

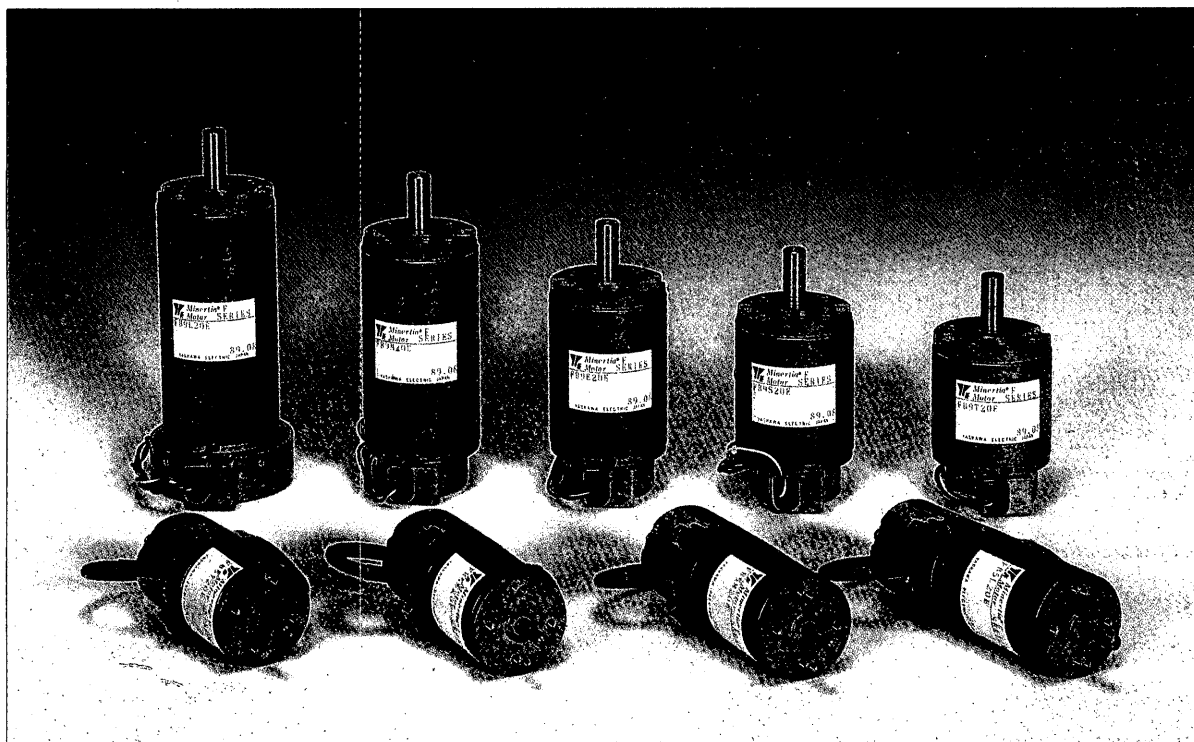


SMALL SIZE DC SERVOMOTORS

Minertia[®] Motor

F Series B TYPE

Type FB5 □ 20E 6.2 TO 17.4W
Type FB9 □ 20E 9.9 TO 30.8W



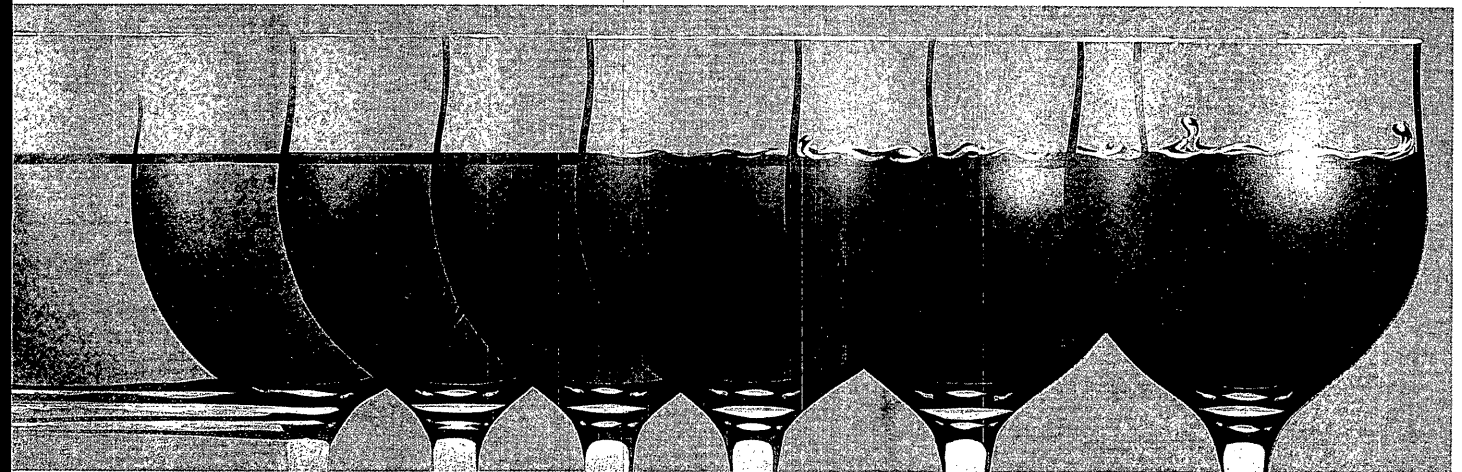
589-64

YASKAWA



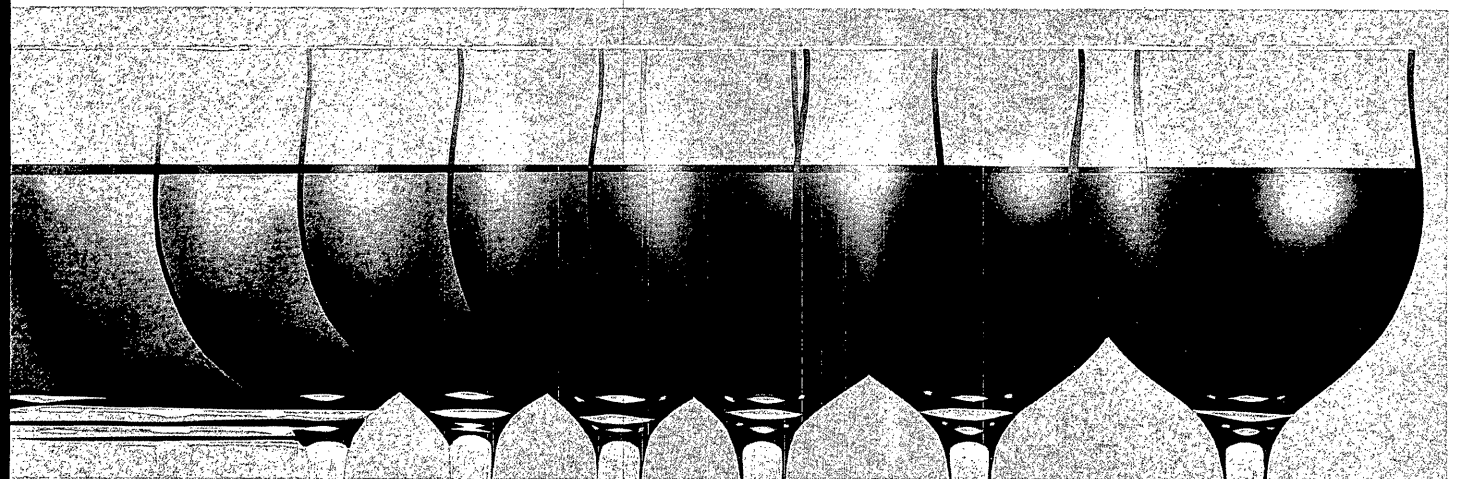
A BREAKTHROUGH IN OFFICE AUTOMATION YASKAWA'S DC SERVOMOTORS WITH ENCODER

FROM THIS...



(BY STEPPING MOTORS)

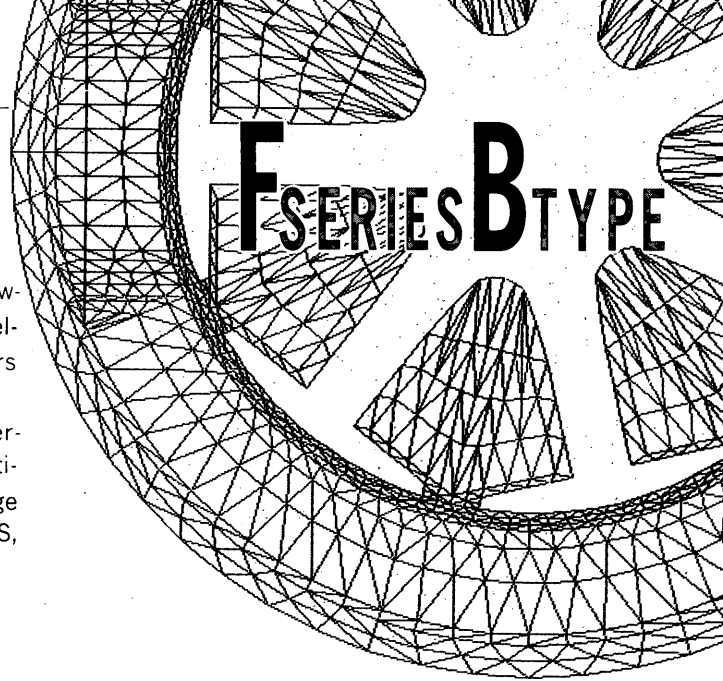
TO THIS...



(BY DC SERVOMOTORS)

OPTIMUM SPECIAL DESIGN — SMALL AND LIGHT

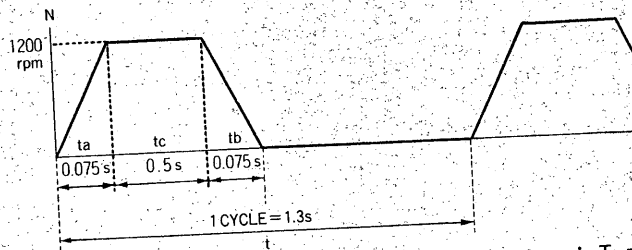
Normally, stepping motors have been used for serial printers however, DC motors have been employed recently, following the development of multi-function printers. This is because DC servomotors can provide stable drive operation in a wider range of speed. YASKAWA MINERTIA MOTORS F SERIES are small and light DC servomotors which have achieved reduction of torque ripple by optimum special design. F SERIES have been accepted for a large variety of applications, such as SERIAL PRINTERS, PLOTTERS, COPY MACHINES, etc.



MOTOR SELECTION METHOD

<Example>

When FB5M20E is used for printer carriage (load inertia: 8.3×10^{-3} oz. in s^2 load torque: 9.0 oz. in) in the following duty.



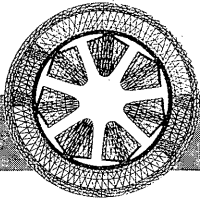
Load inertia: $J_L = 8.3 \times 10^{-3}$ oz. in s^2 Load torque: $T_L = 9.0$ oz. in
Motor inertia: $J_M = 0.86 \times 10^{-3}$ oz. in s^2

$$\text{Acceleration torque } T_{pa} = \frac{2\pi \times N (J_M + J_L)}{60 \times T_a} + T_L = \frac{2\pi \times 1200 (0.86 + 8.3) \times 10^{-3}}{60 \times 0.075} + 9.0 = 24 \text{ oz. in}$$

$$\text{Deceleration torque } T_{pb} = \frac{2\pi \times N (J_M + J_L)}{60 \times T_b} - T_L = \frac{2\pi \times 1200 (0.86 + 8.3) \times 10^{-3}}{60 \times 0.075} - 9.0 = 6.30 \text{ oz. in}$$

$$\text{Actual torque } T_{rms} = \sqrt{\frac{T_{pa}^2 \times t_a + T_L^2 \times t_c + T_{pb}^2 \times t_b}{t}} = \sqrt{\frac{24^2 \times 0.075 + 9.0^2 \times 0.5 + 6.3^2 \times 0.075}{1.3}} = 8.2 \text{ oz. in}$$

Since it is found from specifications and characteristic tables that FB5M20E rating torque is 8.3 oz. in and peak torque is 38.90 oz. in, this motor can be used.



FB5 20E

RATINGS AND SPECIFICATIONS

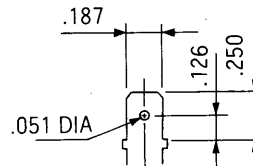
Specifications	Type	FB5T20E	FB5S20E	FB5M20E	FB5L20E
Peak Rated Torque	oz. in	22.2	26.4	38.9	55.6
Rated Torque	oz. in	4.2	5.6	8.3	11.8
Torque Constant	oz. in/amp	5.1	10.3	13.1	8.38
Armature Winding Resistance	Ω	6.2	12.5	11.2	3.1
Armature Inductance	mH	2.4	6.0	6.2	1.9
Peak Current	A	4.4	2.6	3.0	6.7
Induced Voltage Constant	V/1000r/min	3.8	7.6	9.7	6.2
Viscous Damping Coefficient	oz. in/1000r/min	0.056	0.083	0.125	0.14
Friction Torque	oz. in	0.56	0.69	0.83	0.97
Inertia (With Encoder)	oz. in. sec ² × 10 ⁻³	0.42	0.63	0.86	1.1
Mechanical Time Constant	millisec	14	10.5	8.4	6.9
Electrical Time Constant	millisec	0.39	0.48	0.55	0.61
Power Rate	kW/sec	0.29	0.35	0.57	0.90
Torque Inertia Ratio	rad/sec ²	10000	8880	9670	10760
Rated Speed	r/min	2000	2000	2000	2000
Max. Safe Operating Speed	r/min	4000	4000	4000	4000
Rated Voltage	V	16.1	26.0	30.0	19.4
Rated Current	A	1.0	0.66	0.76	1.66
Constant Output	W	6.2	8.2	12.3	17.4

- Time Rating: Continuous
- Dielectric Strength: 500VAC/1 min
- Applicable Environment:
 - Applicable Location: Indoor
 - Ambient Temperature: -10 to +40°C
 - Humidity: 80% RH Max.

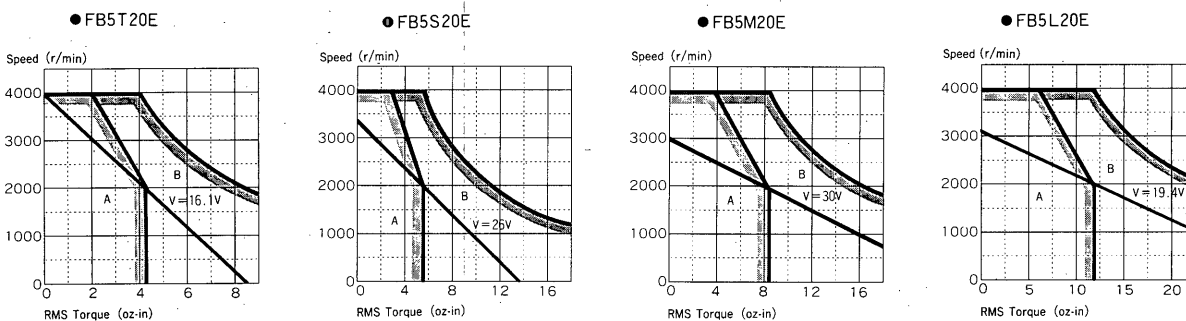
- Direction of Rotation: When (+) current is supplied to terminals with red cap, it rotates counterclockwise from the drive end.

The values described above are those with HA type encoder.
 With HS type encoder (200, 240 pulses), some values differ since the inertia is larger.
 Inertia 200 pulses + 0.11×10^{-3} oz. in. sec²
 240 pulses + 0.24×10^{-3} oz. in. sec²

FASTON 187 SERIES TAB or equivalent



SPEED-TORQUE-CURRENT CHARACTERISTICS



A: Area of safe continuous duty without air cooling.
 B: Area of intermittent duty.

Environmental conditions:
 Temperature 25°C Humidity 80% max.

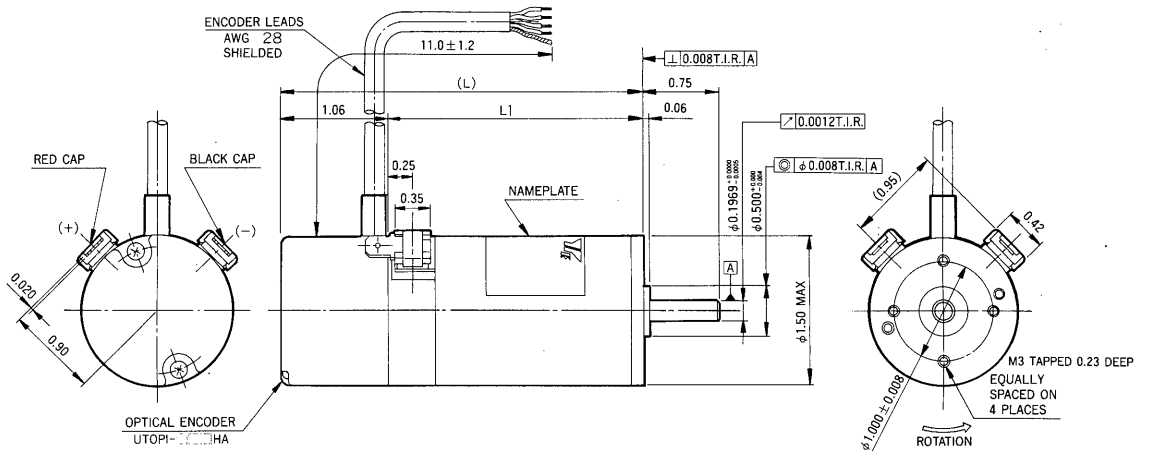
Note: Motor mounted on 4 in × 4 in × 1/8 in heat sink.

Curve data for an armature temp. of 100°C

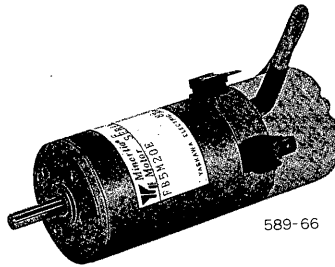
WITH HIGH ACCURACY ENCODER "HA" TYPE

200 to 1000 pulses/rev

■ DIMENSIONS in inches



TYPE	L1	L
FB5T20E	1.72	2.78
FB5S20E	2.15	3.21
FB5M20E	2.56	3.62
FB5L20E	2.96	4.02



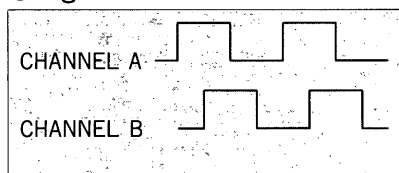
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■ OPTICAL ENCODER CHARACTERISTIC TABLES

TYPE	P/rev
UTOPI-020 HA	200
UTOPI-025 HA	250
UTOPI-028 HA	288
UTOPI-040 HA	400
UTOPI-050 HA	500
UTOPI-060 HA	600
UTOPI-080 HA	800
UTOPI-100 HA	1000

Input Power Requirement	+5VDC ±5% 100mA Max.
Waveform	Square Wave
Output Circuit	TTL Compatible
Flutter	360° ± 18° (10%p-p Max.)
Pulse Duty Cycle	180° ± 36° (50 ± 10%)
Phase Offset	90° ± 40° (25 ± 11%)
Frequency Range	50kHz

● Signal Waveform



(CCW ROTATION WHEN VIEWED FROM SHAFT DRIVE END)

● Encoder Lead

INPUT	RED	+5VDC
	BLACK	0V
OUTPUT	WHITE	CHANNEL A
	GREEN	CHANNEL B
	SHIELD	—

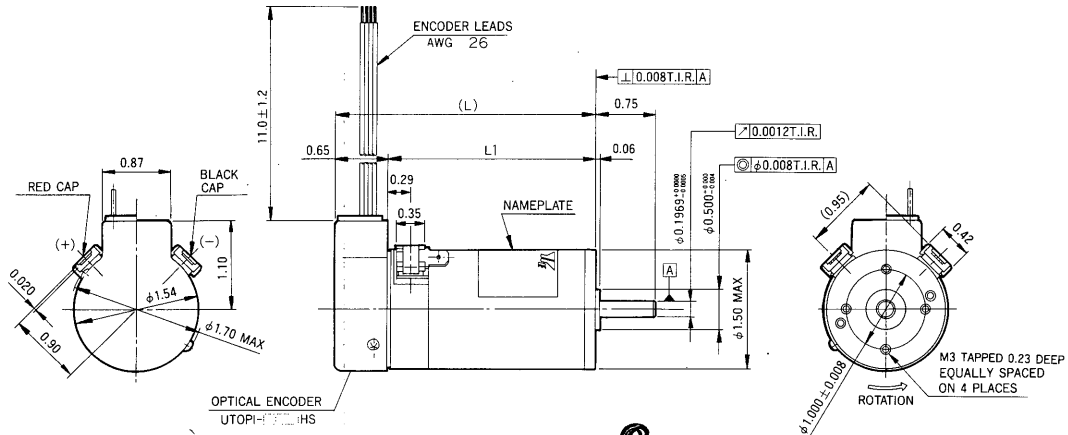
NOTE

- The relation of A and B channels to the motor rotating direction must correctly be set. If not so, overtravel may occur.
- Avoid vibration or shock on the encoder or its output shaft.
- Do not perform the insulation test or measure the insulation resistance.

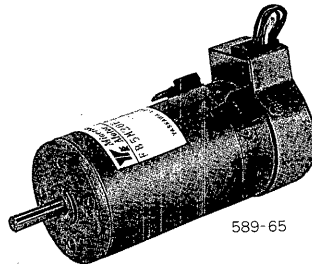
WITH LOW COST ENCODER "HS" TYPE

72 to 144 pulses/rev

■ DIMENSIONS in inches



TYPE	L1	L
FB5T20E	1.76	2.41
FB5S20E	2.19	2.84
FB5M20E	2.60	3.25
FB5L20E	3.00	3.65

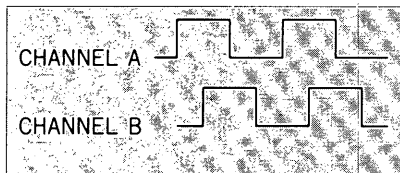


■ OPTICAL ENCODER CHARACTERISTIC TABLES

TYPE	P/rev
UTOPI-007HS	72
UTOPI-010HS	100
UTOPI-012HS	120
UTOPI-014HS	144

Input Power Requirement	+5VDC ± 5% 100mA Max.
Waveform	Square Wave
Output Circuit	TTL Compatible
Flutter	360° ± 4.5° (2.5%p-p Max.)
Pulse Duty Cycle	180° ± 54° (50 ± 15%)
Phase Offset	90° ± 54° (25 ± 15%)
Frequency Range	10kHz

● Signal Waveform



(CCW ROTATION WHEN VIEWED FROM SHAFT DRIVE END)

● Encoder Lead

INPUT	RED	+5VDC
	BLACK	0V
OUTPUT	WHITE	CHANNEL A
	GREEN	CHANNEL B

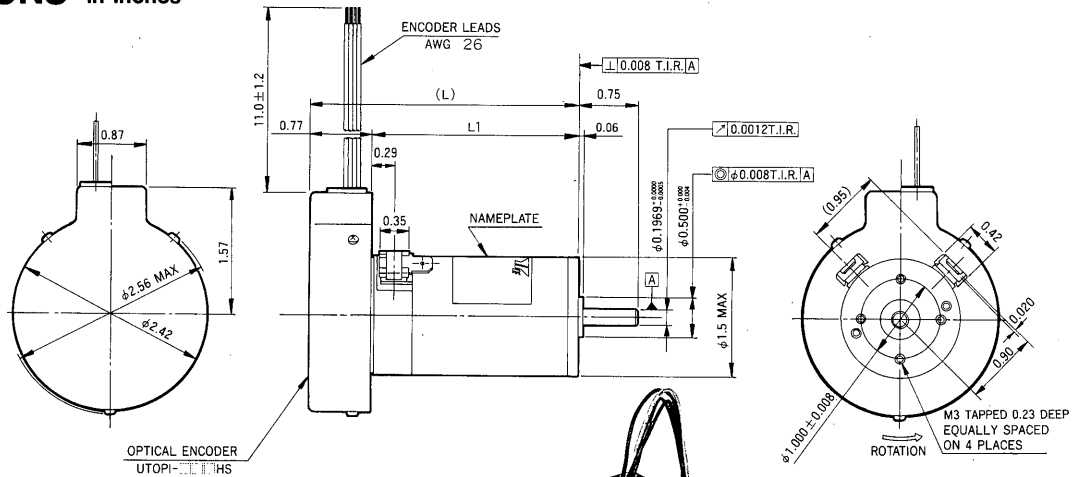
NOTE

- The relation of A and B channels to the motor rotating direction must correctly be set. If not so, overtravel may occur.
- Avoid vibration or shock on the encoder or its output shaft.
- Do not perform the insulation test or measure the insulation resistance.

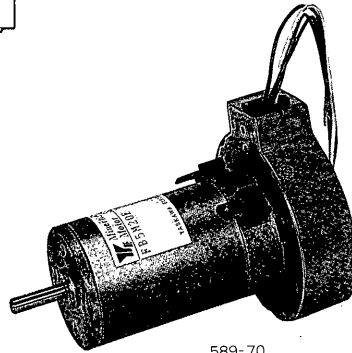
WITH LOW COST ENCODER "HS" TYPE

200 to 240 pulses/rev

DIMENSIONS in inches



TYPE	L1	L
FB5 T20E	1.75	2.52
FB5 S20E	2.19	2.96
FB5 M20E	2.60	3.37
FB5 L20E	3.00	3.77



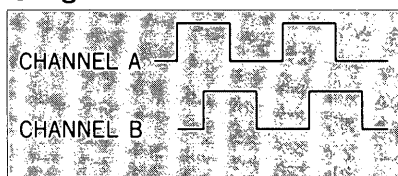
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OPTICAL ENCODER CHARACTERISTIC TABLES

TYPE	P/rev
UTOPI-020HS	200
UTOPI-024HS	240

Input Power Requirement	+5VDC ± 5% 100mA Max.
Waveform	Square Wave
Output Circuit	TTL Compatible
Flutter	360° ± 4.5° (2.5%p-p Max.)
Pulse Duty Cycle	180° ± 54° (50 ± 15%)
Phase Offset	90° ± 54° (25 ± 15%)
Frequency Range	10kHz

Signal Waveform



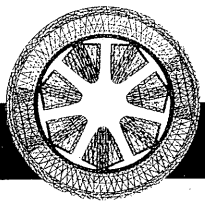
(CCW ROTATION WHEN VIEWED FROM SHAFT DRIVE END)

Encoder Lead

INPUT	RED	+5VDC
	BLACK	0V
OUTPUT	WHITE	CHANNEL A
	GREEN	CHANNEL B

NOTE

- The relation of A and B channels to the motor rotating direction must correctly be set. If not so, overtravel may occur.
- Avoid vibration or shock on the encoder or its output shaft.
- Do not perform the insulation test or measure the insulation resistance.



FBS 20E

RATINGS AND SPECIFICATIONS

Specifications	Type	FB9T20E	FB9S20E	FB9E20E	FB9M20E	FB9L20E
Peak Rated Torque	oz. in	38.9	61.1	77.8	128	156
Rated Torque	oz. in	11.1	16.7	22.2	29.2	34.7
Torque Constant	oz. in/amp	7.0	10.8	14.5	15.3	16.5
Armature Winding Resistance	Ω	4.1	5.3	6.4	4.2	3.9
Armature Inductance	mH	1.9	2.8	3.6	2.6	2.6
Peak Current	A	5.7	5.7	5.7	8.5	9.5
Induced Voltage Constant	V/1000r/min	5.2	8.0	10.7	11.3	12.2
Viscous Damping Coefficient	oz. in/1000r/min	0.43	0.50	0.58	1.86	0.85
Friction Torque	oz. in	1.10	1.31	1.53	2.22	2.36
Inertia (With Encoder)	oz. in. $\text{sec}^2 \times 10^{-3}$	1.94	2.64	3.13	4.61	5.69
Mechanical Time Constant	millisec	22.8	16.9	14.0	11.7	11.5
Electrical Time Constant	millisec	0.46	0.53	0.56	0.62	0.67
Power Rate	KW/sec	0.45	0.74	1.10	1.30	1.50
Torque Inertia Ratio	rad/sec ²	5710	6320	7110	6330	6100
Rated Speed	r/min	1200	1200	1200	1200	1200
Max. Safety Operating speed	r/min	3500	3500	3500	3500	3500
Rated Voltage	V	18.1	23.7	30.0	27.0	28.1
Rated Current	A	2.0	1.90	1.95	2.33	2.54
Constant Output	W	9.9	14.8	19.7	25.9	30.8

- Time Rating: Continuous
- Dielectric Strength: 500VAC/1 min
- Applicable Environment: Indoor
- Applicable Location: Indoor
- Ambient Temperature: -10 to +40°C
- Humidity: 80% Max.

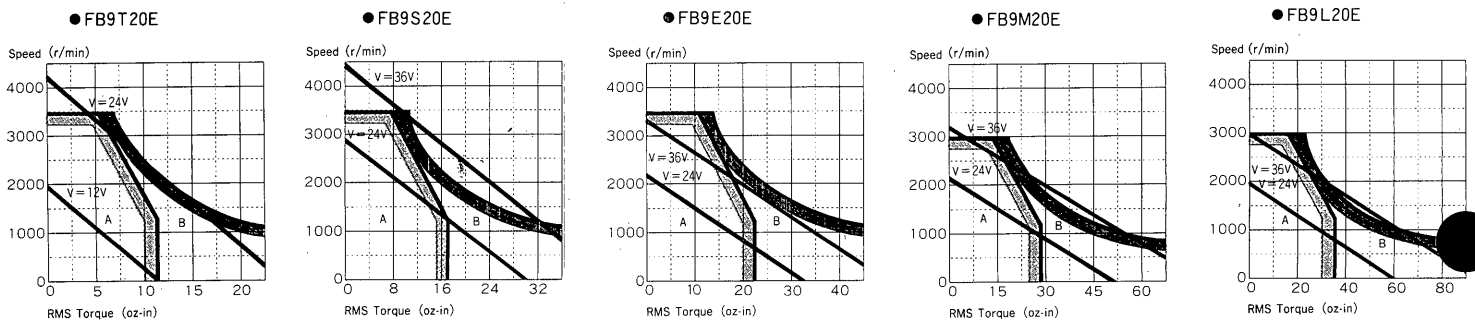
● Direction of Rotation: When (+) current is supplied to the red lead it rotates counterclockwise viewed from drive end.

The values described above are those with HA type encoder.

With HS type encoder (200, 240 pulses), some values differ since the inertia is larger.

Inertia 200 pulses + 0.11×10^{-3} oz. in. sec^2
 240 pulses + 0.24×10^{-3} oz. in. sec^2

SPEED-TORQUE CURRENT CHARACTERISTICS



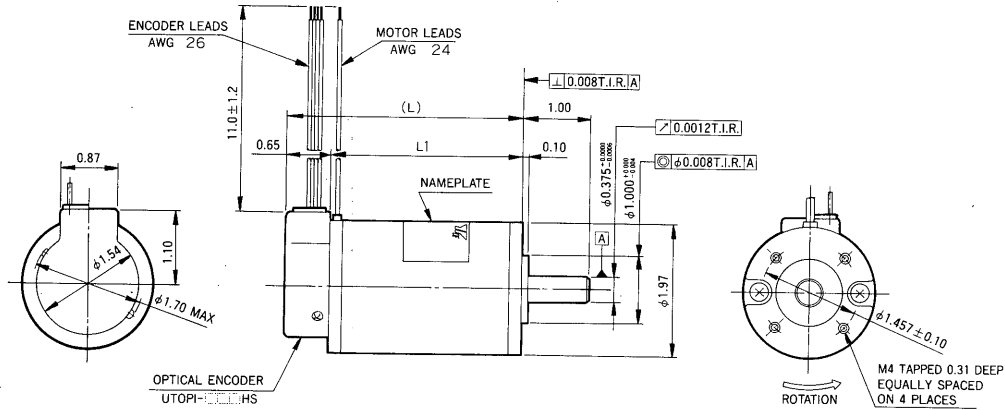
A: Area of safe continuous duty without air cooling.
 B: Area of intermittent duty.

Environmental conditions:
 Temperature 25°C Humidity 80% max.

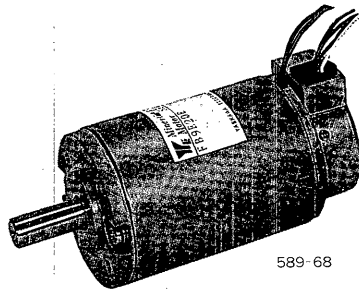
WITH LOW COST ENCODER "HS" TYPE

72 to 144 pulses/rev

■ **DIMENSIONS** in inches



TYPE	L1	L
FB9T20E	2.11	2.76
FB9S20E	2.50	3.15
FB9E20E	2.90	3.55
FB9M20E	3.69	4.34
FB9L20E	4.28	4.93



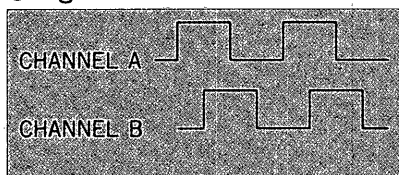
589-68

■ OPTICAL ENCODER CHARACTERISTIC TABLES

TYPE	P/rev
UTOPI-007HS	72
UTOPI-012HS	120
UTOPI-014HS	144

Input Power Requirement	+5VDC ± 5% 100mA Max.
Waveform	Square Wave
Output Circuit	TTL Compatible
Flutter	360° ± 4.5° (2.5%p-p Max.)
Pulse Duty Cycle	180° ± 54° (50 ± 15%)
Phase Offset	90° ± 54° (25 ± 15%)
Frequency Range	10kHz

● Signal Waveform



(CCW ROTATION WHEN VIEWED FROM SHAFT DRIVE END)

● Encoder Lead

INPUT	RED	+5VDC
	BLACK	0V
OUTPUT	WHITE	CHANNEL A
	GREEN	CHANNEL B

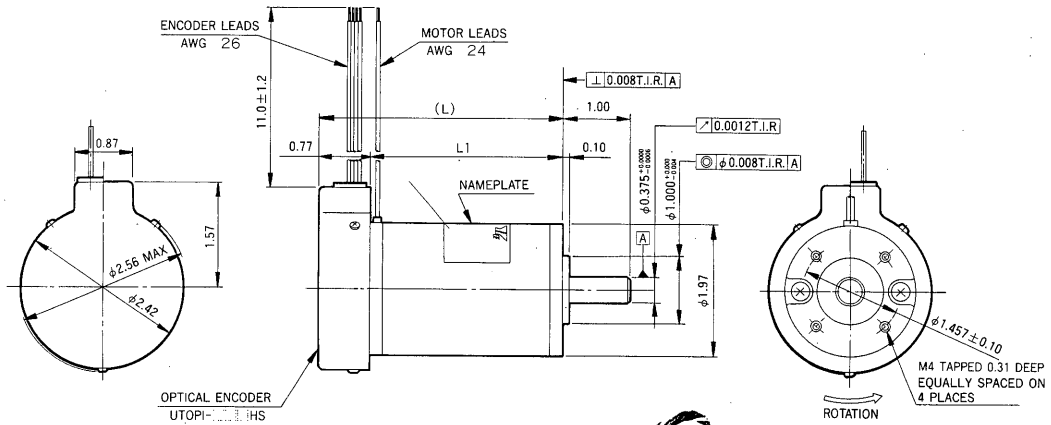
NOTE

- The relation of A and B channels to the motor rotating direction must correctly be set. If not so, overtravel may occur.
- Avoid vibration or shock on the encoder or its output shaft.
- Do not perform the insulation test or measure the insulation resistance.

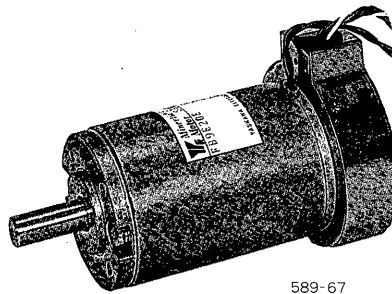
WITH LOW COST ENCODER "HS" TYPE

200 to 240 pulses/rev

■ DIMENSIONS in inches



TYPE	L1	L
FB9T20E	2.11	2.88
FB9S20E	2.50	3.27
FB9E20E	2.90	3.67
FB9M20E	3.69	4.46
FB9L20E	4.28	5.05



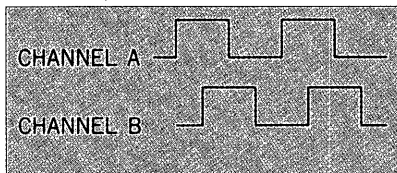
589-67

■ OPTICAL ENCODER CHARACTERISTIC TABLES

TYPE	P/rev
UTOPI-020HS	200
UTOPI-024HS	240

Input Power Requirement	+5VDC ± 5% 100mA Max.
Waveform	Square Wave
Output Circuit	TTL Compatible
Flutter	360° ± 4.5° (2.5%p-p Max)
Pulse Duty Cycle	180° ± 54° (50 ± 15%)
Phase Offset	90° ± 54° (25 ± 15%)
Frequency Range	10kHz

● Signal Waveform



(CCW ROTATION WHEN VIEWED FROM SHAFT DRIVE END)

● Encoder Lead

INPUT	RED	+5VDC
	BLACK	0V
OUTPUT	WHITE	CHANNEL A
	GREEN	CHANNEL B

NOTE

- The relation of A and B channels to the motor rotating direction must correctly be set. If not so, overtravel may occur.
- Avoid vibration or shock on the encoder or its output shaft.
- Do not perform the insulation test or measure the insulation resistance.



A Better Tomorrow for Industry through Automation

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Due to ongoing product modification/improvement, data subject to change without notice.