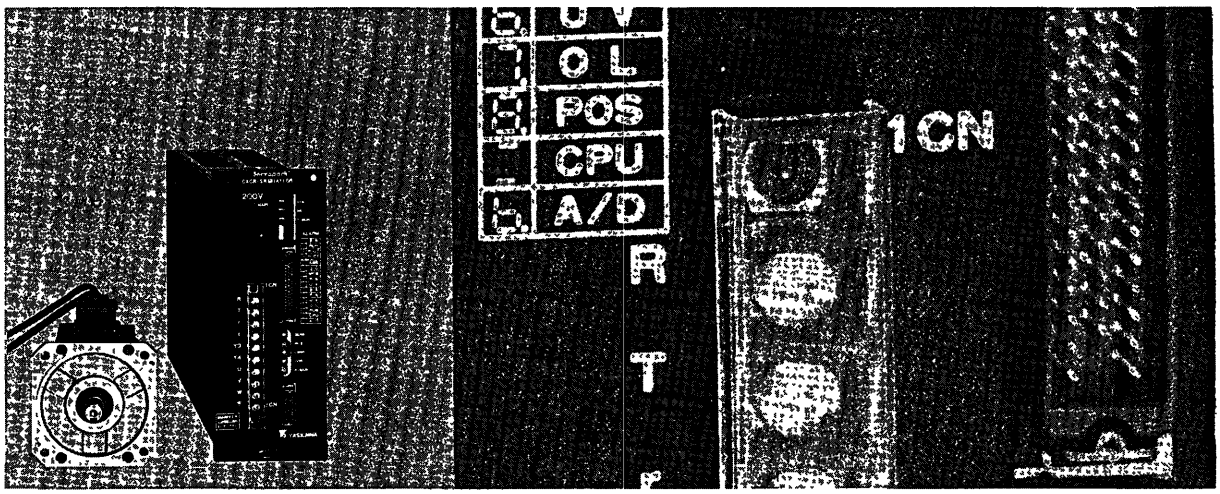
AC SERVO DRIVES

R AND P SERIES FOR SPEED CONTROL

SERVOMOTOR	USAREM, USAPEM (WITH ABSOLUTE ENCODER)
SERVOPACK	CACR-SR□AY□ (RACK-MOUNTED TYPE)
	CACR-SR□AX□ (RACK-MOUNTED TYPE)



YASKAWA

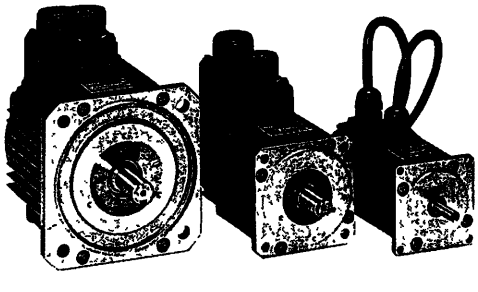
Yaskawa AC Servo Drives have been developed as the basic mechatronics drives for the most advanced FA and FMS including robots and machine tools.

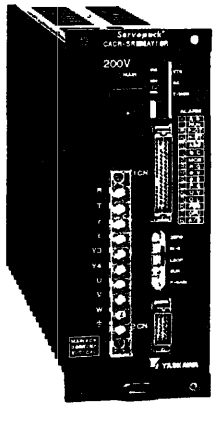
Yaskawa takes great pride in introducing the P series as the latest addition to the R series AC Servo Drives which have enjoyed an outstanding reputation among their users.

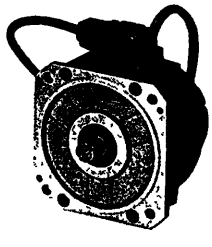
The P series achieves lower cost and smaller size in spite of high speed operation and high reliability. Originally designed for point-to-point positioning, it has been found in such applications as assembly robots, chip mounters,, small-type X-Y tables, coil winding machines, etc.

FEATURES

- High speed operation possible
- High accuracy and quick response for speed control even under adverse environmental conditions
- Compact design and light weight
- User-friendly protective functions with LED alarm indications







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1. RATINGS AND SPECIFICATIONS

1.1 RATINGS AND SPECIFICATIONS OF R SERIES AC SERVOMOTORS (FOR 200 V)

(1) Ratings

Time Rating: Continuous
Insulation: Class B
Isolation Voltage: 1000 VAC, one minute
Insulation Resistance: 500 VDC, 10 MΩ or more
Enclosure: Totally-enclosed, self-cooled
Applicable Ambient Temperature: 0 to +40 °C
Storage Temperature: -20 to +80 °C
Ambient Humidity: 20% to 80% (non-condensing)
Vibration: 15 μm or below
Finish in Munsell Notation: N1.5
Excitation: Permanent magnet
Mounting: Flange mounted
Drive Method: Direct drive

Table 1.1 Ratings and Specifications of R Series AC Servomotors (For 200V)

Item \ Motor Type USAREM-		-A5CS2	-01CS2	-02CS2	-03CS2	-05CS2	-07CS2
Rated Output*	W (HP)	50 (0 07)	100 (0 13)	200 (0 27)	300 (0 40)	500 (0 67)	700 (0 93)
Rated Torque*	N m (oz in)	0 159 (22 5)	0 318 (45)	0 637 (90)	0 955 (135)	1 59 (225)	2 23 (316)
Continuous Max Torque*	N m (oz in)	0 19 (26 9)	0 382 (54 2)	0 765 (108 3)	1 15 (162 5)	1 90 (269 4)	2 67 (378)
Instantaneous Max Torque*	N m (oz in)	0 476 (67 5)	0 955 (135)	1 91 (270)	2 86 (405)	4 76 (675)	6 68 (948)
Rated Current*	A	0 71	1 0	2 0	2 7	3 6	5 7
Rated Speed*	r/min	3000					
Max Speed*	r/min	4500					
Torque Constant	N m/A (oz in/A)	0 235 (33 3)	0 353 (50 0)	0 346 (49 0)	0 378 (53 6)	0 466 (66 0)	0 426 (60 4)
Inertia J_M ($=GD^2/4$)	kg $m^2 \times 10^{-4}$ (oz in $s^2 \times 10^{-3}$)	0 076 (1 08)	0 125 (1 78)	0 507 (7 18)	0 766 (10 9)	2 72 (38 6)	3 72 (52 8)
Power Rate*	kW/s	3 30	8 09	8 01	11 9	9 26	13 3
Inertia Time Constant	ms	4 4	3 4	2 9	2 6	2 8	2 5
Inductive Time Constant	ms	1 3	1 6	4 1	4 5	9 4	10 0

*Values when servomotor is combined with Servopack and the armature winding temperature is 75°C
Other values at 20°C Shewn are normal (TYP) values above

Note
The power supply unit for brake
• Input 200VAC Output 90VDC (DP8401002-1)
For details, see par 8 3 (2)

1.1 RATINGS AND SPECIFICATIONS OF R SERIES AC SERVOMOTORS (FOR 200 V) (Cont'd)

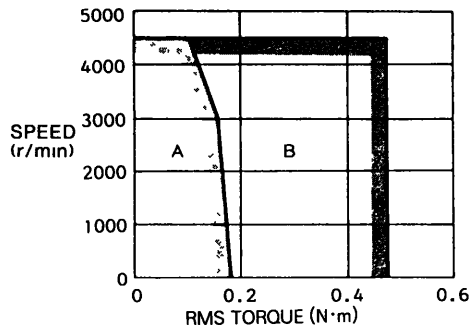
(2) Torque-Speed Characteristics

The values in intermittent duty zone are normal (TYP) values when the power voltage of Servopack is 200 VAC.

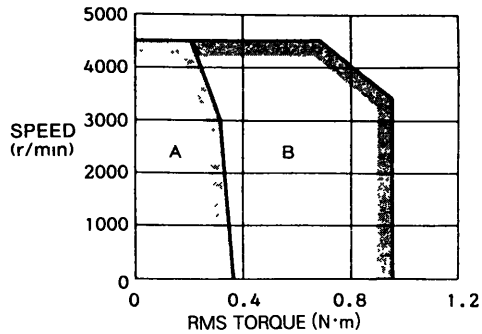
If 200 VAC or below, the output characteristics may be decreased even if the data is within allowable variation.

■ r/min-N·m

Type USAREM-A5C



Type USAREM-01C



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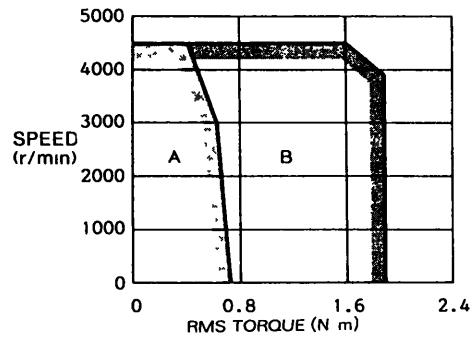
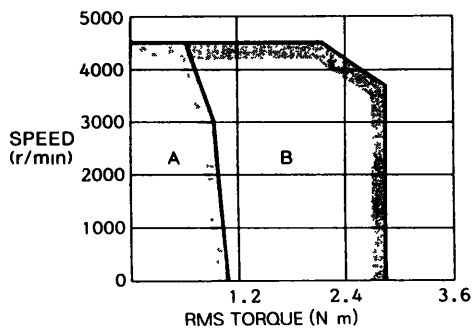
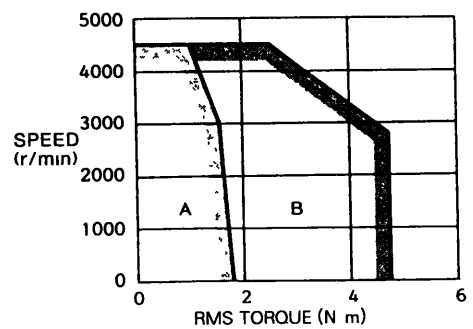


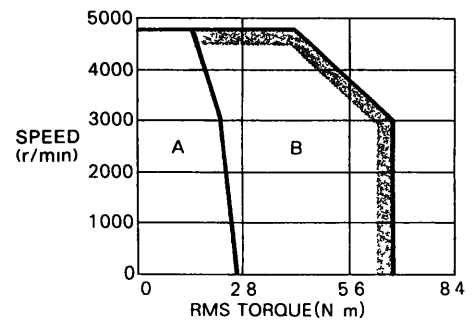
Type USAREM-03C



Type USAREM-05C



Type USAREM-07C

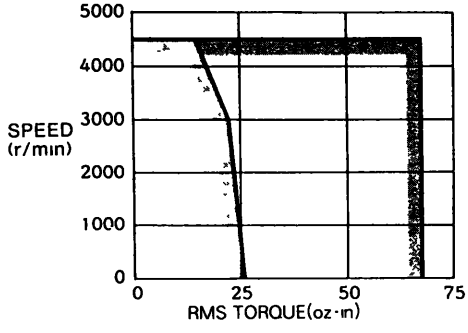


A : Continuous Duty Zone

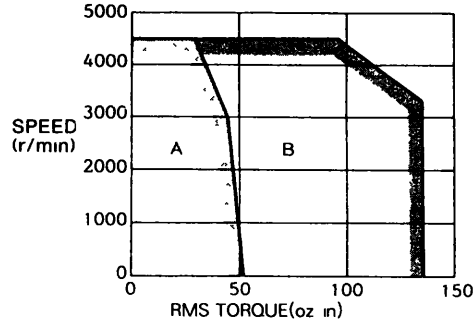
B : Intermittent Duty Zone

■r/min-oz·in

Type USAREM-A5C



Type USAREM-01C



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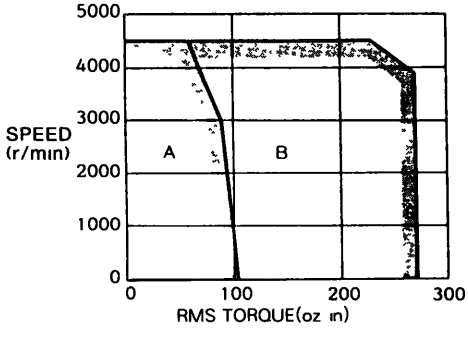

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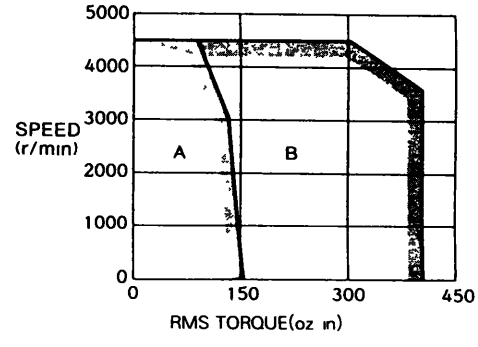

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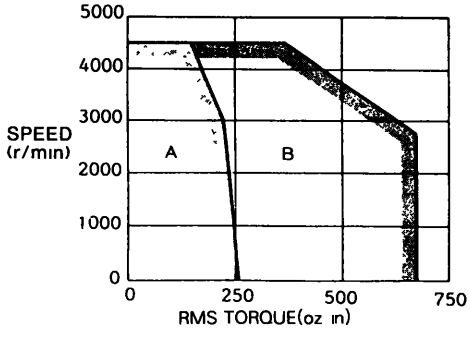

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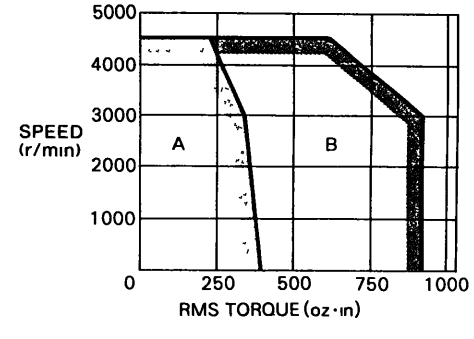


A : Continuous Duty Zone

: Intermittent Duty Zone

1. 2 RATINGS AND SPECIFICATIONS OF R SERIES AC SERVOMOTORS (FOR 100V)

(1) Ratings

Time Rating: Continuous
Insulation: Class B
Isolation Voltage: 1000 VAC, one minute
Insulation Resistance: 500 VDC, 10MΩor more
Enclosure: Totally-enclosed, self-cooled
Applicable Ambient Temperature: 0 to +40°C
Storage Temperature: -20 to +80°C
Ambient Humidity: 20% to 80% (non-condensing)
Vibration: 15 μm or below
Finish in Munsell Notation: N1.5
Excitation: Permanent magnet
Mounting: Flange mounted
Drive Method: Direct drive

Table 1.2 Ratings and Specifications of R Series AC Servomotors (For 100V)

Item \ Motor Type USAREM-		-A5DS2	-01DS2	-02DS2	-03DS2	-05DS2
Rated Output*	W (HP)	50 (0 07)	100 (0 13)	200 (0 27)	300 (0 40)	500 (0 67)
Rated Torque*	N m (oz in)	0 159 (22 5)	0 318 (45)	0 637 (90)	0 955 (135)	1 59 (225)
Continuous Max Torque*	N m (oz in)	0 19 (26 9)	0 382 (54 2)	0 765 (108 3)	1 15 (162 5)	1 90 (269 4)
Instantaneous Max Torque*	N m (oz in)	0 476 (67 5)	0 955 (135)	1 91 (270)	2 86 (405)	4 76 (675)
Rated Current*	A	1 2	1 7	2 9	3 6	5 5
Rated Speed*	r/min	3000				
Max Speed*	r/min	4000				
Torque Constant	N m/A (oz in/A)	0 136 (19 3)	0 198 (28 1)	0 235 (33 3)	0 284 (40 3)	0 308 (43 6)
Inertia J_M ($=GD^2/4$)	kg $m^2 \times 10^{-4}$ (oz in $s^2 \times 10^{-3}$)	0 076 (1 08)	0 125 (1 78)	0 507 (7 18)	0 766 (10 9)	2 72 (38 6)
Power Rate*	kW/s	3 30	8 09	8 01	11 9	9 26
Inertia Time Constant	ms	4 2	3 2	3 0	2 5	2 7
Inductive Time Constant	ms	1 4	1 7	4 0	4 6	9 6

*Values when servomotor is combined with Servopack and the armature winding temperature is 75°C
Other values at 20°C Shewn are normal (TYP) values above

Note
The power supply unit for brake
• Input 100VAC Output 90VDC (DP8401002-2)
For details, see par 8 3 (2)

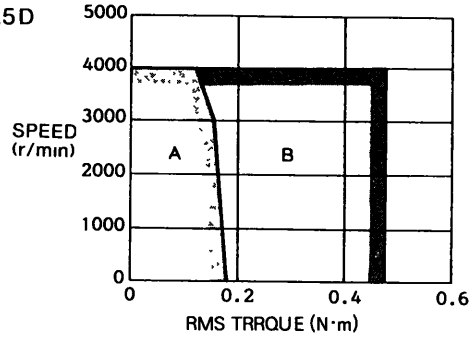
(2) Torque-Speed Characteristics

The values in intermittent duty zone are normal (TYP) values when the power voltage of Servopack is 100 VAC.

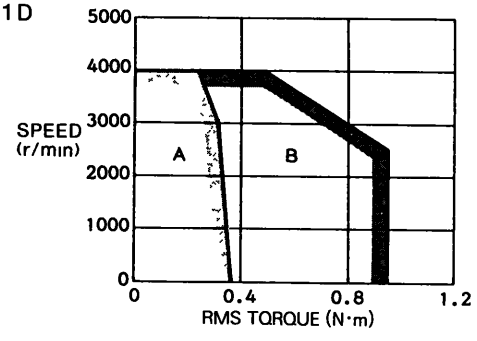
If 100VAC or below, the output characteristics may be decreased even if the data is within allowable variation.

■r/min-N·m

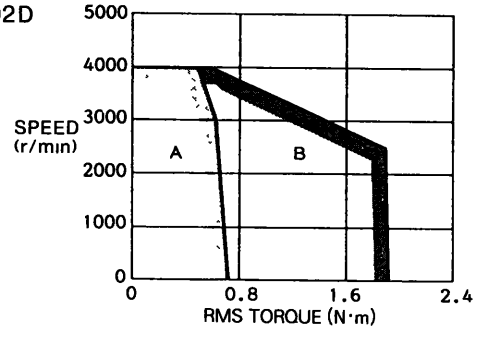
Type USAREM-A5D



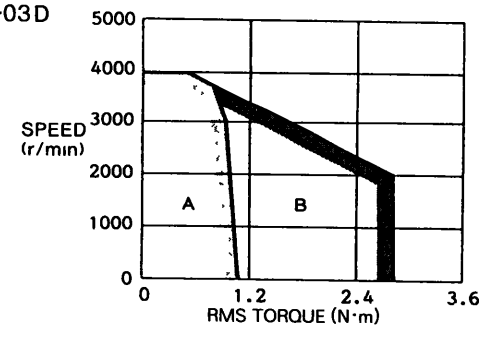
Type USAREM-01D



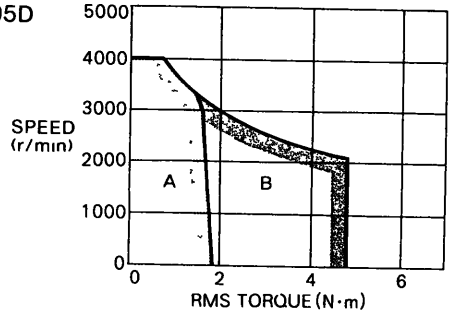
Type USAREM-02D



Type USAREM-03D

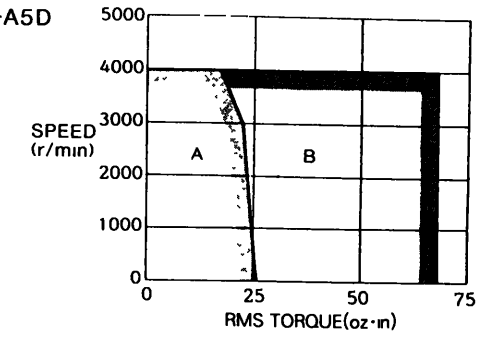


Type USAREM-05D

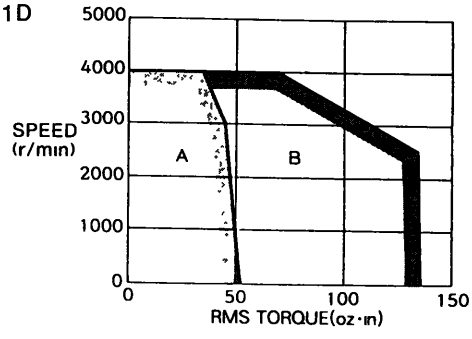


■rpm-oz·in

Type USAREM-A5D



Type USAREM-01D



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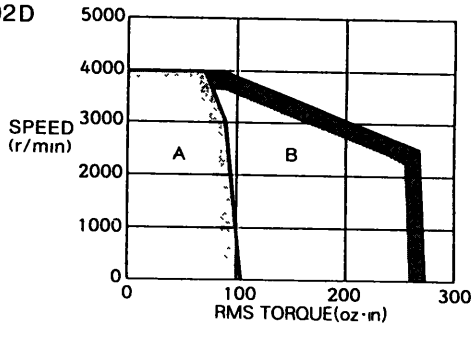

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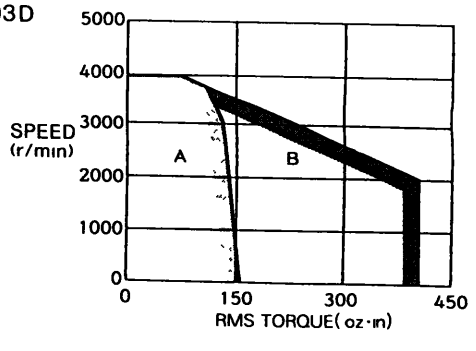
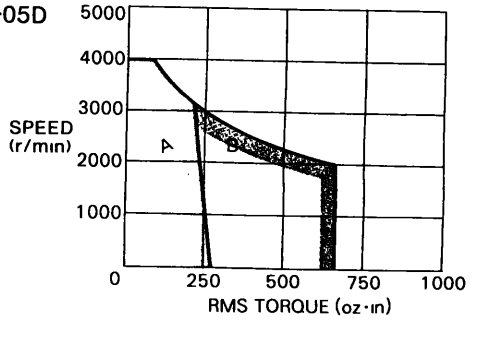


Type USAREM-05D



A : Continuous Duty Zone
B : Intermittent Duty Zone

1.3 RATINGS AND SPECIFICATIONS OF P SERIES AC SERVOMOTORS (FOR 200V)

(1) Ratings

Time Rating: Continuous

Insulation: Class B

Isolation Voltage: 1000 VAC, one minute

Insulation Resistance: 500 VDC, 10MΩ or more

Enclosure: Totally-enclosed, self-cooled

Applicable Ambient Temperature: 0 to +40°C

Storage Temperature: -20 to +80°C

Ambient Humidity: 20% to 80% (non-condensing)

Vibration: 15μm or below

Finish in Munsell Notation: N1.5

Excitation: Permanent magnet

Mounting: Flange mounted

Drive Method. Direct drive

Table 1.3 Ratings and Specifications of P Series AC Servomotors (For 200V)

Item \ Motor Type USAPEM-†		01CW2	02CW2	03CW2	05CW2	07CW2
Rated Output*	W (HP)	100 (0 13)	200 (0 27)	300 (0 40)	500 (0 67)	750 (1 02)
Rated Torque*	N m (oz in)	0 318 (45)	0 637 (90)	0 955 (135)	1 59 (225)	2 39 (339)
Continuous Max Torque*	N m (oz in)	0 318 (45)	0 637 (90)	0 955 (135)	1 59 (225)	2 39 (339)
Instantaneous Max Torque*	N m (oz in)	0 961 (136)	1 91 (270)	2 86 (405)	4 76 (675)	7 06 (1000)
Rated Current*	A	1 0	2 0	2 7	3 6	5 7
Rated Speed*	r/min	3000				
Max Speed*	r/min	4500				
Torque Constant	N m/A (oz in/A)	0 350 (49 6)	0 337 (47 8)	0 373 (52 8)	0 512 (72 5)	0 442 (62 6)
Inertia J_M ($=GD^2/4$)	kg $m^2 \times 10^{-4}$ (oz in $s^2 \times 10^{-3}$)	0 392 (5 55)	0 637 (9 03)	0 98 (13 9)	4 78 (67 8)	6 57 (93 0)
Power Rate*	kW/s	2 59	6 37	9 30	5 27	8 71
Inertia Time Constant	ms	5 3	2 8	2 2	4 9	3 3
Inductive Time Constant	ms	4 7	5 8	6 4	10 0	14 0

* Values when servomotor is combined with Servopack and the armature winding temperature is 75°C
Other values at 20°C Shown are normal (TYP) values above

Note.
The power supply unit for brake
• Input 200VAC Output 90VDC (DP8401002-1)
For details, see par 8 3 (2)

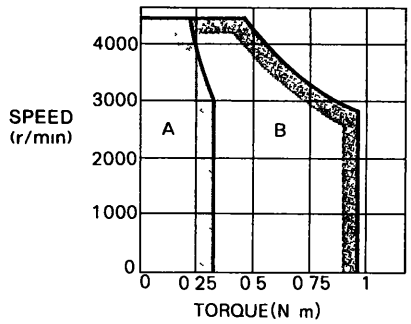
(2) Torque-Speed Characteristics

The values in intermittent duty zone are normal (TYP) values when the power voltage of Servopack is 200 VAC.

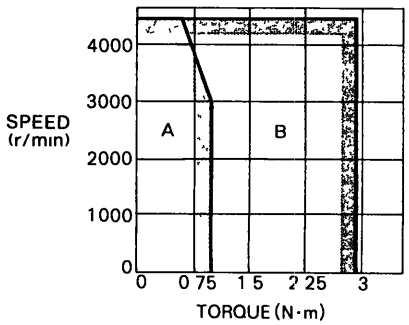
If 200VAC or below, the output characteristics may be decreased even if the data is within allowable variation.

■ r/min-N·m

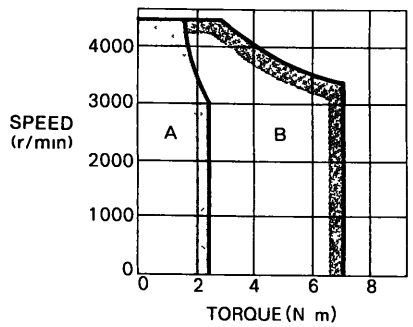
Type USAPEM-01C



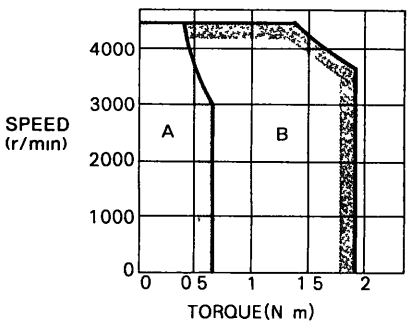
Type USAPEM-03C



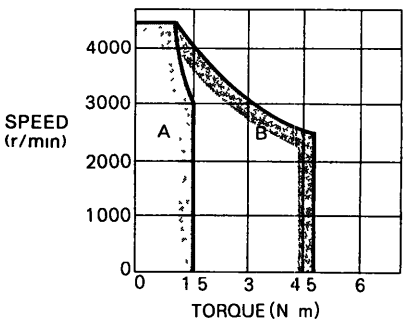
Type USAPEM-07C



Type USAPEM-02C



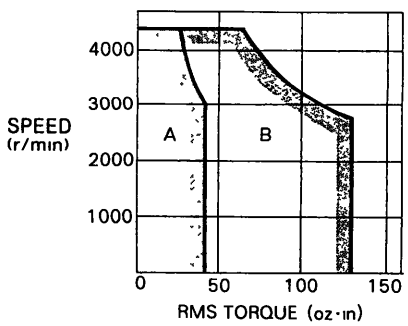
Type USAPEM-05C



A : Continuous Duty Zone
B : Intermittent Duty Zone

■ r/min-oz·in

Type USAPEM-01C



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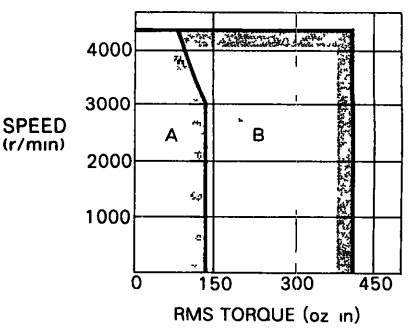

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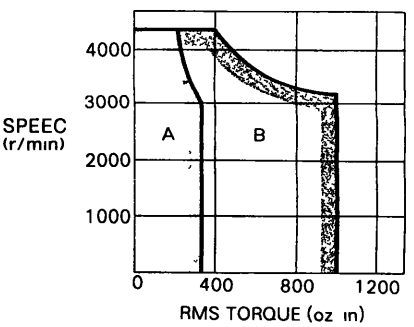

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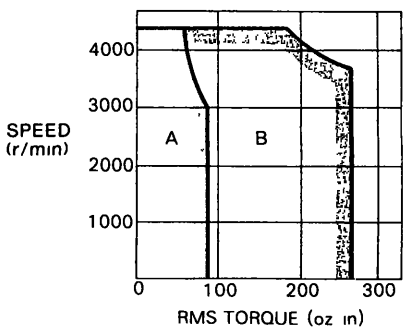
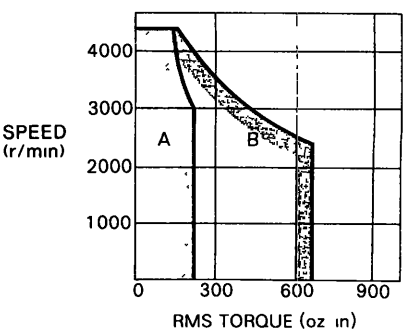


Type USAPEM-05C



A : Continuous Duty Zone
B : Intermittent Duty Zone

1.4 RATINGS AND SPECIFICATIONS SERVOPACK

Table 1 4 Ratings and Specifications of Servopack for R and P series AC servomotor

Voltage Class				R Series 200V					
Servopack Type CACR-				SRA5AY1SR SRA5AX1SR	SR01AY1SR SR01AX1SR	SR02AY1SR SR02AX1SR	SR03AY1SR SR03AX1SR	SR05AY1SR —	SR07AY1SR —
Combined Specifications	Applicable AC Servomotor	Type		USAREM-A5C	USAREM-01C	USAREM-02C	USAREM-03C	USAREM-05C	USAREM-07C
		Output	W (HP)	50 (0 07)	100 (0 13)	200 (0 27)	300 (0 40)	500 (0 67)	700 (0 93)
		Rated/Max Speed	r/min	3000 /4500					
	Continuous Output Current		A(rms)	0 7	1 0	2 0	2 7	3 6	5 7
	Max Output Current		A(rms)	2 1	2 8	5 7	7 8	10 6	16 3
	Allowable Load J (=$GD^2/4$) kg m^2 x10^{-4}(oz in s^2 x10^{-3})			0 76 (10 8)	1 25 (17 8)	5 07 (71 8)	7 66 (109)	27 2 (386)	37 2 (528)
Basic Specifications	Power Supply	Main Control		1-Phase 200 to 230 VAC $^{+10\%}_{-15\%}$ 50/60 Hz*1					
	Control Method			1-Phase full wave rectifying, transistorized PWM control (Sine wave drive)					
	Feedback			Optical encoder (Absolute value 8192 pulses/rev)					
	Environmental Conditions	Ambient Temp		0 to +55°C*2					
		Storage Temp		−20 to +85°C					
		Ambient and Storage Humidity		90% or less (non-condensing)					
		Vibration-/Shock-resistance		0 5 G / 2 G					
	Mounting Structure			Rack mounted					
	Approx Weight kg(lb)	Type SR□AY		2 0 (4 4)	2 1 (4 6)	2 7 (5 7)	3 0 (6 4)	3 5 (7 7)	5 4 (11 9)
		Type SR□AX		2 4 (5 2)	2 5 (5 5)	2 6 (5 7)	2 8 (6 1)	—	—
Speed Control	Speed Control Range *3			1 1000					
	Speed Regulation*4	Load		0 to 100% 0 1% or less at 3000r/min, ±0 05% or less at 3r/min					
		Voltage		Rating ±10% ±0 1% or less at 3000r/min, ±0 05% or less at 3r/min					
		Temperature		25 ±25°C ±0 5% or less at 3000r/min, ±0 2% or less at 3r/min					
	Frequency Response			100Hz at $GD^2_L = GD^2_M$					
Signal I/O	Speed Reference	Rated Reference Voltage		±6VDC at 3000r/min (forward run at plus reference)					
		Input Impedance		Approx 30kΩ					
		Circuit Time Constant		Approx 35μs					
	Auxiliary Reference*5	Rated Reference Voltage		±2 to ±10VDC at 3000r/min (forward run at plus reference)					
		Input Impedance		Approx 5kΩ per V					
		Circuit Time Constant		Approx 22μs					
	Built-in Reference Power Supply			±12VDC ±5%, ±30mA					
	PG Pulse Output	Types		A⌀, B⌀, C⌀, Line driver					
		Frequency Dividing Ratio		1500, 1250, 1000, 750, 625, 500, 400, 300, 200, 100, 1440, 720, 360, 3000, 2500, 2000 (16 decimal digital switch)					
		Absolute Value Output Type		Multi-revolution data (Serial data from A⌀ output) + rotation angle data (incremental pulse from A⌀, B⌀ output)					
		Absolute Value Output Method		After serial data (asynchronous, 9600 baud)is output by SEN signal, incremental pulse is output (pulse discharging speed approx 2747r/min)					
	Sequence Input			Servo ON, P drive, F run inhibit (P-OT), R run inhibit (N-OT), alarm reset, SEN signal					
	Sequence Output			Servo alarm, current limit, TG ON, servo ready, alarm code (serial data)					
	External Current Limit			20% to max current in each of P and N (3V/100% current)					
Built-in Functions	Dynamic Brake			Operated at main power OFF, servo alarm, servo OFF, etc					
	Regeneration			• 50W/100W type Not provided • 200W to 700W type Provided (containing regenerative resistor)					
	Applicable Load Inertia GD^2			Up to 10 times motor inertia*6					
	Overtravel Prevention			DB stop at P-OT, N-OT					
	Protection			Overvoltage (OV), overcurrent (OC), overload (OL), overspeed (OS), MCCB trip (MCCB), PG trouble (PG), voltage drop (UV), CPU error (CPU, A/D), absolute value data error (ABS, POS), regenerative error (RG)					
	Indication			Power supply (MAIN LED), alarm (7-segment LEDs)					
	Monitor Output			Speed 2V ±5% at 1000r/min, torque 3V ±10% at 100%					
	Others			Reverse run connection possible (Reverse at plus reference)					

*1 In main circuit power supply, voltage should not exceed 230V, +10% (253V) If the voltage should exceed this value, a step down transformer is required

*2 When housed in a panel, the inside temperature must not exceed ambient temperature range

*3 In the speed control range, the lowest speed is defined under the condition in which there is 100% load regulation, but not stopped

*4 Speed regulation is generally defined as follows

$$\text{Speec regulation} = \frac{\text{No load speed} - \text{Full load speed}}{\text{Rated speed}} \times 100(\%)$$

Motor speed may be changed by voltage variation or operational amplifier drift due to temperature The ratio of this speed change tc the rated speed represents the speed regulation due to voltage or temperature change

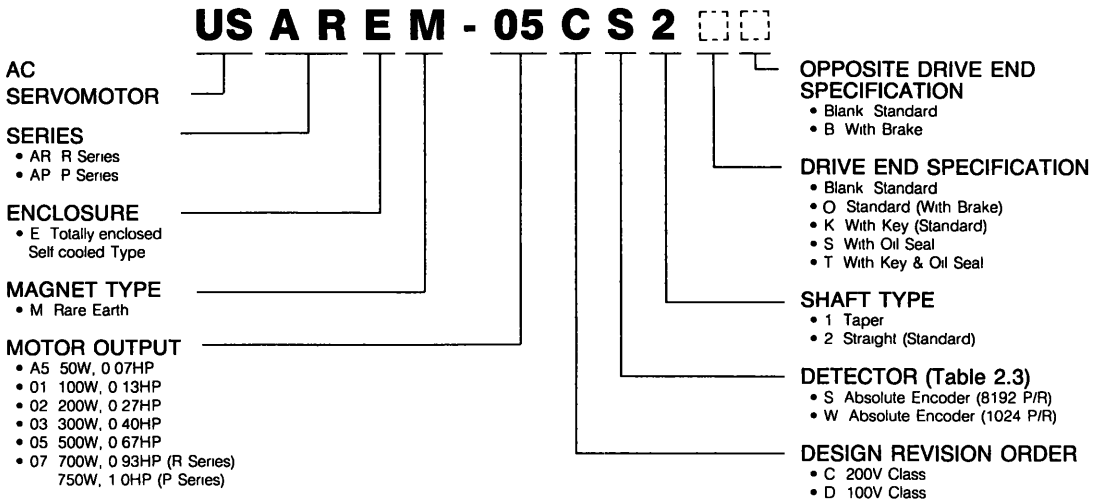
*5 Used for application at rated reference voltages other than ±6V

*6 When load GD^2 exceeds applicable range, see par 6 7 2 Load Inertia (GD^2)

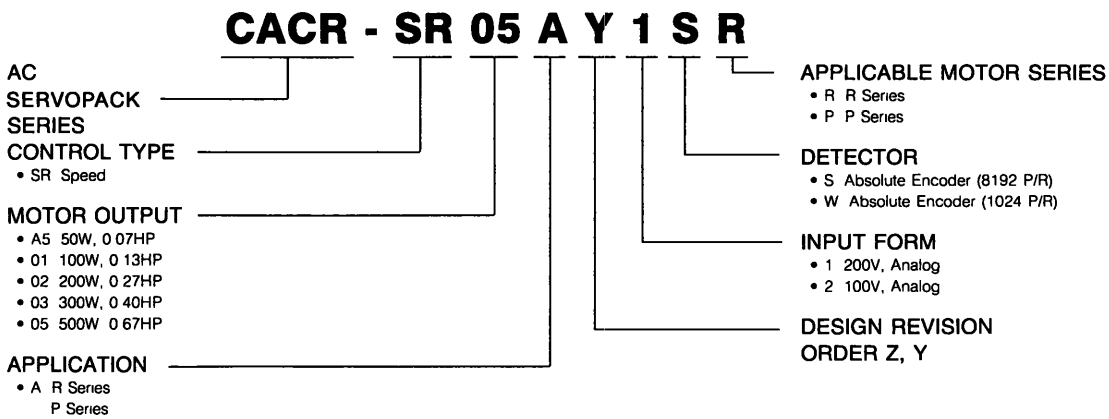
	R Series 100V					P Series 200V				
	SRA5AY2SR	SR01AY2SR	SR02AY2SR	SR03AY2SR	SR05AY2SR	SR01AY1WP	SR02AY1WP	SR03AY1WP	SR05AY1WP	SR07AY1WP
	SRA5AX2SR	SR01AX2SR	SR02AX2SR	—	—	SR01AX1WP	SR02AX1WP	SR03AX1WP	—	—
	USAREM-A5D	USAREM-01D	USAREM-02D	USAREM-03D	USAREM-05D	USAPEM-01C	USAPEM-02C	USAPEM-03C	USAPEM-05C	USAPEM-07C
	50 (0 07)	100 (0 13)	200 (0 27)	300 (0 40)	500 (0 67)	100 (0 13)	200 (0 27)	300 (0 40)	500 (0 67)	750 (1 02)
	3000/4000					3000/4500				
	1 2	1 7	2 9	3 6	5 5	1 0	2 0	2 7	3 6	5 7
	3 6	5 0	8 5	10 6	16 3	2 8	5 7	7 8	10 6	16 3
	0 76 (10 8)	1 25 (17 8)	5 07 (71 8)	7 66 (109)	27 2 (386)	1 96 (27 8)	3 18 (45 2)	4 9 (69 6)	23 9 (339)	32 85 (466)
	1-Phase 100 to 115VAC $^{+10\%}_{-15\%}$ 50/60Hz					1-Phase 200 to 230VAC $^{+10\%}_{-15\%}$ 50 60Hz*1				
	1-Phase full-wave rectifying, transistorized PWM control (Sine wave drive)									
	Optical encoder (Absolute value 8192 pulses/rev)					Optical encoder (Absolute value 1024 pulses/rev)				
	0 to +55°C*2									
	−20 to +85°C									
	90% or less (non-condensing)									
	0 5G / 2G									
	Rack mounted									
	2 1 (4 6)	2 7 (5 7)	3 0 (6 4)	3 5 (7 7)	5 4 (11 9)	2 1 (4 6)	2 7 (5 7)	3 0 (6 4)	3 5 (7 7)	5 4 (11 9)
	2 5 (5 5)	2 6 (5 7)	2 8 (6 1)	—	—	2 5 (5 5)	2 6 (5 7)	2 8 (6 1)	—	—
	1 1000									
	0 to 100% 0 1% or less at 3000r/min, ±0 05% or less at 3r/min									
	Rating ±10% ±0 1% or less at 3000r/min, ±0 05% or less at 3r/min									
	25 ±25°C ±0 5% or less at 3000r/min, ±0 2% or less at 3r/min									
	100Hz at $GD^2_L = GD^2_M$									
	±6VDC at 3000r/min (forward run at plus reference)									
	Approx 30kΩ									
	Approx 35μs									
	±2 to ±10VDC at 3000r/min (forward run at plus reference)									
	Approx 5kΩ per V									
	Approx 22μs									
	±12VDC ±5%, ±30mA									
	A⏚,B⏚, C⏚ Line driver									
	1500, 1250, 1000, 750, 625, 500, 400, 300, 200, 100, 1440, 720, 360 3000, 2500, 2000 (16-decimal digital switch)									
	Multi-revolution data (Serial data from A⏚ output) + rotation angle data (incremental pulse from A⏚, B⏚ output)									
	After serial data (asynchronus, 9600 baud) is output by SEN signal, incremental pulse is output (pulse discharging speed Approx 2747r/min)									
	Servo ON, P drive, F run inhibit (P-OT), R run inhibit (N-OT), alarm reset SEN signal									
	Servo alarm, current limit, TG ON, servo ready, alarm code (serial data)									
	20% to max current in each of P and N (3V/100% current)									
	Operated at main power OFF, servo OFF, etc									
	• 50W type Not provided • 100W to 500W type Provided (containing regenerative resistor)					Provided (containing regenerative resistor)				
	Up to 10 times motor inertia*6									
	DB stop at P-OT, N-OT									
	Overvoltage (OV), overcurrent (OC), overload (OL), overspeed (OS), MCCB trip (MCCB), PG trouble (PG), voltage drop (UV), CPU error (CPU, A/D) absolute value data error (ABS POS), regenerative error (RG)									
	Power supply (MAIN LED), alarm (7-segment LEDs)									
	Speed 2V ±5% at 1000r/min, torque 3V ±10% at 100%									
	Reverse run connection possible (Reverse at plus reference)									

2. TYPE DESIGNATION

- AC Servomotor



- Servopack



3. LIST OF STANDARD COMBINATION

(1) R Series Servomotor and Servopack

Table 3.1 List of Standard Combination

Class	Servopack Type CACR-		AC Servomotor Type USAREM-	AC Servomotor Optical Encoder pulses/rev (ABSO)	Power Capacity per Servopack* kVA	Current Capacity per MCCB or Fuse† A	Applicable Noise Filter	Recommended Noise Filter‡ Type	Recommended Noise Filter‡ Specification		Power ON/OFF Switch
200V	50W (0.07HP)	SRA5AY1SR	A5CS2	8192	0 3	5	Good	LF-205A	Single-phase, 200VAC class	5A	Yaskawa type HI-15E2 rated 30A or equivalent
		SRA5AX1SR									
	100W (0 13HP)	SR01AY1SR	01CS2	8192	0 5						
		SR01AX1SR									
	200W (0.27HP)	SR02AY1SR	02CS2	8192	0 75						
		SR02AX1SR									
	300W (0.40HP)	SR03AY1SR	03CS2	8192	1 0	7		LF-210		10A	
		SR03AX1SR									
	500W (0 67HP)	SR05AY1SR	05CS2	8192	1 4	11		LF-215		15A	
		—									
	700W (0 93HP)	SR07AY1SR	07CS2	8192	2 0	15		LF-220		20A	
		—									
100V	50W (0 07HP)	SRA5AY2SR	A5DS2	8192	0 3	5	Poor	LF-205A	Single-phase, 200VAC class	5A	
		SRA5AX2SR									
	100W (0.13HP)	SR01AY2SR	01DS2	8192	0 5						
		SR01AX2SR									
	200W (0.27HP)	SR02AY2SR	02DS2	8192	0 75	8		LF-210		10A	
		SR02AX2SR									
	300W (0 40HP)	SR03AY2SR	03DS2	8192	1 0	11		LF-215		15A	
		—									
	500W (0 67HP)	SR05AY2SR	05DS2	8192	1 4	15		LF-220		20A	
		—									

* Values at rated load
† Operating characteristic (25°C) 200% 2 s or more 700% 0 01 s or more
‡ Made by Tokin Corp

Table 3 2 Characteristics of R Series AC Servomotor, Detector and Holding Brake for Standard Combination

Class	Servopack Type CACR-		AC Servomotor Type USAREM-	AC Servomotor Optical Encoder pulses/rev (ABSO)	AC Servomotor Receptacle Type	AC Servomotor L-type Plug	AC Servomotor Cable Clamp	Detector Receptacle Type	Detector L-type Plug	Detector Cable Clamp	Holding Brake Receptacle Type	Holding Brake L-type Plug	Holding Brake Cable Clamp
200V	50 W	SRA5AY1SR	A5CS2	8192	MS3101A 14S-2P	MS3106B* 14S-2S	MS3057 -6A	MS3101A 20-29P	MS3106B 20-29S*	MS3057 -12A	MS3101A 14S-6P	MS3106B 14-6S*	MS3057 -6A
		SRA5AX1SR											
	100 W	SR01AY1SR	01CS2	8192									
		SR01AX1SR											
	200 W	SR02AY1SR	02CS2	8192	MS3102A 18-10P	MS3108B 18-10S	MS3057 -10A	MS3102A 20-29P	MS3108B 20-29S	MS3057 -12A	MS3102A 18-12P	MS3108B 18-12S	MS3057 -10A
		SR02AX1SR											
	300 W	SR03AY1SR	03CS2	8192									
		SR03AX1SR											
	500 W	SR05AY1SR	05CS2	8192	MS3102A 20-4P	MS3108B 20-4S	MS3057 -12A				MS3102A 20-17P	MS3108B 20-17S	MS3057 -12A
		—											
	700 W	SR07AY1SR	07CS2	8192									
		—											
100V	50 W	SRA5AY2SR	A5DS2	8192	MS3101A 14S-2P	MS3106B 14S-2S*	MS3057 -6A	MS3101A 20-29P	MS3106B 20-29S*	MS3057 -12A	MS3101A 14S-6P	MS3106B 14S-6S*	MS3057 -6A
		SRA5AX2SR											
	100 W	SR01AY2SR	01DS2	8192									
		SR01AX2SR											
	200 W	SR02AY2SR	02DS2	8192	MS3102A 18-10P	MS3108B 18-10S	MS3057 -10A	MS3102A 20-29P	MS3108B 20-29S		MS3102A 18-12P	MS3108B 18-12S	MS3057 -10A
		SR02AX2SR											
	300 W	SR03AY2SR	03DS2	8192									
		—											
	500 W	SR05AY2SR	05DS2	8192	MS3102A 20-4P	MS3108B 20-4S	MS3057 -12A				MS3102A 20-17P	MS3108B 20-17S	MS3057 -12A
		—											

* Straight plug

(2) P Series Servomotor and Servopack

Table 3.3 List of Standard Combination

Class	Servopack Type CACR-		AC Servomotor Type USAREM-	AC Servomotor Optical Encoder pulses/rev (ABSO)	Power Capacity per Servopack* kVA	Current Capacity per MCCB or Fuse† A	Applicable Noise Filter	Recommended Noise Filter‡ Type	Recommended Noise Filter‡ Specification		Power ON/OFF Switch
200V	100W (0 13HP)	SR01AY1WP	01CW2	1024	0 5	5	 Good	LF-205A	Single-phase, 200VAC class	5A	Yaskawa type HI-15E2 rated 30A or equiv-alent
		SR01AX1WP									
	200W (0.27HP)	SR02AY1WP	02CW2	1024	0 75						
		SR02AX1WP									
	300W (0.40HP)	SR03AY1WP	03CW2	1024	1 0	7		LF-210		10A	
		SR03AX1WP									
	500W (0 67HP)	SR05AY1WP	05CW2	1024	1 4	11	 Poor	LF-215		15A	
		—									
	700W (0 93HP)	SR07AY1WP	07CW2	1024	2 0	15		LF-220		20A	
		—									

* Values at rated load

† Operating characteristic (25°C) 200% 2 s or more 700% 0 01 s or more

‡ Made by Tokin Corp

Table 3.4 Characteristics of P Series AC Servomotor, Detector and Holding Brake for Standard Combination

Class	Servopack Type CACR-		AC Servomotor Type USAREM-	AC Servomotor Optical Encoder pulses/rev (ABSO)	AC Servomotor Pin Terminal Type	Detector Connector Plug	Detector Connector Pin	Holding Brake Pin Terminal Type
200V	100 W	SR01AY1WP	01CW2	1024	PC2005-M	172171-1	170363-1	PC2005-M
		SR01AX1WP						
	200 W	SR02AY1WP	02CW2	1024				
		SR02AX1WP						
	300 W	SR03AY1WP	03CW2	1024				
		SR03AX1WP						
	500 W	SR05AY1WP	05CW2	1024				
		—						
	700 W	SR07AY1WP	07CW2	1024				
		—						

4. CHARACTERISTICS

4. 1 OVERLOAD CHARACTERISTICS

The overload protective circuit built in Servopack prevents the motor and Servopack from overload and restricts the allowable conduction time of Servopack. (See Fig. 4.1.)

If the allowable power-on time during motor locking is maximum, the higher the motor speed is, the quicker the motor responce to the same overload.

The overload detection level is set precisely by the hot start conditions at an ambient temperature of 55°C and cannot be changed.

NOTE

Hot start is the overload characteristics when the Servopack is running at the rated load and thermally saturated

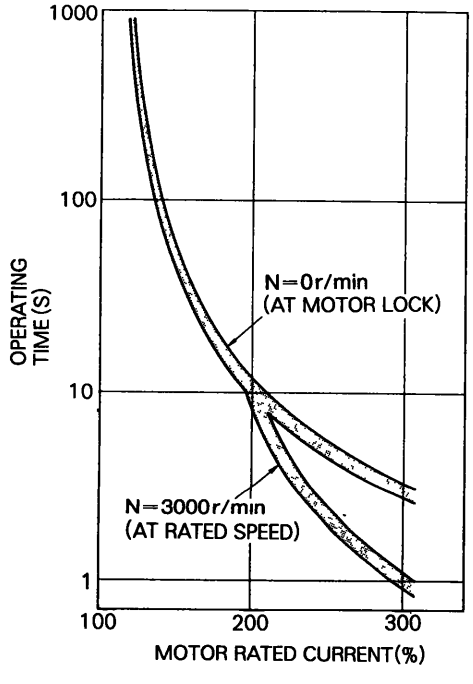


Fig 4.1 Overload Characteristics

4. 2 STARTING AND STOPPING TIME

The starting time and stopping time of servomotor under a constant load is shown by the formula below. Viscous or friction torque of the motor is neglected.

Starting Time:

$$t_r = 104.7 \times \frac{N_R \quad (J_M + J_L)}{Kt \ I_R \ (\alpha - \beta)} \text{ (ms)}$$

Stopping Time:

$$t_f = 104.7 \times \frac{N_R \ (J_M + J_L)}{Kt \ I_R \ (\alpha + \beta)} \text{ (ms)}$$

Where,

N_R : Rated motor speed (r/min)

J_M $(= GD_M^2/4)$: Motor moment of inertia J (kg·cm²)

J_L $(= GD_L^2/4)$: Load moment of inertia J (kg·cm²)

Kt: Torque constant of motor (N·m/A)

I_R: Motor rated current (A)

$\alpha = I_P / I_R$: Accel/decel current constant

I_P: Accel/decel current (Accel/decel current α times the motor rated current) (A)

$\beta = I_L / I_R$: Load current constant

I_L: Current equivalent to load torque (Load current β times the motor rated current) (A)

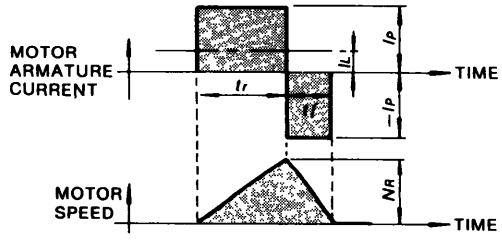


Fig 4.2 Timing Chart of Motor Armature Current and Speed

4.3 ALLOWABLE FREQUENCY OF OPERATION

The allowable frequency of operation is restricted by the servomotor and Servopack, and both the conditions must be considered for satisfactory operation.

- Allowable frequency of operation restricted by the Servopack

  The allowable frequency of operation is restricted by the heat generated in the regenerative resistor in the Servopack, and varies depending on the motor types, capacity, load J(J_L), acceleration/deceleration current values, and motor speed. If the frequency of operation exceeds 60 times/min when load J = 0 before the motor becomes rated speed, or if it exceeds $\frac{60}{m+1}$ cycles/min when load J = motor J(J_M) × m, contact Yaskawa representative.

- Allowable frequency of operation restricted by the Servomotor

  The allowable frequency of operation varies depending on the load conditions, motor running time and the operating conditions. Typical examples are shown below. See par.4.2 Starting and Stopping Time for symbols.

- When the motor repeats rated-speed operation and being at standstill (Fig.4.3).

  Cycle time(T) should be determined so that RMS value of motor armature current is lower than the motor rated current:

$$T \geqq \frac{Ip^2\ (tr+tf)+I_L^2 ts}{I_R^2}\ (s)$$

Where cycle time(T) is determined, values *Ip*, *tr*, *tf* satisfying the formula above, should be specified.

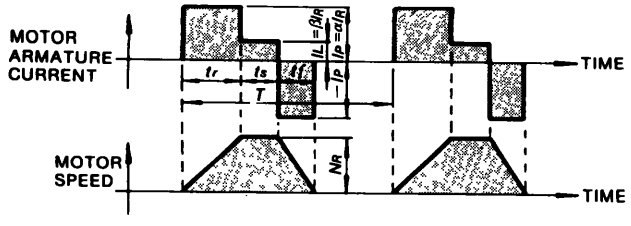


Fig 4 3 Timing Chart of Motor Armature Current and Speed

- When the motor remains at standstill between cycles of acceleration and deceleration without continuous rated speed running (Fig.4.4).

  The timing chart of the motor armature current and speed is as shown in Fig.4.4. The allowable frequency of operation "n" can be calculated as follows:

$$n = 286.5 \times \frac{Kt \cdot I_R}{N_R (J_M + J_L)} \left(\frac{1}{\alpha} - \frac{\beta^2}{\alpha^3} \right)$$

(times/min)

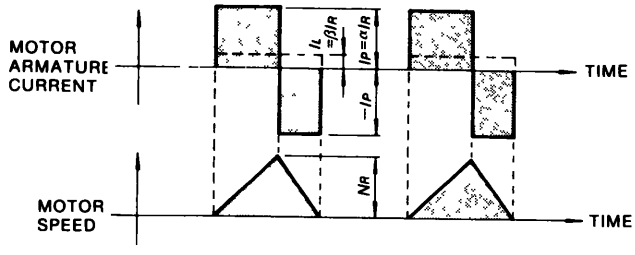


Fig 4 4 Timing Chart of Motor Armature Current and Speed

When the motor accelerates, runs at constant speed, and decelerates in a continuing cycle without being at standstill (Fig. 4.5).

The timing chart of the motor armature current and speed is as shown in Fig.4.5. The allowable frequency of operation "n" can be calculated as follows.

$$n = 286.5 \times \frac{Kt \cdot I_R}{N_R\ (J_M + J_L)} \left(\frac{1}{\alpha} - \frac{\beta^2}{\alpha} \right)$$

(times/min)

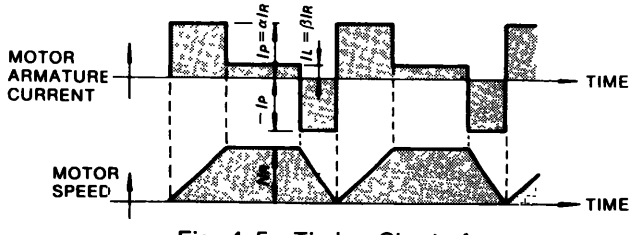


Fig 4 5 Timing Chart of Motor Armature Current and Speed

4.4 SERVOMOTOR FREQUENCY

In the servo drive consisting of Servopack and servomotor, motor speed amplitude is restricted by the maximum armature current controlled by Servopack.

The relation between motor speed amplitude (N) and frequency(f) is shown by the formula below:

$$N = 1.52 \times \frac{\alpha \cdot Kt \cdot I_R}{(J_M + J_L)f} \quad (r/min)$$

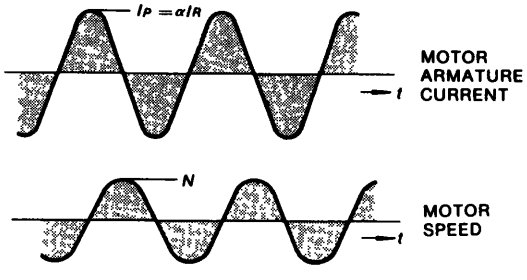


Fig 4 6 Timing Chart of Motor Armature Current and Speed

4.5 MOTOR SPEED-REFERENCE INPUT CHARACTERISTICS

Fig.4.7 shows motor speed and input voltage curve when speed reference input terminals 1CN - ⑫ and ⑬ are used. With auxiliary input terminals, 1CN - ⑭ and ⑮ , motor speed can be set to the rating by adjusting IN-B potentiometer as long as input voltage is within ±2V to ±10V. See Fig. 4.8.

The forward motor rotation(+) means counterclockwise rotation when viewed from the drive end.

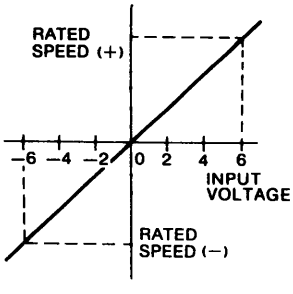


Fig 4 7 Speed-Input Voltage Characteristics

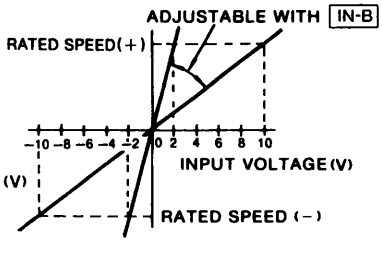


Fig 4 8 Speed-Input Voltage Characteristics when Auxiliary Input Terminals 1CN-⑭ and ⑮ are used.

4.6 MOTOR MECHANICAL CHARACTERISTICS

4.6.1 Mechanical Strength

AC servomotors can carry up to 300% of the rated momentary maximum torque at output shaft.

4.6.2 Allowable Radial Load and Thrust Load

Tables 4.1 and 4.2 show allowable loads according to AC servomotor types.

Table 4.1 R Series Allowable Radial Load and Thrust Load

Motor Type USAREM-	Allowable Radial Load* kg (lb)	Allowable Thrust Load kg (lb)
A5CS2K	8 (18)	4 (9)
01CS2K		
02CS2K	25 (55)	10 (22)
03CS2K		
05CS2K	40 (88)	15 (33)
07CS2K		

* Maximum values of the load applying to the shaft extension

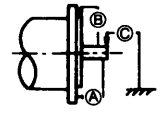
Table 4.2 P Series Allowable Radial Load and Thrust Load

Motor Type USAPEM-	Allowable Radial Load* kg (lb)	Allowable Thrust Load kg (lb)
01□2K	9 (20)	4 (9)
02□2K	15 (33)	6 (13)
03□2K	20 (44)	
05□2K	35 (77)	10 (22)
07□2K	45 (99)	13 (29)

* Maximum values of the load applying to the shaft extension

4.6.3 Mechanical Specifications

Table 4 3 Mechanical Specifications in mm

Accuracy (T I R)†		Reference Diagram
Flange surface perpendicular to shaft Ⓐ	0 04	
Flange diameter concentric to shaft Ⓑ	0 04	
Shaft run out Ⓒ	0 02	

†T I R (Total Indicator Reading)

4 6 4 Direction of Rotation

AC servomotors rotate counterclockwise viewed from drive end when motor and detector leads are connected as shown below.

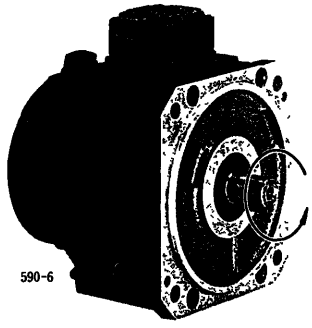


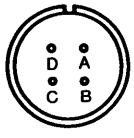
Fig 4 9 AC Servomotor

(1) Connector Specifications

(R Series)

(a) Motor receptacle

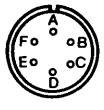
• Standard



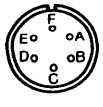
(50 TO 500W)

A	Phase
B	Phase V
C	Phase W
D	Frame ground

• With brake



(For 50W, 100W)

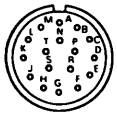


(For 200W, 300W)

(For 500W)

A	Phase U
B	Phase V
C	Phase W
D	Brake
E	Brake
F	Frame ground

(b) Detector receptacle



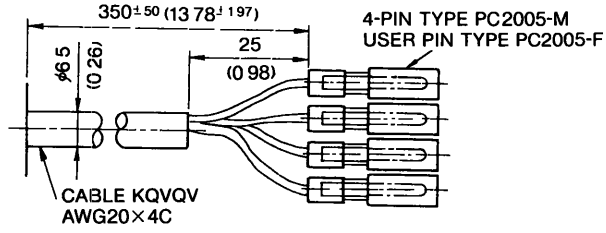
A	Channel A output	K	–
B	Channel $\overline{A}$ output	L	–
C	Channel B output	M	–
D	Channel $\overline{B}$ output	N	–
E	Channel Z output	P	–
F	Channel $\overline{Z}$ output	R	–
G	0V	S	Reset
H	5V(power supply)	T	0V(battery)
J	–	–	3V(battery)

(P Series)

(a) Motor receptacle

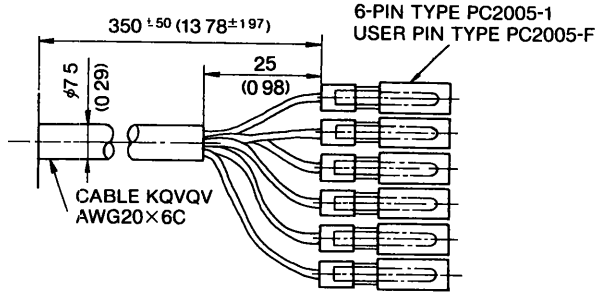
• Standard

mm (in)



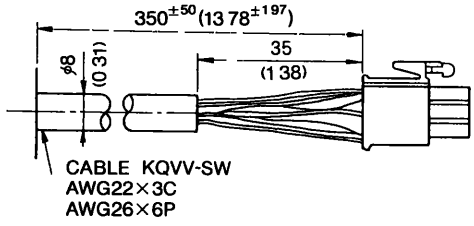
Phase U	RED
Phase V	WHITE
Phase W	BLUE
Frame Ground	GREEN

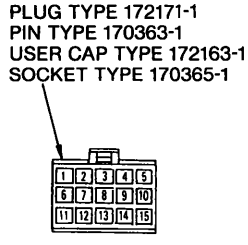
• With brake



Phase U	RED
Phase V	WHITE
Phase W	BLUE
Frame Ground	GREEN
Brake	BLACK
Brake	BLACK

(b) Detector receptacle





1	Channel A output	BLUE
2	Channel $\overline{A}$ output	WHITE/BLUE
3	Channel B output	YELLOW
4	Channel $\overline{B}$ output	WHITE/YELLOW
5	Channel Z output	GREEN
6	Channel $\overline{Z}$ output	WHITE/GREEN
7	0V (Power Supply)	BLACK
8	+5V (Power Supply)	RED
9	FG (frame ground)	GREEN/YELLOW
10	Channel S output	PURPLE
11	Channel $\overline{S}$ output	WHITE/PURPLE
12	Capacitor reset	GRAY
13	Reset	WHITE/GRAY
14	0V (Battery)	WHITE/ORANGE
15	3 6V (Battery)	ORANGE

4 6 5 Impact Resistance

When mounted horizontally and exposed to vertical shock impulses, the motor can withstand up to two impacts with impact acceleration of 50G(Fig.4.10).

NOTE

A precision detector is mounted on the opposite-drive end of AC servomotor. Care should be taken to protect the shaft from impacts that could damage the detector

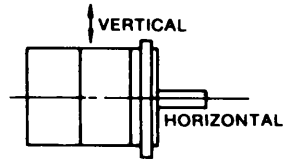


Fig 4 10 Impact Resistance

4 6 6 Vibration Resistance

When mounted horizontally, the motor can withstand vibration (vertical, lateral, axial) of 2.5G (Fig.4.11).

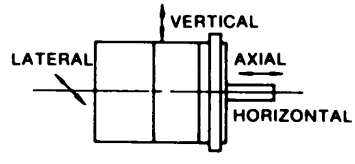


Fig 4.11 Vibration Resistance

4 6 7 Vibration Class

Vibration of the motor running at rated speed is 15μm or below (Fig.4.12).

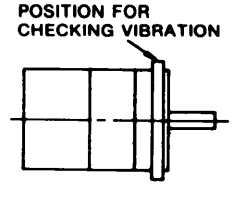


Fig 4.12 Vibration Checking

5. CONFIGURATION

5. 1 CONNECTION DIAGRAM

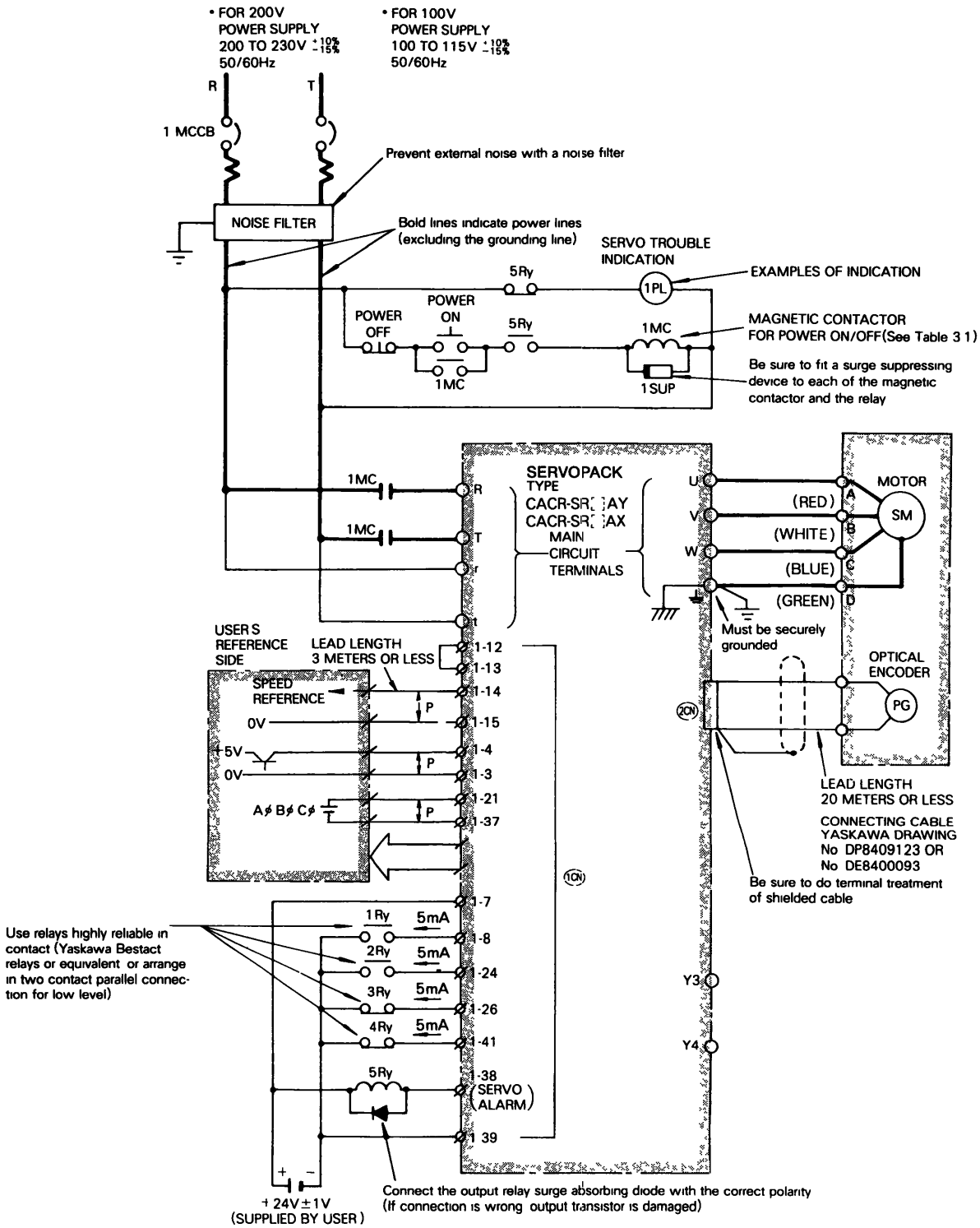
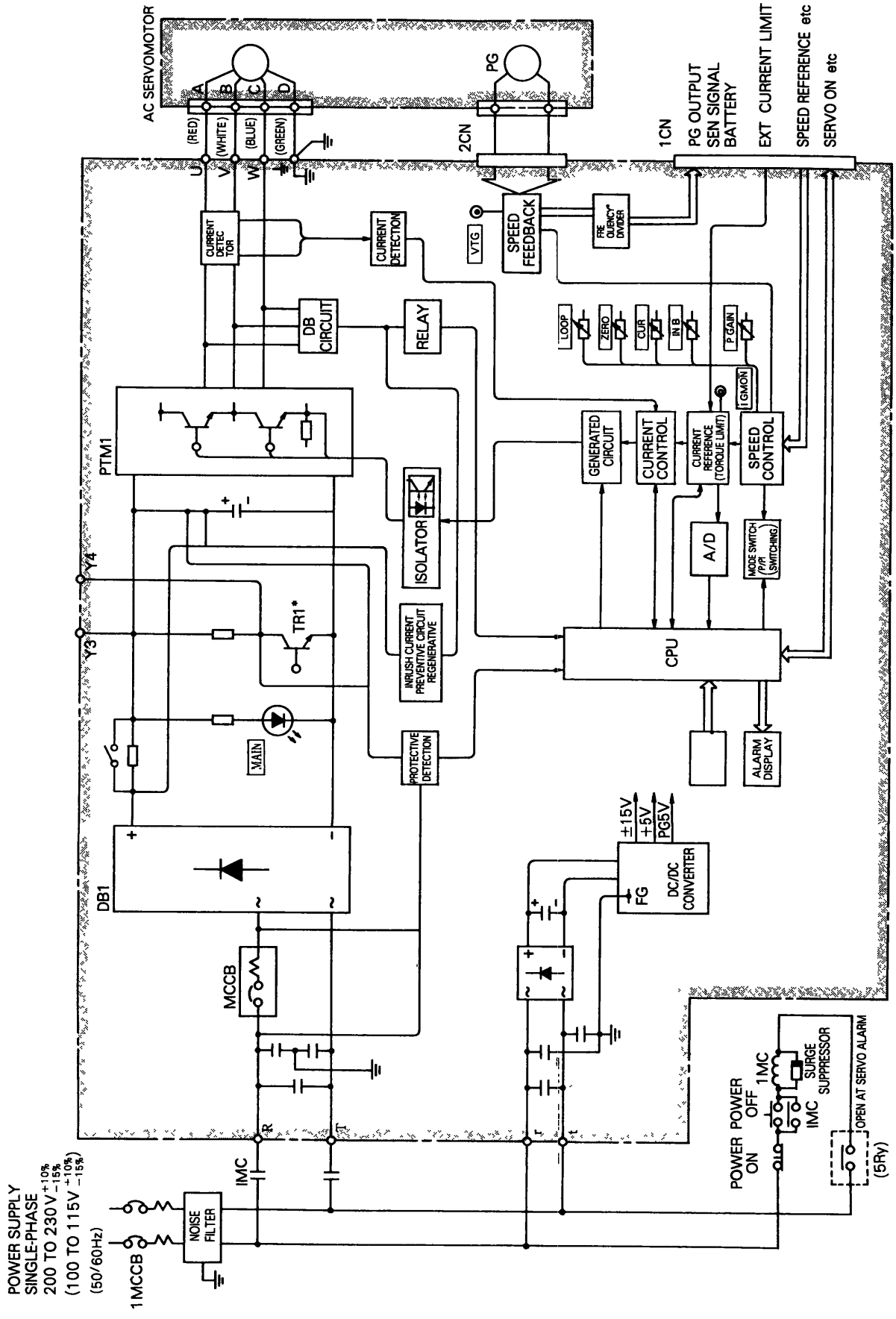


Fig. 5. 1 Example of Connection Diagram of Servopack with a Servomotor and Peripherals

5. 2 INTERNAL BLOCK DIAGRAM



*R Series ··· not provided for *Servopack* of 50W, 100W for 200V and of 50W for 100V

Fig. 5. 2 Internal Block Diagram of Servopack Type CACR-SR□□AY
CACR-SR□□AX

5. 3 MAIN-CIRCUIT TERMINALS

Table 5 1 Main-Circuit Terminals for Servopack

Terminal Symbol	Name	Description
Ⓡ Ⓣ	Main-circuit AC input	• For 200V Single-phase 200 to 230V $^{+10\%}_{-15\%}$ 50/60Hz • For 100V Single-phase 100 to 115V $^{+10\%}_{-15\%}$ 50/60Hz
ⓊⓋⓌ	Motor connection	Connects terminal Ⓤ to motor terminal A (Red), Ⓥ to B(White) and Ⓦ to C(Blue)
ⓡ ⓣ	Control power input	• For 200V Single-phase 200 to 230V $^{+10\%}_{-15\%}$ 50/60Hz • For 100V Single-phase 100 to 115V $^{+10\%}_{-15\%}$ 50/60Hz
⏚	Ground	Connects to motor terminal D(Green) Must be securely grounded
Ⓨ3 Ⓨ4	Regenerative register	External connection not usually required

5. 4 CONNECTOR TERMINAL (1CN) FOR I/O SIGNAL

5 4 1 Specifications of Applicable Receptacles

Table 5 2 Specifications of Applicable Receptacles for Servopack I/O Signal

Connector Type* used in Servopack	Applicable Receptacle Type			
	Manufacturer	Soldered Type	Caulking Type	Case
MR-50RMA (Right angle 50 P)	Honda Tsushin Co , Ltd	MR-50F†	MRP-50F01	MR-50L†

*The connectors for I/O signals used are type MR-50RMA made by Honda Tsushin Co Ltd
†Attached to *Servopack* when shipping

5. 4. 2 Connector 1CN Layout and Connection of Servopack

The terminal layout of the Servopack I/O signal connectors (1CN) is shown in Table 5.3. The external connection and external signal processing are shown in **Fig.5.3** on page 16.

Table 5 3 Connector 1CN Layout of Servopack

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0V	0V	OSEN	SEN	CLT +	CLT −	+24V IN	$\overline{\text{S-ON}}$	TRQ-M	VTG-M	SG	IN-A	SG-A	IN-B	SG-B	+12V	SG	FG
0V for PG Output Signal		SEN Signal Input		Current Limit Detection Output		Ext Power Input	Servo ON Input	Torque Monitor	Speed Monitor		Speed Reference Input		Auxiliary Input		+12V Output		Frame Ground
		19	20	21	22	23	24	25	26	27	28	29	30	31	32		
		PCO	*PCO	BAT	TG ON +	TG ON −	$\overline{\text{P-CON}}$		N-OT	S-RDY −	S-RDY +	N-CL	SG-NCL	−12V	SG		
		PG Output Cφ		Battery (+)	TG ON Output Signal		P Control Input		Reverse Inhibit Input	Servo Ready Output		Reverse Current Limit Input	−12V Output				
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
PAO	*PAO	PBO	*PBO	BATO	ALM +	ALM −		P-OT		$\overline{\text{ALM-RST}}$	P-CL	SG-PCL	−12V	SG	+12V	SG	FG
PG Output Aφ		PG Output Bφ		Battery (−)	Servo Alarm Output			Fwd Inhibit Input		Alarm Reset Input	Fwd Current Limit Input		−12V Output		+12V Output		Frame Ground

Note Do not use any pin shown as a blank space since the other signals have been connected

5. 4. 2 Connector 1CN Layout and Connection of Servopack (Cont'd)

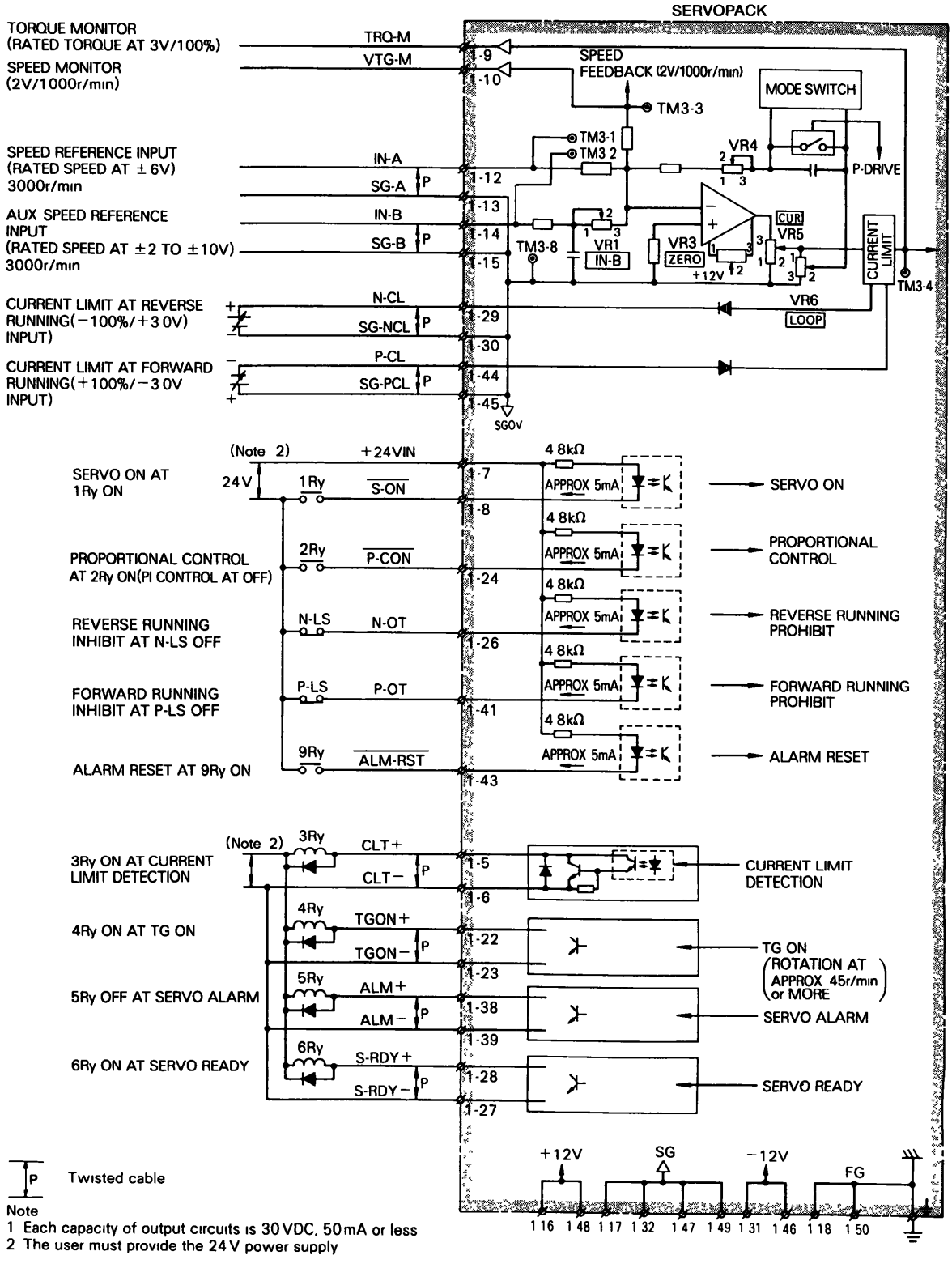


Fig 5.3 1CN I/O Signal Connection and External Signal Processing

5.4 3 Connector 1CN Layout and Connection of Servopack

Table 5 4 Input Signals of Connector 1CN

Signal Name	Connector 1CN No	Function	Description
$\overline{\text{SV-ON}}$	1CN-8	Servo ON	Inputting this signal makes the Servopack ready to receive speed reference input (+6 V) Base block and dynamic brake are cleared
$\overline{\text{P-CON}}$	1CN-24	Proportional drive reference	Proportional drive reference is utilized to prevent drifting when the motor is left motionless without command input, while the main circuit is kept energized
N-OT	1CN-26	Reverse running prohibit	In the case of linear drive, etc , connect limit switch signal according of the run direction This signal is "closed" during normal run When limit switch is tripped, it becomes "open"
P-OT	1CN-41	Forward running prohibit	
+24V IN	1CN-7	24 V	External power supply to 1CN-8, 24, 26, 41 and 43, Prepare a 24 VDC (25mA min) power supply
IN-A	1CN-12(13)	Speed command input	At ±6 0 V, ± rated speed is obtained
IN-B	1CN-14(15)	Aux command input	At ±2 0 to ±10 0 V, ± rated speed is obtained For adjustment, potentiometer [IN-B] is used
N-CL	1CN-29(30)	Current limit reference at reverse running	+3 0 V ±10%/100% torque +9 V max
P-CL	1CN-44(45)	Current limit reference at forward running	−3 0 V ±10%/100% torque −9 V max
$\overline{\text{ALM RST}}$	43	Alarm reset	Resets servo alarm status
SEN	4(3) (2) (1)	Sensor ON	If this signal is changed from low-level to high-level, after +5V is supplied to the absolute encoder, and serial data and initial pulse are output, normal output operation is perfomed If this signal is changed from high-level to low-level, absolute encoder power will drop When the SEN sign signal is changed from high-level to low-level at alarm, the alarm content is output from PG-A phase (PAO, *PAO)
BAT BATO	21 37	Battery ⊕ input Battery ⊖ input	These are connection terminals of battery for back-up The voltage must be 2 8 to 4 5V (The battery should be provided by user)

Table 5 5 Output Signals of Connector 1CN

Signal Name	Connector 1CN No	Function		Description
ALM	38(39)	Servo alarm		Turns OFF when fault is detec·ed For details refer to Table 6 2 "Fault Detection Function "
$\overline{\text{TGON}}$	22(23)	Motor run detection		Turns ON when motor speed exceeds approx 45 r/min or 450 r/min
$\overline{\text{CLT}}$	5(6)	Current limit detection		• N-CL or P-CL used Turns ON when output torque reaches the level set by N-CL or P-CL • N-CL or P-CL not used Turns ON when output torque reaches the level set by potentiometer [CUR]
$\overline{\text{S-RDY}}$	27(28)	Servo ready		Turns ON when the main circuit power supply is ON without any servo alarm occurring and SEN signal is in H level
+12V	16, 48	±12V output power supply		+12V ±5% max output current 30mA Used with speed reference or current limit input
0V	17, 32, 47, 49			
−12V	31, 46			
TRQ-M	9	Torque monitor		(±3 0V/rated torque) ±10%, ±9V max, load 1mA max
VTG-M	10	Speed monitor		±2 V/1000 r/min ±5%, load 1 mA max
PAO	33	Positioning Signal Output 1	Phase A	PG pulse after frequency division is output at line driver (MC3487†) To be received by line receiver equivalent to SN75175† or MC3486†
*PAO	34		Phase $\overline{\text{A}}$	
PBO	35		Phase B	
*PBO	36		Phase $\overline{\text{B}}$	
PCO	19		Phase C	
*PCO	20		Phase $\overline{\text{C}}$	

†Made by Texas Instruments Inc

5. 5 CONNECTOR TERMINAL (2CN) FOR OPTICAL ENCODER (PG) CONNECTION

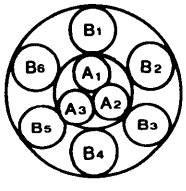
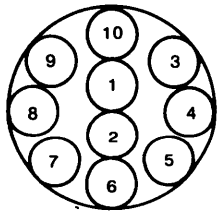
5. 5 1 Specifications of Applicable Receptacles and Cables (Table 5. 6)

Table 5 6 Specifications of Applicable Receptacles and Cables

Connector Type* Used in SERVOPACK	Applicable Receptacle Type				Connection Cable#
	Manufacturer	Soldered Type	Caulking Type	Case†	
MR-20RMA, right angle 20P	Honda Tsushin Co , Ltd	MR-20F‡	MRP-20F01	MR-20L‡	DP8409123 or DE8400093

*Made by Honda Tsushin Co , Ltd
†Attached to each applicable receptacle (soldered and caulking types)
‡Attached to Servopack when shipping
#The cables listed in Table 5 7 are available on request If required, purchase in units of standard length as shown in Table 5 7

Table 5. 7 Details of Specifications of Applicable Cables

Connection	Soldered Type	Caulking Type
Yaskawa Drawing No	DP 8409123	DE 8400093
Manufacturer	Fujikura Cable Co	
General Specifications	Double, KQVV-SW AWG 22 × 3 C AWG 26 × 6 P	KQVV-SB AWG 26 × 10 P
Internal Composition and Lead Color	For Soldered Type 	For Caulking Type 
	A1 Red A2 Black A3 Green yellow B1 Blue White/blue B2 Yellow White/yellow B3 Green White/green B4 orange White/orange B5 Purple White/purple B6 Grey White/grey Twisted cable	1 Blue-White- 2 Yellow-White 3 Green-White 4 Red-White 5 Purple-White 6 Blue-Brown 7 Yellow-Brown 8 Green-Brown 9 Red-Brown 10 Purple-Brown Twisted Cable
Yaskawa Standard Specifications	Standard length 5 m, 10 m, 20 m Terminal ends are not provided (without connectors)	

NOTE

1. When applicable cables listed in Table 5. 7 are used, allowable wiring distance between Servopack and motor is a maximum of 20 meters
2. The cable applied for 50 m wiring distance is available on order (Yaskawa drawing No DP8409179) If wiring distance is 20 m or more, contact your Yaskawa representative.

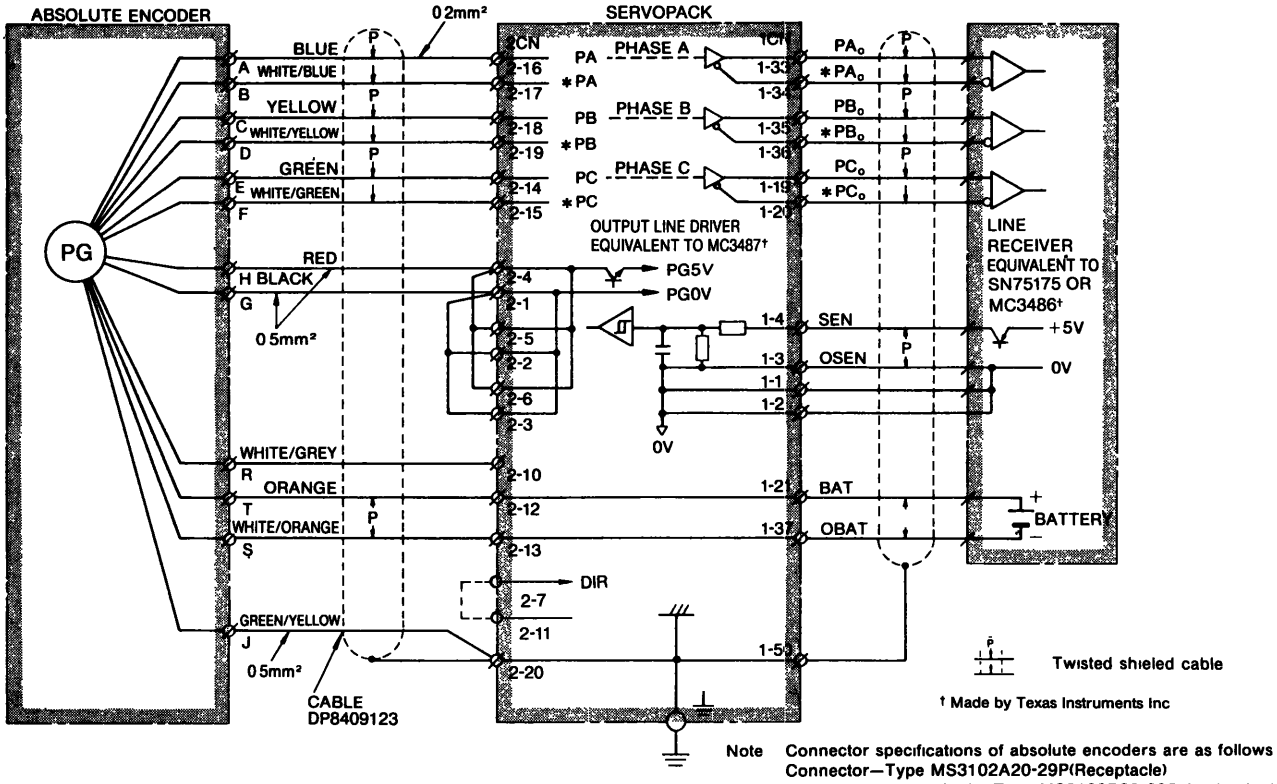
5. 5. 2 Servopack Connector (2CN) Terminal Layout and Connection

The terminal layout for the Servopack connectors (2CN) for connecting the optical encoder is shown in Table 5.8, and the connection method of 2CN and the optical encoder, in Figs. 5.4, 5.5, 5.6 and 5.7.

Table 5 8 Connector 2 CN Layout of Servopack

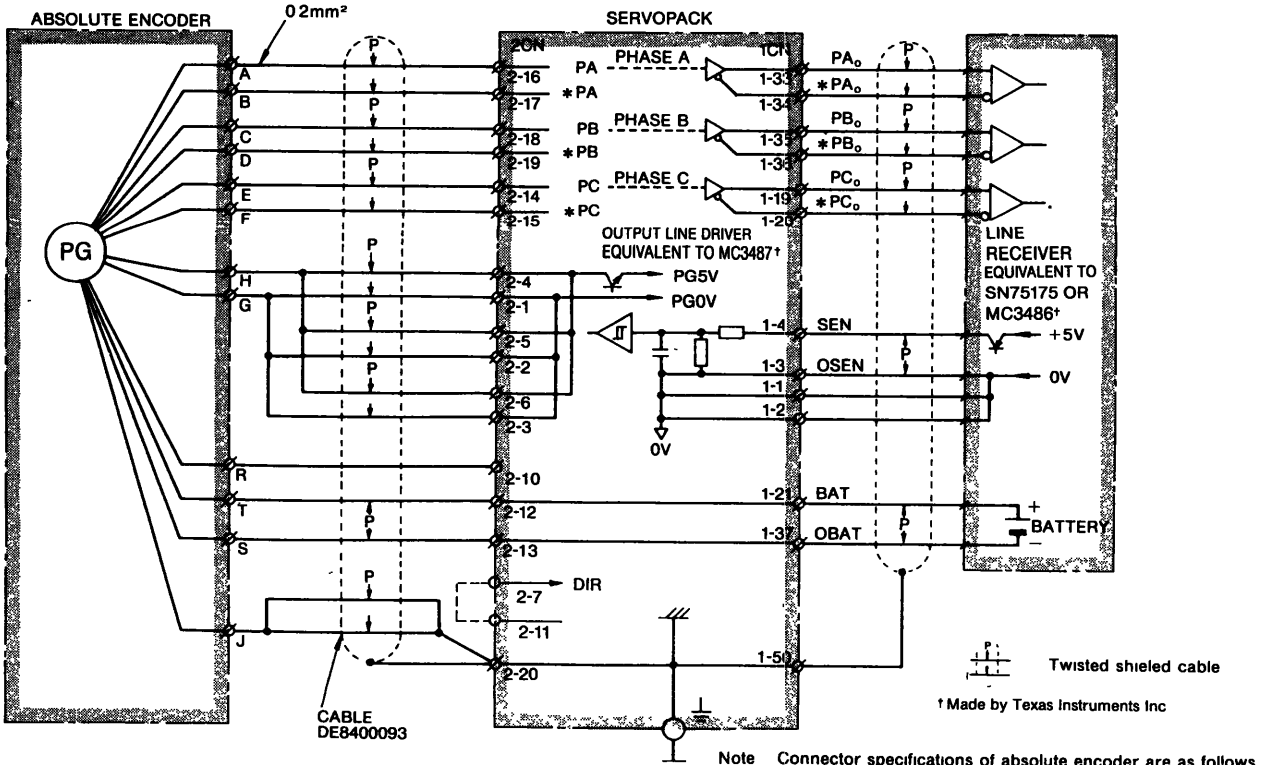
1	2	3	4	5	6	7
PG0V	PG0V	PG0V	PG5V	PG5V	PG5V	DIR†
8	9	10	11	12	13	
—	—	—	ODIR	BAT	BATO	
14	15	16	17	18	19	20
PC	*PC	PA	*PA	PB	*PB	FG

†For DIR, See par 6 9 1



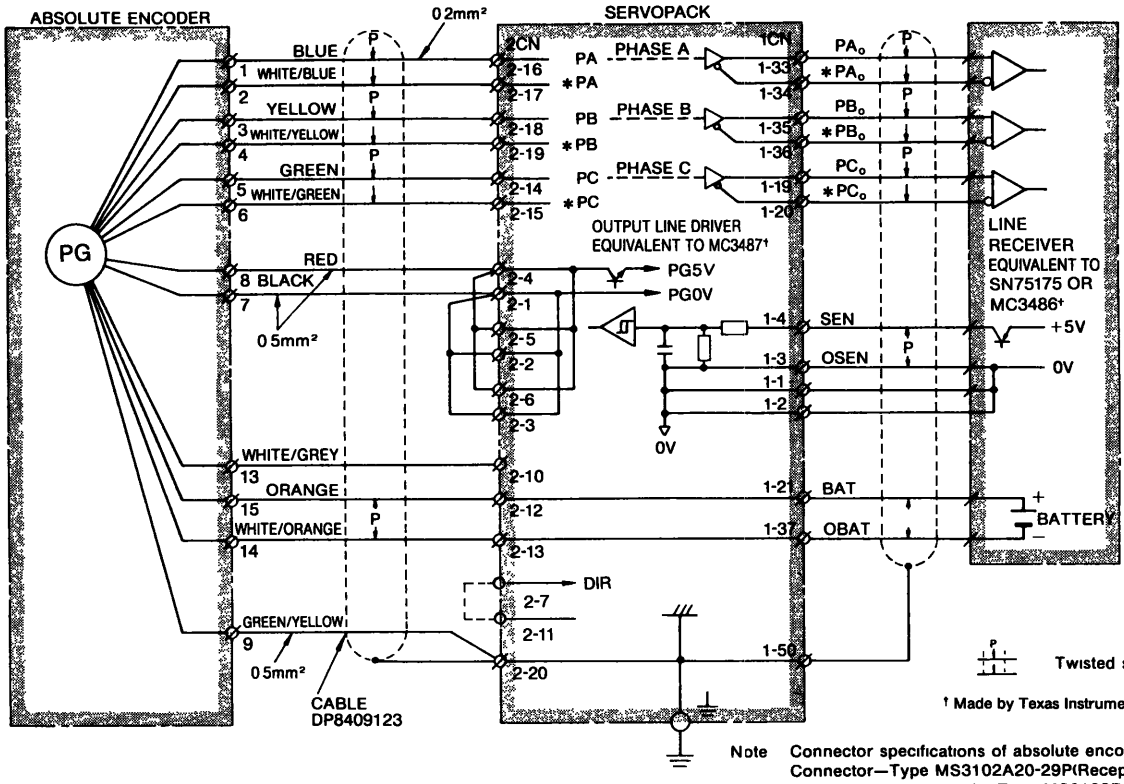
Note Connector specifications of absolute encoders are as follows
Connector—Type MS3102A20-29P(Receptacle)
Accessory(not attached)—Type MS3108B20-29S(Angle plug)
Type MS3057-12A(Cable clamp)

Fig 5 4 R Series Soldered Type Connector 2CN Connection and 1CN Output Processing
(When using Connection Cable DP8401923)



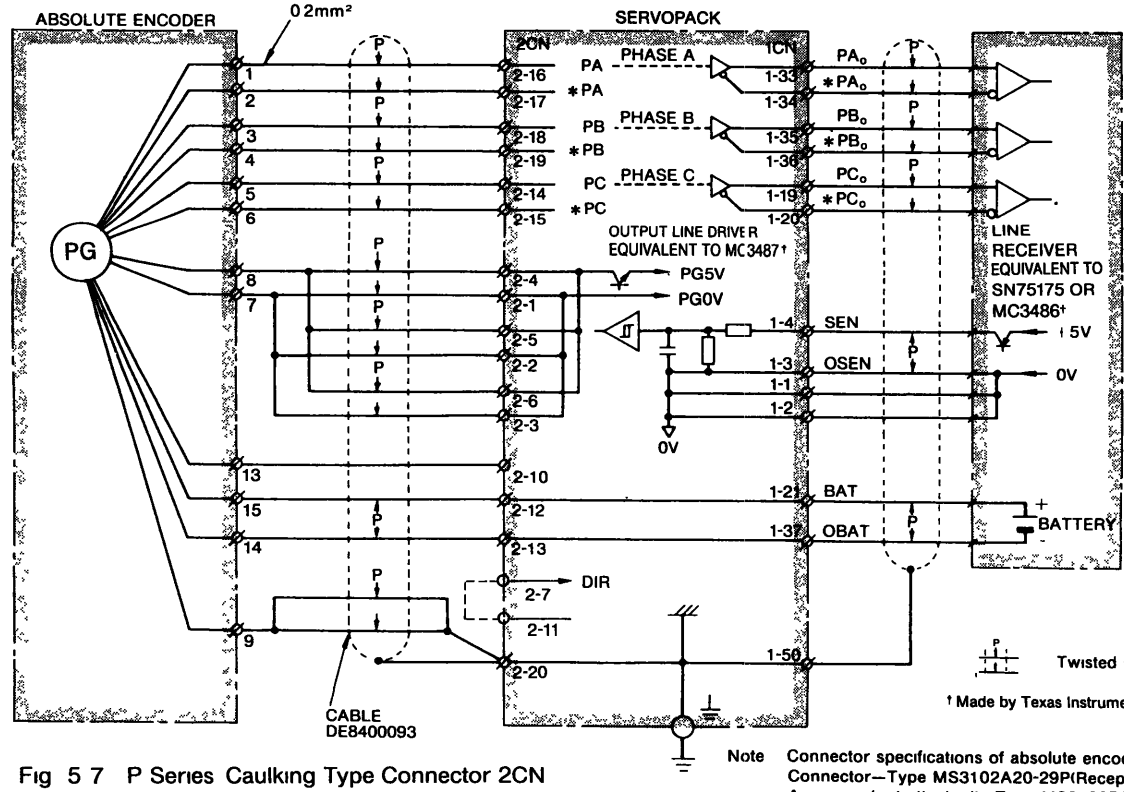
Note Connector specifications of absolute encoder are as follows
Connector—Type MS3102A20-29P(Receptacle)
Accessory(not attached)—Type MS3108B20-29S(Angle plug)
Type MS3057-12A(Cable clamp)

Fig 5 5 R Series Caulking Type Connector 2CN
Connection and 1CN Output Processing
(when using Connection Cable DE8400093)



Note Connector specifications of absolute encoders are as follows
Connector—Type MS3102A20-29P(Receptacle)
Accessory(not attached)—Type MS3108B20-29S(Angle plug)
Type MS3057-12A(Cable clamp)

Fig 5 6 P Series Soldered Type Connector 2CN Connection and 1CN Output Processing
(When using Connection Cable DP8401923)



Note Connector specifications of absolute encoder are as follows
Connector—Type MS3102A20-29P(Receptacle)
Accessory(not attached)—Type MS3108B20-29S(Angle plug)
Type MS3057-12A(Cable clamp)

Fig 5 7 P Series Caulking Type Connector 2CN Connection and 1CN Output Processing
(when using Connection Cable DE8400093)

6. OPERATION

6.1 POWER ON AND OFF

Arrange the sequence so that the power is simultaneously supplied to the main circuit (R, T) and the control circuit (r,t), or supplied to the control circuit first, then the main circuit (Figs.6.1 and 6.2).

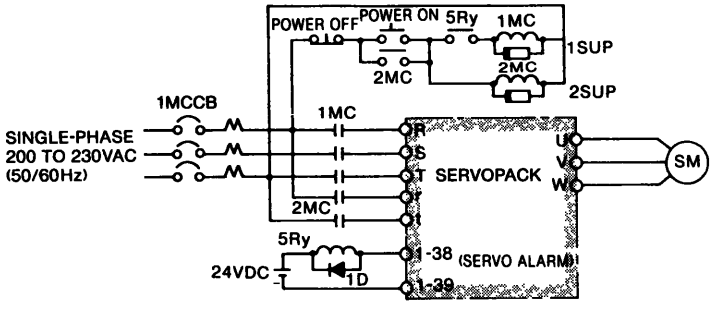
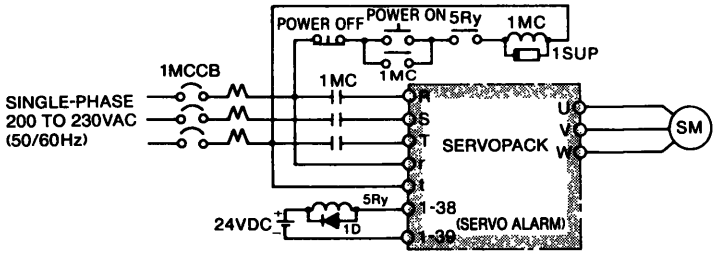


Fig 6 1 Connection Example for Simultaneous Control Power ON/OFF (When using AC Servomotor for 200V)



1SUP, 2SUP Surge suppressor CR50500BA or equivalent (made by Okaya Electric Industries Co , Ltd)
1D Flywheel diode (to prevent spike of 5Ry)

Fig. 6.2 Connection Example for Main-circuit Power ON/OFF (When using AC Servomotor for 200V)

Arrange the sequence so that the power is simultaneously cut (including momentary power failure) (Fig.6.1), or the power to the main circuit is cut first, then the control circuit (Fig.6.2). The order is the reverse of the power ON sequence.

Precautions for connections (in Figs.6.1 and 6.2)

- Make sequence to assure that the main-circuit power will be cut off by a servo alarm signal.

  If the control circuit is turned off, the LED indicating the kind of servo alarm also goes off.

- When power is supplied to the power ON/OFF sequence shown in Fig.6.1, the normal signal is set (5Ry is turned on) in the control circuit after a maximum delay of 1 second.

  When the power is turned on, a servo alarm signal continues for approximately 1 second (normally 200 to 300 ms) to initialize the Servopack.

  Hold the main-circuit power ON signal for approximately 1 second. However, this is unnecessary in the sequence in Fig.6.2, because the control power is always turned on.

- Since Servopack is of a capacitor input type, large recharging current flows when the main-circuit power is turned on (recharging time: 0.2s). If the power is turned on and off frequently, the recharging-current limit resistor may be degraded and a malfunction may occur. When the motor starts, turn ON the speed reference and turn it OFF when the motor stops. Do not turn the power ON or OFF.

- Before power on or off, turn off the "Servo ON" switch to avoid troubles at transient state.

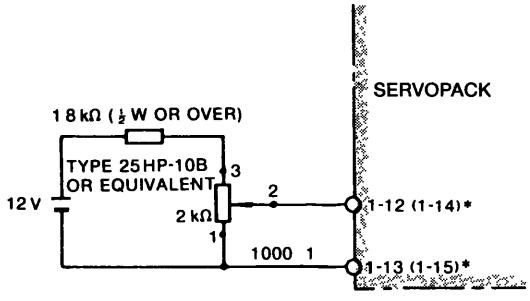
6. 2 SPEED REFERENCE

6 2 1 Speed Reference Circuit

From the Servopack built-in control power(1CN-⑯, ㊽: +12V, 1CN-⑰, ㉜, ㊼, ㊾: 0V, 1CN-㉛, ㊻: -12V) or the external power, the speed reference voltage is given to 1CN-⑫ and ⑬ or to 1CN-⑭ and ⑮. When the Servopack built-in control power is used, the motor speed fluctuates in the range of ±2% of the speed set value.

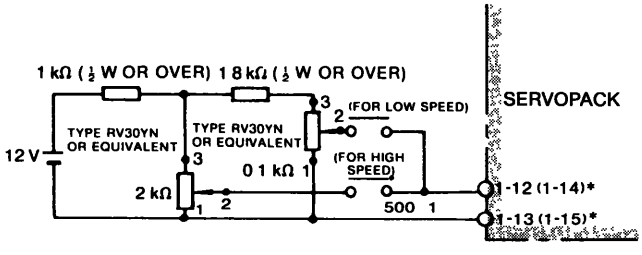
The method for giving speed reference voltage is described below.

(1) For accurate(inching) speed setting



25HP-10B type Multiple-rotation type, wire wound variable resistor (with dial MD10-30B4) made by Sakae Tsushin Inco

(a) When Multiple-rotation Type, Wire Wound Variable Resistor is used



RV30YN type Carbon-film variable resistor made by Tokyo Cosmos Electric

Low- and high-speed relays Reed relay (PG series) made by Nippon Electric or equivalent, or low-level relay (G_2A-432) made by Omron or equivalent

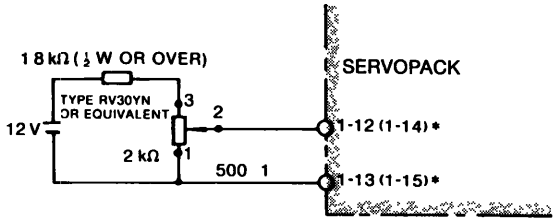
Note When a carbon resistor is used, a great residual resistance remains, and so the speed control range becomes approximately 500 1

(b) When Carbon Variable Resistor is used

*Parentheses are for auxiliary input

Fig 6 3 Method for Giving Speed Reference Voltage (for Accurate Speed Setting)

(2) For relatively rough speed setting

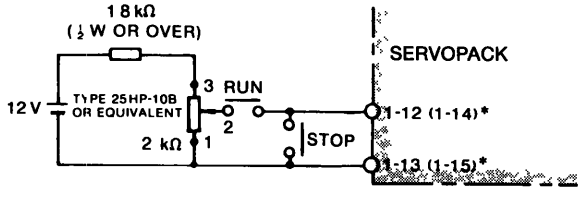


*Parentheses are for auxiliary input
Note When a carbon resistor is used, a great residual resistance remains, and so the speed control range becomes about 500 1

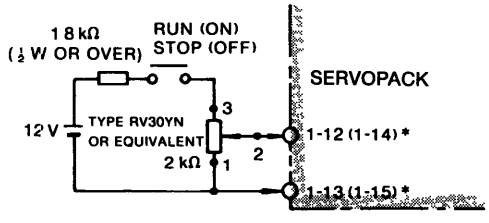
Fig 6 4 Method for Giving Speed Reference Voltage (for relatively Rough Speed Setting as compared with Fig 6 3)

6. 2. 2 Stop Reference Circuit

When commanding a stop, do not open the speed reference circuit (1CN-⑫ or 1CN-⑭), but set to 0 V.



(a) When Multiple-rotation Type, Wire Wound Variable Resistor is used



(b) When Carbon Variable Resistor is used

*Parentheses are for auxiliary input

Fig 6 5 Method for Giving Stop Reference

6. 2. 3 Handling of Speed Reference Input Terminal

The unused terminals, out of the speed reference terminals 1CN-⑫, ⑬ and the auxiliary input terminals 1CN-⑭, ⑮ must be short-circuited.

6. 2. 4 Auxiliary Input Circuit (± 2 to ± 10 V)

Auxiliary input circuit is used for application at rated reference voltage other than ±6V.

- Adjustment procedures

  Between 1CN-⑭ and ⑮ (⑮ is 0V), input the voltage to be used to set the rated speed, and adjust the potentiometer IN-B so that the rated speed is achieved.

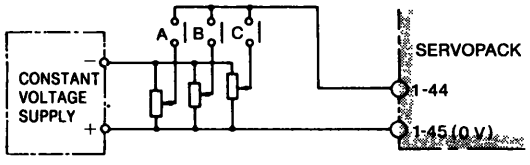
  When combined with Yaskawa Positionpack in positioning system drive, auxiliary input terminals are normally used as speed reference input. In this case, positioning loop gain is adjusted with the potentiometer 1VR IN-B. For adjustment, be sure to refer to Positionpack instruction manuals.

6.3 EXTERNAL CURRENT LIMIT REFERENCE CIRCUIT [P-CL, N-CL]

Current can be limited from the outside as well as within Servopack. The external current limit is used for the following cases:

- To protect the motor from overload current when an abnormal load lock occurs in the load.
- To change the current limit value according to the external sequence.

The current can be limited by multi-stage setting by the use of relays (Fig.6.6). The same effect can be obtained by giving voltage signals making analog change.



Relay Low-level relay type G2A-432A made by Omron Tateishi Electric Co

Fig. 6 6 Multi-stage Switching of Current Value at Forward Side

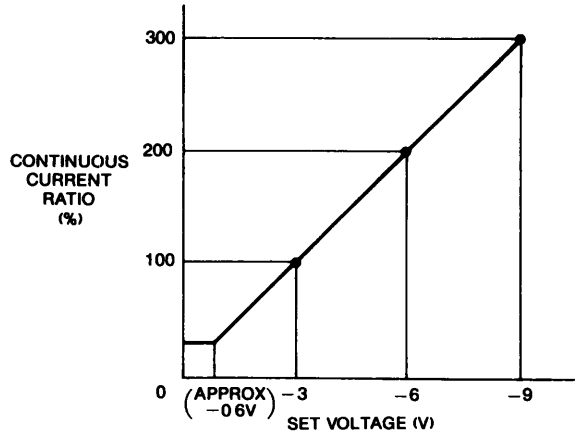
6.3.1 Method for Giving External Current Limit Reference

Forward current and reverse current can be controlled independently. The forward current can be controlled by giving a reverse voltage (0 to -9.0 V) between Servopack terminals 1CN-㊹ and ㊺ ; the reverse current can be controlled by a forward voltage (0 to +9.0 V) between terminals 1CN - ㉙ and ㉚ .

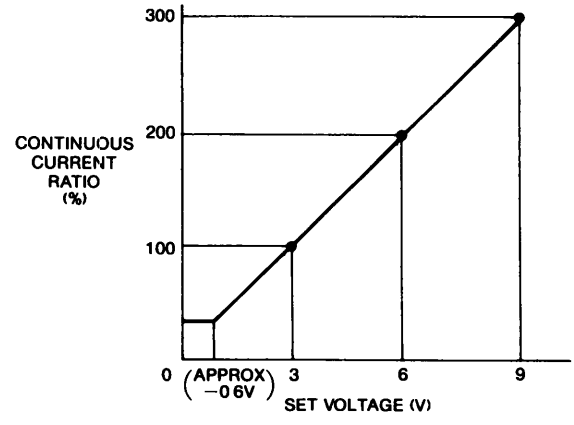
The relation between the rated current of the motor and current limit values is rated current at 3.0 V for applicable motor. The power supply must use an internal resistance less than 2kΩ. The input resistance at Servopack side must be greater than 5kΩ. When external current is not restricted, contacts between terminals 1CN - ㊹ and ㊺ and between 1CN - ㉙ and ㉚ are opened.

6.3.2 Set Voltage and Current Limit Values

The relationship between set voltages of 0 to ±9.0 V and current limit values are shown in Fig. 6.7.



(a) Current Limit at Forward Side



(b) Current Limit at Reverse Side

Note If setting value exceeds max output current value of Servopack, max output current value becomes saturation value

Fig 6 7 Set Voltage and Current Limit Values

6.3.3 Current Limit when Motor is Locked

When locking a motor by applying a current limit, determine a current limit value less than the rated current of the motor. If the load condition requires a current limit exceeding the rated motor current, refer to par. 6.5(3) Overload detection level and make sure to unlock the motor before reaching the trip level.

Note that when the speed reference voltage is less than tens or so millivolts(affected by setting of GAIN [LOOP]), the motor lock current sometimes pulsates. If this is not desirable, the current pulsation can be removed by increasing the speed reference voltage.

6.4 CONFIGURATION OF I/O CIRCUIT

For proportional control, overtravel, servo ON, alarm reset, servo alarm output, current limit detection output, TG ON, servo ready output, etc., each I/O circuit is a noncontact circuit insulated with optical couplers. The external circuit, therefore, must be constructed with the specified voltage and current.

6.4.1 Input Circuit

There are five input signals: Servo ON, proportional control, forward/reverse overtravel protection, alarm reset. Construct the input circuit using 24 V power supply (Fig.6.8). Typical circuits are shown in Fig.5.3.

NOTE

The user must provide the 24 V power supply 24VDC ±1V, 25mA or more (approx 5mA/circuit)

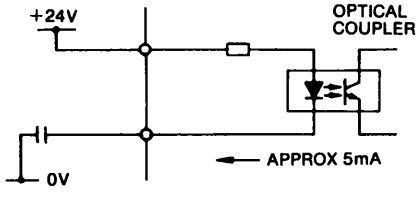


Fig 6.8 Configuration of I/O Circuit

(1) Proportional Control Reference ($\overline{\text{P-CON}}$)

If a position loop is not set for positioning, and after completion of positioning, has been left for quite a long time, the positioned point may have moved due to preamplifier drift. To avoid this, switch the speed amplifier from PI control to P control after the positioning and the loop gain in the control systems drops and the drift decreases. With several percent of friction load, the motor stops completely.

(2) Forward and reverse running prohibit [P-OT, N-OT]

These circuits prohibit motor drive in forward rotation (counterclockwise rotation viewed from the load coupling side) and in reverse rotation.

By inputting the P-OT or N-OT signal, the circuit stops drive of the rotating motor and energizes the built-in dynamic brake to stop the motor. After stopping, the motor can be operated only in a resetting direction. However, drive is not possible on the instruction to operate to the OT side.

The P-OT and N-OT operation specification is as follows:

	Side P Power-ON TR	Side N Power-ON TR	Operable Direction	Display
During P-OT	Base cut off	Power on	Side N	P
During N-OT	Power on	Base cut off	Side P	n

Note Operation in a reverse direction is possible for both sides P and N after cutting off the base and releasing DB during DB operation after P/N-OT

NOTE

When the overtravel prevention circuit is not used, connect 1CN-㊶ and ㉖ to the 0 V terminal of the external 24 V power supply

(3) Servo ON [$\overline{\text{S-ON}}$]

This circuit is used to turn on the main-circuit power-drive circuit of the Servopack. When the signal of the circuit is not input (Servo OFF state), the motor cannot be driven. If this signal is applied during motor running, the motor will coast to stop.

NOTE

Before turning power on or off, turn off the "Servo-ON" switch to avoid troubles resulting from transient current

(4) Alarm reset [$\overline{\text{ALM-RST}}$]

This is the input to reset a servo alarm state other than the overcurrent alarm (Display [1.]).

Turn off control power temporarily to reset the servo alarm if an overcurrent alarm ([1.]) occurs.

6 4 2 Output Circuit

There are four output signals: Current limit detection, TG ON, Servo alarm, Servo ready.

These output circuits are non-contact, employing transistors. Voltage and current specifications are:

Applied Voltage(Vmax) ≦ 30 V

Conduction Current (Ip) ≦ 50 mA

NOTE

The output circuit requires a separate power supply. It is recommended to use the same 24 V power supply used for the input circuit (Fig. 6. 9)

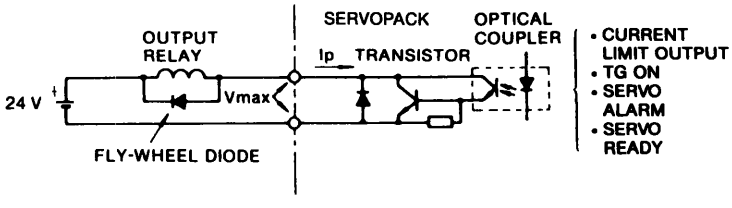


Fig 6 9 Output Circuit

6.4.3 Use of Absolute Encoder

The absolute encoder outputs PAO, PBO, and PCO, as shown below:

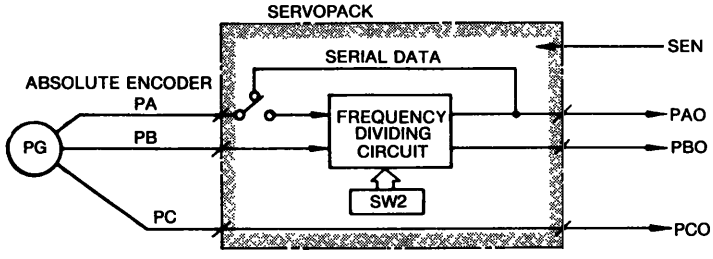


Fig 6.10 Absolute Encoder Output

When SEN signal is input (from a low to high level), absolute data is first output from PAO as serial data, then as initial incremental pulse PAO, PBO (2-phase pulse with 90-degree phase difference).

After this, output operation similar to normal incremental encoder (2-phase pulse with 90-degree phase difference) is performed.

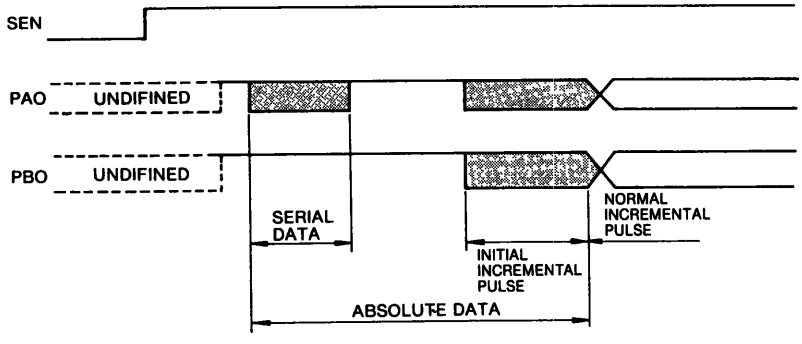


Fig 6 11 Absolute Data Output

(1) Absolute data contents

- Serial data:

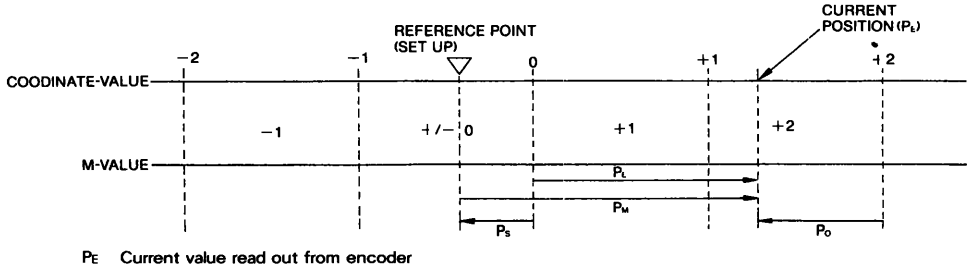
  Indicates the position of the motor shaft (in terms of revolutions) from the reference position (value set at setup time).

- Initial incremental pulse:

  Pulse is output at the same pulse speed as rotation is made at about 2747 r/min from the motor shaft origin position to the current motor shaft position. Assuming that the serial data value is M (revolutions), the initial incremental pulse count value is Po (pulses), and the number of output pulses per revolution of the motor exis (depending on divider circuit setting) is R (pulses/rev), the current position P_E can be found by the expression:

  $$P_E = M \times R + Po$$

(Example)



P_E Current value read out from encoder
M Multi-revolution data
Po Number of initial incremental pulses read out from encoder (minus value in general)
Ps Number of initial incremental pulses read out at set-up point (minus value in general stored in controller of user's system and controlled)
P_M Current value required in user s system
R Number of pulses per revolution of encoder (32768 puses in this encoder)
$P_E + M \times R + Po$
$P_M = P_E - P_S$

(2) Circuit example

Fig. 6. 12 shows an example of an absolute encoder output processing circuit.

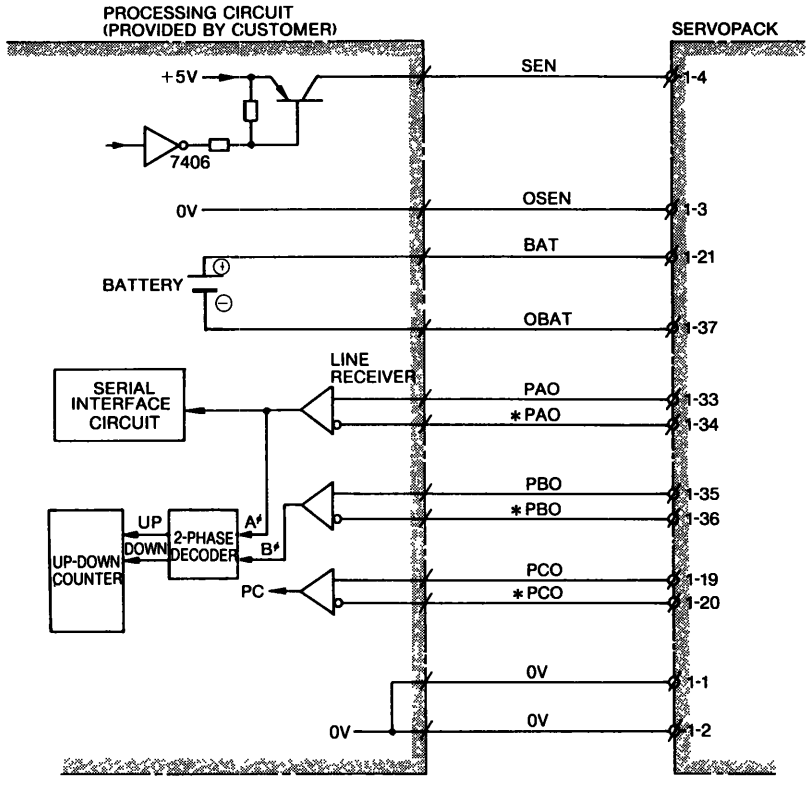


Fig 6 12 Example of Output Processing Cricuit.

(3) Absolute data reception

Process absolute data in the following sequence:

① Make the SEN signal high-level.

② After 100 ms, set serial data reception-waiting-state. Clear the up-down counter for count incremental pulses.

③ Receive serial data of 8 bytes.

④ Normal incremental operation state is entered in approximate 50 ms after the last serial data is received.

(4) Serial data specification

Transmission Mode	Asynchronous(ASYNC)
Baud Rate	9600 baud
Start Bit	1 bit
Stop Bit	1 bit
Parity	Even
Character Code	ASCII 7 bits
Data Format	5-digit 8 characters, (P)(+/−)(0 to 9)(CR)

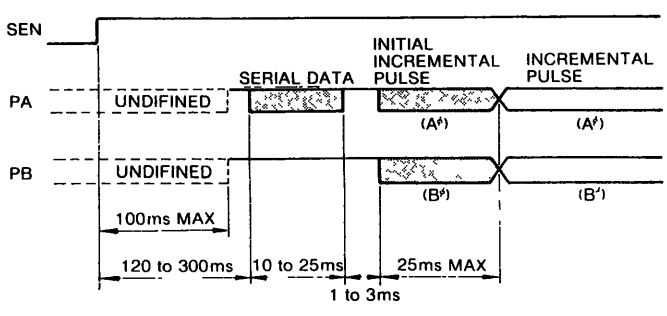


Fig 6 13 Receive Processing of Absolute Data

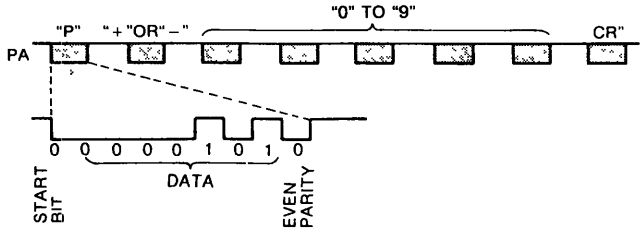


Fig 6 14 Serial Data

6 4.3 Use of Absolute Encoder (Cont'd)

Serial data of 8 bytes (8 characters) is sent.

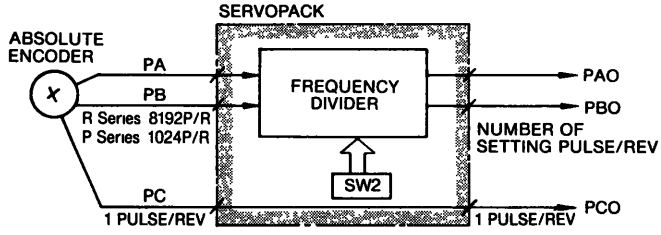
Format: P±XXXXX CR
- CR: Carriage Return Code
- XXXXX: Digit from 0 to 9

The serial data represents the number of revolutions from the reference point (set at setup time). Zero rotation is represented by either P+00000(CR) or P-00000(CR).

For ±99999 revolutions or more, a correct value is not output.

(5) Incremental pulse

Initial incremental pulse giving absolute data and normal incremental pulse are output through the frequency divider. The frequency divider is set by using SW2.

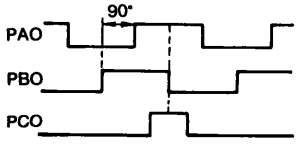


$$\left(\begin{array}{l}\text{R Series FREQUENCY DIVIDING RATIO}=\dfrac{\text{NUMBER OF SETTING PULSES}}{8192}\\ \text{P Series FREQUENCY DIVIDING RATIO}=\dfrac{\text{NUMBER OF SETTING PULSES}}{1024}\end{array}\right)$$

Fig. 6.15 Incremental Pulse

① Output Phase

· For forward running



· For reverse running.

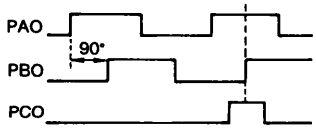
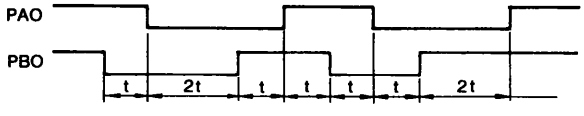


Fig. 6.16 Forward/Reverse Output Phase

PCO (origin pulse) synchronizes with PAO, but the pulse width becomes narrow because PCO is not divided. If the dividing ratio is not 1/2n, accurate 90-degree phase difference is not made and the pulses are ouput as in Fig. 6.17:



(The phase difference t, 2t part equally exists within one revolution, thus the minimum position error results.)

Fig 6 17 Freguency Dividing Ratio and Output Phase Difference

② Frequency divider setting

Set the frequency divider setting switch SW2 as listed in Table 6.1 in accordance with the required resolution.

The frequency deviding ratio is

$$\left(\begin{array}{l}\text{R Series: } \dfrac{\text{NUMBER OF SETTING PULSES}}{8192}\\ \text{P Series: } \dfrac{\text{NUMBER OF SETTING PULSES}}{1024}\end{array}\right)$$

For initial incremental pulses, the same number of pulses are output as those made at rotation of about 2747 r/min. The PAO, PBO output frequency becomes as shown below.

$$\left(\begin{array}{l}\text{R Series: } \dfrac{2747\times 8192}{60}\times\left(\begin{array}{c}\text{frequency}\\ \text{dividing ratio}\end{array}\right)\\ \qquad = 45.78\times\left(\begin{array}{c}\text{number of}\\ \text{setting pulses}\end{array}\right)\ \text{pps.}\\ \text{P Series: } \dfrac{2747\times 1024}{60}\times\left(\begin{array}{c}\text{frequency}\\ \text{dividing ratio}\end{array}\right)\\ \qquad = 45.78\times\left(\begin{array}{c}\text{number of}\\ \text{setting pulses}\end{array}\right)\ \text{pps.}\end{array}\right)$$

Table 6 1 Setting of PG Pulse Frequency Dividing Ratio (R Series)

SW2	0	1	2	3	4	5	6	7	8	9
Dividing Output Pulse	1500	1250	1000	750	625	500	400	300	200	100
SW2	A	B	C	D	E	F	—	—	—	—
Dividing Output Pulse	1440	720	360	3000	2500	2000	—	—	—	—

Table 6.2 Setting of PG Pulse Frequency Dividing Ratio (P Series)

SW2	0	1	2	3	4	5	6	7	8	9
Dividing Output Pulse	1024	1024	1000	750	625	500	400	300	200	100
SW2	A	B	C	D	E	F	—	—	—	—
Dividing Output Pulse	1024	720	360	1024	1024	1024	—	—	—	—

③ Example of output circuit and receiver circuit

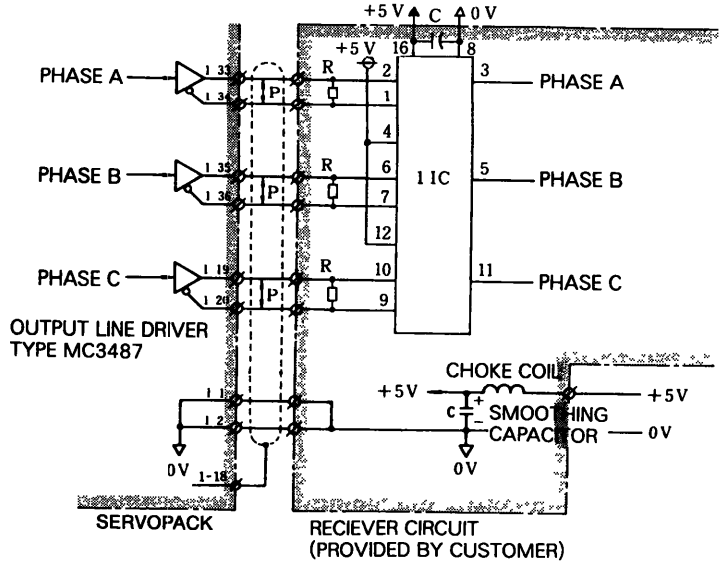
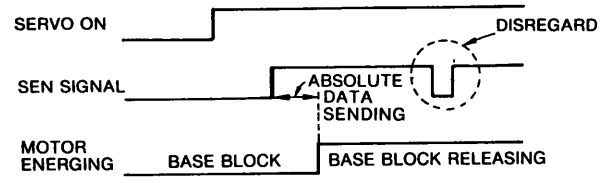


Fig 6.18 Example of Output Circuit and Receiver Circuit

- Line receiver (1 IC) Type SN75175 or MC3486 made by Texas Instrument Inc
- R Terminal resistance 220 to 470Ω
- Decoupling capacitor 0.1μF

(6) SEN signal



· When the SEN signal level is changed from low to high, +5 V power is applied to the absolute encoder and serial data and initial incremental pulses are sent; then normal operation is started.

If the SEN signal level is changed from high to low when the motor is not energized, +5 V power is not supplied to the absolute encoder.

Even if the SEN signal goes low when the motor is energized, it is disregarded.

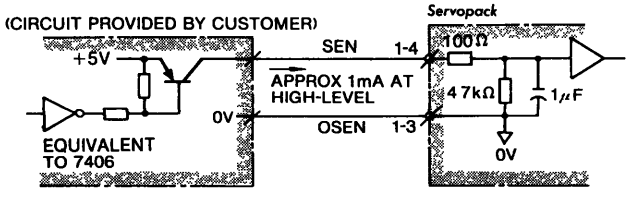
NOTE

Do not change the SEN signal level from low to high for one second after control power or main power is turned on. The PAO, PBO undefined time before serial data is sent is prolonged.

· Even if servo ON signal is entered when the SEN signal is low, the motor cannot be energized. (Base block is set.)

· Even if servo ON signal is entered, the motor is not energized until the SEN signal is input and the encoder starts normal operation, that is, sending of serial data and initial incremental pulses are complete.

· Electrical Specifications:



. The transistor type PNP is recommended.

. Signal level { high-level: 4V min.
low-level: 0.7V max.

Fig. 6.19 Electrical Specifications of SEN Signal

· When the SEN signal is changed from high-level to low-level at alarm, the alarm content is serially transmitted. For details, refer to Par.6.5(5).

(7) Battery

Be sure to use battery to store position information if absolute encoder power should fail.
The following batteries are recommended:

· Lithium battery: type ER6C, 3.6V × 1
Made by Toshiba Corporation
or
· Alkaline battery: type LR14, 1.5V×3
Made by Matsushita Electric Industrial Co., Ltd.

NOTE

· Securely connect the battery so as to prevent an environmental change or a change with the passage of time from causing constant failure.

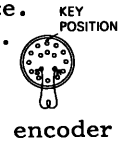
· Battery voltage is not monitored in the Servopack. Prevent the voltage from falling below 2.8V. If necessary in the system, provide a battery voltage lowering detection circuit or monitor.

(8) Setup method

If revolution amount data is to be set to 0 at motor start or the absolute encoder is not connected to the battery for more than four days, the following setup is required: (This is because the encoder capacitor is discharged and the internal elements may not operate normally.)

(R Series Motor (15-bit, with absolute encoder))

Perform the setup in numerical sequence. If this is not done, trouble may occur.



① Discharge of the encoder capacitor

Short-circuit across R and S pins of encoder connector for two minutes or more.

If the extension lead of the encoder side does not have a connector, short-circuit between reset-singal line (white/gray) and 0V (white /orange).

② Wiring and battery connection

Wire the cable normally to connect battery to the encoder.

③ Turning power ON

Turn on the Servopack power and make the SEN signal high level. If alarm [0.] is output at that time, begin again from ①.

NOTE

1. Setup resets the motor revolutions to 0.
2. When the motor is built in the unit and does not make any contact with encoder connector, remove Servopack 2CN from PG cable and short-circuit between S and R of PG cable for setup as shown in Fig. 6.20.
3. At setup, turn off Servopack power supply.

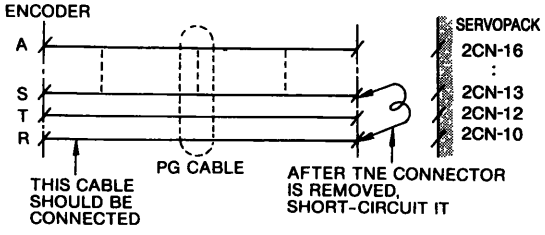


Fig 6.20 Setup Method by PG Cables

(P Series Motor (12-bit, with absolute encoder))

Perform the setup in numerical sequence to prevent trouble.

① **Wiring and battery connection**

Wire the cable of Servopack, motor and encoder normally. Then turn on the Servopack power and keep the SEN signal at high-level for more than 3 minutes.

② **Reset**

Turn off the Servopack power and remove the encoder connector. Short-circuit across pins 13 and 14 of the encoder connector for 1 or 2 seconds.

③ **Turning power ON**

Connect the encoder connector to the Servopack and turn on the Servopack power. Make the SEN signal high-level.

If an alarm occurs at that time, turn the SEN signal OFF (low-level) once and then ON (high-level) again.

If alarm [0.] is output, begin again from ①.

NOTE: If an alarm is not released, check the wiring again.

(9) Battery replacement

Replace absolute value encoder battery (supplied by user) as follows. The life of a lithium battery (type ER6C) is approximately 10 years.

① Turn on Servopack power supply and keep SEN signal at high-level more than three minutes

② Replace the battery.

(At this time, the power supply can be turned on or off.)

Follow the above procedure; The battery can be replaced and the encoder revolution data can remain stored. (After performing ①, the encoder will work normally for 4 days, even without the battery.)

6.5 PROTECTIVE CIRCUIT

Servopack provides functions to protect the body and motor from malfunctions.

(1) Dynamic brake function

Servopack incorporates a dynamic brake for emergency stop. This brake operates when:

- Alarm (fault detection) occurs.
- Servo ON command is opened.
- Main power supply is turned off.
- During deceleration at P/N overtravel

(2) Trouble detecting functions

Table 6.3 Trouble Detecting Functions

Trouble	Detection
Overcurrent	Overcurrent flow in the main circuit
Circuit Protector Trip	Circiut protector tripped
Regeneration Trouble	Regenerative circuit not activated in Servopack [R Series] • For 200V 200 to 700W • For 100V only 100 to 500W [P Series] • For 200V 100 to 750W
Overvoltage	Excessively high DC voltage in the main circuit • For 200V Approx 420V • For 100V Approx 220V
Overspeed	Excessively large speed reference input (detected at approx 4900 rpm)
Voltage Drop	Low DC voltage in the main circuit after power ON For 200V Approx 150V, For 100V Approx 75V
Overload	Overload condition of motor and Servopack
A/D Error	Element error on the printed circuit board of Servopack
Overrun Prevention	Wrong wiring of motor circuit or PG signal line
CPU Error	Any error of CPU
Absolute Encoder Error Detection	Errors on absolute encoder or its related parts

(3) Overload (OL) detection level

Fig.6.21 shows the setting of overload detection level at 100% rated motor current. If the allowable power-on time during motor locking is maximum, the higher the motor speed is, the quicker the motor responce to the same overload.

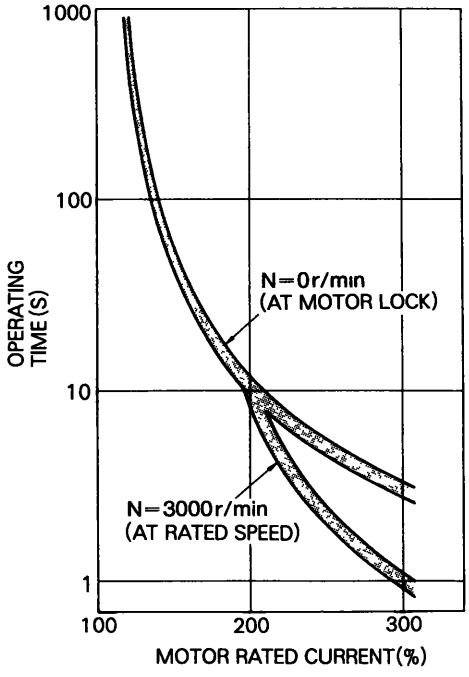


Fig. 6 21 Overloard Characteristics

(4) Servo alarm output [ALM+, ALM-]

If any trouble detection circuits in Table 6.3 functions, the power drive circuit in the Servopack goes off, 7-segment LEDs indicate the operation condition and a servo alarm signal is output.

The alarm codes are also output. The alarm content is output as serial data (ASCII 7-bit) by PG out Aϕ output. See Table 6.5.

(5) Alarm serial data

(a) Serial data receiving
Process alarm data in the sequence as shown in Fig.6.22.

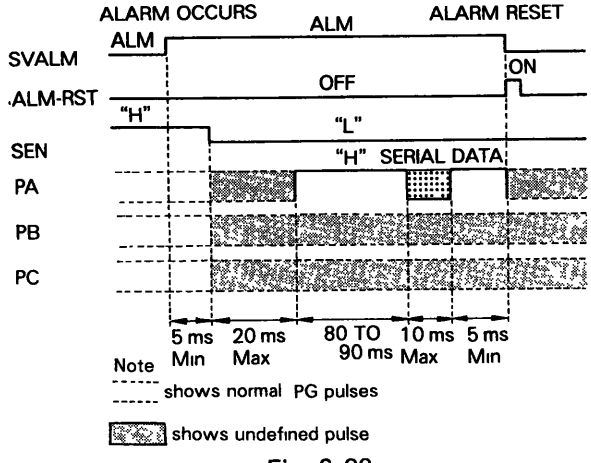


Fig 6 22

① When servo alarm occurs (in alarm status), set SEN signal at low-level.

② Provide serial data receiving holding status 20ms later.

③ Receive 6 bytes of serial data.

④ The alarm can be released approx. 5ms, after the last serial data is received.

NOTE

For SEN signal "L"→"H" in a status other than servo alarm status, absolute value data are transmitted (Refer to Par. 6.4.3.).

(b) Alarm serial data specifications

Data Transmission Method	Assynchronuos (ASYNC)
Baud Rate	9600 baud
Start Bit	1 bit
Stop Bit	1 bit
Parity	Even
Character Code	ASCII 7 bits
Data Format	6 character (A) (L) (M) (.) (CR) (alarm code)

Alarm serial data

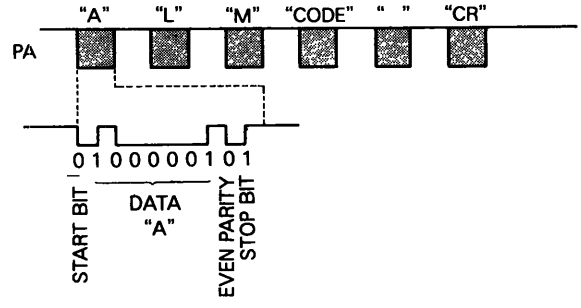


Fig 6.23 Serial Data

6 bytes (6 characters) of serial data are transmitted.
Format: (A), (L), (M), (ALARM CODE), (.) and (CR) *

* CR is a code for the carriage return.

(6) Protective circuit operation

An alarm signal indicates some trouble. Check the cause and correct the trouble, and restart the operation. Before checking the cause, turn off the power to the main circuit to avoid danger. Apply the sequence so that the alarm signal turns off only the main circuit(Ⓡ , Ⓣ), as shown in Figs. 6.1 and 6.2. This allows rapid reaction in the event of a malfunction.

If the power to the control circuit (Ⓡ , Ⓣ) is simultaneously turned off, this also turns off the LED in the Servopack indicating the cause of the alarm signal.

CAUTION

When an alarm signal cuts off only the main circuit, set the speed reference to 0 V before supplying power to the main circuit to resume the operation

6.5 PROTECTIVE CIRCUIT (Cont'd)

(7) Resetting servo alarm

To reset the servo alarm, turn ON the alarm reset ($\overline{\text{ALM-RST}}$) signal of input signal, or turn OFF the control power supply once.

If [7.] or [1.] is on (Servopack is overloaded or overcurrent), the reset alarm is not immediate and occurs at least two minutes later.

6.6 LED INDICATION

Table 6 4 LED Status Indications

Status of Servopack	Indication	
Control Power Applied	Any indications of 7-segment LED is lit	
Main Power Applied	[MAIN] LED is lit	
Base Current Interrupted	7-segment LED	[-] is lit
Current Conducting (Normal Operation)		[ ] is lit
P Side Overtravel		[P] is lit
N Side Overtravel		[n] is lit

Table 6 5 Alarm Display and Alarm Output Code (SVALM and Serial Data)

Specifications	Normal	ABS	OC	MCCB	RG	OV	OS	UV	OL	POS	A/D	PG	CPU
Display (LED)	[ ] [-]	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[b]	[C]	[-]
Serial Data* ASCII 7-bit	—	0	1	2	3	4	5	6	7	8	b	c	—
SVALM	○	×	×	×	×	×	×	×	×	×	×	×	×

○ Output transistor is turned ON
× Output transistor is turned OFF
*The serial data (ASCII 7-bit) are output from PG out Aϕ When the serial data output condition at SVALM = "H" is executed by SEN signal = "H" → "L"

6.7 PRECAUTIONS FOR APPLICATION

6 7.1 Minus Load

The motor is rotated by the load; it is impossible to apply brake(regenerative brake) against this rotation and achieve continuous running.

Example: Driving a motor to lower objects (with no counterweight)

Since Servopack has the regenerative brake capability of short time (corresponding to the motor stopping time), for application to a minus load, contact Yaskawa representative.

6.7 2 Load Inertia (J_L)

The allowable load inertia J_L converted to the motor shaft must be within ten times (R series motor) and five times (P series motor) the inertia of the applicable AC servomotor. If the allowable inertia is exceeded, an overvoltage alarm may be given during deceleration. If this occurs, take the following actions:

- Reduce the current limit.
- Slow down the deceleration curve.
- Decrease the maximum speed.

For details, contact Yaskawa representative.

6.7.3 High Voltage Line

If the supply voltage is 400/440 V, the voltage must be dropped, three-phase 400/440V to single-phase 200 V or 100 V by using a power transformer. Table 6.7 shows the transformer selection. Connection should be made so that the power is supplied and cut through the primary (or secondary) side of the transformer.

6.8 PRECAUTIONS OF OPERATION

6 8 1 Noise Treatment

Servopack uses power transistors in the main circuit. When these transistors are switched, the effect of $\frac{di}{dt}$ or $\frac{dv}{dt}$ (switching noise) may sometimes occur depending on the wiring or grounding method.

The Servopack incorporates CPU. This requires wiring and treatment to prevent noise interference. To reduce switching noise as much as possible, the recommended method of wiring and grounding is shown in **Fig. 6.24**.

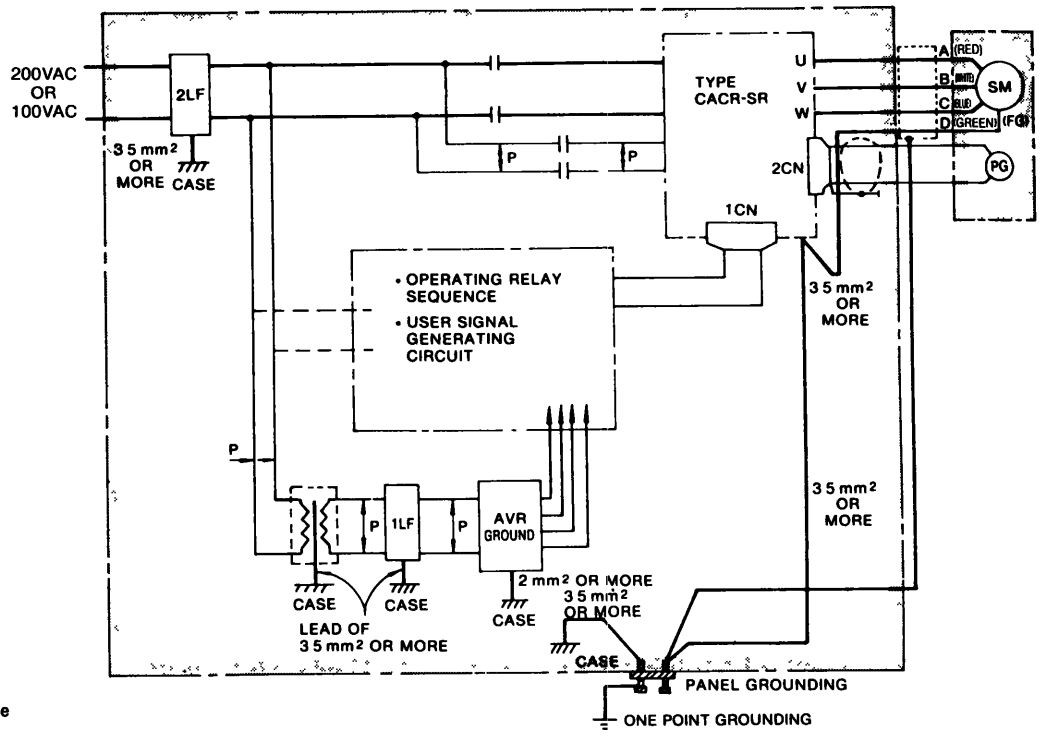
(1) Grounding method (Fig. 6.24)

- Motor frame grounding

When the motor is at the machine side and grounded through the frame, Cf $\frac{dv}{dt}$ current flows from the PWM power through the floating capacity of the motor. To prevent this effect of current, motor ground terminal Ⓓ (motor frame) should be connected to terminal ⏚ of Servopack. (Terminal ⏚ of Servopack should be directly grounded.)

- Servopack SG 0 V

Noise may remain in the input signal line, so make sure to ground SG 0 V. When motor wiring is contained in metal conduits, the conduits and boxes must be grounded. The above grounding uses one-point grounding.



P — Twisted cable

Note
1 Use wires of 3 5mm² or more for grounding to the case (preferably flat-woven copper wire)
2 Connect line filters observing the precautions as shown in (2) Noise filter installation

Fig 6. 24 Grounding Method

(2) Noise filter installation

When noise filters are installed to prevent noise from the power line, the block type must be used. The recommended noise filter is shown in Table 6.6. The power supply to peripherals also needs noise filter.

NOTE

If the noise filter connection is wrong, the effect decreases greatly Observing the precautions, carefully connect them as shown in Figs. 6 25 to 6. 28

Table 6 6 Recommended Noise Filter

Class	Servopack Type CACR-		Applicable Noise Filter	Recommended Noise Filter* Type	Specifications
200V	50W (0 07HP)	SRA5AY1SR	CORRECT	LF-205A	Single-phase 200VAC class, 5A
		SRA5AX1SR			
	100W (0 13HP)	SR01AY1□□			
		SR01AX1□□			
	200W (0 27HP)	SR02AY1□□			
		SR02AX1□□			
	300W (0 40HP)	SR03AY1□□		LF-210	Single-phase 200VAC class, 10A
		SR03AX1□□			
	500W (0 67HP)	SR05AY1□□		LF-215	Single-phase 200VAC class, 15A
		—			
	700W (0 93HP)	SR07AY1□□		LF-220	Single-phase 200VAC class, 20A
		—			
100V	50W (0 07HP)	SRA5AY2SR	WRONG	LF-205A	Single-phase 200VAC class, 5A
		SRA5AX2SR			
	100W (0 13HP)	SR01AY2SR			
		SR01AX2SR			
	200W (0 27HP)	SR02AY2SR		LF-210	Single-phase 200VAC class, 10A
		SR02AX2SR			
	300W (0 40HP)	SR03AY2SR		LF-215	Single-phase 200VAC class, 15A
		—			
	500W (0 67HP)	SR05AY2SR		LF-220	Single-phase 200VAC class, 20A
		—			

* Made by Tokin Corp
If noise filter is required, request your Yaskawa representative

(a) Separate the input and output leads. Do not bundle or run them in the same duct.

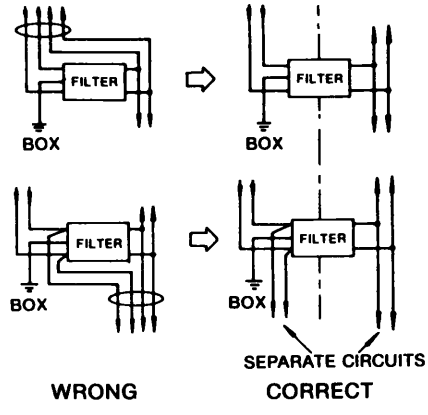


Fig. 6 25

6.8 1 Noise Treatment

(b) Do not bundle the ground lead with the filter output line or other signal lines or run them in the same duct.

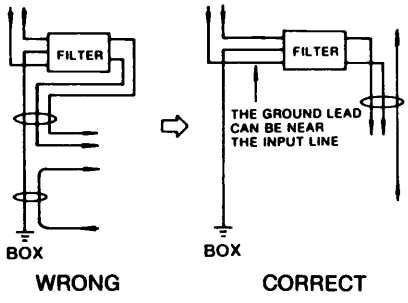


Fig. 6.26

(c) Connect the ground lead singly to the box or the ground panel.

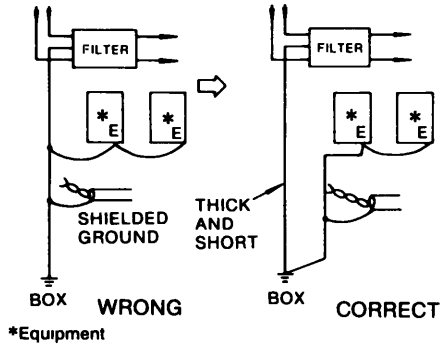


Fig 6 27

(d) If the control panel contains the filter, connect the filter ground and the equipment ground to the base of the control unit.

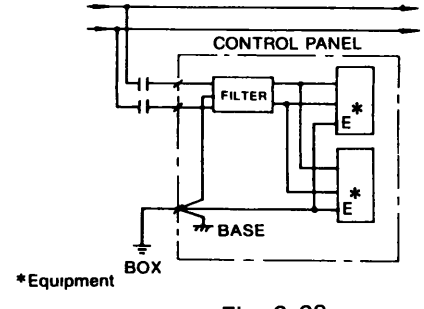


Fig. 6 28

6.8 2 Power Line Protection

The Servopack is operated through the commercial power line (200 V or 100 V). To prevent the power line accidents due to grounding error, contact error, or to protect the system from a fire, circuit breakers (MCCB) or fuses must be installed according to the number of Servopacks used (Table 6.7).

A quick-melting fuse cannot be used, because the Servopack uses the capacitor-input power supply and the charging current might melt such a fuse.

Table 6 7 Power Supply Capacity and MCCB or Fuse Capacity

Class	Rated Output W (HP)	Servopack Type CACR-	Power Capacity* Per Servopack kVA	Current Capacity† Per Servopack A
200V	50 (0 07)	SRA5AY1SR SRA5AX1SR	0 3	5
	100 (0 13)	SR01AY1□□ SR01AX1□□	0 5	5
	200 (0 27)	SR02AY1□□ SR02AX1□□	0 75	5
	300 (0 40)	SR03AY1□□ SR03AX1□□	1 0	7
	500 (0 67)	SR05AY1□□ —	1 4	11
	700 (0 93)	SR07AY1□□ —	2 0	15
100V	50 (0 07)	SRA5AY2SR SRA5AX2SR	0 3	5
	100 (0 13)	SR01AY2□□ SR01AX2□□	0 5	5
	200 (0 27)	SR02AY2□□ SR02AX2□□	0 75	8
	300 (0 40)	SR03AY2□□ —	1 0	11
	500 (0 67)	SR05AY2□□ —	1 4	15

* Values at rated load
† Interruption characteristics at 25°C 200% 2 s or more
700% 0 01s or more

6.9 APPLICATION

6 9 1 Connection for Reverse Motor Running

If the machine construction requires that the normal forward reference is used for reverse motor running and the normal reverse reference for forward running, short across 2CN-11 and 2CN-7 of connector 2CN for the PG. In this case, change of motor and PG connection is not required. If the 2CN-11 and 2CN-7 are shorted, normal incremental pulse and initial incremental pulse in absolute data are output in the reverse direction, but serial data code in absolute data is not reversed. Therefore, when the connection for reverse motor running is used, reverse the serial data code.

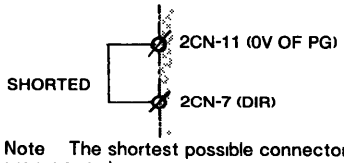


Fig 6 29

Note The shortest possible connector (MR-20F or MRP-20F01) at the cable side must be provided for 2CN-7 and -11 connection If a longer cable is run for connection a malfunction may be caused by noise

6 9 2 Speed and Torque Measurement

When an instrument is connected to measure speed and torque, make the connection as shown in Fig.6.30, using a DC voltmeter of ±1mA load (both swing).

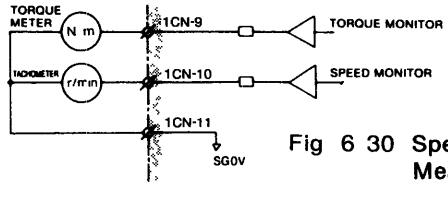


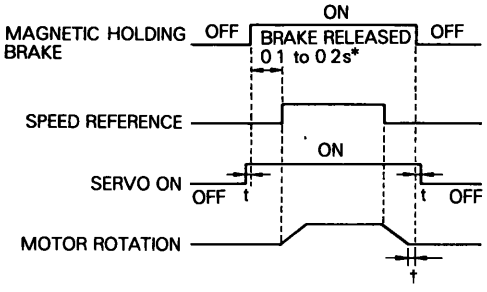
Fig 6 30 Speed and Torque Measurement

- Torque monitor output(CN1-9): ±3.0V ±10%/ 100% torque
- Speed monitor output(CN1-10): ±2.0V ±5%/ 1000 r/min
- Instrument: ±1 mA load (both swing) voltmeter. Use voltmeter of DCF-6 or DCF-12N by Toyo Instrument or equivalent.

· Example: When an R Series motor (rated speed: 3000r/min) is used, and speeds are to be measured up to the maximum speed (4500r/min) in both directions, use ±9V (both swing) DC voltmeter.

6.9.3 Use of Servomotor with Holding Magnetic Brake

When Servomotor with magnetic holding brake is used, execute the following timing for signals ON and OFF. The magnetic holding brake is released by current conduction.



*Input speed reference after waiting 0.1 to 0.2 second after the brake release reference has been input
†Apply brake after the motor has stopped completely (Do not use the brake to declerate the motor)
Note t shows a delay time greater than the operating time (10ms) of one relay. After Servo ON signal is turned on, the motor will enter servo lock status after approx. 50ms

Fig 6.31 Magnetic Holding Brake ON-OFF Timing

7. INSTALLATION AND WIRING

7.1 RECEIVING

This motor has been put through severe tests at the factory before shipped. After unpacking, however, check and see the following.

- Its nameplate ratings meet your requirements.
- It has sustained no damage while in transit.
- The output shaft should be hand-rotated freely. However, the brake-mounted motor does not rotate as it is shipped with the shaft locked.
- Fastening bolts and screws are not loose.

If any part of the motor is damaged or lost, immediately notify us giving full details and nameplate data.

7.2 INSTALLATION

7.2.1 Servomotor

AC Servomotor can be installed either horizontally or vertically.

(1) Before mounting

Wash out anticorrosive paint on shaft extension and flange surface with thinner before connecting the motor to the driven machine. See Fig. 7.1.

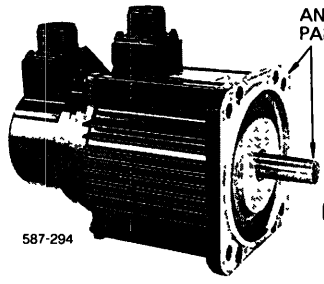


Fig 7.1 Anticorrosive Paint to be Removed

(2) Location

Use the motor under the following conditions.

- Indoors
- Free from corrosive and/or explosive gases or liquids
- Ambient temperature: 0 to +40°C
- Clean and dry
- Accessible for inspection and cleaning

If the AC servomotor is subject to excessive water or oil droplets, protect the motor with a cover. The motor can withstand a small amount of splashed water or oil.

(3) Environmental conditions

Ambient Temperature: 0° to +40°C

Storage Temperature: -20° to +80°C

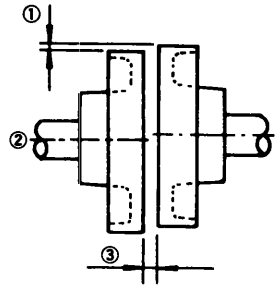
Humidity: 20% to 80% RH(non-condensing)

(4) Load coupling

True alignment of motor and driven machine is essential to prevent vibration, reduced bearing and coupling life, or shaft and bearing failures.

Use flexible coupling with direct drive. The alignment should be made in accordance with Fig. 7.2.

When mounting coupling, ease the impact on the shaft and avoid the excessive force on the bearing.



(1) Measure the gap between the straight-edge and coupling halves at four equi-distant points of the coupling. The each reading should not exceed 0.03 mm
(2) Align the shafts
(3) Measure the gap between the coupling faces at four equidistant points around the coupling rim with thickness gage. The maximum variation between any two readings should not exceed 0.03mm

Fig 7.2 Alignment of Coupling

(5) Allowable bearing load

Avoid both excessive thrust and radial loads to the motor shaft. If unavoidable, never exceed the values in Table 4.1.

When mounting the gear, coupling and pulley, ease the impact on the shaft and avoid excessive force on the bearing. (50G max.)

7.2.2 Servopack

(1) Installation

The Servopack type CACR-SR[][]AY, -SR[][]AX are rack-mounted type.

(2) Location

- When installed in a panel:

  Keep the temperature around Servopack at 55°C or below.

- When installed near a heat source:

  Keep the temperature around Servopack below 55°C.

- If subjected to vibration:

  Mount the unit on shock absorbing material.

- If corrosive gases are present:

  Avoid locations where corrosive gases exist as it may cause extensive damage over long use. Especially vulnerable are switching operation of contactors and relays.

- Unfavorable atmospheric conditions:

  Select a location with minimum exposure to oil, water, hot air, high humidity, excessive dust or metallic particles.

(3) Mounting Method

- Direction

  Mount the Servopack unit vertically on the wall with main terminals being at the bottom to take advantage of natural air convention. (See Fig. 7.5(a).)

- Place

  Use the base mounting hole (4 holes).

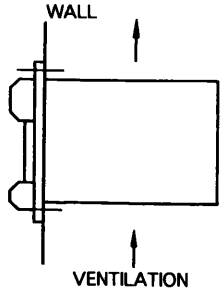


Fig 7.3 Mounting Direction

7.3 WIRING

7.3.1 Rated Current and Cable Size

Tables 7.1 and 7.2 show external terminals, rated current, and cable sizes of the power unit and Servopack, respectively. Select the type and size of cables to meet ambient conditions and current capacity. The cable size is calculated so that a bundle of three cables can bear the rated current at an ambient temperature of 40°C. Table 7.3 lists the type of cables.

Table 7.1 Rated Current

External Terminal		Type CACR- / Symbol	Rated Current (Effective Current)										
			200V Class						100V Class				
			SRA5AY1	SR01AY1	SR02AY1	SR03AY1	SR05AY1	SR07AY1	SRA5AY2	SR01AY2	SR02AY2	SR03AY2	SR05AY2
			SRA5AX1	SR01AX1	SR02AX1	SR03AX1	—	—	SRA5AX2	SR01AX2	SR02AX2	—	—
On Line	Main Circuit Power Input	ⓇⓉ	15	25	40	50	75	100	26	45	80	110	150
	Motor Connection	ⓊⓋⓌ	07	10	20	27	36	57	12	17	29	36	55
	Control Power Input	ⓡⓣ	05										
On Line	Control I/O Signal Connection	1CN	100 mA DC max										
	PG Signal Connector	2CN	100 mA DC max (500 mA DC for power line only)										
	Ground		—										

Table 7.2 Recommended Cable Size of Servopack

External Terminal		Type CACR- / Symbol	Cable Size* mm²										
			200V Class						100V Class				
			SRA5AY1	SR01AY1	SR02AY1	SR03AY1	SR05AY1	SR07AY1	SRA5AY2	SR01AY2	SR02AY2	SR03AY2	SR05AY2
			SRA5AX1	SR01AX1	SR02AX1	SR03AX1	—	—	SRA5AX2	SR01AX2	SR02AX2	—	—
On Line	Main Circuit Power Input	ⓇⓉ	HIV 1 25 or more			HIV 2 0 or more			HIV 1 25		HIV 2 0 or more		
	Motor Connection*	ⓊⓋⓌ	HIV 1 25 or more										
	Control Power Iput	ⓡⓣ	HIV 1 25 or more										
On Line	Control I/O Signal Connection	1CN	• Two-core twisted shielded cable • Core must be 0 2 mm² or more • Tin-plate soft-copper twisted cable • Finished cable dimension 16 dia or less for 1CN, 11dia or less for 2CN										
	PG Signal Connector	2CN											
	Ground		HIV 1 25 or more										

*Conditions for cable size to be provided for use with rated current
Ambient temperature 40°C, 3 lead strands

Table 7 3 Cable

Type of Cable	Allowable Conductor Temperature °C
Vinyl Cable (PVC)	—
600 V Vinyl Cable (IV)	60
Special Heat-Resistant Cable (HIV)	75

Note
1 For main circuits, use cables of 600 V or more
2 Where cables are bundled or run through a duct (unplasticized polyvinyl chloride conduit or metalic conduit), select the larger cable size than listed considering the current drop rate of the cables
3 Where the ambient (panel inside) temperature is high (40°C to 60°C), use heat-resistant cables

7 3.2 Wiring Precautions

Servopack is a device for speed control of 1000:1, and signal level of several milli-volts or less. The following precautions should be taken for wiring.

(1) For signal lines and PG feedback lines, use twisted cables or multi-core shielded twisted-pair cables (Yaskawa Drawing No.DP8409123 or DE8400093).

Cable length is a maximum of 3 m for reference input lines and a maximum of 20 m for PG feedback lines. Use the shortest possible length.

(2) For ground line, cable should be as heavy as possible to provide class 3 ground (ground resistance 100Ω or less). Make sure to ground at one point. If the motor and machine are insulated, ground the motor.

(3) To prevent malfunction due to noise, take the following precautions:

- Place the noise filter, Servopack and I/O reference as near as possible to each other.
- Make sure to mount a surge absorbing circuit into the relay, electromagnetic contact, and solenoid coils.
- Make sure to mount a surge absorbing circuit into the relay, electromagnetic contact, and solenoid coils.
- Run the power line and signal line, holding the distance to 30 cm or more; do not run them in the same duct or in a bundle.
- When the same power is used for Servopack, as for an electric welder or electrical discharge machine or when a high-frequency noise source is present in the vicinity, use filters in the power and input circuits.
- The Servopack uses a switching amplifier, and spurious noise may be present in the signal line. Never leave the termination of the analog input wiring open.

(4) Remedy for Radio Frequency Interference (R.F.I)

Servopack is not provided with protected from radio frequency interference. If the controller is adversely affected by radio waves, connect a noise filter to power supply.

(5) The signal line uses cables whose core is extremely fine (0.2 to 0.3 mm²). Avoid using excessive force which may damage these cables.

7 3 3 Power Loss

The power loss of Servopack is shown in Table 7.4. The values are calculated under the following conditions.

- $GD^2_L = 10 \times GM^2_M$
- Repetitive duty of N=0 ⟷ 4000 r/min is 5%.

Table 7.4 Power Loss at Rated Output

Class	Rated Output W (HP)	Servopack Type CACR-SR	Output Current A(rms)	Power Loss			
				Main Circuit W	Regenerative Resistance* W	Control Circuit W	Total W
200V	50 (0 07)	SRA5AY1SR / SRA5AX1SR	0 7	20	—	30	50
	100 (0 13)	SR01AY1□□ / SR01AX1□□	1 0	25	— (6)†		55(61)†
	200 (0 27)	SR02AY1□□ / SR02AX1□□	2 0	30	6		66
	300 (0.40)	SR03AY1□□ / SR03AX1□□	2 7	35	6		71
	500 (0.67)	SR05AY1□□ / —	3 6	55	6		91
	700 (0.93)	SR07AY1□□ / —	5 7	50	15		95
100V	50 (0 07)	SRA5AY2SR / SRA5AX2SR	1 2	20	—		50
	100 (0.13)	SR01AY2□□ / SR01AX2□□	1 7	25	6		61
	200 (0.27)	SR02AY2□□ / SR02AX2□□	2 9	40	6		76
	300 (0.40)	SR03AY2□□ / —	3 6	50	6		86
	500 (0 67)	SR05AY2□□ / —	5 5	45	15		90

* The regenerative resistor causes power loss when the motor is decelerated These data show allowable resistance values of average power loss If the motor is operated under duty cycle exceeding these values, install the regenerative resistor externally
† Only Servopack for P series have a regenerative resistor within

8. DIMENSIONS

8. 1 SERVOMOTOR DIMENSIONS in mm (inches)

8 1 1 R Series AC Servomotors

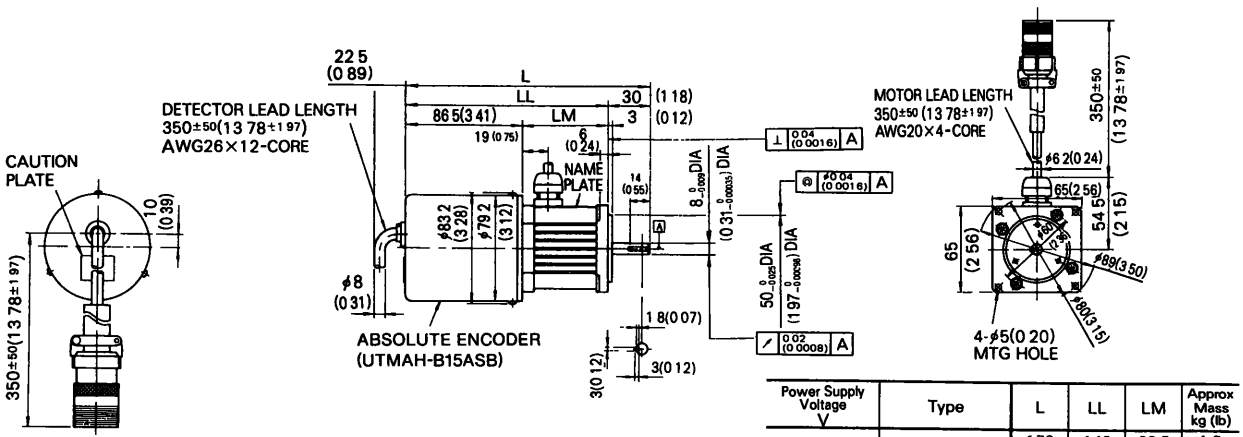
If the capacity is the same, the dimensions are the same even if the voltage or pulse specifications differ (100V, 200V, 1500 pulses or 1000 pulses).

The dimension diagrams show two types: without brake (with key) and with brake (with key). The shaft end dimensions that are non-standard are shown for applied models. The Servomotor proper is the same as shown in each diagram.

(1) Standard (with key, straight shaft)

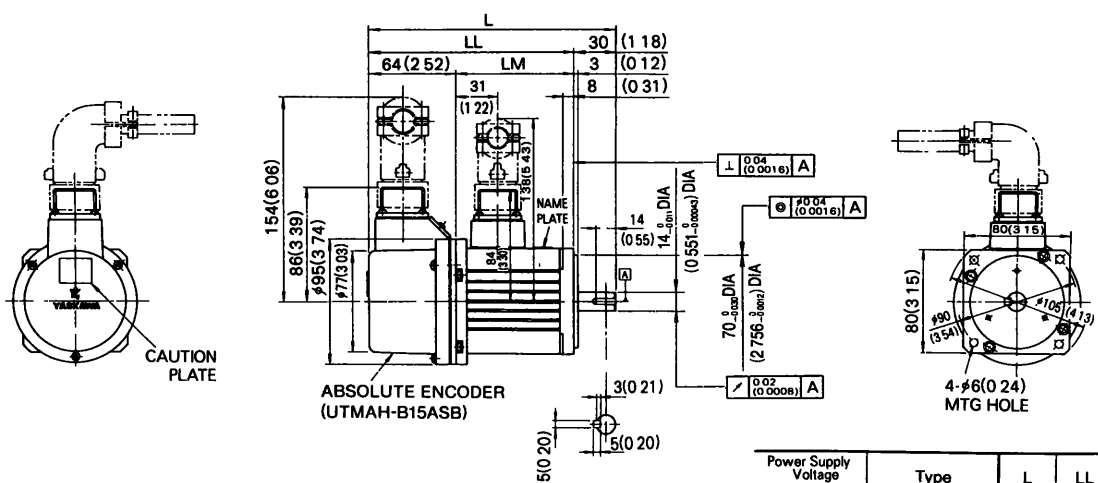
Dimensions of the keyway are based on JIS (Japanese Industrial Standard) B1301(1976) "Sunk keys and their corresponding keyways)." Parallel key has been attached.

• TYPE USAREM-A5□S2K, -01□S2K



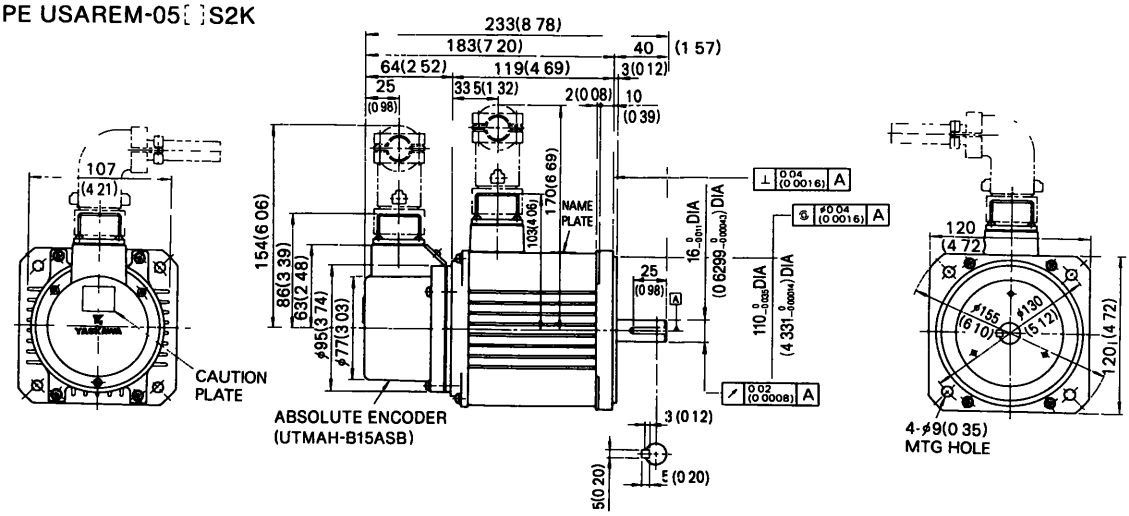
Power Supply Voltage V	Type	L	LL	LM	Approx Mass kg (lb)
200	USAREM-A5CS2K	179 (7 05)	149 (5 87)	62 5 (2 46)	1 5 (3 3)
	USAREM-01CS2K	196 5 (7 74)	166 5 (6 56)	80 (3 15)	1 8 (4 0)
100	USAREM A5DS2K	179 (7 05)	149 (5 87)	62 5 (2 46)	1 5 (3 3)
	USAREM-01DS2K	196 5 (7 74)	166 5 (6 56)	80 (3 15)	1 8 (4 0)

• TYPES USAREM-02□S2K, -03□S2K



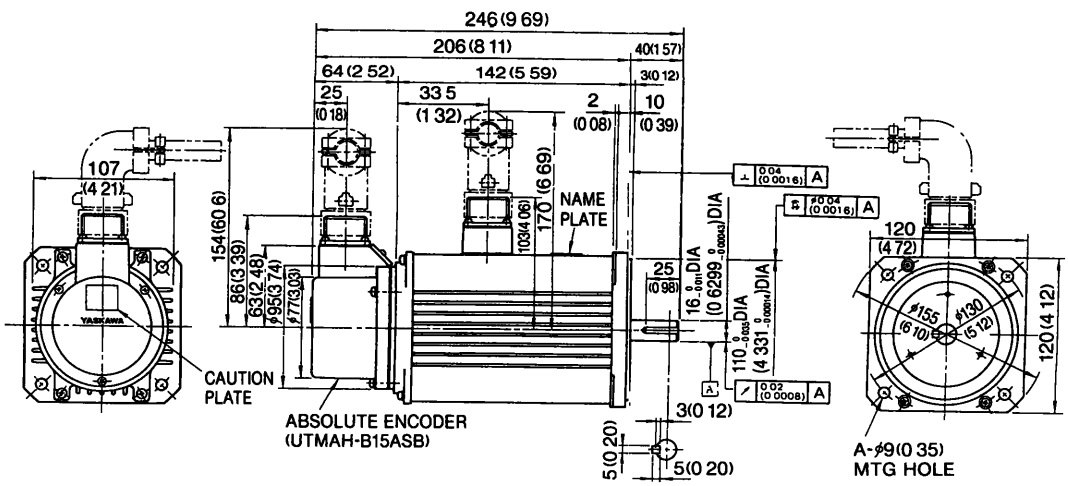
Power Supply Voltage V	Type	L	LL	LM	Approx Mass kg (lb)
200	USAREM-02CS2K	181 5 (7 15)	151 5 (5 96)	87 5 (3 44)	2 5 (5 5)
	USAREM-03CS2K	205 5 (8 09)	175 5 (6 91)	111 5 (4 39)	3 1 (6 9)
100	USAREM-02DS2K	181 5 (7 15)	151 5 (5 96)	87 5 (3 44)	2 5 (5 5)
	USAREM-03DS2K	205 5 (8 09)	175 5 (6 91)	111 5 (4 39)	3 1 (6 9)

• TYPE USAREM-05[ ]S2K



Power Supply Voltage V	Type	Approx Mass kg (lb)
200	USAREM 05CS2K	4 9 (10 9)
100	USAREM-05DS2K	4 9 (10 9)

• TYPE USAREM-07CS2K

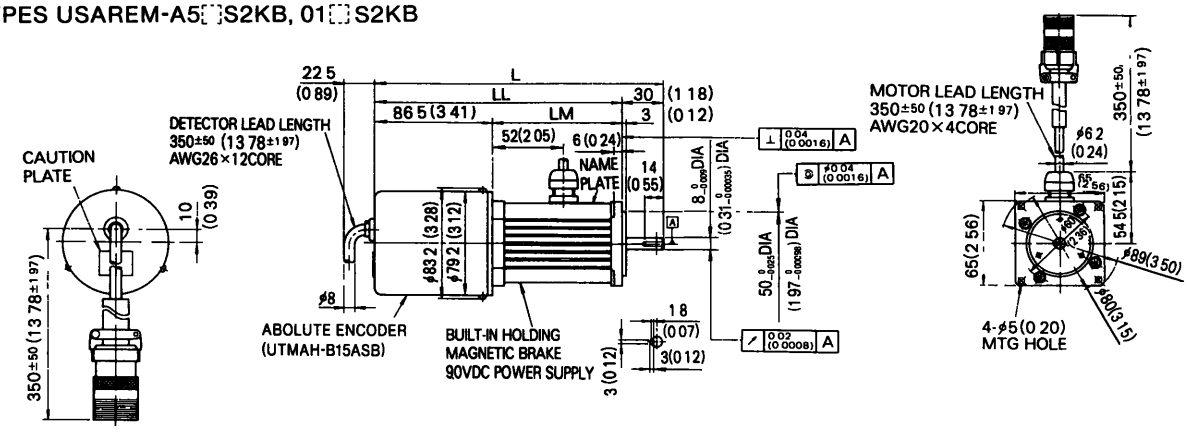


Power Supply Voltage V	Type	Approx Mass kg (lb)
200	USAREM-07CS2K	8 6 (18 9)

(2) With Brake (with key, straight shaft)

Dimensions of the keyway are based on JIS (Japanese Industrial Standard) B1031 "Sunk keys and their corresponding keyways)." Parallel key has been attached.

• TYPES USAREM-A5□S2KB, 01□S2KB

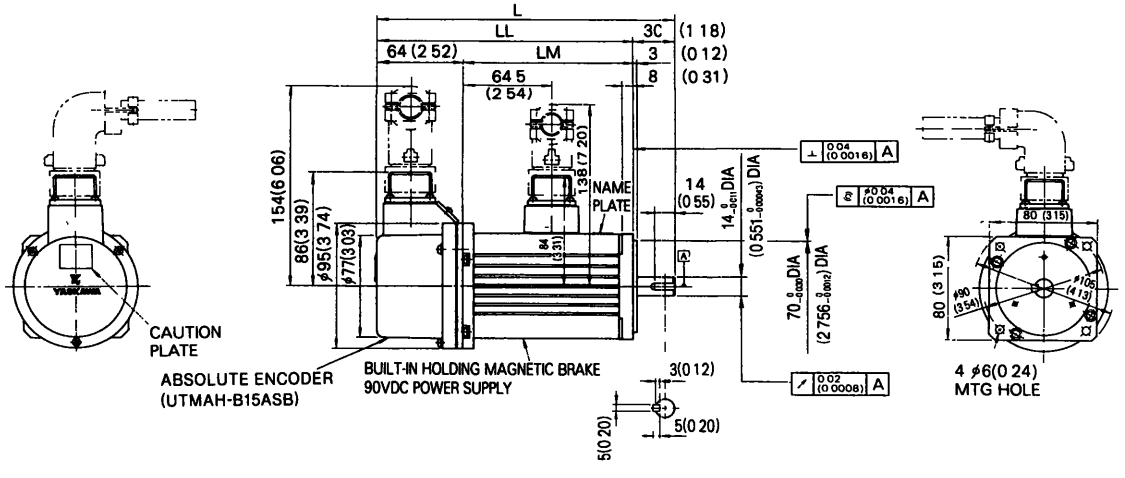


Magnetic Brake Specifications

Type	INERTIA kg m²	Static Friction Torque N m	Voltage V
MSB/90-6YN	0 98 × 10⁻⁴	0 588	90VDC

Power Supply Voltage V	Type	L	LL	LM	Approx Mass kg (lb)
200	USAREM A5CS2KB	212 (8 35)	182 (7 17)	95 5 (3 76)	1 9 (4 2)
	USAREM 01CS2KB	229 5 (9 04)	199 5 (7 85)	113 (4 45)	2 2 (4 9)
100	USAREM A5DS2KB	212 (8 35)	182 (7 17)	95 5 (3 76)	1 9 (4 2)
	USAREM 01DS2KB	229 5 (9 04)	199 5 (7 85)	113 (4 45)	2 2 (4 9)

• TYPES USAREM-02□S2KB, -03□S2KB

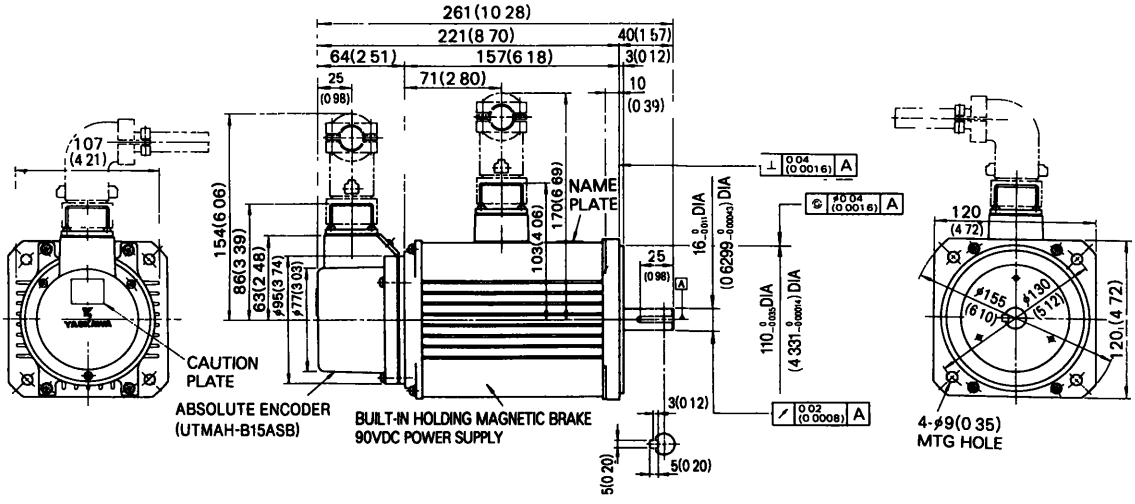


Magnetic Brake Specifications

Type	INERTIA kg m²	Static Friction Torque N m	Voltage V
MSB/90-20YN	0 19 × 10⁻⁴	1 961	90VDC

Power Supply Voltage V	Type	L	LL	LM	Approx Mass kg (lb)
200	USAREM 02CS2KB	219 (8 62)	189 (7 44)	125 (4 92)	3 2 (7 1)
	USAREM 03CS2KB	243 (9 57)	213 (8 39)	149 (5 87)	3 8 (8 4)
100	USAREM 02DS2KB	219 (8 62)	189 (7 44)	125 (4 92)	3 2 (7 1)
	USAREM 03DS2KB	243 (9 57)	213 (8 39)	149 (5 87)	3 8 (8 4)

• TYPE USAREM-05□S2KB

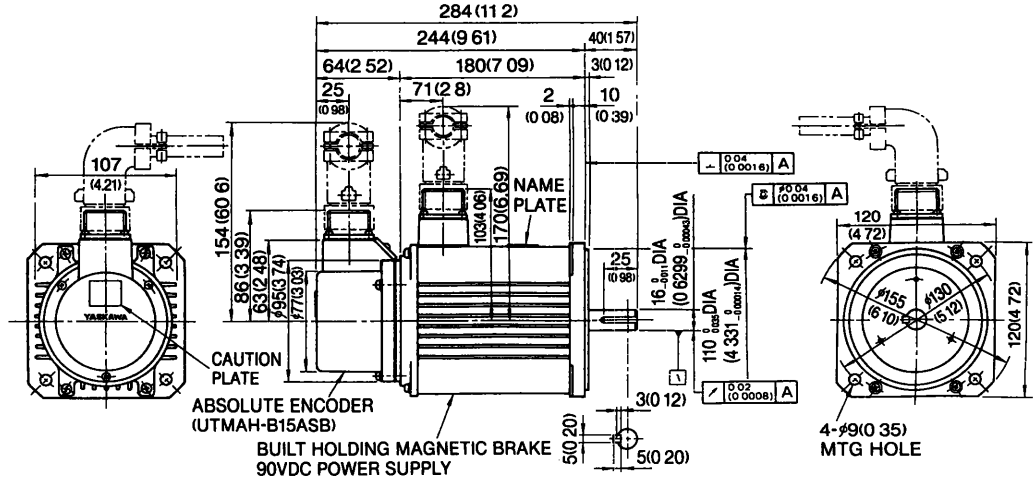


Magnetic Brake Specifications

Type	INERTIA kg m²	Static Friction Torque N m	Voltage V
MSB/90-30YN	0 48 × 10⁻⁴	2 942	90VDC

Power Supply Voltage V	Type	Approx Mass kg (lb)
200	USAREM-05CS2KB	6 0 (13 3)
100	USAREM-05DS2KB	6 0 (13 3)

• TYPE USAREM-07CS2KB



Magnetic Brake Specifications

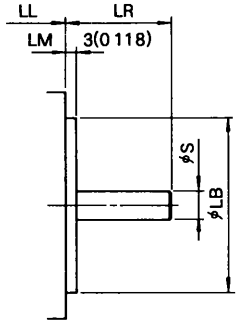
Type	INERTIA kg m²	Static Friction Torque N m	Voltage V
MSB/90-30YN	0 48 × 10⁻⁴	2 942	90VDC

Power Supply Voltage V	Type	Approx Mass kg (lb)
200	USAREM-07CS2KB	8 6 (18 9)

(3) Shaft Extension of Straight Shaft

• TYPE USAREM-A5□S2 to -05□S2 (without brake)
• TYPE USAREM-A5□S2B to -05□S2B (with brake)

Servomotor proper is the same dimensions as standard servomotor. See par. 8.1 (1) and (2). Details of shaft extension are shown below:

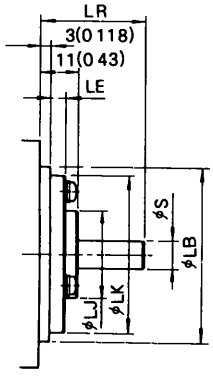


Without Brake Type USAREM-	With Brake Type USAREM-	LR	S	LB
A5□S2	A5□S2B	30 (1 18)	$8\ ^{0}_{-0.009}$ ($0.31\ ^{0}_{-0.00035}$)	$50\ ^{0}_{-0.025}$ ($1.97\ ^{0}_{-0.00098}$)
01□S2	01□S2B			
02□S2	02□S2B		$14\ ^{0}_{-0.011}$ ($0.551\ ^{0}_{-0.00043}$)	$70\ ^{0}_{-0.030}$ ($2.756\ ^{0}_{-0.0012}$)
03□S2	03□S2B			
05□S2	05□S2B	40 (1 57)	$16\ ^{0}_{-0.011}$ ($0.6299\ ^{0}_{-0.00043}$)	$110\ ^{0}_{-0.035}$ ($4.331\ ^{0}_{-0.00014}$)

(4) Shaft Extension of Straight Shaft with Oilseal

• TYPE USAREM-A5□S2S to -05□S2S (without brake)
• TYPE USAREM-A5□S2SB to -05□S2SB (with brake)

Servomotor proper is the same dimensions as standard servomotor. See par. 8.1 (1) and (2). Details of shaft extension are shown below.



Without Brake Type USAREM	With Brake Type USAREM	LR	LE	LJ	LK	S	LB	Oilseal
A5□S2S	A5□S2SB	30 (1 18)	4 5 (0 18)	25 (0 98)	45 (1 77)	$8\ ^{0}_{-0.009}$ ($0.31\ ^{0}_{-0.00035}$)	$50\ ^{0}_{-0.025}$ ($1.97\ ^{0}_{-0.00098}$)	SB08187
01□S2S	01□S2SB							
02□S2S	02□S2SB			36 (1 42)	60 (2 36)	$14\ ^{0}_{-0.011}$ ($0.551\ ^{0}_{-0.00043}$)	$70\ ^{0}_{-0.030}$ ($2.756\ ^{0}_{-0.0012}$)	SB14287
03□S2S	03□S2SB							
05□S2S	05□S2SB	40 (1 57)	2 5 (0 10)	50 (1 97)	73 (2 87)	$16\ ^{0}_{-0.011}$ ($0.6299\ ^{0}_{-0.00043}$)	$110\ ^{0}_{-0.030}$ ($4.331\ ^{0}_{-0.00014}$)	SB16307

(5) Shaft Extension of Straight Shaft with Keyway and Oilseal

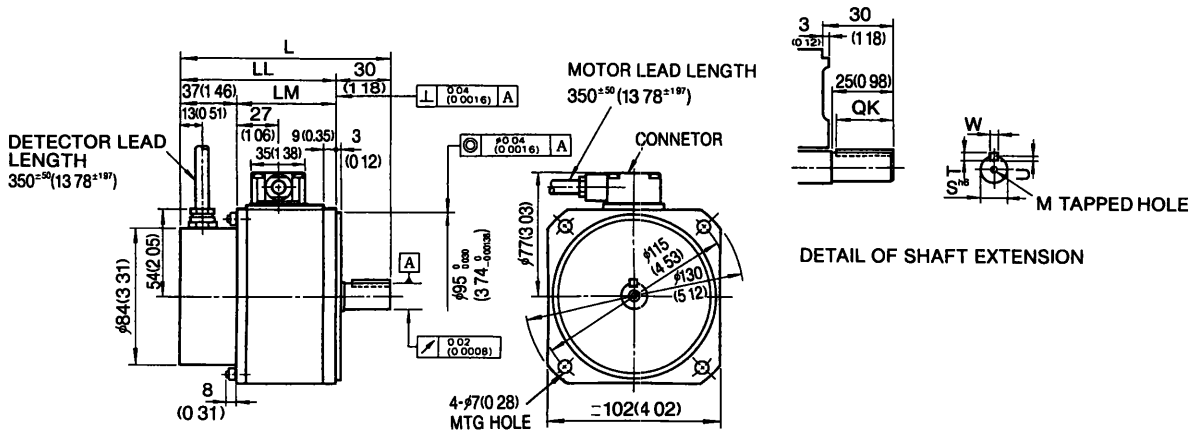
Servomotor proper and shaft extension are same dimensions as standard Servomotor. See par. 8.1 (1) and (2). Oilseal is same dimensions as shown in par. 8.1 (4).

8 1 2 P Series AC servomotors

(1) Standard (with key, straight shaft)

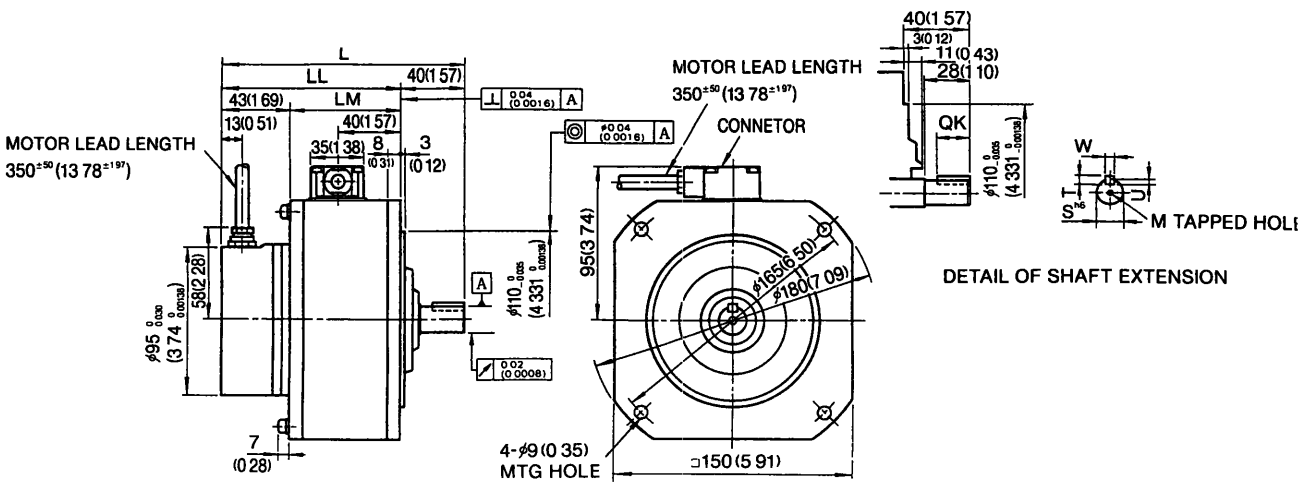
Dimensions of the keyway are based on JIS (Japanese Industrial Standard) B1301(1976) "Sunk keys and their corresponding keyways)." Parallel key has been attached.

• TYPES USAPEM-01[ ]W2K, -02[ ]W2K, -03[ ]W2K



Type	L	LL	LM	Shaft Extension						Approx Mass kg (lb)
				S	QK	U	W	T	M	
USAPEM-01 CW 2K	133 (5 24)	103 (4 06)	52 (2 05)	$11^{0}_{-0.011}$ ($0.433^{0}_{-0.00043}$)	18 (0 71)	2 5 (0 10)	4 (0 1574)	4 (0 1574)	M3 DEEP6 (0 24)	1 7 (3 7)
USAPEM-02 CW 2K	136 (5 35)	106 (4 17)	55 (2 17)	$14^{0}_{-0.011}$ ($0.551^{0}_{-0.00043}$)	18 (0 71)	3 (0 12)	5 (0 1969)	5 (0 1969)	M4 DEEP10 (0 39)	2 0 (4 4)
USAPEM-03 CW 2K	140 (5 51)	110 (4 33)	59 (2 32)							2 3 (5 1)

• TYPES USAPEM-05[ ]W2K, -07[ ]W2K



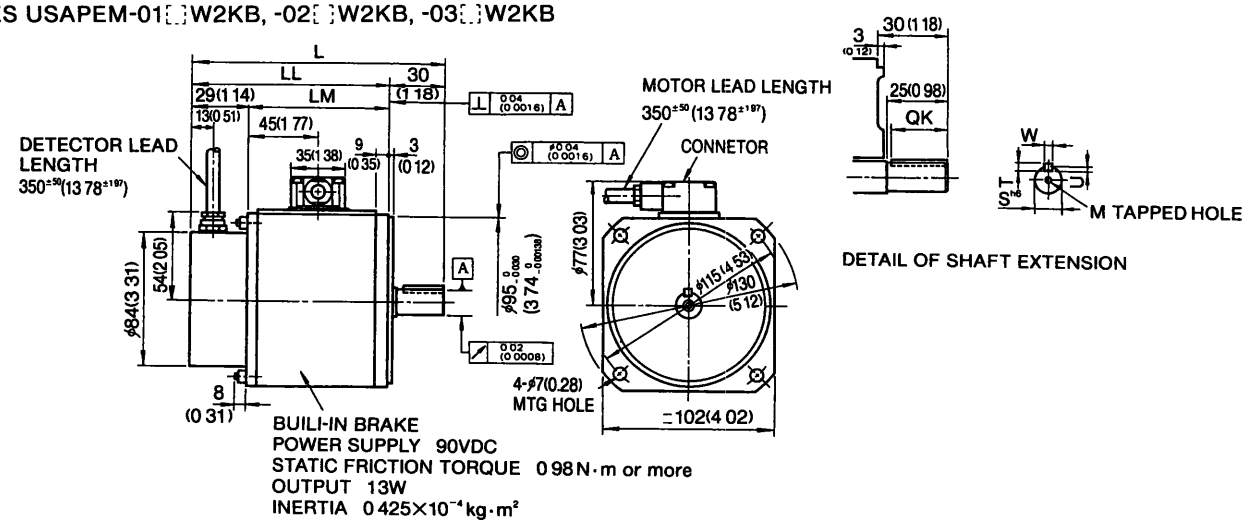
Type	L	LL	LM	Shaft Extension						Approx Mass kg (lb)
				S	QK	U	W	T	M	
USAPEM-05 CW 2K	160 (6 30)	120 (4 72)	69 (2 72)	$16^{0}_{-0.011}$ ($0.63^{0}_{-0.00043}$)	20 (0 79)	3 (0 12)	5 (0 1969)	5 (0 1969)	M4 DEEP10 (0 39)	4 6 (10 1)
USAPEM-07 CW 2K	160 (6 30)	120 (4 72)	69 (2 72)	$16^{0}_{-0.011}$ ($0.63^{0}_{-0.00043}$)	20 (0 79)	3 (0 12)	5 (0 1969)	5 (0 1969)	M4 DEEP10 (0 39)	5 (11 0)

8.1.2 P Series AC Servomotors (Cont'd)

(2) With Brake (with key, straight shaft)

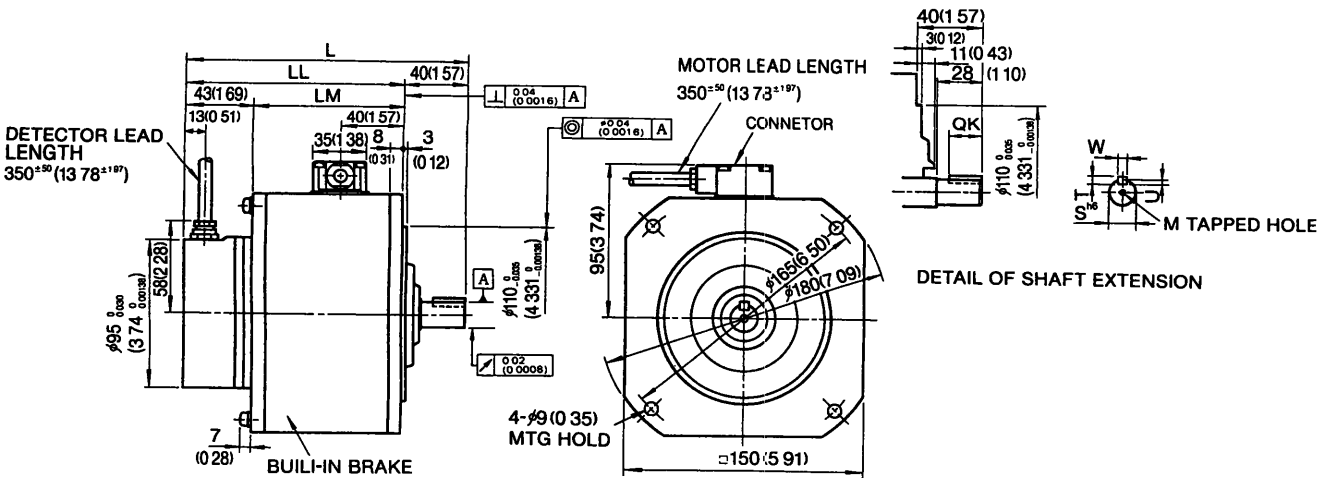
Dimensions of the keyway are based on JIS (Japanese Industrial Standard) B1031 "Sunk keys and their corresponding keyways)." Parallel key has been attached.

• TYPES USAPEM-01□W2KB, -02□W2KB, -03□W2KB



Type	L	LL	LM	Shaft Extension						Approx Mass kg (lb)
				S	QK	U	W	T	M	
USAPEM-01 CW 2KB	159 (6 26)	129 (5 08)	78 (3 07)	$11^{0}_{-0.011}$ ($0.433^{0}_{-0.00043}$)	18 (0 71)	2 5 (0 10)	4 (0 1574)	4 (0 1574)	M3 DEEP6 (0 24)	2 7 (5 9)
USAPEM-02 CW 2KB	162 (6 38)	132 (5 20)	81 (3 19)	$14^{0}_{-0.011}$ ($0.551^{0}_{-0.00043}$)	18 (0 71)	3 (0 12)	5 (0 1969)	5 (0 1969)	M4 DEEP10 (0 39)	3 0 (6 6)
USAPEM-03 CW 2KB	166 (6 54)	136 (5 35)	85 (3 35)							3 3 (7 3)

• TYPES USAPEM-05□W2KB, -07□W2KB



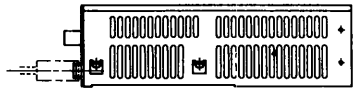
Type	L	LL	LM	Shaft Extension						Approx Mass kg (lb)
				S	QK	U	W	T	M	
USAPEM-05 CW 2KB	178 (7 01)	138 (5 43)	95 (3 74)	$16^{0}_{-0.011}$ ($0.63^{0}_{-0.00043}$)	20 (0 79)	3 (0 12)	5 (0 1969)	5 (0 1969)	M4 DEEP10 (0 39)	6 6 (14 6)
USAPEM-07 CW 2KB	178 (7 01)	138 (5 43)	95 (3 74)	$16^{0}_{-0.011}$ ($0.63^{0}_{-0.00043}$)	20 (0 79)	3 (0 12)	5 (0 1969)	5 (0 1969)	M4 DEEP10 (0 39)	7 (15 4)

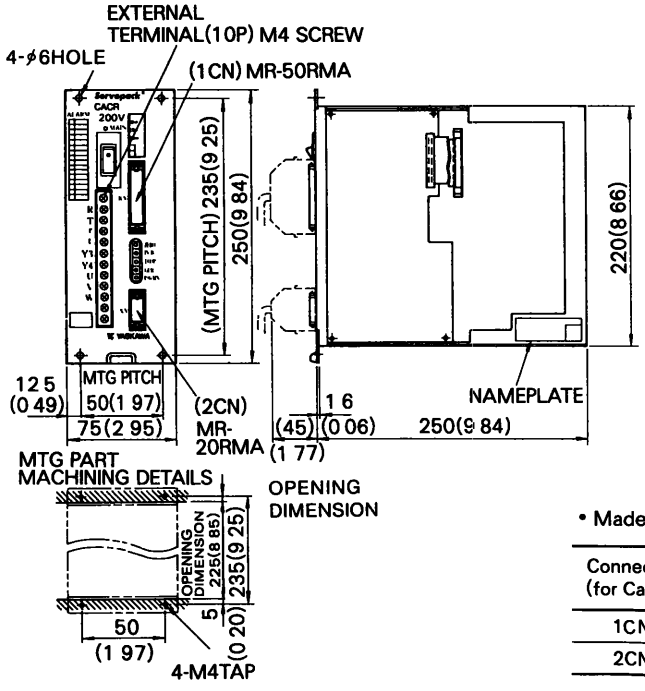
8. 2 SERVOPACK DIMENSIONS in mm (inches)

8 2 1 Type CACR-SR[ ][ ]AY

(1) For 200V

• TYPES CACR-SRA5AY1SR, -SR01AY1[ ][ ]

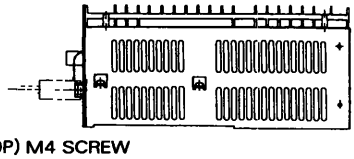


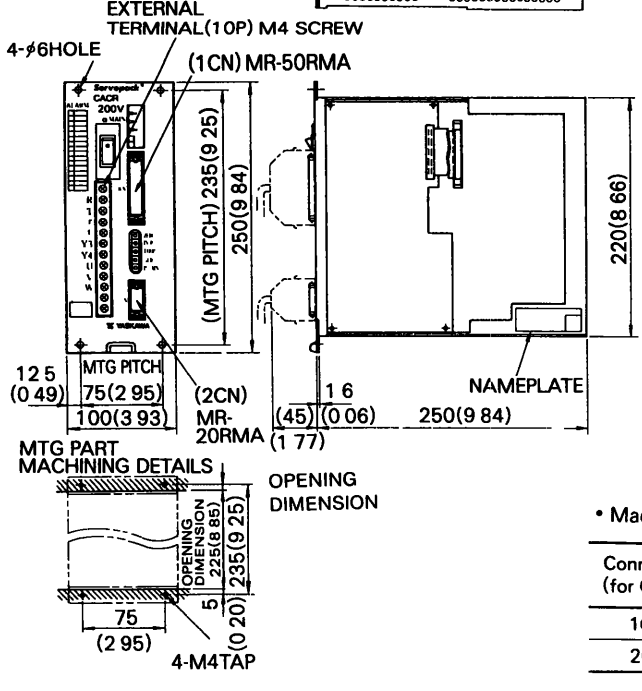


• Made by Honda Tushin Co , Ltd

Connector (for Cable)	Attachments		
	Manufacturer	Housing	Hood
1CN	Honda Tushin Co Ltd	MR-50F	MR-50L
2CN		MR-20F	MR-20L

• TYPES CACR-SR02AY1[ ][ ] TO 05AY1[ ][ ]



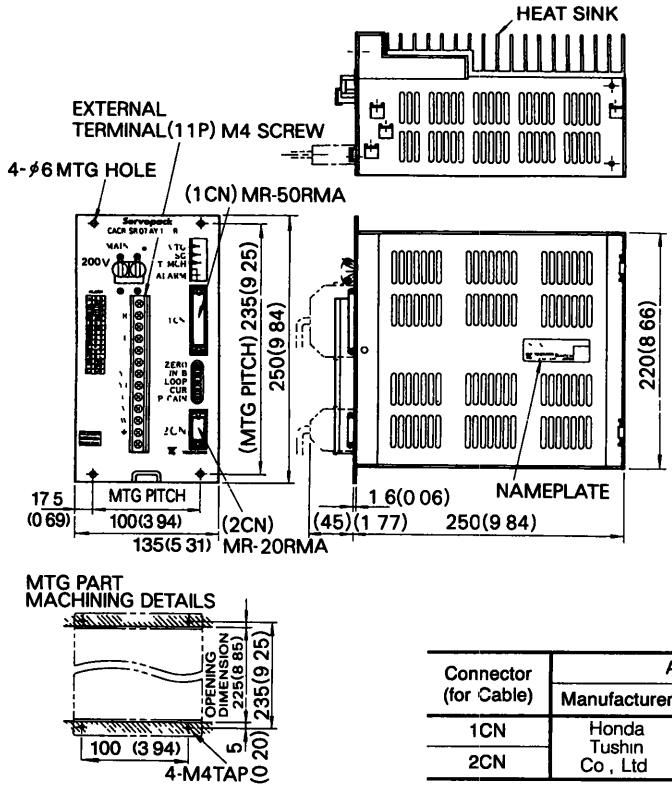


• Made by Honda Tushin Co , Ltd

Connector (for Cable)	Attachments		
	Manufacturer	Housing	Hood
1CN	Honda Tushin Co Ltd	MR-50F	MR-50L
2CN		MR-20F	MR-20L

8.2.1 Type CACR-SR[ ][ ]AY (Cont'd)

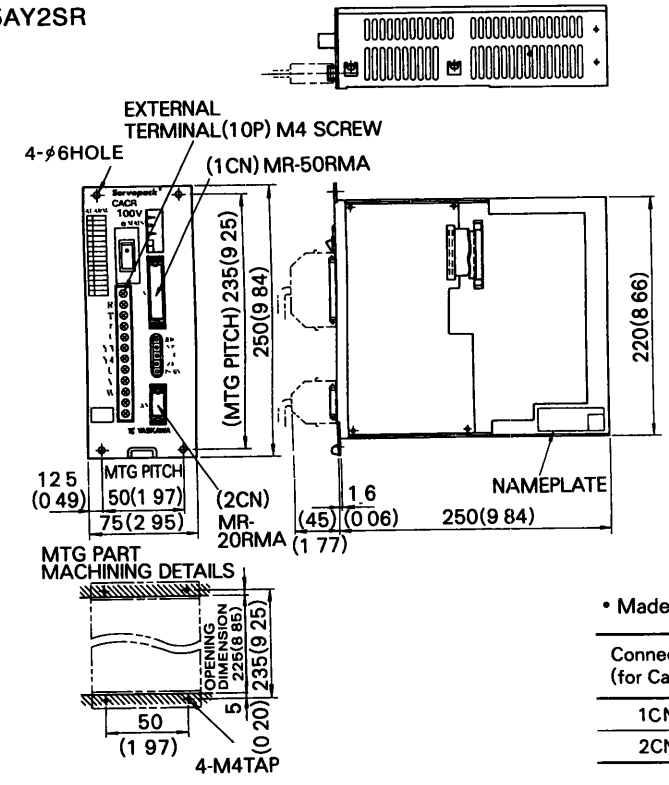
· TYPE CACR-SR07AY1[ ][ ]



Connector (for Cable)	Attachments		
	Manufacturer	Housing	Hood
1CN	Honda Tushin Co , Ltd	MR-50F	MR-50L
2CN		MR-20F	MR-20L

(2) For 100V

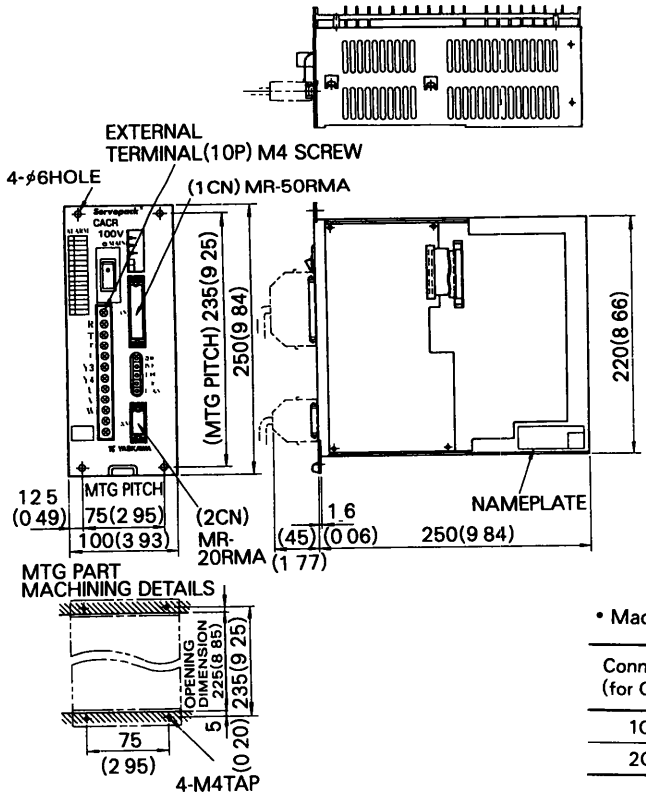
· TYPE CACR-SRA5AY2SR



• Made by Honda Tushin Co , Ltd

Connector (for Cable)	Attachments		
	Manufacturer	Housing	Hood
1CN	Honda Tushin Co Ltd	MR-50F	MR-50L
2CN		MR-20F	MR-20L

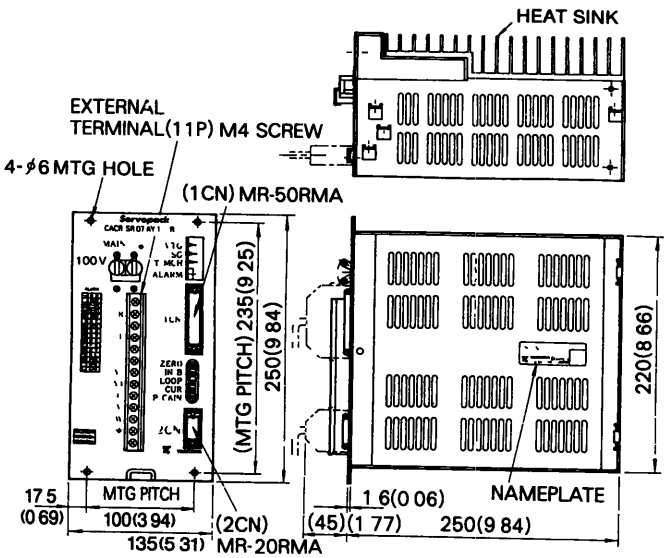
· TYPES CACR-SR01AY2SR TO 03AY2SR

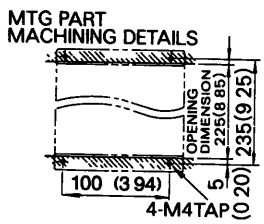


• Made by Honda Tushin Co , Ltd

Connector (for Cable)	Attachments		
	Manufacturer	Housing	Hood
1CN	Honda Tushin Co Ltd	MR-50F	MR-50L
2CN		MR-20F	MR-20L

· TYPE CACR-SR05AY2SR



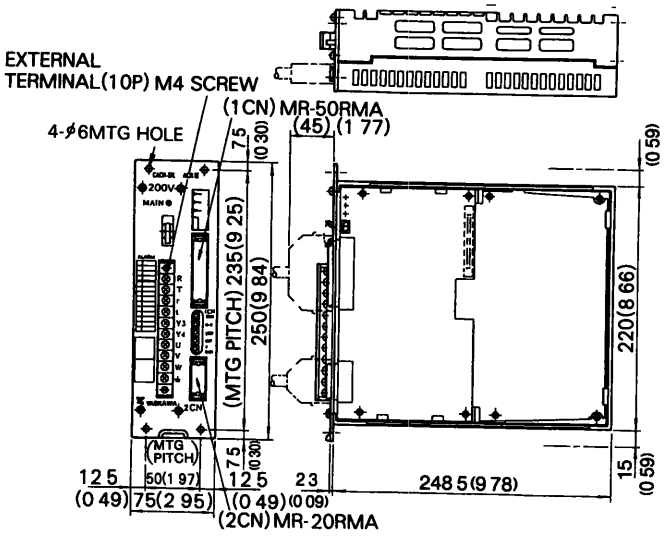


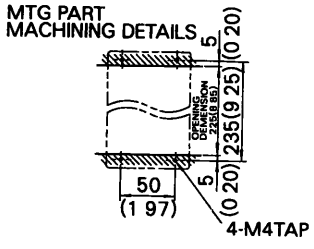
Connector (for Cable)	Attachments		
	Manufacturer	Housing	Hood
1CN	Honda Tushin Co , Ltd	MR-50F	MR-50L
2CN		MR-20F	MR-20L

8.2.2 TYPE CACR-SR□□AX

(1) For 200V

· TYPES CACR-SRA5X1SR, -SR01AX1□□, -SR02AX1□□, -SR03AX1□□

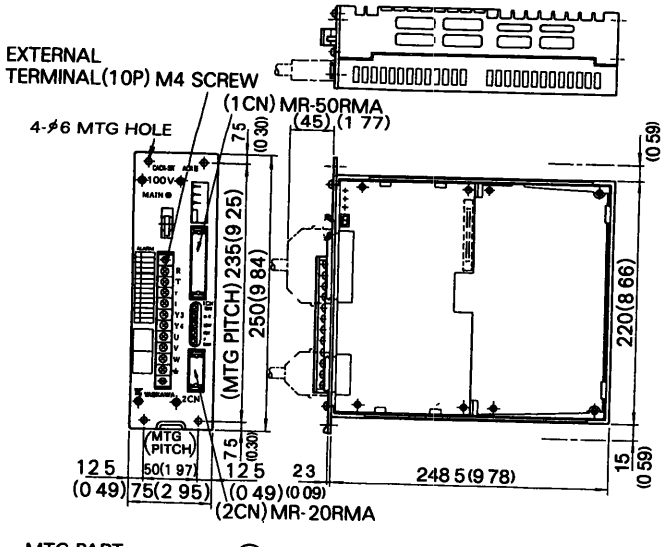


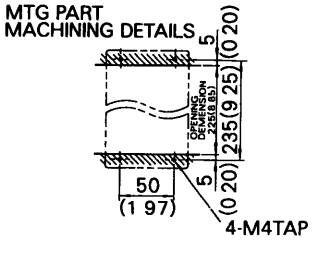


Connector (for Cable)	Attachments		
	Manufacturer	Housing	Hood
1CN	Honda Tushin Co , Ltd	MR-50F	MR-50L
2CN		MR-20F	MR-20L

(2) For 100V

· TYPES CACR-SRA5AX2SR, -SR01AX2SR, -SR02AX2SR

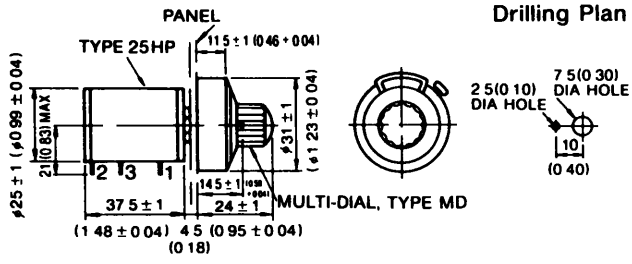




Connector (for Cable)	Attachments		
	Manufacturer	Housing	Hood
1CN	Honda Tushin Co , Ltd	MR-50F	MR-50L
2CN		MR-20F	MR-20L

8. 3 PERIPHERAL EQUIPMENT in mm (inches)

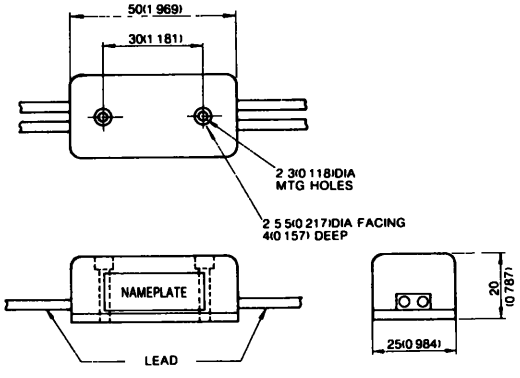
(1) Variable Resistor for Speed Setting Type 25HP-10B



(2) Power Supply for Brake

According to the motor, select 100V/200V power supply for brake.

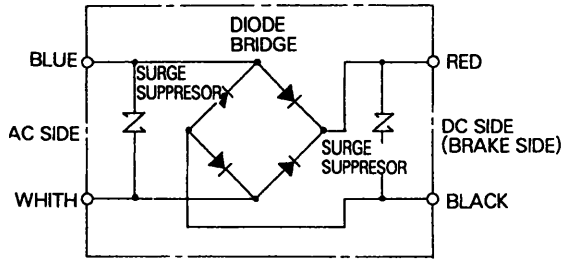
- Input 100 VAC, 90 VDC (DP8401002-2)
- Input 200 VAC, 90 VDC (DP8401002-1)



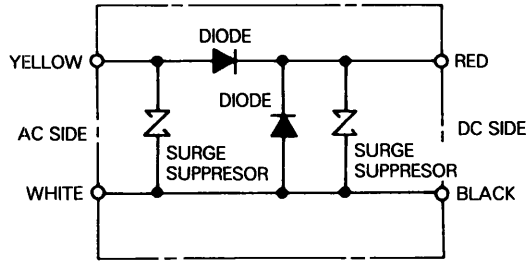
- Lead length: each 500 mm (19.69 inches)
- Lead color:

AC Input Side		Brake Side
100V	200V	
Blue White	Yellow White	Red Black

- Inner circuit for 100 VAC



- Inner circuit for 200 VAC



Note The brake power supply circuit can be opened or closed both at DC and AC sides However, it is safer to do it at AC side Provide a surge suppresor near the brake coil since the brake coil may be destroyed by surge voltage at DC side

9. TEST RUN

Before test run, check the following. Correct any deficiency.

9.1 CHECK ITEMS BEFORE TEST RUN

9 1 1 Servomotor

Before test run, check the following. If the test run is performed after long storage, see par.11 Inspection and Maintenance.

- Connection to machines or devices, wiring, fuse connection, and grounding are correct.
- Bolts and nuts are not loose.
- For motors with oil seals, the seals are not damaged and oil is properly lubricated.

9.1.2 Servopack

- Setting switches are correctly set to satisfy the specifications for the applicable servomotor and optical encoder.
- Connection and wiring leads are firmly connected to terminals or inserted into the connectors.
- The power supply is turned off if servo alarm outputs.
- Voltage supplied to Servopack is 200 to 230V $^{+10}_{-15}$ % or 100 to 115 V $^{+10}_{-15}$ %.
- The speed reference should be 0 V (speed reference circuit is short-circuited.)

9.2 TEST RUN PROCEDURES

9 2 1 Preparation of Operation

During test run, loads should not be applied to the servomotor. If it is necessary to start with the driven machine connected to the motor, confirm that the driven system has been ready for emergency stop at any time.

- Power ON

  After checking items in par. 9.1, turn on the power supply. When the power on sequence is correct, according to par. 6.1, the power is turned on by depressing the POWER pushbutton for approximately 1 second.

- When the power is correctly supplied, 7-segment LED [-.] [MAIN] LED light.

- When Servo on signal is input (contact on), SEN signal is input and, the power circuit in the Servopack operates and the motor is ready to run.

9 2 2 Operation

The operation is possible only while Servo ON signal is on.

- Increase the speed reference voltage gradually from 0 V, then the motor will rotate at a speed proportional to the reference voltage.
- When the reference voltage is positive, the motor rotates forward(counterclockwise viewed from drive end-output shaft) (Fig. 9.1).

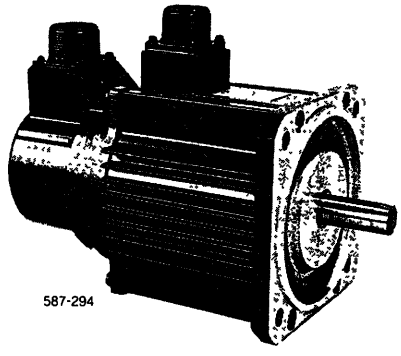


Fig 9 1 Motor Forward Running

9 2 3 Inspection during Test Run

The following items should be checked during the test run.

- Unusual vibration
- Abnormal noise
- Excessive temperature rise

If any abnormality is found, take corrective actions according to par. 12. At a test operation, the load and machine may not fit well at first and result in overload.

9 2 4 Setup of Absolute Encoder

With the absolute encoder providing to the machine, the machine original point, that is, standard position must be set to absolute encoder. This operation is called setup. For setup methods, refer to Par. 6.4.3.(8).

10. ADJUSTMENT

10.1 SETTINGS AT THE TIME OF DELIVERY

The Servopack has been factory-adjusted as follows:

(1) R Series

Table 10.1 Standard Adjustment and Setting Specifications (R Series)

Class	Servopack Type CACR-		Applicable Servomotor			Servopack Adjustment		
			Type USAREM-	Absolute Encoder p/rev	Rated Current A*	Speed Setting	Starting Current Setting*	PG Dividing Ratio
200V	50W	SRA5AY1SR	A5CS2	8192	0.7	3000r/min at rated speed reference	210	1500p/rev
		SRA5AX1SR						
	100W	SR01AY1SR	01CS2	8192	1.0		280	
		SR01AX1SR						
	200W	SR02AY1SR	02CS2	8192	2.0		570	
		SR02AX1SR						
	300W	SR03AY1SR	03CS2	8192	2.7		780	
		SR03AX1SR						
	500W	SR05AY1SR	05CS2	8192	3.6		1060	
		—						
	700W	SR07AY1SR	07CS2	8192	5.7		1630	
		—						
100V	50W	SRA5AY2SR	A5DS2	8192	1.2		360	
		SRA5AX2SR						
	100W	SR01AY2SR	01DS2	8192	1.7		500	
		SR01AX2SR						
	200W	SR02AY2SR	02DS2	8192	2.9		850	
		SR02AX2SR						
	300W	SR03AY2SR	03DS2	8192	3.6		1060	
		—						
	500W	SR05AY2SR	05DS2	8192	5.5		1630	
		—						

*Effective value

Table 10.2 Standard Factory-adjusted Switch Settings

Class	Servopack Type CACR-		SW1	SW2	SEL1	SEL2	*SEL4
			Function Setting	Dividing Ratio Setting	(3P Setting Switch) f/V Filter Time Constant Setting	(3P Setting Switch) Mode Switch (MS) Level Setting	(3P Setting Switch) Encoder Selection
200V	50W	SRA5AY1SR	(DIP Switch) 1 2 3 4 5 6 7 8 ○ ● ● ● ● ● ○ ○	(Hexadecimal Digital Switch) "0" Divided Ratio (1500 p/rev)	(3P short switch) 1 2 3 ●● ○ (0.6 ms)	(3P short switch) 1 2 3 ○ ○ ○ (MS level 200%)	(3P short switch) 1 2 3 ○ ○ ○ (8192 p/rev)
		SRA5AX1SR					
	100W	SR01AY1SR					
		SR01AX1SR					
	200W	SR02AY1SR					
		SR02AX1SR					
	300W	SR03AY1SR					
		SR03AX1SR					
	500W	SR05AY1SR					
		—					
	700W	SR07AY1SR					
		—					
100V	50W	SRA5AY2SR					
		SRA5AX2SR					
	100W	SR01AY2SR					
		SR01AX2SR					
	200W	SR02AY2SR					
		SR02AX2SR					
	300W	SR03AY2SR					
		—					
	500W	SR05AY2SR					
		—					

● Switch ON (Short-circuited) ○ Switch OFF (Open)

* Type CACR-SRCA□RYA REV-B doesn't have SEL4 (SEL3 is MS/P-PI selection Normal setting 1-2 short)

10.1 SETTING AT THE TIME OF DELIVERY (Cont'd)

Table 10.3 Standard Factory-adjusted Potentiometer Setting

Class	Servopack Type CACR-		Auxiliary Input Setting IN-B	Zero Drift Setting ZERO	Max Current Setting CUR	Loop Gain Setting LOOP	Proportional Gain Setting P-GAIN
200V	50W	SRA5AY1SR	10V/rated speed (For user adjustment)	4 to 6/10	10/10 (max)	5/10	5/10
		SRA5AX1SR					
	100W	SR01AY1SR					
		SR01AX1SR					
	200W	SR02AY1SR					
		SR02AX1SR					
	300W	SR03AY1SR					
		SR03AX1SR					
	500W	SR05AY1SR					
		—					
	700W	SR07AY1SR					
		—					
100V	50W	SRA5AY2SR					
		SRA5AX2SR					
	100W	SR01AY2SR					
		SR01AX2SR					
	200W	SR02AY2SR					
		SR02AX2SR					
	300W	SR03AY2SR					
		—					
	500W	SR05AY2SR					
		—					

Note

1 In the Table avobe, ○/□ shows approximate scale of potentiometer
For example,  indicates 7/10 scale

2 The potentiometers other than listed in the Table above are provided for the *Servopack* Do not tamper with these potentiometers except for a special case as they have been preset at the factory

(2) P Series

Table 10.4 Standard Adjustment and Setting Specifications (P Series)

Class	Servopack Type CACR-		Applicable Servomotor			Servopack Adjustment		
			Type USAREM-	Absolute Encoder p/rev	Rated Current A*	Speed Setting	Starting Current Setting*	PG Dividing Ratio
200V	100W	SR01AY1WP	USAPEM-01 CW 2	1024	1 0	3000r/min at rated speed reference	2 8	1024 p/rev
		SR01AX1WP						
	200W	SR02AY1WP	USAPEM-02 CW 2	1024	2 0		5 7	
		SR02AX1WP						
	300W	SR03AY1WP	USAPEM-03 CW 2	1024	2 7		7 8	
		SR03AX1WP						
	500W	SR05AY1WP	USAPEM-05 CW 2	1024	3 6		10 6	
		—						
	700W	SR07AY1WP	USAPEM-07 CW 2	1024	5 7		16 3	
		—						

*Effective value

Table 10.5 Standard Factory-adjusted Switch Settings

Class	Servopack Type CACR-		SW1	Sw2	SEL1	SEL2	*SEL4
			Function Setting	Dividing Ratio Setting	(3P Setting Switch) f/V Filter Time Constant Setting	(3P Setting Switch) Mode Switch (MS) Level Setting	(3P Setting Switch) Encoder Selection
200V	100W	SR01AY1WP	(DIP Switch) 1 2 3 4 5 6 7 8 ○ ● ● ● ● ● ○ ○	(Hexiadecimal Digital Switch) "0" Divided Ratio (1024 p/rev)	(3P short switch) 1 2 3 ● ● ○ (0 6 ms)	(3P short switch) 1 2 3 ○ ○ ○ (MS level 200%)	(3P short switch) 1 2 3 ● ● ○ (1024 p/rev)
		SR01AX1WP					
	200W	SR02AY1WP					
		SR02AX1WP					
	300W	SR03AY1WP					
		SR03AX1WP					
	500W	SR05AY1WP					
		—					
	700W	SR07AY1WP					
		—					

● Switch ON (Short-circuited) ○ Switch OFF (Open)

Table 10.6 Standard Factory-adjusted Potentiometer Setting

Class	Servopack Type CACR-		Auxiliary Input Setting IN-B	Zero Drift Setting ZERO	Max Current Setting CUR	Loop Gain Setting LOOP	Proportional Gain Setting P-GAIN
200V	100W	SR01AY1WP	10V/rated speed (For user adjustment)	4 to 6/10	10/10 (max)	5/10	5/10
		SR01AX1WP					
	200W	SR02AY1WP					
		SR02AX1WP					
	300W	SR03AY1WP					
		SR03AX1WP					
	500W	SR05AY1WP					
		—					
	700W	SR07AY1WP					
		—					

Note
1 In the Table avobe, ○/□ shows approximate scale of potentiometer
For example, indicates 7/10 scale

2 The potentiometers other than listed in the Table above are provided for the *Servopack* Do not tamper with these potentiometers except for a special case as they have been preset at the factory

10. 2 CHARACTERISTICS AT THE TIME OF DELIVERY

The Servopack has been factory-adjusted as follows:

(1) Speed reference input-servomotor speed ratio (no load) (Fig. 10.1)

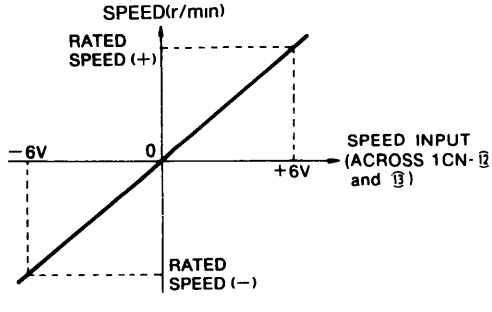


Fig 10 1 Speed Reference Input − Servomotor Speed Ratio

(2) Speed Variation (Fig. 10.2)

Speed variation ΔN, Δn:

$$\frac{\Delta N}{N_R} \times 100\% \leqq 0.1\%$$

$$\frac{\Delta n}{N_R} \times 100\% \leqq 0\ 05\%$$

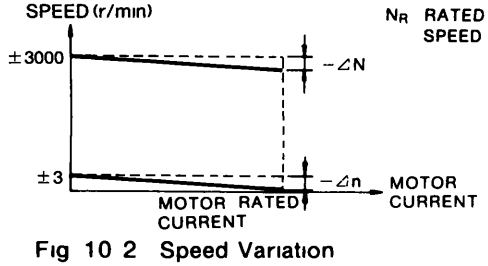


Fig 10 2 Speed Variation

(3) Start-stop characteristics (Fig. 10.3)

I_P : Start current set value in Tables 10.1 and 10.4. The overshoot (ΔN_{OV}) and undershoot (ΔN_{UD}) when $GD^2_L = GD^2_M$, are as shown in Table 10.7 (adjustment level preset at the factory).

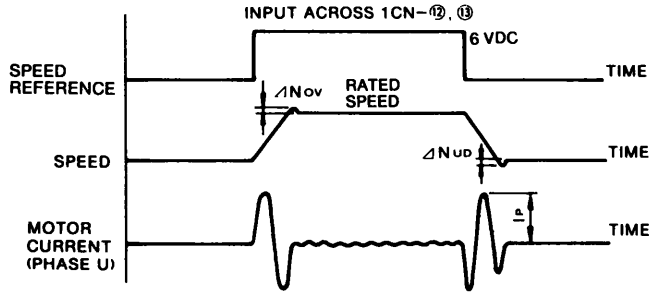


Fig 10.3 Start–Stop Characteristics

Table 10 7 Overshoot and Undershoot at Step Response

Type CACR-	$\Delta N_{OV}/N_R \times 100$	$\Delta N_{UD}/N_R \times 100$
SR[ ][ ]AY	5% max	5% max
SR[ ][ ]AX		

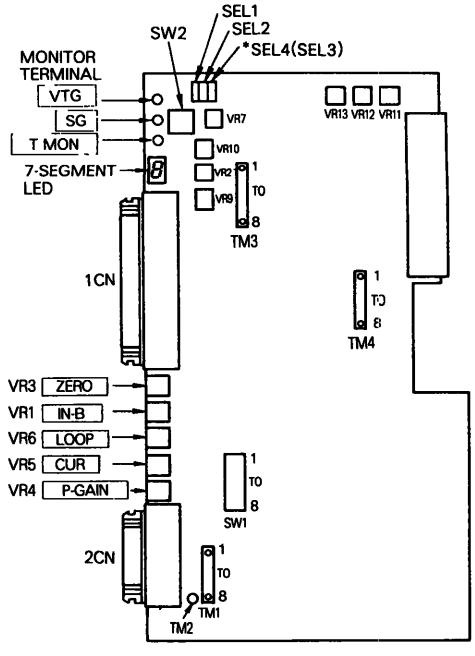
10. 3 READJUSTMENT

The Servopack has been adjusted at the factory to obtain optimum characteristics, and readjustment is normally unnecessary. If adjustment is required depending on the use, readjust the Servopack referring to Table 10.8. (Do not tamper with potentiometers.)

10. 4 ADJUSTMENT PROCEDURES

Fig. 10.4 shows the arrangement of potentiometers, and terminals for checking waveforms; Table 10.8 shows potentiometer adjustment; and Table 10.9 lists check terminals and functions.

Adjust the potentiometers, observing the specified check locations. (Potentiometers should not be tampered with.) Fig. 10.5 shows waveforms at the respective check terminals for step responses at no load.

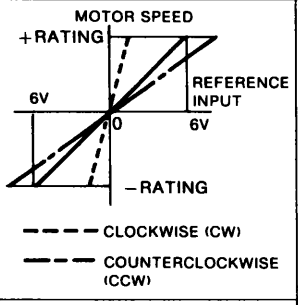
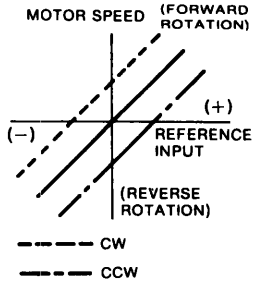


*For type CACR-SRCA[ ]RYA REV B, this becomes SEL3

Fig. 10.4 Printed Circuit Board for Servopack Type CACR-SRCA[ ]RYA CACR-SRCA[ ]RXA

10. 4 ADJUSTMENT PROCEDURES (Cont'd)

Table 10 8 Potentiometer Adjustment

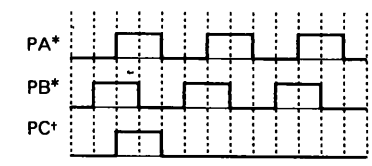
Potentiometer	VR1 [IN-B]	VR4 [P-GAIN]	VR3 [ZERO]	VR5 [CUR]
Functions	Auxiliary input adjustment	Proportional gain adjustment	Zero drift adjustment	Starting current adjustment
How to Adjust	To be adjusted only when the rated reference voltage (±2 to ±10V) is other than ±6V Turn VR1 only to get the rated speed and do not operate other VRs	Turning VR4 CW increases Proportional gain Adjust so that the overshoot and undershoot decrease	To adjust so that the motor does not turn at the speed reference voltage 0V Turning VR3 CW allows the motor to be finely adjusted in forward rotation, and CCW in reverse rotation	Turning VR5 CW increases the starting current This has been adjusted to full scale CW at the factory
Characteristics		• If the proportional gain is too high, overshoot or undershoot increases • If the proportional gain is too low, rise or fall time is unstable		–
Adjustment	○	△	○	△

Potentiometer	VR6 [LOOP]
Functions	Speed loop gain adjustment
How to Adjust	To increase gain, turn VR6 CW
Characteristics	Turn VR6 CCW to prevent hunting
Adjustment	○

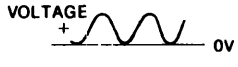
Adjustment Directions
Mark ○ Potentiometer should be adjusted in accordance with specifications and applications
Mark △ Potentiometer should not be adjusted except in special cases

Do not tamper with following potentiometers as they have been set at the factory
- VR2 VR9 VR10 (For speed feedback adjustment)
- VR7 (For max motor current adjustment)
- VR11, VR12 VR13 (For current offset adjustment)

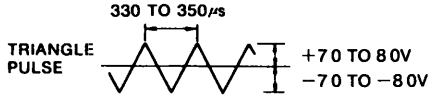
Table 10.9 Check Terminal Functions

Equipment Symbol		Signal Name	Description		
TM1	1	PA	PG input signal	Phase A pulse input	• Waveform at motor forward running  *Two-phase pulse with 90° phase difference One generation per motor turning Symchronizing with PA
	2	*PA		Phase A reverse input	
	3	PB		Phase B pulse input	
	4	*PB		Phase B reverse input	
	5	PC		Phase C pulse input	
	6	*PC		Phase C reverse input	
	7	–	Not used		
	8	PG5V	Optical encoder (PG) power supply voltage +5V		
TM2		PG0V	0V of the PG power supply (TM1 signal 0V)		
TM3	1	IN-A	For monitoring of speed reference input (connector 1CN between ⑫ and ⑬)		
	2	IN-B	For monitoring of speed reference aux input (connector 1CN between ⑭ and ⑮)		
	3	VTG	Motor speed monitoring ±20VDC ±5%/1000r/min		
	4	T-MON	Motor torque monitoring ±30VDC ±10%/100% torque.		
	5	–	Not used		
	6	–			
	7	–			
	8	SG	Signal 0V		
TM4	1	IU	Phase U current monitor		
	2	IV	Phase V current monitor		
	3	U-sin	Monitors phase U sin waveform		
	4	V-sin	Monitors phase V sin waveform		
	5	OSC	Carrier frequency (triangle pulse)		
	6	–	Not used		
	7	–	Not used		
	8	SG	Signal 0V		

Type	For 200V					For 100V			
	A5	01	02	03	05	A5	01	02	03
V/A	08		04	02		08	04	02	



•Frequency varies depending on speed
•Amplitude varies depending on torque



CH1	VTG	DC±2.0V ±5%/1000r/min	Front panel check terminal (For user's observation)
CH2	T-MON	DC±3.0V ±10%/100% torque	
CH3	SG	Signal 0V	

Note
1 Do not touch the check terminals except the front panel check terminal (with buffer)
The check terminals allow oscilloscope connection for measurement
2 When other check terminals must be measured, do not connect the adjacent two check terminals
If connected, the electronic circuit parts may be damaged.

10. 4 ADJUSTMENT PROCEDURES (Cont'd)

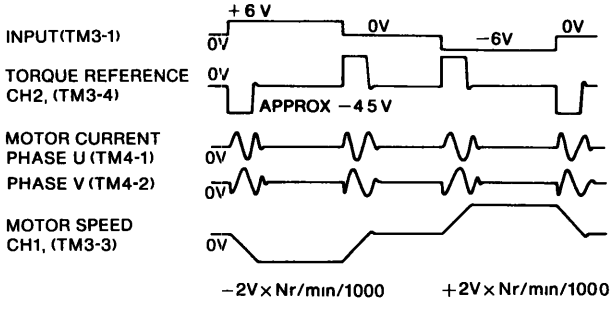


Fig. 10 5 Waveforms at the Respective Check Terminals for Step Responses (No Load)

10. 5 SWITCH SETTING

The four switches(SW1 , SEL1 , SEL2 , SEL4) and hexadecimal digital switch SW2 , have the following functions:

Table 10 10 SW1 Setting and Functions

Setting Switch	No.	Contents		Switch ON	Switch OFF
SW1	1	Position error function selection		Not provided	Provided
	2	Phase compensation		20°*	0°
	3	TG ON level		10%	1%
	4	OT mode		DB operation*	NO DB operation
	5	Motor select	8P-sin/ 3000r/min	User disable for other setting	
	6				
	7	Test mode		Test mode (User disable)	Normal operation*
	8				

*Standard factory-adjusted switch setting

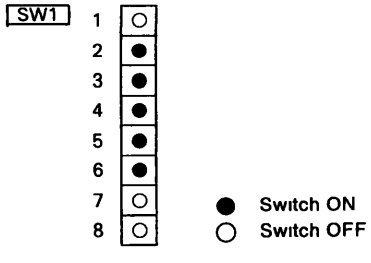


Table 10. 11 SW2 (Digital Switch) Setting and Functions

SW2 Setting	0*	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
R series Frequency Dividing Output Pulse	1500	1250	1000	750	625	500	400	300	200	100	1440	720	360	3000	2500	2000
P series Frequency Dividing Output Pulse	1024	1024	1000	750	625	500	400	300	200	100	1024	720	360	1024	1024	1024

*Standard factory-adjusted switch seeting

Table 10 12 SEL Setting and Functions

SEL	Setting	Functions
SEL1	* 1 2 3 ● ● ○	0 6 ms
	1 2 3 ○ ● ●	1 1 ms
	1 2 3 ○ ○ ○	0 6 ms
SEL2	1 2 3 ● ● ○	No MS
	1 2 3 ○ ● ●	Disable
	* 1 2 3 ○ ○ ○	MS level 200 %
†SEL4	* 1 2 3 ● ● ○	P Series (1024 P/rev)
	1 2 3 ○ ● ●	Disable
	* 1 2 3 ○ ○ ○	R Series (8192 P/rev)

*Standard factory-adjusted switch setting
†Type CACR-SRCA□ □RYA REV B does not have SEL4 (SEL3 is MSIP-PI selection Normal setting 1-2 short)

11. INSPECTION AND MAINTENANCE

11.1 AC SERVOMOTOR

The AC servomotor has no wearing parts(e.g. brushes), so simple daily inspection is sufficient. The inspection schedule for the motor is shown in Table 11.1.

Do not disassemble the motor. If disassembly is necessary, contact your Yaskawa representative.

Table 11 1 Inspection Schedule for Motors

Inspection Item	Frequency	Inspection Operation	
Vibration	Daily	Feel manually	If abnormal vibration or noise is found, contact your Yaskawa representative
Noise		Aurally	
Exterior and Cleaning	As required	Clean with dry cloth or compressed air	
Insulation Resistance	Yearly	Make sure that it is more than 10MΩ by measuring with a 500V megger after disconnecting the motor from the controller	
Oil Seal	Every 5000 hours	If worn or damaged, replace after disconnecting the motor from the driven machine	
Total Inspection	Every 20,000 hours or every 5-year	Contact your Yaskawa representative	

11.2 SERVOPACK

The Servopack is of contactless construction so that no special maintenance is required. Remove dust and tighten screws periodically.

12. TROUBLESHOOTING GUIDE

12.1 AC SERVOMOTOR

WARNING

Remedies in ▭ should be practiced after turning off the power.

Table 12 1 Troubleshooting Guide for AC Servomotor

Trouble	Cause	Corrective Action
Motor does not start	Voltage below rated	Measure voltage across motor terminals U, V, and W with a tester and correct to rated value
	Loose connection	Tighten connection
	Wrong wiring	Correct
	Overload	Reduce load or use a larger motor
	Motor defective	Measure voltage across motor terminals U, V, and W with a tester When correct, replace motor
Unstable operation	Wrong wiring	Inspect and correct wiring across motor terminals U, V, and W, and PG
Motor overheats	Excessive ambient temperature	Reduce below 40 °C
	Motor dirty	Clean motor surface
	Overload	Reduce load or use a larger motor
Unusual noise	Motor loosely mounted	Tighten foundation bolts
	Motor misaligned	Realign
	Coupling out of balance	Balance coupling
	Noisy bearing	Check alignment, loading of bearing, lubrication and contact Yaskawa representative
	Vibration of driven machine	Contact the machine manufacturer

12. 2 SERVOPACK

12. 2 1 LED Indication (7-segment) for Troubleshooting

Table 12. 2 LED Indication for Troubleshooting

LED	Detection	Lighting Condition	Probable Cause	Corrective Action
1.	Over-current	Goes on when power is supplied to the control circuit	• Defective control circuit board (1 PWB)	• Replace the Servopack
		Goes on when power is supplied to the main circuit and servo power is turned on • MCCB does not trip	• Defective current feedback circuit • Defective main circuit transistor module	• Insert the 3CN connector firmly • Replace the Servopack
		Goes on when power is supplied to the main circuit and servo power is turned on. • MCCB trips	• Defective motor grounding • Defective main circuit transistor module	• Replace the motor • Replace the Servopack
		Goes on when power is supplied to the main circuit	• Defective main circuit transistor module	• Replace the Servopack
		Goes on when the motor is running	• Faulty internal elements • Defective internal elements	• Replace the Servopack
2.	Circuit protector tripped	Goes on when power is supplied to the control circuit	• Defective control circuit board (1 PWB)	• Replace the Servopack
		Goes on when power is supplied to the main circuit	• Defective main circuit thyristor–diode module	• Replace the Servopack
			• MCCB trips	• Check if there is disconnection in the wiring leads in Servopack • Check the conduction state on connecting parts
3.	Regener-ative trouble	Goes on when power is supplied to the control circuit	• Defective control circuit board (1 PWB)	• Replace the Servopack
		Goes on approximate 0 5 to 1 second after power is supplied to the main circuit	• Defective regenerative transistor	• Replace the Servopack
			• Regenerative resistor disconnection	• Check and replace the regenerative resistor (Replace the Servopack)
4.	Over-voltage	Goes on when the motor starts or slows down	• Load inertia (GD^2) too large	• Check the inertia of the machine with the value converted to the motor shaft
			• Defective regenerative circuit	• Replace the Servopack
5.	Over-speed	When the reference is input, the motor runs fast and 5. goes on	• Motor connection error • Optical encoder connection error	• Correct the motor connection • Check and correct pulses in phases A, B, C, U, V and W with 2CN
			• The reference input voltage too large	• Decrease the reference input voltage
6.	Voltage drop	Goes on when power is supplied to the main circuit	• Defective main circuit thyristor–diode module	• Replace the Servopack
7.	Overload	Goes on when power is supplied to the control circuit	• Defective control circuit board (1 PWB)	• Replace the Servopack
		Goes on during operation • When power to the control circuit is turned off and then turned on again, the operation starts	• Operation with 105% to 130% or more of the rated load	• Check and correct the load (may be overload)
		The motor rotates, but the torque is unavailable When power to the control circuit is turned off and then turned on again, the operation starts, but the torque is still unavailable	• Motor circuit error connection, such as U→V V→W, W→U or single-phase connection	• Correct the connection

Table 12. 2 LED Indication for Troubleshooting (Cont'd)

LED	Detection	Lighting Condition	Probable Cause	Corrective Action
b.	A/D error	Goes on when power is supplied to the control circuit	• Defective control circuit board (1PWB)	• Replace the Servopack
- -	CPU error	Goes on during operation	• Faulty internal elements	• Resume after reset operation
			• Defective internal elements	• Replace the Servopack
C.	Overrun prevention	Goes on when power is supplied to the control circuit	• Defective control circuit board (1PWB)	• Replace the Servopack
		The motor starts momentarily, then C goes on	• Motor connection error	• Correct the motor connection
			• Optical encoder connection error	• Check and correct pulses in phases A, B, C, U, V and W with 2CN
d.	Absolute error	Goes on when power is supplied to the control circuit	• Defective control circuit board	• Replace the Servopack
		SEN signal goes on 1sec after input	• Faulty absolute encoder • Defective internal elements	• Turn off SEN signal and input it again
			• Faulty absolute encoder • Battery not connected	• Set-up absolute encoder again
			• Absolute encoder connection error	• Correct the connection
			• Defective absolute encoder	• Replace the motor
E.	Position error	Goes on when power is supplied to the control circuit	• Defective control panel	• Replace the Servopack
		Goes on during operation (blinks)	• Absolute encoder connection error	• Check and correct pulses in phases A, B, C, U, V and W with 2CN
			• Defective internal PG pulse counter	• Turn off SEN signal and input it to reset • Check and remove the cause of the noise

Note That alarm for absolute error is reset by turning off the SEN signal

12 2 2 Examples of Troubleshooting for Defective Wiring or Parts

Table 12 3 Example of Troubleshooting for Defective Wiring or Parts

Trouble	Check Items ‹	Corrective Action
MCCB trips immediately after Power On and Servo On	• Main circuit wiring (such as the ground of motor)	• Correct the wiring
The reference is input, but the motor does not run	• Voltage across Ⓡ, Ⓣ • LED [MAIN] on	• Check the AC power supply circuit
	• Trouble LED off	• If LEDs are on, check the cause
	• Speed reference voltage • P-CON, N-OT, P-OT, S-ON signal	• Adjust the speed setting potentiometer (supplied by the user)

12. 2 3 Examples of Troubleshooting for Incomplete Adjustment

Table 12 4 Examples of Troubleshooting for Incomplete Adjustment

Trouble	Cause	Corrective Action
Motor rotates even if the speed reference voltage is 0 V	Incomplete ZERO potentiometer ad ust-ment	Adjust VR3 [ZERO] correctly
Motor vibrates or vibration frequency is too high, approx 200 to 300 Hz (When vibration frequency equals commercial frequency)	Speed loop gain too high • Excessively long lead of *Servopack* input circuit • Noise interference due to bundling of signal line and power line	Turn VR6 [LOOP] CW to decrease the speed loop gain • Decrease length of lead • Separate input circuit line from power line or connect input circuit to low impedance less than several 100 ohms
Motor speed overshoot is too large at starting or stopping	• Speed loop gain too high	• Turn VR6 [LOOP] CW to decrease the speed loop gain

AC SERVO DRIVES

R AND P SERIES FOR SPEED CONTROL

SERVOMOTOR USAREM, USAPEM (WITH ABSOLUTE ENCODER)
SERVOPACK CACR-SR..AY.. (RACK-MOUNTED TYPE)
CACR-SR..AX.. (RACK-MOUNTED TYPE)

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