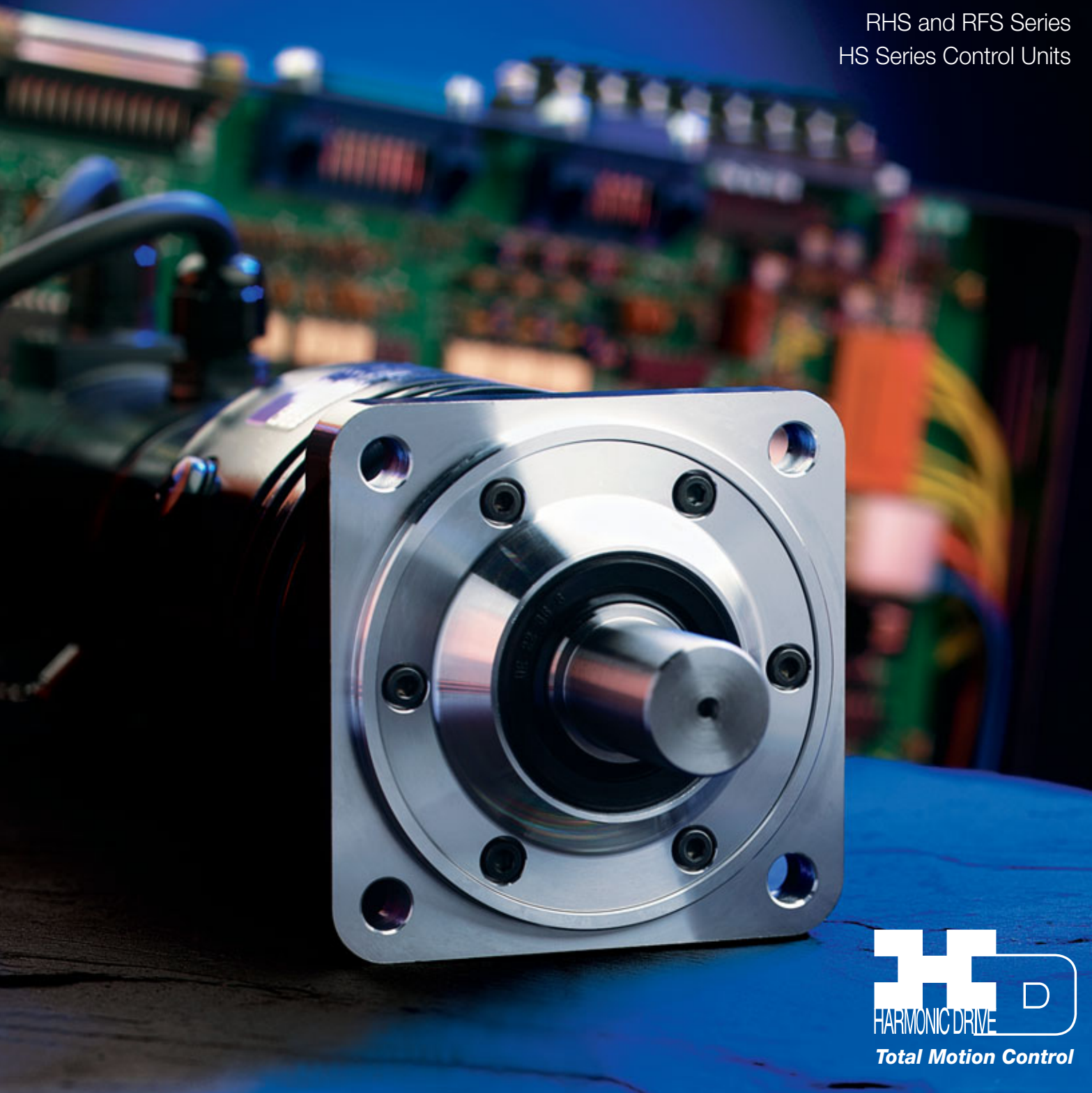


D C S e r v o S y s t e m s

RH Mini Series
RHS and RFS Series
HS Series Control Units

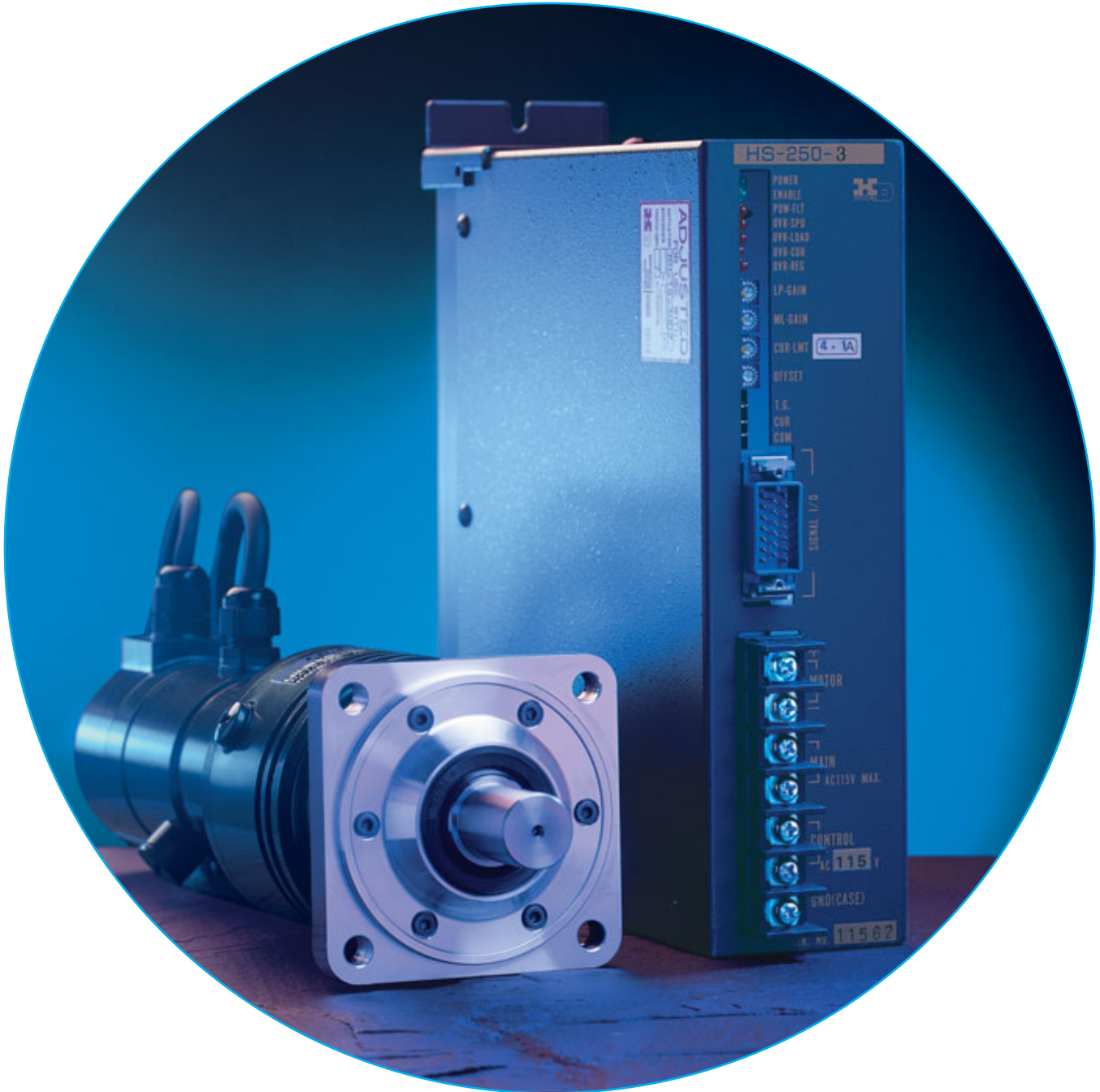


harmonic drive gearing
Precision Gearing & Motion Control

Precision Gearing & Motion Control

DC SERVO ACTUATORS & CONTROLLERS

FEATURES: • ZERO BACKLASH • HIGH POSITIONAL ACCURACY • HIGH STIFFNESS



The RH mini series actuators are used in highly demanding industrial servo systems and provide precision motion control and high torque capacity in very compact packages. RHS and RFS series DC servo actuators feature the patented “S” series harmonic drive precision gearbox for high torque, high torsional stiffness, and high performance. These actuators are powerful yet compact and are specially designed for “S” series harmonic drive gearing. The result is a superior DC servo system with higher power density which is used in highly demanding industrial robot and automation applications.

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Examples of System Configurations

Select the optimum DC servo actuator and control unit system

The RH, RHS, and RFS actuators, combining precision harmonic drive gearing and rare earth DC servo motors offer unique features unsurpassed by conventionally geared drives. Used in highly demanding industrial servo systems, they provide precision motion control and high torque capacity in very compact packages. The tach-generator and/or encoder are directly mounted onto the motor shaft. Since the harmonic drive gearing has zero backlash, high servo gains may be used, providing a very stiff, yet stable servo system.

The harmonic drive gear is lubricated with a specially developed grease to ensure minimum maintenance requirements and long service life. The motor brush holders have seals to prevent dust transfer.

The HS series control units enable the DC servo actuators to function with accurate position and speed control.

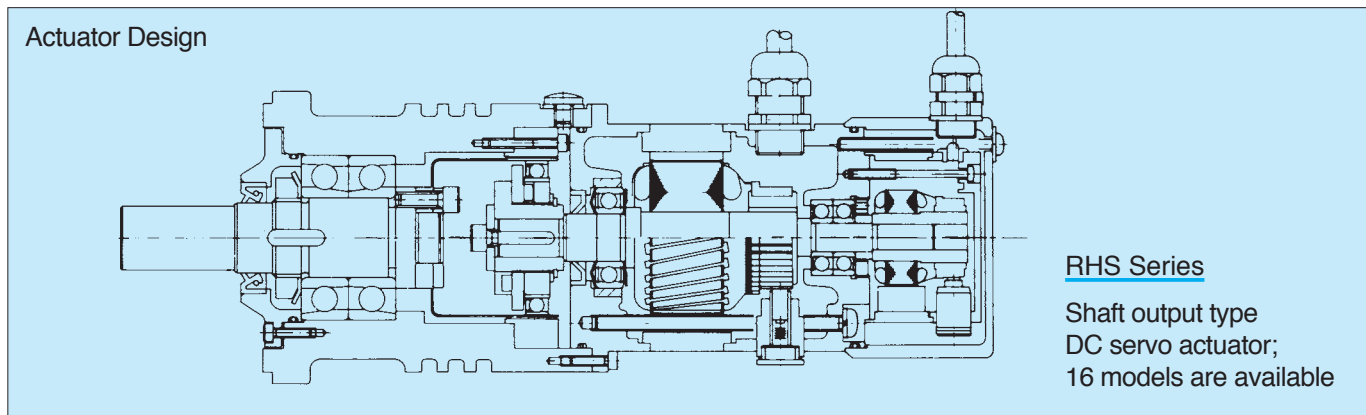
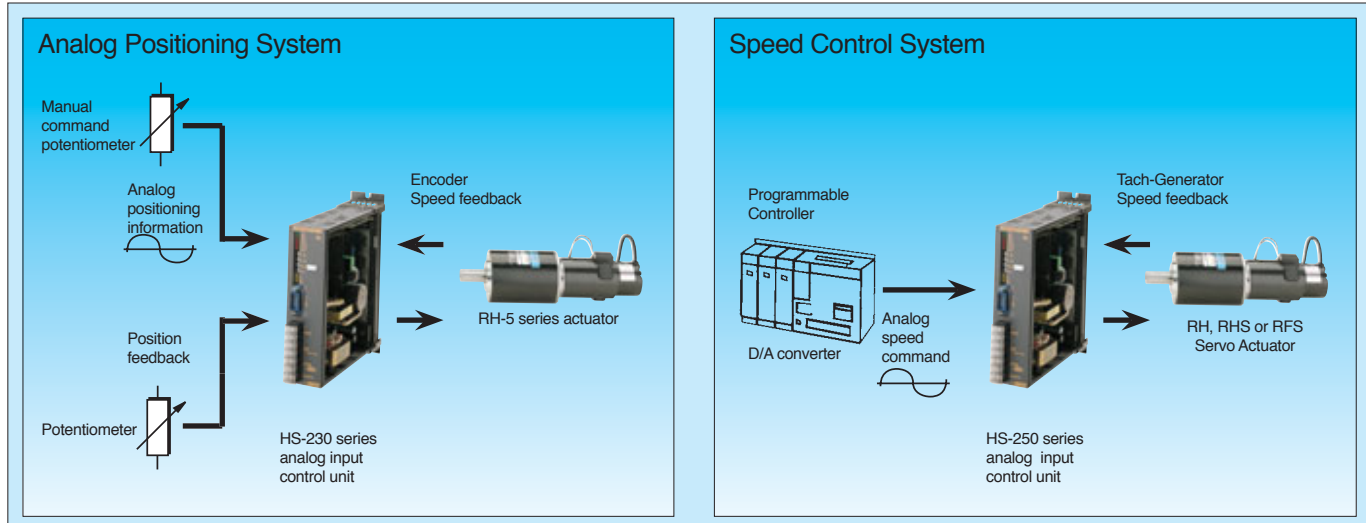
The use of hybrid ICs and gate arrays assures high reliability while keeping the control unit compact. Safety features are incorporated to protect the motors and control units from accidental damage.

Three types of HS series control units are available with either a linear or PWM output stage.

Analog Input

HS-200 Series

The HS-200 series is an analog input control unit for speed control. For velocity feedback, select either a tach-generator, or an encoder (encoder velocity feedback requires external F/V converter). This control unit may also be used as an analog position controller. As an option, the controller may be ordered for use as a current amplifier.



Selection Guide

Several control units are available for each servo actuator. The following chart indicates the available combinations of servo actuators, control units and the corresponding power transformers.

Table 1

Control Unit		Actuator											
		RH-5A	RH-8D	RH-11D	RH-14D	RHS-14 XX03	RHS-17 XX06	RHS-20 / RFS-20		RHS-25 / RFS-25		RHS-32 / RFS-32	
								XX07	XX12	XX12	XX18	XX18	XX30
Analog	HS-230-05-XXX	•											
	HS-250-3-XXX		•	•	•	•	•	•	•				
	HS-250-6-XXX									•	•	•	•
	HS-250-9-XXX												
Digital	HS-330-05-XXX	•											
	HS-350-3-XXX		•	•	•	•	•	•	•				
	HS-350-6-XXX									•	•	•	•
	HS-350-9-XXX												
Intelligent	HS-430-05-XXX	•											
	HS-450-3-XXX		•	•	•	•	•	•	•				
	HS-450-6-XXX									•	•	•	•
	HS-450-9-XXX												
Power Transformer	PT1-03801		•										
	PT1-03802			•									
	PT1-03803				•								
	PT1-10002					•							
	PT1-10004						•						
	PT1-10005							•					
	PT1-10007								•				
	PT1-11010									•			•

Digital Input

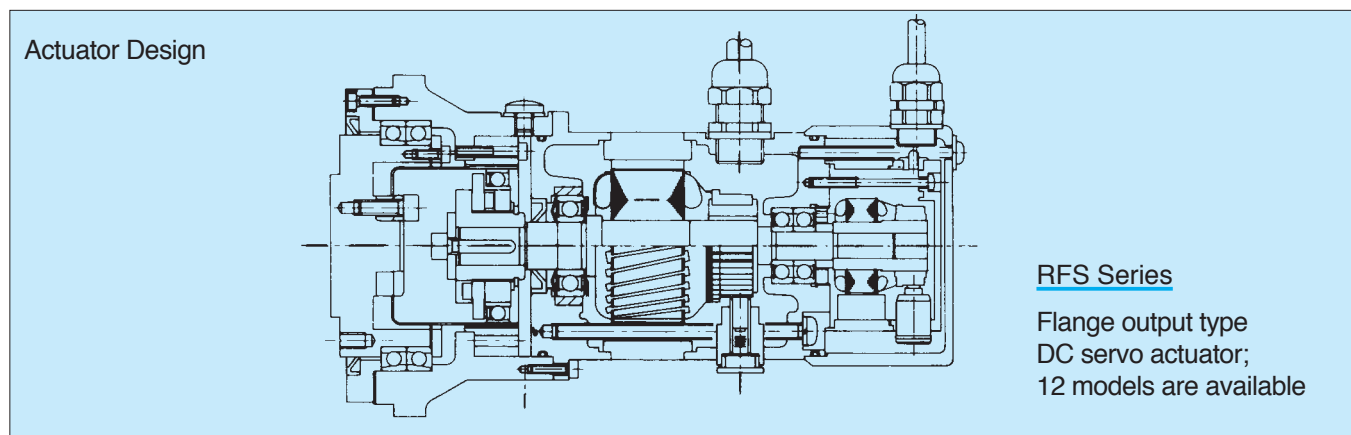
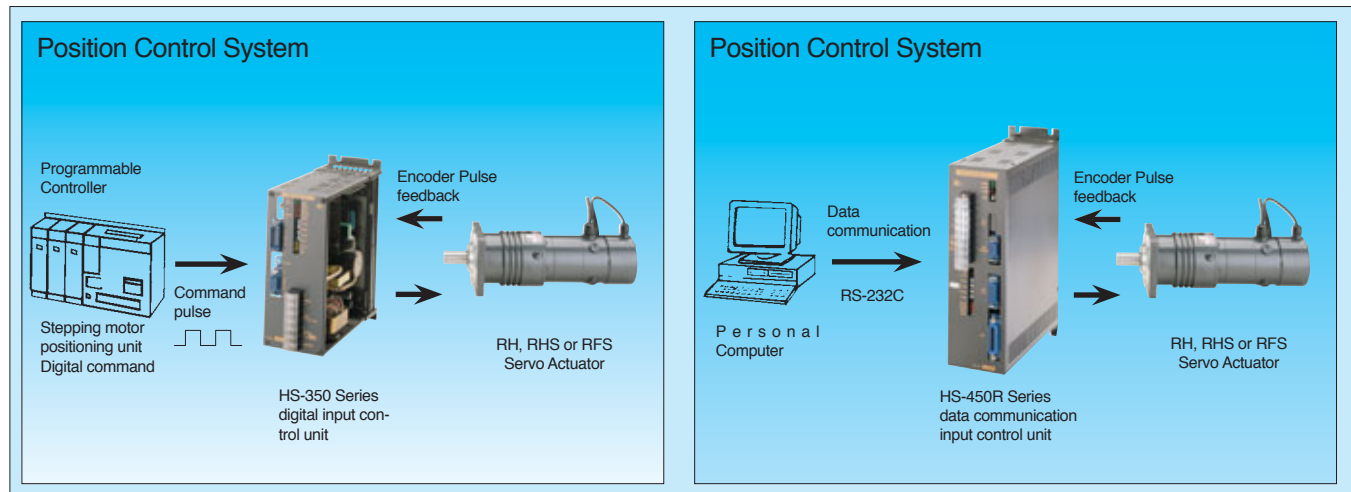
HS-300 Series

The HS-300 series accepts a digital pulse input for position control and speed control. An encoder is used as a combination position and speed sensor. Input pulse count is used for position control, while pulse frequency is used for speed control.

Data Communication Input

HS-400 Series

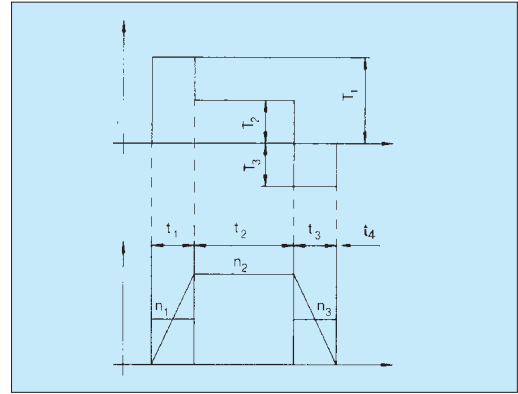
The HS-400 series provides position and speed control using a data communication input interface (RS-232C) for connection to an external computer. Like the HS-300 series, select an encoder as a combination position and speed sensor.



Selection Procedure

Requirements for Preliminary Selection

- Load Torque T_L [Nm] < Rated Torque T_N [Nm]
- Load Speed n_L [rpm] < Rated Output Speed n_N [rpm]
- Load Inertia J_L [kgm²] < 3 J_A (Actuator Inertia) acceptable
- Load Inertia J_L [kgm²] < J_A (Actuator Inertia) for best possible dynamic response



Determination of the duty cycle

Preliminary selection of the actuator

Determination of the acceleration torque T_1 [Nm]

$$T_1 = T_L + 2\pi \cdot \frac{(J_A + J_L) \cdot n_L}{t_1}$$

[Equation 1]

Acceleration Torque T_1 < Maximum Output Torque T_m
(Values for T_m see page 8, 18, and 19)

No

Select another actuator which meets this requirement

Determination of the average torque T_A [Nm]

$$T_A = \sqrt{\frac{T_1^2 \cdot t_1 + T_2^2 \cdot t_2 + T_3^2 \cdot t_3}{t_1 + t_2 + t_3 + t_4}}$$

with: T_1 = Acceleration Torque

T_2 = T_L = Load Torque

T_3 = $T_2 - (T_1 - T_2)$ Braking Torque
(if $t_1 = t_3$)

[Equation 2]

Average Torque T_A < Rated Torque T_N of the actuator
(Values for T_N see page 8, 18 and 19)

No

Select another actuator which meets this requirement

Selected actuator meets all requirements

Select the required encoder resolution

Position Control required

Speed Control required

Encoder Resolution

Where: n = Encoder Resolution

R = Gear reduction ratio

θ_A = Desired position accuracy at the output [arc-min]

γ = Encoder multiplier

$$n \geq (5 \sim 10) \cdot \frac{60 \cdot 360}{\theta_A \cdot R \cdot \gamma}$$

[Equation 3]

Encoder Resolution

Where: n_{min} = Minimum operating output speed [rpm]

f_s = Cut-off frequency [Hz]

$$n \geq 3 \cdot \frac{60 \cdot f_s}{n_{min} \cdot R \cdot \gamma}$$

[Equation 4]

For HS Series Control Units the cut-off frequency f_s can be assumed to be 100 Hz.

Selection of Encoder Output Type

The most suitable encoder output type can be selected according to the following basic specifications:

- ◆ AL - Line Driver (+5V version)
This type can transmit the encoder signal up to 10m and requires a 5V DC power supply
- ◆ BL - Line Driver (+12V version)
This type can transmit the encoder signal up to 100m and requires a 12V DC power supply
- ◆ DO - Open Collector (+ 4.75V to 12.6V); AO - Open Collector (+5V)
These types can transmit the encoder signal up to 10m. They should not be used in environments suffering from high levels of electrical noise.

Example



Load and Operating Conditions		Actuator Data
Load Torque	$T_L = 5 \text{ Nm}$	$< T_N = 20 \text{ Nm}$
Load Speed	$n_L = 50 \text{ rpm}$	$< n_N = 60 \text{ rpm}$
Load Inertia	$J_L = 0.3 \text{ kgm}^2$	$< J_A = 0.46 \text{ kgm}^2$
Acceleration Time	$t_1 = 0.1 \text{ s}$	
Constant Speed Time	$t_2 = 0.2 \text{ s}$	
Braking Time	$t_3 = 0.1 \text{ s}$	
Idle Time	$t_4 = 0.6 \text{ s}$	

Preliminary Selection: RHS - 20 - 6012

Determination of the acceleration torque T_1

$$T_1 = 5 \text{ Nm} + 2\pi \cdot \frac{(0.46 \text{ kgm}^2 + 0.3 \text{ kgm}^2) \cdot 50 \text{ rpm}}{0.1 \text{ s} \cdot 60 \text{ s}} = 44.8 \text{ Nm}$$

Acceleration Torque $T_1 = 44.8 \text{ Nm} < \text{Maximum Output Torque of the actuator } T_m = 57 \text{ Nm}$

Determination of the average torque T_A

$$T_A = \sqrt{\frac{(44.8 \text{ Nm})^2 \cdot 0.1 \text{ s} + (5 \text{ Nm})^2 \cdot 0.2 \text{ s} + (-34.8 \text{ Nm})^2 \cdot 0.1 \text{ s}}{0.1 \text{ s} + 0.2 \text{ s} + 0.1 \text{ s} + 0.6 \text{ s}}} = 18.1 \text{ Nm}$$

with:

$$T_1 = 44.8 \text{ Nm}$$

$$T_2 = T_L = 5 \text{ Nm}$$

$$T_3 = 5 \text{ Nm} - (44.8 \text{ Nm} - 5 \text{ Nm}) = -34.8 \text{ Nm}$$

Average Torque $T_A = 18.1 \text{ Nm} < \text{Rated Torque of the actuator } T_N = 20 \text{ Nm}$

Selected servo actuator: RHS - 20 - 6012

Selection of the necessary encoder resolution (length between actuator and control unit $\leq 10 \text{ m}$)

Position Control required

Encoder Resolution

with: $R = 100$
 $\theta = 1 \text{ arcmin}$
 $\gamma = 4$

$$n \geq 5 \cdot \frac{21600}{1 \cdot 100 \cdot 4} = 270 \text{ ppr}$$

Speed Control required

Encoder Resolution

with: $R = 50$
 $n_{\min} = 0.5 \text{ rpm}$
 $f_s = 100 \text{ Hz}$

$$n \geq 3 \cdot \frac{60 \cdot 100}{0.5 \cdot 50 \cdot 4} = 180 \text{ ppr}$$

The distance between the actuator and the control unit is less than 10 m. Therefore a line driver output is recommended (AL-Type).

Selection:

The above procedure leads to the following selection

Actuator	RHS - 20 - 6012 - E050AL
Control Unit	HS - 350 - 3 - 100 - S0 (as shown in the selection guide on page 5)
Power Transformer	PT1-10005-100

RH Mini Series DC Servo Actuators

Technical Data

Rating:	Continuous
Excitation device:	RE Permanent magnet
Insulation:	Class B
Insulation voltage:	AC 500V, one minute
Insulation resistance:	100M or more (DC 500V Megger)

Vibration:	2.5 g (5 . . . 400 Hz)
Shock:	< 30 g (11 ms)
Construction:	Totally enclosed
Lubrication:	Grease (SK-2)
Ambient temperature:	0 ~ 40°C
Ambient humidity:	20 ~ 80% (non condensing)

Item	Actuator	RH-5A		RH-8D		RH-11D		RH-14D	
		5502	6006	3006	6001	3001	6002	3002	
Control Units	HS-230	HS-250-3							
	HS-330	HS-350-3							
	HS-430 R	HS-450 R-3							
Rated Output Power ¹⁾	W	1.7	8.6	6.2	13.6	12.3	20.3	18.5	
Rated Voltage ¹⁾	V	12	24	24	24	24	24	24	
Rated Current ¹⁾	A	0.5	1.0	0.8	1.3	1.3	1.8	1.8	
Rated Output Torque ¹⁾ T _N	in-lb	2.6	12	17	19	34	28	52	
	Nm	0.29	1.4	2.0	2.2	3.9	3.2	5.9	
Rated Output Speed ¹⁾ n _N	rpm	55	60	30	60	30	60	30	
Max. Continuous Stall Torque ^{1) 2)}	in-lb	3.5	13	20	22	39	48	69	
	Nm	0.39	1.5	2.3	2.5	4.4	5.4	7.8	
Peak Current ^{1) 2)}	A	0.78	1.6	1.1	2.4	2.1	5.4	4.1	
Maximum Output Torque ^{1) 2)} T _m	in-lb	5.2	24	31	43	69	122	174	
	Nm	0.59	2.7	3.5	4.9	7.8	14	20	
Maximum Output Speed ¹⁾	rpm	110	100	50	100	50	100	50	
Torque Constant	in-lb/A	10	19	37	22	43	26	51	
	Nm/A	1.11	2.10	4.20	2.46	4.91	2.92	5.76	
Voltage Constant (B.E.M.F.)	V/rpm	0.12	0.22	0.44	0.26	0.50	0.30	0.60	
Inertia at Output Shaft ³⁾	in-lb-sec ²	0.014	0.033	0.13	0.095	0.38	0.18	0.72	
	kgm ² x10 ³	1.6	3.7	15.0	11.0	43.0	21.6	81.6	
Mechanical Time Constant	msec	13.3	8.5	8.5	8.5	8.5	7.0	7.0	
Torque-Speed Gradient	in-lb/rpm	0.14	0.42	1.6	1.2	4.6	2.9	11	
	Nm/rpm	1.6·10 ⁻²	4.7·10 ⁻²	1.8·10 ⁻¹	1.4·10 ⁻¹	5.2·10 ⁻¹	3.2·10 ⁻¹	1.2	
Viscous Damping Constant	in-lb/rpm	0.20	0.086	0.27	0.16	0.62	0.31	1.3	
	Nm/rpm	2.3·10 ⁻³	9.7·10 ⁻³	3.1·10 ⁻²	1.8·10 ⁻²	1.7·10 ⁻²	3.5·10 ⁻²	1.5·10 ⁻¹	
Rated Power Rate ¹⁾	kW/sec	0.055	0.51	0.26	0.43	0.36	0.51	0.42	
Thermal Time Constant ¹⁾	min	5.2	9	9	10	10	11	11	
Thermal Resistance ¹⁾	°C/W	11.4	4.2	4.2	3.3	3.3	2.8	2.8	
Gear Ratio	1:R	80	50	100	50	100	50	100	
Maximum Radial Load ⁶⁾	lb	13	44	44	55	55	88	88	
	N	59	196	196	245	245	392	392	
Maximum Axial Load	lb	7	22	22	44	44	88	88	
	N	29	98	98	196	196	392	392	
Motor Rated Output ^{1) 5)}	W	(2.6)	(10)	(10)	(20)	(20)	(30)	(30)	
Motor Rated Speed ¹⁾	rpm	4500	3000	3000	3000	3000	3000	3000	
Armature Resistance		8.6	10	10	4.7	4.7	2.7	2.7	
Armature Inductance	mH	2.7	2.2	2.2	1.6	1.6	1.1	1.1	
Electrical Time Constant	ms	0.31	0.22	0.22	0.34	0.34	0.41	0.41	
Starting Current	A	0.13	0.24	0.24	0.31	0.31	0.43	0.43	
No-Load Running Current ⁴⁾	A	0.24	0.38	0.36	0.61	0.55	0.89	0.91	
Actuator Accuracy	arc-min	4.5	2.5		2.0		2.0		
Actuator Repeatability	arc-sec	±90	±60		±60		±60		

Table 2

Additional information

* Actuator specifications show output characteristics, including gear efficiency.

* All specifications are applicable for actuators mounted on aluminum heat sink of the following sizes:

RH-5: 100 x 100 x 3 mm,

RH-8, 11, 14: 150 x 150 x 6 mm.

Please Note:

¹⁾ The values are for saturated actuator temperature. Other values (not marked with ¹⁾) are for actuator temperature of 20°C.

²⁾ The values given represent an upper limit and actual load values should be lower.

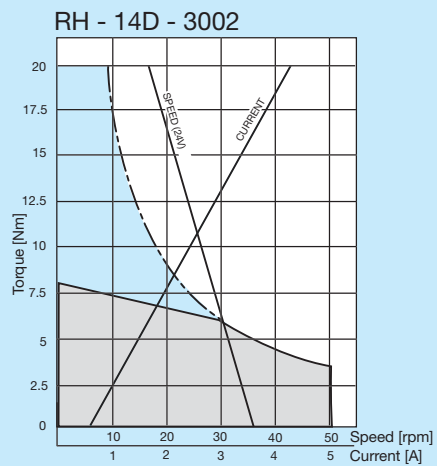
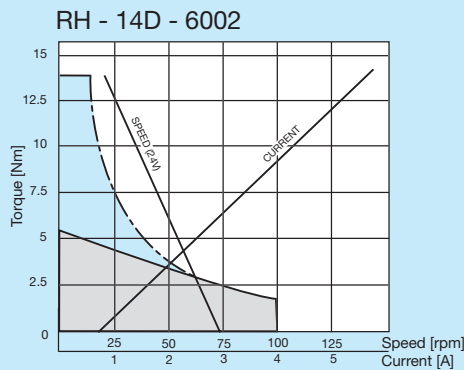
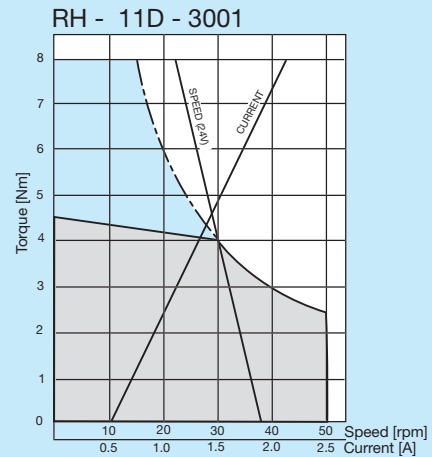
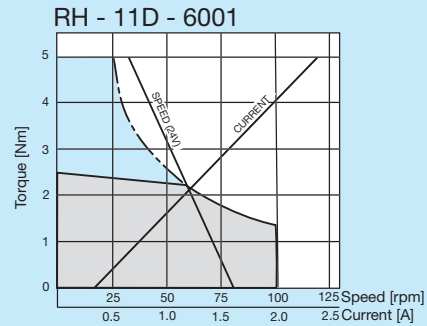
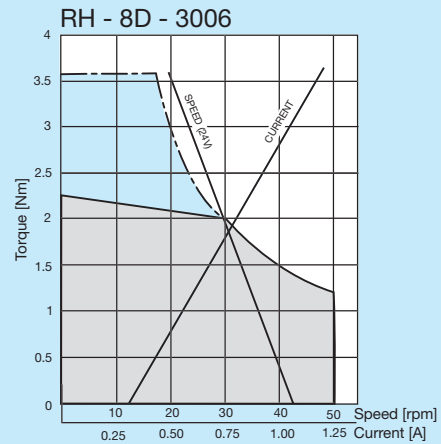
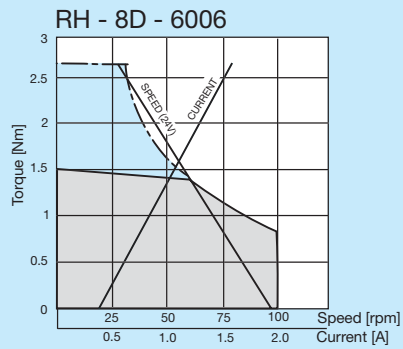
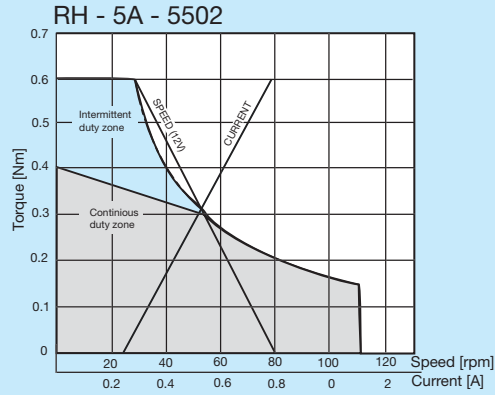
³⁾ The tabulated value is the moment of inertia reflected to the output shaft resulting from the sum of the motor inertia and harmonic drive gear inertia.

⁴⁾ Values are for rated output speed.

⁵⁾ Values are for reference only.

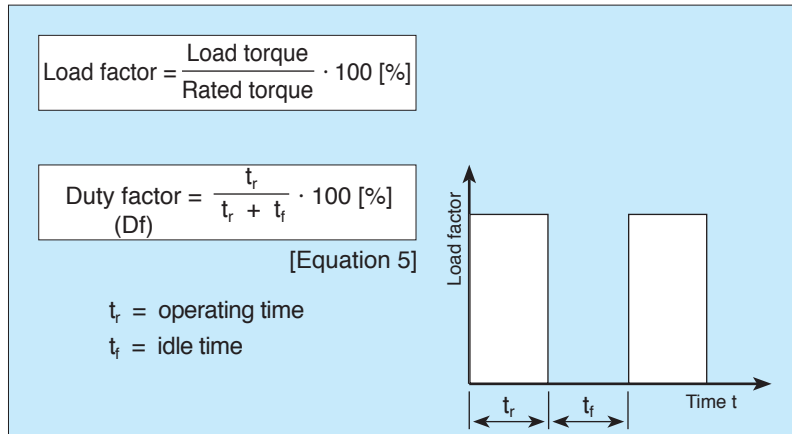
⁶⁾ Cantilevered load applied at the midpoint of the shaft extension.

Performance Curves



Duty Cycle Characteristics

When an actuator is repeatedly operated above the rated torque and speed for periods of 0.1 minute or more, the minimum idle time required to prevent damage from overheating can be calculated from the graphs on this page once the load factor and the duty factor have been established.



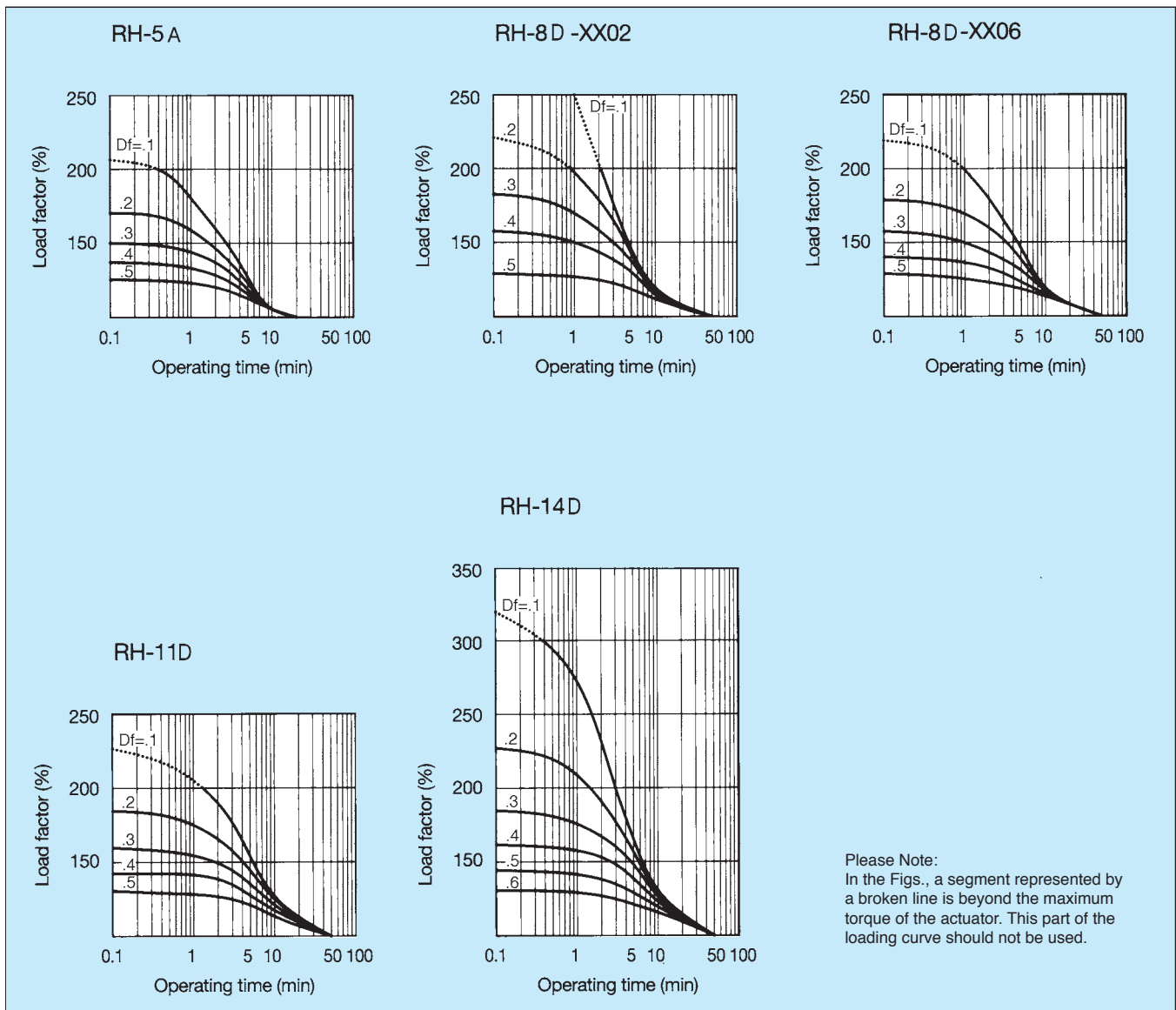
Calculation example: RH-14D-6002 actuator

For a given load factor of 150% and duty factor of 30% a permissible operating time $t_r = 4$ minutes can be read from the curve. For a duty factor of 30% this means that an idle time $t_i = 9.3$ minutes is required between operations.

$$\frac{t_r}{t_r + t_i} \cdot 100 \% = 30\%$$

$$t_i = \frac{tr}{Df} - tr = \frac{4}{.3} - 4 = 9.3 \text{ minutes}$$

Loading Curves



Motor

Polarity

The output shaft rotation is clockwise (when viewed from the output shaft of the actuator), when the voltage applied to the white motor lead is positive with respect to the black lead.

Motor Lead Wires

Table 3

Actuator	Wire	
	length (m)	c. s. area (mm ²)
RH-5A	0.3	0.08
RH-8D	0.6	0.4
RH-11D	0.6	0.4
RH-14D	0.6	0.4

Tach-Generator

For the Mini Series RH-8D, RH-11D and RH-14D, a DC tach- generator is available as an option. The specification of the tach- generator is given in the table below.

Table 4

Output voltage	3 V \pm 10% / 1000 rpm
Ripple (RMS) ¹⁾	1% (200~5000 rpm)
Ripple (peak to peak) ¹⁾	3% (200~5000 rpm)
Linearity ¹⁾	1% (200~5000 rpm)
Direction deviation	1% (200~5000 rpm)
Temperature coefficient	< 0.02% / °C
Moment of Inertia ²⁾	1.2 x 10 ⁻⁶
Armature resistance	45 Ω \pm 10% (at 20 °C)
Armature inductance	7 mH \pm 20%
Maximum rotation speed	5000 rpm
Friction torque	< 4 x 10 ⁻³ Nm
Minimum load resistance	10 k Ω
Insulation resistance	100 M Ω (DC 500 V Megger)
Breakdown voltage	AC 500 V / 1 minute
Weight	0.08 kg

Please note:

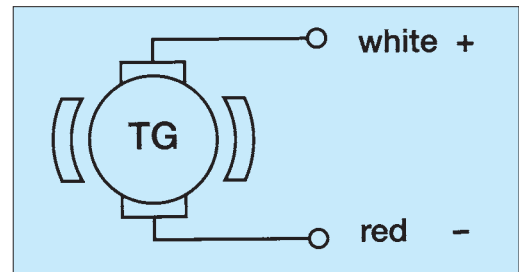
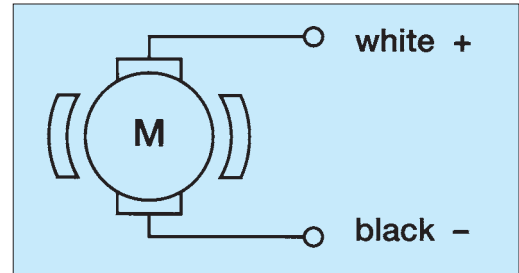
- ¹⁾ This value refers to the tach-generator only.
- ²⁾ This value is referred to the motor shaft. For the moment of inertia referred to the actuator output shaft multiply this value by the square of the reduction ratio.

Tach-Generator Lead Wires

heat resistant vinyl wire (0.4 mm²)

Table 5

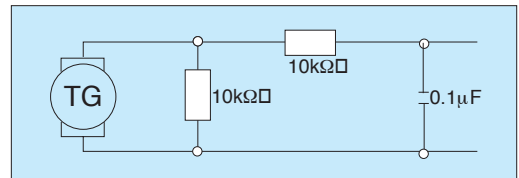
Actuator	Wire	
	length (m)	c. s. area (mm ²)
RH-8D	0.6	0.4
RH-11D	0.6	0.4
RH-14D	0.6	0.4



Polarity

When the rotation is clockwise viewed from the output shaft, white is positive, and red is negative.

Testing Circuit for Output Voltage, Linearity and Ripple:



Encoder

Table 6

Type		RH-5A			RH-8D, RH-11D, RH-14D							
Output Circuit		Open Collector	Line Driver		Open Collector				Line Driver			
		AO	AL		DO				AL	BL		
Power Supply ²⁾	VDC	+ 5 ± 5%				+4.75 ~+12.6				+ 5 ± 5%	+7 ~+12.6	
	mA	60 max.	170 max.		60 max.				170 max.			
Output Voltage V_{OL}, V_{OH}	V	0.5 max., -		0.5max., 2.5in.		0.5 max., -				0.5 max. , 2.5 min.		
Max. Response Frequency	kHz	100				125				125		
Resolution ¹⁾	P/rev	200	360	500	200	360	500	1000	200	360	500	1000
Output Signal		A, B, Z		A, \bar{A} , B, \bar{B} , Z, \bar{Z}		A, B, Z				A, \bar{A} , B, \bar{B} , Z, \bar{Z}		
Max. Voltage V_{CC}	VDC	36		-		36				-		
Max. Current I_{OL}	A	20 max.				20 max.				20 max.		
Moment of Inertia ³⁾	kgm ²	2 x 10 ⁻⁹				3 x 10 ⁻⁸				3 x 10 ⁻⁸		
Lead Wire	mm	Ø 3 x 300L		Ø 0.08/7 Strand		Ø 4 x 600L				Ø 0.12/7 Strand		

Please note:

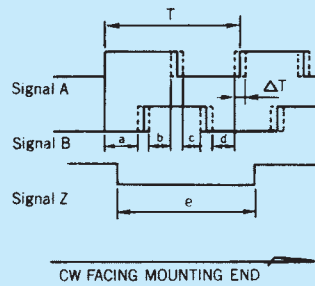
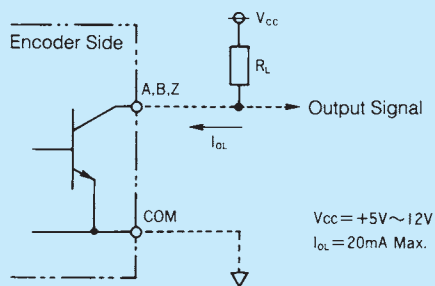
¹⁾ Resolution of encoder only. Resolution at the output of the actuator is equal to the encoder resolution multiplied by the reduction ratio.

²⁾ 12 V DC is recommended in case of cable length longer than 10 m (5 V for AL-type, 12 V for BL-type).

³⁾ Moment of inertia referred to the motor shaft.

RH-5A Open Collector AO

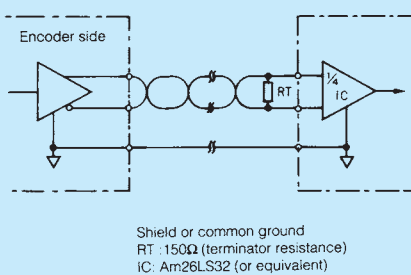
● Output Circuit



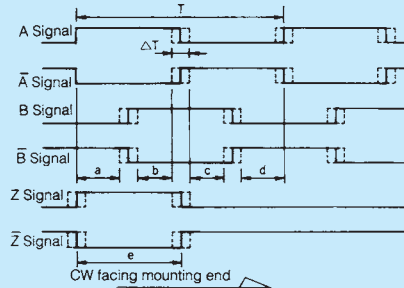
T = Average cycle
a, b, c, d = 0.25T ± 0.1
e = 0.5T ± 0.1
 $\Delta T \leq 0.1T$

RH-8D /11D /14D Line Driver

● Output Circuit



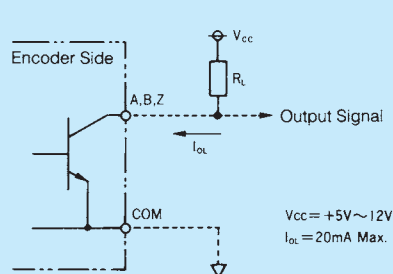
● Output Wave Form



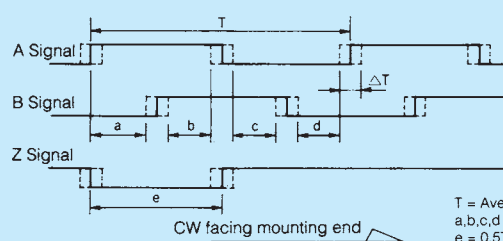
T = Average cycle
a, b, c, d = 0.25T ± 0.1
e = 0.5T ± 0.1
 $\Delta T \leq 0.1T$
Z Signal is synchronized with A Signal

RH-8D /11D /14D Open Collector DO

● Output Circuit



● Output Wave Form



T = Average cycle
a, b, c, d = 0.25T ± 0.1
e = 0.5T ± 0.1
 $\Delta T \leq 0.1T$
Z Signal is synchronized with A Signal

Encoder Wiring

Table 7

RH-5A/8D/11D/14D ¹⁾	Line Driver AL/BL	Open Collector AO	Open Collector DO
Brown	A Signal	A Signal Output	A Signal Output
Blue	\bar{A} Signal	NA	A Signal Common
Red	B Signal	B Signal Output	B Signal Output
Green	\bar{B} Signal	NA	A Signal Common
Yellow	Z Signal	Z Signal Output	Z Signal Output
Orange	\bar{Z} Signal	NA	A Signal Common
White	Power Supply	Power Supply	Power Supply
Black	Common	Common	Common
Shield	Floating	Floating	Floating

¹⁾ Please Note: If the option tach-generator is used in combination with an encoder the wiring of the encoder may vary from the above table.

Encoder Resolutions

Table 8

Actuator	Resolution						
	100	200	300	360	500	720	1000
RH-5A	—	○	—	●	○	—	—
RH-8D/11D/14D	—	○	—	○	○	—	●

● = Standard ○ = Available (special option) — = not available

Since the encoder is connected to the motor side, the resolution is calculated at the actuator output shaft as shown below. For example, when the reduction ratio is 1:100, and the resolution of an encoder is 1000, the resolution at the output shaft becomes $1000 \times 100 = 100000$.

Tach and Encoder Configurations

Table 9

Actuator	Tach	AO	DO	AL	BL
RH-5A	no	●	—	●	—
RH-8D/11D/14D	no	—	●	●	●
RH-8D/11D/14D	yes	—	○	○	—

● = Standard — = not available ○ = Option

Encoder Lead Wires

Table 10

Actuator	Tach	Open Collector AO		Open Collector DO		Line Driver AL		Line Driver BL	
		Length (mm)	Diameter	Length (mm)	Diameter	Length (mm)	Diameter	Length (mm)	Diameter
RH-5A	no	300	4	—	—	600	4	—	—
RH-8D/11D/14D	no	—	—	600	4	600	4	600	4
RH-8D/11D/14D	yes	600	4	—	—	600	5	—	—

Weights

Table 11

Actuator	Gearbox and Motor	Including Tach	Including Encoder	Including Tach and Encoder
RH-5A	0.07	—	0.09	—
RH-8D	0.27	0.35	0.31	0.39
RH-11D	0.47	0.55	0.51	0.59
RH-14D	0.74	0.82	0.78	0.86

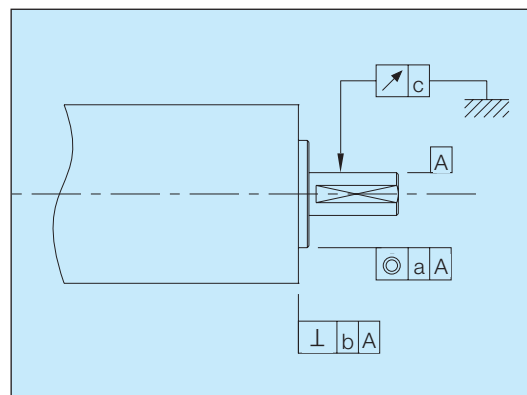
Output Shaft Tolerances

The following table provides the geometric tolerances for the output shaft.

mm

Table 12

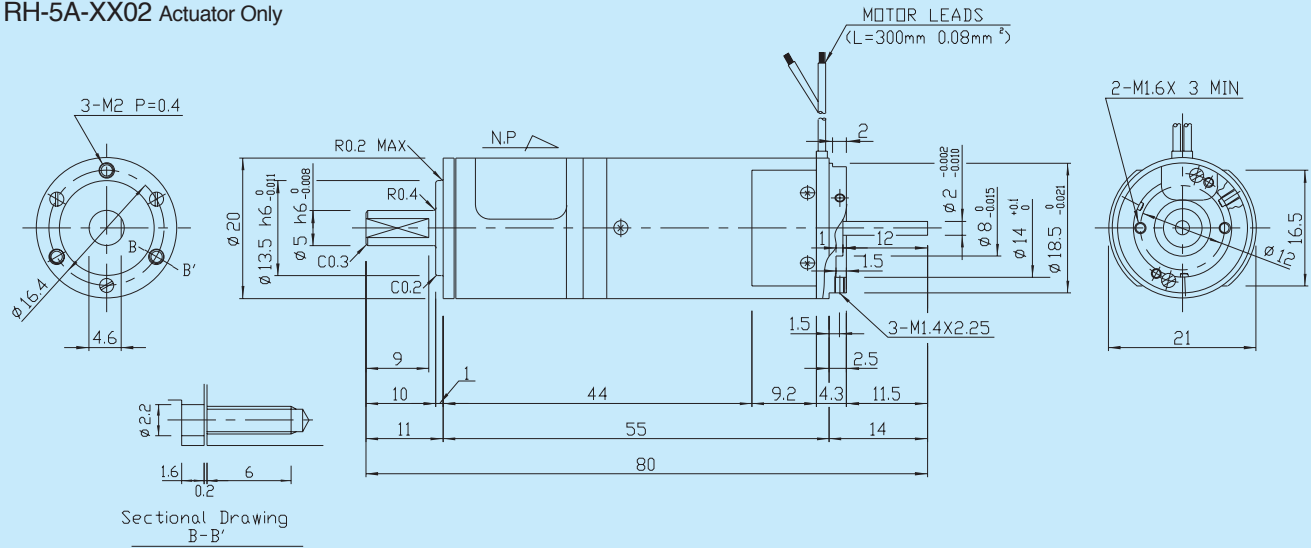
Actuator	Concentricity \odot a	Perpendicularity \perp b	Run-out \blacktriangleright c
RH- 5A	0.04	0.04	0.02
RH- 8D	0.04	0.04	0.02
RH-11D	0.04	0.04	0.02
RH-14D	0.04	0.04	0.02



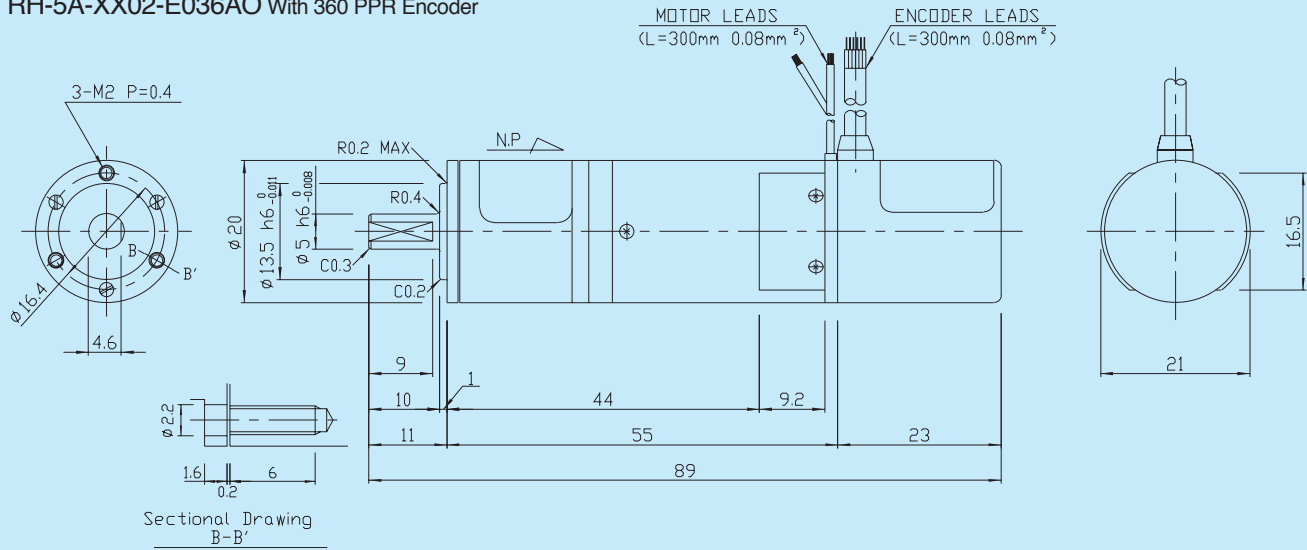
Dimensions

mm

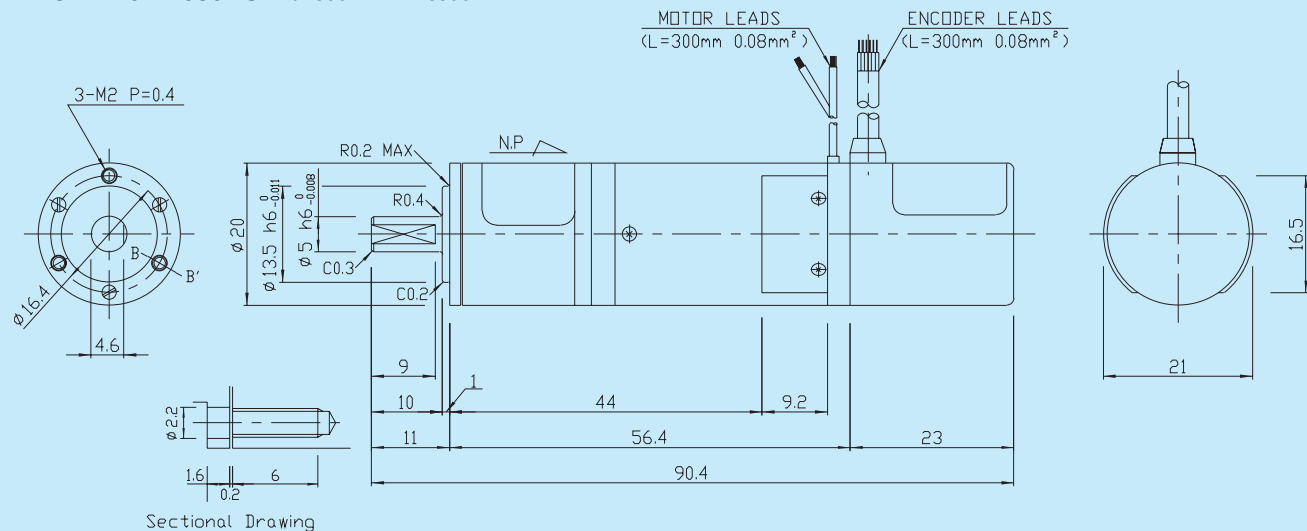
RH-5A-XX02 Actuator Only



RH-5A-XX02-E036AO With 360 PPR Encoder

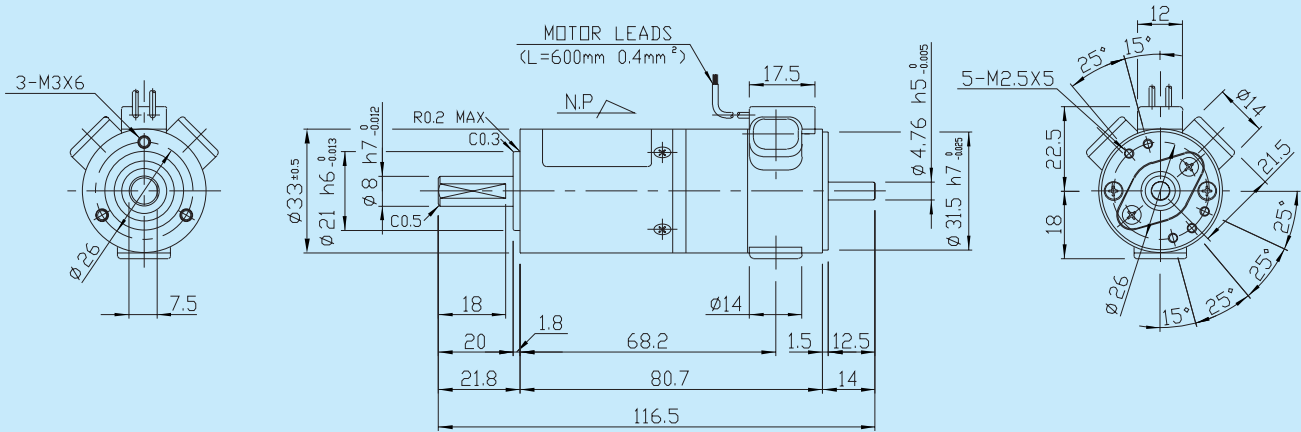


RH-5A-XX02-E050AO With 500 PPR Encoder

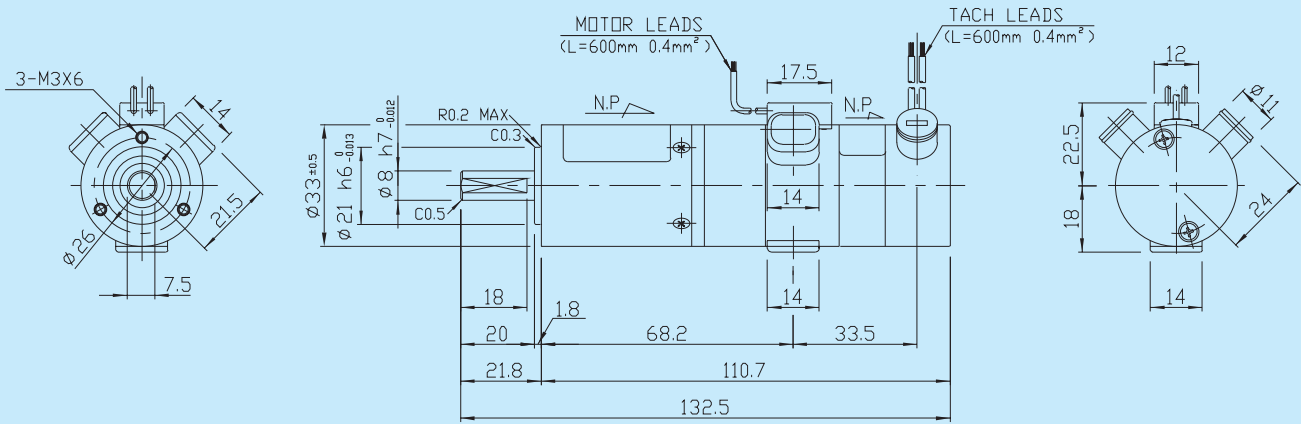


Please Note: Valid for encoder types AO, DO and AL. Please add 9 mm for the BL-type encoder.

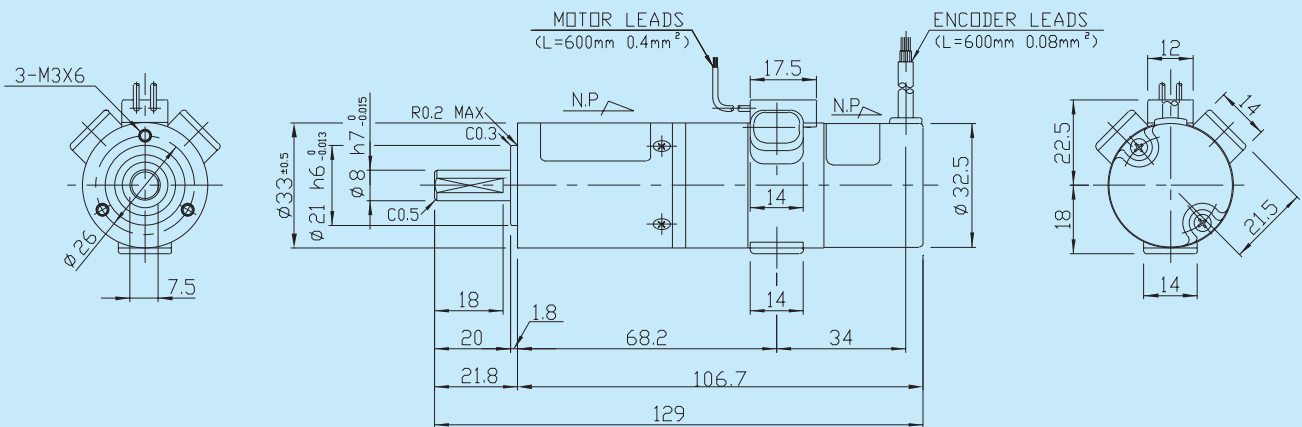
RH-8D-XX06 Actuator Only



RH-8D-XX06-T With Tach-Generator

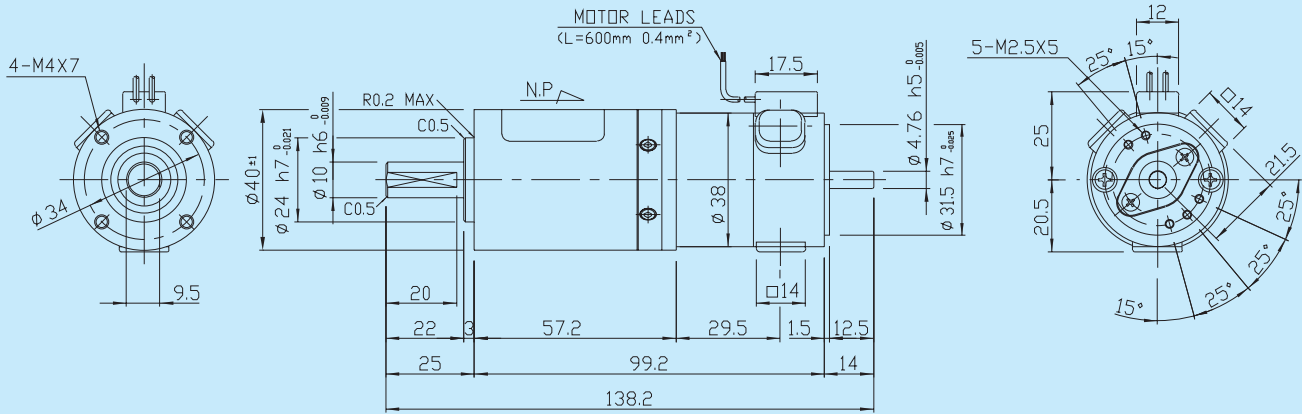


RH-8D-XX06-E With Encoder

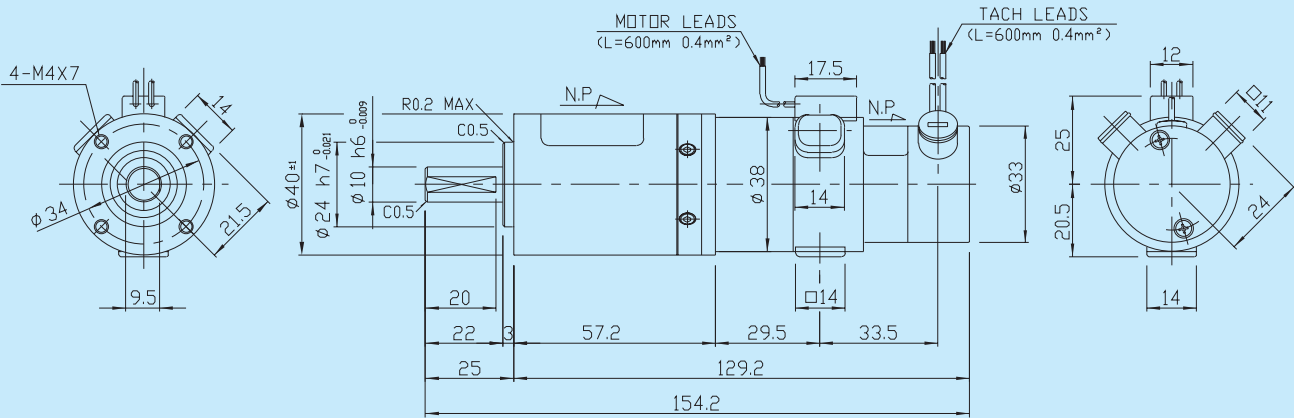


Please Note: Valid for encoder types AO, DO and AL. Please add 9 mm for the BL-type encoder.

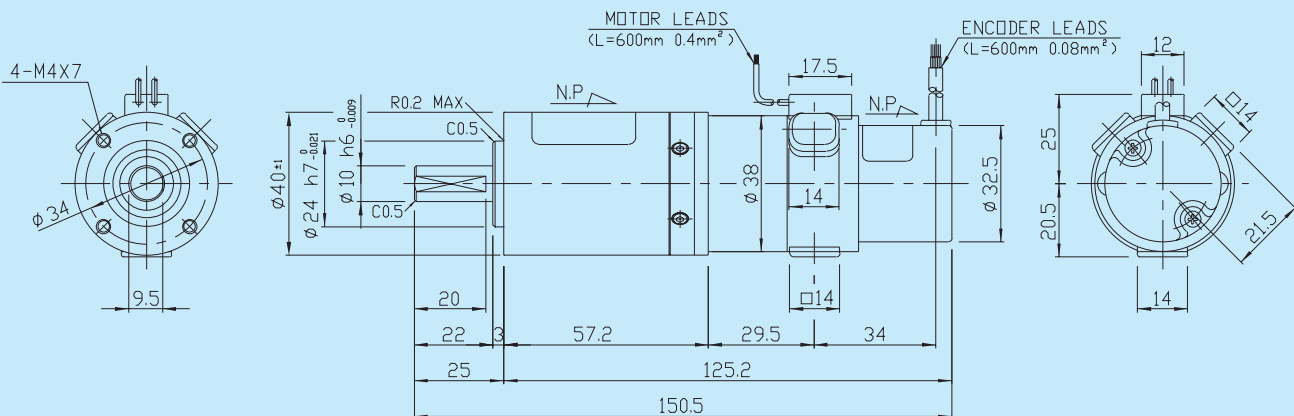
RH-11D-XX01 Actuator Only



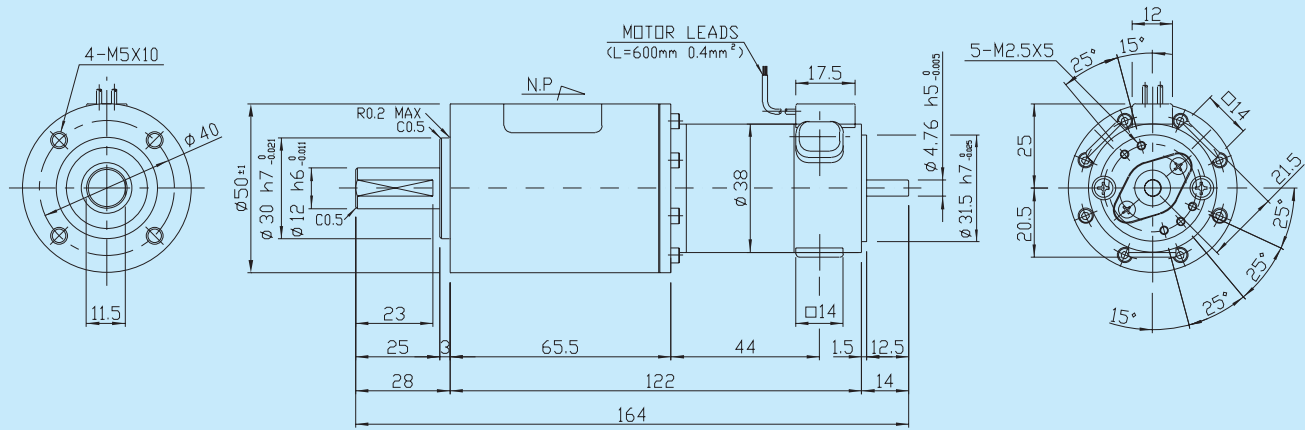
RH-11D-XX01-T With Tach-Generator



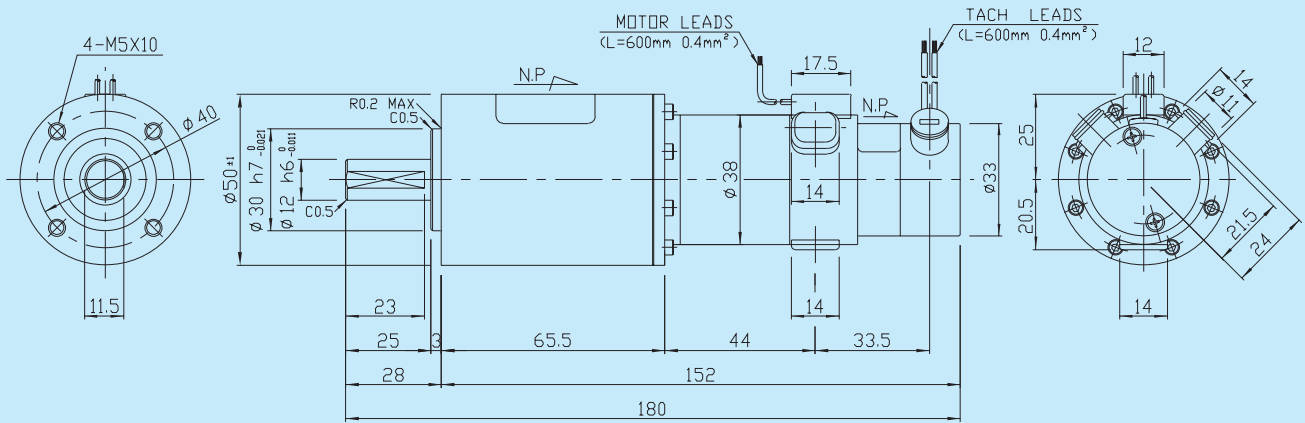
RH-11D-XX01-E With Encoder



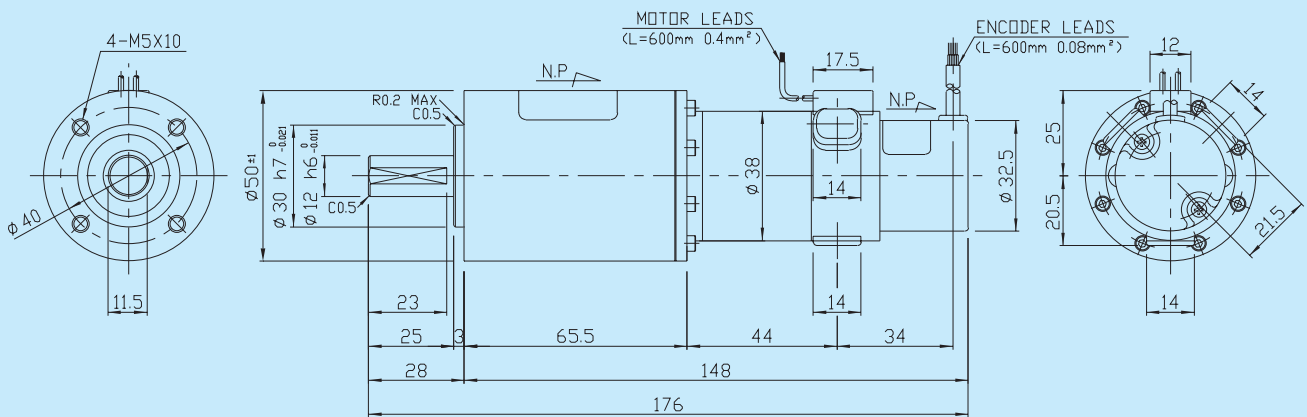
RH-14D-XX02 Actuator Only



RH-14D-XX02 With Tach-generator



RH-14D-XX02-E With Encoder



RHS Series DC Servo Actuators

Technical Data

Table 13

Item	Actuator	RHS-14		RHS-17	
		6003	3003	6006	3006
Control Units		HS-250-3			
		HS-350-3			
		HS-450 R-3			
Rated Output Power ¹⁾⁴⁾	W	34	25	62	
Rated Voltage ¹⁾	V	75		75	
Rated Current ¹⁾	A	1.0	0.9	1.7	
Rated Output Torque ¹⁾ T _N	in-lb	48	69	87	174
	Nm	5.4	7.8	9.8	20
Rated Output Speed ¹⁾ n _N	rpm	60	30	60	30
Max. Continuous Stall Torque ^{1) 2) 4)}	in-lb	54	78	100	195
	Nm	6.1	8.8	11	22
Peak Current ^{1) 2)}	A	2.4	2.0	4.3	3.5
Maximum Output Torque ^{1) 2)} T _m	in-lb	155	250	300	475
	Nm	18	28	34	54
Maximum Output Speed ¹⁾	rpm	100	50	80	40
Torque Constant	in-lb/A	80	160	85	170
	Nm/A	8.9	18	9.6	19
Voltage Constant (B.E.M.F.)	V/rpm	0.9	1.8	1.0	2.0
Inertia at Output Shaft	lb-in-sec ²	0.41	1.61	0.79	3.15
	kgm ²	0.45	1.8	0.089	0.36
Mechanical Time Constant	msec	6.7		4.7	
Torque-Speed Gradient	in-lb/rpm	6.2	25	18	72
	Nm/rpm	0.71	2.8	2.1	8.1
Viscous Damping Constant	in-lb/rpm	0.20	1.2	0.48	2.7
	Nm/rpm	2.3·10 ⁻²	1.4·10 ⁻¹	5.4·10 ⁻²	3.1·10 ⁻¹
Rated Power Rate ¹⁾	kW/sec	0.6	0.3	1.1	
Thermal Time Constant ¹⁾	min	14		16	
Thermal Resistance ¹⁾	°C/W	1.7		1.2	
Gear Ratio	1:R	1:50	1:100	1:50	1:100
Maximum Radial Load ³⁾	lb	88		176	
	N	392		784	
Maximum Axial Load	lb	88		176	
	N	392		784	
Motor Rated Output ¹⁾	(W)	(50)		(100)	
Motor Rated Speed ¹⁾	(rpm)	(3000)		(3000)	
Armature Resistance	Ohm	11.6		4.8	
Armature Inductance	mH	4.5		2.3	
Electrical Time Constant	msec	0.4		0.5	
Starting Current	A	0.25	0.18	0.36	0.23
No-Load Running Current ⁵⁾	A	0.4		0.7	
Actuator Accuracy	arc-min	1.5		1.5	
Actuator Repeatability	arc-sec	± 5		± 5	

Additional information

* Actuator specifications show output characteristics including gear efficiency.

* All specifications are applicable for actuators mounted on aluminum heat sink of the following sizes:

RHS/RFS-14,17, 20:
250 x 250 x 12 mm,
RHS/RFS-25 and RHS/
RFS-32:
300 x 300 x 15 mm.

Rating:	Continuous
Exciting method:	Permanent magnet
Motor Insulation:	Class F
Insulation voltage:	AC 1000V, one minute
Insulation resistance:	100M (DC500V Megger)

Construction:	Totally enclosed
Ambient temperature:	-10 ~ +40°C
Storage temperature:	-20 ~ +60°C
Ambient humidity:	20 ~ 80% (non-condensing)

Vibration:	2.5g (5 ~ 400Hz)
Shock:	30g (11 ms)
Output:	Shaft (RHS series) Flange (RFS Series)
Lubrication:	Grease SK-1A (Sizes 20-32) Grease SK-2 (Sizes 14 & 17)

RHS/RFS Series DC Servo Actuators

Table 14

Item	Actuator	RHS-20, RFS-20				RHS-25, RFS-25				RHS-32, RFS-32			
		6007	3007	6012	3012	6012	3012	6018	3018	6018	3018	6030	3030
		Control Units				Control Units				Control Units			
		HS-250-3				HS-250-6				HS-250-9			
		HS-350-3				HS-350-6				HS-350-9			
		HS-450 R-3				HS-450 R-6				HS-450 R-9			
Rated Output Power ^{1) 4)}	W	74	74	123	111	123	123	185	185	185	185	308	308
Rated Voltage ¹⁾	V	75	75	75	75	75	75	75	75	75	75	85	85
Rated Current ¹⁾	A	1.9	1.9	2.9	2.7	3.1	3.1	3.9	3.9	4.1	4.1	5.4	5.4
Rated Output Torque ¹⁾ T _N	in-lb	104	208	174	312	174	347	260	521	260	521	434	868
	Nm	12	24	20	30	20	40	30	60	30	60	50	100
Rated Output Speed ¹⁾ n _N	rpm	60	30	60	30	60	30	60	30	60	30	60	30
	in-lb	122	243	208	373	208	417	312	625	312	625	521	1040
Max. Continuous Stall Torque ^{1) 2) 4)}	Nm	14	28	24	43	24	48	36	72	36	72	60	120
	A	6.2	4.8	6.4	5.0	10.7	8.8	10.0	8.3	20.6	16.3	18.2	14.4
Maximum Output Torque ^{1) 2)} T _m	in-lb	495	729	495	729	868	1390	868	1390	1910	2950	1910	2950
	Nm	57	84	57	84	100	160	100	160	220	340	220	340
Maximum Output Speed ¹⁾	rpm	80	40	80	40	80	40	80	40	80	40	80	40
Torque Constant	in-lb/A	91	182	91	182	91	182	91	199	100	189	115	231
	Nm/A	10.5	21.0	10.5	21.0	10.5	21.0	11.5	22.9	11.5	22.9	13.3	26.6
Voltage Constant (B.E.M.F.)	V/rpm	1.08	2.15	1.08	2.15	1.08	2.15	1.18	2.35	1.18	2.35	1.37	2.74
Inertia at Output Shaft ³⁾	in-lb-sec ²	2.5	10.4	4.1	16.5	4.6	18.2	9.5	39	12.2	50	27	104
	kgm ²	0.29	1.2	0.47	1.9	0.53	2.1	1.1	4.5	1.4	5.8	3.1	12.0
Mechanical Time Constant	ms	9.2	9.2	5.1	5.1	5.7	5.7	5.2	5.2	6.8	6.8	7.0	7.0
Torque-Speed Gradient	in-lb/rpm	29	115	82	326	82	326	194	779	194	779	396	1580
	Nm/rpm	3.3	13	9.3	37	93	37	22	88	22	88	37	179
Viscous Damping Constant	in-lb/rpm	0.46	2.7	0.76	3.9	0.76	4.6	1.0	5.6	0.67	5.0	0.96	6.5
	Nm/rpm	5.1·10 ⁻²	3.1·10 ⁻¹	8.6·10 ⁻²	4.4·10 ⁻¹	8.6·10 ⁻²	5.2·10 ⁻¹	1.1·10 ⁻¹	6.3·10 ⁻¹	7.6·10 ⁻²	5.6·10 ⁻¹	1.1·10 ⁻¹	7.3·10 ⁻²
Rated Power Rate ¹⁾	kW/s	0.48	0.48	0.83	0.67	0.74	0.74	0.79	0.79	0.61	0.61	0.80	0.80
Thermal Time Constant ¹⁾	min	19	19	21	21	23	23	24	24	25	25	29	29
Thermal Resistance ¹⁾	°C/W	1.14	1.14	0.99	0.99	0.93	0.93	0.76	0.76	0.71	0.71	0.51	0.51
Gear Ratio	1:R	50	100	50	100	50	100	50	100	50	100	50	100
Maximum Radial Load ³⁾	lb	309		441		661		551		992		882	
	N	RHS:1400		RFS:2000		RHS:3000		RFS:2500		RHS:4500		RFS:4000	
Maximum Axial Load	lb	309		198		661		243		992		353	
	N	RHS:1400		RFS:900		RHS:3000		RFS:1100		RHS:4500		RFS:1600	
Motor Rated Output ¹⁾	(W)	(120)	(120)	(200)	(200)	(200)	(200)	(300)	(300)	(300)	(300)	(500)	(500)
Motor Rated Speed ¹⁾	(rpm)	(3000)	(3000)	(3000)	(3000)	(3000)	(3000)	(3000)	(3000)	(3000)	(3000)	(3000)	(3000)
Armature Resistance		3.4	3.4	1.2	1.2	1.2	1.2	0.60	0.60	0.60	0.60	0.40	0.40
Armature Inductance	mH	2.7	2.7	1.1	1.1	1.1	1.1	0.92	0.92	0.92	0.92	0.84	0.84
Electrical Time Constant	ms	0.81	0.81	0.93	0.93	0.93	0.93	1.5	1.5	1.5	1.5	2.1	2.1
Starting Current	A	0.5	0.35	0.5	0.35	0.7	0.45	0.7	0.45	1.1	0.75	1.1	0.75
No-Load Running Current ⁵⁾	A	0.8	0.8	1.0	1.0	1.2	1.2	1.3	1.3	1.5	1.5	1.6	1.6
Actuator Accuracy	arc-min	1.0				1.0				1.0			
Actuator Repeatability	arc-sec	± 5				± 5				± 5			

Please Note:

¹⁾ The values are for saturated actuator temperature. Other values are for actuator temperature of 20°C.

²⁾ Maximum allowable values. Under no circumstances may these limits be exceeded.

³⁾ Cantilevered load applied at the midpoint of the shaft extension.

⁴⁾ All specifications are applicable for actuators mounted on appropriate heatsinks.

⁵⁾ Values are for rated output speed.

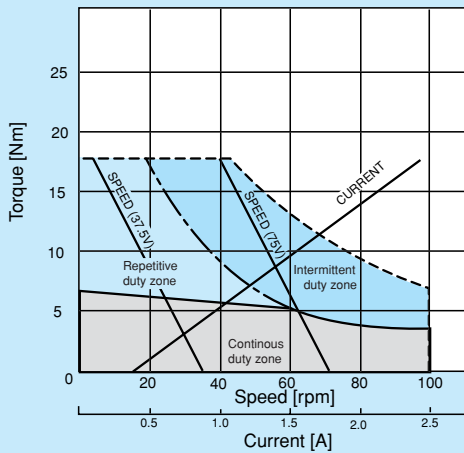
Available Motor and Gear Ratios

Actuator	RHS - 14	RHS - 17	RHS/RFS - 20	RHS/RFS - 25	RHS/RFS - 32
Ratio	50 80 100	50 80 100 120	50 80 100 120 160	50 80 100 120 160	50 80 100 120 160
Motor Power					
50	● ○ ●				
100		● ○ ● ○			
120			● ○ ● ○ ○		
200			● ○ ● ○ ○	● ○ ● ○ ○	
300				● ○ ● ○ ○	● ○ ● ○ ○
500				● ○ ● ○ ○	● ○ ● ○ ○

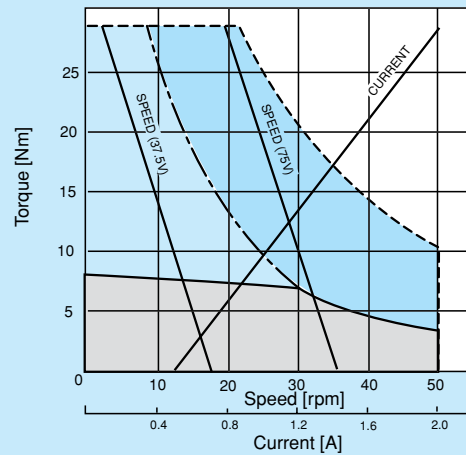
● = Standard ○ = Option

Performance Curves

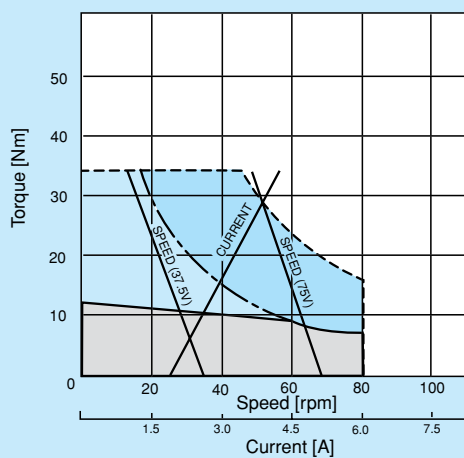
RHS - 14 - 6003



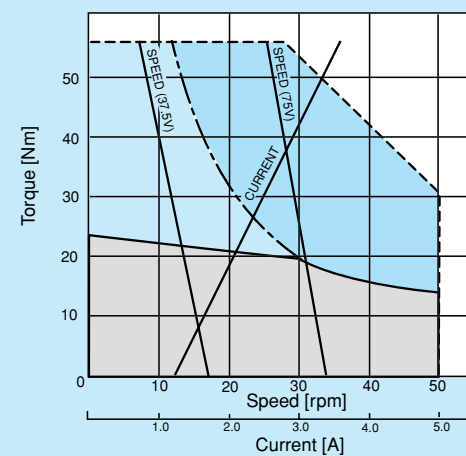
RHS - 14 - 3003



RHS - 17 - 6006



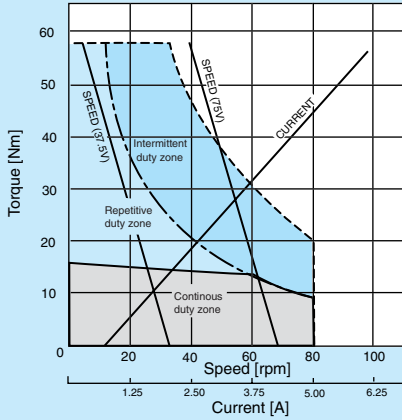
RHS - 17 - 3006



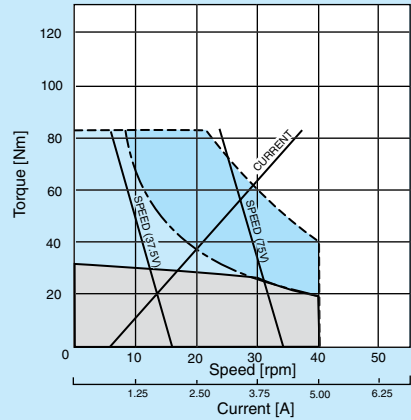


Performance Curves

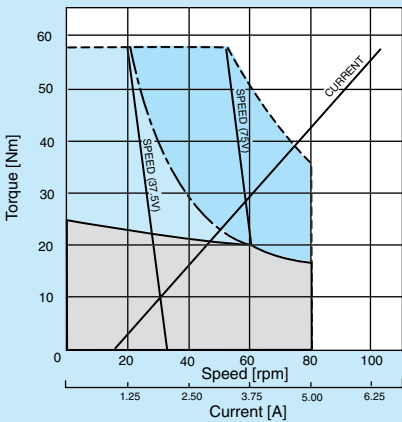
RHS /RFS - 20 - 6007



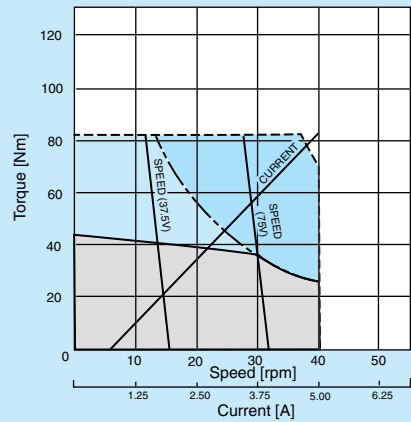
RHS /RFS - 20 - 3007



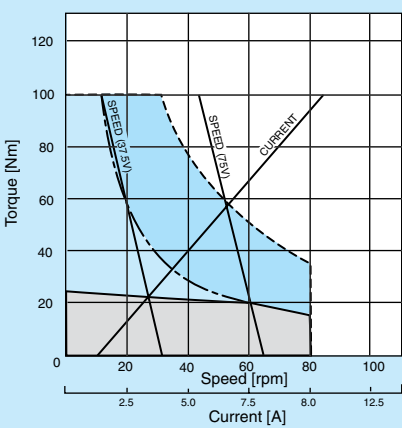
RHS /RFS - 20 - 6012



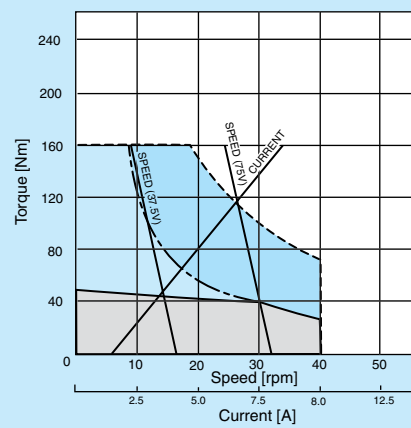
RHS /RFS - 20 - 3012



RHS /RFS - 25 - 6012

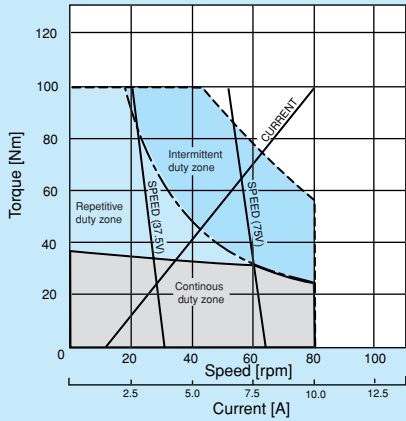


RHS /RFS - 25 - 3012

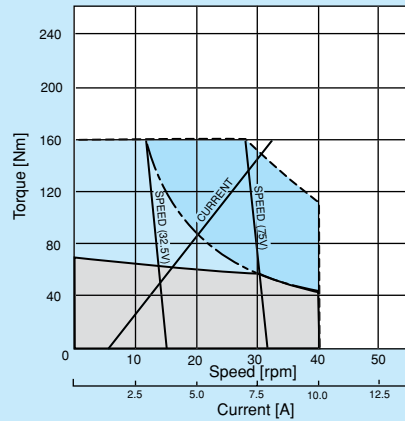




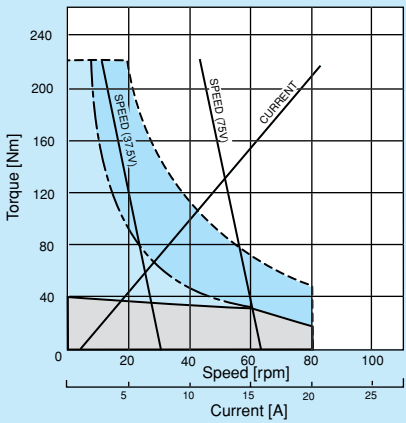
RHS /RFS - 25 - 6018



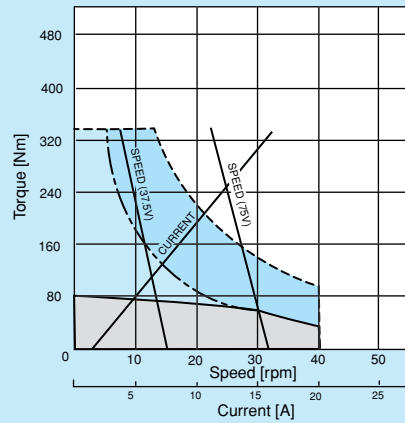
RHS /RFS - 25 - 3018



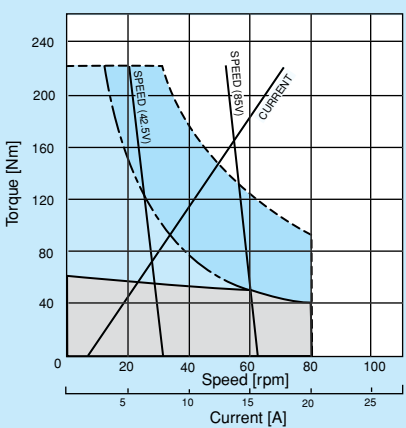
RHS /RFS - 32 - 6018



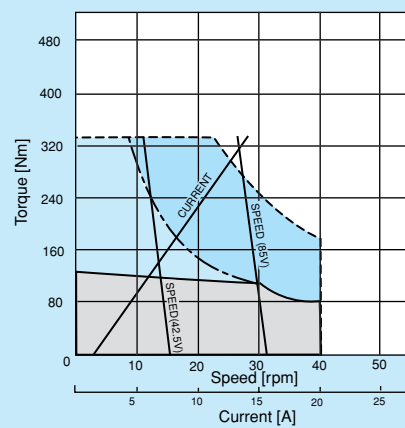
RHS /RFS - 32 - 3018



RHS /RFS - 32 - 6030

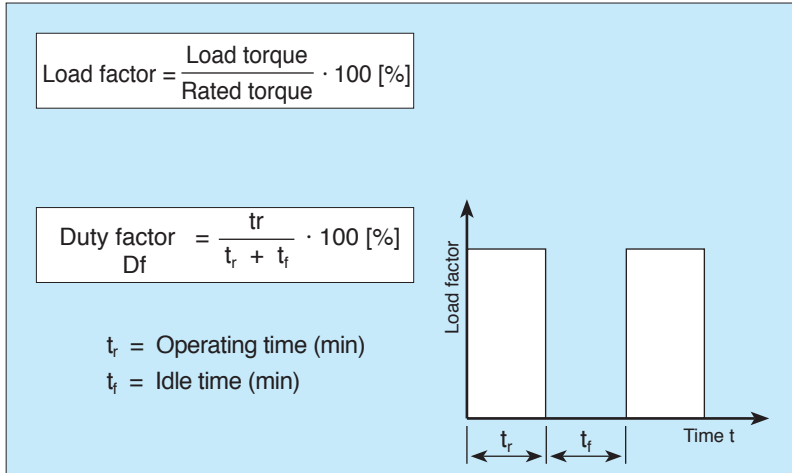


RHS /RFS - 32 - 3030



Duty Cycle Characteristics

When an actuator is repeatedly operated above the rated torque and speed for periods of 0.1 minute or more, the minimum idle time required to prevent damage from overheating can be calculated from the graphs on this page once the load factor and the duty factor have been established.



Example: RHS-25-6018

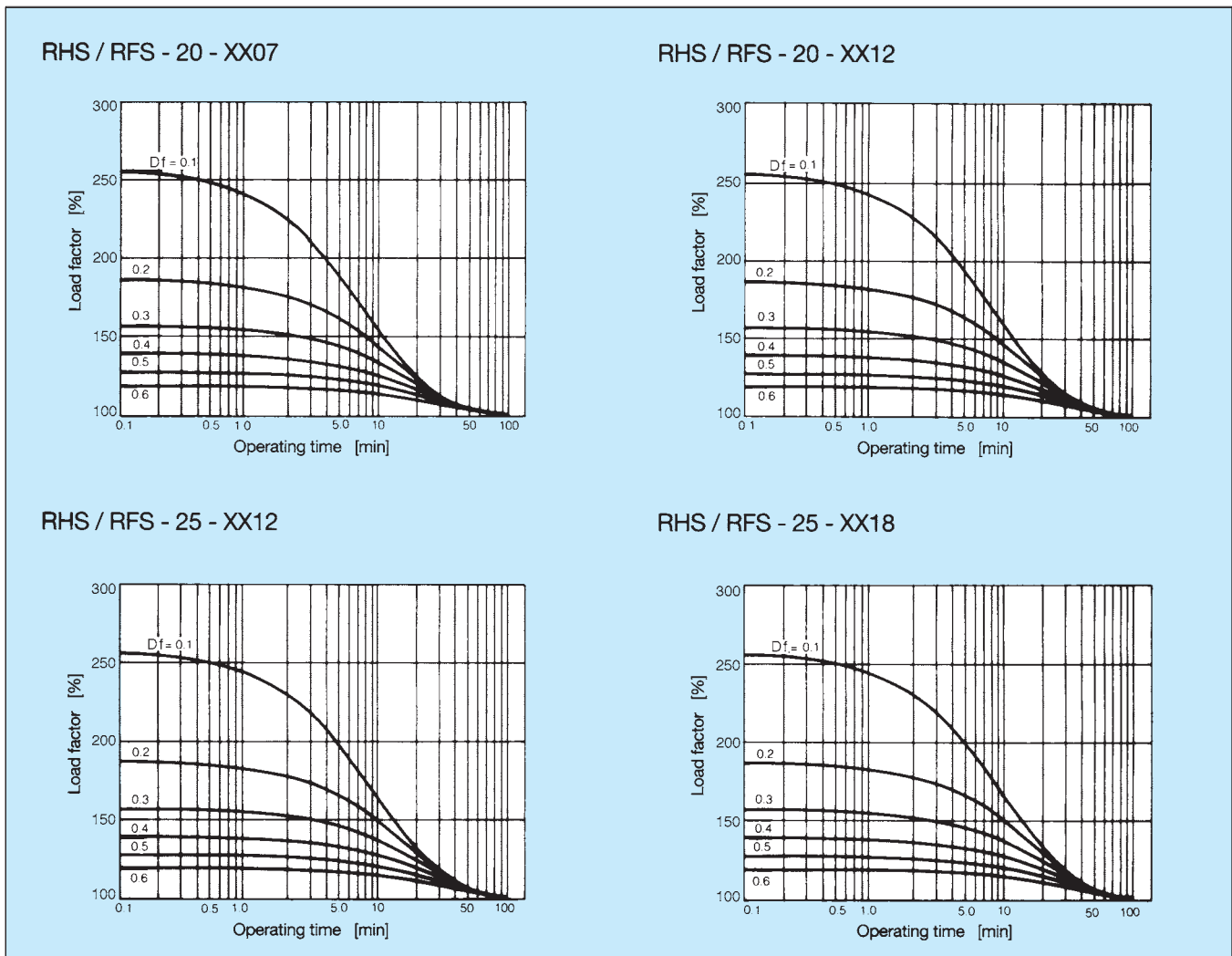
Assume a load factor of 150% for a duration of 3 minutes. As indicated on the graphs below (Overload Duty Cycle Performance Curve), the duty cycle of RHS-25-6018 actuator is approximated at 30%.

The required idle time for operating the actuator under these conditions is calculated as follows:

$$t_i = \frac{t_r}{Df} - t_r = \frac{3}{.3} - 3 = 7 \text{ minutes}$$

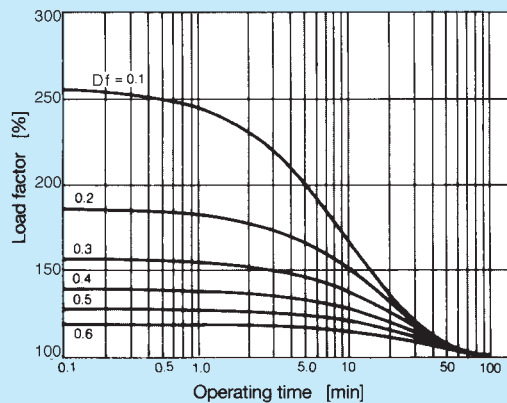
Therefore, the actuator must be turned off for 7 minutes when it has been operated for 3 minutes under a 150% load factor.

Loading Curves

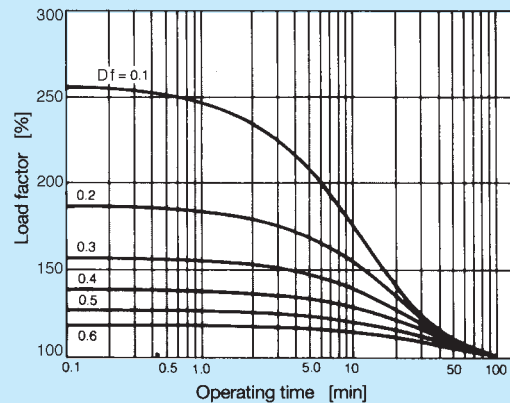




RHS / RFS - 32 - XX18



RHS / RFS - 32 - XX30



Please Note:

In the Figs., a segment represented by a broken line is beyond the maximum torque of the actuator. This part of the loading curve should not be used.

Precautions When Selecting Alternative Control Units

If you choose a control unit other than Harmonic Drive LLC control units (see page 5), confirm the following items to prevent possible damage to the actuator from overheating.

◆ Current Limit

When operating the actuator below the rated torque, the amplifier must be able to limit the maximum current that is available to the motor.

◆ Overload Protection Function

When operating the actuator above the rated torque, an appropriate overload protection function is required to keep the current overload time within the allowable region of the overload duty cycle performance curve for the actuator.

Motor

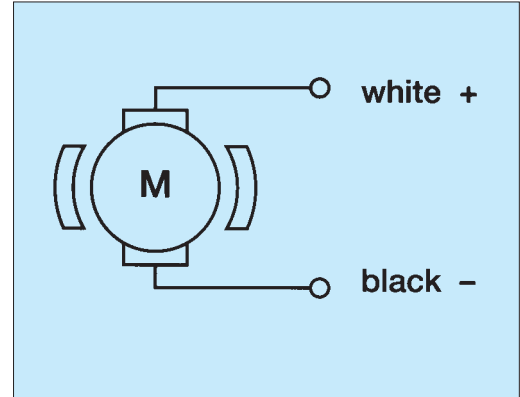
Polarity

The output shaft rotation is clockwise (when viewed from the output shaft of the actuator), when the voltage applied to the white motor lead is positive with respect to the black lead.

Motor Lead Wires

Table 16

Actuator	wire	
	length (m)	c. s. area (mm ²)
RHS - 14	1	0.75
RHS - 17	1	0.75
RHS / RFS-20	1	1.25
RHS / RFS-25	1	1.25
RHS / RFS-32	1	1.25



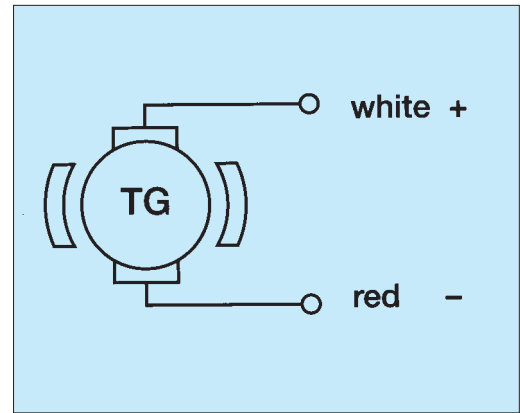
Tach-Generator

Polarity

When the output shaft rotation is clockwise (when viewed from the output shaft of the actuator), the polarity of the white tach lead is positive and the red lead negative.

Table 17

Output Voltage	7 V \pm 10% / 1000 rpm
Ripple (RMS) ¹⁾	3% max.
Linearity ¹⁾	\pm 1% max.
Armature Resistance	25 Ω \pm 10% (at 20°C)
Armature Inductance	4 mH
Moment of Inertia ²⁾	1 x 10 ⁻⁵ kgm ²



Please note:

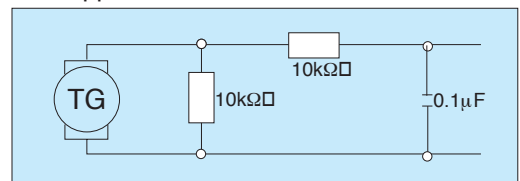
- ¹⁾ This value refers to the tach-generator only.
- ²⁾ This value is referred to the motor shaft. For the moment of inertia referred to the actuator output shaft multiply this value by the square of the reduction ratio.

Tach-Generator Lead Wires

Table 18

Actuator	wire	
	length (m)	c. s. area (mm ²)
RHS - 14	1	0.3
RHS - 17	1	0.3
RHS / RFS-20	1	0.3
RHS / RFS-25	1	0.3
RHS / RFS-32	1	0.3

Testing Circuit for Output Voltage, Linearity and Ripple:



Encoder

Table 19

Output Circuit		Open Collector DO	Line Driver AL	Line Driver BL
Resolution ¹⁾	P/rev	200, 360, 500, 1000, 1024	200, 360, 500, 1000, 1024	200, 360, 500, 1000, 1024
Output Signal		A, B, Z	A, \bar{A} , B, \bar{B} , Z, \bar{Z}	A, A, B, \bar{B} , Z, \bar{Z}
Power Supply ²⁾	V DC	+ 4.75 ~ +12.6 (80 mA max.)	+ 5 \pm 5% (160 mA max.)	+ 7 ~ + 12 (160 mA max.)
Output Voltage V _{OL} , V _{OH}	V	0.5 max. , -	0.5 max. , 2.5 min.	0.5 max. , 2.5 min.
Max. Voltage V _{CC}	VDC	+ 24	-	-
Max. Current I _{OL}	mA	20 max.	20 max.	20 max.
Max. Response Frequency	kHz	100	100	100
Moment of Inertia ³⁾	kgm ²	1 x 10 ⁻⁶	1 x 10 ⁻⁶	1 x 10 ⁻⁶

Please note:

- ¹⁾ Resolution of encoder only. Resolution at the output of the actuator is equal to the encoder resolution multiplied by the reduction ratio.
- ²⁾ 12 V DC is recommended in case of a cable length longer than 10 meters.
- ³⁾ Value at motor shaft. To convert it to the value at the output of the actuator, multiply by the square of the reduction ratio.

Encoder Lead Wires

Table 20

Color	Line Driver	Open Collector
Brown	A-Signal	A-Signal Output
Blue	\bar{A} -Signal	A-Signal Common
Red	B-Signal	B-Signal Output
Green	\bar{B} -Signal	B-Signal Common
Yellow	Z-Signal	Z-Signal Output
Orange	\bar{Z} -Signal	Z-Signal Common
White	Power Supply	Power Supply
Black	Common	Common
Shield	Floating	Floating

Lead Wires:

(Open Collector and Line Driver)

Table 21

Actuator	length (m)	c. s. area (mm ²)	Diameter (mm)
RHS-14	1	0.14	5.5
RHS-17	1	0.14	5.5
RHS/RFS-20	1	0.14	5.5
RHS/RFS-25	1	0.14	5.5
RHS/RFS-32	1	0.14	5.5

Open Collector DO

● Output Circuit

Encoder Side

A, B, Z

Output Signal

COM

$V_{cc} = +5V \sim 12V$
 $I_{OL} = 20mA \text{ Max.}$

Line Driver

● Output Circuit

Encoder side

Shield or common ground
 $R_T : 150\Omega$ (terminator resistance)
IC: Am26LS32 (or equivalent)

Output Wave Form

A Signal

B Signal

Z Signal

$T = \text{Average cycle}$
 $a, b, c, d = 0.25T \pm 0.1T$
 $e = 0.5T \pm 0.1T$
 $\Delta T \leq 0.05T$
Z Signal is synchronized with A Signal

CW facing mounting end

Line Driver

● Output Circuit

Encoder side

Shield or common ground
 $R_T : 150\Omega$ (terminator resistance)
IC: Am26LS32 (or equivalent)

Output Wave Form

A Signal

\bar{A} Signal

B Signal

\bar{B} Signal

Z Signal

\bar{Z} Signal

$T = \text{Average cycle}$
 $a, b, c, d = 0.25T \pm 0.1T$
 $e = 0.5T \pm 0.1T$
 $\Delta T \leq 0.05T$
Z Signal is synchronized with A Signal

CW facing mounting end

Wiring of Tach-Generator and Encoder

Table 22

Color	Tach-Generator	Encoder	
		Line Driver	Open Collector
Brown	—	A-Signal	A-Signal Output
Blue	—	\bar{A} -Signal	A-Signal Common
Red	—	B-Signal	B-Signal Output
Green	—	\bar{B} -Signal	B-Signal Common
Yellow	—	Z-Signal	Z-Signal Output
Orange	—	\bar{Z} -Signal	Z-Signal Common
White	—	Power Supply	Power Supply
Black	—	Common	Common
Shield	—	Floating	Floating
White-Black (thick)	Plus Output ¹⁾	—	—
Red-Black (thick)	Minus Output ¹⁾	—	—

¹⁾ Polarity at CW facing mounting end. These thick wires are lead wires of the tach-generator.

Weights

kg

Table 23

Actuator	Gearbox and Motor	Including Tach	Including Encoder	Including Tach and Encoder
RHS-14-XX03	1.7	1.9	1.9	2.1
RHS-17-XX06	2.7	2.9	2.9	3.1
RHS-20-XX07	3.3	3.8	3.6	4.0
RHS-20-XX12	3.9	4.4	4.2	4.6
RHS-25-XX12	5.4	5.9	5.7	6.1
RHS-25-XX18	6.1	6.6	6.4	6.8
RHS-32-XX18	9.4	9.9	9.7	10.1
RHS-32-XX30	11.1	11.6	11.4	11.8
RFS-20-XX07	3.3	3.8	3.6	4.0
RFS-20-XX12	3.9	4.4	4.2	4.6
RFS-25-XX12	5.4	5.9	5.7	6.1
RFS-25-XX18	6.1	6.6	6.4	6.8
RFS-32-XX18	9.5	10.0	9.8	10.2
RFS-32-XX30	11.2	11.7	11.5	11.9

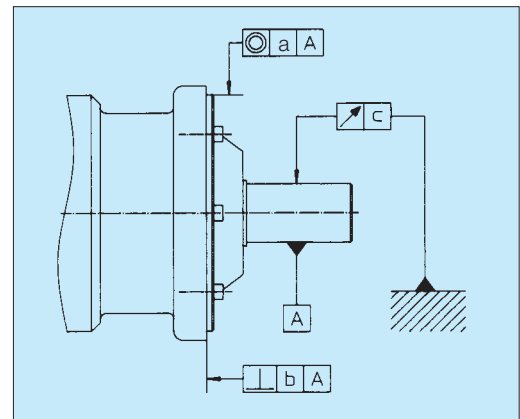
Output Shaft and Flange Tolerances

The following tables provide the geometric tolerances for the output shaft and flange.

RHS Series (Output shaft)

Table 24

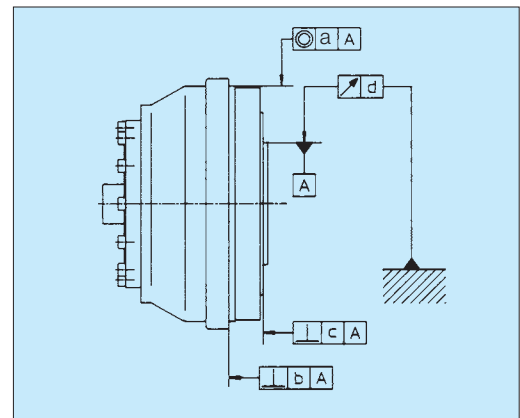
Actuator	Concentricity \odot a	Perpendicularity \perp b	Run-out \nearrow c
14	0.06	0.06	0.04
17	0.06	0.06	0.04
20	0.06	0.06	0.04
25	0.06	0.06	0.04
32	0.06	0.06	0.04



RFS Series (Output flange)

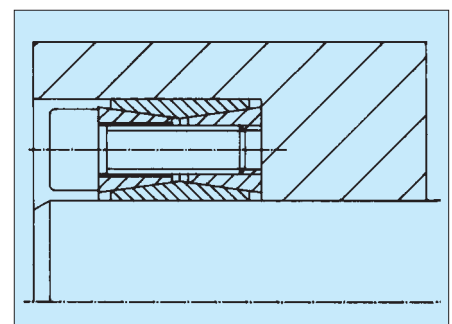
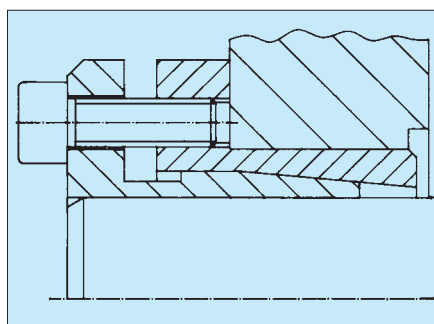
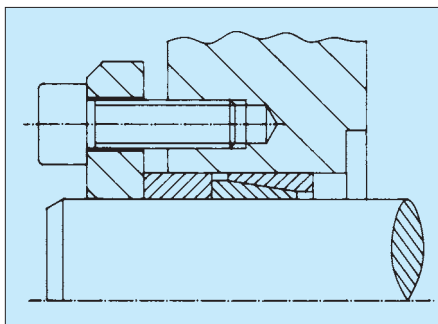
Table 25

Actuator	Concentricity \odot a	Perpendicularity \perp b	Perpendicularity \perp c	Run-out \nearrow d
20	0.05	0.05	0.03	0.03
25	0.05	0.05	0.03	0.03
32	0.05	0.05	0.03	0.03



Connecting the actuator to the load

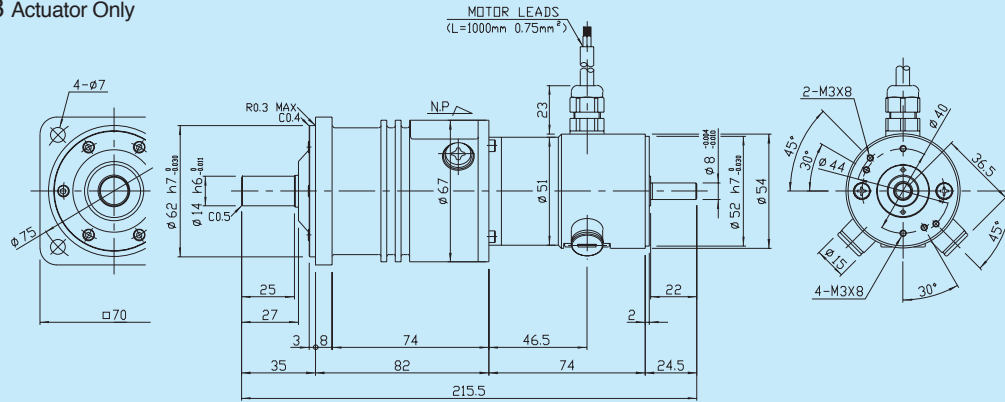
RHS Series actuators are provided with a smooth output shaft. To connect the actuator to the load, we recommend the use of clamping assemblies or clamping elements, as shown in the figures below.



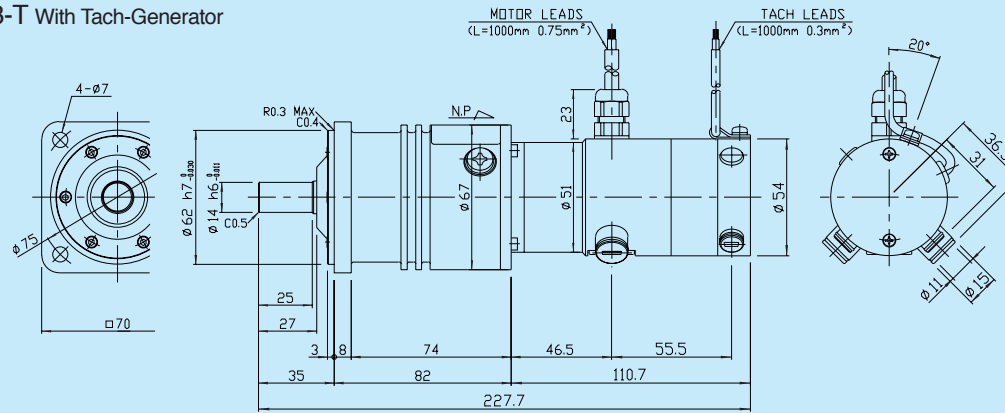
Outline and Dimensions

mm

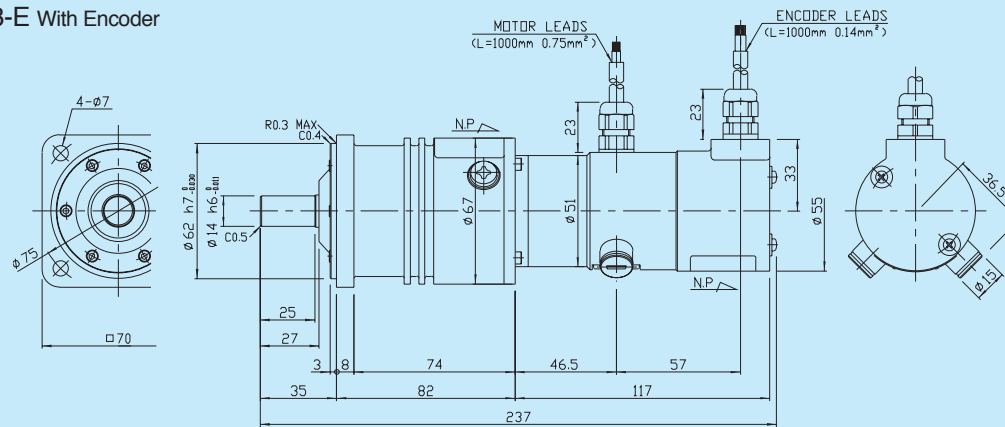
RHS-14-XX03 Actuator Only



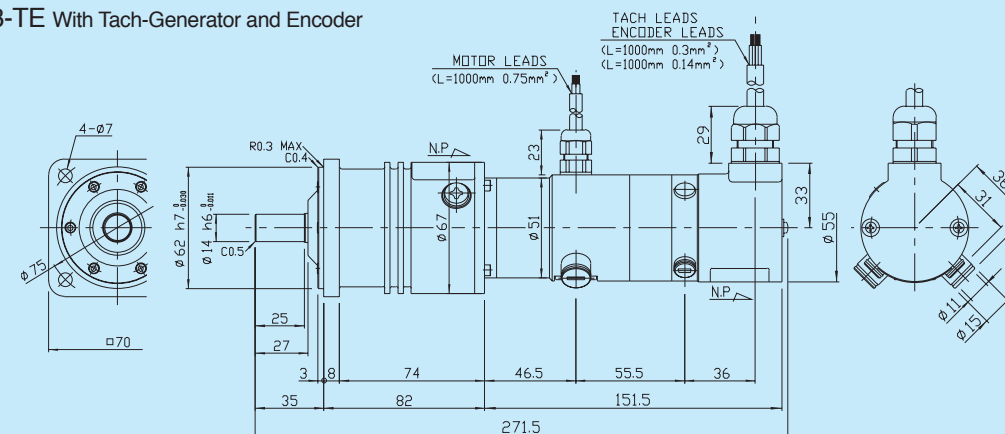
RHS-14-XX03-T With Tach-Generator



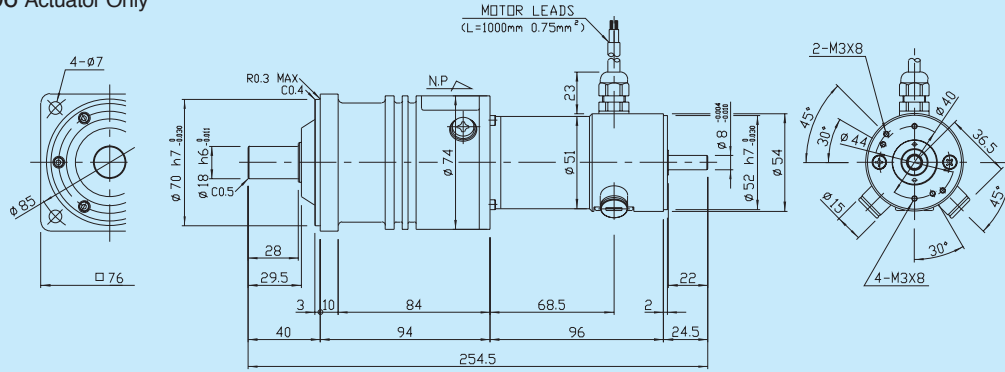
RHS-14-XX03-E With Encoder



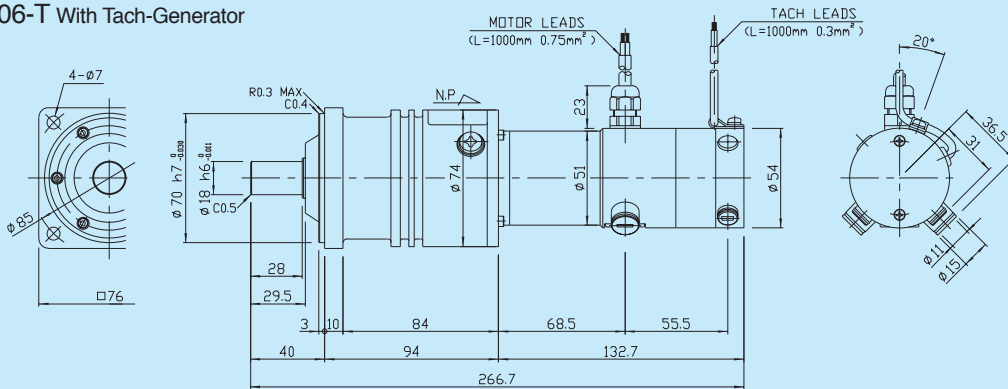
RHS-14-XX03-TE With Tach-Generator and Encoder



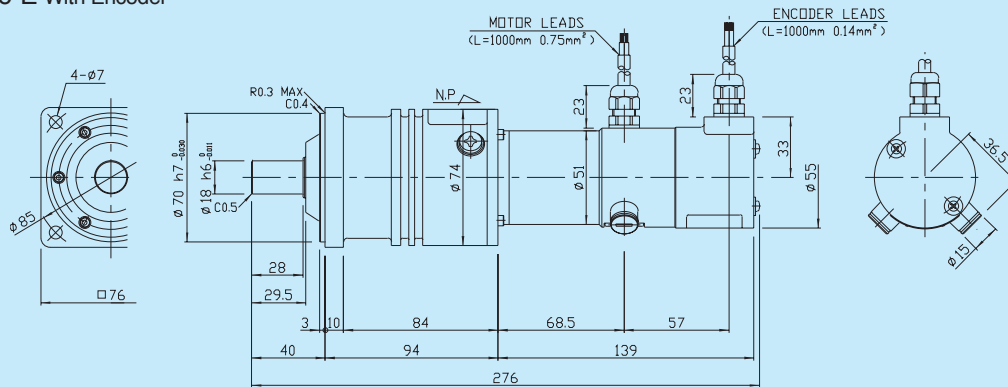
RHS-17-XX06 Actuator Only



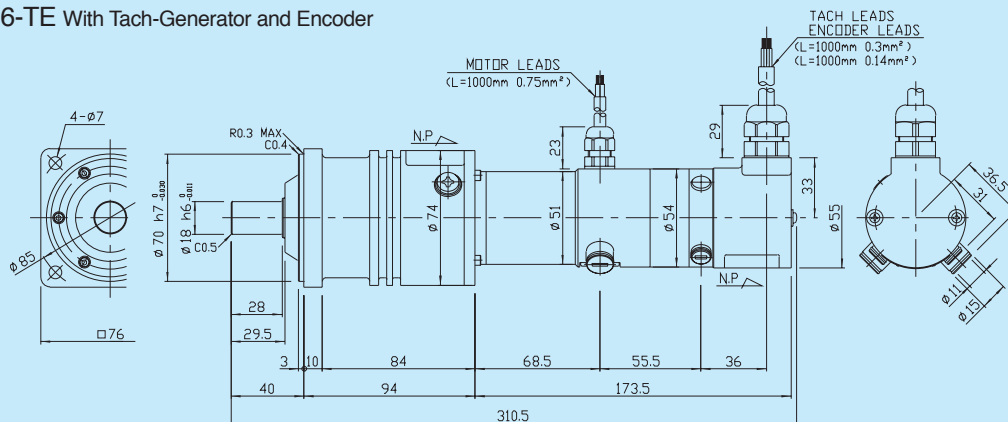
RHS-17-XX06-T With Tach-Generator



RHS-17-XX06-E With Encoder



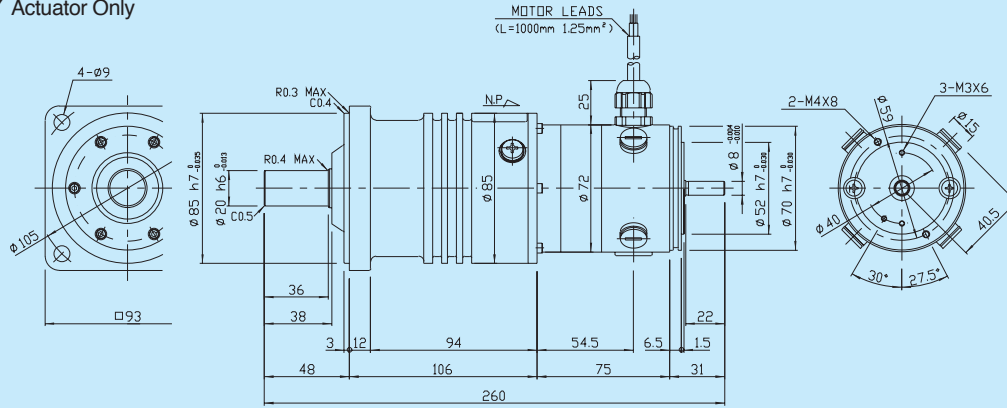
RHS-17-XX06-TE With Tach-Generator and Encoder



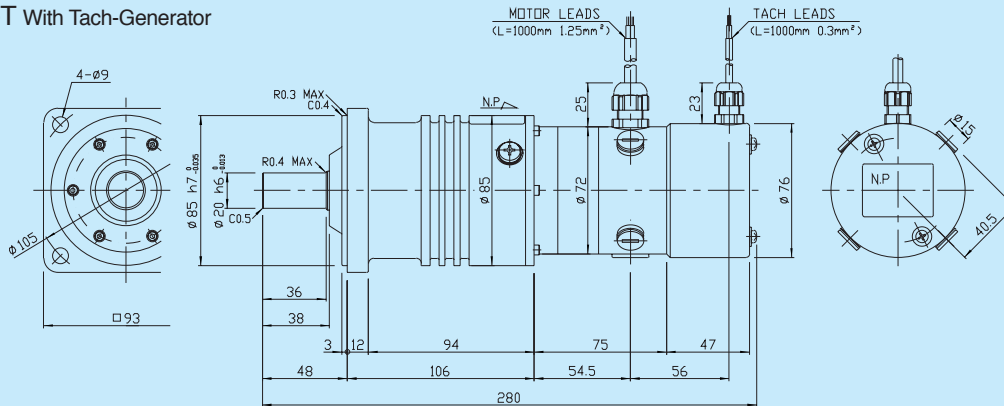
Outline and Dimensions

mm

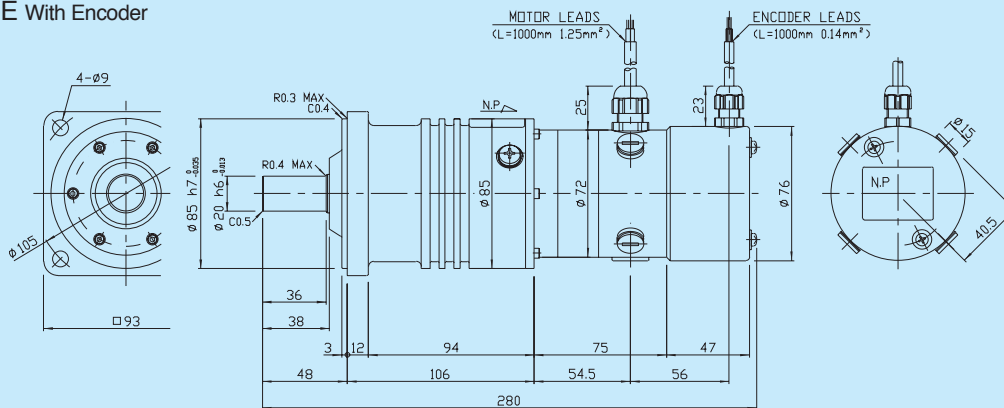
RHS-20-XX07 Actuator Only



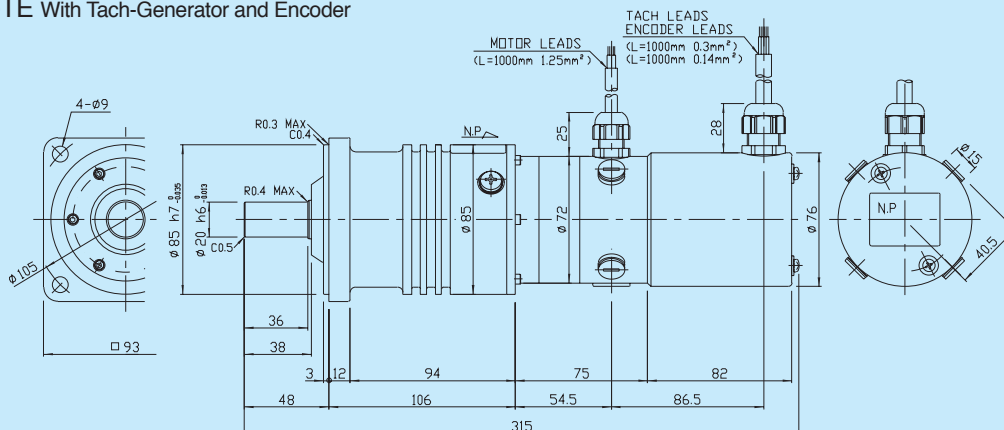
RHS-20-XX07-T With Tach-Generator



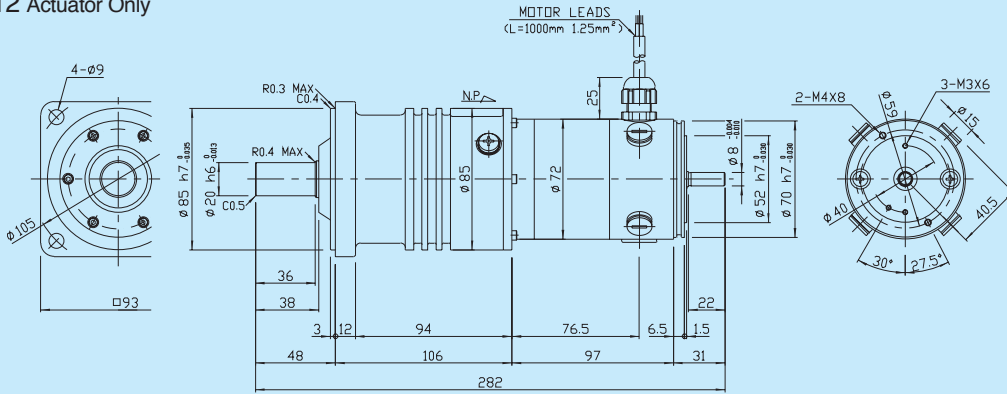
RHS-20-XX07-E With Encoder



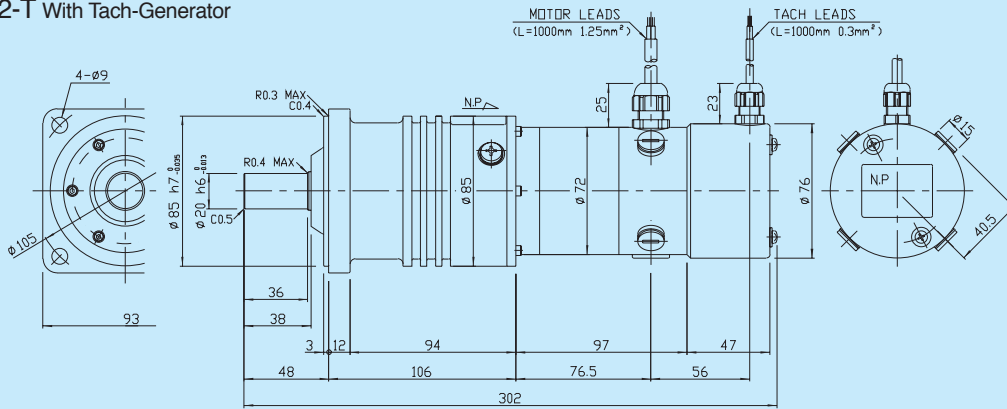
RHS-20-XX07-TE With Tach-Generator and Encoder



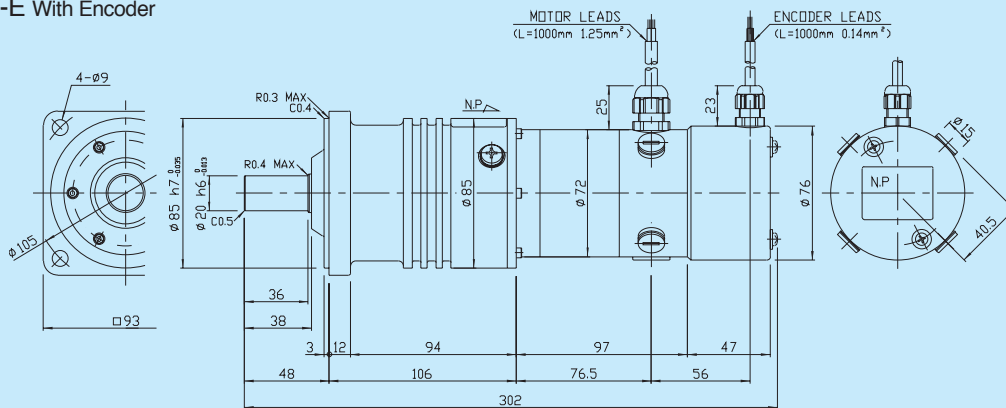
RHS-20-XX12 Actuator Only



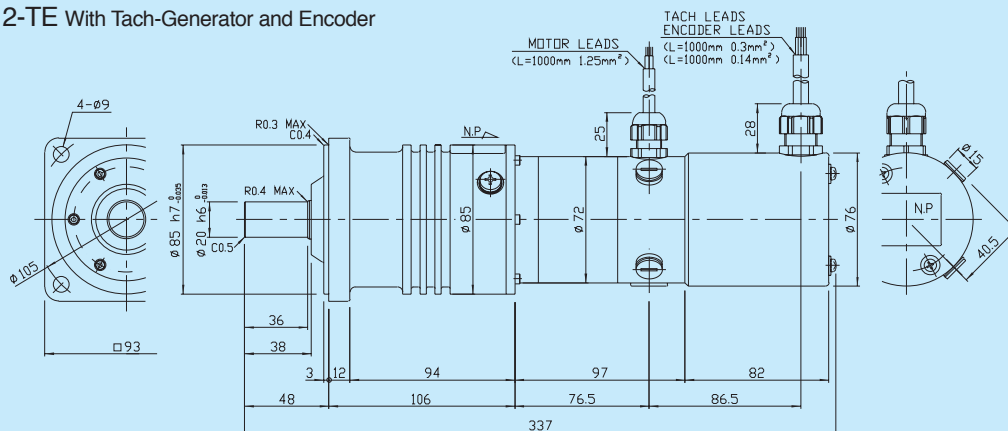
RHS-20-XX12-T With Tach-Generator



RHS-20-XX12-E With Encoder



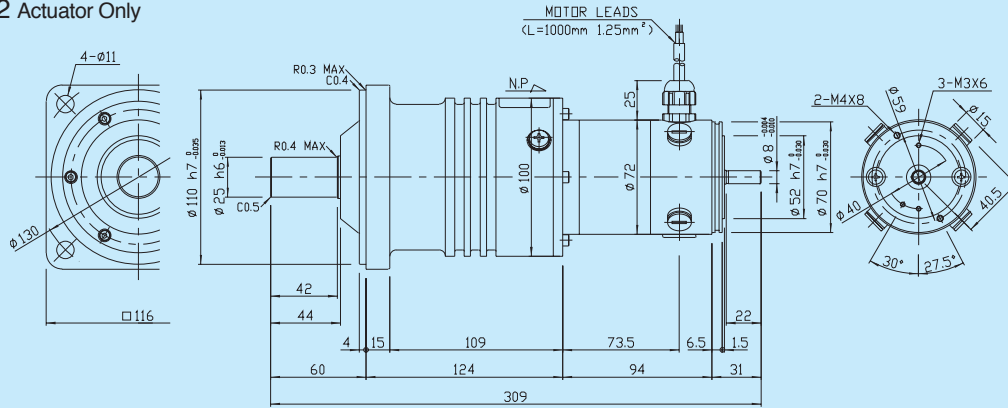
RHS-20-XX12-TE With Tach-Generator and Encoder



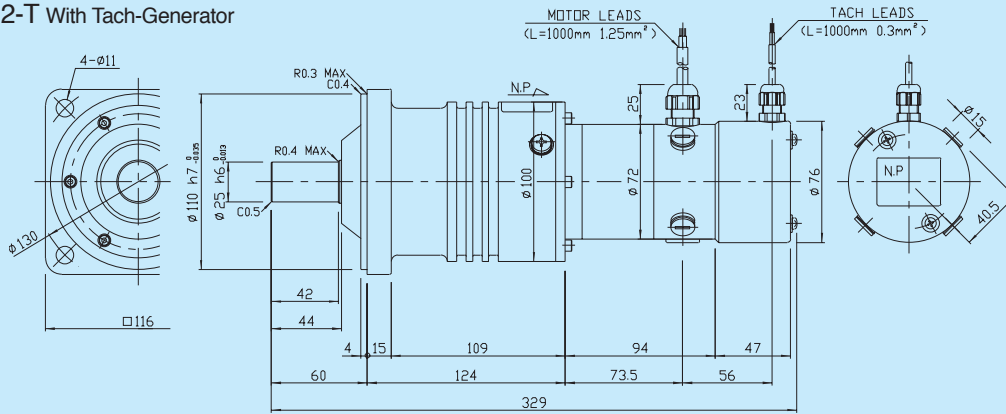
Outline and Dimensions

mm

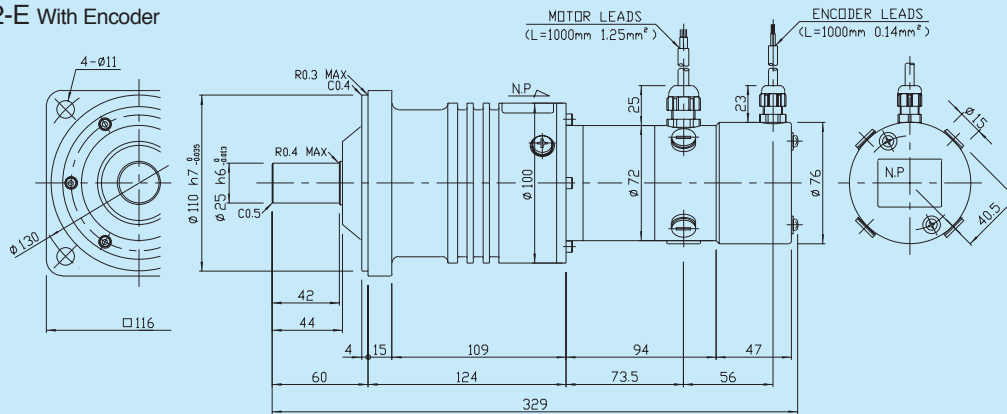
RHS-25-XX12 Actuator Only



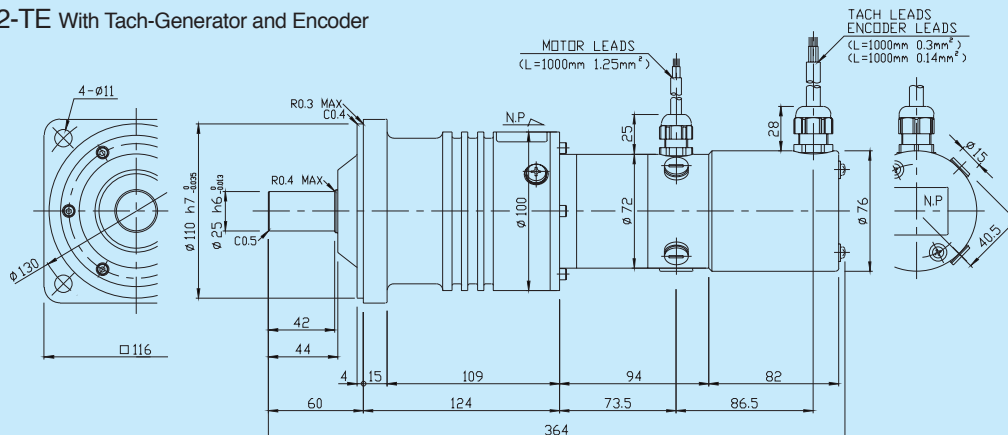
RHS-25-XX12-T With Tach-Generator



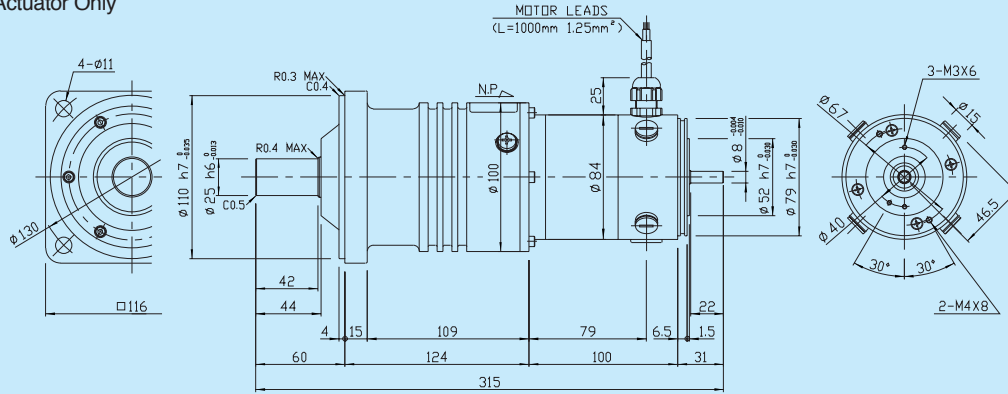
RHS-25-XX12-E With Encoder



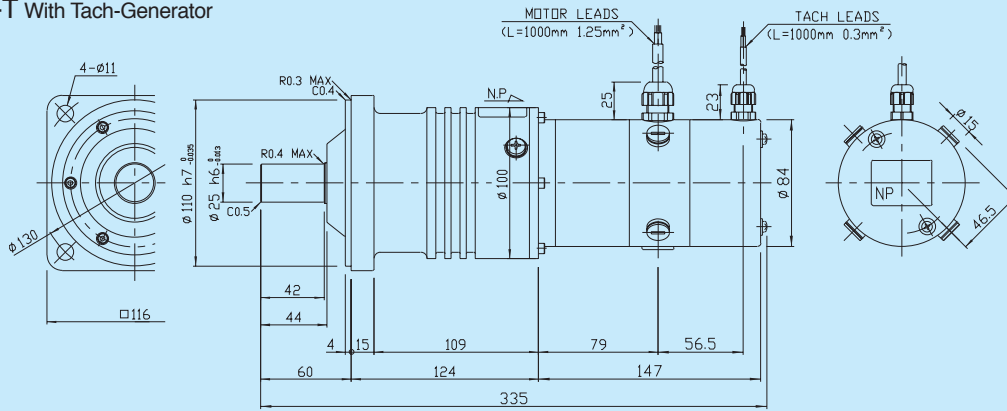
RHS-25-XX12-TE With Tach-Generator and Encoder



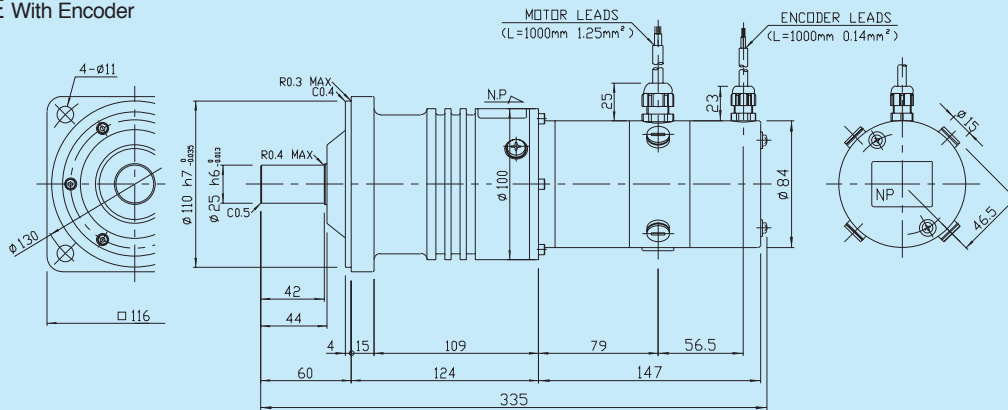
RHS-25-XX18 Actuator Only



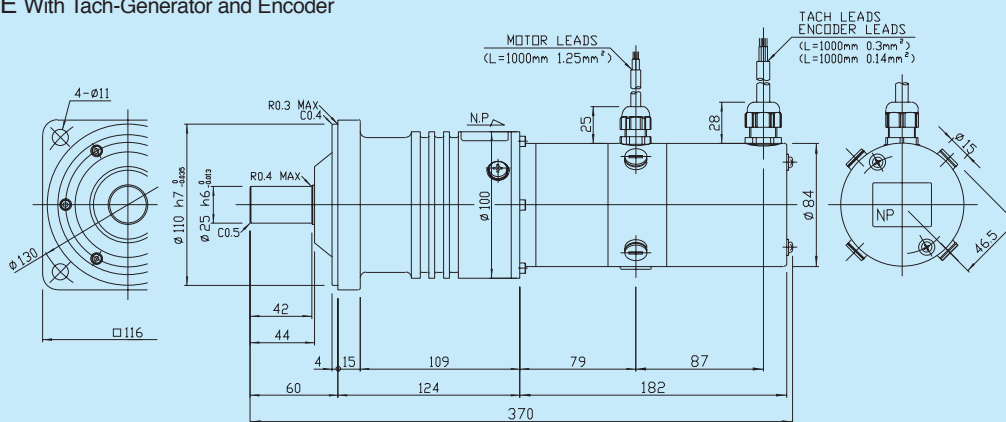
RHS-25-XX18-T With Tach-Generator



RHS-25-XX18-E With Encoder



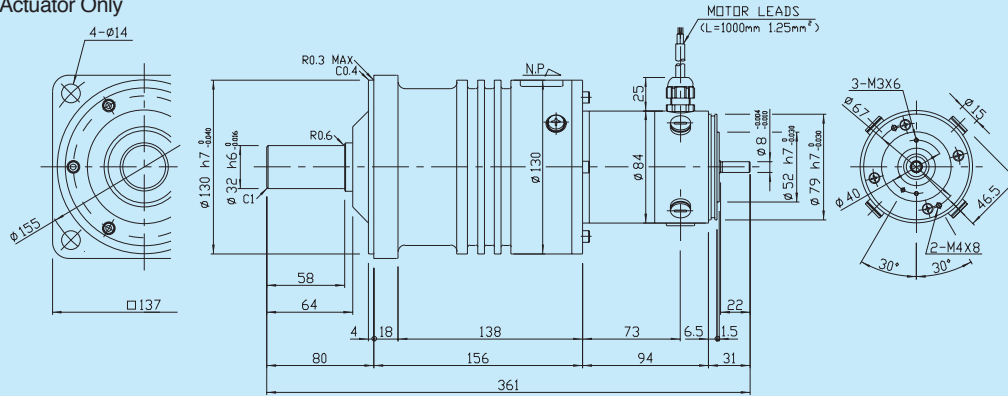
RHS-25-XX18-TE With Tach-Generator and Encoder



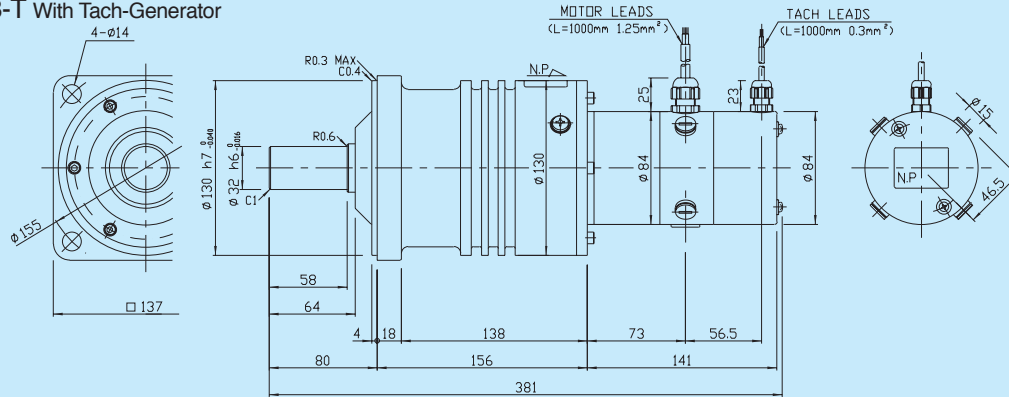
Outline and Dimensions

mm

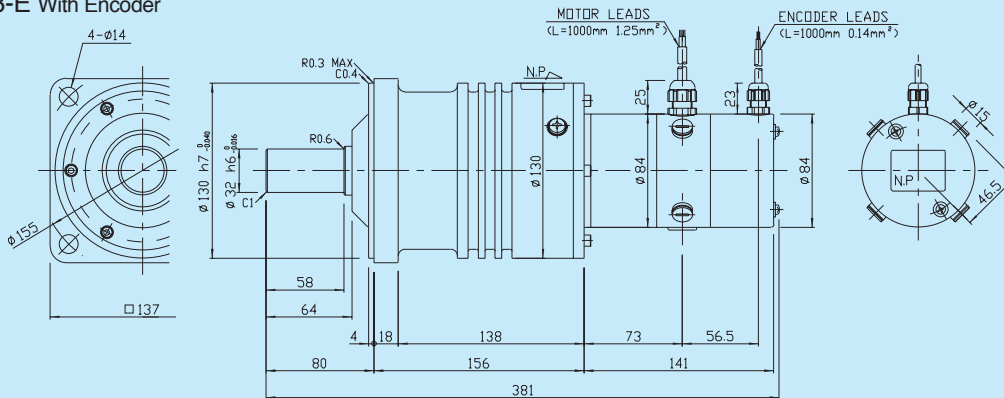
RHS-32-XX18 Actuator Only



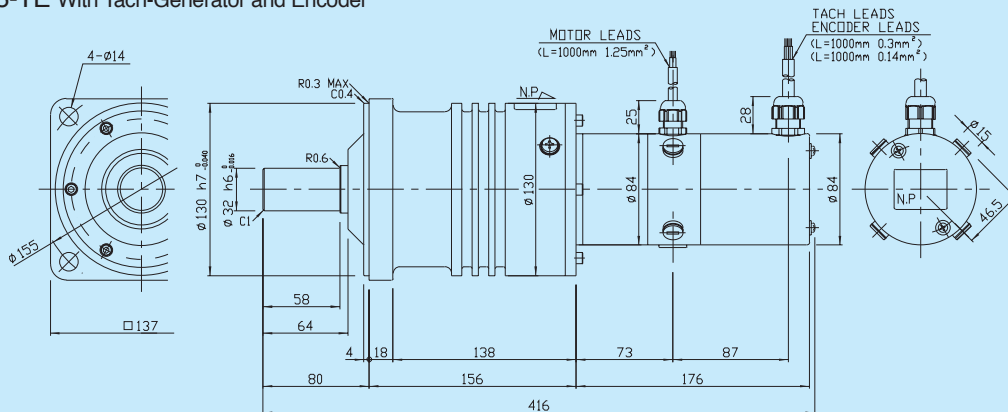
RHS-32-XX18-T With Tach-Generator



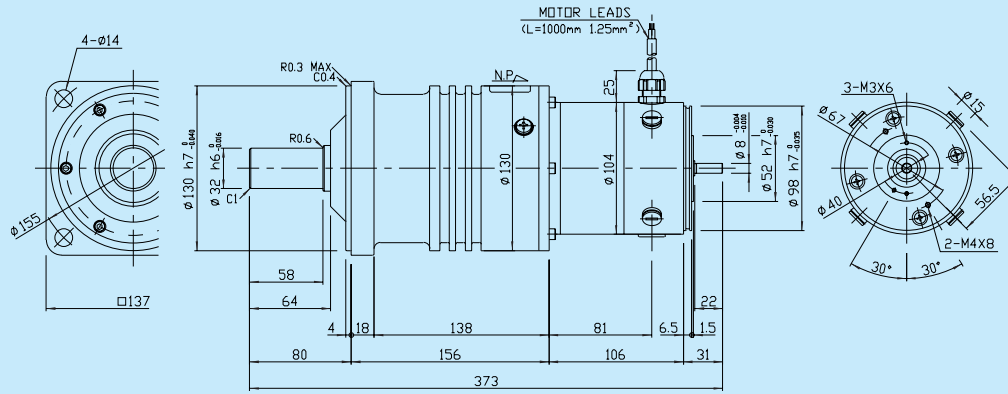
RHS-32-XX18-E With Encoder



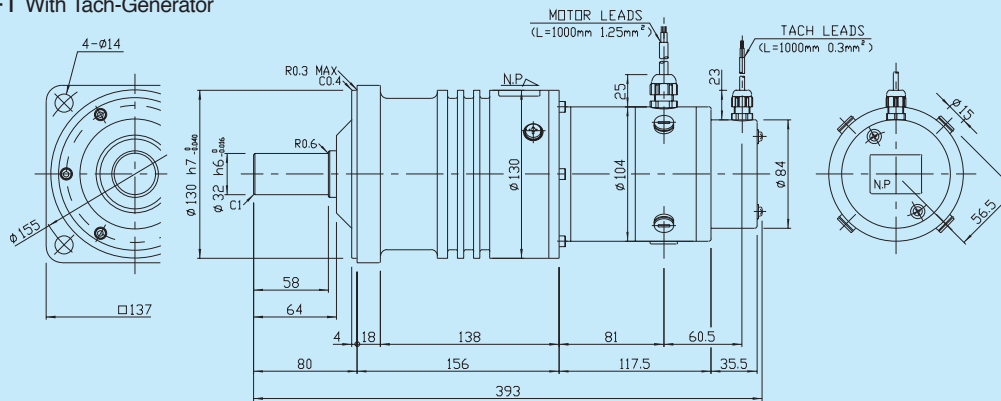
RHS-32-XX18-TE With Tach-Generator and Encoder



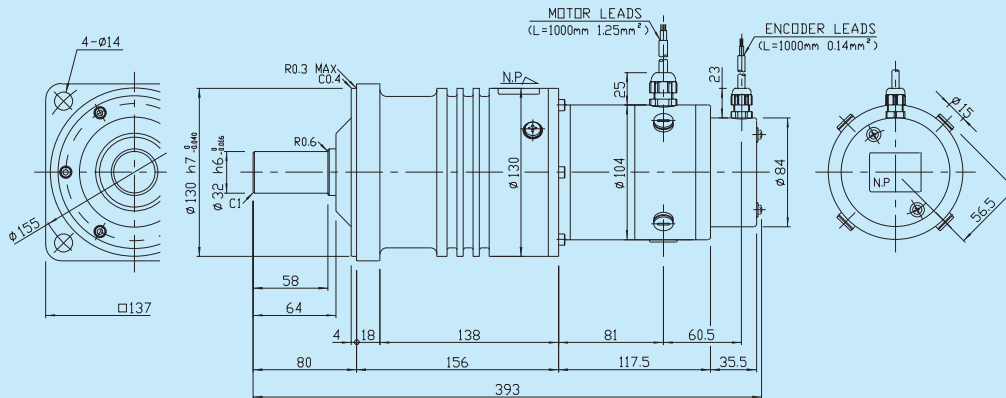
RHS-32-XX30 Actuator Only



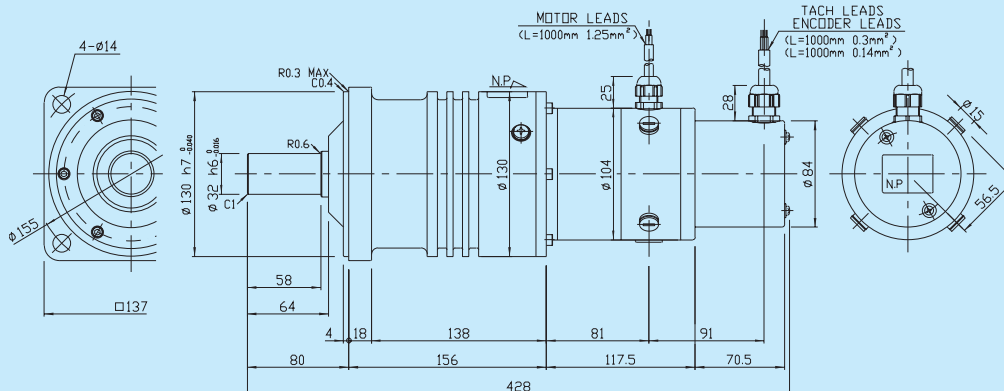
RHS-32-XX30-T With Tach-Generator



RHS-32-XX30-E With Encoder



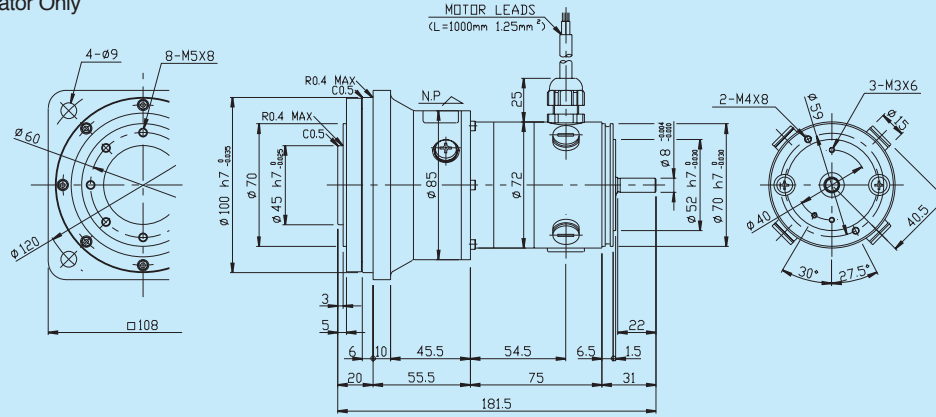
RHS-32-XX30-TE With Tach-Generator and Encoder



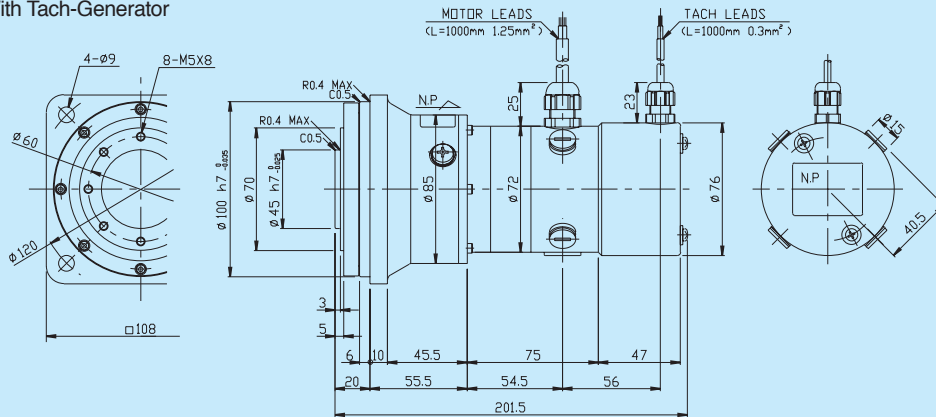
Outline and Dimensions

mm

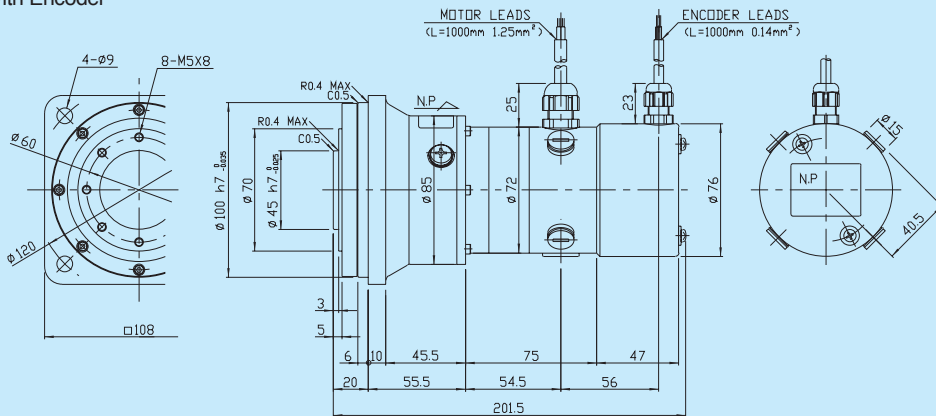
RFS-20-XX07 Actuator Only



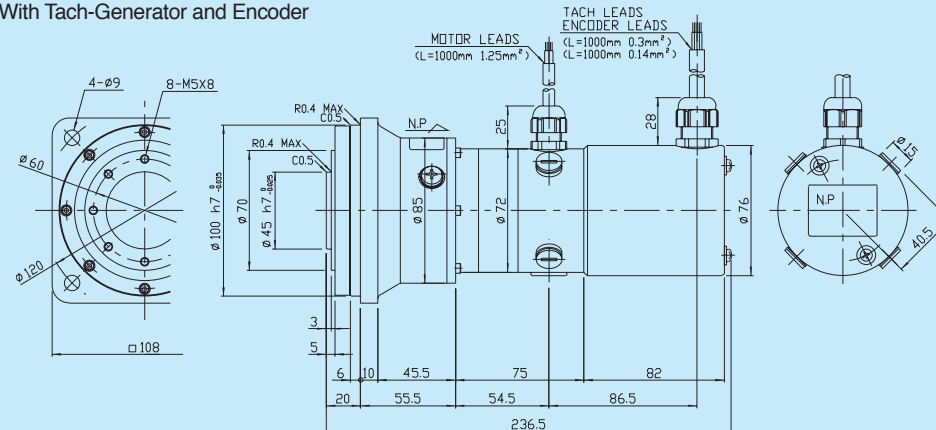
RFS-20-XX07-T With Tach-Generator



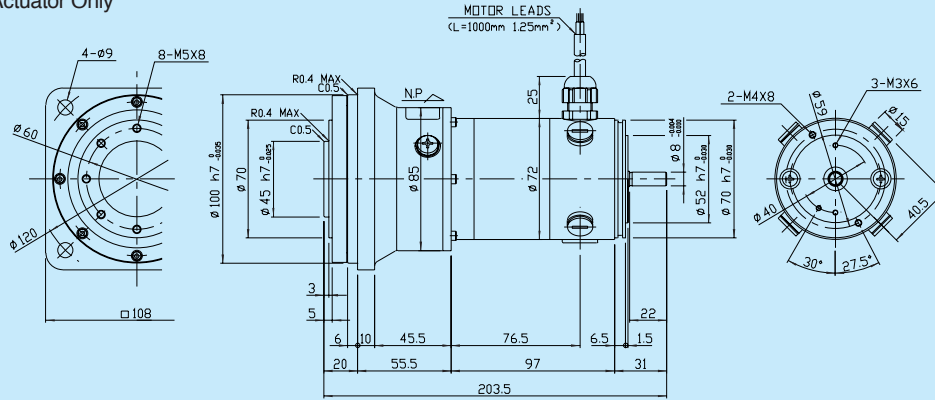
RFS-20-XX07-E With Encoder



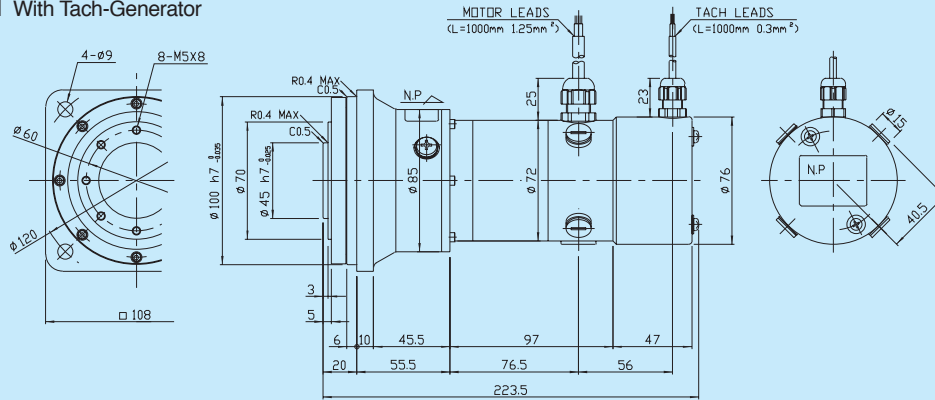
RFS-20-XX07-TE With Tach-Generator and Encoder



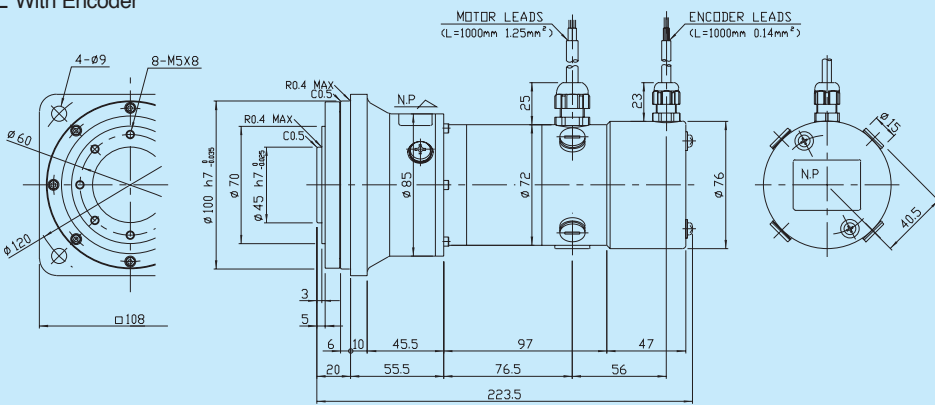
RFS-20-XX12 Actuator Only



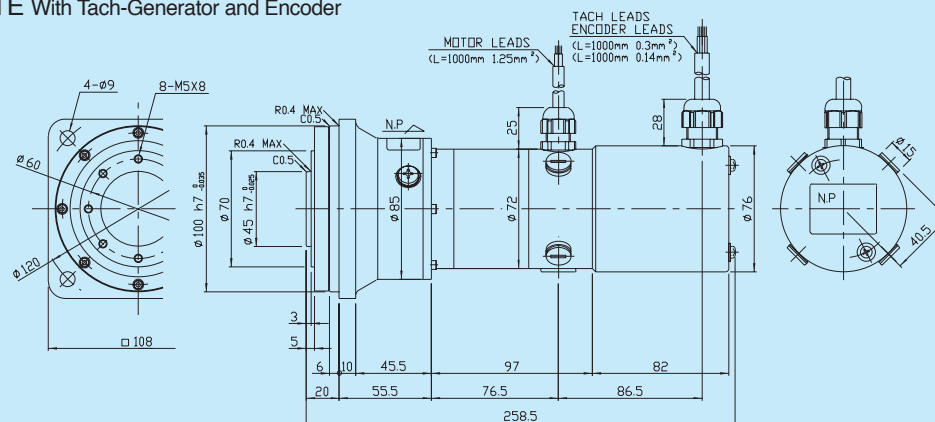
RFS-20-XX12-T With Tach-Generator



RFS-20-XX12-E With Encoder



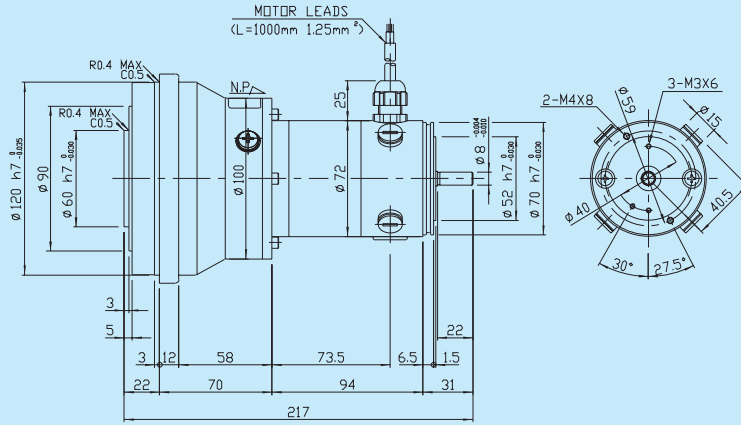
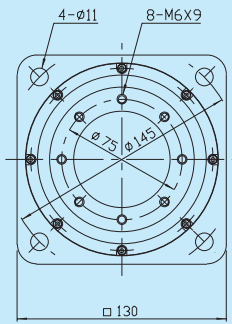
RFS-20-XX12-TE With Tach-Generator and Encoder



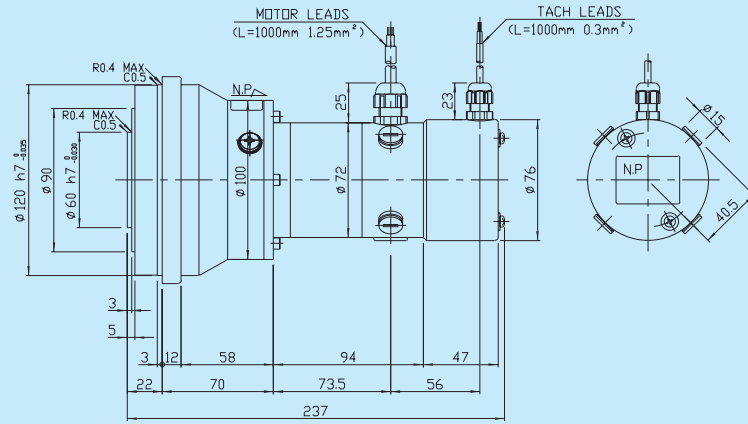
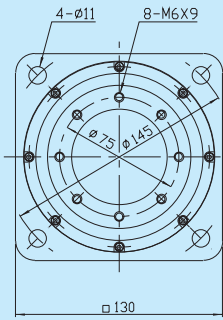
Outline and Dimensions

mm

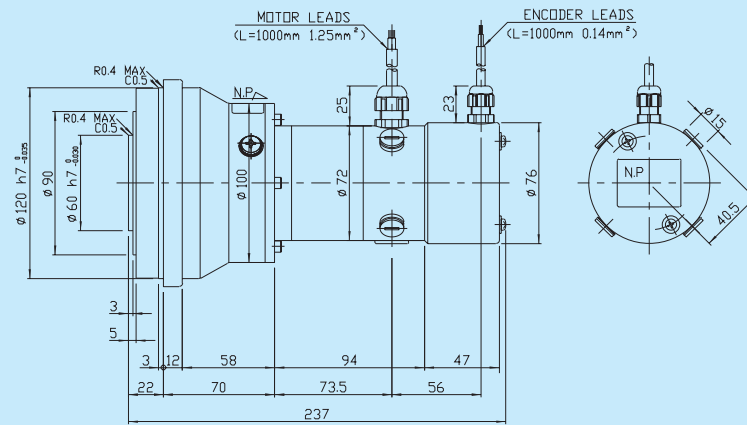
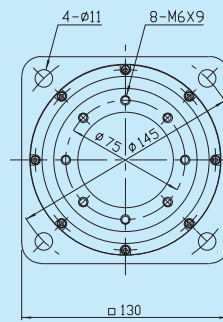
RFS-25-XX12 Actuator Only



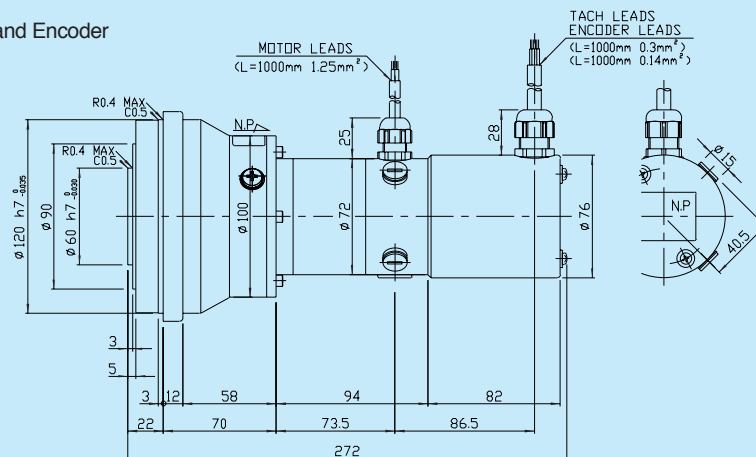
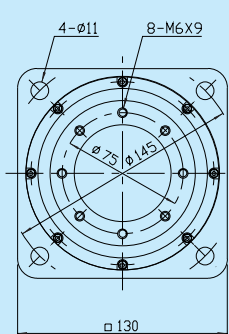
RFS-25-XX12-T With Tach-Generator



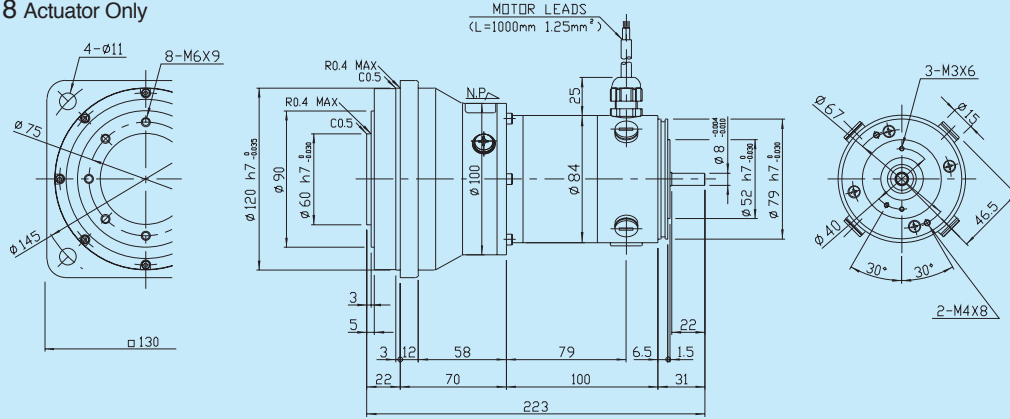
RFS-25-XX12-E With Encoder



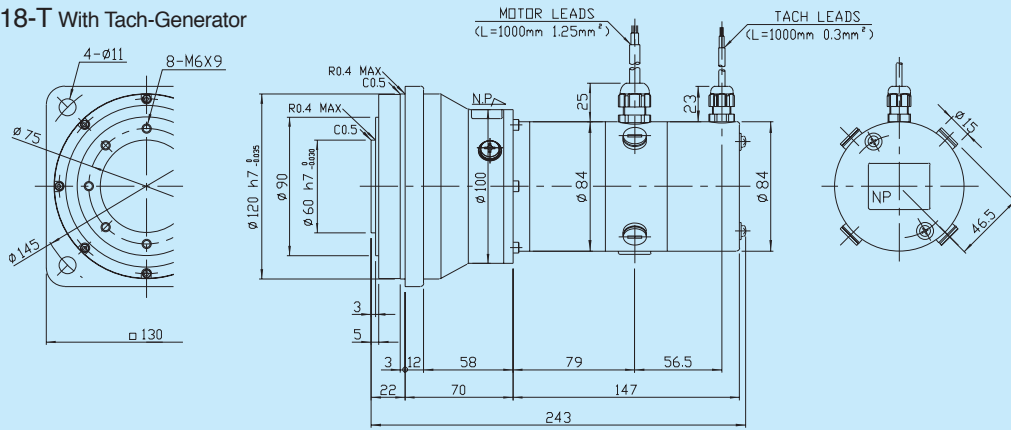
RFS-25-XX12-TE With Tach-Generator and Encoder



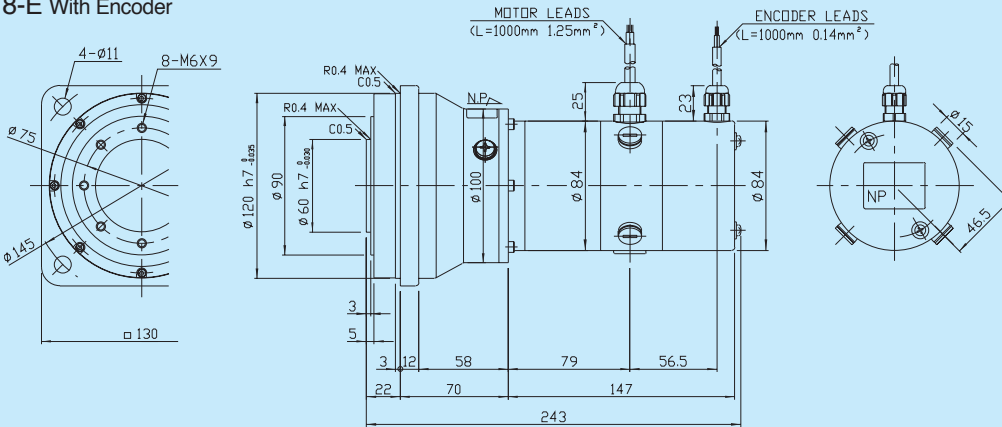
RFS-25-XX18 Actuator Only



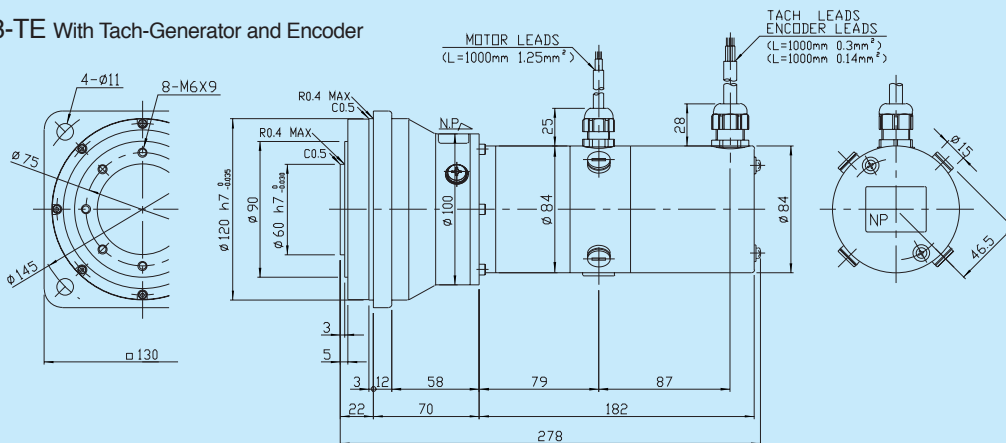
RFS-25-XX18-T With Tach-Generator



RFS-25-XX18-E With Encoder



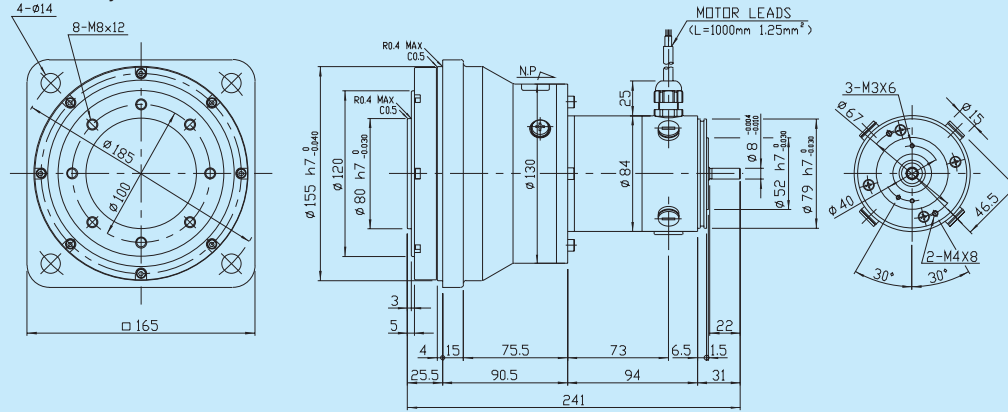
RFS-25-XX18-TE With Tach-Generator and Encoder



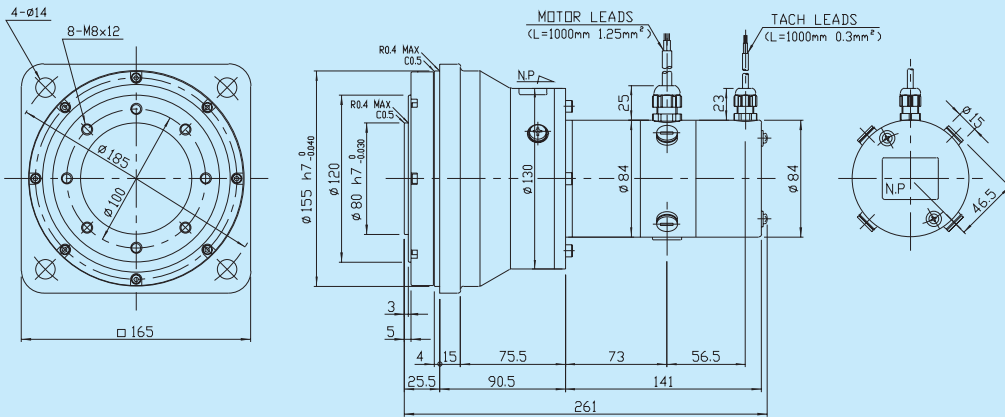
Outline and Dimensions

mm

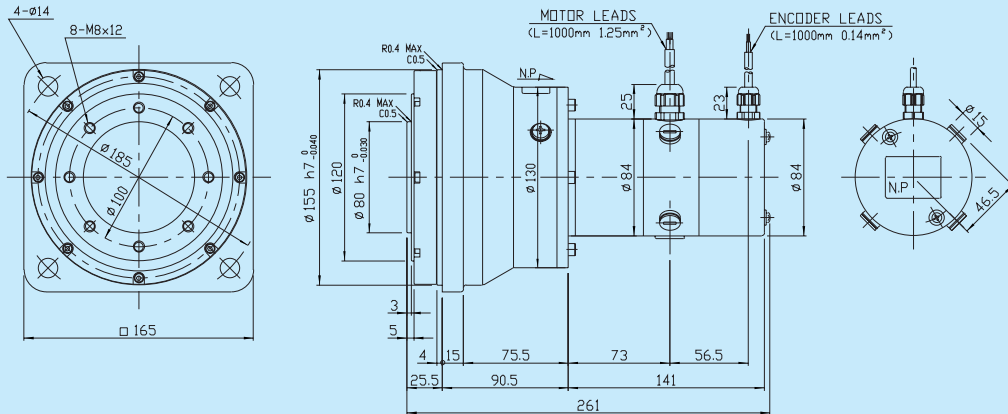
RFS-32-XX18 Actuator Only



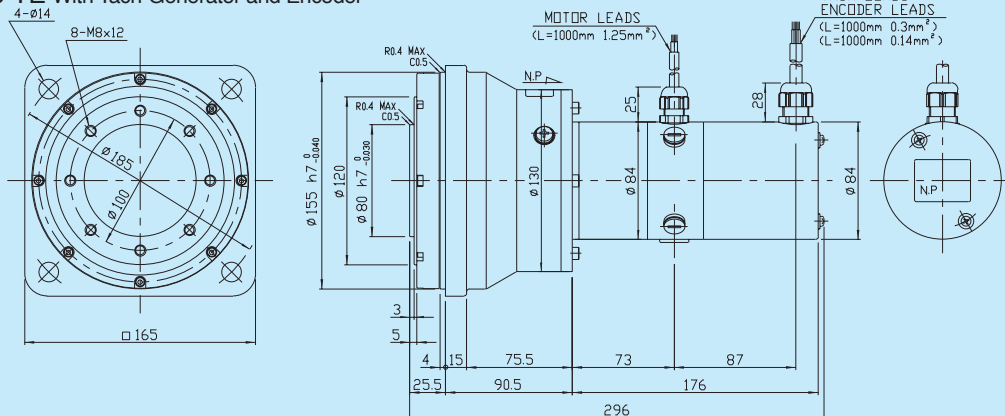
RFS-32-XX18-T With Tach-Generator



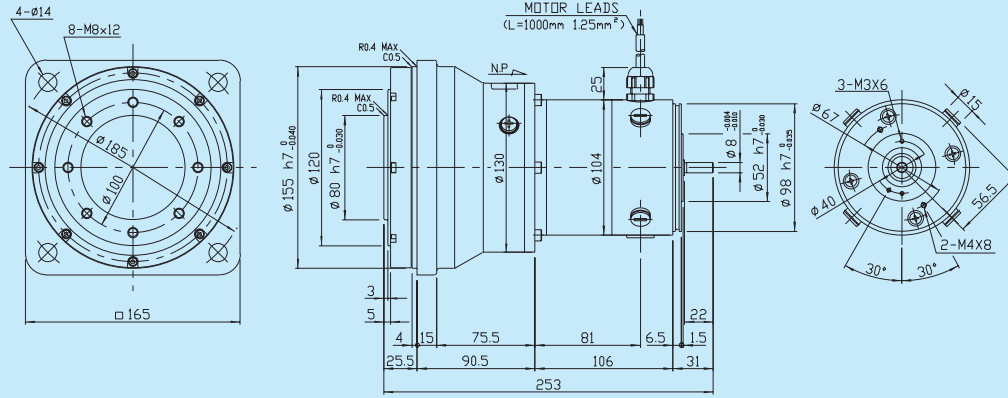
RFS-32-XX18-E With Encoder



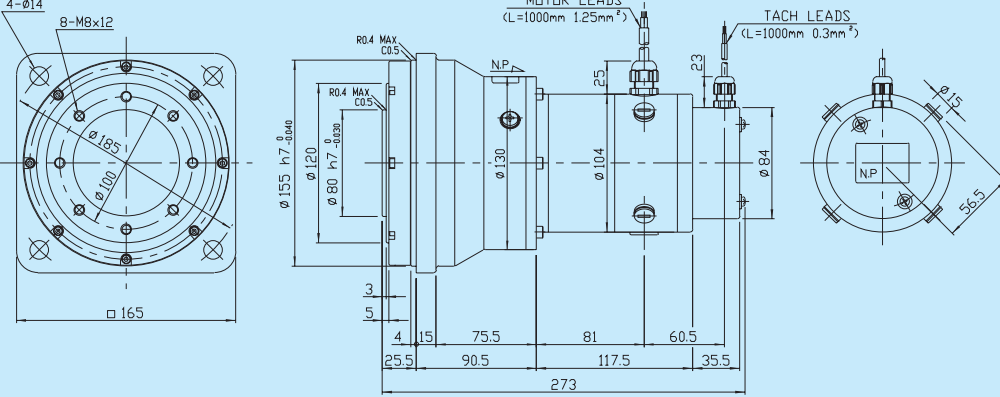
RFS-32-XX18-TE With Tach-Generator and Encoder



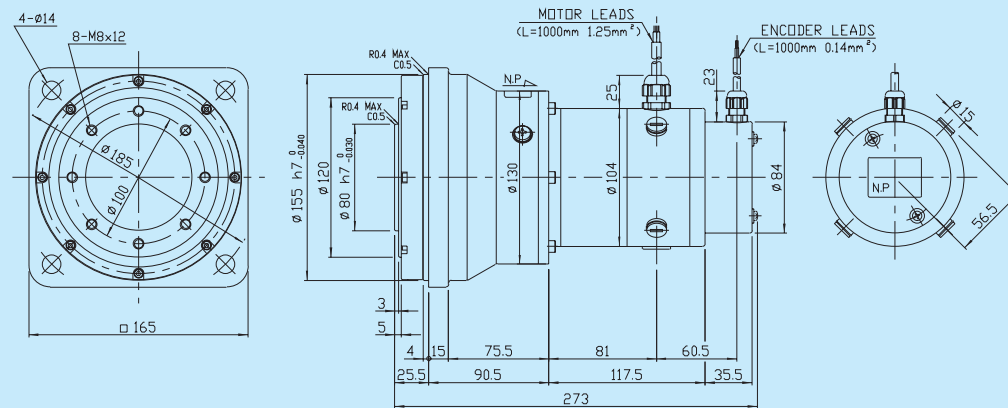
RFS-32-XX30 Actuator Only



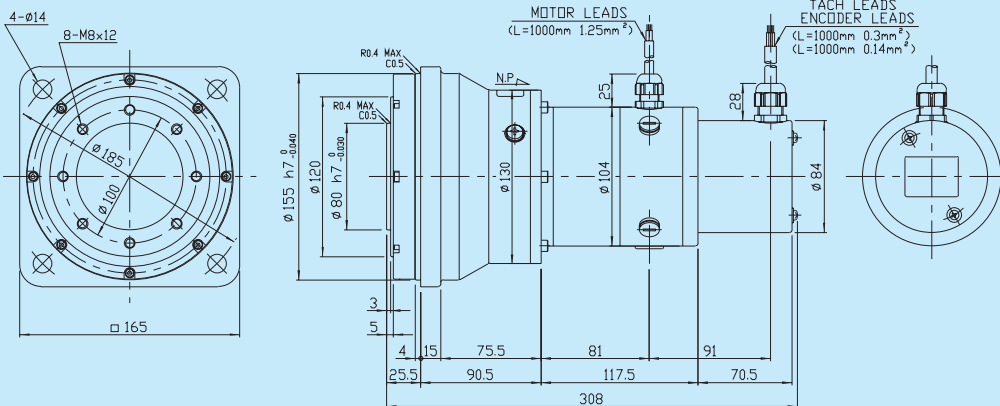
RFS-32-XX30-T With Tach-Generator



RFS-32-XX30-E With Encoder



RFS-32-XX30-TE With Tach-Generator and Encoder



HS Series Control Units

For RH and RHS/RFS Series DC Servo Actuators

The HS series control units enable the DC servo actuators to function at their best with accurate positioning and speed control. The use of hybrid ICs and gate arrays assures high reliability while keeping the units compact. Safety measures are incorporated to protect the motors and control units from accidental damage.

Three types of HS series control units are available, as described below.

HS-200 Series – Analog Input Control Unit

HS-200 series units are designed to control speed. A tach-generator or encoder (external F/V converter required) is used as a speed sensor for the DC motor.

These units can also be used as simple positioners by means of an analog position sensor such as a potentiometer.



HS-300 Series – Digital Pulse Input Control Unit

HS-300 series units are for position and speed control. An encoder is used to detect the position and speed of the DC motor. As a pulse string is input, position is determined by the pulse count while speed is determined by the pulse frequency.



HS 400-Series – Data Communication Input Control Unit

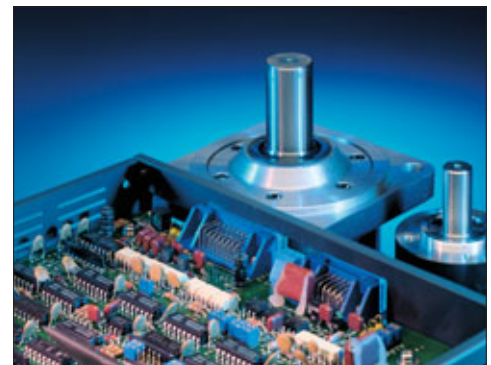
These units control position and speed using an external computer connected via a RS-232C.

An encoder is used to detect the position and speed in the same manner as for the HS-300 series.



Main Specifications of Control Unit

Ambient Temperature:	0 ~ 50°C
Ambient humidity:	Maximum 95% RH (non-condensing)
Vibration resistance:	Maximum 1 g (10 ~ 55 Hz)
Shock resistance:	Maximum 10 g (11 m sec.)
Environment:	Free from metallic powder, dust, oil mist, corrosive gas.



Analog Control Units

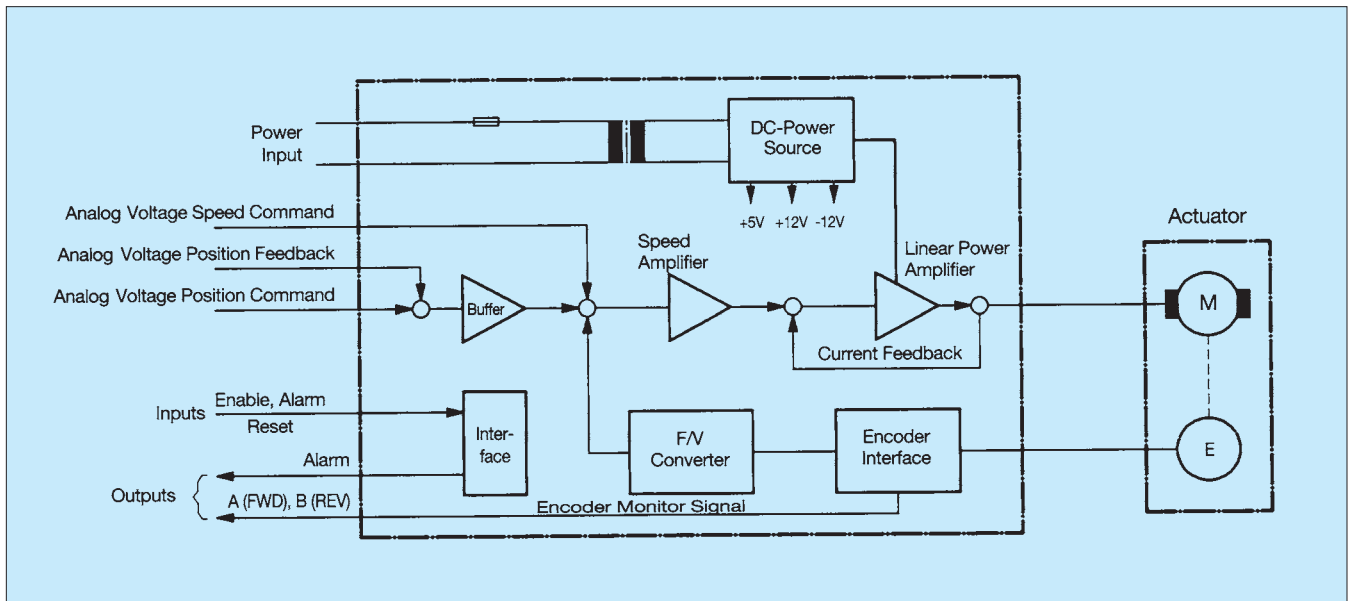
HS-230-05

HS-230 is a new analog type DC servo control unit designed for speed and position control of RH-5A mini series actuators. It includes many new techniques in its design, such as a command input circuit, a linear power amplifier circuit, and an encoder signal feedback circuit.

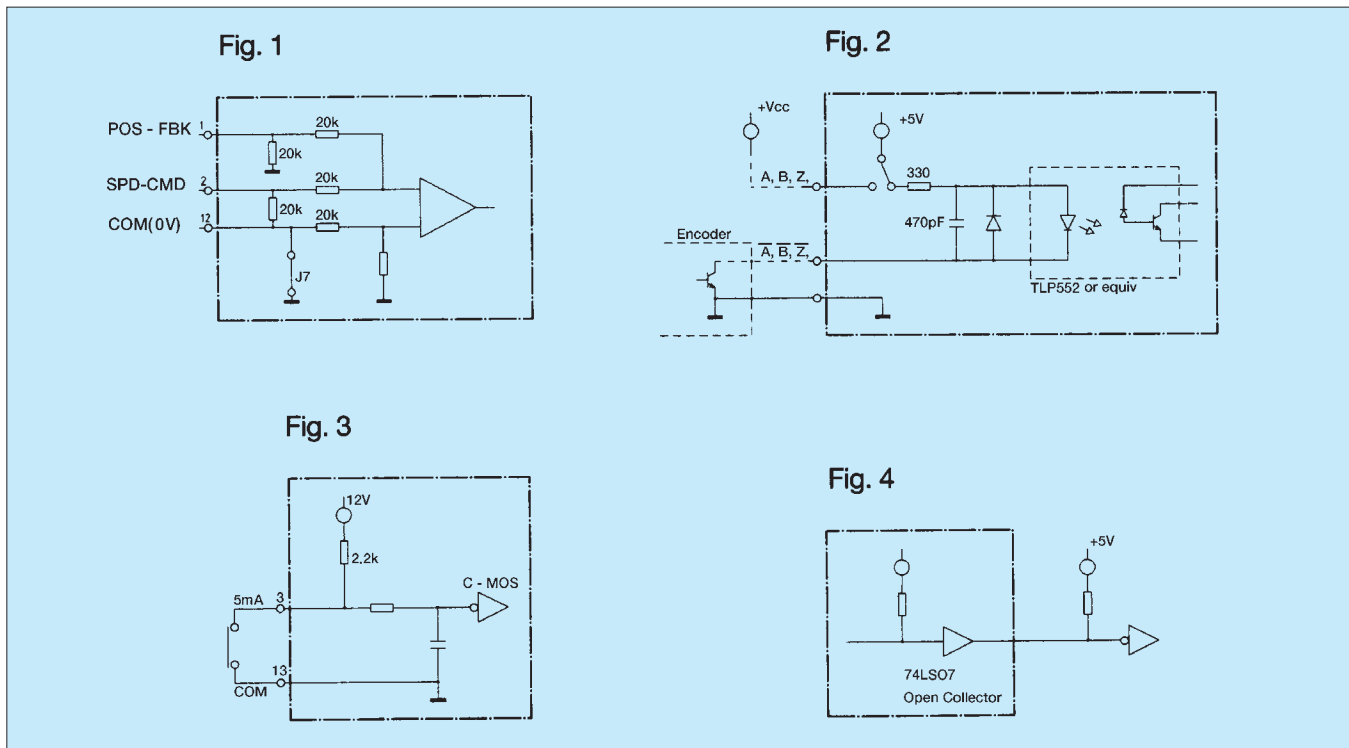
Features:

- ◆ Hybrid circuits make the unit compact and ensure reliable performance.
- ◆ Stable speed control over 1:1000 range.
- ◆ Linear power amplifier assures noise-free motor drive.
- ◆ Analog positioning system is possible with a potentiometer attached to the actuator output.

Block Diagram



Interfaces



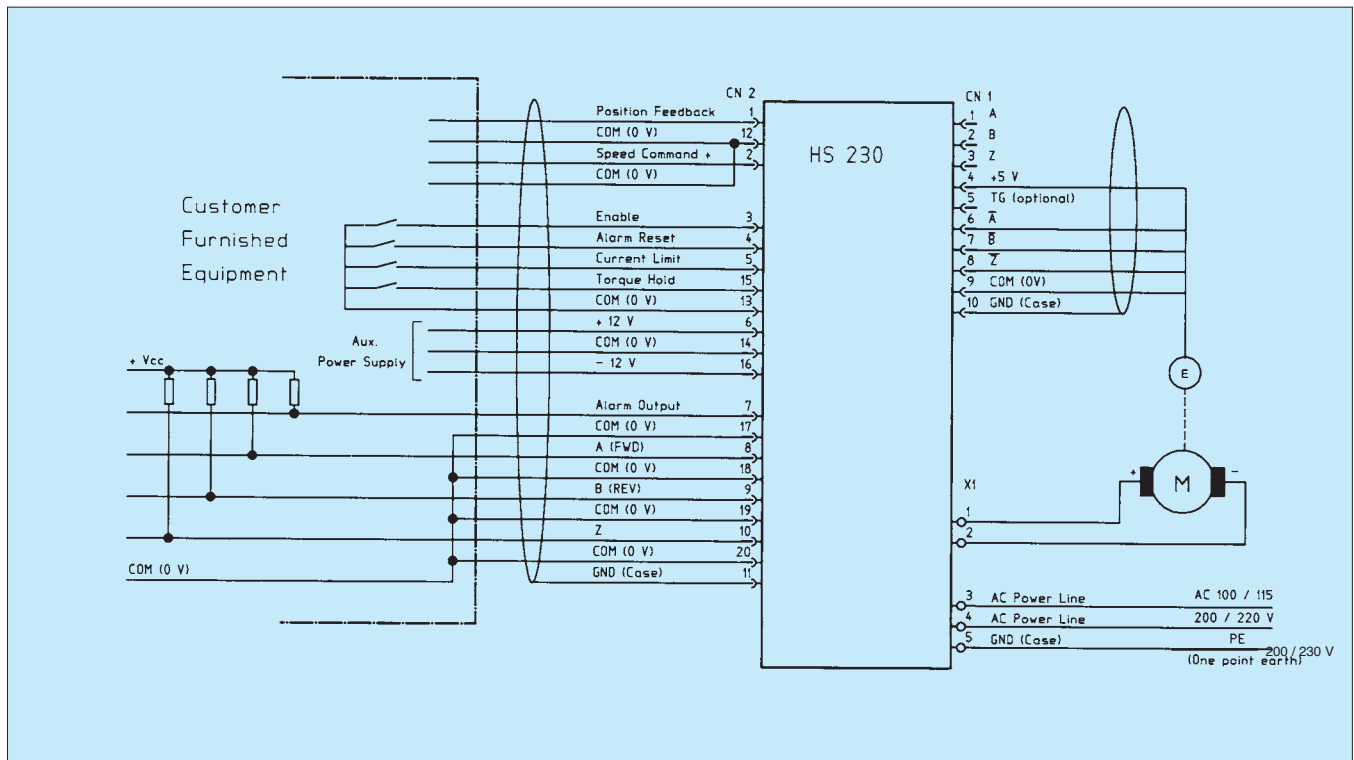


Specifications

Table 26

HS 230-05 Specifications			RH-5A	Interface
MAIN SPECIFICATIONS	Appropriate Actuator			
	Power Supply		User selection AC 100/115/200/230V ± 10% 50/60 Hz 25VA	
	Motor Control		Single phase, full wave rectification transistor linear amplifier drive Rated Output Power : 6W Max. output voltage : ± 18V Continuous output current : 0.5A Peak output current : 1.5A Output current limit range : 0 ~ 1.5A	
	Speed Control Range		1 : 1000	
	Speed Accuracy		better than ± 0.1% against load variation 0 ~ 100% better than ± 1.5% against temperature variation 0 ~ 50°C better than ± 0.1% against line voltage variation ± 10%	
INPUTS	Speed Command	SPD-CMD	Rated command voltage : ± 5V Command voltage range : 0 ~ ± 10V Input impedance : 10K	Fig. 1
	Position Feedback Signal (Optional)	POS-FBK	Voltage range : 0 ~ ± 10V Input impedance : 10K	
	Speed Feedback Signal	A. B. Z.	Encoder signal, open collector Response frequency : 60 KHz max. Input : Photo-coupler	Fig. 2
	Enable	ENABLE	When on, motor activated. When off, output turned off.	
	Alarm Reset	ALM-RST	After a fault, unit may be reset by input to this line.	
	Ext. Current Limit (Optional)	CUR-LMT	Input to this line limits motor current to internally preset value.	Fig. 3
	Torque Hold (Optional)	TRQ-HLD	Internal gain reduced by 10db.	
PROTECTIVE AND SAFETY FUNCTIONS	Over-Speed Stop	OVR-SPD	Prevents motor uncontrolled run.	
	Over-Load Stop	OVR-LOAD	Protects motor from thermal damage.	
	Over-Heat Stop	OVR-HEAT	Protects power amplifier from thermal damage.	
	Over-Current Stop	OVR-CUR	Protects power amplifier from thermal damage.	
	Power Fault	PWR-FLT	Stops motor when power fails.	
	Other		Power-on delay, fuse protection. Main power circuit cut off relay.	
	Alarm	ALARM	Positive logic output when protective functions working.	
OUTPUTS	Encoder Monitor	A: B: Z: (FWD REV. Optional)	Encoder A. B. Z. monitor signal output. Direction indicating pulse (Forward, Reverse) optional.	Fig. 4
	Supply to encoder	+ 5V	DC + 5V 60mA max.	
AUX. POWER SUPPLY	Supply to speed cmd.	± 12V	DC ± 12V 25mA max.	
	Power supply	POWER (Gr.)	Green light indicates power on.	
FRONT PANEL INDICATORS	Enable	ENABLE (Gr.)	Green light indicates enable input signal.	
	Power Fault	PWR-FLT (Red)	Red light indicates faulty power.	
	Over-Speed	OVR-SPD (Red)	Red light indicates over speed stop function.	
	Over-Load	OVR-LOAD (Red)	Red light indicates over-load, over-heat, and over current stop functions.	
	Over-Heat			
	Over-Current			
FRONT PANEL ADJUSTMENTS	Offset	OFFSET	Speed offset adjustment.	
	Loop Gain	LP-GAIN	Speed adjustment or position loop gain adjustment.	
	Current Limit	CUR-LMT	Max. motor current setting.	
	Minor Loop Gain	ML-GAIN	Speed loop gain adjustment	
OTHERS	Environment		Operating Temperature: 0 ~ 50°C Humidity: Max. 95% relative, non-condensing Vibration: Max. 1 g (10 ~ 55Hz) Shock: max. 10 g (11ms)	
	Insulation Resistance		100 M Min. (DC 500V)	
	Dielectric Strength		AC 500 V 1 minute 50/60 Hz	
	Weight		0.9 Kg	

System Wiring Diagram



Connectors and Terminals

CN-1 Encoder Connector

Pin No.	Signal
1	A
2	B
3	Z
4	+ 5V
5	TG (Optional)
6	A̅
7	B̅
8	Z̅
9	COM (OV)
10	Ground (Case)

Table 27

Terminals

Terminal	Signal
1	M+ (Motor)
2	M- (Motor)
3	Power AC
4	100/115/200/230V

Table 28

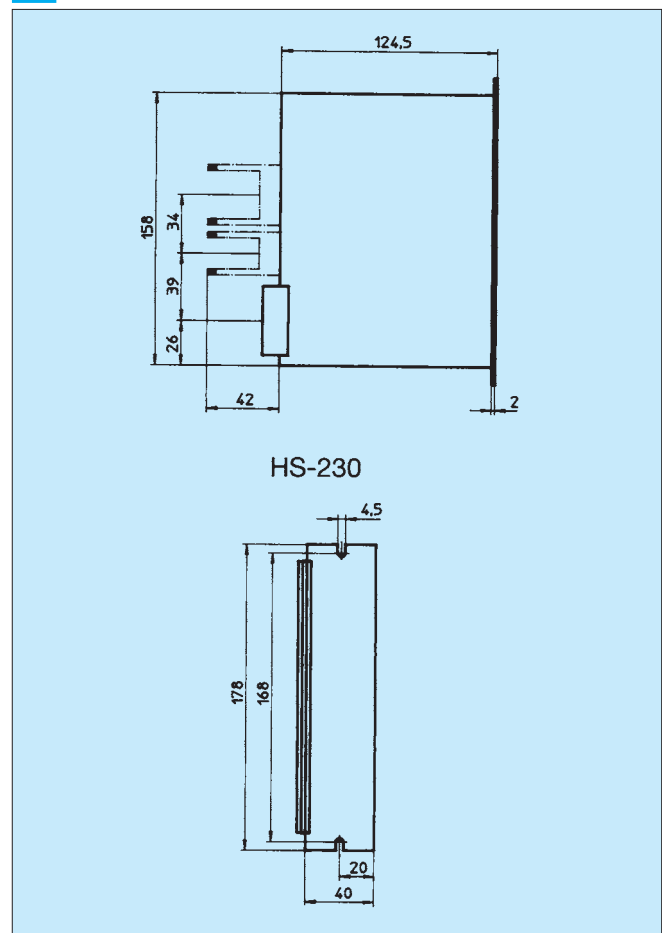
CN-2 Signal Input/Output Connector

Pin No.	Signal
1	POS-FBK
2	SPD-CMD
3	ENABLE
4	ALM-RST
5	CUR-LMT
6	+ 12V
7	ALARM
8	A (FWD)
9	B (REV)
10	Z
11	Ground (Case)
12	COM (OV)
13	COM (OV)
14	COM (OV)
15	TRQ-HLD
16	- 12V
17	COM (OV)
18	COM (OV)
19	COM (OV)
20	COM (OV)

Table 29

Outline and Dimensions

mm



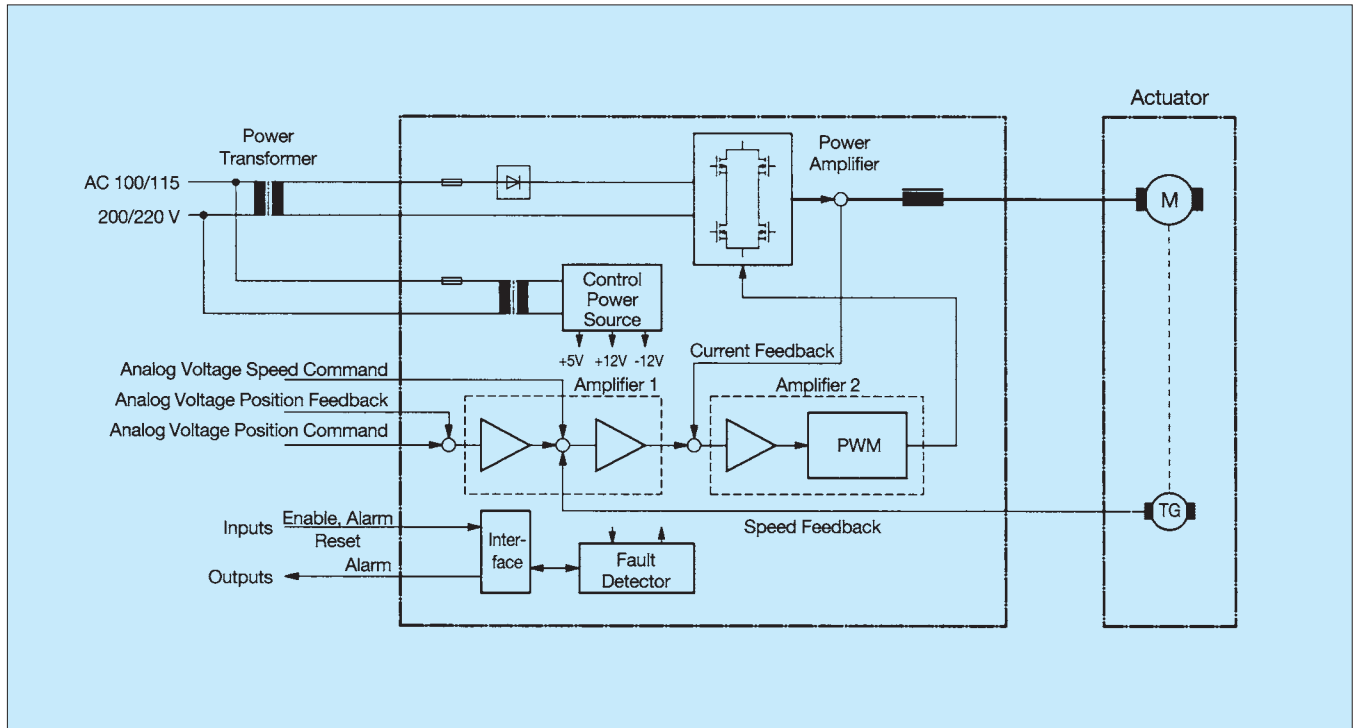
Analog Control Units

HS-250

The HS-250 series analog input control units provide stable speed control over a wide speed range.

- ◆ Utilizing a 20 kHz PWM servo amplifier
- ◆ Controlling actuator speed in a range 1 : 2000 or more when an analog speed command is input
- ◆ Can also be used for position control by means of an analog position sensor such as a potentiometer.

Block Diagram



Interfaces

Fig. 1

Position Feedback
COM(OV)
SPD - CMD
COM(OV)

Input impedance: 10k
Input voltage range: -10V - +10V

Fig. 2

TG.+
TG.-

Input impedance: 10k

Fig. 3

5mA
COM

Dry Contact or Open Collector input.
Circuit is active when connection is made between terminals 8 and 13. Voltage between terminals is not to exceed 1.5 V.

Fig. 4

5mA
COM

Dry contact or Open Collector Input.
TRQ-HLD (terminals 11 and 13), CUR-LMT (12 and 13) are active when the connection is made between terminals. ALM-RST active on the falling (negative-going) edge when the connection is broken.

Fig. 5

Terminals 14 and 16 "open" 15 and 16 close when an alarm occurs.
Relay contacts are rated at AC 110V/0.5A or DC 24V/1A max.

Caution: For input wiring involving more than one "COMMON", use independent twist pair for more than one input.

HS 250 Series Specifications		HS-250-2	HS-250-3	HS-250-6	HS-250-9	Interface
Appropriate Actuator		RH-8D, RH-11D, RH-14D	RHS/RFS-20	RHS/RFS-25	RHS/RFS-32	
MAIN SPECIFICATIONS	Motor Control		Analog voltage command input Single phase, full wave rectification transistor PWM drive.			
	Control Power Supply		User selection AC 100/115/200/230V ± 10% 50/60 Hz			
	Main Power Supply ¹⁾		AC 60V max.	AC 115V max		AC 130V max.
	External Power Transformer ²⁾		Primary voltage user selection AC 100/ 115/ 200/ 230V			
	Rated Output Power		48W	225W	450W	765W
	Maximum Output Voltage		± 44V	± 125V	± 125V	± 140V
	Continuous Output Current		2A	3A	6A	9A
	Peak Output Current		5A	6A	14A	21A
	Output Current Limit Range		0.2 ~ 5A	0.6 ~ 6A	1.4 ~ 14A	2.1 ~ 21A
	Speed Control Range		1 : 2000 Minimum			
Derating Factor		95% Minimum				
Speed Accuracy		better than ± 0.1% against load variation 0 ~ 100% better than ± 1.5% against temperature variation 0 ~ 50°C better than ± 0.1% against line voltage variation ± 10%				
INPUTS	Speed Command ³⁾ (Position Command)	SPD-CMD	Rated command voltage : ± 6V referring to rated speed Command voltage range : 0 ~ ± 10V Input impedance : 10K			Fig. 1
	Position Feedback	POS-FBK	Voltage range : 0 ~ ± 10V Input impedance : 10K			
	Speed Feedback	TG	Tach-Generator 3 ~ 7V / 1000 rpm, input impedance: 10k			Fig. 2
	Enable	ENABLE	When on, motor activated			Fig. 3
	Alarm Reset	ALM-RST	After a fault, unit may be reset by input to this line.			Fig. 4
ExtDI Current Limit	CUR-LMT	Input to this line limits motor current to internally preset value.				
PROTECTIVE AND SAFETY FUNCTIONS	Torque hold	TRQ-HLD	Internal gain reduced by 10 db.			
	Over-Speed Stop	OVR-SPD	Prevents motor uncontrolled run.			
	Over-Load Stop	OVR-LOAD	Protects motor from thermal damage.			
	Over-Heat Stop	OVR-HEAT	Protects power amplifier from thermal damage.			
	Over-Current Stop	OVR-CUR	Protects power amplifier from thermal damage.			
	Power Fault Stop	PWR-FLT	Stops motor in case of power failure.			
	Fuse Protection		Fuse Protection in case of internal short circuit.			
Over BEMF Stop	OVR-REG	Prevents control unit from thermal damage.				
Regenerative Energy Absorption ⁴⁾		Absorption by capacitor	Absorption by capacitor and resistors			
OUTPUTS	Alarm	ALARM	Alarm output indicates protective functions working.			Fig. 5
AUX. POWER SUPPLY	For Speed Command		DC ± 12V 25mA max. (100 internal resistance)			
FRONT PANEL INDICATORS	Power Supply	POWER (Gr.)	Green light indicates power on.			
	Enable	ENABLE (Gr.)	Green light indicates enable input signal.			
	Power Fault	PWR-FLT(Red)	Red light indicates faulty power.			
	Over-Speed	OVR-SPD	Red light indicates over speed stop function.			
	Over-Load	OVR-LOAD	Red light indicates over-load stop function.			
	Over-Heat	OVR-LOAD	Red light indicates over-load stop function.			
FRONT PANEL ADJUSTMENT	Over-Current	OVR-CUR	Red light indicates over-current stop function.			
	Over-BEMF	OVR-REG	Red light indicates over-BEMF stop function.			
	Offset	OFFSET	Speed offset adjustment.			
	Loop Gain	LP-Gain	Speed adjustment or position loop gain adjustment.			
MONITOR TERMINALS	Current Limit	CUR-LMT	Motor current limit setting.			
	Minor Loop Gain	ML-GAIN	Speed loop gain adjustment.			
	Tach Voltage	T. G.	Terminal for monitoring tach feedback voltage.			
OTHERS	Motor Current	CUR	Terminal for monitoring motor current.			
	Environment		Operating Temperature: 0 ~ 50 °C Humidity: Max. 95% relative, non-condensing Vibration: Max. 1 g (10 ~ 55Hz) Shock: max. 10 g (11 ms)			
	Insulation Resistance		100 M Min. (DC 500V)			
	Dielectric Strength		AC 500 V 1 minute 50/60 Hz			
	Weight		1.2 kg	1.7 kg	1.7 kg	3.0 kg
HS 250 Series Specifications		HS-250-2	HS-250-3	HS-250-6	HS-250-9	

Please note:

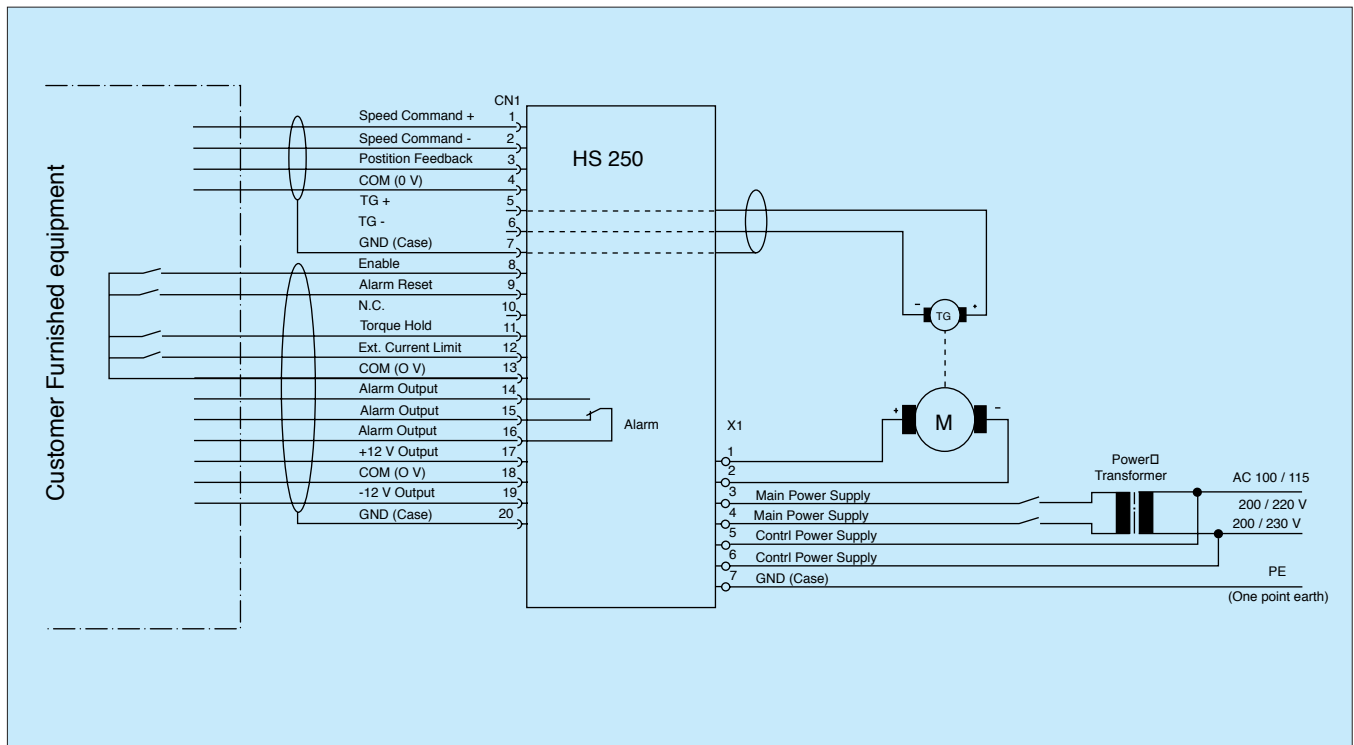
¹⁾ Main Power supply is 38 ~ 60V for RH-8D, RH-11D and RH-14D, and 85 ~ 115V for RHS / RFS 20, RHS / RFS 25, and 85 ~ 130V for RHS / RFS-32 actuators.

²⁾ Select a power transformer with secondary voltage suitable for the actuator. See selection guide, page 5.

³⁾ In analog positioning systems potentiometer outputs are connected to these terminals.

⁴⁾ An external absorption unit is available on request.

System Wiring Diagram



Please note:

GND (CASE) terminal is internally connected with the casing and is open with other terminals.

Connectors and Terminals

Input / Output Connector

Pin No.	Signal
1	SPD-CMD
2	COM (0V)
3	POS-FBK
4	COM (0V)
5	TG +
6	TG -
7	GND (CASE)
8	ENABLE
9	ALM-RST
10	NC
11	TRQ-HLD
12	CUR-LMT
13	COM (0V)
14	ALARM (a)
15	ALARM (b)
16	ALARM (c)
17	+ 12V
18	COM (0V)
19	- 12V
20	GND (CASE)

Table 31

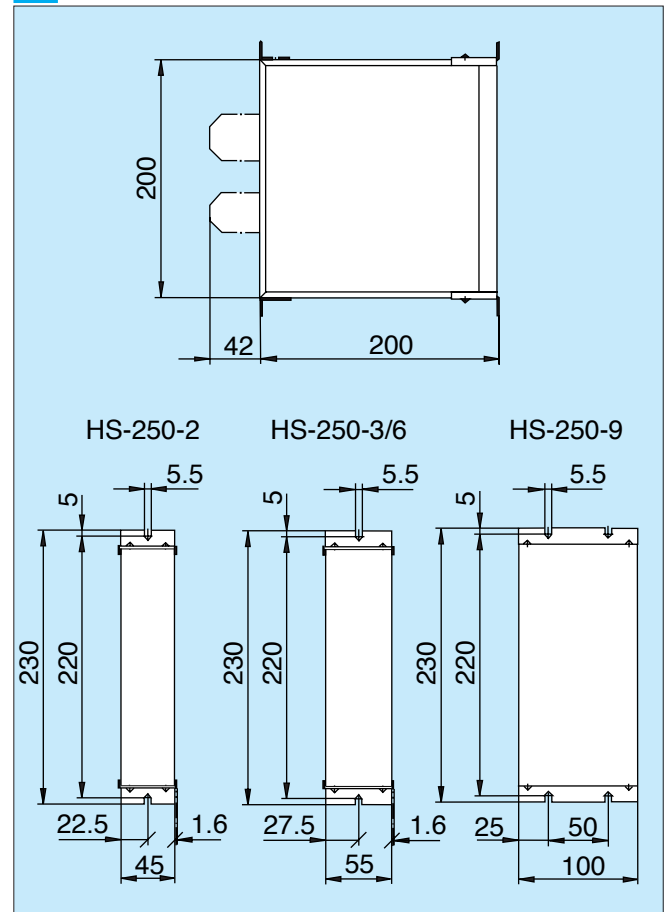
Terminals

Terminal	Signal
1	M+ (Motor)
2	M- (Motor)
3	Main Circuit Power
4	Main Circuit Power
5	Control Power
6	Control Power
7	GND (CASE)

Table 32

Outline and Dimensions

mm



Digital Control Units

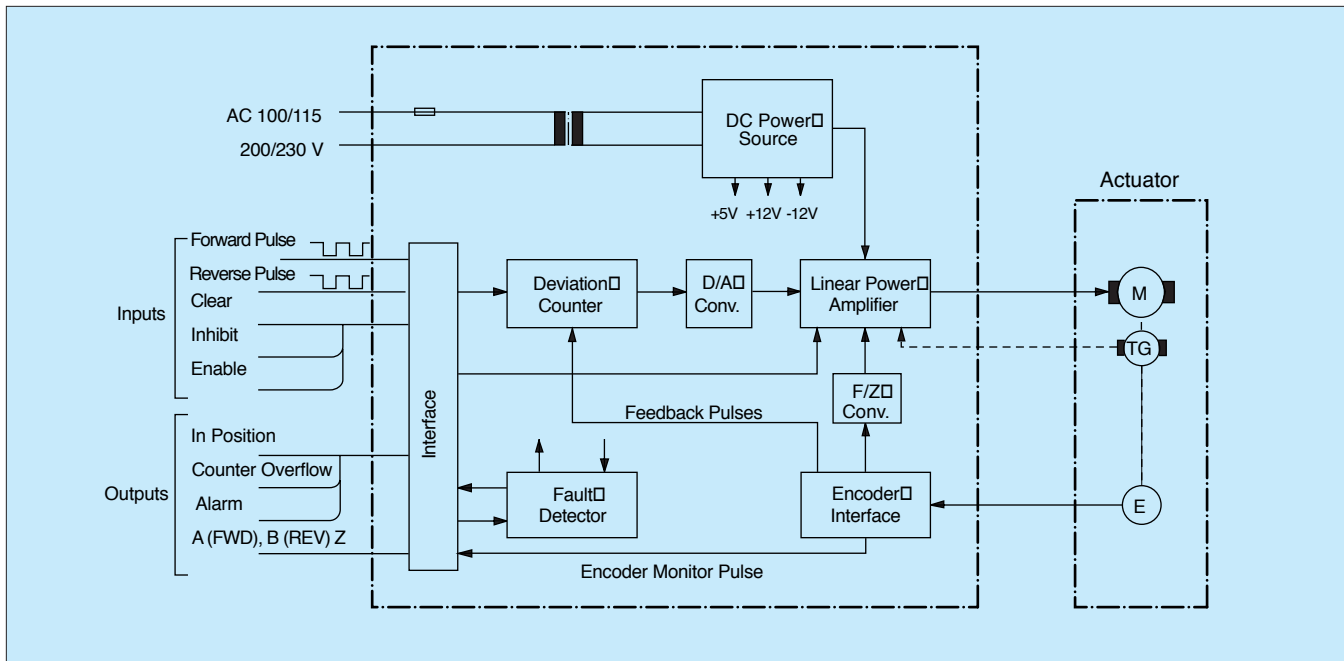
HS-330-05

HS-330-05 is a new digital DC servo control unit designed for speed and position control of RH-5A mini series actuators and other small DC servo motors. It includes many new techniques in its design, such as a command counter, a linear power amplifier circuit, and a F/V converter.

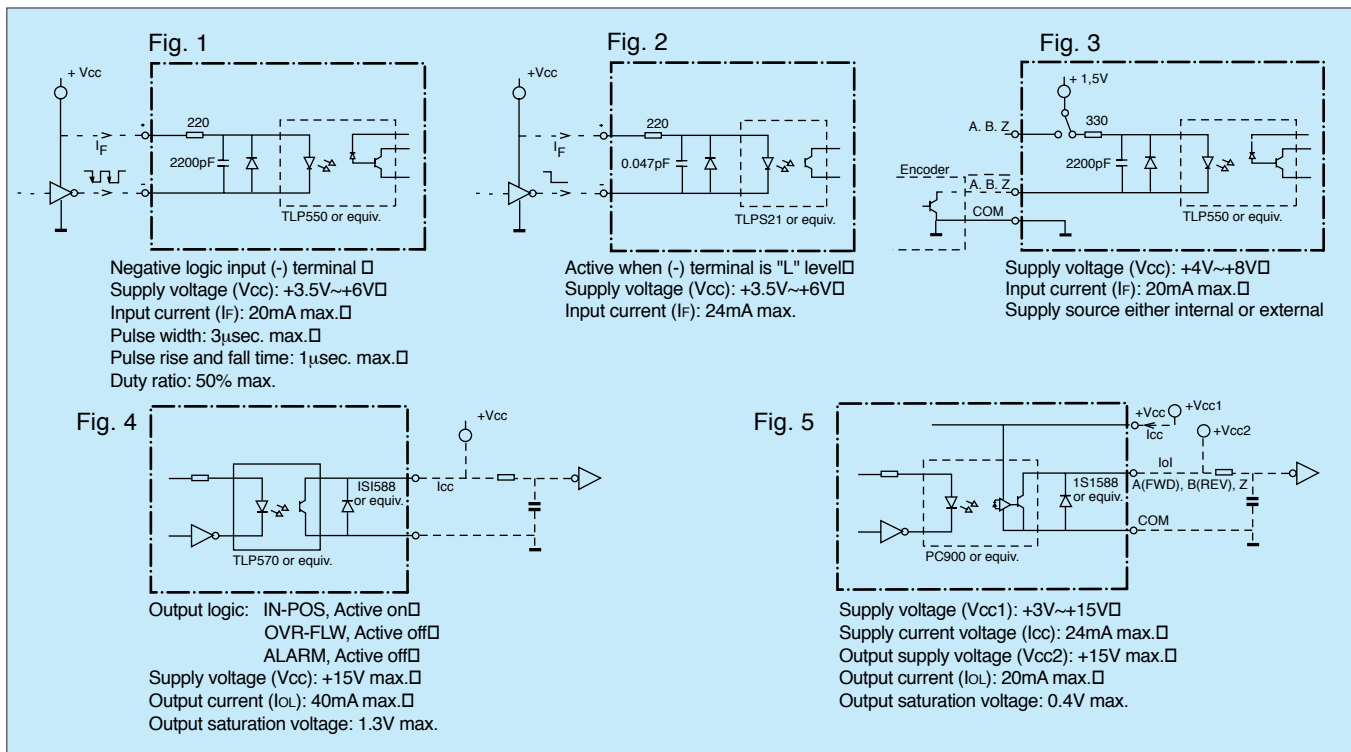
Features:

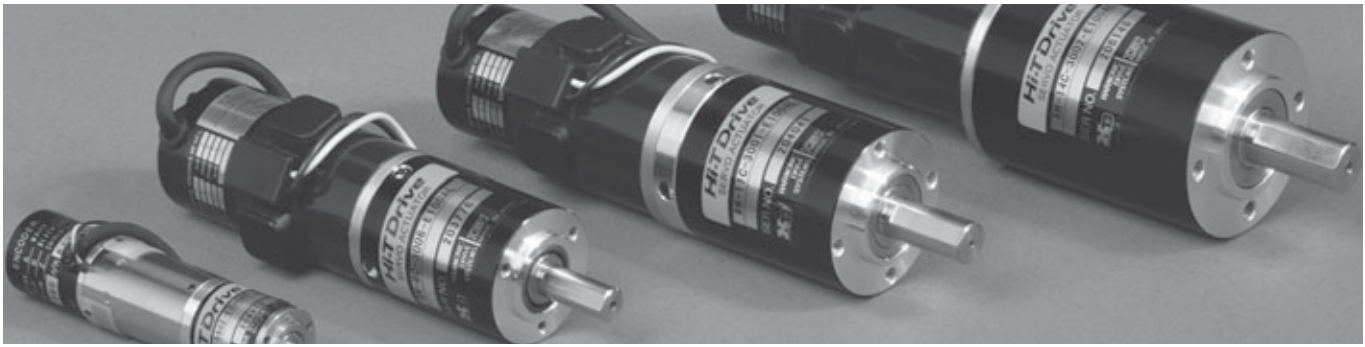
- ◆ Hybrid circuits make the control unit compact and deliver reliable performance.
- ◆ Linear power amplifier assures noise-free motor drive.
- ◆ Motor speed and position controlled by encoder pulse signal feedback to the deviation counter.
- ◆ Unit responds to pulse signal up to 100 kHz.

Block Diagram



Interfaces



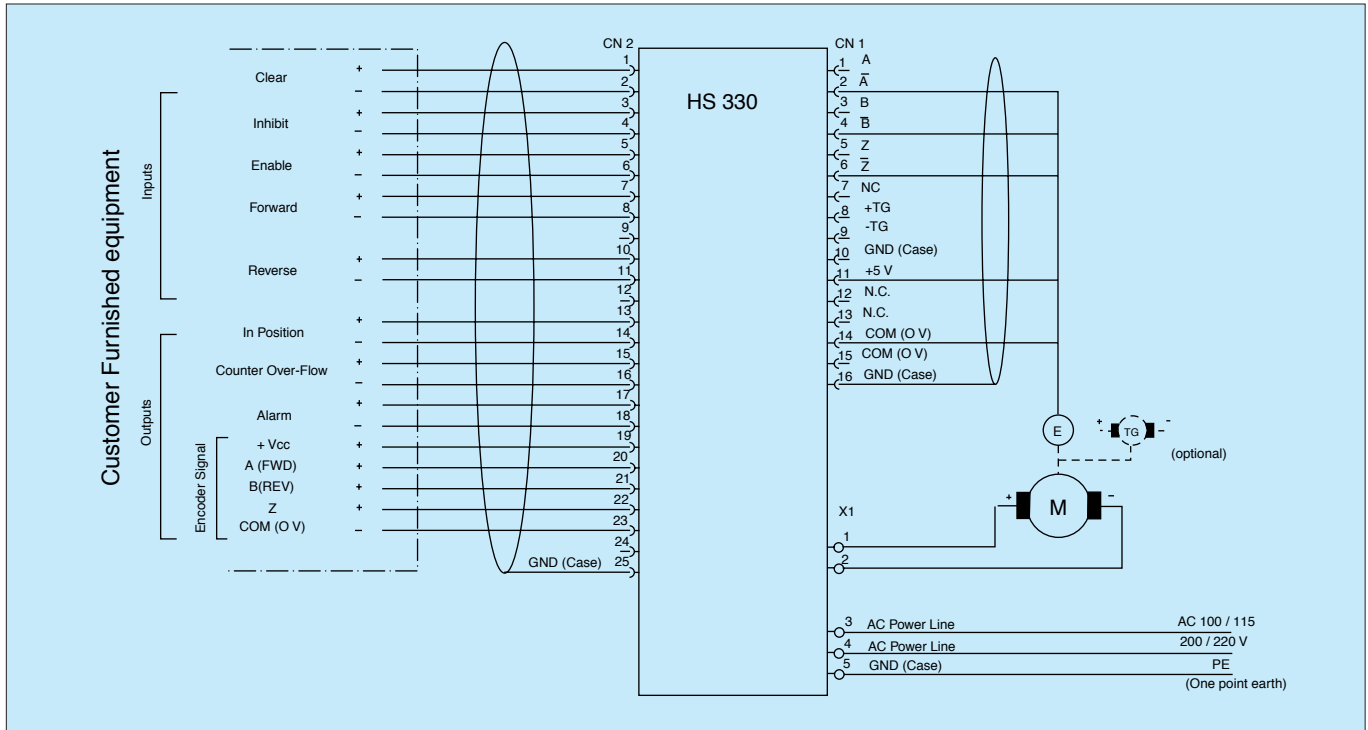


Specifications

Table 33

HS 330-05 Specifications				Interface
MAIN SPECIFICATIONS	Appropriate Actuator		RH-5A	
	Power Supply		User selection AC 100/115/200/230V \pm 10% 50/60 Hz 25VA Single phase, full wave rectification transistor linear amplifier drive Rated Output Power : 6W Max. output voltage : \pm 18V Continuous output current : 0.5A Peak output current : 1.5A Output current limit range : 0 ~ 1.5A	
	Motor Control		100 kHz.	
INPUTS	Max. Response Freq.		\pm 1 pulse of encoder	Fig. 1
	Positioning Accuracy		\pm 1 pulse of encoder	
	Forward Pulse	FORWARD	Pulse signal to drive motor clockwise.	Fig. 2
	Reverse Pulse	REVERSE	Pulse signal to drive motor counter-clockwise.	
	Enable	ENABLE	When on, motor activated.	Fig. 3
	Inhibit	INHIBIT	When on, pulse input cut out. Motor locked.	
Clear	CLEAR	When on, deviation counter cleared.	Fig. 4	
Encoder Feedback	A. B. Z.	Photo-Coupler input A. B. Z. signals		
PROTECTIVE AND SAFETY FUNCTIONS	Over-Flow Stop	OVR-FLW	When accumulated pulse in deviation counter exceeds 6144 pulses, motor stops.	
	Over-Speed Stop	OVR-SPD	Prevents motor from uncontrolled run.	
	Over-Load Stop	OVR-Load	Protects motor from thermal damage.	
	Over-Heat Stop	OVR-HEAT	Protects power amplifier from thermal damage.	
	Over-Current Stop	OVR-CUR	Protects power amplifier from thermal damage.	
	Power Fault	PWR-FLT	Stops motor in case of power failure.	
Other		Fuse in AC line, main circuit cut-off relay.		
OUTPUTS	In Position	IN-POS	Deviation pulses within preset value.	Fig. 4
	Counter Over-Flow Alarm	OVR-FLW ALARM	Deviation pulses overflowing preset value. Positive logic output when protective functions working.	
	Encoder Monitor	A. B. Z. (FWD. REV. Optional)	Monitors A. B. Z. signals Optionally monitors FORWARD and REVERSE signals.	Fig. 5
AUX. POWER SUPPLY	Encoder Supply	+ 5V	DC + 5V 60mA max.	
FRONT PANEL INDICATORS	Power Supply	POWER (Gr.)	Green light indicates power on.	
	Enable	ENABLE (Gr.)	Green light indicates enable input.	
	Power Fault	PWR-FLT (Red)	Red light indicates faulty power.	
	Over Speed	OVR-SPD (Red)	Red light indicates over-speed stop function.	
	Over-Load	OVR-LOAD (Red)	Red light indicates over-load, over heat and over-current stop function.	
	Over-Heat			
	Over-Current			
FRONT PANEL ADJUSTMENTS	In Position	IN-POS (Gr.)	Green light indicates accumulated pulse within preset value.	
	Over-Flow	OVR-FLW (Red)	Red light indicates an over-flow state.	
	Loop Gain	LP-GAIN	Position loop gain adjustment.	
	Minor Loop Gain	ML-GAIN	Speed loop gain adjustment.	
	F/V Feedback Gain	F/V	Frequency to voltage converter gain adjustment.	
MONITOR TERMINALS	Current Limit	CUR-LMT	Max. motor current setting.	
	Offset	OFFSET	Speed offset adjustment.	
	Position Zone	POS-Zone	In-position zone setting. (0 ~ \pm 15 pulses)	
	Speed Feedback	F/V (or TG)	Terminal for monitoring speed feedback signals (F/V or tach).	
OTHERS	Motor current,	CUR	Terminal for monitoring motor current.	
	Speed command Voltage	SPD-CMD	Terminal for monitoring speed command (D/A signal).	
	Environment		Operating Temperature: 0 ~ 50°C Humidity: Max. 95% relative, non-condensing Vibration: Max. 1 g (10 ~ 55Hz) Shock: max. 10 g (11 ms)	
	Insulation Resistance		100 M Min. (DC 500V)	
	Dielectric Strength		AC 500 V 1 minute 50/60 Hz	
	Weight		1.4 kg	

System Wiring Diagram



Connectors and Terminals

CN-1 Encoder Connector

Pin No.	Signal
1	A
2	\bar{A}
3	B
4	\bar{B}
5	Z
6	\bar{Z}
7	N. C.
8	TG + (Optional)
9	TG - (Optional)
10	GND (CASE)
11	+ 5V
12	N. C.
13	N. C.
14	COM (0V)
15	COM (0V)
16	GND (CASE)

Table 34

CN-2 Signal Input/Output Connector

Pin No.	Signal
1	CLEAR +
2	CLEAR -
3	INHIBIT +
4	INHIBIT -
5	ENABLE +
6	ENABLE -
7	FORWARD +
8	FORWARD -
9	N. C.
10	REVERSE +
11	REVERSE -
12	N. C.
13	IN-POS +
14	IN-POS -
15	OVR-FLW +
16	OVR-FLW -
17	ALARM +
18	ALARM -
19	+ Vcc
20	A (FWD)
21	B (REV)
22	Z
23	(COM 0V)
24	N. C.
25	GND (CASE)

Table 36

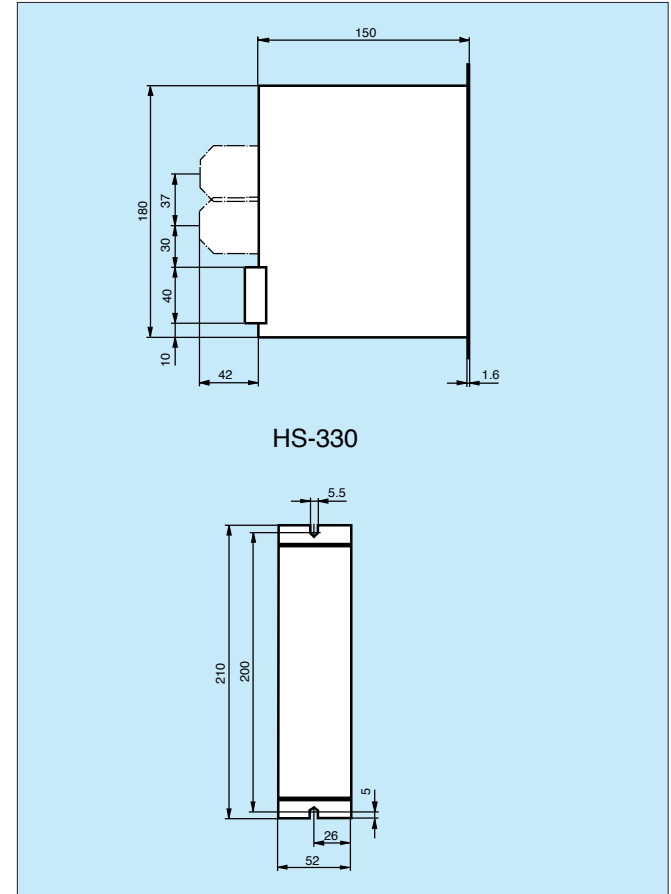
Terminals

Terminal	Signal
1	M+ (Motor)
2	M- (Motor)
3	Power AC
4	100/115/200/230V
5	GND (CASE)

Table 35

Outline and Dimensions

mm



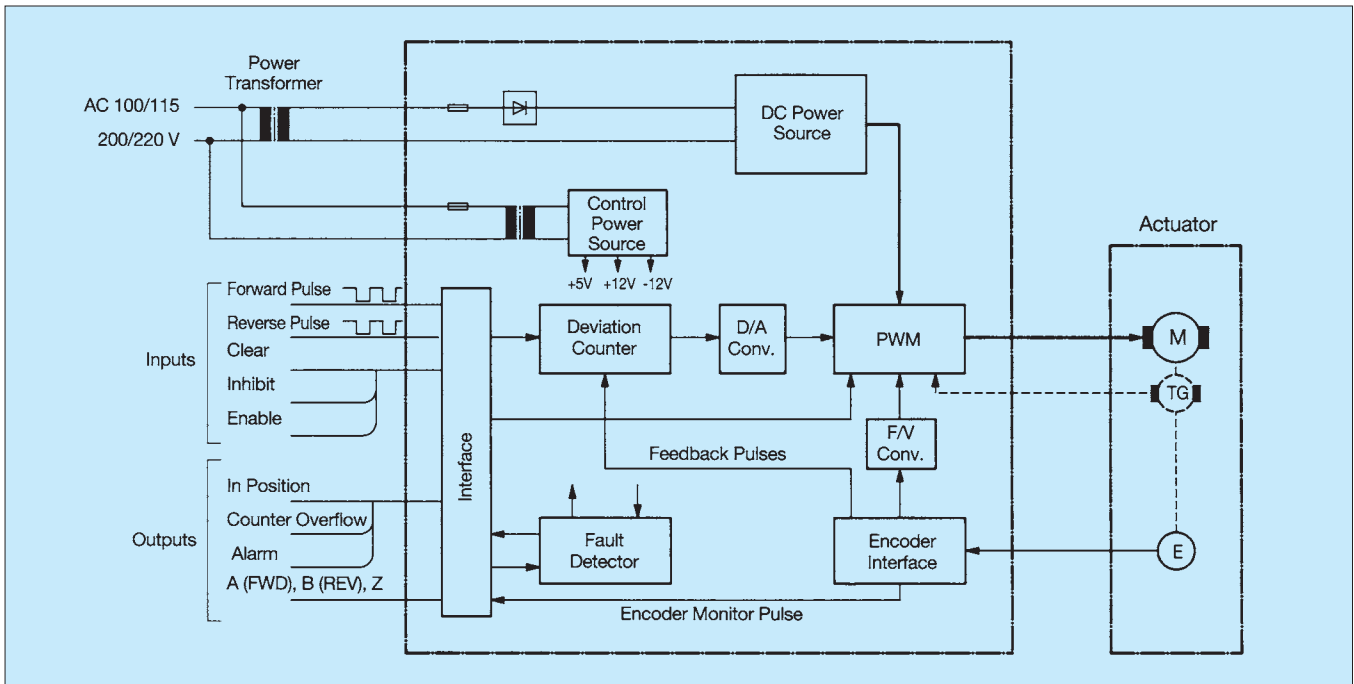
Digital Control Units

HS-350

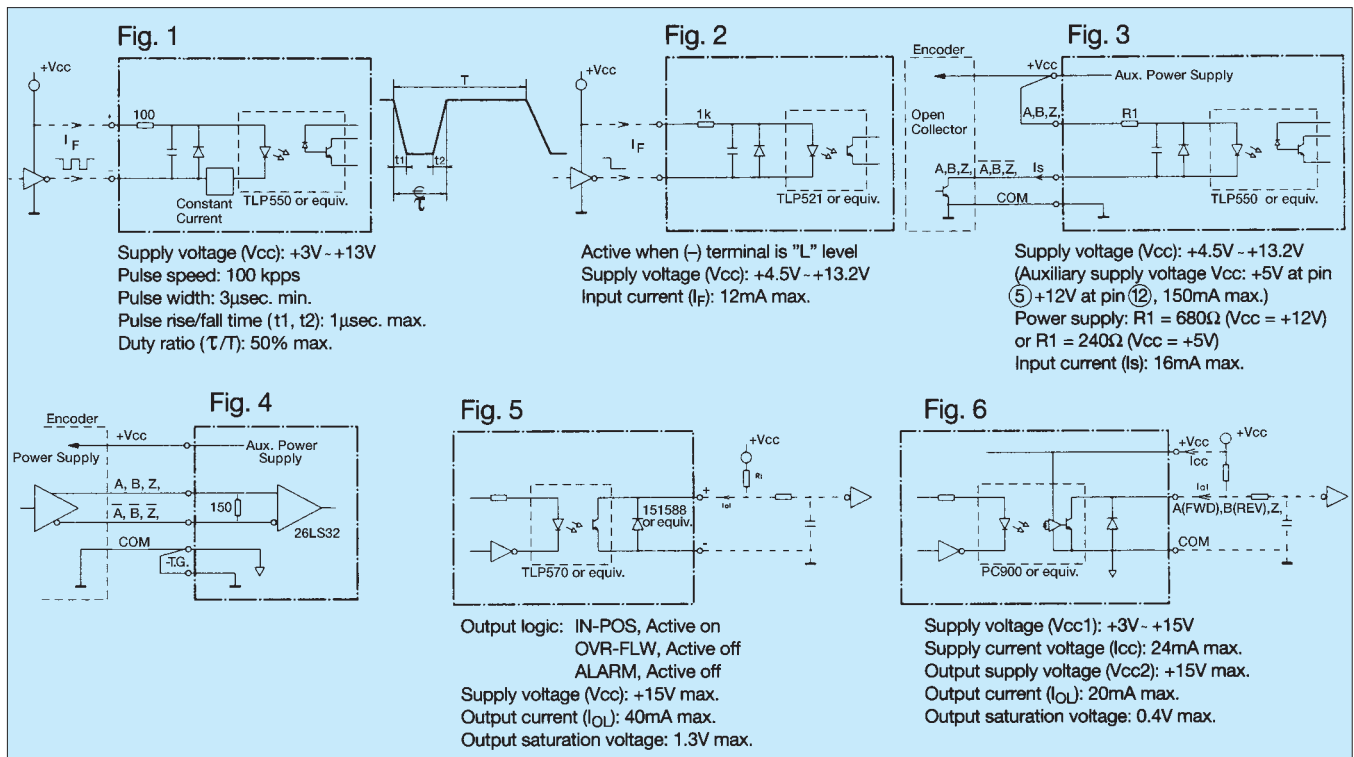
The HS-350 series digital input control units perform position control and speed control in response to a pulse string command input.

- ◆ Circuit includes up/down counter, D/A converter, and PWM servo amplifier.
- ◆ The pulses sent from the incremental encoder, which is directly coupled to the motor, are sent back to the up/down counter.
- ◆ Position and speed of the actuator are controlled in response to a command input.

Block Diagram



Interfaces



HS 350 Series Specifications		HS-350-2	HS-350-3	HS-350-6	HS-350-9	Interface	
MAIN SPECIFICATIONS	Appropriate Actuators	RH-8D, RH-11D, RH-14D	RHS/RFS-20	RHS/RFS-25	RHS/RFS-32		
	Motor Control	Single phase, full wave rectification transistor PWM drive.					
	Control Power Supply	User selection AC 100/115/200/230V ± 10% 50/60 Hz					
	Main Power Supply ¹⁾	AC 60V max.	AC 115V max		AC 130V max.		
	External Power Transformer ²⁾	Primary voltage user selection AC 100/ 115/ 200/ 230V					
	Rated Output Power	48W	225W	450W	765W		
	Maximum Output Voltage	± 44V	± 125V	± 125V	± 140V		
	Continuous Output Current	2A	3A	6A	9A		
	Peak Output Current	5A	6A	14A	21A		
	Output Current Limit Range	0.2 ~ 5A	0.6 ~ 6A	1.4 ~ 14A	2.1 ~ 21A		
	Max. Response Frequency	100 kHz					
	Positioning Accuracy	= 1 pulse of encoder					
INPUTS	Forward Pulse	FORWARD	Pulse signal to drive motor clockwise.			Fig. 1	
	Reverse Pulse	REVERSE	Pulse signal to drive motor counter-clockwise.				
	Enable	ENABLE	When on, motor activates.			Fig. 2	
	Inhibit	INHIBIT	When on, pulse input cut out. Motor locked.				
	Clear	CLEAR	When on, deviation counter cleared.			Fig. 3+4	
	Encoder Feedback	A. B. Z.	Photo-coupler input or line receiver. A. B. and index Z. signals.				
PROTECTIVE AND SAFETY FUNCTIONS	Tach-generator	TG	Feedback from Tach (3~ 7V / 1000 rpm standard) Input impedance: 10k .				
	Over-Flow Stop	OVR-FLW	When accumulated pulses in deviation counter exceeds 6144 pulses, motor stops.				
	Over-Speed Stop	OVR-SPD	Prevents motor uncontrolled run.				
	Over-Load Stop	OVR-LOAD	Protects motor from thermal damage.				
	Over-Heat Stop	OVR-HEAT	Protects power amplifier from thermal damage.				
	Over-Current Stop	OVR-CUR	Protects power amplifier from thermal damage.				
	Power Fault Stop	PWR-FLT	Stops motor in case of power failure.				
	Fuse Protection		Fuse Protection in case of internal short circuit.				
OVER BEMF Stop	OVR-REG	Prevents control unit from thermal damage.					
	Regenerative Energy Absorption ⁴⁾		Absorption by capacitor	Absorption by capacitor and resistors			
OUTPUTS	In Position	IN-POS	Negative logic output when deviation pulses within preset value.			Fig. 5	
	Counter Over-Flow	OVR-FLW	Positive logic output when counter overflows.				
	Alarm	ALARM	Positive logic output when protective functions working.			Fig. 6	
	Encoder Monitor	A. B. Z.	Encoder monitor signals A. B. Z. (optional monitors FORWARD and REVERSE signals)				
AUX. POWER SUPPLY	Encoder Supply	+ 5V	DC + 5V = 5% 160mA				
		+ 12V	DC + 12V = 5% 160mA				
FRONT PANEL INDICATORS	Power Supply	POWER (Gr.)	Green light indicates power on.				
	Enable	ENABLE (Gr.)	Green light indicates enable input signal.				
	Power Fault	PWR-FLT(Red)	Red light indicates faulty power.				
	Over-Speed	OVR-SPD	Red light indicates over speed stop function.				
	Over-Load	OVR-LOAD	Red light indicates over-load stop function.				
	Over-Heat	OVR-LOAD	Red light indicates over-load stop function.				
	Over-Current	OVR-CUR	Red light indicates over-current stop function.				
	Over-BEMF	OVR-REG	Red light indicates over-BEMF stop function.				
FRONT PANEL ADJUSTMENTS	In Position	In-POS	Green light indicates accumulated pulse within preset value.				
	Over-Flow	OVR-FLW	Red light indicates over-flow state.				
	Loop Gain	LP-Gain	Position loop gain adjustment.				
	Minor Loop Gain	ML-GAIN	Speed loop gain adjustment.				
	F/V Feedback Gain	F/V	Frequency to voltage converter gain adjustment.				
	Current Limit	CUR-LMT	Motor max. current setting.				
	Offset	OFFSET	Speed offset adjustment.				
	Position Zone	POS-ZONE	In-position zone setting. (0~ 15 pulses)				
MONITOR TERMINALS	Speed Feedback	F/V (or TG)	Terminal for monitoring speed feedback signals (F/V or tach voltage).				
	Motor Current	CUR	Terminal for monitoring motor current.				
	Speed Command Voltage	TG	Terminal for monitoring speed command (D/A signal).				
OTHERS	Environment	Operating Temperature: 0 ~ 50°C					
		Humidity: Max. 95% relative, non-condensing					
		Vibration: Max. 1 g (10 ~ 55Hz)					
		Shock: max. 10 g (11 ms)					
	Insulation Resistance	100 M (DC 500V)					
Dielectric Strength	AC 500V; 1 minute (50/60 Hz)						
Weight	1.6 kg	2.4 kg	2.4 kg	3.5 kg			
HS 350 Series Specifications		HS-350-2	HS-350-3	HS-350-6	HS-350-9		

Please note:

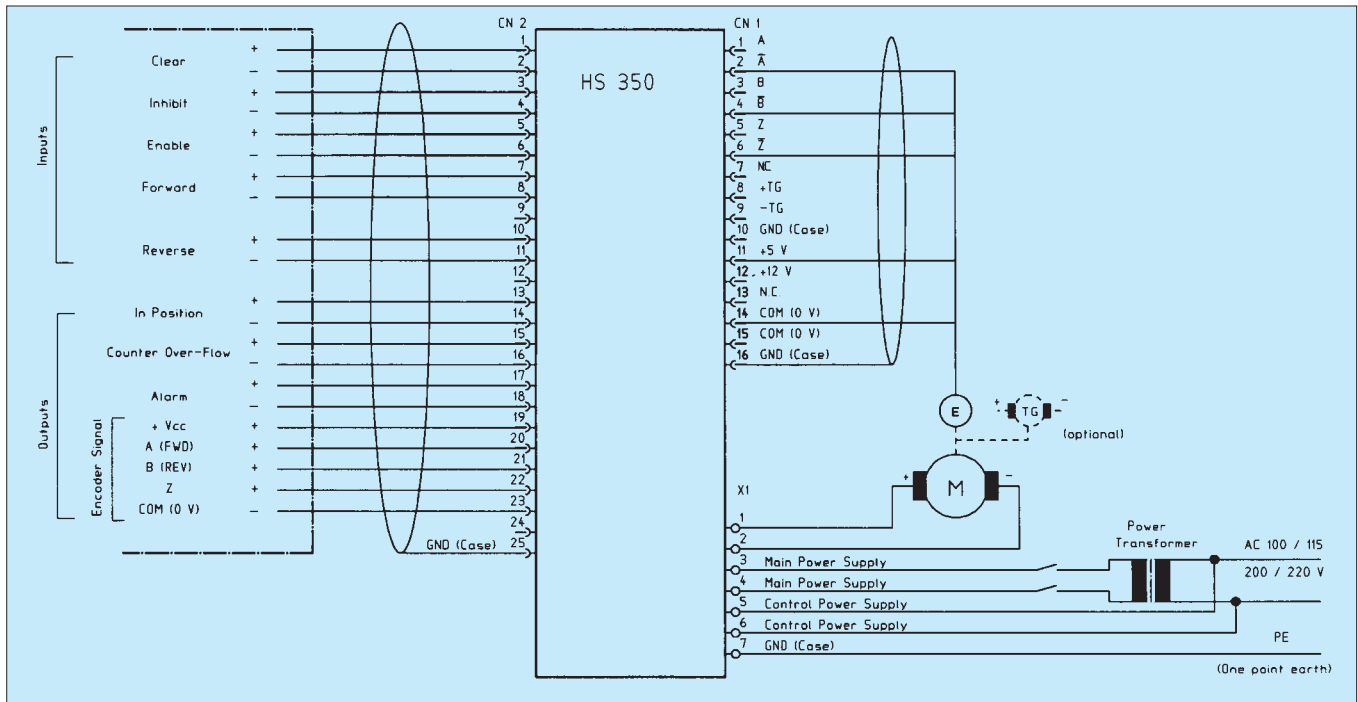
¹⁾ Main Power supply is 38 ~ 60V for RH-8D, RH-11D and RH-14D, and 85 ~ 115V for RHS / RFS 20, RHS / RFS 25, and 85 ~ 130V for RHS / RFS-32 actuators.

²⁾ Select a power transformer with secondary voltage suitable for the actuator. See selection guide, page 5.

³⁾ In analog positioning systems potentiometer outputs are connected to these terminals.

⁴⁾ An external absorption unit is available on request.

System Wiring Diagram



Please note:

- 1) Open collector connection is shown as example, for encoders powered from +12V, connect the encoder power line to pin 12.
- 2) GND (CASE) terminals are internally connected with the casing and open with other terminals.

Connectors and Terminals

CN-1 Encoder Connector

Pin No.	Signal
1	A
2	\bar{A}
3	B
4	\bar{B}
5	Z
6	\bar{Z}
7	N. C.
8	TG + (Optional)
9	TG - (Optional)
10	GND (CASE)
11	+5V
12	+12V
13	N. C.
14	COM (0V)
15	COM (0V)
16	GND (CASE)

Table 38

Terminals

Terminal	Signal
1	M+ (Motor)
2	M- (Motor)
3	Main Circuit Power
4	Main Circuit Power
5	Control Power
6	Control Power
7	GND (CASE)

Table 39

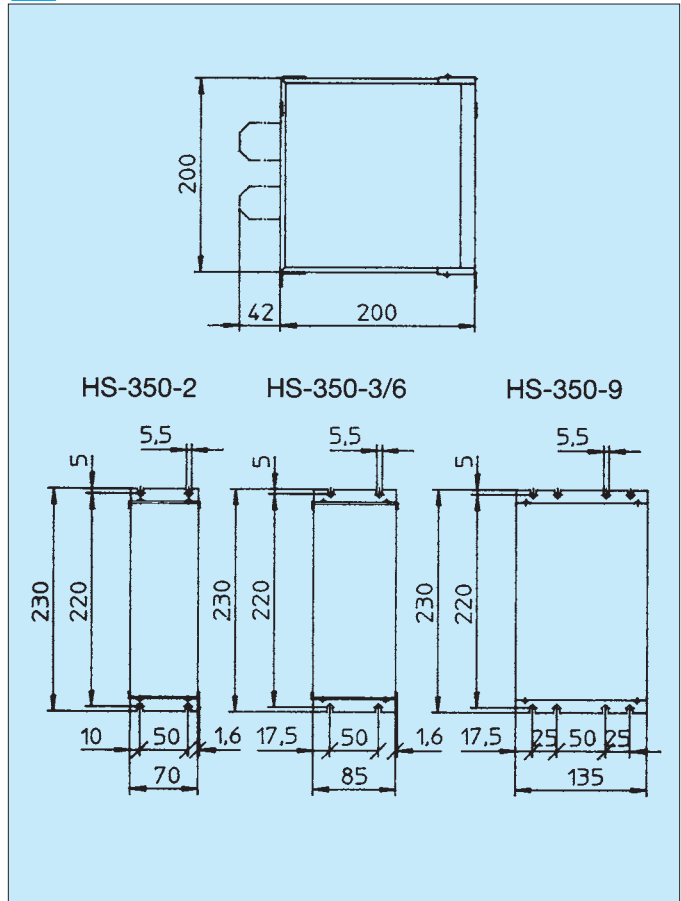
CN-2 Signal Input/Output Connector

Pin No.	Signal
1	CLEAR +
2	CLEAR -
3	INHIBIT +
4	INHIBIT -
5	ENABLE +
6	ENABLE -
7	FORWARD +
8	FORWARD -
9	N. C.
10	REVERSE +
11	REVERSE -
12	N. C.
13	IN-POS +
14	IN-POS -
15	OVR-FLW +
16	OVR-FLW -
17	ALARM +
18	ALARM -
19	+ Vcc
20	A (FWD)
21	B (REV)
22	Z
23	(COM 0V)
24	N. C.
25	GND (CASE)

Table 40

Outline and Dimensions

mm



Intelligent Control Units

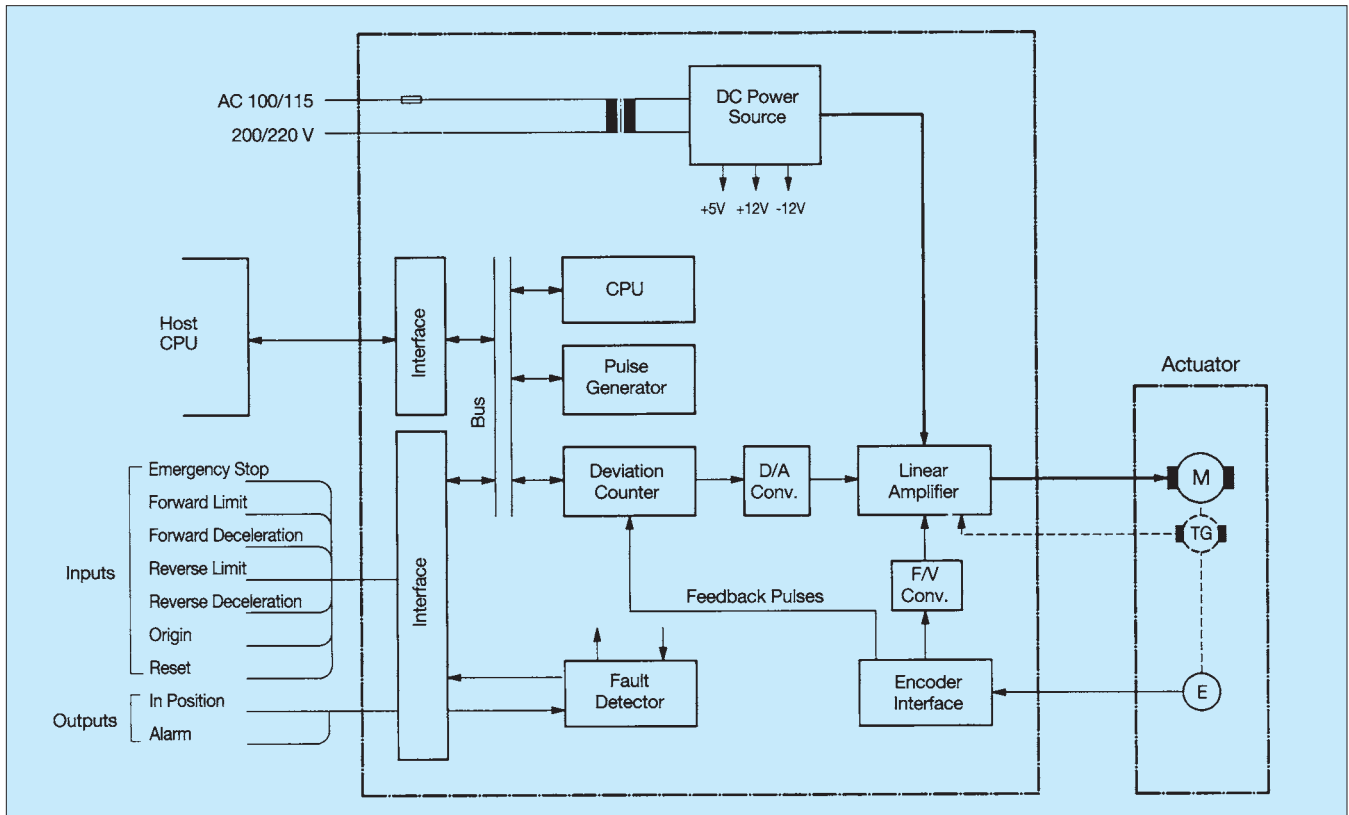
HS 430R-05

The HS-430R-05 DC servo control unit is capable of receiving a wide range of commands from a host computer. These control units incorporate a micro processor and are used for speed and position control of RH-5A mini series actuators and other small DC servo motors.

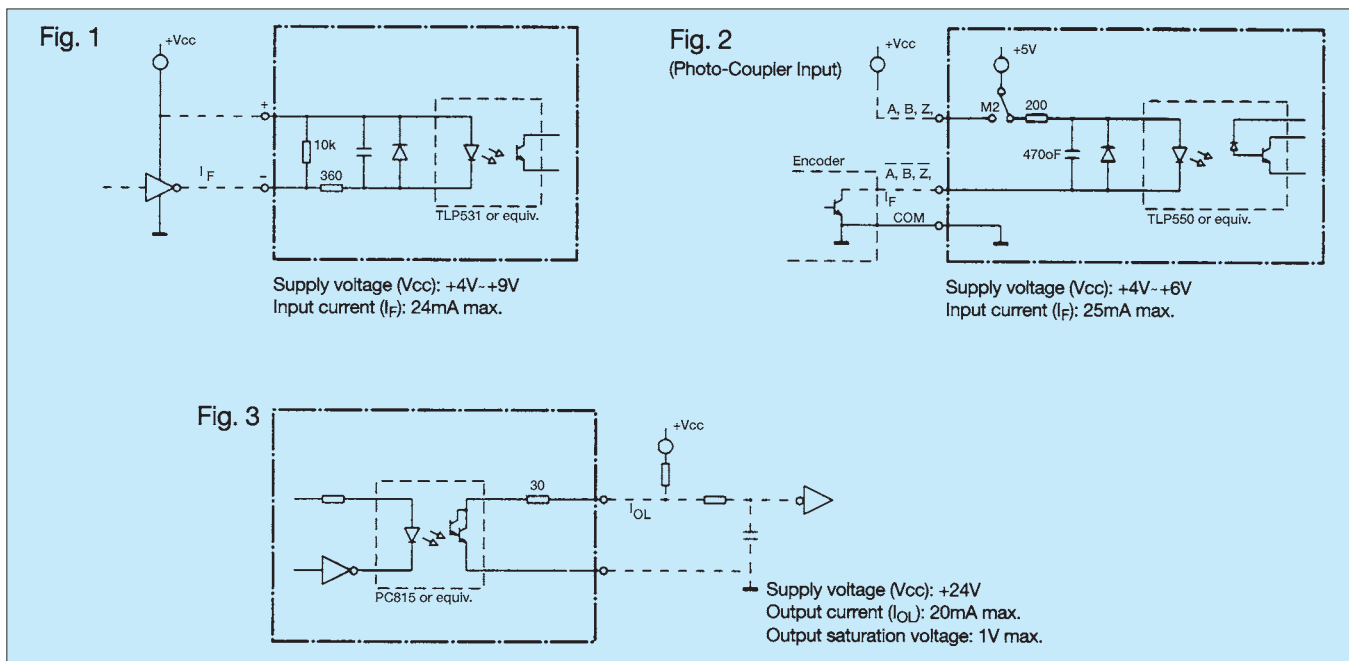
Features:

- ◆ Controller circuitry including a CPU, deviation counter, D/A converter, F/V converter, linear servo amplifier, and RS-232C data communication interface.
- ◆ A wide range of control commands including numerical and functional control can be programmed in the host computer. These commands are communicated through data interfaces.

Block Diagram



Interfaces



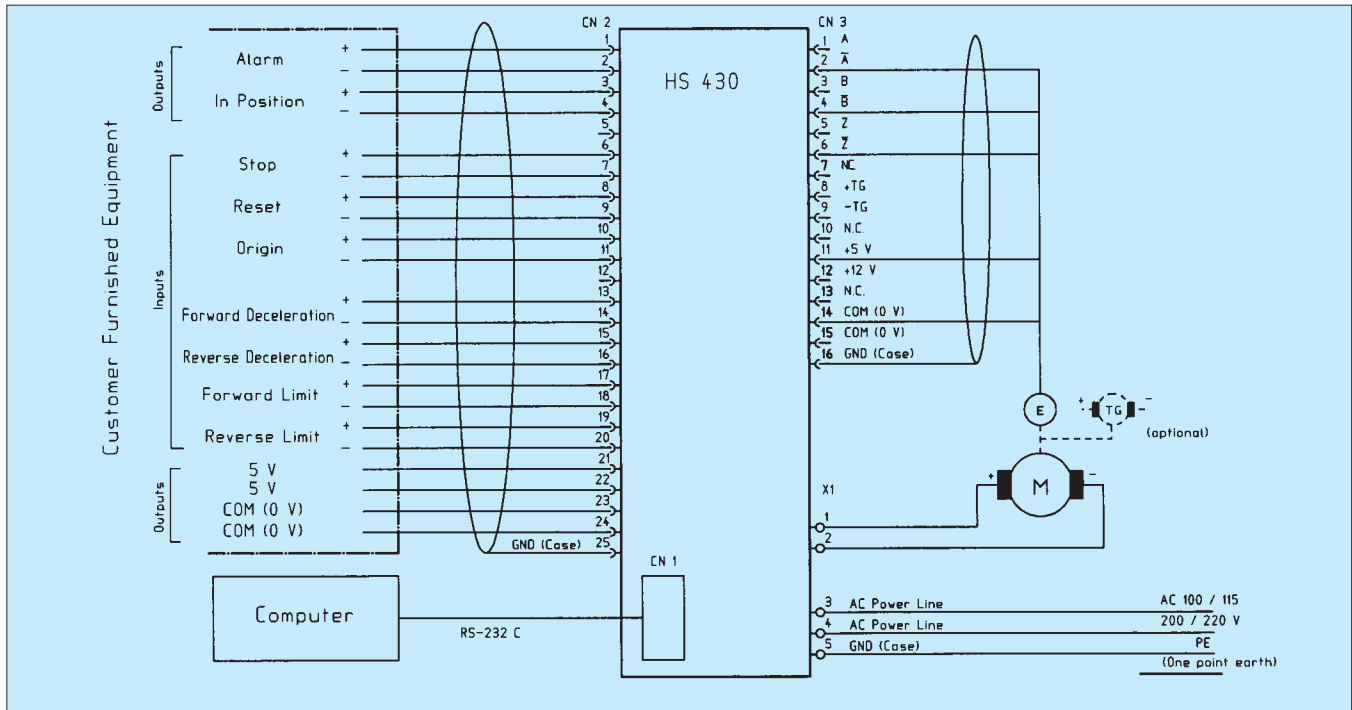


Specifications

Table 41

HS 430 R-05 Specifications				Interface
MAIN SPECIFICATIONS	Appropriate Actuator		RH-5A	Interface
	Power Supply		User selection AC 100/115/200/230V ± 10% 50/60 Hz 35VA	
	Computer Interface		RS-232 C	
	Motor Control		Single phase, full wave rectification transistor linear amplifier drive Rated output power: 6 W / Max. output voltage : ± 18V Continuous output current : 0.5A Peak output current : 1.5A Output current limit range : 0 ~ 1.5A	
	Max. Response Freq.		80 kHz	
INPUTS	Positioning Accuracy		± 1 pulse of encoder	Fig. 1
	Emergency Stop	STOP	Motor emergency stop. Frees motor.	
	Reset	RESET	Internally resets protective functions.	
	Origin	ORG	Origin signal from mechanical origin point.	
	Forward Limit	+ END	+ End command stops motor rotating clockwise.	
	Reverse Limit	- END	- End command stops motor rotating counter-clockwise.	
	Forward Deceleration	+ SDWN	Decelerates motor rotating clockwise.	
PROTECTIVE AND SAFETY FUNCTIONS	Reverse Deceleration	- SDWN	Decelerates motor rotating counter-clockwise.	Fig. 2
	Encoder Feedback	A. B. Z.	A. B. and index Z. Photo-coupler input.	
	Over-Speed Stop	OVR-SPD	Prevents Motor from uncontrolled run.	
	Over-Load Stop	OVR-Load	Protects motor from thermal damage.	
	Over-Heat Stop	OVR-HEAT	Protects power amplifier from thermal damage.	
	Over-Current Stop	OVR-CUR	Protects power amplifier from thermal damage.	
OUTPUTS	Power Fault Stop	PWR-FLT	Stops motor in case of power failure.	Fig. 3
	Other		Power on delay, fuse protection, main circuit cut off delay.	
	In Position	IN-POS	Deviation pulses within preset value.	
AUX. POWER SUPPLY	Alarm	ALARM	Positive logic output when protective functions working.	Fig. 3
	Encoder Supply	+ 5V + 12V	DC + 5V 60mA max. DC + 12V 100mA max.	
FRONT PANEL INDICATORS	Power Supply	POWER (Gr.)	Green light indicates power on.	Fig. 3
	In Position	IN-POS (Gr.)	Green light indicates accumulated pulse within preset value.	
	Alarm	ALARM (Red)	Red light indicates protective functions working or faulty communication with host computer.	
	Over-Load	OVR-LOAD (Red)	Red light indicates over-load, over heat and over-current stop function.	
	Over-Heat			
	Over-Current			
	Over-Speed	OVR-SPD (Red)	Red light indicates over-speed stop function.	
Power Fault	PWR-FLT (Red)	Red light indicates faulty power.		
Enable	ENABLE (Gr.)	Green light indicates enable input.		
FRONT PANEL ADJUSTMENTS	Loop Gain	LP-GAIN	Position loop gain adjustment.	Fig. 3
	Minor Loop Gain	ML-GAIN	Speed loop gain adjustment.	
	Current Limit	CUR-LMT	Max. Motor current setting.	
	Offset	OFFSET	Speed offset adjustment.	
OTHERS	Environment		Operating Temperature: 0 ~ 50°C Humidity: Max. 95% relative, non-condensing Vibration: Max. 1 g (10 ~ 55Hz) Shock: max. 10 g (11ms)	Fig. 3
	Insulation Resistance		100 M Min. (DC 500V)	
	Dielectric Strength		AC 500 V 1 minute 50/60 Hz	
	Weight		3.3 kg	

System Wiring Diagram



Please note:

- 1) Open collector connection is shown as example for encoders powered from + 12V, connect the encoder power line to pin 12.
- 2) GND (CASE) terminals are internally connected with the casing and open with other terminals.

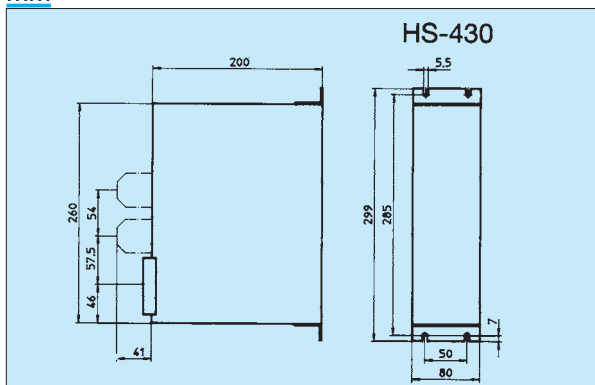
Command Code (ASCII)

Table 42

Instruction	Command	
Request title message	@ (40H)	Request for title message.
Alarm zone setting	A (41H)	Sets the upper limit of accumulated pulse in deviation counter (128 ~ 32640 pulses).
Acceleration/Deceleration	C (43H)	Sets the accelerating and decelerating time rates.
Positioning data setting	D (44H)	Sets the number of pulses corresponding to positioning distance (± 8388607 max.).
Encoder multiplier setting	E (45H)	Sets encoder multiplier at x1, x2, x4.
Max. speed setting	F (46H)	Sets the maximum motor speed (10 ~ 81910 pps).
Start	G (47H)	Starts motor.
Stop	H (48H)	Stops motor.
Accumulated error pulse	J (4AH)	Request for information on accumulated deviation pulse.
Stepping	K (4BH)	Motor rotates by 1 pulse increment.
Servo amplifier enable	M (4DH)	On-off switching of servo amplifier.
Slow speed setting	N (4EH)	Sets the speed at motor start, slowdown and stop.
Constant speed setting	O (4FH)	Sets the constant speed for motor continuous rotation.
Position zone setting	P (50H)	Sets the In-Position signal output range.
Present position	Q (51H)	Request for total number of command pulse.
Reset	R (52H)	Internal reset.
Present value setting	S (53H)	Sets the present value (0 ~ 8388607 pulses).
Return to origin	Z (5AH)	Return to origin.

Outline and Dimensions

mm



Intelligent Control Units

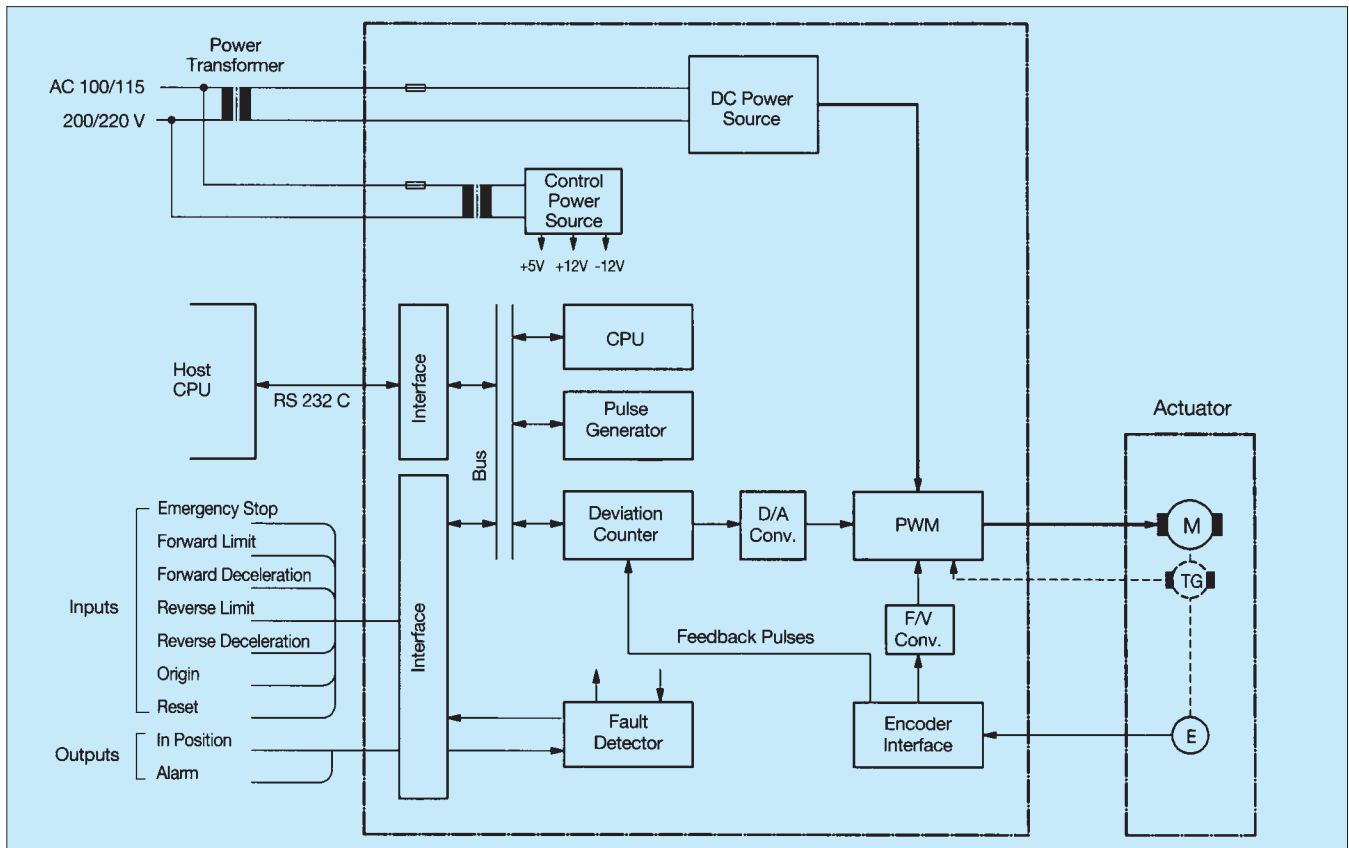
HS-450R

HS-450 series of DC servo control units are capable of receiving a wide range of command data from a host computer. The control units incorporate a micro processor and are used for speed and position control of harmonic drive actuators and other DC motors.

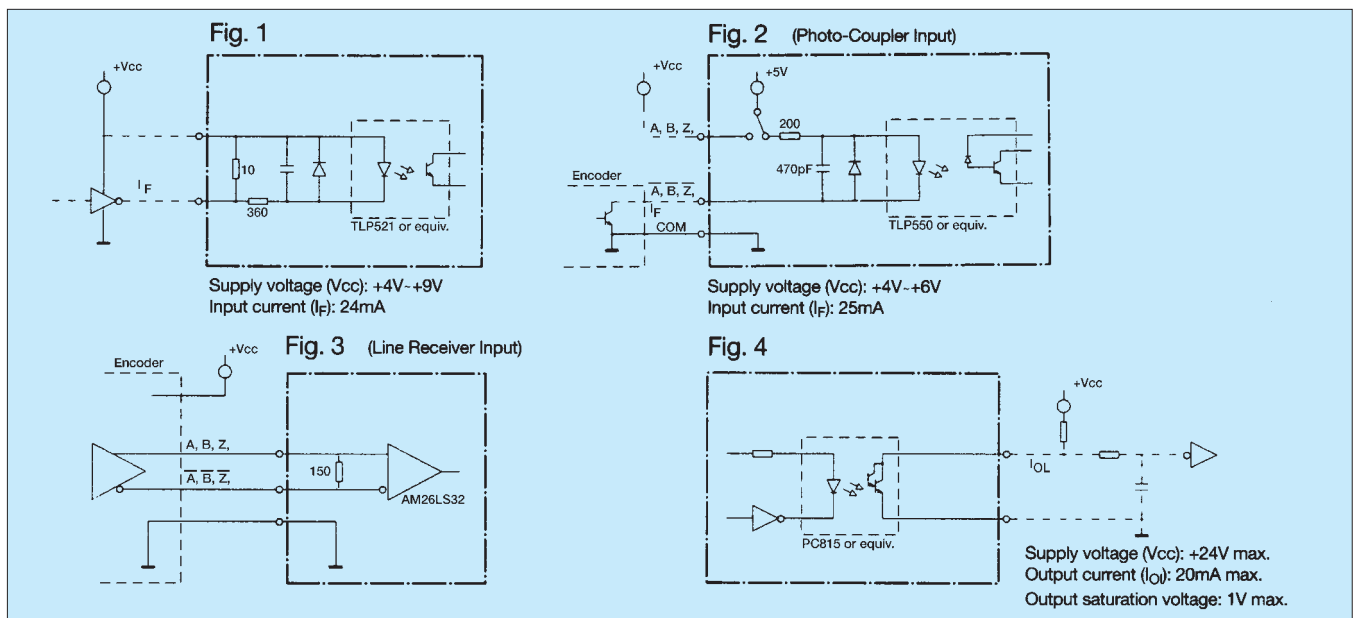
Features:

- ◆ Controller circuitry includes a CPU, deviation counter, D/A converter, F/V converter, PWM amplifier, and an RS-232C data communication interface.
- ◆ A wide range of control commands including numerical and functional control can be programmed in the host computer. These commands are communicated through data interfaces.

Block Diagram



Interfaces



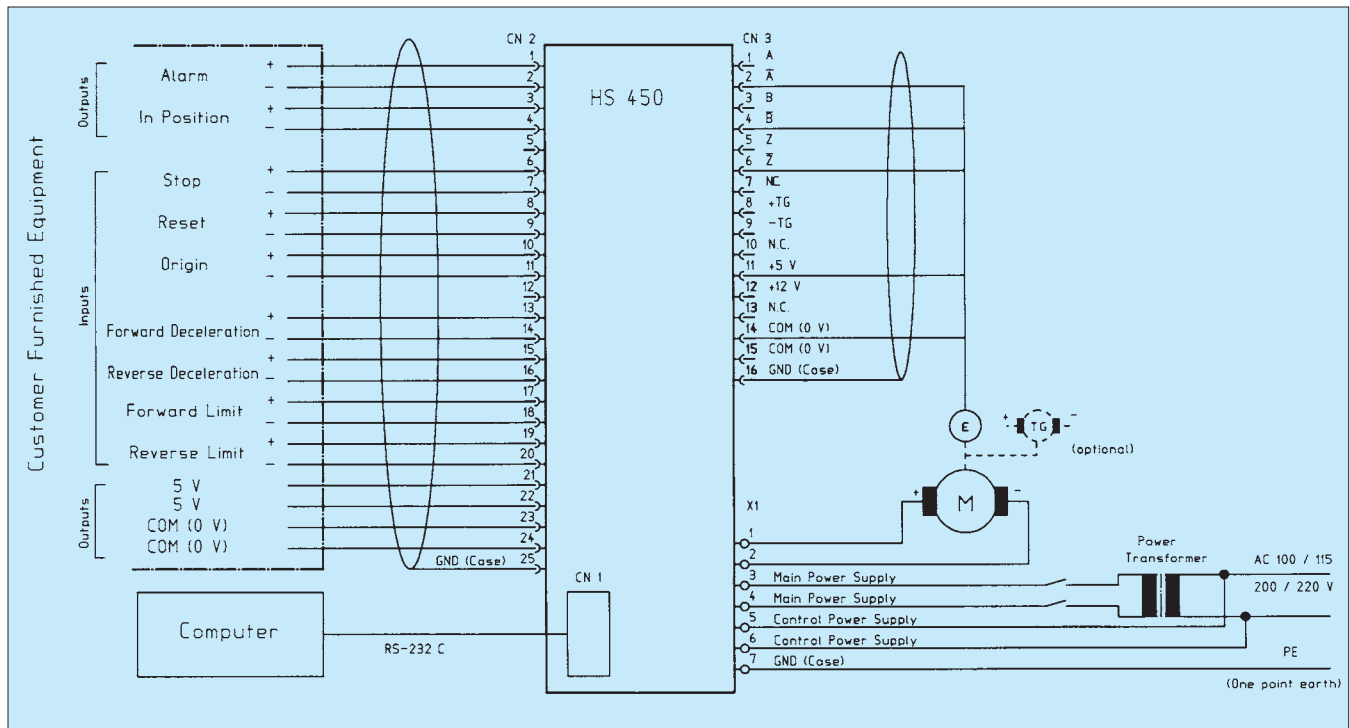
HS 450 Series Specifications		HS-450-2	HS-450-3	HS-450-6	HS-450-9	Interface	
MAIN SPECIFICATIONS	Appropriate Actuators	RH-8D, RH-11D, RH-14D	RHS/RFS-20	RHS/RFS-25	RHS/RFS-32		
	Control Power Supply	User selection AC 100/115/200/230V ± 10% 50/60 Hz					
	Main Power Supply ¹⁾	AC 60V max.	AC 115V max		AC 130V max.		
	Computer Interface	RS-232 C					
	Motor Control	Single phase, full wave rectification transistor PWM.					
	External Power Transformer ²⁾	Primary voltage user selection AC 100/ 115/ 200/ 230V					
	Rated Output Power	48W	225W	450W	765W		
	Maximum Output Voltage	± 44V	± 125V	± 125V	± 140V		
	Output Current	2A	3A	6A	9A		
	Limit Range	0.2 ~ 5A	0.6 ~ 6A	1.4 ~ 14A	2.1 ~ 21A		
	Max. Response Frequency	80 kHz					
	Positioning Accuracy	± 1 pulse of encoder					
	INPUTS	Emergency Stop	STOP	Motor emergency stop. Frees Motor			Fig. 1
Reset		RESET	Internally resets protective functions				
Origin		ORG	Origin signal from mechanical origin point.				
Forward Limit		+ END	+ End command stops motor rotating clockwise.				
Reverse Limit		- END	- End command stops motor rotating counter-clockwise.				
Forward Deceleration		+ SDWN	Decelerates motor rotating clockwise.				
Reverse Deceleration		- SDWN	Decelerates motor rotating counter-clockwise.				
Encoder Feedback		A. B. Z.	A. B. and index Z. Photo-coupler input or line receiver.				
PROTECTIVE AND SAFETY FUNCTIONS	Over-Flow Stop	OVR-FLW	Stops motor when accumulated pulses in deviation counter exceeds the upper limit of alarm zone.			Fig. 2+3	
	Over-Speed Stop	OVR-SPD	Prevents Motor from uncontrolled run.				
	Over-Load Stop	OVR-Load	Protects motor from thermal damage.				
	Over-Heat Stop	OVR-HEAT	Protects power amplifier from thermal damage.				
	Over-Current Stop	OVR-CUR	Protects power amplifier from thermal damage.				
	OVER-BEMF STOP	OVR-REG	Prevents control unit from thermal damage.				
	Power Fault Stop	PWR-FLT	Stops motor in case of power failure.				
	Others	Power on delay, fuse protection, main power circuit cut off relay.					
OUTPUTS	Regenerative Energy Absorption ⁴⁾	Absorption by capacitor		Absorption by capacitor and resistors		Fig. 4	
	In Position Alarm	IN-POS ALARM	Negative logic output when accumulated pulses within preset value. Positive logic output when protective functions working or faulty communication with host computer.				
AUX. POWER SUPPLY	Encoder Supply	+ 5V + 12V	DC + 5V = 5% 160mA DC + 12V = 5% 160mA				
FRONT PANEL INDICATORS	Power Supply	POWER (Gr.)	Green light indicates power on.				
	In Position	IN-POS (Gr.)	Green light indicates protective function working or faulty communication with host computer.				
	Alarm	ALARM (Red)	Red light indicates abnormal regenerative voltage stop function.				
	Over-BEMF	OVR-REG (Red)	Red light indicates abnormal regenerative voltage stop function.				
	Over-Current	OVR-CUR (Red)	Red light indicates over-current stop function.				
	Over-Load	OVR-LOAD (Red)	Red light indicates over-load function.				
	Over-Speed	OVR-SPD (Red)	Red light indicates over speed function.				
	Power Fault	PWR-FLT(Red)	Red light indicates faulty power.				
MONITOR TERMINALS	Enable	ENABLE (Gr.)	Green light indicates enable input.				
	Loop Gain	LP-Gain	Position loop gain adjustment.				
	Minor Loop Gain	ML-GAIN	Speed loop gain adjustment.				
	Current Limit	CUR-LMT	Motor max. current setting.				
	Offset	OFFSET	Speed offset adjustment.				
OTHERS	Speed Feedback	F/V (or TG)	Terminal for monitoring speed feedback signals (F/V or tach voltage).				
	Motor Current	CUR	Terminal for monitoring motor current.				
OTHERS	Environment	Operating Temperature: 0 ~ 50°C Humidity: Max. 95% relative, non-condensing Vibration: Max. 1 g (10 ~ 55Hz) Shock: max. 10 g (11ms)					
	Insulation Resistance	100 M (DC 500V)					
	Dielectric Strength	AC 500V; 1 minute (50/60 Hz)					
	Weight	3.5 kg	4 kg	4 kg	4.7 kg		
	HS 450 Series Specifications	HS-450-2	HS-450-3	HS-450-6	HS-450-9		

Figure 1 to 4 please refer to page 58.

Please note:

- ¹⁾ Main Power supply is 38 ~ 60V for RH-8D, RH-11D and RH-14D, and 85 ~ 115V for RHS / RFS-20, RHS / RFS-25, and 85 ~ 130V for RHS / RFS-32 actuators.
- ²⁾ Select a power transformer with secondary voltage suitable for the actuator. See selection guide, page 5.
- ³⁾ In analog positioning systems potentiometer outputs are connected to these terminals.
- ⁴⁾ An external absorption unit is available on request.

System Wiring Diagram



Please note:

- 1) Open collector connection is shown as example, for encoders powered from + 12V, connect the encoder power line to pin 12.
- 2) GND (CASE) terminals are internally connected with the casing and open with other terminals.

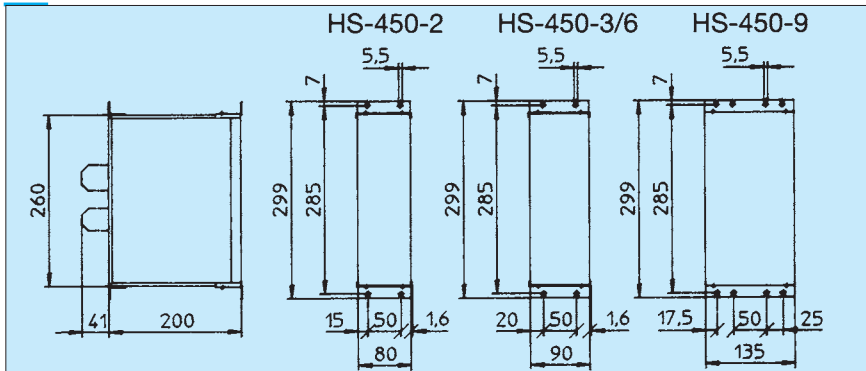
Command Code (ASCII)

Table 44

Instruction	Command	
Request title message	@ (40H)	Request for title message.
Alarm zone setting	A (41H)	Sets the upper limit of accumulated pulse in deviation counter (128 ~ 32640 pulses).
Acceleration/Deceleration	C (43H)	Sets the accelerating and decelerating time rates.
Positioning data setting	D (44H)	Sets the number of pulses corresponding to positioning distance (± 8388607 max.).
Encoder multiplier setting	E (45H)	Sets encoder multiplier at x1, x2, x4.
Max. speed setting	F (46H)	Sets the maximum motor speed (10 ~ 81910 pps).
Start	G (47H)	Starts motor.
Stop	H (48H)	Stops motor.
Accumulated error pulse	J (4AH)	Request for information on accumulated deviation pulse.
Stepping	K (4BH)	Motor rotates by 1 pulse increment.
Servo amplifier enable	M (4DH)	On-off switching of servo amplifier.
Slow speed setting	N (4EH)	Sets the speed at motor start, slowdown and stop.
Constant speed setting	O (4FH)	Sets the constant speed for motor continuous rotation.
Position zone setting	P (50H)	Sets the In-Position signal output range.
Present position	Q (51H)	Request for total number of command pulse.
Reset	R (52H)	Internal reset.
Present value setting	S (53H)	Sets the present value (0 ~ 8388607 pulses).
Return to origin	Z (5AH)	Return to origin.

Outline and Dimensions

mm



Power Transformers Series

Table 45

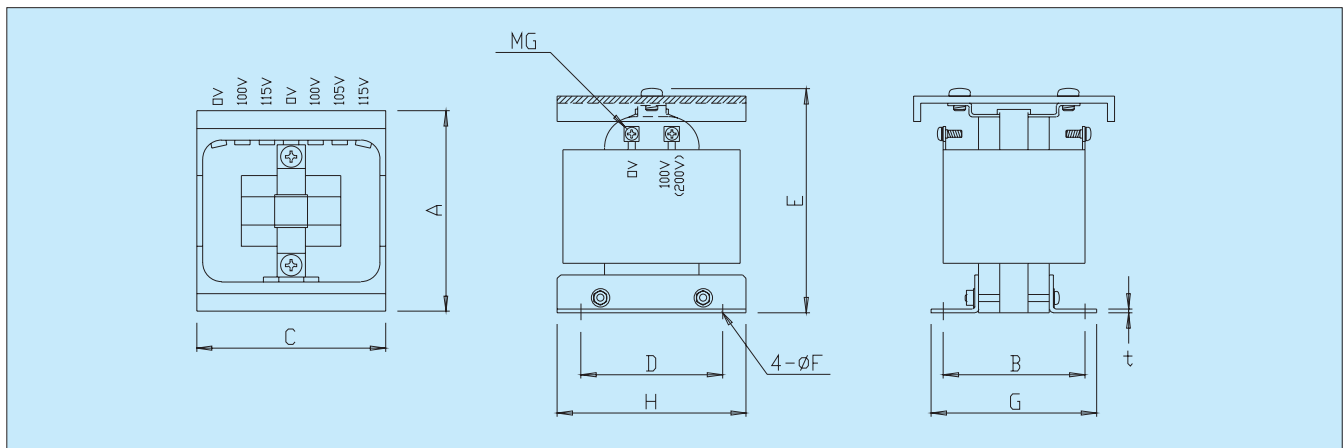
Power Transformer	PT1-03801-***	PT1-03802-***	PT1-03803-***	PT1-10002-***	PT1-10004-**	PT1-10005-**	PT1-10007-**	PT1-11010-**
Rated Output Voltage/Current	38V/1A	38V/2A	38V/3A	100V/2A	100V/4A	100V/5.5A	100V/7A	110V/10A
Rated Input Voltage	AC 100 V / 115 / 200 / 220 V 50 / 60 Hz							
Rated Output	38 VA	76 VA	114 VA	200 VA	400 VA	550 VA	700 VA	1100 VA
Insulation	B							
Insulation Resistance	500M Min. (DC 1000V)							
Dielectric Strength	AC2000V for one minute (50/60Hz)							
Environment	- 10 ~ +55°C							
Protection	Thermal switch incorporated (cutoff temperature: 130°C)							
Weight	0.9kg (2.0lb)	1.5kg (3.3lb)	2.1kg (4.6lb)	3.0kg (6.6lb)	4.4kg (9.7lb)	5.5kg(12.2lb)	7.5kg(17lb)	12kg(27lb)

Dimensions

mm

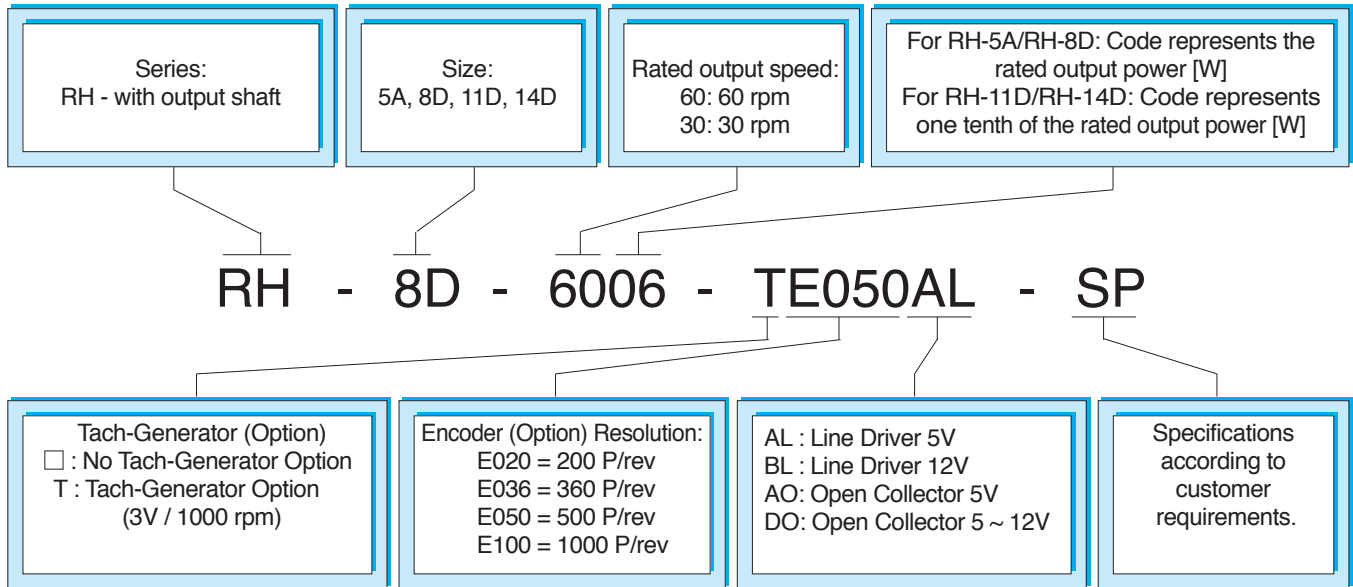
Table 46

Power Transformer	PT1-03801-***	PT1-03802-***	PT1-03803-***	PT1-10002-***	PT1-10004-**	PT1-10005-**	PT1-10007-**	PT1-11010-**
A	85	91	97	105	125	145	145	180
B	60	66	72	60	80	90	96	115
C	80	86	92	100	105	150	150	165
D	70	76	82	80	80	105	120	130
E	95	105	120	140	150	160	160	180
F	4.5	4.5	4.5	5.5	5.5	6.5	6.5	6.5
G	3	3	3	3	4	4	4	4
H	70	76	82	80	95	110	120	135
I	80	86	92	95	95	125	140	150
t	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6

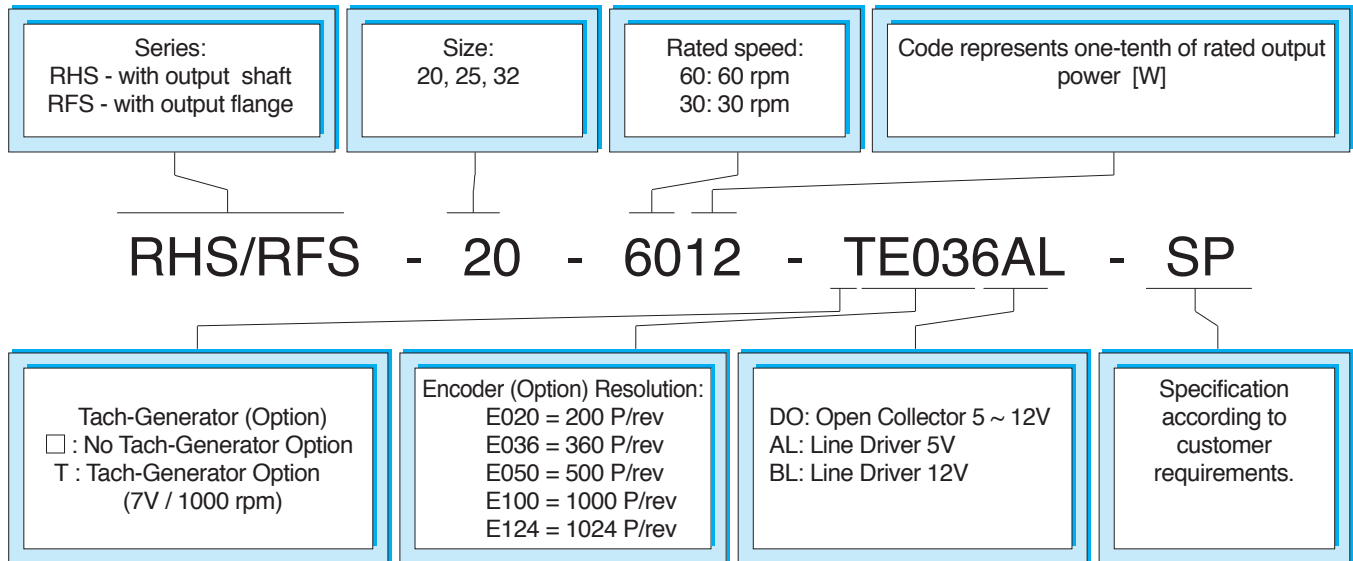


Ordering Codes

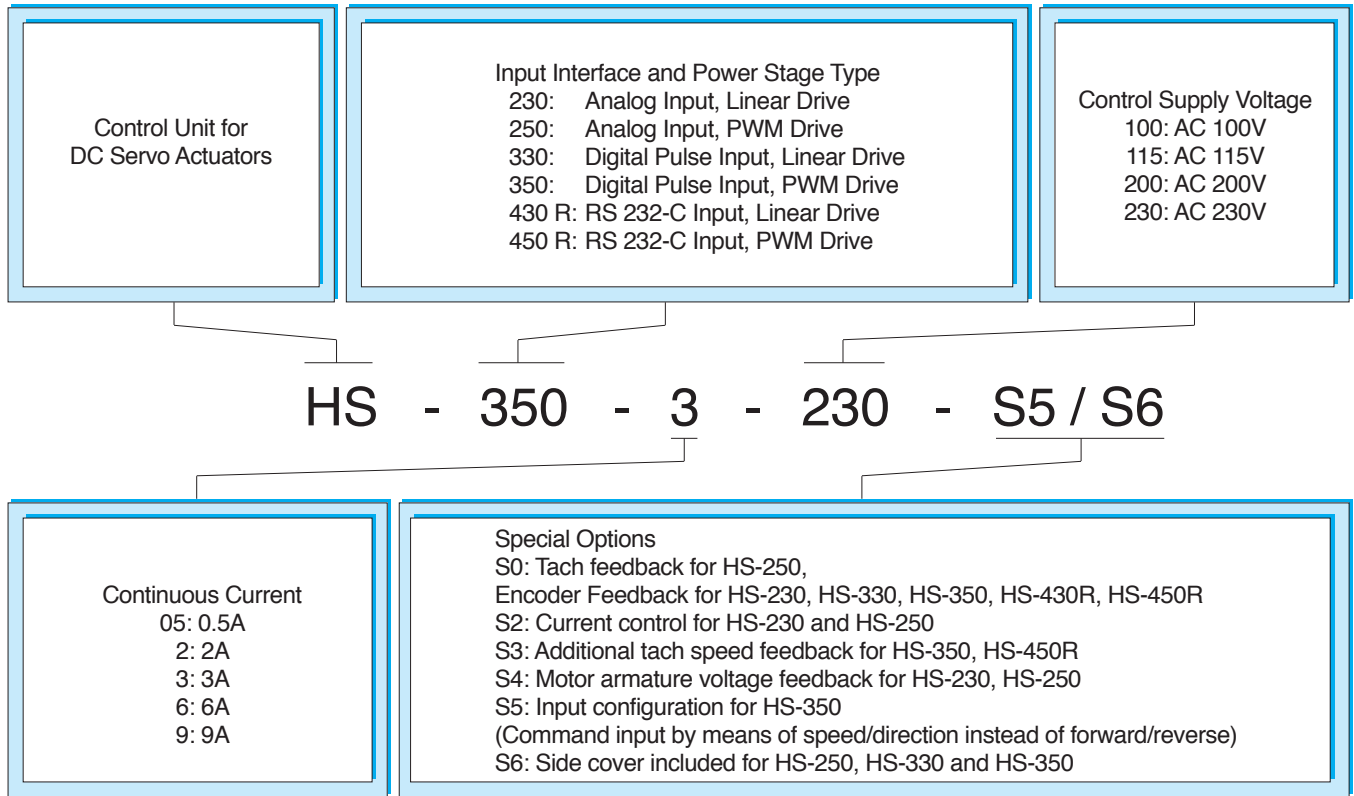
Servo Actuators



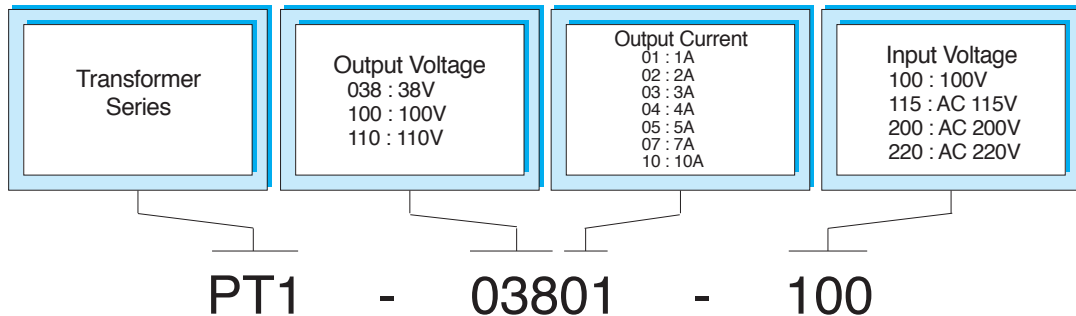
Servo Actuators



Control Units



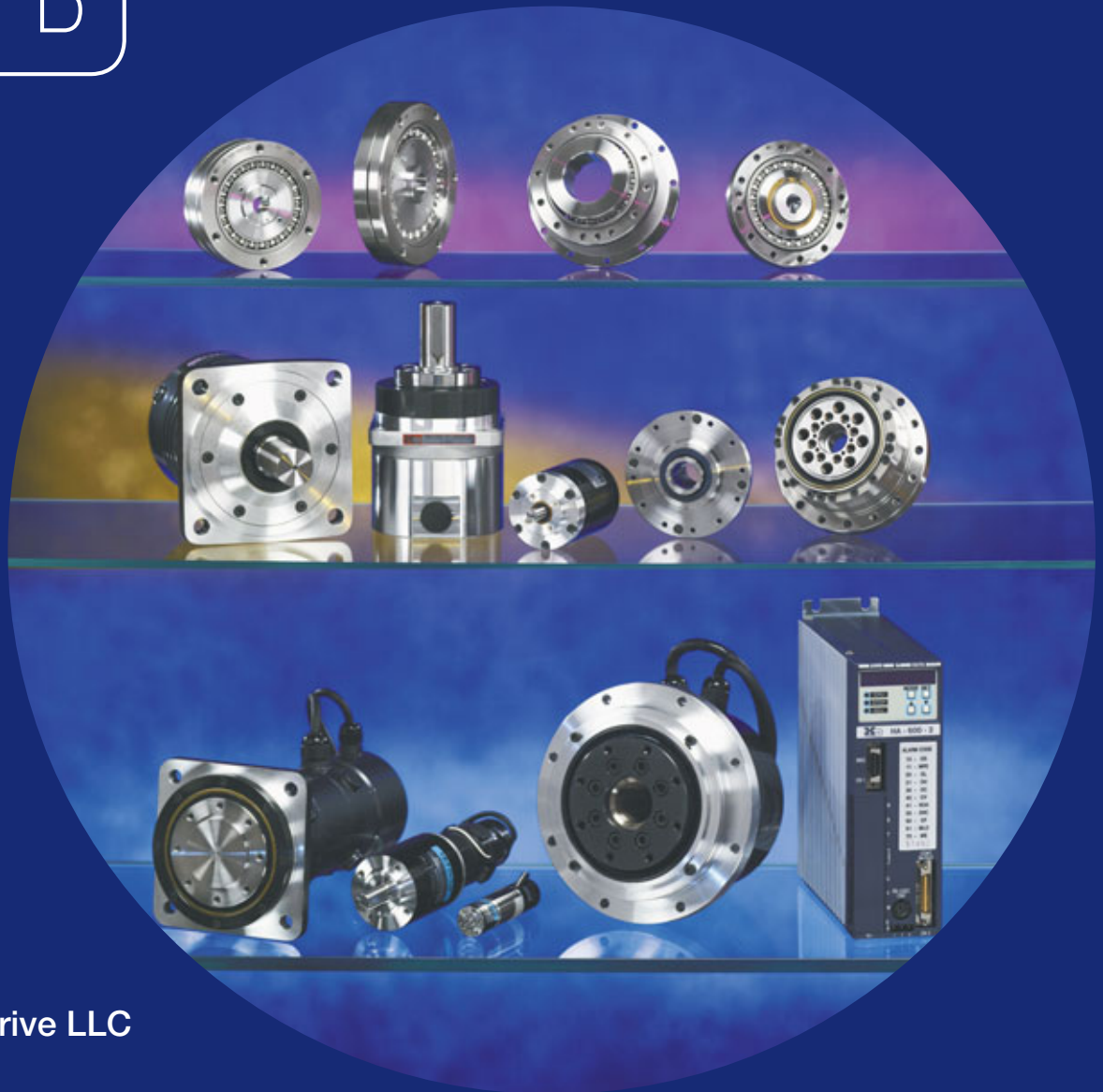
Power Transformers



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