IB-18B003

DIGITAL INCREMENTAL MOTION DEVICES AUGUST 1993

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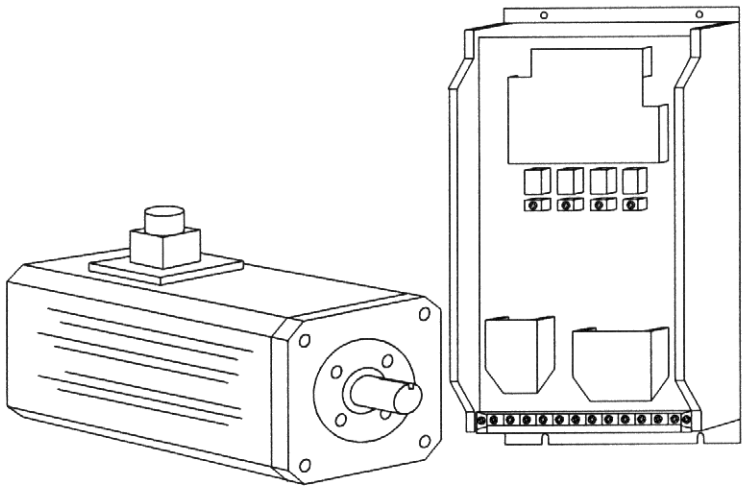

USER'S GUIDE

INDUSTRIAL INDEXING SYSTEMS, Inc.

Revision - 0

ER-6020

ERRATA SHEET, IB-18B003 — SEPTEMBER 1994

Date	Rev.	ECN No.	DR	CHK	CHK
05/17/94	A	ECN-94-129 (See Note 1)	KY	EB	WES
06/02/94	B	ECN-94-134 (See Note 2)	DAD		
07/28/94	C	ECN-94-204 (See Note 3)	KY	ELS	
09/15/94	D	ECN-94-244 (See Note 4)	KY	CA	
09/21/94	E	ECN-94-248 (See Note 5)	KY	CA	
09/26/94	F	ECN-94-229 (See Note 6)	KY	CA	

Notes:

1) Appendix B, added Drive Setup SU-053004.
   Appendix E, removed cable drawing C-463YYYRA and replaced with C-463YYYRB.

2) Appendix E, removed cable drawing C-673YYYR0 and replaced with C-673YYYRA.

3) Appendix E, added cable drawing C-470YYY.

4) Appendix A, added drawings SERVOPRO-D and IC-253001.
   Appendix B, added SU-053008.

5) Appendix B, added SU-053002.

6) Appendix A, replaced SERVOPRO-D Rev. 0 with Rev. A.

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1.1 RATINGS AND SPECIFICATIONS OF M SERIES AC SERVOMOTORS

1.1.1 Ratings

Time Rating: Continuous
Insulation: Class F
Isolation Voltage: 1500 VAC, one minute
Insulation Resistance: 500 VDC, 10MΩ or more
Enclosure: Totally-enclosed, self-cooled (Equivalent to IP-55 exclusive shaft opening)
Ambient Temperature: 0 to +40°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 1.1 Ratings and Specifications of M Series AC Servomotors

Item \ Motor Type USAMED-*2		03B□1	06B□1	09B□2	12B□2	20B□2	30B□2	44B□2
Rated Output*	kW (HP)	0.3 (0.4)	0.6 (0.8)	0.9 (1.2)	1.2 (1.6)	2.0 (2.7)	3.0 (4.0)	4.4 (5.9)
Rated Torque*	N•m (lb•in)	2.84 (25)	5.68 (50)	8.63 (76)	11.5 (102)	19.1 (169)	28.4 (252)	41.9 (372)
Continuous Max Torque*	N•m (lb•in)	2.94 (26)	5.88 (52)	8.82 (78)	11.8 (104)	21.6 (191)	32.3 (286)	46.1 (408)
Instantaneous Peak Torque*	N•m (lb•in)	7.17 (63)	14.1 (125)	19.3 (171)	28.0 (248)	44.0 (390)	63.7 (564)	91.1 (807)
Rated Current*	A	3.0	5.8	7.6	11.7	18.8	26	33
Rated Speed*	r/min	1000						
Instantaneous Max Speed*	r/min	2000						1500
Torque Constant	N•m/A (lb•in/A)	1.01 (8.9)	1.04 (9.2)	1.21 (10.7)	1.02 (9.0)	1.07 (9.5)	1.16 (10.2)	1.33 (11.8)
Moment of Inertia $J_M(=GD^2/4)$	$kg•m^2\times10^{-4}$ ($lb•in•s^2\times10^{-3}$)	13.5 (12.0)	24.3 (21.5)	36.7 (32.5)	58.0 (51.2)	110 (97.2)	143 (126.7)	240 (212.6)
Power Rate*1	kW/s	6.0	13.3	20.3	22.7	33.2	57.0	74.0
Inertia Time Constant	ms	12.8	6.3	4.4	6.0	5.2	3.5	3.6
Inductive Time Constant	ms	2.7	5.1	6.5	10.4	12.9	15.3	16.2
Insulation		Class F						

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

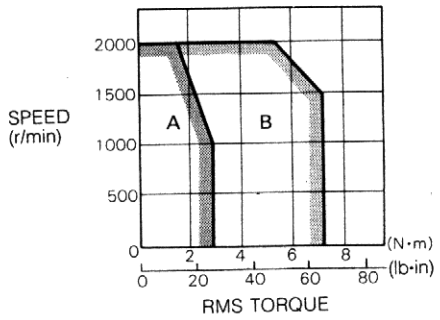
*2: The blank □ of motor type depends on class of detectors.
Standard: 2 (8192 pulses/rev)
Semi-Standard: 3 (2048 pulses/rev)
Optical encoder is used as a detector.

Note: The power supply units for brake:
- Input 100 VAC, Output 90 VDC: Type OPR 109 F
- Input 200 VAC, Output 90 VDC: Type OPR 109 A

For details, see par. 10.3 (2).

1.1.2 Torque-Speed Characteristics

- TYPE USAMED-03B□1



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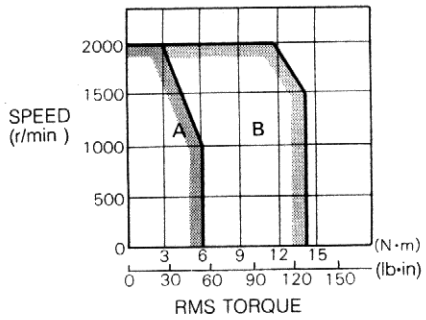

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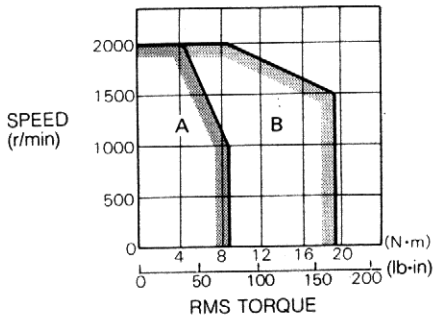

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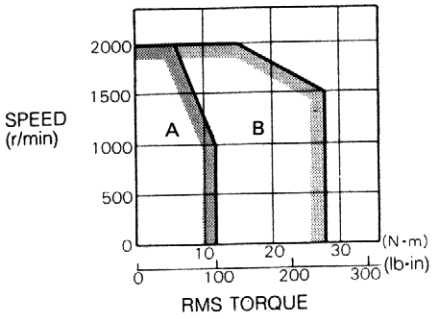

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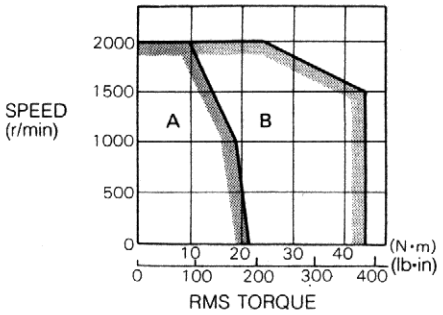

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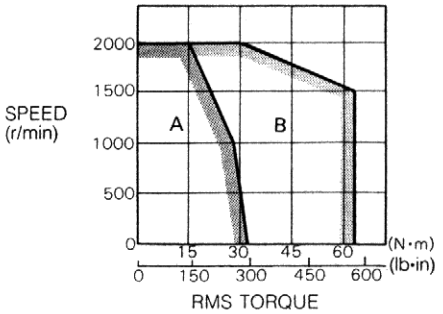

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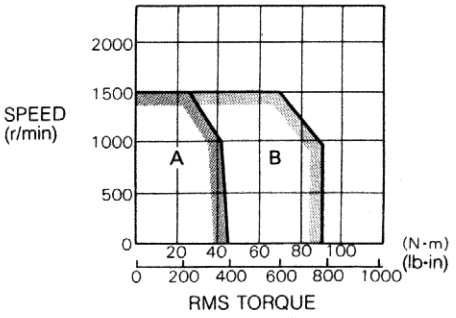


A: CONTINUOUS DUTY ZONE
B: INTERMITTENT DUTY ZONE
POWER SUPPLY: 200 V

1.2 RATINGS AND SPECIFICATIONS OF F SERIES AC SERVOMOTORS

1.2.1 Ratings

Time Rating: Continuous
Insulation: Class F
Isolation Voltage: 1500 VAC, one minute
Insulation Resistance: 500 VDC, 10MΩ or more
Enclosure: Totally-enclosed, self-cooled (Equivalent to IP-55 exclusive shaft opening)
Ambient Temperature: 0 to +40°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 1.2 Ratings and Specifications of F Series AC Servomotors

Item \ Motor Type USAFED-*2		02C□1	03C□1	05C□1	09□1	13C□2	20C□2	30C□2	44C□2
Rated Output*	kW (HP)	0.15 (0.2)	0.3 (0.4)	0.45 (0.6)	0.85 (1.1)	1.3 (1.7)	1.8 (2.4)	2.9 (3.9)	4.4 (5.9)
Rated Torque*	N•m (lb•in)	0.98 (8.7)	1.96 (17)	2.84 (25)	5.39 (48)	8.34 (74)	11.5 (102)	18.6 (165)	28.4 (252)
Continuous Max Torque*	N•m (lb•in)	1.08 (10)	2.16 (19)	2.94 (26)	5.88 (52)	8.83 (78)	11.8 (104)	22.6 (200)	37.3 (330)
Instantaneous Peak Torque*	N•m (lb•in)	2.91 (26)	5.83 (52)	8.92 (79)	15.2 (135)	24.7 (219)	34.0 (301)	54.1 (479)	76.2 (675)
Rated Current*	A	3.0	3.0	3.8	6.2	9.7	15	20	30
Rated Speed*	r/min	1500							
Instantaneous Max Speed*	r/min	2500							
Torque Constant	N•m/A (lb•in/A)	0.36 (3.2)	0.72 (6.3)	0.80 (7.1)	0.92 (8.2)	0.92 (8.2)	0.82 (7.3)	0.98 (8.7)	1.02 (9.0)
Moment of Inertia J_M(=GD^2/4)	$kg•m^2×10^{-4}$ ($lb•in•s^2×10^{-3}$)	1.3 (1.2)	2.06 (1.8)	13.5 (12.0)	24.3 (21.5)	36.7 (32.5)	58 (51.2)	110 (97.2)	143 (126.7)
Power Rate*1	kW/s	7.4	18.3	6.0	12	18.9	22.7	31.5	57.0
Inertia Time Constant	ms	3.9	2.5	10.9	6.0	4.4	5.9	5.2	3.7
Inductive Time Constant	ms	3.4	4.3	3.2	5.2	6.1	10.4	13.0	15.2
Insulation		Class F							

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

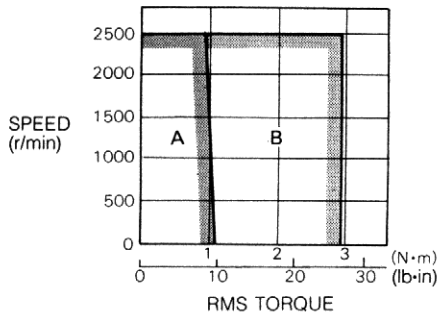
*2: The blank □ of motor type depends on class of detectors.
Standard: 2 (8192 pulses/rev)
Semi-Standard: 3 (2048 pulses/rev)
Optical encoder is used as a detector.

Note: The power supply units for brake:
- Input 100 VAC, Output 90 VDC: Type OPR 109 F
- Input 200 VAC, Output 90 VDC: Type OPR 109 A

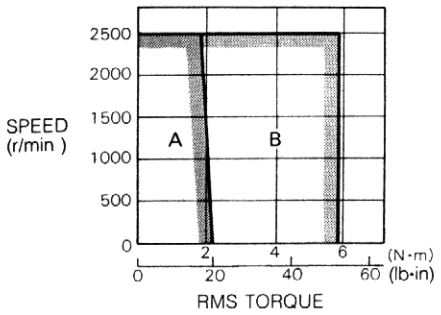
For details, see par. 10.3 (2).

1.2.2 Torque-Speed Characteristics

- TYPE USAFED-02C□1



- TYPE USAFED-03C□1



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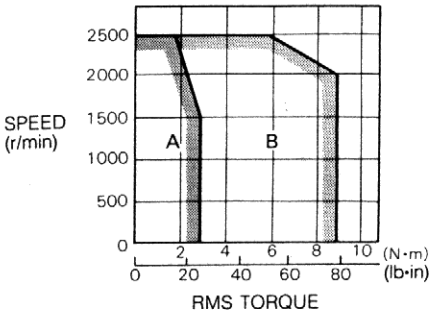
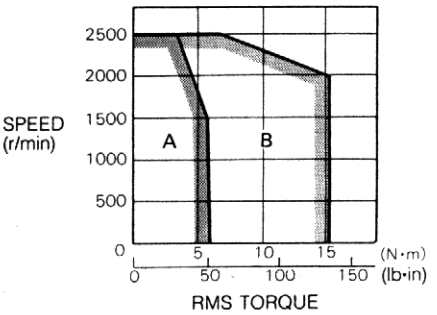
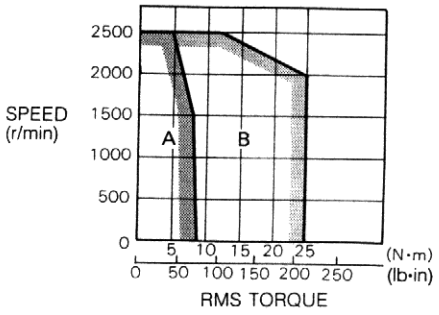


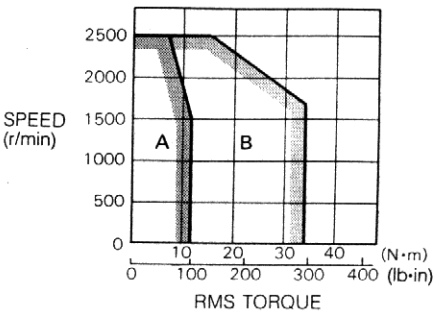
- TYPE USAFED-09C□1



- TYPE USAFED-13C□1



- TYPE USAFED-20C□1



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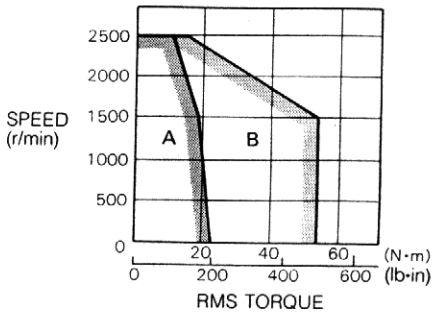
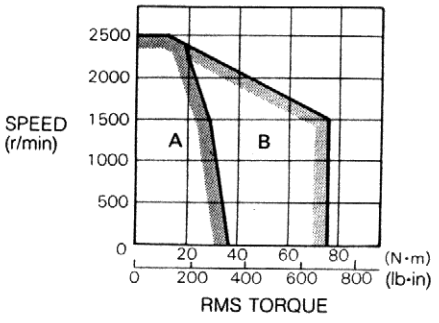


- TYPE USAFED-44C□1



A: CONTINUOUS DUTY ZONE
B: INTERMITTENT DUTY ZONE
POWER SUPPLY: 200 V

1.3 RATINGS AND SPECIFICATIONS OF G SERIES AC SERVOMOTORS

1.3.1 Ratings

Time Rating: Continuous
Insulation: Class F
Isolation Voltage: 1500 VAC, one minute
Insulation Resistance: 500 VDC, 10MΩ or more
Enclosure: Totally-enclosed, self-cooled (Equivalent to IP-55 exclusive shaft opening)
Ambient Temperature: 0 to +40°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 G Series AC Servomotors

Item \ Motor Type USAGED-*2		02A □1	03A □1	05A □1	09A □1	13A □1	20A □2	30A □2	44A □2
Rated Output*	kW (HP)	0.15 (0.2)	0.3 (0.4)	0.45 (0.6)	0.85 (1.1)	1.3 (1.7)	1.8 (2.4)	2.9 (3.9)	4.4 (5.9)
Rated Torque*	N•m (lb•in)	0.98 (8.7)	1.96 (17)	2.84 (25)	5.39 (48)	8.34 (74)	11.5 (102)	18.6 (165)	28.4 (252)
Continuous Max Torque*	N•m (lb•in)	1.08 (10)	2.16 (19)	2.94 (26)	5.88 (52)	8.83 (78)	11.8 (104)	22.6 (200)	37.3 (330)
Instantaneous Peak Torque*	N•m (lb•in)	2.9 (26)	5.83 (52)	8.92 (79)	13.3 (118)	23.3 (207)	28.0 (248)	45.1 (339)	66.2 (587)
Rated Current*	A	3.0	3.0	3.8	7.6	11.7	19	26	33
Rated Speed*	r/min	1500							
Instantaneous Max Speed*	r/min	3000							
Torque Constant	N•m/A (lb•in/A)	0.36 (3.2)	0.72 (6.3)	0.8 (7.1)	0.8 (7.1)	0.83 (7.4)	0.67 (5.9)	0.80 (7.1)	0.95 (8.4)
Moment of Inertia J_M(=GD^2/4)	$kg•m^2×10^{-4}$ ($lb•in•s^2×10^{-3}$)	1.3 (1.2)	2.06 (1.8)	13.5 (12.0)	24.3 (21.5)	36.7 (32.5)	58 (51.2)	110 (97.2)	143 (126.7)
Power Rate*1	kW/s	7.4	18.3	6.0	12	18.9	22.7	36.5	57.0
Inertia Time Constant	ms	4.5	2.5	10.9	6.1	4.3	5.8	5.2	3.4
Inductive Time Constant	ms	3.4	4.3	3.2	5.2	6.7	10.6	13.2	15.9
Insulation		Class F							

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

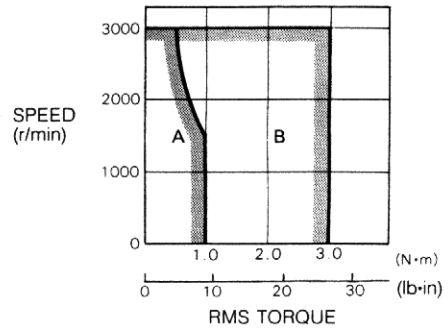
*2: The blank □ of motor type depends on class of detectors.
Standard: 2 (8192 pulses/rev)
Semi-Standard: 3 (2048 pulses/rev)
Optical encoder is used as a detector.

Note: The power supply units for brake:
- Input 100 VAC, Output 90 VDC: Type OPR 109 F
- Input 200 VAC, Output 90 VDC: Type OPR 109 A

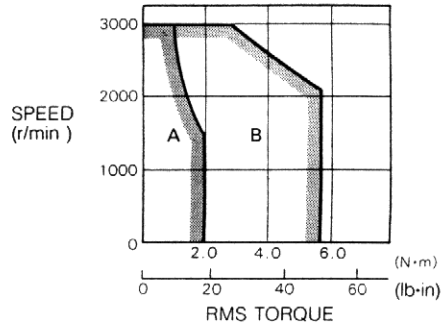
For details, see par. 10.3 (2).

1.3.2 Torque-Speed Characteristics

- TYPE USAGED-02A



- TYPE USAGED-03A



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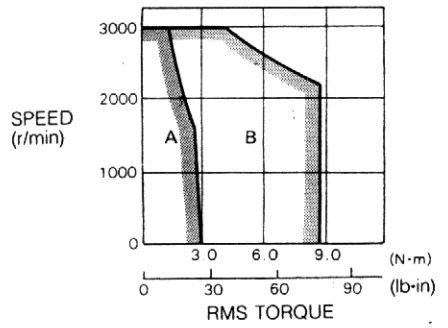
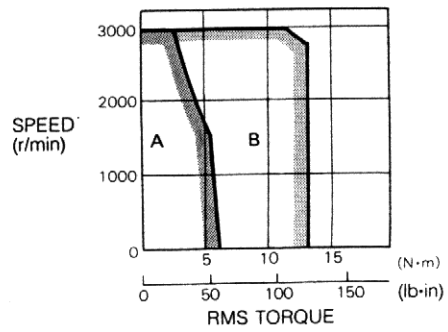
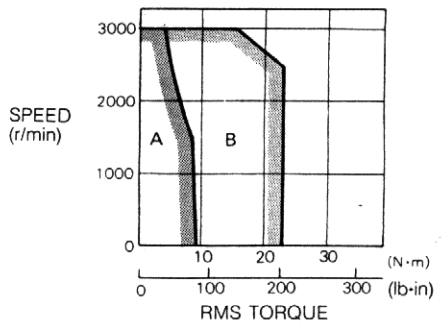


- TYPE USAGED-09A



- TYPE USAGED-13A



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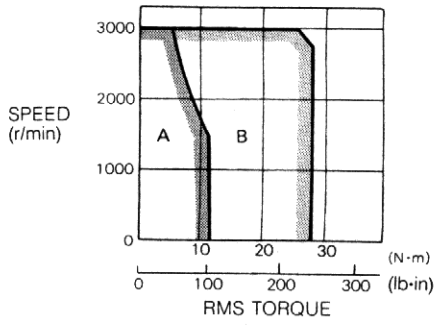

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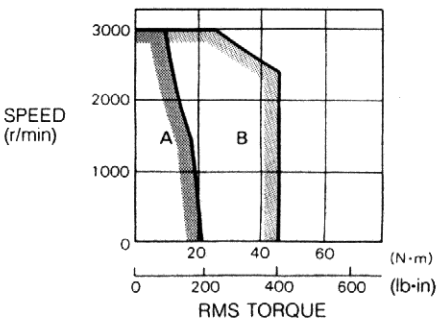
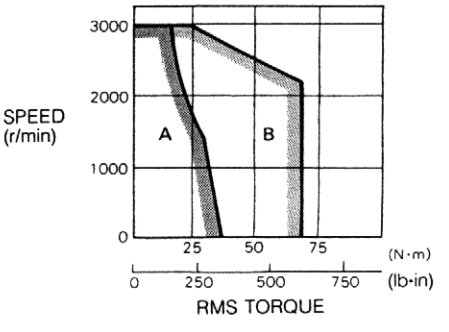


- TYPE USAGED-44A



A: CONTINUOUS DUTY ZONE
B: INTERMITTENT DUTY ZONE
POWER SUPPLY: 200 V

1.4 RATINGS AND SPECIFICATIONS OF S SERIES AC SERVOMOTORS

1.4.1 Ratings

Time Rating: Continuous
Insulation: Class B (Types USASEM-02A□2, -03A□2, -05A□2)
Class F (Types USASEM-08A□1, -15A□1, -30A□1)
Isolation Voltage: 1500 VAC, one minute
Insulation Resistance: 500 VDC, 10MΩ or more
Enclosure: Totally-enclosed, self-cooled

Ambient Temperature: 0 to +40°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 1.4 Ratings and Specifications of S Series AC Servomotors

Item \ Motor Type USASEM- *2		02A□2	03A□2	05A□2	08A□1	15A□1	30A□1
Rated Output*	kW (HP)	0.15 (0.2)	0.31 (0.4)	0.46 (0.6)	0.77 (1.0)	1.54 (2.1)	3.08 (4.1)
Rated Torque*	N•m (lb•in)	0.49 (4.3)	0.98 (8.7)	1.47 (13)	2.45 (22)	4.90 (43)	9.80 (87)
Continuous Max Torque*	N•m (lb•in)	0.57 (5.0)	1.18 (10)	1.67 (15)	3.33 (30)	6.17 (55)	12.2 (108)
Instantaneous Peak Torque*	N•m (lb•in)	1.47 (13)	2.94 (26)	4.02 (36)	7.35 (65)	13.7 (122)	29.0 (257)
Rated Current*	A	2.1	3.0	4.2	5.3	10.4	19.9
Rated Speed*	r/min	3000					
Instantaneous Max Speed*	r/min	4000					
Torque Constant	N•m/A (lb•in/A)	0.25 (2.19)	0.35 (3.10)	0.37 (3.25)	0.51 (4.49)	0.50 (4.43)	0.52 (4.64)
Moment of Inertia $J_M(=GD^2/4)$	$kg•m^2×10^{-4}$ ($lb•in•s^2×10^{-3}$)	0.13 (0.11)	0.51 (0.45)	0.75 (0.67)	2.85 (2.53)	3.3 (2.88)	5.74 (5.09)
Power Rate*[1]	kW/s	18.5	18.9	28.9	21	74	167
Inertia Time Constant	ms	1.8	2.2	1.8	1.9	0.7	0.4
Inductive Time Constant	ms	1.5	2.7	3.1	6.2	13	26
Insulation		Class B			Class F		

* Values when servomotor is combined with Servopack and the armature winding temperature is 100°C. Shown are normal (TYP) values above.

† Values when servomotor is combined with Servopack and the armature winding temperature is 20°C. Shown are normal (TYP) values above.

The blank □ of motor type depends on class of detectors.

Standard: 3 (2048 pulses/rev)
Semi-Standard: 4 (2500 pulses/rev)

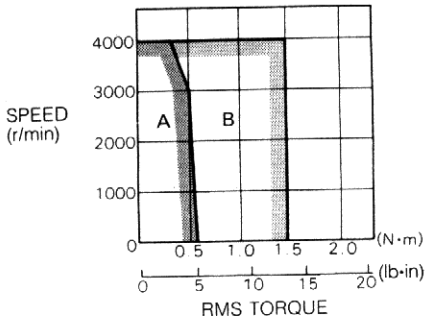
Optical encoder is used as a detector.

Note: The power supply units for brake:
- Input 100 VAC, Output 90 VDC: Type OPR 109 F (DP8401002-2)
- Input 200 VAC, Output 90 VDC: Type OPR 109 A (DP8401002-1)

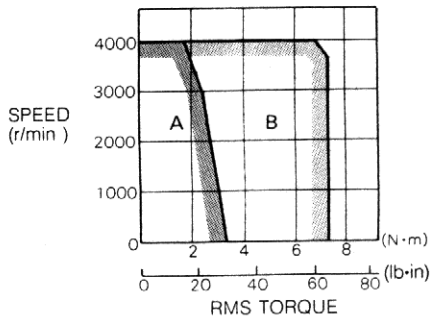
For details, see apr.10.3 (2)

1.4.2 Torque-Speed Characteristics

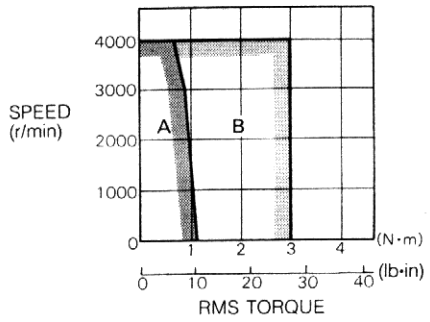
- TYPE USASEM-02A



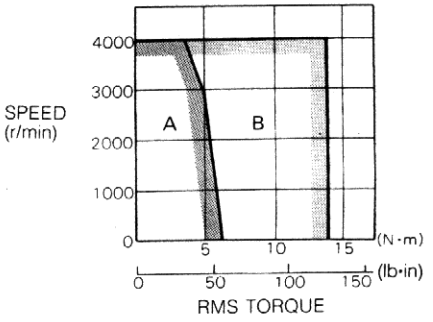
- TYPE USASEM-08A



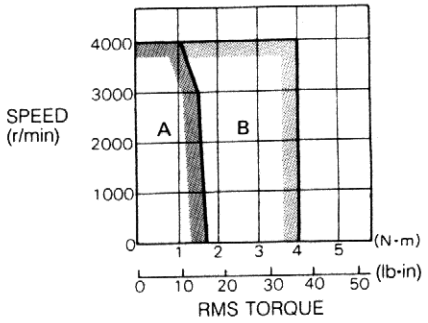
- TYPE USASEM-03A



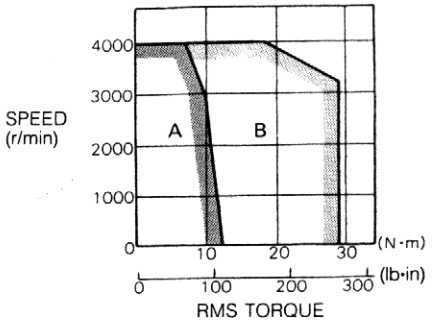
- TYPE USASEM-15A



- TYPE USASEM-05A



- TYPE USASEM-30A



A: CONTINUOUS DUTY ZONE
B: INTERMITTENT DUTY ZONE
POWER SUPPLY: 200 V

1.5 RATINGS AND SPECIFICATIONS OF D SERIES AC SERVOMOTORS

1.5.1 Ratings

Time Rating: Continuous
Insulation: Class F
Isolation Voltage: 1500 VAC, one minute
Insulation Resistance: 500 VDC, 10MΩ or more
Enclosure: Totally-enclosed, self-cooled
Ambient Temperature: 0 to +40°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
Holding Brake Provided.

Table 1.5 Ratings and Specifications of D Series AC Servomotors

Item \ Motor Type USADED-*2		05E□3	10E□3	15E□3	22E□3	37E□3
Rated Output*	kW (HP)	0.5 (0.67)	1.0 (1.3)	1.5 (2.0)	2.2 (2.9)	3.7 (5.0)
Rated Torque*	N•m (lb•in)	2.35 (21)	4.80 (43)	7.16 (63)	10.5 (93)	17.7 (156)
Continuous Max Torque*	N•m (lb•in)	3.43 (30)	6.37 (56)	8.82 (78)	13.7 (122)	21.6 (191)
Instantaneous Peak Torque*	N•m (lb•in)	8.24 (73)	16.9 (149)	25.1 (222)	36.8 (326)	61.8 (547)
Rated Current*	A	3.5	7.9	12.6	16.6	23.3
Rated Speed*	r/min	2000				
Instantaneous Peak Speed*	r/min	2500				
Torque Constant	N•m/A (lb•in/A)	0.83 (7.38)	0.69 (6.07)	0.64 (5.64)	0.71 (6.25)	0.82 (7.29)
Moment of Inertia $J_M(=GD^2/4)$	$kg•m^2×10^{-4}$ ($lb•in•s^2×10^{-3}$)	21, 13† (18.2, 11.3†)	32, 24† (28.6, 21.5†)	62, 59† (54.7, 52.1†)	83, 80† (73.8, 71.1†)	148, 145† (131, 128†)
Power Rate*1	kW/s	2.7 4.4†	7.3 9.7†	8.2 8.6†	13 14†	21 22†
Inertia Time Constant	ms	18 11†	7.8 5.9†	7.1 6.8†	6.2 6.0†	4.3 4.2†
Inductive Time Constant	ms	4.4	6.9	9.4	11	15
Insulation		Class F				
Holding Brake	Power Supply VDC	90				
	Static Function Torque N•m (lb•in)	8.82 (78)		21.56 (191)		
Approx Weight	kg (lb)	17, 16† (37.5, 35.3†)	19, 18† (41.9, 39.7†)	30, 27† (66.2, 59.5†)	32, 29† (70.6, 64†)	39, 36† (86.0, 79.4†)

* Values when servomotor is combined with Servopack and the armature winding temperature is 20°C. Shwon are normal (TYF) values above.

† Values show those of D series without holding brake.

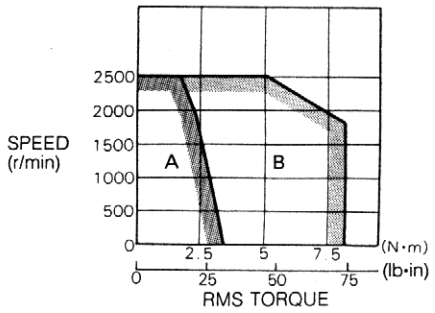
The blank □ of motor type depends on class of detectors.
Standard: 2 (2048 pulses/rev)
Semi-Standard: 3 (8192 pulses/rev)
Optical encoder is used as a detector.

Brake power supply specifications: 2 types.
- Input: 100 VAC Output: 90 VDC; OPR 109 F Type
- Input: 200 VAC Output: 90 VDC; OPR 109 A Type

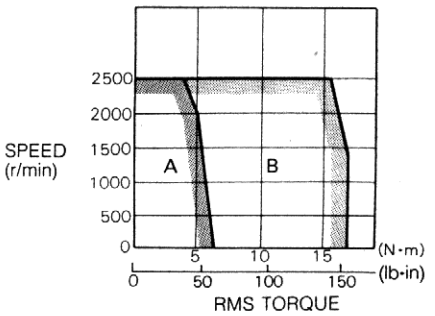
For details, refer to Par. 10.3.

1.5.2 Torque-Speed Characteristics

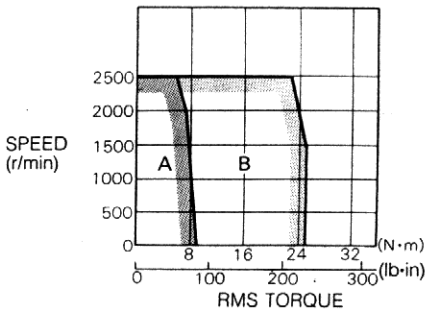
- TYPE USADED-05E



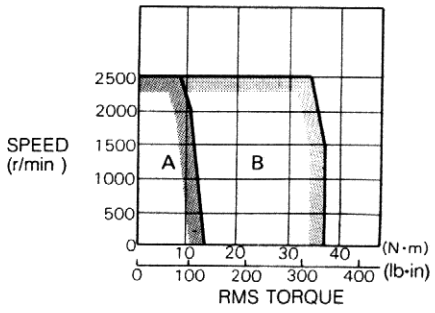
- TYPE USADED-10E



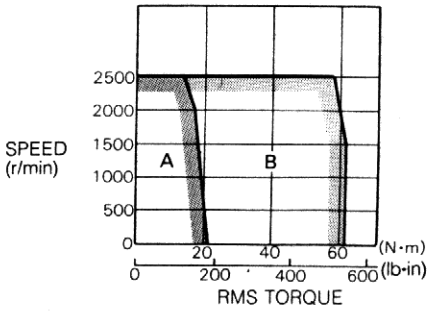
- TYPE USADED-15E



- TYPE USADED-22E



- TYPE USADED-37E



A: CONTINUOUS DUTY ZONE
B: INTERMITTENT DUTY ZONE

1.6 RATINGS AND SPECIFICATIONS OF *Servopack*

Table 1.6 Ratings and Specifications of *Servopack*

Servopack Type CACR-			SR02BE	SR03BE	SR05BE	SR07BE	SR10BE	SR15BE	SR20BE	SR30BE	SR44BE
Max Motor Output		kW (HP)	0.2 (0.3)	0.3 (0.4)	0.5 (0.67)	0.7 (0.94)	1.0 (1.34)	1.5 (2.0)	2.0 (2.7)	3.0 (4.1)	4.4 (5.9)
Servomotor	M Series	Applicable Optical Encoder	Standard : 8192pulses/rev (Semi-Standard : 2048pulses/rev)								
		AC Servomotor Type USAMED-	—	03B2	—	06B2	09B2	12B2	20B2	30B2	44B2
		AC Servomotor Output kW (HP)	—	0.3 (0.4)	—	0.6 (0.8)	0.9 (1.2)	1.2 (1.6)	2.0 (2.7)	3.0 (4.1)	4.4 (5.9)
		AC Servomotor Rated Speed r/min	1000/2000 (44B2 : 1000/1500)								
		Servopack Type CACR-	—	SR03BE12M	—	SR07BE12M	SR10BE12M	SR15BE12M	SR20BE12M	SR30BE12M	SR44BE12M
		Continuous Output Current Arms	—	3.0	—	5.8	7.6	11.7	18.8	26.0	33.0
		Max Output Current Arms	—	7.3	—	13.9	16.6	28.0	42.0	56.6	70.0
		Allowable $J_L(=GD_L^2/4)$ kg•m²×10⁻⁴ (lb•in•s²×10⁻³)	—	67.5 (60)	—	122 (107.5)	184 (162.5)	334 (296)	550 (486)	715 (633.5)	1200 (1063)
	F Series	Applicable Optical Encoder	Standard : 8192pulses/rev (Semi-Standard : 2048pulses/rev)								
		AC Servomotor Type USAFED-	02C2	03C2	05C2	—	09C2	13C2	20C2	30C2	44C2
		AC Servomotor Output kW (HP)	0.15 (0.2)	0.3 (0.4)	0.45 (0.6)	—	0.85 (1.1)	1.3 (1.7)	1.8 (2.4)	2.9 (3.9)	4.4 (5.9)
		AC Servomotor Rated Speed r/min	1500/2500								
		Servopack Type CACR-	SR02BE12F	SR03BE12F	SR05BE12F	—	SR10BE12F	SR15BE12F	SR20BE12F	SR30BE12F	SR44BE12F
		Continuous Output Current Arms	3.0	3.0	3.8	—	6.2	9.7	15.0	20.0	30.0
		Max Output Current Arms	8.5	8.5	11.0	—	17.0	27.6	42.0	56.5	77.0
		Allowable $J_L(=GD_L^2/4)$ kg•m²×10⁻⁴ (lb•in•s²×10⁻³)	6.5 (5.75)	10.3 (9)	67.5 (60)	—	122 (107.5)	184 (162.5)	334 (296)	550 (486)	715 (633.5)
	G Series	Applicable Optical Encoder	Standard : 8192pulses/rev (Semi-Standard : 2048pulses/rev)								
		AC Servomotor Type USAGED-	02A2	03A2	05A2	—	09A2	13A2	20A2	30A2	44A2
		AC Servomotor Output kW (HP)	0.15 (0.2)	0.3 (0.4)	0.45 (0.6)	—	0.85 (1.1)	1.3 (1.7)	1.8 (2.4)	2.9 (3.9)	4.4 (5.9)
		AC Servomotor Rated Speed r/min	1500/3000								
		Servopack Type CACR-	SR02BE12G	SR03BE12G	SR05BE12G	—	SR10BE12G	SR15BE12G	SR20BE12G	SR30BE12G	SR44BE12G
		Continuous Output Current Arms	3.0	3.0	3.8	—	7.6	11.7	19.0	26.0	33.0
		Max Output Current Arms	8.5	8.5	11.0	—	17.0				
		Allowable $J_L(=GD_L^2/4)$ kg•m²×10⁻⁴ (lb•in•s²×10⁻³)	6.5 (5.75)	10.3 (9)	67.5 (60)	—	122 (107.5)	184 (162.5)	290 (256)	475 (418)	715 (630)
	S Series	Applicable Optical Encoder	Standard : 2048pulses/rev (Semi-Standard : 2500pulses/rev)								
		AC Servomotor Type USASEM-	02A3	03A3	05A3	—	08A3	15A3	—	30A3	—
		AC Servomotor Output kW (HP)	0.15 (0.2)	0.31 (0.4)	0.46 (0.6)	—	0.77 (1.0)	1.54 (2.1)	—	3.08 (4.1)	—
		AC Servomotor Rated Speed r/min	3000/4000								
		Servopack Type CACR-	SR02BE13S	SR03BE13S	SR05BE13S	—	SR10BE13S	SR15BE13S	—	SR30BE13S	—
		Continuous Output Current Arms	2.1	3.0	4.2	—	5.3	10.4	—	19.9	—
		Max Output Current Arms	6.0	8.5	11.0	—	15.6	28.0	—	56.5	—
		Allowable $J_L(=GD_L^2/4)$ kg•m²×10⁻⁴ (lb•in•s²×10⁻³)	0.65 (0.55)	2.55 (2.25)	3.8 (3.35)	—	14.3 (12.65)	16.5 (14.4)	—	28.7 (25.4)	—
	D Series	Applicable Optical Encoder	Standard : 2048pulses/rev (Semi-Standard : 8192pulses/rev)								
		AC Servomotor Type USADED-	—	—	05E3	—	—	10E3	15E3	22E3	37E3
		AC Servomotor Output kW (HP)	—	—	0.5 (0.67)	—	—	1.0 (1.34)	1.5 (2.0)	2.2 (2.9)	3.7 (4.9)
		AC Servomotor Rated Speed r/min	2000/2500								
		Servopack Type CACR-	—	—	SR05BE13D	—	—	SR15BE13D	SR20BE13D	SR30BE13D	SR44BE13D
		Continuous Output Current Arms	—	—	3.8	—	—	7.9	12.6	16.6	23.3
		Max Output Current Arms	—	—	11.0	—	—	25.2	40.7	54.0	77.0
		Allowable $J_L(=GD_L^2/4)$ kg•m²×10⁻⁴ (lb•in•s²×10⁻³)	—	—	105 (91)	—	—	160 (143)	310 (273.5)	415 (369)	740 (655)

Table 1.6 Ratings and Specifications of *Servopack* (Cont'd)

Servopack Type				SR02BE	SR03BE	SR05BE	SR07BE	SR10BE	SR15BE	SR20BE	SR30BE	SR44BE
Max Motor Output			kW (HP)	0.2 (0.3)	0.3 (0.4)	0.5 (0.67)	0.7 (0.94)	1.0 (1.34)	1.5 (2.01)	2.0 (2.7)	3.0 (4.1)	4.4 (5.9)
Servopack	Basic Specifications	Power Supply	Main Circuit	Three-phase 200 to 230 VAC $^{+10\%}_{-15\%}$ 50/60 Hz*1								
			Control Circuit	Single phase 200 to 230 VAC $^{+10\%}_{-15\%}$ 50/60 Hz*1								
		Control Method		Three-phase Full-wave Rectifier Transistorized-PWM Control (Sine Wave Drive)								
		Feedback		Optical encoder (8192 pulses/rev, 2048 pulses/rev)								
		Ambient Temperature		0 to 55°C*B5								
		Storage Temperature		−20°C to +85°C								
		Ambient and Storage Humidity		90% or less (non-condensing)								
		Vibration-resistance/Impact-resistance		0.5G/2G								
		Mounting Structure		Base mounted								
		Approx Weight	kg (lb)	6.0 (13.2)							7.0 (15.4)	
	Speed Control	Speed Control Range*2		1 : 5000								
		Speed*3 Regulation	Load Regulation 0 to 100%	+0.01% or less at rated r/min								
			Voltage Regulation ±10%	0%								
			Temp. Regulation 25 ± 25C°	±0.1% or less at rated r/min								
		Frequency Response Charactristics		100 Hz ($J_L=J_M$)								
	Signal I/O	Speed Reference Input	Rated Reference Voltage	Speed Control Mode: ±6 VDC at rated r/min (forward run at plus reference)								
				Torque Control Mode: ±3 VDC at rated torque (forward torque generated at plus reference)								
			Input Impedance	Approx 30kΩ								
			Circuit Time Constant	Approx 70μs								
		Auxiliary Reference Input*4	Reference Voltage	±12 VDC at rated r/min (forward run at plus reference)								
			Input Impedance	Approx 30kΩ								
			Circuit Time Constant	Approx 70μs								
		Built-in Reference Power Supply		±12 VDC ±5%, ±30mA Output-able								
		Position Output (PG Pulse)	Output Form	Line Driver and Open Collector (A-phase, B-plase, C-phase)								
			Dividing Ratio	(1 to N)/N N=8192, 2048 (by number of optical encoder pulse)								
		Sequence Input Signal		Servo ON, P drive, F run stop, R run stop, etc.								
		Sequence Output Signal		Servo ready, TG ON, current limit, servo alarm, overload, MCCB trip								
		External Current Limit		0 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, overtravel, etc.								
		Regeneration		Provided								
		Applicable Load Inertia J_L		Up to 5 times motor inertia*6								
		Overtravel Prevention		DB stop or slowdown stop at P-OT, N-OT								
		Protection		Communication error, over current(OC), MCCB trip(MCCB), Regenerative error(RG), overvoltage(OV), overload(OL), origin error, overrun, open phase detection, CPU error(CPU, A/D)								
		Indication		7-segment LEDs×5 figures (Alarm, status, parameter indications)								
		Monitor Output		Speed monitor : 2V (4V)±5%/1000r/min, Torque monitor : 3V ±10%/100%								
		Other functions		Torque control, zero cramp, soft start, brake interlock, reverse turn connection, JOG Operat								

*1. Supply voltage should not exceed 230 V +10% (253 V). If the voltage should exceed this value, a step down transformer is required.

*2. In the speed control range, the lowest speed is defined as the condition in which there is 100% load variation, but not stopped.

*3 Speed regulation is generally defined as follows:

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

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

*4. Used for application at rated reference voltage other than ±6V.

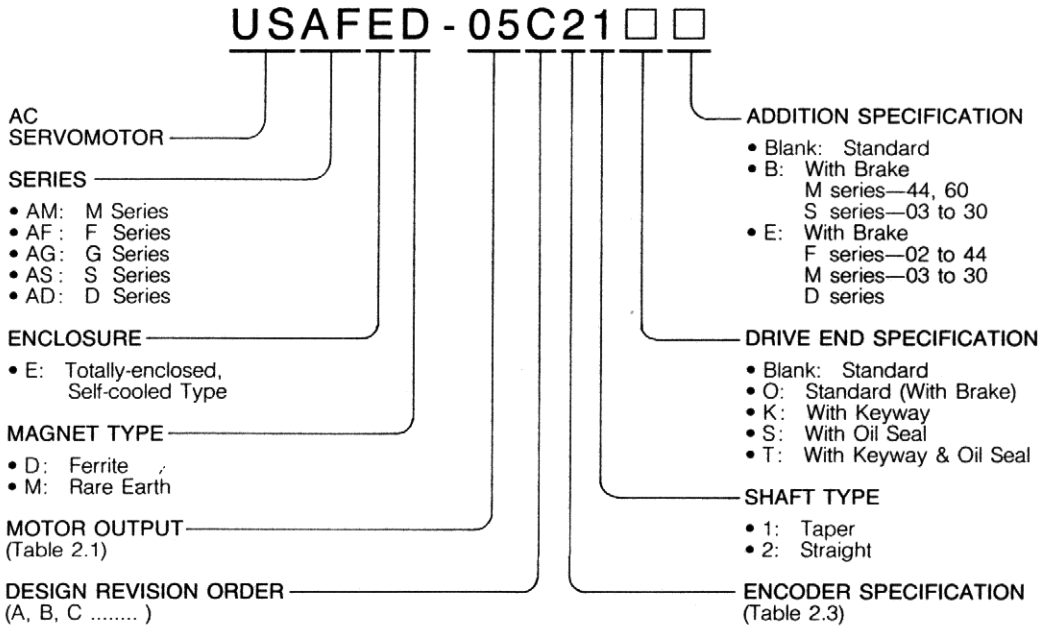
*5. When housed in a panel, the inside temperature must not exceed ambient temper ature range.

*6. When load J_L exceeds applicable range, be sure to refer to 6.7.2. Load Inertia.

*7. JOG operation with monitor switch.

2. TYPE DESIGNATION

- AC Servomotor



- ***Servopack***

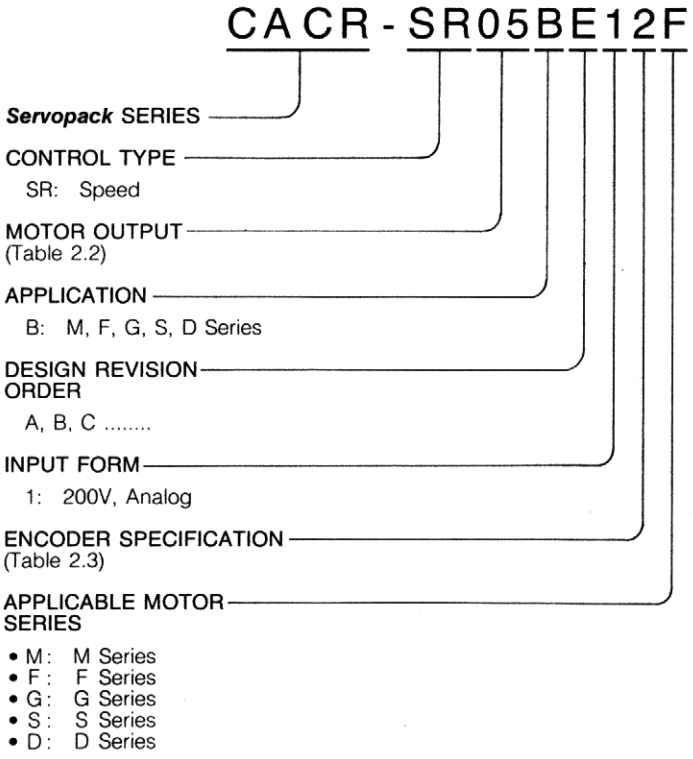


Table 2.1

	Motor Output				
	M Series	F Series	G Series	S Series	D Series
02	—	0.15kW(0.2HP)	0.15kW(0.2HP)	154W(0.2HP)	—
03	0.3kW(0.4HP)	0.3kW(0.4HP)	0.3kW(0.4HP)	308W(0.4HP)	—
05	—	0.45kW(0.6HP)	0.45kW(0.6HP)	462W(0.6HP)	0.5kW(0.67HP)
06	0.6kW(0.8HP)	—	—	—	—
08	—	—	—	771W(10HP)	—
09	0.9kW(1.2HP)	0.85kW(1.1HP)	0.85kW(1.1HP)	—	—
10	—	—	—	—	1.0kW(1.3HP)
12	1.2kW(1.6HP)	—	—	—	—
13	—	1.3kW(1.7HP)	1.3kW(1.7HP)	—	—
15	—	—	—	1540W(2.1HP)	1.5kW(2.0HP)
20	2.0kW(2.7HP)	1.8kW(2.4HP)	1.8kW(2.4HP)	—	—
22	—	—	—	—	2.2kW(2.9HP)
30	3.0kW(4.1HP)	2.9kW(3.9HP)	2.9kW(3.9HP)	3080W(4.1HP)	—
37	—	—	—	—	3.7kW(5.0HP)
44	4.4kW(5.9HP)	4.4kW(5.9HP)	4.4kW(5.9HP)	—	—

Table 2.2

	Motor Output				
	M Series	F Series	G Series	S Series	D Series
02	—	0.15kW(0.2HP)	0.15kW(0.2HP)	0.15kW(0.2HP)	—
03	0.3kW(0.4HP)	0.3kW(0.4HP)	0.3kW(0.4HP)	0.3kW(0.4HP)	—
05	—	0.45kW(0.6HP)	0.45kW(0.6HP)	0.46kW(0.6HP)	0.5kW(0.67HP)
07	0.6kW(0.8HP)	—	—	—	—
10	0.9kW(1.2HP)	0.85kW(1.1HP)	0.85kW(1.1HP)	0.77kW(10HP)	—
15	1.2kW(1.6HP)	1.3kW(1.7HP)	1.3kW(1.7HP)	1.54kW(2.1HP)	1.0kW(1.3HP)
20	2.0kW(2.7HP)	1.8kW(2.4HP)	1.8kW(2.4HP)	—	1.5kW(2.0HP)
30	3.0kW(4.1HP)	2.9kW(3.9HP)	2.9kW(2.4HP)	3.08kW(4.1HP)	2.2kW(2.9HP)
44	4.4kW(5.9HP)	4.4kW(5.9HP)	4.4kW(5.9HP)	—	3.7kW(5.0HP)

Table 2.3

Motor Type	Standard (pulses/rev)		Semi-standard (pulses/rev)	
M Series	2	8192	3	2048
F Series	2	8192	3	2048
G Series	2	8192	3	2048
S Series	4	2048	4	2500
D Series	3	2048	2	8192

3. LIST OF STANDARD COMBINATION

Table 3.1 Combination of **Servopack**, AC Servomotors and Associate Units

• M SERIES

Servopack Type CACR-	AC Servomotor Type	Power Capacity*1 per Servopack kVA	Current Capacity per MCCB or Fuse A	Applicable Noise Filter
SR 03 BE 12 M	USAMED-03 B 21	0.65	5	 Good  Poor
SR 07 BE 12 M	USAMED-06 B 21	1.5	8	
SR 10 BE 12 M	USAMED-09 B 22	2.1	8	
SR 15 BE 12 M	USAMED-12 B 22	3.1	10	
SR 20 BE 12 M	USAMED-20 B 22	4.1	12	
SR 30 BE 12 M	USAMED-30 B 22	6.0	18	
SR 44 BE 12 M	USAMED-44 B 22	8.0	24	

*1: Values at rated load. *2: Made by Tokin Corp.

• F SERIES

Servopack Type CACR-	AC Servomotor Type	Power Capacity per Servopack kVA	Current Capacity per MCCB or Fuse A	Applicable Noise Filter
SR 02 BE 12 F	USAFED-02 C 21	0.65	5	 Good  Poor
SR 03 BE 12 F	USAFED-03 C 21			
SR 05 BE 12 F	USAFED-05 C 21	1.1	5	
SR 10 BE 12 F	USAFED-09 C 21	2.1	8	
SR 15 BE 12 F	USAFED-13 C 22	3.1	10	
SR 20 BE 12 F	USAFED-20 C 22	4.1	12	
SR 30 BE 12 F	USAFED-30 C 22	6.0	18	
SR 44 BE 12 F	USAFED-44 C 22	8.0	24	

• G SERIES

Servopack Type CACR-	AC Servomotor Type	Power Capacity per Servopack kVA	Current Capacity per MCCB or Fuse A	Applicable Noise Filter
SR 02 BE 12 G	USAGED-02 A 21	0.65	5	 Good  Poor
SR 03 BE 12 G	USAGED-03 A 21			
SR 05 BE 12 G	USAGED-05 A 21	1.1	5	
SR 10 BE 12 G	USAGED-09 A 21	2.1	8	
SR 15 BE 12 G	USAGED-13 A 22	3.1	10	
SR 20 BE 12 G	USAGED-20 A 22	4.1	12	
SR 30 BE 12 G	USAGED-30 A 22	6.0	18	
SR 44 BE 12 G	USAGED-44 A 22	8.0	24	

• S SERIES

Servopack Type CACR-	AC Servomotor Type	Power Capacity per Servopack kVA	Current Capacity per MCCB or Fuse A	Applicable Noise Filter
SR 02 BE 13 S	USASEM-02 A 32	0.65	5	 Good  Poor
SR 03 BE 13 S	USASEM-03 A 32			
SR 05 BE 13 S	USASEM-05 A 32	1.1	5	
SR 10 BE 13 S	USASEM-08 A 31	2.1	8	
SR 15 BE 13 S	USASEM-15 A 31	3.1	10	
SR 30 BE 13 S	USASEM-30 A 31	6.0	18	

• D SERIES

Servopack Type CACR-	AC Servomotor Type	Power Capacity per Servopack kVA	Current Capacity per MCCB or Fuse A	Applicable Noise Filter
SR 05 BE 13 D	USADED-05 E 32	1.5	8	 Good  Poor
SR 15 BE 13 D	USADED-10 E 32	3.1	10	
SR 20 BE 13 D	USADED-15 E 32	4.1	12	
SR 30 BE 13 D	USADED-22 E 32	6.0	18	
SR 44 BE 13 D	USADED-37 E 32	8.0	24	

Recommended Noise Filter*2		Power ON/OFF Switch
Type	Specifications	
LF-305	3-phase 200 VAC class, 5 A	Yaskawa type HI-15E2 rated 30 A or equivalent
LF-310	3-phase 200 VAC class, 10 A	
LF-315	3-phase 200 VAC class, 15 A	
LF-315	3-phase 200 VAC class, 15 A	
LF-320	3-phase 200 VAC class, 20 A	Yaskawa type HI-18E rated 35 A or equivalent
LF-330	3-phase 200 VAC class, 30 A	
LF-340	3-phase 200 VAC class, 40 A	

Recommended Noise Filter		Power ON/OFF Switch
Type	Specifications	
LF-305	3-phase 200 VAC class, 5 A	Yaskawa type HI-15E2 rated 30 A or equivalent
LF-305	3-phase 200 VAC class, 5 A	
LF-305	3-phase 200 VAC class, 5 A	
LF-315	3-phase 200 VAC class, 15 A	
LF-315	3-phase 200 VAC class, 15 A	
LF-320	3-phase 200 VAC class, 20 A	Yaskawa type HI-18E rated 35 A or equivalent
LF-330	3-phase 200 VAC class, 30 A	
LF-340	3-phase 200 VAC class, 40 A	

Recommended Noise Filter		Power ON/OFF Switch
Type	Specifications	
LF-305	3-phase 200 VAC class, 5 A	Yaskawa type HI-15E2 rated 30 A or equivalent
LF-305	3-phase 200 VAC class, 5 A	
LF-305	3-phase 200 VAC class, 5 A	
LF-315	3-phase 200 VAC class, 15 A	
LF-315	3-phase 200 VAC class, 15 A	
LF-320	3-phase 200 VAC class, 20 A	Yaskawa type HI-18E rated 35 A or equivalent
LF-330	3-phase 200 VAC class, 30 A	
LF-340	3-phase 200 VAC class, 40 A	

Recommended Noise Filter		Power ON/OFF Switch
Type	Specifications	
LF-305	3-phase 200 VAC class, 5 A	Yaskawa type HI-15E2 rated 30 A or equivalent
LF-305	3-phase 200 VAC class, 5 A	
LF-305	3-phase 200 VAC class, 5 A	
LF-315	3-phase 200 VAC class, 15 A	
LF-315	3-phase 200 VAC class, 15 A	
LF-330	3-phase 200 VAC class, 30 A	Yaskawa type HI-18E rated 35 A or equivalent

Recommended Noise Filter		Power ON/OFF Switch
Type	Specifications	
LF-310	3-phase 200 VAC class, 10 A	Yaskawa type HI-15E2 rated 30 A or equivalent
LF-315	3-phase 200 VAC class, 15 A	
LF-320	3-phase 200 VAC class, 20 A	Yaskawa type HI-18E rated 35 A or equivalent
LF-330	3-phase 200 VAC class, 30 A	
LF-340	3-phase 200 VAC class, 40 A	

Table 3.2 Specifications of AC Servomotors, Detectors

• M SERIES

Servopack Type CACR-	AC Servomotor Type	Receptacle Type	L-type Plug	Straight Plug	Cable Clamp
SR 03 BE 12 M	USAMED-03 B 2	MS 3102 A 18 - 10 P	MS 3108 B 18 - 10 S	MS 3106 B 18 - 10 S	MS 3057 - 10 A
SR 07 BE 12 M	USAMED-06 B 2				
SR 10 BE 12 M	USAMED-09 B 2				
SR 15 BE 12 M	USAMED-12 B 2	MS 3102 A 22 - 22 P	MS 3108 B 22 - 22 S	MS 3106 B 22 - 22 S	MS 3057 - 12 A
SR 20 BE 12 M	USAMED-20 B 2				
SR 30 BE 12 M	USAMED-30 B 2				
SR 44 BE 12 M	USAMED-44 B 2	MS 3102 A 32 - 17 P	MS 3108 B 32 - 17 S	MS 3106 B 32 - 17 S	MS 3057 - 20 A

• F SERIES

Servopack Type CACR-	AC Servomotor Type	Receptacle Type	L-type Plug	Straight Plug	Cable Clamp
SR 02 BE 12 F	USAFED-02 C 2	MS 3102 A 14 S - 2 P	MS 3108 B 14 S - 2 S	MS 3106 B 14 S - 2 S	MS 3057 - 6 A
SR 03 BE 12 F	USAFED-03 C 2				
SR 05 BE 12 F	USAFED-05 C 2	MS 3102 A 18 - 10 P	MS 3108 B 18 - 10 S	MS 3106 B 18 - 10 S	MS 3057 - 10 A
SR 10 BE 12 F	USAFED-09 C 2				
SR 15 BE 12 F	USAFED-13 C 2				
SR 20 BE 12 F	USAFED-20 C 2	MS 3102 A 22 - 22 P	MS 3108 B 22 - 22 S	MS 3106 B 22 - 22 S	MS 3057 - 12 A
SR 30 BE 12 F	USAFED-30 C 2				
SR 44 BE 12 F	USAFED-44 C 2				

• G SERIES

Servopack Type CACR-	AC Servomotor Type	Receptacle Type	L-type Plug	Straight Plug	Cable Clamp
SR 02 BE 12 G	USAGED-02 A 2	MS 3102 A 14 S - 2 P	MS 3108 B 14 S - 2 S	MS 3106 B 14 S - 2 S	MS 3057 - 6 A
SR 03 BE 12 G	USAGED-03 A 2				
SR 05 BE 12 G	USAGED-05 A 2	MS 3102 A 18 - 10 P	MS 3108 B 18 - 10 S	MS 3106 B 18 - 10 S	MS 3057 - 10 A
SR 10 BE 12 G	USAGED-09 A 2				
SR 15 BE 12 G	USAGED-13 A 2				
SR 20 BE 12 G	USAGED-20 A 2	MS 3102 A 22 - 22 P	MS 3108 B 22 - 22 S	MS 3106 B 22 - 22 S	MS 3057 - 12 A
SR 30 BE 12 G	USAGED-30 A 2				
SR 44 BE 12 G	USAGED-44 A 2				

• S SERIES

Servopack Type CACR-	AC Servomotor Type	Receptacle Type	L-type Plug	Cable Clamp
SR 02 BE 13 S	USASEM-02 A 3	—	—	—
SR 03 BE 13 S	USASEM-03 A 3	MS 3102 A 18 - 10 P	MS 3108 B 18 - 10 S	MS 3057 - 10 A
SR 05 BE 13 S	USASEM-05 A 3			
SR 10 BE 13 S	USASEM-08 A 3	MS 3102 A 20 - 4 P	MS 3108 B 20 - 4 S	MS 3057 - 12 A
SR 15 BE 13 S	USASEM-15 A 3			
SR 30 BE 13 S	USASEM-30 A 3			

• D SERIES

Servopack Type CACR-	AC Servomotor Type	Receptacle Type	L-type Plug	Straight Plug	Cable Clamp
SR 05 BE 13 D	USADED-05 E 3	MS 3102 A 20 - 15 P	MS 3108 B 20 - 15 S	MS 3106 B 20 - 15 S	MS 3057 - 12 A
SR 15 BE 13 D	USADED-10 E 3				
SR 20 BE 13 D	USADED-15 E 3	MS 3102 A 24 - 10 P	MS 3108 B 24 - 10 S	MS 3106 B 24 - 10 S	MS 3057 - 16 A
SR 30 BE 13 D	USADED-22 E 3				
SR 44 BE 13 D	USADED-37 E 3				

Holding Brakes for Connection

Detector				Holding Brake			
Receptacle Type	L-type Plug	Straight Plug	Cable Clamp	Receptacle Type	L-type Plug	Straight Plug	Cable Clamp
MS 3102 A 20 - 29 P	MS 3108 B 20 - 29 S	MS 3106 B 20 - 29 S	MS 3057 - 12 A	MS 3102 A 20 - 15 P	MS 3108 B 20 - 15 S	MS 3106 B 20 - 15 S	MS 3057 - 12 A
				MS 3102 A 24 - 10 P	MS 3108 B 24 - 10 S	MS 3106 B 24 - 10 S	MS 3057 - 16 A
				—	—	—	—

Detector				Holding Brake			
Receptacle Type	L-type Plug	Straight Plug	Cable Clamp	Receptacle Type	L-type Plug	Straight Plug	Cable Clamp
MS 3102 A 20 - 29 P	MS 3108 B 20 - 29 S	MS 3106 B 20 - 29 S	MS 3057 - 12 A	MS 3102 A 14 S - 6 P	MS 3108 B 14 S - 6 S	MS 3106 B 14 S - 6 S	MS 3057 - 6 A
				MS 3102 A 20 - 15 P	MS 3108 B 20 - 15 S	MS 3106 B 20 - 15 S	MS 3057 - 12 A
				MS 3102 A 24 - 10 P	MS 3108 B 24 - 10 S	MS 3106 B 24 - 10 S	MS 3057 - 16 A

Detector				Holding Brake			
Receptacle Type	L-type Plug	Straight Plug	Cable Clamp	Receptacle Type	L-type Plug	Straight Plug	Cable Clamp
MS 3102 A 20 - 29 P	MS 3108 B 20 - 29 S	MS 3106 B 20 - 29 S	MS 3057 - 12 A	MS 3102 A 14 S - 6 P	MS 3108 B 14 S - 6 S	MS 3106 B 14 S - 6 S	MS 3057 - 6 A
				MS 3102 A 20 - 15 P	MS 3108 B 20 - 15 S	MS 3106 B 20 - 15 S	MS 3057 - 12 A
				MS 3102 A 24 - 10 P	MS 3108 B 24 - 10 S	MS 3106 B 24 - 10 S	MS 3057 - 16 A

Detector			Holding Brake		
Receptacle Type	L-type Plug	Cable Clamp	Receptacle Type	L-type Plug	Cable Clamp
—	—	—	—	—	—
MS 3102 A 20 - 29 P	MS 3108 B 20 - 29 S	MS 3057 - 12 A	MS 3102 A 18 - 12 P	MS 3108 B 18 - 12 S	MS 3057 - 10 A
			MS 3102 A 20 - 17 P	MS 3108 B 20 - 17 S	MS 3057 - 12 A

Detector			
Receptacle Type	L-type Plug	Straight Plug	Cable Clamp
MS 3102 A 20 - 29 P	MS 3108 B 20 - 29 S	MS 3106 B 20 - 29 S	MS 3057 - 12 A

Note: When plugs or clamps are required, contact Yaskawa representative. The following connections are provided: soldered type (type MS) and solderless type (type JA).

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.)

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 characterisitcs when the Servopack is running at the rated load and thermally saturated.

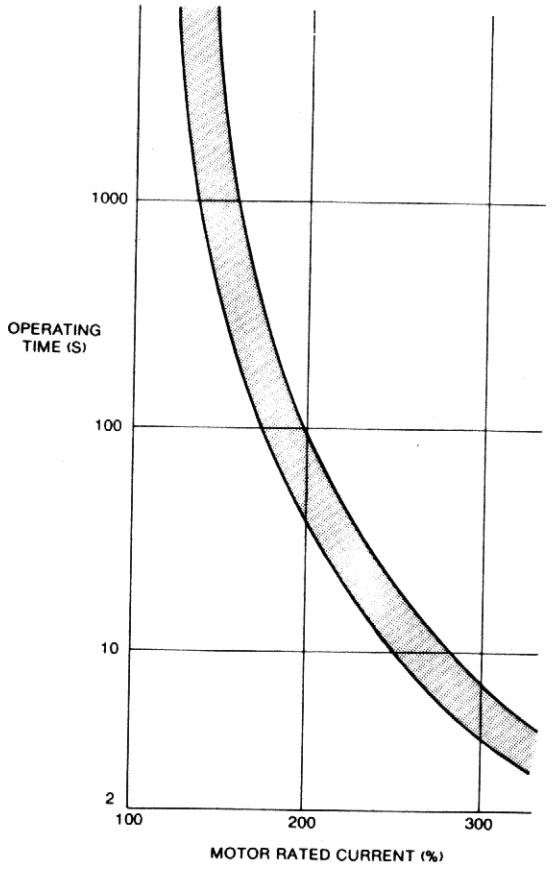


Fig. 4.1 Allowable Conduction Current of ***Servopack***.

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:

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

Stopping Time:

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

Where,

N_R: Rated motor speed (r/min)
$J_M \left(= GD_M^2/4 \right)$: Moment of rotor inertia (kg•m^2)
$J_L \left(= GD_L^2/4 \right)$: Moment of load inertia (kg•m^2)
K_t: Torque constant of motor (N•m/A)
I_R: Motor rated current (A)
$= I_P/I_R$: Acceleration/deceleration current constant
I_P: Acceleration/deceleration current
(Acceleration/deceleration current α times the motor rated current) (A)
$= I_L/I_R$: Load current constant
I_L: Current equivalent to load torque
(Load current β times the motor rated current) (A)

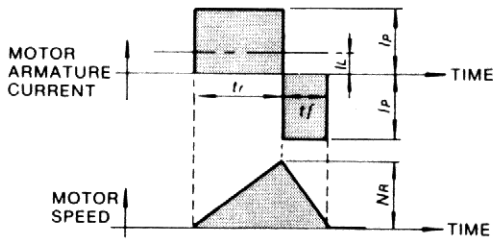


Fig. 4.2 Timing Chart of
Motor Armature Current and Speed

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 rated speed is reached, or if it exceeds $\frac{60}{m+1}$ cycles/min when $J_L = J_M \times m$, 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:

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

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

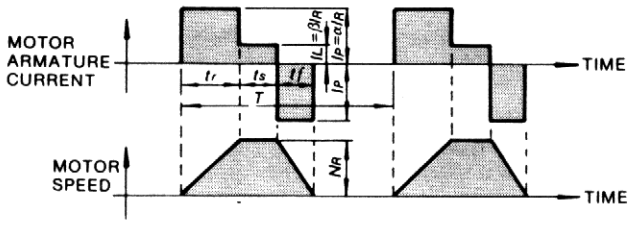


Fig. 4.3 Timing Chart of
Motor Armature Current and Speed

- **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:

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

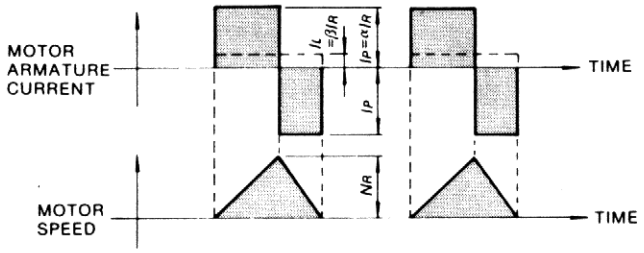


Fig. 4.4 Timing Chart of
Motor Armature Current and Speed

- **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.

$$n = 286.5 \times \frac{K_t \cdot I_R}{(J_M + J_L)} \times \left(\frac{1}{\alpha} - \frac{\beta^2}{\alpha} \right) \quad \text{(times/min)}$$

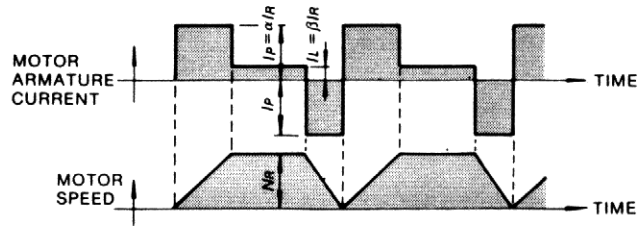


Fig. 4.5 Timing Chart of
Motor Armature Current and Speed

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:

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

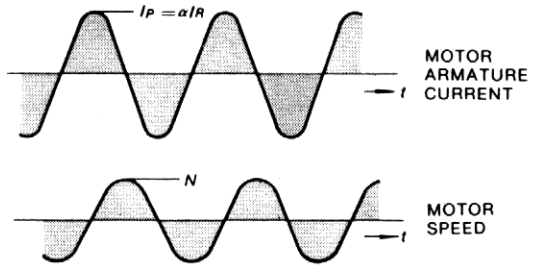


Fig. 4.6 Timing Chart of
Motor Armature Current and Speed

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.

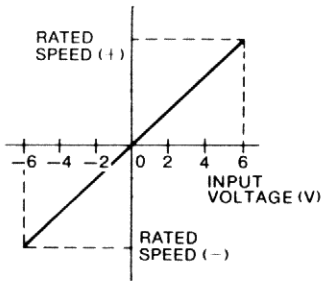


Fig. 4.7 Speed-Input Voltage Characteristics

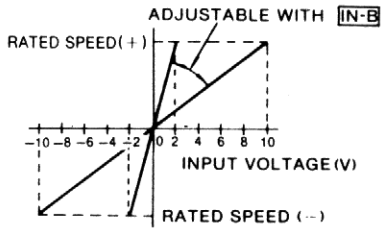


Fig. 4.8 Speed-Input Voltage Characteristics when Auxiliary Input Terminals 1CN- ⑭ and ⑮ are used.

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. (D series up to 350%)

4.6.2 Allowable Radial Load and Thrust Load

Table 4.1 shows allowable loads according to AC servomotor types.

Table 4.1 M Series Allowable Radial Load and Thrust Load

Motor Type USAMED-	Allowable Radial Load* N (lb)	Allowable Thrust Load N (lb)
03 B 21	490 (110)	98 (22)†
06 B 21	490 (110)	98 (22)†
09 B 22	686 (154)	343 (77)
12 B 22	1470 (330)	490 (110)
20 B 22	1470 (330)	490 (110)
30 B 22	1470 (330)	490 (110)
44 B 22	1764 (397)	588 (132)

Table 4.2 F Series Allowable Radial Load and Thrust Load

Motor Type USAFED-	Allowable Radial Load* N (lb)	Allowable Thrust Load N (lb)
02 C 21	147 (33)	49 (11)†
03 C 21	147 (33)	49 (11)†
05 C 21	490 (110)	98 (22)†
09 C 21	490 (110)	98 (22)†
13 C 22	686 (154)	343 (77)
20 C 22	1470 (331)	490 (110)
30 C 22	1470 (331)	490 (110)
44 C 22	1470 (331)	490 (110)

Table 4.3 G Series Allowable Radial Load and Thrust Load

Motor Type USAGED	Allowable Radial Load* N (lb)	Allowable Thrust Load N (lb)
02 A 21	147 (33)	49 (11)
03 A 21	147 (33)	49 (11)
05 A 21	490 (110)	98 (22)
09 A 21	490 (110)	98 (22)
13 A 22	686 (154)	343 (77)
20 A 22	1470 (331)	490 (110)
30 A 22	1470 (331)	490 (110)
44 A 22	1470 (331)	490 (110)

Table 4.4 S Series Allowable Radial Load and Thrust Load

Motor Type USASEM-	Allowable Radial Load* N (lb)	Allowable Thrust Load N (lb)
02 A 32	78.4 (18)	39.2 (9)
03 A 32	245 (55)	98 (22)
05 A 32	245 (55)	98 (22)
08 A 31	392 (88)	147 (33)
15 A 31	490 (110)	147 (33)
30 A 31	686 (154)	196 (44)

Table 4.5 D Series Allowable Radial Load and Thrust Load

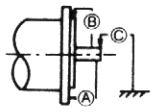
Motor Type USADED-	Allowable Radial Load N (lb)	Allowable Thrust Load N (lb)
05 E 32	686 (154)	343 (77)
10 E 32	686 (154)	343 (77)
15 E 32	1176 (265)	490 (110)
22 E 32	1176 (265)	490 (110)
37 E 32	1176 (265)	490 (110)

* Maximum values of the load applying to the shaft extension.

† Do not apply the exceeding load because motor cannot be rotated.

4.6.3 Mechanical Specifications

Table 4.6 Mechanical Specifications in mm

Accuracy (T.I.R.)†		Reference Diagram
Flange surface perpendicular to shaft Ⓐ	0.04 (0.06)‡	
Flange diameter concentric to shaft Ⓑ	0.04	
Shaft run out Ⓒ	0.02 (0.04)*	

† T.I.R. (Total Indicator Reading)
‡ Accuracy for motor types USADED-15E3, -22E3, and -37E3.
* Accuracy for motor type USAMED-44B22.

4.6.4 Direction of Rotation

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

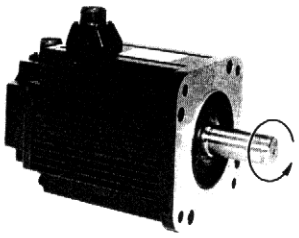
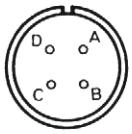


Fig. 4.9 AC Servomotor

(1) Connector Specifications for Standard Servomotors

(a) Motor receptacle

• M,F,G Series

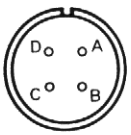


A	Phase U
B	Phase V
C	Phase W
D	Frame ground

• S Series
(Type USASEM-02A)

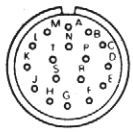
Color of Lead	Applicable
Red	Phase U
White	Phase V
Blue	Phase W
Green	Frame ground

(Types USASEM-03A to 30A)



A	Phase U
B	Phase V
C	Phase W
D	Frame ground

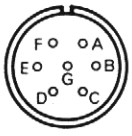
(b) Detector receptacle



A	Channel A output	K	—
B	Channel $\overline{A}$ output	L	—
C	Channel B output	M	—
D	Channel $\overline{B}$ output	N	—
E	Channel C output	P	—
F	Channel $\overline{C}$ output	R	—
G	0 V	S	—
H	+ 5 VDC	T	—
J	Frame ground	—	—

(2) Connector Specifications for Servomotor with Brake

• M, F, G, D Series (Brake is provided to all types of D series as standard.)



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

Types without brake of D series do not use E and F.

• S Series

(Type USASEM-02A)

Color of Lead	Applicable
Red	Phase U
White	Phase V
Blue	Phase W
Black	Brake
Black	
Green	Frame Ground

(Types USASEM-03A, -05A)

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

(Types USASEM-08A to 30A)

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

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.

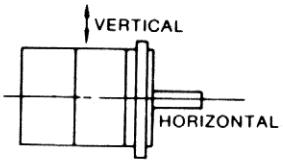


Fig. 4.10 Impact Resistance

4.6.6 Vibration Resistance

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

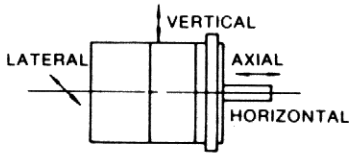


Fig. 4.11 Vibration Resistance

4.6.7 Vibration Class

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

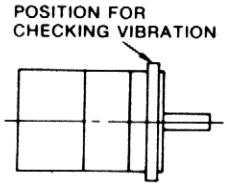


Fig. 4.12 Vibration Checking

5. CONFIGURATION

5.1 CONNECTION DIAGRAM

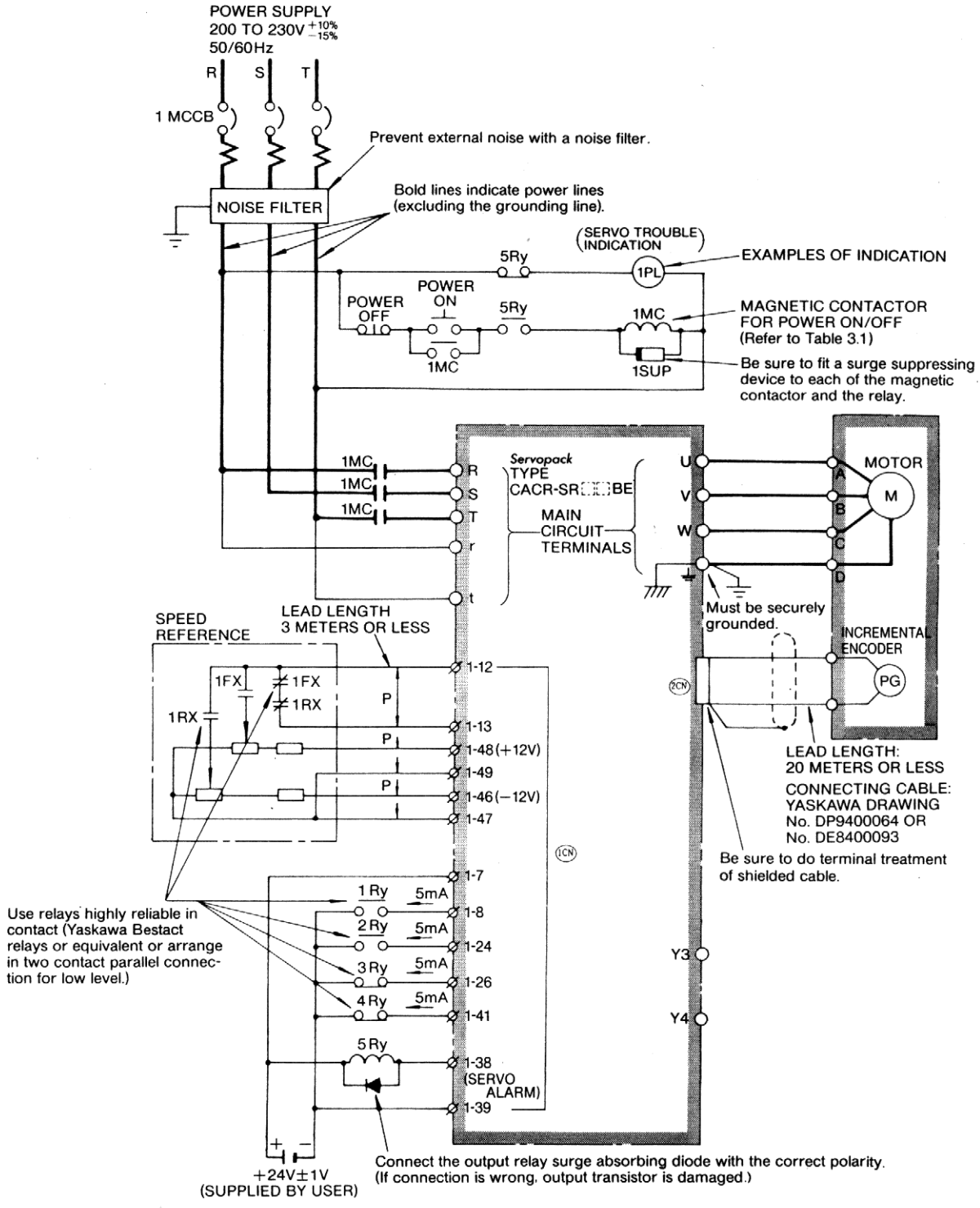


Fig. 5.1 Example of Connection Diagram of **Servopack** with a Servomotor and Peripherals

5.2 MAIN CIRCUIT TERMINALS

Table 5.1 shows the specifications of main circuit terminals for Servopack.

Table 5.1 Main Circuit Terminals for ***Servopack***

Terminal Symbol	Name	Description
Ⓡ Ⓢ Ⓣ	Main-circuit AC input	Three-phase 200 to 230 VAC $^{+10}_{-15}$%, 50/60 Hz.
Ⓤ Ⓥ Ⓦ	Motor connection	Connects terminal Ⓤ to motor terminal A, Ⓥ to B and Ⓦ to C.
ⓡ ⓣ	Control power input	Single-phase 200 to 230 VAC $^{+10}_{-15}$%, 50/60 Hz
⏚	Frame ground	Connects to motor terminal D. Must be securely grounded.
Ⓨ3 Ⓨ4	Regenerative resistor	External connection not usually required.

5.3 APPLICABLE RECEPTACLES

5.3.1 Specifications of Connector Terminal (1CN) for Input/Output Signal

Table 5.2 Specifications of Applicable Receptacles for ***Servopack*** Input/Output 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 input/output signals used are type MR-50RMA made by Honda Tsushin Co.
† Attached to Servopack when shipping.

5.3.2 Specifications of Connector Terminal (2CN) for Encoder

Table 5.3 Specifications of Applicable Receptacles for ***Servopack*** Encoder

Connector Type* used in Servopack	Applicable Receptacle Type				Specifications of Connecting Cable
	Manufacturer	Soldered Type	Caulking Type	Case	
MR-20RMA (Right angle 20 P)	Honda Tsushin Co., Ltd.	MR-20F†	MRP-20F01	MR-20L†	Yaskawa Drawing No. DP8409123 or No. DE8400093

* The connectors for encoder used are made by Honda Tsushin Co.
† Attached to Servopack when shipping.

5.4 CONNECTOR TERMINAL (1CN) FOR I/O SIGNAL

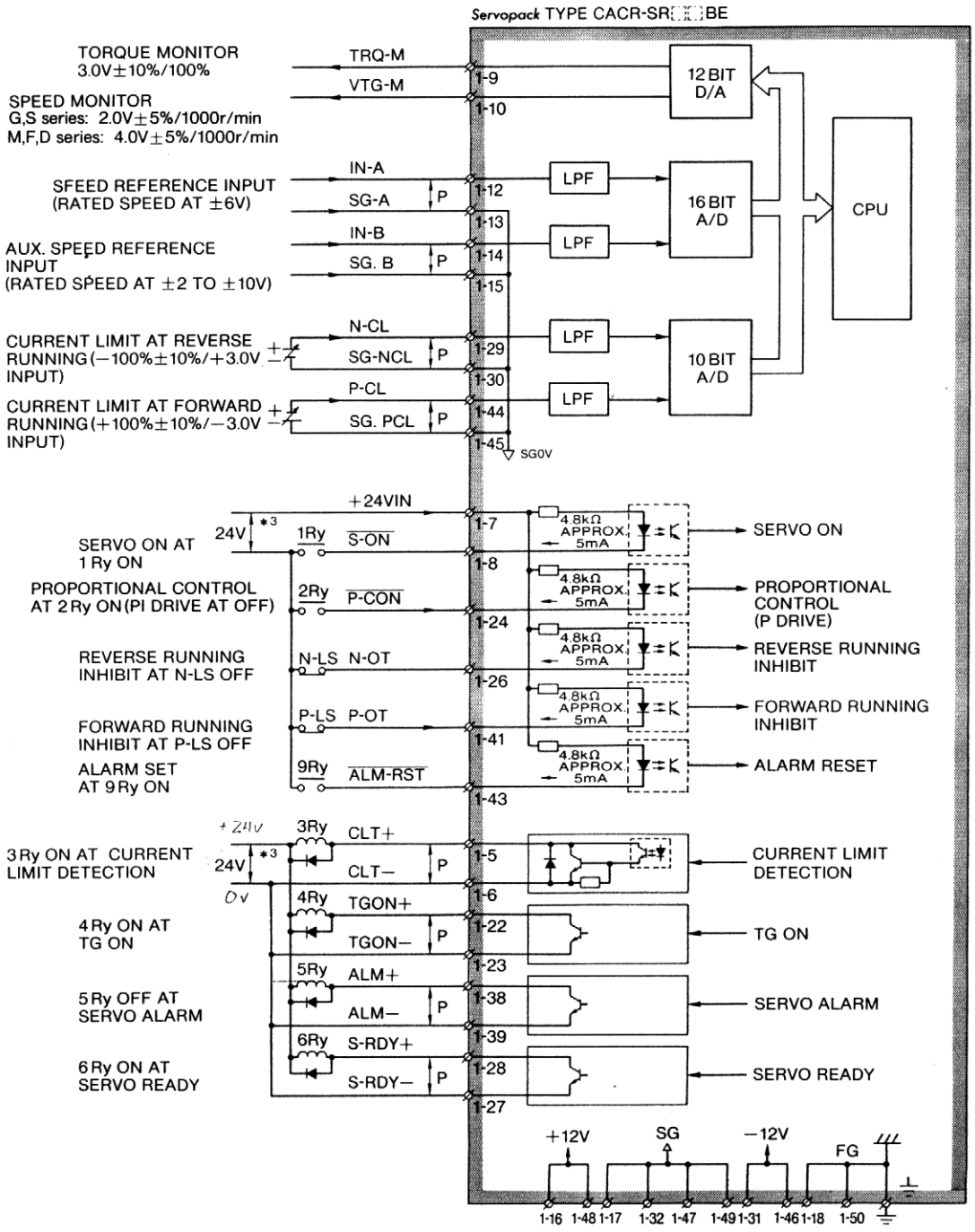
5.4.1 Connector 1CN Layout and Connection of *Servopack*

The terminal layout of the Servopack input/output signal connectors (1CN) is shown in **Table 5.4.** The external connection and external signal processing are shown in **Fig. 5.2** on page 30.

Table 5.4 Connector 1CN Layout of ***Servopack***

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0 V	0 V	0 V	PHA	CLT +	CLT −	+24V IN	$\overline{\text{S-ON}}$	TRQ -M	VTG -M	SG	IN-A	SG-A	IN-B	SG-B	+12V	SG	FG
0 V for PG Output Signal			Open Collector Output Aϕ	Current Limit Detection Output		Ext Power Input	Servo ON Power	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	PHC	TGON +	TGON −	$\overline{\text{P-CON}}$	ALO1	N-OT	S-RDY −	S-RDY +	N-CL	SG-NCL	−12V	SG		
		Line Driver Output Cϕ		Open Collector Output Cϕ	TG ON Signal Output		P Drive Input	Open Collector Output	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	PHB	ALM +	ALM −	ALO2	P-OT	ALO3	$\overline{\text{ALM-RST}}$	P-CL	SG-PCL	−12V	SG	+12V	SG	FG
Line Driver Output Aϕ		Line Driver Output Bϕ		Open Collector Output Bϕ	Servo Alarm Output		Open Collector Output	Fwd. Inhb. Input	Open Collector Output	Alarm Reset Input	Fwd. Current Limit Input		−12V Output		+12V Output		Frame Ground

Note: For input signal and method of application, refer to Table 5.5 and 5.6.



p : Twisted cable.

Notes:
1. Each capacity of output circuits is 30VDC, 50mA or less.
2. The user must provide the 24V power supply and battery.

Fig. 5.2 Input/output of Signals and Connector 1CN

5.4.2 Input Signal and Method of Application

Table 5.5 Input Signals of Connector 1CN

Signal Name	Connector 1CN No.	Function	Description
$\overline{\text{S-ON}}$	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 (Three functions are selectable with parameter setting.)	Proportional drive reference	•Proportional control command applies friction torque to the motor to prevent drifting when the motor is left motionless without command input, while the main circuit is kept energized.
		Zero clamp operation reference	•Inputting this signal makes the motor keep speed zero (stop) state and prevent drifting.
		Changeover command for torque control/ speed control	•In torque control II mode, inputting this signal makes the Servopack change torque control to speed control.
N-OT	1CN-26	Reverse running prohibit	•In the case of linear drive, etc., connect limit switch signal according to the run direction. Since it is a bar signal (reverse signal), it is "closed" during normal run. When limit switch is tripped, it becomes "open". •Inputting this signal makes the Servopack cancel the functions and become "normally $\overline{\text{N-OT}}$" or "normally $\overline{\text{P-OT}}$".
P-OT	1CN-41	Forward running prohibit	
+24 VIN	1CN-7	24 V	•External power supply to 1CN-8, 24, 26, 41 and 43 Prepare a 24 VDC (25 mA 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 ±2.0V to ±10.0V, ±rated speed is obtained.
		• When either of IN-A or IN-B is used, be sure to set the unused input "Zero specification".	
N-CL	1CN-29 (30)	Current limit reference at reverse running	+3.0 V ±10%/100% torque +9V max.
P-CL	1CN-44 (45)	Current limit reference at forward running	−3.0 V ±10%/100% torque −9V max.
$\overline{\text{ALM-RST}}$	43	Alarm reset	Resets Servo alarm state.

* Torque command input: ±3V/rated torque.

5.4.3 Input Circuit

There are five types of protective functions to prevent continued rotation of the motor in forward and reverse direction: Servo ON inputs, proportional drive circuits, overtravel protection circuits, and alarm reset inputs. Construct the input circuit using 24V power supply (Fig.5.3). Typical circuits are shown in Fig. 5.2.

NOTE

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

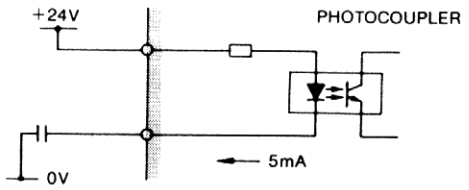


Fig. 5.3 Configuration of Input/Output Circuit

(1) P-CON

This input signal is used with three types as follows:

(a) Proportional Drive

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 drive to P drive after the positioning and the loop gain in the control system drops and the drift decreases. With several percent of friction load, the motor stops completely.

(b) Zero-clamp Operation

It keeps the speed of the motor at zero for a long time in servo lock condition when the motor stops. This operation is efficient for such as vertical loads. Continuous duty torque in servo lock condition must be 70% or below.

(c) Torque/Speed Control Changeover

In torque control mode Ⅱ, the P-CON signal input determines whether the torque or speed control system takes effect.

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

These circuits are used to stop the forward running of the motor (counterclockwise when viewed from the drive end of the motor) and reverse running.

When the overtravel prevention circuit is not used, this function can be canceled with connecting. Four operations are selectable with parameter setting when the overtravel prevention circuit is used. 1CN- ㉖ and ㊶ to the 0 V terminal of the external 24 V power supply or parameter setting.

(a) Coasting to a stop

In the overtravel state, the motor runs freely.

(b) DB Stop

In the overtravel state, the motor can be stopped by the dynamic brake. A parameter is used to determine whether the stopped motor is to be continuously locked by the dynamic brake or freed.

(c) Stop at Torque Setting Defined by User Constant

In the overtravel state, the internal circuitry forcibly issues a speed reference of 0, without respect to the presence of another speed reference, so as to stop the motor immediately. After the motor is brought to a stop, it becomes free.

(d) Stop at Torque Setting Defined by User Constant, Which Is Followed by a Zero Clamp Opertion

After the motor stops as indicated in paragraph (C) above, it enters the zero clamp mode.

(3) Servo ON [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. Servo ON signal can be omit with parameter setting.

NOTE

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

(4) Alarm reset (ALM-RST)

This signal is used as a servo alarm external reset signal. Resume operations after eliminating the cause of alarm signal generation. In the interests of safety, set the speed reference to 0 V before activating the reset signal.

5.4.4 Use of Output Signals

Table 5.6 Output Signal

Signal Name	Connector 1CN No.	Function	Description
ALM	38 (39)	Servo alarm	· Turns OFF when fault is detected. · For details, refer to Table 6.1 Fault Detection Function.
$\overline{\text{TGON}}$	22 (23)	Rotation detection	· Turns ON when motor speed exceeds speed set with parameter.
		Brake interlock output	· Outputs timing signal of external brake signal.
$\overline{\text{CLT}}$	5 (6)	Current limit detection	· N-CL or P-CL used : Turns ON when output torque reaches the lower level set by N-CL, P-CL or [TLMTF] [TLMTR]. · N-CL or P-CL not used : Turns ON when output torque reaches the level set by [TLMTF] [TLMTR].
$\overline{\text{S-RDY}}$	28 (27)	Servo ready	· Turns ON when main power supply ON and servo alarm OFF.
+ 12 V 0 V − 12 V	16, 48 17, 32, 47, 49 31, 46	± 12 V Output Power supply	· ±12V ±5% max output current : 30 mA · Used with speed command or current input.
TRQ-M	9	Torque monitor	· (Rated torque at ±3.0 V) ±10%, ±9V max, load 1 mA max
VTG-M	10	Speed monitor	· ±2.0V/1000r/min ±5% (G, S series) · ±4.0V/1000r/min ±5% (M, F, D series) · Load : 1 mA max
PAO	33	PG Signal Output-1 Phase A	· Pulse after frequency division is output line driver (MC 3487*). · To be received by line receiver (MC 3486*).
*PAO	34	PG Signal Output-1 Phase $\overline{\text{A}}$	
PBO	35	PG Signal Output-1 Phase B	
*PBO	36	PG Signal Output-1 Phase $\overline{\text{B}}$	
PCO	19	PG Signal Output-1 Phase C	
*PCO	20	PG Signal Output-1 Phase $\overline{\text{C}}$	
PHA	4 (1)	PG Signal Output-2 Phase A	· Open collector output Pulse after frequency division. · Max operating voltage : 30 VDC · Max output current : 20 mA DC
PHB	37 (2)	PG Signal Output-2 Phase B	
PHC	21 (3)	PG Signal Output-2 Phase C	
ALO1	25 (1)	Alarm Output Code (BCD code)	· Open collector output · Max Operating voltage : 30V DC · Max output current : 20 mA DC
ALO2	40 (2)		
ALO3	42 (3)		

* Made by Texas Instrument Inc.

5.4.5 Output Circuit

There are four non-contact output signals, employing transistors: Current limit detection, TG ON, Servo alarm, Servo ready, and three alarm codes with open collector output.

Voltage and current specifications are:

Applied Voltage (V max) ≦ 30V
Conduction Current (Ip) ≦ 100 mA

NOTE

The output circuit requires a separate power supply of 20mA or below for open collector output. It is recommended to use the same 24V power suppy used for the input circuit (Fig. 5.4).

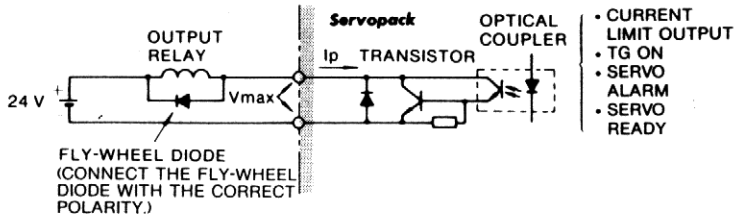


Fig. 5.4 Output Circuit

(1) Optical encoder (PG) output circuit
[PAO, *PAO, PBO, *PBO, PCO, *PCO]

Phases A, B, and C (original point) signals for the optical encoder, PG are output.

Use these signals as positioning signals. The output signal specifications are as follows:

(a) Signal form

- Two-phase pulse with 90° pulse difference (phases A and B)
- Original point pulse (phase C)

(b) Output circuit and receiver circuit

Two types of output circuits are provided: line driver output and open collector output. Fig. 5.5 shows an example of line driver output.

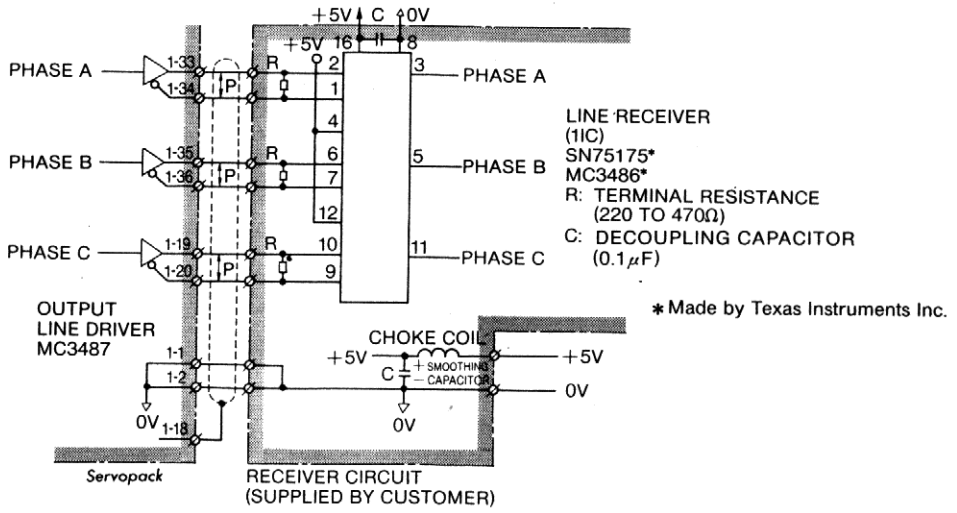


Fig. 5.5 Output Circuit and Receiver Circuit

(c) Output phase (frequency dividing ratio: 1/1)

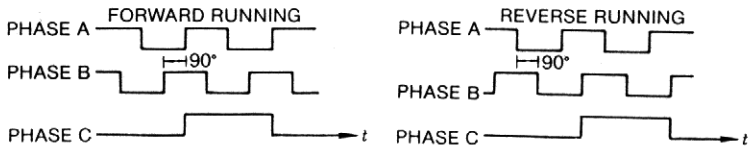


Fig. 5.6 Output Phase

For details of frequency division, refer to sect. 7, "USER CONSTANT" (8).

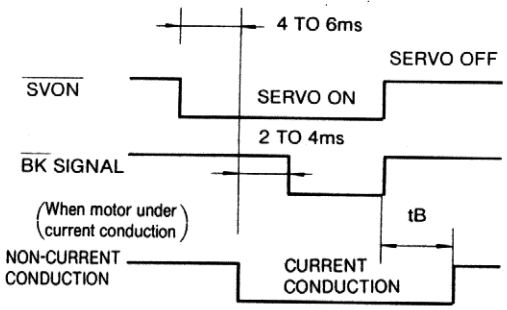
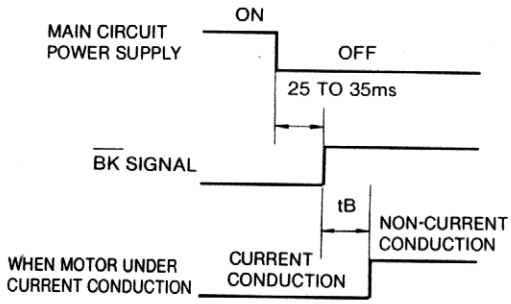
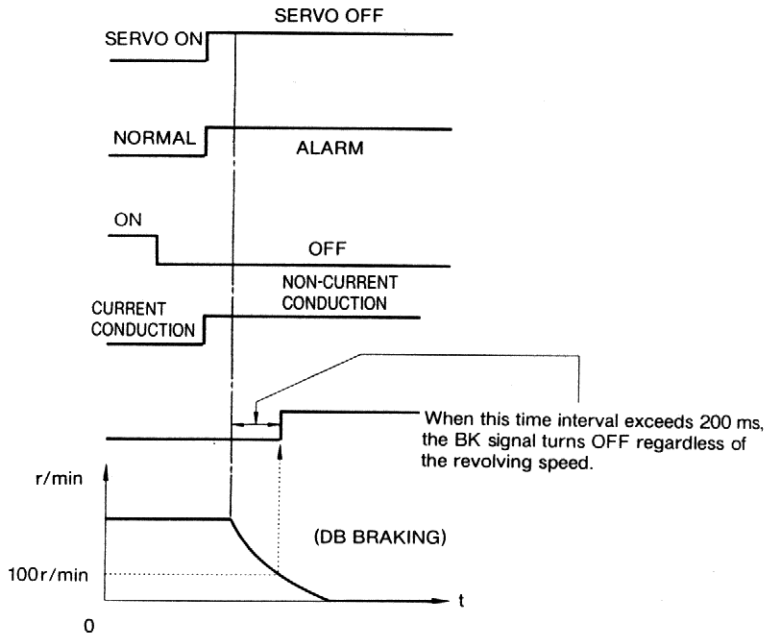
(2) Holding Brake Interlock Signal

The brake signal output, which is dependent on the motor circuit conduction state and motor revolving speed, can be generated.

<Setup Procedure>

When the user constant (memory switch) is set to provide the braking function, the brake signal output is generated from the CN23 (TG ON). The time interval tB [× 10 ms] between braking and motor conduction termination is determined by the BRKTIM. user constant.

Table 5.7 Timing with Servo ON signal and Main Circuit Power Supply

	Timing with Servo ON Signal	Timing with Main Circuit Power Supply
When Motor Stops		
	tB : Braking time (setting 10 to 500 ms at BRKTIM	
When Motor Rotates	Timing when Serco OFF, Main Circuit Power Supply OFF or Alarm •When Servo OFF •When Alarm •When Main Circuit Power Supply OFF •When Motor Under Current Conduction BK SIGNAL MOTOR SPEED	

5.5 CONNECTOR TERMINAL (2CN) FOR OPTICAL ENCODER CONNECTION

5.5.1 Connector Layout

Table 5.8 Connector 2CN Layout of Servopack

1	2	3	4	5	6	7
O_5P	O_5P	O_5P	+5P	+5P	+5P	DIR

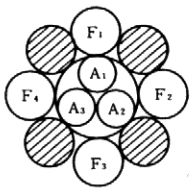
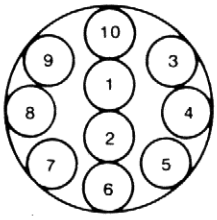
8	9	10	11	12	13

14	15	16	17	18	19	20
PC	*PC	PA	*PA	PB	*PB	FG

5.5.2 Applicable Cables

The cables listed in Table 5.9 are available on request. If required, purchase in units of standard length as shown in Table 5.7.

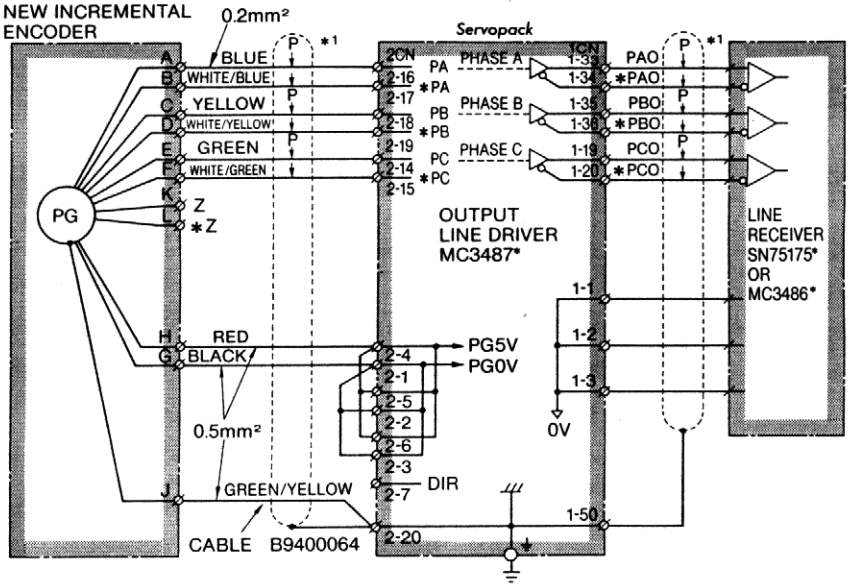
Table 5.9 Details of Specifications of Applicable Cables

Connection	Soldered Type	Caulking Type
Yaskawa Drawing No.	B9400064	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
Finishing Dimensions	φ7.5mm	φ10.0mm
(Recommended Receptacle Type)	For Soldered Type 	For Caulking Type 
Internal Composition and Lead Color	A1 Red A2 Black A3 Green yellow F1 Blue-White/blue F2 Yellow-White/yellow F3 Light green-White/light green F4 orange-White/orange 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
(Sandard Application: B9400064)		
Yaskawa Standard Specifications	Standard length: 5m, 10m, 20m Terminal ends are not provided (with connectors).	

NOTE

1. When applicable cables listed in Table 5.9 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 20m or more, contact your Yaskawa representative.

5.5.3 Method of Connection

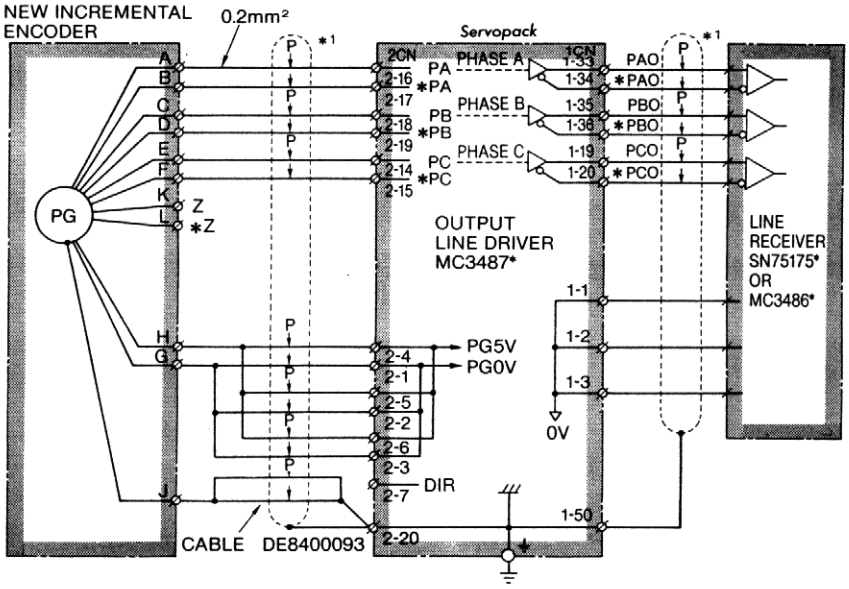


*1 (P) :Twisted shield cable

*Made by Texas Instruments Inc.

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. 5.7 Soldered Type Connector 2CN Connection and 1CN Output Processing (When using Connection Cable B9400064)



*1 (P) :Twisted shield cable

*Made by Texas Instruments Inc.

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. 5.8 Caulking Type Connector 2CN Connection and 1CN Output Processing (when using Connection Cable DE8400093)

5.6 INTERNAL CONNECTION DIAGRAM

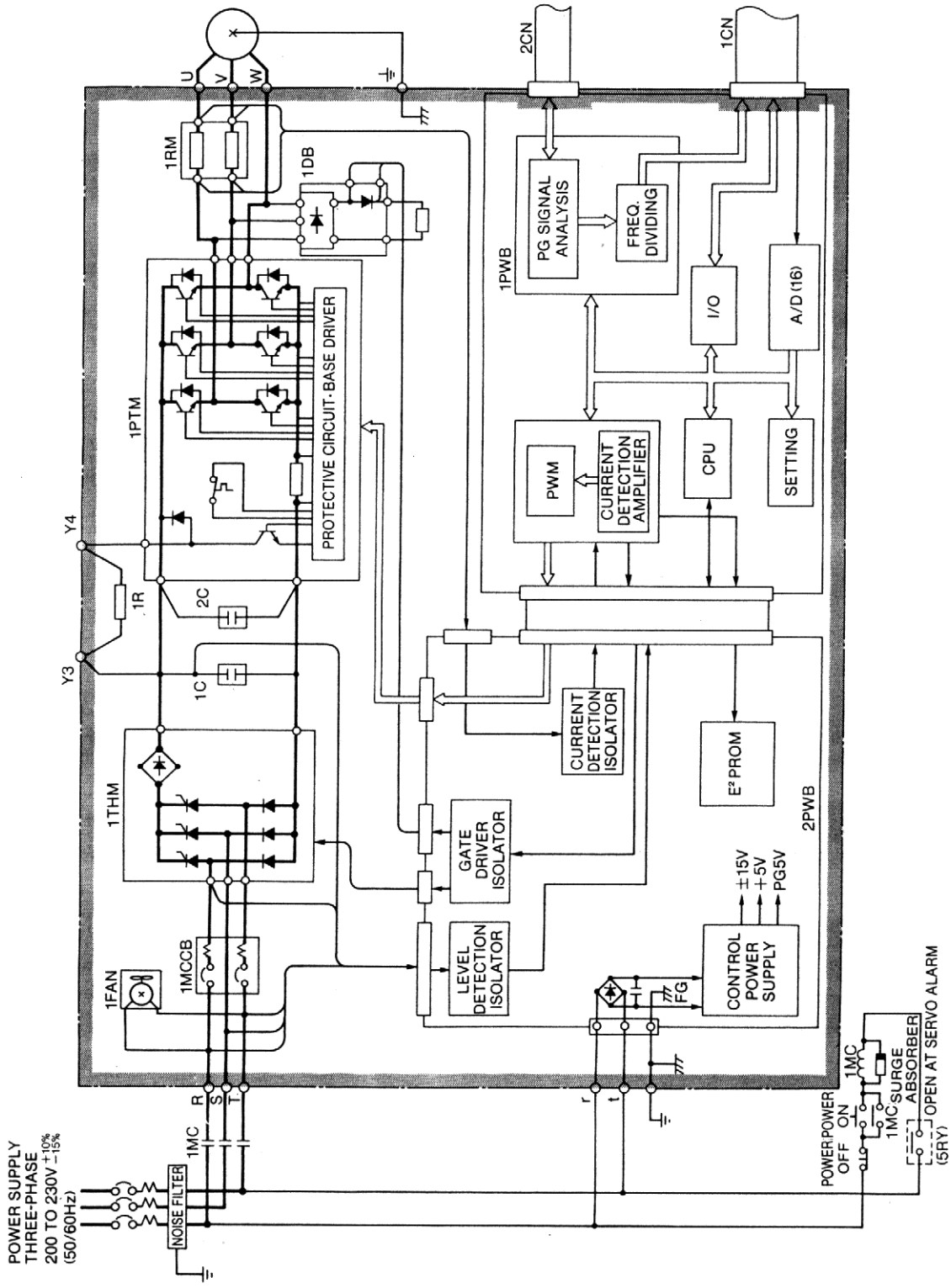


Fig. 5.9 Internal Block Diagram of ***Servopack***

6. OPERATION

6.1 POWER ON AND OFF

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

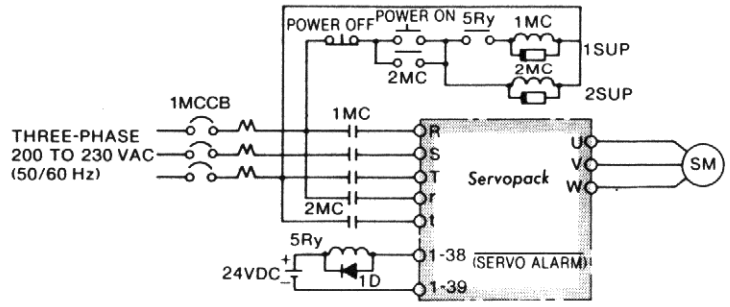
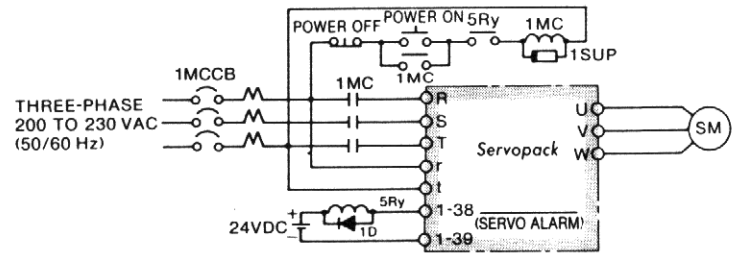


Fig. 6.1 Connection Example for Simultaneous Control Power ON/OFF



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

Arrange the sequence so that the power is simultaneouly 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. (The alarm information is written on E^2 PROM, so when the power is simultaneously cut, the alarm subject can be checked with the power resupplied.)

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

- 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.

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

- Since Servopack is of a capacitor input type, large recharging current flows when the main-circuit power is turned on (recharging time: 0.5s to 1s). 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 transient troubles.

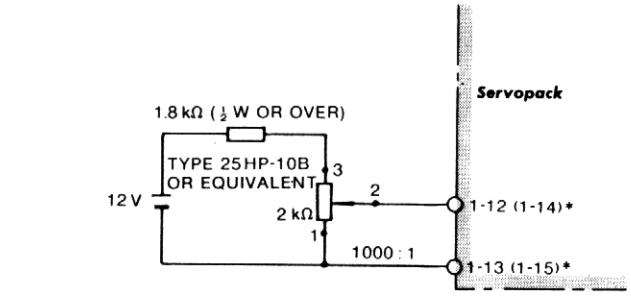
6.2 SPEED REFERENCE

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.

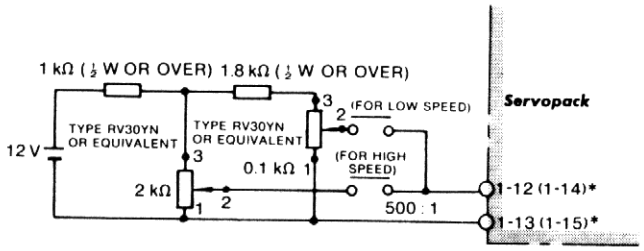
The method for giving speed reference voltage is described below.

(1) For accurate (inching) speed setting



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

(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 (SRF-B, SRG-B) made by Nippon Electric or equivalent, or low-level relay (G_2A-432) made by Omron Corporation or equivalent.

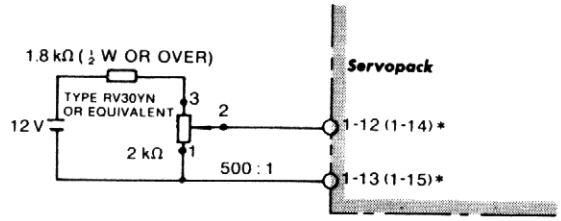
Note: When a carbon resistor is used, a great residual resistance remains, and so the speed control range becomes approximately 500:1.

(b) When Carbon Variable Resistor is used

* Parenthses are for auxiliary input.

Fig. 6.3 Method for Giving Speed Reference Voltage [for Accurate (inching) Speed Setting]

(2) For relatively rough speed setting



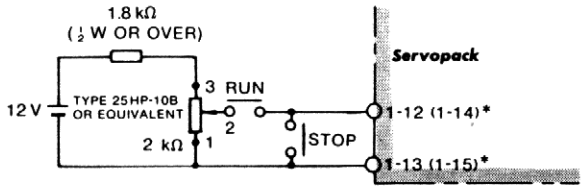
* Parentheses are for auxiliary input.

Note: When a carbon rsistor is used, a great residual resistance remains, and so the speed control range becomes about 500:1.

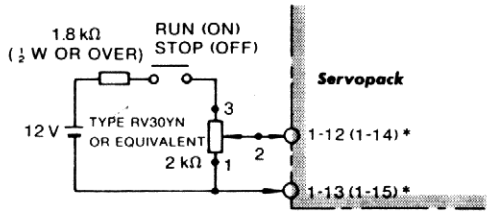
Fig. 6.4 Method for Giving Speed Reference Voltage
(for relatively Rough Speed Setting as Compared with Fig. 6.3)

6.2.2 Stop Reference Circuit

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



(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 terminal 1CN- ⑭ , ⑮ must be short-circuited or select "Zero-speed Reference" with parameter setting.

6.2.4 Auxiliary Input Circuit (±2 to ±10V)

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

- Adjustment procedures
  For parameter setting of auxiliary input reference, input motor rotation per 1V (r/min/V) to user constant [INBGN] .

  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 [INBGN] .

6.2.5 Zero Clamp Speed Control

The zero clamp speed control mode can be selected by properly setting user constant Cn-01 (bits A and B). In this mode, when the motor rotating speed goes below the user constant Cn-0F (ZCLVL) setting, the speed reference is cut off to clamp the motor revolving speed to zero.

- The zero clamp operation starts when the P-CON signal is turned ON.
- In the zero clamp speed control mode, P/PI control changeover cannot be effected as in regular speed control because the P-CON signal serves as the zero clamp function ON/OFF signal.

6.2.6 Soft Start Function

The motor accel/decel time can be set up.

<Setup Procedure>

Enter as the SFSACC user constant the time (ms) required for the motor to reach the maximum rotating speed.

6.2.7 Jogging Function

Even if no speed reference is entered during a test run, the motor can be operated by a circuit board mounted switch. The jogging speed (r/min) can be varied by adjusting the JOGSPD user constant.

6.3 TORQUE CONTROL

In the torque control mode, the speed loop is disconnected so that the motor is driven according to the torque reference. This mode provides two submodes: torque control I and torque control II. Submode changeover can be effected by changing user constant Cn-01 (bits A and B).

6.3.1 Torque Control I

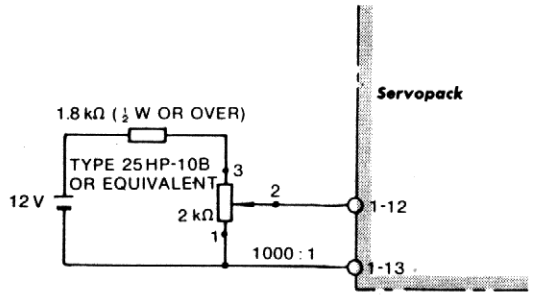
The torque reference voltage is applied between input terminals 1CN 12 and 13 from the Servopack incorporated control power supply (1CN-16, 48: +12 V; 1CN-17, 32, 47, 49: 0 V; 1CN-31, 46: -12 V) or external power supply.

The I/O relationship is fixed at 3 V/rated torque (see note below).

Note: If a rating other than 3 V is desired, contact your YASKAWA representative.

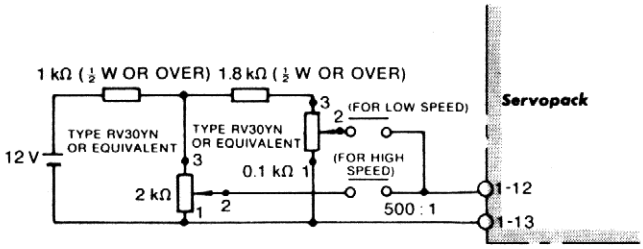
The method for giving torque reference voltage is described below.

(1) For accurate (inching) torque setting



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

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



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

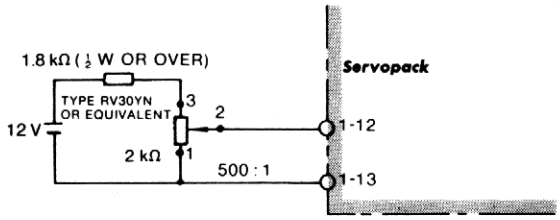
Low- and high-speed relays: Reed relay (SRF-B. SRG-B) made by Nippon Electric or equivalent, or low-level relay (G_2A-432) made by Omron Corporation or equivalent.

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

(b) When Carbon Variable Resistor is used

Fig. 6.6 Method for Giving Torque Reference Voltage (for Accurate Torque Setting)

(2) For relatively rough torque setting



Note: When a carbon resistor is used, a great residual resistance remains, and so the torque control range becomes about 500:1.

Fig. 6.7 Method for Giving Torque Reference Voltage (for relatively Rough Torque Setting as Compared with Fig. 6.6)

6.3.2 Torque Control II (Speed-Limited Torque Control + Speed Control)

- In the torque control II mode, torque control is exercised with the motor speed limited. Further, mode switching from torque control to speed control can be effected by turning ON the P-CON signal.
- In the torque control II mode, P/PI control changeover cannot be effected as in regular speed control because the P-CON signal serves as the torque/speed control mode changeover signal.
- The torque reference voltage is applied between input terminals 1CN 14 and 15 from the Servopack incorporated control power supply (1CN-16, 48: +12 V; 1CN-17, 32, 47, 49: 0 V; 1CN-31, 46: -12 V) or external power supply. The speed limit voltage (a positive voltage sets both speed limits) is applied between input terminals 1CN 12 and 13. The I/O relationship is fixed at 3 V/rated torque (see note below).

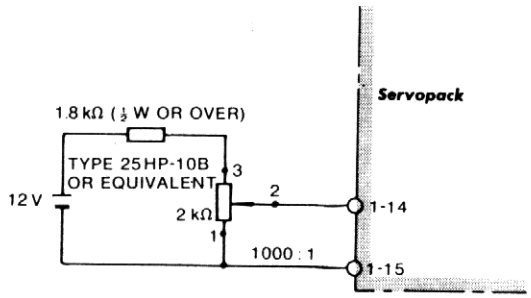
Note: If a rating other than 3 V is desired, contact your YASKAWA representative.

Torque reference voltage and speed limit voltage application procedure examples are given below.

- For accurate (inching) torque or speed limit setting

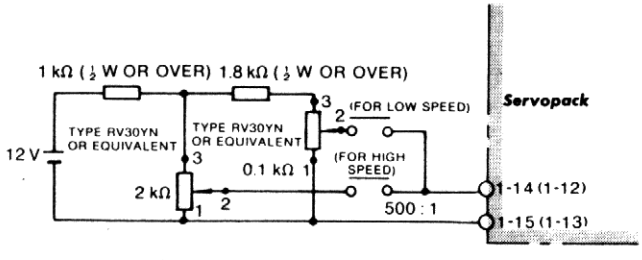
The Servopack input terminal numbers shown in Figs. 6.8 and 6.9 are for torque reference voltage input. Parenthesized terminal numbers are for speed limit voltage input.

(1) For accurate (inching) torque setting or speed limiting



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

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



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

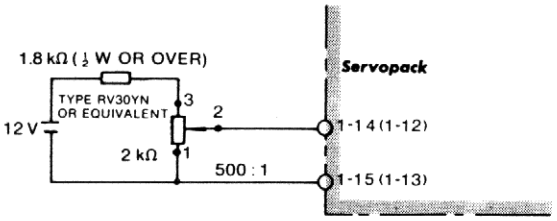
Low- and high-speed relays: Reed relay (SRF-B, SRG-B) made by Nippon Electric or equivalent, or low-level relay (G_2 A-432) made by Omron Corporation or equivalent.

Note: When a carbon rsistor is used, a great residual resistance remains, and so the torque control or speed limiting control range becomes approximately 500:1.

(b) When Carbon Variable Resistor is used

Fig. 6.8 Method for Giving Torque Reference or Speed Limiting Reference Voltage (for Accurate Speed Setting)

(2) For relatively rough torque setting or speed limiting setting



Note: When a carbon resistor is used, a great residual resistance remains, and so the torque control or speed limiting control range becomes about 500:1.

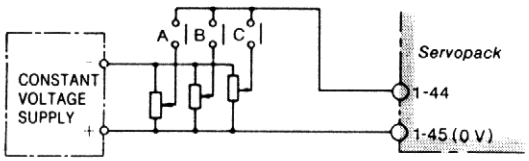
Fig. 6.9 Method for Giving Speed Reference Voltage (for relatively Rough as Compared with Fig. 6.8)

6.4 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. 6.10). The same effect can be obtained by giving voltage signals making analog change.



Relay: Low-level relay type G2A-432A made by Omron Corporation.

Fig. 6.10 Multi-stage Switching of Current Value at Forward Side

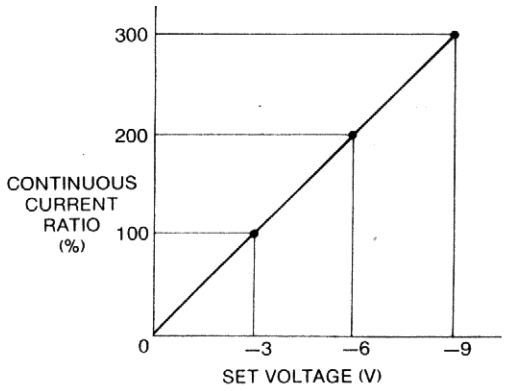
6.4.1 Method of Giving External Current Limit Reference

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 .

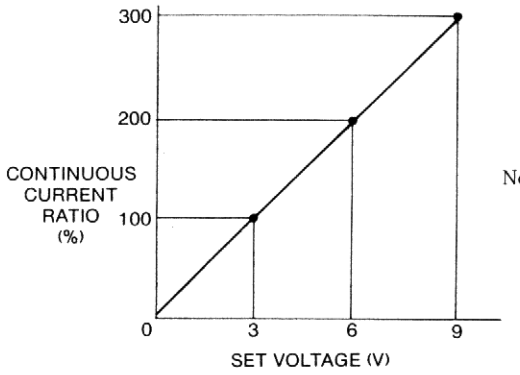
The relation between the rated current of the motor and current limit values is rated current at 3.0 V for applicable motor. The power supply must use an internal resistance less than 2kΩ. The input resistance at Servopack side must be greater than 5kΩ. When external current is not restricted, contacts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

6.4.2 Set Voltage and Current Limit Values

The relationship between set voltages of 0 to ±9.0 V and current limit values ar e shown in Fig. 6.11. Setting precision is I 10%.



(a) Current Limit at Forward Side



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

(b) Current Limit at Reverse Side

Fig. 6.11 Set Voltage and Current Limit Values

6.4.3 Current Limit when Motor is Locked

When locking a motor by applying a current limit, determine a current limit value less than 70% of 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 user constant [INBGN] [LOOPHZ]), the motor lock current sometimes pulsates. If this is not desirable, the current pulsation can be removed by increasing the speed reference voltage.

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 tuned off.
- Over travel (P/N-OT)

Normally, this dynamic brake is not applied while the motor stops, but can be made operational by parameter setting.

(2) Trouble detecting functions

Table 6.1 Trouble Detecting Functions

Indication	Trouble	Detection
A.1	[OC] Overcurrent	• Overcurrent flow in the main circuit. • Overheat heat sink of Servopack.
A.2	[MCCB] Circuit Protector Trip	Circuit protecter tripped.
A.3	[RG] Regeneration Trouble	Regenerative circuit not activated in Servopack.
A.4	[OV] Overvoltage	Excessively high DC voltage in the main circuit (approx 420V.)
A.5□*	[OS] Overspeed	• Excessively large speed reference input. • Over maximum speed reference voltage applied.
A.6	[UV] Voltage Drop	Low DC voltage in the main circuit after power ON. (150V or less.)
A.7□*	[OL] Overload	Overload condition of motor and Servopack.
A.b□*	[A/D] A/D Error	Element error on the printed circuit board of Servopack.
A.F□*	Open Phase	Any one phase open in three-phase power supply.
A.C□*	[PG] Overrun Prevention	Wrong wiring of motor circuit or PG signal line.
— (1LED)	[CPU] CPU Error	Any error of CPU
A.0□*	Other Trouble Detection	• Parameter error • Main circuit detection section error.

* Indicates the cause of the alarm signal classifficationed numerically.

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

If any trouble detection circuits in **Table 6.1** functions, the power drive circuit in the Servopack goes off, 7-segment LEDs indicate the operation condition and a servo alarm signal is output.

(4) 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.** allows rapid reaction in the event of a malfunction. For traceback, refer to Par. 8.6 "Abnormal Traceback Mode."

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.

(5) Resetting servo alarm

Servo alarm is reset with external signal input.

6.6 STATUS INDICATION

Status indication in the monitor panel consists of abbreviation indication and bit indication.

For the status indication mode operation of the monitor panel, refer to Par. 8, "Monitor Panel Operation".

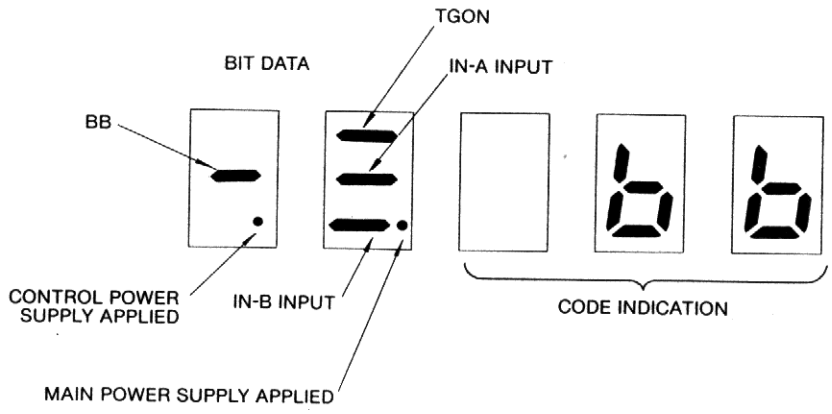


Fig. 6.12 Monitor Panel Status Indication

Table 6.2 and 6.3 show the contents of abbreviation indications.

Table 6.2 Status Indication

Monitor Panel Indication	Conditions
bb	Base current is interrupted (BB)
run	Under the current conduction
Pot	Forward running is interrupted
not	Reverse running is interrupted

Table 6.3 Trouble Indications with Monitor Panel and Error Output Code (SVALM and 3-bit Output)

Monitor Panel Indication (Traceback Data)	Detection	Error Output Code			SVALM	Remarks
		0	1	2		
A. 02	Parameter breakdown	×	×	×	○	E²PROM error
A. 03	Main circuit detection error	×	×	×	○	
A. 04	Parameter sefting error	×	×	×	○	
A. 10	Overcurrent	○	×	×	○	
A. 11	Ground fault	○	×	×	○	
A. 20	MCCB trip	×	○	×	○	
A. 30	Regeneration error	○	○	×	○	
A. 40	Overvoltage	×	×	○	○	
A. 51	Feedback overspeed	○	×	○	○	
A. 52	Overspeed reference input	○	×	○	○	
A. 60	Undervoltage	×	○	○	○	
A. 71	Overload detection (high load)	○	○	○	○	
A. 72	Overload detection (low load)	○	○	○	○	
A. b1	Reference input read error	×	×	×	○	A/D error
A. b2	External current limit read error	×	×	×	○	A/D error
A. C1	Overrun (Wrong wiring of motor circuit PG signal line)	○	×	○	○	Overrun prevention
A. C2	Phase detection error (Wrong wiring or disconnection of PG signal line : PU, PV, PW)	○	×	○	○	Overrun prevention
A. C3	PA, PB-phasedisconnection of PG signal line	○	×	○	○	Overrun prevention
A. F1	Open phase of power supply	×	○	×	○	
A. F2	Power supply rise error	×	○	×	○	
	CPU error	×	×	×	○	Non-alarm indication

○ .... Output transistor ON

× .... Output transistor OFF

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 five times 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 200 V by using a power transformer. Table 6.5 shows the transformer selection. Connection should be made so that the power is supplied and cut through the primary side of the transformer. Single-phase 100 V class power supply should not be used.

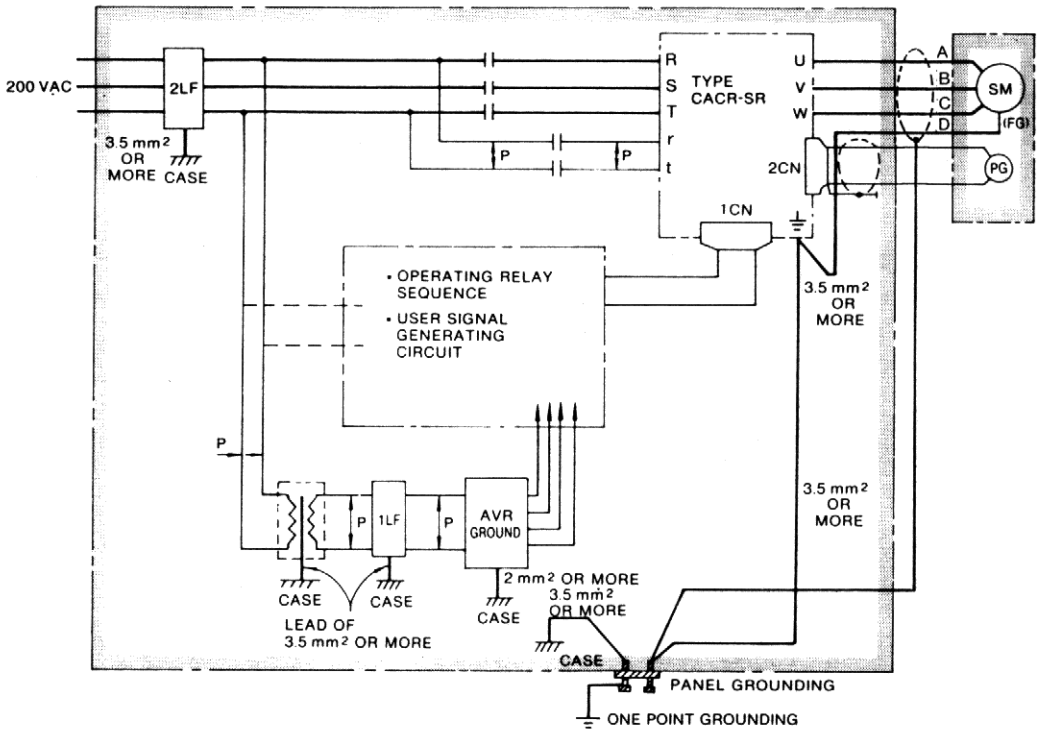
6.8 PRECAUTIONS OF OPERATION

6.8.1 Noise Treatment

Servopack uses is a power transistor 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. 6.13.**

(1) Grounding method



P : Twisted cable

Notes:
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. 6.13 Grounding Method

- 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.

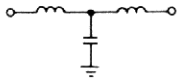
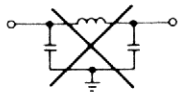
(2) Noise filter installation

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 6.4. The power supply to peripherals also needs noise filters.

NOTE

If the noise filter connection is wrong, the effect decreases greatly. Observing the precautions, carefully connect them as shown in Figs. 6.14 to 6.17.

Table 6.4 Recommended Noise Filter

Servopack Type CACR-	Applicable Noise Filter	Recommended Noise Filter	
		Type	Specifications
SR02BE SR03BE SR05BE		LF-305	Three-phase 200 VAC class, 5A
SR07BE		LF-310	Three-phase 200 VAC class, 10A
SR10BE SR15BE	CORRECT	LF-315	Three-phase 200 VAC class, 15A
SR20BE		LF-320	Three-phase 200 VAC class, 20A
SR30BE		LF-330	Three-phase 200 VAC class, 30A
SR44BE	WRONG	LF-340	Three-phase 200 VAC class, 40A

Note: Noise filter made by Tokin Corp.

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

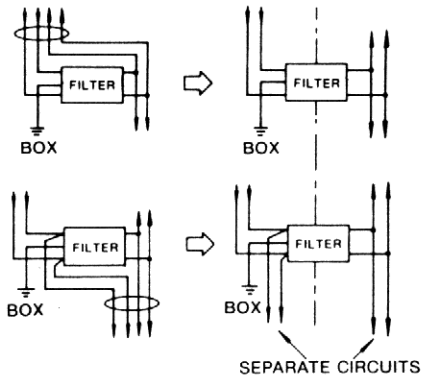


Fig. 6.14 WRONG CORRECT

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

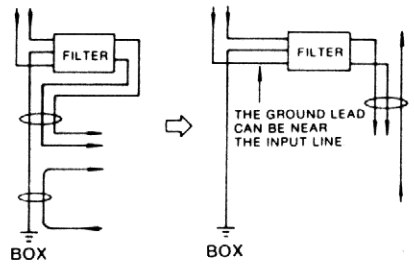


Fig. 6.15 WRONG CORRECT

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

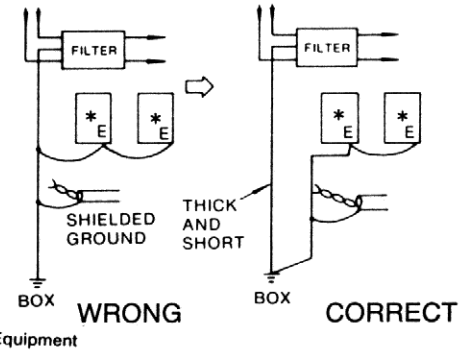


Fig. 6.16 WRONG CORRECT

*Equipment

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

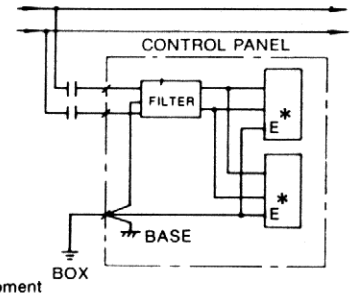


Fig. 6.17 *Equipment

6.8.2 Power Line Protection

The Servopack is operted through the commercial power line (200 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 6.5).

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 6.5 Power Supply Capacity and MCCB or Fuse Capacity

Servopack Type CACR-	Power Capacity* per Servopack	Current Capacity per MCCB or Fuse
SR02BE · SR03BE	0.65 kVA	5 A
SR05BE	1.1 kVA	5 A
SR07BE	1.5 kVA	8 A
SR10BE	2.1 kVA	8 A
SR15BE	3.1 kVA	10 A
SR20BE	4.1 kVA	12 A
SR30BE	6.0 kVA	18 A
SR44BE	8.0 kVA	24 A

* Values at rated load.

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-1 and 2CN-7 of connector 2CN for the PG. In this case, change of motor and PG connection is not required.

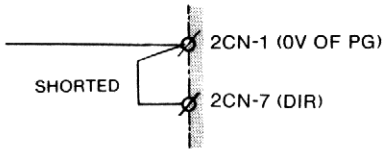


Fig. 6.18

In forward running reference, frequency dividing output from Servopack applies phase-B lead.

6.10 MOTOR SPEED MEASUREMENT AND TORQUE REFERENCE

When an instrument is connected to measure speed and torque, make the connection as shown in Fig. 6.19, using a DC ammeter of ±1 mA (both swing).

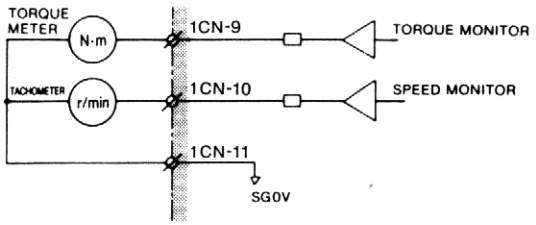


Fig. 6.19 Speed and Torque Measurement

- Torque monitor output (1CN-9): ±3.0V ±10%/100% torque
- Speed monitor output (1CN-10):
  M, F, D series — ±4.0 V ±5%/1000 r/min
  G, S series — ±2.0 V ±5%/1000 r/min
- Instrument: ±1 mA (both swing) ammeter.
  Use ammeter of DCF-6 or DCF-12N by Toyo Instrument or equivalent.
- Example: When an M Series motor (rated speed: 1000 r/min) is used, and speeds are to be measured up to the maximum speed (2000 r/min) in both directions, use ±8V(both swing) DC voltmeter.

7. USER CONSTANTS

The Servopack offers the following user constants. These constants can be set up variously to suit the system requirements. Understand the functions of the constants before using them. For constant setup or adjustment, use the monitor panel (see Section 8, "MONITOR PANEL OPERATIONS").

(1) Speed Reference Adjustment Gain: Cn-03 [INBGN]

- IN-B input motor rotating speed adjustment constant. The adjustment range is from 0 through 2000 r/min/V.
- For position control purposes, the loop gain increases with an increase in this gain setting.
- This constant is preset at the factory to rated rotating speed/10 V prior to shipment.

(2) Speed Loop Gain: Cn-04 [LOOPHZ]

- Speed controller proportional gain. The adjustment range is from 20 through 500 Hz (when equivalent inertia used).
- This constant is preset at the factory to 50 Hz prior to shipment.

(3) Speed Loop Integration Time Constant: Cn-05 [PITIME]

- Speed controller integration time. The adjustment range is from 2 through 5112 ms.
- This constant is preset at the factory to 20 ms prior to shipment.

(4) Emergency Stop Torque: Cn-06 [EMGTRQ]

- Overtravel stop braking torque setting (set in a percentage relative to the rated motor torque). The setting range is from 0 through MAX (%).
- When the overtravel P/N-OT (1CN-26, 41) operates, the brake stop mode can be selected according to this torque setting (Cn-01 bit 7).
- This constant is preset at the factory to MAX (%) prior to shipment.

(5) Soft Start time: Cn-07 [SFSACC]

- This constant refers to the time required for the speed reference to change from 0 (r/min) to the maximum rotating speed or from the maximum rotating speed to 0 (r/min). The setting range is from 0 through 10,000 ms.
- This constant is preset at the factory to 0 ms prior to shipment.
- For position control purposes, this constant should normally be set to 0 ms.

(6) Forward Running Torque Limit: Cn-08 [TLMTF]

- Forward running motor torque limit. The setting range is from 0 through MAX (%)
- This constant is preset at the factory to MAX (%) prior to shipment.

(7) Reverse Running Torque Limit: Cn-09 [TLMTR]

- Reverse running motor torque limit. The setting range is from 0 through MAX (%).
- This constant is preset at the factory to MAX (%) prior to shipment.

(8) PG Division Ratio: Cn-0A [PGRAT]

- The detection pulses (A and B pulses) fed from the PG (optical encoder) are divided by this ratio setting and transferred to connector 1CN terminals 33 and 36.
- This ratio setting refers to the number of output pulses per revolution. The setting range varies with the PG.

  1 to number of PG pulses (integer) ($n < 32$, integer)

  For the 2500P/R PG, only the above 7 different ratios are provided.

(9) Zero Speed Level: Cn-0B [TGONLV]

- Motor zero speed judgment level. The setting range is from 10 through 200 r/min.
- When the motor rotating speed lowers below this setting, sequence output TGON turns OFF (the path between 1CN terminals 22 and 23 is closed).
- This constant is preset at then factory to 20 r/min prior to shipment.

(10) Mode Switch (Torque Reference)

- Mode switch actuation level setting. When accel/decel involving speed controller output saturation is to be implemented, mode switching is effected from PI control to P control in order to improve the transition characteristics. This constant refers to the detection point setting at which such mode switching is effected. The mode switch allows you to select three different detection points and set up their level.

  Torque reference (speed controller output)
  Speed reference
  Motor acceleration detection

- Detection point selection is made by performing user constant Cn-01 bit setup.

(11) Zero Clamp Level: Cn-OF [ZCLVL]

- Motor rotating speed level at which zero clamping is effected. The setting range is from 0 through 100 r/min.
- In the zero clamp speed control mode (set up by Cn-01 bits A and B), the P-Con speed reference is disconnected to clamp the motor rotating speed to zero when the motor rotating speed falls below this setting.

(12) Jogging Speed: Cn-10 [JOGSPD]

- This constant refers to the jogging operation speed. The setting range is from 0 through 1000 r/min.
- In the jogging mode, operational instructions are issued from the setup panel.
- This constant is preset at the factory to 100 r/min prior to shipment.

(13) Number of Encoder Pulses: Cn-11 [PULSNO]

- This constant indicates the number of pulses per encoder revolution. The setting range is from 1000 through 32767 (P/R).

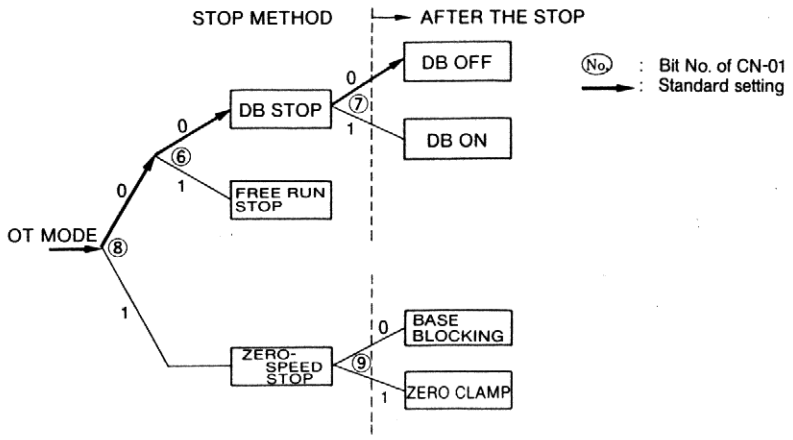
(14) Delay Time between Braking command Output and SVOFF Operation: Cn-12 BRKTI M

- The braking command output is generated according to Cn-01 bit E.
- This constant indicates the delay time between braking command output and SVOFF operation for a brake attached motor. The setting range is from 0 through 50 (× 10 ms).

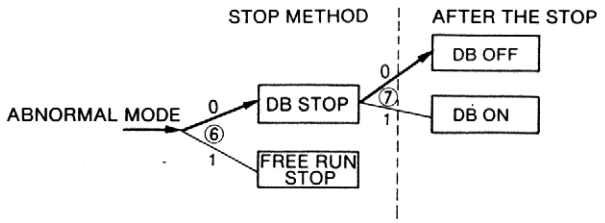
(15) Sequence Input, Reference Signal Emergency Stop Method, Control Mode, and Mode Switch Selection

Use the user constant Cn-01 memory switch for selection purposes (see Table 7.1 "User Constant Cn-01 List" for memory switch assignments).

In accordance with sequence (1) or (2) below, select the emergency stop method suitable for the system.



(a) Abnormal Stop Sequence at Overtravel (OT) Mode



(b) Abnormal Stop Sequence other than Overtravel (OT) Mod

Fig. 9.1 Abnormal Stop Sequence

7.1 USER CONSTANT Cn-01 (MEMORY SWITCH)

Table 7.1 shows memory switches of user constants Cn-01.

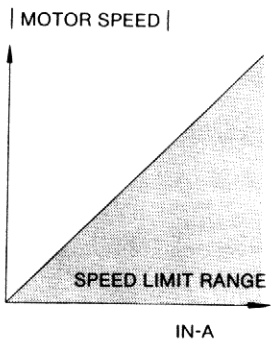
Table 7.1 User Constant Cn-01 (Memory Switch) Cn-02:Spare

Selection	Bit No.	Setting	Conditions	Standard
Sequence Input Selection	0	0	Servo ON/OFF by external input (SV-ON).	0
		1	The servo is ON at all times.	
	1	0	The external input (SEN) is used.	0
		1	Regardless of the SEN signal presence, the Servopack automatically conculdes that the "H" level prevails.	
	2	0	The P-OT signal prohibits forward running.	0
		1	Forward running is permitted at all times.	
	3	0	The N-OT signal permits reverse running.	0
		1	Reverse running is permitted at all times.	
Input Signal Selection	4	0	The IN-A input is used.	0
		1	Regardless of the IN-A input presence, the Servopack concludes that the IN-B input is 0.	
	5	0	The IN-B input is used.	0
		1	Regardless of the IN-B input presence, the Servopack concludes that the IN-B input is 0.	
Abnormal Stop Selection	6	0	<DB stop> The dynamic brake stops the motor.	0
		1	<Coasting to stop> The motor is freed and brought to a stop.	
	7	0	<DB OFF after DB stop> The dynamic brake is turned OFF after the motor is stopped.	0
		1	<DB continuously ON after DB stop> The dynamic brake remains activated after the motor is stopped.	
	8 Note 1	0	The overtravel state stop method agrees with bit 6.	0
		1	<Overtravel zero speed stop> In the overtravel state, the motor is stopped at the torque setting defined by user constant Cn-06.	
	9 Note 2	0	In the overtravel state, base blocking (BB) is implemented after zero speed stop.	0
		1	In the overtravel state, zero clamping is effected after zero speed stop.	
Mode Switch Selection (for Speed Control only)	D-C Note 3	0-0	<Torque reference> Based on the torque reference level defined by user constant Cn-0C.	00
		0-1	<Speed Reference> Based on the speed reference level defined by user constant CN-0D.	
		1-0	<Acceleration> Based on the acceleration level defined by user constant Cn-0E.	
		1-1	<None> The mode switch function is not provided.	
Presence of External Brake	E	0	The braking command function is not provided.	0
		1	The braking command function is provided.	

Notes: 1. The abnormal stop method in the torque control mode complies with bit 6.
2. Selects a state prevailing when the zero speed stop method has been selected for the overtravel state (bit 8).
3. Selects a mode switch operating condition. When the mode switch operates, the speed control mode changes to P control. However, this is effective for speed control only.

Table 7.1 User Constant Cn-01 (Memory Switch) List (Cont'd)

Cn-02: Reserved.

Option	Bit No.	Setting	Description	Reference Input	Sequence Signal Input	Standard
Control Mode Selection	B • A	0 • 0	<Speed control> • Regular speed control. • The $\overline{\text{P-CON}}$ signal (CN1-24) is used to effect P/PI control changeover.	Speed reference (IN-A) Auxiliary reference input (IN-B)	$\overline{\text{P-CON}}$ OFF: PI control ON: P control	0 • 0
		0 • 1	<Zero clamp speed control> • After the motor is stopped (ZCLVL), the speed reference is disconnected to execute the zero speed stop function. • The P-CON signal (CN1-24) is used to turn ON and OFF the zero clamp function.		$\overline{\text{P-CON}}$ OFF: Zero clamp function OFF ON: Zero clamp function ON	
		1 • 0	<Torque control I> • The motor output torque is controlled by the torque reference (IN-A). • The IN-B cannot be used.	Torque reference (IN-A)	None	
		1 • 1	<Torque control II> • The $\overline{\text{P-CON}}$ signal (CN1-24) is used for torque/speed control mode changeover. Torque control mode • The motor output torque is controlled by the torque reference (IN-B). • The speed limit can be entered from outside (IN-A). The IN-A voltage (+) limits both the forward and reverse running speeds.  Speed control mode • The speed reference is entered from the IN-A. • The IN-B cannot be used.	Torque control mode Torque reference (IN-B) Speed limit (IN-A) Speed control mode Speed reference (IN-A) Notes: • When the speed is outside the speed control range, the torque proportional to the speed difference from the limit is negatively fed back to place the speed within the limit. Therefore, the actual motor rotating speed limit varies with the load conditions. • If the torque reference continuously reduces the motor speed, due caution must be exercised. If such a condition occurs, contact your YASKAWA representative.	$\overline{\text{P-CON}}$ OFF: Torque control ON: Speed control	
Reverse Rotation Mode Selection	0	0	CCW: Forward Running			0
		1	CW: Forward Running			
Spare	1 to F		Do not adjust.			

7.2 USER CONSTANT Cn-03 to Cn-12 (CONSTANT SETTING)

Table 7.2 shows user constants (constant setting).

Table 7.2 User Constant Cn-03 to Cn-12 (Constant Setting)

	User Constant	Code	Name	Unit	Lower Limit	Upper Limit	Setting before Shipment	Remarks
Constants for Gains	Cn-03	INBGN	Speed Reference Adjustment Gain	(r/min)/v	0	2000	Rating/10V	
	Cn-04	LOOPHZ	Speed Loop Gain	Hz	20	500	40	
	Cn-05	PITIME	Speed Loop Integral Time Constant	ms	2	512	20	
Constants for Torque	Cn-06	EMGTRQ	Emergency Stop Torque	%	0	Maximum Torque	Maximum Torque	OT Mode
	Cn-08	TLMTF	Forward Torque Limit	%	0	Maximum Torque	Maximum Torque	
	Cn-09	TLMTR	Reverse Torque Limit	%	0	Maximum Torque	Maximum Torque	
Constants for Sequences	Cn-07	SFSACC	Soft Start Time	ms	0	10000	0	
	Cn-0B	TGONLV	Zero-speed Level	r/min	10	200	20	
	Cn-0F	ZCLVL	Zero-clamp Level	r/min	0	100	10	
	Cn-12	BRKTIM	Delay Time from Brake Reference to SVOFF	10ms	0	50	20	
Constants for Encoder Pulses	Cn-0A	PGRAT	PG Frequency Dividing Ratio Setting	P/R	1000	32768	PG Pulse	
	Cn-11	PULSNO	Number of Pulses	P/R	1000	32768	PG Pulse	
Constants for Others	Cn-0C	TRQMSW	Mode Switch (Torque Reference)	%	0	Maximum Torque	200	
	Cn-0D	REFMSW	Mode Switch (Speed Reference)	r/min	0	Maximum Speed	0	
	Cn-0E	ACCMSW	Mode Switch (Accelerating Speed)	10(r/min)/S	0	3000	0	
	Cn-10	JOGSPD	JOG Speed	1r/min	0	Maximum Speed	100	
	Cn-13	TCRFGN	Torque Reference Gain	1/10V Rated Torque	10	100	30	
	Cn-14	TCRLMT	Speed Limit in Torque Control I	r/min	0	Maximum Speed	Maximum Speed	
	Cn-15	BRKSPD	Brake Timing at Motor Rotating {Speed Level that Outputs Brake Reference}	r/min	0	Maximum Speed	100	
	Cn-16	BRKWA1	Brake Timing at Motor Rotating {Waiting Time from SVOFF until Brake Reference is output}	10ms	10	100	50	
	Cn-17	TRQFIL	Torque Reference Filter Time Constant	100ms	4	250	4	

8. MONITOR PANEL OPERATION

8.1 SWITCH OPERATION

Fig. 8.1 shows the monitor panel. Operating control switches SW1 through SW4 are used to execute the f•1 through f•7 functions. Functions f•1 through f•7 vary with monitor panel mode.

Notes:

1. The monitor panel constant setup data are retained even after the power is turned off.
2. Even if the power is turned off after abnormal occurrence, the abnormal data are retained in memory. Therefore, it is possible to check the abnormal data after the power is turned back on.
3. The monitor mode can be changed even during operations.

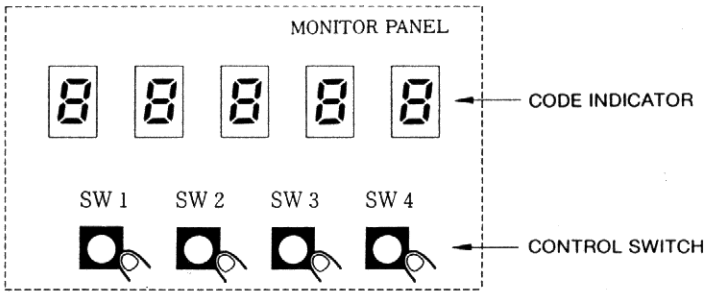


Fig. 8.1 Monitor Panel

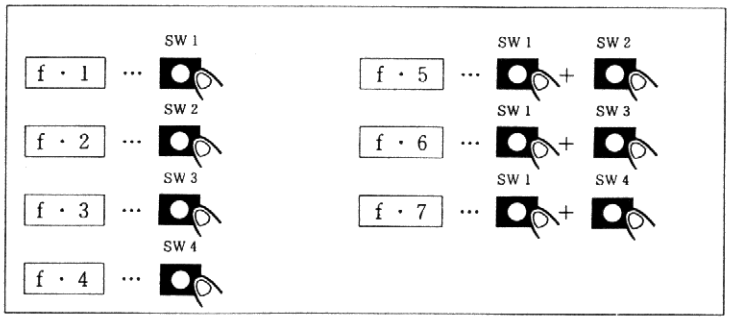


Fig. 8.2 Description of Switch Function

8.2 FUNCTION OF MONITOR PANEL

Table 8.1 shows the monitor panel functions Note that the status display mode prevails upon control power ON. To change the mode, use switch SW4 as shown in Fig. 8.3.

Table 8.1 Monitor Panel Functions

Mode	Function
State Indication Mode	Various States Indication • Base Block • On Operation • Trouble For details, refer to Table 8.2
Setting Mode	Refer to "User Constant Setting."
	• Operation (JOG) from Monitor Panel • Speed Reference Offset Adjustment
Monitor Mode	Various Monitoring • Speed • Speed Reference • Torque Reference • Number of Pulses from Origin (Phase-U) • Electrical Equipment • Interior Status Bit
Abnormal Traceback Indication Mode	Trouble Indication of the past

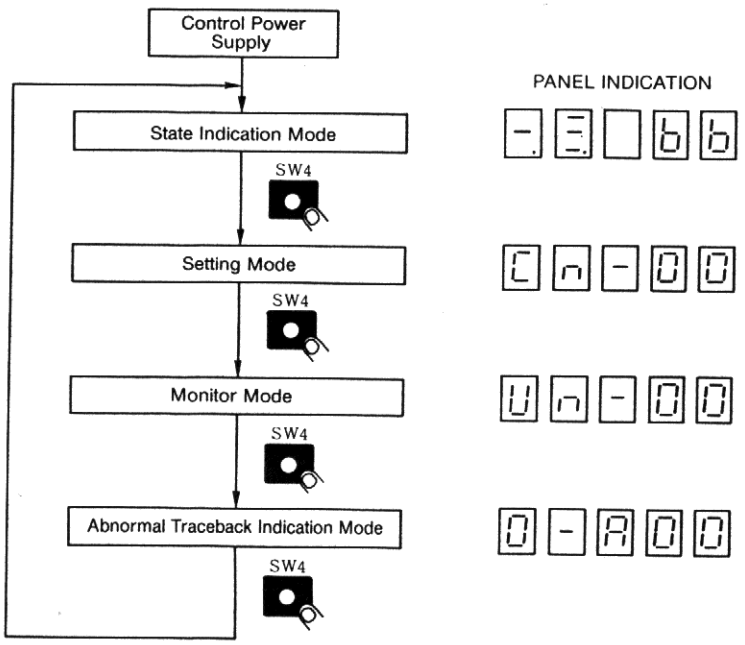


Fig. 8.3 Mode Changeover

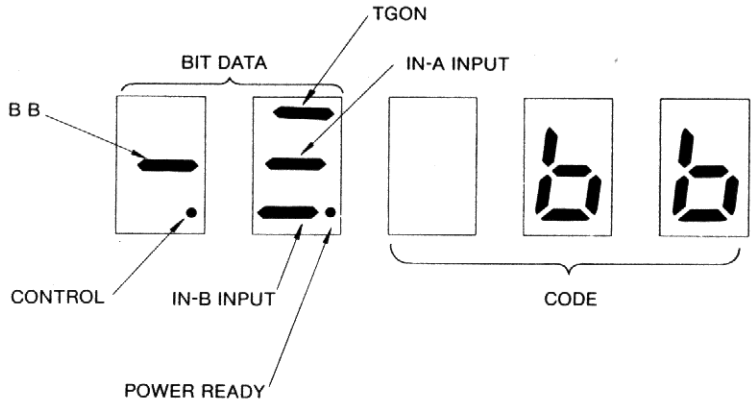
8.3 STATUS INDICATION MODE

When this mode is selected, the condition of Servopack is indicated with bit and code as shown in Fig. 8.4. Fig. 8.2 shows the bits and the conditions. Fig. 8.5 shows the function allocations of switches.

[RST] : Becomes alarm reset switch.

[SET] : Changes state indication mode into setting mode.

Panel Display



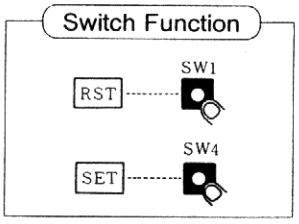


Fig. 8.4 Status Indication

Table 8.2 Codes and Conditions

Code	Condition
bb	Base Block
run	On Operation
Pot	Forward Running Interrupted
not	Reverse Running Interrupted
A. 00	Alarm Contents Refer to Par. "6·6 Status Indication".
A. 01	
1	

8.4 SETTING MODE

In this mode, the following operations can be performed.

- User constant setup and check
- Controlling operations from the monitor panel
- Speed reference offset adjustment

8.4.1 User Constant (Data) Setup and Check

The switch functions are indicated in Fig. 8.5.

Panel Display

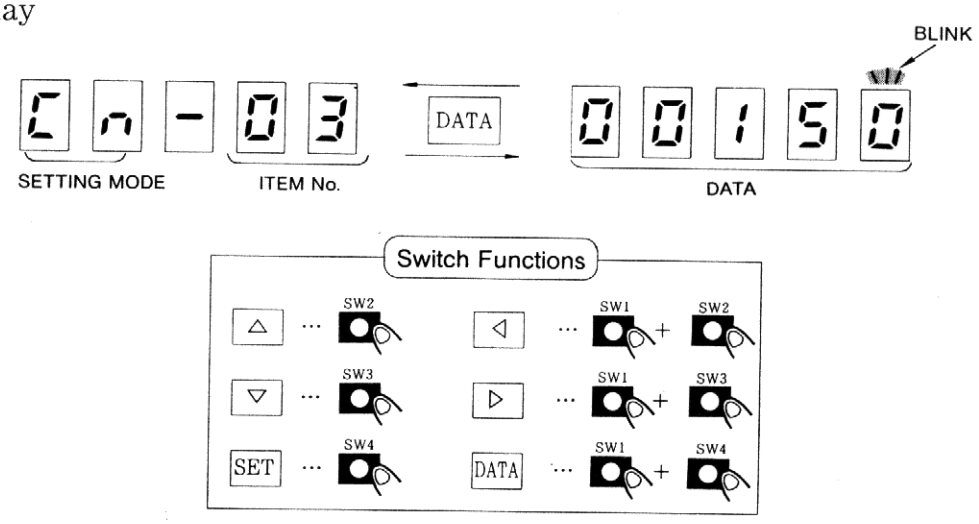


Fig. 8.5 Switch Functions for User Constant Setting

1. Set up the item number with the [△], [▽], [◁], and [▷] keys.
   - With the [◁] and [▷] keys, choose a setup digit. The chosen digit then starts blinking to indicate that its numerical value can be changed.
   - With the [△] and [▽] keys, increase or decrease the numerical value until the desired value is obtained.
2. With the [DATA] key, display the data related to the selected item number.
3. With the [△], [▽], [◁], and [▷] keys, set up the data.
4. Store the data with the [SET] key.
5. Repeat steps [1] through [4] as needed.
6. With the [DATA] key, return to the item No. display state.
7. Using the [SET] key, switch from the setting mode to the monitor mode.

8.4.2 User Constant (Memory Switch) and Check

User constant Cn-01 can be set up or checked as memory switch bits. The procedures for item number setup and data display are the same as indicated in Par. 8.4.1.

The switch functions provided after bit data display are indicated in Fig. 8.6.

Panel Display

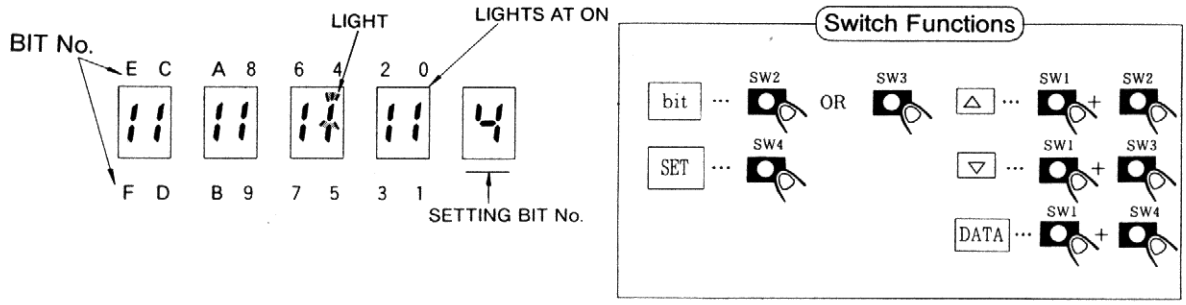


Fig. 8.6 Switch Functions Provided after Bit Data Display

1. With the [△] and [▽] keys, enter the setup memory switch number at the far right end of the panel.
2. With the [bit] key, set the memory switch to ON or OFF (either switch SW2 or SW3 can be used). The panel indication comes on when the switch is ON, and goes off when the switch is OFF.
3. Repeat steps [1] and [2] as needed.
4. With the [DATA] key, return to the item No. display state.
5. Using the [SET] key, switch from the setting mode to the monitor mode.

8.4.3 Monitor Panel Controlled Operation Mode Selection and Operating Procedure

(1) Monitor Panel Controlled Operation Mode Selection

When user constant Cn-00 is set to 00, the operations are to be controlled from the monitor panel. The switch functions are indicated in Fig. 8.7.

Panel Display

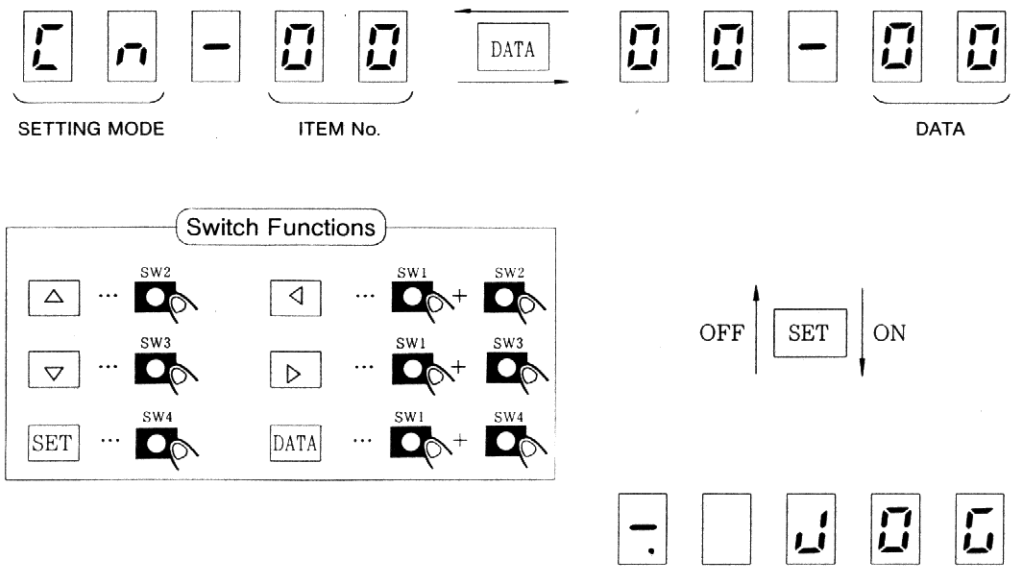


Fig. 8.7 Switch Functions in Monitor Panel Controlled Operation Mode

1. Select the item number 00 with the [△], [▽], [◁] and [▷] keys.
2. With the [DATA] key, display the data related to the selected item number.
3. With the [△], [▽], [◁] and [▷] keys, select the number 00.
4. With the [SET] key, turn ON or OFF the monitor panel controlled operation mode.
5. With the [DATA] key, return to the item No. display state.
6. Using the [SET] key, switch from the setting mode to the monitor mode.

(2) Monitor Panel Controlled Operation Procedure

For speed reference adjustment, use user constant Cn-10 (see Par. 8.4.1).

The switch functions provided for monitor panel controlled operations are indicated in Fig. 8.8.

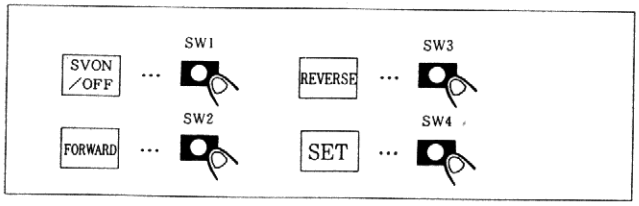


Fig. 8.8 Switch Functions for Monitor Panel Controlled Operations

1. With the [SVON/OFF] switch, effect SVON/SVOFF changeover.
2. The motor runs in the forward direction while the [FORWARD] key is held down.
3. The motor runs in the reverse direction while the [REVERSE] key is held down.
4. The [SET] key is used to switch from the monitor panel controlled operation mode to the user constant Cn-00 data display state.
5. With the [DATA] key, return to the item No. display state.
6. Using the [SET] key, switch from the setting mode to the monitor mode.

8.4.4 Speed Reference Offset Adjustment

When user constant Cn-00 is set to 01, the system enters the speed reference off set adjustment mode. The switch functions are indicated in Fig. 8.9.

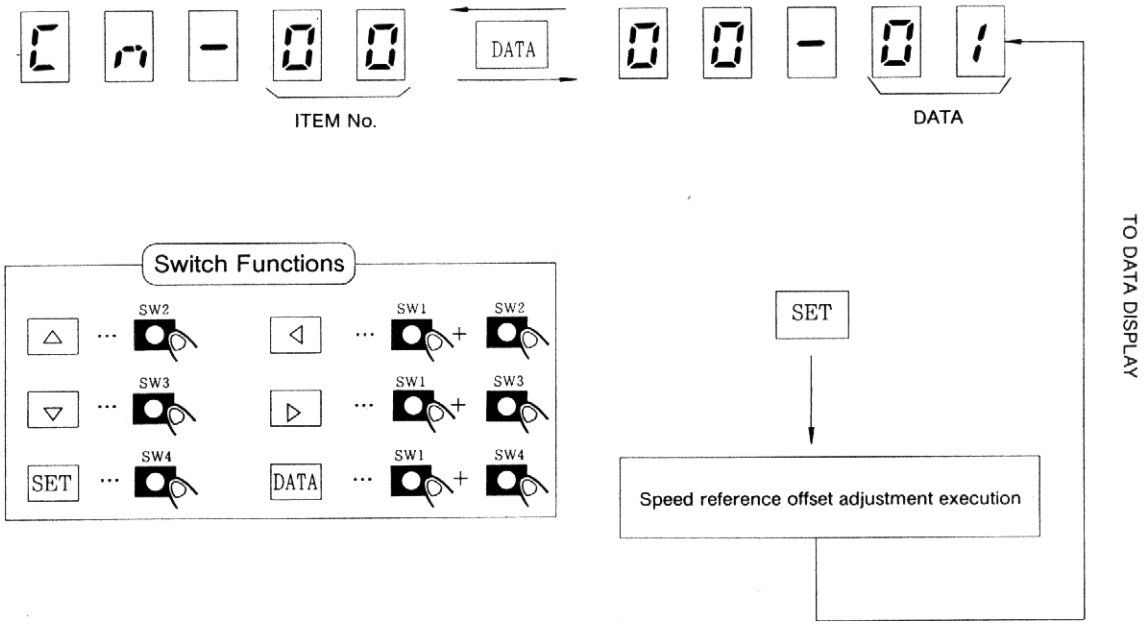


Fig. 8.9 Speed Reference Offset Adjustment

1. Select the item number 00 with the [△], [▽], [◁] and [▷] keys.
2. With the [DATA] key, display the data related to the selected item number.
3. With the [△], [▽], [◁] and [▷] keys, select the number 01.
4. Apply a desired zero speed reference voltage between speed reference input terminals IN-A and IN-B (a voltage of 0V should normally be applied).
5. With the [SET] key, make speed reference offset adjustment and return to the user constant Cn-00 data display state.
6. With the [DATA] key, return to the item No. display state.
7. Using the [SET] key, switch from the setting mode to the monitor mode.

8.4.5 Clearing Abnormal Traceback Data

When user constant Cn-00 is set to 02, abnormal traceback data are cleared. The switch functions are indicated in Fig. 8.10.

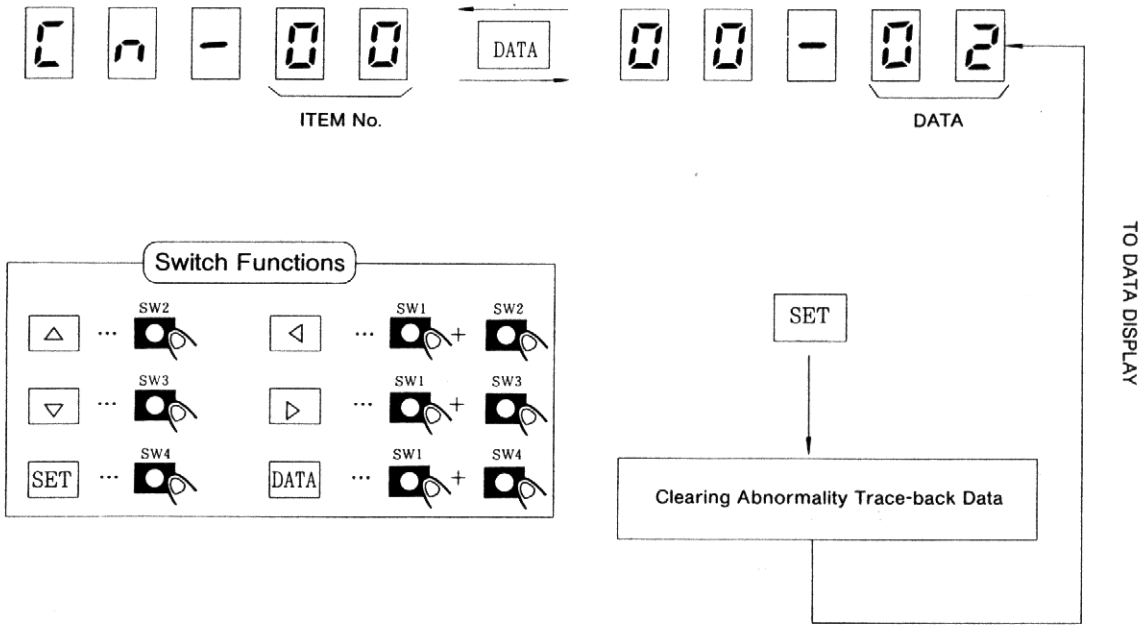


Fig. 8.10 Speed Reference Offset Adjustment

1. Select the item number 00 with the [△], [▽], [◁] and [▷] keys.
2. With the [DATA] key, display the data related to the selected item number.
3. With the [△], [▽], [◁] and [▷] keys, select the number 02.
4. With the [SET] key, clear abnormal trace-back data and return to the user constant Cn-00 data display state.
5. With the [DATA] key, return to the item No. display state.
6. Using the [SET] key, switch from the setting mode to the monitor mode.

8.5 MONITOR MODE

In this mode, the speed reference, torque reference, and other data can be observed on the monitor panel.

Table 8.3 lists the data that can be monitored. The switch functions are indicated in Fig. 8.10.

Table 8.3 Data Monitored

Moniter No.	Data Monitored
00	Feedback Speed (r/min)
01	Speed Reference (r/min)
02	Torque Reference (%)
03	No. of Pulses from Phase-U edge (Phase-U)
04	Electrical Angle (1/10deg)
05	Internal Status Bit Display (Refer to Table 8.4.)

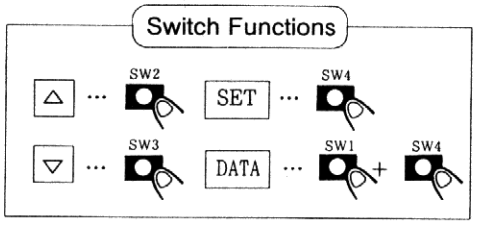
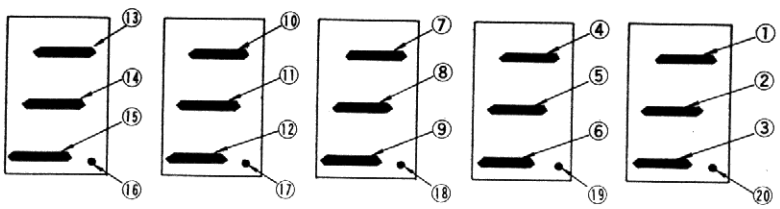


Fig. 8.10 Switch Functions in Monitor Mode



Bit. No.	Symbol	Contens
①	SVALM	Servo Alarm
②	DBON	Dynamic Brake ON
③	DIR	Reverse Rotation Mode
④	CLT	Current Limit
⑤	TGON	Motor Running
⑥	MSON	Mode Switch ON
⑦	ACON	AC Power Supply ON
⑧	SVRDY	Servo Ready
⑨	B-ON	Motor Under Current Conduction
⑩	PA	Phase-A
⑪	PB	Phase-B
⑫	PC	Phase-C
⑬	PU	Phase-U
⑭	PV	Phase-V } SR□BD only
⑮	PW	Phase-W
⑯	SVON	Servo ON
⑰	P-CON	P Operation Input
⑱	P-OT	Forward Running Inhibit Input
⑲	N-OT	Reverse Running Inhibit Input
⑳	SEN	SEN Signal Input (-SR□BY only)

1 With the [△] and [▽] keys, select a desired monitor No.

2 With the [DATA] key, initiate monitor display.

3 Using the [DATA] key, return to the monitor No. selection state.

4 With the [SET] key, switch from the monitor mode to the abnormal traceback mode.

8.6 ABNORMAL TRACEBACK MODE

In this mode, the information on past abnormal occurrences can be displayed.

- The information on up to 10 past abnormal occurrences can be stored.
- When an abnormality is reset or the control power is turned on, trace-back data A. 99 is saved (These data are also counted as one of a total of 10 stored items of abnormal information).
- For the relationship between traceback data and abnormal descriptions, refer to Table 8.4. The switch functions are indicated in Fig. 8.11.

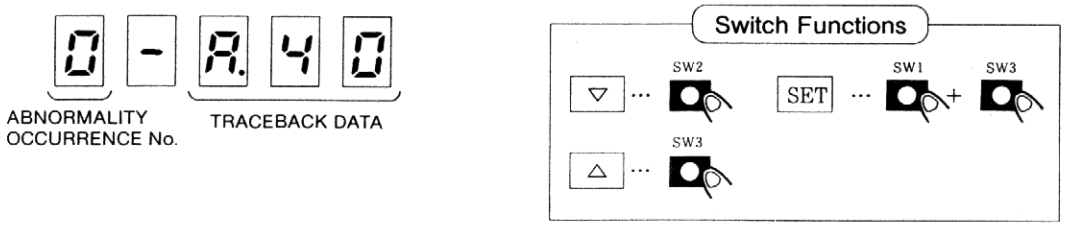


Fig. 8.11 Switch Functions in Abnormal Traceback Mode

1. With the [△] and [▽] keys, increase or decrease the abnormal occurrence number. The abnormal information related to the selected number is then displayed. (The higher the abnormal occurrence number, the older the abnormal occurrence.)
2. With the [SET] key, switch from the abnormal trace-back mode to the status display mode.

Table 8.5 Trouble Indications with Monitor Panel and Traceback Data

Monitor Panel Indication (Traceback Data)	Detection
A. 02	Parameter Breakdown
A. 03	Main circuit detection error
A. 04	Parameter setting error
A. 10	Overcurrent
A. 11	Ground fault
A. 20	MCCB trip
A. 30	Regeneration error
A. 40	Overvoltage
A. 51	Feedback overspeed
A. 52	Overspeed reference input
A. 60	Undervoltage
A. 71	Overload (high load)
A. 72	Overload (low load)
A. b1	Reference input read error
A. b2	External current limit read error
A. C1	Overrun (wrong wiring of motor circuit PG signal line)
A. C2	Phase detection error (wrong wiring or disconnection of PG signal line: PU, PV, PW)
A. C3	PA,PB-phase disconnection of PG signal line
A. F1	Open phase of power supply
A. F2	Power supply rise error
———	CPU error

9. INSTALLATION AND WIRING

9.1 RECEIVING

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

- 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 your YASKAWA representative giving full details and nameplate data.

9.2 INSTALLATION

9.2.1 AC Servomotor

AC Servomotor can be installed either horizontally or vertically.

(1) Before mounting

Remove anticorrosive paint on shaft extension and flange surface with thinner before connecting the motor to the driven machine. See Fig. 9.1.

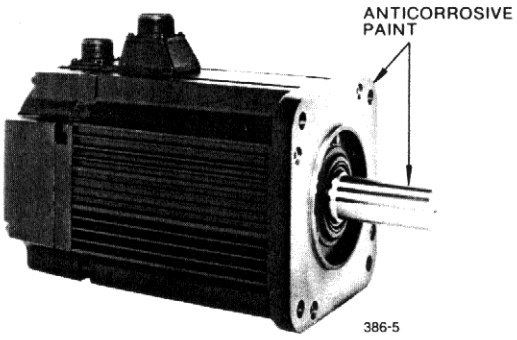


Fig. 9.1 Anticorrosive Paint to be Removed

(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 or mist, protect the motor with a cover. The motor can withstand a small amount of splashed water or oil (except for C series).

It is recommended that the motor be mounted with its connector placed down.

(3) Environmental conditions

Ambient Temperature: 0 to +40°C

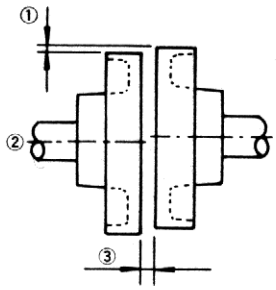
Storage Temperature: −20 to +60°C

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

(4) Load coupling

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

Use flexible a coupling with direct drive. The alignment should be made in accordance with **Fig. 9.2.**



① Measure the gap between the straightedge and coupling halves at four equidistant points of the coupling. The each reading should not exceed 0.03 mm (0.0012 in.).

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 read ings should not exceed 0.03 mm (0.0012 in.).

Fig. 9.2 Alignment of Coupling

(5) Allowable bearing load

Avoid both thrust and radial loads to the motor shaft. If unavoidable, never exceed the values in Tables 4.1 to 4.5.

9.2.2 *Servopack*

(1) Installation

The Servopack type CACR-SR□□BE is mounted on the base as standard.

(2) Location

- When installed in a panel:

  Keep the temperature around Servopack at 55°C or below. (**Fig. 9.3**)

- When installed near a heat source:

  Keep the temperatuer around Servopack below 55°C. (**Fig. 9.4**)

- 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.

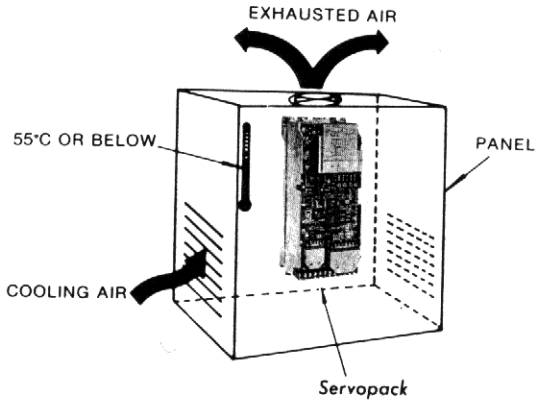


Fig. 9.3 Typical Layout for Panel Mounting

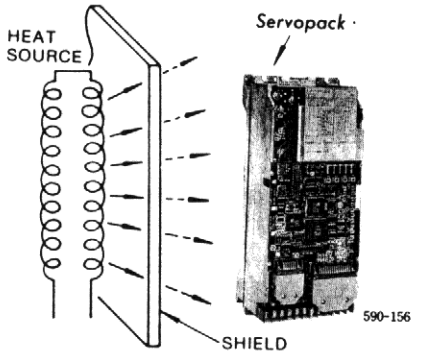


Fig. 9.4 Protection Against Heat Radiation

(3) Mounting Direction

Mount the unit vertically on the wall using the mounting holes (4) on the base plate, with main terminals at the bottom. (Fig. 9.5)

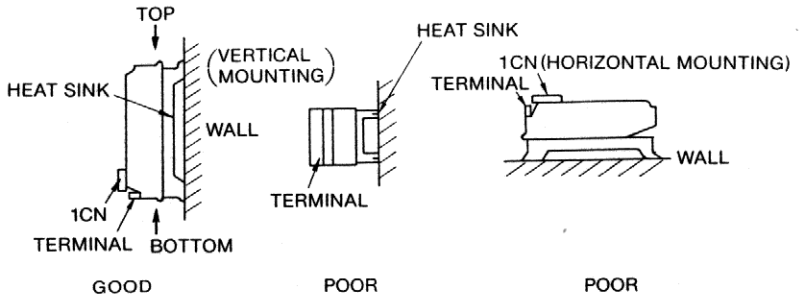
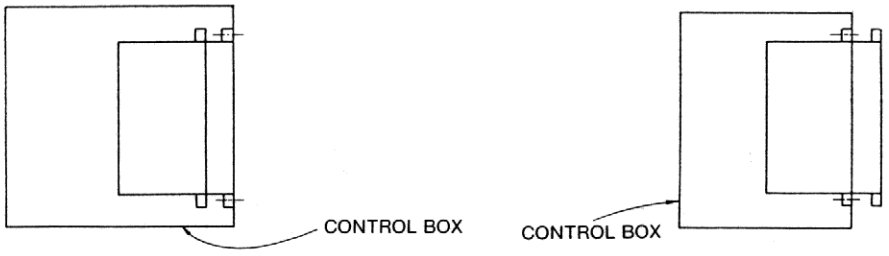


Fig. 9.5 Mounting Direction of ***Servopack***



(a) Usual Mounting (b) Mounting with Radiation Fin out

Fig. 9.6 Method of Mounting

Fig. 9.7 shows mounting hole processing with radiation fin out.

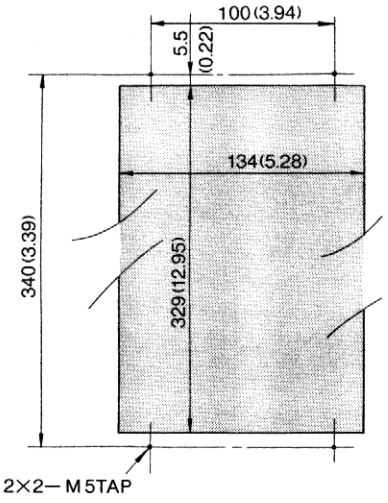


Fig. 9.7 Mounting Hole Processing in mm (inch)

(4) Precautions

- Mounting Pitch

  Standard mounting pitch is 150mm (5.91 in). If panel inside circulation is sufficient, such as when housed into the panel, 145mm (5.71 in) is also available.

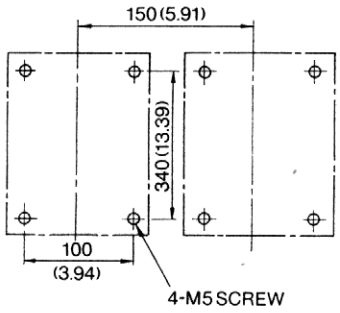
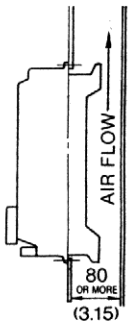


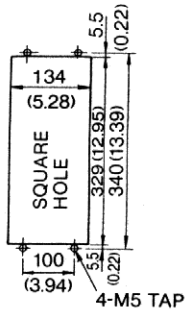
Fig. 9.8 Mounting Pitch

- Duct Ventilation

  When heat sink section of Servopack is stored on the panel exterior or in the duct, refer to Fig. 9.9.



Mounting of Duct Ventilation Type



Panel Punching size

Fig. 9.9 Mounting **Servopack**

9.3 WIRING

9.3.1 Rated Current and Cable Size

Tables 9.1 and 9.2 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 9.3 lists the type of cables.

Table 9.1 Rated Current

External Terminal		Type CACR- / Symbol	Rated Current A (Effective Current)								
			SR02BE	SR03BE	SR05BE	SR07BE	SR10BE	SR15BE	SR20BE	SR30BE	SR44BE
On Line	Main Circuit Power Input	R,S,T	2	2	5	6	8	10	12	18	24
	Motor Connection	U,V,W	3.0	3.0	4.2	5.8	7.6	11.7	18.8	26.0	33.0
	Control Power Input	r, t	0.5								
Off Line	Control I/O Signal Connector	1CN	100 mA DC max								
	PG Signal Connector	2CN	100 mA DC max (500 mA DC for power line only)								
	Ground	⏚	—								

Table 9.2 Recommended Cable Size of ***Servopack***

External Terminal		Type CACR- / Symbol	Cable Size mm²								
			SR02BE	SR03BE	SR05BE	SR07BE	SR10BE	SR15BE	SR20BE	SR30BE	SR44BE
On Line	Main Circuit Power Input	R,S,T	HIV 1.25 or more			HIV 2.0 or more		HIV 3.5 or more		HIV 5.5 or more	HIV 5.5 or more
	Motor Connection	U,V,W	HIV 1.25 or more			HIV 2.0 or more	HIV 1.25 or more				
	Control Power Input	r, f	HIV 1.25 or more								
Off Line	Control I/O Signal Connector	1CN	• Two-core twisted shielded cable • Core must be 0.2 mm² or more • Tin-plated soft-copper twisted cabje • Finished cable dimension: 16 dia or less for 1CN. 11 dia or less for 2CN								
	PG Signal Connector	2CN									
	Ground	⏚	HIV 2.0 or more								

Notes: 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.

9.3.2 Wiring Precautions

Servopack is a device for speed control of 3000:1, 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. DP9400064 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 100 Ω 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 insert 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 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 mm^2). Avoid using excessive force which may damage these cables.

9.3.3 Power Loss

The power loss of Servopack is shown in **Table 9.3.**

Table 9.3 Power Loss at Rated Output

Servopack Type CACR-	Output Current A	Power Loss			
		Main Circuit W	Regenerative Resistance W	Control Circuit W	Total W
SR02BE	3.0	20	10	60	90
SR03BE	3.0	20			90
SR05BE	4.2	40			110
SR07BE	5.8	60	20		140
SR10BE	7.6	70			150
SR15BE	11.7	80			160
SR20BE	18.8	100	40		200
SR30BE	26.0	160	80		300
SR44BE	33.0	210	100		370

Note: The regenerative risistor causes power loss when the motor is decelerated, but is negligible if the motor is not started and stopped frequently.

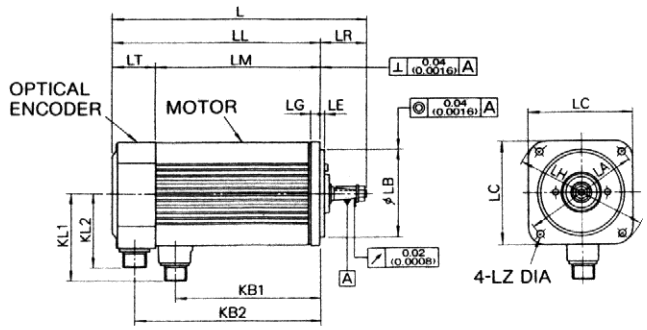
10. DIMENSIONS in mm (inches)

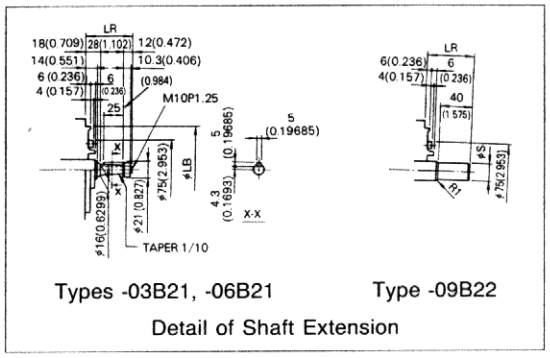
10.1 SERVOMOTOR

10.1.1 M Series

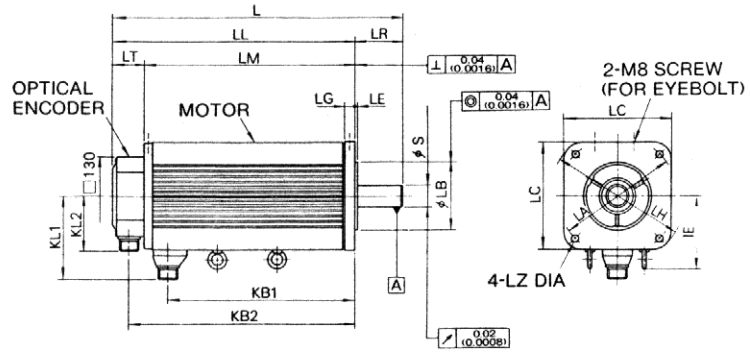
(1) Standard Type

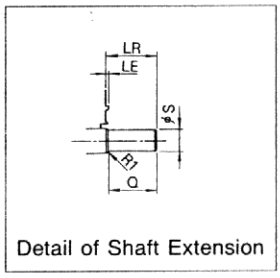
• Types USAMED-03B21, -06B21 (Taper Shaft), -09B22(Straight Shaft)





• Types USAMED-12B22, -20B22, -30B22, -44B22 (Straight Shaft)





AC Servomotor. Type USAMED-	L	LL	LM	LR	LT	KB1	KB2	IE	KL1	KL2	Flange Surface							Shaft Extension		Approx Weight kg (lb)
											LA	LB	LC	LE	LG	LH	LZ	S	Q	
03B21*	263 (10.34)	205 (8.06)	150 (5.9)	58 (2.28)	55 (2.16)	127 (5.0)	177 (6.97)	—	109 (4.29)	92 (3.62)	145 (5.71)	110 (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	8.5 (18.7)
06B21*	320 (12.59)	262 (10.31)	207 (8.15)	58 (2.28)	55 (2.16)	184 (7.24)	234 (9.21)	—	109 (4.29)	92 (3.62)	145 (5.71)	110 (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	13 (28.7)
09B22*	389 (15.31)	331 (13.03)	276 (10.87)	58 (2.28)	55 (2.16)	253 (9.96)	303 (11.93)	—	109 (4.29)	92 (3.62)	145 (5.71)	110 (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	22 ($^{0}_{-0.013}$ $^{0}_{-0.0005}$)	40 (1.575)	20 (44.1)
12B22*	343 (13.49)	264 (10.38)	211 (8.30)	79 (3.11)	53 (2.08)	171 (6.73)	237 (9.33)	—	139 (5.47)	92 (3.62)	200 (7.87)	114.3 (4.5 $^{0}_{-0.001}$)	180 (7.08)	3.2 (0.13)	18 (0.71)	230 (9.1)	13.5 (0.53)	35 ($^{+0.01}_{0}$ $^{+0.0004}_{0}$)	76 (2.992)	22 (48.5)
20B22	401 (15.79)	322 (12.68)	269 (10.60)	79 (3.11)	53 (2.08)	229 (9.01)	295 (11.61)	123 (4.84)	139 (5.47)	92 (3.62)	200 (7.87)	114.3 (4.5 $^{0}_{-0.001}$)	180 (7.08)	3.2 (0.13)	18 (0.71)	230 (9.1)	13.5 (0.53)	35 ($^{+0.01}_{0}$ $^{+0.0004}_{0}$)	76 (2.992)	29 (63.9)
30B22	486 (19.13)	407 (16.02)	354 (13.94)	79 (3.11)	53 (2.08)	314 (12.36)	380 (14.96)	123 (4.84)	139 (5.47)	92 (3.62)	200 (7.87)	114.3 (4.5 $^{0}_{-0.001}$)	180 (7.08)	3.2 (0.13)	18 (0.71)	230 (9.1)	13.5 (0.53)	35 ($^{+0.01}_{0}$ $^{+0.0004}_{0}$)	76 (2.992)	41 (90.4)
44B22	687 (27.04)	577 (22.71)	524 (20.63)	110 (4.33)	53 (2.08)	476 (18.74)	550 (21.65)	124 (4.88)	149 (5.87)	92 (3.62)	200 (7.87)	114.3 (4.5 $^{0}_{-0.001}$)	180 (7.08)	3.2 (0.13)	18 (0.71)	230 (9.1)	13.5 (0.53)	42 ($^{0}_{-0.016}$ $^{0}_{-0.0006}$)	110 (4.33)	66 (145.5)

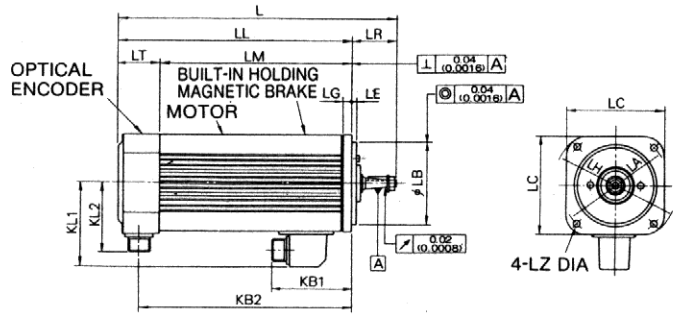
* Not Provided with an eyebolt.

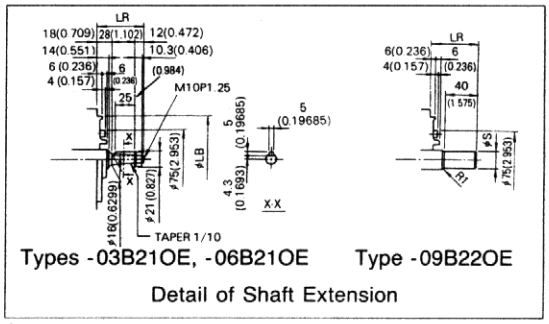
† TIR: Total Indicator Reading

Notes: 1. Optical encoder 8192 pulses/rev is used as a detector.
2. Vibration: 15 μm or below.
3. Plug and clamp are not attached for receptacle connection.
4. Connector specifications: Refer to Table 3.6.
5. It is recommended that the motor be mounted with its connector placed down.

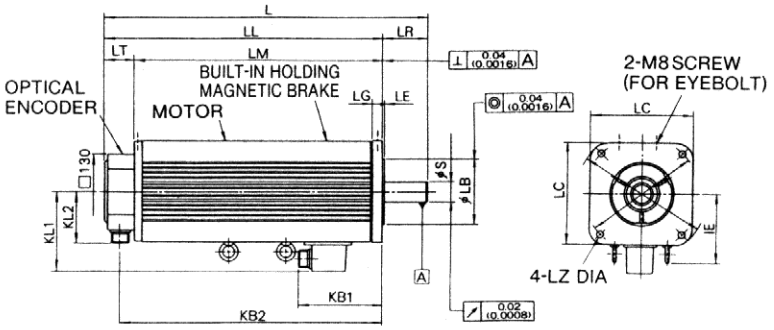
(2) With Brake

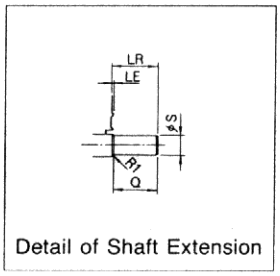
• Types USAMED-03B21OE, -06B21OE (Taper Shaft), -09B22OE (Straight Shaft)





• Types USAMED -12B22OE, -20B22OE, -30B22OE (Straight Shaft)



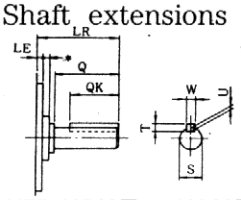


AC Servomotor Type USAMED-	L	LL	LM	LR	LT	KB1	KB2	IE	KL1	KL2	Flange Surface							Shaft Extension		Approx Weight kg (lb)	BRAKE	
											LA	LB	LC	LE	LG	LH	LZ	S	Q		BRAKING TORQIE N•m (kgf•cm)	INERTIA (GD²)/kg•m²
03B210E	321 (12.64)	263 (10.36)	208 (8.2)	58 (2.28)	55 (2.16)	118 (4.65)	235 (9.25)	—	112 (4.41)	92 (3.62)	145 (5.71)	110 (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	11.5 (25.4)	5.88 (0.6)	3.4 x 10^{-4}
06B210E	366 (14.41)	308 (12.13)	253 (9.97)	58 (2.28)	55 (2.16)	105 (4.13)	280 (11.02)	—	112 (4.41)	92 (3.62)	145 (5.71)	110 (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	15 (33.1)		
09B220E	436 (17.17)	378 (14.89)	323 (12.73)	58 (2.28)	55 (2.16)	108 (4.25)	350 (13.78)	—	112 (4.41)	92 (3.62)	145 (5.71)	110 (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	22 $^{0}_{-0.0005}$) (0.8661 $^{0}_{-0.0005}$)	40 (1.575)	23 (50.7)	6.53 (0.9)	
12B220E	421 (16.57)	342 (13.46)	289 (11.38)	79 (3.11)	53 (2.08)	148 (5.83)	315 (12.4)	—	142 (5.59)	92 (3.62)	200 (7.87)	114.3 $^{0}_{-0.001}$) (4.5 $^{0}_{-0.001}$)	180 (7.08)	3.2 (0.13)	18 (0.71)	230 (9.1)	13.5 (0.53)	35 $^{+0.001}_{0}$ (1.3779 $^{+0.0004}_{0}$)	76 (2.992)	30 (66.2)	35.28 (3.6)	2.5 x 10^{-4}
20B220E	486 (19.13)	407 (16.02)	354 (13.94)	79 (3.11)	53 (2.08)	148 (5.83)	380 (14.96)	123 (4.84)	142 (5.59)	92 (3.62)	200 (7.87)	114.3 $^{0}_{-0.001}$) (4.5 $^{0}_{-0.001}$)	180 (7.08)	3.2 (0.13)	18 (0.71)	230 (9.1)	13.5 (0.53)	35 $^{+0.001}_{0}$ (1.3779 $^{+0.0004}_{0}$)	76 (2.992)	37 (81.6)		
30B220E	567 (22.32)	488 (19.21)	435 (17.13)	79 (3.11)	53 (2.08)	148 (5.83)	461 (18.15)	123 (4.84)	142 (5.59)	92 (3.62)	200 (7.87)	114.3 $^{0}_{-0.001}$) (4.5 $^{0}_{-0.001}$)	180 (7.08)	3.2 (0.13)	18 (0.71)	230 (9.1)	13.5 (0.53)	35 $^{+0.001}_{0}$ (1.3779 $^{+0.0004}_{0}$)	76 (2.992)	49 (108)		

* Not provided with an eyebolt.
† TIR: Total Indicator Reading
Notes: 1. Optical encoder 8192 pulses/rev is used as a detector.
2. Vibration: 15 μm or below.
3. Plug and clamp are not attached for receptacle connection.
4. Connector specifications: Refer to Table 3.7.
5. It is recommended that the motor be mounted with its connector placed down.
6. Power supply for brake is 90VDC.
7. Type USAMED-44B22OB is for 44kW. Contact your Yaskawa representative.

(3) Shaft Extension of Straight Shaft with Keyway

Both Servomotors with brake and without brake have the same dimensions except for shaft extension. Shaft extensions are shown below:



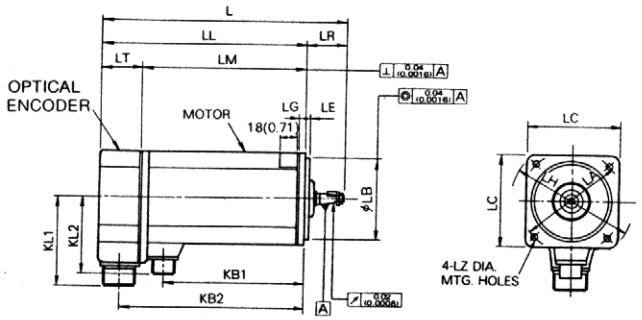
* 6 mm (0.236 in.) for USAMED-03B22□ to 09B22□

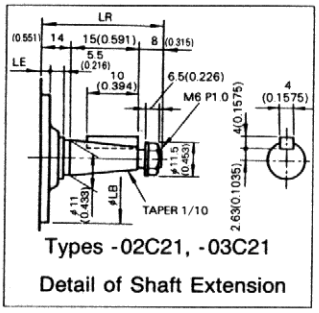
Motor Type		LR	LE	Dimensions of Shaft Extension					
Without Brake	With Brake			S	Q	QK	T	U	W
*USAMED-03B22K	*USAMED-03B22KE	58 (2.28)	6 (0.24)	19 $^{0}_{-0.0005}$) (0.7480 $^{0}_{-0.0005}$)	40 (1.57)	25 (0.98)	5 (0.1968)	3 (0.1181)	5 (0.1968)
*USAMED-06B22K	*USAMED-06B22KE	58 (2.28)	6 (0.24)	19 $^{0}_{-0.0005}$) (0.7480 $^{0}_{-0.0005}$)	40 (1.57)	25 (0.98)	5 (0.1968)	3 (0.1181)	5 (0.1968)
*USAMED-09B22K	*USAMED-09B22KE	58 (2.28)	6 (0.24)	22 $^{0}_{-0.0005}$) (0.8661 $^{0}_{-0.0005}$)	40 (1.57)	25 (0.98)	6 (0.2362)	3.5 (0.1378)	6 (0.2362)
USAMED-12B22K	USAMED-12B22KE	79 (3.11)	3.2 (0.13)	35 $^{+0.001}_{0}$ (1.3379 $^{+0.0004}_{0}$)	76 (2.99)	60 (2.36)	8 (2.2835)	5 (0.1968)	10 (0.3937)
USAMED-20B22K	USAMED-20B22KE	79 (3.11)	3.2 (0.13)	35 $^{+0.001}_{0}$ (1.3379 $^{+0.0004}_{0}$)	76 (2.99)	60 (2.36)	8 (2.2835)	5 (0.1968)	10 (0.3937)
USAMED-30B22K	USAMED-30B22KE	79 (3.11)	3.2 (0.13)	35 $^{+0.001}_{0}$ (1.3379 $^{+0.0004}_{0}$)	76 (2.99)	60 (2.36)	8 (2.2835)	5 (0.1968)	10 (0.3937)
USAMED-44B22K	USAMED-44B22KB	110 (4.33)	3.2 (0.13)	42 $^{0}_{-0.0006}$) (1.6535 $^{0}_{-0.0006}$)	110 (4.33)	90 (3.54)	8 (2.2835)	5 (0.1968)	12 (0.3937)

10.1.2 F Series

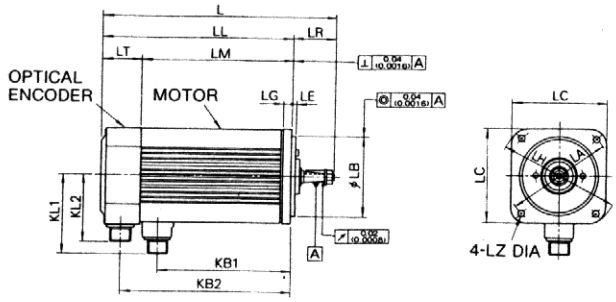
(1) Standard Type

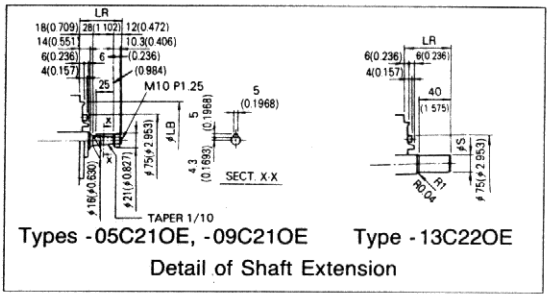
• Types USAFED-02C21, -03C21 (Taper Shaft)



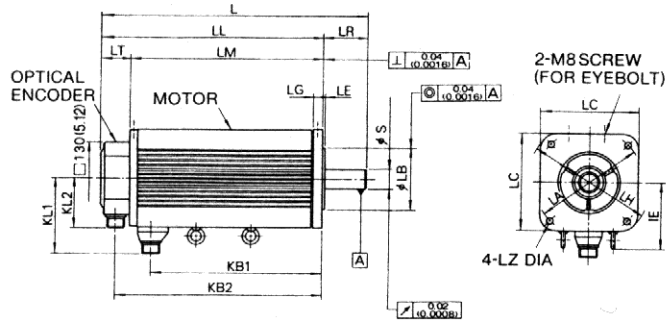


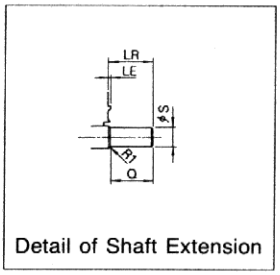
• Types USAFED-05C21, -09C21 (Taper Shaft), -13C22 (Straight Shaft)





• Types USAFED-20C22, -30C22, -44C22 (Straight Shaft)





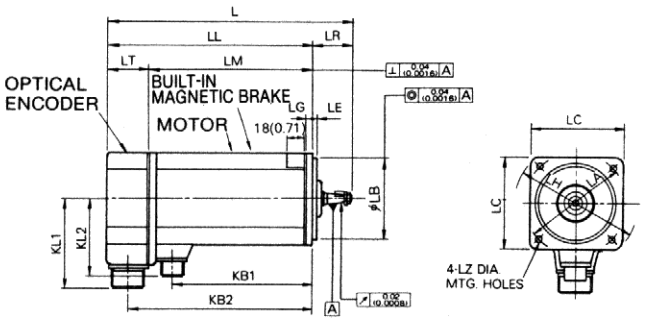
AC Servomotor Type USAFED-	L	LL	LM	LR	LT	KB1	KB2	IE	KL1	KL2	Flange Surface							Shaft Extension		Approx Weight kg (lb)
											LA	LB	LC	LE	LG	LH	LZ	S	Q	
02C21*	190 (7.48)	153 (6.02)	113 (4.45)	37 (1.46)	40 (1.57)	90 (3.54)	132 (5.19)	—	76 (3.43)	89 (2.99)	100 (3.94)	80 $^{0}_{-0.030}$ (3.1496 $^{0}_{-0.0012}$)	90 (3.54)	4 (0.157)	7 (0.276)	120 (4.72)	6.6 (0.26)	—	—	3.5 (7.7)
03C21*	236 (9.29)	199 (7.83)	159 (6.26)	37 (1.46)	40 (1.57)	136 (5.35)	178 (7.0)	—	76 (3.43)	89 (2.99)	100 (3.94)	80 $^{0}_{-0.030}$ (3.1496 $^{0}_{-0.0012}$)	90 (3.54)	4 (0.157)	7 (0.276)	120 (4.72)	6.6 (0.26)	—	—	4.0 (8.8)
05C21*	263 (10.35)	205 (8.07)	150 (5.91)	58 (2.28)	55 (2.16)	127 (5.0)	177 (6.97)	—	109 (4.29)	92 (3.62)	145 (5.71)	110 $^{0}_{-0.035}$ (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	8.5 (18.7)
09C21*	320 (12.6)	262 (10.32)	207 (8.16)	58 (2.28)	55 (2.16)	184 (7.24)	234 (9.21)	—	109 (4.29)	92 (3.62)	145 (5.71)	110 $^{0}_{-0.035}$ (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	13 (28.7)
13C22*	389 (15.31)	331 (13.03)	276 (10.87)	58 (2.28)	55 (2.16)	253 (9.96)	303 (11.93)	—	109 (4.29)	92 (3.62)	145 (5.71)	110 $^{0}_{-0.035}$ (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	22 $^{0}_{-0.013}$ (0.8661 $^{0}_{-0.0005}$)	40 (1.57)	20 (44.1)
20C22*	343 (13.5)	264 (10.39)	211 (8.3)	79 (3.11)	53 (2.09)	171 (6.73)	237 (9.33)	—	139 (5.47)	92 (3.62)	200 (7.88)	114.3 $^{0}_{-0.025}$ (4.5 $^{0}_{-0.001}$)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.06)	13.5 (0.53)	35 $^{+0.01}_{0}$ (1.3379 $^{+0.0004}_{0}$)	76 (2.99)	22 (48.5)
30C22	401 (15.79)	322 (12.68)	269 (10.59)	79 (3.11)	53 (2.09)	229 (9.02)	295 (11.61)	123 (4.85)	139 (5.47)	92 (3.62)	200 (7.88)	114.3 $^{0}_{-0.025}$ (4.5 $^{0}_{-0.001}$)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.06)	13.5 (0.53)	35 $^{+0.01}_{0}$ (1.3379 $^{+0.0004}_{0}$)	76 (2.99)	29 (63.9)
44C22	486 (19.14)	407 (16.02)	354 (13.93)	79 (3.11)	53 (2.09)	314 (12.36)	380 (14.96)	123 (4.85)	139 (5.47)	92 (3.62)	200 (7.88)	114.3 $^{0}_{-0.025}$ 4.5 $^{0}_{-0.001}$)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.06)	13.5 (0.53)	35 $^{+0.01}_{0}$ (1.3379 $^{+0.0004}_{0}$)	76 (2.99)	41 (90.4)

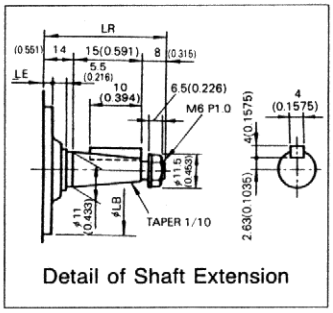
* Not Provided with an eyebolt.

Notes: 1. Optical encoder 8192 pulses/rev is used as a detector.
2. Vibration: 15 μm or below.
3. Plug and clamp are not attached for receptacle connection.
4. Connector specifications: Refer to Table 3.7.
5. It is recommended that the motor be mounted with its connector placed down.
6. Power suppily for brake is 90VDC.

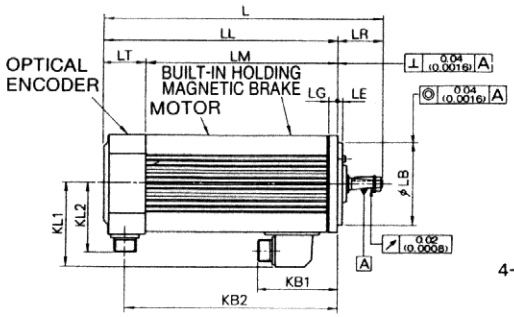
(2) With Brake

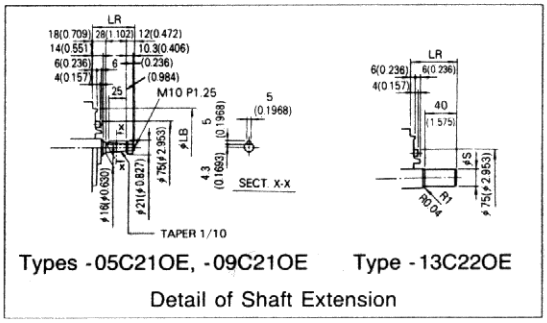
• Types USAFED-02C21OE, -03C21OE (Taper Shaft)



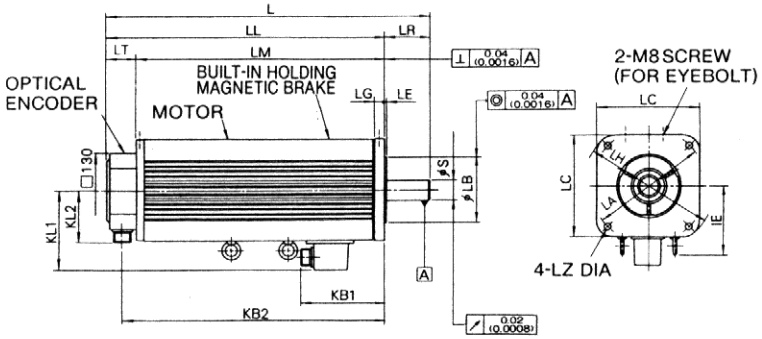


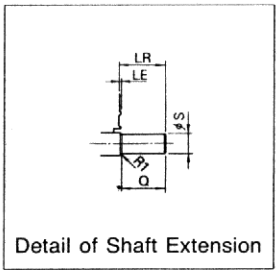
• Types USAFED-05C21OE, -09C21OE (Taper Shaft), -13C22OE (Straight Shaft)





• Types USAFED-20C22OE, -30C22OE, -44C22OE (Straight Shaft)



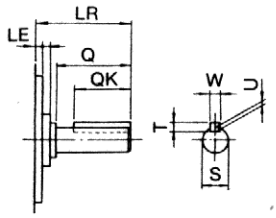


AC Servomotor Type USAFED-	L	LL	LM	LR	LT	KB1	KB2	IE	KL1	KL2	Flange Surface							Shaft Extension		Approx Weight kg (lb)	BRAKE	
											LA	LB	LC	LE	LG	LH	LZ	S	Q		BRAKING TORQIE N·m (kgf·cm)	INERTIA (GD²)/kg·m²
02C21OE	236 (9.29)	199 (7.83)	159 (6.26)	37 (1.46)	40 (1.57)	24 (0.95)	178 (7.0)	—	76 (3.43)	89 (2.99)	100 (3.94)	80 (3.1496)	90 (3.54)	4 (0.157)	7 (0.276)	120 (4.72)	6.6 (0.26)	—	—	4.4 (9.7)	0.98 (0.1)	0.3 x 10⁻⁴
03C21OE	286 (11.26)	249 (9.8)	209 (8.23)	37 (1.46)	40 (1.57)	24 (0.95)	228 (8.98)	—	76 (3.43)	89 (2.99)	100 (3.94)	80 (3.1496)	90 (3.54)	4 (0.157)	7 (0.276)	120 (4.72)	6.6 (0.26)	—	—	5.0 (11)	1.47 (0.15)	0.3 x 10⁻⁴
05C21OE	321 (12.64)	263 (10.36)	208 (8.20)	58 (2.28)	55 (2.16)	118 (4.65)	235 (9.25)	—	112 (4.41)	92 (3.62)	145 (5.71)	110 (4.3307)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	11.5 (25.4)	5.88 (0.6)	3.4 x 10⁻⁴
09C21OE	366 (14.41)	308 (12.13)	253 (9.97)	58 (2.28)	55 (2.16)	105 (4.13)	280 (11.02)	—	112 (4.41)	92 (3.62)	145 (5.71)	110 (4.3307)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	15 (33.1)		
13C22OE	436 (17.17)	378 (14.89)	323 (12.73)	58 (2.28)	55 (2.16)	108 (4.25)	350 (13.78)	—	112 (4.41)	92 (3.62)	145 (5.71)	110 (4.3307)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	22 (0.8661)	40 (1.57)	23 (50.7)	6.53 (0.9)	
20C22OE	421 (16.57)	342 (13.46)	289 (11.38)	79 (3.11)	53 (2.09)	148 (5.83)	315 (12.4)	—	142 (5.59)	92 (3.62)	200 (7.88)	114.3 (4.5)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.6)	13.5 (0.53)	35 (1.3379)	76 (2.99)	30 (66.2)	35.28 (3.6)	2.5 x 10⁻⁴
30C22OE	486 (19.13)	407 (16.02)	354 (13.94)	79 (3.11)	53 (2.09)	148 (5.83)	380 (14.96)	123 (4.85)	142 (5.59)	92 (3.62)	200 (7.88)	114.3 (4.5)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.6)	13.5 (0.53)	35 (1.3379)	76 (2.99)	37 (81.6)		
44C22OE	567 (22.32)	488 (19.21)	435 (17.13)	79 (3.11)	53 (2.09)	148 (5.83)	461 (18.15)	123 (4.85)	142 (5.59)	92 (3.62)	200 (7.88)	114.3 (4.5)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.6)	13.5 (0.53)	35 (1.3379)	76 (2.99)	49 (108.1)		

* Not provided with an eyebolt.
† TIR: Total Indicator Reading
Notes: 1. Optical encoder 8192 pulses/rev is used as a detector.
2. Vibration: 15μm or below.
3. Plug and clamp are not attached for receptacle connection.
4. Connector specifications: Refer to Table 3.7.
5. It is recommended that the motor be mounted with its connector placed down.
6. Power supply for brake is 90VDC.

(3) Shaft Extension of Straight Shaft with Keyway

Both Servomotors with brake and without brake have the same dimensions except for shaft extension. Shaft extensions are shown below:



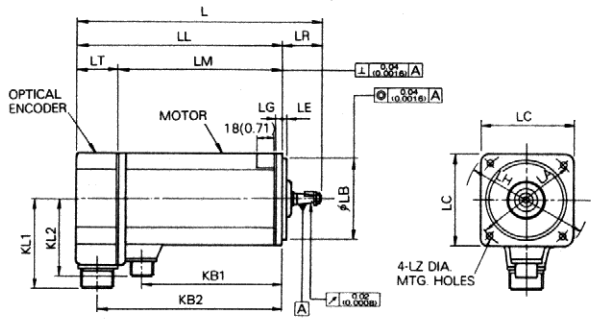
Motor Type		LR	LE	Dimensions of Shaft Extension					
Without Brake	With Brake			S	Q	QK	T	U	W
*USAFED-02C22K	*USAFED-02C22KE	37 (1.46)	4 (0.157)	14 (0.5512 $^{0}_{-0.011}$ $^{0}_{-0.0004}$)	25 (0.98)	15 (0.59)	5 (0.1968)	3 (0.1181)	5 (0.1968)
*USAFED-03C22K	*USAFED-03C22KE	37 (1.46)	4 (0.157)	14 (0.5512 $^{0}_{-0.011}$ $^{0}_{-0.0004}$)	25 (0.98)	15 (0.59)	5 (0.1968)	3 (0.1181)	5 (0.1968)
*USAFED-05C22K	*USAFED-05C22KE	58 (2.28)	6 (0.24)	19 (0.7480 $^{0}_{-0.013}$ $^{0}_{-0.0005}$)	40 (1.57)	25 (0.98)	5 (0.1968)	3 (0.1181)	5 (0.1968)
*USAFED-09C22K	*USAFED-09C22KE	58 (2.28)	6 (0.24)	19 (0.7480 $^{0}_{-0.013}$ $^{0}_{-0.0005}$)	40 (1.57)	25 (0.98)	5 (0.1968)	3 (0.1181)	5 (0.1968)
*USAFED-13C22K	*USAFED-13C22KE	58 (2.28)	6 (0.24)	22 (0.8661 $^{0}_{-0.013}$ $^{0}_{-0.0005}$)	40 (1.57)	25 (0.98)	6 (0.2362)	3.5 (0.1378)	6 (0.2362)
USAFED-20C22K	USAFED-20C22KE	79 (3.11)	3.2 (0.13)	35 (1.3379 $^{+0.01}_{0}$ $^{+0.0004}_{0}$)	76 (2.99)	60 (2.36)	8 (2.2835)	5 (0.1968)	10 (0.3937)
USAFED-30C22K	USAFED-30C22KE	79 (3.11)	3.2 (0.13)	35 (1.3379 $^{+0.01}_{0}$ $^{+0.0004}_{0}$)	76 (2.99)	60 (2.36)	8 (2.2835)	5 (0.1968)	10 (0.3937)
USAFED-44C22K	USAFED-44C22KB	79 (3.11)	3.2 (0.13)	35 (1.3379 $^{+0.01}_{0}$ $^{+0.0004}_{0}$)	76 (2.99)	60 (2.36)	8 (2.2835)	5 (0.1968)	10 (0.3937)

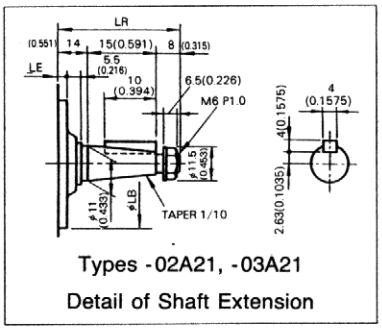
*: 4 mm (in.) for USAFED-02C22☐ and 03C22☐
6 mm (in.) for USAFED-05C22☐ to 13C22☐

10.1.3 G Series

(1) Standard Type

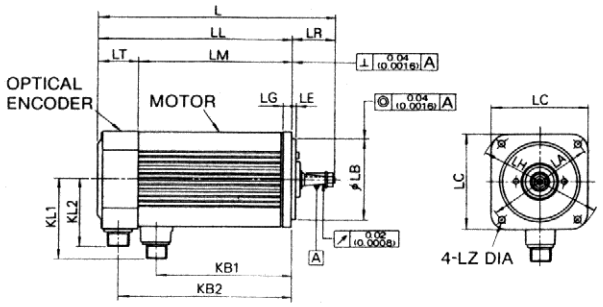
• Types USAGED-02A21, -03A21 (Taper Shaft)

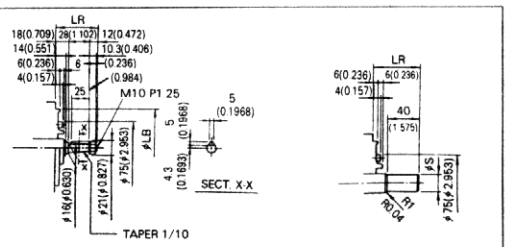




Types -02A21, -03A21
Detail of Shaft Extension

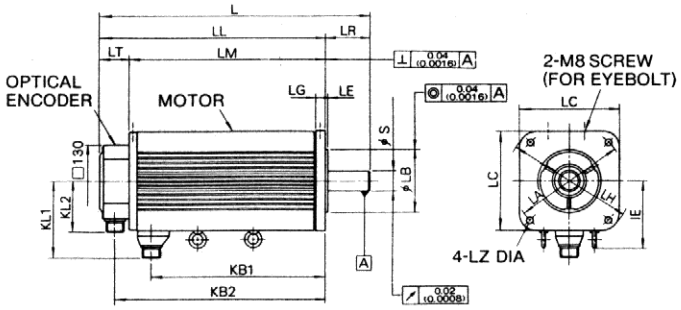
• Types USAGED-05A21, -09A21 (Taper Shaft), -13A22 (Straight Shaft)

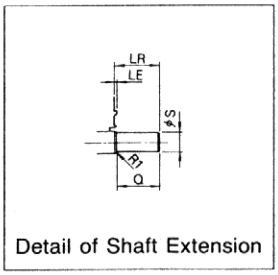




Types -05A21, -09A21 Type -13A22
Detail of Shaft Extension

• Types USAGED-20A22, -30A22, -44A22 (Straight Shaft)





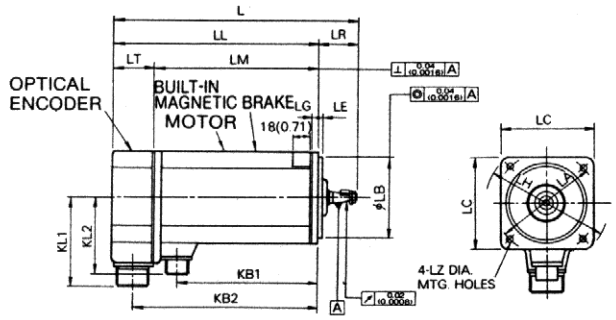
Detail of Shaft Extension

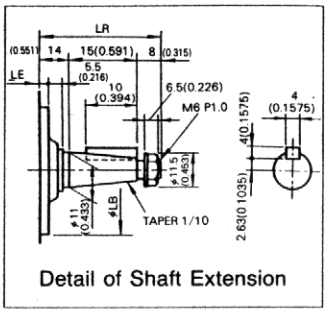
AC Servomotor Type USAGED-	L	LL	LM	LR	LT	KB1	KB2	IE	KL1	KL2	Flange Surface							Shaft Extension		Approx Weight kg (lb)
											LA	LB	LC	LE	LG	LH	LZ	S	Q	
02A21*	190 (7.48)	153 (6.02)	113 (4.45)	37 (1.46)	40 (1.57)	90 (3.54)	132 (5.19)	—	76 (3.43)	89 (2.99)	100 (3.94)	80 $^{0}_{-0.030}$ (3.1496 $^{0}_{-0.0012}$)	90 (3.54)	4 (0.157)	7 (0.276)	120 (4.72)	6.6 (0.26)	—	—	3.5/(7.7)
03A21*	236 (9.29)	199 (7.83)	159 (6.26)	37 (1.46)	40 (1.57)	136 (5.35)	178 (7.0)	—	76 (3.43)	89 (2.99)	100 (3.94)	80 $^{0}_{-0.030}$ (3.1496 $^{0}_{-0.0012}$)	90 (3.54)	4 (0.157)	7 (0.276)	120 (4.72)	6.6 (0.26)	—	—	4.0/(8.8)
05A21*	263 (10.35)	205 (8.07)	150 (5.91)	58 (2.28)	55 (2.16)	127 (5.0)	177 (6.97)	—	109 (4.29)	92 (3.62)	145 (5.71)	110 $^{0}_{-0.035}$ (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	8.5/(18.7)
09A21*	320 (12.6)	262 (10.32)	207 (8.16)	58 (2.28)	55 (2.16)	184 (7.24)	234 (9.21)	—	109 (4.29)	92 (3.62)	145 (5.71)	110 $^{0}_{-0.035}$ (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	13/(28.7)
13A22*	389 (15.31)	331 (13.03)	276 (10.87)	58 (2.28)	55 (2.16)	253 (9.96)	303 (11.93)	—	109 (4.29)	92 (3.62)	145 (5.71)	110 $^{0}_{-0.0035}$ (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	22 $^{0}_{-0.013}$ (0.8661 $^{0}_{-0.0005}$)	40 (1.57)	20/(44.1)
20A22*	343 (13.5)	264 (10.39)	211 (8.3)	79 (3.11)	53 (2.09)	171 (6.73)	237 (9.33)	—	139 (5.47)	92 (3.62)	200 (7.88)	114.3 $^{0}_{-0.025}$ (4.5 $^{0}_{-0.001}$)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.06)	13.5 (0.53)	35 $^{+0.01}_{0}$ (1.3379 $^{+0.0004}_{0}$)	76 (2.99)	22/(48.5)
30A22	401 (15.79)	322 (12.68)	269 (10.59)	79 (3.11)	53 (2.09)	229 (9.02)	295 (11.61)	123 (4.85)	139 (5.47)	92 (3.62)	200 (7.88)	114.3 $^{0}_{-0.025}$ (4.5 $^{0}_{-0.001}$)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.06)	13.5 (0.53)	35 $^{+0.01}_{0}$ (1.3379 $^{+0.0004}_{0}$)	76 (2.99)	29/(63.9)
44A22	486 (19.14)	407 (16.02)	354 (13.93)	79 (3.11)	53 (2.09)	314 (12.36)	380 (14.96)	123 (4.85)	139 (5.47)	92 (3.62)	200 (7.88)	114.3 $^{0}_{-0.025}$ (4.5 $^{0}_{-0.001}$)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.06)	13.5 (0.53)	35 $^{+0.01}_{0}$ (1.3379 $^{+0.0004}_{0}$)	76 (2.99)	41/(90.4)

* Not provided with an eyebolt.
† TIR: Toral Indicator Reading
Notes: 1. Optical encoder 8192 pulses/rev is used as a detector.
2. Vibration: 15 μm or below.
3. Plug and clamp are not attached for receptacle connection.
4. Connector specifications: Refer to Table 3.8.
5. It is recommended that the motor be mounted with its connector placed down.

(2) With Brake

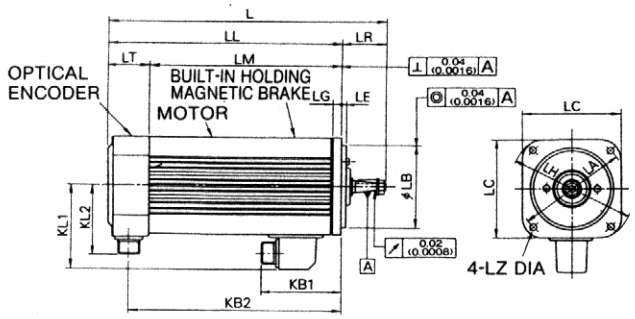
• Types USAGED-02A21OE, -03A21OE (Taper Shaft)

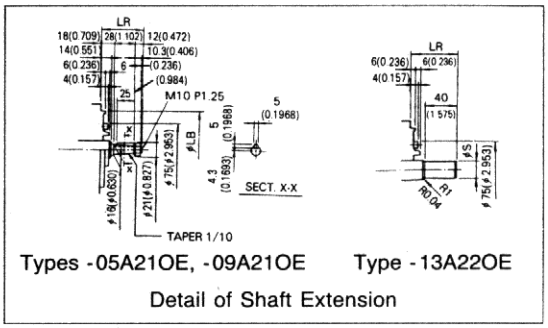




Detail of Shaft Extension

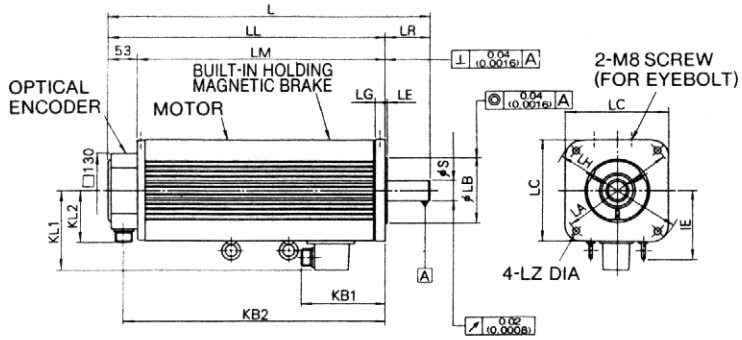
• Types USAGED-05A21OE, -09A21OE (Taper Shaft), -13A22OE (Straight Shaft)

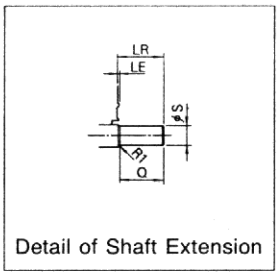




Detail of Shaft Extension

• Types USAGED-20A22OE, -30A22OE, -44A22OE (Straight Shaft)





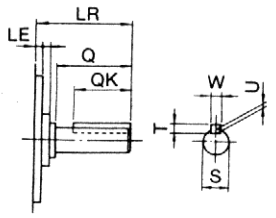
Detail of Shaft Extension

AC Servomotor Type USAGED-	L	LL	LM	LR	LT	KB1	KB2	IE	KL1	KL2	Flange Surface							Shaft Extension		Approx Weight kg (lb)	BRAKE	
											LA	LB	LC	LE	LG	LH	LZ	S	Q		BRAKING TORQUE N-m (kgf-cm)	INERTIA $(GD^2)/kg \cdot m^2$
02A21OE	236 (9.29)	199 (7.83)	159 (6.26)	37 (1.46)	40 (1.57)	24 (0.95)	178 (7.0)	—	76 (3.43)	89 (2.99)	100 (3.94)	80 $^{0}_{-0.030}$ ($3.1496\ ^{0}_{-0.0012}$)	90 (3.54)	4 (0.157)	7 (0.276)	120 (4.72)	6.6 (0.26)	—	—	4.4 (9.7)	0.98 (0.1)	0.3×10^{-4}
03A21OE	286 (11.26)	249 (9.8)	209 (8.23)	37 (1.46)	40 (1.57)	24 (0.95)	228 (8.98)	—	76 (3.43)	89 (2.99)	100 (3.94)	80 $^{0}_{-0.030}$ ($3.1496\ ^{0}_{-0.0012}$)	90 (3.54)	4 (0.157)	7 (0.276)	120 (4.72)	6.6 (0.26)	—	—	5.0 (11)	1.47 (0.15)	0.3×10^{-4}
05A21OE	321 (12.64)	263 (10.36)	208 (8.20)	58 (2.28)	55 (2.16)	118 (4.65)	235 (9.25)	—	112 (4.41)	92 (3.62)	145 (5.71)	110 $^{0}_{-0.035}$ ($4.3307\ ^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	11.5 (25.4)	5.88 (0.6)	3.4×10^{-4}
09A21OE	366 (14.41)	308 (12.13)	253 (9.97)	58 (2.28)	55 (2.16)	105 (4.13)	280 (11.02)	—	112 (4.41)	92 (3.62)	145 (5.71)	110 $^{0}_{-0.035}$ ($4.3307\ ^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	—	—	15 (33.1)		
13A22OE	436 (17.17)	378 (14.89)	323 (12.73)	58 (2.28)	55 (2.16)	108 (4.25)	350 (13.78)	—	112 (4.41)	92 (3.62)	145 (5.71)	110 $^{0}_{-0.035}$ ($4.3307\ ^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	22 $^{0}_{-0.013}$ ($0.8661\ ^{0}_{-0.0005}$)	40 (1.57)	23 (50.7)	6.53 (0.9)	
20A22OE	421 (16.57)	342 (13.46)	289 (11.38)	79 (3.11)	53 (2.09)	148 (5.83)	315 (12.4)	—	142 (5.59)	92 (3.62)	200 (7.88)	114.3 $^{0}_{-0.025}$ ($4.5\ ^{0}_{-0.001}$)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.06)	13.5 (0.53)	35 $^{+0.01}_{0}$ ($1.3379\ ^{+0.0004}_{0}$)	76 (2.99)	30 (66.2)	35.28 (3.6)	2.5×10^{-4}
30A22OE *	486 (19.13)	407 (16.02)	354 (13.94)	79 (3.11)	53 (2.09)	148 (5.83)	380 (14.96)	123 (4.85)	142 (5.59)	92 (3.62)	200 (7.88)	114.3 $^{0}_{-0.025}$ ($4.5\ ^{0}_{-0.001}$)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.06)	13.5 (0.53)	35 $^{+0.01}_{0}$ ($1.3379\ ^{+0.0004}_{0}$)	76 (2.99)	37 (81.6)		
44A22OE	567 (22.32)	488 (19.21)	435 (17.13)	79 (3.11)	53 (2.09)	148 (5.83)	461 (18.15)	123 (4.85)	142 (5.59)	92 (3.62)	200 (7.88)	114.3 $^{0}_{-0.025}$ ($4.5\ ^{0}_{-0.001}$)	180 (7.09)	3.2 (0.13)	18 (0.71)	230 (9.06)	13.5 (0.53)	35 $^{+0.01}_{0}$ ($1.3379\ ^{+0.0004}_{0}$)	76 (2.99)	49 (108.1)		

* Not provided with an eyebolt.
† TIR: Total Indicator Reading
Notes: 1. Optical encoder 8192 pulses/rev is used as a detector.
2. Vibration: 15 μm or below.
3. Plug and clamp are not attached for receptacle connection.
4. Connector specifications: Refer to Table 3.8.
5. It is recommended that the motor be mounted with its connector placed down.
6. Power supply for brake is 90VDC.

(3) Shaft Extension of Straight Shaft with Keyway

Both Servomotors with brake and without brake have the same dimensions except for shaft extension. Shaft extensions are shown below:



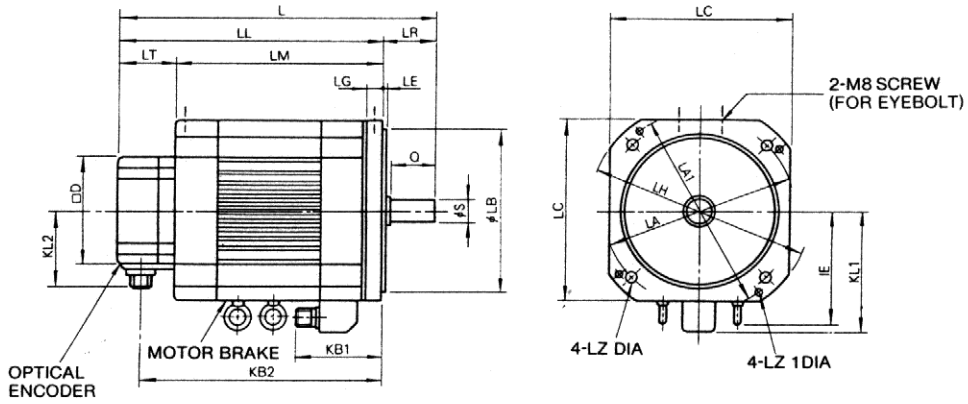
Motor Type		LR	LE	Dimensions of Shaft Extension					
Without Brake	With Brake			S	Q	QK	T	U	W
*USAGED-02A22K	*USAGED-02A22KE	37 (1.46)	4 (0.157)	14 (0.5512 $^{0}_{-0.011}$ $^{0}_{-0.0004}$)	25 (0.98)	15 (0.59)	5 (0.1968)	3 (0.1181)	5 (0.1968)
*USAGED-03A22K	*USAGED-03A22KE	37 (1.46)	4 (0.157)	14 (0.5512 $^{0}_{-0.011}$ $^{0}_{-0.0004}$)	25 (0.98)	15 (0.59)	5 (0.1968)	3 (0.1181)	5 (0.1968)
*USAGED-05A22K	*USAGED-05A22KE	58 (2.28)	6 (0.24)	19 (0.7480 $^{0}_{-0.013}$ $^{0}_{-0.0005}$)	40 (1.57)	25 (0.98)	5 (0.1968)	3 (0.1181)	5 (0.1968)
*USAGED-09A22K	*USAGED-09A22KE	58 (2.28)	6 (0.24)	19 (0.7480 $^{0}_{-0.013}$ $^{0}_{-0.0005}$)	40 (1.57)	25 (0.98)	5 (0.1968)	3 (0.1181)	5 (0.1968)
*USAGED-13A22K	*USAGED-13A22KE	58 (2.28)	6 (0.24)	22 (0.8661 $^{0}_{-0.013}$ $^{0}_{-0.0005}$)	40 (1.57)	25 (0.98)	6 (0.2362)	3.5 (0.1378)	6 (0.2362)
USAGED-20A22K	USAGED-20A22KE	79 (3.11)	3.2 (0.13)	35 (1.3379 $^{+0.01}_{0}$ $^{+0.0004}_{0}$)	76 (2.99)	60 (2.36)	8 (2.2835)	5 (0.1968)	10 (0.3937)
USAGED-30A22K	USAGED-30A22KE	79 (3.11)	3.2 (0.13)	35 (1.3379 $^{+0.01}_{0}$ $^{+0.0004}_{0}$)	76 (2.99)	60 (2.36)	8 (2.2835)	5 (0.1968)	10 (0.3937)
USAGED-44A22K	USAGED-44A22KB	79 (3.11)	3.2 (0.13)	35 (1.3379 $^{+0.01}_{0}$ $^{+0.0004}_{0}$)	76 (2.99)	60 (2.36)	8 (2.2835)	5 (0.1968)	10 (0.3937)

*: 4 mm (in.) for USAGED-02A22☐ and 03A22☐
6 mm (in.) for USAGED-05A22☐ to 13A22☐

10.1.4 D Series

(1) Standard Type

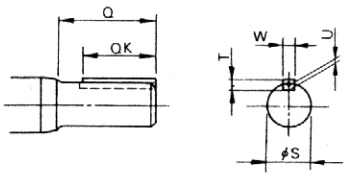
• Types USADED-05E32OE to -37E32OE



AC Servomotor Type USADED-	L	LL	LM	LR	LT	KB1	KB2	IE	KL1	KL2	D	Flange Surface									Shaft Extension		Approx Weight † kg (lb)
												LA	LA1	LB	LC	LE	LG	LH	LZ	LZ1	S	Q	
05E32OE	237 (9.33)	182 (7.17)	138 (5.44)	55 (2.16)	44 (1.73)	90 (3.54)	158 (6.22)	—	138 (5.43)	93 (3.66)	130 (5.12)	200 (7.87)	—	114.3 $^{0}_{-0.025}$ (4.5 $^{0}_{-0.001}$)	180 (7.09)	3.2 (0.126)	12 (0.472)	230 (9.06)	13.5 (0.53)	—	22 $^{0}_{-0.013}$ (0.8661 $^{0}_{-0.0005}$)	50 (1.97)	17 (16)/ 37.5 (35.3)
10E32OE	257 (10.12)	202 (7.96)	158 (6.23)	55 (2.16)	44 (1.73)	90 (3.54)	178 (7.0)	—	138 (5.43)	93 (3.66)	130 (5.12)	200 (7.87)	—	114.3 $^{0}_{-0.025}$ (4.5 $^{0}_{-0.001}$)	180 (7.09)	3.2 (0.126)	12 (0.472)	230 (9.06)	13.5 (0.53)	—	22 $^{0}_{-0.013}$ (0.8661 $^{0}_{-0.0005}$)	50 (1.97)	19 (18)/ 41.9 (39.7)
15E32OE	270 (10.63)	217 (8.47)	171 (6.66)	55 (2.16)	46 (1.81)	95 (3.74)	191 (7.52)	142 (5.59)	160 (6.3)	93 (3.66)	130 (5.12	235 (9.25)	250 (9.84)	200 $^{0}_{-0.046}$ (7.874 $^{0}_{-0.0018}$)	220 (8.66)	4 (0.157)	16 (0.63)	270 (10.63)	13.5 (0.53)	M8	28 $^{0}_{-0.013}$ (1.1024 $^{0}_{-0.0005}$)	50 (1.97)	30 (27)/ 66.2 (59.5)
22E32OE	285 (11.22)	232 (9.06)	186 (7.25)	55 (2.16)	46 (1.81)	95 (3.74)	206 (8.11)	142 (5.59)	160 (6.3)	93 (3.66)	130 (5.12)	235 (9.25)	250 (9.84)	200 $^{0}_{-0.046}$ (7.874 $^{0}_{-0.0018}$)	220 (8.66)	4 (0.157)	16 (0.63)	270 (10.63)	13.5 (0.53)	M8	28 $^{0}_{-0.013}$ (1.1024 $^{0}_{-0.0005}$)	50 (1.97)	32 (29)/ 70.6 (63.9)
37E32OE	345 (13.58)	282 (11.02)	236 (9.21)	65 (2.56)	46 (1.81)	95 (3.74)	256 (10.08)	142 (5.59)	160 (6.3)	93 (3.66)	130 (5.12)	235 (9.25)	250 (9.84)	200 $^{0}_{-0.046}$ (7.874 $^{0}_{-0.0018}$)	220 (8.66)	4 (0.157)	16 (0.63)	270 (10.63)	13.5 (0.53)	M8	32 $^{0}_{-0.016}$ (1.2598 $^{0}_{-0.0006}$)	60 (2.36)	39 (36)/ 86 (79.4)

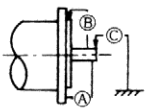
* Not provided with an eyebolt. †: ( ) shows without brake.
† TIR: Total Indicator Reading
Notes: 1. Optical encoder 2048 pulses/rev is used as a detector.
2. Plug and clamp are not attached for receptacle connection.
3. It is recommended that the motor be mounted with its connector placed down.
4. Both Servomotors with brake and without brake have the same dimension.

(2) Shaft Extension of Straight with Keyway



Note: Dimensions of the shaft extension key and keyway are based on JIS (Japanese Industrial Standard) B 1301 "Sunk Keys and Their Corresponding Keyways (Normal keys)." Shaft extension key is furnished.

Mechanical Specifications in mm

Accuracy (T.I.R.)†		Reference Diagram
Flange surface perpendicular to shaft Ⓐ	0.04 (0.06)*	
Flange diameter concentric to shaft Ⓑ	0.04	
Shaft run out Ⓒ	0.02	

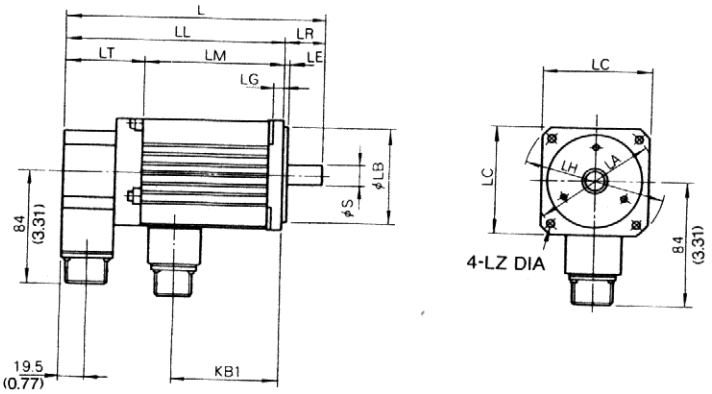
* Accuracy for motor types USADED -15E3, -22E3, and -37E3.
† T.I.R. (Total Indicator Reading)

AC Servomotor Type USADED-	Shaft Extension					
	S	Q	QK	T	U	W
05E32K□	22 $^{0}_{-0.021}$ (0.8661 $^{0}_{-0.0008}$)	50 (1.97)	45 (1.77)	6 (0.236)	3.5 (0.138)	6 (0.2362)
10E32K□	22 $^{0}_{-0.021}$ (0.8661 $^{0}_{-0.0008}$)	50 (1.97)	45 (1.77)	6 (0.236)	3.5 (0.138)	6 (0.2362)
15E32K□	28 $^{0}_{-0.013}$ (1.1024 $^{0}_{-0.0005}$)	50 (1.97)	45 (1.77)	7 (0.275)	4 (0.157)	8 (0.3149)
22E32K□	28 $^{0}_{-0.013}$ (1.1024 $^{0}_{-0.0005}$)	50 (1.97)	45 (1.77)	7 (0.275)	4 (0.157)	8 (0.3149)
37E32K□	32 $^{0}_{-0.016}$ (1.2598 $^{0}_{-0.0006}$)	60 (2.36)	50 (1.97)	8 (0.315)	5 (0.197)	10 (0.3937)

10.1.5 S Series

(1) Standard Type

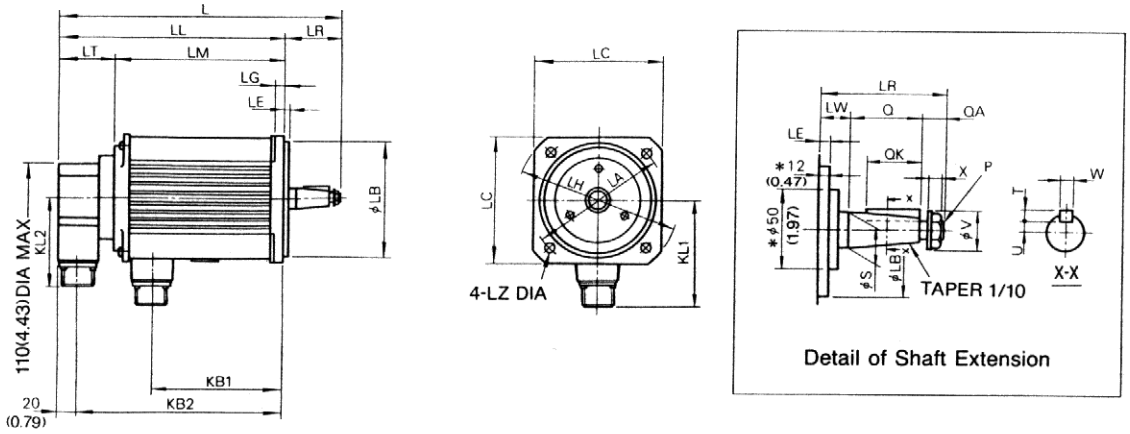
• Types USASEM-02A32, -03A32, -05A32 (Straight Shaft)



AC Servomotor Type USASEM-	L	LL	LM	LT	LR	KB1	Flange Surface and Shaft Extension								Approx Weight kg (lb)
							LA	LB	LC	LE	LG	LH	LZ	S	
02A32	164.5 (6.48)	134.5 (5.3)	95.5 (3.76)	39.5 (1.54)	30 (1.18)	76.5 (3.61)	80 (3.15)	50 $^{0}_{-0.025}$ (1.9685 $^{0}_{-0.01}$)	65 (2.559)	3 (0.118)	6 (0.24)	89 (3.50)	5 (0197)	8 $^{0}_{-0.009}$ (0.315 $^{0}_{-0.0003}$)	1.4 (3.1)
03A32	178.5 (7.03)	148.5 (5.85)	109 (4.29)	39.5 (1.56)	30 (1.18)	78 (3.07)	90 (3.54)	70 $^{0}_{-0.030}$ (2.7559 $^{0}_{-0.0012}$)	80 (3.15)	3 (0.118)	8 (0.31)	105 (4.13)	6 (0.236)	14 $^{0}_{-0.0011}$ (0.5512 $^{0}_{-0.0004}$)	2.6 (5.7)
05A32	200.5 (7.89)	170.5 (6.71)	131 (5.16)	39.5 (1.55)	30 (1.18)	100 (3.94)	90 (3.54)	70 $^{0}_{-0.030}$ (2.7559 $^{0}_{-0.0012}$)	80 (3.15)	3 (0.118)	8 (0.31)	105 (4.13)	6 (0.236)	14 $^{0}_{-0.0011}$ (0.5512 $^{0}_{-0.0004}$)	3.3 (7.3)

Notes: 1. The draw-out construction of Type USASEM-02A32 is of the waterproof gland type. Therefore, the figure and dimensions of the connector section slightly differ from the above. For details contact your YASKAWA representative.
2. Optical encoder 2048 pulses/rev is used as a detector.
3. Vibration: 15 μm or below.
4. Plug and clamp are not attached for receptacle connection.
5. It is recommended that the motor be mounted with its connector placed down.

• Types USASEM-08A31, -15A31, -30A31 (Taper Shaft)



AC Servomotor Type USASEM-	L	LL	LM	LT	LR	KB1	KB2	KL1	KL2	Flange Surface								Shaft Extension										Approx Weight kg (lb)
										LA	LB	LC	LE	LG	LH	LZ	LW	Q	QK	QA	X	S	V	P	U	W	T	
08A31	257 (10.12)	199 (7.84)	148.5 (5.85)	50.5 (1.99)	58 (2.28)	115 (4.53)	188 (7.4)	102 (4.02)	86 (3.39)	130 (5.12)	110 $^{0}_{-0.035}$ (4.3307 $^{0}_{-0.0014}$)	120 (4.72)	3 (0.12)	10 (0.4)	155 (6.1)	9 (0.35)	18 (0.71)	28 (1.1)	25 (0.98)	12 (0.47)	10.3 (0.41)	16 (0.63)	21 (0.83)	M10 P1.25	4.3 $^{0}_{-0.01}$ (0.169 $^{0}_{-0.004}$)	5 (0.1968)	5 (0.1968)	6 (13.2)
15A31	317.5 (12.5)	259.5 (10.22)	203.5 (8.02)	56 (2.2)	58 (2.28)	166.5 (6.56)	239.5 (9.43)	109 (4.29)	87 (3.43)	145 (5.71)	110 $^{0}_{-0.035}$ (4.3307 $^{0}_{-0.0014}$)	130 (5.12)	6 (0.24)	12 (0.47)	165 (6.5)	9 (0.35)	18 (0.71)	28 (1.1)	25 (0.98)	12 (0.47)	10.3 (0.41)	19 (0.75)	21 (0.83)	M10 P1.25	5.8 $^{0}_{-0.1}$ (0.228 $^{0}_{-0.004}$)	5 (0.1968)	5 (0.1968)	11 (24.3)
30A31	366 (14.41)	296 (11.65)	240 (9.45)	56 (2.2)	70 (2.76)	206 (8.11)	276 (10.87)	135 (5.32)	87 (3.43)	200 (7.87)	114.3 $^{0}_{-0.040}$ (4.5 $^{0}_{-0.0016}$)	180 (7.09)	6 (0.24)	18 (0.71)	230 (9.1)	13.5 (0.53)	20 (0.79)	36 (1.42)	32 (1.26)	14 (0.55)	12.5 (0.49)	22 (0.87)	24 (0.94)	M12 P1.25	6.6 $^{0}_{-0.1}$ (0.26 $^{0}_{-0.004}$)	6 (0.2362)	6 (0.2362)	24 (52.9)

Note: 1. Optical encoder 2048 pulses/rev is used as a detector.
2. Vibration: 15μm or below.
3. Plug and clamp are not attached for receptacle connection.
4. Use hexagon socket head cap screw as flange-mounted bolt.
5. It is recommended that the motor be mounted with its connector placed down.
6. Dimensions of the shaft extension key and keyway are based on JIS (Japaneese Industrial Standard) B 1301 "Sunk Keys and Their Corresponding Keyways (Normal keys)" Shaft extension key is furnished.

(2) With Brake

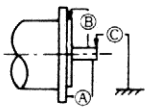
• Types USASEM-02A32OB, -03A32OB, -05A32OB

Motor Type	L	LL	LM	BRAKE			Approx Weight kg (lb)
				INERTIA $kg \cdot m^2$	BRAKING TORQIE N•m (kgf•cm)	Voltage V	
USASEM-02A32OB	228 (8.98)	198 (7.8)	137 (5.39)	0.0163×10^{-4}	0.98 (10)	DC90	2.2 (4.9)
USASEM-03A32OB	241 (9.49)	211 (8.31)	150 (5.91)	0.0163×10^{-4}	0.98 (10)	DC90	3.5 (7.7)
USASEM-05A32OB	263 (10.35)	233 (9.17)	172 (6.77)	0.0163×10^{-4}	1.764 (18)	DC90	4.1 (9.1)

• Types USASEM-08A31OB, -15A31OB, -30A31OB

Motor Type	L	LL	LM	BRAKE			Approx Weight kg (lb)
				INERTIA $kg \cdot m^2$	BRAKING TORQIE N•m (kgf•cm)	Voltage V	
USASEM-08A31OB	305 (12.0)	247 (9.72)	146 (5.75)	0.5365×10^{-4}	2.94 (30)	DC90	7 (15.4)
USASEM-15A31OB	377.5 (14.86)	319.5 (12.58)	197.5 (7.78)	0.6717×10^{-4}	5.88 (60)	DC90	12.5 (27.6)
USASEM-30A31OB	432 (17.0)	362 (14.24)	240 (9.45)	0.6717×10^{-4}	11.76 (120)	DC90	25.5 (56.2)

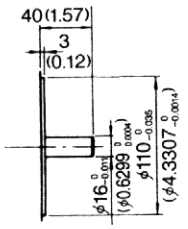
Mechanical Specifications in mm

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	

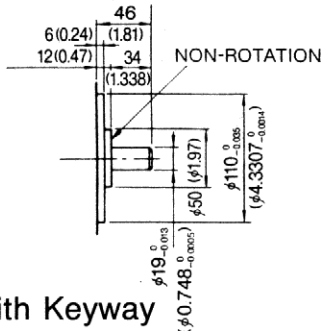
† T.I.R. (Total Indicator Reading)

(3) Shaft Extension of Straight

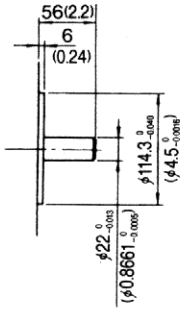
Type USASEM-08A



Type USASEM-15A

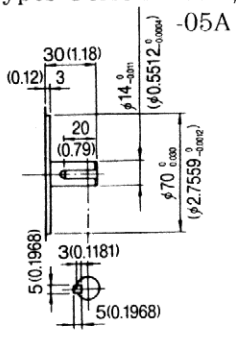


Type USASEM-30

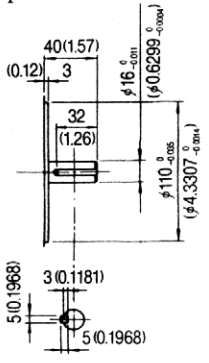


(4) Shaft Extension of Straight with Keyway

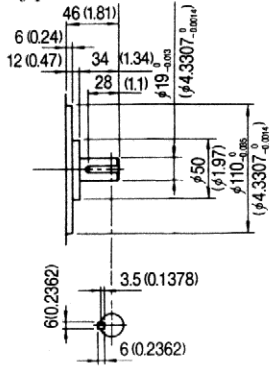
Types USASEM-03A, -05A



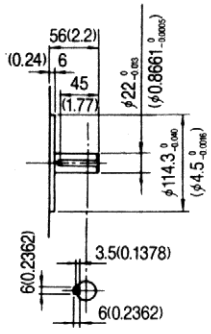
Type USASEM-08A



Type USASEM-15A

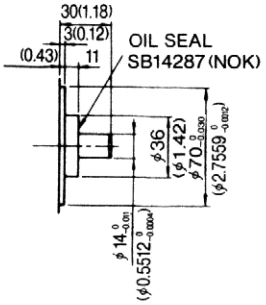


Type USASEM-30A



(5) Shaft Extension of Straight with Oil Seal

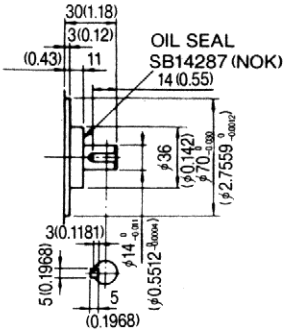
Types USASEM-03A, -05A



Note: Proper dimensions comply with standard dimensions.

(6) Shaft Extension of Straight with Key and Oil Seal

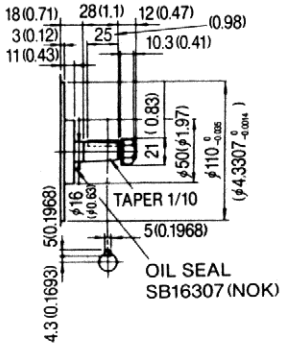
Types USASEM-03, -05A



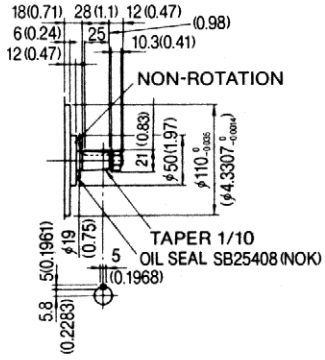
Note: Proper dimensions comply with standard dimensions.

(7) Shaft Extension of Taper with Oil Seal

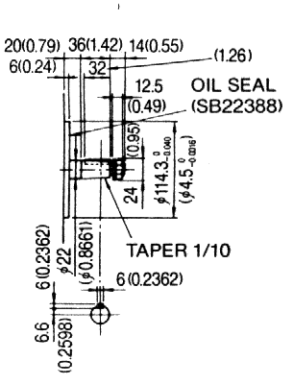
Type USASEM-08A



Type USASEM-15A



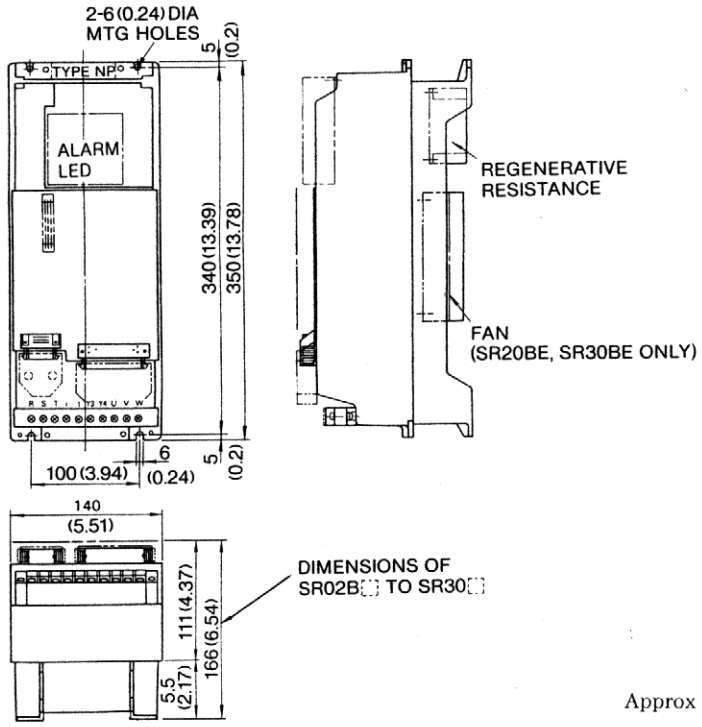
Type USASEM-30A



Note: Proper dimensions comply with standard dimensions.

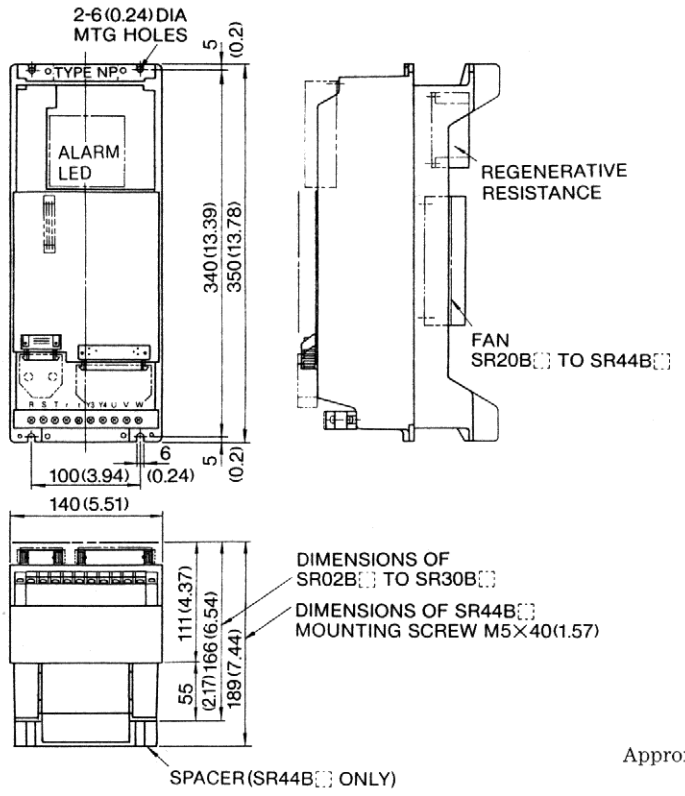
10.2 *Servopack*

Types CACR-SR02BE to SR30BE



Approx Weight: 6kg (13.2lb)

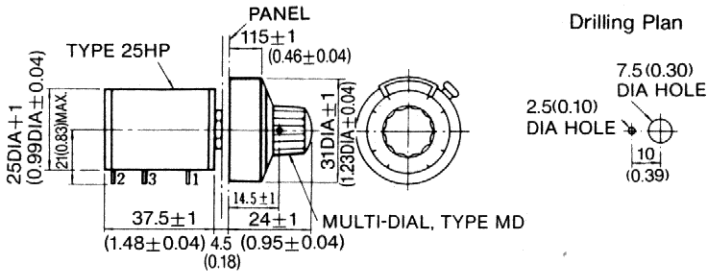
Type CACR-SR44BE



Approx Weight: 7kg (15.4lb)

10.3 PERIPHERAL EQUIPMENT in mm (inches)

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

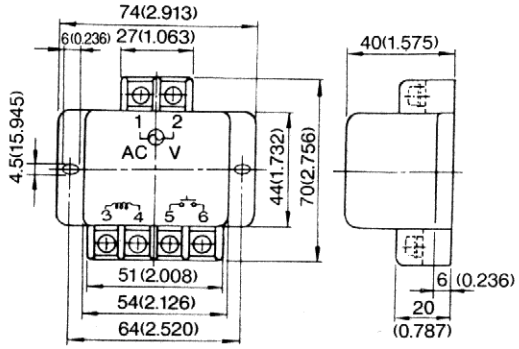


(2) Power Supply for Brake

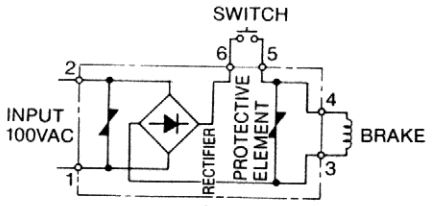
According to the motor, select 100V/200V power supply for brake.
(Made by Kokura Clutch Co., Ltd.)

Power Supply for Brake (for M,F,G,D,S Series)

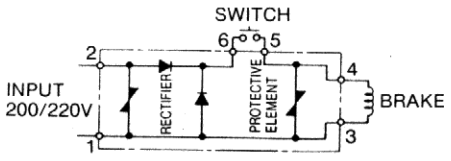
- Input 100VAC, Output 90VDC (Type OPR109F) 1.0ADC Max.
- Input 200VAC, Output 90VDC (Type OPR109A) 1.0ADC Max.



- Type OPR109F Internal Circuit

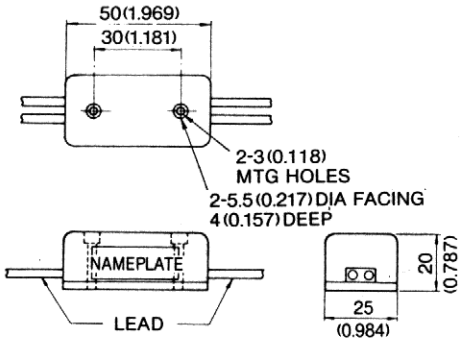


- Type OPR109A Internal Circuit



Notes:
1. Do not short-circuit between ouput terminal Nos. 3 and 4.
2. The open/close value of the contact used for Nos. 5 and 6 is 5 to 10 times the rated current of the brake used.
   Direct current open/close contacts must be used.
3. Insert a fuse in the input or output side to protect the power unit.

- Power Supply for Brake (for S Series)
  - Input 100VAC Output 90VDC 1.0ADC Max. (DP8401002-2)
  - Input 200VAC Output 90VDC 1.0ADC Max. (DP8401002-1)

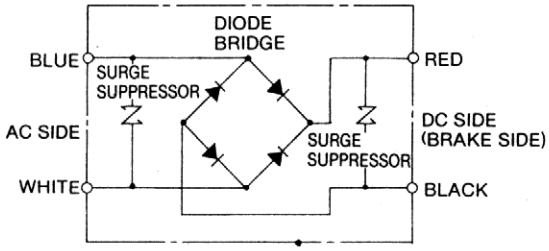


- Leadlength: each 500 mm (19.69 inches.)
- Lead Color:

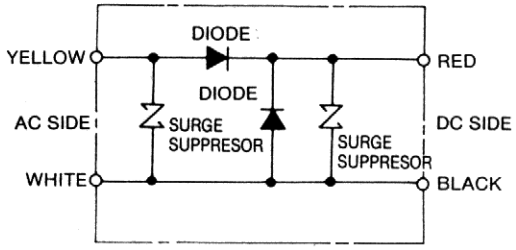
AC Input Side		Brake Side
100V	200V	
Blue White	Yellow White	Red Black

- Max Ambient Temp: 60°C.

- AC 100V Internal Circuit



- AC 200V Internal Circuit



Note:
Open/close of brake power supply circuit is possible at AC and DC sides. Normally safety operation is more available at AC side. If the circuit is opened/closed at DC side, provide surge suppressor near brake coil otherwise the brake coil might be destroyed.

11. TEST RUN

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

11.1 CHECK ITEMS BEFORE TEST RUN

11.1.1 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.

11.1.2 *Servopack*

- Setting switches are correctly set to satisfy the specifications for the applicable servomotor and optical encoer.
- 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 $^{+10}_{-15}$ %.
- The speed reference should be 0V (speed reference circuit is short-circuited.)

11.2 TEST RUN PROCEDURES

11.2.1 Preparation of Operation

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

(1) Power ON

After checking items in par. 11.1, 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.

(2) When the power is correctly supplied, the following five figures [LED] s light:
(LED indicates the motor is stopped)

(3) When a Servo ON signal is input (contact is on), the power circuit in the Servopack operats and the motor is ready to run. (LED indicates the motor is stopped.)

11.2.2 Operation

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

(1) Increase the speed reference voltage gradually from 0V, then the motor will rotate at a speed proportional to the reference voltage.

(2) When the reference voltage is positive, the motor rotates forward (counterclockwise viewed from drive end-output shaft) (**Fig. 9.1**)

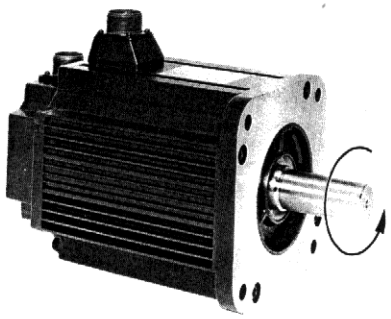


Fig. 11.1 Motor Forward Running

11.2.3 Inspection during Test Run

The follwing 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. 14. At a test operation, the load and machine may not fit well at first and result in overload.

12. ADJUSTMENT

12.1 CHARACTERISTICS AT THE TIME OF DELIVERY

The Servopack has been factory-adjusted as follows:

(1) Speed reference input-servomotor speed ratio (no load) (**Fig. 12.1**)

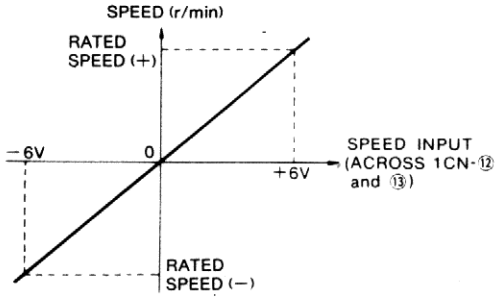


Fig. 12.1 Speed Reference Input-Servomotor Speed Ratio

(2) Speed Variation (**Fig. 12.2**)

Speed variation $\Delta N, \Delta n$

$$\frac{\Delta N}{N_R} \times 100\ \% \leqq 0.01\ \%$$

$$\frac{\Delta n}{N_R} \times 100\ \% \leqq 0.01\ \%$$

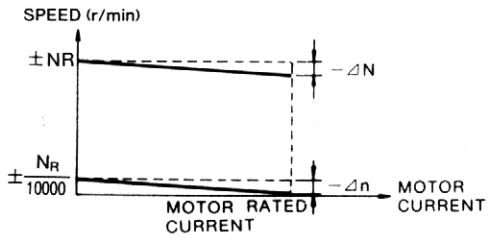


Fig. 12.2 Speed Variation

(3) Start-stop characteristics (**Fig. 12.3**)

Ip: Start current set value in Table **12.1**. The overshoot (⊿Nov) and undershoot (⊿NUD) when $J_L = J_M$, are as shown in Table **12.1** (adjustment level preset at the factory).

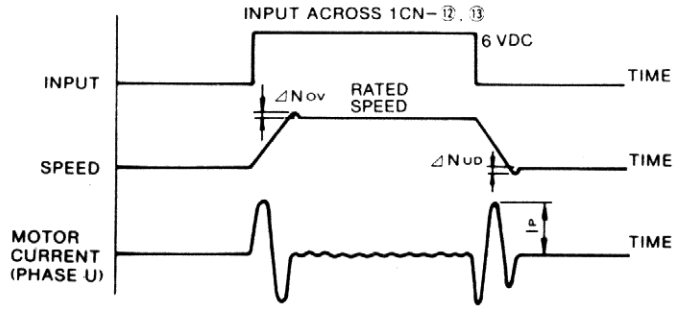


Fig. 12.3 Start-Stop Characteristics

Table 12.1 Overshoot and Undershoot at Step Response

Type CACR-	$N_{OV}/N_R \times 100$	$N_{UD}/N_R \times 100$
SR02BE	5 % max	5 % max
SR03BE		
SR05BE		
SR07BE		
SR10BE		
SR15BE		
SR20BE		
SR30BE		
SR44BE		

12.2 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 Par.8 "MONITOR PANEL OPERATION". (Do not tamper with potentiometers.)

13. INSPECTION AND MAINTENANCE

13.1 AC SERVOMOTOR

The AC servomotor has no wearing parts (eg. brushes), so simple daily inspection is sufficient. The inspection schedule for the motor is shown in **Table 13.1**.

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

Table 13.1 Inspection Schedule for Motors

Inspection Item	Frequency	Inspection Operation
Vibration	Daily	Feel manually.
Noise	Daily	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	Contact Yaskawa representative.

13.2 *Servopack*

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

14. TROUBLESHOOTING GUIDE

14.1 SERVOMOTOR

WARINING

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

Table 14.1 Troubleshooting Guide for AC Servomotor

Trouble	Cause	What to do
Motor does not start.	Loose connection	Tighten connection.
	Wrong wiring	Correct.
	Overload	Reduce load or use a larger 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.

14.2 *Servopack*

14.2.1 LED Indication (7-segment) for Troubleshooting

Table 14.2 LED Indication for Troubleshooting

LED Detection	Lighting Condition	Probable Cause	Corrective Action
A. 10	Goes on when power is supplied to the control circuit	Defective control circuit board (1 PWB).	• Repalce the Servopack.
Overcurrent	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.	• Replace the Servopack.
	Goes on when power is supplied to the main circuit.	• Detective main circuit transistor module.	• Replace the Servopack.
	Goes on during operation. • When power to the control circuit is turned off and then turned on again. When reset later, the operation starts.	• Fan has stopped.	• Check the fan. (SR20, 30, 44)
		• Temperature around the Servopack exceeds 55°C.	• Decrease the temperature below 55°C (The heat sink may be overheated.)
A. 11	Goes on when power is supplied to the main circuit. • MCCB trips.	• The motor ground	• Replace the motor.
Ground fault		• Defective main circuit transistor module.	• Replace the Servopack.
A. 20	Goes on when power is supplied to the control circuit.	• Defective control circuit board (1PWB).(MCCB is ON status.)	• Replace the Servopack.
Circuit protector tripped	Goes on when power is supplied to the main circuit.	• Defective main circuit thyristor diode module.	• Replace the Servopack.
		• MCCB trips.	• Replace the Servopack.
A. 30	Goes on when power is supplied to the control circuit.	• Defective control circuit board. (1 PWB).	• Replace the Servopack.
Regenerative trouble	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.)
A. 40	Goes on when the motor starts or slows down.	• Load inertia $J_L(GD^2)$ too large.	• Check the inertia of the machine with the value converted to the motor shaft.
Over-voltage		• Defective regenerative circuit.	• Replace the Servopack.
A. 51	When the reference is input, the motor runs fast and continues running.	• Motor connection error.	• Correct the motor connection.
Over-speed		• Optical encoder connection error.	• Check and correct pulses in phases A,B,C,U,V,W with 2CN.
A. 52	When the reference is input, the motor runs fast and continues running.	• The reference input voltage too large.	• Decrease the reference input voltage.
Overspeed reference detection			
A. 60	Goes on when power is supplied to the main circuit.	• Defective main circuit thyristor-diode module.	• Replace the Servopack.
Voltage drop			
A. 70	Goes on whe power is supplied to the control circuit.	• Defective control circuit board (1 PWB).	• Replace the Servopack.
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 uavailable.	• Motor circuit error connection, such as U→V, V→W, W→U or single-phase connection.	• Correct the connection.
A. 71	Goes on during operation. • When power to the control circuit is turned off and then turned on again, the operation starts.	• Operation with more of the rated torque for a number of seconds.	• Check and correct the load (may be overload).

Table 14.2 LED Indication for Troubleshooting (Cont'd)

LED Detection	Lighting Condition	Probable Cause	Corrective Action
A. 72	Goes on during operation. • When power to the control circuit is turned off and then turned on again, the operation starts.	• Operation with more of the rated torque for a number of seconds.	• Check and correct the load (may be overload).
A. b□ A/D error	Goes on when power is supplied to the control circuit.	• Defective control circuit board (1PWB).	• Replace the Servopack.
A. b1	Goes on during operation.	• Erroneous operation of reference input reader.	• Resume after reset operation.
		• Defective external current limit reader.	• Replace the Servopack.
A. b2	Goes on during operation.	• Erroneous operation of reference input reader.	• Resume after reset operation.
		• Defective external current limit reader.	• Replace the Servopack.
A. C□ Overrun prevention	Goes on when power is supplied to the control circuit.	• Defective control circuit board (1 PWB).	• Replace the Servopack.
A. C1 Overrun detection	Goes on when the motor starts and rotates for a moment.	• Motor wiring error.	• Correct the motor connection.
		• Optical encoder wiring error, disconnection.	• Correct the optical encoder connection.
A. C2 Phase detection error	Goes on when the motor starts and rotates for a moment.	• Optical encoder wiring error, disconnection (PU,PV,PW)	• Correct the optical encoder connection.
A. C3 Phase PA,PB disconnection	Goes on when the motor starts and rotates for a moment.	• Phase A and B of optical encoder disconnection (PA, PB)	• Correct the optical encoder signal line.
A. C4 Phase PC disconection	Goes on when the motor starts and rotates for a moment.	• Phase C of optical encoder disconnection (PC).	• Correct the optical encoder signal line.
A. F□ Open phase	Goes on when power is supplied to the control circuit.	• Defective control circuit board (1 PWB).	• Replace the Servopack.
A. F1	Goes on when power is supplied to the main circuit.	• Open phase of power supply.	• Check the main circuit power supply.
A. F2	Goes on when power is supplied to the main circuit.	• Large distortion of power supply.	• Check the main circuit power supply.
CPU error	Goes on when power is supplied to the control circuit.	• Defective control circuit board (1 PWB).	• Replace the Servopack.
	Goes on during operation.	• Faulty internal elements.	• Resume after reset operation.
		• Defective internal elements.	• Replace the Servopack.
A. 02 Parameter breakdown	Goes on when power is supplied to the control circuit.	• Defective control circuit board. (1PWB, 2PWB)	• Replace the Servopack.
A. 03	Goes on when power is supplied to the control circuit.	• Defective control circuit board (1PWB, 2PWB)	• Replace the Servopack.
Defective main circuit section	Goes on during operation.	• Faulty internal elements.	• Resume after reset operation.
		• Defective internal elements.	• Replace the Servopack.
A. 04 Parameter settig error	Goes on during parameter charge.	• Set value without setting range.	• Reset the parameter.

Note: 1. Indication format: A. 1 1

2. □: unspecified.

14.2.2 Examples of Troubleshooting for Defective Wiring or Parts

Table 12.3 Example of Troubleshooting for Defective Wiring or Parts

Trouble	Check Items	What to do
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 Ⓡ, Ⓢ, and Ⓣ. • Trouble LED off • Speed reference voltage • P-CON, N-OT, P-OT, S- ON signals • LED [.] [-.] [r] [u] [n] on	• Check the AC power supply circuit. • If LEDs are on, check the cause. • Adjust the reference volume.

14.2.3 Examples of Troubleshooting for Incomplete Adjustment

Table 12.4 Examples of Troubleshooting for Incomplete Adjustment

Trouble	Cause	What to do
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 signal line and power line.	Set Cn-04 [LOOPHZ] to decrease the speed loop gain. • 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	• Set Cn-04 [LOOPHZ] to decrease the speed loop gain.
Motor rotates even if the speed reference voltage is 0V.	• Offset in speed reference voltage.	• Adjust the speed reference offset. (Refer to Par.8.4.4.)

MEMO

APPENDIX A
ELECTRICAL CONNECTIONS

DRAWING NUMBER	DESCRIPTION
AC-100098	Circuit Board Assembly, Interface
IC-18B003	Interconnect, Digital Incremental Encoder
IC-253001	Interconnect, Digital Incremental Encoder
SERVOPRO-D	Controller Assembly Drawing

NOTES

DATE	SYM	REVISION RECORD	DR	CK	CK
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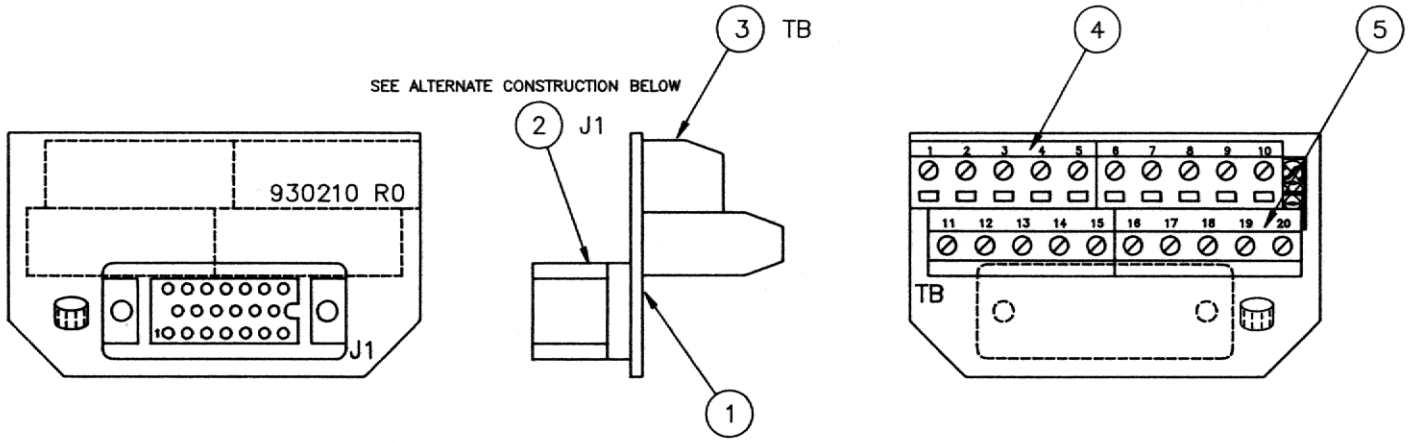
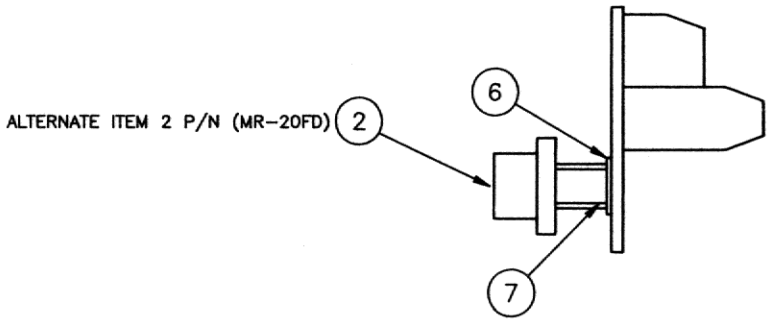
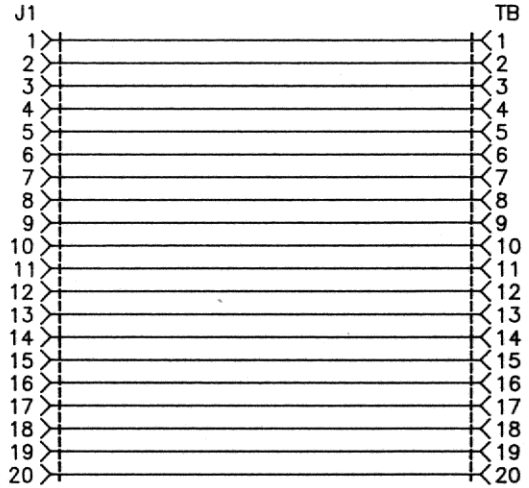




ALTERNATE CONSTRUCTION

FOR USE WHEN ITEM 2 IS P/N (MR-20FD)



CIRCUIT BOARD SCHEMATIC

INDUSTRIAL INDEXING SYSTEMS, Inc.
626 FISHERS RUN
VICTOR, NEW YORK 14564
(716) 924-9181 FAX: (716) 924-2169

CHECKED BY / DATE	
APPROVED BY / DATE	
APPROVED BY / DATE	
MATERIAL	
FINISH	

TITLE: CIRCUIT BOARD ASSY, INTERFACE

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE SHOWN (mm)

TOLERANCES: X.X± ; X.XX± ; X.XXX± ; ANGULAR ±

DRAWN BY: D.A.DAUNCE

AutoCAD FILE LOCATION

DRAWING NUMBER: AC-100098

C | DATE: 23MAR93 | SCALE: 2 = 1 | SHEET NO.: 1 OF 1 | REVISION: 0

DATE	SYM	REVISION RECORD	DR	CK	CK
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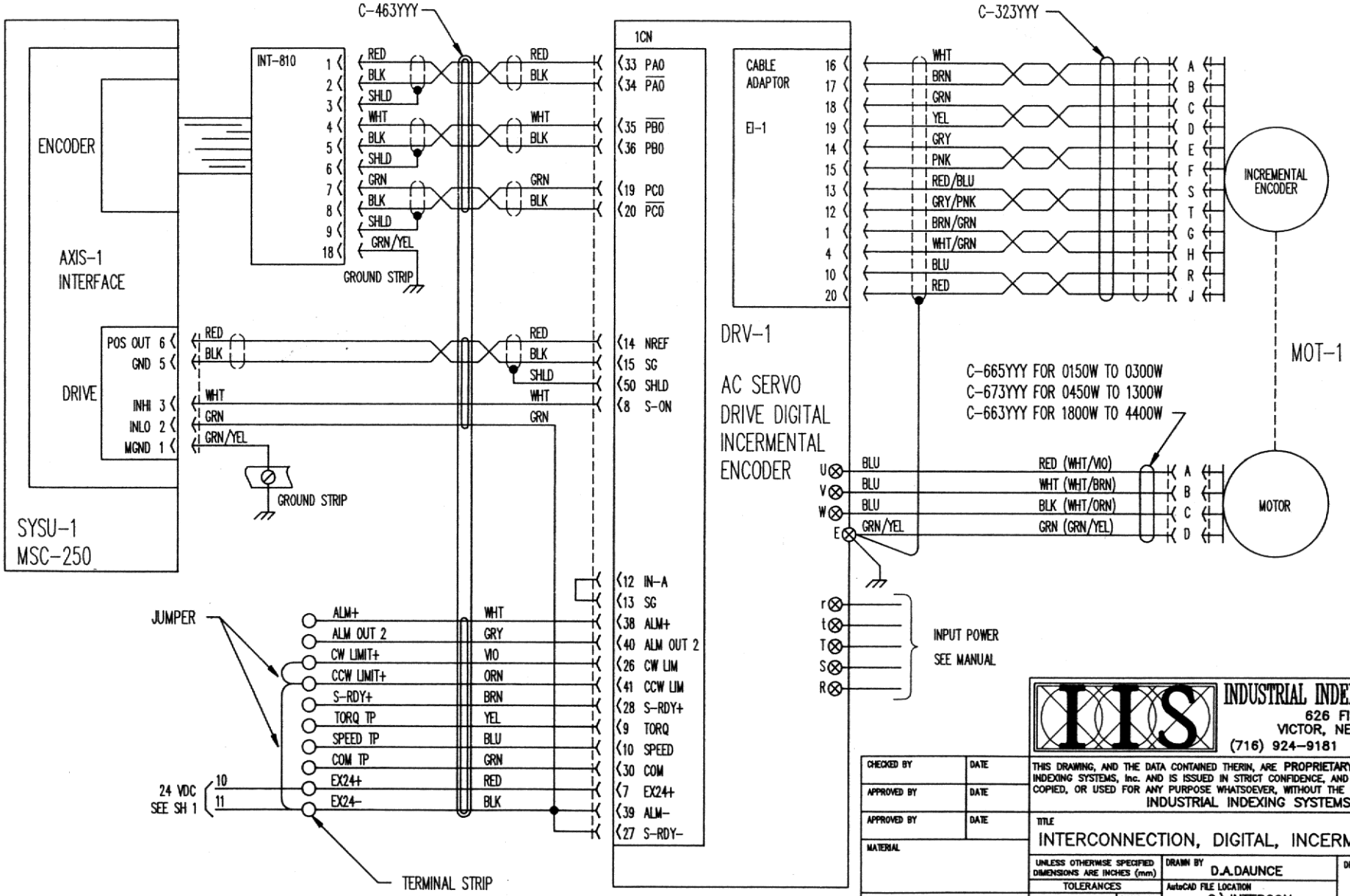

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CHECKED BY	DATE
APPROVED BY	DATE
APPROVED BY	DATE
MATERIAL	
FINISH	

TITLE
INTERCONNECTION, DIGITAL, INCERMENTAL ENCODER

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY D.A.DAUNCE		DRAWING NUMBER
TOLERANCES	AutoCAD FILE LOCATION Q:\INTERCON		IC-18B003
X.X± / X.XX± / X.XXX± ANGULAR ±	B	DATE 28JUL93 / SCALE	SHEET NO. 1 OF 1 / REVISION 0

DATE	SYM	REVISION RECORD	DR	CK	CK
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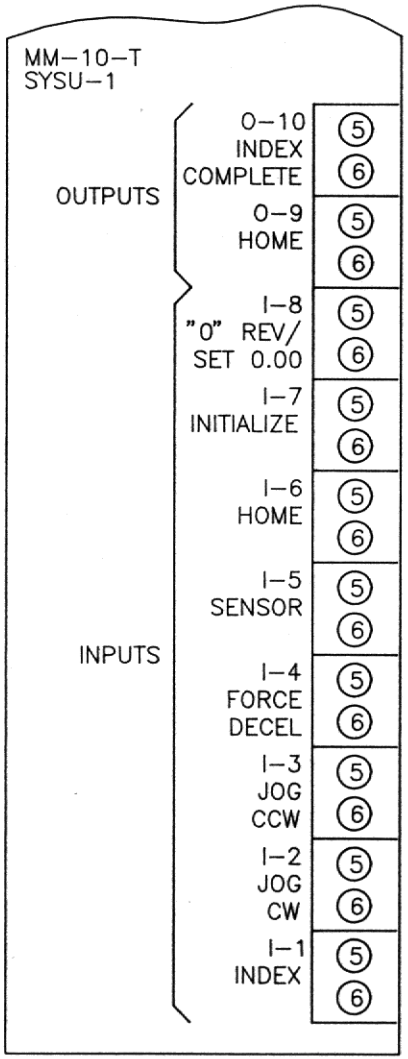
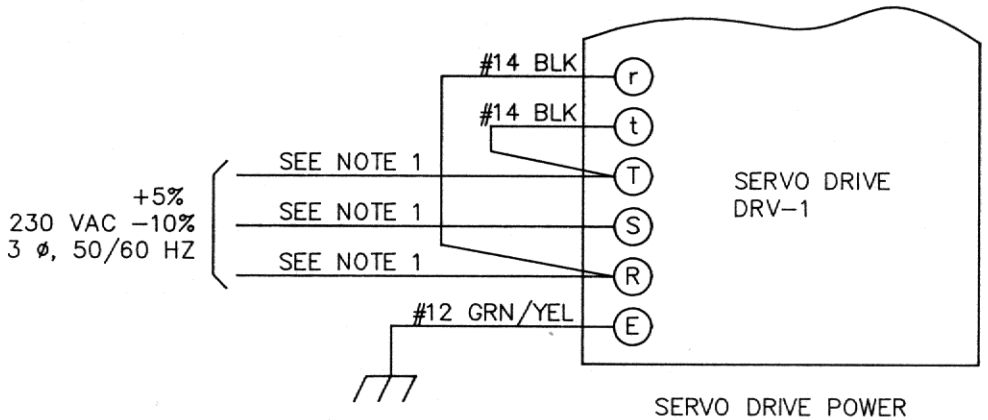


INPUT / OUTPUT MODULES

NOTES

1) DRIVE WIRING PER THE FOLLOWING:
   14 AWG BLACK FOR 0150W TO 0300W
   12 AWG BLACK FOR 0450W TO 1300W
   10 AWG BLACK FOR 1800W TO 4400W



SERVO DRIVE POWER

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626 FISHERS RUN
VICTOR, NEW YORK 14564
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CHECKED BY	DATE
APPROVED BY Taylor A. Shaw	DATE 9-14-94
APPROVED BY	DATE
MATERIAL ----	
FINISH ----	

TITLE: INTERCONNECTION, DIGITAL, INCREMENTAL ENCODER

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TOLERANCES	AutoCAD FILE LOCATION Q:\DRAFTING\INTERCON\		IC-253001	
X.X± --- ANGULAR	B	DATE 13SEPT94	SCALE ---	SHEET NO. 1 OF 2
X.XX± --- ± ---				REVISION 0
X.XXX± ---				

DATE	SYM	REVISION RECORD	DR	CK	CK
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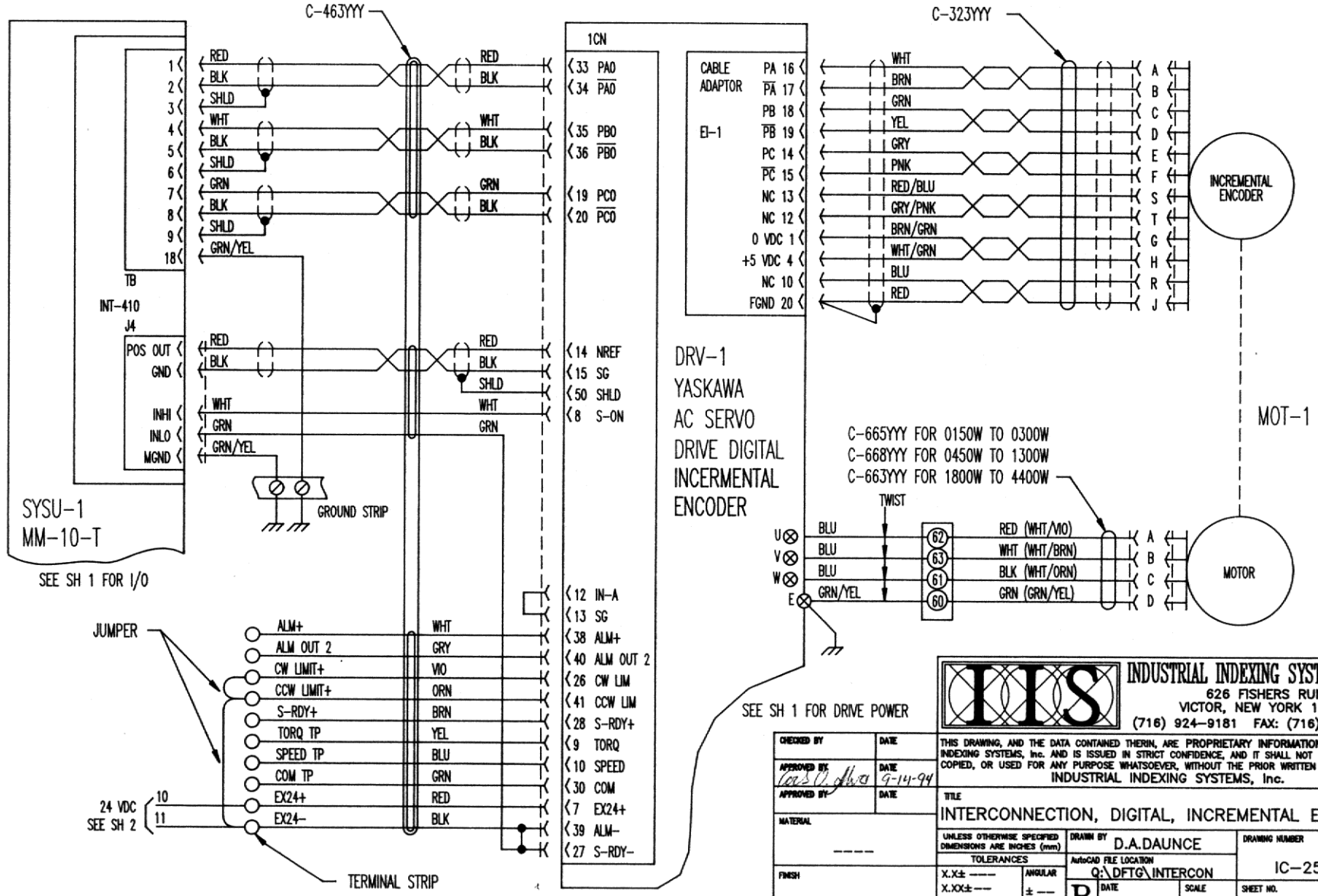

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CHECKED BY	DATE
APPROVED BY	DATE 9-14-94
APPROVED BY	DATE
MATERIAL	-----
FINISH	-----

TITLE: INTERCONNECTION, DIGITAL, INCREMENTAL ENCODER

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY D.A.DAUNCE		DRAWING NUMBER IC-253001
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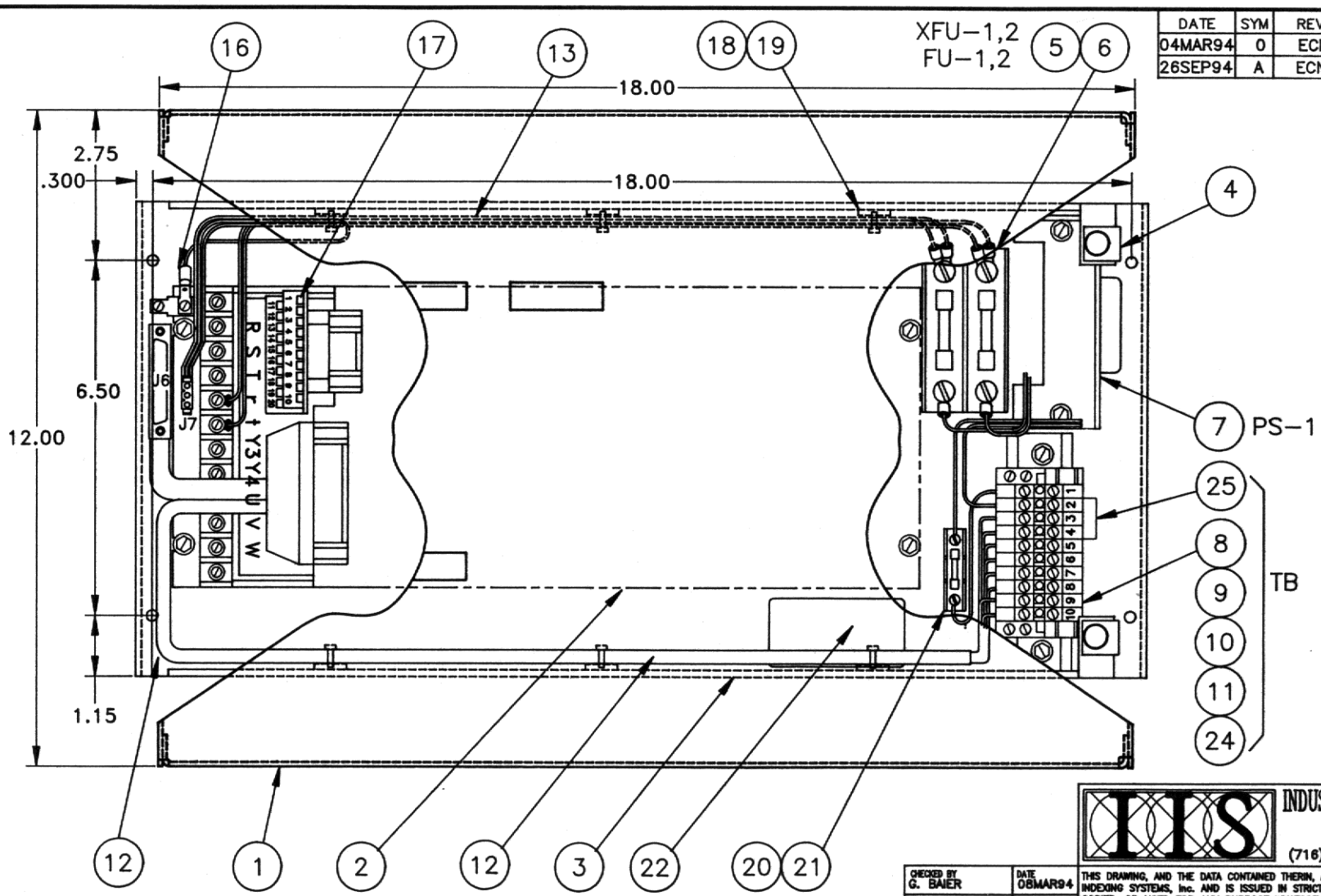
X.XXX± ---			



DATE	SYM	REVISION RECORD	DR	CK	CK
04MAR94	0	ECN 94-029	DAD		
26SEP94	A	ECN 94-229	EB		

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CHECKED BY G. BAIER	DATE 08MAR94
APPROVED BY C. ALVA	DATE 09MAR94
APPROVED BY	DATE
MATERIAL -----	
FINISH -----	

TITLE: CONTROLLER ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)
TOLERANCES
X.X± ---
X.XX± ---
X.XXX± ---
ANGULAR ± ---

DRAWN BY: G.BAIER
AutoCAD FILE LOCATION: G:\CAD\SERVOPRO
DRAWING NUMBER: SERVOPRO-D
B
DATE: 04MAR94
SCALE: -----
SHEET NO.: 1 OF 3
REVISION: A

NOTES:

1) DRIVE WIRING PER THE FOLLOWING:
   - 14 AWG BLACK FOR 0150W TO 0300W
   - 12 AWG BLACK FOR 0450W TO 1300W
   - 10 AWG BLACK FOR 1800W TO 4400W
2) REQUIRED TRANSFORMER OUTPUT VOLTAGE:
   230 VAC $^{+5\%}_{-10\%}$ 3ø, 50/60 HZ

DATE	SYM	REVISION RECORD	DR	CK	CK
04MAR94	0	PER ECN 94-029	EB		
26SEP94	0	PER ECN 94-229	EB		

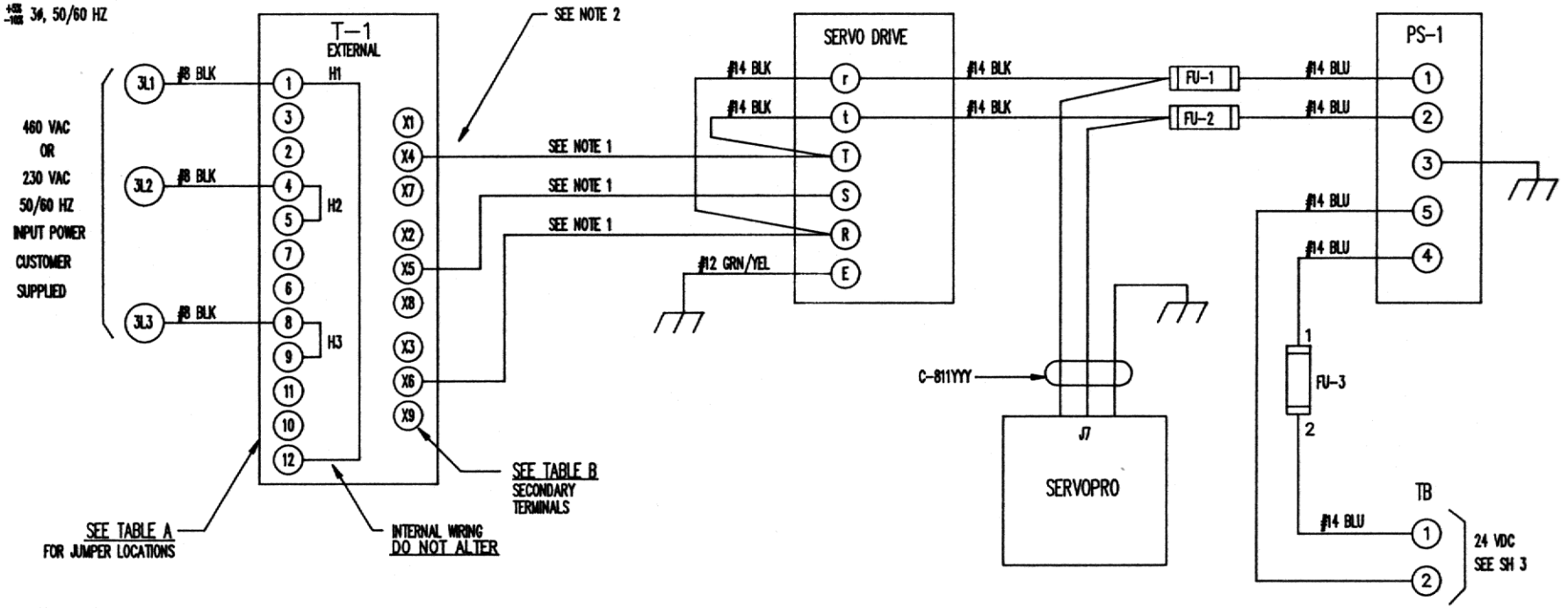

TABLE A

LOW VAC OPERATION	HIGH VAC OPERATION
JUMPER	JUMPER
1-3	2-3
2-4	6-7
5-7	10-11
6-8	
9-11	
10-12	

TABLE B

SECONDARY TERMINALS	SECONDARY VOLTAGE
X1, X2, X3	207 VAC
X4, X5, X6	230 VAC
X7, X8, X9	253 VAC

DRIVE ISOLATION TRANSFORMER IS RECOMMENDED FOR ALL LINE VOLTAGES BUT IS NOT REQUIRED IF THE INCOMING LINE IS $^{+5\%}_{-10\%}$ 230 VAC, 3 Ø, 50/60 HZ.

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CHECKED BY: G. Baier	DATE: 08MAR94
APPROVED BY: C. Alva	DATE: 09MAR94
APPROVED BY:	DATE:
MATERIAL: ----------	
FINISH: ----------	

TITLE: CONTROLLER ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY: G.Baier
TOLERANCES: X.X± ----- ANGULAR ± ---	AutoCAD FILE LOCATION: G:\CAD\SERVOPRO\
X.XX± -----	DRAWING NUMBER: SERVOPRO-D
X.XXX± -----	B / DATE: 04MAR94 / SCALE: ----- / SHEET NO.: 2 / REVISION: A

DATE	SYM	REVISION RECORD	DR	CK	CK
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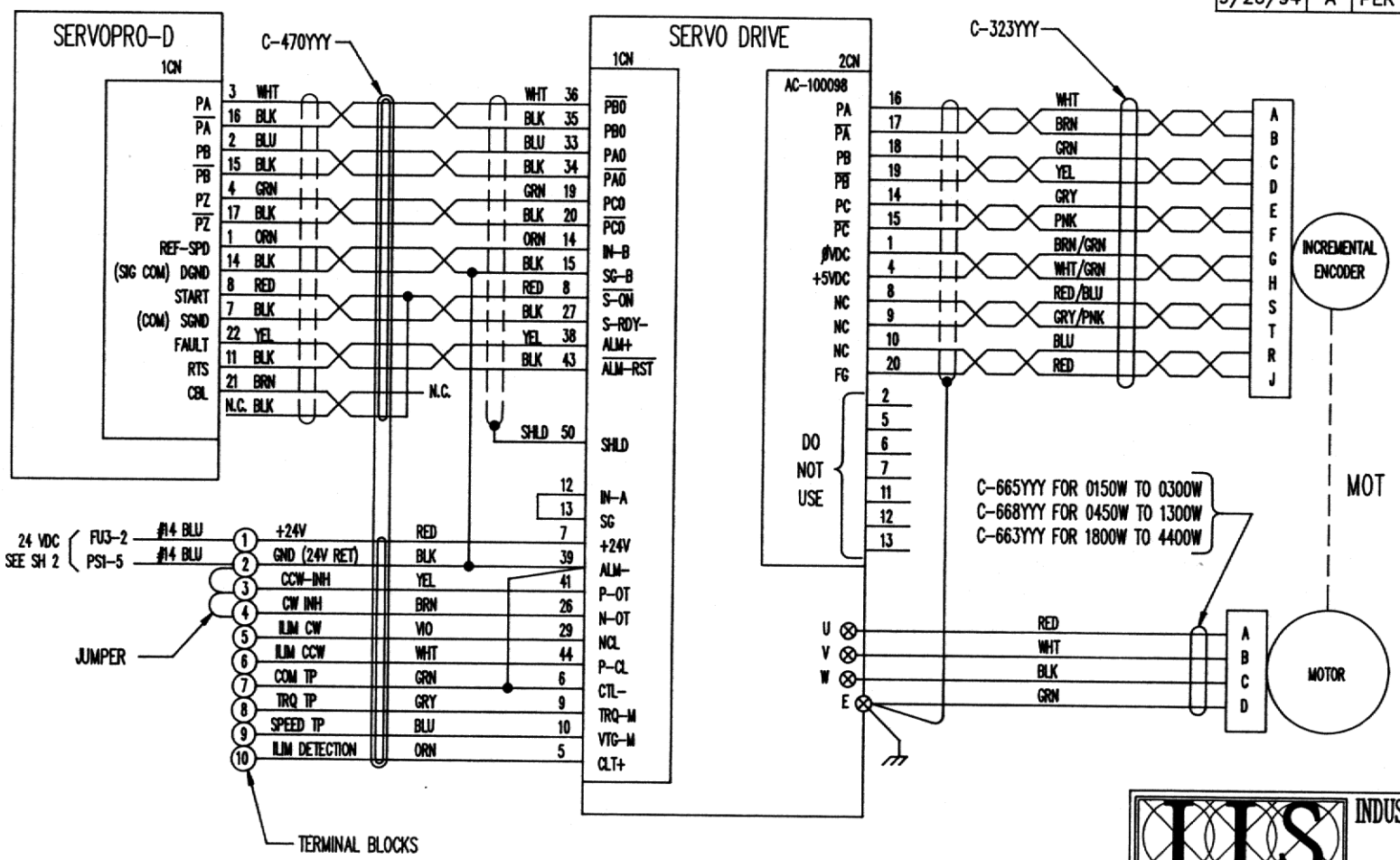
9/26/94	A	PER ECN 94-229	EB		



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CHECKED BY: G. BAIER	DATE: 08MAR94
APPROVED BY: C. ALVA	DATE: 08MAR94
APPROVED BY	DATE
MATERIAL: ----------	
FINISH: ----------	

TITLE: CONTROLLER ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY: G.Baier
TOLERANCES	AutoCAD FILE LOCATION: G:\CAD\SERVOPRO
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X.XX± ----	
X.XXX± ----	ANGULAR ± ---
B	DATE: 2MAR94
SCALE: ----	SHEET NO.: 3
REVISION: A	

APPENDIX B
DRIVE SETUPS

DRAWING NUMBER	DESCRIPTION
SU-053002	Drive Setup, INGD-0300
SU-053004	Drive Setup, INGD-0850
SU-053006	Drive Setup, INGD-1800
SU-053008	Drive Setup, INGD-4400

SU-053002
INGD-0300

User Constant Cn-00 to Cn-17 (Constant Setting)

USER CONSTANT	Bit No.	CONTENTS	UNIT	LOWER LIMIT	UPPER LIMIT	DEFAULT SETTING	APPLICATION SETTING
Cn-00	0	- Jog	----	---	---	---	---
	1	Speed ref offset adjust	mV	0	±50	▲	▲
	2	Clear fault history	----	---	---	---	---
	3	A.XXX B.XXX	mV	0	±50	■	■
	4	A.XXX B.XXX	▲	0	---	☼	☼
	5	F.0503 Y.0000 P.0000	Motor # Modif #	---	---	---	---
Cn-01	0	SV • ON Mask	bit	0	1	0	0
	1	SEN Mask	bit	0	1	0	0
	2	P-OT Mask	bit	0	1	0	0
	3	N-OT Mask	bit	0	1	0	0
	4	IN-A Mask	bit	0	1	0	0
	5	IN-B Mask	bit	0	1	0	0
	6	Coasting to a stop/DB stop	bit	0	1	0	0
	7	DB ON/OFF after Stop	bit	0	1	0	0
	8	OT Zero Speed Stop	bit	0	1	0	0
	9	Zero Clamp after OT Stop	bit	0	1	0	0
	A B	Control Mode Selection	bit	0	1	0	0
	C D	Mode Switch Selection	bit	0	1	0	0
	E	Braking Command Selection	bit	0	1	0	0
	F	Multi-turn Data Clear	bit	0	1	0	0
Cn-02	0	Reverse Rotation Mode	bit	0	1	0	0
Cn-03		IN-B Input Adjustment [(r/min)/V]	r/min/V	0	2000	150	375
Cn-04		Speed Loop Gain [Hz]	Hz	20	500	40	120
Cn-05		Speed Loop Integral Time Constant	ms	2	512	20	10
Cn-06		Emergency Stop Torque	%	0	MAX τ	283	283
Cn-07		Soft Start Time	ms	0	10000	0	0
Cn-08		Forward Torque Limit [%]	%	0	MAX τ	283	283

Cn-09	Reverse Torque Limit [%]	%	0	MAX τ	283	283
Cn-0A	PG Frequency Dividing Ratio Setting		1	PG Pulse	8192	1024
Cn-0B	Zero-speed Level [r/min]	r/min	10	200	20	20
Cn-0C	Mode Switch (Torque Reference) [%]	%	0	MAX τ	200	200
Cn-0D	Mode Switch (Speed Reference) [r/min]	r/min	0	MAX SPD	0	0
Cn-0E	Mode Switch [10(r/min)/s] (Motor Acceleration Detection)	r/min/s	0	3000	0	0
Cn-0F	Zero-clamp Level [r/min]	r/min	0	100	10	10
Cn-10	JOG Speed [r/min]	r/min	0	MAX SPD	100	100
Cn-11	Number of Encoder Pulses [pulses/rev]	Pulses/rev	---	---	8192	8192
Cn-12	Delay Time From Brake Reference (x 10 ms)	ms	0	50	20	20
Cn-13	Torque Reference Gain [1/10 V Rated Torque]	V	10	100	30	30
Cn-14	Speed Limit [r/min]	r/min	0	MAX SPD	3000	3000
Cn-15	Brake Timing (Speed) [r/min]	r/min	0	MAX SPD	100	100
Cn-16	Brake Timing (Time) [r/min]	r/min	10	100	50	50
Cn-17	Torque Reference Filter [x 100 μs]	μs	0	250	4	4

▲ V between IN-A & IN-B to set to "0" RPM.
■ Manual speed ref. adjust.
☼ **DO NOT ADJUST!** Set priorly at factory.

SU-053004
INGD-0850

User Constant Cn-00 to Cn-17 (Constant Setting)

USER CONSTANT	Bit No.	CONTENTS	UNIT	LOWER LIMIT	UPPER LIMIT	DEFAULT SETTING	APPLICATION SETTING
Cn-00	0	- Jog	----	---	---	---	---
	1	Speed ref offset adjust	mV	0	±50	▲	▲
	2	Clear fault history	----	---	---	---	---
	3	A.XXX B.XXX	mV	0	±50	■	■
	4	A.XXX B.XXX	▲	0	---	☼	☼
	5	F.0509 Y.0000 P.0004	Motor # Modif #	---	---	---	---
Cn-01	0	SV • ON Mask	bit	0	1	0	0
	1	SEN Mask	bit	0	1	0	0
	2	P-OT Mask	bit	0	1	0	0
	3	N-OT Mask	bit	0	1	0	0
	4	IN-A Mask	bit	0	1	0	0
	5	IN-B Mask	bit	0	1	0	0
	6	Coasting to a stop/DB stop	bit	0	1	0	0
	7	DB ON/OFF after Stop	bit	0	1	0	0
	8	OT Zero Speed Stop	bit	0	1	0	0
	9	Zero Clamp after OT Stop	bit	0	1	0	0
	A B	Control Mode Selection	bit	0	1	0	0
	C D	Mode Switch Selection	bit	0	1	0	0
	E	Braking Command Selection	bit	0	1	0	0
	F	Multi-turn Data Clear	bit	0	1	0	0
Cn-02	0	Reverse Rotation Mode	bit	0	1	0	0
Cn-03		IN-B Input Adjustment [(r/min)/V]	r/min/V	0	2000	150	375
Cn-04		Speed Loop Gain [Hz]	Hz	20	500	40	55
Cn-05		Speed Loop Integral Time Constant	ms	2	512	20	30
Cn-06		Emergency Stop Torque	%	0	MAX τ	224	224
Cn-07		Soft Start Time	ms	0	10000	0	0
Cn-08		Forward Torque Limit [%]	%	0	MAX τ	224	224

Cn-09	Reverse Torque Limit [%]	%	0	MAX τ	224	224
Cn-0A	PG Frequency Dividing Ratio Setting	P/R	1	32768	8192	1024
Cn-0B	Zero-speed Level [r/min]	r/min	10	200	20	20
Cn-0C	Mode Switch (Torque Reference) [%]	%	0	MAX τ	200	200
Cn-0D	Mode Switch (Speed Reference) [r/min]	r/min	0	MAX SPD	0	0
Cn-0E	Mode Switch [10(r/min)/s] (Motor Acceleration Detection)	r/min/s	0	3000	0	0
Cn-0F	Zero-clamp Level [r/min]	r/min	0	100	10	10
Cn-10	JOG Speed [r/min]	r/min	0	MAX SPD	100	100
Cn-11	Number of Encoder Pulses [pulses/rev]	P/R	1	32768	8192	8192
Cn-12	Delay Time From Brake Reference (x 10 ms)	ms	0	50	20	20
Cn-13	Torque Reference Gain [1/10 V Rated Torque]	V	10	100	30	30
Cn-14	Speed Limit [r/min]	r/min	0	MAX SPD	3000	3000
Cn-15	Brake Timing (Speed) [r/min]	r/min	0	MAX SPD	100	100
Cn-16	Brake Timing (Time) [r/min]	r/min	10	100	50	50
Cn-17	Torque Reference Filter [x 100 μs]	μs	0	250	4	4

▲ V between IN-A & IN-B to set to "0" RPM.
■ Manual speed ref. adjust.
☼ **DO NOT ADJUST!** Set priorly at factory.

SU-053006
INGD-1800

User Constant Cn-00 to Cn-17 (Constant Setting)

USER CONSTANT	Bit No.	CONTENTS	UNIT	LOWER LIMIT	UPPER LIMIT	DEFAULT SETTING	APPLICATION SETTING
Cn-00	0	- Jog	----	---	---	---	---
	1	Speed ref offset adjust	mV	0	±50	▲	▲
	2	Clear fault history	----	---	---	---	---
	3	A.XXX B.XXX	mV	0	±50	■	■
	4	A.XXX B.XXX	▲	0	---	☼	☼
	5	F.0514 Y.0000 P.0004	Motor # Modif #	---	---	---	---
Cn-01	0	SV • ON Mask	bit	0	1	0	0
	1	SEN Mask	bit	0	1	0	0
	2	P-OT Mask	bit	0	1	0	0
	3	N-OT Mask	bit	0	1	0	0
	4	IN-A Mask	bit	0	1	0	0
	5	IN-B Mask	bit	0	1	0	0
	6	Coasting to a stop/DB stop	bit	0	1	0	0
	7	DB ON/OFF after Stop	bit	0	1	0	0
	8	OT Zero Speed Stop	bit	0	1	0	0
	9	Zero Clamp after OT Stop	bit	0	1	0	0
	A B	Control Mode Selection	bit	0	1	0	0
	C D	Mode Switch Selection	bit	0	1	0	0
	E	Braking Command Selection	bit	0	1	0	0
	F	Multi-turn Data Clear	bit	0	1	0	0
Cn-02	0	Reverse Rotation Mode	bit	0	1	0	0
Cn-03		IN-B Input Adjustment [(r/min)/V]	r/min/V	0	2000	150	188
Cn-04		Speed Loop Gain [Hz]	Hz	20	500	40	40
Cn-05		Speed Loop Integral Time Constant	ms	2	512	20	20
Cn-06		Emergency Stop Torque	%	0	MAX τ	100	100
Cn-07		Soft Start Time	ms	0	10000	0	0
Cn-08		Forward Torque Limit [%]	%	0	MAX τ	100	100

Cn-09	Reverse Torque Limit [%]	%	0	MAX τ	100	100
Cn-0A	PG Frequency Dividing Ratio Setting		1	PG Pulse	8192	1024
Cn-0B	Zero-speed Level [r/min]	r/min	10	200	20	20
Cn-0C	Mode Switch (Torque Reference) [%]	%	0	MAX τ	200	200
Cn-0D	Mode Switch (Speed Reference) [r/min]	r/min	0	MAX SPD	0	0
Cn-0E	Mode Switch [10(r/min)/s] (Motor Acceleration Detection)	r/min/s	0	3000	0	0
Cn-0F	Zero-clamp Level [r/min]	r/min	0	100	10	10
Cn-10	JOG Speed [r/min]	r/min	0	MAX SPD	100	100
Cn-11	Number of Encoder Pulses [pulses/rev]	Pulses/rev	---	---	8192	8192
Cn-12	Delay Time From Brake Reference (x 10 ms)	ms	0	50	20	20
Cn-13	Torque Reference Gain [1/10 V Rated Torque]	V	10	100	30	38
Cn-14	Speed Limit [r/min]	r/min	0	MAX SPD	1500	1500
Cn-15	Brake Timing (Speed) [r/min]	r/min	0	MAX SPD	100	100
Cn-16	Brake Timing (Time) [r/min]	r/min	10	100	20	20
Cn-17	Torque Reference Filter [x 100 μs]	μs	0	250	4	4

▲ V between IN-A & IN-B to set to "0" RPM.
■ Manual speed ref. adjust.
☼ **DO NOT ADJUST!** Set priorly at factory.

SU-053008
INGD-4400

User Constant Cn-00 to Cn-17 (Constant Setting)

USER CONSTANT	Bit No.	CONTENTS	UNIT	LOWER LIMIT	UPPER LIMIT	DEFAULT SETTING	APPLICATION SETTING
Cn-00	0	- Jog	----	---	---	---	---
	1	Speed ref offset adjust	mV	0	±50	▲	▲
	2	Clear fault history	----	---	---	---	---
	3	A.XXX B.XXX	mV	0	±50	■	■
	4	A.XXX B.XXX	▲	0	±50	☼	☼
	5	F.052C Y.0000 P.0004	Motor # Modif #	---	---	---	---
Cn-01	0	SV • ON Mask	bit	0	1	0	0
	1	SEN Mask	bit	0	1	0	0
	2	P-OT Mask	bit	0	1	0	0
	3	N-OT Mask	bit	0	1	0	0
	4	IN-A Mask	bit	0	1	0	0
	5	IN-B Mask	bit	0	1	0	0
	6	Coasting to a stop/DB stop	bit	0	1	0	0
	7	DB ON/OFF after Stop	bit	0	1	0	0
	8	OT Zero Speed Stop	bit	0	1	0	0
	9	Zero Clamp after OT Stop	bit	0	1	0	0
	A B	Control Mode Selection	bit	0	1	0	0
	C D	Mode Switch Selection	bit	0	1	0	0
	E	Braking Command Selection	bit	0	1	0	0
	F	Multi-turn Data Clear	bit	0	1	0	0
Cn-02	0	Reverse Rotation Mode	bit	0	1	0	0
Cn-03		IN-B Input Adjustment [(r/min)/V]	r/min/V	0	2000	150	312
Cn-04		Speed Loop Gain [Hz]	Hz	20	500	40	40
Cn-05		Speed Loop Integral Time Constant	ms	2	512	20	20
Cn-06		Emergency Stop Torque	%	0	MAX τ	212	212
Cn-07		Soft Start Time	ms	0	10000	0	0
Cn-08		Forward Torque Limit [%]	%	0	MAX τ	212	212

Cn-09	Reverse Torque Limit [%]	%	0	MAX τ	212	212
Cn-0A	PG Frequency Dividing Ratio Setting		1	PG Pulse	8192	1024
Cn-0B	Zero-speed Level [r/min]	r/min	10	200	20	20
Cn-0C	Mode Switch (Torque Reference) [%]	%	0	MAX τ	200	200
Cn-0D	Mode Switch (Speed Reference) [r/min]	r/min	0	MAX SPD	0	0
Cn-0E	Mode Switch [10(r/min)/s] (Motor Acceleration Detection)	r/min/s	0	3000	0	0
Cn-0F	Zero-clamp Level [r/min]	r/min	0	100	10	10
Cn-10	JOG Speed [r/min]	r/min	0	MAX SPD	100	100
Cn-11	Number of Encoder Pulses [pulses/rev]	Pulses/rev	---	---	8192	8192
Cn-12	Delay Time From Brake Reference (x 10 ms)	ms	0	50	20	20
Cn-13	Torque Reference Gain [1/10 V Rated Torque]	V	10	100	30	30
Cn-14	Speed Limit [r/min]	r/min	0	MAX SPD	3000	3000
Cn-15	Brake Timing (Speed) [r/min]	r/min	0	MAX SPD	100	100
Cn-16	Brake Timing (Time) [r/min]	r/min	10	100	50	50
Cn-17	Torque Reference Filter [x 100 μs]	μs	0	250	4	4

▲ V between IN-A & IN-B to set to "0" RPM.
■ Manual speed ref. adjust.
☼ **DO NOT ADJUST!** Set priorly at factory.

APPENDIX C
PWRPAK™ SPECIFICATIONS

PWRPAK™ List of Materials

PWRPAK™ Specifications

PWRPAK™ LIST OF MATERIALS

DESCRIPTION	TRANSFORMER	MANUAL
PWRPAK5-1000	T-300/3-3	IB-14B005
PWRPAK5-1500	T-300/5-3	IB-14B005
PWRPAK5-2200	T-300/7.5-3	IB-14B005
PWRPAK5-2250	TE-300/7.5-3	IB-14B005
PWRPAK5-4500	TE-300/15-3	IB-14B005
PWRPAK5-9000	TE-300/30-3	IB-14B005
PWRPAK5-15000	TE-300/58-3	IB-14B005
PWRPAK5-22500	TE-300/75-3	IB-14B005
PWRPAK5-28500	TE-300/95-3	IB-14B005

PWRPAK™ SPECIFICATIONS

TRANSFORMER	OUTPUT POWER (Watts)	INPUT PHASES	PM*	FS*	PRIMARY TERMINAL CURRENT (Amps)		SECONDARY TERMINAL CURRENT (Amps)		
					230 VAC	460 VAC	253 VAC	230 VAC	207 VAC
T-300/3-3	1000	3	X		3	6	3	3	3
T-300/5-3	1500	3	X		5	2.5	5	5	5
T-300/7.5-3	2200	3	X		7.5	3.7	7.5	7.5	7.5
TE-300/7.5-3	2250	3		X	7.5	3.7	6.8	7.5	8.3
TE-300/15-3	4500	3		X	15	7.5	13.7	15	16.7
TE-300/30-3	9000	3		X	30	15	27.4	30	33.5
TE-300/58-3	15000	3		X	57.7	28.8	52.5	57.7	64.1
TE-300/75-3	22500	3		X	67.7	33.9	61.6	67.8	75.3
TE-300/95-3	28500	3		X	95	47.5	86.4	95	105

*NOTE: PM = Panel Mount, FS = Free-standing

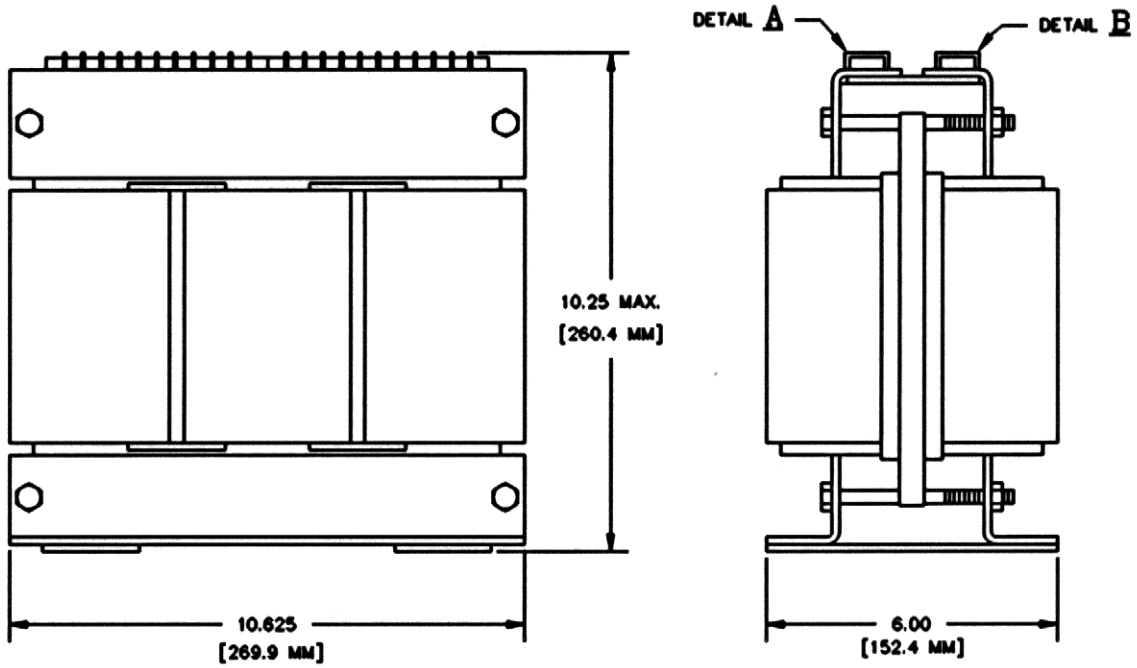
NOTES

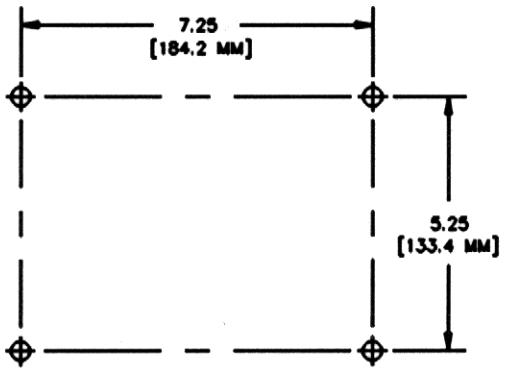
APPENDIX D
PWRPAK™ DIMENSIONS AND CONNECTIONS

Panel-mount Transformer Dimensions and Connections

Free-standing Transformer Dimensions and Connections

PANEL-MOUNT TRANSFORMER DIMENSIONS AND CONNECTIONS



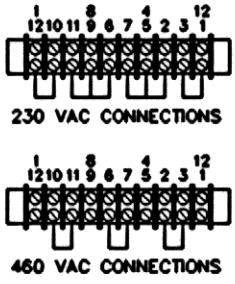


MOUNTING PATTERN

.625 [15.9 MM] DIA. THRU (4 PLACES)
USE 3/8-16 UNC MOUNTING HARDWARE

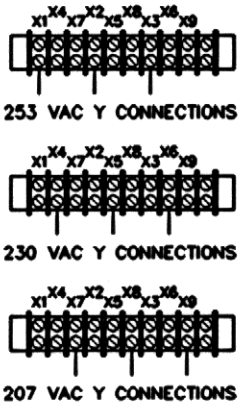
DETAIL A

WIRING/PRIMARY TERMINALS



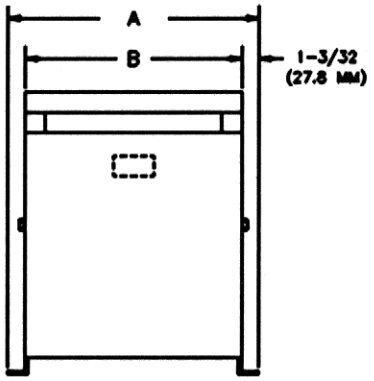
DETAIL B

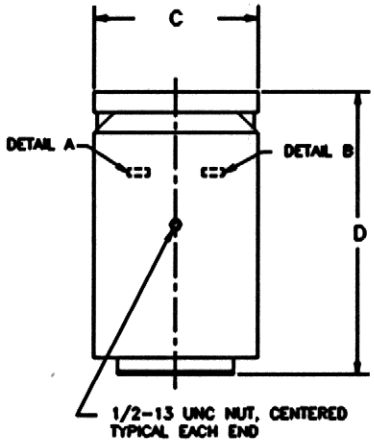
WIRING/SECONDARY TERMINALS

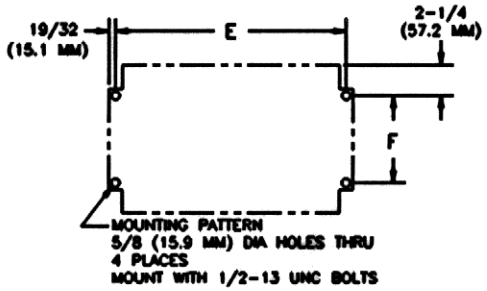


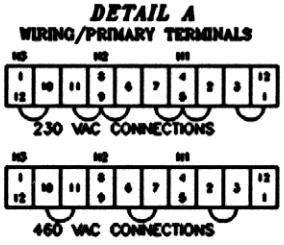
TRANSFORMER	FREQ. (HZ)	PHASE	OUTPUT POWER (WATTS)	TEMP. RISE (°C)	WEIGHT (LBS.)
T-300/3-3	60	3	1000	150	80
T-300/5-3	60	3	1500	150	80
T-300/7.5-3	60	3	2200	150	80

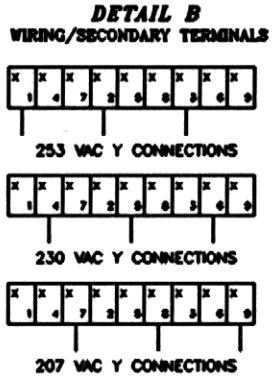
FREE-STANDING TRANSFORMER DIMENSIONS AND CONNECTIONS











TRANSFORMER	FREQ. (HZ)	PHASE	OUTPUT POWER (WATTS)	TEMP. RISE (°C)	WEIGHT (LBS.)	A	B	C	D	E	F
TE-300/7.5-3	60	3	2250	150	110	18.19 (462)	16.00 (406)	8.00 (203)	21.00 (533)	17.00 (432)	3.50 (89)
TE-300/15-3	60	3	4500	150	125	18.19 (462)	16.00 (406)	8.00 (203)	21.00 (533)	17.00 (432)	3.50 (89)
TE-300/30-3	60	3	9000	150	175	22.19 (564)	20.00 (508)	12.00 (305)	21.00 (533)	21.00 (533)	7.50 (191)
TE-300/58-3	60	3	15000	150	216	28.19 (716)	26.00 (660)	16.00 (406)	27.00 (686)	27.00 (686)	11.50 (292)
TE-300/75-3	60	3	22500	150	400	28.19 (716)	26.00 (660)	16.00 (406)	27.00 (686)	27.00 (686)	11.50 (292)
TE-300/95-3	60	3	28500	150	400	28.19 (716)	26.00 (660)	16.00 (406)	27.00 (686)	27.00 (686)	11.50 (292)

DIMENSIONS = INCHES
(MILLIMETERS)

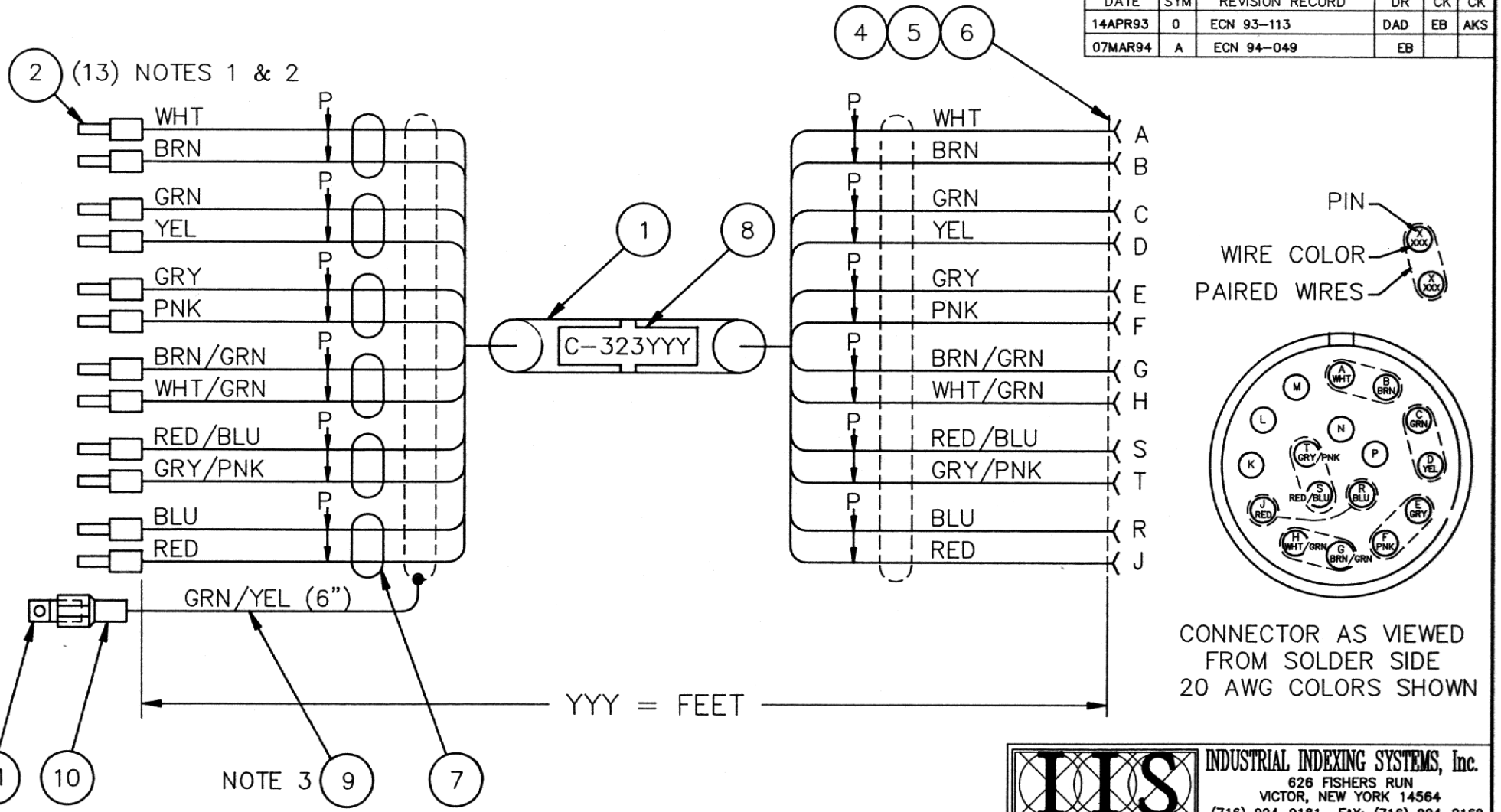
NOTES

APPENDIX E
CONNECTING CABLES

DRAWING NUMBER	DESCRIPTION
C-323YYY	Cable, Encoder
C-463YYY	Cable, Command, Digital Incremental
C-470YYY	Cable, Command, ServoPro
C-663YYY	Cable, Motor
C-665YYY	Cable, Motor
C-673YYY	Cable, Motor

NOTES

DATE	SYM	REVISION RECORD	DR	CK	CK
14APR93	0	ECN 93-113	DAD	EB	AKS
07MAR94	A	ECN 94-049	EB		



CONNECTOR AS VIEWED
FROM SOLDER SIDE
20 AWG COLORS SHOWN

NOTES:

1. INSTALL ITEM 2 & 3 USING WEIDMULLER CRIMP TOOL PZ4 OR EQUIV
2. ALTERNATE CONSTRUCTION; STRIP AND TIN 1/4"
3. GRN/YEL WIRE SOLDERED TO SHIELD

INDUSTRIAL INDEXING SYSTEMS, Inc.
626 FISHERS RUN
VICTOR, NEW YORK 14564
(716) 924-9181 FAX: (716) 924-2169

CHECKED BY E.B.	DATE 4/21/93
APPROVED BY A.K.S.	DATE 4/21/93
APPROVED BY	DATE 3/8/94
MATERIAL -----	
FINISH -----	

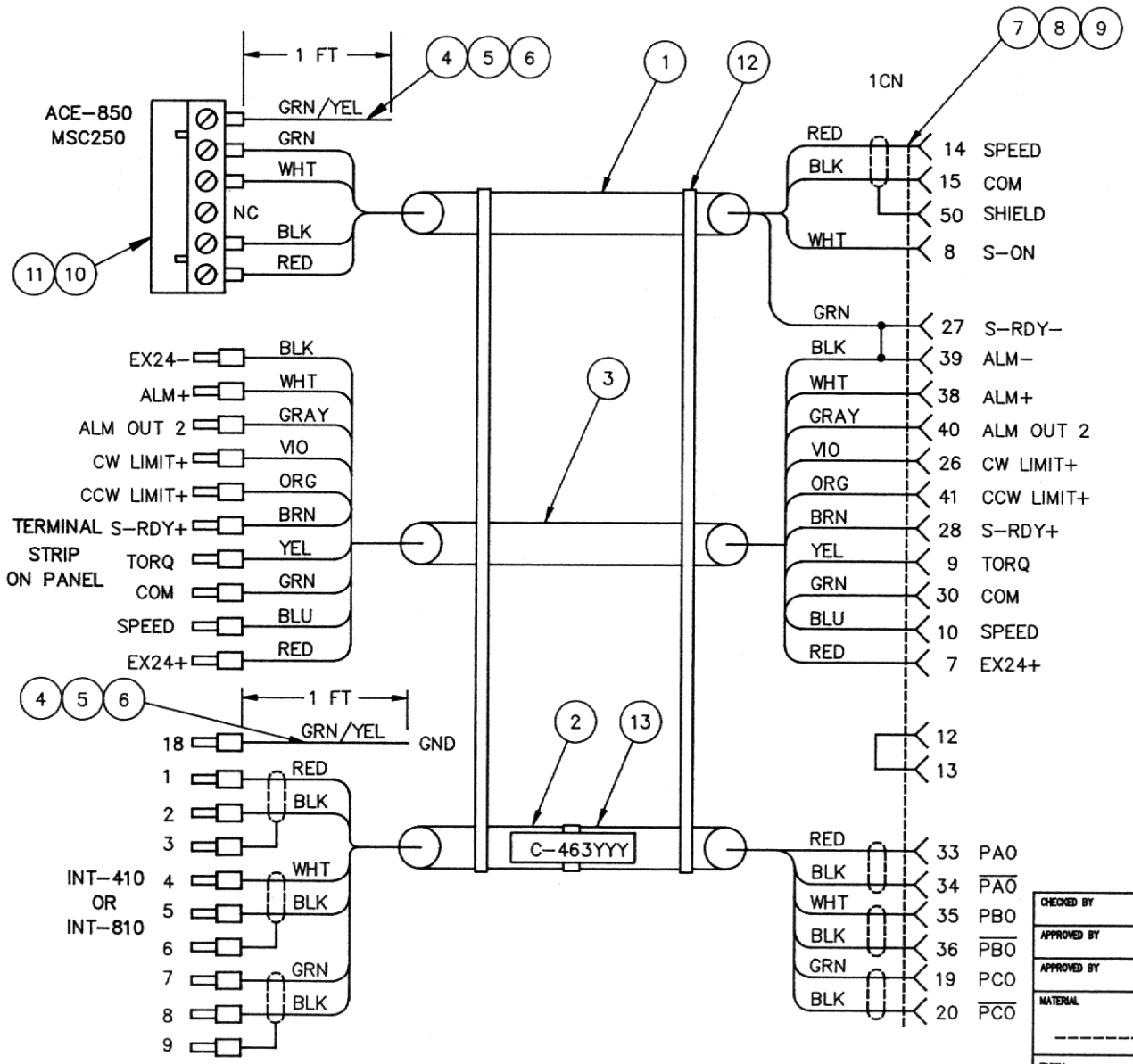
TITLE: CABLE, ENCODER

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY D.A.DAUNCE		DRAWING NUMBER C-323YYY
TOLERANCES: X.X± ----- X.XX± ---- X.XXX± --- ANGULAR ± ---	AutoCAD FILE LOCATION CABLES		
B	DATE 06APR93	SCALE -----	SHEET NO. 1 OF 1 / REVISION A

NOTES:

1. ALTERNATE CONSTRUCTION; STRIP AND TIN 1/4"
2. INSTALL ITEM 8 USING WEIDMULLER CRIMP TOOL PZ4 OR EQUIV

DATE	SYM	REVISION RECORD	DR	CK	CK
7/28/93	A	ECN 93-225	EB	WS	
5/12/94	B	ECN 94-128	DAD		



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CHECKED BY	DATE
APPROVED BY	DATE
APPROVED BY	DATE
MATERIAL	----------
FINISH	----------

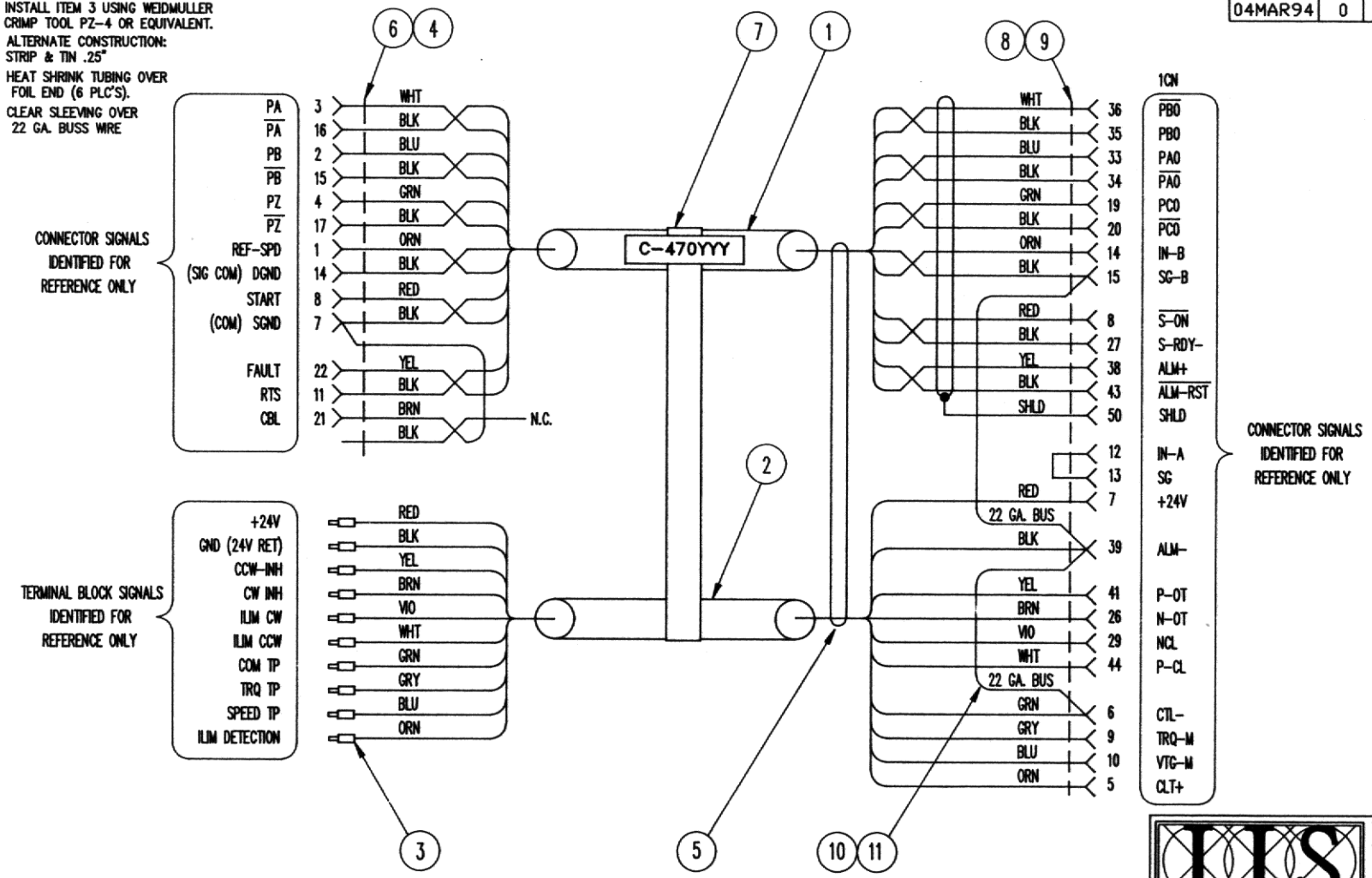
TITLE: CABLE, YASKAW COMMAND DIGITAL INCREMENTAL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY: CAD/BAIER		DRAWING NUMBER: C-463YYY
TOLERANCES: X.X± ------- ANGULAR ± ---	AutoCAD FILE LOCATION: G:\CABLES\C-463		
X.XX± ------	B	DATE: 7/28/93	SCALE: ---	SHEET NO.: 1 OF 1	REVISION: B
X.XXX± -----			

NOTES:

1. INSTALL ITEM 3 USING WEIDMULLER CRIMP TOOL PZ-4 OR EQUIVALENT.
2. ALTERNATE CONSTRUCTION: STRIP & TIN .25"
3. HEAT SHRINK TUBING OVER FOIL END (6 PLC'S).
4. CLEAR SLEEVING OVER 22 GA. BUSS WIRE

DATE	SYM	REVISION RECORD	DR	CK	CK
04MAR94	0	ECN 94-029	EB		



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VICTOR, NEW YORK 14564
(716) 924-9181 FAX: (716) 924-2169

CHECKED BY	DATE
APPROVED BY: Carl O. Mott	DATE 3/4/94
APPROVED BY	DATE
MATERIAL: ----------	
FINISH: ----------	

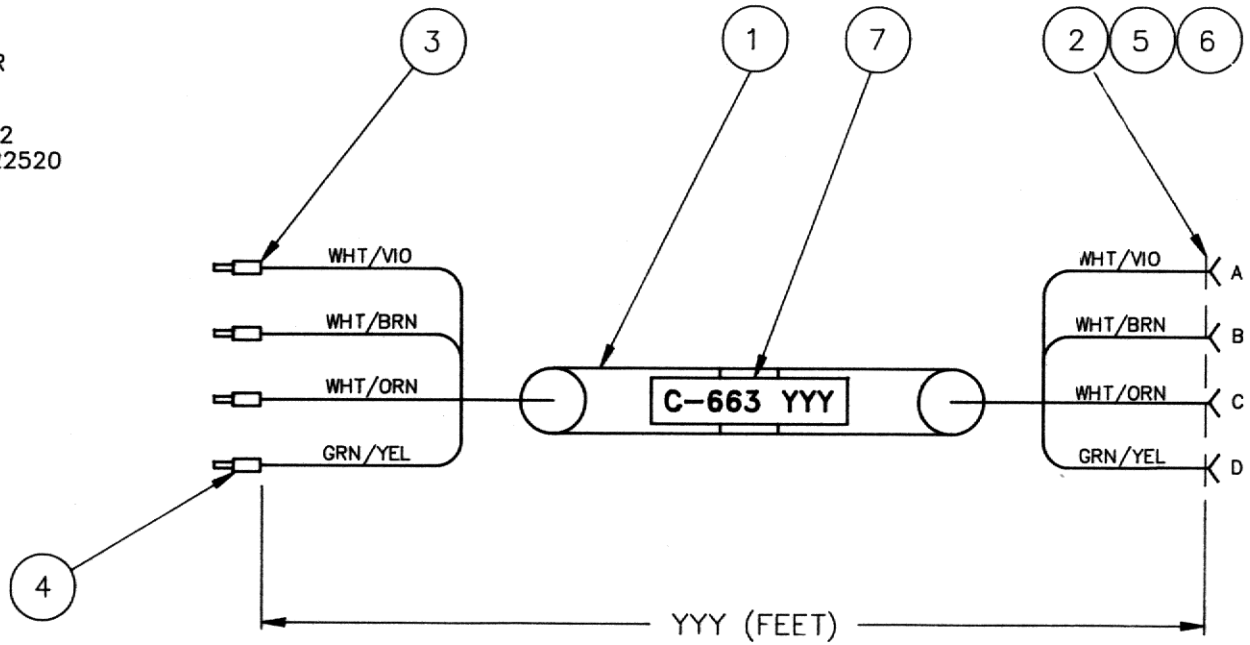
TITLE: CABLE, COMMAND, SERVOPRO

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY G.Baier		DRAWING NUMBER C-470YYY
TOLERANCES: X.X± ------- ANGULAR ± ---	AutoCAD FILE LOCATION G:\CAD\CABLES		
X.XX± -------	B	DATE 04MAR94	SCALE ----	SHEET NO. 1 OF 1	REVISION 0
X.XXX± -----			

NOTES:

1. INSTALL ITEMS 3 & 4 USING WEIDMULLER CRIMP TOOL PZ–4 OR EQUIVALENT.
2. ALTERNATE CONSTRUCTION: STRIP & TIN .25"
3. PIN NUMBERS SHOWN FOR REFERENCE ONLY.
4. INSTALL PINS FROM ITEM 2 USING DMC TOOL NO. M22520 OR EQUIVALENT.

DATE	SYM	REVISION RECORD	DR	CK	CK



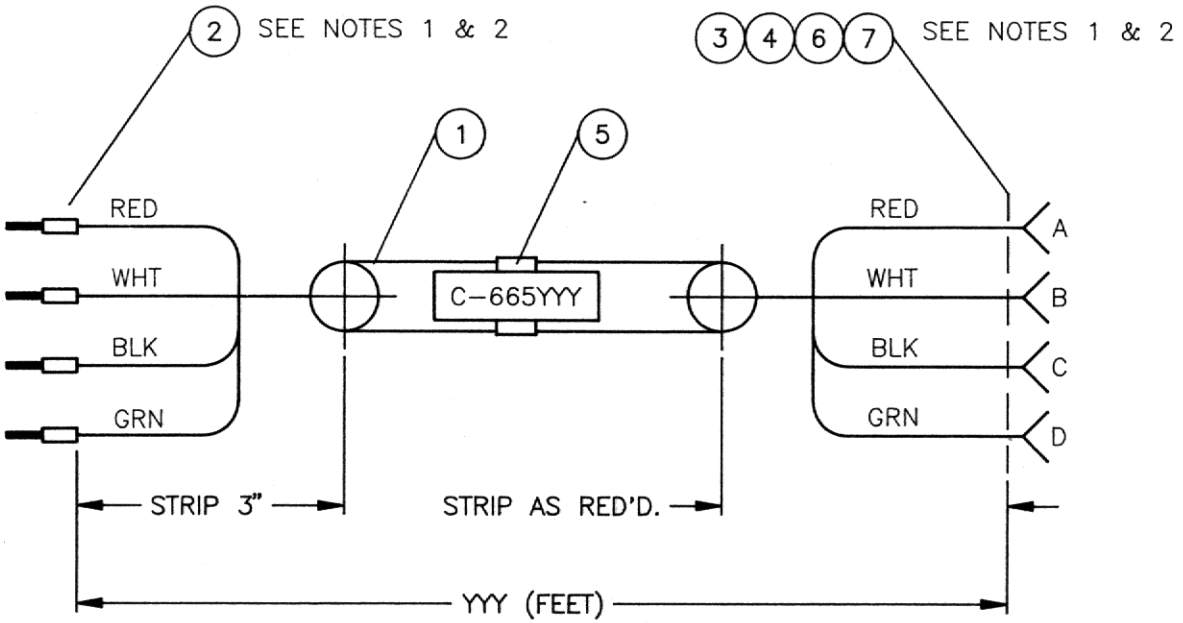
TOLERANCES (EXCEPT AS NOTED)	IIS INDUSTRIAL INDEXING SYSTEMS			
XX± --- XXX± ---	AutoCAD FILE LOCATION G:\CAD\CABLES	SCALE ---	DRAWN BY CAD\BAIER APPROVED BY JTF	
ANGULAR ± ---	TITLE CABLE, MOTOR			
DATE 12/14/90	SHEET NO. 1 OF 1	DRAWING NUMBER C-663YYY		REVISION 0

NOTES:

1) ALTERNATE CONSTRUCTION
   STRIP & TIN 1/4"

2) CRIMP FERRULES USING WEIDMULLER
   CRIMP TOOL 'PZ4' OR EQUIVALENT

DATE	SYM	REVISION RECORD	DR	CK	CK
8/10/93	0	ECN-93-263	EB		



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VICTOR, NEW YORK 14564
(716) 924-9181 FAX: (716) 924-2169

CHECKED BY: Bob	DATE: 8/93
APPROVED BY	DATE
APPROVED BY	DATE
MATERIAL: ----------	
FINISH: ----------	

TITLE: **CABLE, MOTOR**

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY: CAD		DRAWING NUMBER: C-665YYY
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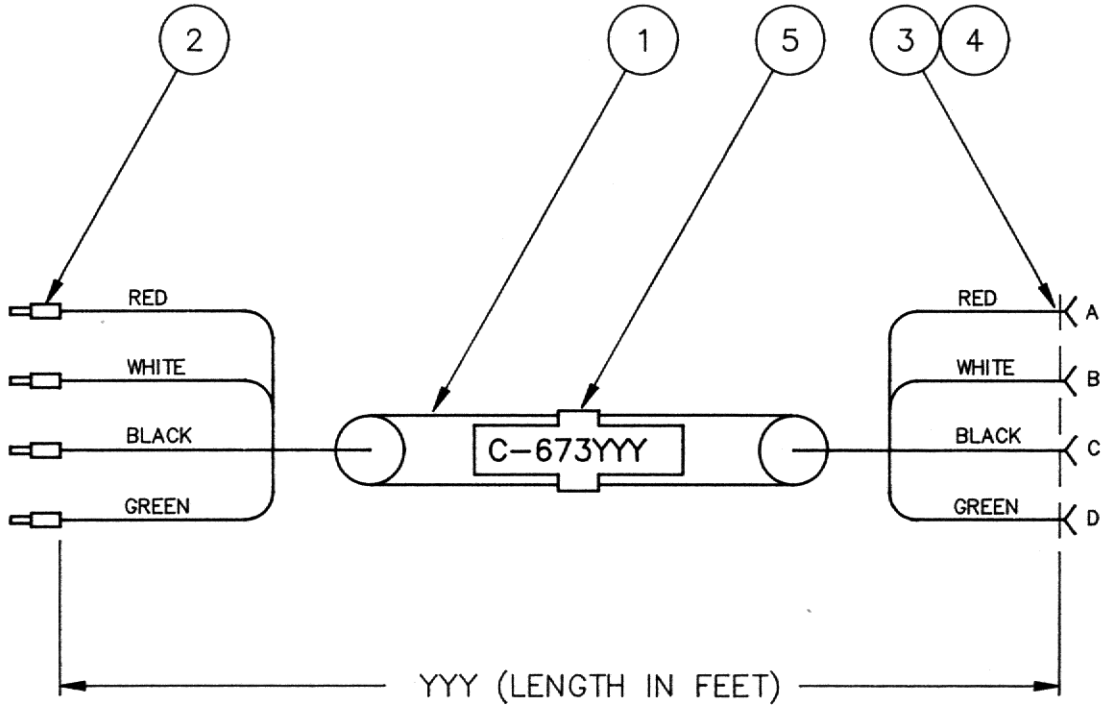
		SHEET NO.: 1 OF 1	REVISION: 0

DATE	SYM	REVISION RECORD	DR	CK	CK
6/29/93	0	ECN 93-172	EB		
6/2/94	A	ECN 94-134	DAD	EB	

NOTES:

1. INSTALL ITEM 3 USING WEIDMULLER CRIMP TOOL PZ-4 OR EQUIVALENT.
2. ALTERNATE CONSTRUCTION: STRIP & TIN .25"
3. PIN NUMBERS SHOWN FOR REFERENCE ONLY.
4. INSTALL PINS FROM ITEM 3 USING DMC TOOL NO. M22520 OR EQUIVALENT.



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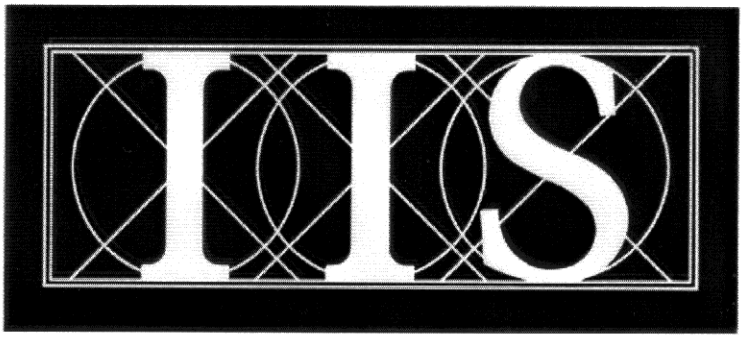
CHECKED BY EB	DATE 3/94	THIS DRAWING, AND THE DATA CONTAINED THERIN, ARE PROPRIETARY INFORMATION OF; INDUSTRIAL INDEXING SYSTEMS, Inc. AND IS ISSUED IN STRICT CONFIDENCE, AND IT SHALL NOT BE REPRODUCED, COPIED, OR USED FOR ANY PURPOSE WHATSOEVER, WITHOUT THE PRIOR WRITTEN PERMISSION OF; INDUSTRIAL INDEXING SYSTEMS, Inc.
APPROVED BY	DATE	
APPROVED BY	DATE	TITLE: CABLE, MOTOR
MATERIAL: ----------	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE INCHES (mm)	DRAWN BY CAD; DRAWING NUMBER C-673YYY
	TOLERANCES: X.X± ---- ; X.XX± 0.01 ; X.XXX± 0.005	ANGULAR ± ----
FINISH: ----------	AutoCAD FILE LOCATION G:\CAD\CABLES	B; DATE 6/29/93; SCALE ----
		SHEET NO. 1 OF 1; REVISION A

IB-18B003



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