YASKAWA
A World of Automation Solutions™

- Flexible
- Digital, Network-Ready
- Compact, Simple
- High Performance
- Reliable
- Powerful

Motion Application Modules
Sigma II Servo Systems
Product Catalog Supplement

SGDH Servo Amplifier/Application Modules

Application Modules snap on to any Sigma II amplifier

The Sigma II Servo System is designed to be the power platform that is flexible enough to meet your present and future control system requirements.

Servo System Power, Performance, and Flexibility

Application Modules conveniently add servo positioning and communication functions to Sigma II's proven high-performance servo capabilities. Providing such advantages as improved performance, and simplified connections between the drive and master control, the add-on Sigma II Application Modules lower your costs by:

- Eliminating separate wiring between the servo amplifier and position controller
- Simplifying system wiring with the optional field bus network.
- Reducing time for machine commissioning.
- Minimizing panel space requirements.
- Using common motors, amplifiers, and accessories for a variety of servo-positioning applications.
- Reducing inventory requirements.

Sigma II Servo Systems are available in 30 sizes with peak torque from 13.5oz•in to 6,120in•lb. Whether you require $110V_{ac}$ single-phase, $230V_{ac}$ or $480V_{ac}$ three-phase motors, or linear motor systems up to 6000 N peak force, incremental or absolute encoder feedback, holding brake options, or units that fit into a tight mounting space, there is a Sigma II servo system to fit your automation needs.

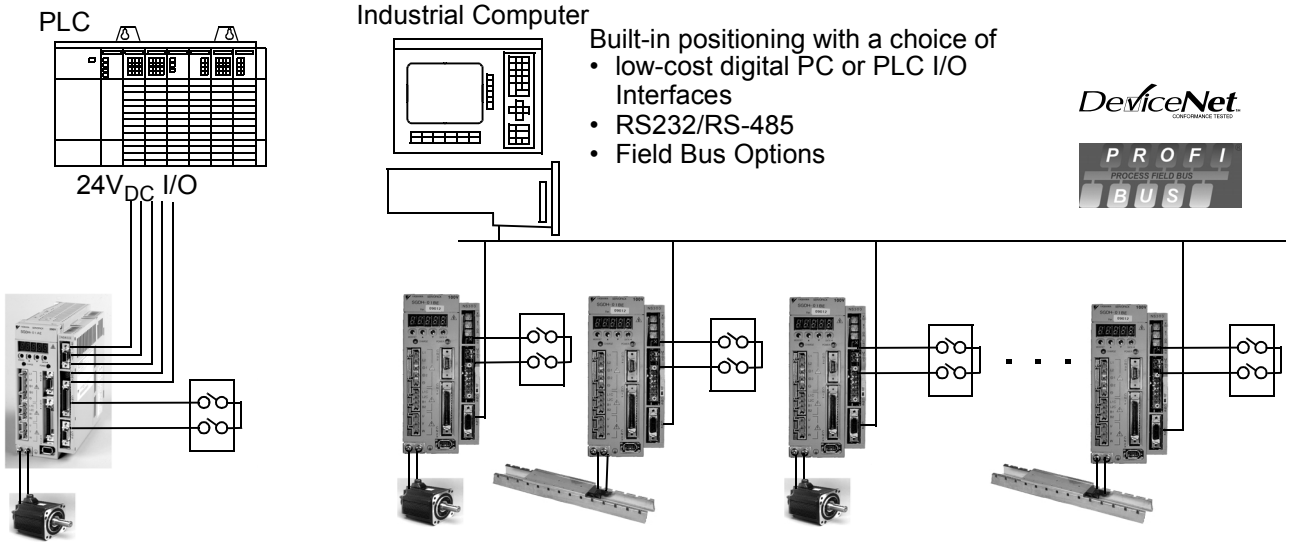
Digital Driving Forces

Easier control system design, set-up and recommissioning

Each application module shares a common digital interface with any size amplifier. All servo loops, trajectory planning, sequential and I/O control are included in a self-contained servo/ motion controller package.

This reduces system bottlenecks, simplifies control and programming and boosts overall system performance. During system power-up, Yaskawa's servo amps auto-configure for motor size and type (specific Yaskawa rotary or linear motor series).

They also auto-configure functionality of the application module attached to the amp. All-Digital AC servos have proven to be the most effective way to ensure trouble-free, reliable performance and operation for factory automation applications.



Programming Position Made Easy

Yaskawa provides a choice of modules - configurable or fully programmable. Many applications will benefit from built-in programming software configurable via parameters and point and click set-up software. There are no motion programming languages required to complete the commissioning of the servo axis positioning.

Application Modules, Additional Information . . . . . Page

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NOTES

SIGMA II Indexer - Configurable Single-Axis Servo Positioning

Sigma II with Indexer Application Module

Used for a wide variety of functions, including:

- **Point-to-Point Positioning**
- **Precise Velocity Control**
- **Conditional Profile Execution in response to a registration input**

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**Sigma II Servo System Product Catalog Supplement* G-MI#99001D-Sigma II

Design Features

1. Easy to Use
- Single-axis positioning or network multi-axis indexing applications
- Versatile: network or stored program function
- Fifteen inputs/thirteen $24V_{DC}$ outputs, including five settable outputs and a high speed input for registration capability

2. Simple to Set Up and Configure
- IndexWorks™ Software simple Windows®-based setup software
  - Fill-in-the-blank style settings
  - No programming language requirements
- Memory table contains up to 128 moves that may be linked for sequential execution
- Easy interfacing with PLCs, operator interfaces, and industrial computers
  - Accepts economical digital I/O signals to activate preconfigured index moves
  - Alternative ASCII RS232/422/485 serial commands (configure, monitor, and control up to 16 indexers per serial link)

3. Compact

Hardware: any Yaskawa Sigma II amplifier with a field installable add-on option card

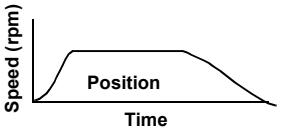
4. Affordable

5. Application Emphasis
- Feed-to-length applications including:
  - Roll feeding
  - Bag making
  - Press feed
- High speed, accurate indexing
- Packaging and labeling
- Linear motors, linear slides, indexing conveyors and rotary tables
- Replacement for mechanical index tables, clutch brake systems
- Cut-to-length
- Pick and place systems

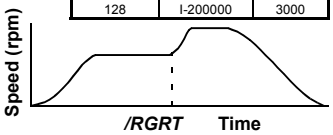
6. UL, cUL, and CE compliance

Sigma II Indexer Functional Features and Capabilities

Preset Index Moves: Program Steps (PGMSTEP)



PGMSTEP	POS	SPD
0	I+200000	3000
1	I-100000	2500
2	A+200000	1500
n	—	1500
128	I-200000	3000



PGMSTEP	POS	SPD	RDST	RSPD
0	I+200000	1500	20000	2000
1	I-100000	3000	60000	1000
2	A+200000	1500	15000	1000
n	—	1500	—	1000
128	I-200000	3000	—	1000

One hundred twenty eight directly addressable PGMSTEPS

- PGMSTEPS are stored in non-volatile memory
- Specify either: I = incremental or A = absolute moves:
  Positioning range: ±99,999,999 reference units
  Absolute: Reference units from the home position
- Compatible with absolute encoders
- Separately settable acceleration and deceleration

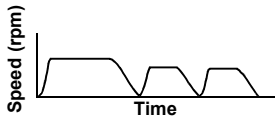
Index moves with Registration

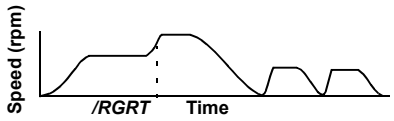
- Supported with high speed input (/RGRT)
- Distance (RDST)
- Speed (RSPD)

Choice of Three Styles of Homing Routines

Optional: Up to 16 Preset Bi-Directional Speed Settings

Looping and Linking





LOOP command

Up to 99,999 times (to facilitate selectable batch counting)

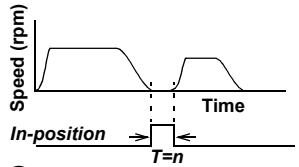
PGMSTEP	POS	SPD	LOOP
0	I+200000	3000	1
1	I+100000	2500	2
2	A+200000	1500	1
n	—	—	—
128	I-200000	3000	1

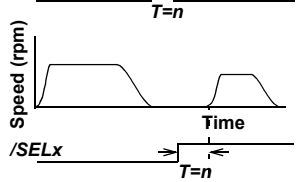
Linking program steps

NEXT = Go to and start PGMSTEP

PGMSTEP	POS	SPD	RDST	RSPD	LOOP	NEXT
0	I+200000	3000	20000	4000	1	1
1	I+200000	2500	60000	1000	2	End
2	A+200000	1500	15000	1000	1	3
n	—	—	—	—	—	—
128	I-200000	3000	—	1000	1	5

Linking Index Moves with a Combination of Events





In-Position + Time Delay

Time Delay Range: n = 0 to 99,999ms

Input /SELX + Time Delay

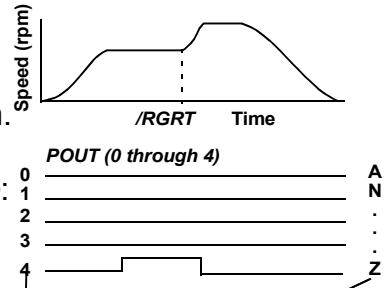
/SELX = choice of seven selectable hardware inputs (/SEL0, /SEL1, etc.)

PGMSTEP	POS	SPD	RDST	RSPD	EVENT	LOOP	NEXT
0	I+200000	1500	20000	1000	SEL1T0	1	1
1	I+200000	3000	60000	1000	SEL3T100	1	End
2	A+200000	1500	15000	1000	IT0	1	3
n	—	—	—	—	—	—	—
128	I-200000	3000	—	1000	NT0	1	5

Setting Outputs

Two ways to set five adjustable outputs

- Set conditions of outputs at the **start** of a PGMSTEP action.
- Set conditions of outputs at the **end** of a PGMSTEP action.
  Example: reserve the next PGMSTEP for P OUT only. *See*: PGMSTEP Number 127 in the table).



Setting Terminology	
Setting	Description
A	Active
N	Non-Active
:	No change from previous state
Z	Zone (PLS-style function)

PGMSTEP	POS	SPD	RDST	RDSP	/POUT	EVENT	LOOP	NEXT
0	I+200000	1500	200000	2000	Z::NA	SEL1, T0	1	1
1	I-200000	3000	60000	1000	NA::Z	SEL1, T100	2	End
2	A+200000	1500	15000	1000	::NZZ	—	1	3
n	—	—	—	—	—	—	—	—
127	—	1000	—	1000	NZZZZ	IT0	1	End
128	I-200000	3000	—	1000	ZZZZZ	DT1000	1	5

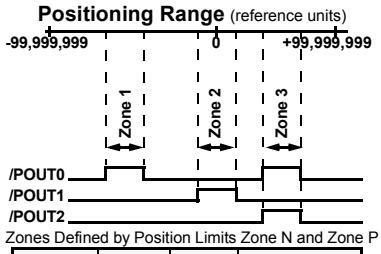
Output Zones

Zone Signal Outputs up to 32 definable zones

Zone Table Example

- IF there is a PGMSTEP that:
  —Indexes in Zone 2 (defined in the table as -10,000,000 to +10,000,000)
- AND
  —Defines /POUT number 1 as Z-output type
- THEN
- —/POUT1 is active within the range
  -10,000,000 to +10,000,000 (as specified in the table)

Zone 2 = 00010_2 (binary) defining active outputs /POUT0 - /POUT4



Zones Defined by Position Limits Zone N and Zone P

Zone Number	Zone N	Zone P	/POUT				
			4	3	2	1	0
0	0	0	—	—	—	—	—
1	-50000000	-30000000	—	—	—	—	X
2	-10000000	+10000000	—	—	—	X	—
3	+20000000	+40000000	—	—	—	X	X
4	0	0	—	—	X	—	—
n	—	—	—	—	—	—	—
31	0	0	X	X	X	X	X

Built-in Routines for Single-Axis Applications

Definable software limits

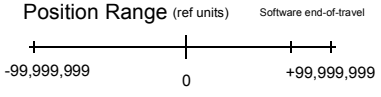
Hardware limit switch stopping routines

- Coasting
- Decelerating
- Applying dynamic brake

Power loss or alarm stopping routines

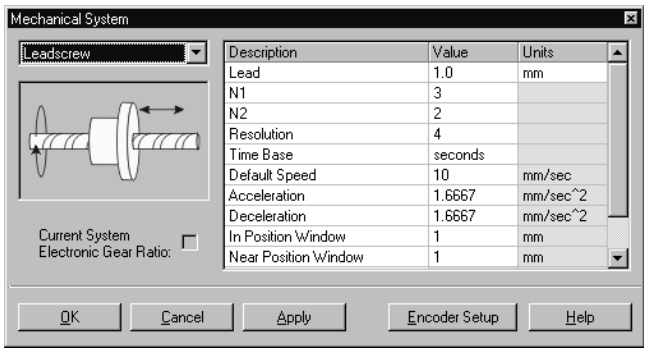
- Coasting
- Dynamic braking

Adjustable Holding Brake actuation for vertical loads



Index Works™ Utility Software Features

Time Saving Indexer Configuration Utility



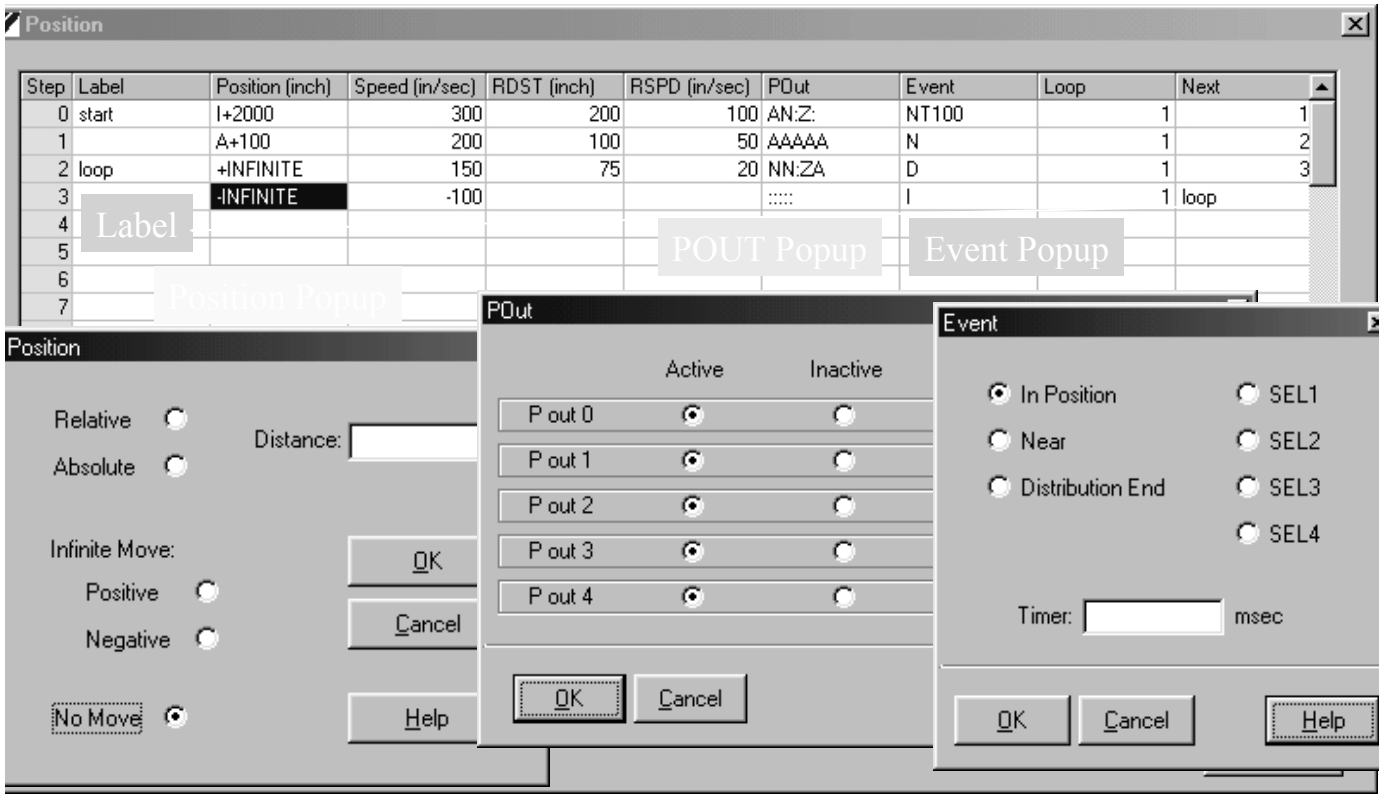
Fill-in-the-blank settings

- Machine setups, reference units
- The smallest definable increment of movement is based on the encoder count

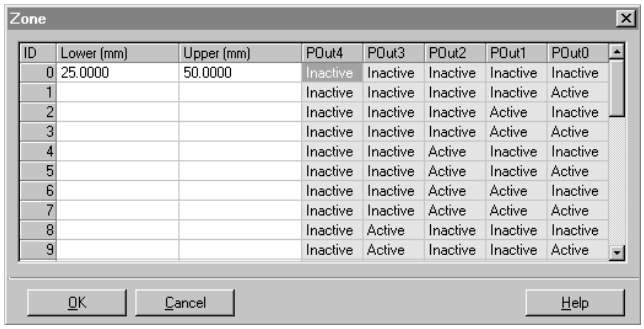
No programming language requirements

Includes on-line monitoring and off-line setup capabilities

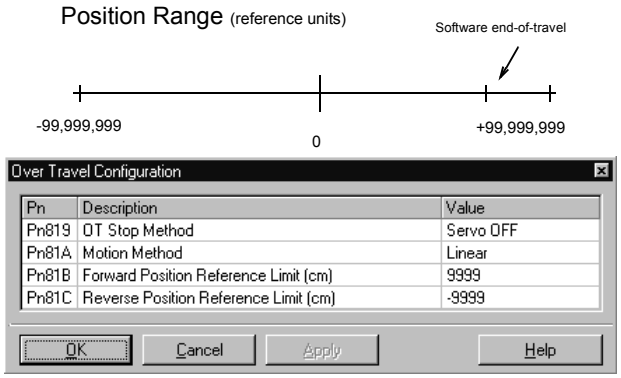
Position Programming



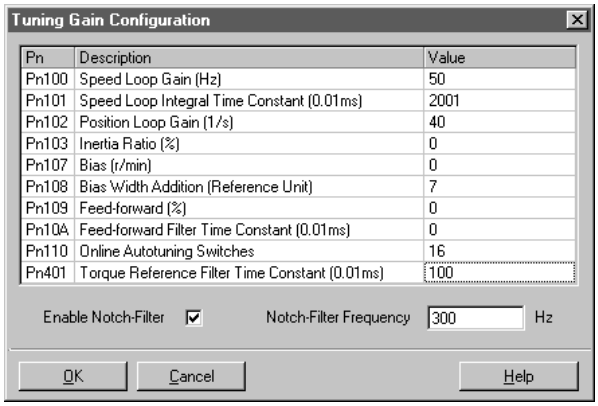
Zone Tables



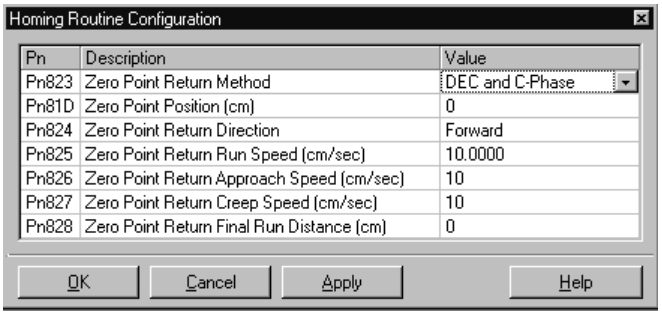
Overtravel Configuration



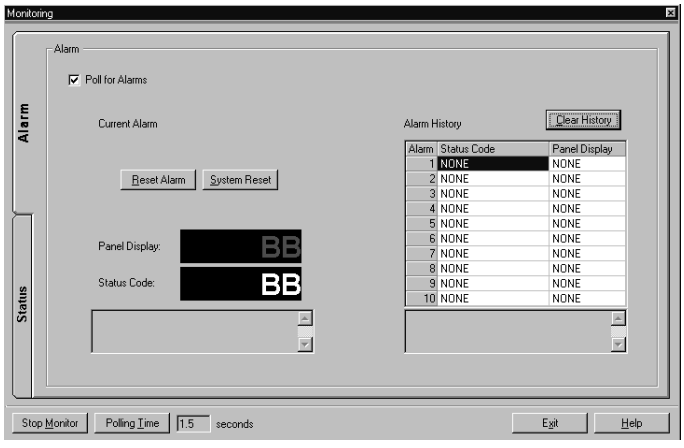
Settings and Parameter Editor

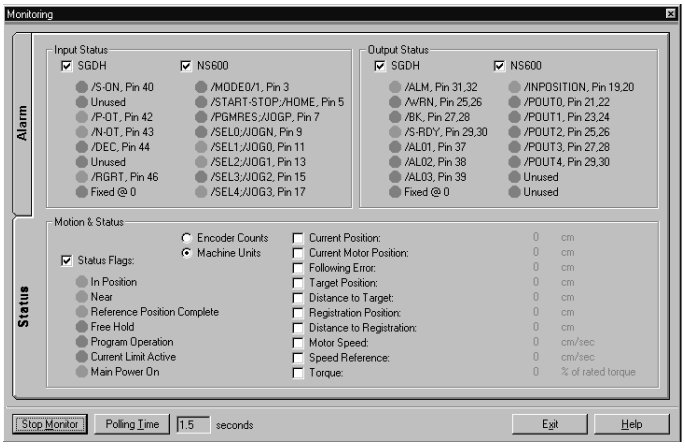


Homing Routines



Motion Diagnosis

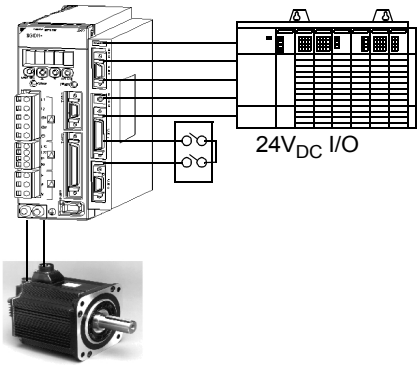




Control System Architecture

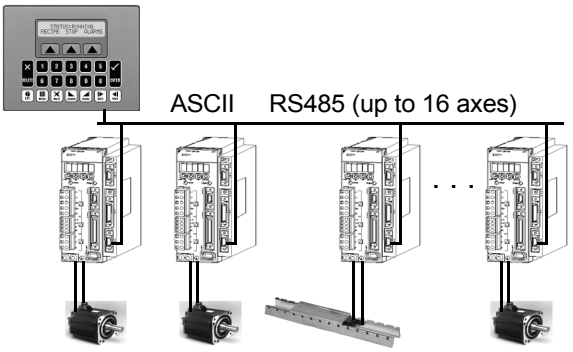
The Sigma II Indexer is a compact, cost-effective solution for the needs of both the machine OEM and the end user. All servo loops and positioning functions are included in a self-contained servo amplifier/indexer package. This eliminates the requirement for both a higher cost host controller axis module and the traditional analog elements of a servo amplifier command reference. Machine controller to servo axis interfacing simplifies to either lower cost digital I/O modules or serial communications wiring.

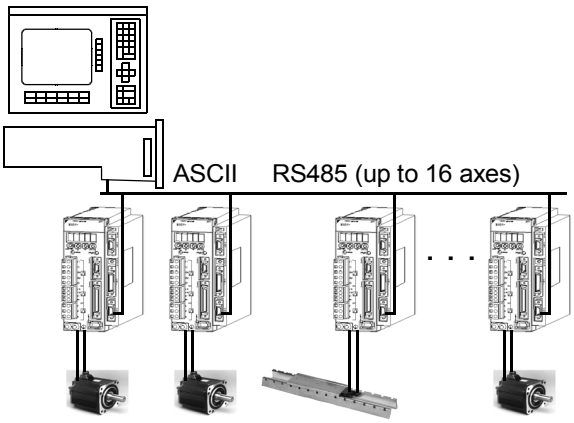
Peripheral to a PLC



An Indexer's I/O is used by a machine controller for addressing and initiating one or more set(s) of pre-programmed positioning moves or velocity commands. For sequencing the servo axis from a machine controller, use such I/O signals as: start-stop, feed hold, homing, in-position signals, conditional input events, programmable indexer outputs, etc.

Peripheral to an HMI or Personal Computer





All indexer setup parameters, system alarms and monitors, and program configurations are read/write accessible through the serial network. The indexer can easily be set for various network transmission speeds (i.e., 9.6kbaud, 19.2kbaud, or 38.4kbaud).

Examples:

- Initiate point-to-point positioning with a global start command
- Individually communicate positions, speeds, and start commands to each indexer
- Easily change batch counts and machine setups

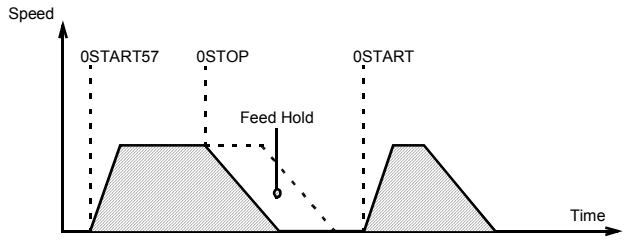
Serial Commands and Examples

Motion Commands n= axis address (0 to F)	Description	Setting Range	Reference Units (RU)
nSPDx	Speed Setting	x = 1 to 99999999	×1000 RU/min
nACCx	Acceleration	x = 1 to 99999999	×1000 RU/min/ms
nDECx	Deceleration	x = 1 to 99999999	×1000 RU/min/ms
nPOS+-x	Absolute Position Setting	-99999999 ≤ x ≤ +99999999	RU
nPOSI+-x	Relative Position Setting	-99999999 ≤ x ≤ +99999999	RU
nST	Positioning Start	—	—
nJOGPx	JOG Forward	x = 1 to 99999999	×1000 RU/min
nJOGNx	JOG Reverse	x = 1 to 99999999	×1000 RU/min
nZRN	Zero Point Return (Homing)	3 homing routines	—
nRDSTx	Registration Distance Setting	x = 0 to 99999999	RU
nRSPDx	Registration Speed Setting	x = 1 to 99999999	×1000 RU/min
nPOUTxxxxx	Programmable Output Settings	x = active, non-active, previous, or zone	—
and others			

Command Type	Summary	Command Function Description
Parameter Operation	4 commands	Parameter read, write, temporary write, and initialization.
Program Table Setup	29 commands	Program table, jog speed table, and zone table read, write, save, and initialization.
Program Table Operation	4 commands	Program start, program stop, and program reset.
Monitor and Function	46 commands	Alarms, errors, inputs, outputs, position, speed, torque, regenerative load, program status, product type, rigidity, absolute encoder setup, and more.

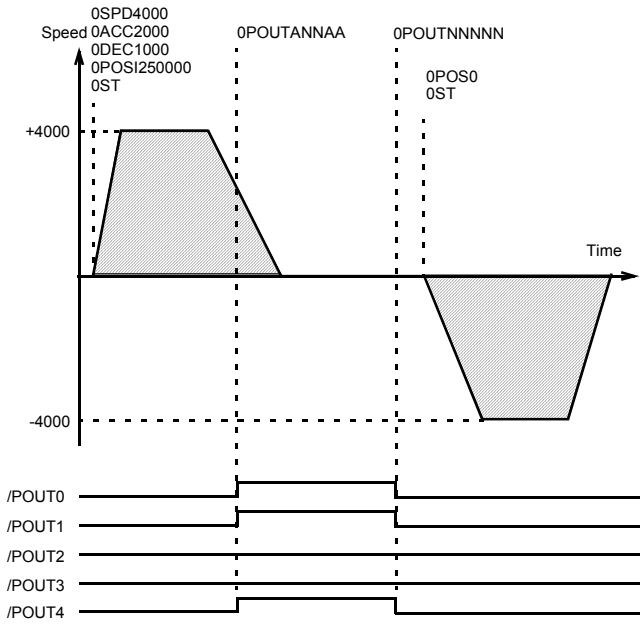
Example 1: Commanding Preset Index Moves Serially

Command	Description
0START57	Starts program step 57 of the preset program table.
0STOP	Stops and holds program step 57.
0START	Resumes positioning.



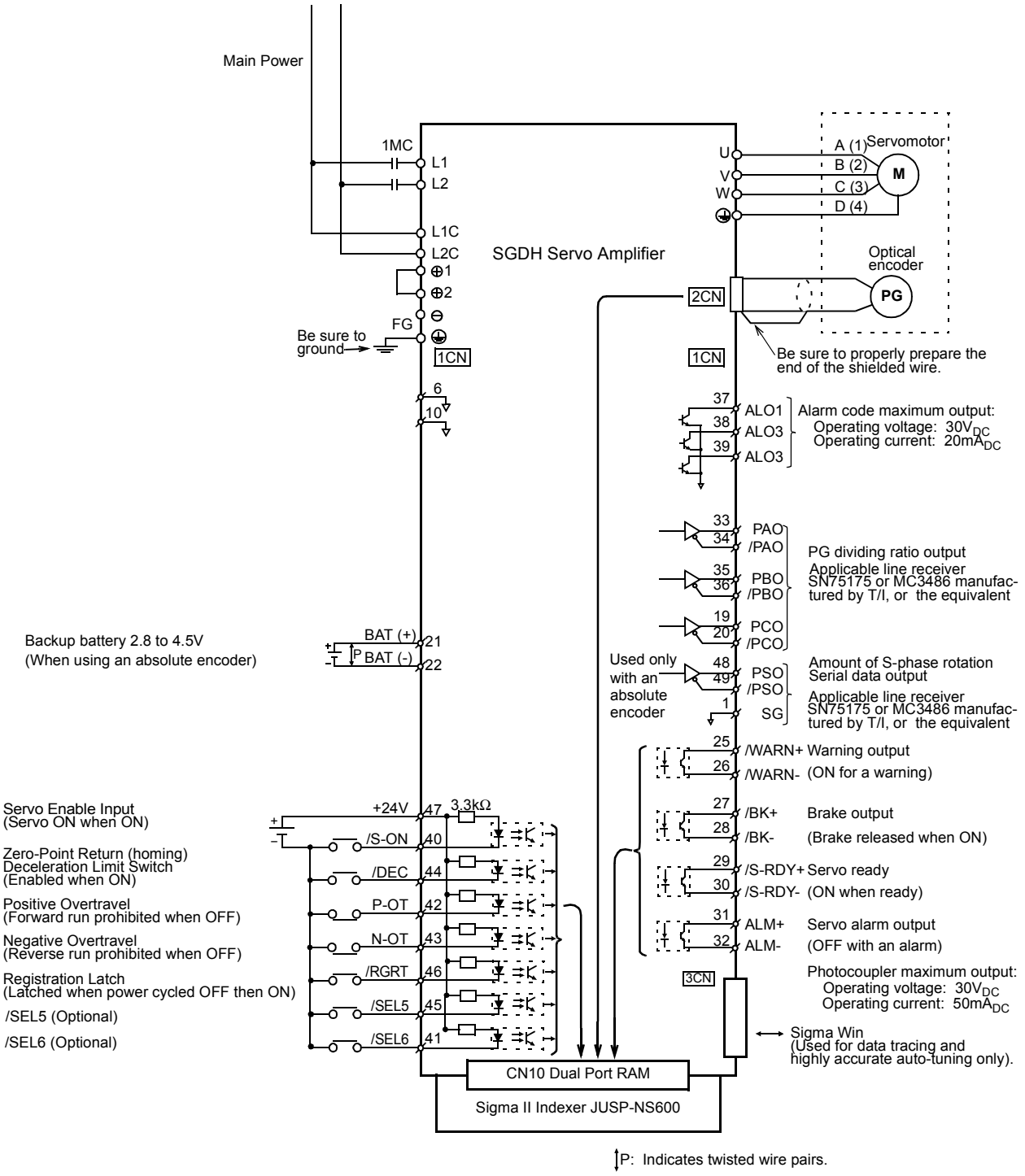
Example 2: Commanding Positions and Output Settings Serially

Command	Description
0SPD4000	Sets speed.
0ACC2000	Sets acceleration.
0DEC1000	Sets deceleration.
0POSI250000	Sets relative position.
0ST	Starts positioning.
0POUTANNAA	Sets programmable outputs.
0POUTNNNNN	Sets programmable outputs.
0POS0	Sets absolute position.
0ST	Starts positioning.

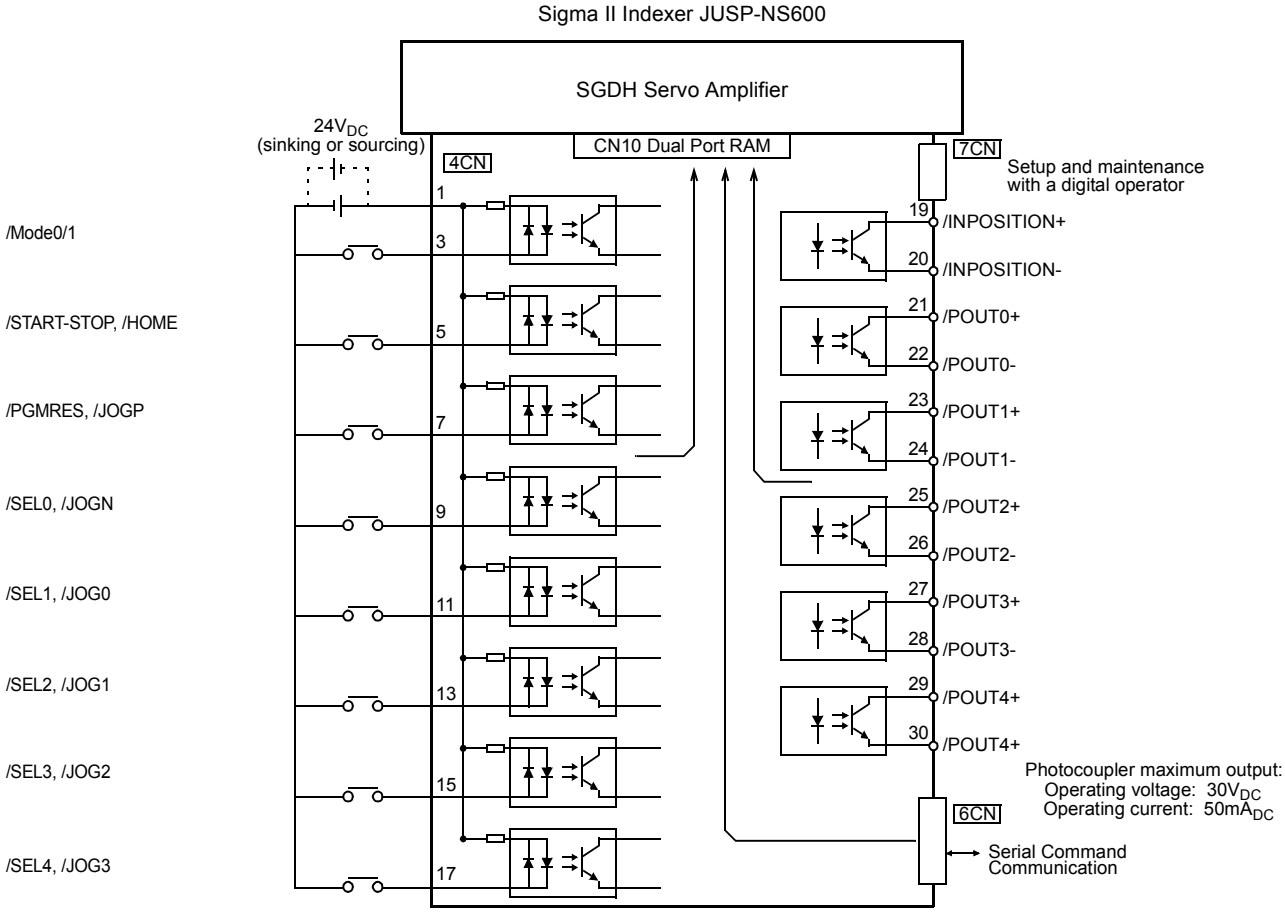


I/O Connections

Example of I/O Signal Connector (CN1, CN4)



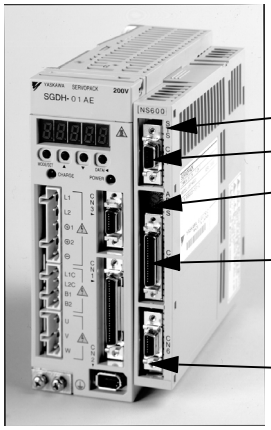
Sigma II Indexer Application Module I/O



Sigma II Indexer JUSP-NS600	
Mode	Activates Input Functions
0	/START-STOP, /PGMRES, /SEL0, /SEL1, /SEL2, /SEL3, /SEL4, /SEL5*, and SEL6*
1	/HOME, /JOGP, /JOGN, /JOG0, /JOG1, /JOG2, and /JOG3

***** Located on 1CN of SGDH amp. The amp automatically configures for NS600 functionality on power-up sequence.

Indexer Ratings and Specifications



Add-on Indexer Hardware

Indexer Green/Red status LED

CN7: Setting up, commissioning, and monitoring port

Rotary address switch (default 0)

Up to 16 addresses

CN4: Indexer digital I/O connector

- Fifteen optically isolated inputs
- Thirteen outputs (including five programmable)

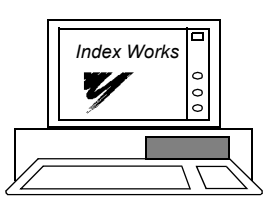
CN6: Network and setup port (RS232, 422, 485)

Specifications	
Serial Command Mode	With registration and separate acceleration and deceleration setting.
Serial Port Operating Modes	RS232/422/485 multiple indexer addressing up to 16 units Baud Rate setting range: 9600 to 38,400
Stored Motion Program	Linked index table with 128 configurable Indices
— Acceleration ≠ Deceleration	Acceleration and deceleration are defined in separate parameters
—Batch count	99,999
—Dwell	Yes with event processing, I/O signals, in position, etc.
—Registration	Standard
—Index Link	Standard
Inputs and Outputs (Combined with the Amplifier's I/O)	
Digital Inputs	15 optically isolated $24V_{DC}$ inputs: Servo-ON, registration latch, mode select, start, home switch, program reset, forward overtravel, reverse overtravel, and 7 preset select inputs.
Digital Outputs	13 optically isolated $24V_{DC}$ outputs: alarm out, servo-ready, servo warning, holding brake, in-position, 3 alarm codes, and 5 settable outputs. Also included: a scalable encoder position output.
Servo System Specifications	
Motor feedback resolution / standard	13-bit incremental encoder (8,192PPR) for motors below 1hp
	17-bit incremental encoder (16,384PPR) for motors above 1hp
Motor feedback resolution / optional	16-bit absolute encoder for motors below 1hp
	17-bit incremental/absolute for motors above 1hp
Linear motor feedback resolution / standard	0.078 micron (using 20 micron linear scale pitch)
Amplifier sizes	115 V_{ac} single-phase, 30 to 200W
	230 V_{ac} single-phase, 30W to 1.5kW
	230 V_{ac} three-phase, 500W to 15kW
	480 V_{ac} three-phase, 500W to 55kW
Environmental	
Ambient/Storage Temperature	0° to 55°C / -20° to 85°C
Global Safety Certifications	UL, CUL, CE, TUV

Selecting Your Sigma II Indexer System

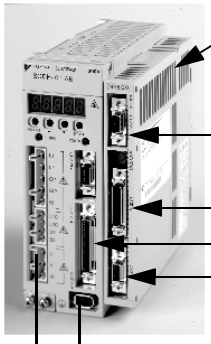
Specify part number JUSP-NS600, the indexer add-on application module.
Use the tables beginning on the following page to specify choice of indexer interface cables, mating connectors only, set-up and monitoring tools, and software.

System Configuration



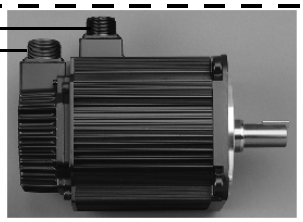
(B) SGDH Amplifier

Sigma II Application Module



- •Programming cable or connector
- •4CN I/O cable or connector
- •1CN I/O cable or connector
- •Serial network cable or connector

(A) Sigma II servomotor or linear motor



Power Components

(E) Additional regeneration resistor capacity (if necessary), optional DC reactor, etc.

(C) Pre-wired power and feedback cables or

(D) Connector kits for local cable assembly

Specify a technical manual, if it is needed, on your servo system purchase order:
Users Manual, Sigma II Indexer: YEA-SIA-S800-32.11
Users Manual, Linear Motor: YEA-S800-39.11
(Manuals provided at no charge with a purchase order, but must be requested).

Power Components

(motor, amplifier, and connections for power and feedback)

Select the required power components (servomotor, power and feedback connectors or pre-wired cables, amplifier, regenerative packs, etc.) from the following catalog pages.

Use this table to determine which catalog section describes the best servomotor for the application.

Application Requirements (Maximum)			Number of Motor Sizes	System Voltage and Sigma II Servomotor Series				Selection Guide for Power Components Page Number *
Speed (rpm)	Rated Torque oz • in [lb • in]	Peak Torque oz • in [lb • in]		$100V_{ac}$ Single-phase	$200V_{ac}$ Single-phase	$200V_{ac}$ Three-phase	$480V_{ac}$ Three-phase	
5000	338	1010	6	SGMAH	SGMAH	—	—	11
5000	676	2027	5	SGMPH	SGMPH	—	—	29
3000	[845]	[1988]	10	—	—	SGMGH	—	57
5000	[140]	[422]	6	—	—	SGMSH	—	85
3000	[845]	[1988]	10	—	—	—	SGMGH	127
5000	[140]	[422]	6	—	—	—	SGMSH	139
6000	[43]	[190]	2	—	—	—	SGMUH	139
2000	[1240]	[6120]	5	—	—	—	SGMBH	165

* Yaskawa publication: *Sigma II Servo System Product Catalog Supplement* G-MI#99001D-SigmaII.
Linear Motor Catalog KAE-S800-39.10

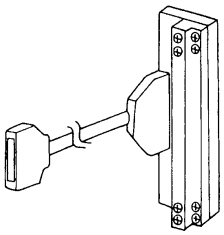
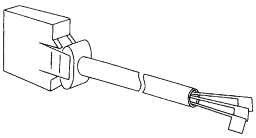
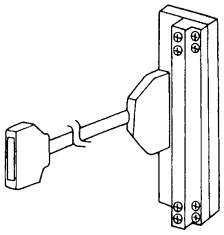
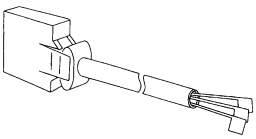
Sigma II Indexer Selection

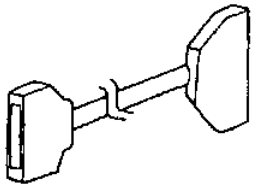
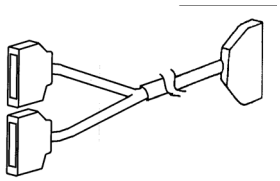
Use the servomotor and amplifier selection of this catalog for specification and selection of Sigma II servomotor and servo amplifier.

Component Description	Part Number	Comments	Item Class
Sigma II Add-on Indexer Application Module	JUSP-NS600	Mounting hardware requirements: one ground strap mounting screw. (See supplementary information on the next page.)	Stock

Use the Sigma II Application Module Mounting Dimensions on pages 75 to 82 for determining overall indexer panel space requirements. For 480VAC large capacity amplifiers (22 - 55kW), refer to the Sigma II catalog for amp dimensions.

Indexer I/O Interface Cable Selection

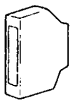
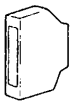
Component Description **(E)**		Part Number	Comments	Item Class
Input/Output 1CN Cable & Transition Terminal Block		JUSP-TA50P	35mm DIN rail mountable; the cable length is 0.5m.	Stock
Input/Output 1CN Cable with Pigtail Leads		JZSP-CKI01-□(A)*	Use the following key to specify required cable length (last digit of the part number): 1: 1m (standard) 2: 2m 3: 3m	
Input/Output 4CN Cable & Transition Terminal Block		JUSP-TA36P	35mm DIN rail mountable; the cable length is 0.5m.	
Input/Output 4CN Cable with Pigtail Leads		CKI-NS600-□□	Use the following key to specify required cable length (last two digits of the part number): 01: 1m (standard) 02: 2m 03: 3m	

Input/Output 1CN Cable Cable with Female D-Sub output Connector		JZSP-CKI0D-□□**	Use the following key to specify required cable length (last two digits of the part number): D50: 0.5m 01: 1m (standard) 02: 2m 03: 3m	
Input/Output 1CN+4CN Cable with Female D-Sub output Connector* Applicable only for SGDH-1E (15 kW) and below.		CKI-NS600D-□□** (for use with NS600 Indexer)	Use the following key to specify required cable length (last two digits of the part number): D50: 0.5m 01: 1m (standard) 02: 2m 03: 3m	

***** The "(A)" at the end of the cable part number indicates the revision level. Revision level may be subject to change prior to this catalog reprinting.

****** 50 Pin Female D-Sub output connector mates to customer supplied third party terminal block. (e.g., Wago #289-449, Weidmuller #919658, Phoenix #2283647, Amphenol/Sine #20-51039, and many others.

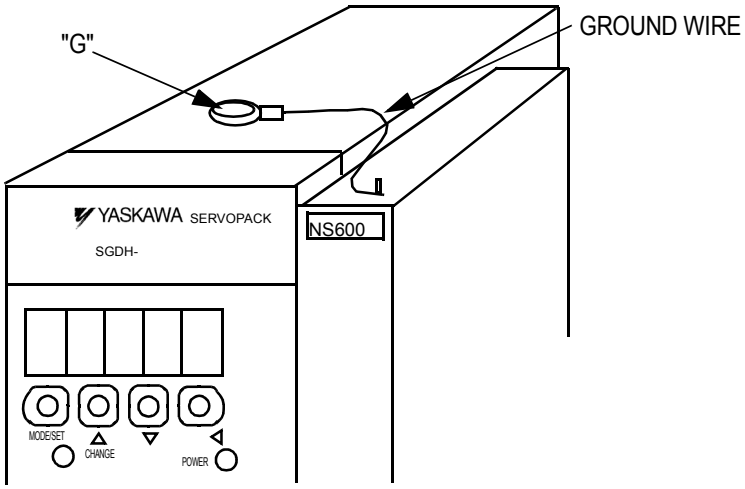
Mating Connector Selection

Component Description **(E)**		Part Number	Comments	Item Class
1CN Mating Connector		JZSP-CKI9	for SGDH I/O 50-pin	Stock
4CN Mating Connector		DP-9420007	Solder type with cover	
3CN, 6CN, and 7CN Peripheral Mating Connector	—	YSC-1	—	
5CN Analog Monitor Connector	—	DE9404559	—	

Supplementary Information

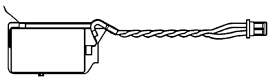
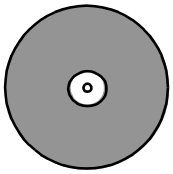
For grounding, connect the ground wire of the Sigma II Indexer application module to the point marked "G" on the SGDH servo amplifier. Refer to the following table for the proper screw size.

Servo Amplifier	"G" Screw	Comments
SGDH-A3-02BE SGDH-A3-10AE	M3 x 10 (round head phillips with split lock washer and flat washer	One supplied with NS600
SGDH-15-50AE SGDH-15-50DE	M4 x 10 (round head phillips with split lock washer and flat washer	One supplied with NS600
SGDH-60-1EAE SGDH-60-1EDE	M4 x 8 (round head phillips with split lock washer and flat washer	One supplied with NS600 Use front panel side screw hole.



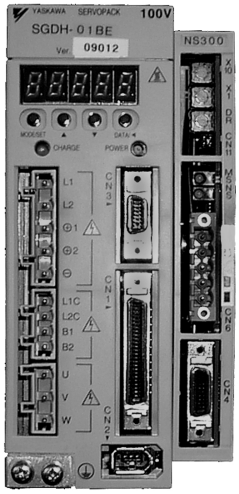
Example: For SGDH (30W to 5.0kW)

Peripheral Device Selection

Component Description **(E)**		Part Number	Comments	Item Class
Hand-held Digital Operator Panel		JUSP-OP02A-1 and JZSP-CMS00-1	Portable unit with 1m adapter cable for Sigma II Indexer	Stock
Absolute Encoder Battery		JZSP-BA01	3.6V, 1000mAh (lithium battery)	
Software Interface Cable for 3CN, 6CN, or 7CN	—	YS-12	Pre-wired 2.0m cable with 9-pin connector (RS232)	
IndexWorks™ Software		NS600-GUI	Monitoring and set-up software for Windows 95, Windows 98, and Windows NT on a CD-ROM.	

NOTES

SIGMA II - DeviceNet™ Connectivity for Single-Axis Positioning



DeviceNet™ CONFORMANCE TESTED

Used for a wide variety of applications, including:

- **Point-to-Point Positioning**
- **Precise Velocity Control**
- **Conditional Profile Execution in response to an external input**

For Additional Information	Page(s)
DeviceNet™ Communication	22 - 23
Functional Features and Capabilities	24 - 27
Setup Software	28 - 29
I/O Connections	30 - 31
Indexer Ratings and Specifications	32
Indexer Selection/Ordering Information	33 - 37
Indexer Application Module Dimensions	75 - 82
Servomotor and Amplifier Ratings & Selections	*

**Sigma II Servo System Product Catalog Supplement* G-MI#99001D-Sigma II

For more information about DeviceNet, visit www.odva.org

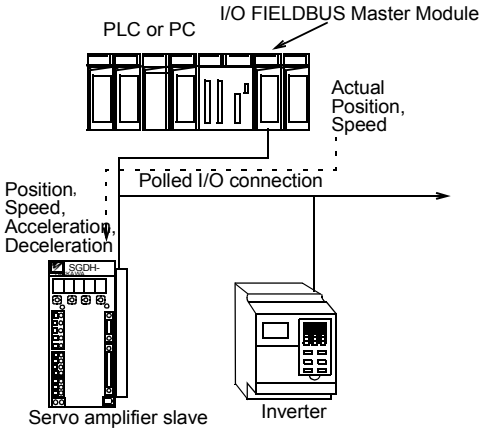
Design Features

1. **Simplified Control System**
   - ODVA Conformance Tested, Device type: Generic
   - Supports DeviceNet™ polled I/O and explicit message mode
   - Baud Rates: 125k, 250k, or 500k (Rotary switch settable)
2. **Easy to Set Up and Use**
   - Just snap the JUSP-NS300 application module onto any Sigma II SGDH servo amplifier
   - No programming required: Configure with ODVA conformance tested EDS file
3. **Various Motion Control Functions**
   - Point table positioning
     - Edit up to 50 positions and corresponding speeds to the NS300's set of parameters via either DeviceNet™ or Yaskawa's NSXXX pc setup utility
   - External input positioning
   - Station number input (indexing a rotary table)
   - Positioning moves with up to 16 stages of speed changes
   - Homing: choice of four styles
4. **Applications**
   - Semiconductor fabrication, test, and assembly equipment
   - Food processing and packaging
   - Pharmaceutical packaging and test equipment
   - Automotive assembly and test equipment
   - Material handling, pick and place, linear motors
   - Machine tool (tool changers, sheet feeders, etc.)
5. **Certified International Standards**
   - UL, cUL recognized (File #: E165827), CE compliance

Sigma II DeviceNet Communication

The Sigma II Indexer is a compact, cost-effective solution for the needs of both the machine OEM and the end user. All servo loops and positioning functions are included in a self-contained servo amplifier/indexer package. Machine controller to servo axis interfacing simplifies to DeviceNet™ communications and wiring.

Control System Architecture

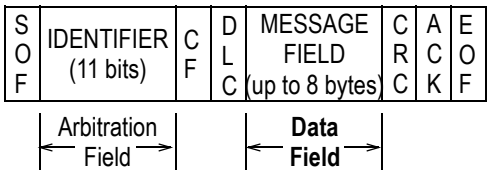


DeviceNet Protocol

- By general industry agreement, the ODVA DeviceNet specification established a **Predefined Master/Slave Connection Set.**
- Polled I/O command/response communication messages are suitable for time-critical, control-oriented data.
- The Sigma II messages are eight bytes long, embedded within the data field of the DeviceNet™ **Data Frame**.

DeviceNet™ Data Frame Overview and Protocol

DeviceNet™ Data Frame Overview



Where:
SOF = Start of frame
CF = Control field
DLC = Data length code
CRC = Cyclic redundancy code
ACK = Acknowledgment
EOF = End of field

Using the Eight-Byte Data Field

- Sigma II with DeviceNet™ accepts two types of polled I/O messages in the **Data Field** for positioning applications:
  - Move commands (monitor and control)
  - Set/Read commands (setup and trouble-shooting)
- Also supports explicit messaging and EDS file transfer

Sigma II Move Commands

Command Message Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	ALRST	ESTP	0	0	SVON	C_STRT
1	Response type				Command code			
2	HOME	PTBL	STN	STEP	FEED	0	HOLD	CANCEL
3	0	0	0	0	0	0	DIR	INC
4	Command data							
5								
6								
7								

Refer to the DeviceNet™ Interface Unit User's Manual (SIE-C718-6) for a detailed description of the command bits.

Using move command messages

- Initiate positioning or speed control moves
- Communicate positioning move variables
- Activate point tables of index moves
- Activate homing, alarm reset, emergency stop, feed hold, and servo amplifier functions

Example of Command Execution:

- Set the positioning command code and data
- Change the Command Start(C-Start), byte 0, bit 0, from 0 to 1

Positioning Command Codes	Operation
0000	No operation
0001	Simple positioning
0010	External positioning
0011	Positioning with notch signal outputs
0100	Multi-speed positioning

Sigma II Responses to Move Commands

Response Messages

- Reports the status of the current positioning move , i.e., in position, near position, home, overtravel,, alarm, etc.
- Move data can be collected in the response. See the response type table at the right.
- The data requirements in the response message are specified in the command message, byte 1, bits 4 through 7, (as shown on the Command Message Format table on the previous page).
- Response codes are returned in the response message (byte 1, bits 4 through 7) along with the data.

Response Message Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	READY	PWRON	ESTP_R	ALRM	WARN	SVON_R	C_STRT_R
1	Response type				Command code			
2	HOME_R	PTBL_R	STN_R	STEP_R	FEED_R	0	HOLD_R	PRGS
3	POT	NOT	INPOS	NEAR	HOME_P	0	DIR_R	INC_R
4	Response data							
5								
6								
7								

Response Type	Response Data Reference Units (RU)
0000	Command position (RU)
0001	Current position (RU)
0010	Following error (RU)
0011	Command speed (1000RU/min)
0100	Current speed (1000RU/min)
0101	Torque (%)
1010	Station number
1011	Point table number

Refer to the DeviceNet™ Interface Unit User's Manual (SIE-C718-6) for a detailed description of the status bits.

JUSP-NS300 Indexer

Sigma II Set/Read Commands and Command Codes

Set/Read messages enable user friendly network routines that can reconfigure machine positioning variables, initialize setup routines, enable auto-tuning, source alarm and warning data, etc. These functions are available to any master on the network.

Uses of Set/Read Messages

- Set up and configuration data
- Edit parameters
- Set/edit preprogrammed point tables of index moves
- Report alarm codes
- Used with polled I/O messaging

Defining Set/Read Messages (versus move command messages)

- Set by byte 0, bit 7 = 1
- It is not necessary to specify response type for Set/Read commands

Command Codes

- Set "No Operation" to prevent execution of commands.
- Out-of-range parameters generate a setting error (WARN bit)

Command Message Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	0	ALRST	ESTP	0	0	SVON	C_STRT
1	0				Command code			
2	Command number							
3								
4	Command message							
5								
6								
7								

Command Code	Operation
0000	No operation
1000	Read parameter
1001	Write parameter
1010	Set current position
1011	Set zero point
1100	Read alarm
1110	Reset Unit

Response Message Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	READY	PWRON	ESTP_R	ALRM	WARN	SVON_R	C_STRT_R
1	0				Command code			
2	Command number							
3								
4	response data							
5								
6								
7								

Sigma II DeviceNet™ Functional Features and Capabilities

Sigma II DeviceNet™ acts as a servo position or velocity controller slave to a master controller. For application flexibility, use polled I/O messages from the applications software to dynamically load incremental or absolute point-to-point positioning data. For these applications use:

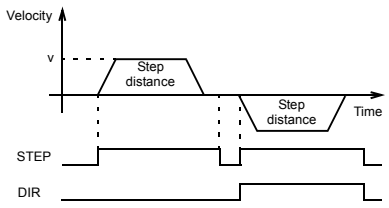
- Simple positioning
- Simple positioning with notch outputs
- External input positioning
- Multistage velocity positioning

For precise velocity control only, use Feed operation. For applications where the parameters of the positioning moves can be preset, use:

- Stepping operation
- Point-table positioning
- Station number positioning (rotary table operation)

Note: Establish or change parameters of a preset move with an EDS file configuration, Yaskawa's Windows NSXXX software utility, or a dynamic Sigma II polled I/O Set/Read Commands. For more permanent settings, recycle the power or issue a unit reset command (to move the parameters into non-volatile memory).

Stepping Operation



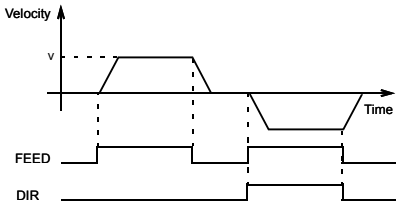
STEP bit: Refer to the Move Command message format, byte 2, bit 4.

DIR bit: Refer to the Move Command message format, byte 3, bit 1.

How it works:

- When the STEP bit turns ON, the axis moves in the specified direction (DIR bit).
- Use command data to select one of four preset parameters that define the step distance. Moves can be incremental or absolute.
- When the STEP bit turns OFF during movement, step movement is cancelled.
- Additional parameters to help define the stepping operation are preset to determine:
  - Approach velocity (v) and acceleration/ deceleration type (eight types are available, including S-curve)
  - Acceleration/deceleration values

Feed Operation



FEED bit: Refer to the Move Command message format, byte 3, bit 3.

How it works:

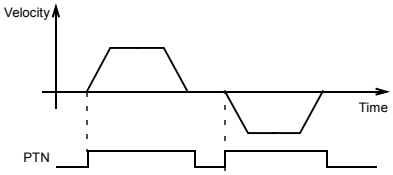
- While the FEED bit is ON, the axis jogs in the direction specified.
- Use command data during movement to set or override the preset velocity feed.
- Parameters are preset to determine:
  - Feed velocity (v)
  - Acceleration/deceleration type
  - Acceleration/deceleration rate

Point Table Positioning

How it works:

- Use command data to select point table number and then the PTN bit to initiate positioning.
- Fifty positioning points are available.
- Point table parameters are preset to determine:
  - Target position
  - Positioning velocity

PRESET INDEX MOVES		
POINT TABLE NUMBER	TARGET POSITION	POSITIONING VELOCITY
1	X1	V1
:	—	—
50	X50	V50

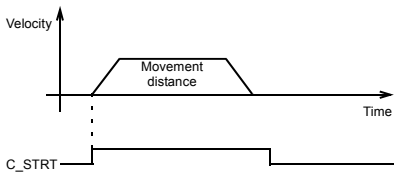


PTN bit: Refer to the Move Command message format, byte 2, bit 6.

Simple Positioning

How it works:

- Use simple positioning to receive target position data from a DeviceNet™ master controller's application software.
- When the C_STRT bit turns ON, the system moves from the current position to the target position.
- Communicate target positions with a move command message* using the positioning command code (set to 0001) and command data set with the target position.
- Velocity, acceleration type, and acceleration rate work the same way as in stepping operation.



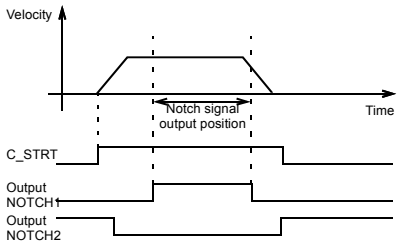
C-STRT bit: Refer to the Move Command message format, byte 0, bit 0.

* Refer to the Move Command Message Format on page 22.

Positioning with Notch/Zone (PLS) Outputs

How it works:

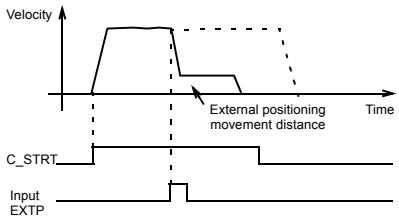
- Use the same procedure as simple positioning, except the positioning command code is to 0011.
- Two settable notch signal outputs are available.
- Notch signal output ON and OFF positions can be incremental or absolute.



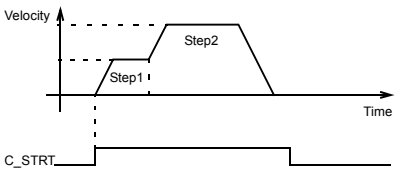
External Input Positioning

How it works:

- Use the same procedure as simple positioning, except the positioning command code is 0010.
- When the EXTP (external input signal) is activated during a move, the system will perform the final positioning.
- Parameters determine:
  - External positioning distance
  - External positioning velocity



Multi-Stage Velocity Positioning

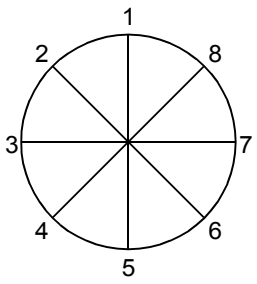


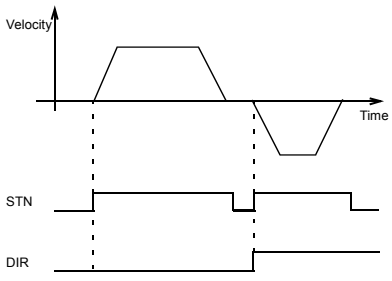
C_STRT bit: Refer to the Move Command message format, byte 0, bit 0.

How it works:

- Use the same procedure as simple positioning, except the positioning command code is 0100.
- During axis movement, after reaching the parameter's initial target position, the axis switches to the next speed and moves to the position specified in the next step.
- A maximum of 16 steps are available.
- Parameters set:
  - The number of steps
  - Reference velocity
  - Acceleration/deceleration

Station Number Positioning



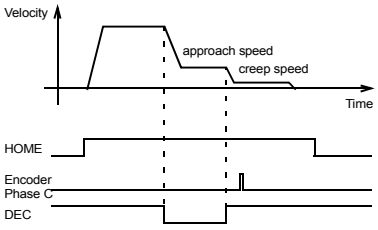


STN bit: Refer to the Move Command message format, byte 2, bit 5.

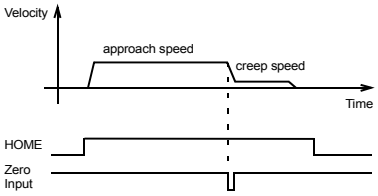
How it works:

- The system will index to the prescribed station number when the STN command bit is turned ON. The target station is defined with command data in the move command message (refer to page 22).
- Define (by parameter) up to 32,767 equidistant stations per rotation.
- Set the direction of rotation with the DIR bit or set the system (by a parameter) to automatically select the shortest distance.
- Set acceleration and deceleration with parameters.
- Accommodate rotary systems with gearing or belt ratios with parameters for electronic gear ratios.

Homing type 0



Homing type 1

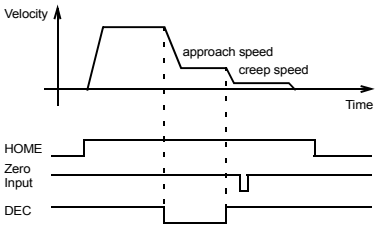


How it works:

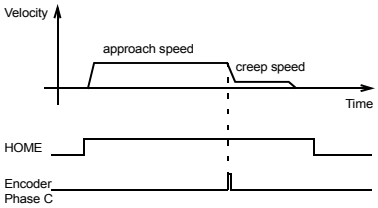
When the HOME bit turns ON, the system returns to the home position at the programmed speed and direction. After reaching home, the position of the Sigma II DeviceNet™ resets to zero.

- If the HOME bit turns OFF during the procedure, the rest of the homing operation is cancelled.
- Homing methods:
  - Type 0: DEC and Encoder Phase C
  - Type 1: Zero Input
  - Type 2: DEC and Zero Input
  - Type 3: Encoder Phase C
- Use parameters to set:
  - Homing direction
  - Homing approach and creep speed
  - Acceleration/deceleration velocity
  - Acceleration/deceleration type
  - Home offset (zero-point return final travel distance).

Homing type 2



Homing type 3

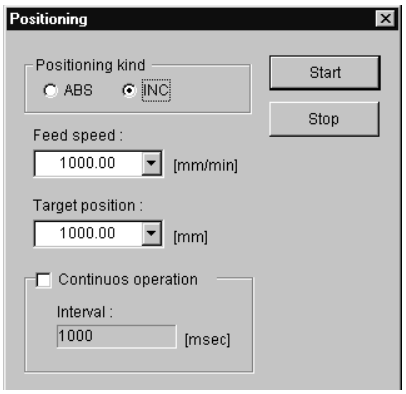


Sigma II DeviceNet™ Software Utility

The Electronic Data Sheet (EDS) file is the recommended setup utility to configure Sigma II DeviceNet™ from the network software manager. Use Yaskawa's NSXXX software for local setup of the Sigma II DeviceNet™ via personal computer. The following are examples of this software and the utilities available through the EDS file.

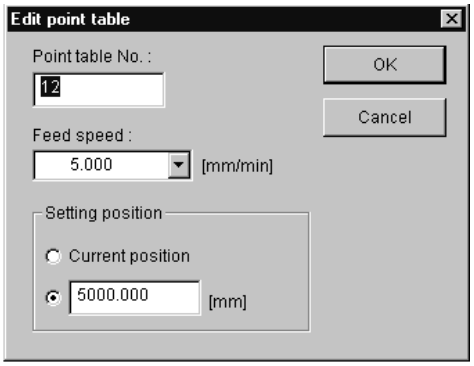
Monitoring/Setup Software

Positioning Setup

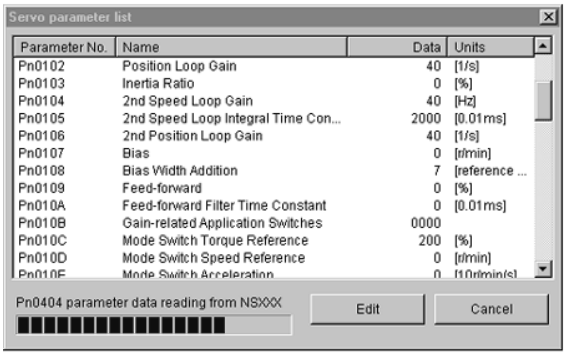


Point Table Positioning Setup

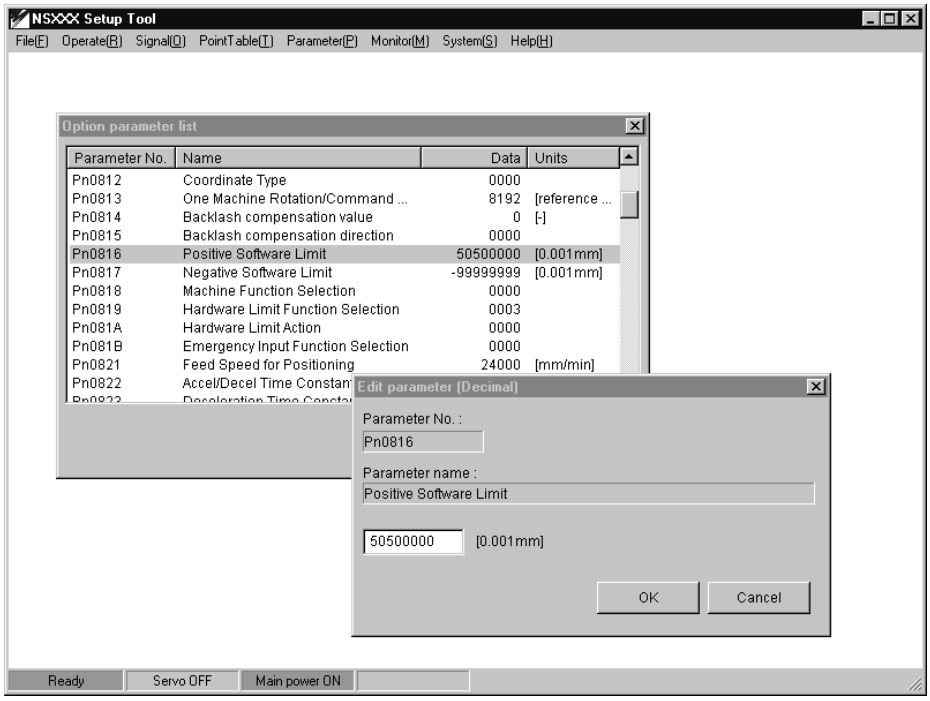
Point table No.	Feed speed	Target position
1	15.000	3000.000
2	30.000	5000.000
3	20.000	18000.000
4	15.000	18000.000
5	30.000	25000.000
6	45.000	50000.000
7	5.000	64000.000
8	15.000	75000.000
9	45.000	90000.000
10	30.000	50000.000
11	15.000	20000.000
12	5.000	5000.000



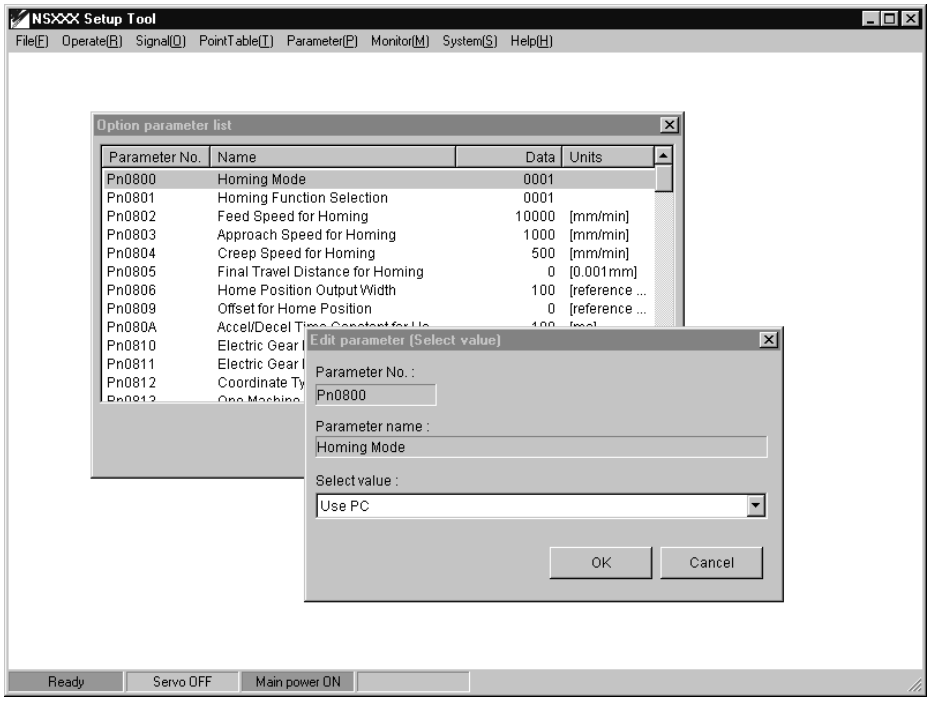
Settings and Parameters Editing



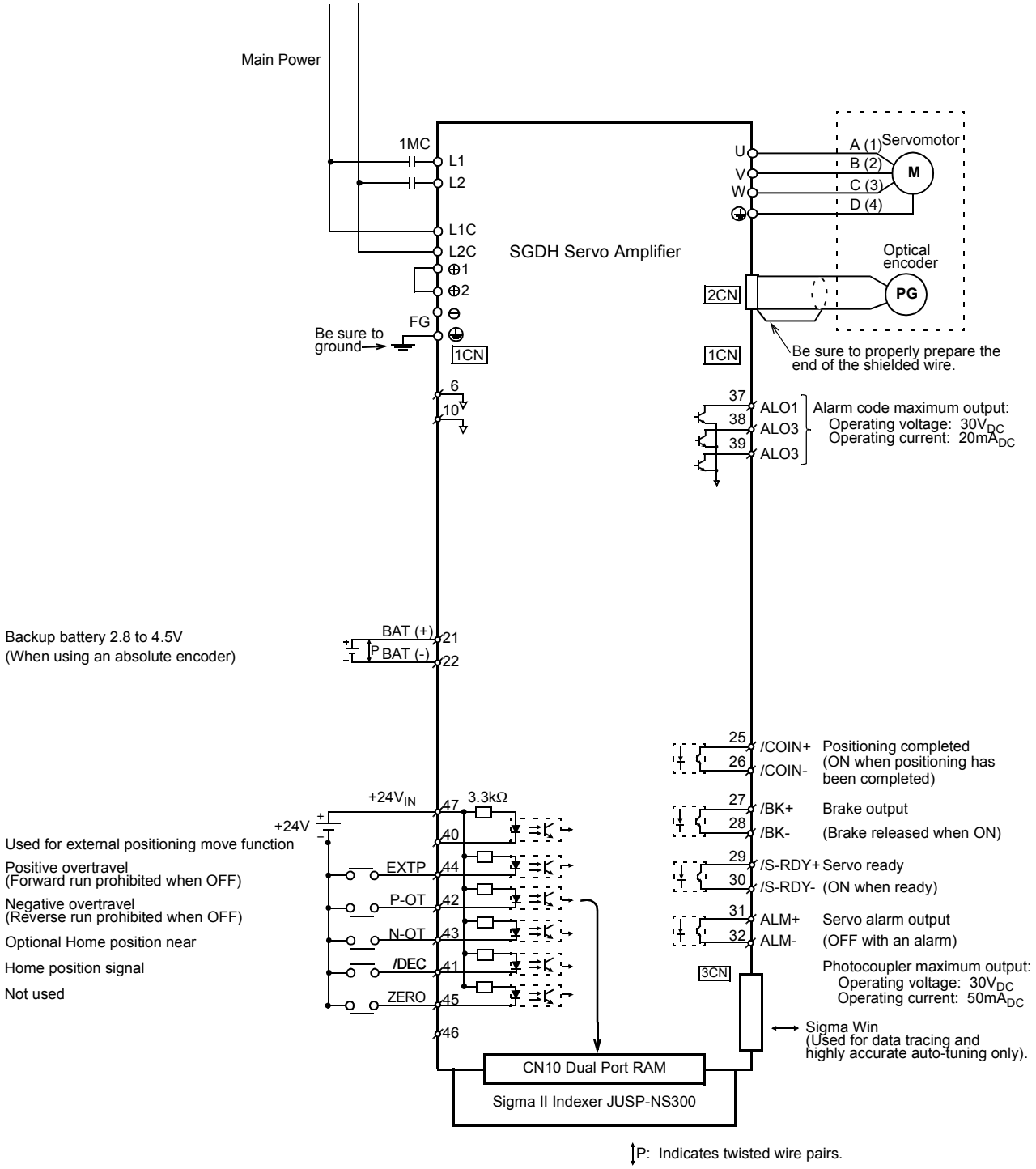
Overtravel Configuration



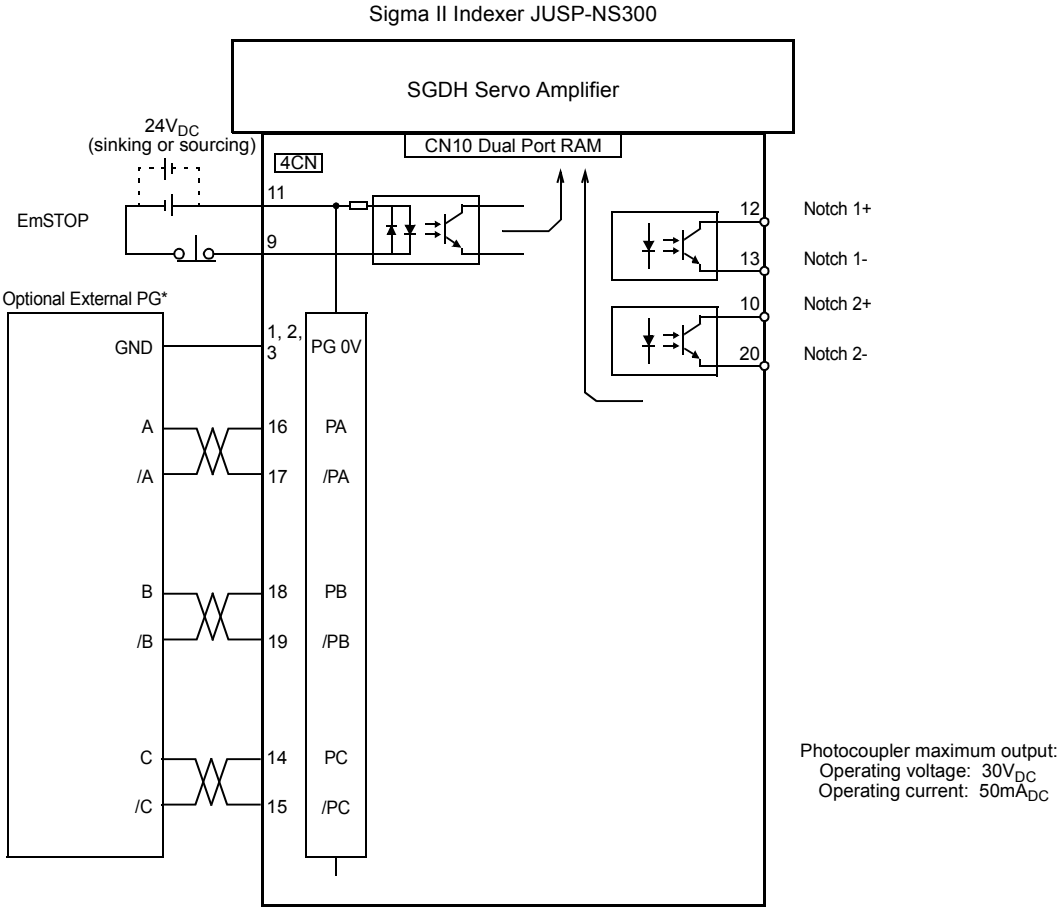
Homing Setup



Example of I/O Signal Connector (CN1, CN4)



Sigma II Indexer Application Module I/O

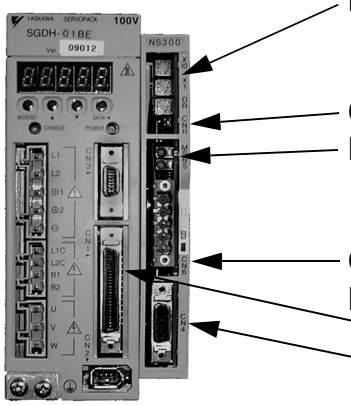


*Use for "Full Closed Loop " function (alternative position loop feedback). Refer to the User's Manual for details.

Sigma II Indexer with DeviceNet™ JUSP-NS300					
Pin Number	Signal	Description	Pin Number	Signal	Description
1	PG0V	signal ground	11	+24V	24V shared terminal for external inputs
2	PG0V	signal ground	12	NOTCH1+	Notch output 1
3	PG0V	signal ground	13	NOTCH1-	—
4	—	—	14	PC	Phase C input
5	—	—	15	/PC	—
6	—	—	16	PA	Phase B input
7	—	—	17	/PA	—
8	—	—	18	PB	Phase A input
9	EMSTOP		19	/PB	—
10	NOTCH2+		20	NOTCH2-	Notch output 2

Indexer Ratings and Specifications

The JUSP-NS300 application module uses ODVA DeviceNet™ Standard network connector, LED status indicators, and address and baud rate settable switches.



Rotary switches (three)
- MAC I.D. (node address) 0 - 63
- Baud rate selection: 125k, 250k, 500k

CN11: Setting up, commissioning, and monitoring port

LEDs
- Module Status (MS)
- Network Status (NS)

CN6: DeviceNet™ network port

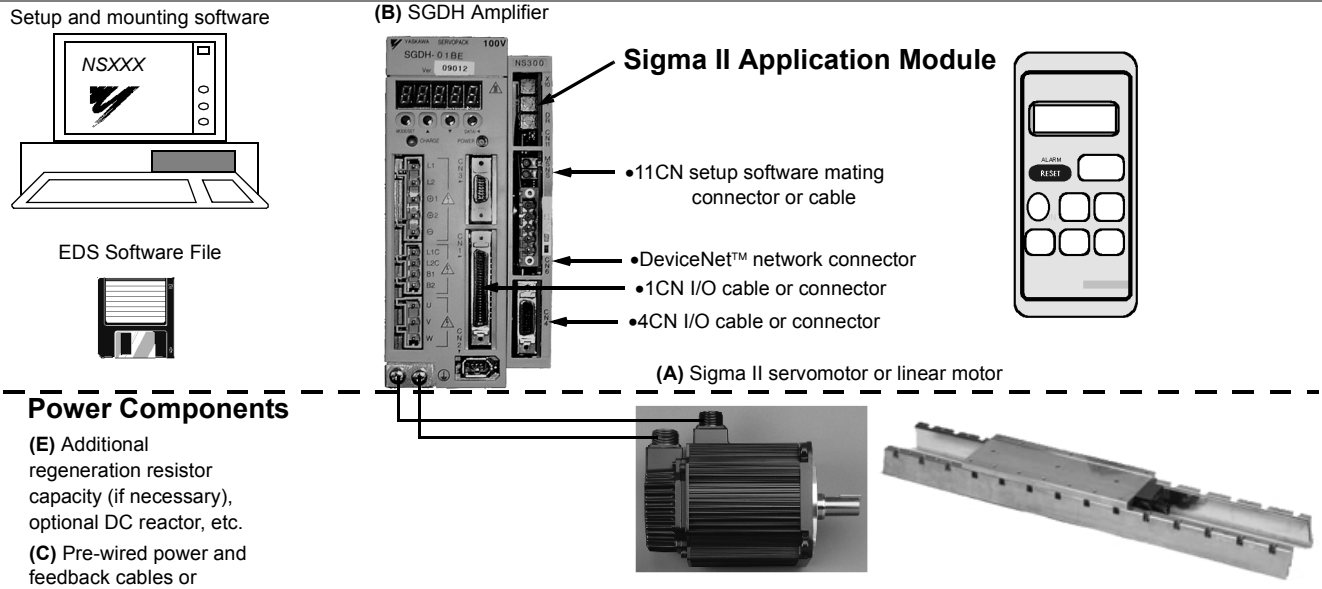
Local node I/O
- CN1 (Refer to connections on previous page)
- CN4: Two optically isolated notch outputs

DeviceNet™ Application Module Specifications: JUSP-NS300	
Power Supply Method	Supplied from the SGDH power supply.
Power Consumption	1.3W
Consumption Current	250mA
External Dimensions (w, h, d) inches (mm)	0.79 × 5.59 × 5.04 (20 × 142 × 128)
Approximate Mass in lb. (kg)	0.441 (0.2)
Local Node Inputs and Outputs (Combined with the Amplifier's I/O)	
Digital Inputs	Six optically isolated $24V_{DC}$ inputs: Emergency Stop (E,Stop), latch, home near (DEC) switch, forward overtravel, reverse overtravel, and inputs for an optional full closed loop feedback.
Digital Outputs	Ten optically isolated $24V_{DC}$ outputs: alarm out, servo-ready, servo warning, holding brake, in-position, 3 alarm codes, and 2 notch settable outputs. Also included: a scalable encoder position output.
Servo System Specifications	
Motor feedback resolution / standard	13-bit incremental encoder (8,192PPR) for motors below 1hp
	17-bit incremental encoder (16,384PPR) for motors above 1hp
Motor feedback resolution / optional	16-bit absolute encoder for motors below 1hp
	17-bit incremental/absolute for motors above 1hp
Linear motor feedback resolution / standard	0.078 micron (using 20 micron linear scale pitch)
Choice of Amplifier sizes	115 V_{ac} single-phase, 30 to 200W
	230 V_{ac} single-phase, 30W to 1.5kW
	230 V_{ac} three-phase, 500W to 15kW
	480 V_{ac} three-phase, 500W to 15kW
Environmental	
Ambient/Storage Temperature	0° to 55°C / -20° to 85°C
Global Safety Certifications	UL, CUL, CE, TUV

Selecting Your Sigma II Indexer System

Specify part number JUSP-NS300, the indexer add-on application module.
Use the tables beginning on the following page to specify choice of indexer interface cables, mating connectors only, set-up and monitoring tools, and software.

System Configuration



Specify a technical manual, if it is needed, on the servo system purchase order:
DeviceNet Interface Unit Users Manual: SIE-C718-6
Linear Motor Users Manual: YEA-S800-39.11
(Manual provided at no charge with a purchase order, but must be requested).

Power Components

(motor, amplifier, and connections for power and feedback)

Select the required power components (servomotor, power and feedback connectors or pre-wired cables, amplifier, regenerative packs, etc.) from the following catalog pages.

Use this table to determine which catalog section describes the best servomotor for the application.

Application Requirements (Maximum)			Number of Motor Sizes	System Voltage and Sigma II Servomotor Series				Selection Guide for Power Components Page Number *
Speed (rpm)	Rated Torque oz • in [lb • in]	Peak Torque oz • in [lb • in]		$100V_{ac}$ Single-phase	$200V_{ac}$ Single-phase	$200V_{ac}$ Three-phase	$480V_{ac}$ Three-phase	
5000	338	1010	6	SGMAH	SGMAH	—	—	11
5000	676	2027	5	SGMPH	SGMPH	—	—	29
3000	[845]	[1988]	10	—	—	SGMGH	—	57
5000	[140]	[422]	6	—	—	SGMSH	—	85
3000	[845]	[1988]	10	—	—	—	SGMGH	127
5000	[140]	[422]	6	—	—	—	SGMSH	139
6000	[43]	[190]	2	—	—	—	SGMUH	139
2000	[1240]	[6120]	5	—	—	—	SGMBH	165

* Yaskawa publication: *Sigma II Servo System Product Catalog Supplement* G-MI#99001E.
Linear Motor Catalog KAE-S800-39.10

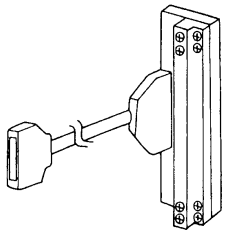
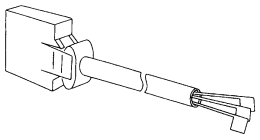
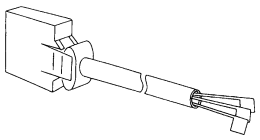
Sigma II Indexer Selection

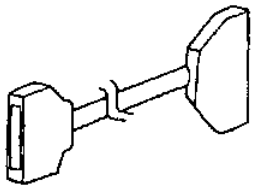
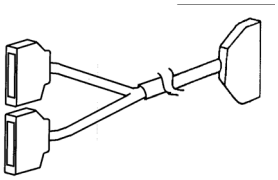
Use the servomotor and amplifier selection of this catalog for specification and selection of Sigma II servomotor and servo amplifier.

Component Description	Part Number	Comments	Item Class
Sigma II Add-on Indexer Application Module	JUSP-NS300	Mounting hardware requirements: one ground strap mounting screw. (See supplementary information on the next page.)	Stock

Use the Sigma II Application Module Mounting Dimensions on pages 75 to 82 for determining overall indexer panel space requirements. For 480VAC large capacity amplifiers (22 - 55kW), refer to the Sigma II catalog for amp dimensions.

Indexer I/O Interface Cable Selection

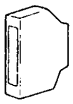
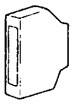
Component Description **(E)**		Part Number	Comments	Item Class
Input/Output 1CN Cable & Transition Terminal Block		JUSP-TA50P	35mm DIN rail mountable; the cable length is 0.5m.	Stock
Input/Output 1CN Cable with Pigtail Leads		JZSP-CKI01-□(A)*	Use the following key to specify required cable length (last digit of the part number): 1: 1m (standard) 2: 2m 3: 3m	
Input/Output 4CN Cable with Pigtail Leads		CKI-NS300-□□	Use the following key to specify required cable length (last two digits of the part number): 01: 1m (standard) 02: 2m 03: 3m	

Input/Output 1CN Cable Cable with Female D-Sub output Connector*		JZSP-CKI0D-□□**	Use the following key to specify required cable length (last two digits of the part number): D50: 0.5m 01: 1m (standard) 02: 2m 03: 3m	
Input/Output 1CN+4CN Cable with Female D-Sub output Connector* Applicable only for SGDH-1E (15 kW) and below.		CKI-NS300D-□□** (for use with NS300 Indexer)	Use the following key to specify required cable length (last two digits of the part number): D50: 0.5m 01: 1m (standard) 02: 2m 03: 3m	

* The "(A)" at the end of the cable part number indicates the revision level. Revision level may be subject to change prior to this catalog reprinting.

** 50 Pin Female D-Sub output connector mates to customer supplied third party terminal block. (e.g., Wago #289-449, Weidmuller #919658, Phoenix #2283647, Amphenol/Sine #20-51039, and many others.

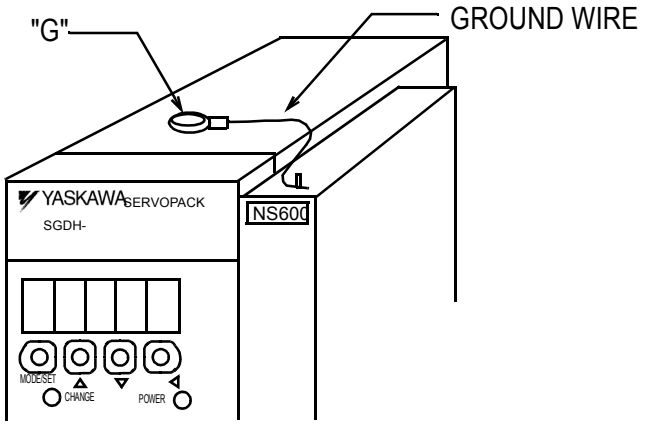
Mating Connector Selection

Component Description **(E)**		Part Number	Comments	Item Class
1CN Mating Connector		JZSP-CKI9	for SGDH I/O 50-pin	Stock
4CN Mating Connector		DE-9406973	Solder type with cover	
3CN Peripheral Mating Connector	—	YSC-1	—	
CN11 Setup Software Mating Connector	—	DE9404559	Strongly advised:YS-16 cable (next page)	
DeviceNet Mating Connector	—	YDN-1	Alternate source: USA Phoenix Contact part number: MSTB2.5/5-STF-5.08AU	

Supplementary Information

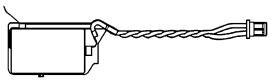
For grounding, connect the ground wire of the Sigma II Indexer application module to the point marked "G" on the SGDH servo amplifier. Refer to the following table for the proper screw size.

Servo Amplifier	"G" Screw	Comments
SGDH-A3-02BE SGDH-A3-10AE	M3 x 10 (round head phillips with split lock washer and flat washer	One supplied with NS300
SGDH-15-50AE SGDH-15-50DE	M4 x 10 (round head phillips with split lock washer and flat washer	One supplied with NS300
SGDH-60-1EAE SGDH-60-1EDE	M4 x 8 (round head phillips with split lock washer and flat washer	One supplied with NS300 Use front panel side screw hole.

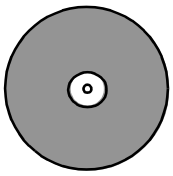


Example: For SGDH (30W to 5.0kW)

Peripheral Device Selection

Component Description **(E)**		Part Number	Comments	Item Class
Hand-held Digital Operator Panel		JUSP-OP02A-1 and JZSP-CMS00-1	Portable unit with 1m adapter cable for Sigma II Indexer	Stock
Absolute Encoder Battery		JZSP-BA01	3.6V, 1000mAh (lithium battery)	
Setup Software Interface Cable for CN10	—	YS-16	Pre-wired 1.5m cable with 9-pin connector (RS232) for NSXXX software	

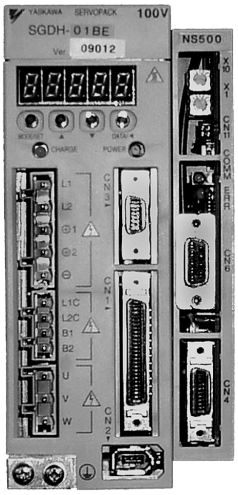
Sigma II Network Tools and Documentation

Component Description **(E)**		Publication Number*	Comments	Item Class
Fieldbus tools and documentation*		YEA-CD-S800-34.1	Includes : • Yaskawa's NSXXX monitoring and set-up software for Windows 95, Windows 98, and Windows NT. • Electronic Data Sheet (EDS) software for DeviceNet™ configuration software manager. • NS300 User's Manual.pdf.	Stock

*Available by request. Contact: literature@yaskawa.com.

NOTES

SIGMA II - Profibus DP™ Connectivity for Single-Axis Positioning



Used for a wide variety of applications, including:

- **Point-to-Point Positioning**
- **Precise Velocity Control**
- **Conditional Profile Execution in response to an external input**

For Additional Information	Page(s)
Profibus DP™ Communication	40 - 41
Functional Features and Capabilities	42 - 45
Software Utility	46 - 47
I/O Connections	48 - 49
Indexer Ratings and Specifications	50
Indexer Selection/Ordering Information	51 - 55
Indexer Application Module Dimensions	75 - 82
Servomotor and Amplifier Ratings & Selections	*

**Sigma II Servo System Product Catalog Supplement* G-MI#99001E

For more information about Profibus™, visit www.profibus.com

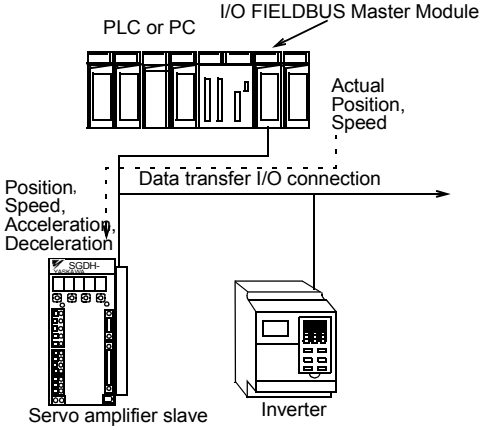
Design Features

1. **Simplified Control System**
   - Conformance Tested Profibus DP™ (EN50170), Device type: Generic I/O
   - Supports Profibus™ cyclic data transfer
   - Baud Rates: Autobaud detect sets the application module speed to 9600bps to 12Mbps
2. **Easy to Set Up and Use**
   - Just snap the JUSP-NS500 application module onto any Sigma II SGDH servo amplifier
   - No programming required: Configure with Profibus™ conformance tested GSD file
3. **Various Motion Control Functions**
   - Point table positioning
     - Edit up to 50 positions and corresponding speeds to the NS500's set of parameters via either Profibus™ or Yaskawa's NSXXX pc setup utility
   - External input positioning
   - Station number input (indexing a rotary table)
   - Positioning moves with up to 16 stages of speed changes
   - Homing: choice of four styles
4. **Applications**
   - Semiconductor fabrication, test, and assembly equipment
   - Food processing and packaging
   - Pharmaceutical packaging and test equipment
   - Automotive assembly and test equipment
   - Material handling, pick and place, linear motor
   - Machine tool (tool changers, sheet feeders, etc.)
5. **Certified International Standards**
   - UL, cUL recognized (File #: E165827), CE compliance

Sigma II Profibus Communication

The Sigma II Indexer is a compact, cost-effective solution for the needs of both the machine OEM and the end user. All servo loops and positioning functions are included in a self-contained servo amplifier/indexer package. Machine controller to servo axis interfacing simplifies to Profibus DP™ communications and wiring.

Control System Architecture



Profibus Protocol

- The Profibus DP™ specification divides network transmissions into three phases:
  - Parameterization: specifies DP services.
  - Configuration: the master transfers application setup files to each node.
  - Data transfer: cyclic data exchange
- Data transfer communication messages are suitable for time-critical, control-oriented data.
- The Sigma II messages are eight bytes long, embedded within the data unit of the **Profibus™ FDL Frame Format.**

Profibus™ FDL Frame Overview

Profibus™ FDL Frame Format

SD	DA/SA	FC	DATA UNIT	FCS	ED

FDL Telegram

Where:

SD = Start Delimiter Data Link
SA = Source Address
DATA_UNIT=Data Field Length
ED = End Diameter
CRC = Cyclic Redundancy Code
DA = Destination Address
FC = Function Code
FCS = Frame Check Sequence

Using the Eight-Byte Data Field

- Sigma II with Profibus™ accepts two types of messages in the **Data Unit Field** for positioning applications:
  - Move commands (monitor and control)
  - Set/Read commands (setup and troubleshooting)

Sigma II Move Commands

Command Message Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	0	ALRST	ESTP	0	0	SVON	C_STRT
1	Response type				Command code			
2	HOME	PTBL	STN	STEP	FEED	0	HOLD	CANCEL
3	0	0	0	0	0	0	DIR	INC
4	Command data							
5								
6								
7								

Refer to the Profibus™ Interface Unit User's Manual (SIE-C718-8) for a detailed description of the command bits.

Using move command messages

- Initiate positioning or speed control moves
- Communicate positioning move variables
- Activate point tables of index moves
- Activate homing, alarm reset, emergency stop, feed hold, and servo amplifier functions
- **Example of Command Execution:**
- Set the positioning command code and data
- Change the Command Start(C-Start), byte 0, bit 0, from 0 to 1

Positioning Command Codes	Operation
0000	No operation
0001	Simple positioning
0010	External positioning
0011	Positioning with notch signal outputs
0100	Multi-speed positioning

Sigma II Responses to Move Commands

Response Messages

- Reports the status of the current positioning move , i.e., in position, near position, home, overtravel, alarm, etc.
- Move data can be collected in the response. See the response type table at the right.
- The data requirements in the response message are specified in the command message, byte 1, bits 4 through 7, (as shown on the Command Message Format table on the previous page).
- Response codes are returned in the response message (byte 1, bits 4 through 7) along with the data.

Response Message Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	0	READY	PWRON	ESTP_R	ALRM	WARN	SVON_R	C_STRT_R
1	Response type				Command code			
2	HOME_R	PTBL_R	STN_R	STEP_R	FEED_R	0	HOLD_R	PRGS
3	POT	NOT	INPOS	NEAR	HOME_P	0	DIR_R	INC_R
4	Response data							
5								
6								
7								

Response Type	Response Data Reference Units (RU)
0000	Command position (RU)
0001	Current position (RU)
0010	Following error (RU)
0011	Command speed (1000RU/ min.)
0100	Current speed (1000RU/min.)
0101	Torque (%)
1010	Station number
1011	Point table number

Refer to the Profibus DP™ Interface Unit User's Manual (SIE-C718-8) for a detailed description of the status bits.

Sigma II Set/Read Commands and Command Codes

Set/Read messages enable user friendly network routines that can reconfigure machine positioning variables, initialize setup routines, enable auto-tuning, source alarm and warning data, etc. These functions are available to any master on the network.

Uses of Set/Read Messages

- Set up and configuration data
- Edit parameters
- Set/edit preprogrammed point tables of index moves
- Report alarm codes
- Use with data transfer I/O communication

Defining Set/Read Messages (versus move command messages)

- Set by byte 0, bit 7 = 1
- It is not necessary to specify response type for Set/Read commands

Command Message Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	0	ALRST	ESTP	0	0	SVON	C_STRT
1	0				Command code			
2	Command number							
3								
4	Command message							
5								
6								
7								

Command Code	Operation
0000	No operation
1000	Read parameter
1001	Write parameter
1010	Set current position
1011	Set zero point
1100	Read alarm
1110	Reset Unit

Response Message Format

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	1	READY	PWRON	ESTP_R	ALRM	WARN	SVON_R	C_STRT_R
1	0				Command code			
2	Command number							
3								
4	response data							
5								
6								
7								

Command Codes

- Set "No Operation" to prevent execution of commands.
- Out-of-range parameters generate a setting error (WARN bit)

Sigma II Profibus™ Functional Features and Capabilities

Sigma II Profibus™ acts as a servo position or velocity controller slave to a master controller. For application flexibility, use a data transfer connection from the applications software to dynamically load incremental or absolute point-to-point positioning data. For these applications use:

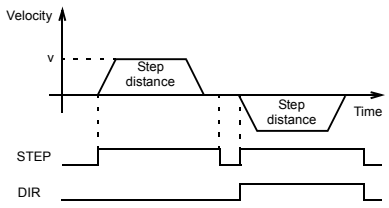
- Simple positioning
- Simple positioning with notch outputs
- External input positioning
- Multistage velocity positioning

For precise velocity control only, use Feed operation. For applications where the parameters of the positioning moves can be preset, use:

- Stepping operation
- Point-table positioning
- Station number positioning (rotary table operation)

Note: Establish or change parameters of a preset move with an GSD file configuration, Yaskawa's Windows NSXXX software utility, or a dynamic Sigma II data transfer of Set/Read Commands. For more permanent settings, recycle the power or issue a unit reset command (to move the parameters into non-volatile memory).

Stepping Operation



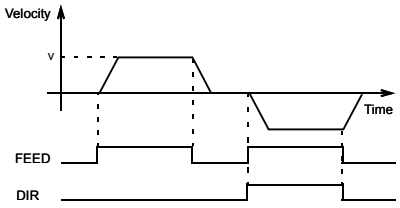
STEP bit: Refer to the Move Command message format, byte 2, bit 4.

DIR bit: Refer to the Move Command message format, byte 3, bit 1.

How it works:

- When the STEP bit turns ON, the axis moves in the specified direction (DIR bit).
- Use command data to select one of four preset parameters that define the step distance. Moves can be incremental or absolute.
- When the STEP bit turns OFF during movement, step movement is cancelled.
- Additional parameters to help define the stepping operation are preset to determine:
  - Approach velocity (v) and acceleration/deceleration type (eight types are available, including S-curve)
  - Acceleration/deceleration values

Feed Operation



FEED bit: Refer to the Move Command message format, byte 3, bit 3.

How it works:

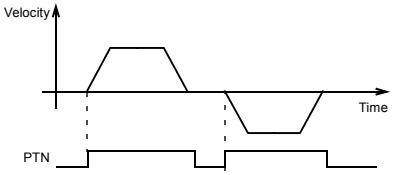
- While the FEED bit is ON, the axis jogs in the direction specified.
- Use command data during movement to set or override the preset velocity feed.
- Parameters are preset to determine:
  - Feed velocity (v)
  - Acceleration/deceleration type
  - Acceleration/deceleration rate

Point Table Positioning

How it works:

- Use command data to select point table number and then the PTN bit to initiate positioning.
- Fifty positioning points are available.
- Point table parameters are preset to determine:
  - Target position
  - Positioning velocity

PRESET INDEX MOVES		
POINT TABLE NUMBER	TARGET POSITION	POSITIONING VELOCITY
1	X1	V1
:	—	—
50	X50	V50

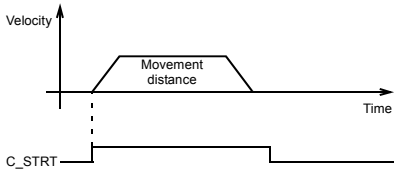


PTN bit: Refer to the Move Command message format, byte 2, bit 6.

Simple Positioning

How it works:

- Use simple positioning to receive target position data from a Profibus™ master controller's application software.
- When the C_STRT bit turns ON, the system moves from the current position to the target position.
- Communicate target positions with a move command message* using the positioning command code (set to 0001) and command data set with the target position.
- Velocity, acceleration type, and acceleration rate work the same way as in stepping operation.



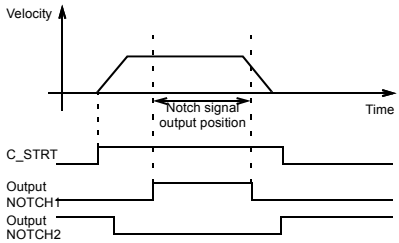
C-STRT bit: Refer to the Move Command message format, byte 0, bit 0.

* Refer to the Move Command Message Format on page 40.

Positioning with Notch/Zone (PLS) Outputs

How it works:

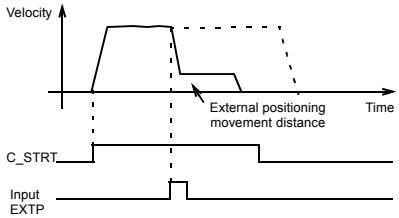
- Use the same procedure as simple positioning, except the positioning command code is to 0011.
- Two settable notch signal outputs are available.
- Notch signal output ON and OFF positions can be incremental or absolute.



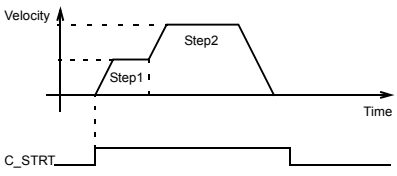
External Input Positioning

How it works:

- Use the same procedure as simple positioning, except the positioning command code is 0010.
- When the EXTP (external input signal) is activated during a move, the system will perform the final positioning.
- Parameters determine:
  - External positioning distance
  - External positioning velocity



Multi-Stage Velocity Positioning

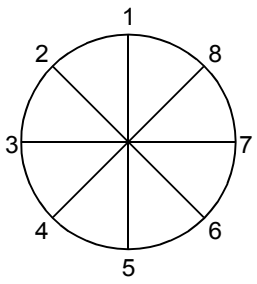


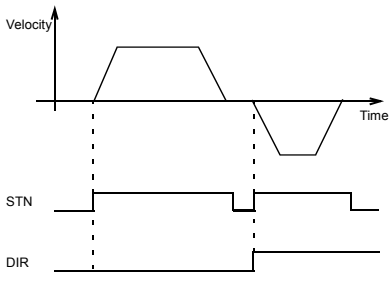
C_STRT bit: Refer to the Move Command message format, byte 0, bit 0.

How it works:

- Use the same procedure as simple positioning, except the positioning command code is 0100.
- During axis movement, after reaching the parameter's initial target position, the axis switches to the next speed and moves to the position specified in the next step.
- A maximum of 16 steps are available.
- Parameters set:
  - The number of steps
  - Reference velocity
  - Acceleration/deceleration

Station Number Positioning



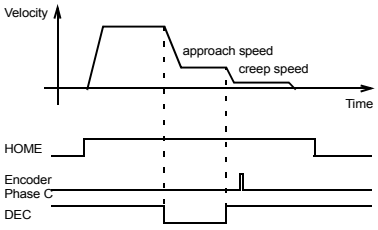


STN bit: Refer to the Move Command message format, byte 2, bit 5.

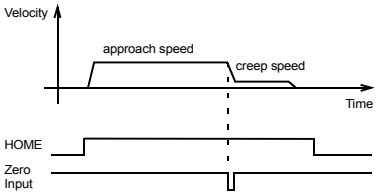
How it works:

- The system will index to the prescribed station number when the STN command bit is turned ON. The target station is defined with command data in the move command message (refer to page 36).
- Define (by parameter) up to 32,767 equidistant stations per rotation.
- Set the direction of rotation with the DIR bit or set the system (by a parameter) to automatically select the shortest distance.
- Set acceleration and deceleration with parameters.
- Accommodate rotary systems with gearing or belt ratios with parameters for electronic gear ratios.

Homing type 0



Homing type 1

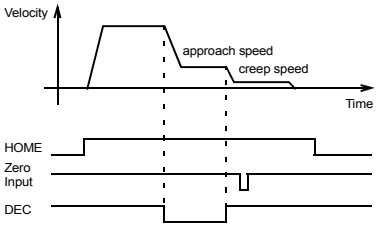


How it works:

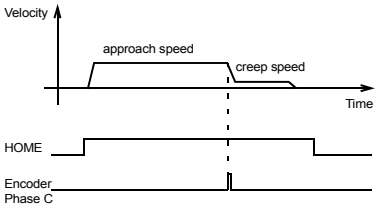
When the HOME bit turns ON, the system returns to the home position at the programmed speed and direction. After reaching home, the position of the Sigma II Profibus™ resets to zero.

- If the HOME bit turns OFF during the procedure, the rest of the homing operation is cancelled.
- Homing methods:
  - Type 0: DEC and Encoder Phase C
  - Type 1: Zero Input
  - Type 2: DEC and Zero Input
  - Type 3: Encoder Phase C
- Use parameters to set:
  - Homing direction
  - Homing approach and creep speed
  - Acceleration/deceleration velocity
  - Acceleration/deceleration type
  - Home offset (zero-point return final travel distance).

Homing type 2



Homing type 3

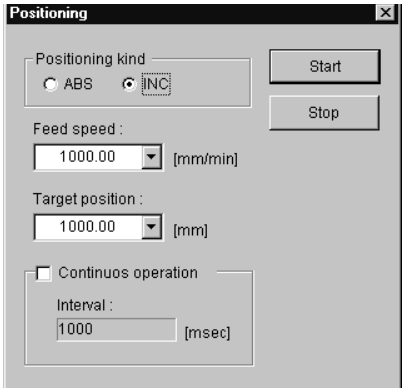


Sigma II Profibus™ Software Utility

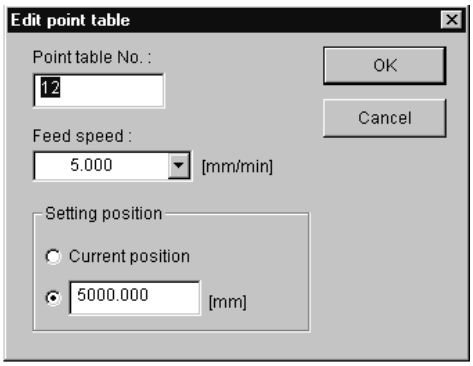
The Electronic Data Sheet (GSD) file is the recommended setup utility to configure Sigma II Profibus™ from the network software manager. Use Yaskawa's NSXXX software for local setup of the Sigma II Profibus™ via personal computer. The following are examples of this software and the utilities available through the GSD file.

Monitoring/Setup Software

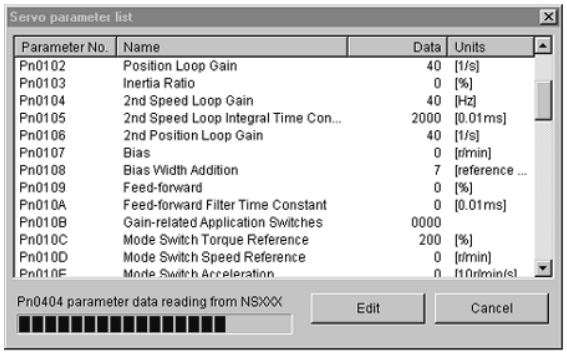
Positioning Setup



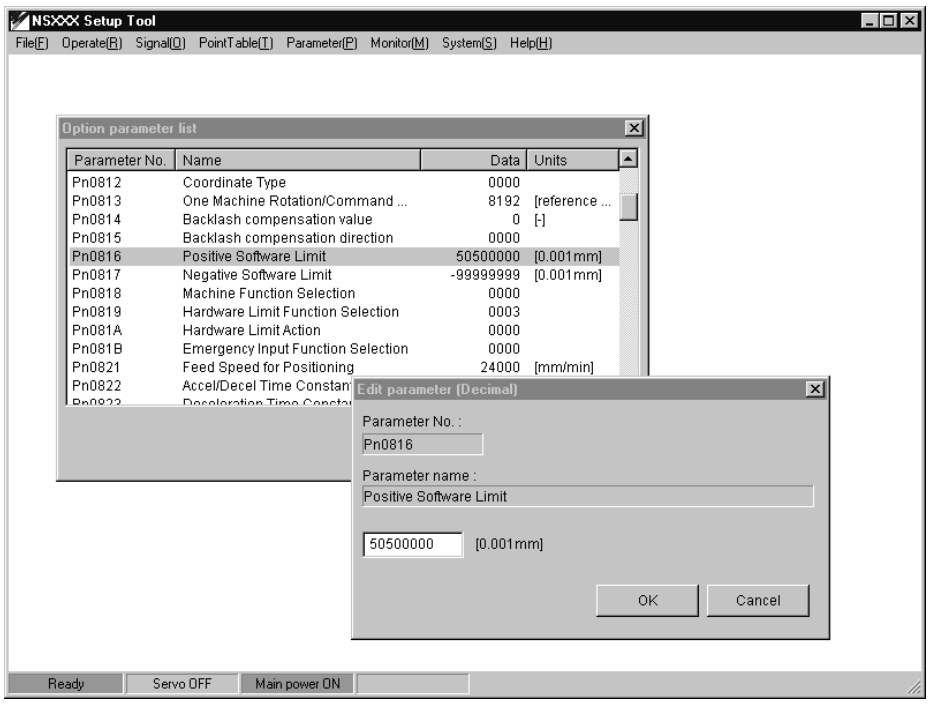
Point Table Positioning Setup



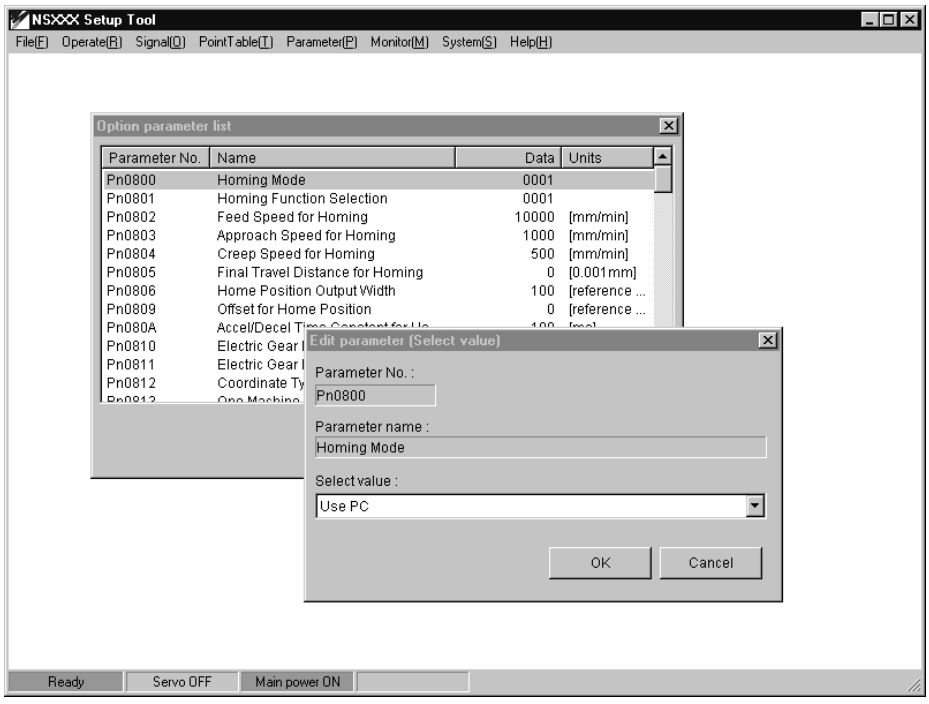
Settings and Parameters Editing



Overtravel Configuration

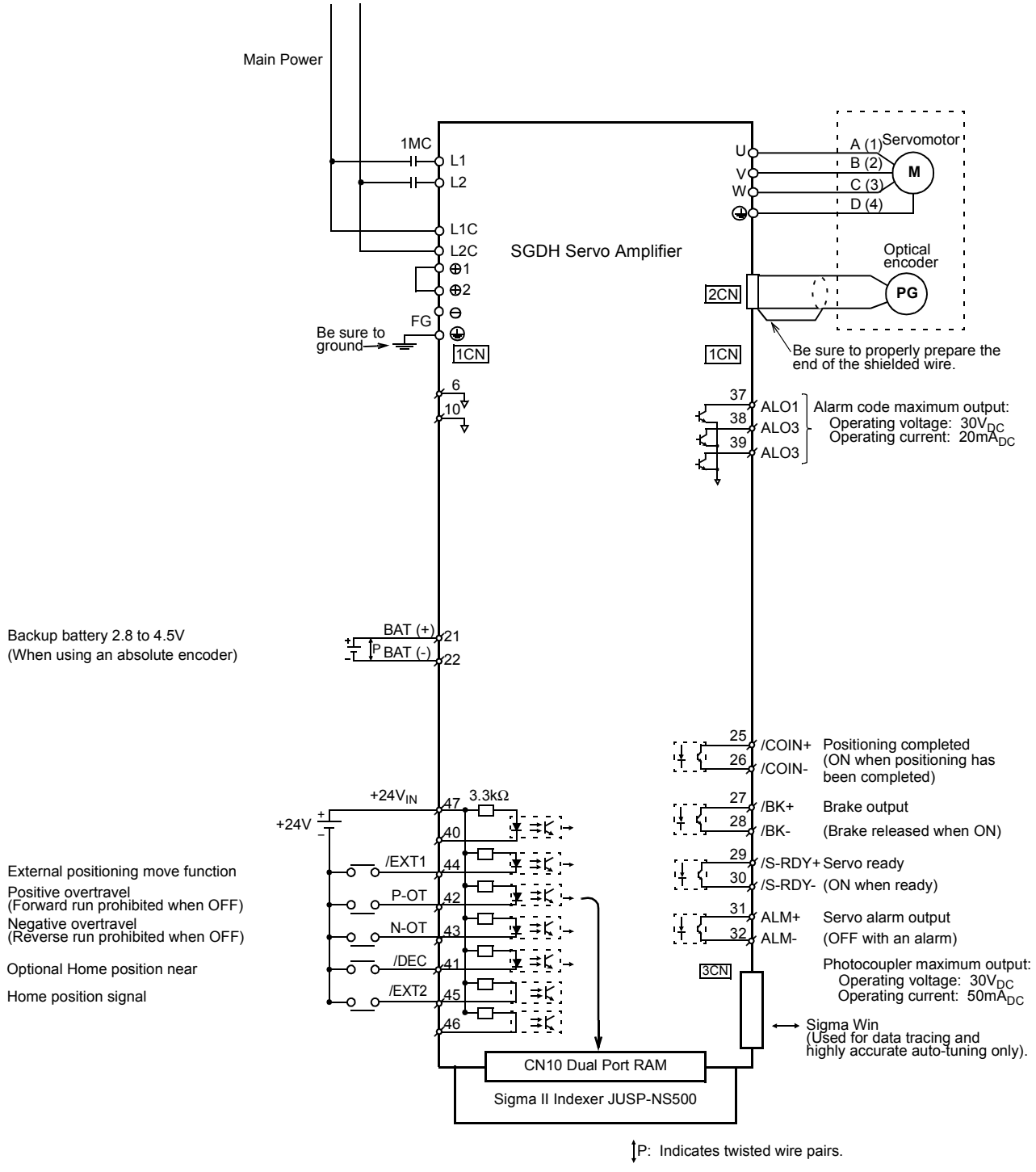


Homing Setup

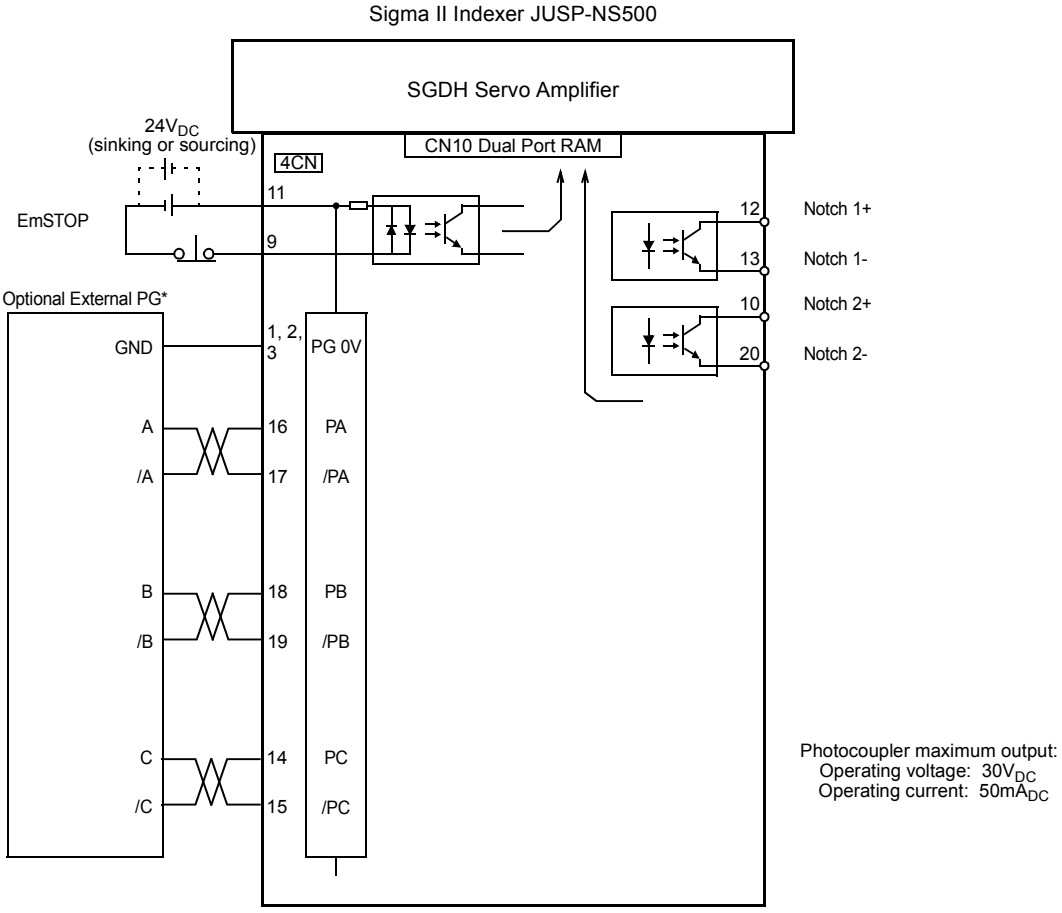


I/O Connections

Example of I/O Signal Connector (CN1)



Sigma II Indexer Application Module I/O (CN4)

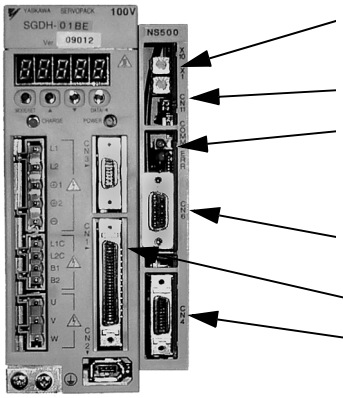


*Use for "Full Closed Loop " function (alternative position loop feedback). Refer to the User's Manual for details.

Sigma II Indexer with Profibus™ JUSP-NS500					
Pin Number	Signal	Description	Pin Number	Signal	Description
1	PG0V	signal ground	11	+24V	24V shared terminal for external inputs
2	PG0V	signal ground	12	NOTCH1+	Notch output 1
3	PG0V	signal ground	13	NOTCH1-	—
4	—	—	14	PC	Phase C input
5	—	—	15	/PC	—
6	—	—	16	PA	Phase B input
7	—	—	17	/PA	—
8	—	—	18	PB	Phase A input
9	EMSTOP		19	/PB	—
10	NOTCH2+		20	NOTCH2-	Notch output 2

Indexer Ratings and Specifications

The JUSP-NS500 application module uses Profibus™ Standard network connector, LED status indicators, and address and baud rate settable switches.



Rotary switches (two)
- Station Addresses 0 - 126

CN11: Setting up, commissioning, and monitoring port

LEDs
- Module Status (ERR)
- Network Status (COMM)

CN6: Profibus™ network port

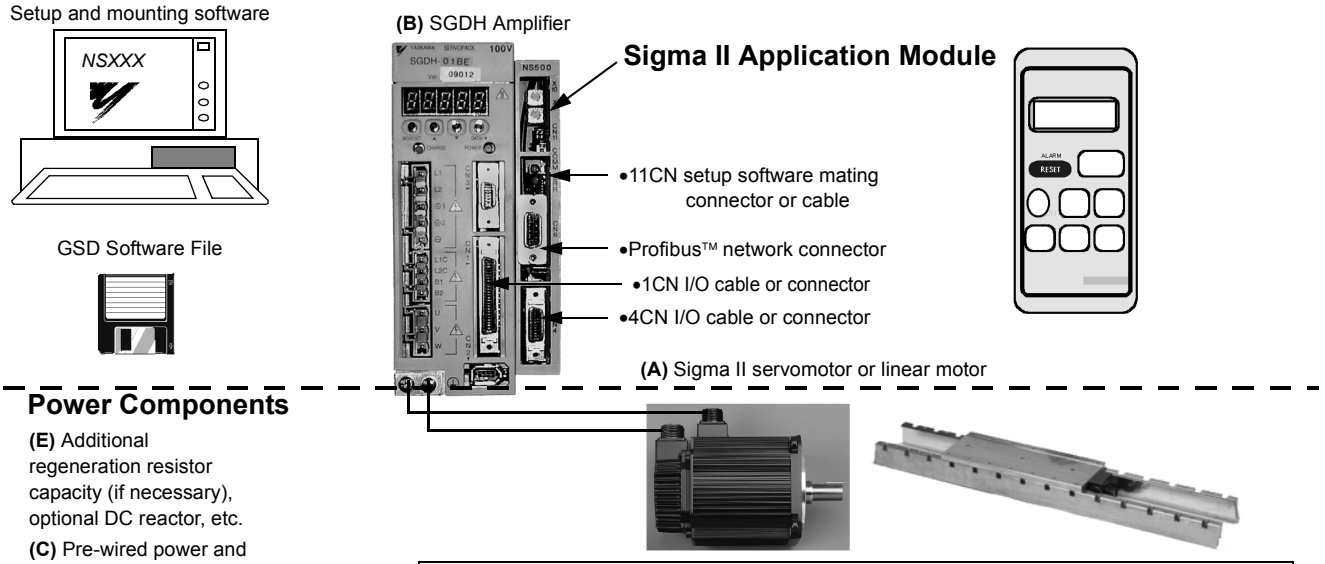
Local node I/O
- CN1 (Refer to connections on previous page)
- CN4: Two optically isolated notch outputs

Profibus™ Application Module Specifications: JUSP-NS500	
Power Supply Method	Supplied from the SGDH power supply.
Power Consumption	1.3W
Consumption Current	250mA
External Dimensions (w, h, d) inches (mm)	0.79 × 5.59 × 5.04 (20 × 142 × 128)
Approximate Mass in lb. (kg)	0.441 (0.2)
Local Node Inputs and Outputs (Combined with the Amplifier's I/O)	
Digital Inputs	Six optically isolated $24V_{DC}$ inputs: Emergency Stop (E Stop), latch, home near (DEC) switch, forward overtravel, reverse overtravel, and inputs for an optional full closed loop feedback.
Digital Outputs	Ten optically isolated $24V_{DC}$ outputs: alarm out, servo-ready, servo warning, holding brake, in-position, 3 alarm codes, and 2 notch settable outputs. Also included: a scalable encoder position output.
Servo System Specifications	
Motor feedback resolution / standard	13-bit incremental encoder (8,192PPR) for motors below 1hp
	17-bit incremental encoder (16,384PPR) for motors above 1hp
Motor feedback resolution / optional	16-bit absolute encoder for motors below 1hp
	17-bit incremental/absolute for motors above 1hp
Linear motor feedback resolution / standard	0.078 micron (using 20 micron linear scale pitch)
Choice of Amplifier sizes	115 V_{ac} single-phase, 30 to 200W
	230 V_{ac} single-phase, 30W to 1.5kW
	230 V_{ac} three-phase, 500W to 15kW
	480 V_{ac} three-phase, 500W to 15kW
Environmental	
Ambient/Storage Temperature	0° to 55°C / -20° to 85°C
Global Safety Certifications	UL, CUL, CE, TUV

Selecting Your Sigma II Indexer System

Specify part number JUSP-NS500, the indexer add-on application module.
Use the tables beginning on the following page to specify choice of indexer interface cables, mating connectors only, set-up and monitoring tools, and software.

System Configuration



Specify a technical manual, if it is needed, on your servo system purchase order:
Profibus™ Interface Unit Users Manual: SIE-C718-8
Linear Motor Users Manual: YEA-S800-39.11
(Manual provided at no charge with a purchase order, but must be requested).

Power Components (motor, amplifier, and connections for power and feedback)

Select the required power components (servomotor, power and feedback connectors or pre-wired cables, amplifier, regenerative packs, etc.) from the following catalog pages.

Use this table to determine which catalog section describes the best servomotor for the application.

Application Requirements (Maximum)			Number of Motor Sizes	System Voltage and Sigma II Servomotor Series				Selection Guide for Power Components Page Number *
Speed (rpm)	Rated Torque oz • in [lb • in]	Peak Torque oz • in [lb • in]		$100V_{ac}$ Single-phase	$200V_{ac}$ Single-phase	$200V_{ac}$ Three-phase	$480V_{ac}$ Three-phase	
5000	338	1010	6	SGMAH	SGMAH	—	—	11
5000	676	2027	5	SGMPH	SGMPH	—	—	29
3000	[845]	[1988]	10	—	—	SGMGH	—	57
5000	[140]	[422]	6	—	—	SGMSH	—	85
3000	[845]	[1988]	10	—	—	—	SGMGH	127
5000	[140]	[422]	6	—	—	—	SGMSH	139
6000	[43]	[190]	2	—	—	—	SGMUH	139
2000	[1240]	[6120]	5	—	—	—	SGMBH	165

* Yaskawa publication: *Sigma II Servo System Product Catalog Supplement* G-MI#99001D-SigmaII.
Linear Motor Catalog KAE-S800-39.10

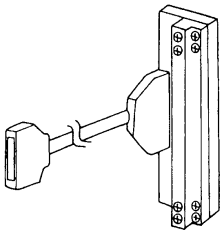
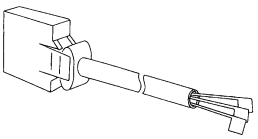
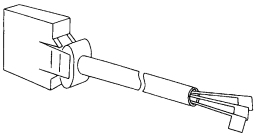
Sigma II Indexer Selection

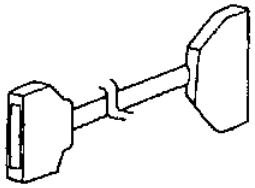
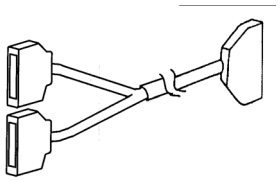
Use the servomotor and amplifier selection of this catalog for specification and selection of Sigma II servomotor and servo amplifier.

Component Description	Part Number	Comments	Item Class
Sigma II Add-on Indexer Application Module	JUSP-NS500	Mounting hardware requirements: one ground strap mounting screw. (See supplementary information on the next page.)	Stock

Use the Sigma II Application Module Mounting Dimensions on pages 75 to 82 for determining overall indexer panel space requirements. For 480VAC large capacity amplifiers (22 - 55kW), refer to the Sigma II catalog for amp dimensions.

Indexer I/O Interface Cable Selection

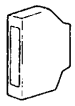
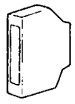
Component Description **(E)**		Part Number	Comments	Item Class
Input/Output 1CN Cable & Transition Terminal Block		JUSP-TA50P	35mm DIN rail mountable; the cable length is 0.5m.	Stock
Input/Output 1CN Cable with Pigtail Leads		JZSP-CKI01-□(A)*	Use the following key to specify required cable length (last digit of the part number): 1: 1m (standard) 2: 2m 3: 3m	
Input/Output 4CN Cable with Pigtail Leads		CKI-NS300-□□	Use the following key to specify required cable length (last two digits of the part number): 01: 1m (standard) 02: 2m 03: 3m	

Input/Output 1CN Cable Cable with Female D-Sub output Connector*		JZSP-CKI0D-□□**	Use the following key to specify required cable length (last two digits of the part number): D50: 0.5m 01: 1m (standard) 02: 2m 03: 3m	
Input/Output 1CN+4CN Cable with Female D-Sub output Connector* Applicable only for SGDH-1E (15 kW) and below.		CKI-NS300D-□□** (for use with NS500 Indexer)	Use the following key to specify required cable length (last two digits of the part number): D50: 0.5m 01: 1m (standard) 02: 2m 03: 3m	

***** The "(A)" at the end of the cable part number indicates the revision level. Revision level may be subject to change prior to this catalog reprinting.

****** 50 Pin Female D-Sub output connector mates to customer supplied third party terminal block. (e.g., Wago #289-449, Weidmuller #919658, Phoenix #2283647, Amphenol/Sine #20-51039, and many others).

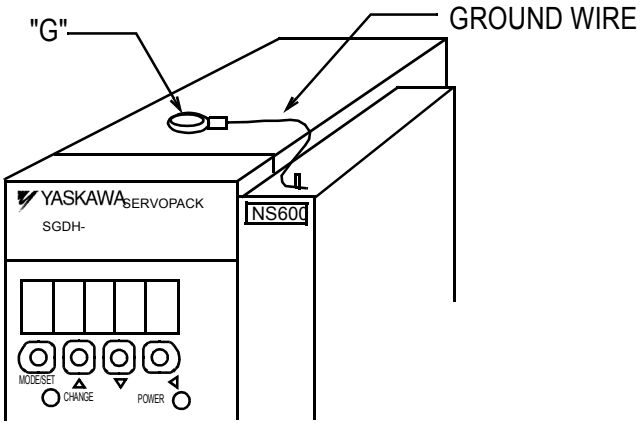
Mating Connector Selection

Component Description **(E)**		Part Number	Comments	Item Class
1CN Mating Connector		JZSP-CKI9	for SGDH I/O 50-pin	Stock
4CN Mating Connector		DE-9406973	Solder type with cover	
3CN Peripheral Mating Connector	—	YSC-1	—	
CN11 Setup Software Mating Connector	—	DE9404559	Strongly advised: YS-16 cable (next page)	
Profibus Mating Connector	—		Standard 9-pin male D-Sub connector. (Note: termination resistors are required for the end of the network.)	

Supplementary Information

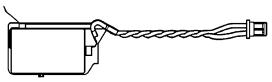
For grounding, connect the ground wire of the Sigma II Indexer application module to the point marked "G" on the SGDH servo amplifier. Refer to the following table for the proper screw size.

Servo Amplifier	"G" Screw	Comments
SGDH-A3-02BE SGDH-A3-10AE	M3 x 10 (round head phillips with split lock washer and flat washer	One supplied with NS500
SGDH-15-50AE SGDH-15-50DE	M4 x 10 (round head phillips with split lock washer and flat washer	One supplied with NS500
SGDH-60-1EAE SGDH-60-1EDE	M4 x 8 (round head phillips with split lock washer and flat washer	One supplied with NS500 Use front panel side screw hole.

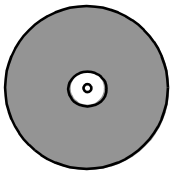


Example: For SGDH (30W to 5.0kW)

Peripheral Device Selection

Component Description **(E)**		Part Number	Comments	Item Class
Hand-held Digital Operator Panel		JUSP-OP02A-1 and JZSP-CMS00-1	Portable unit with 1m adapter cable for Sigma II Indexer	Stock
Absolute Encoder Battery		JZSP-BA01	3.6V, 1000mAh (lithium battery)	
Setup Software Interface Cable for CN10	—	YS-16	Pre-wired 1.5m cable with 9-pin connector (RS232) for NSXXX software	

Sigma II Network Tools and Documentation

Component Description **(E)**		Publication Number*	Comments	Item Class
Fieldbus Tools and documentation*		YEA-CD-S800-34.1	Includes : • Yaskawa's NSXXX monitoring and set-up software for Windows 95, Windows 98, and Windows NT. • Electronic Data Sheet (GSD) software for Profibus™ configuration software manager. • NS500 User's Manual.pdf.	Stock

*Available by request. Contact: literature@yaskawa.com.

NOTES

MP940 - A 1.5 axis machine controller

Integrated Sigma II servo amp with MP940 controller

Used for a wide variety of functions, including:

- **Positioning, speed, synchronous phase or torque control including on-the-fly mode switching**
- **Includes registration, following, electronic camming and gearing**

For Additional Information	Page(s)
Functional Features and Capabilities	58 - 59
Control System Architecture	60 - 61
Programming Environment	62 - 65
MotionWorks+™ Software Features	62 - 63
MotionWorks Software Features	64 - 65
I/O Connections	66 - 67
MP940 Ratings and Specifications	68
Remote IO Ratings and Specifications	69 - 70
MP940 Selection/Ordering Information	71 - 74
Application Module Dimensions	75 - 82
Servomotor and Amplifier Ratings & Specifications	*

**Sigma II Servo System Product Catalog Supplement* G-MI#99001D-Sigma II

Design Features

1. Easy to Use

- Integrated 1.5 axis motion control with a built-in programmable logic control (PLC)
- Any size Sigma II Servo amplifier provides for an add-on MP940 module: reduces wiring and panel space requirements
- Local programmable I/O: eight $24V_{DC}$ inputs/outputs (with auxiliary encoder axis input), two high speed registration inputs, one 16 bit analog input and output
- Standard remote I/O network or optional Devicenet Fieldbus provides the link to distributed control
- A variety of optional remote I/O modules available for distributed control
- Two Memobus serial ports standard

2. Simple to Set Up and Configure

- System design, debugging, and maintenance in a single development environment for motion and sequence
- Choice of ladder based programming (MotionWorks™) or an icon graphical (MotionWorks+™) programming environment
- Includes a rich set of motion and sequence programming commands including floating point math and trigonometric functions
- Up to eight simultaneous multitasking programs
- Large programmable memory: 80kB (approx. 2000 lines of user program)

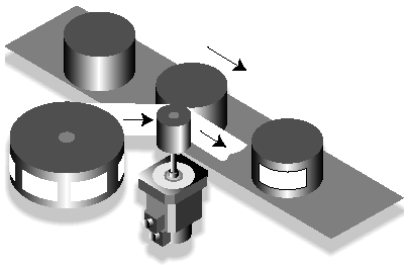
3. Application Emphasis

- Feed-to-length, flying cut-offs, roll feeding, bag making, press feed
- Packaging, form, fill, seal and random infeeds
- Linear motors, linear slides, indexing conveyors and rotary tables
- Pick and place systems

4. UL, c-UL recognized (File # E165827) and CE compliance tested

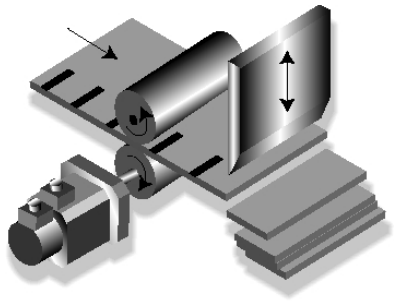
Functional Features and Capabilities

Labeling Application



In this application, a roller or set of pinch rollers feed labels through a labeling head. The product approaching a labeling head triggers a sensor, which initiates the MP940 profile. The predefined profile causes the label to be pulled through the labeling head and applied to the product. The servo must provide low acceleration to prevent tearing the labels and quick deceleration to stop between tightly placed labels. The control can compensate for variation in package separation and changes to conveyor speeds.

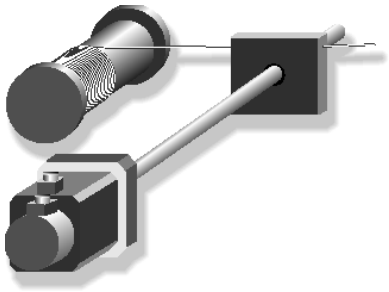
Cut-To-Length



The performance of many applications, in particular those requiring conditional indexing, can be improved by obtaining real-time position information. In order to improve thru-put, the MP940 utilizes dedicated high speed input for capturing registration marks at the highest possible process speeds. This input can acquire and store the position of the motor or external encoder in less than 30 microseconds.

A system that is synchronized by an MP940 provides faster and more accurate cut lengths exactly placed on the registration marks or adjustable offsets.

Coil Winding



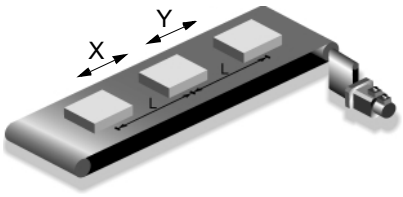
The product is wound onto a bobbin that rotates at a constant speed. The filament will be laid onto the bobbin by a ball screw driven guiding mechanism that will slowly decrease its travel rate as the winding diameter is increased.

With an MP940 servo system, complex changes of ratio based on master position are possible. In addition, the arm must reverse quickly at the end of the move.

These processes are done at a very high speed and precise motion control is required for consistency and quality in high production environments. Product changeover is easily programmable with an MP940 servo system.

Functional Features and Capabilities

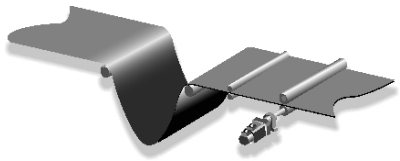
Random Timing In-feed - Conveying



Frequently, a product at a particular point in a process arrives with non-repeatable, or random timing. In this application, a product needs to be placed on an exit conveyor with perfect spacing to ensure it can be wrapped and packaged accurately.

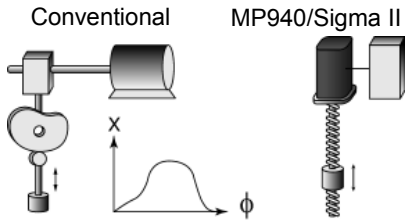
The MP940 servo system regulates the spacing on an output conveyor by advancing and retarding conveyor position and speed to obtain the required shift and then matching speed with the feeding conveyor for a smooth transition.

Feed To Length



Many process lines that unwind a roll continuously and feed a converting process in discrete moves use an MP940. The servo feeds a variable length of material to the process and can include an optional external encoder to compensate for material slippage. In addition, an MP940 analog output varies the speed of the unwind roll as the depth of the material accumulator and the diameter of the unwind roll changes.

Electronic Cam



Machines that previously required mechanical cam changes for product or process changes may now be settable and reconfigured electronically. The servomotor is linked to a master encoder with synchronized phase control mode. With synchronized phase control mode, the AC servo system moves the same way as with a mechanical cam.

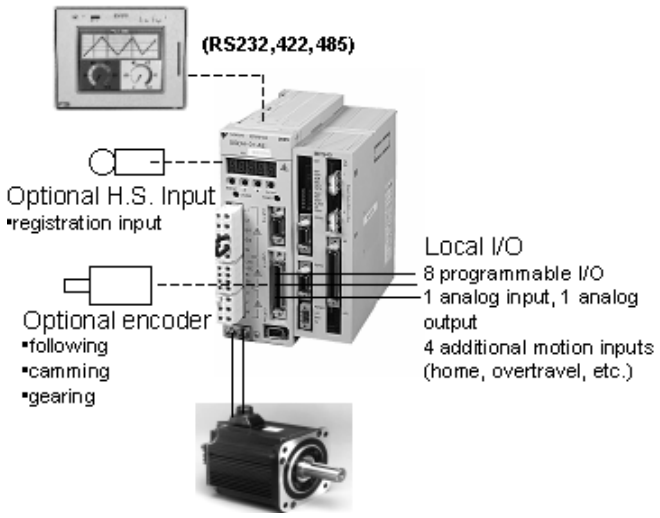
With an MP940, each cam profile can have as many as 20 definable segments with each segment curve shape settable with 21 available shapes including straight line, parabolic, simple harmonic, cycloidal, modified trapezoidal, modified sine, asymmetrical cycloidal, etc.

The electronic cam is an ideal mode for periodic operation, especially those requiring varying gear ratios along the motion cycle. Such applications include flying shears, rotating knives, and packaging systems.

Control System Architecture

The MP940 provides solutions for applications that previously required more wiring and additional controllers. It is designed to plug in to any size Sigma II servo amp and share a common backplane. All servo loops, trajectory planning, sequential and I/O control are included in a self contained servo/motion controller package. This reduces system bottlenecks, simplifies control and programming and boosts overall system performance. High performance MP940 motion control moves your machines and/or parts quickly and precisely to increase productivity and business profit.

Standalone Motion Control Applications

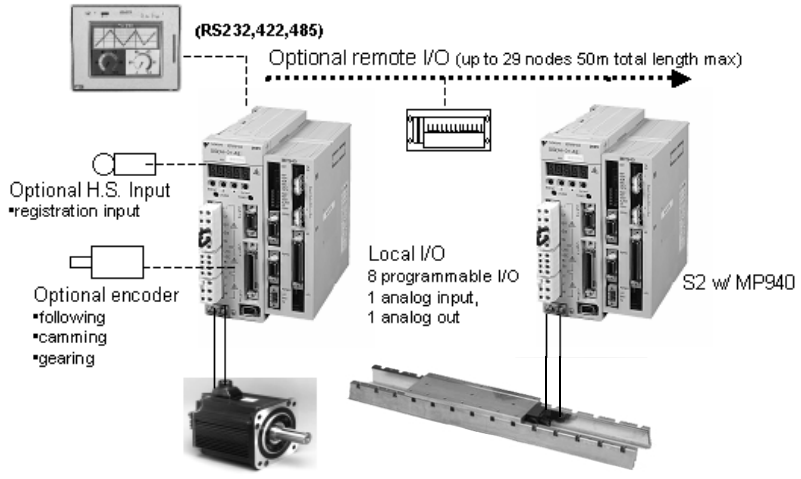


For applications with a fixed amount of I/O requirements, the MP940 includes a rich instruction set of ladder, math, and motion functions with 80kB of memory and 32-bit processing power for several motion programs, conditional logic, fault handling and power-up routines.

One serial RS232 interface port and one serial RS422/485 interface port utilize an industry standard Memobus protocol making digital adjustments of machine set-ups, parameters, and process variables easy to set up from an operator panel. HMI vendors include; Exor, Red Lion, Eason, Cimrex, TCP, etc.

System voltages (VAC): 100, 200 or 400
35 servo sizes: 13.5 in. oz. to 6120 in. lbs. peak torque.

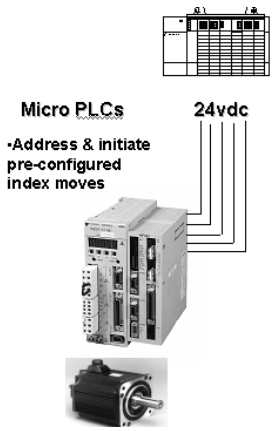
Standalone Distributed Control Applications



Larger systems link (no additional MP940 hardware requirements) remote I/O modules, and Sigma II/MP940 axes. Up to 8 bytes of input and 8 bytes of output data can be shared with each node in real time with up to 14 MP940 nodes per system. **Multiple servo axes can be synchronized within 2 ms.**

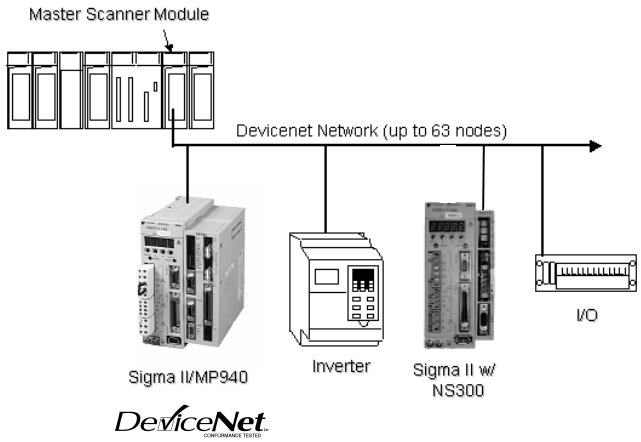
Eight standard panel mounted remote I/O modules:
- 16 pt. 12/24 VDC inputs
- 16 pt. 12/24 VDC outputs
- 8 pt. 100 VAC inputs
- 8 pt. 200 VAC inputs
- 8 pt. 100/200 VAC outputs
- 8 pt. relay outputs
- 4 pt. A/D inputs
- 4 pt. D/A outputs

Peripheral Connection to a PLC



A PLC is the most common type of machine control. However, suppliers have difficulty maintaining state of the art high performance motion control. The MP940 has unique features to help integrate it easily with an existing PLC control system:

- functions controlled via discrete I/O
- DeviceNet fieldbus interface

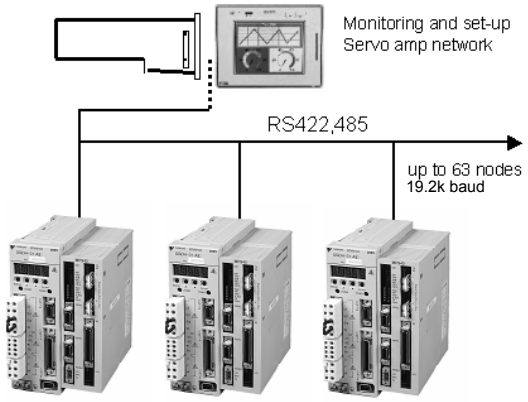


Recent advances in fieldbus increase the flexibility of communications with many different elements of the control system. MP940 allows high performance motion control wider accessibility from cell and process controllers. This simplifies monitoring, set-up and troubleshooting of the machine and process.

- ODVA conformance tested
- Device type: communication
- Supports DeviceNet poled I/O
- Baud rates: 125k, 250k or 500k (dip switch settable)
- Input/output packet size: 256 bytes

NOTE: The MP940 can be a master for other DeviceNet components, replacing the PLC in some applications.

Peripheral to an Operator Interface or PC



Each MP940 contains its own application(s) programs. They are enabled via interface and multiple servos. PC and operator interfaces facilitate monitoring and configuring processes, parameters, fault history, machine set-ups, offsets, overspeed setpoints, etc.

MP940 controllers mount on any Sigma II amp. Specifications shown are for packages of MP940 and Sigma II amp.

Programming Environment

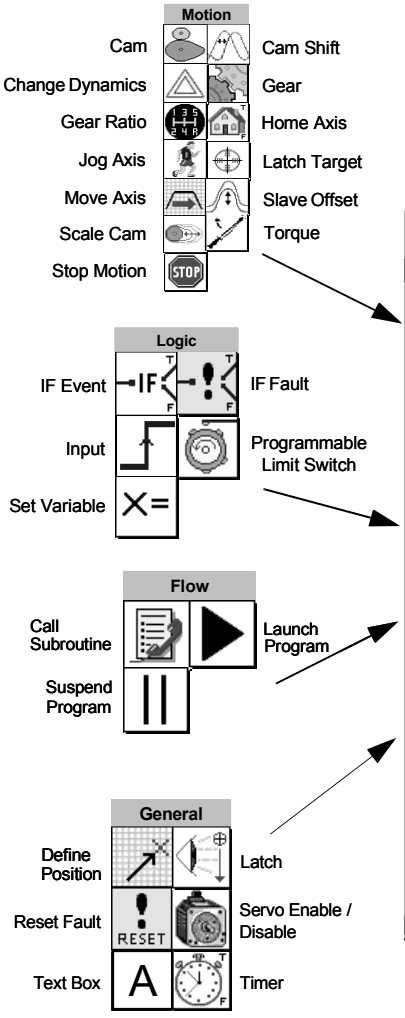
Yaskawa provides a choice of programming environments with the MP940.
1. MW+ is an intuitive icon based programming environment. -- part# CP717 Plus
2. LadderWorks provides a familiar PLC-style language. -- part# MPE720

Most local and distributed control applications that include sequential and process logic can easily be developed in the flow charting MW+ environment. In addition, an MW+ program can be opened within the Ladderworks environment for convenient shop floor monitoring and troubleshooting. Both MW+ and Ladderworks contain servo setup, tuning and troubleshooting utilities for charting position, I/O status, torque transitions, etc. during operation.

MotionWorks+™ (MW+) Software Features

Create programs by arranging motion and control icons in a visual flow chart. Setup wizards and simple menus guide you through controller setup, servo setup and tuning, variable management, and communications options. Monitoring tools for start-up and troubleshooting are included.

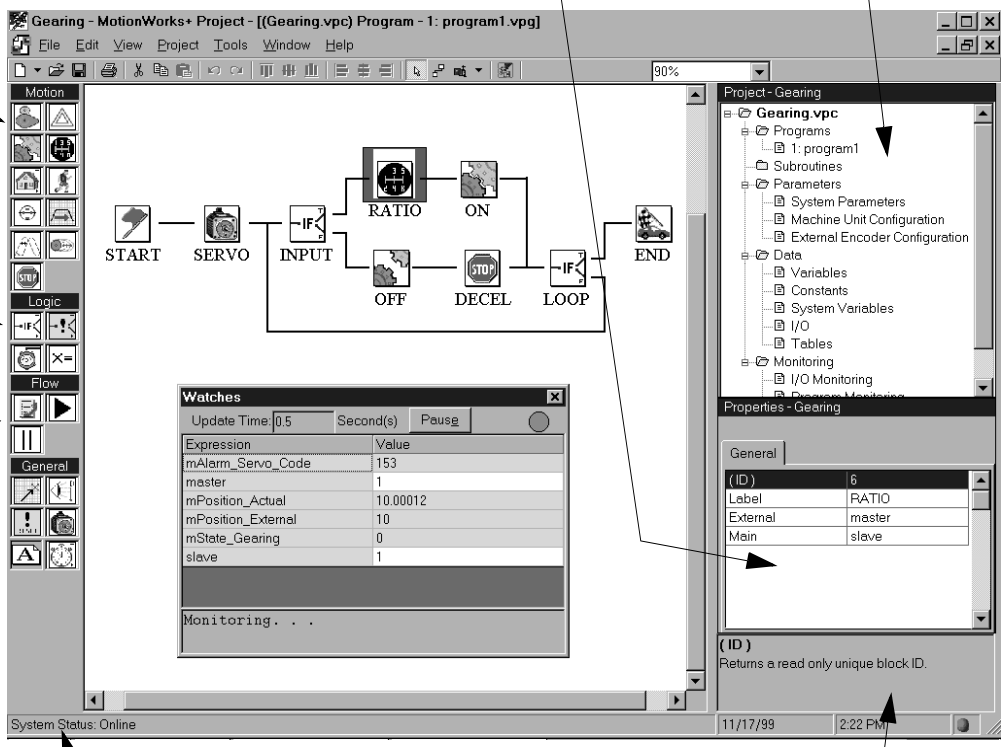
Drag and drop programming tools



Visual Basic™ like front end*

Tool box properties
- definable program priorities (high/low scan rates)
- real world tag names definable for I/O and variables

Project explorer
- up to 8 multi-tasking program files per project
- up to 62 subroutines for each program



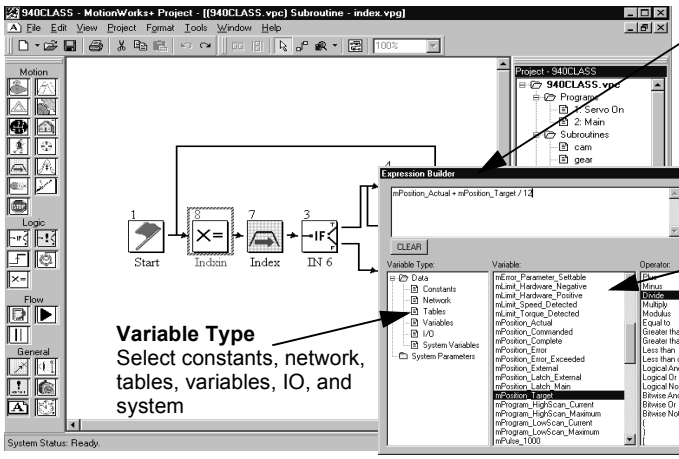
Choice of ON or OFF-line programming

Brief property descriptions
Complete on-line help manual included

* Visual Basic is a trademark of Microsoft

Capabilities and Performance

Object-based flow-charting language

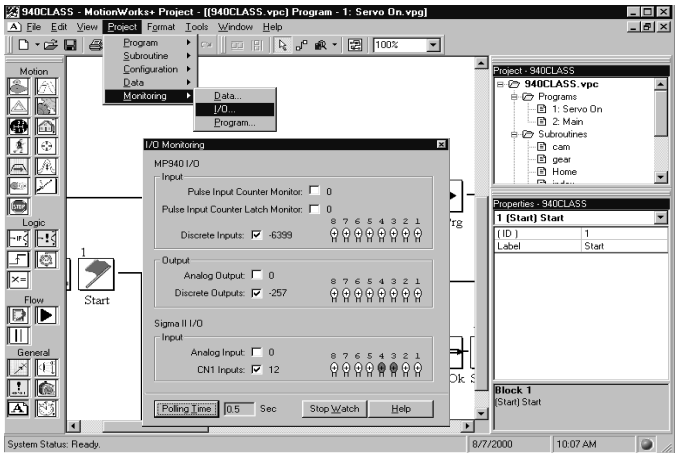


Expression Builder
- used for any object property that accepts an expression (examples; SET VARIABLE, MOVE AXIS, CHANGE DYNAMICS, etc.)
- logic expressions can be created for blocks such as IF EVENT and IF FAULT

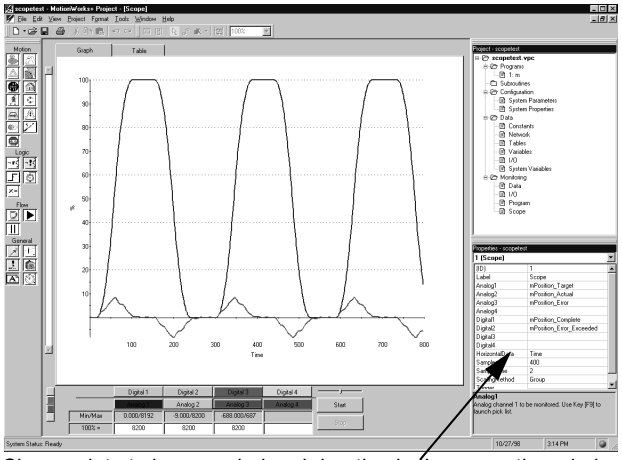
Variables
- Includes accessible system data
- Up to 72 readable system variables including actual position, speed, torque, network and controller variables, etc. that can be updated at run time

Math functions
select from this list that also includes trigonometric, square root, etc.

I/O Monitoring



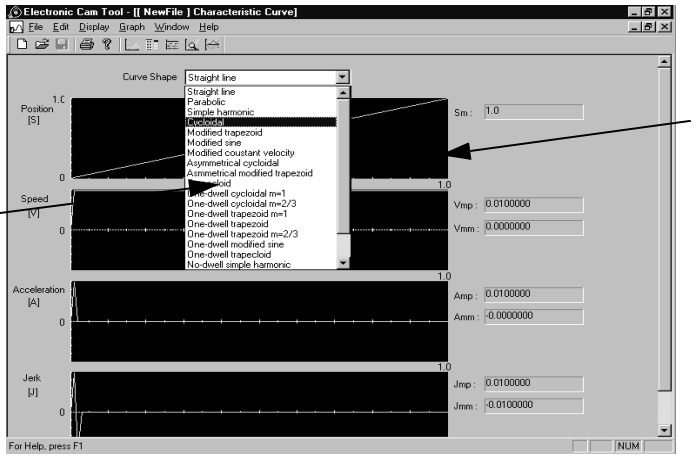
Troubleshooting Scope



Choose data to be recorded and duration in the properties window
Up to 8 separate data elements can be displayed simultaneously

Electronic Cam Tools

- A cam profile can be divided up to 20 definable sections with 4096 points
- Automatic interpolation between points
- Select cam curve shape for each section from 21 available shapes

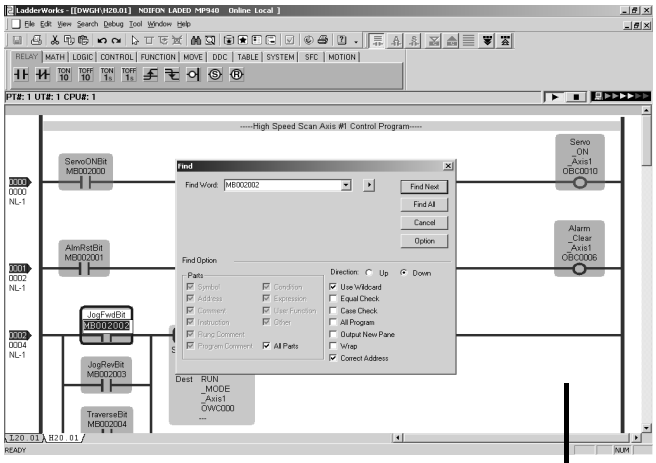


Data graph shows resulting cam profile from the information set provided from the parameter set-up window

MotionWorks™ (MW) Software Features

MotionWorks integrates motion, sequence, and process control within the widely accepted PLC programming environment. The Ladder works editor is ideal for those applications with larger amounts of ladder logic and I/O processing requirements within a motion control application. MotionWorks will upload a machine program developed in the MW+ environment for editing, monitoring, and/or debugging within a ladder environment.

Programming Environment



Traditional Relay Logic

Comparison Functions

Controlling Program Flow

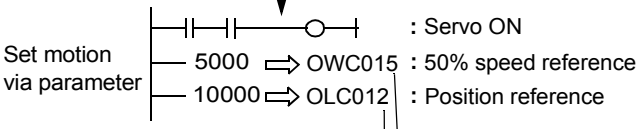
Standard Math Instructions

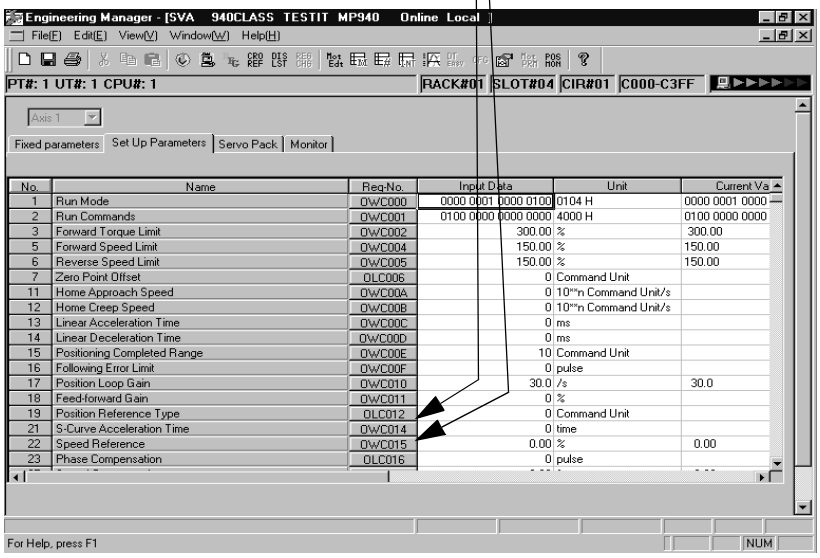
Advanced Math Instructions

Additional instructions include:

- Controlling memory registers - 9 instructions
- Advanced control algorithms - 9 instructions
- Data table controls - 9 instructions
- System - 6 instructions

Register based motion programming

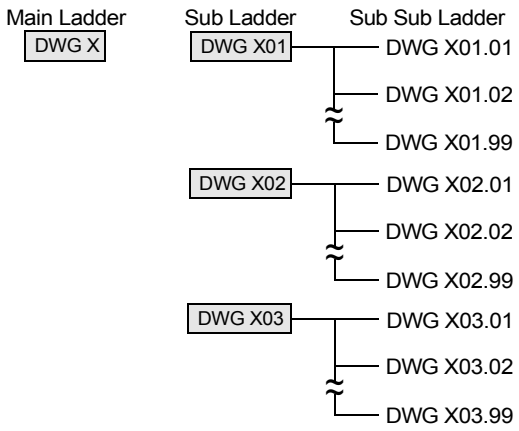




Program Management and Documentation

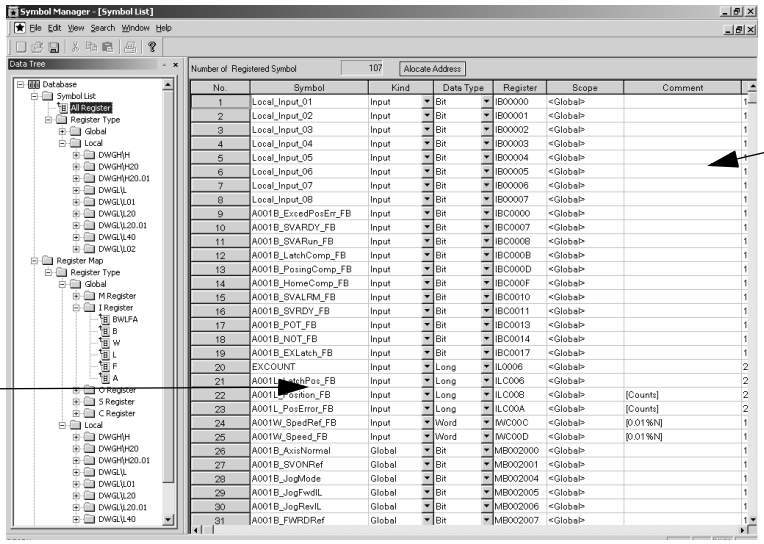
Programs are managed in drawing unit (DWG). Drawings are hierarchically ordered at the basic, detailed, and expanded levels, and are grouped by program process to clarify the structure of the program. There are three types of drawings; initialization, high-speed scanning, and low-speed scanning.
The advantages are:

- Programs are standardized as drawings, making reuse possible.
- Using merge and copy reduces design time.
- Drawings can be managed by regrouping them by processes, functions, and designers. This reduces scan time by only executing the programming for a required drawing.
- Password protection at the drawing level



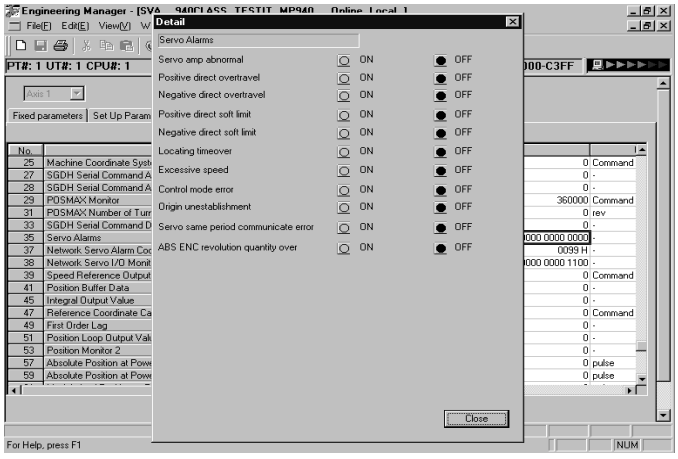
System configuration

The File Manager program provides the administrative functions for all MotionWorks files (hardware configuration, register files, I/O,communication functions, etc.)



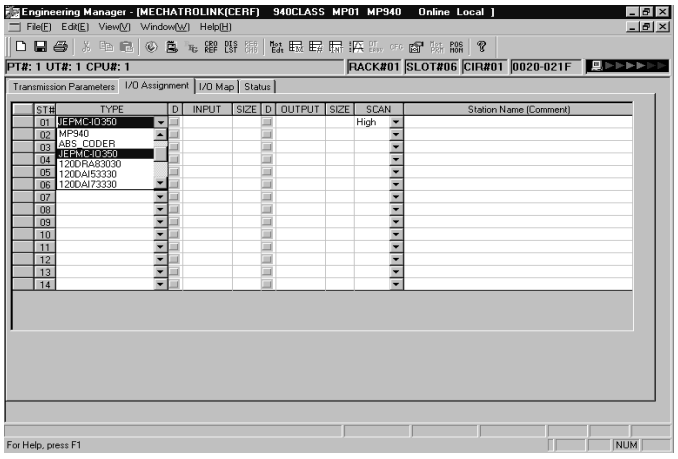
Monitoring

Register list
Tuning Panel for adjustments



Network Configuration

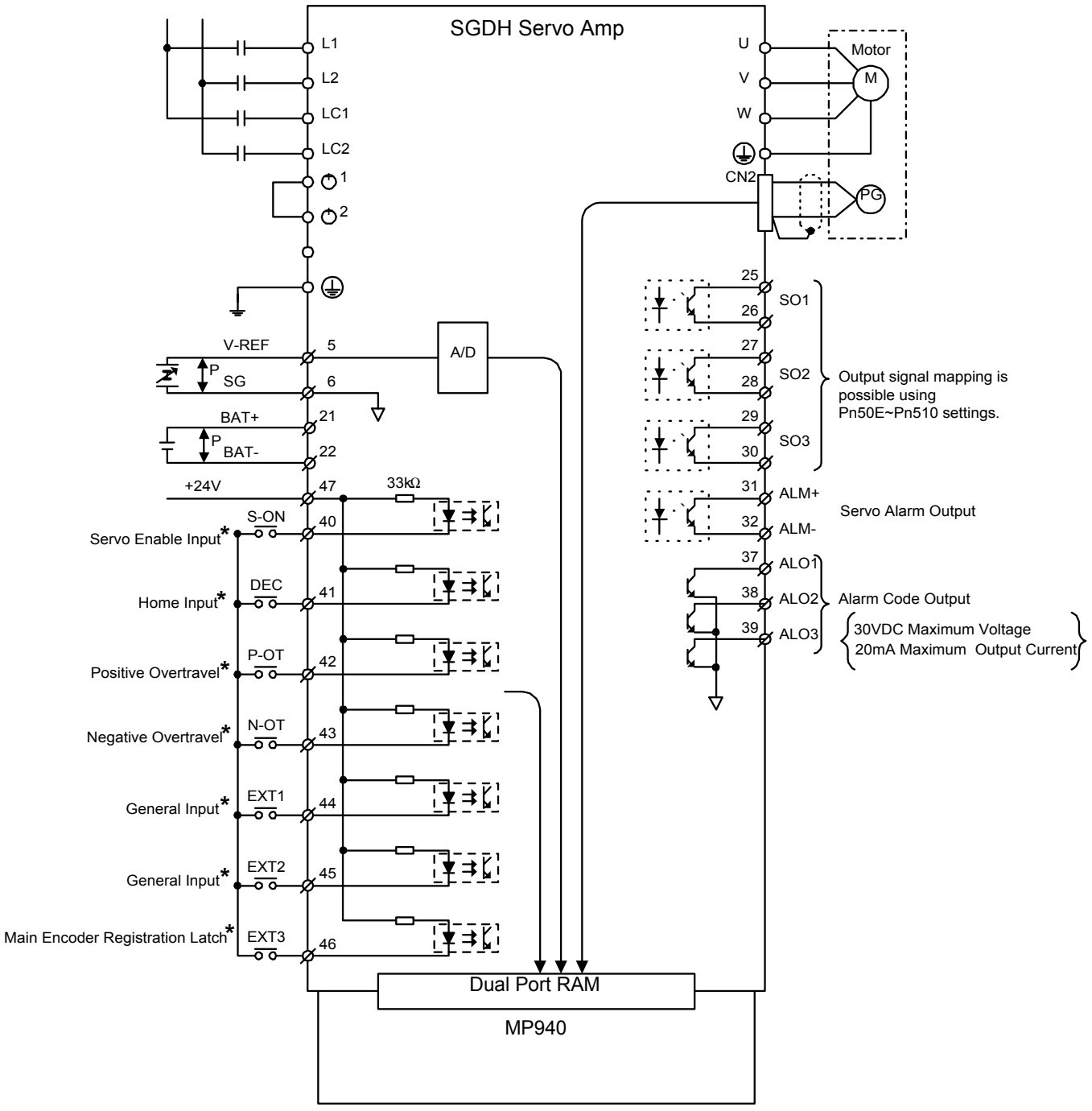
Serial port, network, I/O counter module



MP 940

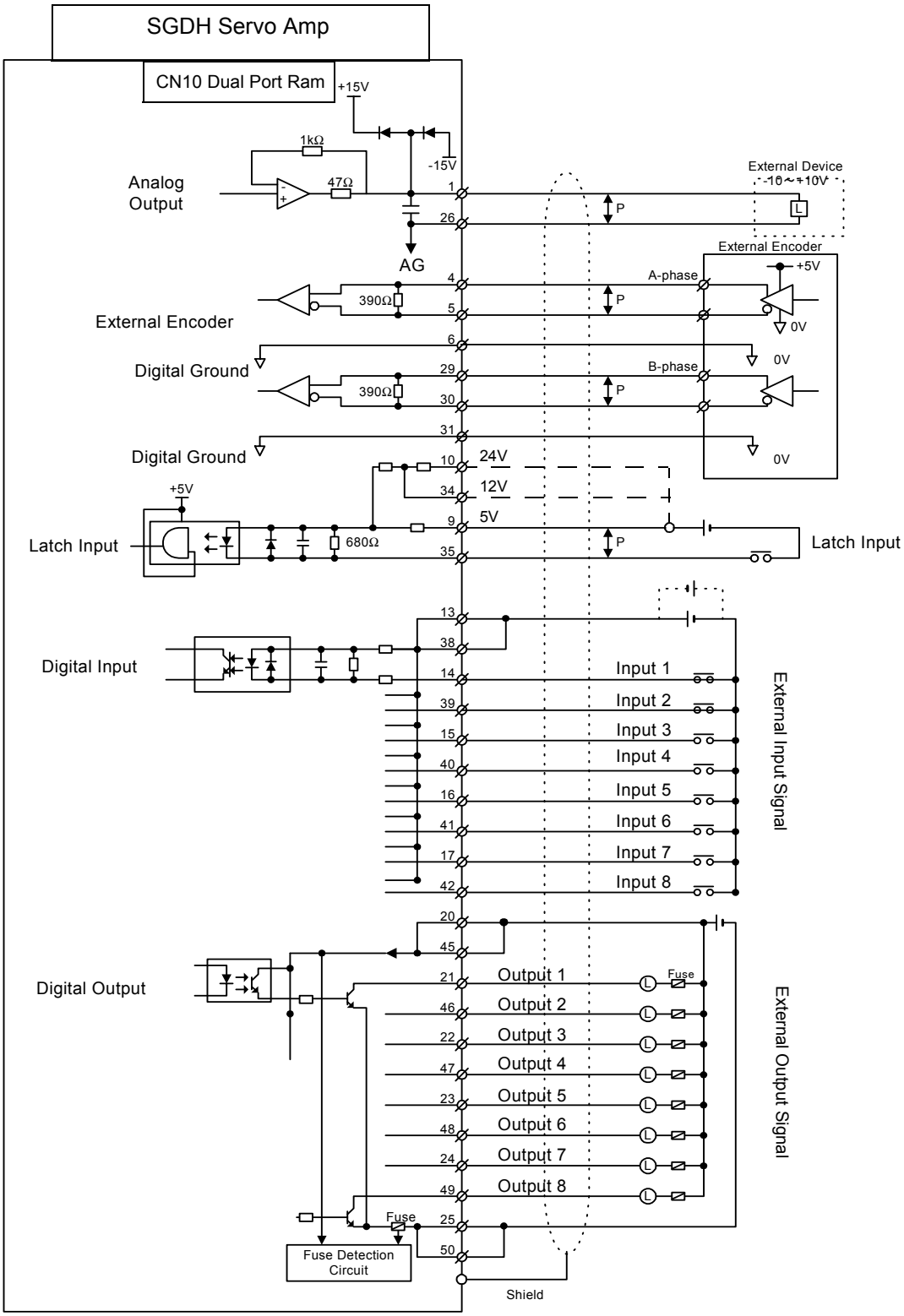
I/O Connections

Example of I/O Signal Connector



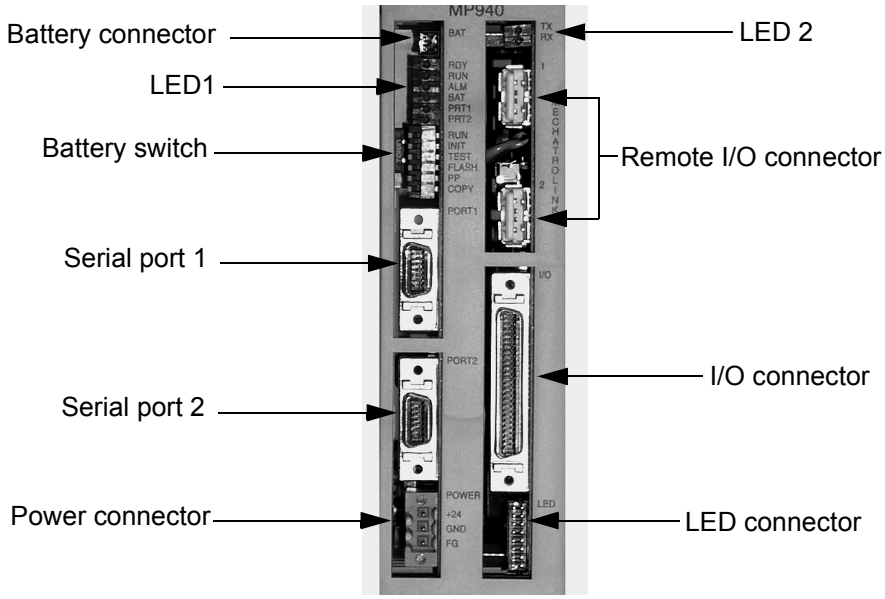
* Typical application usage. All inputs can be programmable (re-allocated for other system uses).

MP940 Application Module I/O



MP940 controllers mount on any Sigma II amp. Specifications shown are for packages of MP940 and Sigma II amps

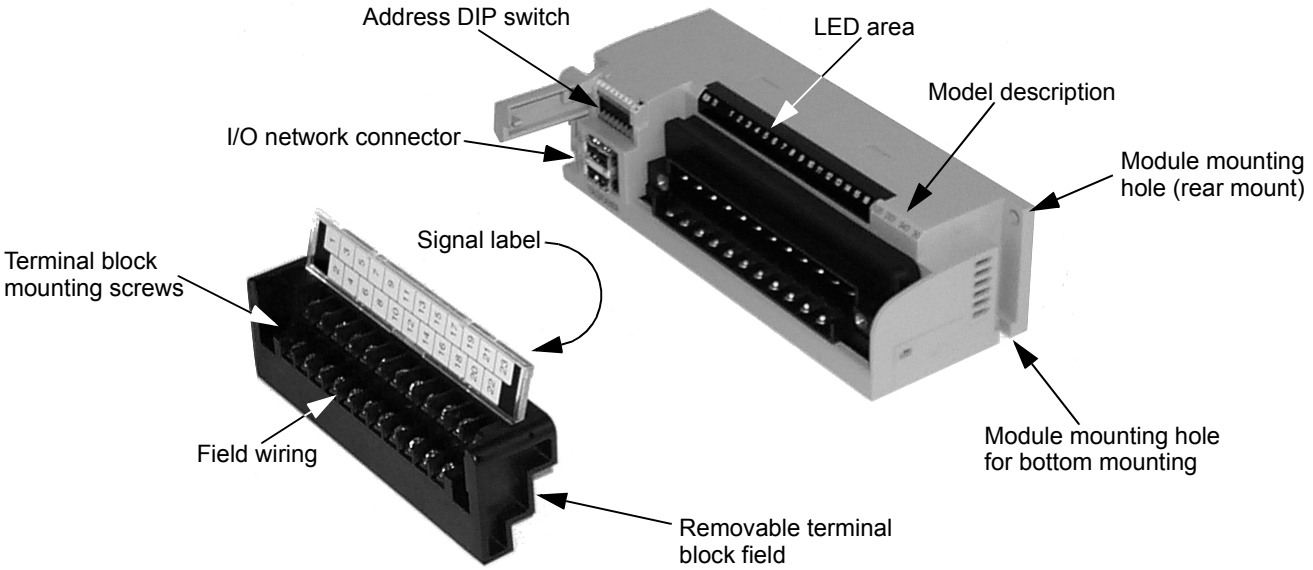
MP940 Ratings and Specifications



Specifications	
Microprocessor	486DX2, 64MHz, 32-bit, floating decimal
System / programmable memory	2 mB RAM, 2 mB flash / 80kB, approx. 2000 user program lines
Inputs*	
— Analog	1 @ +/- 12V, 16 bit resolution
— Digital - programmable	8
— Digital - programmable	7 (typically dedicated for Home, Overtravel, Servo-ON, etc.)
— H. S. Digital (Registration)	2 @ 30μs
Outputs*	Standard
— Analog	1 @ +/- 10V, 16 bit resolution
— Digital - programmable	8
Network communications	Remote IO standard (Mechatrolink™) or optional DeviceNet™
Position	
— Position loop update period	500μs
— Resolution	32-bit (+/- 2,147,483,648 encoder counts)
Velocity	
— Velocity loop response	400Hz
— Resolution	0.01%
Control input power	24VDC, 0.4A
Servo System Specifications	
Motor feedback resolution / standard (post quadrature)	13-bit incremental encoder (8,192PPR) for motors below 1hp
	17-bit incremental encoder (131,768PPR) for motors above 1hp
Motor feedback resolution / optional	16-bit absolute encoder for motors below 1hp
	17-bit incremental/absolute for motors above 1hp
Linear motor feedback resolution / standard	0.078 micron (using 20 micron linear scale pitch)
Amplifier sizes	115 V_{ac} single-phase, 30 to 200W
	230 V_{ac} single-phase, 30W to 1.5kW
	230 V_{ac} three-phase, 500W to 15kW
	480 V_{ac} three-phase, 500W to 55kW
Environmental	
Ambient/Storage Temperature	0° to 55°C / -20° to 85°C
Global Safety Certifications	UL, CUL, CE, TUV

* Including those used on SGDH amplifier

Remote I/O Ratings and Specifications



Type	Items	Specifications
INPUT	**12 / 24 VDC MODULE**	
	Model	JAMSC-120DDI34330
	Input points, Common	16 points, 8 points/common, 2 common
	Rated voltage / Range / Max.	12/24 VDC / Min. ON voltage: 9 VDC, Max. OFF voltage: 5 VDC / 30 VDC max.
	Rated current	2.5 mA (12VDC) Sink/source / 5 mA (24VDC) Sink/source
	Input delay time / Impedance	OFF to ON: 5 ms max., ON to OFF: 5 ms max. / 3.0 kΩ
	External power requirements	For module: 24 VDC (20.4 to 26.4 V), 90 mA (when all points ON)
	ANALOG INPUT MODULE	
	Model	JAMSC-120AVI02030
	Input signal range / delay time	-10 to +10 V rated, ±20 V - 20 mA max. load / 4 ms or less
	Number of input channels	4 input channels (isolated), 1 MΩ or more input impedance
	Digital resolution / error	16 bits / ± 0.5% F. S. (25° C), ± 1.0% F. S. (0 to 60° C)
	Sampling cycle	Every communication cycle with watch dog timer
	Status display	Module normal: RDY illuminates Connection waiting: green light blinks (communication cables are connected or master stopped communication) Sending data: TX (green) illuminates, receiving data: RX (green) illuminates Communication error: ERR (red) blinks, setting error, hardware error: FLT (red) illuminates Overrange detected at each channel: CH1 to CH4 illuminates (overrange: +10.02 V < each channel input signal or each channel input signal < -10.02)
	External power requirements	24 VDC 120 mA or less
	INPUT MODULES - 100VAC / 200VAC	
	Model - 100VAC / 200VAC	JAMSC-120DAI53330 / JAMSC-120DAI73330
	Input points, Common	8 points/common, 1 common
	Rated voltage / frequency / range (100VAC)	100 VAC, 132 VAC max. / 50/60 Hz / ON range: 74 to 132 VAC, OFF range: 30 VAC or less
	Rated voltage / frequency / range (200VAC)	200 VAC, 246 VAC max. / 50/60 Hz / ON range: 159 to 264 VAC, OFF range: 40 VAC or less
	Inrush / rated current (100VAC)	160 mA / 7 mA (100 VAC 50 Hz)
	Inrush / rated current (200VAC)	320 mA / 7 mA (200 VAC 50 Hz)
	Input delay time	OFF to ON: 20 ms max., ON to OFF: 35 ms max.
	Impedance - (100VAC) / (200VAC)	14.3 kΩ (50 Hz), 12.5 kΩ (60 Hz) / 28.6 kΩ (50 Hz), 23.1 kΩ (60 Hz)
	External power requirements	80 mA or less (when all points ON)

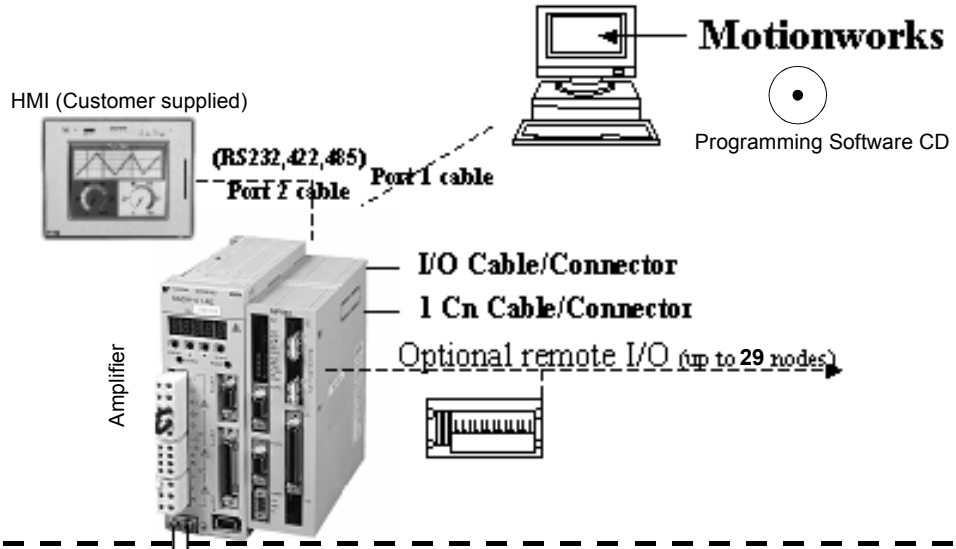
Type	Items	Specifications
OUTPUT	**12 / 24 VDC MODULE**	
	Model	JAMSC-120DDO34340
	Output points	16 points, 8 points/common, 2 common
	Rated / allowable voltage / drop	12/24 VDC / 10.2 to 30 VDC / 1.5 V max. (0.3 A)
	Max. load current / output delay time	0.3 A/point / OFF to ON: 1 ms max., ON to OFF: 1 ms max.
	Output type, leakage current (OFF)	Transistor, 1 mA max. (24 VDC) Sink output
	Built-in fuse	3.5 A, 2 fuses, 1/common, burn out time: within 5 sec. @ 200% rated current
	External power requirements	For driving load: 110 mA (when all points ON)
	ANALOG OUTPUT MODULE	
	Model	JAMSC-120AVI01030
	Output signal range / delay time	-10 to +10 V / 1 ms or less
	Max. allowable load current	±5 mA (2 kΩ)
	Digital resolution / error	16 bits / ± 0.2% F. S. (25° C), ± 0.5% F. S. (0 to 60° C)
	Output at CPU stop	Select mode with the dip switch: • clear output (0 V output) • holding the previous output
	Status display	Module normal: RDY illuminates Connection waiting: green light blinks Sending data: TX (green) illuminates, receiving data: RX (green) illuminates Communication error: ERR (red) blinks, setting error, hardware error: FLT (red) illuminates
	External power requirements	24 VDC 120 mA or less
	OUTPUT MODULE - 100VAC / 200VAC	
	Model	JAMSC-120DAO83330
	Output points, Common	8 points/common, 1 common
	Rated / allowable voltage / frequency	100/200 VAC / 80 to 264 VAC / 50/60 Hz
	Max. load current / output type	0.6 Arms/point, 2.4 A/common / triac output w/varister surge suppressor
	Output voltage drop / delay time	1.0 Vms / OFF to ON: 10 ms max., ON to OFF: 1/2 max. cycle +5 ms
	Min. open/close current leakage	10 mArms
	Built-in fuse	3 A 1 fuse, 1/common (burn out time: within 1 sec @ 200% rated current)
	External power requirements	100 mA or less (when all points ON)
	RELAY OUTPUT MODULE	
	Model	JAMSC-120DRA83030
	Output points	8 relay contacts/module; each point independent
	External power supply voltage	+24 VDC (+19.2 to +30 VDC)
	Internal power supply voltage	+5 to +24 VDC, isolation DC/DC converter
	Load voltage	24 VDC, 100/200 VAC
	Min. open/close capability	100 mVDC, 0.1 mA
	Max. open/close voltage	264 VAC, 125 VDC
	Contact resistance	100 mΩ or less
	Relay life (life varies according to current level and ambient temperature)	Electrical life: 150,000 times or more (250 VAC, 3A), 100,000 times or more (30 VDC, 5A) Mechanical life: 20,000,000 times or more
	Response time	ON to OFF: 15 ms or less, OFF to ON: 10 ms or less

INPUT/ OUTPUT	**64-Point I/O MODULE**	
	Model	JEPMC-IO350
	I/O signal ratings	Input: 64 points, 24 VDC, 5mA, sink/source Output: 64 points, 24 VDC, 100 mA per point (50mA when all points ON, sink output)
	Module power supply requirements	24 VDC (20.4 V to 28.8 V), Rated current: 0.5 A, Inrush current: 1 A

Selecting Your Sigma II MP940 Motion System

Use the tables beginning on the following page to specify choice of MP940 cables, mating connectors only, set-up and monitoring tools, and software.

System Configuration



Power Components

Additional regeneration resistor capacity (if necessary), optional DC reactor, etc.

Pre-wired power and feedback cables.

Connector kits for local cable assembly

Sigma II Servomotor

Linear Motor

Specify any hardware or software technical manuals, if needed, on the servo system purchase order: refer to page 74.

(Manual is provided at no charge with a purchase order upon request)

User Manual for linear motor YEA-S800-39.11

Power Components

(motor, amplifier, and connections for power and feedback)

Select the required power components (servomotor, power and feedback connectors or pre-wired cables, amplifier, regenerative packs, etc.) from the following catalog pages.

Use this table to determine which catalog section describes the best servomotor for the application.

Application Requirements (Maximum)			Number of Motor Sizes	System Voltage and Sigma II Servomotor Series				Selection Guide for Power Components Page Number *
Speed (rpm)	Rated Torque oz • in [lb • in]	Peak Torque oz • in [lb • in]		$100V_{ac}$ Single-phase	$200V_{ac}$ Single-phase	$200V_{ac}$ Three-phase	$480V_{ac}$ Three-phase	
5000	338	1010	6	SGMAH	SGMAH	—	—	11
5000	676	2027	5	SGMPH	SGMPH	—	—	29
3000	[845]	[1988]	10	—	—	SGMGH	—	57
5000	[140]	[422]	6	—	—	SGMSH	—	85
3000	[845]	[1988]	10	—	—	—	SGMGH	127
5000	[140]	[422]	6	—	—	—	SGMSH	139
6000	[43]	[190]	2	—	—	—	SGMUH	139
2000	[1240]	[6120]	5	—	—	—	SGMBH	165

* Yaskawa publication: *Sigma II Servo System Product Catalog Supplement* G-MI#99001E.
Linear Motor Catalog KAE-S800-39.10

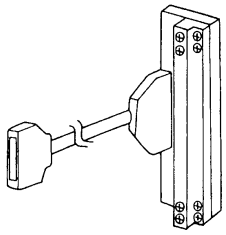
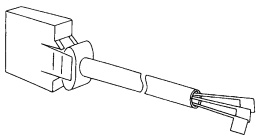
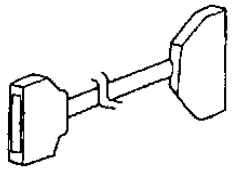
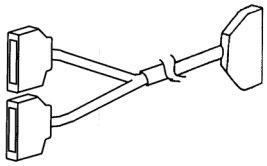
MP940 System Selection

Component Description	Part Number	Item Class
MP940 Application Module*	JEPMC-MC400	Stock
MP940 with DeviceNet	JEPMC-MC410	

* Includes optional remote I/O network interface as standard

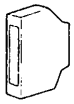
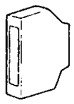
Use the Sigma II Application Module Mounting Dimensions on pages 75 to 82 for determining overall MP940 panel space requirements. For 480VAC large capacity amplifiers (22 - 55kW), refer to the Sigma II catalog for amp dimensions.

I/O Interface Cable Selection

Component Description **(E)**		Part Number	Comments	Item Class
1CN and I/O Cable & Transition Terminal Block		JUSP-TA50P	35mm DIN rail mountable; the cable length is 0.5m.	Stock
1CN and I/O Cable with Pigtail Leads		JZSP-CKI01-□(A)*	Use the following key to specify required cable length (last digit of the part number): 1: 1m (standard) 2: 2m 3: 3m	
Input/Output 1CN Cable Cable with Female D-Sub output Connector		JZSP-CKI0D-□□**	Use the following key to specify required cable length (last two digits of the part number): D50: 0.5m 01: 1m (standard) 02: 2m 03: 3m	
Cable with Female D-Sub* output Connec-tor Applicable only for SGDH-1E (15 kW) and below.		CKI-MP940D-□□□**	Use the following key to specify required cable length (last two or three digits of the part number): D50: 0.5m 01: 1m (standard) 02: 2m 03: 3m	

* The "(A)" at the end of the cable part number indicates the revision level. Revision level may be subject to change prior to the catalog reprinting.
** 50 pin female D-Sub output connector mates to customer supplied third party terminal block. (e.g., Wago #289-449, Weidmuller #919658, Phoenix #2283647, Amphenol/Sine #20-51039, and many others.

Mating Connector Selection

Component Description **(E)**		Part Number	Comments	Item Class
1CN and I/O Mating Connector		JZSP-CKI9	for SGDH I/O 50-pin	Stock
4CN Mating Connector		DP-9420007	Solder type with cover	
DeviceNet mating connector (for JEPMC-MC410 only)	—	YDN-1*	Alternate source: USA Phoenix Contact part number: MSTB2.5/5-STF-5.08AU	
Port 1 and 2 Mating Connector only	—	YSC-1	—	
5CN Analog Monitor Connector	—	DE9404559	—	

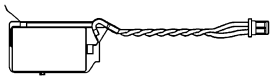
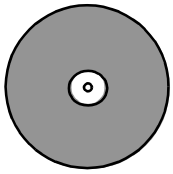
* This mating connector is already included w/the JEPMC-MC410 application module

Optional Remote I/O Modules

Up to 14 modules can be connected. Use cables that are not longer than 50m total network length. Reference detail specifications and dimensions starting on page 75.

Component Name	Description	Model JAMSC-	Item Class
64-Point I/O Module	24 VDC, 64 point inputs, 64 point outputs	(JEPMC-IO350)	Stock
DC Input Module	12/24 VDC, 16 point inputs, 5 mA / point	120DDI34330	
DC Output Module	12/24 VDC, 16 point outputs, 0.3 A / point, sink type	120DDO34330	
AC Input Module	100 VAC, 8 point inputs, 7 mA / point	120DAI53330	
AC Input Module	200 VAC, 8 point inputs, 7 mA / point	120DAI73330	
AC Output Module	100/200 VAC, 8 point inputs, 0.6 A / point 2.4 A / 8 points	120DAO83330	
Relay Module	Wide range voltage relay contact: 8 point outputs, 1A / point	120DRA83030	
A/D Module	A/D -10 to +10 V, 4 channels	120AVI02030	
D/A Module	D/A -10 to +10 V, 2 channels	120AVI01030	
Mechatrolink Network Cable	0.5 meter USB-USB	JEPMC-W6000-A5	
Mechatrolink Network Cable	1.0 meter USB-USB	JEPMC-W6000-01	
Mechatrolink Network Cable	3.0 meter USB-USB	JEPMC-W6000-03	
Mechatrolink Network Cable	5.0 meter USB-USB	JEPMC-W6000-05	
Mechatrolink Network Cable	10.0 meter USB-USB	JEPMC-W6000-10	
Mechatrolink Network Cable	20.0 meter USB-USB	JEPMC-W6000-20	
Mechatrolink Network Terminator Plug	----------	JEPMC-W6020	

Peripheral Device Selection

Component Description **(E)**		Part Number	Comments	Item Class
Battery		BA000518	3.6V, 1000mAh (lithium battery) Battery backup for current values of motion program variables and axis position. Programs are stored in non-volatile memory.	Stock
Interface Cable	Port 1	YS-15	Pre-wired 3.0m cable with 9-pin connector (RS232)	
	Port 2	YS-14	Pre-wired 3.0m cable with pig tail leads	
MotionWorks™ Software w/ Ladder Editor MotionWorks+ Icon Graphic Programming Software		MPE720* CP717 Plus**	System setup, programming, debugging, and maintenance software. Choose one. If there is no clear preference for either Icon or Ladder based programs, Yaskawa recommends Icon based programming for most motion applications. For applications that include a larger amount of machine sequencing logic, Ladder based MotionWorks may be preferred.	Stock

* Use the following publications for MotionWorks (MPE720) and Ladderworks Programming environments:
- MP940 Reference Manual - YEA-SIA-C887-4.2A
- MotionWorks File Manager/Engineering Manager Manual (Chapters 4 & 5) - SIEZ-C887-2.2-1
- Ladder Works Programming Manual - YEA-SIA-C887-2.1
- Ladder Editor Operator's Manual - YEA-SIA-C887-2.3B

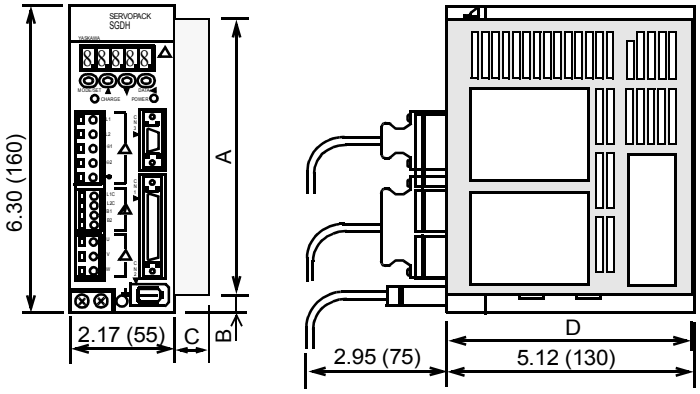
** Use the following publications for MotionWorks (CP717 Plus) Programming environments:
- MP940 Hardware Manual - YEA-SIA-C887-4.1A
- Icon based Programming Manual - YEA-SIA-C887-1.5E

Use the following publication for R - network I/O modules:
- YEA-SIA-C887-5.1

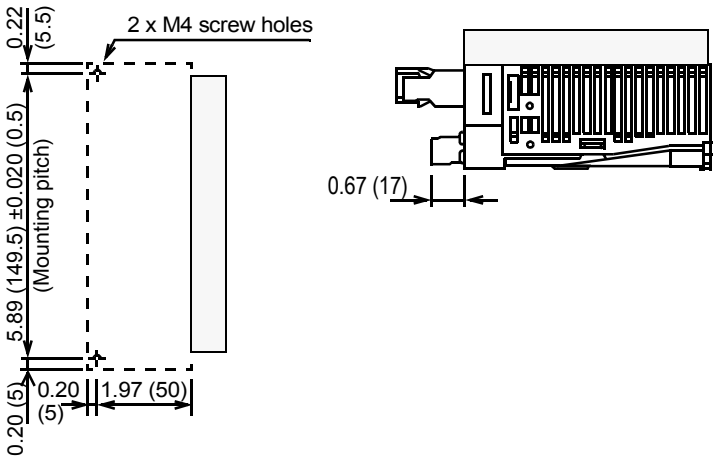
Dimensions in inches (mm)

SGDH Servo Amplifier/Application Modules

- **SGDH-A3AE to -02AE (200V Single-phase, 30 to 200W) and**
- **SGDH-A3BE to -01BE (100V Single-phase, 30 to 100W)**



Mounting Hole Diagram



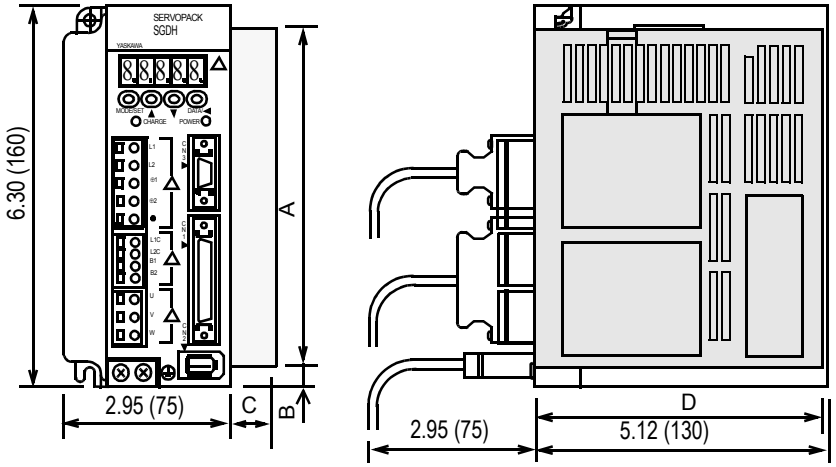
Part Number	SGDH Option Description	A	B	C	D	Approximate Mass** lb (kg)
JUSP-NS100	Mechatrolink	5.59 (142)	0.35 (9)	0.79 (20)	5.08 (129)	0.44 (0.2)
JUSP-NS300	Indexer with DeviceNet™					
JUSP-NS310	Indexer with DeviceNet™	5.67 (144)	0.32 (8)		5.24 (133)**	0.7 (0.32)
JUSP-NS500	Profibus	5.59 (142)	0.35 (9)		5.08 (129)	0.44 (0.2)
JUSP-NS600	Indexer					
JUSP-FC100	Full Closed Loop					
MP940	Single Axis Control			1.22 (31)***		0.89 (0.40)

* Option card only.

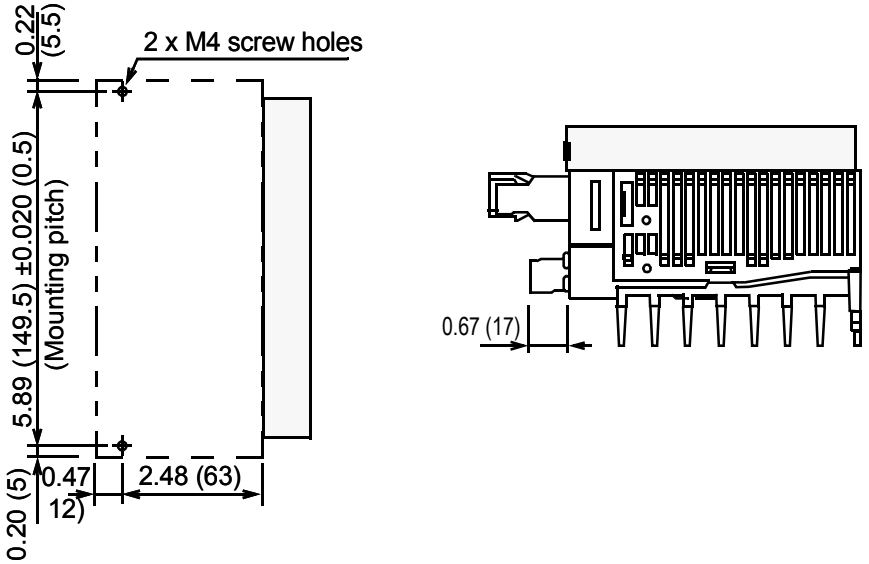
** Add 0.75in (19mm) to front end of card for micro connector.

*** Add approx. 0.75in (19mm) for optional back-up battery.

- **SGDH-04AE (200V Single-phase, 400W),**
- **SGDH-02BE (100V Single-phase, 200W) and**
- **SGDH-04FE (100V Single-phase, 400W)**



Mounting Hole Diagram



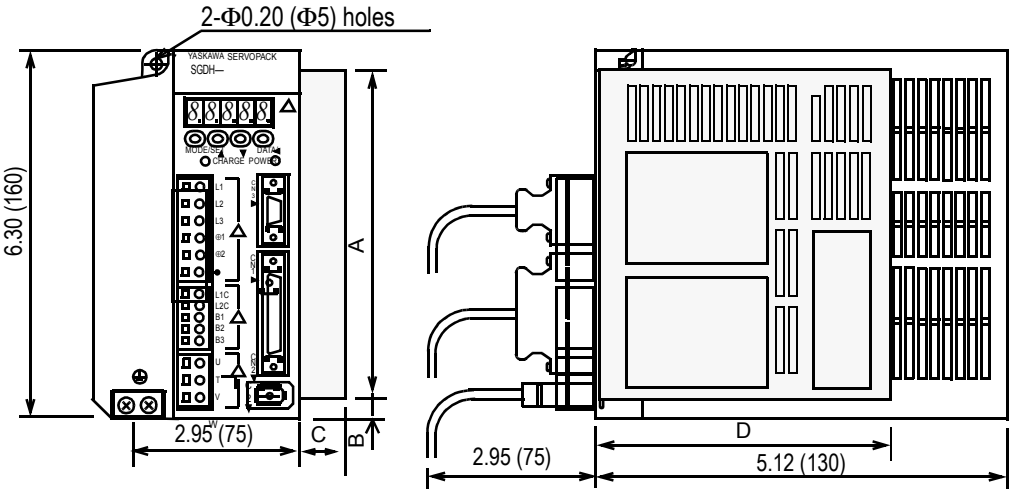
Part Number	SGDH Option Description	A	B	C	D	Approximate Mass** lb (kg)
JUSP-NS100	Mechatrolink	5.59 (142)	0.35 (9)	0.79 (20)	5.08 (129)	0.44 (0.2)
JUSP-NS300	Indexer with DeviceNet™					
JUSP-NS310	Indexer with DeviceNet™	5.67 (144)	0.32 (8)		5.24 (133)**	0.7 (0.32)
JUSP-NS500	Profibus	5.59 (142)	0.35 (9)		5.08 (129)	0.44 (0.2)
JUSP-NS600	Indexer					
JUSP-FC100	Full Closed Loop					
MP940	Single Axis Control			1.22 (31)***		0.89 (0.40)

* Option card only.

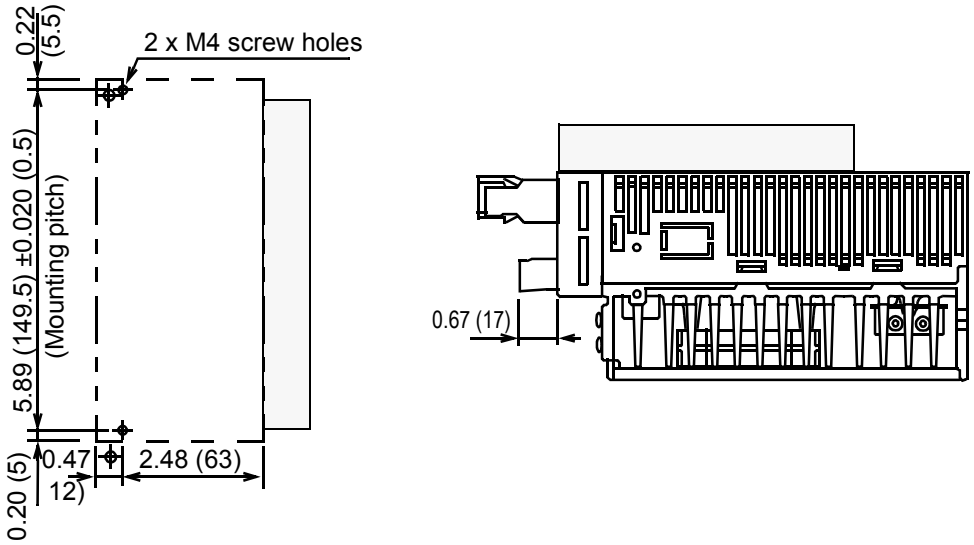
** Add 0.75in (19mm) to front end of card for micro connector.

*** Add approx. 0.75in (19mm) for optional back-up battery.

- **SGDH-05AE to -10AE (200V Three-phase, 0.5 to 1.0kW)**
- **SGDH-08AE-S (200V* Single-phase, 750W)**



Mounting Hole Diagram



Part Number	SGDH Option Description	A	B	C	D	Approximate Mass* lb (kg)
JUSP-NS100	Mechatrolink	5.59 (142)	0.35 (9)	0.79 (20)	5.08 (129)	0.44 (0.2)
JUSP-NS300	Indexer with DeviceNet™					
JUSP-NS310	Indexer with DeviceNet™	5.67 (144)	0.32 (8)		5.24 (133)**	0.7 (0.32)
JUSP-NS500	Profibus	5.59 (142)	0.35 (9)		5.08 (129)	0.44 (0.2)
JUSP-NS600	Indexer					
JUSP-FC100	Full Closed Loop					
MP940	Single Axis Control			1.22 (31)***		0.89 (0.40)

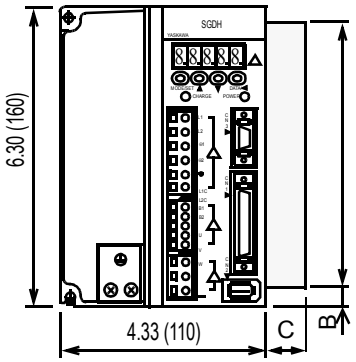
* Option card only.

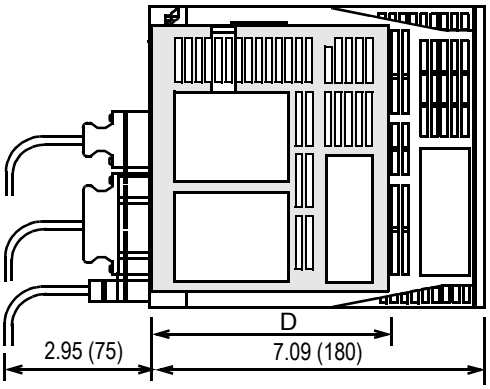
** Add 0.75in (19mm) to front end of card for micro connector.

*** Add approx. 0.75in (19mm) for optional back-up battery.

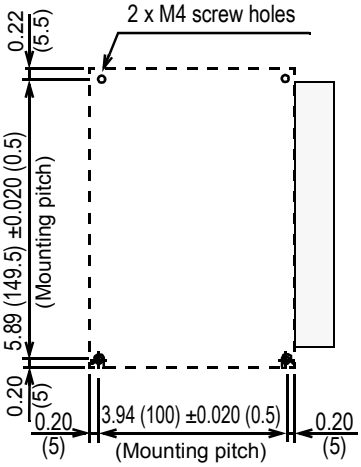
* Rating 200 to 230V_{ac} +10% -5%

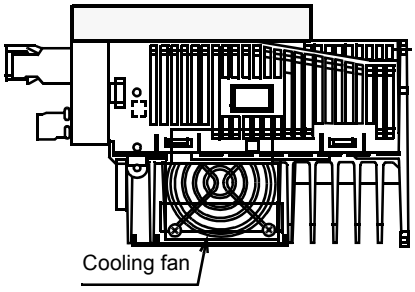
- **SGDH-15AE (200V Three-phase, 1.5kW)**
- **SGDH-05DE (400V Three-phase, 0.5kW to 1.5kW)**





Mounting Hole Diagram





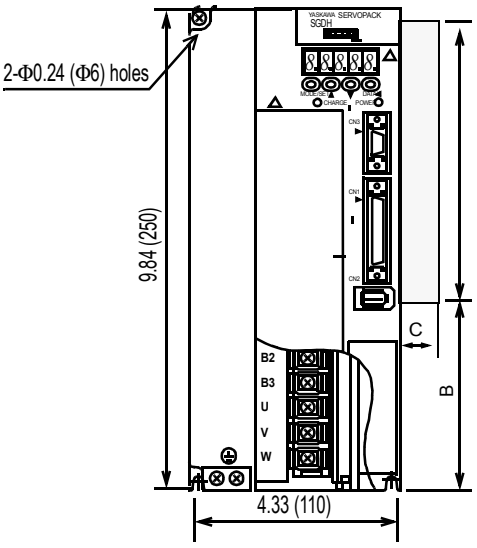
Part Number	SGDH Option Description	A	B	C	D	Approximate Mass** lb (kg)
JUSP-NS100	Mechatrolink	5.59 (142)	0.35 (9)	0.79 (20)	5.08 (129)	0.44 (0.2)
JUSP-NS300	Indexer with DeviceNet™					
JUSP-NS310	Indexer with DeviceNet™	5.67 (144)	0.32 (8)		5.24 (133)**	0.7 (0.32)
JUSP-NS500	Profibus	5.59 (142)	0.35 (9)		5.08 (129)	0.44 (0.2)
JUSP-NS600	Indexer					
JUSP-FC100	Full Closed Loop					
MP940	Single Axis Control			1.22 (31)***		0.89 (0.40)

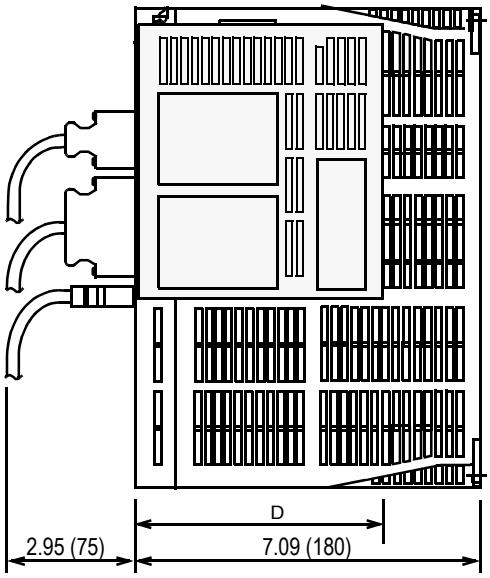
* Option card only.

** Add 0.75in (19mm) to front end of card for micro connector.

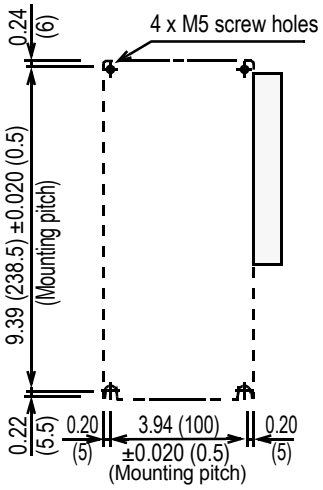
*** Add approx. 0.75in (19mm) for optional back-up battery.

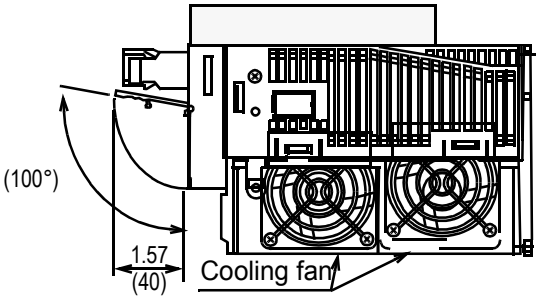
- **SGDH-20AE, 30AE (200V Three-phase, 2.0kW, 3.0kW)**
- **SGDH-15AE-S (200V Single-phase, 1.5 kW)***
- **SGDH-20DE, 30DE (400V Three-phase, 2.0kW, 3.0kW)**





Mounting Hole Diagram





Part Number	SGDHG Option Description	A	B	C	D	Approximate Mass** lb (kg)
JUSP-NS100	Mechatrolink	5.59 (142)	3.9 (99)	0.79 (20)	5.08 (129)	0.44 (0.2)
JUSP-NS300	Indexer with DeviceNet™					
JUSP-NS310	Indexer with DeviceNet™	5.67 (144)	3.86 (98)		5.24 (133)**	0.7 (0.32)
JUSP-NS500	Profibus	5.59 (142)	3.9 (99)		5.08 (129)	0.44 (0.2)
JUSP-NS600	Indexer					
JUSP-FC100	Full Closed Loop					
MP940	Single Axis Control			1.22 (31)***		0.89 (0.40)

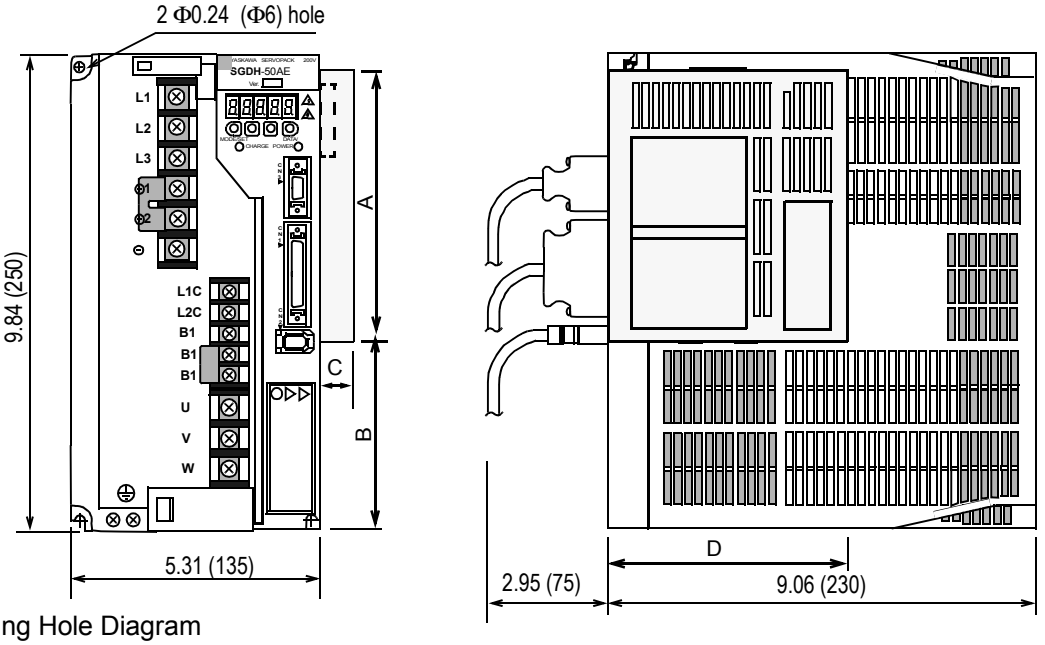
* Option card only.

** Add 0.75in (19mm) to front end of card for micro connector.

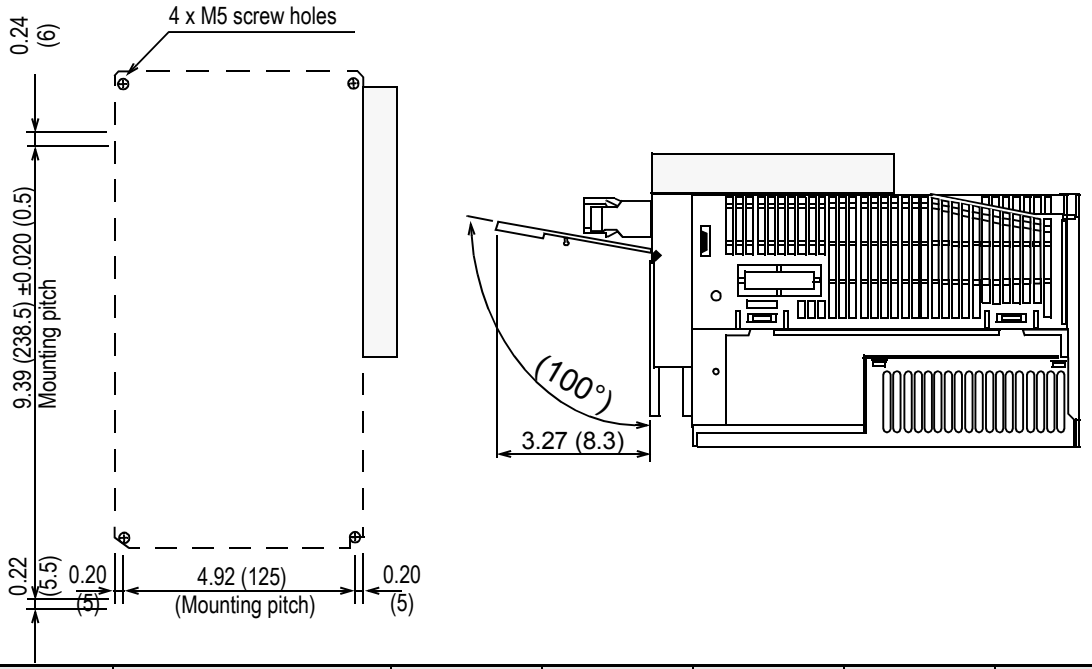
*** Add approx. 0.75in (19mm) for optional back-up battery.

* Rating: 200 to 230V_{ac} +10%, -5%

- **SGDH-50AE (200V Three-phase, 5.0kW)**
- **SGDH-50DE (400V Three-phase, 5.0kW to 1.5kW)**



Mounting Hole Diagram



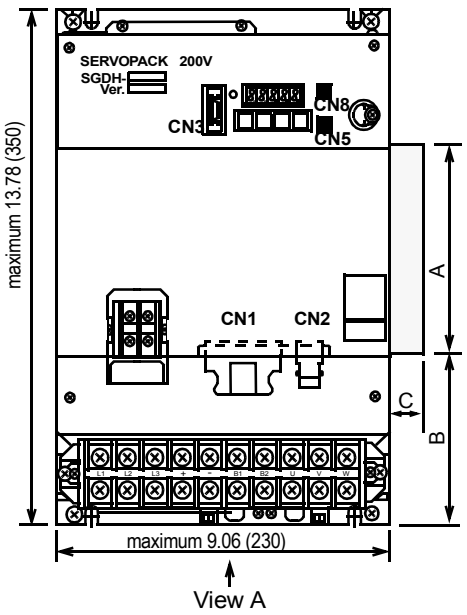
Part Number	Description	A	B	C	D	Approximate Mass** lb (kg)
JUSP-NS100	Mechatrolink	5.59 (142)	3.9 (99)	0.79 (20)	5.08 (129)	0.44 (0.2)
JUSP-NS300	Indexer with DeviceNet™					
JUSP-NS310	Indexer with DeviceNet™	5.67 (144)	3.86 (98)		5.24 (133)**	0.7 (0.32)
JUSP-NS500	Profibus	5.59 (142)	3.9 (99)		5.08 (129)	0.44 (0.2)
JUSP-NS600	Indexer					
JUSP-FC100	Full Closed Loop					
MP940	Single Axis Control			1.22 (31)***		0.89 (0.40)

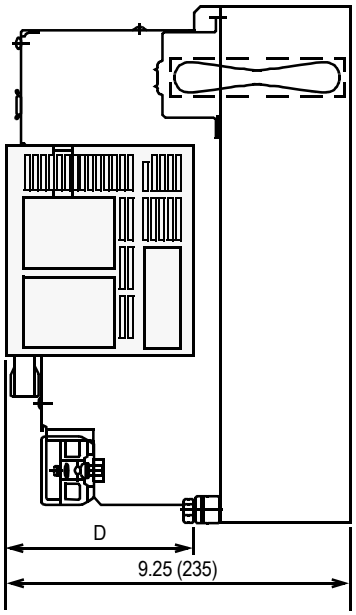
** Option card only.

** Add 0.75in (19mm) to front end of card for micro connector.

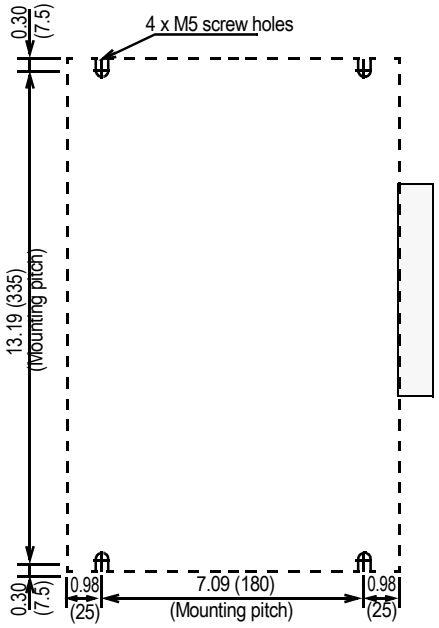
*** Add approx. 0.75in (19mm) for optional back-up battery.

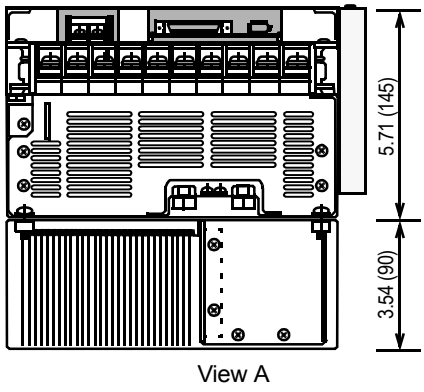
- **SGDH-60AE, SGDH-75AE (200V Three-phase, 6.0kW, 7.5kW)**
- **SGDH-60DE, SGDH-75DE (400V Three-phase, 6.0kW, 7.5kW)**





Mounting Hole Diagram





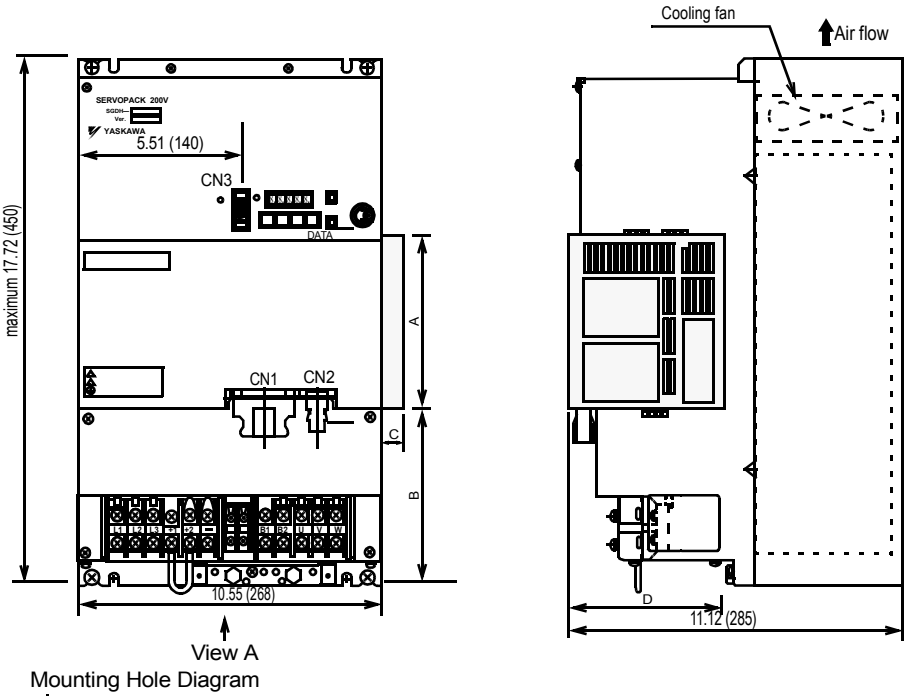
Part Number	SGDH Option Description	A	B	C	D	Approximate Mass* lb (kg)
JUSP-NS100	Mechatrolink	5.59 (142)	4.5 (114.5)	0.79 (20)	5.08 (129)	0.44 (0.2)
JUSP-NS300	Indexer with DeviceNet™					
JUSP-NS310	Indexer with DeviceNet™	5.67 (144)	4.47 (113.5)		5.24 (133)**	0.7 (0.32)
JUSP-NS500	Profibus	5.59 (142)	4.5 (114.5)		5.08 (129)	0.44 (0.2)
JUSP-NS600	Indexer					
JUSP-FC100	Full Closed Loop					
MP940	Single Axis Control			1.22 (31)***		0.89 (0.40)

* Option card only.

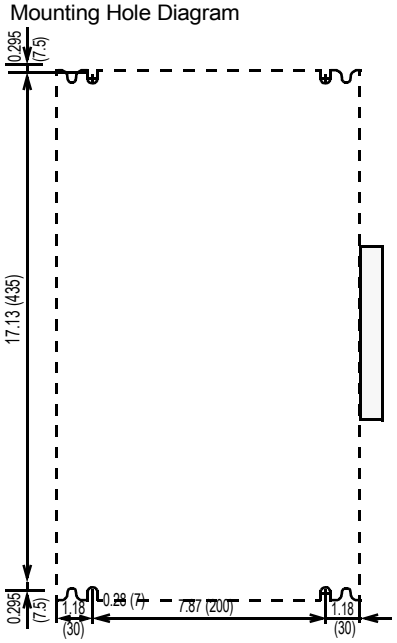
** Add 0.75in (19mm) to front end of card for micro connector.

*** Add approx. 0.75in (19mm) for optional back-up battery.

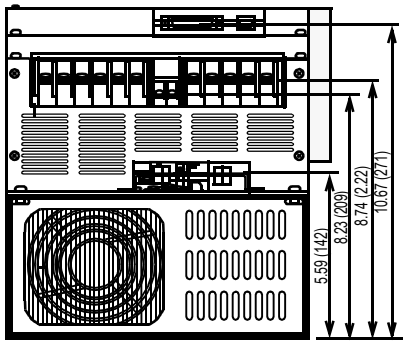
- **SGDH-1AAE, SGDH-1EAE (200V Three-phase, 11.0kW, 15.0kW)**
- **SGDH-1ADE, SGDH-1EDE (400V Three-phase, 11.0kW, 15.0kW)**



Mounting Hole Diagram



View A:



Part Number	SGDH Option Description	A	B	C	D	Approximate Mass* lb (kg)
JUSP-NS100	Mechatrolink	5.59 (142)	4.5 (114.5)	0.79 (20)	5.08 (129)	0.44 (0.2)
JUSP-NS300	Indexer with DeviceNet™					
JUSP-NS310	Indexer with DeviceNet™	5.67 (144)	4.47 (113.5)		5.24 (133)**	0.7 (0.32)
JUSP-NS500	Profibus	5.59 (142)	4.5 (114.5)		5.08 (129)	0.44 (0.2)
JUSP-NS600	Indexer					
JUSP-FC100	Full Closed Loop					
MP940	Single Axis Control			1.22 (31)***		0.89 (0.40)

* Option card only.

** Add 0.75in (19mm) to front end of card for micro connector.

*** Add approx. 0.75in (19mm) for optional back-up battery.

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