder) in constant velocity section, and output digital output signal “ZONE”. At this time, action like cutting can be performed. After completing the moving forward section of flying shear - linear profile, slave axis (cutting axis) will execute the returning section of flying shear - linear profile to get back to the initial position, and wait for the material to pass MARK sensor again to trigger flying shear - linear procedure.

3.8 Introduction for flying shear - rotary system

Refer to Figure 3.6.2 and Figure 3.6.3 for the structure of flying shear - rotary system.
After flying shear - rotary procedure is activated, make master axis (material feeder) operate with constant velocity and slave axis (cutting axis) back to the initial position. After slave axis (cutting axis) gets back to the initial position, if the material on master axis (material feeder) passes MARK sensor, slave axis (cutting axis) will execute the profile of flying shear - rotary. When the material enters the synchronous zone angle, slave axis (cutting axis) will maintain the same velocity with master axis (material feeder) and output digital output signal “ZONE”. At this time, action like cutting can be performed. After the synchronous zone angle section of flying shear - rotary profile is done, slave axis (cutting axis) will get back to the initial position and wait for the material to pass MARK sensor again to trigger flying shear - rotary procedure.

3.9 Electronic cam control interface setting

Through Thunder, select **Tools** in the menu bar and click **Electronic cam** to open “Electronic cam” window. Complete the following three steps.

Step 1: Select electronic cam mechanism
Step 2: Set profile parameters
Step 3: Test run

3.9.1 Step 1: Select electronic cam mechanism

Select the desired electronic cam mechanism via the drop-down menu of approach.

- Flying shear - linear system
- Flying shear - rotary system

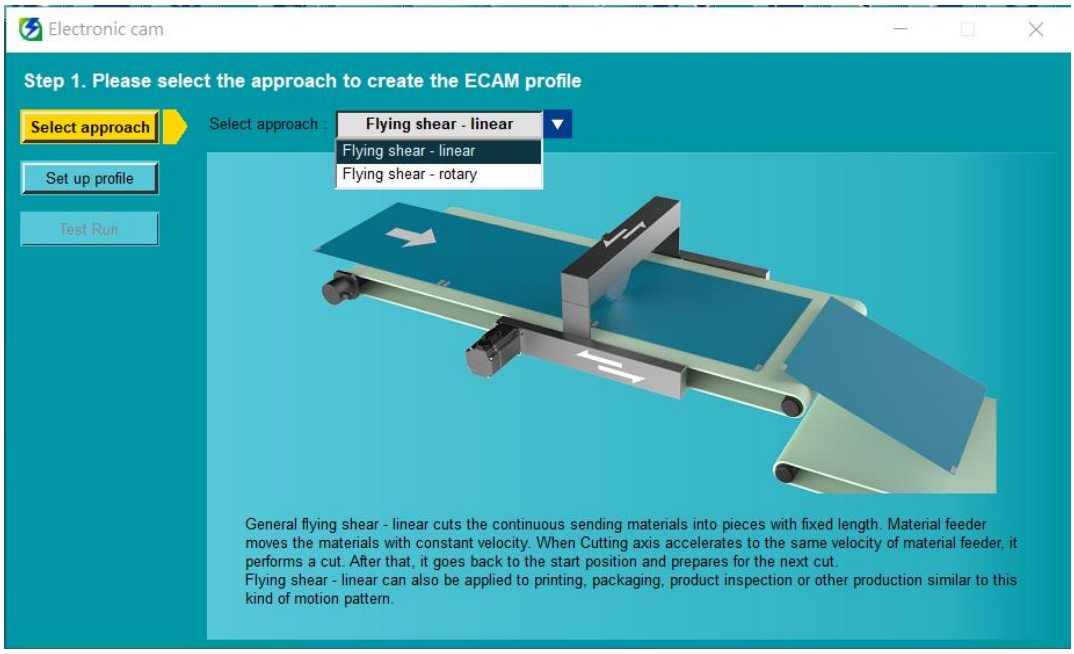


Figure 3.9.1.1

3.9.2 Step 2: Set profile parameters

■ Profile parameters setting of flying shear - linear system

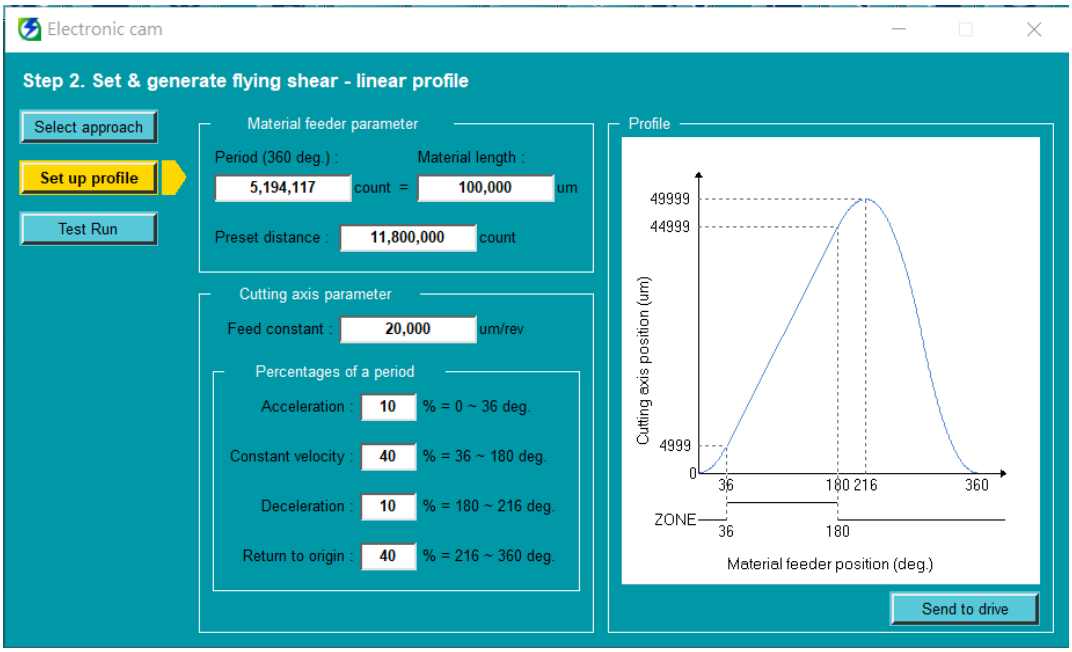


Figure 3.9.2.1

Table 3.9.2.1

Category	Item	Unit	Description
Material feeder parameter	Period (360 deg.)	count	The total length of the material. Refer to Figure 3.6.1.
	Material length	um	
	Preset distance	count	The distance from MARK sensor to the initial position of cutting axis. Refer to Figure 3.6.1.
Cutting axis parameter	Feed constant	um/rev	Set the lead of cutting axis. (When linear motor or full-closed loop control is used, there is no need to set this parameter. The value will be directly filled in by Configuration Wizard in Thunder.)
	Acceleration	%	Set the percentage in a period for cutting axis to accelerate.
	Constant velocity	%	Set the percentage in a period for cutting axis to maintain constant velocity. In this section, material feeder and cutting axis are in sync (same velocity), and cutting axis will output a digital output signal “ZONE” to make the tool prepare for cutting.
	Deceleration	%	Set the percentage in a period for cutting axis to decelerate.

Category	Item	Unit	Description
	Return to origin	%	Set the percentage in a period for cutting axis to return to the initial position.
Profile	--	--	Based on the parameters setting of material feeder and cutting axis, users can observe the position profile of cutting axis in a period in advance.
Send to drive	--	--	After completing parameters setting, click this button.

■ Profile parameters setting of flying shear - rotary system

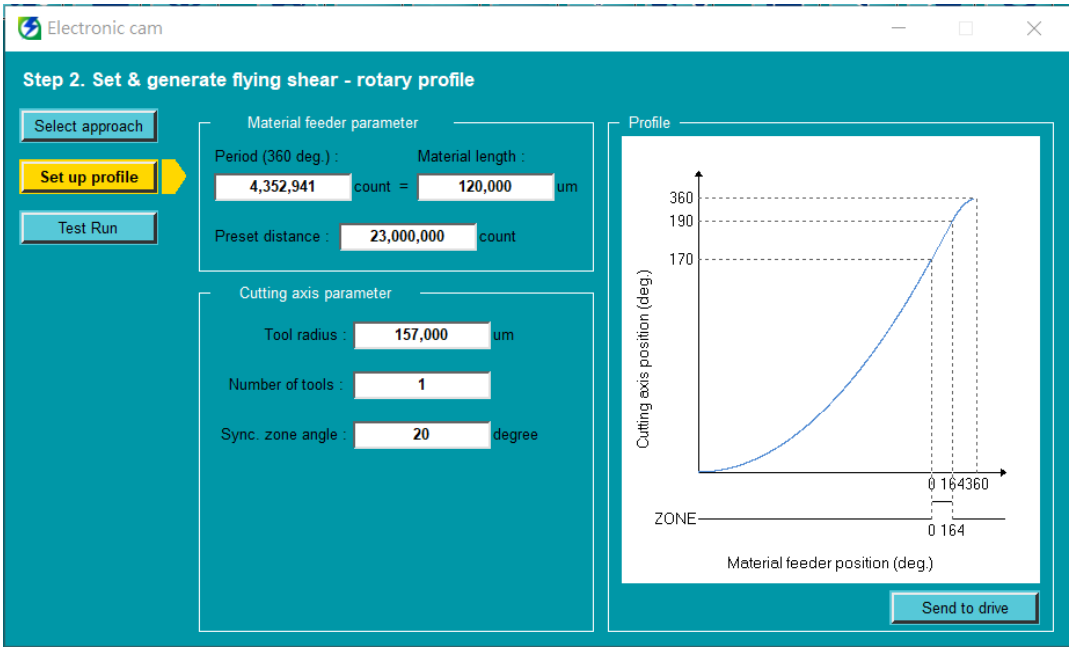


Figure 3.9.2.2

Table 3.9.2.2

Category	Item	Unit	Description
Material feeder parameter	Period (360 deg.)	count	The total length of the material. Refer to Figure 3.6.2.
	Material length	um	
	Preset distance	count	The distance from MARK sensor to the initial position of cutting axis. Refer to Figure 3.6.2.
Cutting axis parameter	Tool radius	um	The distance from the center of motor to the tip of tool. Refer to Figure 3.6.2.
	Number of tools	1 tool	Support 1~4 tools. It is the number of tools installed on the mechanism of cutting axis. The installed position of tools must equally divide 360 degrees. (For example, if there are 4 tools, the interval must be 90 degrees.) Its initial position depends on the number of tools, refer to

Category	Item	Unit	Description
			section 3.6 for the description.
	Sync. zone angle	degree	Set the angle passed during the synchronization (same velocity) of cutting axis and material feeder. At this time, cutting axis will output a digital output signal “ZONE”. Synchronous zone angle will decide the size of zone and equally divide 180 degrees. (For example, if 20 degrees is set, 170~190 degrees are the synchronous zone angle.)
Profile	--	--	Based on the parameters setting of material feeder and cutting axis, users can observe the position profile of cutting axis in a period in advance.
Send to drive	--	--	After completing parameters setting, click this button.

3.9.3 Step 3: Test run

- Group communication mode

  Figure 3.9.3.1 is the test run page of electronic cam control system. The operating procedure is shown in Figure 3.9.3.2, and the parameters in this page are described in Table 3.9.3.1.

- Pulse input mode

  Without using group communication mechanism, pulse input mode receives external pulses as signal sources of master axis (material feeder). Therefore, Figure 3.9.3.1 is only for the operation of error status and performance monitor. To enable servo drive and activate electronic cam control system on this mode, use the digital input signals S_ON and ECAM. The operating procedure is shown in Figure 3.9.3.3.

Figure 3.9.3.1

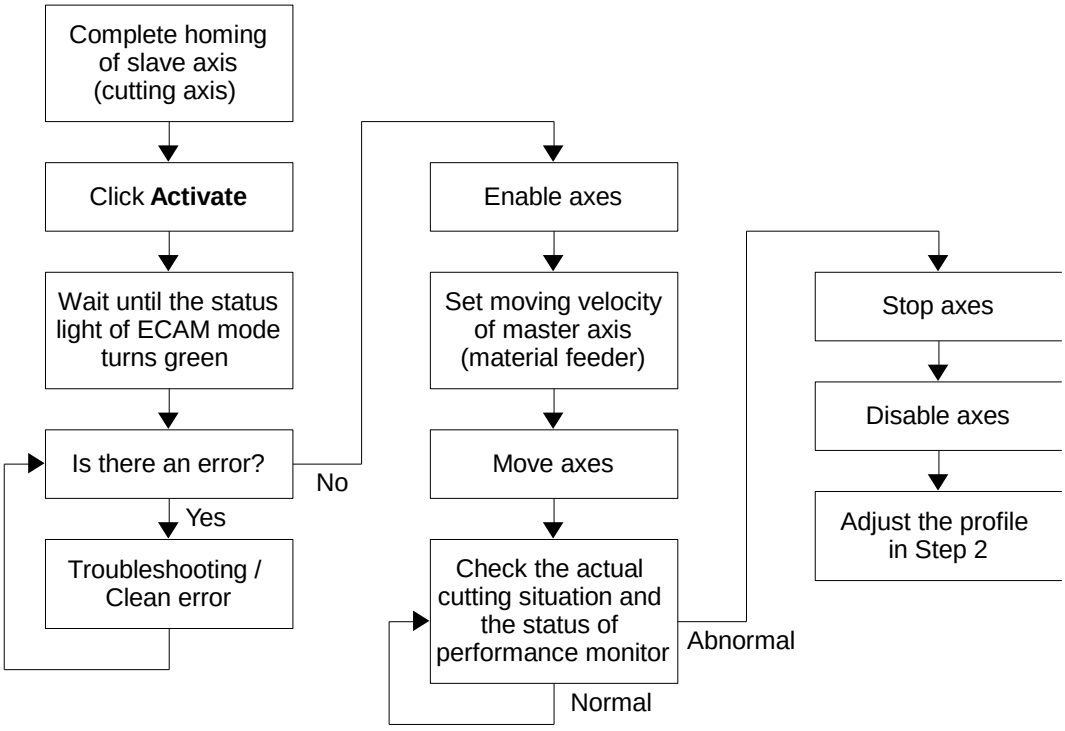


Figure 3.9.3.2 The procedure of operating electronic cam control system via STEP3 Test Run page

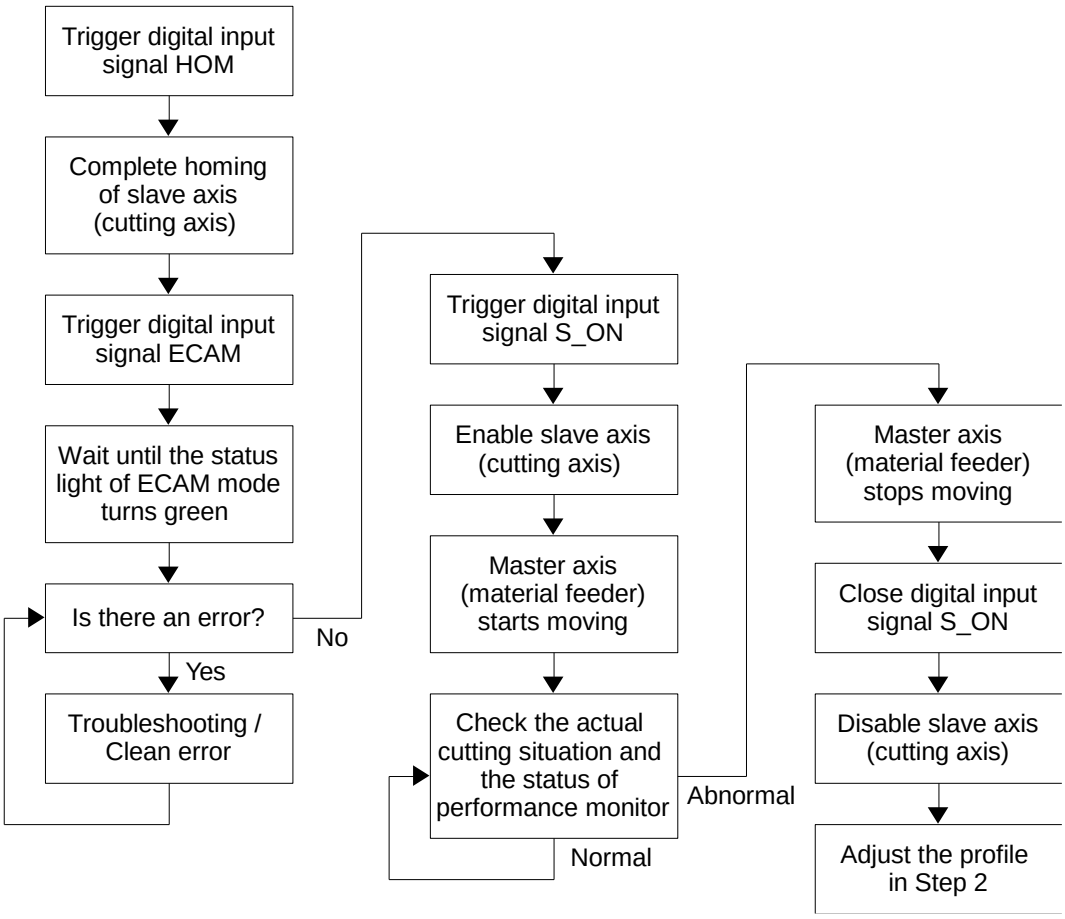


Figure 3.9.3.3 The procedure of operating electronic cam control system via digital input signals

Table 3.9.3.1

Category	Item	Description
--	Light - ECAM mode	This status is used to check if electronic cam control mode is activated.
	Button - Activate	Click this button to activate electronic cam control mode (for group communication).
Error status (for group communication)	Light - Communication error	This status is used to check if the communication of axes is abnormal (for group communication).
	Light - Material feeder alarm	This status is used to check if an alarm occurs on material feeder (for group communication).
	Light - Cutting axis alarm	This status is used to check if an alarm occurs on cutting axis.
	Button - Clean error	Click this button to clean errors.
Drive status (for group communication)	Light - Drive ready	This status is used to check if the servo drive is ready to receive S_ON signal and become enabled.
	Light - Servo ready	This status is used to check if the motor is enabled.
	Button - Enable axes	Click this button to simultaneously enable / disable axes (for group communication).
Axes operation (for group communication)	Light - Constant velocity	This status is used to check if cutting axis maintains constant velocity (for group communication).
	Light - Homed	This status is used to check if cutting axis has completed homing.
	Light - Initialized	This status is used to check if cutting axis has got back to the initial position.
	Light - Activated	This status is used to check if cutting axis has executed electronic cam control mode.
	Button - Move axes	Click this button to simultaneously move axes (for group communication).
	Column - Velocity	Set the velocity of material feeder (for group communication).
Performance monitor	Column - Remaining	Record the number of materials to be processed.
	Column - Total	Record the total number of materials passing MARK sensor.
	Column - Miss	Record the number of materials not processed due to the abnormal situation.
	Column - Misjudgment	Record the number of materials abnormally got by MARK sensor.
	Button - Clear	Click this button to clear the number of the corresponding column.
	Light - ZONE	This status shows the velocity of material feeder and cutting

Category	Item	Description
		axis are the same.
	Light - MARK	If the status flashes once, it means the material passes MARK sensor once.

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4. Troubleshooting

Incorrectly operating electronic cam control system may cause damage to the stage. For safety, pay attention to the following features before entering electronic cam control mode.

4.1 Enable/Disable axes in electronic cam system

- Group communication mode
  1. After entering electronic cam control mode, users must perform test run via the electronic cam control interface of slave axis (cutting axis). Therefore, clicking **Enable axes** equals enabling both axes; clicking **Disable axes** equals disabling both axes.
  2. After entering electronic cam control mode, both axes will be disabled if any axis triggers an error.

- Pulse input mode
  1. The enable/disable behavior of slave axis (cutting axis) is determined by servo on input (S_ON) signal.
  2. After entering electronic cam control mode, slave axis (cutting axis) will not be disabled if master axis (material feeder) triggers an error. Slave axis (cutting axis) will only be disabled when it receives the disabled signal or an alarm occurs on it.

4.2 Motor stopping method for alarm

In electronic cam control system, the motor stopping method for alarm is the same as that of single axis. Refer to “E1 Series Servo Drive User Manual” and “E2 Series Servo Drive User Manual” for details.

4.3 Relevant alarms

■ AL.FC0 Group control system communication error (when group communication mode is used)

Table 4.3.1

Cause	Confirmation Method	Corrective Action
Communication is interrupted. It could be disconnection of the communication cable or poor connection.	Check if the communication cable is correctly connected.	Check if the communication cable is correctly connected.
Communication is interfered.	Check if there is interference source or the communication cable is not correctly connected.	Add ferrite ring or replace the communication cable.
Power off or reset one of the axes.	N/A	Perform alarm reset on master axis via Thunder or external signal, or reset both axes.
The group control mode settings are different.	Check if the group control mode settings of both axes are the same.	Set the group control mode (Pt003 = t.□□□X) of both axes as the same value based on usage.
Communication cannot be established (only detected when auto gantry is activated).	Check if the communication cable is correctly connected.	Check if the communication cable is correctly connected.
Communication cannot be established (The station address setting of Fieldbus servo drive slave axis is abnormal).	Please check if the slave axis servo drive panel rotary switches are turned to 8.	Please turn the slave axis servo drive panel rotary switches to 8.

Note:

After the relationship of master and slave is built up, users should power off and reset the servo drives to make some Pt parameters become effective. Therefore, it is normal if alarm AL.FC0 occurs. To clear the error of both axes, users can click “Clean error” or enter alarm reset input (ALM-RST) signal via the electronic cam control interface of master axis (material feeder) or the electronic cam control interface - STEP3 Test Run of slave axis (cutting axis).

■ AL.FC1 Slave axis error in group control system (when group communication mode is used)

Table 4.3.2

Cause	Confirmation Method	Corrective Action
An error occurs in the slave axis of group control system.	Check the cause of the error.	After the cause of the error is cleared, perform alarm reset on master axis via Thunder or external signal, or reset both axes.

Note:

1. On group communication mode, if any error occurs in slave axis (cutting axis), alarm AL.FC1 will pop up in master

axis (material feeder) window.

2. On group communication mode, to clear the error of both axes, users can click “Clean error” or enter alarm reset input (ALM-RST) signal via the electronic cam control interface of master axis (material feeder) or the electronic cam control interface - STEP3 Test Run of slave axis (cutting axis).

■ AL.Fd0 Electronic cam control system alarm

Table 4.3.3

Cause	Confirmation Method	Corrective Action
An alarm occurs in electronic cam control system.	Check the causes of the alarm. (Observe the variable “ECAM_ErrorLog”)	After the causes of the alarm are cleared, perform alarm reset on both axes via Thunder or external signal, or reset both axes.

The error codes of AL.Fd0 are listed below.

Table 4.3.4

Error code (ECAM_ErrorLog)	Description
0	No error.
1	Master axis (material feeder) does not maintain constant velocity on group communication mode. **Solution: Adjust Pt503 in master axis (material feeder).**
2	Overtravel signal is triggered.
3	Slave axis (cutting axis) is not on position mode.
4	During the process of flying shear - linear or flying shear - rotary, master axis (material feeder) or slave axis (cutting axis) is not servo ready.
5	The total number of miss is abnormal.
6	The total number of misjudgment is abnormal.
7	Internal error.
8	Slave axis (cutting axis) moves abnormally.
9	The calculation of profile is abnormal.