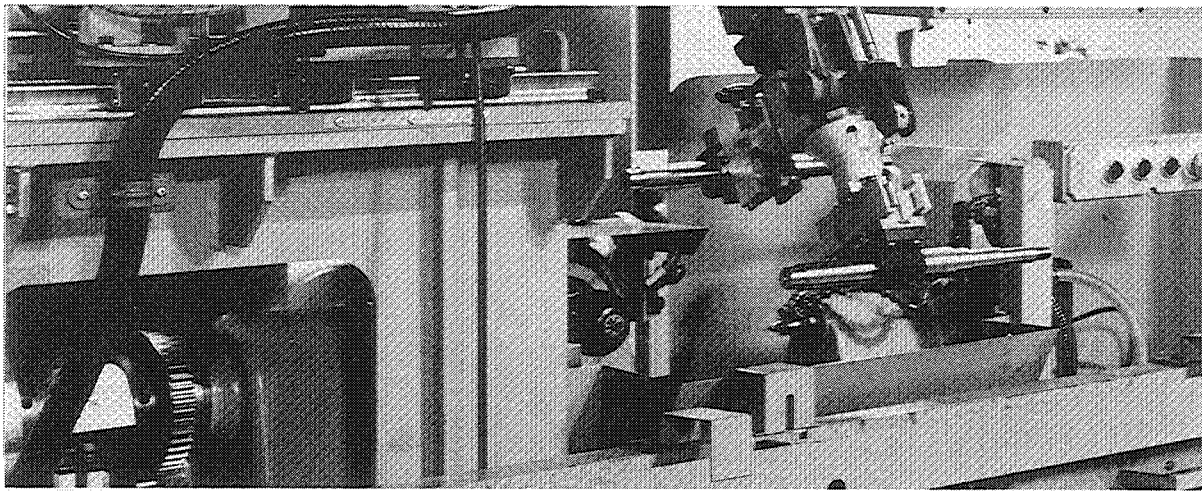
MOTIONPACK-SG1
USER'S MANUAL



YASKAWA

MANUAL NO. SIE-C884-1

Safety Precautions

Safety precautions in this manual apply to MOTIONPACK-SG1.

Please read this manual carefully and be sure you understand the information provided before operation.

Keep this manual at your disposal for daily maintenance and inspection.

General Precautions

- Some drawings in this manual are shown with the protective covers or shields removed, in order to describe the detail with more clarity. Make sure all covers and shields are replaced before operating this product, and operate it in accordance with the directions in the manual.
- The figures and photographs in this manual show a representative product for reference purposes and may differ from the product actually delivered to you.
- This manual may be modified when necessary because of improvement of the product, modification, or changes in specifications.
  Such modification is made as a revision by renewing the manual No. on front cover.
- To order a copy of this manual, if your copy has been damaged or lost, contact your Yaskawa representative listed on the last page starting the manual No. On the front page.
- If any of the nameplates affixed to the product become damaged or illegible, please send the nameplates to your Yaskawa representative.
- Yaskawa is not responsible for any modification of the product made by the user since that will void our guarantee.

Related Manuals

Refer to the following manuals as required.

Manual Name	Manual Number
Σ Series SGM/SGMP/SGD-□N User's Manual	SIE-S800-26.3
Σ Series SGM/SGDB-□N User's Manual	SIE-S800-26.4
MOTIONPACK-SG1 Descriptive Information	SIE-C884-1.1
MOTIONPACK-SG Personal Computer Programmer Operation Manual	TOE-X881-1.2

NOTES FOR SAFE OPERATION

Read this manual thoroughly before installation, operation, maintenance or inspection for the MOTIONPACK-SG1.

Function and performance are not determined by the positioning control device alone. Before operation, read the machine tool builder's documents thoroughly relating to the machine tool concerned.

In this manual, the NOTES FOR SAFE OPERATION are classified as "WARNING" or "CAUTION".

⚠ WARNING : Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.

Symbol  is used in labels attached to the product.

⚠ CAUTION : Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury to personnel and damage to equipment.

Even items described in ⚠ CAUTION may result in a vital accident in some situations. In either case, follow these important items.

Please note that symbol mark used to indicate caution differs between ISO and JIS.

ISO	JIS
	

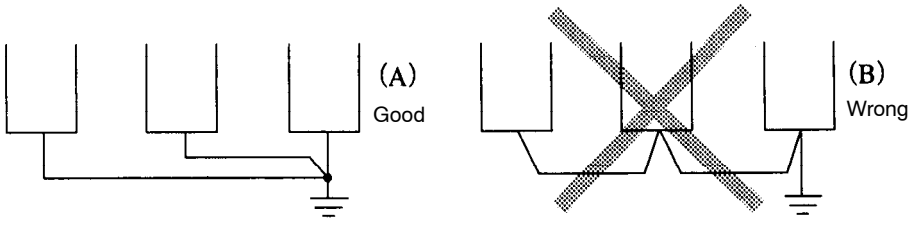
In this manual, symbol mark stipulated by ISO is used.

On products, caution symbol marks of ISO and JIS are used in labels. Please follow the same safety instructions concerning caution.

■ Application Safety Precautions

⚠ WARNING

- Make sure to note the following precautions in order to avoid any risk of electric shock or machine malfunctions.
  - · Do not touch any unit, terminals , etc. while the power is ON.
    Failure to observe this warning may lead to electric shock or device malfunction.
  - · Immediately after switching the power OFF, the product retains some electric charge. Do not touch any parts which are live when the power is ON for 5 minutes after switching the power OFF.
    Failure to observe this warning may lead to electric shock or device malfunction.
  - · Select the cable size in conformance with local electrical codes or the cable manufacturer's technical data.
  - · Ground at one point. (Ground resistance 100Ω or less)
  - · Be sure to separate the grounding line of the unit from a power unit.
    Failure to observe this warning may lead to malfunction.
  - · When more than one unit exists, grounding should be made as shown in Fig. (A), but not as shown in Fig. (B).



- Do not damage cables, subject them to excessive stress, or pinch them.
  Excessive load on cables may lead to electric shock.
- When the unit is turned ON, never touch its rotating parts.
  Failure to observe this warning may lead to personal injury.
- Never modify the product.
  Failure to observe this warning may lead to electric shock, fire, or product failure.

⚠ CAUTION

- Use the product in an environment with the following characteristics.
  Using it in an environment in which it is subject to high temperatures, high humidity, dust, corrosive gasses, vibration or impact may lead to fire, electric shock or malfunction.

  Free from gases or vapors that create a potentially explosive atmosphere.

  Free from corrosive oil, organic solvents, etc.

  Relative humidity in the range 30 to 85 % RH , with no condensation.

  Ambient temperature in the range 0 to 55°C with no freezing.
  (Installation site must not be exposed to direct sunlight, must be distanced from heat generating devices, and must be indoors.)

  Vibration not exceeding 4.9 mm/s^2 (0.5 G).
- Install the units in accordance with the following.
  Failure to observe this caution may lead to product failure or malfunction.

  Mount the unit vertically with screws or bolts.

  The unit will generate heat, therefore, install it with adequate clearance around it.

  When circulating air inside the enclosure, do not blow air directly onto the unit
  (in order to prevent dust contamination).

  Arrange units so that maintenance, inspection or replacement of parts can be made easily.
- Design and install the box in accordance with the following.
  Failure in box such as electric control panel may lead to product failure or malfunction.

  Use an airtight enclosure.

  Limit the average temperature increase of internal air within the enclosure to under 10°C (50°F) compared to the ambient temperature.

  Use a fan to circulate air in order to improve the cooling efficiency of a closed enclosure and to prevent abnormal temperature rise.

  Seal the cable inlet, door, etc. completely.

  The board inside the unit attracts airborne particles because of high voltage and may lead to malfunction, therefore, provide a structure to prevent entry of dust.

  Install packing on the cable inlet, doors, back covers, etc. to eliminate gaps or openings.
- Do not let foreign matter such as electric wire scrap enter the unit.
  Failure to observe this caution may lead to fire, product failure or malfunction.
- Set the power line capacity higher than the power consumption of the device.
  Failure to observe this caution may lead to product malfunctions.
- The current capacity of 24 VDC power unit for external input/output contacts is determined by the number of contact points to be used. When the current capacity is low, install an additional external power unit.

■ Receiving

⚠ CAUTION
• Confirm that the product is the same as ordered. Installation of improper product may result in personal injury or product damage.

■ Storage

⚠ CAUTION
• Do not store the product in locations subject to rain, water drops, or harmful gases or liquids. Failure to observe this caution may lead to product failure or malfunction. • Select a storage area indoors that is clean and meets the following temperature and humidity requirements. Failure to observe this caution may lead to product failure or malfunction. · Ambient temperature: –20°C to +70°C · Relative humidity: 10% to 90%

■ Transport

⚠ CAUTION
• Do not lift the cable when moving the product. Failure to observe this caution may lead to personal injury or product failure.

■ Installation

⚠ CAUTION
• When installing the product, avoid shutting the inlet port or exhaust port. Also avoid foreign matter from entering the device. Failure to observe this caution may lead to fire. • Avoid strong impact during installation. Failure to observe this caution may lead to product failure.

■ Wiring

⚠ CAUTION

- Always turn the power OFF(including the primary power supply) before carrying out wiring.
  Carrying out wiring with the power ON may lead to electric shock.
- Be sure to connect the grounding terminal of the motor to the grounding terminal of the drive unit.
  Failure to observe this caution may lead to electric shock, fire, or malfunction.
- Ground at one point(Ground resistance 100Ω or less)
  Failure to observe this caution may lead to electric shock, fire, or malfunction.
- Be sure to separate the grounding line of the unit from a power unit.
  Failure to observe this caution may lead to malfunction.
- Correct and precise wiring should be performed by qualified, authorized personnel only.
  Failure to observe this caution may lead to electric shock, fire, or malfunction.
- Select the type of wire and size according to your requirements and current capacity.
  Failure to observe this caution may lead to fire.
- When the ambient temperature exceeds 30°C (86°F), the allowable current goes down. Select the cable size in conformance with local electrical codes or the cable manufacturer's technical data.
- Use twisted wire or multi-core twisted pair shielded wire for general signal wires and PG feedback signal wires for the encoder.
  Failure to observe this caution may lead to malfunction.
- Make wire connections as short as possible.
  Failure to observe this caution may lead to malfunction.
- Connect the power supply of 24 VDC to the control power terminal.
  Connect the power supply of 24 VDC to the I/O signals terminal.
  Connecting to a power supply with different voltage may lead to fire.

  The input power supply to CPU unit works normally until a momentary power loss of 1/2 cycle or a voltage drop by 50% within 1 cycle.

  The allowable range of voltage fluctuation should be –5% to 5%; however, use the average voltage at the rated 24 VDC.
- External connection wiring should be made with consideration of the following points :
  Failure to observe this caution may lead to fire or malfunction.

  · Mechanical strength
  · Influence of noise
  · Wiring distance
  · Signal voltage

⚠ CAUTION

- Do not run the I/O signal wires with power wires or in the same duct with power wires.
  Failure to observe this caution may lead to malfunction from excessive noise.
- Use a noise filter to reduce power line noise when necessary.
  Failure to observe this caution may lead to malfunction from excessive noise.

■ Operations

⚠ CAUTION

- Before carrying out cutting operation with a new program, confirm safety by performing single block operation.
  Failure to observe this caution may lead to unexpected operation due to mis-setting of offset, and accidents involving injuries to personnel.
- Do not change parameters relating to machine accuracy, travel axis control and spindle axis control.
  Failure to observe this caution may lead to unexpected operation.
- Strictly observe the cautions in the user's manual when using programming functions.
  Failure to observe this caution may lead to injuries to personnel and malfunctions.

■ Maintenance and Inspection

⚠ WARNING

- Always turn the power OFF (including the primary power supply) before carrying out daily inspection.
  Failure to observe this warning may lead to electric shock.
- Wait 5 minutes after turning the power(including the primary power supply) OFF before removing or replacing any unit or part.
  Failure to observe this warning may lead to electric shock or malfunction.
- Be sure to turn the power OFF before replacing the battery.
  Failure to observe this warning may lead to electric shock or malfunction.

⚠ CAUTION

- To prevent personnel other than those involved in maintenance and inspection work from turning the power ON while maintenance and inspection is in progress, place sign stating "Do not turn the power ON" or words to that effect at the primary power supplies of related control panels and other relevant locations.
  Failure to observe this caution may lead to electric shock.
- Replace fuses and batteries with the designated products.
  Failure to observe this caution may lead to fire or product failure.
- Electric devices such as CMOS ICs are used on the control boards. Static electricity from direct hand contact may cause damage; take care.
  Failure to observe this cautionmay lead to injuries or product failure.
- Do not install or remove boards, wiring, connectors, etc., while the power is ON.
  Failure to observe this caution may lead to electric shock, product failure, or malfunction.
- When an alarm occurs, eliminates the cause and confirm safety before resetting it.
  Failure to observe this caution may lead to malfunction.
- Be sure to check the following points on completing maintenance and inspection work.
  · All fastening bolts are tightened.
  · No tools or other objects have been left inside the control panel.
  · The control panel door is closed properly.
  Failure to observe this caution may lead to electric shock, injuries, fire, or malfunction.
- For details on trouble relating to machine sequence, refer to the manual issued by the machine tool builder.
- Never attempt to disassemble or modify units or devices inside the control panel.
  Failure to observe this caution may lead to fire, product failure, or malfunction.

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8. TEST RUN

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APPENDIX B PARAMETER LIST

APPENDIX C FUNCTION COMMAND LIST

APPENDIX D I/O SIGNAL LIST

APPENDIX E ALARM LIST

1

FEATURES

This chapter describes the features of MOTIONPACK-SG1.

1.1 FEATURES

MOTIONPACK-SG1 is a single-axis controller unit with functions for general industries in addition to functions for conventional transfer machines and special machines.

Main features are as follows.

(1) Equipped with functions necessary for machine tool feed and transfer machine system

(a) Position command unit may be set freely.

(b) Multiple coordinate systems may be used, and tool exchange, correction, and combinations of fixed cycle may be made easily.

(c) Various motion control functions

- Skip positioning function
- External positioning function
- Pass signal output function
- Variable speed positioning function
- Solid tap function

(d) Compensation function

(e) Area signal output function

(2) Servo unit is external separately-installed type.

(a) Adaptable to servo unit evolution

(b) Connection with servo unit is MECHATROLINK interface.

(3) Controllable axes; one axis plus spindle.

2-axis synchronous operation such as solid tap function, follow operation function etc. are enabled.

2

SYSTEM CONFIGURATION

This chapter describes the system configuration.

2.1 CONNECTION DIAGRAM

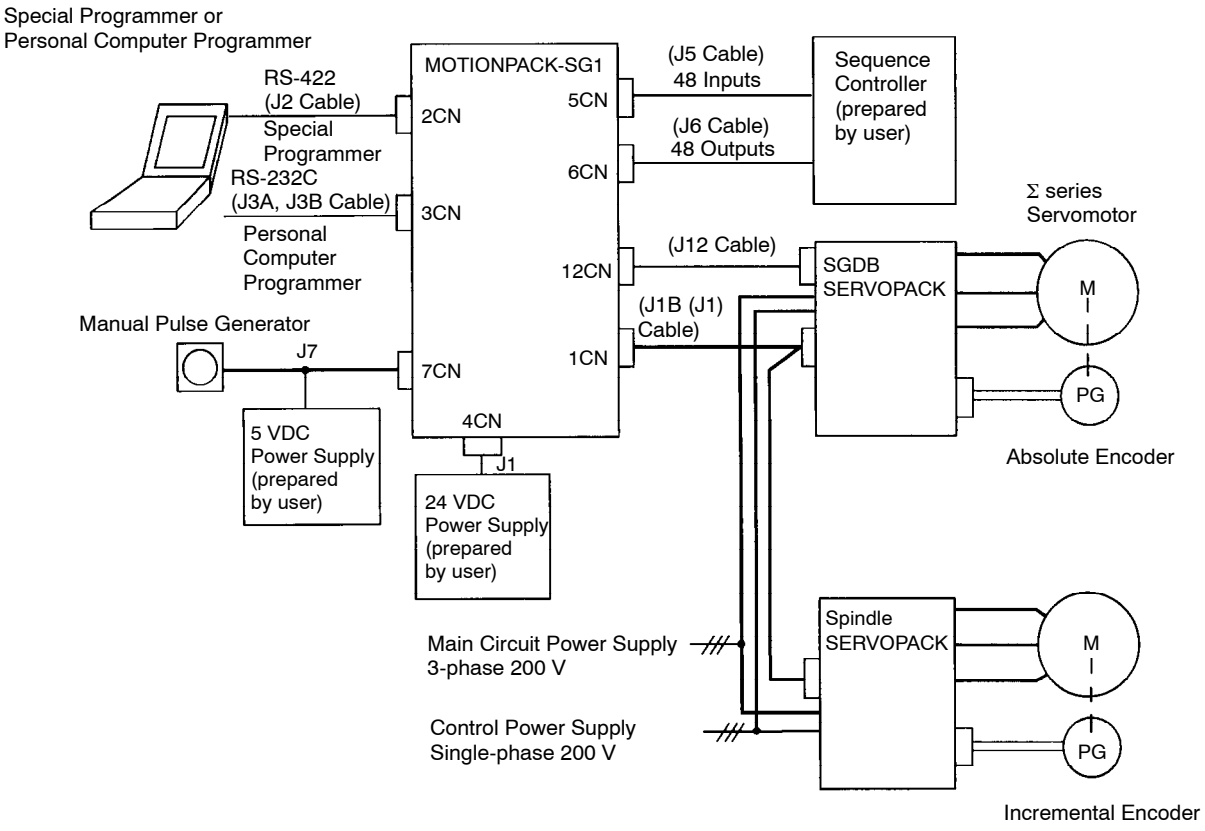


Fig. 2.1 Connection Diagram

2.2 MODEL

(1) Controller Model

JEMP-SG1 *

- MOTIONPACK-SG1 controller
- Design revision order 0: standard

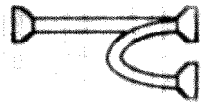
(2) Special Programmer Model

JEMP-PSG1

- MOTIONPACK-SG1 special programmer
  +J2 cable (model: JEFMC-WU13)

(3) Cable Model

Table 2.1 Cable Model

Name	Application	Model	Length	Specification	Cable Connector Type	
					SG1 side	User side
J1	Between 1CN and SERVOPACK	JEMP-W010	0.5m	 Both connectors are the same.	MR-8FG/MR-8L (Manufactured by Honda)	MR-8FG/MR-8L (Manufactured by Honda)
		JEMP-W011	1m			
		JEMP-W012	3m			
		JEMP-W013	0.3m			
J1B	Between 1CN and SERVOPACK +spindle	JEFMC-W010B	0.3m+	 All 3 connectors are the same.	MR-8FG/MR-8L (Manufactured by Honda)	MR-8FG/MR-8L (Manufactured by Honda)
		JEFMC-W011B	1m+1m			
		JEFMC-W012B	3m+3m			
J2	Between 2CN and special programmer	JEMP-WU13	3m(P.P. included)		DE-9PF-N/ DE-C8-J9-F1-1 (Manufactured by JAE)	DE-9SF-N/ DE-C8-J9-F1-1 (Manufactured by JAE)
		JEMP-WU16	10m			
		JEMP-WU17	15m			
J3A	Between 3CN and personal computer programmer (for PC-9801 series)	JEMP-W030A	1m	 Connector for personal computer is as specified at right.	DE-9SF-N/ DE-C8-J9-F2-1 (Manufactured by JAE)	DB-25SF-N/ DB-C8-J10-F1-1 (Manufactured by JAE)
		JEMP-W031A	3m			
		JEMP-W032A	5m			
J3B	Between 3CN and personal computer programmer (for J3100, PC-AT, etc.)	JEMP-W030B	1m	 Connector for personal computer is as specified at right.	DE-9SF-N/ DE-C8-J9-F2-1 (Manufactured by JAE)	DB-9SF-N/ DE-C8-J9-F1-1 (Manufactured by JAE)
		JEMP-W031B	3m			
		JEMP-W032B	5m			
J4	For 4CN (24VDC) power supply	JEMP-W040	5m	 One side has split output.	VHR-4N/ SVH-21T-P1.1 (Manufactured by JST)	–
J5	5CN I/O cable	JEMP-W050	1m	 One side has split output.	MR-50F/MR-50L (Manufactured by Honda)	–
		JEMP-W051	2m			
		JEMP-W052	5m			
J6	6CN I/O cable	JEMP-W060	1m	 One side has split output.	MR-50M/MR-50L (Manufactured by Honda)	–
		JEMP-W061	2m			
		JEMP-W062	5m			
J7	Between 7CN and Handle PG	JEMP-W070	1m	 One side has split output.	MR-8MG/MR-8L (Manufactured by Honda)	–
		JEMP-W071	2m			
		JEMP-W072	5m			
J12	For 12CN (PG Backup) power supply	JEMP-W120	3m	 One side has split output.	DF11-4DS-2C/ DF11-2428SCF (Manufactured by Hirose Denki)	–
Connector Kit	1CN, 3CN, 4CN*, 5CN, 6CN, 7CN	JEMP-A01	–	Soldering type	–	–
		JEMP-A02	–	Calking type	–	–

*4CN connector is calking type. In the case without calking tool, arrange J4 cable.

3

UNIT SPECIFICATIONS

This chapter describes unit specifications for the MOTION-PACK-SG1.

3.1 CONTROLLER

Table 3.1 Controller Specifications

Item	Specifications
Model	JEMP-SG10
Module Specifications	< Basic control section > Main board • Clock: 16 MHz • Memory : System ROM (512 KB) < Flash ROM > : Work RAM (128 KB) : User RAM (256 KB) < SRAM > • MECHATROLINK interface : 1 port • RS-422 interface : 1 port • RS-232C interface : 1 port • 24 VDC single power input • Manual pulse input • Clock function (calendar) < I/O section > Discrete I/O board (with watchdog) • Digital input circuit : 48 points : Isolate input by photocoupler : Voltage level (+24V) : Sink/source current (7 mA max.) • Digital output circuit : 48 points : Photocoupler insulated open collector output : Impress voltage level (+24V) : Sink current (50mA)
Number of Controlled Axes	One axis + spindle
Applicable Servomotor	MECHATROLINK servomotor (Model: SGD-□□□N, SGDB-□□AN)
Peripheral Device	Programmer: special programmer, or personal computer programmer Manual pulse generator
Power Supply	24 VDC (±5%), 300 mA
Environmental Conditions	Ambient operating temperature : 0 to 55°C Ambient storage temperature : –20 to +70°C Ambient humidity : 30 to 85% RH (with no condensing) Atmosphere : Free from inflammable and corrosive gases, dust, metallic dust, high temperature or high humidity Grounding : 100Ω or less
External Dimensions (in mm)	75 (W) × 250 (H) × 100 (D)
Approx. Mass	1.5 kg

3.2 SPECIAL PROGRAMMER

Table 3.2 Special Programmer Specifications

Item	Specifications
Model	JEMP-PSG1
Indicator	Liquid crystal module with EL back-light 16 characters × 4 lines and LEDs for display
EL Service Lifetime	Luminance deteriorates slightly after approx. 2000 hours.
Switch	Operation key switch × 40
Auxiliary Memory Unit	No-contact method memory card (built-in reader/writer)
Printer Port	Built-in RS-232 interface (D-SUB 9-pin)
Power Supply	Supplied from SG1 controller through cable
Environmental Conditions	Ambient operating temperature : 0 to 50°C natural air cooling Ambient storage temperature : –20 to +60°C Ambient humidity : 30 to 85%RH (with no condensing) Vibration resistance : In accordance with JIS C 0911 (9.8 m/s^2 max.) Shock resistance : In accordance with JIS C 0912 (98 m/s^2 max.) Atmosphere : Free from inflammable and corrosive gases, dust, metallic dust, high temperature or high humidity
External Dimensions (in mm)	85 (W) × 190 (H) × 37 (D)
Approx. Mass	450 g

3.3 I/O SIGNAL DC POWER SUPPLY

Recommended power supply is as follows.

- Name and Type: switching power supply EWS50-24
- Manufacturer: NEMIC-LAMBADA Co., Ltd.
- Specifications

Table 3.3 Specifications of I/O Signal DC Power Supply

Item	Specifications
Rated DC Output Voltage	24 V
Max DC Output Current	2.4 A
Max Output Power Supply	57.6 W
Efficiency(TYP) *1	78%
Input Current (TYP)	100 VAC: 1.2 A, 200 VAC: 0.6 A (At full load)
Input Surge Current (TYP)	100 VAC: 6.8 A, 200 VAC: 13.5 A (With input surge current prevention circuit)
Output Voltage Regulation (TYP)	±10%
Max Ripple Voltage (Including Noise)	200 mA
Max Input Regulation*2	96 mV
Max Load Regulation	150 mV
Overload Current Prevention	2.5 A min.
Overvoltage Prevention	27.6 to 32.4 V
Approx. Mass	450 g
UL Standard	Qualified part
CSA Standard	Qualified part
VDE Standard	TüV qualified part

*1 At 100VAC max. output power supply

*2 At max. output power supply

3.4 MANUAL PULSE GENERATOR

Table 3.4 Manual Pulse Generator Specifications

Item	Specifications
Model	PRET-2E5T/100M2
Power Supply	4.5 to 13.2 VDC, 50 mA
Output Waveform and Type	Rectangular voltage output, open collector
Output Level	1: power voltage 1 V or greater, 0: 0.5 V or below
Tr Collector Current	20 mA
Output Impedance	2 kΩ
Output Waveform	Pulse duty : 50 ± 10%, output phase difference : 25 ± 10%
Response Frequency	0 to 10 kHz
Allowable Max Speed	500 r/min
Starting Torque	150 to 600 g·cm
Ambient Operating Temperature	0 to 55°C
Ambient Storage Temperature	–20 to +70°C
Ambient Humidity	30% to 85% RH (with no condensing)
Vibration Resistance	19.6 m/s^2 50 Hz
Shock Resistance	294 m/s^2/11 ms
Atmosphere	Free from inflammable or corrosive gases
External Dimensions (in mm)	77 (∅) × 117 (D)
Approx. Mass	540 g

3.5 MEMORY CARD

Table 3.5 Memory Card Specifications

Item	Specifications
Model	R-128KB-Y
Memory Capacity	128 KB, CMOS memory
Backup Battery	Lithium battery, Service lifetime: 5 years from date of manufacture
Data Transmission Speed	500 KB/s
Ambient OperatingTemperature	0 to 50°C
Ambient Storage Temperature	–10 to +65°C
Ambient Humidity	Condensation allowed
Vibration Resistance	Drop test on concrete from 1 m high in direction X, Y or Z three times each
Bending Test	Load 10 kg for 10 seconds
Waterproof, Oilproof	Immersed in water or coolant for 24 hours (25°C)
External Dimensions (in mm)	85.6 (W) × 54 (H) × 3.8 (D)
Approx. Mass	20 g

4

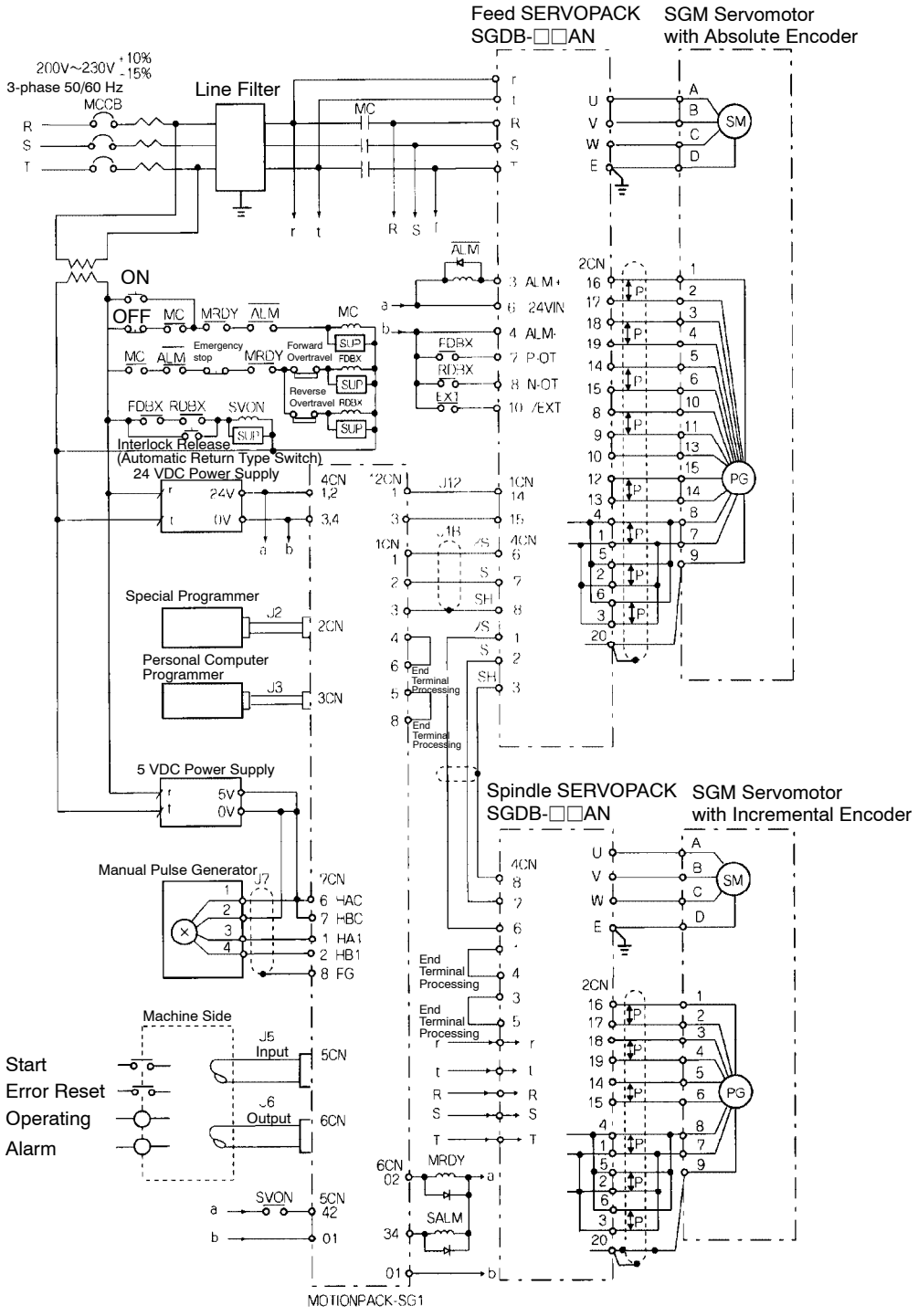
SIGNAL SPECIFICATIONS

This chapter describes the specifications of I/O signals and their connections.

4.1 CONNECTION DIAGRAM

(1) When using the SGDB Servos for Both Feed Axis and Spindle

Motors with absolute encoders are provided with feed axis.



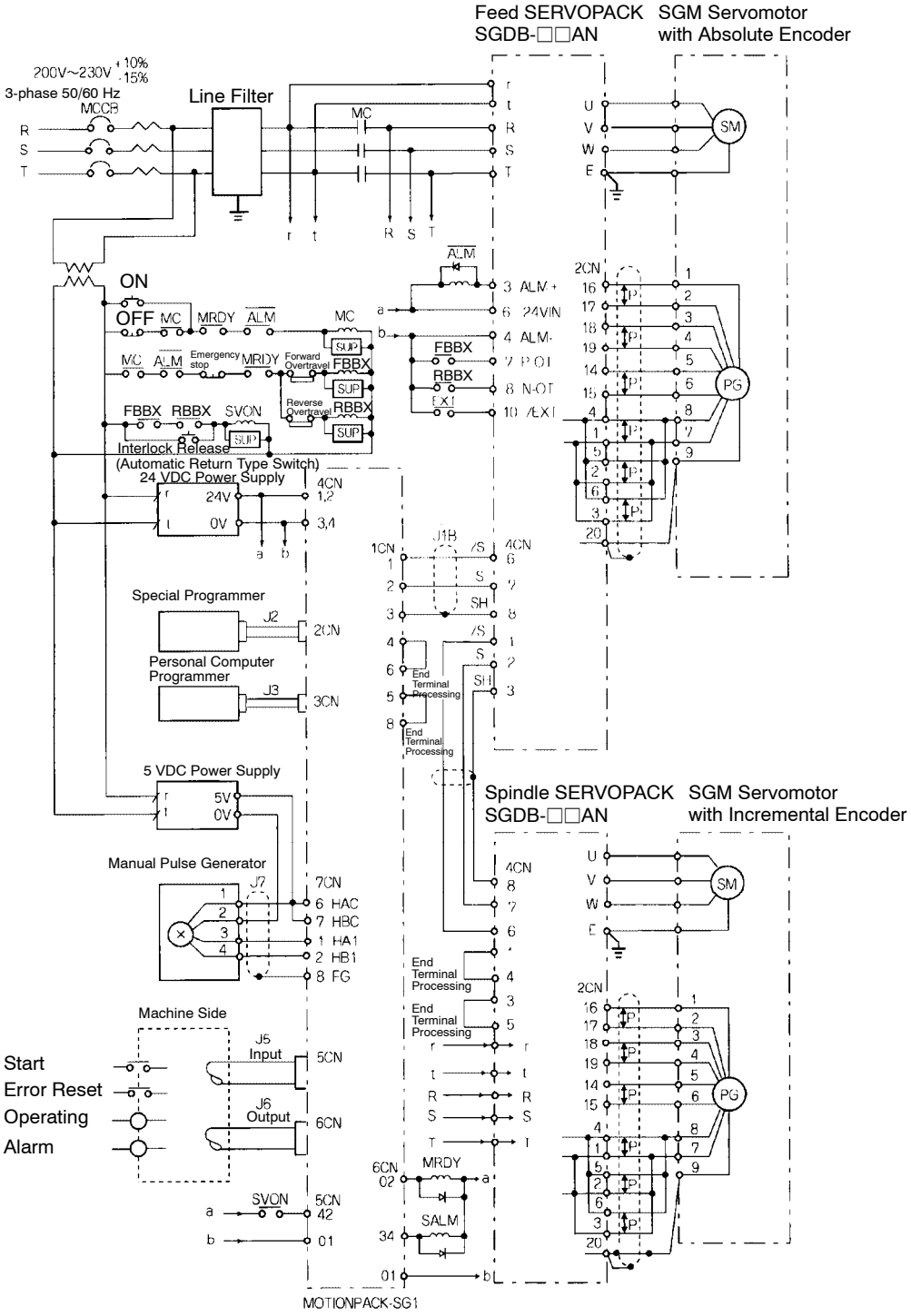
Note 1: Either the special programmer or the personal computer programmer is available.

2: End terminal processing is necessary for the last unit of MECHATROLINK.

3: Set the rotary switch (SW1) at the front of the SERVOPACK:
Feed axis: SW1 = 1
Spindle : SW1 = 2

(2) When using SGDB Servos for Both Feed Axis and Spindle

Motors with incremental encoders are provided with feed axis.



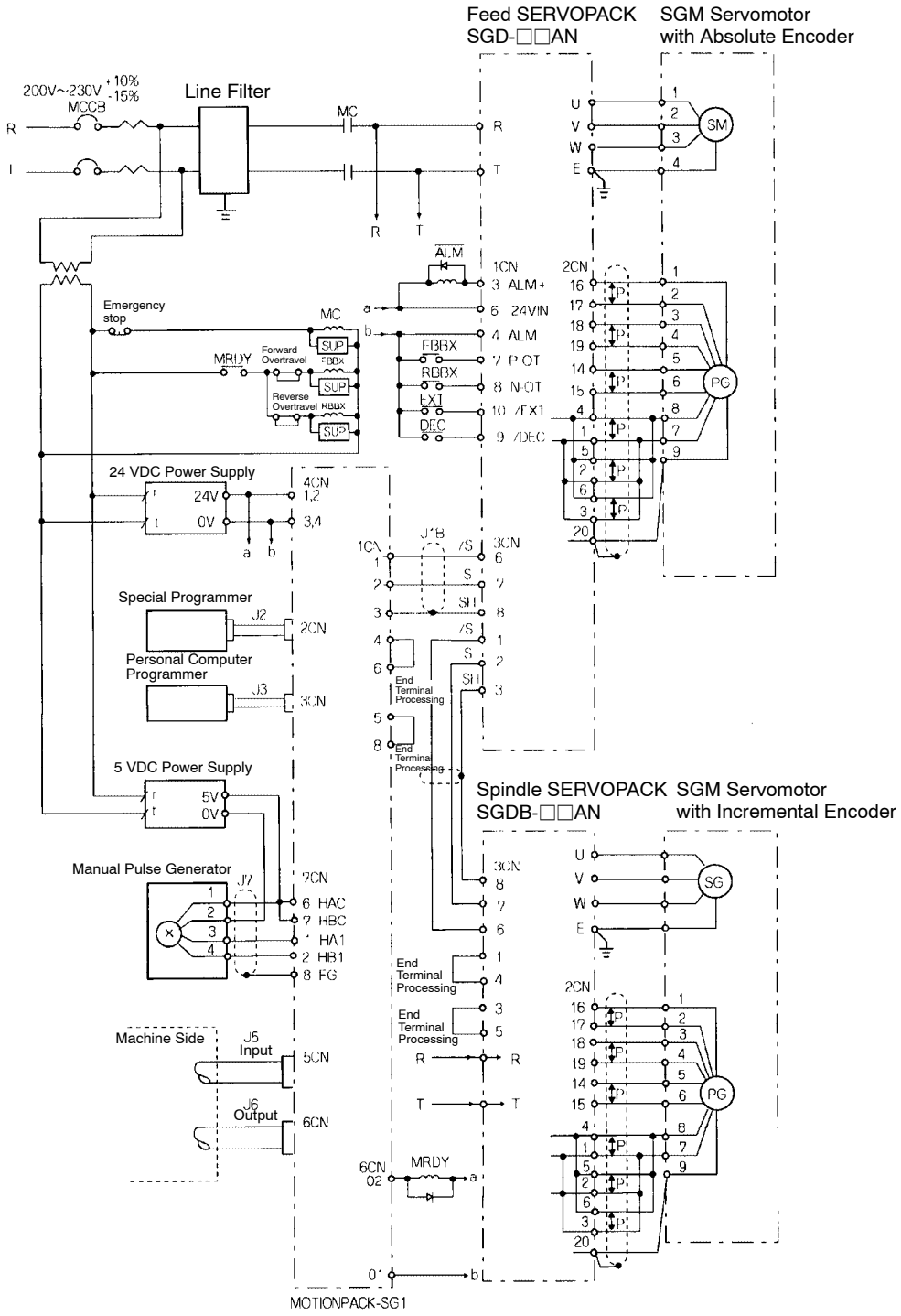
Note 1: Either the special programmer or the personal computer programmer is available.

2: End terminal processing is necessary for the last unit of MECHATROLINK.

3: Set the rotary switch (SW1) at the front of the SERVOPACK:
Feed axis: SW1 = 1
Spindle : SW1 = 2

(3) When using SGD Servos for Both Feed Axis and Spindle

Motors with absolute encoders are provided with feed axis.



Note 1: Either the special programmer or the personal computer programmer is available.

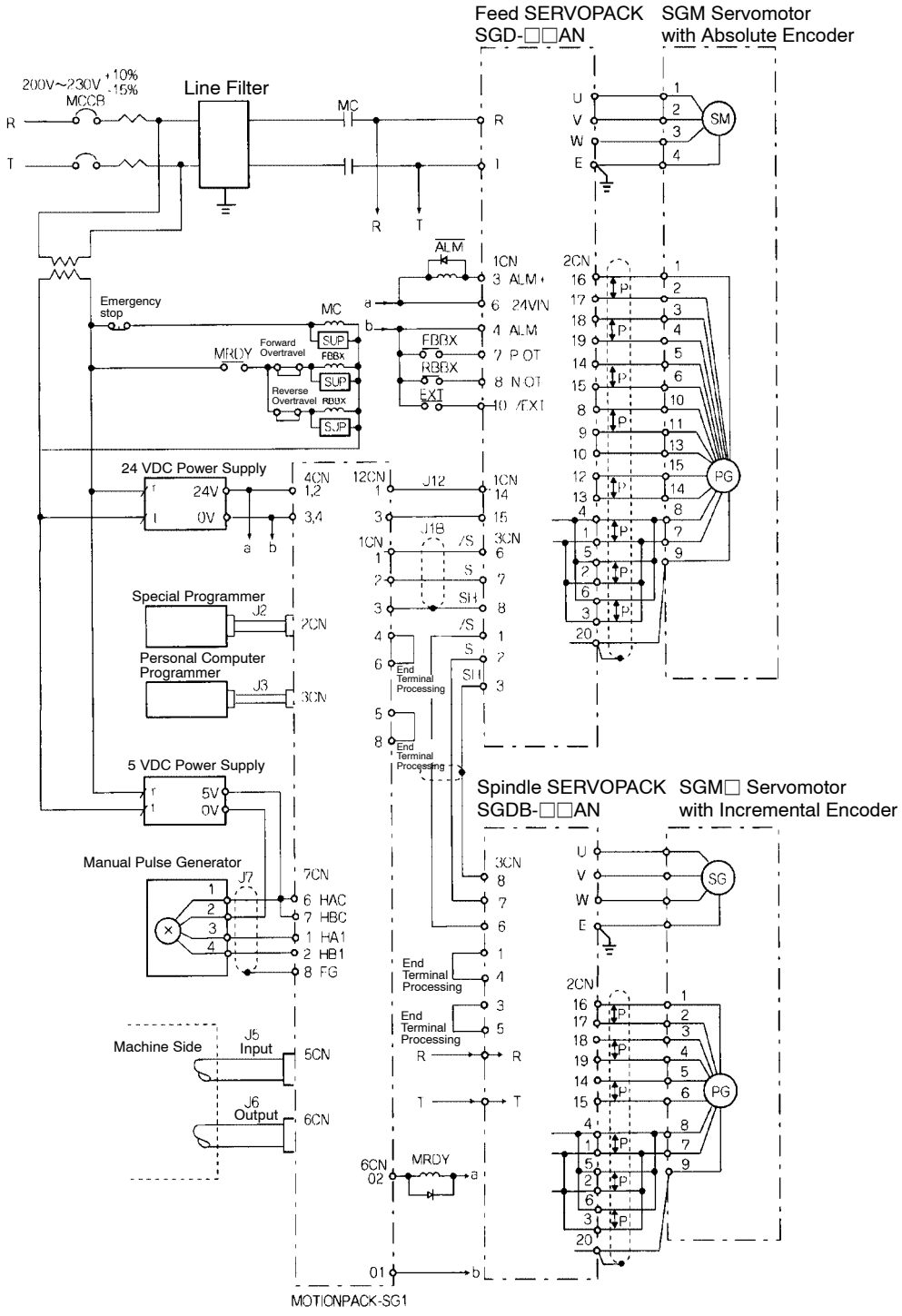
2: End terminal processing is necessary for the last unit of MECHATROLINK.

3: Set the rotary switch (SW1) at the front of the SERVOPACK:
Feed axis: SW1 = 1
Spindle : SW1 = 2

4: When the emergency stop is pressed, SGD-AN is turned OFF, causing system check error (communication error with servo) with MOTIONPACK-SG1. To release the emergency stop, turn ON the ERS (error reset) signal over 3 seconds or more after release, and reset the system check error.

(4) When using SGD Servos for Both Feed Axis and Spindle

Motors with incremental encoders are provided with feed axis.



Note 1: Either the special programmer or the personal computer programmer is available.

2: End terminal processing is necessary for the last unit of MECHATROLINK.

3: Set the rotary switch (SW1) at the front of the SERVOPACK:
Feed axis: SW1 = 1
Spindle : SW1 = 2

4: When the emergency stop is pressed, SGD-AN is turned OFF, causing system check error (communication error with servo) with MOTIONPACK-SG1. To release the emergency stop, turn ON the ERS (error reset) signal over 3 seconds or more after release, and reset the system check error.

4.2 CONTROL POWER SIGNAL (4CN)

Table 4.1 Control Power Signal (4CN)

No.	Item	Contents
1	Terminal layout	B4PS-VH 1 — 24 V 2 — 24 V 3 — 0 V 4 — 0 V

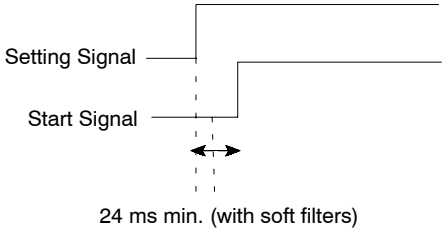
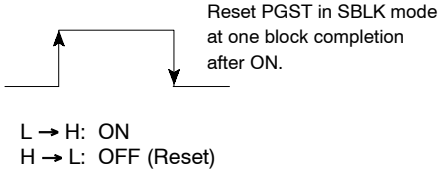
4.3 DIGITAL INPUT SIGNAL (5CN)

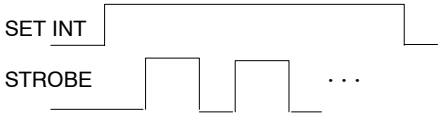
4.3.1 Signal Specifications

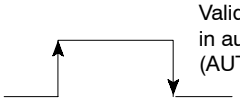
4

Table 4.2 Signal Specifications

No.	Item	Contents
1	Signal Specifications - discrete I/O board	Input signal current 24 VDC, 5 mA at ON 1μA at OFF Input signal common 0 V/24 V common switching available Input signal minimum continuous time 24 ms (with soft filter) 2 ms (without soft filter)
2	Input signal	MR-50RMA4 — MOTIONPACK 5CN EDIT mode (EDIT) — 02 AUTO mode (AUTO) — 34 JOG mode (JOG) — 03 HANDL mode (HANDL) — 19 JOG select(J SV/J SP) — 36 JOG speed (JSPD) — 35 +JOG start (+JS) — 04 –JOG start (–JS) — 20 Return (ZRN) — 26 Single-block (SBLK) — 21 Program start (PGST) — 05 Program select 1 (PGSL1) — 37 Program select 2 (PGSL2) — 06 Program select 3 (PGSL3) — 22 Program select 4 (PGSL4) — 38 Program select 5 (PGSL5) — 07 Program select 6 (PGSL6) — 23 External skip 5 (ESP5) — 09 External skip 6 (ESP6) — 25 External positioning completion (G34F) — 11 Follow-up operation completion (G85F) — 27 M completion (M-FIN) — 43 INC T8/T9 (INC 8/9) — 40

<table>
<tr><th>No.</th><th>Item</th><th>Contents</th></tr>
<tr><td>2</td><td>Input signal</td><td>
+ increment (+INC) — 08
– increment (–INC) — 24
Error reset (ERS) — 39
Program clear (PGCL) — 10
Spindle clear (SCLR) — 41
Servo ON (SVON) — 42
Condition jump 0 (D0) — 47
Condition jump 1 (D1) — 16
Condition jump 2 (D3) — 32
Condition jump 3 (D4) — 48
External data setting (I-DATA0) — 13
External data setting (I-DATA1) — 29
External data setting (I-DATA2) — 45
External data setting (I-DATA3) — 14
External data setting (I-DATA4) — 30
External data setting (I-DATA5) — 46
External data setting (I-DATA6) — 15
External data setting (I-DATA7) — 31
External data setting (IN/OUT) — 12
External data setting (STROBE) — 28
External data setting (SET INT) — 44
Reserved
Reserved
Reserved
0 V or 24 V — 01
0 V or 24 V — 33
</td></tr>
<tr><td>3</td><td>Input Signal Classification</td><td>
<table>
<tr><th colspan="2">Classification</th><th>Signal Name</th><th>Timing</th></tr>
<tr><td rowspan="3">Setting Signal</td><td>Mode signal</td><td>EDIT, AUTO, JOG, HANDL, SBLK</td><td rowspan="3">< Level signal >
 
</td></tr>
<tr><td>Program select signal</td><td>PGSL1 – PGSL6</td></tr>
<tr><td>Other setting</td><td>JSPD
SV ON,
J SV/J SP</td></tr>
<tr><td rowspan="2">Start Signal</td><td>Operation signal</td><td>+JS/+SS, –JS/ –SS, ZRN, PGST</td><td>< Transient signal>
 
</td></tr>
</table>
</td></tr>
</table>

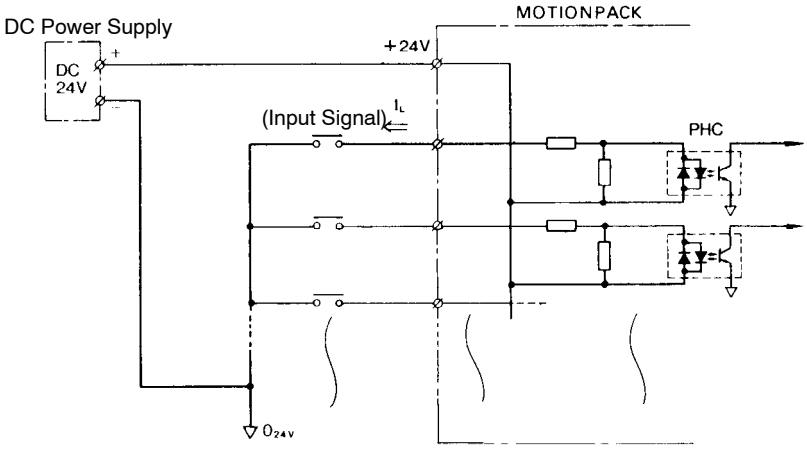
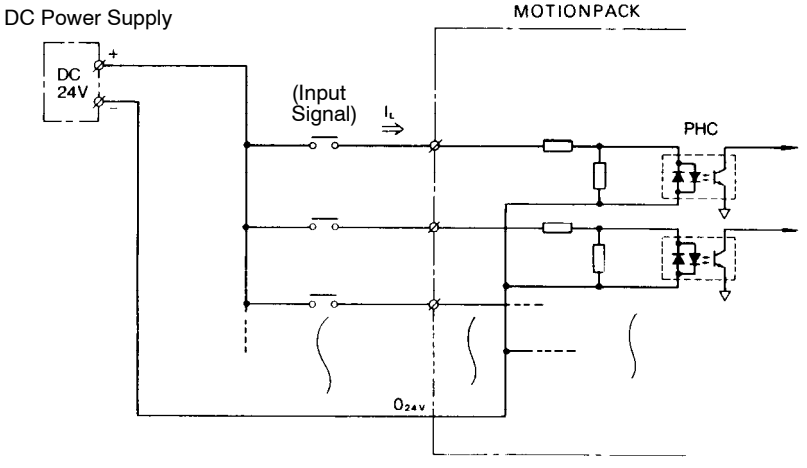
<table>
<tr><th>No.</th><th>Item</th><th>Contents</th></tr>
<tr><td>3</td><td>Input Signal Classification</td><td>
<table>
<tr><th colspan="2">Classification</th><th>Signal Name</th><th>Timing</th></tr>
<tr><td rowspan="2">External Data Setting</td><td>Setting data</td><td>I-DATA0 to I-DATA7, IN/OUT</td><td rowspan="2">< Level signal >
Turn ON the start signal (STROBE) for each data setting after turning ON the function selection signal (SET INT).
 

OFF timing of STROBE signal is at receiving SET RDY (output signal).</td></tr>
<tr><td>Start signal</td><td>STROBE, SET INT</td></tr>
<tr><td colspan="2">Incremental command</td><td>+INC, –INC, INC8/9</td><td>< Transient signal>
 

L → H: ON
H → L: OFF</td></tr>
<tr><td colspan="2">Skip input</td><td>ESP5, ESP6, G34F, G85F</td><td>< Transient signal>
 
L → H: ON
H → L: OFF</td></tr>
<tr><td colspan="2">M completion signal</td><td>M-FIN</td><td>< Transient signal>
 

L → H: ON (M signal reset)
H → L: OFF (Next block start)</td></tr>
<tr><td colspan="2">Error reset</td><td>ERS</td><td>< Transient signal>
 

L → H: ON (Reset)
H → L: OFF</td></tr>
</table>
</td></tr>
</table>

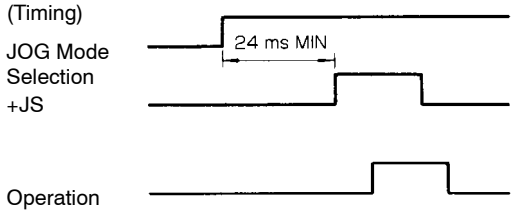
<table>
<tr><th>No.</th><th>Item</th><th>Contents</th></tr>
<tr><td>3</td><td>Input Signal Classification</td><td>
<table>
<tr><th>Classification</th><th>Signal Name</th><th>Timing</th></tr>
<tr><td>Condition jump</td><td>D0 to D3</td><td>< Level signal >
 
Valid only at execution of condition jump program</td></tr>
<tr><td>Clear signal</td><td>PGCL
SCLR</td><td>< Transient signal>
 
Valid only at feed hold
L → H: ON
H → L: OFF</td></tr>
</table>
</td></tr>
<tr><td>4</td><td>How to Build Input Circuit
0_{24} V Common
(Source Current)</td><td> 
</td></tr>
<tr><td>5</td><td>How to Build Input Circuit
+24 V Common
(Sink Current)</td><td> 
</td></tr>
</table>

4

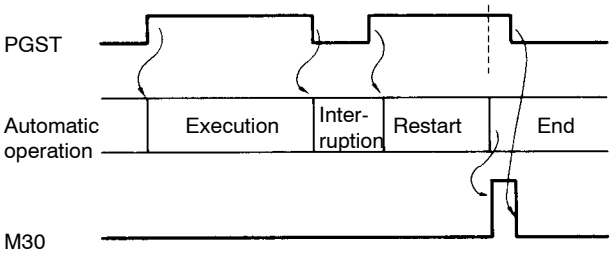
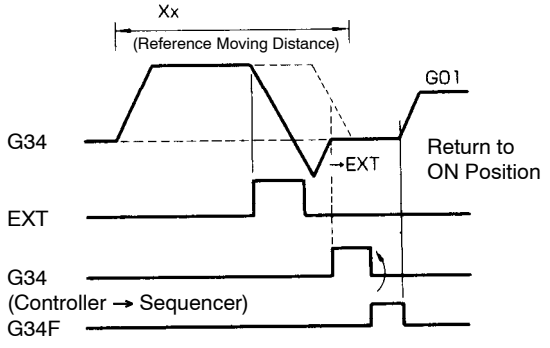
4.3.2 Input Signal Name and Contents

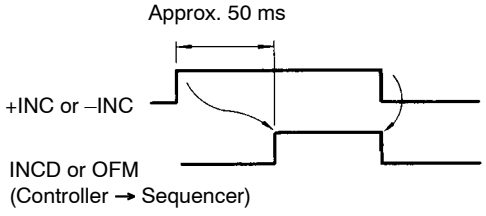
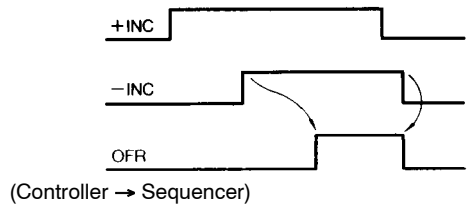
Table 4.3 Input Signal Name and Contents

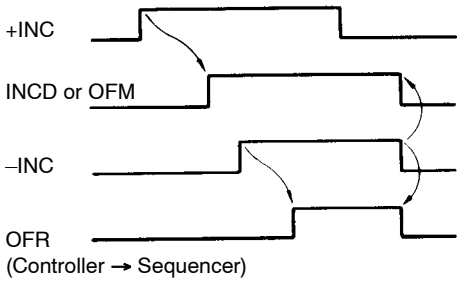
No.	Connector Pin No.	Name	Contents
1	5CN-02	EDIT mode (EDIT)	Turning ON this signal goes to EDIT mode and enables setting of programs or parameters by programmer. Even in EDIT mode, servo clamp operation continues.
2	5CN-34	AUTO mode (AUTO)	In AUTO mode, automatic operation is available. When EDIT mode signal is turned ON while this signal is ON, EDIT mode signal has priority. When more than one mode signal is entered, EDIT, HANDL, JOG, AUTO have the priority in this order.
3	5CN-03	JOG mode (JOG)	When this signal is turned ON while the EDIT and HANDL signals are OFF, JOG mode is entered. When this signal is turned ON during automatic operation, operation is interrupted and the machine decelerates to a stop. In automatic operation, program reset is executed, and the mode is changed to JOG, and output signal becomes as shown below. (1) Output signals that are turned OFF (a) Start signal (STL) (b) M decode signal (M50 to M58) (c) External positioning error signal (EPALM) (d) External positioning completion (G34) (e) Automatic operation completion (M30) (f) MOTIONPACK alarm (only stored stroke limit alarm) (g) Operating signal (OP) (h) Synchronous signal (SLPS) (i) Positioning completion (COIN) (2) Output signals that hold status (a) Operation ready signal (MRDY) (b) Battery alarm (BALM)
4	5CN-19	HANDL mode (HANDL)	When the EDIT mode is not entered, turning ON this signal enters HANDL mode. The motor is operated by pulse input from handle PG.
5	5CN-36	JOG select (J SV/J SP)	This signal designates the selection of controlled axis in JOG mode. When this signal is ON, the controlled axis of JOG operation is the spindle side, while it is OFF, the controlled axis is the servomotor side.

<table>
<tr><th>No.</th><th>Connector Pin No.</th><th>Name</th><th>Contents</th></tr>
<tr><td>6</td><td>5CN-35</td><td>JOG speed (JSPD)</td><td>The following shows the meanings of this signal when MOTION-PACK is in JOG or HANDL mode.
<table>
<tr><th rowspan="2">JSPD</th><th>JOG Mode</th><th>HANDL Mode</th></tr>
<tr><th>JOG Speed*</th><th>Pulse Magnification</th></tr>
<tr><td>OFF</td><td>Low speed</td><td>×1</td></tr>
<tr><td>ON</td><td>High speed</td><td>×100</td></tr>
</table>
*JOG speed is set by parameter.</td></tr>
<tr><td>7</td><td>5CN-04</td><td>+JOG start (+JS)</td><td>This signal is a start signal in the plus direction in JOG mode.
While this signal is turned ON, the machine moves in the plus direction at the feed speed selected by JOG speed (JSPD).
When this signal is turned OFF, the machine decelerates to a stop.
 

Note: Turn ON +JS at least 24 ms after JOG mode selection, JOG selection, and JOG speed selection are completed.</td></tr>
<tr><td>8</td><td>5CN-20</td><td>–JOG start (–JS)</td><td>Same as +JOG except that plus direction is replaced with minus direction.</td></tr>
<tr><td>9</td><td>5CN-26</td><td>Return (ZRN)</td><td>When ZRN signal is turned ON, operation under execution is interrupted and positioning is performed to the dwell position (defined by Pr7).
If ZRN signal is turned OFF during operation, the machine decelerates to a stop.
Rapid return operation is valid in AUTO mode and JOG mode.
Rapid return speed is defined by Pr6.
After Pr73=1 is set in the ABS-PG automatic home position setup method, PG home position setup operation is activated when ZRN signal is turned OFF to ON.</td></tr>
<tr><td>10</td><td>5CN-21</td><td>Single-block (SBLK)</td><td>Turning ON this signal in the automatic operation mode starts single-block operation. In this mode, the currently selected program is executed block by block at each time when PGST signal is turned ON.
At M30 execution, the program returns to the head and one block is executed.</td></tr>
</table>

No.	Connector Pin No.	Name	Contents
11	5CN-05	Program start (PGST)	Program execution starts when this signal is turned ON. When it is turned OFF during program execution, feed-hold status is entered. Turning it ON again restarts the execution. Turn OFF this signal after M30 signal is turned ON after the program is completed. 
12	5CN-37 5CN-06 5CN-22 5CN-38 5CN-07 5CN-23	Program select 1 (PGSL1) Program select 2 (PGSL2) Program select 3 (PGSL3) Program select 4 (PGSL4) Program select 5 (PGSL5) Program select 6 (PGSL6)	Turn ON the signal 24 ms prior to input PGST signal. By combining PGSL1 to 6, the head block of program to be selected ranges from 0 to 63. By providing the jump command to this block, each program is executed.
13	5CN-09	External skip 5 (ESP5)	When ESP5 signal is turned ON during feeding by G05 command, the machine decelerates to a stop and then the program of the next block is executed.
14	5CN-25	External skip 6 (ESP6)	ESP6 is for G06 command.
15	5CN-11	External positioning completion (G34F)	This signal is the FIN signal to reset the MOTIONPACK external positioning completion (G34) output signal for the external positioning operation by G34 command, and proceeds the program to next block. When MOTIONPACK outputs external positioning alarm (EPALM) signal, EPALM signal can be reset by G34F input. When G34F is turned OFF, program goes to the next block.  Note: Response time from EXT ON to position stored is 20μs.

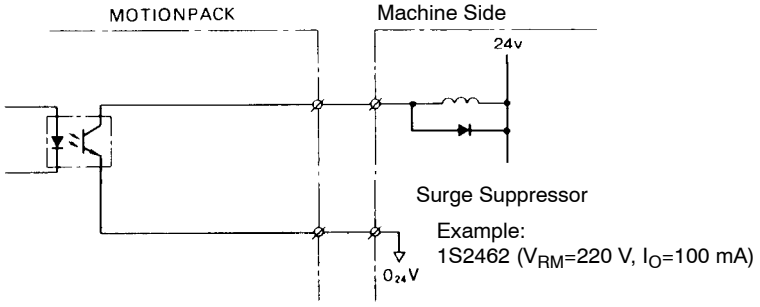
No.	Connector Pin No.	Name	Contents
16	5CN-27	Follow-up operation completion (G85F)	When follow-up operation is performed by G85/G75 follow-up operation start command, the FIN signal completes the follow-up operation, and the program of the next block is executed. To enter the other mode, it is necessary to perform G94.
17	5CN-43	M completion (M-FIN)	This signal clears M decode output (M50 to M58), and proceeds the program to next block. When M-FIN signal is turned ON, M decode output is cleared. Then when M-FIN signal is turned OFF, the next block program is executed.
18	5CN-40	INCT$_8$/T$_9$ (INC8/9)	This signal specifies coordinates (T$_8$ or T$_9$) to perform the coordinates compensation by +INC or –INC. INC8/9 = OFF : T$_8$ designation INC8/9 = ON : T$_9$ designation
19	5CN-08 5CN-24	+ incremental (+INC) – incremental (–INC)	When this signal is turned ON, incremental value (set by parameters) is added/subtracted to/from offset register corresponding to the coordinate system designated by INC8/9. These signals are executed only in AUTO mode when the machine stops . When +/–INC incremental commands are turned ON simultaneously, offset register is cleared to 0. When offset register value reaches or exceeds offset value ±maximum value (determined by parameters) after tool offset register addition is completed by +/– incremental commands, the offset value ± max reach signal (OFM) signal is output. If not, ±incremental completion(INCD) signal is output.  When +/– incremental commands are turned ON simultaneously, offset register is cleared to 0, and offset value (OFR) signal is output. (1) When –INC is turned ON before completion (INCD or OFM) signal is output by +INC 

No.	Connector Pin No.	Name	Contents
19	5CN-08 5CN-24	+ incremental (+INC) – incremental (–INC)	(2) When –INC is turned ON after completion signal is output by +INC 
20	5CN-39	Error reset (ERS)	If an alarm occurs, it can be reset by this signal. However, the following alarms cannot be reset: CPU error, parameter error, S-I/F down, communication setting error, CPU overrun
21	5CN-10	Program clear (PGCL)	When this signal is turned ON in the feed-hold status, program under execution is cleared. OP, STL, G34, EPALM, SLPS, M50 to M58 signals, and G85F are OFF.
22	5CN-41	Spindle clear (SCLR)	When this signal is turned ON, spindle stop command is sent.
23	5CN-42	Servo ON (SVON)	This signal enables to turn ON/OFF the servo clamp. (SVON) = ON : Servo clamp ON (SVON) = OFF : Servo clamp OFF When (SVON) = OFF to clear servo clamp, MP ready completion (MRDY) signal is turned OFF. However, when Pr39=1, MRDY is not turned OFF even if (SVON) = OFF but if the other conditions are established.
24	5CN-47 5CN-16 5CN-32 5CN-48	Condition jump 0 (D0) Condition jump 1 (D1) Condition jump 2 (D2) Condition jump 3 (D3)	This is the signal for G65/G66 condition jump command.
25	5CN-13 5CN-29 5CN-45 5CN-14 5CN-30 5CN-46 5CN-15 5CN-31 5CN-12 5CN-28 5CN-44	External data setting (I-DATA0) (I-DATA1) (I-DATA2) (I-DATA3) (I-DATA4) (I-DATA5) (I-DATA6) (I-DATA7) (IN/OUT) (STROBE) (SET INT)	This is the input signal to be used when performing external data setting functions. I-DATA0 to I-DATA7 : Write data IN/OUT (0: IN, 1: OUT) : Setting/read selection STROBE : Setting data transfer SET INT : External data setting start

4.4 DIGITAL OUTPUT SIGNAL (6CN)

4.4.1 Signal Specifications

Table 4.4 Signal Specifications

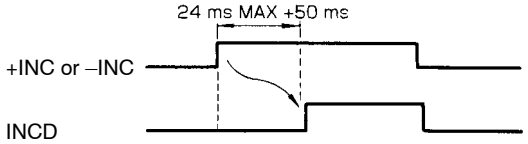
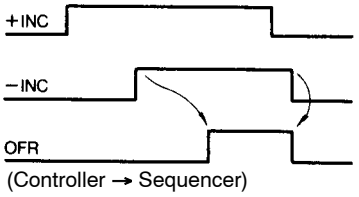
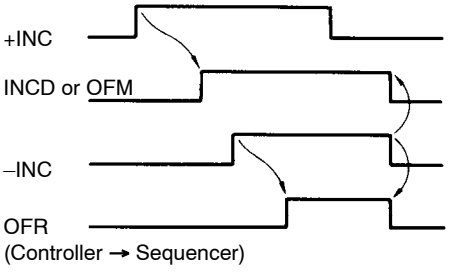
No.	Item	Contents
1	Signal Specifications - discrete I/O board	Output signal capacity 24 VDC, 50 mA max. Output circuit type No-contact output
2	Output Circuit Protective Actions	When an inductive load such as relay coils is connected, make sure to insert a surge suppressor within 20 cm of the load. If the surge suppressor polarities are reversed, the controller no-contact output circuit may be broken. 
3	Output signal	MOTIONPACK MR-50RFA4 6CN 02 — Controller ready completion (MRDY) 34 — System alarm (SALM) 03 — Operating (OP) 19 — Starting (STL) 20 — ± incremental completion (INCD) 35 — Offset value reset (OFR) 04 — Offset value ± maximum reach (OFM) 24 — External positioning completion (G34) 40 — External positioning alarm (EPALM) 36 — Automatic operation completion (M30) 05 — M50 (M50) 21 — M51 (M51) 37 — M52 (M52) 06 — M53 (M53) 22 — M54 (M54) 38 — M55 (M55) 07 — M56 (M56) 23 — M57 (M57) 39 — M58 (M58) 08 — During current limiting (CLD) 13 — Zone signal 1 (PSW1) or home positioning completion (ZPM) 29 — Zone signal 2 (PSW2) or home position adjacent (ZNP)

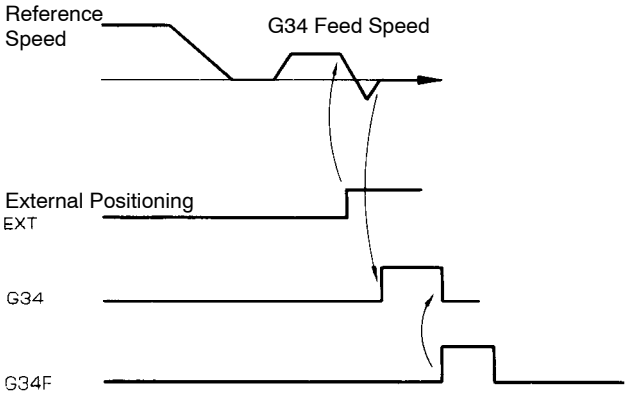
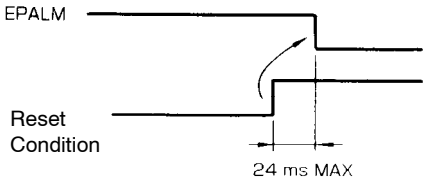
No.	Item	Contents
3	Output signal	45 — Zone signal 3 (PSW3) 14 — Zone signal 4 (PSW4) 30 — Zone signal 5 (PSW5) 46 — Zone signal 6 (PSW6) 15 — Zone signal 7 (PSW7) 31 — Zone signal 8 (PSW8) 09 — Battery alarm (BALM) 25 — Synchronous operation (SLPS) 26 — External data setting (D-DATA0) 42 — External data setting (D-DATA1) 11 — External data setting (D-DATA2) 27 — External data setting (D-DATA3) 43 — External data setting (D-DATA4) 12 — External data setting (D-DATA5) 28 — External data setting (D-DATA6) 44 — External data setting (D-DATA7) 41 — External data setting (SET RDY) 10 — External data setting (ALM) 47 — Positioning completion (COIN) — Reserved — Reserved — Reserved — Reserved — Reserved — Reserved — Reserved 01 — 0 V 33 — 0 V

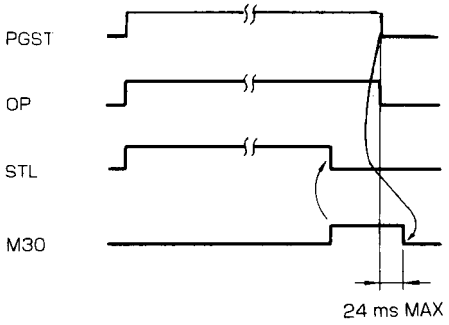
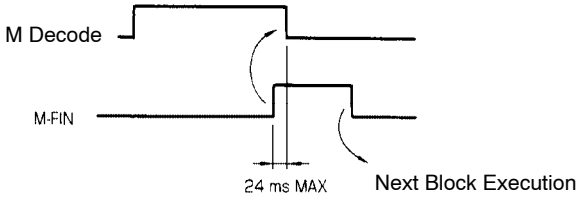
4.4.2 Output Signal Name and Contents

Table 4.5 Output Signal Name and Contents

No.	Connector Pin No.	Name	Contents
1	6CN-02	Controller ready completion (MRDY)	Indicates that MOTIONPACK is ready for operation. MRDY = (controller RUN) (controller operation mode) (SVON = ON) (servo main circuit power ON) (SALM = OFF) (absolute value data read completion) When the above conditions are established, controller is ready for operation. Controller operation mode: AUTO, JOG, HANDL
2	6CN-34	System alarm (SALM)	Alarm output of MOTIONPACK system. Details of alarm contents can be monitored by the programmer. This signal is reset using the alarm reset ERS signal.
3	6CN-03	Operating (OP)	Indicates that the MOTIONPACK is in automatic operation. This signal is turned ON during program operation or single-block operation. Even when the program start input signal is turned OFF (feed-hold status), the operating signal (OP) is not turned OFF. The following shows the conditions where the OP signal is turned OFF. (1) The mode is switched. (2) M30 execution is completed. (3) Program is input during feed–hold status. (4) Return to home position is started.
4	6CN-19	Starting (STL)	Indicates that the MOTIONPACK is in automatic operation. This signal is turned ON during program operation or single-block operation. Even when the program start input signal is turned OFF (feed-hold status), the starting signal (STL) is not turned OFF. The following shows the conditions where the STL signal is turned OFF. (1) The mode is switched. (2) M30 execution is completed. (3) One block is completed during single-block operation. (4) Program clear is input during feed–hold status. (5) Return to home position is started.

No.	Connector Pin No.	Name	Contents
5	6CN-20	± Incremental completion (INCD)	When offset register addition is completed by + (or –) incremental command, ± incremental completion (INCD) signal is output if the offset register value has not reached (or exceeded)the offset value ± max value. The INCD output delays up to 74 ms. This is because a 50 ms software timer is provided to check whether +/ –INC are turned ON simultaneously and because signal read-in time is 24 ms maximum. Reset condition: +INC (or –INC) is turned OFF. 
6	6CN-35	Offset value reset (OFR)	When + and – incremental commands are turned ON simultaneously, the offset register is cleared to 0 and offset value reset (OFR) signal is output. (1) When –INC is turned ON before completion (INCD or OFM) signal is output by +INC  (2) When –INC is turned ON after completion signal is output by +INC  OFR reset condition is that both + and –signals are turned OFF simultaneously.
7	6CN-04	Offset value ± max reach (OFM)	This signal is turned ON when offset absolute value in the offset register exceeds the maximum value set by parameter. The timing to turn ON and reset are the same as those for INCD signal.

No.	Connector Pin No.	Name	Contents
8	6CN-24	External positioning completion (G34)	In the external positioning (G34 command), when the external positioning signal (EXT) is turned ON, the machine decelerates to a stop and positions after returning to the position where the EXT was turned ON. After positioning, in-position check is performed. When there is no error, this external positioning completion signal (G34) is turned ON. This signal is turned OFF when the external positioning completion signal (G34F) is turned ON. 
9	6CN-40	External positioning alarm (EPALM)	An alarm signal at external positioning (G34 command). The following describes the conditions of the alarm. (1) The machine reaches the position specified by X(U) after G34 execution and the EXT is not turned ON until feed is in-position. (2) If EXT or G34F signal is already “ON” when G34 command executes status, both signals will not turn OFF until 2 seconds have passed. The following describes the conditions required for this signal to be reset. (1) G34F signal is turned OFF to ON. (2) Operation mode is changed. (3) A new program starts. 

No.	Connector Pin No.	Name	Contents
10	6CN-36	Automatic operation completion (M30)	This signal is turned ON when the program completion command (M30) is executed in automatic operation. When the program start signal (PGST) is turned OFF, this signal is reset. 
11	6CN-05 6CN-21 6CN-37 6CN-06 6CN-22 6CN-38 6CN-07 6CN-23 6CN-39	M50 (M50) M51 (M51) M52 (M52) M53 (M53) M54 (M54) M55 (M55) M56 (M56) M57 (M57) M58 (M58)	When M function command is executed, a corresponding signal within M50 to M58 is turned ON. These signals are reset when the M completion signal (M-FIN) is turned OFF. 
12	6CN-08	During current limiting (CLD)	The CLD signal is turned ON when the motor load current exceeds the current limit value.
13	6CN-09	Battery alarm (BALM)	This signal is turned ON when the battery memory back-up and built-in absolute encoder, becomes lower than a certain voltage. Replace the battery within a month. This signal cannot be reset by the ERS (reset) signal. This alarm signal output will not affect the MOTIONPACK operation.
14	6CN-25	Synchronous operation (SLPS)	This signal is turned ON when the servomotor is synchronous with the spindle in solid tap or follow-up operation function command. However, in the case of G97 command, this signal is turned ON after completion of feed axis positioning and in-positioning.
15	6CN-13 6CN-29 6CN-45 6CN-14 6CN-30 6CN-46 6CN-15 6CN-31	Zone signal 1 (PSW1) Zone signal 2 (PSW2) Zone signal 3 (PSW3) Zone signal 4 (PSW4) Zone signal 5 (PSW5) Zone signal 6 (PSW6) Zone signal 7 (PSW7) Zone signal 8 (PSW8)	Output is turned ON in the zone set by parameter. There are eight (PSW1 to PSW8) and four zones per signal that can be set independently by parameter. PSW is output after absolute value data are read-in, disregarding program execution. However, in incremental system, signal specifications are as shown below: PSW1 : Home return completion (ZPM) PSW2 : Home position adjacent (ZNP) PSW3 to PSW8 : Reserved (SPARE)

No.	Connector Pin No.	Name	Contents
16	6CN-26 6CN-42 6CN-11 6CN-27 6CN-43 6CN-12 6CN-28 6CN-44 6CN-41 6CN-10	External data setting (D-DATA0) (D-DATA1) (D-DATA2) (D-DATA3) (D-DATA4) (D-DATA5) (D-DATA6) (D-DATA7) (SET RDY) (ALM)	These signals are to be used when using the external data setting function. 0-DATA 0 to 7 : Output data SET RDY : External data setting ready ALM : Data format error
17	6CN-47	Positioning completion (COIN)	This signal indicates motor movement completion at positioning control. When this signal is turned ON, it means positioning is completed. OFF means that positioning is not completed.

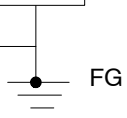
4.5 SERVO I/O SIGNAL FOR MECHATROLINK (1CN)

Table 4.6 Servo I/O Signal for MECHATROLINK (1CN)

No.	Item	Contents
1	Terminal layout	MR-8RMA4G 1 /S 2 S 3 SH 4 R 5 FG 6 /S 7 S 8 SH

4.6 SPECIAL PROGRAMMER SIGNAL (2CN)

Table 4.7 Special Programmer Signal (2CN)

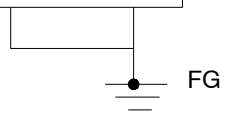
No.	Item	Contents
1	Terminal layout	17LE–13090–27 1 RXD1 2 *RXD1 3 TXD1 4 *TXD1 5 6 +5 V 7 +5 V 8 0 V 9 0 V  Cable is attached to programmer. By cable connection, either 2CN or 3CN connector becomes automatically valid. (not available simultaneously)

4.7 PERSONAL COMPUTER PROGRAMMER SIGNAL (3CN)

Table 4.8 Personal Computer Programmer Signal (3CN)

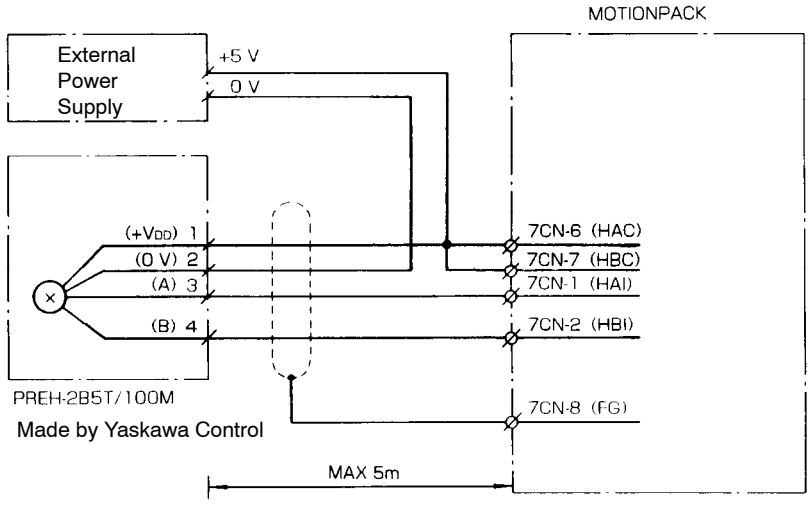
No.	Item	Contents
1	Terminal layout	17LE-23090-27

1	
2	/RXD
3	/TXD
4	
5	GND
6	
7	RTS
8	CTS
9	

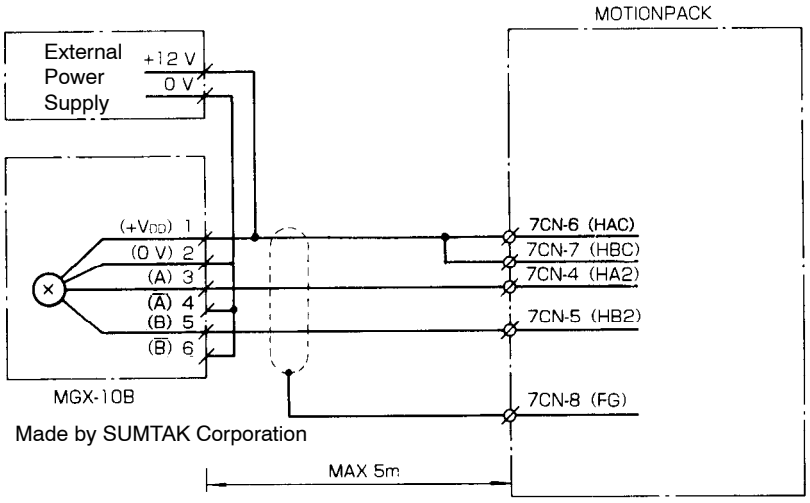


4.8 MANUAL PULSE GENERATOR SIGNALS (7CN)

Table 4.9 Manual Pulse Generator Signals (7CN)

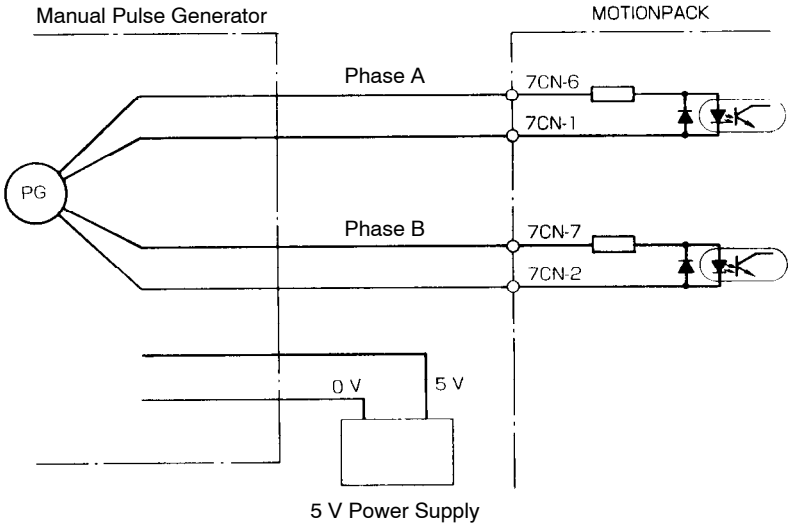
<table>
<tr><th>No.</th><th>Item</th><th>Contents</th></tr>
<tr><td>1</td><td>Terminal layout</td><td>MR-8RMA4G
<table><tr><td>1</td><td>HA1</td></tr><tr><td>2</td><td>HB1</td></tr><tr><td>3</td><td></td></tr><tr><td>4</td><td>HA2</td></tr><tr><td>5</td><td>HB2</td></tr><tr><td>6</td><td>HAC</td></tr><tr><td>7</td><td>HBC</td></tr><tr><td>8</td><td>FG</td></tr></table></td></tr>
<tr><td>2</td><td>Signal</td><td><table><tr><th>Signal Name</th><th>Contents</th></tr><tr><td>HA1, HB1</td><td>5 V signal input of phase A/B</td></tr><tr><td>HA2, HB2</td><td>12 V signal input of phase A/B</td></tr><tr><td>HAC, HBC</td><td>5 V/12 V input of common for phase A/B</td></tr><tr><td>FG</td><td>Frame ground</td></tr></table></td></tr>
<tr><td>3</td><td>Connection examples</td><td>Connection between manual pulse generator and MOTIONPACK-SG1
(1) 5 V Manual Pulse Generator
 
</td></tr>
</table>

No.	Item	Contents
3	Connection examples	(2) +12 V Manual Pulse Generator



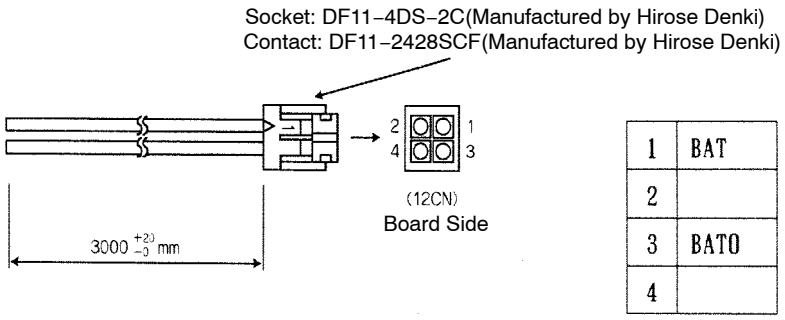
Note: The above figure shows the connection of voltage level output.

(3) Line Driver Output



4.9 ABSOLUTE VALUE ENCORDER BACKUP BATTERY SIGNAL (12CN)

Table 4.10 Absolute Value Encoder Backup Battery Signal (12CN)

No.	Item	Contents
1	Connection examples	Connect to J12 special cable, model: JEMP–W120. 

5

CONTROLLER PARAMETERS

This chapter describes the parameters for MOTIONPACK-SG1.

5.1 DETAILS OF PARAMETERS

Remarks

U : Can be changed anytime.

P : Can be changed in EDIT mode. Effective after turning OFF power supply once and then ON again.

S : Can be changed when motor stops.

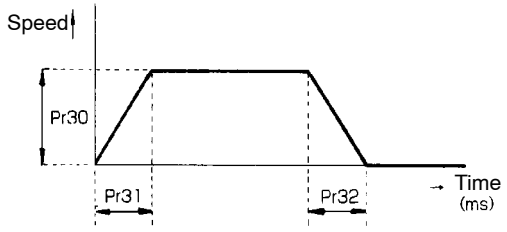
SS : Can be changed when spindle motor stops.

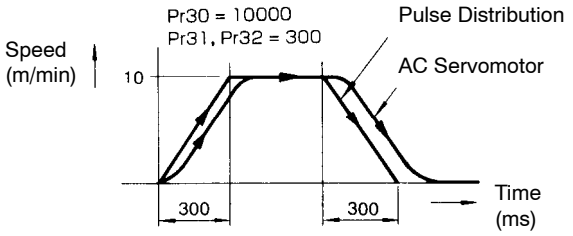
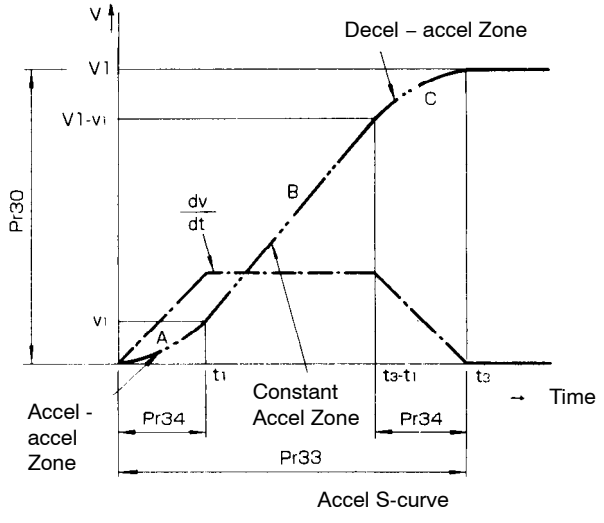
T : Can be changed when motor stops. Effective after turning OFF power supply once and then ON again.

G : Can be changed by G code.

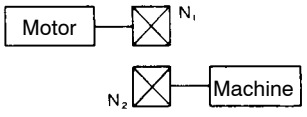
Table 5.1 Details of Parameters

Parameter No.	Name (Range/Unit)	Change	Description
Pr1	JOG low speed (0 to 99999/speed unit)	U	Parameter to define JOG speed. JOG speed becomes this parameter value when JSPD signal is OFF.
Pr2	JOG high speed (0 to 99999/speed unit)	U	Parameter to define JOG speed. JOG speed becomes this parameter value when JSPD signal is ON.
Pr3	HANDL feed maximum speed (0 to 99999/speed unit)	U	Parameter to define the maximum speed at HANDL operation. Pr5 = 0 : Pulses above Pr3 are accumulated and the motor runs even after handle operation is stopped. Pr5 = 1 : Pulses above Pr3 are revoked.
Pr4	JOG low speed feed torque limit (0 to 400/%)	S	Parameter to set JOG low speed feed torque limit. Set in % for the motor rated torque.
Pr5	HANDL PG Reference Speed/Position Change (0, 1/–)	S	0 : Position reference is given and the motor runs as many pulses as HANDL PG generates. When the number of pulses is so large that the motor cannot follow,the motor keeps rotating even after HANDL PG is stopped. 1 : Speed reference is given and the motor runs as many pulses as HANDL PG generates. When the number of pulses is so large that the motor cannot follow, the pulses that cannot be discharged are revoked. The motor will not run after HANDL PG is stopped.
Pr6	Rapid return speed (0 to 99999/speed unit)	U	When the return signal (ZRN) is turned ON during program operation, “rapid return” operation is entered regardless of executing program and the axis returns to the dwell position. This parameter defines the speed. For systems equipped with incremental encoder, this parameter is not used.
Pr7	Dwell position (–99999999 to +99999999/ reference unit)	S	Defines “rapid return” dwell position. The dwell position is set To coordinates. For systems equipped with incremental encoder, the dwell position after reference point setup is defined.
Pr13	Software filter (0, 1/–)	S	0 : Software filter provided (Input signal sampling 10 msec) 1 : Software filter not provided (Input signal sampling 2 msec)

Parameter No.	Name (Range/Unit)	Change	Description
Pr14	Pulse output stop time at current limitation (0 to 32767/ms)	S	The current limitation signal (CLD) is output during current limitation. This parameter is set when this signal output is too short to be detected by host PLC. By setting not to stop the pulse output for a certain time after current limitation, CLD signal output time can be made longer.
Pr20	Coordinate System 8 one-time offset value (0 to 400/reference unit)	U	Defines offset value for one-time set up by incremental signal (+INC or –INC). At this time, it is necessary to turn OFF coordinate system designation signal INC 8/9.
Pr21	Coordinate System 8 maximum offset value (0 to 99999999/reference unit)	U	Defines maximum offset value for coordinate system T_8 by incremental signal(+INC or –INC). Any signals exceeding maximum value cannot be accepted. Set 0 when the offset function is not used.
Pr22	Coordinate System 9 one-time offset value (0 to 400/reference unit)	U	Defines offset value for one-time set up by incremental signal (+INC or –INC). At this time, it is necessary to turn ON coordinate system designation signal INC 8/9.
Pr23	Coordinate System 9 maximum offset value (0 to 99999999/reference unit)	U	Defines maximum offset value for coordinate system T_9 by incremental signal(+INC or –INC). Any signals exceeding this maximum value cannot be accepted. Set 0 when the correction function is not used.
Pr24	Reserved		
Pr25	Reserved		
Pr30	Maximum speed (0 to 99999/speed unit)	S	Motor accel/decel speed is defined by Pr30, Pr31, or Pr32. Set the maximum speed to be used in the system for Pr30. Set the time to reach the maximum speed to Pr31, and set the deceleration time to Pr32. ACCEL RATE = (Pr30/Pr31) DECEL RATE = (Pr31/Pr32)  For accel/decel speed setting, calculate mechanical inertia and time in which acceleration is possible. When torque limit is provided in program, the accel/decel time slows in accordance with the torque limit.

Parameter No.	Name (Range/Unit)	Change	Description
Pr31	Linear accel/decel time (0 to 60000/ms)	S	<Example> Drill machines Assuming speed reference unit is mm/min, when maximum speed 10 m/min is reached in 300 ms, set parameters as follows: Pr30 = 100000 Pr31, Pr32 = 300 
Pr32	Linear accel/decel time (0 to 60000/ms)	S	
Pr33	S-curve accel/decel time (0 to 10000/ms)	S	S-curve accel/decel control is defined by three parameters, Pr30,Pr33 and Pr34. Pr30 defines the maximum speed and is used in common for linear accel/decel control. Pr33 defines S-curve accel/decel time and is equivalent to Pr31 and Pr32 of linear accel/decel control. Pr34 defines the S-curve time in constant accel/decel zone. This time indicates the length of accel – accel zone(accel rate increases at a constant ratio)and decel – accel zone(accel rate decreases at a constant ratio). The upper limit value of Pr34 is smaller value of either 2000 ms or Pr33/2. 
Pr34	S-curve accel/decel time (0 to 2000/ms)	S	

5

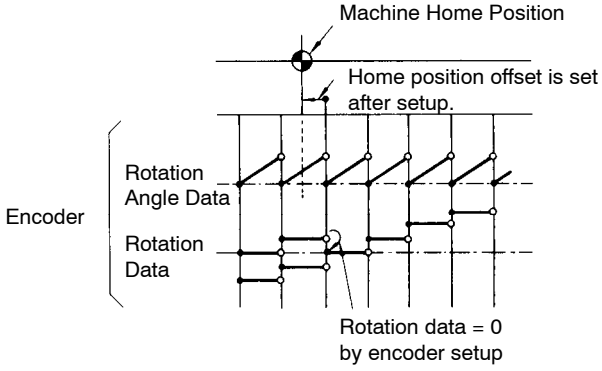
Parameter No.	Name (Range/Unit)	Change	Description
Pr35	Check timer (1 to 300/5 ms)	P	Set the time since the SG1 power supply is turned ON until a MECHATROLINK communication check with the servo/spindle is started. If the communication with the servo/spindle is not established after the time set in this parameter has passed, a system alarm will occur. When Pr35 is set to "0", 10 seconds(default) will be set.
Pr36	In-position Range (0 to 400/pulses)	S	The allowable number of lag pulses is set when in-position check is performed by G04 command. By decreasing the in-position range, the setting time becomes longer, therefore positioning time also becomes longer. Set in the range of approx. 30 to 50 pulses for general-purpose machine tools.
Pr37	Reserved		
Pr38	Reserved		
Pr39	MRDY output mode change (0, 1/–)	S	When servo main power is turned ON/OFF by input signal servo ON (SVON), this parameter specifies whether MP ready signal (MRDY) is turned ON or OFF. 0 : MRDY signal is turned OFF by turning SVON signal OFF to turn OFF servo main power. 1 : MRDY signal is not turned OFF even by turning OFF SVON signal to turn OFF servo main power if the other conditions are established.
Pr50	Minimum reference unit (0 to $5/10^{-n}$ mm)*	P	The minimum reference unit is expressed in 10^{-n} mm and n value is set. <Example> n = 2 : 10^{-2} mm, or 10 μm n = 3 : 10^{-3} mm, or 1 μm
Pr51	Ball Screw Pitch (1000 to 99999/(μm/r))	P	Ball screw pitch is expressed inμm/r. <Example> 10 mm/r : Pr51 = 10000 2.5 mm/r : Pr51 = 2500
Pr52	Gear ratio N_1 (Motor side) (1 to 999999/–)	P	Gear Ratio N_1/N_2 is set to Pr52/Pr53. Set the number of gears at the motor side to N_1 and that of machine side to N_2.
Pr53	Gear ratio N_2 (Machine side) (1 to 999999/–)	P	

* Changes to (0 to $3/10^{-n} \times 10°$) in Rotation mode. (SW 1 = 1)

Parameter No.	Name (Range/Unit)	Change	Description
Pr54	Decimal point position (speed unit) (0 to 5/reference unit × 10^n/min)	P	Parameter to determine at which digit of the position reference value(expressed in minimum reference unit)the decimal point is located. This decimal point position is the speed unit per minute. <Example 1> When position reference unit is 1 μm and Pr54 = 3: X(U)□□□□□.□□□ ↑ ↑ ↖ μm mm 3rd-digit Then speed unit is mm/min. At this time, if the following is written in the program; G01 X5000.000 F10000 I200 the moving speed F is as shown below: F = 10000 mm/min. = 10 m/min. <Example 2> When position reference unit is 1 μm and Pr54 = 4: X(U)□□□□.□□□□ ↑ ↑ ↖ μm cm 4th-digit Then speed unit is cm/min.
Pr55	Reserved		
Pr56	Reserved		
Pr60	Minus direction stored stroke limit (–99999999 to +99999999/reference unit)	S	Maximum movable range is set. Pr60 : Limited position in minus direction Pr61 : Limited position in plus direction When the current value reaches the stored stroke limit position in JOG or HANDL operation, the speed reference becomes 0 and the machine can no longer move in that direction. Returning is possible by JOG or HANDL operation in the reverse direction. In a feed command that exceeds the stored stroke limit, an alarm occurs without starting the feed command. When Pr60 = Pr61 = 0 the stored stroke limit becomes ineffective. During home position return or home position setup operation, the stored stroke limit is disregarded.
Pr61	Plus direction stored stroke limit (–99999999 to +99999999/ reference unit)	S	
Pr65	Registration mode setting (0, 1/–)	S	0 : Automatic operation continue mode (basic operation) 1 : N operation mode
Pr66	Registration N count number (0, 1/–)	S	N number at N operation mode is set in Pr66.

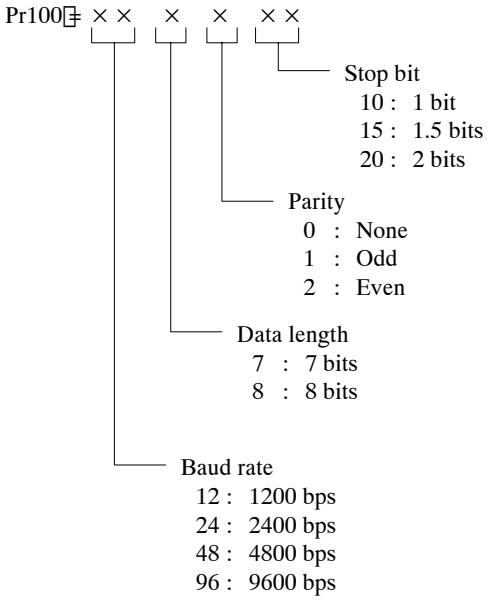
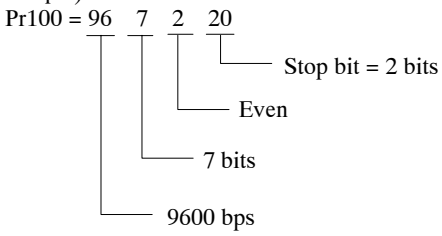
Parameter No.	Name (Range/Unit)	Change	Description
Pr70	Home position coordinate setting method	U	Pr70 consists of 7-digit numeric value as shown below: Pr = GFEDCBA The meaning of each digit is as follows: A : Reference point setting method This designates timing of reference point setting, or use of absolute encoder. A = 0 : No reference point setting (Home return operation is executed.) A = 1 : Reference point setting is executed only at the first reference return operation after turning the power ON. (Second and subsequent reference point return operation is executed, but reference point setting is not executed.) A = 2 : Reference point setting is executed for each reference point return. A = 3 : Absolute encoder is used. B : Home return direction This designates the direction to seek for the home position LS (DEC). (when an absolute encoder is used, direction to seek for stopper is specified.) B = 0 : Minus direction B = 1 : Plus direction C : Home return start direction (Invalid when an absolute encoder is used.) This designates the moving direction to start the reference point return operation. C = 0 : Moves always to the direction designated by item B. C = 1 : Setup alarm occurs when start point is at the home position LS. Otherwise, moves to the direction designated by item B. C = 2 : When start point is at the home position LS, moves to the opposite direction to the designation of item B until it deviates from home position LS once. Otherwise, moves to the direction designated by item B. D : Home position LS method This designates the relation between the home position LS and the reference point. D = 0 : Home position LS is not used. The motors do not move at the home position return. Define a reference point where the home position returning position. D = 1 : Defines a reference point where the home position LS is turned ON and speed decelerates to the Pr74 setting value and reads the first C phase pulse. D = 2 : Defines a reference point where the home position LS is turned ON and speed decelerates to the Pr74 setting value and deviates from home position LS and reads the first C phase pulse.

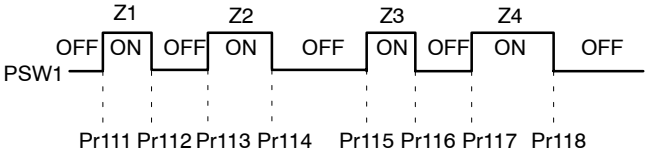
Parameter No.	Name (Range/Unit)	Change	Description
Pr70	Home position coordinate setting method	U	D = 3 : When an incremental encoder is used; Define the position where the home position LS is turned ON and speed decelerates to the Pr74 setting value and pushes to stopper. When an absolute encoder is used; All automatic setup method. “0” or “3”will be designated. E : Home position LS / reference point check This designates whether to perform the home position LS check and reference point deviation check. Home position LS check is to confirm whether the condition (ON/OFF) of home position LS at reference point is as designated by item D. When to perform the home position LS check, positioning is once performed to the reference point. Reference point deviation check is to confirm whether in second and subsequent reference point return, the reference point is not deviated to the Pr77 setting value in comparison with reference point set at the first reference point (item A = 1) or the last reference point (item A = 2). As a result of check, if the conditions are not satisfied, setup alarm occurs. Note 1: If designated, check is also performed when item A = 0, therefore, when item A = 0, set E = 0. 2: Home position LS check is performed when item E = 2 and item D = 0, therefore, when item D = 0, use it with item E = 1 or 0. E = 0 or 4 : No check is performed. E = 1 : Check for deviation of reference point is performed, but home position LS check is not performed. E = 2 : Both checks are performed. When an absolute encoder is used, specify “0” or “4”. (0 is same as 4, and PG disconnection check is always performed.) F : Dwell position(invalid when an absolute encoder is used) This designates whether to move to the dwell position after setting reference point (or after home position LS check). Moving speed is designated by Pr80. F = 0 : Dwell position not provided F = 1 : Moves to the dwell position G : (RESERVED) Servo user constant(0014, b12) designates to read home position LS by whether N.O. contact or N.C. contact .

Parameter No.	Name (Range/Unit)	Change	Description
Pr71	T_0 Coordinate offset value (–99999999 to +99999999/reference unit)	P	By setting up a mounted absolute encoder on the machine, it is possible to make encoder rotation data (data output by serial data when power supply is turned ON) zero. However, the rotation angle data(data output by initial incremental pulse when power supply is turned ON) are determined by installation of motor and machine shaft. By setting home position offset to Pr71, the MOTIONPACK can define the relation between coordinate home position and encoder home position. Therefore, it is possible to match the dislocation of absolute encoder and machine shaft mounting angle. Pr71 is equivalent to the distance from coordinate system home position to absolute encoder home position.  For systems equipped with an incremental encoder, set the coordinates of the reference point.
Pr72	Reference point coordinate value (–99999999 to +99999999/ reference unit)	S	Reference point value in the coordinate system after home positioning. In the full-automatic setup method, it is necessary to keep the following relation for moving starting direction defined by Pr70 and Pr72. Otherwise, setup error occurs when ZRN is input. For systems equipped with an incremental encoder, this parameter is not used. <table><tr><th>Setup Starting Direction (Pr70)</th><th>Sign of Pr72</th></tr><tr><td>0 (Minus)</td><td>Minus</td></tr><tr><td>1 (Plus)</td><td>Plus</td></tr></table>
Pr73	Home position setup command (0, 1/ –)	S	Pr73 is set to 1 before home positioning is performed by automatic setup method. By setting Pr73, the MOTIONPACK is in the home position setup mode and ready for set up. When the home position setup is completed, this parameter is automatically reset to 0. For systems with an incremental encoder, this parameter is not used.

Parameter No.	Name (Range/Unit)	Change	Description
Pr74	Home position feed speed (0 to 99999/speed unit)	S	Feed speed at automatic home position setup method is set to Pr74. The unit is speed reference unit and the range is from 0 to 99999. For systems with an incremental encoder, the moving speed after the deceleration LS is turned ON is set.
Pr75	Pushing Torque (10 to 400/%)	S	Pushing torque limit value in the home return using the stopper is set to Pr75. The unit is % unit for servo rated torque and the range is from 10 to 400.
Pr76	Stopper pushing time (0 to 60000/ms)	S	In the automatic home position setup method, dwell time, from when the machine reaches the stopper the torque limit is exceeded until setup is performed, is set to Pr76.
Pr77	Encoder allowable moving value for systems with absolute encoder (0 to 99999999/reference unit)	P	In the absolute method, position data are stored even while the power is shut OFF. At the same time, the position data when power is shut OFF is stored in MOTIONPACK. MOTIONPACK checks the dislocation when the power supply is turned OFF and when it is turned ON again. With this function, it is possible to detect that the machine has moved for some reason and also to detect an error at absolute encoder position detection. If the dislocation is more than Pr77 in the result of the above checking, an alarm occurs. Pr77 value varies 0 to 99999999. Normally, set at approx. 500.
	Reference point allowable error amount for systems with incremental encoder (0 to 99999/reference unit)	P	In the incremental value method, Pr77 setting value is compared with the deviation amount during reference point setting for systems with reference check (set by Pr70), and excessive deviation triggers an alarm.
Pr78	ABS-PG alarm reset command (0, 1/–)	P	If ABS-PG error occurs, it can be reset by setting Pr78 = 1 and turn the power ON or OFF. For systems with an incremental encoder, this parameter cannot be used.
Pr80	Home position return speed (0 to 99999/speed unit)	S	In systems with an incremental encoder, the moving speed before home position LS turns ON is set.
Pr90	Maximum spindle speed (except for synchronous operation) (0 to 99999 /r/min)	SS	Set the maximum spindle speed. Analog reference voltage becomes ± 10 V when spindle reference S equals to Pr90.

<table>
<tr><th>Parameter No.</th><th>Name (Range/Unit)</th><th>Change</th><th>Description</th></tr>
<tr><td>Pr91</td><td>Spindle designation method selection (0, 10/–)</td><td>SS</td><td>Specifications for spindle reference in automatic operation are defined.
<table>
<tr><th>Program</th><th>Pr91 = 0</th><th>Pr91 = 10</th></tr>
<tr><td>Forward Reference M03</td><td>Forward reference S (–) designation impossible</td><td>Forward/reverse reference S (–) designation possible</td></tr>
<tr><td>Reverse Reference M04</td><td>Reverse reference S (–) designation impossible</td><td>Not used.
If used, program alarm occurs.</td></tr>
</table></td></tr>
<tr><td>Pr95</td><td>Spindle speed coincidence detection dwell time
(10 to 1000/ms)</td><td>SS</td><td>Set the dwell time until the speed coincidence is detected.</td></tr>
<tr><td>Pr96</td><td>Reserved</td><td></td><td></td></tr>
<tr><td>Pr97</td><td>Spindle low speed
(0 to 99999/r/min)</td><td>SS</td><td>Set the spindle low speed.</td></tr>
<tr><td>Pr98</td><td>Spindle high speed
(0 to 99999/r/min)</td><td>SS</td><td>Set the spindle high speed.</td></tr>
<tr><td>Pr99</td><td>Spindle (0, 1/–)</td><td>P</td><td>0 : Spindle not provided
1 : Spindle provided</td></tr>
</table>

Parameter No.	Name (Range/Unit)	Change	Description
Pr100	Communication condition	U	Set the communication condition of MOTIONPACK side when performing data backup via RS-232C to external memory media. (planned for development)  (Example) 
Pr101	MF output delay time (0 to 1000/ms)	S	Delay time of strobe output signal for coded M output signals is set. 0 : Coded M signal not provided

<table>
<tr><th>Parameter No.</th><th>Name (Range/Unit)</th><th>Change</th><th>Description</th></tr>
<tr><td>Pr111 to Pr118
Pr121 to Pr128
Pr131 to Pr138
Pr141 to Pr148
Pr151 to Pr158
Pr161 to Pr168
Pr171 to Pr178
Pr181 to Pr188</td><td>Zone signal (PSW 1 to PSW8) relation 1st to 4th zone range (–99999999 to +99999999/ reference unit)</td><td>S</td><td>In the zone signal output function, the range where zone signal (PSW1 to PSW8) is turned ON is defined by Pr111 to Pr188. It is possible for each zone signal (PSW1 to PSW8) to define four zones. Since a zone is defined at both ends, eight parameters are necessary for each zone signal. The following table shows the relation between zones for each zone signal and parameters.
<table>
<tr><th rowspan="2">Signal Name</th><th colspan="8">Zone Number</th></tr>
<tr><th colspan="2">Z1</th><th colspan="2">Z2</th><th colspan="2">Z3</th><th colspan="2">Z4</th></tr>
<tr><td>PSW1</td><td>Pr111</td><td>Pr112</td><td>Pr113</td><td>Pr114</td><td>Pr115</td><td>Pr116</td><td>Pr117</td><td>Pr118</td></tr>
<tr><td>PSW2</td><td>Pr121</td><td>Pr122</td><td>Pr123</td><td>Pr124</td><td>Pr125</td><td>Pr126</td><td>Pr127</td><td>Pr128</td></tr>
<tr><td>PSW3</td><td>Pr131</td><td>Pr132</td><td>Pr133</td><td>Pr134</td><td>Pr135</td><td>Pr136</td><td>Pr137</td><td>Pr138</td></tr>
<tr><td>PSW4</td><td>Pr141</td><td>Pr142</td><td>Pr143</td><td>Pr144</td><td>Pr145</td><td>Pr146</td><td>Pr147</td><td>Pr148</td></tr>
<tr><td>PSW5</td><td>Pr151</td><td>Pr152</td><td>Pr153</td><td>Pr154</td><td>Pr155</td><td>Pr156</td><td>Pr157</td><td>Pr158</td></tr>
<tr><td>PSW6</td><td>Pr161</td><td>Pr162</td><td>Pr163</td><td>Pr164</td><td>Pr165</td><td>Pr166</td><td>Pr167</td><td>Pr168</td></tr>
<tr><td>PSW7</td><td>Pr171</td><td>Pr172</td><td>Pr173</td><td>Pr174</td><td>Pr175</td><td>Pr176</td><td>Pr177</td><td>Pr178</td></tr>
<tr><td>PSW8</td><td>Pr181</td><td>Pr182</td><td>Pr183</td><td>Pr184</td><td>Pr185</td><td>Pr186</td><td>Pr187</td><td>Pr188</td></tr>
</table>
It is necessary to keep the following relations among parameters, taking the example of PSW1:
Pr111 < Pr112 < Pr113 < Pr114 < Pr115 < Pr116 < Pr117 < Pr118.
If the parameter value relation is reversed or the values are made equal, the zone is undefined.
Therefore, set 0 to both parameters of a zone which is not used.
The following shows the relation between zones, parameters and output signals, taking the example of PSW1:
 
</td></tr>
<tr><td>Pr200</td><td>Spindle encoder mounting position (0, 1/–)</td><td>S</td><td>0 : Mounting on spindle side
1 : Mounting on motor side</td></tr>
<tr><td>Pr201</td><td>Pulse number per rotation of spindle encoder (with no multiplication) (1 to 32768/pulses)</td><td>S</td><td>This sets output pulse per rotation of spindle encoder.</td></tr>
<tr><td>Pr202</td><td>Spindle motor maximum speed at synchronous, follow-up operation (1 to 32767/r/min)</td><td>S, G</td><td>Set the maximum speed of spindle motor in synchronous operation.</td></tr>
<tr><td>Pr204</td><td>Spindle linear accel/decel time (0 to 60000/ms)</td><td>S, G</td><td>Set the linear accel/decel time to spindle motor maximum speed.</td></tr>
<tr><td>Pr206</td><td>Spindle in-position range (1 to 255/pulses)</td><td>S</td><td>Set the spindle in-position check range.</td></tr>
<tr><td>Pr207</td><td>Solid tap return path feed axis drawing-in in-position width (1 to 255/pulses)</td><td>S</td><td>When the deviation reaches this range at the end of a solid tap return path, feed axis is removed from spindle synchronous control and positioned at start point.</td></tr>
</table>

Parameter No.	Name (Range/Unit)	Change	Description
Pr208	Spindle, feed axis synchronous offset parameter (K1) (–32767 to 32767/1/256 magnifications)	S, G	Adjust synchronous error at solid tap constant cutting feed. This parameter is automatically set when executing solid tap with Pr215 set to “1”.
Pr209	Spindle, feed axis synchronous offset parameter (K2) (0 to 32767/0.01%)	S, G	Adjust synchronous error at solid tap constant cutting feed. This parameter is automatically set when executing solid tap with Pr215 set to “1”.
Pr210	Reserved		
Pr211, Pr212	Number of gear teeth of spindle and motor (1 to 511/–)	S, G	Pr211 : Number of teeth of gears at the spindle side Pr212 : Number of teeth of gears at the motor side Set “1” when no gear is provided.
Pr213	Gear ratio of spindle and spindle PG (1 to 511/–)	S	Set the gear ratio of spindle PG/spindle.
Pr214	Rotation direction designation at synchronous and follow-up operation (1, 2/–)	S	1 : Plus designation by FRN, minus designation by RRN 2 : Minus designation by FRN, plus designation by RRN
Pr215	Synchronous error automatic offset setting reference (0, 1/–)	S	0 : Offset completed (normal operation) 1 : Offset execution
Pr216 to Pr218	Synchronous error amount (–99999999 to +99999999/pulses)	S	Pr216 : Servo position deviation Pr217 : Synchronous error + peak value Pr218 : Synchronous error – peak value
Pr219	Reserved		
Pr220	G93 home position indexing (0, 1/–)	S	0 : Home position indexing is not performed by G93. 1 : Home position indexing is performed by G93.
Pr221	Home position indexing direction (0, 1/–)	S	Set the indexing direction of home position by G93. 0 : Forward direction 1 : Reverse direction

Parameter No.	Name (Range/Unit)	Change	Description
Pr222	Home position indexing in-position range (0 to 32767/pulses)	S	Set the in-position range to check at the end of home position indexing.
Pr223	Home position indexing start speed (0 to 32767/r/min)	S	Set the speed to start the home position indexing.
Pr224	Home position indexing creep speed (0 to 32767/r/min)	S	Set the speed after detection of home position pulse at home position indexing.
Pr225	Spindle maximum speed at home position indexing (0 to 32767/r/min)	S	Set the maximum speed of the spindle at home position indexing.
Pr226	Final travel distance at home position indexing (0 to 99999999/pulses)	S	Set the pulse number in the range from home position pulse to indexing position during home position indexing. When the deviation at detection of home position pulse is larger than this parameter set value, the motor runs one more time.
Pr227	Spindle feed roll diameter (0 to 99999999/reference unit)	S	Use this parameter to execute follow-up operation. Set the feed roll diameter according to the reference unit of feed axis.
Pr228	In-position width during feed axis synchronous operation (0 to 32767/pulses)	S	Set the in-position width of the feed axis during synchronous operation.
Pr229	G97 spindle feed distance (0 to 99999999/reference unit)	S, G	Use this parameter to perform G97 follow-up operation. As the spindle moves by the set amount of this parameter, the feed axis moves.

6

CONTROLLER OPERATION

This chapter describes the operations of MOTIONPACK-SG1.

6.1 OPERATION MODE

(1) Types of Operation Modes

There are four modes: (1) EDIT, (2) HANDL operation, (3) JOG operation and (4) automatic operation.

Single-block operation mode can be specified for automatic operation mode. The mode priority is provided in the above order.

(2) JOG Operation

Conditions:

EDIT signal = OFF, JOG signal = ON, HANDL signal = OFF

Start/stop:

Starts moving in forward direction when +JS signal is turned from OFF to ON.

Stops when +JS signal is turned ON to OFF.

Starts moving in reverse direction when –JS signal is turned from OFF to ON.

JOG speed:

Pr1 = JOG low speed

Pr2 = JOG high speed

JOG low speed selected at JSPD signal is OFF.

JOG high speed selected at JSPD signal is ON.

Torque limit:

Torque limit specified by Pr4 is effective only at JOG low speed operation.

Relation with other operation modes:

When JOG signal is turned ON during AUTO operation, motion under execution is interrupted and the machine decelerates to a stop.

(3) HANDL Operation

Conditions:

EDIT signal = OFF, HANDL signal = ON

Start/stop:

Moves in forward direction by forward direction pulse input from handle PG.

Moves in reverse direction by reverse direction pulse input.

Speed:

Moving amount = Number of pulse inputs at JSPD signal is OFF

Moving amount = Number of pulse inputs × 100 at JSPD signal is ON

Max. speed limit:

Set in Pr3. Input pulse process above setting of Pr3 varies depending on Pr5 setting. (Refer to the description of Pr3.)

Reference switching:

Speed/position reference modes can be switched by Pr5 setting.

Pr5 = 0:

Position reference mode is entered and the machine moves according to number of input pulses only.

Therefore, the machine keeps moving a distance equivalent to number of lag pulses even after handle PG stops.

Pr5 = 1:

Speed reference mode is entered and the machine moves according to input pulse speed. Therefore, moving distance differs from HANDL PG rotation amount since the machine stops when handle PG stops.

(4) Automatic Operation (AUTO Mode)

Conditions:

EDIT signal = OFF, JOG signal = OFF, HANDL signal = OFF and AUTO signal = ON

Program selection: specified by PGSL 1 to PGSL6.

Start:

Execution starts from program block selected by turning PGST signal OFF to ON.

Programs (except for feed-hold) are executed in order until M30 is executed.

Stop:

M30 is executed. Or the machine is stopped by turning PGST signal ON to OFF and performing feed-hold.

Program functions:

Refer to Chapter 7.

Program blocks:

1000 blocks (0 to 999)

Start block designation:

Blocks 000 to 063 are specified by combination of PGSL1 to PGSL6.

A function to jump to the head block of execution programs is set to blocks 000 to 063.

Relation between combination of PGSL1 to PGSL6 and head block is shown in Table 6.1.

Table 6.1 Relation between Combination of PGSL1 to PGSL6 and Head Block

PGSL1	PGSL2	PGSL3	PGSL4	PGSL5	PGSL6	Heading Block
0	0	0	0	0	0	000
1	0	0	0	0	0	001
0	1	0	0	0	0	002
1	1	0	0	0	0	003
0	0	1	0	0	0	004
:	:	:	:	:	:	:
1	1	0	1	1	1	059
0	0	1	1	1	1	060
1	0	1	1	1	1	061
0	1	1	1	1	1	052
1	1	1	1	1	1	063

Program switching:

(1) PGSL(program select) signal is switched after M30 execution.

(2) Switching during the program execution by switching PGSL signal after feed-hold.

Feed-hold:

To interrupt program operation temporarily.

When PGST(program start) signal is turned ON to OFF, the machine decelerates to a stop even during block execution.

Turning PGST signal ON again continues program operation.

(5) Single-block Operation

Conditions:

SBLK (single-block) signal is turned ON in the automatic operation mode (EDIT signal = OFF, JOG signal = OFF, HANDL signal = OFF, AUTO signal = ON).

Start:

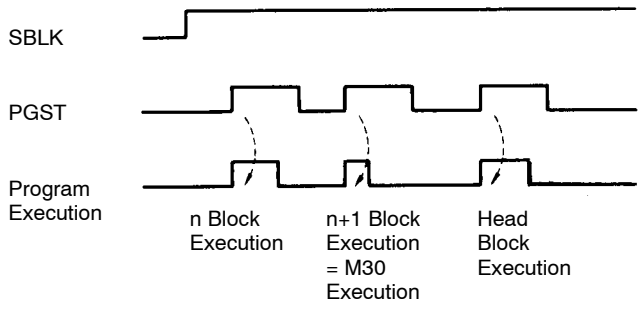
One block is executed from the selected program block at the rising edge of the PGST signal. However, program execution is stopped when the PGST signal is turned OFF during execution of the block.

To keep the program executing, set parameter Pr102 to "1".

Head block is executed at the rising edge of the PGST signal after M30 execution.

Stop:

Stop at completion of block execution



(6) Editing

Conditions:

EDIT signal = ON

Relation with other modes:

The EDIT mode has highest priority of all operation modes.

Servo clamp:

Effective in the EDIT mode.

Controller ready (MRDY) signal is OFF.

Function:

Programs or parameters can be set by programmer.

(7) Spindle JOG drive (when using spindle)

Conditions:

EDIT signal = OFF, JOG signal = ON, HANDLE signal = OFF,

J SV/J SP signal = ON

Start/stop:

Starts moving in forward direction when +JS signal is turned from OFF to ON.

Stops when +JS signal is turned ON to OFF.

Starts moving in reverse direction when –JS signal is turned from OFF to ON.

Spindle speed:

Pr 1 = Spindle low speed

Pr 2 = Spindle high speed

Low speed selected at JSPD signal is OFF.

High speed selected at JSPD signal is ON.

6.2 COORDINATE SYSTEM AND COMPENSATION

(1) Coordinate System

Total 10 (T_0 to T_9)

Coordinate T_0:

Defined by encoder output.

Coordinates T_1 to T_9:

Set by the procedures described below with the reference of coordinate system T_0.

(2) Coordinate Setting Method

Effective setting method differs partially on each coordinate.

○: Effective ×: Ineffective

Method	G52	Preset by Programmer	± INC Signal Input	Compensation by External Data	ABS-PG Setup
T_0	×	×	×	×	○
T_1	○	○	×	×	×
T_2	○	○	×	×	×
T_3	○	○	×	×	×
T_4	○	○	×	×	×
T_5	○	○	×	×	×
T_6	○	○	×	×	×
T_7	○	○	×	×	×
T_8	○	○	○	○	×
T_9	○	○	○	○	×

(3) Interrelation between Coordinates

Interrelation between coordinates T_0 and T_1 to T_9, is defined by shift register (S_n) and offset register (O_n) corresponding to coordinate Nos.

Coordinate System	Reference System Current Value	Shift Register	Offset Register
T_0	A_0		
T_1	A_1	S_1	
T_2	A_2	S_2	
T_3	A_3	S_3	
T_4	A_4	S_4	
T_5	A_5	S_5	
T_6	A_6	S_6	
T_7	A_7	S_7	
T_8	A_8	S_8	O_8
T_9	A_9	S_9	O_9

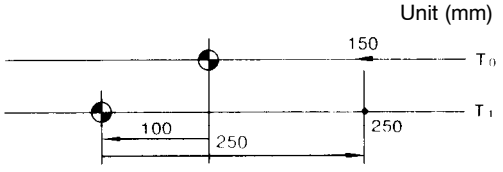
6

(4) Coordinate Shift (Tool Length Compensation)

When coordinate value in coordinate T_n is t_0 and shifting register value corresponding to coordinate T_n is S_n, the coordinate value t_n for T_n coordinate is expressed by the following equation:

$$t_n = t_0 + S_n$$

<Example> The following shows the relation between coordinate T_0 and T_1 when shifting register value (S_1) in T_1 coordinate system is 100:



Coordinate value t_1 in coordinate T_1 at 150 mm in coordinate T_0 is as shown below:

$t_1 = t_0 + S_1$
= 150 mm (T_0) + 100 mm
= 250 mm

When a positive value is set to S_n, the home position of coordinate T_n is shifted for the value in the negative direction. Thus coordinate setting by shifting makes tool length compensation easier to perform.

That is, by setting tool length to shifting register S_n, coordinate system with coordinate home position is moved back by the value.

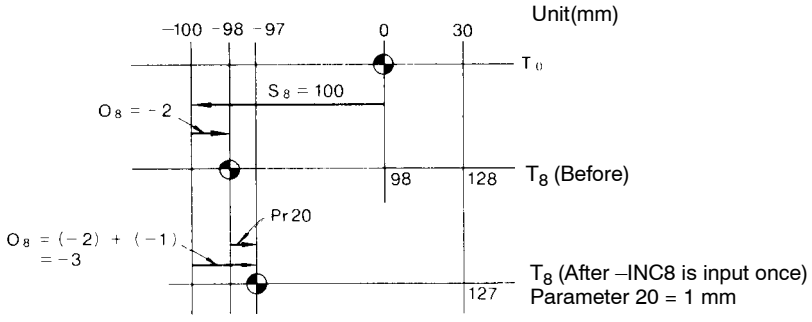
(5) Coordinate Shift of T_8, T_9 Coordinate Systems (Tool Wear Compensation)

T_8 or T_9 coordinate system is provided with offset registers (O_8, O_9) in addition to shifting registers (S_8, S_9).

When coordinate value in T_8 coordinate system is t_8 and corresponding shifting register and offset register are S_8 and O_8 respectively, the coordinate value is as shown below:

$$t_8 = t_0 + S_8 + O_8$$

<Example> When the value of T_8 coordinate system shifting register S_8 is 100 mm and that of offset register O_8 is –2 mm, the relation between coordinate system T_0 and T_8 is as shown below:



Coordinate value t_8 in T_8 coordinate system at 30 mm in T_0 coordinate system is expressed by the following equations:

$$\begin{aligned} t_8 &= t_0 + S_8 + O_8 \\ &= 30 + 100 + (-2) \\ &= 128 \text{ mm} \end{aligned}$$

Coordinate setting by offset amount can be used for tool wear compensation. That is, by setting tool wear amount to offset register, the coordinate home position is shifted by the value.

Concerning shifting direction, when offset register is negative, the coordinate home position is shifted in the positive direction.

(6) Coordinate Shift by +INC/–INC Signals (T_8, T_9)

T_8 coordinate system can add (or subtract) a value set in Pr20 by +INC (or –INC) ON/OFF to offset register.

The coordinate value is expressed by (or from) an offset register.

Therefore, by setting wear compensated value per one time to Pr20 and turning ON/OFF –INC signal, automatic compensation can be performed.

The same can be applied to T_9 coordinate system.

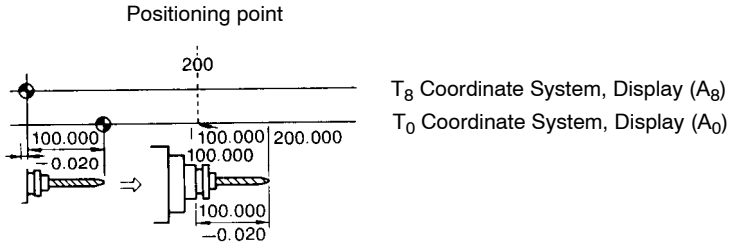
INC8/9 signals specify whether T_8 or T_9 coordinate is compensated for by +INC and –INC signals.

INC8/9 = OFF: T_8 coordinate system specified

INC8/9 = ON: T_9 coordinate system specified

Coordinate System	Coordinate Designation	+Compensation	–Compensation	Correction for One Time	Max Correction
T_8	INC8/9 = OFF	+ INC	– INC	Pr20	Pr21
T_9	INC8/9 = ON	+ INC	– INC	Pr22	Pr23

<Example> When shifting amount (S_8) from T_0 of coordinate No. T_8 is 100.000 and offset amount (O_8) is –0.020, G01 X200.000 makes positioning at a point of A_8=200.000 (A_0 = 100.020) as shown below:



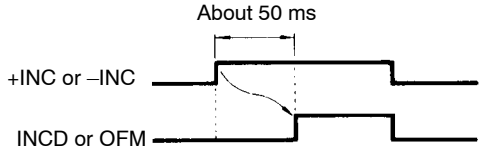
(7) Coordinate Shifting Operation by +INC/–INC

Conditions:

Not when moving in automatic operation mode

Operation:

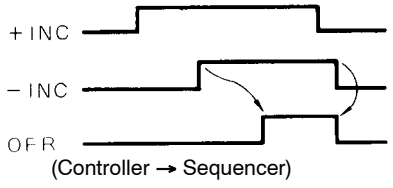
After offset register addition is completed by + (or –) incremental reference, if offset value maximum value is reached (or exceeded), offset value ± max. reach signal (OFM) is output;



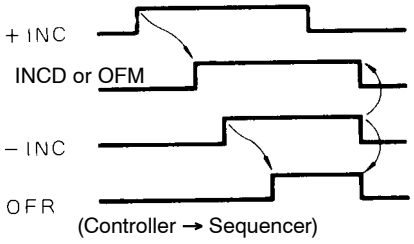
Offset value clear:

When both + and – incremental references are turned ON simultaneously, offset register 8 is cleared to 0 and offset value zero (OFR) signal is output.

(a) When –INC is ON before completion (INCD or OFM) signal is output by +INC:



(b) When –INC is ON after completion signal is output by +INC:



(8) Coordinate Setting by Programmer

T_1 to T_9 coordinate systems can be used by presetting by programmer. Both shifting value (S_n) and offset value (O_n) can be preset by programmer. (However, only T_8 and T_9 coordinate systems have O_n.) These preset values are renewed by coordinate setting performed during operation or coordinate shifting by INC signals.

6.3 ZONE SIGNAL OUTPUT

(1) Specifications of Zone Signal Output

No. of output signals: 8

Signal names: PSW1, PSW2, PSW3, PSW4, PSW5, PSW6, PSW7, PSW8

No. of zones: 4 zones for each signal (total 32)
A zone can be set independently for each signal.

(2) Operation

After the power supply is turned ON and absolute value data transmission is completed to establish the position data, the zone signal output function becomes effective. (Can be used only for systems equipped with absolute encoder)

After that, when the current position (feedback) is in the set zone, regardless of program execution, the corresponding zone signal (PSW1 to PSW8) is turned ON.

(3) Zone Setting

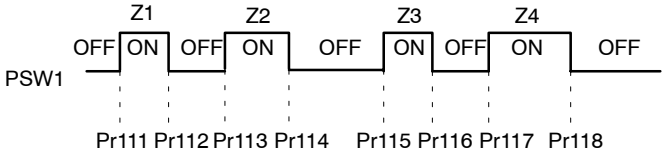
Each zone signal (PSW1 to PSW8) can define four zones. Since a zone is defined at both ends, eight parameters are necessary for one zone signal.

The following shows the relation between zone signal zones and parameters.

Signal Name	Zone Signal							
	Z1		Z2		Z3		Z4	
PSW1	Pr111	Pr112	Pr113	Pr114	Pr115	Pr116	Pr117	Pr118
PSW2	Pr121	Pr122	Pr123	Pr124	Pr125	Pr126	Pr127	Pr128
PSW3	Pr131	Pr132	Pr133	Pr134	Pr135	Pr136	Pr137	Pr138
PSW4	Pr141	Pr142	Pr143	Pr144	Pr145	Pr146	Pr147	Pr148
PSW5	Pr151	Pr152	Pr153	Pr154	Pr155	Pr156	Pr157	Pr158
PSW6	Pr161	Pr162	Pr163	Pr164	Pr165	Pr166	Pr167	Pr168
PSW7	Pr171	Pr172	Pr173	Pr174	Pr175	Pr176	Pr177	Pr178
PSW8	Pr181	Pr182	Pr183	Pr184	Pr185	Pr186	Pr187	Pr188

(4) Relation between Zone and Output

The following shows the relation between zones, parameters and output signals, using the example of PSW1:



(5) Value Comparison among Zone Setting Parameter

It is necessary to keep the relation of parameter values as:

Pr111 < Pr112 < Pr113 < Pr114 < Pr115 < Pr116 < Pr117 < Pr118

When the above relation is reversed or some parameters are made equal, the zones are not defined.

<Example> Pr111 = Pr112

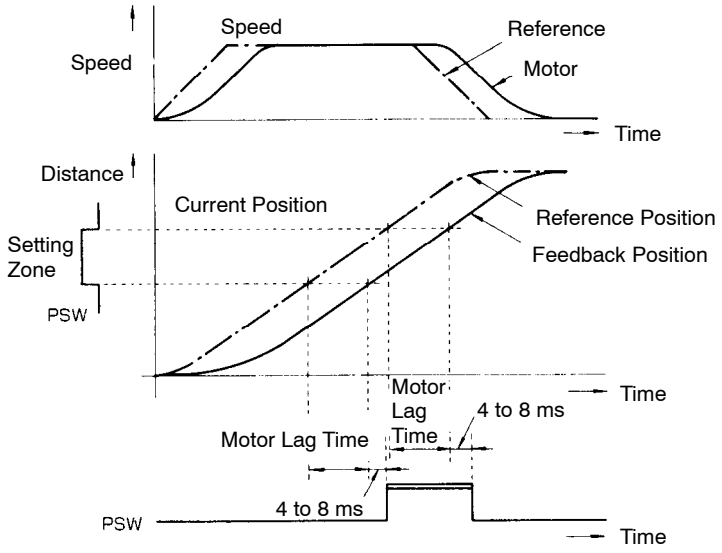
Therefore, it is appropriate to set 0 to both parameters for zones that are not used.

(6) Applications

- When the current position is in a zone that has been set by parameters in advance, PSW signal is turned ON. (The current position is feedback position.)
- Eight PSW signals (PSW1 to PSW8) are provided. Each PSW signal can define four zones (Z1 to Z4) by using eight parameters.
- PSW signals become effective when the power supply is turned ON, absolute position initial data transmission is completed and the controller is in RDY (ready) status. After that, regardless of program execution, they are output according to the current position. (Ignore PSW signals before RDY since the signals are uncertain.)
- At absolute encoder home positioning, when Pr73 = 1 (home position setting-up command) is set, the PSW signal is turned OFF and becomes ineffective. It becomes effective when home position setting-up is completed and Pr73 = 0.
- The zone signals can be used as limit switches to detect feed unit position.

(7) Output Lag Time

The following figure shows zone signal output lag time:



6

(8) Precautions for Zone Setting

When a zone is set at a positioning point, pay attention to the following items.

Assume that the program starts from X=0.000 as shown below and positioning is to be performed at X=10.000. And the zone is set from 10.000 to 10.500.

Program

```
      :
      :
      :
G01   X10.000   F___   I___
M30
```

```
Pr111 = 10000 (10.000)
Pr112 = 10500 (10.500)
```

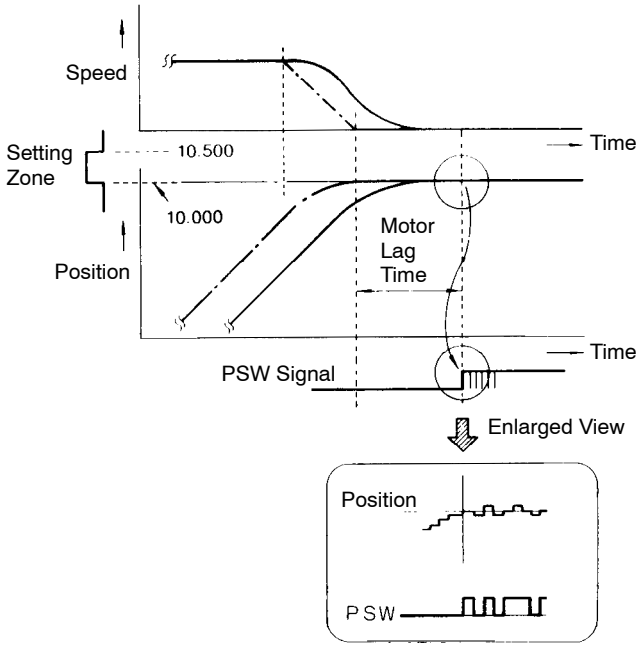
In the above case, PSW output is as shown below.

After completion of positioning, the feedback position varies in width of some pulses with the aimed position as the center.

Therefore, PSW output causes chattering.

Corrective Action:

Extend zone setting. For the above example, the following is effective:



6.4 EXTERNAL DATA SETTING AND READING OPERATION

(1) Functions

(a) Types of Data

Four types of data to be handled by this function:

- Register data
- Offset data
- Position data
- Controller parameter data

(b) Functions

- Function to set the above data from external device
- Function to read the above data to external device

(2) I/O Signal Allocation

(a) Input signal

- I-DATA (write data) (0 to 7)
- SET INT (external data setting start)
- STROBE (setting data transfer)
- IN/OUT (setting/read) (0: IN, 1: OUT)

(b) Output signal

- O-DATA (output data)
- SET RDY (external data setting ready)
- ALM (data format error. Reset by turning SET INT signal OFF.)

(3) Data Contents

Input/output data are all binary data.

As for the timing of each data transfer, refer to the timing diagram in item (5).

(a) External data setting (input signal → SG1)

- External data setting is the function to set data from input signal to MOTION-PACK-SG1.
- Data to be set are as shown below:

  (Types of data are designated by SEL1 to SEL3 signals.)

	SEL1	SEL2	SEL3
Register	0	0	0
Offset Register	1	0	0

- Setting of offset register is valid only when the machine is not under operation.
- Absolute/incremental selection (ABS/INC) determines whether to perform absolute compensation or incremental compensation at offset register setting.

  Absolute compensation: Input data is entered to offset register as it is.

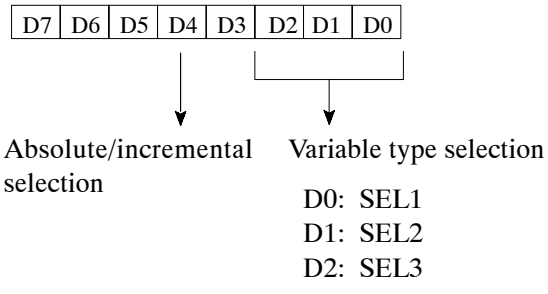
  Incremental compensation: Input data is added to offset register.
- Write data (I-DATA) are sent by 1 byte in the order [setting variable], [variable number], [data] as shown below.

  Send data is fixed to 6 bytes.

  ① Setting variable (S1)

  Variable type selection
  Absolute/incremental selection
  } 1 byte

  I-DATA (S1)



② Variable number (N1)

Variable number of data to be written is transferred. (1 byte)

③ Write data (T0 to T3)

Write data is sent by 4 bytes from the high-order byte.

(b) Internal data read (SG1 → output signal)

- Internal data read is the function to read data from MOTIONPACK-SGI to output signal.
- Data to be read are as follows:

  (Types of data are designated by SEL1 to SEL3 signals.)

	SEL1	SEL2	SEL3
Register	0	0	0
Offset Register	1	0	0
Position(only Read)	0	1	0
Parameter (only Read)	0	0	1

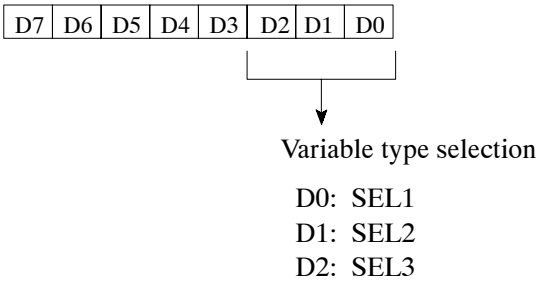
- In internal data read, when [setting variable], [variable number], [END CODE1], (0FFH) are entered, [data] is output by 1 byte.

(i) I-DATA transfer order

① Setting variable (S1)

Variable type selection

I-DATA (S1)



② Variable number (N1)

Variable number of data to be read is transferred.

(Set 0 to the position variable.) (1 byte)

③ END CODE1 (E1)

After transfer of variable number, 0FFH is sent at end.

(ii) 0-DATA output order

- Read data (T0 to T3)

  Read data is output by 4 bytes from the high-order byte. (binary data)

(4) Notes

- Setting of offset register is available only when motor is stopped in automatic operation mode.
- Variable number at reading may be changed until END CODE is input.
- When STROBE signal is ON, SET RDY signal is not turned ON even when SET INT signal is turned ON. Turn the STROBE signal OFF in advance, and then turn SET INT signal ON.
- ALM signal is turned ON when input data is not correct.
  - · When ALM signal is ON, external data setting and reading are not available.
  - · ALM signal is reset when SET INT signal is OFF.
  - · Continuous setting and readout can be executed with SET INT signal left ON.

(5) Timing Chart

(a) External data setting

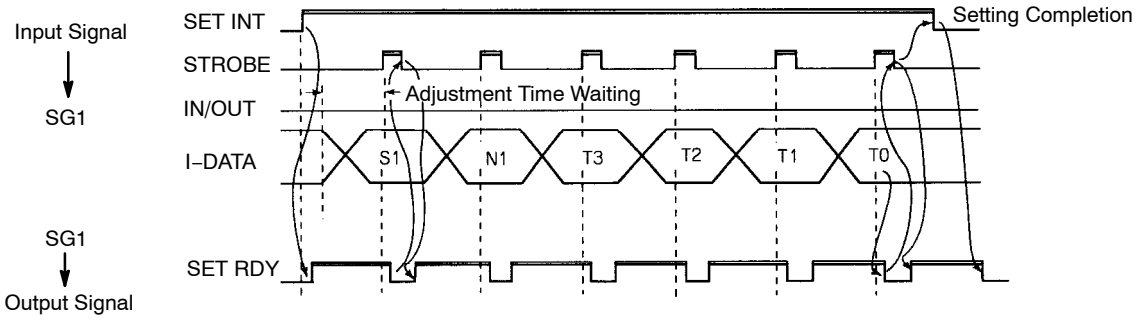


Fig. 6.1 External Data Setting Timing Chart

(b) Internal data read

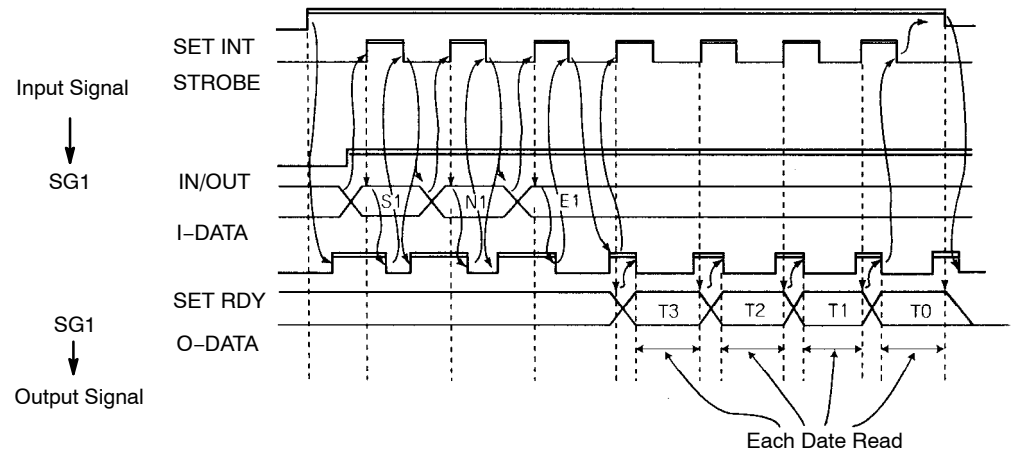


Fig. 6.2 Internal Data Read Timing Chart

6.5 HOME POSITION COORDINATE SETUP

6.5.1 Systems Equipped with Absolute Encoders

(1) Necessity of Home Position Setup

For systems equipped with absolute encoders, set up the encoder and home position in the following cases:

- Motor is mounted on the machine.
- More than 2 days pass with encoder not connected to battery.
- Position data is abnormal.
- Battery voltage becomes low.

(2) Home Position Setup Procedures

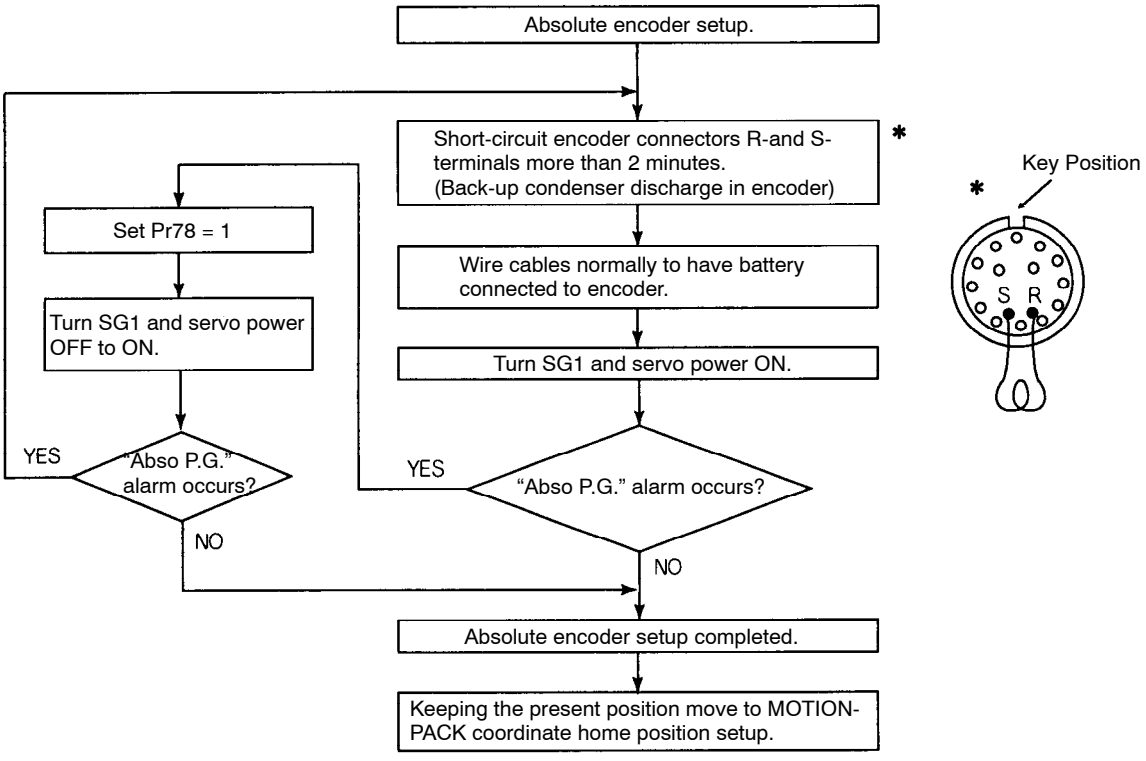
The following shows the procedures for home position setup.

① Set up absolute encoder.

② Set up MOTIONPACK coordinate home position.

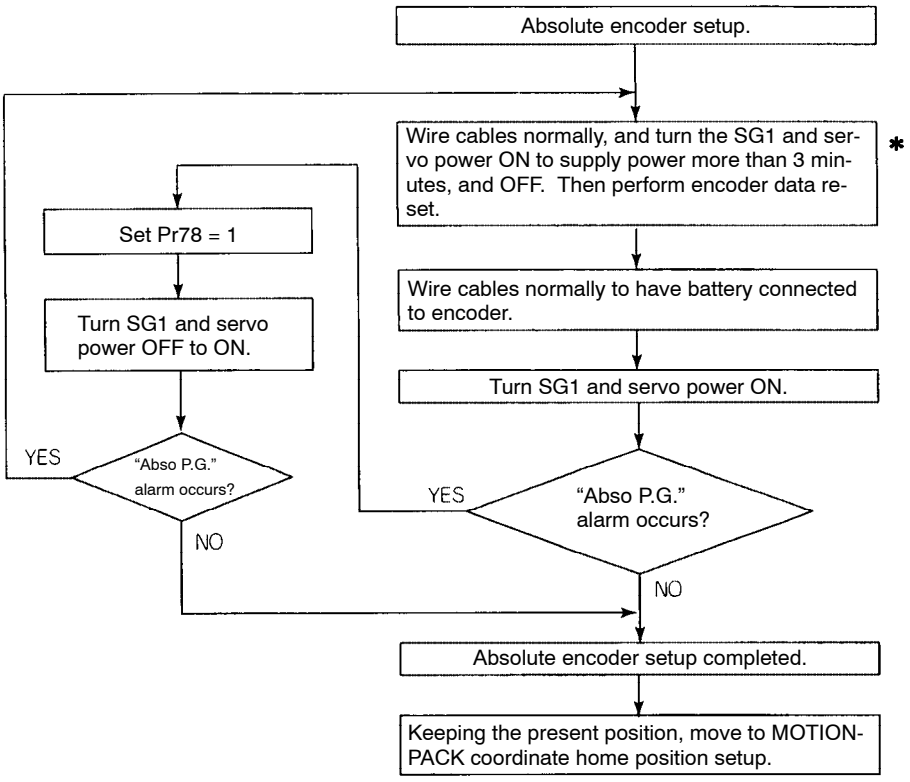
(3) Absolute Encoder Setup

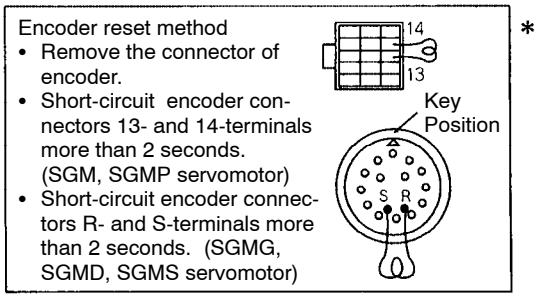
(a) In the case of 15-bit specifications (motor type encoder specifications “S”)



6

(b) In the case of 12-bit specifications (motor type encoder specifications "W")





(4) Coordinate Home Position Setup

The following two types of home position setup methods are provided for the MOTIONPACK-SG1 series:

- Full-automatic setup method (Pr70 = 430□3)
- Semi-automatic setup method (Pr70 = 43003)

(5) Full-automatic Setup Method

Full-automatic setup method (stopper method)

① Set Pr73 = 1 and enter the home position setup mode. Then turn ZRN signal ON, and the machine starts moving from the current position at the Pr74 speed to the direction that is set in Pr70, until it reaches the stopper (reference point).

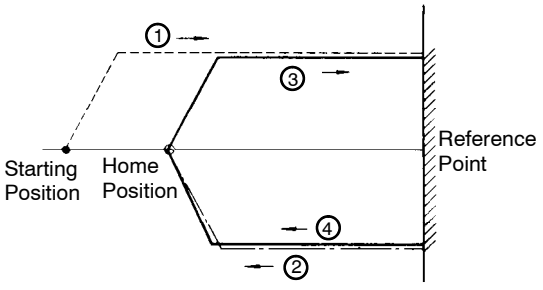
Pushing torque: Pr75

Pushing time: Pr76

② Perform positioning at a temporary home position (A_0 = 0.000) assuming the stopper (reference point) position = Pr72.

③ The home position coordinate offset is set automatically by moving the machine toward the stopper (reference point) position from the temporary home position again until it reaches there.

④ Perform positioning by moving the machine to the home position (A_0 = 0.000) and stop it there. (Pr73 is automatically reset to "0" and the end of operation is reported.)



(6) Semi-automatic Setup Method

The machine is moved to the reference point by manual operation and "1" is set to Pr73.

Then the home position offset value is automatically set by inputting the ZRN signal at that point to set up the home position. (Pr73 is automatically reset to "0" and the end of operation is reported.)

(7) Setup at Machine Transfer

When the factory test run is completed and the machine is transferred to the end user's location, the encoder cannot be backed up by battery if the cables between the MOTIONPACK and motor are disconnected. In this case, make sure to set up the encoder before the power supply is first turned ON after the transfer.

If the encoder super capacitor is not fully charged or discharged, the battery may be consumed excessively or malfunction may occur.

(8) ABS-PG Alarm Reset

ABS-PG alarm cannot be reset by the ERS signal.

This is because ABS-PG alarm is caused by absolute value position data and distinguished from the other alarms. To reset ABS-PG alarm, set Pr78 = 1 and turn OFF and ON the power supply.

After resetting, Pr78 becomes 0 automatically.

6.5.2 Systems Equipped with Incremental Encoders

(1) Home Return Regulation Parameter

(a) Pr70: Home position coordinate setting method

Pr70 consists of 7-digit numeric value as shown below:

Pr 70 = GFEDCBA

The meaning of each digit is as follows:

A: Reference point setting method

This designates timing of reference point setting, or use of absolute encoder.

A = 0: No reference point setting (Home return operation is executed.)

A = 1: Reference point setting is executed only at the first home return operation after turning the power ON. (Second and subsequent home return operation is executed, but reference point setting is not executed.)

A = 2: Reference point setting is executed at every home return operation.

A = 3: Absolute encoder is used.

B: Home return direction

This designates the direction to seek for the home position LS (DEC). (when an absolute encoder is used, the direction to seek for stopper is specified.)

B = 0: Minus direction

B = 1: Plus direction

C: Home return operation start direction (invalid in absolute system)

This designates the moving direction at the start of home return operation.

C = 0: Moves always to the direction designated by item B.

C = 1: Setup alarm occurs when start point is at the home position LS. Otherwise, moves to the direction designated by item B.

C = 2: When start point at the home position LS, moves to the opposite direction to the designation of item B until it deviates from home position LS once.
Otherwise, moves to the direction designated by item B.

D: Home position LS method

This designates the relation between the home position LS and the reference point.

In absolute system, specify “0” or “3”.

D = 0: Home position LS is not used.
The motors do not move at the home position return.
Define a reference point where the home position returning position.

D = 1: Defines a reference point where the home position LS is turned ON, speed decelerates to Pr74 setting value and reads the first C phase pulse.

D = 2: Defines a reference point where the home position LS is turned ON, speed decelerates to Pr74 setting value, and deviates from home position LS and reads the first C phase pulse.

D = 3: Incremental system : Define the reference position where home position is turned ON, speed decelerates to Pr74 setting value, and pushes to stopper.

Absolute system : All automatic setup method is adopted.

E: Home position LS/reference point check

This designates whether to execute the home position LS check and reference point deviation.

Home position LS check is to confirm whether the condition (ON/OFF) of home position LS at reference point is as designated by item D. When to execute the home position LS check, positioning is once executed at reference point.

Reference point deviation check is to confirm whether in second and subsequent home return, the reference point has not deviated from Pr77 setting value in comparison with initial reference point (item A = 1) or last reference point (item A = 2).

As a result of check, if conditions are not satisfied, setup alarm occurs.

Note 1: If designated, check is also performed when item A = 0. Therefore, when item A = 0, set E = 0.

2: Home position LS check is performed when item E = 2 and item D = 0. Therefore, when item D = 0, use it with item E = 1 or 0.

E = 0 or 4: No check is performed. In absolute system, specify “0” or “4”. (0 is same as 4, and PG disconnection check is always performed.)

E = 1: Check for deviation of reference point is performed, but home position LS check is not performed.

E = 2: Both checks are performed.

F: Dwell position specify(invalid in absolute system)

This designates whether to move to the dwell position after setting reference point (or after home position LS check).

Moving speed is designated by Pr80.

F = 0: Does not move to dwell position

F = 1: Moves to dwell position

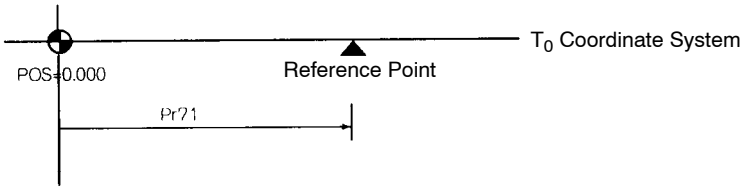
G: (RESERVED)

Servo user constant (0014, b12) designates to read home position LS by whether N.O. contact or N.C. contact.

(b) Pr71: Reference point coordinate value
(–99999999 to +99999999/reference unit)

T_0 coordinate value of the reference point is set by user.

The relation between the coordinate values of reference point and those of T_0 coordinate is as shown below.



(c) Pr74: Home position meeting speed (0 to 99999/speed unit)

Moving speed after home position LS is turned ON. Speed to seek for C phase pulse or stopper pushing position.

Invalid when item D of Pr70 is 0.

(d) Pr80: Home position return speed (0 to 99999/speed unit)

Moving speed before home position LS is turned ON. Speed to seek for home position LS.

Moves at this speed when positioning to the dwell position.

(e) Pr75: Pushing torque (10 to 400/%)

Pushing torque limit value in the home return using the stopper is set when the item D of Pr70 is 3.

Invalid when item D of Pr70 ≠ 3.

(f) Pr76: Stopper pushing time (0 to 600000/ms)

Set the time from the start of stopper pushing to set the reference point when item D of Pr70 is 3.

Invalid when item D of Pr70≠ 3.

(g) Pr77: Reference point allowable error amount (0 to 99999/reference unit)

When to perform the reference point check (item E of Pr70 is 1 or 2), if the dislocation between the first reference point after turning the power ON (item A = 1) and the last reference point is more than Pr77 setting value, setup alarm occurs. Set 1 or above when using this parameter.

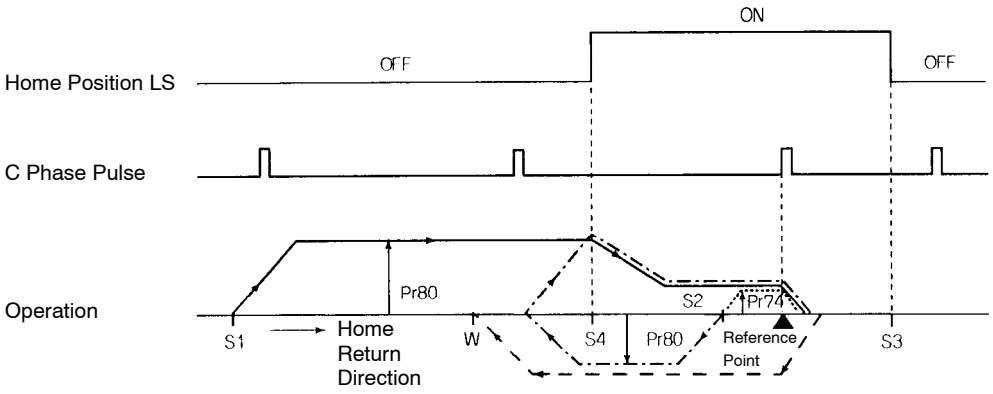
Invalid when item E is 0.

When the setup alarm occurs (even when item A is 2), reference point setting is not performed.

(2) Home Return Basic Operation

(a) Method for specifying the C-phase as a reference point during home position LS ON

F E D C B A
(Pr70 = □□1 □□□)



-·-·-·-·- : When start position is at the home position LS (S2) with item C of Pr70 is 2. (It does not move when item C of Pr70 is 1, and setup alarm occurs.)

····· : When start position is at the home position LS (S2) with item C of Pr70 is 0.

— — — : When item F of Pr70 is 1, C phase pulse is read and the machine decelerates to a stop (when item E of Pr70 is 1), or after positioning to the reference point for confirmation of home position LS (when item E of Pr70 is 2), the machine moves to the dwell position (Pr7).

① When OT LS is not established and the operation starts in the home return direction in advance of S3, the machine moves Pr80 setting speed until it crushes the stroke end, therefore, move the machine before S3 in advance.

② When item A of Pr70 is 0, or item A of Pr70 is 1, reference point is not set by second or subsequent home return after turning the power ON

③ Home return direction is designated by item B of Pr70. (B = 0: :minus direction, B = 1: plus direction)

④ Select home position LS A(0) or B(1) contacts using servo contacts (0014, b12).

⑤ When item E of Pr70 is 1 or 2, at home return after second or subsequent time after turning the power ON, it is checked whether the reference point is same as the reference point set at the first reference point after turning the power ON (item A of Pr70 is 1) or the last reference point (item A of Pr70 is 2).

Allowable range is Pr77.

⑥ Coordinate value of reference point is determined by Pr71.

⑦ When item E of Pr70 is 2, the machine is positioned at reference point for confirmation of LS after C phase pulse is read and the machine stops.

⑧ It is necessary to consider the position and length of LS so that deceleration can be made sufficiently before home position LS is turned ON and the first C phase pulse comes.

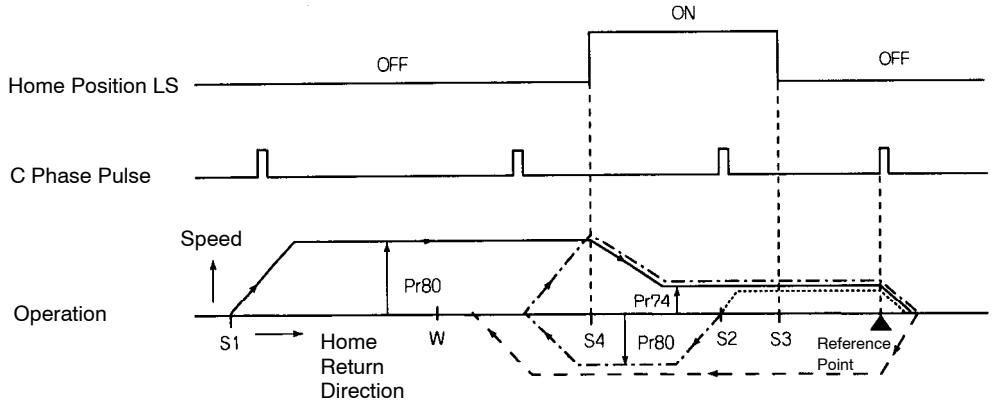
⑨ When the home return is completed, and there is no alarm, home return completion signal (ZPM) is turned ON.

When dwell position is provided, this signal is turned ON after positioning to dwell position.

⑩ Even when home position LS is turned ON and home position LS is turned OFF before C phase pulse comes, it will not cause an alarm.

(b) Method for specifying the first C phase as a reference point after changing home position LS from ON to OFF

F E D C B A
(Pr70 = □□2 □□□)



- - - - - - - - : Same as item(a).

· · · · · · · · · : The machine starts to move as Pr74 setting speed from the start when item C of Pr70 is 0 and start position (C2) is at the home position LS.

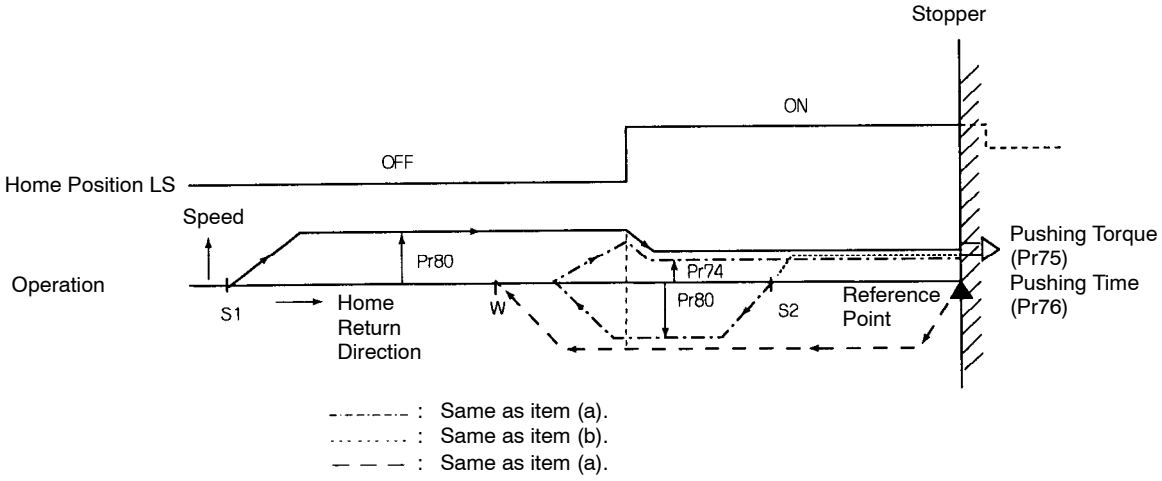
— — — : Same as item (a).

① Refer to the explanations ① to ⑦ and ⑨ in item (a).

② Consider the LS position and length so that deceleration can be made sufficiently when LS is ON.

(c) Method for using stopper

F E D C B A
(Pr70 = □□3 □□□)



- - - - - - - - : Same as item (a).
. . . . . : Same as item (b).
— — — : Same as item (a).

① Refer to the explanations ② to ⑥ and ⑨ in item (a).

② Reference point has no relation with C phase pulse.

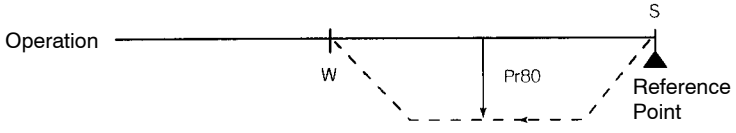
③ When item F of Pr70 is 1 and the dwell position is in home return direction, the machine does not move after ZRN input but setup alarm occurs at once.

④ Consider the LS position and length so that deceleration can be made sufficiently when LS is ON.

(d) Method when not using LS

F E D C B A
(Pr70 = □□0 0 0 □)

The machine does not move but the current position is used as a reference point.



— — — — : Same as item (a).

① Refer to the explanations ②, ⑤, ⑥ and ⑨ in item (a).

② Used when item E of Pr70 is 0 or – 1.

(3) Related Specifications

(a) Pr60, Pr61: Stored stroke limit

Stored stroke limit is invalid until home return is performed once after turning the power ON. (also same as when item A of Pr70 is 0)

Stored stroke limit is always invalid during home return operation. (also same as dwell position)

(b) Invalid parameters

Invalid parameters in incremental system are as shown below. (Display and setting available)

Pr6	:	Rapid return speed
Pr73	:	Home position setup command
Pr78	:	ABS-PG alarm reset command
Pr111 to Pr118	:	Zone signal lower limit/upper limit
Pr121 to Pr128	:	Zone signal lower limit/upper limit
Pr131 to Pr138	:	Zone signal lower limit/upper limit
Pr141 to Pr148	:	Zone signal lower limit/upper limit
Pr151 to Pr158	:	Zone signal lower limit/upper limit
Pr161 to Pr168	:	Zone signal lower limit/upper limit
Pr171 to Pr178	:	Zone signal lower limit/upper limit
Pr181 to Pr188	:	Zone signal lower limit/upper limit
Pr72	:	Reference point coordinate value

(c) Home return related output signal

(i) Home return completion signal (ZPM) (PSW1 in absolute system)

Signal that is turned ON at completion of home return operation. It is not turned ON when an alarm occurs during the home return operation.

The following shows conditions when the ZPM signal is turned OFF:

- The mode is switched.
- Home return is started (ZRN signal is turned ON)
- An alarm is reset by ERS signal input
- At emergency stop

(ii) Home position adjacent signal (ZNP) (PSW2 in absolute system)

Signal that is turned ON when home position LS is turned ON. This signal indicates reference point adjacent.

(iii) Reserved (SPARE) (PSW3 to PSW8 in absolute system)

(d) Input signal

(i) Home return start signal (ZRN) (Return in absolute system)

When this signal is turned ON, home return operation regulated by Pr70 is started.

(ii) Home position LS signal (/DEC)

Use 1CN-Pin 10 (/DEC) or 1CN-Pin 6 (+24V IN) for feed SERVOPACK.

For connection details, refer to the SERVOPACK operation manual.

(e) Position at turning the power ON

The position at turning the power ON is the reproduced position of the previous one before turning the power OFF. (POS is not 0.000 even with power OFF to ON)

7

FUNCTION COMMANDS OF CONTROLLER

This chapter describes the function commands of MOTION-PACK-SG1.

7.1 POSITIONING COMMAND (G01)

Format: G01 X(U) pppppppppFffffffIiiiSssssss

(1) Value Range

Position reference:

X = Aimed position absolute expression
(–99999999 to +99999999/position reference unit)

U = Aimed position incremental expression (–99999999 to +99999999)

Speed reference:

F = Speed (0 to 99999/speed unit)

Torque reference:

I = Torque limit value (10 to 400/%)

Spindle reference:

S = Spindle speed reference (0 to 60000/r/min)

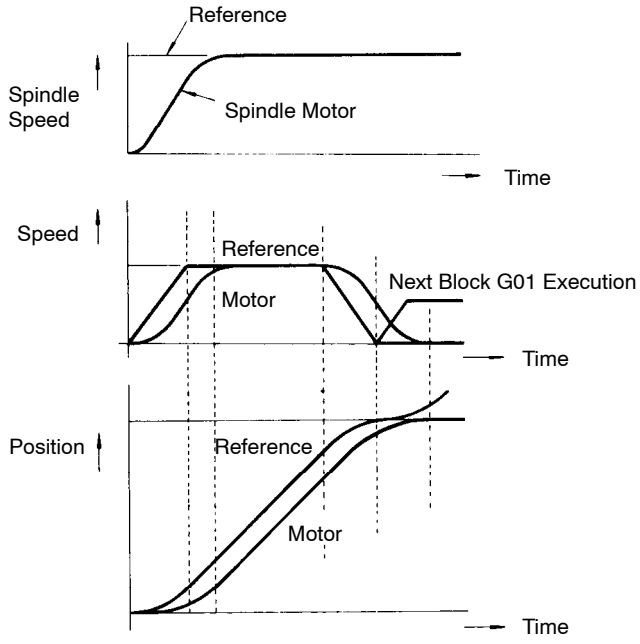
(2) Operation

The machine moves to position X (or distance U) of the coordinate system currently selected at speed F with torque limit I.

The aimed position X indicates absolute expression and U indicates incremental expression from which the moving distance from the last reference position to the current reference position is taken.

Spindle command S is output simultaneously with the feed command. Then the spindle starts rotating. However, spindle rotation speed is not interlocked with feed.

The spindle command is modal and the same spindle command is held until another S command is executed.



All positioning commands start or stop in linear accel/decel unless specified by G10/G11.

Speed designation (F) can be omitted from positioning command. At this time, the speed is the same as the former feed speed. (Make sure to specify the speed for the first feed command in the program. Otherwise, the speed will be 0.)

Torque limit I can be set in the range of 10 to 400. The unit is the percentage (%) of rated torque. However, set it within 250% for linear accel/decel.

Torque is provided with the same limit in both plus and minus directions at the same time, with a ±5% of error.

Torque limit designation can be omitted from positioning command. At this time, the torque limit is the same value as the former torque limit. It is set to 250% torque limit at program clear.

(3) Next Block Execution

When the reference up to the aimed position programmed by G01 command is completed, the MOTIONPACK controller starts to execute the next block. The figure shown on the previous page indicates a case where G01 command is also stored in the next block.

As shown in the figure, the motor moves with a constant error for the reference.

Therefore, when reference pulses are completely discharged and the next block starts to be executed, the motor may not yet reach the aimed position. When it is required to execute the next block after the motor reaches the aimed position, it is necessary to insert the in-position check command (G04) which will be described later.

(4) Spindle Command

Spindle command: Modal. The reference value is held until another command is executed.

7.2 SKIP POSITIONING COMMANDS (G05, G06)

Format: G05 X(U) pppppppppFffffffIiiiSssssss

(1) Value Range

Position reference:

X = Aimed position absolute expression
(–99999999 to +99999999/position reference unit)

U = Aimed position incremental expression (–99999999 to +99999999)

Speed reference:

F = Speed (0 to 99999/speed unit)

Torque reference:

I = Torque limit value (10 to 400/%)

Spindle reference:

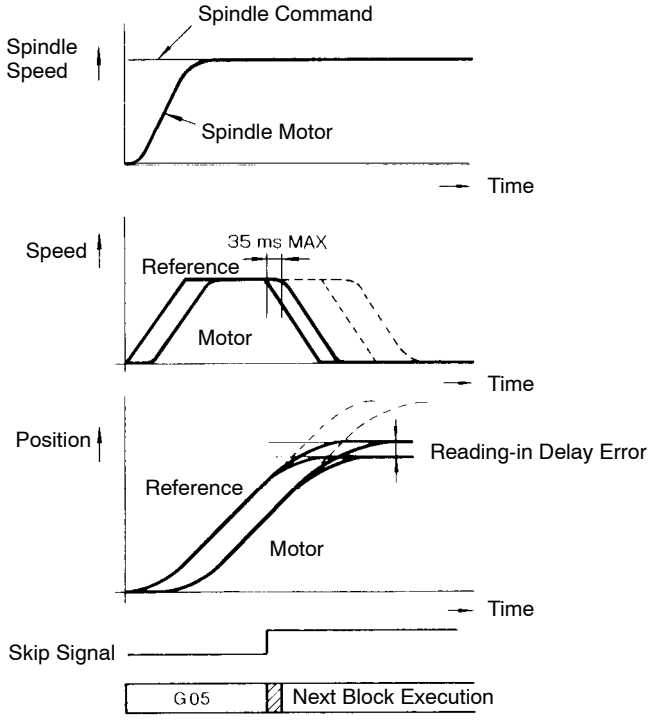
S = Spindle speed reference (0 to 60000/r/min)

(2) Operation

The machine moves to position X(or distance U) of the coordinate system that is currently selected at speed F with torque limit I.(F or I can be omitted in the same way as the positioning command described before.) When the skip signal is turned ON during moving, the execution is interrupted and the next block is executed.

Spindle command S is output simultaneously with the feed command. Then the spindle starts rotating. However, spindle rotation speed is not interlocked with feed.

The spindle command is modal and is not interrupted even by skipping. The same command is held until another S command is executed.



(3) Difference between G01 and G05 (G06)

When the skip signal is not turned ON until the X(U) specified position is reached, the aimed position is reached and the block is completed. In this case, the same operation is performed as G01.

The most remarkable difference is given when load torque exceeds the programmed torque limit.

G01: Command continues regardless of torque limit.

G05 (G06): Command suspended at torque limit and continues after the limit is released. (The time until the command is suspended is defined by Pr14.)

Therefore, G05 or G06 is more suitable for cutting feed than G01.

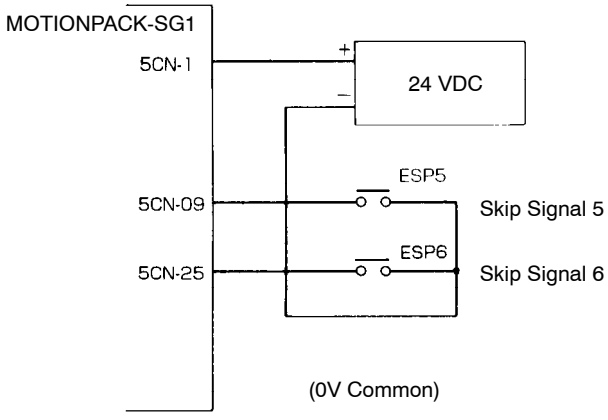
(4) Skip Signal

The following shows the relation between the skip commands and skip signals:

G05: ESP5

G06: ESP6

When the skip signal has already been turned ON at command execution, execution is held until this signal is turned OFF. If the signal is not turned OFF in 2 seconds, a skip signal fault (MP alarm) occurs.



(5) Application(Related to G67)

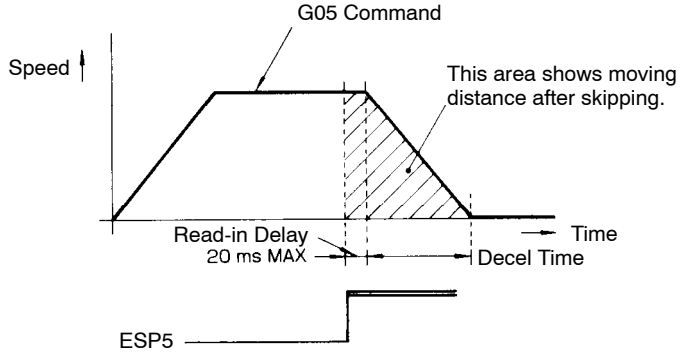
In-position check command (G67) is a condition jump command to execute jump determining whether skip has been performed or not.

Therefore, by providing G67 for the next block of G05(G06), it is possible to branch the program by determining whether skip has been performed.

According to the above, the skip positioning command stops positioning when external signal is ON and skips the execution to an other block.

(6) Skip Response Time

The skip signal read-in delay time is up to 20 ms. After skip signal is read-in, feeding decelerates and the next block is executed after reference pulses are discharged.



(7) Spindle Command

Spindle command: Modal. The reference value is held until another S command is executed.

7.3 POSITIONING COMMAND WITH PASSING SIGNAL OUTPUT (G07)

Format: G07 X(U) pppppppp
G12 X(U) pppppppFffffIiii

(1) Value Range

Position reference:

X = Aimed position absolute expression
(–99999999 to +99999999/position reference unit)

U = Aimed position incremental expression (–99999999 to +99999999)

Speed reference:

F = Speed (0 to 99999/speeds unit)

Torque reference:

I = Torque limit value (10 to 400/%)

(2) Operation

① Positioning point is provided by G07 command. Torque limit and speed are specified by G12.

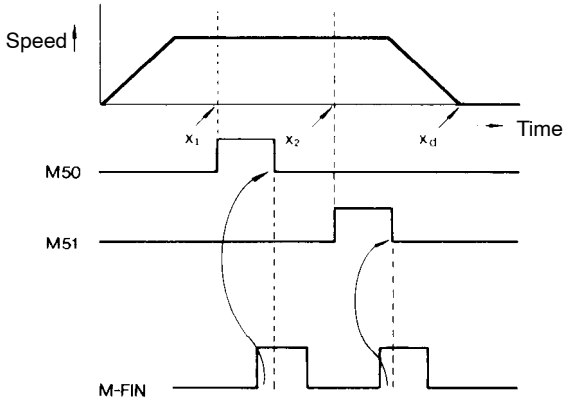
② A position where passing signal is output is determined by G12.

M50 to M58: M signal which is required M-FIN signal

M80 to M88/M 90 to M98: M signal which is not required M-FIN signal

③ Passing signal is programmed by M command.

The following figure shows operation of the program below.



G07 X $\underline{xd}$
G12 X $\underline{x_1}$ F_I_
M50
G12 X $\underline{x_2}$ F_ I_
M51

④ Whether M signal which is required M-FIN signal or not is determined by Pr101 setting. (For details, refer to M signal description.)

(3) Passing Signal Output Position

The passing signal output position is the feedback position.

(4) Program Limitations

① Do not insert any other positioning commands between G07 and G12.

Otherwise, operation cannot be performed normally.

② Arrange the G12 position reference values in order along the moving direction.

- Improper example 1 (Current value: X = 0.000)

```
G07 X100.000
G12 X50.000
M50
G12 X25.000 ←┐
M51          │ Reversed direction
G12 X35.000 ←┘
M52
```

- Improper example 2 (Current value: X = 100.000)

```
G07 X100.000
G12 X–10.000 ← No passing position between X = 0.000 and 100.000
M50
```

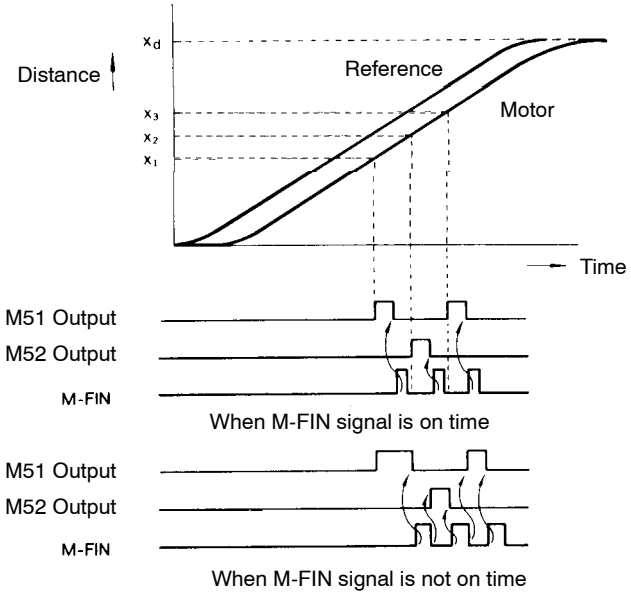
7

(5) M signal when G12 is used

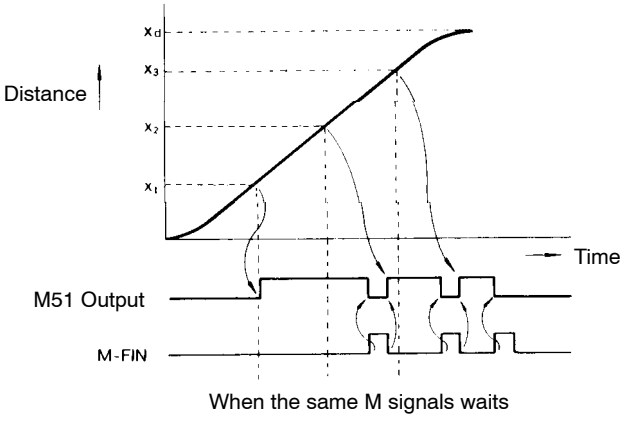
When M signal which is required M-FIN signal is used as a passing signal, note the following:

① If the next passing signal is output before M-FIN signal is returned, M signal output waits until the former M signal is reset by M-FIN signal.

After the former M-signal is reset by M-FIN and M-FIN signal is turned OFF, the next M signal is immediately output.



② In the same way as ①, if the next passing signal is turned ON without resetting the former M signal when the same M signal is specified as passing signal, the relation between M signal output and M-FIN signal is as shown below:



(6) Output Delay Time

The time from the specified position passing to the next block execution varies up to 4 ms for signal I/O time delay. Therefore, this command is not suitable for applications where high position accuracy is required for passing signals.

7.4 SPEED PROFILE POSITIONING COMMAND (G08)

Format: G08 X(U) pppppppp
G12 X(U) ppppppppFffffIiii

(1) Value Range

Position reference:

X = Aimed position absolute expression
(–99999999 to +99999999/position reference unit)

U = Aimed position incremental expression (–99999999 to +99999999)

Speed reference: F = Speed (0 to 99999/speed unit)

Torque reference: I= Torque limit value (10 to 400/%)

(2) Operation

① Positioning point is provided by G08 command.

② The position where speed is changed during positioning and speed to the position is set by G12 after the next block.

The following figure shows the speed chart explaining the program and movement.

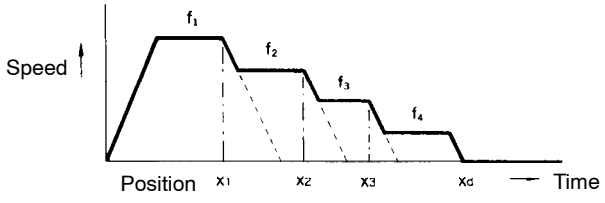
G08 X $\underline{xd}$

G12 X $\underline{x_1}$ F $\underline{f_1}$

G12 X $\underline{x_2}$ F $\underline{f_2}$

G12 X $\underline{x_3}$ F $\underline{f_3}$

G12 X $\underline{xd}$ F $\underline{f_4}$



③ Set position reference to xd or any position further than xd for the final block G12.

(3) Speed Changing Position

In this function, a position where speed is changed is the current value of the reference (command).

(4) Program Limitations

- Do not mix any other positioning commands with G12 to determine the speed change.
- Arrange the G12 position reference values in order. Do not provide any reference to positions that are not within the moving range.

(5) Speed Change Delay Time

Speed change (accel/decel start) may be delayed up to 15 ms.

Therefore, the changing point varies at the maximum distance (speed before/after change × 15 ms).

(6) Speed Change Distance

In this function, linear accel/decel are used.

Therefore, as a minimum time, total of change delay time (described in item 5) and accel/decel time is required. In the meantime, the motor keeps rotating and the position changes moment to moment. In some programs, the next speed changing point may be passed before the next speed is reached.

The setting of speed and speed changing positions must be checked.

7.5 SPEED PROFILE POSITIONING 2 COMMANDS (G13)

Format: G13 X(U) pppppppppFffffffIiii

(1) Value Range

Position reference :

X = Aimed position absolute expression
(–99999999 to +99999999/position reference unit)

U =Aimed position incremental expression (–99999999 to +99999999)

Speed reference: F = Speed (0 to 99999/speed unit)

Torque reference: I = Torque limit value (10 to 400/%)

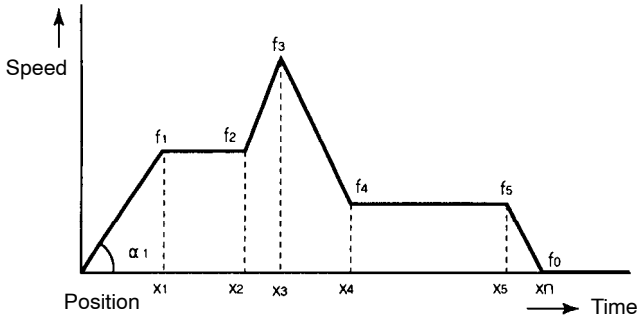
(2) Operation

① The machine moves to the first aimed position X1 (U1) of the coordinate value that is currently selected at acceleration α1, and torque I1. Then the machine moves to the second aimed position X2 (U2) at acceleration α2, and torque I1. And similar acceleration change is performed until Xn.

Note: The acceleration between x_1 and x_2 in the example below is equal to zero.

The following figure shows a speed chart that explains the program and its movement.

G13 X(x_1) U(u_1) F(f_1) I1
G13 X(x_2) U(u_2) F(f_2)
G13 X(x_3) U(u_3) F(f_3)
G13 X(x_4) U(u_4) F(f_4)
G13 X(x_5) U(u_5) F(f_5)
:
G13 Xn Un F0 I1



② Positioning point and speed are designated by G13.

This is the same when speed is changed during positioning or speed is set to the position.

③ The maximum number of acceleration setting times is 999.

(3) Program Limitations

- Designates the final speed reference (speed reference F0) at positioning to the final aimed position Xn (Un).
- In G13 command, there may be absolute expression X and incremental expression U.
- G13 command must be for unidirectional positioning, therefore, subsequent aimed position, numeric value and sign to invert the previous positioning direction should not be reverse.

  + direction: X0 < X1 < X2 < X4 < X4 < X5

  – direction: X0 > X1 > X2 > X3 > X4 > X5

  However, there is no problem with reverse operation after execution of F0.

The following shows a speed chart explaining the program and operation.

G13 X(x_1) F(F1) I(I1) G13 U(u_1) F(F1) I(I1)

G13 X(x_3) F(F2) I(I1) G13 U(u_2) F(F2) I(I1)

G13 X(x_2) F(F3) I(I1) G13 U(u_3) F(F3) I(I1)

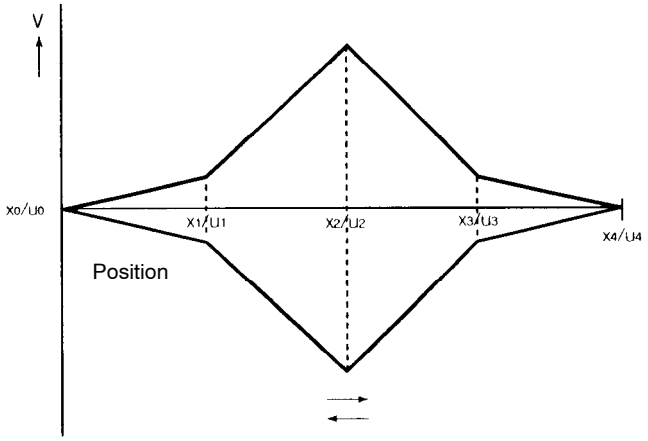
G13 X(x_4) F0 G13 U(u_4) F0

G13 X(x_3) F(F3) I(I2) G13 U($-u_3$) F(F3) I(I2)

G13 X(x_2) F(F2) I(I2) G13 U($-u_2$) F(F2) I(I2)

G13 X(x_1) F(F1) I(I2) G13 U($-u_1$) F(F1) I(I2)

G13 X(x_0) F0 I(I2) G13 U(u_0) F0 I(I2)



(4) Program Alarm Conditions

- Other positioning commands are mixed during G13 command.
- Final deceleration speed command (speed designation F0) is not specified in the last G13 command.
- The current feed direction is reverse to the last feed direction
- Acceleration is excessive (acceleration calculation overflow).
- There is U0 setting in positioning designation
- The last positioning point overlaps the current one.

  However, in this case, alarm does not occur immediately after program start, but after positioning to the last point.
- First positioning is performed by F0.
- The same command as the current point is executed.

(5) Feed-hold

The following shows the status to perform feed-hold during operation:

- The machine decelerates to a stop at the acceleration specified by Pr30 and Pr32. (This is the same as in mode change.)
- Alarm occurs when the program is started.
- Program start is available after alarm reset.

7.6 EXTERNAL POSITIONING COMMAND (G34)

Format: G34 X(U) pppppppppFffffffIiii

(1) Value Range

Position reference:

X = Aimed position absolute expression
(–99999999 to +99999999/position reference unit)

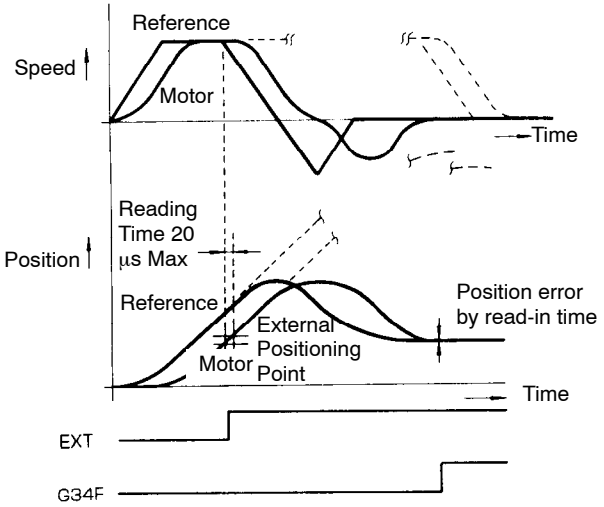
U = Aimed position incremental expression (–99999999 to +99999999)

Speed reference: F = Speed (0 to 99999/speed unit)

Torque reference: I = Torque limit value (10 to 400/%)

(2) Operation

The machine moves at speed F with torque limit I to the position X(U) of the coordinate value that is currently selected.(F and I can be omitted as well as the positioning command). When the external positioning signal (EXT: SERVOPACK input signal) is turned ON during moving, the machine returns to the position where EXT is turned ON.

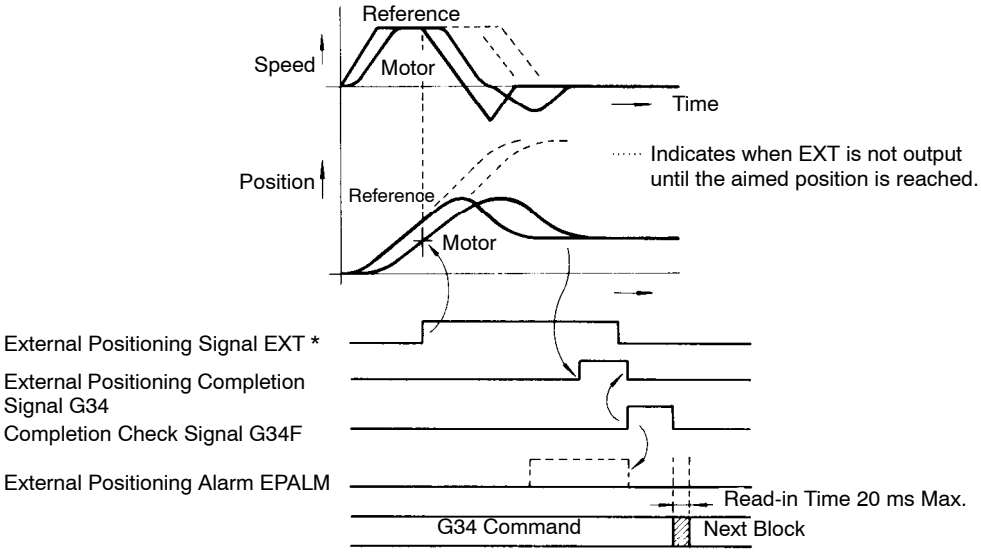


After stopping by external positioning, if feed is in-position, the external positioning completion signal (G34) is turned ON. Then when the completion check signal (G34F) is input (or turned ON), G34 signal is turned OFF.

If EXT is not turned ON until the machine reaches the X(U) specified position and feed is in-position, the external positioning alarm (EPALM) signal is output.

When the completion check signal (G34F) is turned ON, the completion signal (G34) or alarm signal (EPALM) is reset.

If EXT or G34F signal has already been turned ON at G34 execution start, both signals are held before going OFF. If they are not turned OFF in 2 seconds, an alarm (EPALM) is output.



* 1CN-Pin 10 (EXT) and 1CN-Pin 6 (+24V IN) for feed SERVOPACK are used. See the servo operation manual for details of connection.

(3) EPALM Reset Conditions

External positioning alarm (EPALM) is reset by the following conditions:

- When G34F signal is turned ON.
- When mode is changed.

(4) Signal Read-in

EXP signal: 70 μs max.

G34F: 20 ms max.

(5) Next Block Execution

When the completion check signal (G34F) is turned ON, the external positioning completion signal (G34) or alarm (EXPALM) is reset and the program moves to the next block.

7.7 SECOND EXTERNAL POSITIONING COMMAND (G35)

Format: G35 X(U) pppppppppFffffffIiii

(1) Value Range

Position reference:

X = Aimed position absolute expression
(–99999999 to +99999999/position reference unit)

U = Aimed position incremental expression (–99999999 to +99999999)

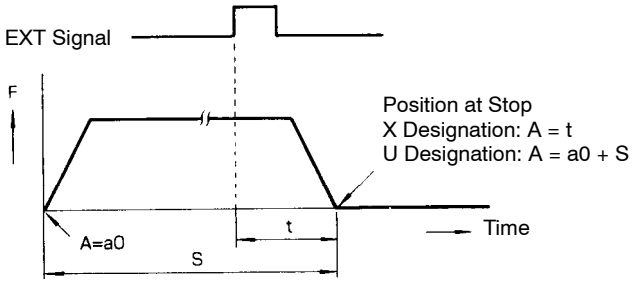
Speed reference: F = Speed (0 to 99999/speed unit)

Torque reference: I = Torque limit value (10 to 400/%)

(2) Operation

Feed by G35 command continues until the EXT signal is turned ON. Then positioning is performed at the position of specified length L after the EXT signal is turned ON.

Therefore, it is possible to perform positioning by external signals after infinite length operation.



(3) Moving Direction

Direction of a sign specified by G35 X (U)

Even in subprograms specified with the end position, it is possible to specify the moving distance exceeding the G68 specified position X. The G68 specified position X only specifies the limit position to search the EXT signal.

(4) Maximum Moving Distance

When the machine moves a distance of approx. 5×10^8 in position reference unit or it keeps moving more than 2 minutes, the EPALM signal is turned ON.

However, the machine keeps moving as it does.

When the stored stroke limit is reached, the EPALM signal is also turned ON.

(5) Moving Distance after EXT Signal ON

The machine moves distance L regardless of position designation X or U.

(6) Coordinate after EXT

- U designation

  Coordinate system does not change before/after the G34 command is started. Therefore, the current position after external positioning is completed is displayed, adding the G35 starting point value with the moving distance.

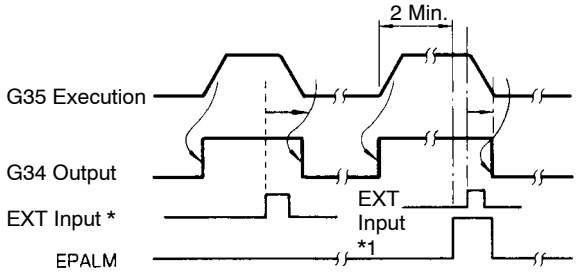
- X designation

  The position where the EXT signal is turned ON becomes the home position. Coordinate shift is effective.

(7) Stop Operation

When the machine cannot decelerate in the distance L after the EXT signal is turned ON, it passes the specified position. Then it returns to the position where the machine moves L distance after the EXT is turned ON.

(8) Timing Chart



* 1CN-Pin 10 (EXT) and 1CN-Pin 6 (+24V IN) for feed SERVOPACK are used. See the servo operation manual for details of connection.

7.8 S-CURVE ACCEL/DECEL POSITIONING COMMANDS (G10/G11)

(1) S-curve Accel/decel Positioning

Positioning reference between G10 and G11 becomes S-curve accel/decel positioning command.

<Example>

G10

G01 X(U)__F__I__ ← S-curve accel/decel positioning

G11

(2) Value Range

Position Reference:

X = Aimed position absolute expression
(–99999999 to +99999999/position reference unit)

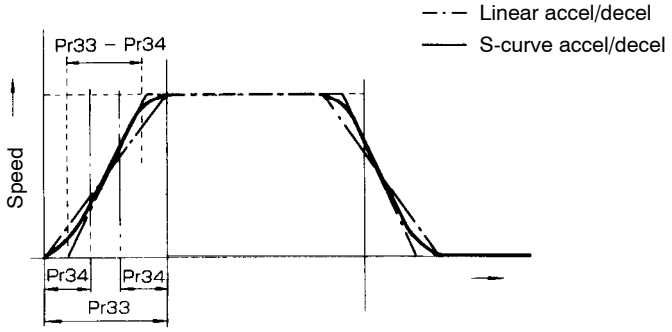
U = Aimed position incremental expression (–99999999 to +99999999)

Speed reference: F = Speed (0 to 99999/speed unit)

Torque reference: I = Torque limit value (10 to 400/%)

(3) Operation

S-curve accel/decel positioning is performed according to the S-curve accel/decel curve defined by Pr33 (all S-curve accel/decel time) and Pr34 (S-curve section accel/decel time).



(4) Definition of S-curve Accel/decel Curve

① S-curve accel/decel curve consists of the following three zones:

A: Accel-accel zone

B: Constant accel zone

C: Decel-accel zone

② Acceleration and declaration are symmetric patterns.

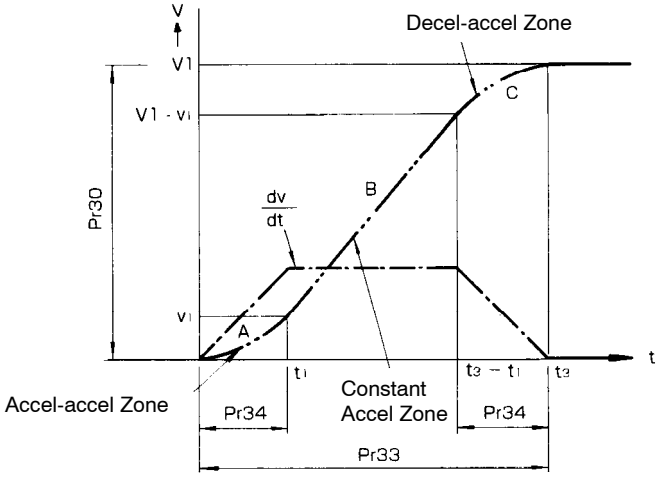
③ S-curve accel/decel curve is defined by the following three parameters:

V1 = Pr30: Maximum speed (0 to 99999)

ta = Pr33: Accel time (0 to 10000/ms)

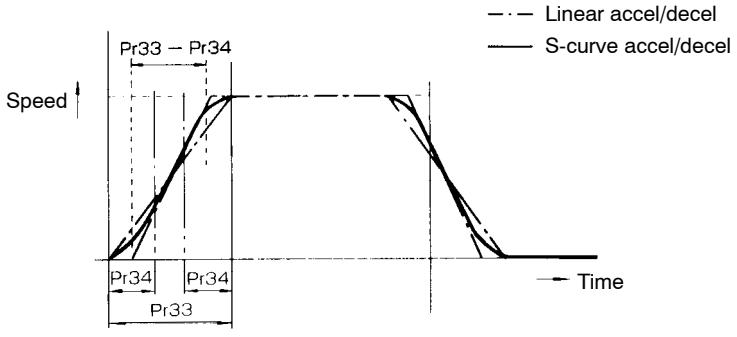
t1 = Pr34: S-curve accel/decel time (0 to 2000/ms)

The upper limit value of Pr33 is smaller value of 10000 ms or Pr32 × 1/2.



(5) Operation Curve

The basic operation is the same as G01 positioning operation. Only accel/decel curve becomes S-curve. The S-curve accel/decel times are the same (symmetric type accel/decel).



When the stop signal is input during operation, the movement is shown in figure below.

① Normal operation

Positioning by symmetric type S-curve accel/decel shown in the figure below is executed.

② Operation with short moving distance

When reference moving distance is short, positioning without constant accel zone or constant speed zone is performed as shown in the figure below.

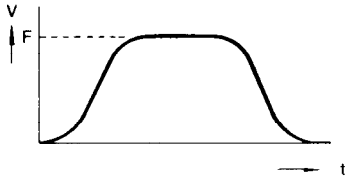


Fig. A Normal Operation Speed Curve

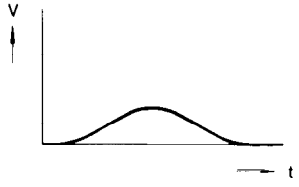


Fig. B Speed Curve at Short Moving Distance

7

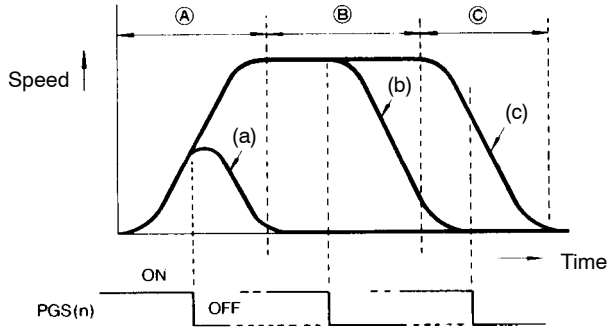
③ Speed curve when operation is suspended

When the operation is suspended, the operation speed curve varies according to the timing, as shown below:

A: When suspended during accel, the machine stops by symmetric curve as curve (a).

B: When suspended during constant speed, the machine stops by decel curve of S-curve accel/decel curve.

C: When suspended during deceleration, the machine continues to decelerate to a stop.



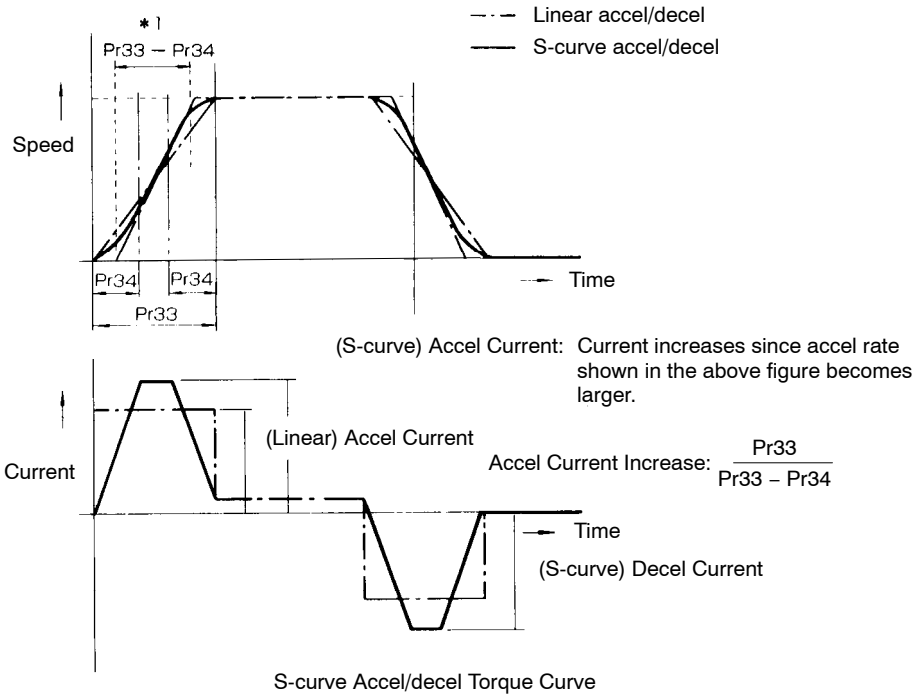
(6) Using Method

Accel (decel) torque

As shown in the figure below, S-curve accel(decel)defined by Pr34 is provided at the beginning and the end of accel (decel). Then linear accel (decel) speed in the middle of accel or decel becomes larger as ratio of Pr34/Pr33 increase. Accel(decel)speed becomes linear when accel(decel) time reaches (Pr33-Pr34). At that point torque becomes the peak torque of S-curve accel/decel positioning.

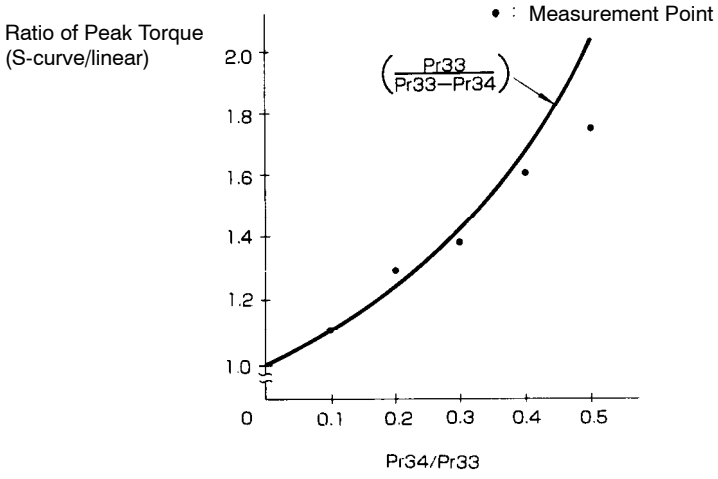
Peak torque at S-curve accel/decel
= Pr33/(Pr33 – Pr34) × peak torque at linear accel/decel

According to the above equation, when Pr34 = 0, S-curve and linear peak torque are equal. When Pr34 = Pr33/2 (linear section is not provided), S-curve peak torque becomes twice as large as that of linear accel/decel.



S-curve Accel/decel Torque Curve

The ratio of Pr33 and Pr34 peak torque is shown below:



(7) Accel/decel Time Adjusting Method

① Measure accel current waveform of linear accel/decel operation by using an oscilloscope.

② Calculate the ratio of linear accel current and motor rated current.

a = Motor rated current × 2* / Linear accel current

*: Normally I = 250% for MOTIONPACK

Up to 400% can be set for insufficient torque.

③ According to "a" obtained in ②;

a ≦ 1: MOTIONPACK momentary current has already come to the limit with linear accel current.
It is necessary to increase accel time to use S-curve accel/decel.

a > 1: S-curve accel/decel possible.

④ According to the figure in the previous page;

The ratio of Pr34 and Pr33 is obtained when accel current ratio is equal to the "a" above.

At this time, Pr34 is the limit value of S-curve accel/decel time.

(8) Applications and Capacity Selection

Since S-curve accel/decel positioning function can supply constant ratios of the accel/decel speed (accel-accel speed) or accel-decel speed), it is possible to decrease the shock provided at start/stop. However, this makes it necessary to have larger servo drive capacity than that for linear accel/decel, as described in item (7).

If required accel/decel time cannot be obtained and the specifications of accel/decel time cannot be increased after the above adjustment, select the servo capacity again.

This means that larger capacity servo must be selected just for the peak torque at accel/decel. However, this servo drive capacity is necessary to perform shockless operation promptly.

When the servo capacity is not increased, adjust Pr34, by checking the aimed shockless operation, and control the peak torque within the range of maximum momentary current. ("Servo" includes SERVOPACK and servomotor.)

7.9 REGISTRATION FUNCTIONS (G36, G37)

Format: G36 X(U) pppppppppFffffffIiii

(1) Value Range

Position reference:

X = Aimed position absolute expression
(–99999999 to +99999999/position reference unit)

U = Aimed position incremental expression (–99999999 to +99999999)

Speed reference: F = Speed (0 to 99999/speed unit)

Torque reference: I = Torque limit value(10 to 400/%)

(2) Programming Method

Registration function is possible by programming G36 and G37 commands into continued block.

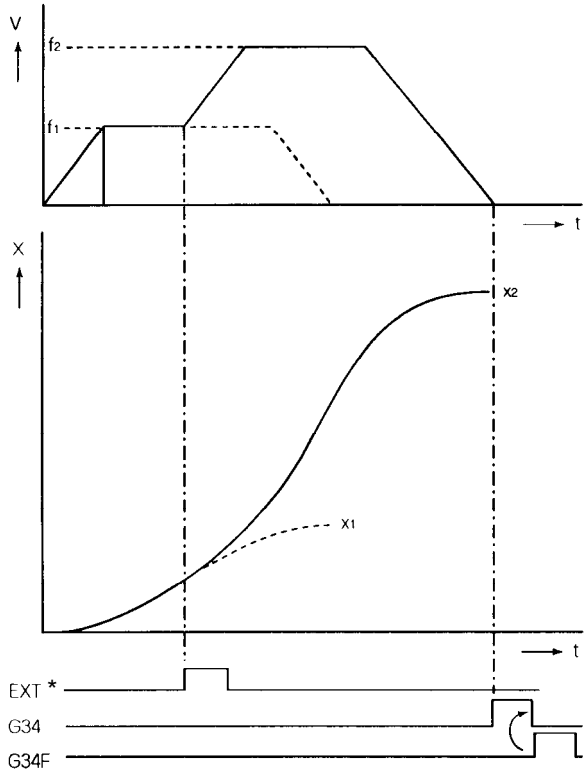
< Block >

n G36 $X(x_1)/U(u_1)F(f_1)I(i_1)$

n+1 G37 $X(x_2)/U(u_2)F(f_2)I(i_2)$

(3) Operation

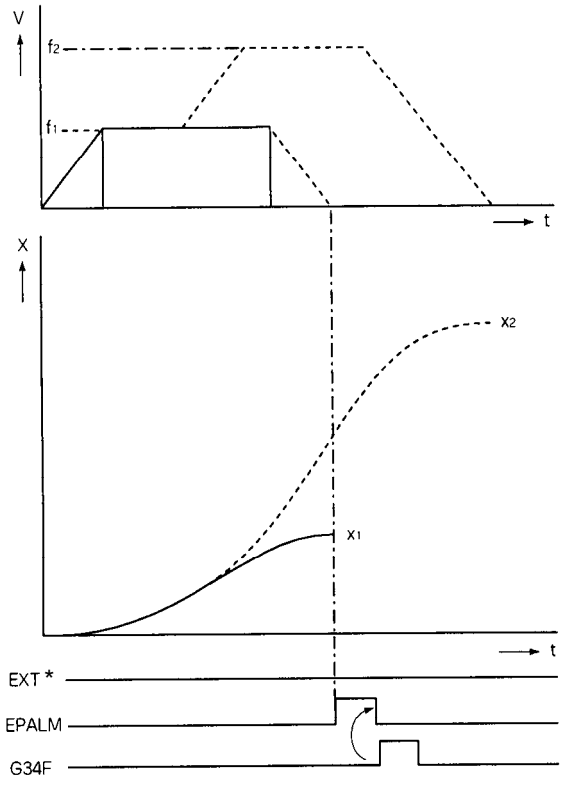
The machine moves at speed F(f_1) with torque limit I to the position X (x_1) or U (u_1) designated by G36 command. When the external positioning signal (EXT) is turned ON during moving, execution shifts to the next block, and the machine starts moving at speed F(f_2) with torque limit I(i_2) to the position X (x_2) or U (u_2) designated by G37 command.



After stop by external positioning, if the machine is in the in-position, the external positioning completion signal (G34) is turned ON. Then when the completion confirmation signal (G34F) is turned ON, G34 signal is turned OFF. If it reaches the position X (U) designated by G36 command and EXT signal is turned ON, external positioning alarm (EPALM) signal is output.

However, in the case of n operation mode, after completion of n time, external positioning error (EPALM) occurs. For details, refer to the item (5).

When the completion confirmation signal (G34F)is turned ON, completion signal (G34) or alarm signal (EPALM) is reset. At start of G36 command execution, if EXT or G34F signal is already ON, it waits until both the signals are turned OFF. If this condition is not satisfied after 2 seconds has elapsed, alarm (EPALM) is output.



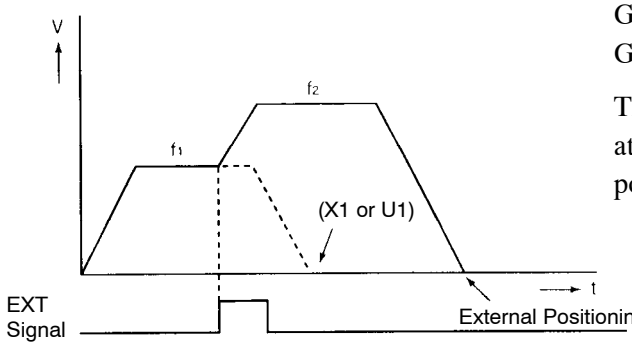
* 1CN-Pin 10 (EXT) and 1CN-Pin 6 (+24V IN) for feed SERVOPACK are used. See the servo operation manual for details of connection.

(4) Operation U (X) Designation

(a) Operation U designation

When the external positioning signal (EXT) is turned ON during moving by data designated by G36 command, the machine moves the distance of U2 from the position of X1 or U1.

(Example)



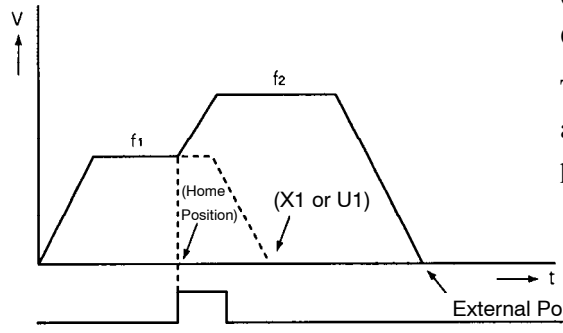
G36 U100.000 F1000
G37 U300.000 F2000

The current value display at completion of external positioning is 400.000.

(b) Operation X designation

When the external positioning signal (EXT) is turned ON during moving by data designated by G36 command, positioning is performed to the X2 position designated by G37 command with the position as home position.

(Example)



G36 X100.000 F1000
G37 X200.000 F2000

The current value display at completion of external positioning is 200.000.

(5) Mode No. 0 and No. 1

The contents of MODE No. 0 and No. 1 are as shown below:

(a) MODE No. change

Pr65 = 0: Automatic operation continue mode (basic operation)

Pr65 = 1: n operation mode

(When external positioning signal is mistaken in reading for n times, EPALM (external positioning alarm) is output, and automatic operation stops.)

(b) Setting of n times in n operation mode (n count)

Pr66 = 0 to 10

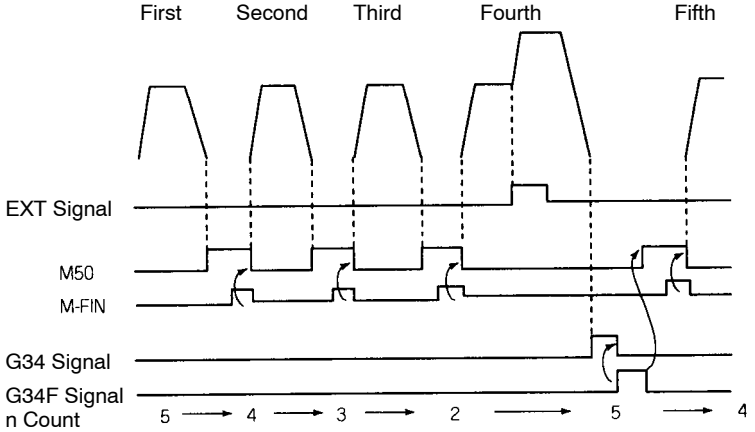
When parameter is entered to the above parameter to start program, SALM alarm occurs.

(6) Operation

Explanation is made on MODE No. 1.

The following is an example when external positioning signal is turned ON for the 4th time.

N0100 G36 U100.000 F10000 I100 ← n-th object position
N101 G37 X200.000 F20000 I100
N0102 M50
N0103 G69 P100



When external positioning signal (EXT) is not turned ON even in the 5th time, EPALM (external positioning alarm) occurs.

(7) n Count Updating

n count updating is performed in the following cases:

- External positioning signal (EXT) is turned ON.
- At completion of n-th time
- When the operation mode is changed
- At power ON
- When M30 is executed

(8) Coordinate after EXT

- X designation

  The position where EXT signal is turned ON is home position.

  The home position of T_0 coordinate moves and T_1 to T_9 coordinate systems also move along with it.

  Therefore, the coordinate shift amount of each coordinate system is kept same.

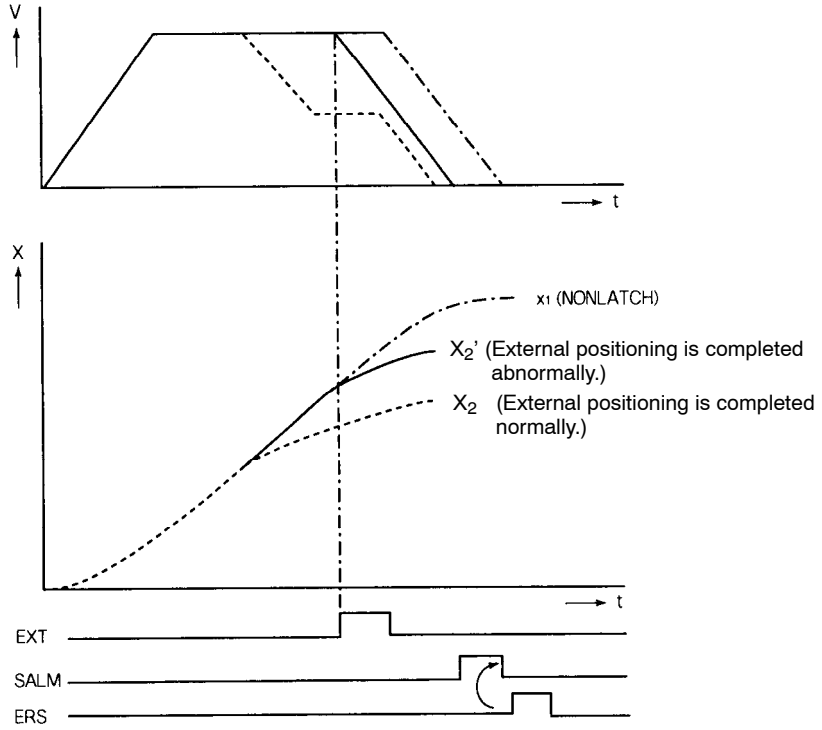
- U designation

  Coordinate remains in the coordinate system when G36 command starts.

  Therefore, the current position display after completion of external positioning becomes the sum of the shift amount designated by G36 and the shift amount designated by G37.

(9) Stop Operation

When EXT signal is turned ON and positioning cannot be performed at the aimed position designated by G37, after passing the aimed position designated by G37, the machine decelerates to a stop, and SALM (program alarm) signal is output.



(10) Execution of Next Block

When completion confirmation signal (G34F) is turned ON, external positioning completion signal (G34) or alarm (EPALM) is reset.

Then, when MOTIONPACK reads that G34F signal is turned OFF, the program goes to the next block.

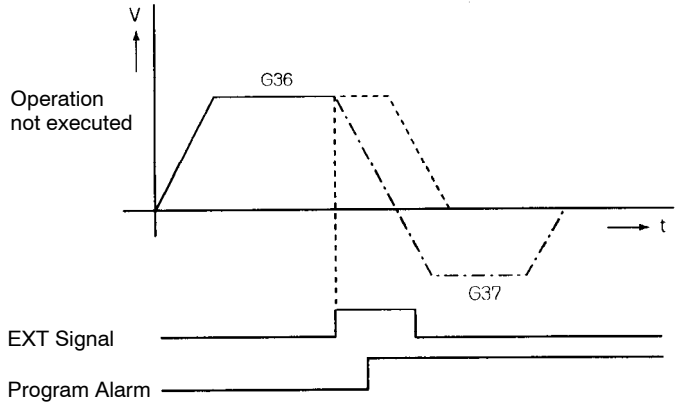
(11) EPLAM Reset Conditions

External positioning abnormal signal (EPALM) rest conditions are as follows:

- When G34F signal is turned ON
- When the mode signal is changed

(12) Program Limitations

- Do not mix any other G codes between G36 and G37.
- Do not change the order for G36 and G37.
- Use the same sign of the position designation for G36 and G37.
- The position designated by G36 command should not be the same as the current position.
- This positioning operation is not available in the end point position designation subprogram.
- Do not jump to G37 block.



Note: Starting the program without observing the above limitations causes ALM (program alarm).

7.10 ROTATING SOLID ANGLE INDEXING (G05, G06)

(1) System Setting

When using the rotating solid indexing function, it is necessary to set the following:

- Set the SW1 rotary switch at the front of the controller to "1" in power OFF status. Normally, 0 is set.
- SW1 is read when power is turned ON, so be sure to set it in power OFF status.

By the above setting, MOTIONPACK-SG1 executes angle designated positioning.

(2) Functions

Under the rotating solid indexing designation, the following angle indexing function commands become effective.

G05: Angle indexing function for rotating angle designation

G06: Angle indexing function for short distance direction automatic selection

Function command at normal setting (SW1=0) is also effective, but note that position unit is called angle.

Details of G05 and G06 are explained hereinafter, and for convenience, command position is described as angle when one rotation is expressed by 360 degrees.

(3) Details of Functions

(a) Angle indexing function for rotating angle designation (G05)

(i) Designation method

G05 X (θ) F (f) I (i) S (s)

Provided, $|\theta| < Pr51 = (360°)$

Namely, $-360° < \theta < 360°$

Do not set numeric values to S, but ignore it. If S is set, command is output, but if S command is connected to other drive unit, it is actually ignored.

(ii) Operation

- The machine performs positioning from the current position to the angle X = θ.
- Rotating direction is determined by the sign of X

  X = θ ≧ 0: Forward direction

  X = θ < 0: Reverse direction
- The machine does not move but completes moving when the current position is the designated position.
- After execution of this function, the current position becomes reference position θ.

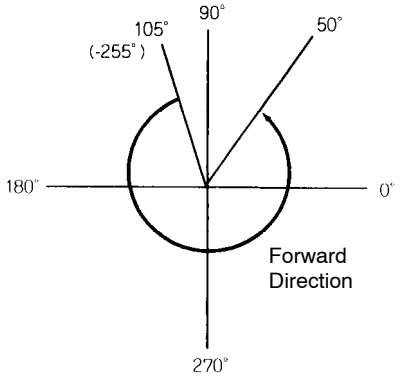
(Example)

When G05 X (50) F (f) I (i) is executed from the current position (X = 105), the current position (X) is

X = 105°
= 105° – 360°
= –225°

and the positioning position is X = 50°.

Since X > 0, it is recognized as a forward rotation command, rotates counterclockwise as shown in the right figure.



- This function is valid only in absolute system. In incremental system, standard skip positioning is performed.
- Coordinate shift remains valid after execution of this function.
- When the reference point position exceeds 360°, standard skip positioning is performed.

  θ = 360°n + 8θ

  Therefore, positioning is performed at 8θ of n-th time from home position.

(b) Angle indexing function for short distance direction automatic designation

(i) Designation method

G06 X (θ) F (f) I (i)

Provided, $|\theta| < 360°$ $(-360° < \theta < 360°)$

(ii) Operation

- The machine performs positioning from the current position to the angle X = θ.
- Rotating direction is in the short distance direction from the current position.

(Example 1)

When G06 X 270° F (f) I (i) is executed from the current position X = 80°,

X = 270° – 80° = 190° > 180°

Therefore, positioning is performed at X = 270° from the reverse rotating direction as shown in figure (a).

(Example 2)

When G06 X 200° F (f) I (i) is executed from the current position X = 80°,

X = 200°– 80° = 120° > 180°

Therefore, positioning is performed at X = 200° from the forward rotating direction as shown in figure (b).

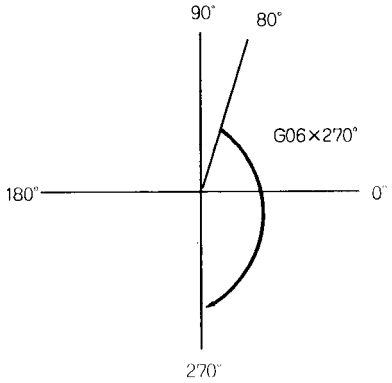


Fig. (a)

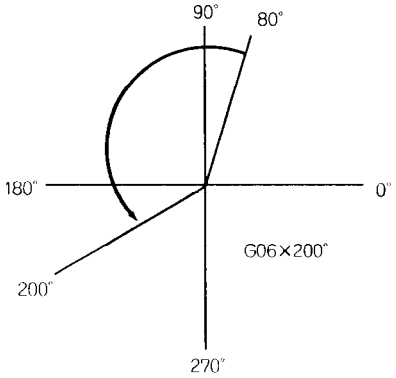


Fig. (b)

- When the designated shift amount is 180°, rotation is performed in the forward direction.
- This function is valid only in absolute system. In the case of incremental system, standard skip positioning is performed.
- When current position is the reference position, the machine does not move but completes movement.
- After execution of this function, the current position becomes the reference position θ.

  Coordinate shift remains valid after execution of this function.

(c) General Notes

(i) When the reference position exceeds 360°

When $|\theta| \geqq 360°$, the machine moves the same as standard G05 operation.

When G05 X (750°) F (f) I (i) is executed from the current position X = 15°, positioning is performed at 30° after 2 rotations from the angle 15°. Coordinate of positioning position becomes 30°.

(ii) Relation of skip signal

When skip signal is turned ON during angle indexing, the machine decelerates to a stop the same as standard skip positioning.

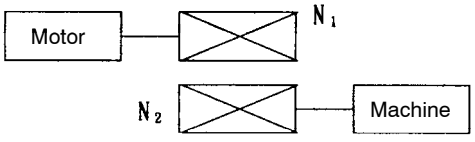
G67 (reach check function) function is also the same as standard one.

However, coordinate value is the value minus integer times of 360° the same as this function.

(iii) Use in end point position designation subprogram

This function cannot be used in end point position designation subprogram.

(4) Parameter Settings

<table>
<tr><th>Parameter No.</th><th>Name (Range/Unit)</th><th>Change</th><th>Description</th></tr>
<tr><td>Pr50</td><td>Minimum reference unit
(0 to 3/10^{–n} × 10°)</td><td>P</td><td>Exchange mm in linear reciprocating reference with 10°.
When Pr50 = n, minimum reference unit is 10^{–n} × 100°.
Maximum reference unit when N = 0 to 3 is shown in the following table.
<table>
<tr><th>Pr50</th><th>Minimum Reference Unit</th></tr>
<tr><td>0</td><td>10°</td></tr>
<tr><td>1</td><td>1°</td></tr>
<tr><td>2</td><td>0.1°</td></tr>
<tr><td>3</td><td>0.01°</td></tr>
</table></td></tr>
<tr><td>Pr51</td><td>Ball screws/pitch rotating ratio
(1000 to 99999/0.01°/r)</td><td>P</td><td>Movement (rotating angle) of one rotation of machine axis is set to Pr51.
Angle unit is expressed in 0.01°.
(Example) In the case of motor is connected directly
Pr51 = 36000 since 360° rotation by motor one rotation.</td></tr>
<tr><td>Pr52</td><td>Gear ratio N_1 (Motor side)
(1 to 999999/–)</td><td>P</td><td rowspan="2">Gear ratio N_1/N_2 is set to Pr52/Pr53. Set the number of gears at the motor side to N_1, and that of machine side to N_2.
 
</td></tr>
<tr><td>Pr53</td><td>Gear ratio N_2 (Machine side)
(1 to 999999/–)</td><td>P</td></tr>
<tr><td>Pr54</td><td>Decimal point position
(speed unit)
(0 to 5/reference unit × 10ⁿ/min)</td><td>P</td><td>Parameter to determine at which digit of the position reference value (expressed in minimum reference unit) the decimal point is to be located. This decimal point position is to be the speed unit per minute. The relationship between minimum reference unit and speed unit is shown below.
<table>
<tr><th colspan="2" rowspan="2">Pr54 \ Pr50</th><th colspan="4">Minimum Reference Unit</th></tr>
<tr><th>10°</th><th>1°</th><th>0.1°</th><th>0.01°/min</th></tr>
<tr><th colspan="2">Decimal Point Position</th><th>0</th><th>1</th><th>2</th><th>3</th></tr>
<tr><td colspan="2">0</td><td>10°/min</td><td>1°/min</td><td>0.1°/min</td><td>0.01°/min</td></tr>
<tr><td colspan="2">1</td><td>100°/min</td><td>10°/min</td><td>1°/min</td><td>0.1°/min</td></tr>
<tr><td colspan="2">2</td><td>1000°/min</td><td>100°/min</td><td>10°/min</td><td>1°/min</td></tr>
<tr><td colspan="2">3</td><td>10000°/min</td><td>1000°/min</td><td>100°/min</td><td>10°/min</td></tr>
</table></td></tr>
</table>

Other parameters than the above are the same of those of linear operation (SW1=0).

7.11 FOLLOW-UP OPERATION FUNCTIONS (G95, G96, G97, G85, G75)

Format: G95 X (U) ___ ; /G96;/G94
G97 X (U) ___ ; F__ I__ S__ ;
G85 X (U) ___ ; F__ I__ S__ ;
(G75 X (U) ___ ; F__ I__ S__ ;)

(1) Outline of Function

This is the follow-up (synchronous) operation for general-purpose machines to be realized in connection with the spindle by use of servo drive (feed axis) function, and the spindle command function.

The outline of functions are as shown below:

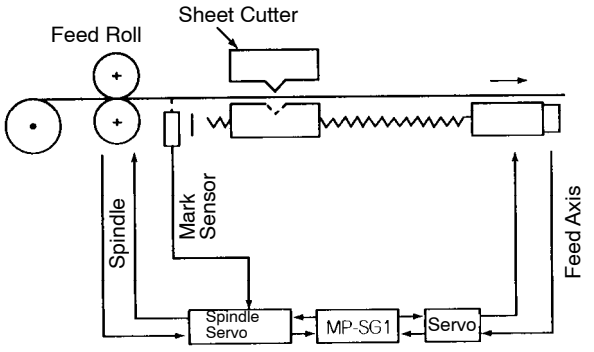
- Point designation synchronization by mark sensor input
  (G95: Mark sensor mode)
- Proportional designation synchronization by program
  (G96: Non mark sensor mode)
- Feed axis inching per spindle designated movement
  (G97: Position follow-up operation mode)

Function names of the above 3 types are called by the names in parentheses.

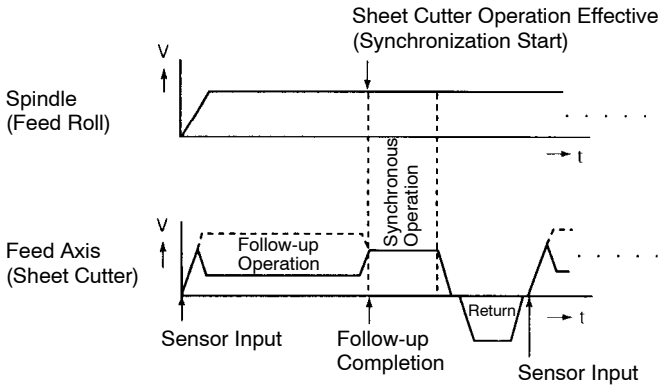
(2) Operation

(a) Mark sensor mode (G95)

(i) System block diagram



(ii) Speed chart



< Explanation >

First, the spindle starts to feed the sheet.

Then, when mark position is input from the sensor, follow-up operation of the feed axis starts.

At completion of follow-up operation, synchronous operation starts, and sheet cutter can be operated.

After cutting, when completion command signal (G85F) is input, the synchronous operation completes, and only the feed axis decelerates to a stop.

After return (G01) to the start position once, subsequent cutting may be executed in the same manner.

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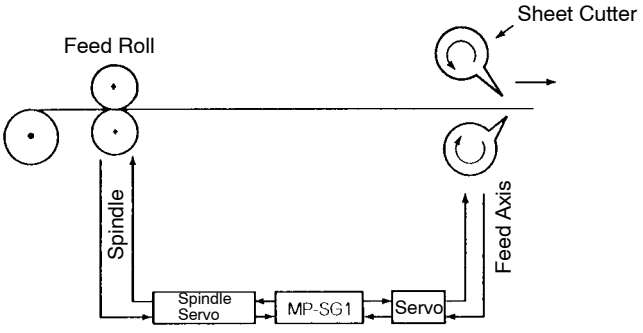
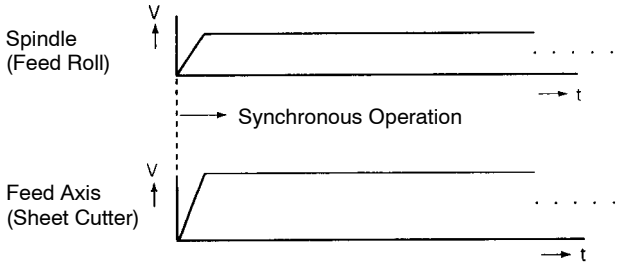
(b) Non mark sensor mode (G96)

(i) System block diagram



(ii) Speed chart



< Explanation >

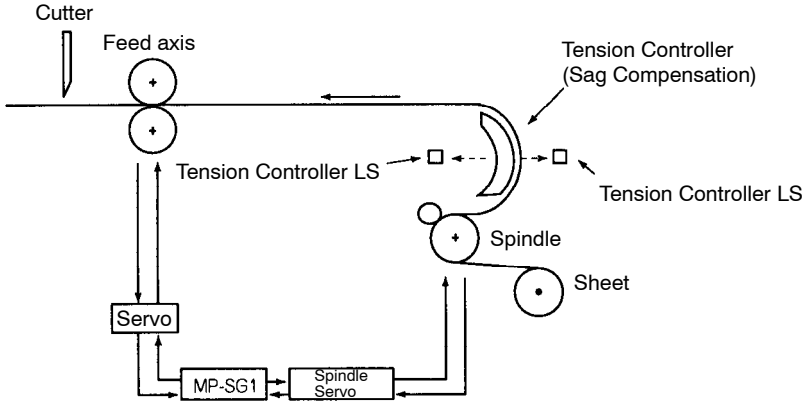
Synchronous operation starts from feed axis under the speed ratio designated by program in advance.

When changing the speed ratio, stop the machine first.

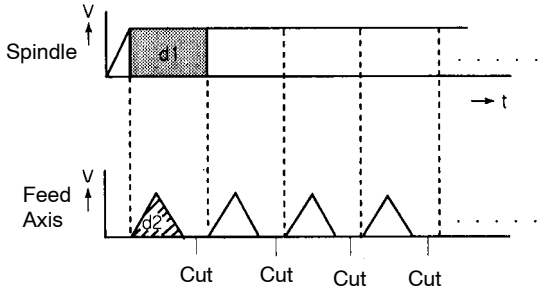
Speed ratio cannot be changed under operation.

(c) Position follow-up operation mode (G97)

(i) System block diagram



(ii) Speed chart



< Explanation >

First, the spindle starts, and as it reaches the preset distance (d1), positioning occurs at fixed intervals on the feed axis at the arrival moment.

However, only in the first positioning of the feed axis, positioning starts when the spindle reaches the designated speed.

As for the d1 distance it is designated by Pr229, while the d2 distance is designated by program (G97 x_).

(3) Related Parameters

The main parameters that require setting for follow-up operation are as shown below.

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Parameter No.	Contents	Range/Unit
Pr200	Spindle encoder mounting position	0: Spindle side, 1: Motor side
Pr201	Pulse number per rotation of spindle encoder (with no magnification)	1 to 32768/pulses
Pr202	Spindle motor maximum speed at synchronous, follow-up operation	1 to 32767/r/min
Pr204	Spindle linear accel/decel time	0 to 60000/ms
Pr206	Spindle in-position range	1 to 255/pulses
Pr208	Spindle, feed axis synchronous offset parameter (K1)	–32767 to +32767 / 1/256 magnification
Pr209	Spindle, feed axis synchronous offset parameter (K2)	0 to 32767/0.01%
Pr211	Number of teeth of gears at the spindle side	1 to 511
Pr212	Number of teeth of gears at the motor side	1 to 511
Pr213	Gear ratio of spindle and spindle PG	1 to 511

Parameter No.	Contents	Range/Unit
Pr214	Rotation direction method at synchronous and follow-up operation 1: +/– command by FRN/RRN 2: –/+ command by FRN/RRN	
Pr215	Synchronous error automatic offset setting reference	0: Offset completion (normal operation) 1: Offset execution
Pr216	Synchronous error amount (servo position deviation)	0 to ±99999999/pulses
Pr217	Synchronous error amount (synchronous error + peak value)	0 to ±99999999/pulses
Pr218	Synchronous error amount (synchronous error – peak value)	0 to ±99999999/pulses
Pr227	Spindle feed roll diameter	0 to 99999999/ reference unit
Pr228	In-position width during feed axis synchronous operation	0 to 32767/pulses
Pr229	G97 spindle feed distance (d1)	0 to 99999999/ reference unit

(4) Input/output Signals

(a) Input signals (G95, G96 mode)

- External mark sensor signal (EXT)* (used only in G95 mode)
- Follow-up operation completion command signal (G85F)

* 1CN-Pin 10 (EXT) and 1CN-Pin 6 (+24V IN) for feed SERVOPACK are used. See the servo operation manual for details of connection.

(b) Output signal

Synchronous operation signal (cutter operation available signal) (SLPS)

Internal read delay at input of external mark sensor signal (EXT) is approx. 70 μs max.

(5) Program

(a) Follow-up operation mode designation command

(i) Mark sensor mode (G95)

Format: G95 X/U__ ;

Mark sensor position (–99999999 to +99999999/reference unit)

[Explanation]

- When the follow-up operation command (G85/G75) is performed after execution of this command, follow-up operation with the mark sensor starts.
- Execution of this command outputs the spindle stop command, and completes the block after confirmation of stop (zero speed), and it goes to the next program block.

Note: Execution of the following G code during G95 mode causes alarm (program error).
Ineffective G code: G01 (with S designation), G05 (with S designation), G06 (with S designation), G15, G68X, G96, G97, M03, M04, M05

(ii) Non mark sensor mode (G96)

Format: G96;

[Explanation]

- When follow-up operation command (G85/G75) is performed after execution of this command, synchronous operation starts from the moment the spindle starts.
- Execution of this command outputs the spindle stop command, and completes the block after confirmation of stop (zero speed), and goes to the next program block.

Note: Execution of the G code except for the following during G96 mode causes alarm (program error).
Effective G code: G04, G04D, G68L, G69, G69P, G85/G75, G94, M signals

(iii) Position follow-up operation mode (G97)

Format: G97 X/U_F_I_S_;

X/U: Feed axis positioning distance (d2)
(–99999999 to +99999999/reference unit)

F: Speed reference (0 to 99999/speed unit)

I: Torque reference (10 to 400/%)

S: Spindle speed reference (–60000 to +60000/r/min)
When the spindle is used in reverse rotating direction, set Pr91 = 10, and designate s (–).

< Explanation >

① Execution of this command starts the spindle.

② When the spindle reaches the constant speed (initial time) or designated distance (d1: Pr229) (second or subsequent), positioning of the feed axis (d2) starts.

③ After completion of the feed axis positioning (d2) and in-position, cutter operation available signal is turned ON.

④ After second follow-up operation, procedures start from the ② above.

The cutter operation available signal is turned OFF immediately before start of feed axis positioning (d2).

⑤ As for PGST signal OFF (feed-hold) during G97, spindle also decelerates to a stop.

⑥ To complete the follow-up operation mode, execute G94.

⑦ Cutter operation available signal is reset at the following:

- At power start
- At emergency stop
- At mode change
- At program clear (PGCL)
- At error reset
- In the case of ④ above

Note: Execution of the G code except for the followings during G97 mode causes alarm (program error).
Effective G codes: G04, G04D, G10/G11, G15, G52/G53, G66, G67, G68X/G68L, G69, G69P, G94, G97, M30, M signals

In the following cases, mode designation is reset, so when restarting the follow-up operation, perform mode designation again:

- At power start
- At emergency stop
- At mode change
- At program clear (PGCL)
- At error reset

To change the mode designation (G95 ↔ G96 ↔ G97), execute G94.

(b) Follow-up operation start command (G85/G75) (Used in G95, G96 mode)

G85/G75 X/U_F_I_S_;

G85/G75: Feed axis forward/ reverse rotation command

X/U: Distance of follow-up point from marked position (–99999999 to +99999999/reference unit)

F: Follow-up minimum speed reference (0 to 99999/speed reference)

I: Feed axis speed magnification (0 to 400/%)

S: Spindle speed reference (–60000 to +60000/r/min)

(i) Mark sensor mode (G95)

① X/U

This designates the distance of cutting portion from marked position.

There is no difference of X/U, and both can be used.

Sign of X/U is same as the feed axis moving direction.

② F

This is the minimum speed reference of the feed axis follow-up speed.

Follow-up maximum speed is Pr30 designation speed.

When set value F is too low and it is necessary for the feed axis to follow at the speed, follow-up operation is canceled (feed axis/spindle decelerates to a stop), speed display (FEED) will be –1, and at the same time, program error occurs.

In this case, it is necessary to increase the set value F.

③ I

Speed magnification I is ignored (100% fixed).

④ S

When the spindle is used in the reverse rotating direction, set Pr91 = 10, and designate S (–).

(ii) Non mark sensor mode (G96)

① X/U

X/U value is ignored. (0 set okay)

② F

F value is ignored. (0 set okay)

③ I

Speed magnification of feed axis to spindle.

Speed magnification (I) during operation cannot be changed.

In this case, decelerate the feed axis and spindle to a stop, then change it.

④ S

When the spindle is used in the reverse rotating direction, set Pr91 = 10, and designate S (–).

< Explanation >

① Execution of this command starts the spindle, and feed axis follow-up operation.

When the PGST signal is OFF (feed-hold) during G97, the spindle also decelerates to a stop.

② In G95 mode, restart after feed-hold is not possible. In this case, execute G85/G75 operation after resetting the program and G95 mode.

③ Follow-up operation is completed by input of follow-up operation completion signal, and it goes to the next program block.

④ To complete the follow-up operation mode, execute G94.

⑤ Synchronous operation signal is reset at the following:

- At power start
- At emergency stop
- At mode change
- At program clear

- At error reset
- In the case of exceeding Pr228 setting value (synchronous in-position width)

⑥ Execution of G85/G75 without designation of follow-up operation (G95/G96) causes program alarm.

(c) Follow-up operation mode cancel (G94)

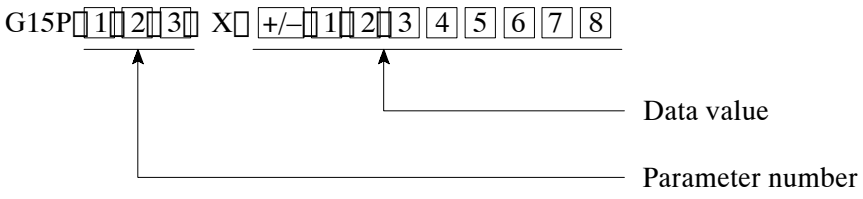
Format: G94 ;

< Explanation >

① Execution of this command when spindle/feed axis is rotating, it decelerates to a stop, and further, follow-up operation mode designation is reset.

② When to restart the follow-up operation, designate mode by G95/G96 or G97, and execute G85/G75.

(d) Follow-up operation parameter change command (G15)



< Explanation >

Parameters that can be changed are as follows:

① Pr208: Spindle, feed axis synchronous offset parameter (K1)
(–32767 to +32767/ 1/251 magnification)

② Pr209: Spindle, feed axis synchronous offset parameter (K2)
(0 to 32767/0.01%)

③ Pr202: Spindle motor maximum speed at synchronous, follow-up operation
(1 to 32767/r/min)

④ Pr204: Spindle linear accel/decel time (0 to 60000/ms)

⑤ Number of gear teeth of spindle and motor

Pr211: Number of teeth of gears at the spindle side (1 to 511)

Pr212: Number of teeth of gears at the motor side (1 to 511)

⑥ Pr229: G97 spindle feed distance (0 to 99999999/reference unit)

Perform the parameter setting by G15 before designating the follow-up operation.

G15 cannot be executed in the follow-up operation mode. (Program error occurs.)

Execute it after canceling follow-up operation mode (G94).

However, setting irregular changes of spindle feed distance (d1) (Pr229) at G97 mode may also be made.

(6) Synchronous Error Offset Parameter Setting (G96 mode)

In the non mark sensor mode (G96), follow-up operation is compensated by the following parameters to minimize synchronous errors.

Pr208: Offset parameter to minimize synchronous errors at constant speed.

Pr209: Offset parameter to minimize synchronous errors at accel/decel.

These are set as Pr215 = 1, Pr208 = 0, Pr209 = 0

and the execution of the following example program (dry run) determines these offset parameters and these data are written to the memory.

(a) Automatic offset parameter setting program (example)

```
N100 : G96
N101 : G85/G75 X0 F0 I100 S300
N102 : G94
N103 : G69 P100
```

Note: Input the follow-up operation completion signal (#40180) so that constant speed time should be 1 second minimum and repeat this approx. 10 times.

(b) Synchronous error

When offset parameters are determined by the above automatic offset parameter setting program, Pr215 = 0 is automatically set, and automatic offset parameter setting is complete.

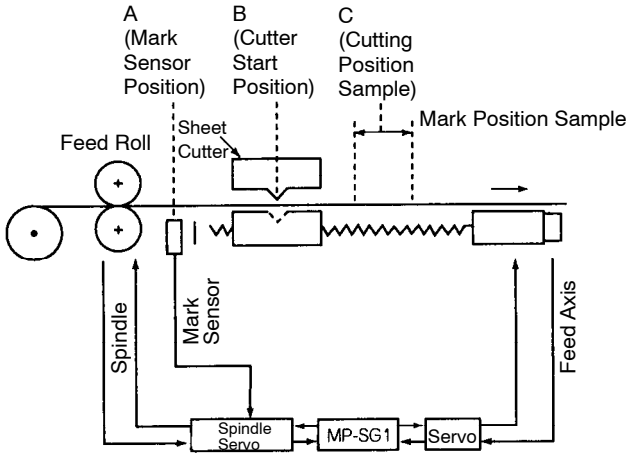
Synchronous error during operation is stored in the following parameters:

- Pr216 = Synchronous error amount (servo position deviation)
- Pr217 = Synchronous error amount (synchronous error + peak)
- Pr218 = Synchronous error amount (synchronous error – peak)

When offset parameter is not set properly (Pr215 = 1), or the values of the above Pr216 to Pr218 are too large, adjust the gain of spindle or feed axis, and set the automatic offset parameter once again.

(7) Programming Examples

(a) Application example in mark sensor (G95) mode



(Example)

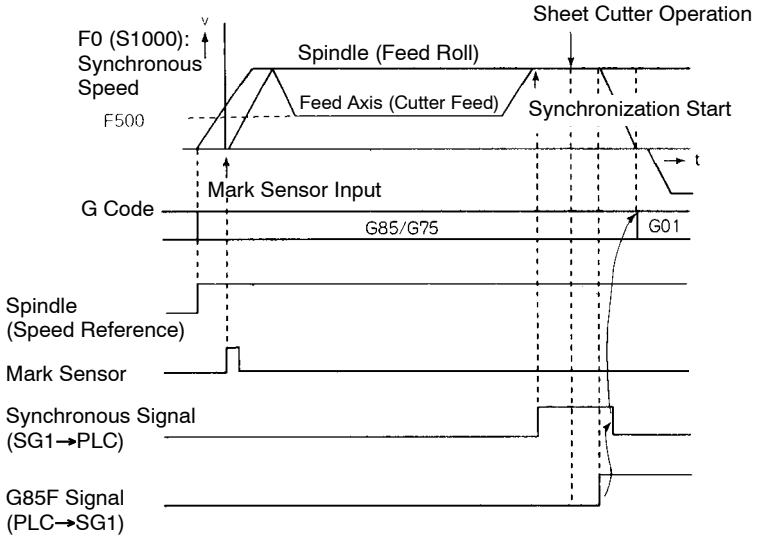
N100 G95 X(A) ← A is the mark sensor position. (feed axis coordinate system)

N101 G85 X(C) F500 S1000 ← C is the distance of marked cutting position. F500 shows minimum speed reference during follow-up operation of sheet cutter (feed axis) before synchronization start. (Maximum speed is designated by Pr30.)

N102 G01 X(B) F1000 ← B is the cutter start waiting position. (return)

N103 G04
N104 G69 P101

7

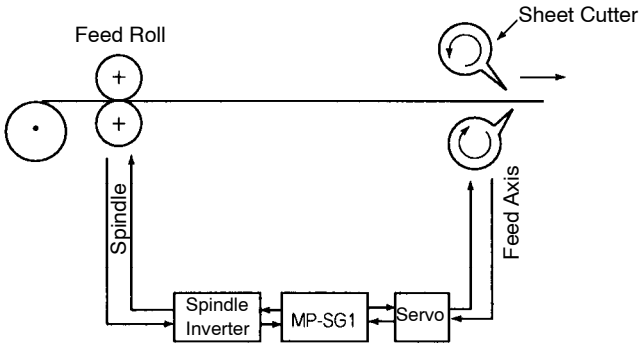


Note 1: The distance between marks (cutting distance) should be at least longer than the distance between cutter and sensor (A-B in the figure). Otherwise, cutting is not possible.

2: When the next G85 program is not started before mark input to the next marker sensor, the marker input is ignored. Therefore it is necessary to adjust so that marker input should be done during execution of the next G85 program.

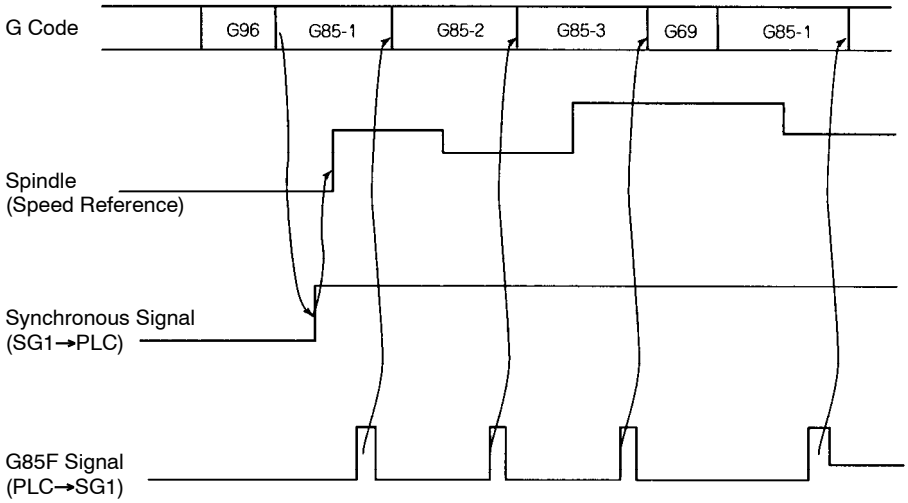
3: The distance (C in the figure) of marked cutting position (feed axis follow-up position) from the marked position on sheet may be designated by G85X, but the position of follow-up start feed axis cannot be designated. Synchronous start feed axis position varies with mark sensor position (A in figure), cutter start position (B in the figure), or spindle/feed axis speed, therefore, it is necessary to set these setting values according to user system.

(b) Application example in non mark sensor (G96) mode



(Example)

```
N100 G96
N101 G85 X0 F0 I100 S1000 ←——— G85-1
N102 G85 X0 F0 I100 S500  ←——— G85-2
N103 G85 X0 F0 I100 S2000 ←——— G85-3
N104 G69 P101
```



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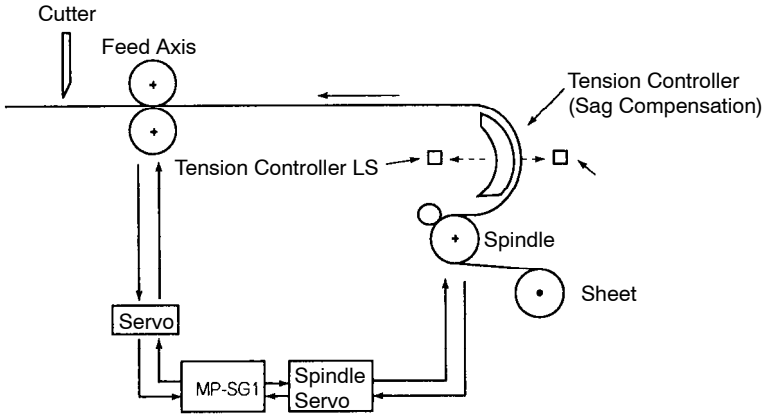
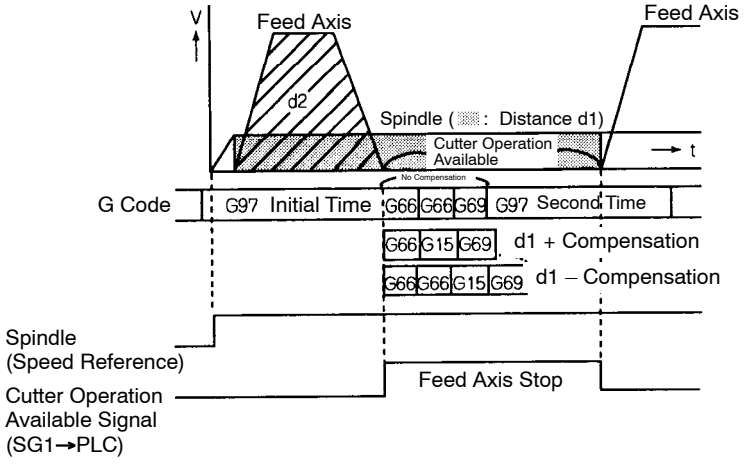
(c) Application example in position follow-up operation (G97) mode



(Example)

```
N100 G97 X(d2) F10000 I250 S300
N101 G66 P200 D0  ←——  Condition jump (+ Compensation)
N102 G66 P300 D1  ←——  Condition jump (– Compensation)
N103 G69 P100

N200 G15 P229 U1000  ←——  d1 (Pr229) +Compensation
                          (LS Operation)
N201 G69 P100
N300 G15 P229 U–1000 ←——  d1 (Pr229) –Compensation
                          (LS Operation)
N301 G69 P100
```



* When the spindle setting goes ahead by distance d1 during execution of other program processing such as G66 and G15, the next feed axis starts when G97 is started.

7.12 SOLID TAP FUNCTIONS (G93, G94, G84, G74)

The solid tap function executes tapping by synchronizing the feed axis with spindle rotation. If tapping is executed by using this function, a floating chuck is no longer necessary and, at the same time accurate tapping is made possible at a high speed.

(1) Solid tap command

The method for using solid tap command when the automatic operation by programming is described below.

(a) Solid tap mode command

To execute solid tapping, change the mode to the solid tap mode.

Solid tap mode ON/OFF is designated by the following G codes.

(i) Solid tap mode command (G93)

Execution of G93 ; command goes to the solid tap mode.

[Operation]

① Speed reference to spindle is changed to 0.

② When zero speed signal (ZSPD) is turned ON after spindle stop, spindle position loop (to control spindle position according to feedback pulse) is established.

③ When spindle position loop is established, SLPS output signal (spindle position loop ON status signal) is turned ON, and G93 processing is complete. (SLPS signal becomes SG1 output signal #45030.)

(If G93 is executed when the Pr220 is 1, spindle home position indexing is executed, and then spindle position loop ON status signal is turned ON.

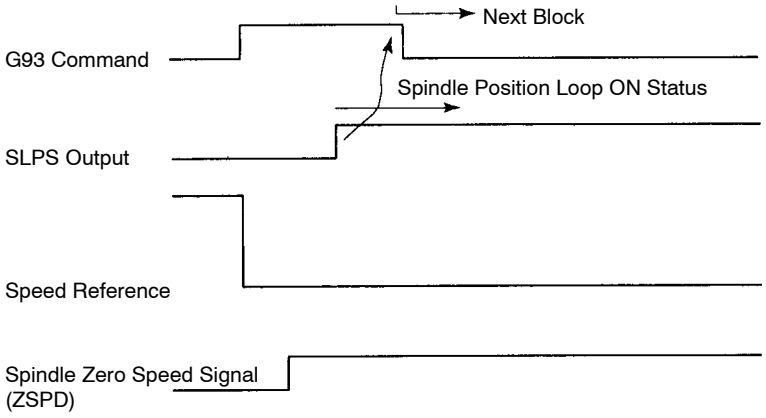
If tapping cycle commands (G84/G74) are executed in this mode, solid tapping is executed.

Note 1: Designation of G codes other than the followings in G93 mode causes alarm (program error).
Effective G codes: G04, G74/G84, G94, G68L, G69, G69(RET), M signals(M40 to M98)

2: SLPS output signal is turned OFF at the followings. And spindle position loop ON status signal is also turned OFF.
- At program clear
- At emergency stop
- At mode change
- At error reset

3: Solid tap command cannot be used in the subroutine of the end point command (G68X).

Following indicates the sequence when the G93 is executed.



(ii) Solid tap mode cancel command (G94)

Execution of G94; command cancels the solid tap mode.

[Operation]

SLPS output signal is turned OFF, and G94 processing is complete.

In G94 mode, solid tapping is not executed even when G84/G74 is executed.

Note 1: When G94 is executed, feed speed becomes 0.

2: When the power is turned ON or reset, G94 is cancelled.

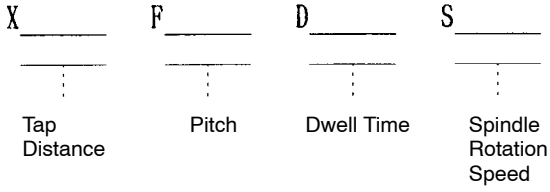
(b) Solid tap cycle command

When the tapping cycle command is executed after G93 command and before G94 command, solid tapping cycle is entered.

When tapping cycle command is executed without G93 command, alarm(program error) occurs and the machine does not move.

(i) Command format

G84/G74



(ii) Value Range

Position reference	X = Tapping bottom position absolute expression (–99999999 to +99999999/position reference unit)
	U = Tapping bottom position incremental expression (–99999999 to +99999999/position reference unit)
Tap pitch	F = Tap pitch (1 to 99999/position reference unit × 0.1)
Time setting	D = Dwell time (0.01 to 600.00/decimal point position = s)
Spindle reference	S = Spindle speed reference (1 to 32767/r/min)

(iii) Operation(in the case of G84)

① Check that spindle error pulse is under Pr206 setting value, and start the spindle at linear accel/decel, and at the same time, move the feed axis synchronized with spindle.

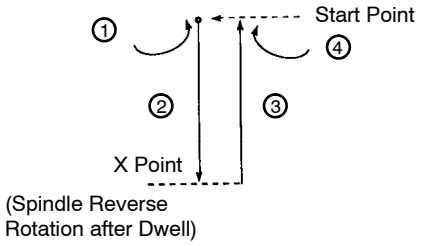
② When spindle command reaches the aimed position, in-position check is performed for spindle and feed axis. If D command (dwell time designation) is provided, then dwell is executed. When feed axis is not entered in the in-position within 2 seconds after spindle command is output, in-position set alarm occurs.

③ Rotate the spindle in the reverse direction at linear accel/decel, and move the feed axis synchronized with spindle in the start point direction.

④ After completion of command to spindle, spindle is in in-position and feed axis remaining shift amount is within Pr207 (feed axis drawing-in width) setting value, feed axis is released from spindle synchronous control, and is drawn in to start point at feed axis shift speed at that moment. Therefore, solid tapping is not decelerated near the start point, and solid tapping is performed at a high speed.

In the case of G74, the order of forward rotation, reverse rotation of spindle is inverted.

Note 1: How the tapping cycle is executed in the solid tap mode is described below.



2: Pitch that can be specified in solid tapping is up to 99999, and unit is 1/10 of position reference unit. Larger values than this cannot be set.

3: During spindle synchronous feed in the solid tap mode, temporary stop for emergency is valid.

4: When mode is changed during solid tapping spindle synchronous feed, the machine decelerates to a stop.

5: When ZRN signal is turned ON during solid tap spindle synchronous feed, positioning is performed to the spindle synchronous feed start point by synchronous operation (return operation). Then synchronous operation is released, and feed axis is positioned to the home position of T_0 coordinate system.

(2) Various Settings

(a) Setting of spindle accel /decel constant (Pr204)

Set Pr204 to a value near or larger than spindle accel/decel time. Spindle accel/decel time is obtained by the following equation.

$$t = 2\pi J_L \frac{n}{T \times 60}$$

t: Acceleration time(s)

J_L: Motor load inertia[kg · m^2 ($J_L = GD^2_L/4$)]

n: Motor rotation speed[r/min]

T: Accel/decel torque[N · m]

The value of accel/decel torque is obtained by the following equation.

$$T = \frac{1.2 \times 1000 \times P \times 60}{2\pi n}$$

T: Accel/decel torque [N · m]

P: 30-minute rated output [kW]

n: Motor rotation speed [r/min]

[Example] Motor rated output 5.5/3.7 kW

Motor rotor inertia = 0.1/4 [kg · m^2]

Motor axis conversion load inertia = 0.2/4 [kg · m^2]

Spindle acceleration time is calculated with motor maximum rotation speed 4000 r/min at solid tapping is to be calculated.

$$T = \frac{1.2 \times 5500 \times 60}{2\pi \times 4000} = 15.76\ [N \cdot m]$$

$t = 2\pi \times (0.1 + 0.2)/4 \times 4000/60 \times 1/15.76$

$= 1.993$ [s] → 1993 [ms]

Therefore, Pr204 = 2000.

(b) Setting of synchronous error compensation parameter

There are the two synchronous error compensation parameters are provided.

- Pr208: Compensation parameter (K1)

  Makes the synchronous error at constant cutting feed minimum.

- Pr209: Compensation parameter (K2)

  Makes the synchronous error at accel/decel cutting feed minimum.

When solid tap program is executed to Pr215 = 1, respective values are determined and written by automatic compensation software.

(i) Solid tap program for automatic compensation (example)

```
G01 X0.000 F100000 I200
G93
G68 L5 P100
G94
M30
100 : G84 X10.000 F1.0 D1.00 S400
      G69
```

Note: Adjust the value of G84X_ so that constant speed time should become 1 second minimum. Do not perform actual processing, but dry run.

(ii) Execution of automatic compensation

When dry run of the above solid tap processing program is performed with Pr215 = 1, Pr208 and Pr209 are automatically set by software.

Pr216 shows the synchronous error of spindle and feed axis. Automatic setting is made so that the servo position error should be minimum. Pr209 is automatically set so that the synchronous error should be equal at +/– peak vale under the situation where the above Pr208 is set.

When M30 is executed after completion of solid tap processing program, Pr215 = 0 is automatically set, and automatic compensation is complete.

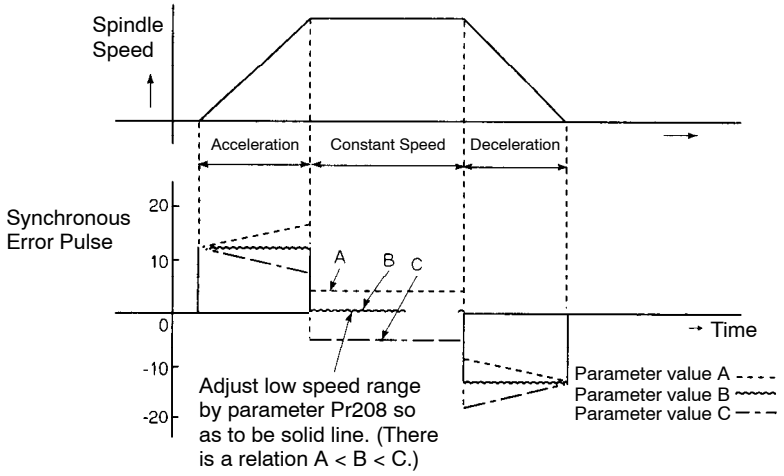
And as a result of automatic compensation, the synchronous error amount is stored into the following parameters.

- Pr216: Synchronous error amount (servo position deviation amount)
- Pr217: Synchronous error amount (synchronous error + peak value)
- Pr218: Synchronous error amount (synchronous error – peak value)

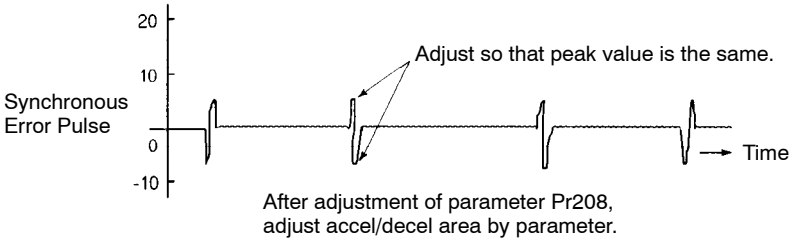
After completion of automatic compensation, check the above Pr216 to Pr218, and when synchronous error is excessive, perform automatic compensation again in the same manner, and check whether Pr216 to Pr218 becomes smaller or not.

(iii) Synchronous error change by parameter adjustment

① Synchronous error change by parameter Pr208



② Synchronous error after adjustment of Pr208 and Pr209 parameters



7

(3) Solid Tap related Parameters

① Pr200: Spindle encoder mounting position (0: Spindle side, 1: Motor side)

② Pr201: Pulse number per rotation of spindle encoder (with no magnification)
(1 to 32768/pulses)

③ Pr202: Spindle motor maximum speed at synchronous, follow-up operation
(1 to 32767/r/min)

④ Pr204: Spindle linear accel/decel time (0 to 60000/ms)

⑤ Pr206: Spindle in-position range (1 to 255/pulses)

⑥ Pr207: Solid tap return path feed axis drawing-in in-position width
(1 to 255/pulses)

⑦ Pr208: Spindle, feed axis synchronous compensation parameter (K1)
(–32767 to +32767 / 1/256 magnifications)

⑧ Pr209: Spindle, feed axis synchronous compensation parameter (K2)
(0 to 32767/0.01%)

⑨ Number of gear teeth of spindle and motor

Pr211: Number of teeth of gears at the spindle side
(1 to 511, 1 is set without gear)

Pr212: Number of teeth of gears at the motor side
(1 to 511, 1 is set without gear)

⑩ Pr213: Gear ratio of spindle and spindle PG (1 to 511, 1 is set without gear)

⑪ Pr214: Rotation direction designation at synchronous, follow-up operation

1: Plus designation by FRN, minus designation by RRN

2: Minus designation by FRN, plus designation by RRN

FRN: Forward rotation, RRN: Reverse rotation

⑫ Pr215: Synchronous error automatic compensation setting reference

0: Compensation completed (normal operation)

1: Compensation execution

⑬ Pr216: Synchronous error amount (servo position deviation)
(–99999999 to +99999999/pulses)

⑭ Pr217: Synchronous error amount (synchronous error + peak value)
(–99999999 to +99999999/pulses)

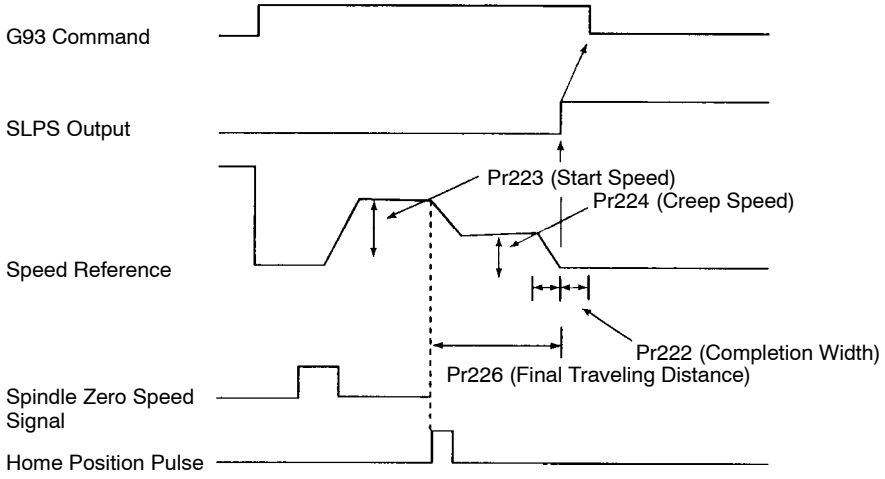
⑮ Pr218: Synchronous error amount (synchronous error – peak value)
(–99999999 to +99999999/pulses)

(4) Automatic Home Position Indexing by G93

When G93 is executed with Pr220 = 1, spindle home position indexing is performed. Then spindle position loop ON status signal (SLPS) is turned ON, and G93 block is complete.

(a) Automatic home position indexing action sequence

The following shows the sequence when G93 is executed.



① When spindle position is entered in the area set in Pr222 after home position command is output, home position indexing is complete.

② When home position indexing is completed, position loop ON status signal (SLPS) is turned ON and G93 block is complete.

③ If G93 is executed again in SLPS ON status, alarm (program error) occurs.

Therefore, in solid tap mode, spindle home position indexing cannot be made.

④ To execute home position indexing, home position pulse output once per spindle rotation is necessary.

In the case of home position pulse output twice or more per spindle rotation, home position may deviate at each home position indexing.

⑤ When home position pulse is output, comparison is made between error pulse (deviation amount) and home position indexing final traveling distance parameter (Pr226). If error pulse is larger than the parameter setting value, shift amount equivalent to spindle rotation is added to final traveling distance, and final traveling distance is made larger than error pulse. (Indexing is executed not in reverse direction but in the same direction.)

(b) Spindle home position indexing related parameters

① Pr220: G93 home position indexing (0: Not provided, 1: Provided)

② Pr221: Home position indexing direction
(0: Forward rotation, 1: Reverse rotation)

③ Pr222: Home position indexing in-position range (0 to 32767/pulses)

④ Pr223: Home position indexing start speed (0 to 32767/r/min)

⑤ Pr224: Home position indexing creep speed (0 to 32767/r/min)

⑥ Pr225: Spindle maximum speed at home position indexing (0 to 32767/r/min)

⑦ Pr226: Final traveling distance at home position indexing
(0 to 99999999/pulses)

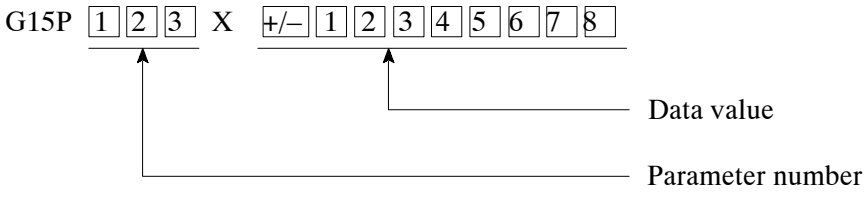
(5) Solid Tap Gear Change

(a) Outline

The gear ratio of solid tap is set to Pr211 and Pr212. Gear may be changed by G15 (parameter write) to change the values of Pr211 and Pr212.

(b) Parameter write command (G15)

(i) Command format



Parameters that can be changed are as follows:

① Pr208: Spindle, feed axis synchronous compensation parameter (K1)
(–32767 to +32767/1/256 magnifications)

② Pr209: Spindle, feed axis synchronous compensation parameter (K2)
(0 to 32767/0.01%)

③ Pr202: Spindle motor maximum speed at synchronous, follow-up operation
(1 to 32767/r/min)

④ Pr204: Spindle linear accel/decel time (0 to 60000/ms)

⑤ Number of gear teeth of spindle and motor

Pr211: Number of teeth of gears at the spindle side (1 to 511)

Pr212: Number of teeth of gears at the motor side (1 to 511)

(ii) Programming method

Perform parameter setting by G15 before entering solid tap mode. G15 cannot be executed during solid tapping. Before changing gear, cancel solid tap by G94 once.

(Example)

```
G15 P211 X_
G15 P212 X_
   :
   :
   :
G93
G84
G94
M30
```

If G15 is programmed in solid tap mode, alarm (program error) occurs.

7.13 JUMP WITH CONDITION (G66)

(1) Function

(a) Command format

G66 PnDm

(b) Function

When signal Dm is ON, control jumps to the nth block. When Dm is OFF, execution goes to the next block.

(c) Jump condition

Jump condition is designated by input signal #4005.

	D7	D6	D5	D4	D3	D2	D1	D0
#4005					3	2	1	0

Signal is described by 3 to 0 of D3 to D0 bits.

(Example)

G660 P500 D2: Jump to 500th block when #4005 D2 bit is ON.

(2) Notes

- When G66 is programmed in serial, it is processed as a single command.

  n G01 X_F_I_
  n + 1 G66 P_D_
  n + 2 G66 P_D_
  n + 3 G66 P_D_
  n + 4 G66 P_D_
  n + 5 M50

  n + 1 to n + 4 are processed as a single command.

- Even NOP is inserted between G66 commands, it is processed as a consecutive G66.

  n M50
  n + 1 G66 P_D_
  n + 2 NOP
  n + 3 G66 P_D_
  n + 4 M51

  n + 1 to n + 3 are considered as a consecutive G66 command, and processed as a single command.

- When there is a block with the same jump condition in consecutive G66 commands, the first block has priority.

  (Example)

  #4005 00000100

  N000 G66 P100 D2 ←——— Jump

  N001 G66 P200 D2 ←——— Ignored

- When more than2 bits of #4005 are ON, the former block has priority.

  (Example)

  #4005 00001100

  ① N000 G66 P100 D3 ←——— Jump

  N001 G66 P200 D2 ←——— Ignored

  ② N000 G66 P100 D2 ←——— Jump

  N001 G66 P200 D3 ←——— Ignored

- Multiple G66 and NOP commands do not cause alarm, however, execution time may take longer.

7.14 I/O SET (M20, M21, M22)

Format: M20 Ddddd
M21 Ddddd
M22

(1) Value Range

D = I/O address: Input signals (40000 to 40057)
Output signals (45000 to 45057)

(2) Operation

① When M20 Ddddd is executed, I/O designated by D is forcibly turned ON.

② When M21 Ddddd is executed, I/O designated by D is forcibly turned OFF.

③ When M22 is executed, forced ON/OFF status is released. Release is also performed at execution of M30 and program clear.

- Input signal changes into input status when released.
- Output signal remains status when released, and changes into output status when output signal is newly output.

7.15 I/O READ (G16)

Format: G16 XRr Dddddd

(1) Value Range

R = Register number (1 to 9)

D = I/O address: Input signals (40000 to 40057)

Output signals (45000 to 45057)

(2) Operation

I/O status designated by D is memorized to the register number designated by X.

For example, if you want R1 register to read the I/O status of 40012, program as follows:

G16 XR1 D40012

7.16 PARAMETER WRITE (G15)

Format: G15 Pddd Xpppppppp

(1) Value Range

P = Parameter number (0 to 999)

X = Set value (–99999999 to +99999999)

(2) Operation

Value designated by X is written to the parameter number designated by P.

However, only parameters of attribute “G” can be written.

7.17 TIME DWELL (G04)

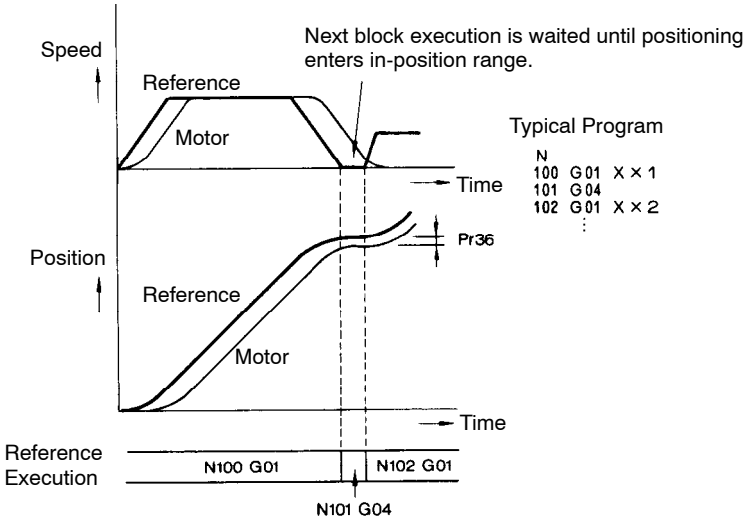
7.17.1 In-position Waiting Command (G04)

(1) Operation

If dwell time is not specified in G04 command, in-position waiting is applied.

Positioning commands G01, G05 and G06 start execution of the next block after the reference pulses are output. When it is necessary to start the next command execution after feed is in-position, G04 command is programmed next to the positioning command. If in-position is not applied in 2 seconds after the G04 command execution, the in-position alarm (MP alarm) occurs.

The number of error pulses to determine in-position value is set to Pr36.



As shown in the figure above, when feed by the positioning command enters in-position range, the next block is executed.

7.17.2 Time Dwell Command (G04)

Format: G04 Dddddd

(1) Value Range

Time setting: D = Dwell time (1 to 60000/10 ms)

(2) Operation

The machine stops temporarily for the period of time specified by D. At this time, in-position check is not performed. The next block is executed after the period of time specified by D.

7.18 COORDINATE SETTING COMMAND (G52)

Format: G52 X(U) ppppppppTt

(1) Value Range

Position reference:

X = Aimed position absolute expression
(–99999999 to +99999999/position reference unit)

U = Aimed position incremental expression (–99999999 to +99999999)

Coordinate system:

T = Coordinate No. (1 to 9)

(2) Operation

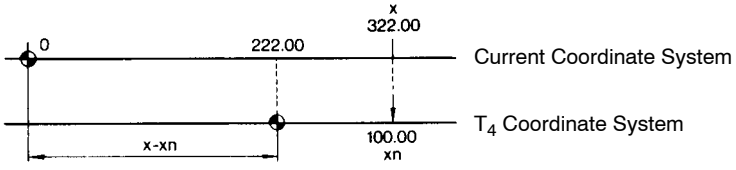
The current value is set to position X (or U) in coordinate t. Shifting amount by G52 is set to shift register. Even if a coordinate position is set by G52, the coordinate system is not changed. T_0 coordinate cannot be set by G52 command.

(a) Operation (X designation)

Programming example

G01 X322.00
G52 X100.00 T_4

The current coordinate system position 322.00 is set to position 100.00 in T_4 coordinate system.

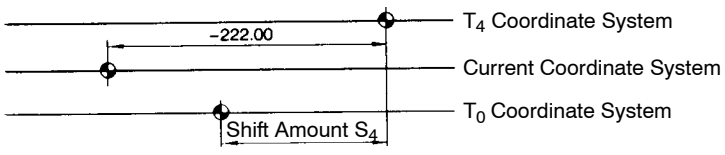


(b) Operation (U designation)

Programming example

G01 X322.00
G52 U–222.00 T_4

T_4 coordinate system is shifted by +222.00 from the currently selected coordinate.



(c) Operation (T_8, T_9 coordinate)

Programming example

```
100  G01 X100.00 __
101  G52 X100.00 T8
102  G53 T8
103  G01 X250.00 __
          :
```

T_8 coordinate system has S_8 shifting register and O_8 offset register. G52 command performs shift register setting. The following table shows the variation of registers A, S and O corresponding to program executions.

Command	Register Contents after Command Execution			
	A_0	A_8	S_8	O_8
Initial Status	0.000	2.500	0.00	2.500
100 G01 X100.00	100.000	102.500	0.00	↑
100 G52 X200.00 T_8	↑	202.500	100.00	↑
102 G53 T_8	↑	202.500	↑	↑
103 G01 X250.00	147.500	250.000	↑	↑
+INC8 = ON (1st Time)	↑	250.002	↑	2.502
+INC8 = ON (2nd Time)	↑	250.004	↑	2.504
–INC8 = ON (1st Time)	↑	250.002	↑	2.502
–INC8 = ON (2nd Time)	↑	250.000	↑	2.500
–INC8 = ON (3rd Time)	↑	249.998	↑	2.498

When Pr20 = 2, Pr21 = 10

(3) Next Block Execution

The next block is executed after several ms of execution time for G52.

7.19 COORDINATE CHANGE COMMAND (G53)

Format: G53 Tt

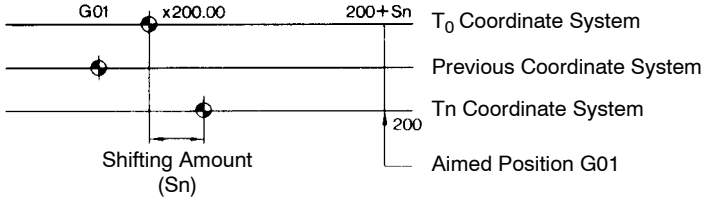
(1) Value Range

Coordinate system: T = Coordinate No. (0 to 9)

(2) Operation

Position is decided using coordinate selected by G53 command. (The position shifted by shifting amount S_n from T_0 coordinate system is obtained. T_8 or T_9 coordinate system is shifted by (shifting amount S_n + offset amount O_n)).

T_0 coordinate system has been selected as a default coordinate after the power is turned ON.



7

7.20 IN-POSITION CHECK COMMAND(G67)

Format: G67 Pbbb

(1) Value Range

Block No.: P = Jumping destination block No. (000 to 999)

(2) Operation

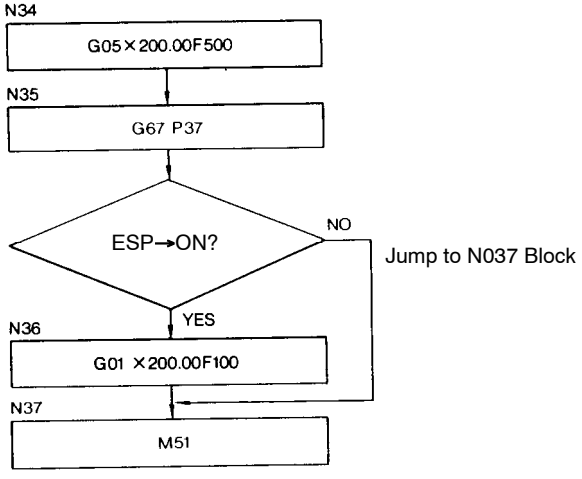
The in-position check command is used together with the skip positioning command (G05, G06).

When the skip signal is turned ON and the operation is skipped and execution interrupted, jump is not executed but the next block is executed. When the skip signal is not turned ON and the machine reaches the position specified by X(U), execution jumps to the block specified by P.

Programming example

```
N034 G05 X200.00 F500
N035 G67 P37
N036 G01 X200.00 F100
N037 M51
```

When the skip signal 5 (ESP5) is turned ON during N034 execution, N035, N036 and N037 are executed in this order. However, if the skip signal is not turned ON, jump is executed at N035, and N037 is executed.



7.21 SUBPROGRAM CALL (G68)

7.21.1 Repeating No. Designation Subprogram Call (G68)

Format: G68 L1 Pbbb

(1) Value Range

L: Repeating No. designation (1 to 99)

P: Subprogram head block (000 to 999)

(2) Operation

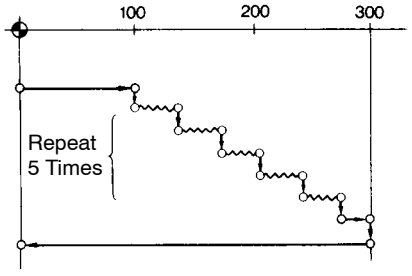
Subprogram starting from the block specified by P is repeatedly executed as many times as specified by L.

After execution, the block next to the G68 command is executed.

(3) Sample Program

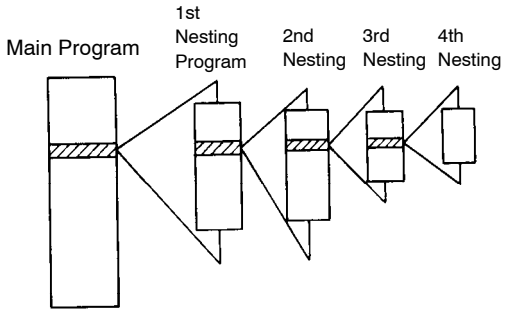
The following shows a sample using the repeating No. designation subprogram call command:

```
N110 G01 X100 F12000
     111 G04
     112 M51   <----------  Related operation
     113 G68 L5  P318  <--  5-time Subprogram Repeat
     114 G01 X300 F12000
     115 G04
     116 M51   <----------  Related operation
     117 G27 X0  <--------  Home Position Return
     118 M30   <----------  End
N318 G01 U35   <----------  Subprogram
     319 G04
     320 M51   <----------  Related operation
     321 G69   <----------  Return from Subprogram
```



(4) Nesting

In a repeating No. designation subprogram, it is possible to jump from the subprogram to the others, up to four nestings as shown below:



7.21.2 End Point Designation Subprogram Call (G68)

Format: G68 X(U) ppppppppPbbb

(1) Value Range

Position reference:

X = Aimed position absolute expression
(–99999999 to +99999999/position reference unit)

U = Aimed Position incremental expression (–99999999 to +99999999)

Block No.: P = Subprogram head block No. (000 to 999)

(2) Operation

The subprogram starting from the block specified by P is repeatedly executed until the machine reaches the position specified by X(U) in the coordinate system selected at G68 execution.

When the position is reached, the block to G68 is returned even in the middle of feed command.

In subprogram executed by the end point designation command, a feed command block that moves in the direction specified by X(U) is necessary, which must reach the specified position by repeating the subprogram execution.

Even if the coordinate value is changed in subprogram, the end point program specified by X(U) does not change.

(3) Sample Program

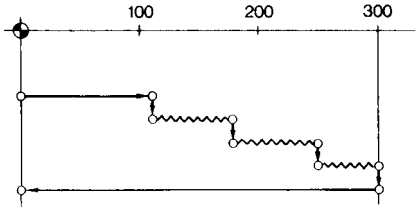
The following shows a sample program using the end point designation subprogram call command:

N060 G01 X110 P12000

061 G68 X300 P066 ← Subprogram Repeated until X = 300
062 G01 X0 F12000
063 M30

N066 G01 U70 F300

063 M30 ← Subprogram
067 M51
068 G69 ← Return from Subprogram



(4) Nesting

In a repeating No. designation subprogram, it is possible to jump from the subprogram to the others, up to four nestings. However, subroutine call is prohibited in the end point designation subprogram.

7.22 JUMP(G69)

7.22.1 Simple Jump Command (G69)

Format: G69 Pbbb

(1) Value Range

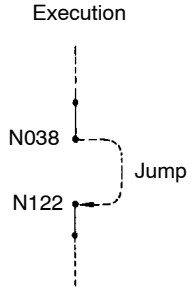
Block No.: P = Jump designation block No. (000 to 999)

(2) Operation

The block specified by P is executed after the jump command execution.

Programming example

```
N037 G01 X200.00
N038 G69 P122
N039
  :
  :
N122 G52 X0  T2
N123
```



7.22.2 Subprogram Return Command (G69)

(1) Operation

Make sure to program this command in the end blocks of the subprogram.

This command returns to the block next to the G68 subprogram call command.

In the subprogram executed by the repeating No. designation, G68 jumps to the subprogram starting block specified by P until the machine reaches the repeating times specified by L. When reaching the specified repeating times, execution jumps to the block next to G68.

G69 in the subprogram executed by the end point designation command jumps to the subprogram starting block until specified end position is reached.

7.23 SPINDLE COMMANDS (M03, M04, M05)

(1) Value Range

Speed reference: S = Spindle speed reference (0 to 60000/r/min)

(2) Spindle FWD Run Command (M03)

① Format: M03 Ssssss

② Operation

Spindle rotation starts simultaneously when this command is executed.

Moving condition to next block is speed coincidence.

③ Command method: Varies according to the Pr91 setting.

(3) Spindle REV Run Command (M04)

① Format: M04 Ssssss

② Same as ② and ③ in item (2).

(4) Spindle Stop (M05)

① Format: M05

② Operation

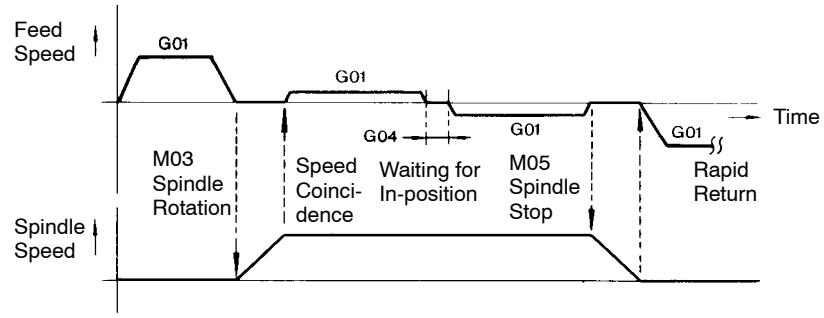
Spindle rotation stops simultaneously when this command is executed.

Moving condition to next block completes stop.

(5) Sample Program

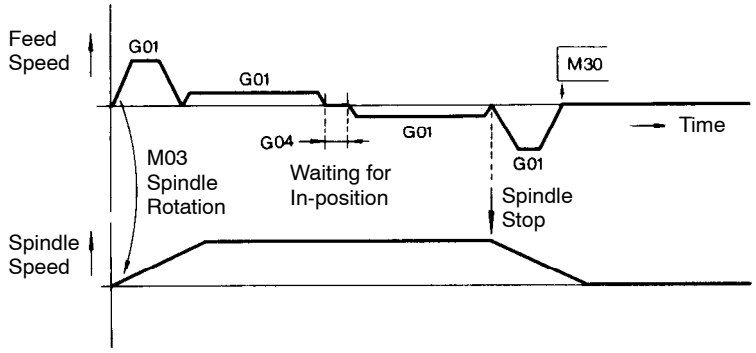
- When spindle command M03 is used

```
G01 X10.  F24000
M03 S5000 ←——— To next block after waiting for speed coincidence
G01 X20. F1000
G04
G01 X10.
M05 ←——————— To next block
G01 X0
M30
```



- When positioning command S command is used

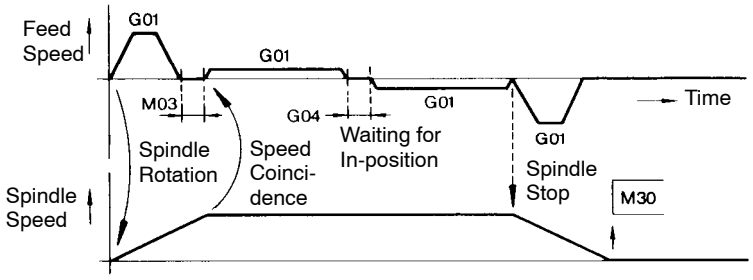
```
G01 X10.F24000 S5000 ←—— Execution of spindle run command to next
                         block without waiting for speed coincidence
G01 X20. F1000
G04
G01 X10.
G01 X0 S0 ←——————— Execution of spindle stop command to next
                   block without waiting for completion of stop
M30
```



7

- When positioning command S is used and speed coincidence is checked

```
G01 X10. F24000 S5000 ←  Execution of spindle run command
                         To next block after speed coincidence check
M03 S5000
G01 X20. F1000
G04
G01 X10.
G01 X0 S0 ←              Execution of spindle stop command
M05 ←                    To next block after stop completion check
M30
```



7

7.24 AUXILIARY FUNCTIONS (M**)

M50 to M58, M80 to M88/M90 to M98, M40 to M89

(1) Individual Signal Mode (M50 to M58)

Assume: Pr101 = 0

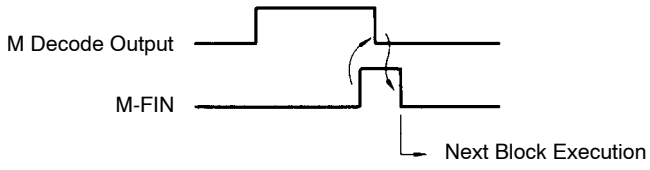
Each of auxiliary functions M50 to M58 corresponds to each of output signals M50 to M58. Therefore, when one of M50 to M58 is executed, the corresponding signal among M50 to M58 is output individually.

(2) M-FIN Signal (Individual Signal Mode)

For individual signals M50 to M58, M signal is output after checking that M-FIN signal has been turned OFF. If M-FIN signal is ON, it waits to output until the signal is turned OFF.

M signal output is reset when the M-FIN signal is turned ON.

Additionally, the M signal waits for M-FIN to be OFF. When it is turned OFF, the next block is executed.



(3) Set/Reset Type M Signal (M80 to M88, M90 to M98)

Assume: Pr101 = 0

When any of M80 to M88/M90 to M98 is used with the same conditions as individual signal mode, M output that does not need M-FIN signal.

M80 to M88: Each corresponding M50 to M58 signal is turned ON.

M90 to M98: Each corresponding M50 to M58 signal is turned OFF.

Output Signal		M50	M51	M52	M53	M54	M55	M56	M57	M58
Code	ON	M80	M81	M82	M83	M84	M85	M86	M87	M88
	OFF	M90	M91	M92	M93	M94	M95	M96	M97	M98

Application:

Using this command for the positioning function provided with passing signal output makes programming easier.

(4) Coded M Signal (M40 to M89)

Assume: Pr101 = 1 to 1000

Output signal M50 to M53: Coded M function 1st digit (m_1)

Output signal M54 to M57: Coded M function 2nd digit (m_{10})

Output signal M58: Strobe signal

When coded M function = $Mm_{10}m_1$ is expressed, those codes are as shown below:

m_1	M50	M51	M52	M53
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

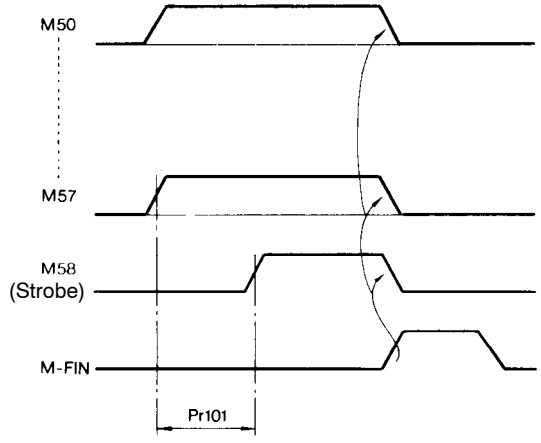
m_{10}	M54	M55	M56	M57
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1

<Example>

Each M signal status at M45 designation

M50	M51	M52	M53	M54	M55	M56	M57
1	0	1	0	0	0	1	0

(5) Coded M Signal, Signal Timing Chart



7.25 PROGRAM END (M30)

RUN signal (STL) is reset and then M30 signal is reset.

When the program start signal (PGST) is turned OFF, M30 signal is reset.

7.26 INEFFECTIVE COMMAND (NOP)

Ineffective command does not perform any operation and only execution block is executed.

7.27 INDIRECT REGISTER DESIGNATION

Instead of designating numeric value directly by program, it may be designated indirectly by designating register number.

(1) Register range

99 types from R1 to R99

(2) Characters

Command may be available to X, U, F, I, S, and D.

(3) Sample Program

```
G01 X R1 FR10 I200
```

When R1 = 10000, R10 = 1000,

the above command is equivalent to G01 X10.000 F1000 I200.

8

TEST RUN

This chapter describes a test run of the MOTIONPACK-SG1.

8.1 VERIFICATION PRIOR TO TEST RUNS

Before conducting a test run, verify the operating conditions for the following three units.

(1) Servomotor

Verify the following items:

- All connections, wiring, or grounding between the machines and the instruments are correct.
- All attached parts are tightened.
- The oil seal is not damaged when used.

When conducting a test run for a SERVOPACK that has not been in use for an extended period, consult the user's manual for procedures.

(2) SERVOPACK

Verify the following items:

- Connections and wiring leads are securely connected to terminals and connectors are securely in place.
- The SERVOPACK power supply is of the appropriate voltage range.
- The rotary switch(SW1) is correctly set.

  Feed axis : 1

  Spindle : 2

(3) Motionpack

Verify the following items:

- Cables are securely attached to connectors.
- The power supply voltage for the Motionpack is 24VDC (±5%).
- The rotary switch(SW1) is correctly set.

  Normal : 0 (linear operation)

  When using rotating axis : 1

8.2 Test Run

(1) Test Run Preparation

Observe the following procedures to prepare for a test run.

① Turn ON the power of MOTIONPACK-SG1 and SERVOPACK.

Refer to 4.1 CONNECTION DIAGRAM when turning the power ON.

When power is turned ON, the POWER ON LEDs for the Motionpack and the SERVOPACK are lit. Then communications between the Motionpack and the SERVOPACK starts. The Motionpack RUN LED (green) is lit and the SERVOPACK ALARM LED (red) turns OFF.

② Set the necessary parameters (user constants) for a test run.

Set all the parameters using a SG1 programmer. Always set the following parameters.

- Motor selection (when using SGDB SERVOPACK: User constant Cn-0037; when using SGD SERVOPACK: b8 of the user constant Cn-0002)
- Encoder type (bE of the SERVOPACK user constant Cn-0001)
- Encoder pulse number (SERVOPACK user constant Cn-0001)
- Command/Speed units according to machine specifications (Motionpack parameters: Pr50 to Pr54).
  The following conditions should be fully satisfied when setting the parameters:
  $1/100 \leqq Pr51 \times 10(Pr50-3) \times Pr52 / \text{encoder pulse count} \times 4 \times Pr53 \leqq 100$
- Home position coordinate setting method (Motionpack parameter: Pr70 units)
- Stroke limit (Motionpack parameters: Pr60, Pr61)

  The stroke limit cannot be set using SERVOPACK user constants.

③ Turn the MOTIONPACK-SG1 and the SERVOPACK power supply ON.

④ Input the Motionpack servo ON signal(SVON).

The SERVOPACK internal power circuit is activated making the motor operation possible.

⑤ Set up the home position coordinate.

Refer to 6.5 HOME POSITION CORDINATE SETTING-UP for the correct setup.

(2) Operation

A test run can be carried out while the main circuit is in operation (with the baseblock released).

Run the motor at a low speed during JOG operation etc. Refer to 6.1 OPERATION MODE.

During a test run, operate the servomotor without load to avoid any unexpected accidents. If loaded conditions are unavoidable, run the motor so that an emergency stop can be activated in case of motor overload.

Verify the following items during a test run:

- No abnormal vibration
- No abnormal sound
- No abnormal temperature rise

If any of the above problems are found, consult the SERVOPACK user's manual, TROUBLESHOOTING, to determine and eliminate the problem.

9

MAINTENANCE

This chapter describes the maintenance and fault diagnosis of MOTIONPACK-SG1.

9.1 INSPECTION/REPLACEMENT OF THE BATTERY

9.1.1 Inspection of the Battery

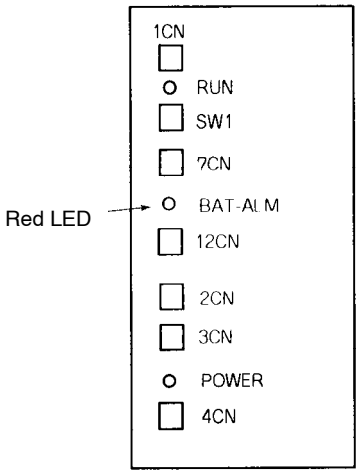
A drop in battery voltage is indicated by the following:

- Red LED at the front of the controller is lit.
- Battery alarm signal (BALM) is output from I/O to #45024.

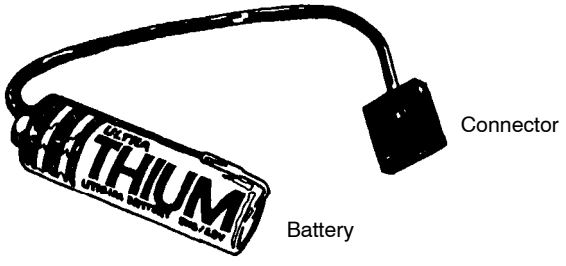
The controller is normally in the control panel, and the LED at the front of the controller cannot be seen from the outside.

To easily check the battery, a blinking lamp from the battery alarm signal output is required outside the controller.

If the lamp is not provided, check whether the red LED is lit or not once a month. The battery life is about 5 years in a system with an absolute encoder.



Standard batteries cannot be used. For a spare battery, contact your Yaskawa representative. (Battery type: ER6VC3, electric part code: BA507)



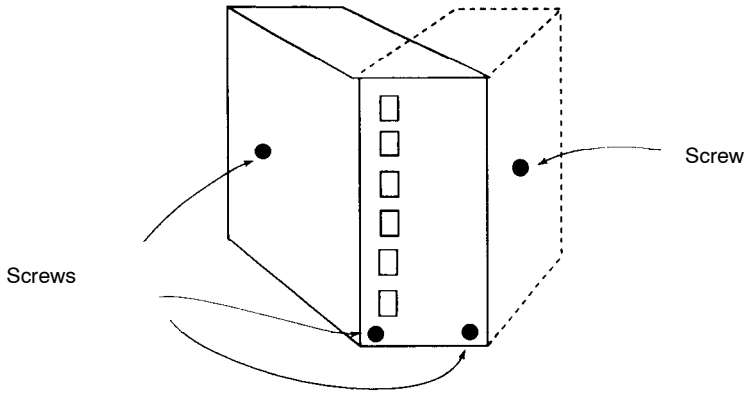
9.1.2 Replacement of the Battery

Replace the battery quickly by the following procedure.

① Turn the power OFF.

② Remove the controller from the control panel.

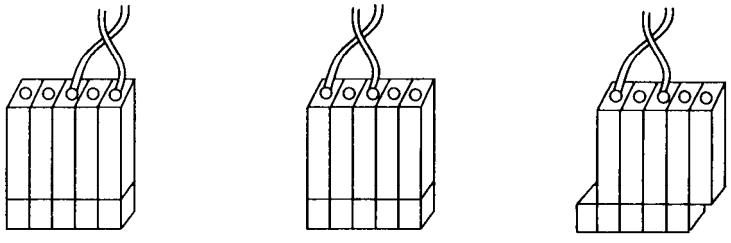
③ Remove the 4 screws from the panel, and remove the panel.



④ Remove the board on which the battery is mounted.

⑤ Remove the old battery from the holder.

⑥ Fit the new battery in the holder, and insert the connector. Although the connector may be inserted in either direction, it must be securely inserted. Otherwise, the battery will not supply power.



⑦ Place the board back and attach the panel to the control panel.

⑧ Turn the power ON.

⑨ Make sure that the red LED at the front of the controller is OFF.

9.2 LED DISPLAY

(1) SERVOPACK

SERVOPACK LEDs are displayed on the front panel.

- During power ON : POWER LED (green) is lit
- During an alarm : ALARM LED (red) is lit
- During MECHATROLINK communications : LED (green) is lit

(2) Motionpack

Motionpack LEDs are displayed on the front panel.

- During power ON : POWER LED (green) is lit
- During battery undervoltage : BAT-ALM LED (red) is lit
- During MECHATROLINK communications : RUN LED (green) is lit

Replace battery within one month after BAT-ALM turns.

9.3 REPLACEMENT OF THE SERVOPACK

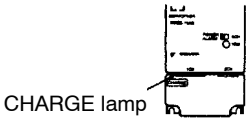
Observe the following procedures to replace the SERVOPACK.

① With the Motionpack and the SERVOPACK connected, turn the power ON for at least 3 minutes to charge the absolute value encoder capacitor.
When using an incremental encoder system, this step is not required.

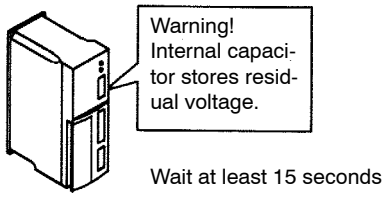
② Turn OFF the power supplies of the Motionpack and the SERVOPACK.

③ Replace the SERVOPACK.

- When using an SGDB SERVOPACK, an internal capacitor stores residual voltage. To prevent the danger of electric shock, verify that the CHARGE lamp is turned OFF before an inspection.



- When using an SGD SERVOPACK, an internal capacitor stores residual voltage. To prevent danger of electric shock, wait at least 15 seconds after power is turned OFF before an inspection.



④ Turn ON the power. SERVOPACK parameters (user constants) are recorded on the Motionpack's side. As long as no changes are made to the system, resetting the constants is not necessary.

9.4 REPLACEMENT OF THE MOTIONPACK

① Store all data for Motionpack program, parameters, registers and offset values are in an external storage device such as memory cards. For saving procedures, refer to 5.21 "Memory Card Write" of MOTIONPACK-SG1 PROGRAMMER DESCRIPTIVE INFORMATION (Manual No. SIE-C884-1.1), or chap. 3-6 of MOTIONPACK-SG1 PERSONAL COMPUTER PROGRAMMER OPERATING MANUAL (Manual No. TOE-C884-1.2).

② Record the SERVOPACK parameter data (user constants) or save them on the external storage device. For saving procedures, refer to 5.5 "Parameter (Servo) Check" of PROGRAMMER DESCRIPTIVE INFORMATION, or chap.9 "Servo Parameter Operations" of PERSONAL COMPUTER PROGRAMMER OPERATING MANUAL .

③ With the Motionpack and the SERVOPACK connected, turn ON the power for at least 3 minutes to charge the absolute value encoder capacitor.
When using an incremental encoder system, this step is not required.

④ Turn OFF the Motionpack and SERVOPACK power supplies.

⑤ Replace the Motionpack.

⑥ Turn On the SERVOPACK and Motionpack power supplies.

⑦ Read the data for Motionpack programs, parameters, registers, and offset values from the external storage device to the Motionpack. For reading procedures, refer to 5.20 "Memory Card Read" of PROGRAMMER DESCRIPTIVE INFORMATION or chap. 3-6 of the PERSONAL COMPUTER PROGRAMMER OPERATING MANUAL.

⑧ Set the SERVOPACK parameters (user constants) recorded at step 2. For setting procedures, refer to 5.6 “Parameter (Servo) Change” of PROGRAMMER DESCRIPTIVE INFORMATION or chap. 9 “Servo Parameter Operations” of PERSONAL COMPUTER PROGRAMMER OPERATING MANUAL.

⑨ Turn the SERVOPACK and Motionpack power supplies OFF and then ON again.

9.5 FAULT DIAGNOSIS

(1) Alarm history and input signal history display

The time and date of the last 100 alarms and the Motionpack input signal history are accessible by the programmer for verification.

For display procedures, refer to Programmer 5.26 or 5.27 “Status Screen” in PROGRAMMER DESCRIPTIVE INFORMATION or chap. 7 “Maintenance Operations” PERSONAL COMPUTER PROGRAMMER OPERATING MANUAL.

(2) Alarm maintenance

All alarm messages are accessible by the programmer for verification.

For display procedures, refer to 5.27 “Status Screen” of PROGRAMMER DESCRIPTIVE INFORMATION or chap. 7 “Maintenance Operations” of PERSONAL COMPUTER PROGRAMMER OPERATING MANUAL.

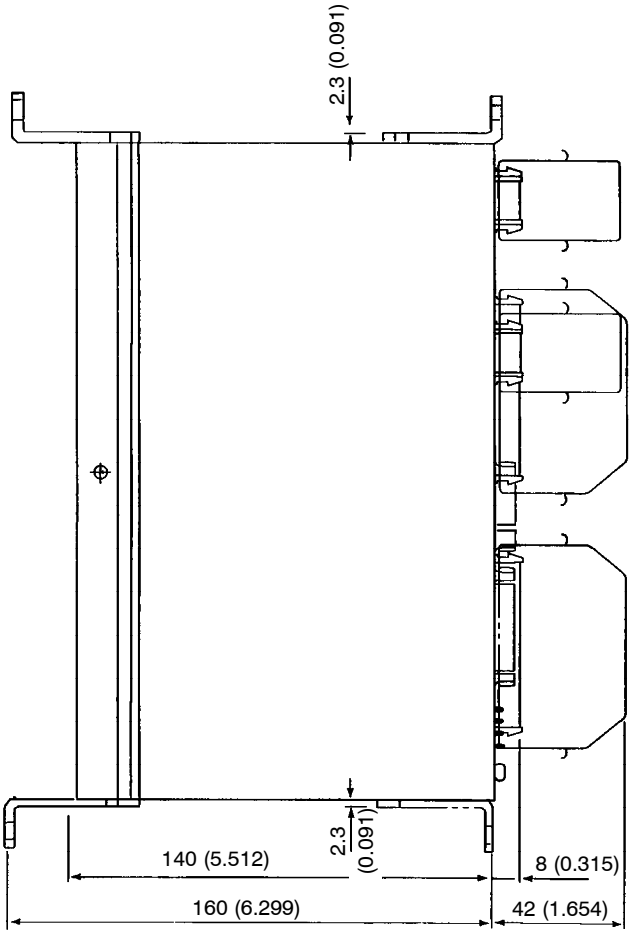
For corrective actions for each alarm, refer to Appendix E.1 “Alarm List.”

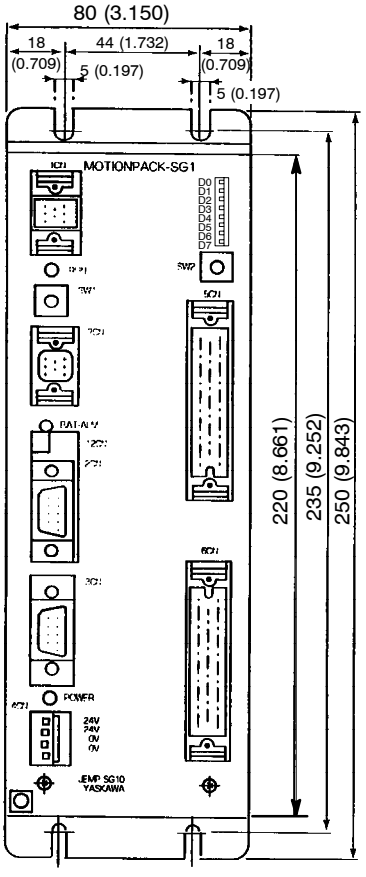
APPENDIX A

EXTERNAL DIMENSIONS

Appendix A shows the external dimensions of the controller and peripheral devices.

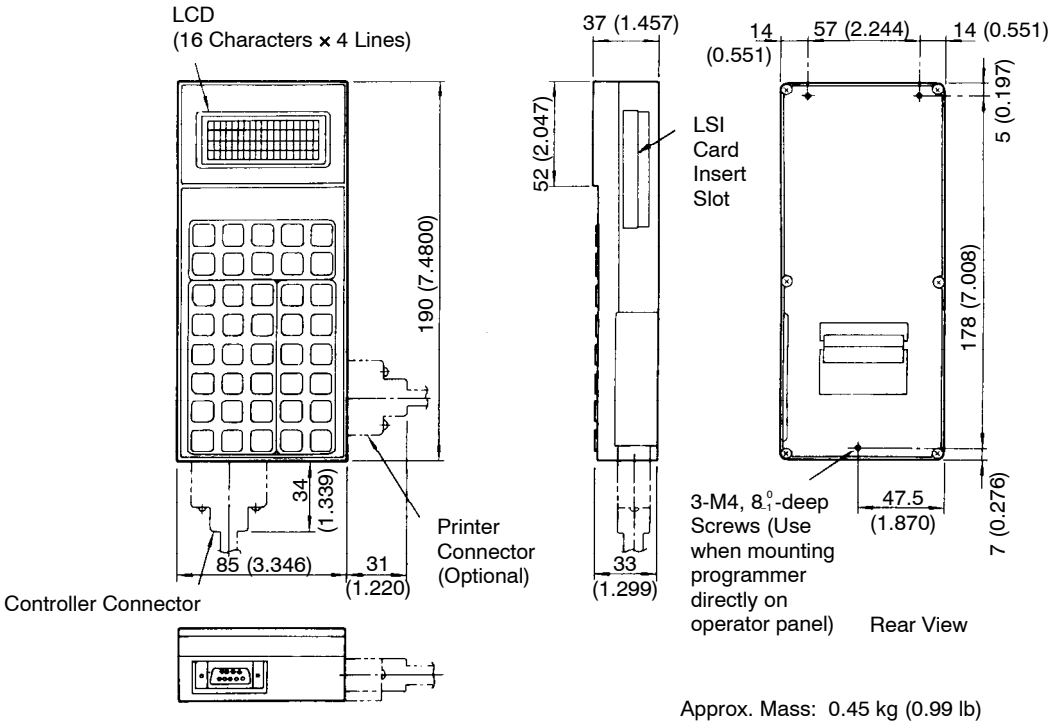
APPENDIX A.1 CONTROLLER (MODEL: JEMP-SG10)





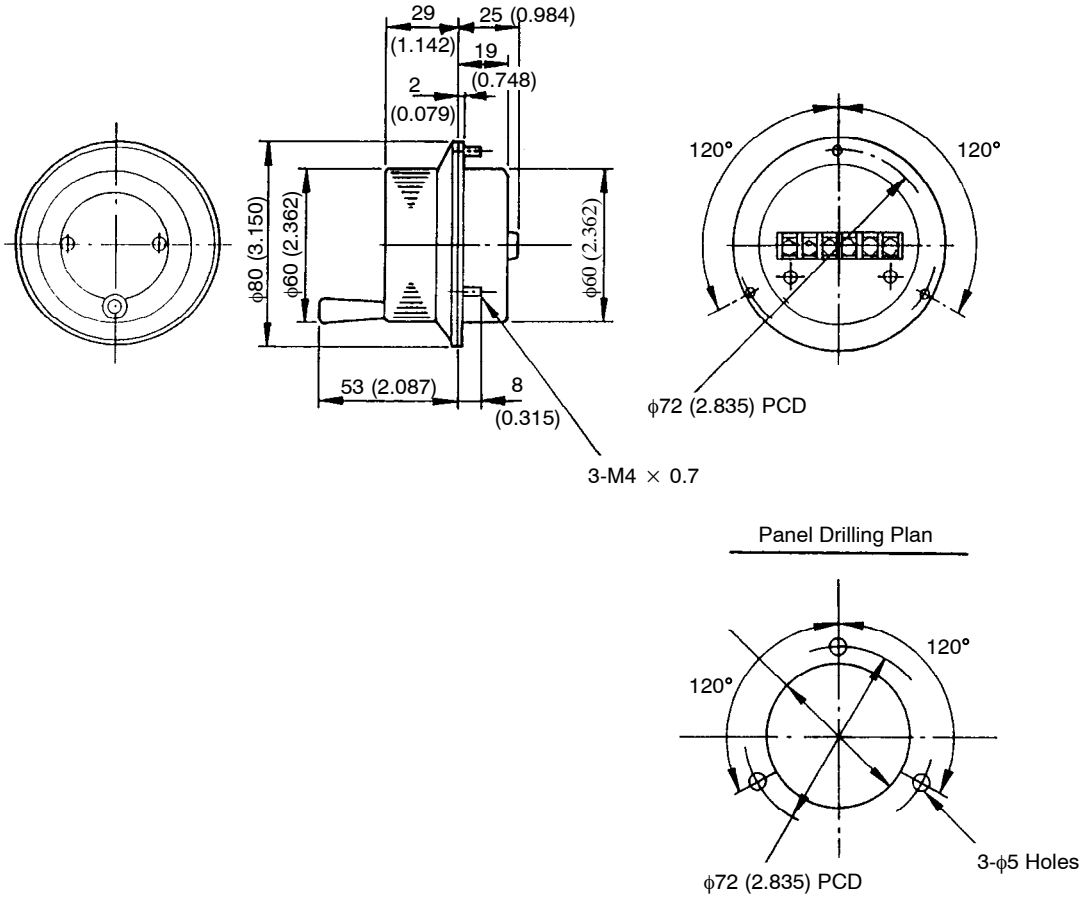
Approx. Mass: 1.5 kg (3.31 lb)

APPENDIX A.2 SPECIAL PROGRAMMER (MODEL: JEMP-PSG1)



Approx. Mass: 0.45 kg (0.99 lb)

APPENDIX A.3 MANUAL PULSE GENERATOR (PRET-2E5T/100M12)



Note 1: Use the M3 terminal screws with foot length 6.

2: Refer to upper right diagram for panel cut.

3: Dial is made of resin (Cr plated).

APPENDIX B

PARAMETER LIST

Appendix B shows the parameter list explaining names and setting ranges.

APPENDIX B.1 PARAMETER LIST

Remarks:
- U : Can be changed anytime.
- P : Can be changed in EDIT mode. Effective after turning OFF the power supply once and then ON again.
- S : Can be changed when motor stops.
- SS : Can be changed when spindle motor stops.
- T : Can be changed when motor stops. Effective after turning OFF the power supply once and then ON again.
- G : Can be changed by G code.

B

Appendix Table B.1 Parameter List

Parameter No.	Name	Range	Unit	Remarks	Default Value
Pr0	Reserved				0
Pr1	JOG low speed	0 to 99999	Speed unit	U	500
Pr2	JOG high speed	0 to 99999	Speed unit	U	10000
Pr3	HANDL feed speed	0 to 99999	Speed unit	U	1000
Pr4	JOG low speed feed torque limit	0 to 400	%	S	100
Pr5	HANDL PG reference speed/position change	0 or 1 (0: Position, 1: Speed)		S	0
Pr6	Rapid return speed	0 to 99999	Speed unit	U	10000
Pr7	Dwell position	–99999999 to +99999999	Reference unit	S	0
Pr8 to Pr12	Reserved				0
Pr13	Soft filter provided/not provided	0 or 1 (0: Provided, 1: Not provided)		S	0
Pr14	Pulse output stop time at current limitation	0 to 32767	ms	S	0
Pr15 to Pr19	Reserved				0
Pr20	Coordinate system 8 one-time correct value	0 to 400	Reference unit	U	1
Pr21	Coordinates system 8 maximum correct value	0 to 99999999	Reference unit	U	5
Pr22	Coordinates system 9 one-time correct value	0 to 400	Reference unit	U	15
Pr23	Coordinates system 9 maximum correct value	0 to 99999999	Reference unit	U	100
Pr24 to Pr29	Reserved				0
Pr30	Maximum speed	0 to 99999	Speed reference	S	10000

Parameter No.	Name	Range	Unit	Remarks	Default Value
Pr31	Linear accel time	0 to 60000	ms	S	200
Pr32	Linear decel time	0 to 60000	ms	S	200
Pr33	S-curve accel/decel time	0 to 10000	ms	S	500
Pr34	S-curve accel/decel time (constant accel/decel zone)	0 to 2000	ms	S	0
Pr35	Check timer	1 to 300 (0: 10s-timer)	s	S	0
Pr36	In-position range	0 to 400	Pulse	S	50
Pr37	Reserved				0
Pr38	Reserved				0
Pr39	MRDY output mode change	0 or 1 (0: Synchronized with SVON, 1: Not synchronized with SVON)		S	0
Pr40 to Pr49	Reserved				0
Pr50	Minimum reference unit	0 to 5	10^{-n} mm	P	2
Pr51	Ball screw pitch	1000 to 99999	μm/r	P	10000
Pr52	Gear ratio N_1 (Motor side)	1 to 999999		P	1
Pr53	Gear ratio N_2 (Machine side)	1 to 999999		P	1
Pr54	Decimal point position (speed unit)	0 to 5	Reference unit $\times 10^n$/min	P	2
Pr55 to Pr59	Reserved				0
Pr60	Minus direction stored stroke limit	–99999999 to +99999999	Reference unit	S	–1000000
Pr60	Plus direction stored stroke limit	–99999999 to +99999999	Reference unit	S	–1000000
Pr62 to Pr64	Reserved				0
Pr65	Registration mode setting	0 or 1		S	0
Pr66	Registration N count number	0 to 10		S	0
Pr67 to Pr69	Reserved				0
Pr70	Home position coordinate setting method			U	40003

Parameter No.	Name	Range	Unit	Remarks	Default Value
Pr71	T_0 coordinate offset value in absolute system	–99999999 to +99999999	Reference unit	P	0
	T_0 coordinate offset value in incremental system	–99999999 to +99999999	Reference unit	P	0
Pr72	Reference point coordinate value in absolute system	–99999999 to +999999999	Reference unit	S	0
	Reserved in incremental system				0
Pr73	Home position setup command	0 or 1 (0: Completion, 1: Start)		S	0
Pr74	Home position feed speed	0 to 99999	Speed reference	S	0
Pr75	Pushing torque	10 to 400	%	S	0
Pr76	Stopper pushing time	0 to 60000	ms	S	0
Pr77	Encoder allowable moving value in absolute system	0 to 99999999	Reference unit	P	2500
	Reference point allowable error amount in incremental system	0 to 99999	Reference unit	P	2500
Pr78	ABS-PB alarm reset command	0 or 1 (0: Completion, 1: Start)		P	0
Pr79	Reserved				1111
Pr80	Home position return speed with an incremental encoder	0 to 99999	Speed reference	S	0
	Reserved in absolute system				0
Pr81 to Pr89	Reserved				0
Pr90	Maximum spindle speed (other than synchronous operation)	0 to 99999	r/min	SS	0
Pr91	Spindle reference method selection	0 or 1		SS	0
Pr92 to Pr94	Reserved				0
Pr95	Spindle speed coincidence detection dwell time	10 to 1000	ms	SS	100
Pr96	Reserved				0
Pr97	Spindle low speed	0 to 99999	r/min	SS	50
Pr98	Spindle high speed	0 to 99999	r/min	SS	1000

Parameter No.	Name	Range	Unit	Remarks	Default Value
Pr99	Spindle	0 or 1 (0: Not provided, 1: Provided)		P	0
Pr100	Communication condition			U	0
Pr101	MF output delay time	0 to 1000	ms	S	0
Pr102 to Pr110	Reserved				0
Pr111	PSW1 1st zone lower limit <for absolute system>	–99999999 to +9999999	Reference unit	S	0
Pr112	PSW1 1st zone upper limit <for absolute system>	–99999999 to +9999999	Reference unit	S	0
Pr113	PSW1 2nd zone lower limit <for absolute system>	–99999999 to +9999999	Reference unit	S	0
Pr114	PSW1 2nd zone upper limit <for absolute system>	–99999999 to +9999999	Reference unit	S	0
Pr115	PSW1 3rd zone lower limit <for absolute system>	–99999999 to +9999999	Reference unit	S	0
Pr116	PSW1 3rd zone upper limit <for absolute system>	–99999999 to +9999999	Reference unit	S	0
Pr117	PSW1 4th zone lower limit <for absolute system>	–99999999 to +9999999	Reference unit	S	0
Pr118	PSW1 4th zone upper limit <for absolute system>	–99999999 to +9999999	Reference unit	S	0
Pr119, Pr120	Reserved				0
Pr121	PSW2 1st zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr122	PSW2 1st zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr123	PSW2 2nd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr124	PSW2 2nd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr125	PSW2 3rd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr126	PSW2 3rd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0

Parameter No.	Name	Range	Unit	Remarks	Default Value
Pr127	PSW2 4th zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr128	PSW2 4th zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr129, Pr130	Reserved				0
Pr131	PSW3 1st zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr132	PSW3 1st zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr133	PSW3 2nd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr134	PSW3 2nd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr135	PSW3 3rd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr136	PSW3 3rd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr137	PSW3 4th zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr138	PSW3 4th zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr139, Pr140	Reserved				0
Pr141	PSW4 1st zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr142	PSW4 1st zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr143	PSW4 2nd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr144	PSW4 2nd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr145	PSW4 3rd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr146	PSW4 3rd zone upper limit<for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr147	PSW4 4th zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0

Parameter No.	Name	Range	Unit	Remarks	Default Value
Pr148	PSW4 4th zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr149, Pr150	Reserved				0
Pr151	PSW5 1st zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr152	PSW5 1st zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr153	PSW5 2nd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr154	PSW5 2nd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr155	PSW5 3rd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr156	PSW5 3rd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr157	PSW5 4th zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr158	PSW5 4th zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr159, Pr160	Reserved				0
Pr161	PSW6 1st zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr162	PSW6 1st zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr163	PSW6 2nd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr164	PSW6 2nd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr165	PSW6 3rd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr166	PSW6 3rd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr167	PSW6 4th zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr168	PSW6 4th zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0

Parameter No.	Name	Range	Unit	Remarks	Default Value
Pr169, Pr170	Reserved				0
Pr171	PSW7 1st zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr172	PSW7 1st zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr173	PSW7 2nd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr174	PSW7 2nd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr175	PSW7 3rd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr176	PSW7 3rd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr177	PSW7 4th zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr178	PSW7 4th zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr179, Pr180	Reserved				0
Pr181	PSW8 1st zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr182	PSW8 1st zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr183	PSW8 2nd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr184	PSW8 2nd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr185	PSW8 3rd zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr186	PSW8 3rd zone upper limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr187	PSW8 4th zone lower limit <for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr188	PSW8 4th zone upper limit<for absolute system>	–99999999 to +99999999	Reference unit	S	0
Pr189 to Pr199	Reserved				0

Parameter No.	Name	Range	Unit	Remarks	Default Value
Pr200	Spindle encoder mounting position	0 or 1 (0: Spindle side, 1: Motor side)		S	1
Pr201	Pulse number per rotation of spindle encoder (with no multiplication)	1 to 32768	Pulse	S	2048
Pr202	Spindle motor maximum speed at synchronous, follow-up operation	1 to 32767	r/min	S, G	1000
Pr203	Reserved				0
Pr204	Spindle linear accel/decel time	0 to 60000	ms	S, G	1000
Pr205	Reserved				0
Pr206	Spindle in-position range	1 to 255	Pulse	S	100
Pr207	Solid tap return path feed axis drawing-in in-position width	1 to 255	Pulse	S	100
Pr208	Spindle, feed axis synchronous compensation parameter (K1)	–32767 to +32767	1/256 magnifications	S, G	0
Pr209	Spindle, feed axis synchronous compensation parameter (K2)	0 to 32767	0.01%	S, G	0
Pr210	Reserved				0
Pr211	Number of teeth of gears at the spindle side	1 to 511		S, G	1
Pr212	Number of teeth of gears at the motor side	1 to 511		S, G	1
Pr213	Gear ratio of spindle and spindle PG	1 to 511		S	1
Pr214	Rotation direction designation at synchronous, follow-up operation	1 or 2 (1: + designation by FRN/RRN, 2: – designation by FRN/RRN)		S	1
Pr215	Synchronous error automatic compensation value setting reference	0: Compensation completed (normal operation), 1: Compensation execution		S	0
Pr216	Synchronous error amount (servo position deviation)	–99999999 to +99999999	Pulse	S	0
Pr217	Synchronous error amount (synchronous error + peak value)	–99999999 to +99999999	Pulse	S	0
Pr218	Synchronous error amount (synchronous error – peak value)	–99999999 to +99999999	Pulse	S	0
Pr219	Reserved				0
Pr220	G93 home position indexing	0 or 1 (0: Not provided, 1: Provided)		S	0

Parameter No.	Name	Range	Unit	Remarks	Default Value
Pr221	Home position indexing direction	0 or 1 (0: Forward rotation direction, 1: Reverse rotation direction)		S	1
Pr222	Home position indexing in-position range	0 to 32767	Pulse	S	60
Pr223	Home position indexing start speed	0 to 32767	r/min	S	100
Pr224	Home position indexing creep speed	0 to 32767	r/min	S	50
Pr225	Spindle maximum speed at home position indexing	0 to 32767	r/min	S	1000
Pr226	Final traveling distance at home position indexing	0 to 99999999	Pulse	S	2048
Pr227	Spindle feed roll diameter	0 to 99999999	Reference unit	S	100
Pr228	In-position width during feed axis synchronous operation	0 to 32767	Pulse	S	100
Pr229	G97 spindle feed distance	0 to 99999999	Reference unit	S, G	10000

APPENDIX B.2 SERVO PARAMETER LIST

Appendix Table B.2 Servo Parameter List

Parameter No.	Name	Range	Unit	Remarks	Default Value
SVPr0	Servo related parameter (edited by SG1 programmer)	Refer to the servo manual.		S	
SVPr1H	Memory switch 1	–	Bit	S	408CH
SVPr11H	Number of encoder pulses	513 to 32767	P/R	S	400H
SVPr14H	Memory switch 4	–	Bit	S	0CH
SVPr24H	Electronic gear B (numerator)	1 to 65535		S	1 *
SVPr25H	Electronic gear A (denominator)	1 to 65535		S	1 *

* Use initial values as set. Set units Pr 50 to Pr 54.

APPENDIX B.3 SPINDLE PARAMETER LIST

Appendix Table B.3 Spindle Parameter List

Parameter No.	Name	Range	Unit	Remarks	Default Value
SPPr0	Spindle related parameter (edited by SG1 programmer)	Refer to the servo manual.		SS	
SPPr1H	Memory switch 1	–	Bit	SS	8CH
SPPr11H	Number of encoder pulses	513 to 32767	P/R	SS	800H
SPPr14H	Memory switch 4	–	Bit	SS	0CH
SPPr24H	Electronic gear B (numerator)	1 to 65535		SS	1 *
SPPr25H	Electronic gear A (denominator)	1 to 65535		SS	1 *

* Use initial values as set. Set units Pr 50 to Pr 54.

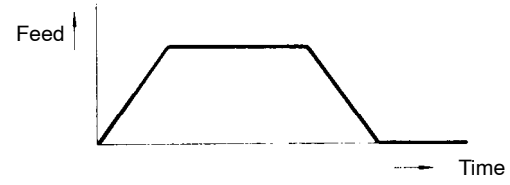
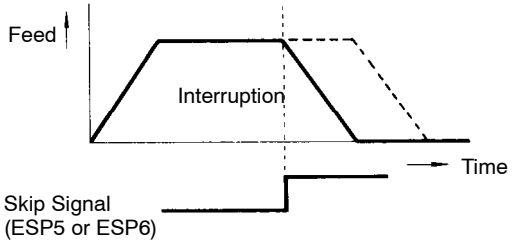
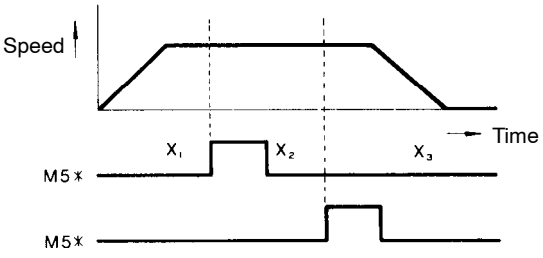
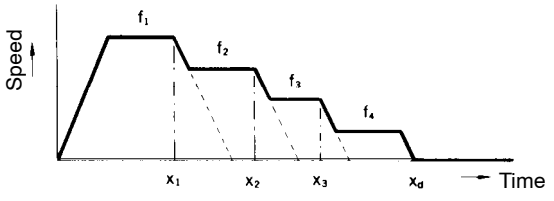
APPENDIX C

FUNCTION COMMAND LIST

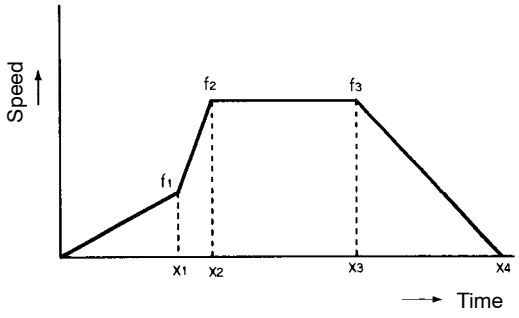
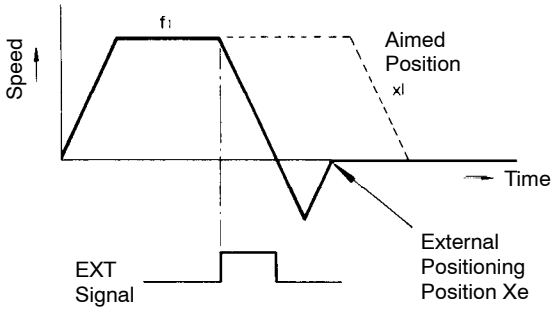
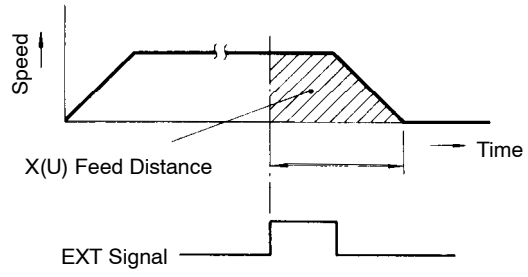
Appendix C shows the function command list explaining the names and command formats.

APPENDIX C.1 FUNCTION COMMAND LIST

Appendix Table C.1 Function Command List

Function Command	Symbol	Function Command Format	Contents
Positioning	G01	G91 X/U_F_I_S_	Positioning to position X (or distance U) at speed F with torque limit I. Spindle command can be set simultaneously. 
Skip positioning	G05, G06	G05 X/U_F_I_S_ G06 X/U_F_I_S_	When the skip signal is turned ON during feed, the execution is interrupted and moves to the next block. 
Positioning with passing signal output	G07	G07 X_U_ G12 X_U_ M5* G21 X/U_ M5* Note: Both X and U can be used for G07. M-FIN is provided for M50 to M58. M-FIN is not required for M80 to M88/M90 to M98. Other coded M outputs can be used.	M5* signal is output at the position specified by G12 during feed to the position specified by G07. 
Speed profile positioning	G08	G08 X/Uxd_ G12 X/Ux1_Ff1_I_ G12 X/Ux2_Ff2_I_ G12 X/Ux3_Ff3_I_ G12 X/Ux4_Ff4_I_ X or U can be specified for G08 and G12.	Speed is changed at the G12 specified position during G08 positioning. 

C

Function Command	Symbol	Function Command Format	Contents
Speed profile positioning 2	G13	G13 X/Ux_1_Ff_1_I_ G13 X/Ux_2_Ff_2_I_ G13 X/Ux_3_Ff_3_I_ G3 X/Ux_4_F0_I_ X or U can be specified	Acceleration changes so that specified speed is attained at the G93 command position. 
External positioning	G34	G34 X/Ux_1_Ff_1_I_	Positioning is performed at a position where external positioning signal (EXT) is turned ON during feed to X (or U) position at speed F with torque limit I. 
Second External Positioning	G35	G35 X/U(x)_F_I_	When the machine continues moving until EXT signal is turned ON. When the EXT is turned ON, positioning is performed at the specified position. (1) X designation To point x with EXT position as home position (2) U designation U-distance move from EXT position 

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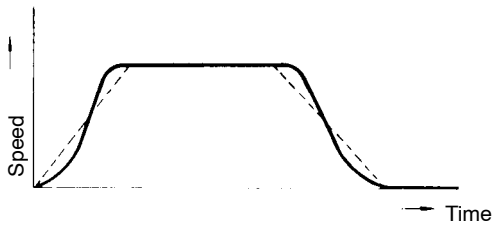
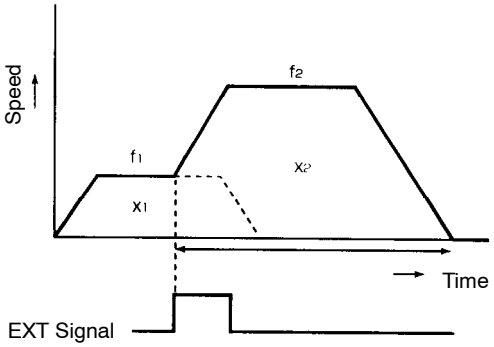
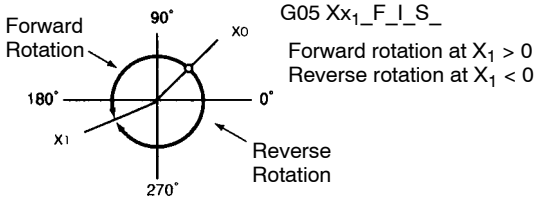
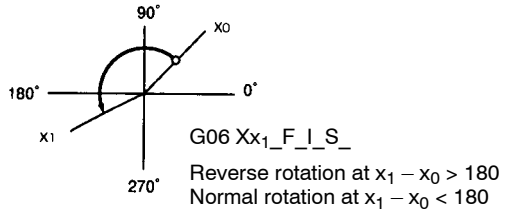
Function Command	Symbol	Function Command Format	Contents
S-curve accel/decel positioning	G10, G11	G10 G01 X_F_I_ G11 Positioning commands (G01, G05, G06, G34, G35) that are held between G10 and G11 becomes S-curve accel/decel.	Positioning is performed by S-curve accel/decel specified by the parameters. 
Registration	G36	G36 X/Ux_1_Ff_1_I_ G37 X/Ux_2_Ff_2_I_ X, U designation available	The machine moves to the G36 command position. Then when EXT is turned ON, positioning is performed at G37 command position. (1) G37X designation To x_2 point with EXT position at home position (2) G37U designation U-distance move from G36 command position 
Rotating solid angle indexing	G05, G06	G05 X/Ux_1_F_I_S_ Limited at rotating solid mode designation	(1) Rotation direction designation type X sign determines rotation direction. 
		G06 X/U_F_I_S_ Limited at rotating solid mode designation	(2) Short distance direction designation type Positioning through short distance direction 

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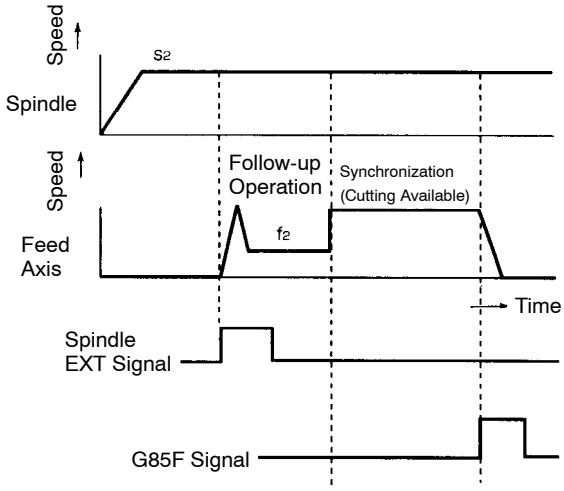
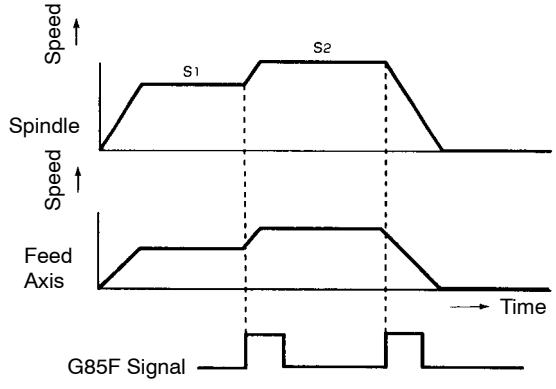
Function Command	Symbol	Function Command Format	Contents
Follow-up operation function	G95	G95 Xx_1 G85 $Xx_2\_Ff_2\_I\_Ss_2$ x_1 is the mark sensor position. x_2 is the distance between mark position and synchronous position (cutting position). f_2 is the minimum speed during follow-up operation.	(1) Mark sensor mode (G95) (2) When the spindle such as feed roll starts and mark position (spindle EXT signal) is input, synchronous operation starts with the position as reference, and follow-up operation of feed axis such as sheet cutter starts. When completion signal (G85F) is input, synchronization is released, and only feed axis decelerates to a stop. (G85)  In the case to use feed axis in reverse rotation, use G75.
	G96	G85 $X0\_F0\_Ii_1\_Ss_1\_$ G85 $X0\_F0\_Ii_1\_Ss_2\_$ G85 $X0\_F0\_Ii_1\_S0\_$ i_1 is the speed magnification of feed axis to spindle.	(1) Non mark sensor mode (G96) (2) Synchronous operation starts at speed ratio preset by program from feed axis and spindle start position. When completion signal (G85F) is input, it goes to the next block. (G85)  In the case to use feed axis in reverse rotation, use G75.

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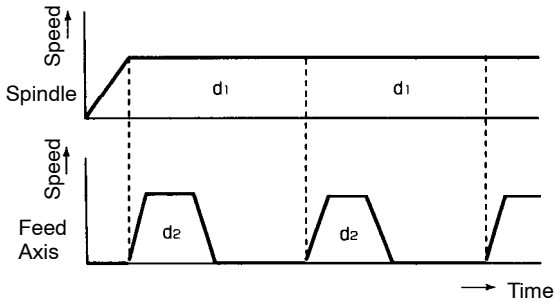
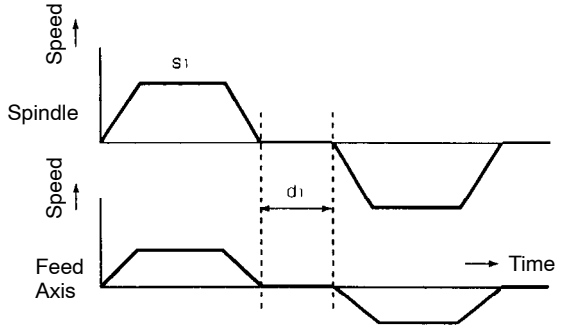
Function Command	Symbol	Function Command Format	Contents
Follow-up operation function (cont'd)	G97	G97 Xx_1_F_I_S_ x_1 is the distance d2 in the right figure.	(1) Position follow-up mode (G97) (2) By performing G97 in succession, positioning of a certain distance (d2) of feed axis from the moment, every time reaching spindle shift distance (d1) is performed.  Spindle shift distance d1 is designated by parameter.
Solid tap	G93	G93 G84 Xx_1_Ff_1_Dd_1_Ss_1_ (G74 X_F_D_S_) x_1 is the tapping bottom position. f_1 is the tap pitch. d_1 is the tapping bottom dwell time.	(1) Solid tap mode (G93) (2) Synchronous operation is performed, with the current position as start point, toward tapping bottom position (x_1), under designated speed (s_1) as for spindle, under designated tap pitch (f_1) as for feed axis. Then designated time dwell (d_1) is performed at tapping bottom position, and synchronous operation is performed further toward the start point. (G84)  With spindle in reverse rotation, use G74.
Synchronous operation completion	G94	G94	Synchronous operation (G95, G96, G97, G93) modes are released.
Jump with condition	G66	G66 Pp_1_Dd_1_ d_1 is the monitor signal.	If monitor signal (d_1) is ON, it jumps to jump destination (p_1).
		G66 Pp_2_DRd_2_ d_2 is the register number.	If register number (d_2) is 1, it jumps to jump destination (p_2).
	G65	G65 Pp_1_Dd_1_ d_1 is the monitor signal	If monitor signal (d_1) is OFF, it jumps to jump destination (p_1).
		G65 Pp_2_DRd_2_ d_2 is the register number.	If register number (d_2) is 0, it jumps to jump destination (p_2).

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Function Command	Symbol	Function Command Format	Contents
I/O set	M20	M20 Dd_1_ d_1 is the I/O signal.	Designated I/O signal (d_1) is forcibly turned ON (Disable).
	M21	M21 Dd_2_ d_2 is the I/O signal.	Designated I/O signal (d_2) is forcibly turned OFF (Disable).
	M22	M22	Mask of the signal, which is forcibly turned ON/OFF by M20 or M21, is released (Enable).
I/O read	G16	G16 X Rx_1_Dd_1_ X_1 is the register number, and d_1 is the monitor signal.	Designated monitor signal (d_1) is read to designated register (x_1). (1) When monitor signal (d_1) = ON, designated register (x_1) is set to 1. (2) When monitor signal (d_1) = OFF, designated register (x_1) is set to 0.
Parameter write	G15	G15 Pp_1_Xx_1_ p_1 is the parameter number. x_1 is the setting data.	Designated data (x_1) is set to designated parameter number (p_1).
Time dwell	G04	In-position waiting G04	The next block is executed by waiting for in-position after feed command execution.
		Dwell time G04 D_	The next block is executed after time specified by D.
Coordinate setting	G52	G52 X/U_ T_	Current position is set as Tn coordinate system position X (or U).
Coordinate change	G53	G53 T_	Change to Tn coordinate system.
In-position check	G67	G67 P_	Jumps to P when feedback position is reached in-position without skipping by skip positioning command.
Subprogram call	G68	Repeating number designation G68 L_P_	Executes subprogram from P block L times.
		End position designation G68 X/U_P_	Executes subprogram from P block until position X (or U) is reached..
Jump	G69	Simple jump G69 P_	Moves to P block execution.
		Subprogram return G69	Returns to main program from subprogram (G68).
Spindle control function	M	M03 S_ M04 S_ M05	M03: Spindle forward rotation command M04: Spindle reverse rotation command M05: Spindle stop The next block is executed by M-FIN signal input.
Auxiliary function	A	M50 to M58 (Pr101 = 0) Set/reset type and coding available	When M signal is output, M-FIN signal is turned ON, M signal output is reset and then the next block is executed by M-FIN signal.
		Program end M30	AUTO signals (STL, OP) are reset, and M30 signal is output.
Ineffective command	NOP	NOP	

C

APPENDIX D

I/O SIGNAL LIST

Appendix D shows the I/O signal list.

APPENDIX D.1 INPUT SIGNAL (ADDRESS 4000* TO 4005*)

Appendix Table D.1 Input Signal

Bit / Address	D7	D6	D5	D4	D3	D2	D1	D0
4000 (SW2 = 0)	J SV/J SP	–JS	+JS	J SPD	HANDL	JOG	AUTO	EDIT
	JSP	ON	ON	ON	ON	ON	ON	ON
	JSV	OFF	OFF	OFF	OFF	OFF	OFF	OFF
4001 (SW2 = 1)	PGSL6	PGSL5	PGSL4	PGSL3	PGSL2	PGSL1	SBLK	PGST
	ON	ON	ON	ON	ON	ON	ON	ON
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
4002 (SW2 = 2)	PGCL	SLCR	ESP6	ESP5	INC8/9	–INC	+INC	ERS
	ON	ON	ON	ON	T_9 designation	ON	ON	ON
	OFF	OFF	OFF	OFF	T_8 designation	OFF	OFF	OFF
4003 (SW2 = 3)	SET INT	STROBE	IN/OUT	M-FIN	G85F	G34F	SV ON	ZRN
	ON	ON	ON	ON	ON	ON	ON	ON
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
4004 (SW2 = 4)	I-DATA7	I-DATA6	I-DATA5	I-DATA4	I-DATA3	I-DATA2	I-DATA1	I-DATA0
	ON	ON	ON	ON	ON	ON	ON	ON
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
4005 (SW2 = 5)					D3	D2	D1	D0
					ON	ON	ON	ON
					OFF	OFF	OFF	OFF

* By changing rotary switch (SW2) at the front of 5G7 controller, input signal may be monitored by LED (D0 to D7).

APPENDIX D.2 OUTPUT SIGNAL (ADDRESS 4500* TO 4505*)

Appendix Table D.2 Output Signal

Bit / Address	D7	D6	D5	D4	D3	D2	D1	D0
4500 (SW2 = 8)	M30	INCD	OFM	OFR	STL	OP	SALM	MRDY
	JSP	ON	ON	ON	ON	ON	ON	ON
	JSV	OFF	OFF	OFF	OFF	OFF	OFF	OFF
4501 (SW2 = 9)	M57	M56	M55	M54	M53	M52	M51	M50
	ON	ON	ON	ON	ON	ON	ON	ON
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
4502 (SW2 = A)	ALM	SET RDY	SLPS	BALM	EPALM	G34	CLD	M58
	ON	ON	ON	ON	ON	ON	ON	ON
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
4503 (SW2 = B)	O-DATA7	O-DATA6	O-DATA5	O-DATA4	O-DATA3	O-DATA2	O-DATA1	O-DATA0
	ON	ON	ON	ON	ON	ON	ON	ON
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
4504 (SW2 = C)	PSW8	PSW7	PSW6	PSW5	PSW4	PSW3	PSW2	PSW1
	ON	ON	ON	ON	ON	ON	ON	ON
	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
4505 (SW2 = D)								COIN
								ON
								OFF

* By changing rotary switch (SW2) at the front of 5G7 controller, output signal may be monitored by LED (D0 to D7).

APPENDIX E

ALARM LIST

Appendix E shows the alarm list.

APPENDIX E.1 ALARM LIST

Appendix Table E.1 Alarm and its Status

◎: Corresponding
○: ON
●: OFF

Alarm No.	Alarm Name and its Contents	Special Programmer Display Message	Status at Alarm					
			Stop		I/O Signal			
			Immediate stop	Deceleration to Stop	Alarm Signal (SALM)	Battery Alarm Signal (BALM)	Current Control Signal (CLD)	MRDY signal (MRDY)
1	CPU error (Error is detected with system software.)	CPU Error	◎					●
2	Program error (Error is detected with the program under execution.)	Program Alarm		◎	○			
3	Parameter error (Error is detected with the parameter.)	Parameter Alarm	◎		○			
4								
5								
6	Current saturation (Current is limited.)	Current Limit				○		
7	Forward overtravel (P-OT signal has been turned ON.)	Forward O.T.	◎		○			
8	Reverse overtravel (N-OT signal has been turned ON.)	Reverse O.T.	◎		○			
9	Home position setup alarm (Error has been detected during home position setup.)	Setup Alarm		◎	○			
10								
11								
12								

Alarm No.	Alarm Name and its Contents	Special Programmer Display Message	Status at Alarm					
			Stop		I/O Signal			
			Immediate stop	Deceleration to Stop	Alarm Signal (SALM)	Battery Alarm Signal (BALM)	Current Control Signal (CLD)	MRDY signal (MRDY)
13	Power failure (Power has been turned OFF during motor operation/program execution.)	Power Down			○			
14	Battery alarm (Voltage of backup battery has run out.)	Battery Down						
15	+ stored stroke limit exceeded (Designated position has exceeded stored stroke limit.)	Pos + Over		◎	○			
16	– stored stroke limit exceeded (Designated position has exceeded stored stroke limit.)	Pos – Over		◎	○			
17								
18								
19	In-position error (In-position is not set over 2 seconds after completion of drawing-in of pulses.)	Inpos Alarm		◎	○			
20	External positioning error (Error has been detected during execution of positioning using EXT signal.)	Ext Pos Alarm		◎				
21	Skip signal error (ESP5/ESP6 signal is ON at execution of G05/G06.)	Skip On		◎	○			
22	Encoder position error (Encoder memory value is different from that of SG1.)	Abso P.G.	◎		○			●
23	External data setting error (Error has been detected with external data setting sequence.)	DGSW Alarm			○			
24								

Alarm No.	Alarm Name and its Contents	Special Programmer Display Message	Status at Alarm					
			Stop		I/O Signal			
			Immedi-ate stop	Decel-eration to Stop	Alarm Signal (SALM)	Battery Alarm Signal (BALM)	Current Control Signal (CLD)	MRDY signal (MRDY)
25	Register error (Error has been detected with register.)	Register Alarm		◎	○			
26	System check error (Error has been detected with wiring/communication of MECHATROLINK.	System Alarm	◎		○			●
27	P.P. communication error (Error has been detected with communication between programmer and SG1.	Com. Error						
28								
29								
30	Communication setting error (Error has been detected with setting of Pr190 and Pr191.	Condition Par	◎		○			
31	Serial communication error (Error has been detected with serial communication.	Serial Alarm	◎		○			●
32	S-I/F failure (Malfunction occurred during serial communication.	S-I/F Down	◎		○			●
33								
34								
35	Servo alarm (Error has been detected with feed servo.	SV ALM (××)	◎		○			●
36	Spindle alarm (Error has been detected with spindle servo.	SP ALM (××)	◎		○			●

Appendix Table E.2 Alarm and Resetting Method

◎: Corresponding

Alarm No.	Alarm Name and its Contents	Special Programmer Display Message	Resetting Method					
			Automatic Reset by Alarm Cause Recovery	Reset by Error Reset Input	Reset by SERVOPACK Error Reset	Reset by Mode Change Signal Input	Reset by Program Clear Signal Input	Reset by External Positioning Completion Signal Input
1	CPU error (Error is detected with system software.)	CPU Error	Turn OFF to ON.					
2	Program error (Error is detected with the program under execution.)	Program Alarm		◎				
3	Parameter error (Error is detected with the parameter.)	Parameter Alarm	◎	Turn OFF to ON.				
4								
5								
6	Current saturation (Current is limited.)	Current Limit	◎					
7	Forward overtravel (P-OT signal has been turned ON.)	Forward O.T.	◎					
8	Reverse overtravel (N-OT signal has been turned ON.)	Reverse O.T.	◎					
9	Home position setup alarm (Error has been detected during home position setup.)	Setup Alarm		◎				
10								
11								
12								
13	Power failure (Power has been turned OFF during motor operation/program execution.)	Power Down		◎				

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Alarm No.	Alarm Name and its Contents	Special Programmer Display Message	Resetting Method					
			Automatic Reset by Alarm Cause Recovery	Reset by Error Reset Input	Reset by SERVOPACK Error Reset	Reset by Mode Change Signal Input	Reset by Program Clear Signal Input	Reset by External Positioning Completion Signal Input
14	Battery alarm (Voltage of backup battery has run out.)	Battery Down		◎	Turn OFF to ON.			
15	+ stored stroke limit exceeded (Designated position has exceeded stored stroke limit.)	Pos + Over	◎	◎		◎		
16	– stored stroke limit exceeded (Designated position has exceeded stored stroke limit.)	Pos – Over	◎	◎		◎		
17								
18								
19	In-position error (In-position is not set over 2 seconds after completion of drawing-in of pulses.)	Inpos Alarm		◎				
20	External positioning error (Error has been detected during execution of positioning using EXT signal.)	Ext Pos Alarm				◎		◎
21	Skip signal error (ESP5/ESP6 signal is ON at execution of G05/G06.)	Skip On		◎				
22	Encoder position error (Encoder memory value is different from that of SG1.)	Abso P.G.	◎	Turn the power OFF to ON after setting Pr78 = 1.				
23	External data setting error (Error has been detected with external data setting sequence.)	DGSW Alarm		◎				
24								
25	Register error (Error has been detected with register.)	Register Alarm	◎	◎				

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Alarm No.	Alarm Name and its Contents	Special Programmer Display Message	Resetting Method					
			Automatic Reset by Alarm Cause Recovery	Reset by Error Reset Input	Reset by SERVO-PACK Error Reset	Reset by Mode Change Signal Input	Reset by Program Clear Signal Input	Reset by External Positioning Completion Signal Input
26	System check error (Error has been detected with wiring/communication of MECHATROLINK.)	System Alarm		◎				
27	P.P. communication error (Error has been detected with communication between programmer and SG1.)	Com. Error	Press CLR Key on the Personal Computer Programmer.					
28								
29								
30	Communication setting error (Error has been detected with setting of Pr190 and Pr191.)	Condition Par	◎	Turn the power OFF to ON.				
31	Serial communication error (Error has been detected with serial communication.)	Serial Alarm	◎	Turn the power OFF to ON.				
32	S-I/F failure (Malfunction has been occurred during serial communication.)	S-I/F Down		◎				
33								
34								
35	Servo alarm (Error has been detected with feed servo.)	SV ALM (××)	Alarm code is displayed in message (××).* As for details, refer to the manual for servo.					
36	Spindle alarm (Error has been detected with spindle servo.)	SP ALM (××)	Alarm code is displayed in message (××).* As for details, refer to the manual for spindle.					

* As for Servo/Spindle alarm, refer to Appendix E.2 “SERVO/SPINDLE ALARM LIST.”

APPENDIX E.2 SERVO/SPINDLE ALARM LIST

Appendix Table E.3 Servo/spindle Alarm List

Alarm No.	Alarm Name
94	User constant setting alarm
95	MECHATROLINK command alarm
96	MECHATROLINK communication error alarm
00	Absolute value data error
02	User constant breakage
10	Over current
11	Grounding error
30	Regeneration error detection
40	Over voltage
41	Low voltage
51	Over speed
71	Overload (instantaneous)
72	Overload (continuous)
7A	Heat sink overheat
80	Absolute encoder error
81	Absolute encoder backup error
82	Absolute encoder sum check error
83	Absolute encoder battery error
84	Absolute encoder data error
85	Absolute encoder overspeed
B1	Gate array 1 error
B2	Gate array 2 error
B3	Current feedback U phase error
B4	Current feedback V phase error
B5	Watchdog detector error
B6	Main power supply circuit error
C1	Servo runaway

Alarm No.	Alarm Name
C2	Encoder phase detection mistake
C3	Encoder A phase/B phase disconnection
C4	Encoder C phase disconnection
C5	Incremental encoder initial pulse error
D0	Position deviation overflow
E5	MECHATROLINK synchronization error
E6	MECHATROLINK communication error
F1	Power line open phase
F3	Instantaneous power failure

APPENDIX E.3 ALARM MAINTENANCE LIST

Appendix Table E.4 Alarm Maintenance List

No.	Alarm Message	Contents	Corrective Actions
1	CPU Error	An error is detected with the system software.	Replace the Motionpack.
2	Program Alarm	An error is detected with the program under execution.	Verify program.
3	Parameter Alarm	An error is detected with the Motionpack parameters.	Verify parameters before turning power ON/OFF.
4	–––	–––	–––
5	–––	–––	–––
6	Current Limit	Current is limited.	Verify that current limit is not too low. (Program : I data Parameter : Pr4, Pr75)
7	Forward O.T.	Forward overtravel (P-OT signal has turned ON.)	1. Verify machine position. 2. Verify SERVOPACK parameter b2 of 0001. 3. Verify that SERVOPACK parameter b6 of 00002 is 0. 4. Verify that SERVOPACK parameter b2 of 0014 is 1. 5. Check P–OT signal wiring.
8	Reverse O.T.	Reverse overtravel (N-OT signal has turned ON.)	1. Verify machine position. 2. Verify SERVOPACK parameter b3 of 0001. 3. Verify that SERVOPACK parameter b6 of 00002 is 0. 4. Verify that SERVOPACK parameter b3 of 0014 is 1. 5. Check N–OT signal wiring.
9	Setup Alarm	When setting home position, home position starting direction (Pr 70) and Pr 72 signal codes do not match.	Align Pr 70 and Pr 72 signal codes.
10	–––	–––	–––
11	–––	–––	–––
12	–––	–––	–––

No.	Alarm Message	Contents	Corrective Actions
13	Power Down	Power loss occurred while motor is moving or program is executed.	1. Check the power. 2. Check the program operation. (The power is not turned OFF before M30.)
14	Battery Down	Voltage of backup battery has run out.	Replace battery within one month.
15	Pos +Over	+ stored stroke limit exceeded	Verify that machine position or reference position does not exceed Pr61.
16	Pos –Over	– stored stroke limit exceeded	Verify that machine position or reference position does not exceed Pr 60.
17	----	----	----
18	----	----	----
19	Inpos Alarm	Positioning is not effective even after 2 sec has elapsed from completion of positioning command.	1. Verify that current limit is not too low. (Program : I data Parameter: Pr4, Pr75) 2. Verify in-position range (Pr 36).
20	Ext Pos Alarm	An error is detected after execution of external positioning.	1. Check wiring of /EXT signal (SERVOPACK input signal). 2. Verify correct use of external positioning functions (G34,G35, G36/G37).
21	Skip On	Skip signal (ESP5/ESP6) is ON before execution of skip positioning (G05/G06).	Check wiring for ESP5, ESP6 signals (Motionpack input signals).
22	Abso P.G.	Encoder storage values are different from Motionpack values.	1. Check wiring between SERVOPACK and encoder. 2. Verify encoder allowable moving value (Pr77). 3. Verify that coordinate offset (Pr71) has not been changed. 4. If no problem, set Pr78 to 1, and turn power OFF/ON to reset alarm. 5. Re-execute home position setup to improve safety.
23	DGSW Alarm	An error is detected when using external data setting function.	Verify the following points for external data setting function: • Data classification • Data item size • Setting sequence

No.	Alarm Message	Contents	Corrective Actions
24	–––	–––	–––
25	Register Alarm	An error is detected in the register.	Verify the register.
26	System Alarm	An error related to MECHATROLINK communication is detected.	1.Verify the spindle setting (Pr 99). 2.Check MECHATROLINK communication cable wiring. 3.Verify SERVOPACK slave station number (SW1). 4.Replace Motionpack if operation is not restored after turning ON error reset (ERS) signal.
27	Com. Err	An error occurred between the programmer and Motionpack.	Press the programmer CLR key.
28	–––	–––	–––
29	–––	–––	–––
30	Condition Par	An error on the serial communication setting with the upper controller	Verify that incorrect settings for Pr190, Pr191, have not been made.
31	Serial Alarm	An error occurred during the serial communication setting with the upper controller.	Check the wiring between the upper controller and the serial communication cable.
32	S–I/F Down	Serial communication CPU operation with Upper controller stopped.	1. Check Pr190, Pr191 settings. 2. Check the Motionpack communication board setting. * 3. Check the serial communication cable wiring. * 4. Replace Motionpack.
33	–––	–––	–––
34	–––	–––	–––
35	SV ALM(XX)	An error occurred with the feed axis SERVOPACK. “XX”indicates the SERVOPACK alarm code.	Refer to the SERVOPACK user’s manual “Troubleshooting” to remove the error. (See note.)
36	SP ALM (XX)	An error occurred with the spindle SERVOPACK. “XX” indicates the SERVOPACK alarm code.	Refer to the SERVOPACK user’s manual “Troubleshooting” to remove the error. (See note.)

* Verification is not required for Motionpack model JEMP-SG10.

Note: The SERVOPACK user’s manual includes explanations on using the MECHATROLINK communication command. Communication command is controlled by the Motionpack. Therefore, those additional explanations are not required for Motionpack users. Refer to Appendix Table E.5 “Explanation Chart for Motionpack Users” to replace them.

Appendix Table E.5 Explanation Chart for Motionpack Users

Item	SERVOPACK User's Manual	Motionpack User's Explanation
1	SENS_ ON command transmission (Including after SENS_ OFF) CONNECT command transmission SYNC_SET command transmission Command sending Simultaneous command sending	Each command is automatically sent from the Motionpack by turning the power ON/OFF .
2	SV_ON command transmission	Sent from the Motionpack by turning input signal(SVON) ON
3	MECHATROLINK communication setting	Setting made in Motionpack programmer
4	Error diagnosis using MECHATROLINK sending data	Fault diagnosis using Motionpack programmer alarm display
5	Renewing WDT data	WDT data is successively renewed for both Motionpack and SERVOPACK.

MOTIONPACK-SG1
USER'S MANUAL

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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice
for ongoing product modifications and improvements.

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