Servo Drivers

JSMD Series CE

Overview

The JSMD series are digital servo drivers which embed a DSP processor optimized for linear motors. They enable precision motion control by use of digital current control based on space voltage vectors.

〈Pic〉 JSMD series

Model Name

JSMD - 0x

- JSMD Series
- 02 : 500W
- 03 : 1.5kW

Features

- High performance vector control
- Up to 20 KHz PWM switching
- Up to 6 MHz pulse input position control mode
- Force control mode with ± 10V analog input
- High resolution current sensing
- 9-input, 9-output general purpose I/O
- Easy motion programming with GUI
- PC based communication with RS232, USB, etc.
- Status display via a 7-segment LED array
- Self-protection functions
  - Both over voltage and under voltage protection
  - Internal 12T protection

Specifications

Specification \ Model		JSMD-02	JSMD-03
Input Power Supply	Voltage	3 Phase AC200~230V, 50/60Hz	
	Capacity	1.4 kVA	3.2 kVA
Max Applicable Motor	Voltage Type	3 Phase Sinusoidal AC Servo Motor	
	Rated Output	500 W	1,500 W
	Rated Output Current	5.3 A	11 A
	Peak Output Current	15.9 A	42 A
Control Type		Sinusoidal PWM Control, Current Control Type	
Built-in Function	Protection	Over-current, Over-voltage, Low-voltage, Over-speed, Encoder Error, CPU error, Over-temperature	
	Regeneration	Internal Regenerative Resistor	Customer's selection
Encoder	Type	Incremental	
	Output Type	Differential Line Driver Output	
	Resolution	0.05um, 0.1um, 0.2um, 0.5um, 1um, 5um	
	Power Supply	DC 5V, Less than 0.3A	
Position Control	Position Pulse Input Frequency	Max 3Mpps (Line Drive), 6Mpps (Option) 1Mpps (Open Collector)	
	Position Input Coding	1) Direction + Pulse, 2Phase Pulse(A+B) - Line Drive Type 2) Digital Input (32 point), 3) Analog DC -10V~+10V, 4) RS-232C Input	
Speed Control	Speed Control Range	1 : 1000	
	Speed Command Input	Analog DC -10V~+10V, Maximum speed (Adjusted with control parameters)	
Force Control	Force Command Input	Analog DC -10V~+10V,	
	Force Linear Input	Less than 4%	
Environment	Operating Temperature	0℃ ~ 45℃	
	Operating Humidity	20 ~ 80% (Without condensation or frost)	
	Storage Temperature	-20℃ ~ 80℃	
	Insulation Resistance	Higher than 10MΩ (DC500V)	
Weight		1.9 kg	4.8 kg

Note: Specifications may improve without prior notice.

JSMD 0xD CE

Overview

- High performance direct PWM amplifier
- Direct PWM control by use of Delta Tau UMAC motion controller

〈Pic〉 JSMD 0xD series

Model Name

JSMD - 0xD

- JSMD : JSMD Series
- 0xD :
  - 02D : 1.5kW
  - 03D : 3kW
  - 04D : 6kW

Features

- Jitter of less than 50nm
- Direct PWM compatibility
- Easy cable wiring with the UMAC motion controller
- Up to 15KHz PWM switching
- 12/14bit resolution current sensing (optional)
- Dynamic braking signal output (optional)
- Self-protection functions
  - Both over voltage and under voltage protection
  - Over temperature protection
  - Arm short protection
  - Dead time protection

Specifications

Specification \ Model			JSMD-02D	JSMD-03D	JSMD-04D
Input Power	Nominal Input Voltage(VAC)		208		
	Rated Input Voltage(VAC)		180~230		
	Input Frequency(Hz)		50/60		
	Phase Requirement		1 phase or 3 phase		3 phase
Output Power	Output Voltage(VAC)		0~150		
	Output Frequency(Hz)		0~5000		
	Rated Continuous Output Current(Arms)		7.5	15.0	30.0
	Peak Output Current(Arms) for 2seconds		15.0	30.0	60.0
	Rated Output Power(kW)		1.5	3	6
	PWM Frequency(kHz)@rated current		15	12	12
	Minimum Dead Time(us)		3.5		
Bus Protection	Nominal DC Bus Voltage(VDC)		290		
	Over-voltage Trip Level(VDC)		410		
	Under-voltage Lockout Level(VDC)		200		
	Regeneration Turn-on Voltage(VDC)		370		
	Regeneration Turn-off Voltage(VDC)		340		
Feedback	Current Sensing	Resolution(Bits)	12/14		
		Range(Apeak)	±25	±50	±100
I/O interface	Connection to Motion Controller		Mini-Din 36p		
Environment	Operation Temperature(℃)		5 to 45		
	Storage Temperature(℃)		0 to 70		
	Ambient Humidity(%)		10 to 90		
	Atmosphere		No corrosive gasses, dust		
	Vibration(G)		0.5		

Network Servo Drivers

JSMD 0xM CE

Overview

- High performance MACRO® network servo drivers
- Direct PWM control based on Delta Tau UMAC motion controller and PMAC Ultra–Lite

〈Pic〉 JSMD 0xD series

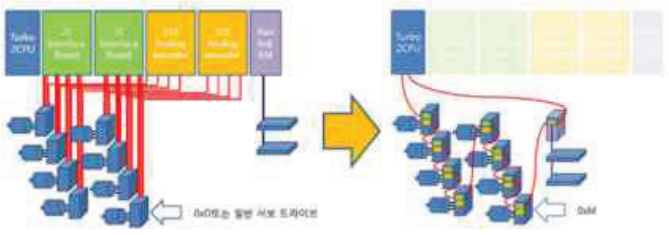
Model Name

JSMD - 0 x M

- JSMD: Justek Motion Drive Series
- 0 x M:
  - 02M : 1.5kW
  - 03M : 3kW
  - 04M : 6kW

Features

- Optically isolated electronic circuit
- MACRO® motion network compatible
- Easy cable wiring by MACRO® ring
- Up to 12 KHz PWM switching
- Analog/ digital encoder compatible
- 14bit resolution current sensing
- Dynamic braking
- Self–protection functions
  - Excessive or short voltage protection
  - Internal 12T protection
  - Dead time protection
  - Network watch dog
  - CPU watch dog

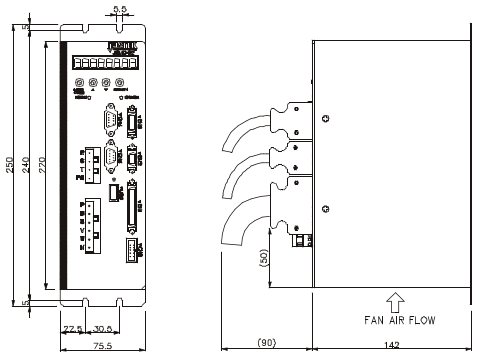


Specifications

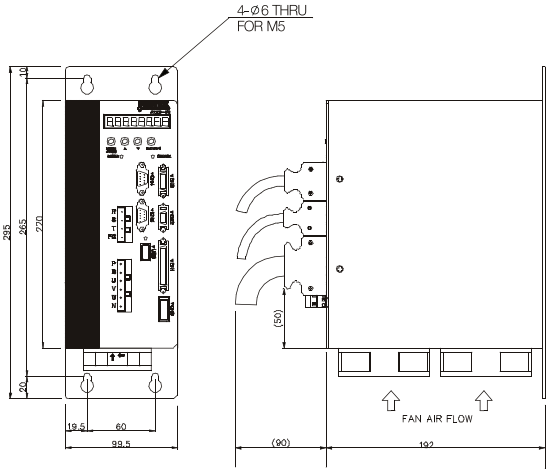
Specification \ Model		JSMD-02M	JSMD-03M	JSMD-04M
Input Power	Nominal Input Voltage(VAC)	208		
	Rated Input Voltage(VAC)	180~230		
	Input Frequency(Hz)	50/60		
	Phase Requirement	1 phase or 3 phase		3 phase
Output Power	Output Voltage(VAC)	0~150		
	Output Frequency(Hz)	0~5000		
	Rated Continuous Output Current(Arms)	7.5	15.0	30.0
	Peak Output Current(Arms) for 2seconds	15.0	30.0	60.0
	Rated Output Power(kW)	1.5	3	6
	PWM Frequency(kHz)@rated current	15	12	12
	Minimum Dead Time(us)	3.5		
Bus Protection	Nominal DC Bus Voltage(VDC)	290		
	Over-voltage Trip Level(VDC)	410		
	Under-voltage Lockout Level(VDC)	200		
	Regeneration Turn-on Voltage(VDC)	370		
	Regeneration Turn-off Voltage(VDC)	340		
Feedback	Current Sensing Resolution(Bits)	12/14		
	Full-Scale Current Reading(Apeak)	±25	±50	±100
	Digital Encoder Interface	ABZ type Quadrature encoder up to 20MHz(after x4)		
	Analog Encoder Interface	**1Vpp SIN/COS encoder up to 100kHz**		
I/O interface	Fieldbus Interface	MACRO® 100base-FX (SC-SC Multi-mode)		
	Hall/Limit Sensor Interface	5V open collector 3M 20p connector		
	Communication Speed(MHz)	100		
Environment	Operation Temperature(℃)	5 to 45		
	Storage Temperature(℃)	0 to 70		
	Ambient Humidity(%)	10 to 90		
	Atmosphere	No corrosive gasses, dust, or condensation		
	Vibration(G)	0.5		

Servo Drivers

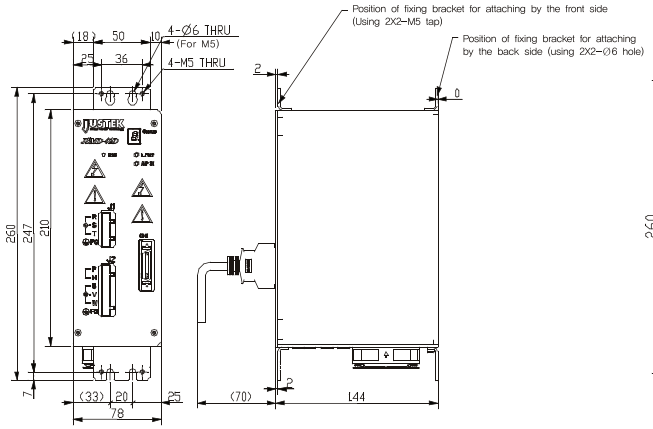
Appearance : JSMD-02



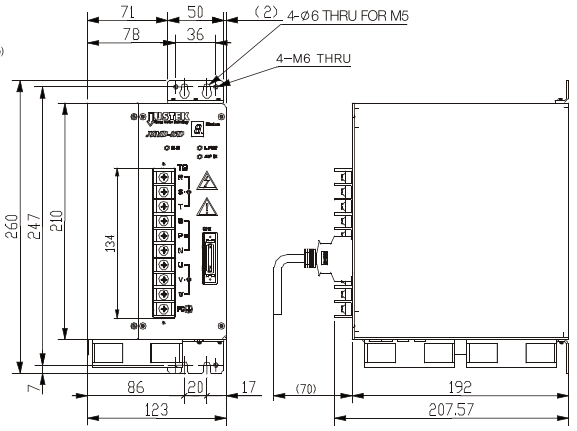
Appearance : JSMD-03



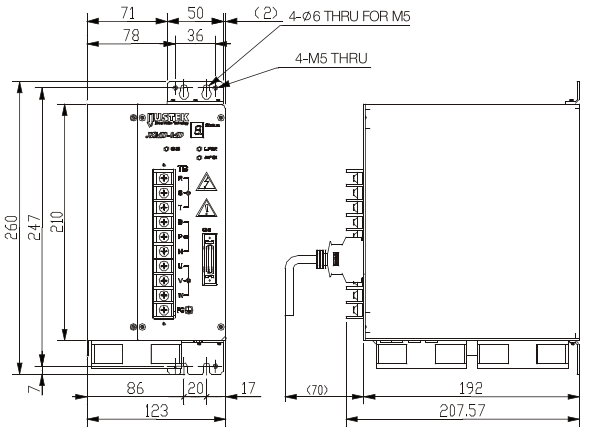
Appearance : JSMD-02D



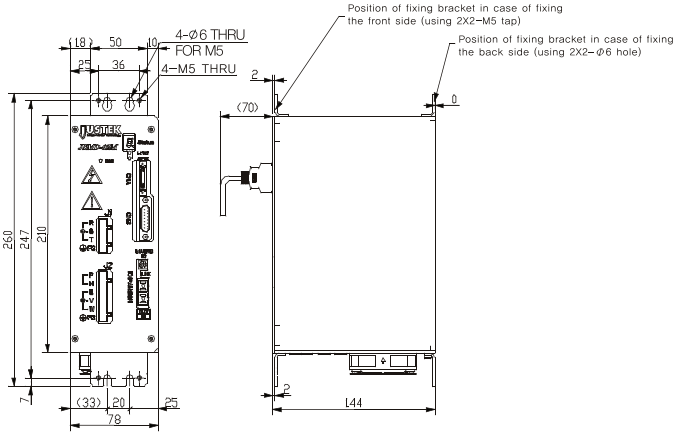
Appearance : JSMD-03D



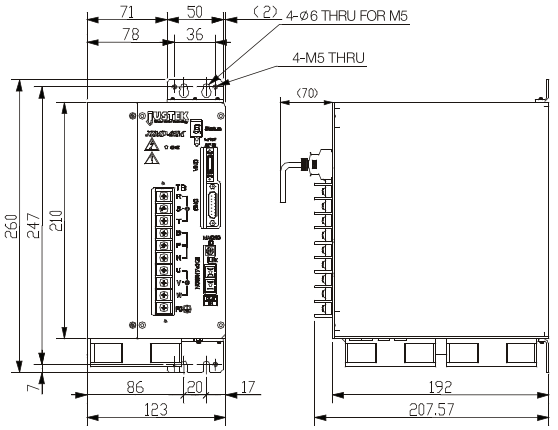
Appearance : JSMD-04D



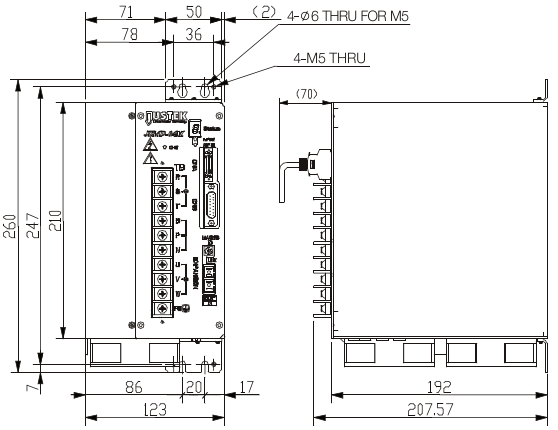
Appearance : JSMD-02M



Appearance : JSMD-03M



Appearance : JSMD-04M

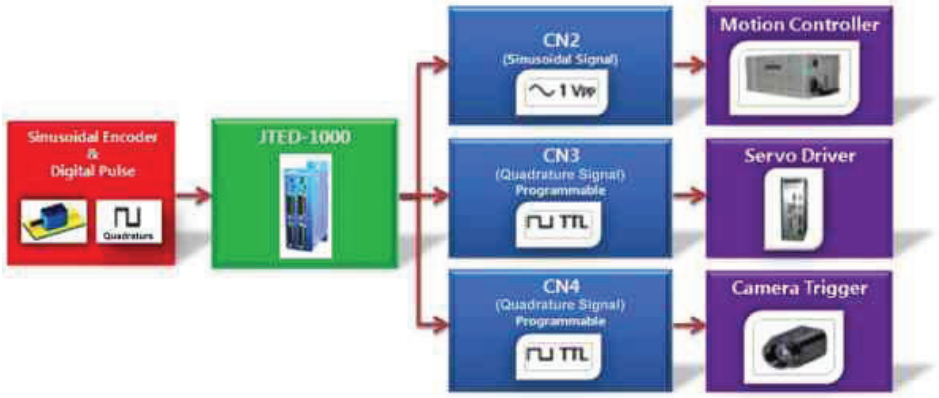


Unipolators : JTED Series CE

Overview

- Multi-function pulse modulator incorporating signal distribution, interpolation, decimation, compensation and digital filtering.
- The JTED-1000 generates high precision digital encoder/ trigger signals, interpolated up to 1000 times, to 3 selectable output channels for one input signal from the analog encoder and compensates for position errors for each signal high speed
- The JTED-500 series generates 2 selectable high precision encoder/ trigger signals whose position error is compensated for one digital input. (output in 3 channels optional)

〈Pic〉 JTED series



Concept of Unipolator operation

Features

- Simple to integrate with existing devices
  - Compact size : Easy to install on the existing devices due to small space requirement
  - Easy integration : Simple to install between the encoder and controller
  - Many pulse type conversions(A/B, Pulse/Dir, CW/CCW) : applicable to a variety of devices
- Free from synchronization of multiple encoders
  - Generates up to 3 synchronized signals for 1 analog/ digital encoder signal
  - High space efficiency and signal synchronization by use of a single encoder
- Interpolation of analog encoder
  - Capable of high resolution – up to 20nm(x1000) if using a 20um pitch standard encoder scale
- Generation of real time high precision signals based on patented algorithms
  - Works on an arbitrary input/output frequency ratio (5/3, 117/23, etc.)
  - Signal compensation: pulse with encoder position error compensated in real time
- Easy parameter setting/management using GUI

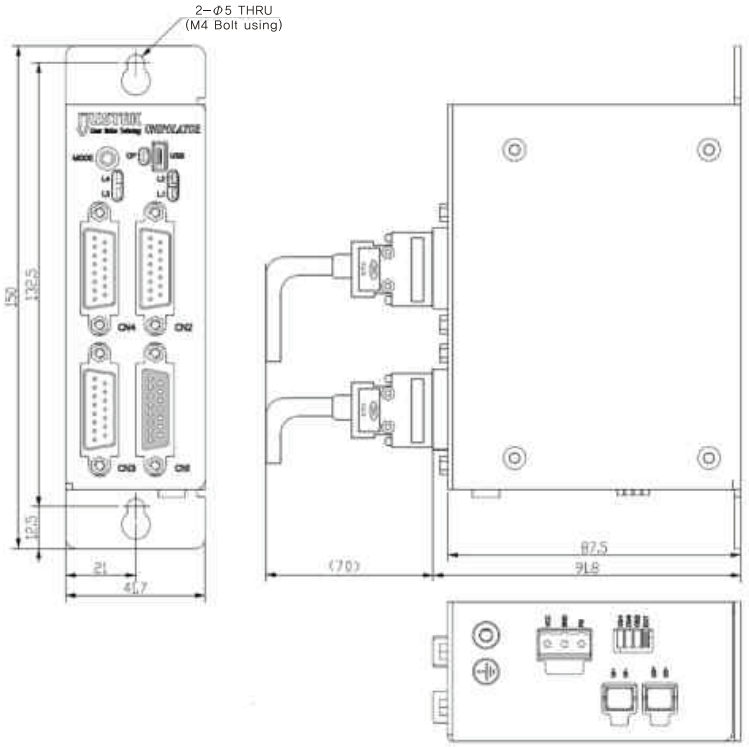
Model Name

JTED – X X X X

- 0: 2 Digital output
  1: 3 Digital output
  2: 2 Digital in put
- 100: Analog input
  50: RS422 input

Design Type	CN1	CN2		CN3	CN4	Functions		
	Input1	Input2	Output1	Output2	Output3	Compensation	Interpolation(M)	Decimation(Nx)
JTED–1000	1Vpp	–	1Vpp	RS422	RS422	1D	x50~x1000	Rational number
JTED–1001	1Vpp	–	RS422	RS422	RS422	1D	x50~x1000	Rational number
JTED–500	RS422	–	–	RS422	RS422	1D	N/A	Rational number
JTED–501	RS422	–	RS422	RS422	RS422	1D	N/A	Rational number
JTED–502	RS422	RS422	–	RS422	RS422	1D	N/A	Rational number

Appearance and Dimensions



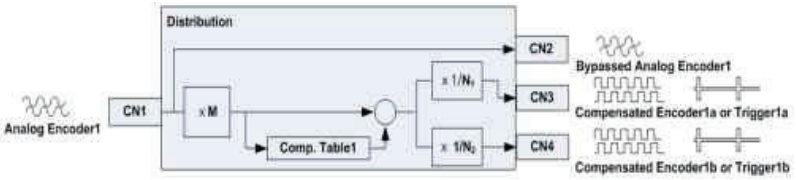
Unipolators

Main Functions

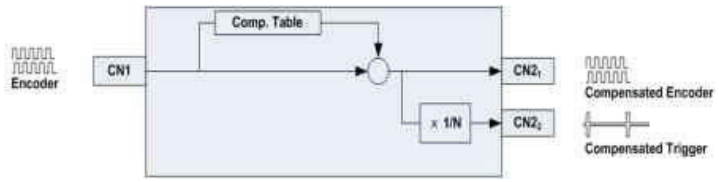
- Signal distribution : generates up to 3 synchronized digital encoder output signals in various forms (A/B, Pulse/Dir, CW/CCW) from 1 analog/ digital input signal
- Signal interpolation : generates encoder pulse interpolated up to 1000 times (JTED-1000)
- Signal decimation : generates high precision trigger signals with an arbitrary input/output ratio based on a patented algorithm
- Signal compensation : real time position error compensation based on patented algorithm
- Signal modulation : processes various types of signals and mitigates vibration via digital pulse modulation

Types of Applications

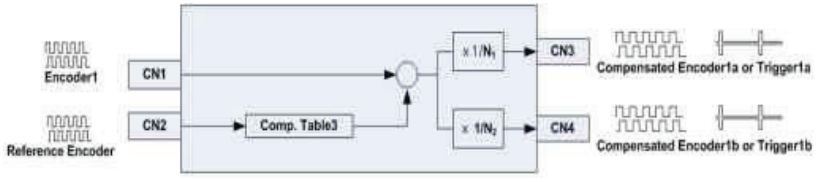
- Simultaneous control of high precision scanning and high precision image capture



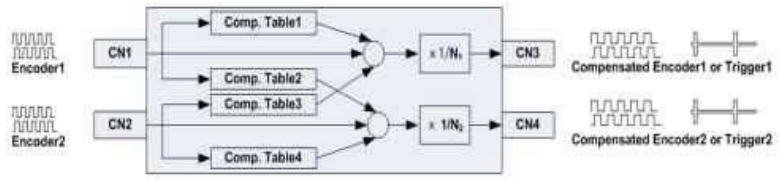
- Image capture synchronized with motor position by 1 encoder



- Flatness compensation for auto focusing



- Simultaneous position compensation of both X and Y axis



Performance Comparison : 1 Unipolator JTED-1000 vs. 3 Encoders

Model		JTED–1000	3 encoders	Remarks
number of encoders needed		~1Vpp 1ea	~1Vpp 1ea ㅠ TTL 2ea	Controller input(SIN) Servo driver input(TTL) Trigger input(TTL)
max. output frequency		18MHz	10MHz	–
Trigger precision	running at 400mm/s	12.5nm	50nm	using 20um grating encoder scale
	running at 900mm/s	25nm	100nm	
	running at 1800mm/s	50nm	500nm	
Control–trigger position error		0	one digit nm	–

Specifications of JTED signals

- Resolution and maximum working speed by encoder specification & basic interpolation factor

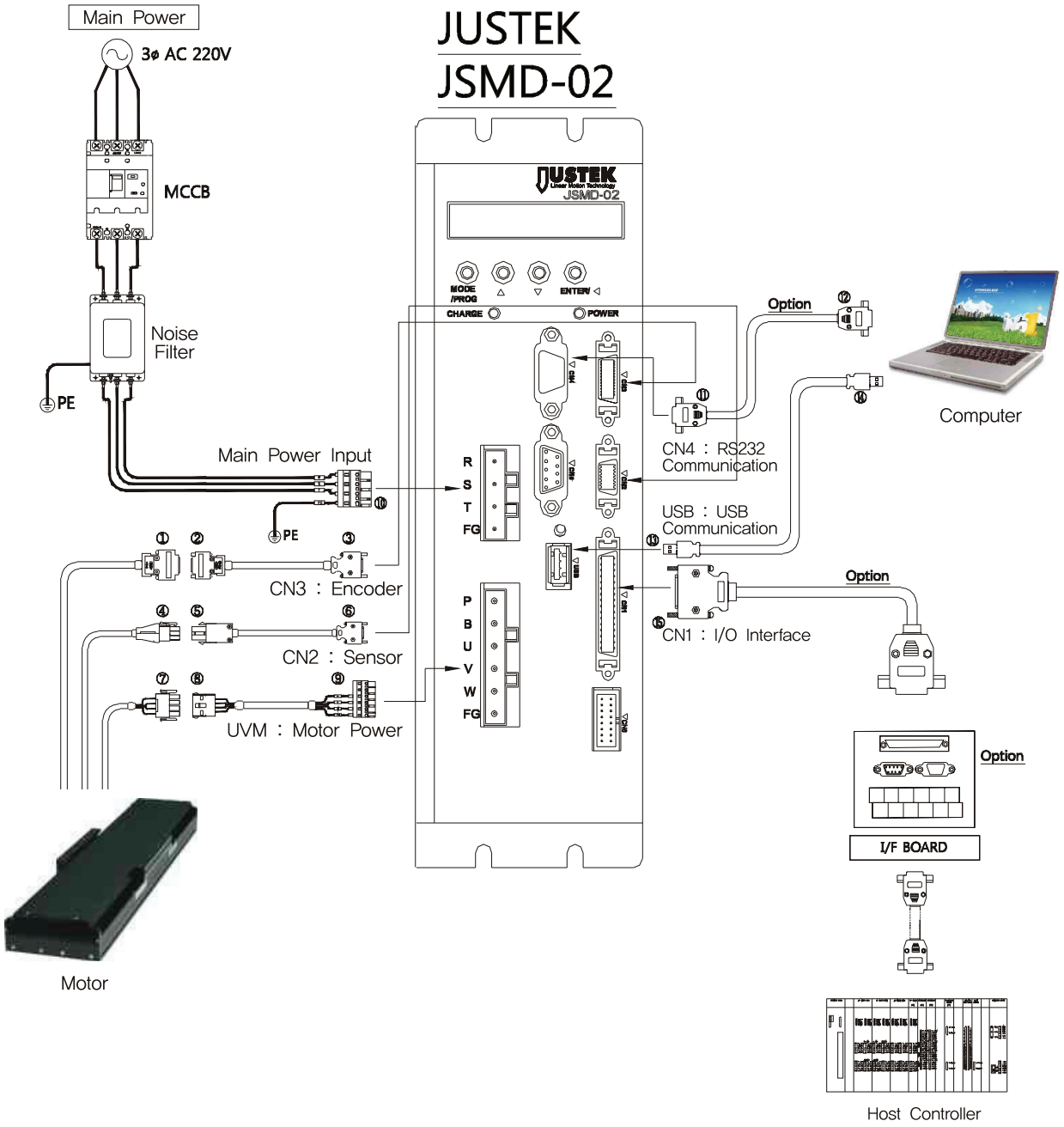
Item		Max. Input frequency	Max. Output frequency	20um pitch encoder		40um pitch encoder	
				Max. resolution	Max. speed	Max. resolution	Max. speed
Interpolation factor	X100	100kHz	10MHz	0.2um	2m/s	40nm	0.4m/s
	X200	100kHz	20MHz	0.1um	2m/s	20nm	0.4m/s
	X400	50kHz	20MHz	50nm	1m/s	10nm	0.2m/s
	X800	25kHz	20MHz	25nm	0.5m/s	5nm	0.1m/s
	X1000	20kHz	20MHz	20nm	0.4m/s	4nm	0.08m/s

- Setting of 0.25um encoder when using a 20um pitch analog encoder

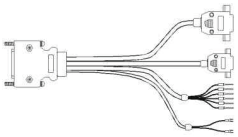
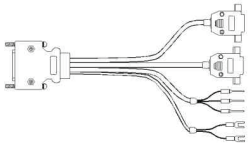
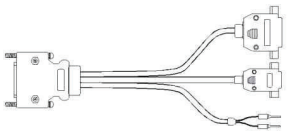
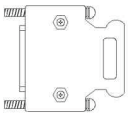
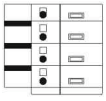
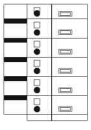
Multiplying Quantity	Dividing rates	Precision	Max. speed
X100	1.25(=5/4)	100nm	2m/s
X200	2.5(=5/2)	50nm	2m/s
X400	5	25nm	1m/s
X800	10	12.5nm	0.5m/s
X1000	12.5(=25/2)	10nm	0.4m/s

Options For Justek Servo Drivers

Schematic Diagram

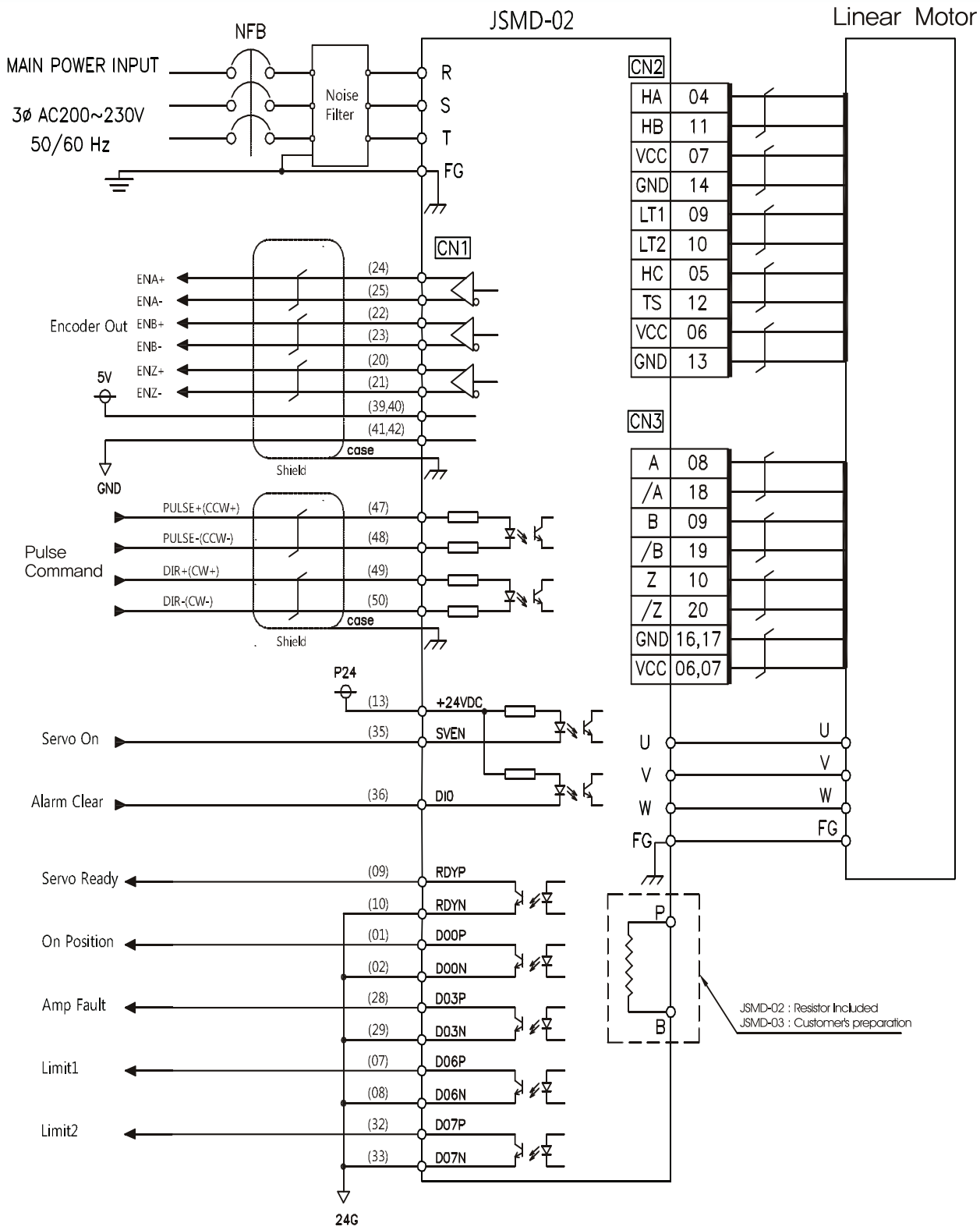


Cables And Connectors

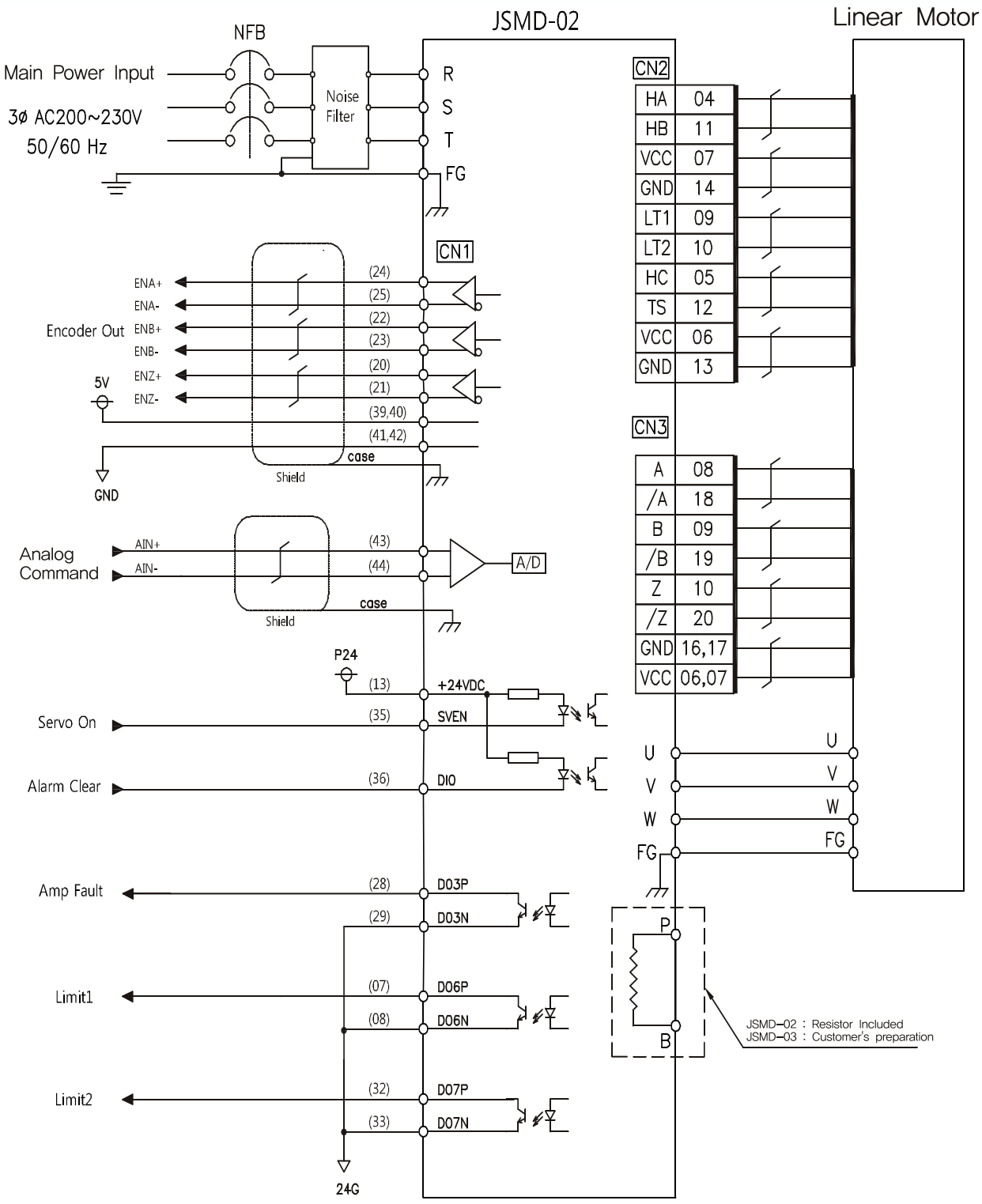
Description			Model	Remarks
For Motor Power Driver Terminal	④	Motor Power Cable	CA–PWRBxM (x:1,2,3,5,7,10)	
For CN2 ↕ Sensor	③	Sensor Cable	CA–SENBxM (x:1,2,3,5,7,10)	
For CN3 ↕ Encoder	②	Encoder Cable	CA–ENCBxM (x:1,2,3,5,7,10)	
For USB ↕ PC	⑤	USB Cable	CA–USBBxM (x:1,2,3,5,7,10)	
For CN4 ↕ PC	⑥	RS232C Cable	CA–RTXBxM (x:1,2,3,5,7,10)	
For CN1 ↕ Host Controller	①	Control Cable (ACC–8DK)	CA–CONDxM (x:1,2,3)	
		Control Cable (UMAC)	CA–CONUxM (x:1,2,3)	
		Control Cable (SERI)	CA–CONSxM (x:1,2,3)	
		Direct PWM Cable	CA–CONPxM (x:2,3)	
Connector		CN–MDR 50P(3M) (10150–3000VE)		
		CN– 4P(WAGO) (721–204/206–000)		
		CN– 6P(WAGO) (721–206/206–000)		

Cabling Examples

Servo Driver Cabling (Pulse Mode)



Servo Driver Cabling (Analog Mode)



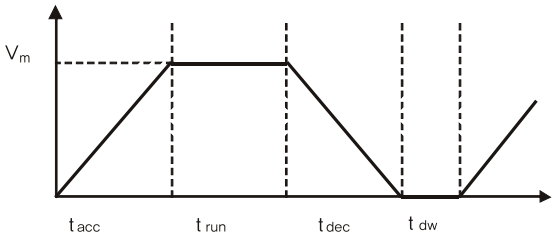
Motor Sizing

Sizing of Linear Motor

Procedure for sizing of motor

Determine velocity profile –〉 Calculate effective force –〉 Select motor power

Determination of velocity profile



#INPUT#

S_m : moving distance (m)
t_{acc} : acceleration time (s)
t_{run} : time for constant velocity (s)
t_{dec} : deceleration time (s)
t_{dw} : dwell time (s)
$t_m = t_{acc} + t_{run} + t_{dec}$: moving time (s)

#OUTPUT#

$V_m = (2\ S_m) / (t_{acc} + t_{dec} + 2\ t_{run})$: Max. velocity (m/s)
$A_{max} = V_{max} / t_{acc}$: Max. acceleration (m/s2)
$D_{max} = V_{max} / t_{dec}$: Max. deceleration (m/s2)
$g(A_{max}) = A_{max}/9.8$

Calculation of effective force

#INPUT#

M_l : payload (kg)
M_m : Mass of linear motor mover (kg)
μ : friction factor of LM bearing (0.003)
g : acceleration of gravity (9.8m/s2)

#OUTPUT#

$F_{acc} = (M_l + M_m) \times A_{max}$: Force at acceleration (N)
$F_{run} = (M_l + M_m) \times \mu \times g$: Force at constant velocity (N)
$F_{dec} = (M_l + M_m) \times D_{max}$: Force at deceleration (N)
F_{rms} : Effective force (N)

$$F_{rms} = \sqrt{\frac{F_{acc}^2 \times t_{acc} + F_{run}^2 \times t_{run} + F_{dec}^2 \times t_{dec}}{t_{acc} + t_{run} + t_{dec} + t_{dw}}}$$

Selection of motor power

V_{max} : Max. velocity of Linear motor(m/s)
F_p : Max. force of Linear motor(N)
F_c : Rated force of Linear motor (N)

Necessary conditions

1) $V_m \leq V_{max}$
2) F_{accmax}, $F_{decmax} \leq F_p$
3) $F_{rms} \leq F_c$

Example of linear motor selection

ex) S_m = 0.3m, t_m = 0.3sec
t_{acc}= t_{dec} = 0.1sec, t_{dw}= 0.2sec
M_m = 3kg, M_l = 5kg

Velocity profile

t_{run}=0.3–(t_{acc}–t_{dec})=0.1sec
V_m = (2 S_m) / (t_{acc} + t_{dec} + 2 t_{run}) = (2 0.4) /0.4 = 2 m/sec
A_{max} = D_{max} = V_m / t_{acc} = 2 / 0.1 = 20 m/sec^2
g(A_{max}) = 20/9.8 = 2.04g

Force calculation

F_{acc} = (M_l + M_m) A_{max} = (5 + 3) 20 = 160N
F_{run} = (M_l + M_m) g = (5 + 3) 0.003 9.8 = 0.23 N
F_{dec} = (M_l + M_m) D_{max} = (5 + 3) 20 = 160 N

$$F_{rms} = \sqrt{\frac{160^2 \times 0.1 + 0.23^2 \times 0.1 + 160^2 \times 0.1}{0.1 + 0.1 + 0.1 + 0.2}} = 101.2N$$

Motor power selection

V_m=1.5m/sec V_{max}, F_{acc}=F_{dec}=160N, F_p ,F_{rms}=101.2N F_c is, The applicable motor is JTKL3619 (V_{max}= 3m/sec, F_p = 312N, F_c=104N)