Dynamic Motor Motion
Technology Corporation

DYN232M
DYN AC SERVO SYSTEM - RS232 MOTION

DTPU
POSITIONING

adaptive TUNING II

DYN 4 Series

AC SERVO DRIVE
INSTRUCTION MANUAL

TYPE A - GENERAL PURPOSE PULSE / ANALOG / RS232
TYPE B - MODBUS
TYPE C - CAN

MODEL: DYN4 - □□□ A, DYN4 - □□□ B, DYN4 - □□□ C

MANUAL CODE: DYN4MS-ZM5-A18A
REVISION: A1.8A

This manual must be kept accessible for the user or operator.

■ Safety Notice ■

The user or operator should read through this manual completely before installation, testing, operation, or inspection of the equipment. The DYN4 series AC Servo Drive should be operated under correct circumstances and conditions. Bodily harm or damage to equipment and system may result if specifications outlined in this document are not followed. Take extra precaution when the following warning convention is used for certain specifications.

⚠ WARNING

■ Notations Used ■

All specification and units of measurement used in the manual are in METRIC:

Mass: Kilogram [kg]
Length: Millimeter [mm]
Time: Seconds [s]
Temperature: Celsius [°C]

■ Standards Compliance ■

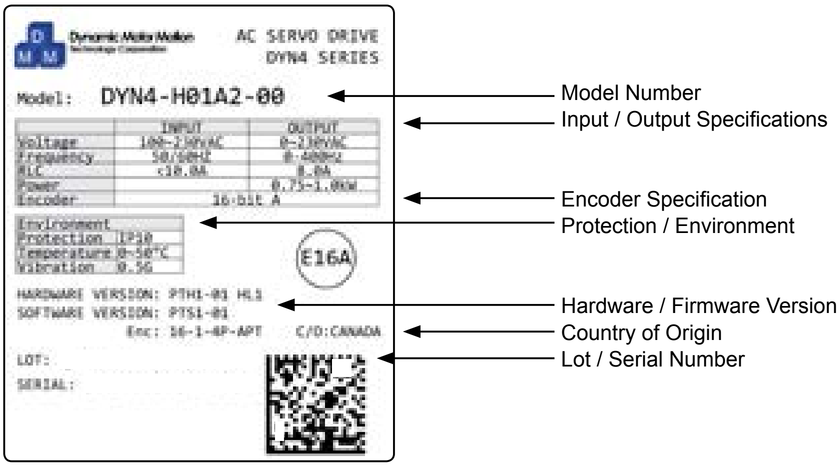
CE	Machinery Directive 2006/42/EC Low Voltage Directive 2014/35/EU Electromagnetic Compatibility 2014/30/EU EN12100:2010 EN 60034-1:2010; EN 60204-1:2006/AC: 2010 EN 61000-6-1: 2007; EN 61000-6-2:2005/AC: 2005

Manual Contents

1 General Specification

1.1 Servo Drive Name Plate

*Note the name plate is region specific and may vary between each region model.



Model Number

Input / Output Specifications

Encoder Specification

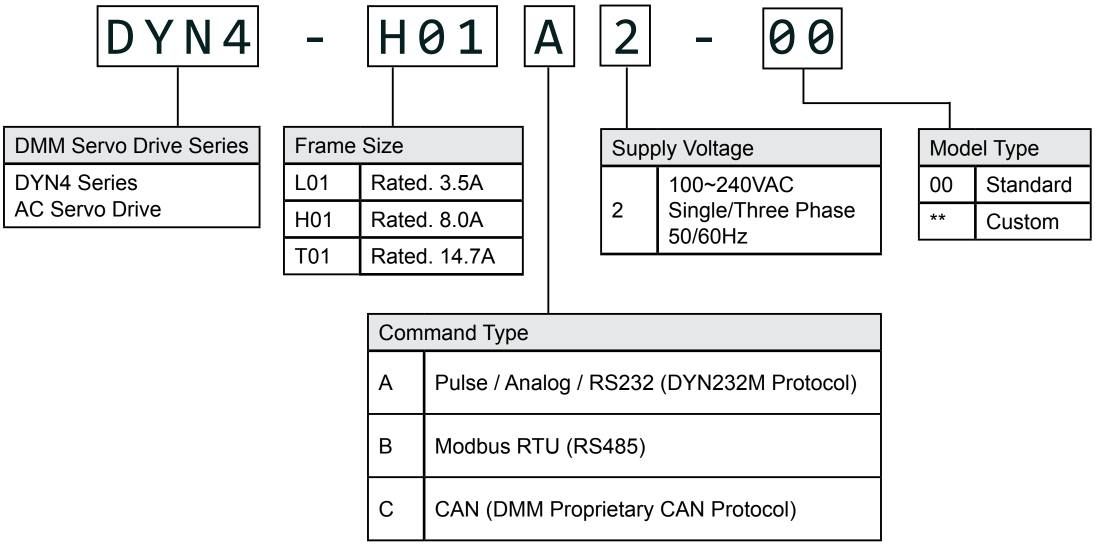
Protection / Environment

Hardware / Firmware Version

Country of Origin

Lot / Serial Number

1.2 Model Designation



DMM Servo Drive Series
DYN4 Series AC Servo Drive

Frame Size	
L01	Rated. 3.5A
H01	Rated. 8.0A
T01	Rated. 14.7A

Supply Voltage	
2	100~240VAC Single/Three Phase 50/60Hz

Model Type	
00	Standard
**	Custom

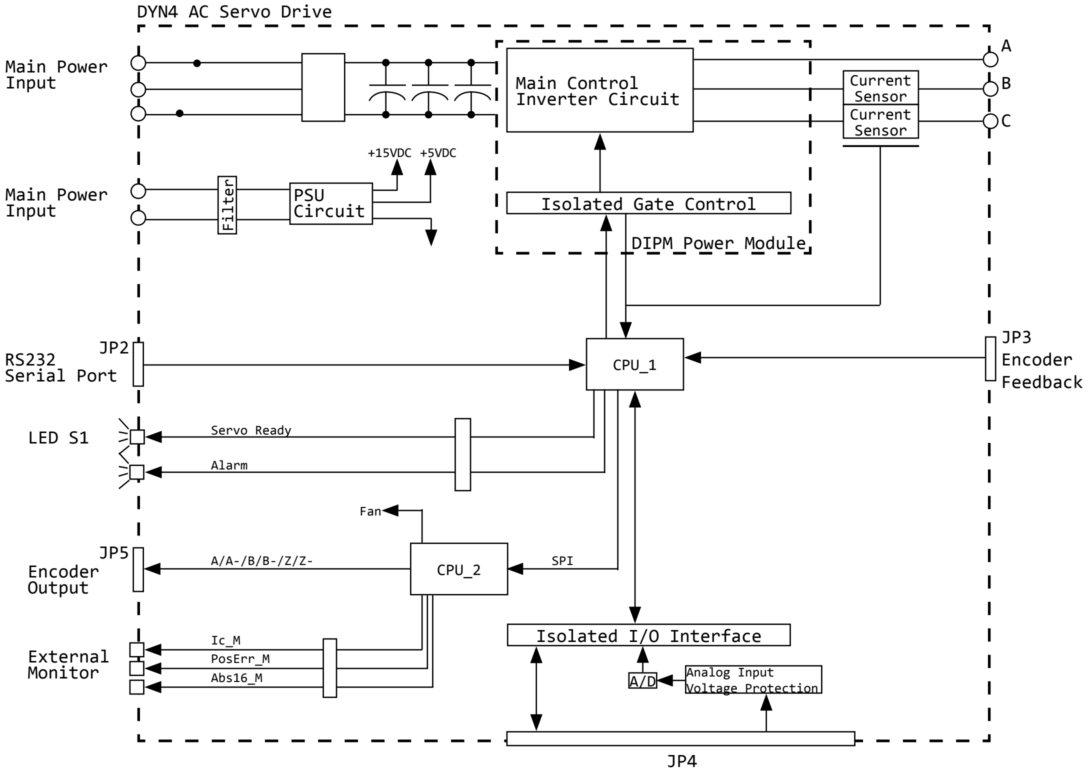
Command Type	
A	Pulse / Analog / RS232 (DYN232M Protocol)
B	Modbus RTU (RS485)
C	CAN (DMM Proprietary CAN Protocol)

1.3 Servo Drive Overall Specification

Model: DYN4 - □□□ - A2		L01	H01	T01
Main Circuit	Rated Voltage	Single-phase or Three-phase 110~240VAC ± 10% 50/60Hz 300VAC Peak		
	Rated Current	3.5A	8.0A	14.7A
Control Logic Circuit	Rated Voltage	Single-phase 110~240VAC ± 10% 50/60Hz		
	Rated Current	0.2A		
Servo Motor Control Method		SVPWM		
Switching Circuit		DMM DIPM Power Module		
Dynamic Brake		Integrated non-adjustable		
Encoder Feedback		16-bit [65,536ppr] Absolute Serial		
Encoder Output		A/B/Z Quadrature Differential Line Driver		
Protection Functions		Over-Current, Over-Voltage, Under-Voltage, Temperature, Over-Power, Position Lost Follow, Encoder Error, CRC Error		
Position Servo	Command Reference Pulse*1	Pulse+Sign, A/B Phase Quadrature 90° Phase Differential, CW+CCW		
	Max. Input Frequency	500kHz		
	Input Voltage	5VDC ± %5 (Higher voltage available as option) Over drive photocoupler diode		
	Electronic Gear Ratio	Set by parameter 500 to 65,536 ppr		
	On Position Output Range	0 ~ 508 pulse		
Speed Servo	Speed Control Range	0:5000		
	Input Reference Voltage	-10VDC ~ +10VDC 3,000rpm at ± 5VDC		
	Resolution	1rpm		
	Max Input Voltage	± 12VDC		
Torque Servo	Input Reference Voltage	-10VDC ~ +10VDC		
	Resolution	5mA motor coil current		
	Max Input Voltage	± 12VDC		
Environment	Protection	IP10		
	Cooling	Chassis Heat Sink		
	Operation Temperature	0~55°C		
	Storage Temperature	-20 ~ 65°C		
	Max. Operation Humidity	95RH% (no dew)		
	Max. Storage Humidity	95RH% (no dew)		
Standards Compliance		CE, ROHS		

Note: 1. CW+CCW Pulse format optional

1.4 Circuit Block Diagram



1.5 Encoder Specification

■ Encoder Model

Model Number	Type	Resolution	Data Type	Interface Type	Sensor	Voltage	Status
ABS-16-00	Absolute	16-bits [65,536ppr]	4-Wire Serial	Differential Driver/ Receiver	Magnetic	+5VDC	A
ABS-14-00	Absolute	14-bits [16,384ppr]	6-Wire Serial	Differential Driver/ Receiver	Magnetic	+5VDC	L

1.6 Servo Motor Pair

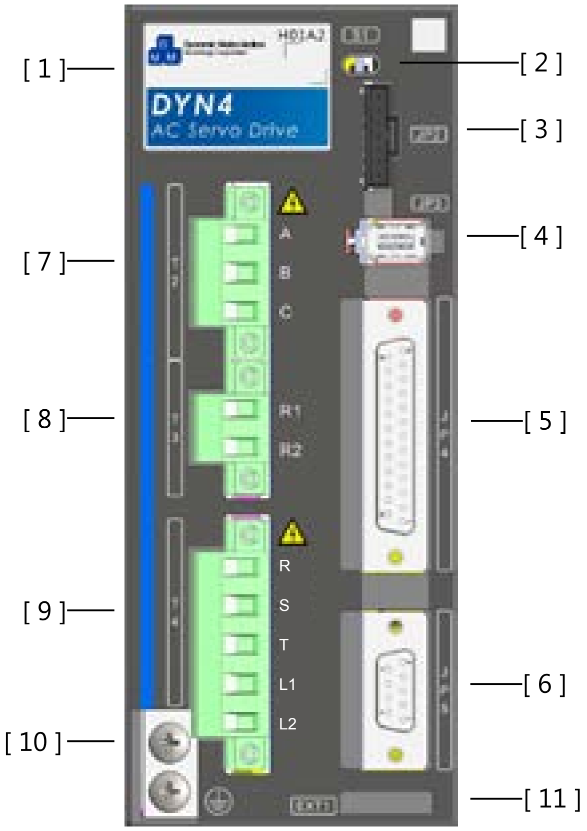
■ Applicable Servo Motor Model

Rated Output	Servo Motor Model		Rated/Peak Torque	Rated/Peak Speed	Servo Drive Pair
	Without Brake	With Brake			
50W Low Inertia	405-DST-A6H□1	405-DST-A6H□B	0.16 / 0.48 Nm	3,000 / 5,000rpm	DYN4 - L01
100W Low Inertia	410-DST-A6H□1	410-DST-A6H□B	0.32 / 0.96 Nm	3,000 / 5,000rpm	
200W Low Inertia	620-DST-A6H□1	620-DST-A6H□B	0.64 / 1.91 Nm	3,000 / 5,000rpm	
400W Low Inertia	640-DST-A6H□1	640-DST-A6H□B	1.27 / 3.82 Nm	3,000 / 5,000rpm	
750W Low Inertia	880-DST-A6H□1	880-DST-A6H□B	2.39 / 7.16 Nm	3,000 / 5,000rpm	DYN4 - H01
750W Medium Inertia	86M-DHT-A6M□1	86M-DHT-A6M□B	2.4 / 7.2 Nm	3,000 / 5,000rpm	
1.0kW Medium Inertia	110-DST-A6H□1	110-DST-A6H□B	4.1 / 12 Nm	1,500 / 3,000rpm	
1.3kW Medium Inertia	115-DST-A6H□1	115-DST-A6H□B	8.27 / 23.3 Nm	1,500 / 3,000rpm	DYN4 - T01
1.8kW Medium Inertia	120-DST-A6H□1	120-DST-A6H□B	11.5 / 28.7 Nm	1,500 / 3,000rpm	

2 Connection and Wiring

2.1 DYN4 Servo Drive Body Layout

■ DYN4 - L01, H01, T01 Frame



No.	Name	Description
1	---	Face plate and frame code
2	S1	Status LED / charge LED
3	JP2	PC interface connection
4	JP3	Encoder feedback connector
5	JP4	Main signal I / O
6	JP5	Encoder output connector
7	T2	Servo motor power output
8	T3	Regenerative resistor connector
9	T4	Main circuit and control logic circuit input connector
10	PE	Protective earth / chassis ground
11	EXT1	Extended interface connector

2.2 Connector Terminal and Signal Specification

Connector Details — Signal Layout

- **JP2** PC interface connection
  Connector Type: 2.54mm Pitch Rectangular
  Drive Header: (Molex) 70553-0041
  Plug Connector: (Molex) 50-57-9407

Pin.1	Gnd
Pin.2 ~ Pin.4	NC
Pin.5	RS232 signal input, RxD, TTL/CMOS
Pin.6	RS232 signal output, TxD, TTL/CMOS
Pin.7	+5(V), <10(mA)

- **JP3** Encoder feedback connector
  Connector Type: IEEE1394 USB
  Drive Header: (3M) 3E106
  Plug Connector: (3M) 36210-0100FD

Pin.1	+5VDC
Pin.2	Gnd
Pin.3~4	NC
Pin.5	S+
Pin.6	S-

- **JP4** Main Signal I/O
  *Refer to Section 2.3

*Refer to Section 2.3

- **JP5** Encoder output connector
  *Refer to Section 2.4

*Refer to Section 2.4

- **T2** Servo motor power output
  Connector Type: Terminal Block
  Drive Header: (Phoenix) GMSTB 2.5/3-GF-7.62
  Plug Connector: (Phoenix) GMSTB 2.5/3-STF-7.62

Pin.1	Motor A Phase
Pin.2	Motor B Phase
Pin.3	Motor C Phase

- **T3** Regenerative resistor connector
  Connector Type: Terminal Block
  Drive Header: (Phoenix) GMSTB 2.5/2-GF-7.62
  Plug Connector: (Phoenix) GMSTB 2.5/2-STF-7.62

Pin.1	R1 - Resistor 1
Pin.2	R2 - Resistor 2

- **T4** Main circuit input connector
  Connector Type: Terminal Block
  Drive Header: (Phoenix) GMSTB 2.5/5-GF-7.62
  Plug Connector: (Phoenix) GMSTB 2.5/5-STF-7.62

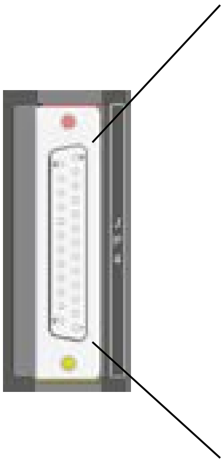
Pin.1	Main circuit R
Pin.2	Main circuit S
Pin.3	Main circuit T
Pin.4	Logic circuit L1
Pin.5	Logic circuit L2

2.3 JP4 Main I/O Terminal Details

2.3.1 JP4 Specification

- JP4 Main signal I/O
  Connector Type: D-Sub 25 pin female
  Recommended Wire Gauge: 0.2mm^2 (AWG24)

- Pin Layout (Viewed from drive header side)



		AIN+	13
25	AIN-	GND	12
24	+5VOUT	PUL+	11
23	PUL-	DIR-	10
22	DIR+	GND	9
21	MO_IC	MO_POS	8
20	MO_ABS	SRDY	7
19	BKO	ONPOS	6
18	ALM	COM	5
17	+14VOUT	+14VIN	4
16	+24VIN	SHOLD	3
15	ENA	ABS_H	2
14	DIN4	COM	1

- Pin Details

See section 2.3.2 for interface circuit type examples

Pin No.	Symbol	Details	I/O	Interface Circuit
1	GND	Internal Signal Ground	NA	NA

Pin No.	Symbol	Details	I/O	Interface Circuit
2	ABS_H	- Absolute encoder auto home - Servo motor position returns to absolute encoder zero position. Servo starts from absolute zero. - Active High	Input	A

Pin No.	Symbol	Details	I/O	Interface Circuit
3	SHOLD	- Servo hold input - Servo drive ignores command input - Active High - *Not installed for firmware version PTS1-01	Input	A

See section 2.3.2 for interface circuit type examples

Pin No.	Symbol	Details	I/O	Interface Circuit
4	+14VIN	- External +14VDC input - Supply power for digital input circuit A	Input	A

Pin No.	Symbol	Details	I/O	Interface Circuit
5	COM	- Output photocoupler open collector common - For digital output circuit B	Output	B

Pin No.	Symbol	Details	I/O	Interface Circuit
6	ONPOS	- Servo on position output - Photo transistor ON when on position - Servo On Position if motor position error within value set by *OnPosRange* parameter. - Refer to section 5.1 for parameter setting details	Output	B

Pin No.	Symbol	Details	I/O	Interface Circuit
7	SRDY	- Servo Ready Output - Photo transistor ON when servo ready for command	Output	B

Pin No.	Symbol	Details	I/O	Interface Circuit
8	MO_POS	- Position error monitor output - Refer to section 4.6 for details	Output	E

Pin No.	Symbol	Details	I/O	Interface Circuit
9	GND	- Internal signal ground	NA	NA

Pin No.	Symbol	Details	I/O	Interface Circuit
10	DIR-	DIR-, B-, CCW- pulse reference	Input	C

Pin No.	Symbol	Details	I/O	Interface Circuit
11	PUL+	PUL+, A+, CW+ pulse reference	Input	C

Pin No.	Symbol	Details	I/O	Interface Circuit
12	GND	- Internal signal ground	NA	NA

Pin No.	Symbol	Details	I/O	Interface Circuit
13	AIN+	- Analog reference input POSITIVE	Input	D

See section 2.3.2 for interface circuit type examples

Pin No.	Symbol	Details	I/O	Interface Circuit
14	DIN4	Optional digital input 4	Input	A

Pin No.	Symbol	Details	I/O	Interface Circuit
15	ENA	- Servo enable/disable input - Active Low (servo disabled when low) - Motor coasts when servo disabled (shaft free) - Disable clears all pulse/analog commands - Disable clears all position calculation and error	Input	A

Pin No.	Symbol	Details	I/O	Interface Circuit
16	+24VIN	- External +24VDC input - Supply power for digital input circuit A	Input	A

Pin No.	Symbol	Details	I/O	Interface Circuit
17	+14VOUT	- Servo drive internal +14VDC output - Max Current Draw: 100mA	Output	NA

Pin No.	Symbol	Details	I/O	Interface Circuit
18	ALM	- Servo alarm output - Photo transistor ON when servo alarmed	Output	B

Pin No.	Symbol	Details	I/O	Interface Circuit
19	BKO	- Holding brake output - Refer to section 2.6 for wiring details - Refer to section 3.3.2 for timing details	Output	Section 2.6

Pin No.	Symbol	Details	I/O	Interface Circuit
20	MO_ABS	- Absolute encoder position monitor output - Refer to section 4.6 for details	Output	E

See section 2.3.2 for interface circuit type examples

Pin No.	Symbol	Details	I/O	Interface Circuit
21	MO_IC	- Servo drive output current monitor - Refer to section 4.6 for details	Output	E

Pin No.	Symbol	Details	I/O	Interface Circuit
22	DIR+	DIR+, B+, CCW+ pulse reference	Input	C

Pin No.	Symbol	Details	I/O	Interface Circuit
23	PUL-	PUL-, A-, CW- pulse reference	Input	C

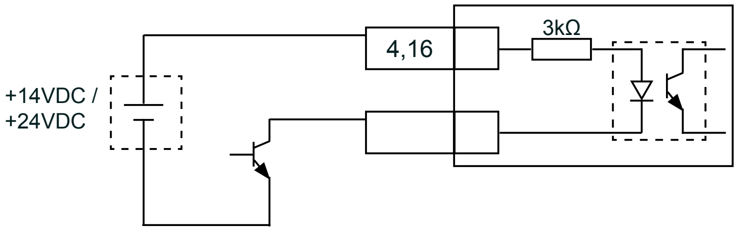
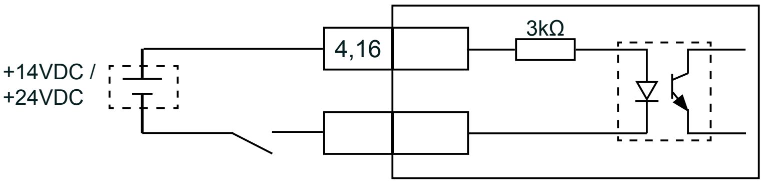
Pin No.	Symbol	Details	I/O	Interface Circuit
24	+5VOUT	- Servo drive internal +5VDC output - Max current draw: 50mA	Output	NA

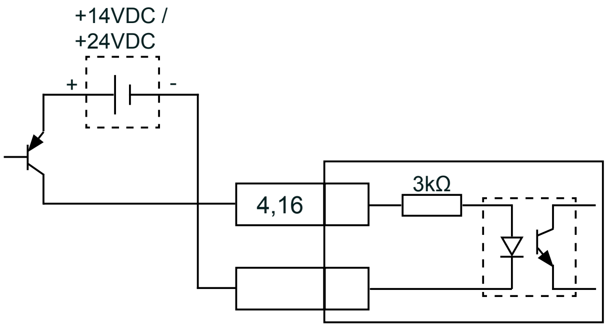
Pin No.	Symbol	Details	I/O	Interface Circuit
25	AIN-	- Analog reference input NEGATIVE	NA	D

2.3.2 JP4 Interface Circuit Examples

General Input Circuit

Interface Type	Applicable Signals	Specification
A	[JP4-2] ABS_H [JP4-3] SHOLD [JP4-4] +14VIN [JP4-14] DIN4 [JP4-15] ENA [JP4-16] +24VIN	- Use external +14VDC or +24VDC power supply - Can also use internal +14VDC power supply JP4-17 - Max 30VDC input, 10mA - Do not use same +24VDC power supply as holding brake

Circuit Example (Sink Circuit)	Notes
Open Collector  	- NPN Transistor
Relay/Switch  	

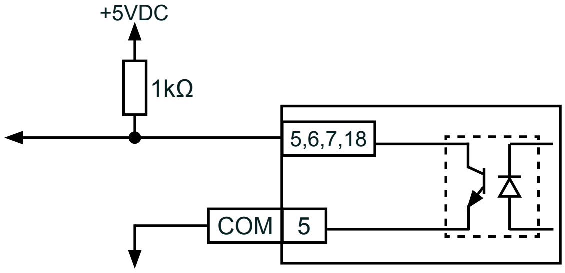
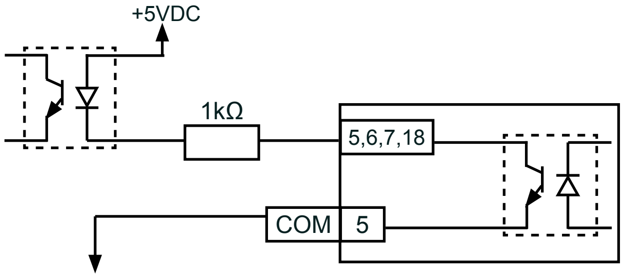
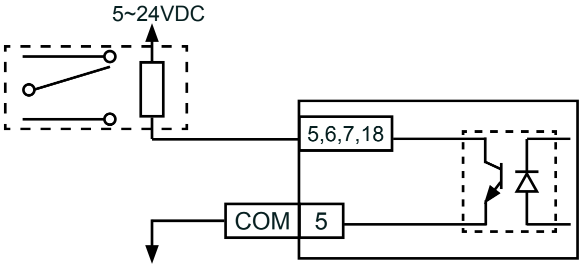
Circuit Example (Source Circuit)	Notes
Open Collector  	- PNP Transistor

Example logic using +24VDC power supply:

Power Supply	PNP Transistor	Voltage Level	Signal
+24VDC	OFF	0V	Low
	ON	24V	High

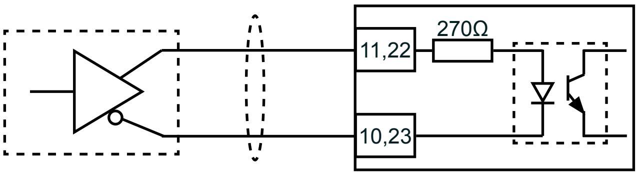
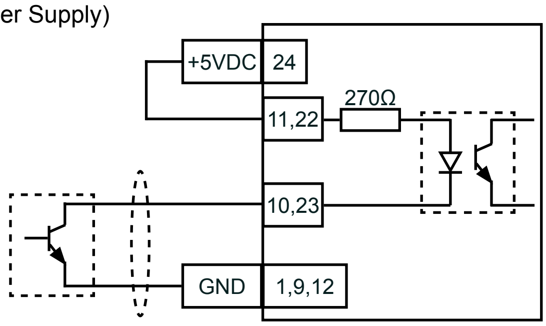
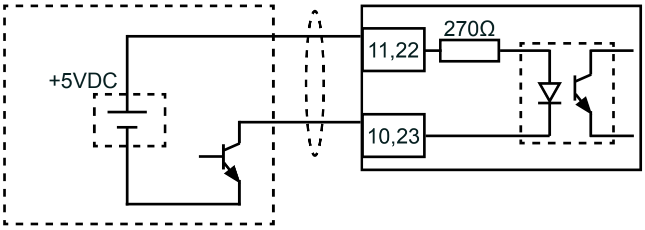
General Output Circuit

Interface Type	Applicable Signals	Specification
B	[JP4-5] COM [JP4-6] ONPOS [JP4-7] SRDY [JP4-18] ALM	- Max 30VDC, 50mA - Recommended +24VDC or +5VDC

Circuit Example	Notes
Collector 	
Photocoupler 	
Relay 	

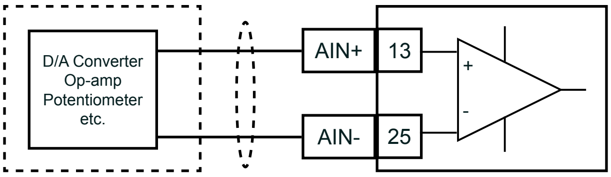
Position Reference Pulse Input Circuit

Interface Type	Applicable Signals	Specification
C	[JP4-10] DIR- [JP4-11] PUL+ [JP4-22] DIR+ [JP4-23] PUL-	- Voltage: +5VDC ± %10 (Contact DMM if higher level such as 12/24VDC is required) - Max pulse frequency: 500kHz - Minimum pulse width: 800us

Circuit Example	Notes
Line Driver 	- Twisted pair cable with shield grounded on receiver side.
Open Collector (DYN4 Internal Power Supply) 	- Twisted pair cable with shield grounded on receiver side.
Open Collector (External Power Supply) 	- Power supply provided by host controller or external source. - Twisted pair cable with shield grounded on receiver side.

Analog Input Circuit

<table>
<tr><th>Interface Type</th><th>Applicable Signals</th><th colspan="2">Specification</th></tr>
<tr><td>D</td><td>[JP4-13] AIN+
[JP4-25] AIN-</td><td colspan="2">- Max ±12VDC
- Max 0.1mA</td></tr>
<tr><th colspan="3">Circuit Example</th><th>Notes</th></tr>
<tr><td colspan="3">



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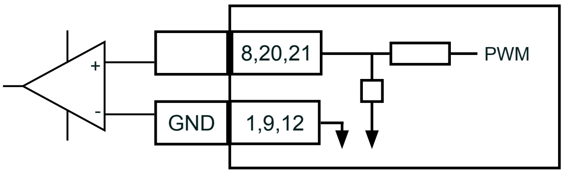
Analog Output Circuit

<table>
<tr><th>Interface Type</th><th>Applicable Signals</th><th colspan="2">Specification</th></tr>
<tr><td>E</td><td>[JP4-8] MO_POS
[JP4-20] MO_ABS
[JP4-21] MO_IC</td><td colspan="2">- 0~3.3VDC output
- Max 0.33mA</td></tr>
<tr><th colspan="3">Circuit Example</th><th>Notes</th></tr>
<tr><td colspan="3">



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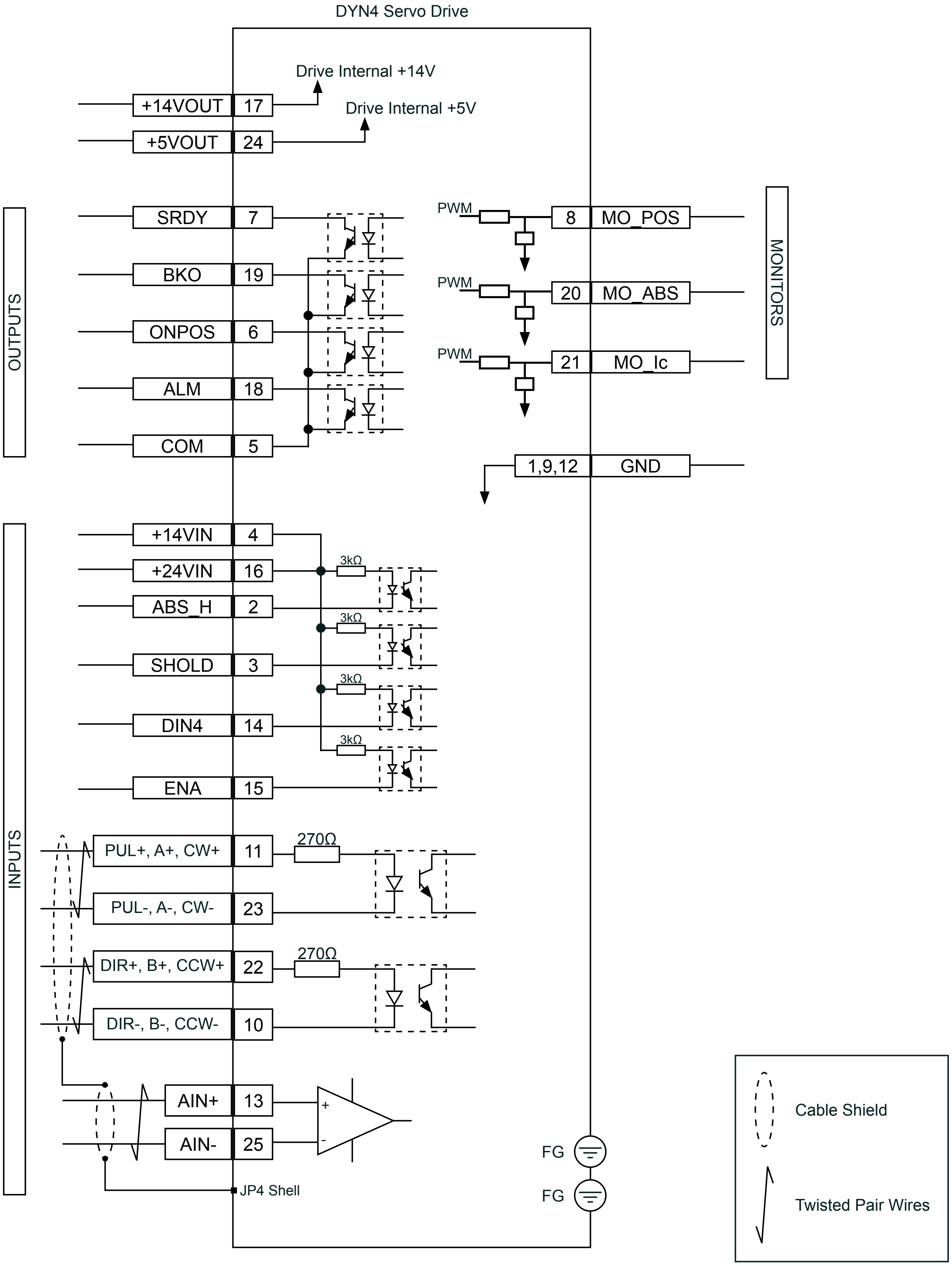
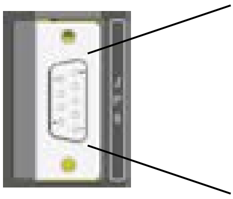
2.3.3 JP4 Consolidated Interface Circuit



- JP5 Encoder output
  Connector Type: D-Sub 9-pin
  Recommended Wire Gauge: 0.2mm^2 (AWG24)

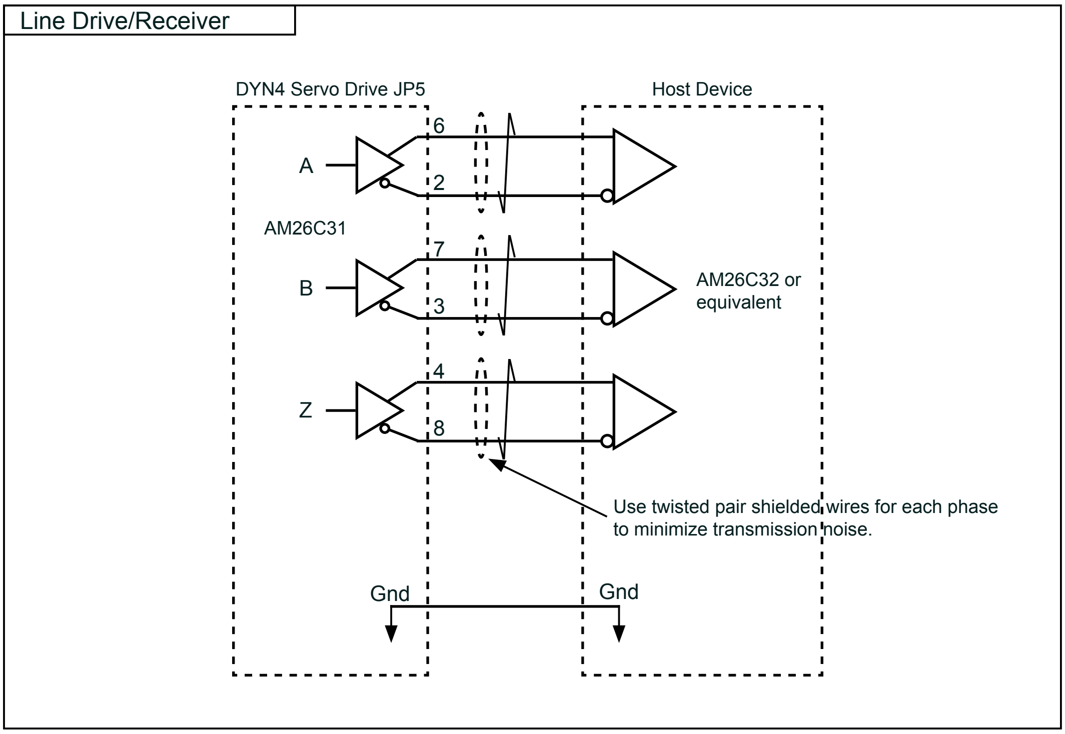
- Pin Layout (Viewed from drive header side)

Ground of JP5 connector is connected to D-Sub 9 shell. When using encoder output, make sure ground between host device and DYN4 servo drive is connected together.



		NC	5
9	NC	Z+	4
8	Z-	B-	3
7	B+	A-	2
6	A+	NC	1

- Connection Circuit



Use twisted pair shielded wires for each phase to minimize transmission noise.

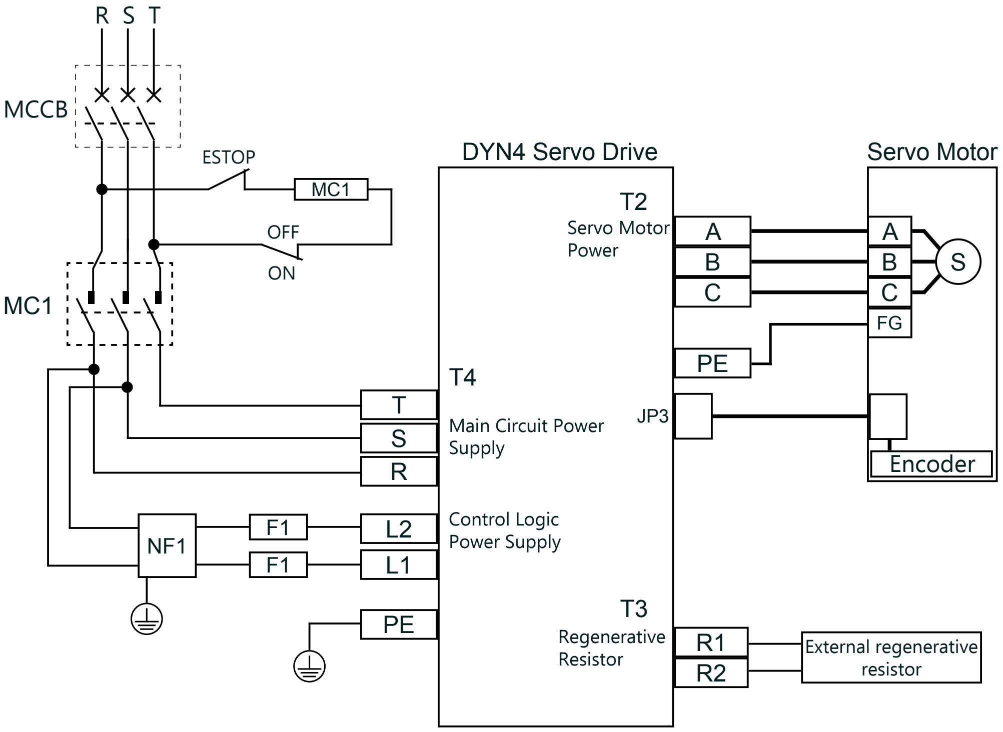
Main Circuit Wiring

Supply Voltage: Single / Three Phase 100VAC ~ 240VAC.

⚠ WARNING

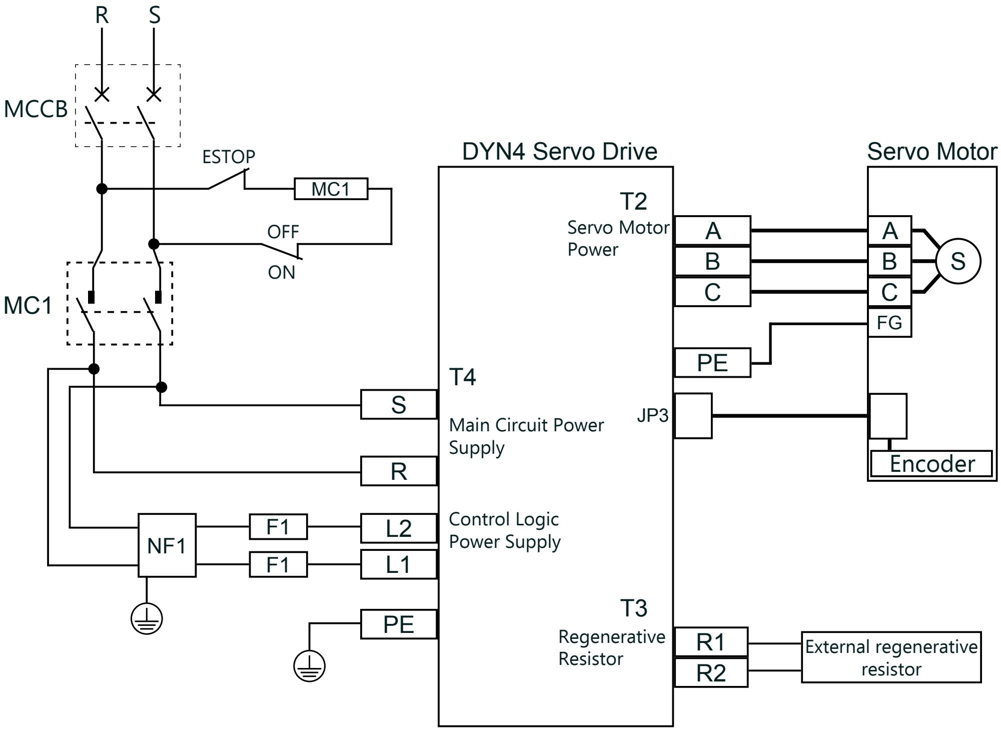
- For Single Phase input, connect the power supply to the R and S terminals of the Main Circuit Power Supply T4.
- Voltage across any two R,S,T,L1,L2 terminals must not exceed 240VAC.
- Refer to Appendix B - DYN4 Servo Drive - AC Power Supply Guidelines (Application Note# AP15-48)

Three Phase Input:



Component	Part	Recommended Component Specifications
MCCB	Molded case circuit breaker	240VAC 30A Rated Current
MC1	Magnetic contactor	240VAC 30A Rated Current
F1	Fuse	1A
NF1	Common mode noise filter	Schaffner FN610-1 or equivalent

Single Phase Input:

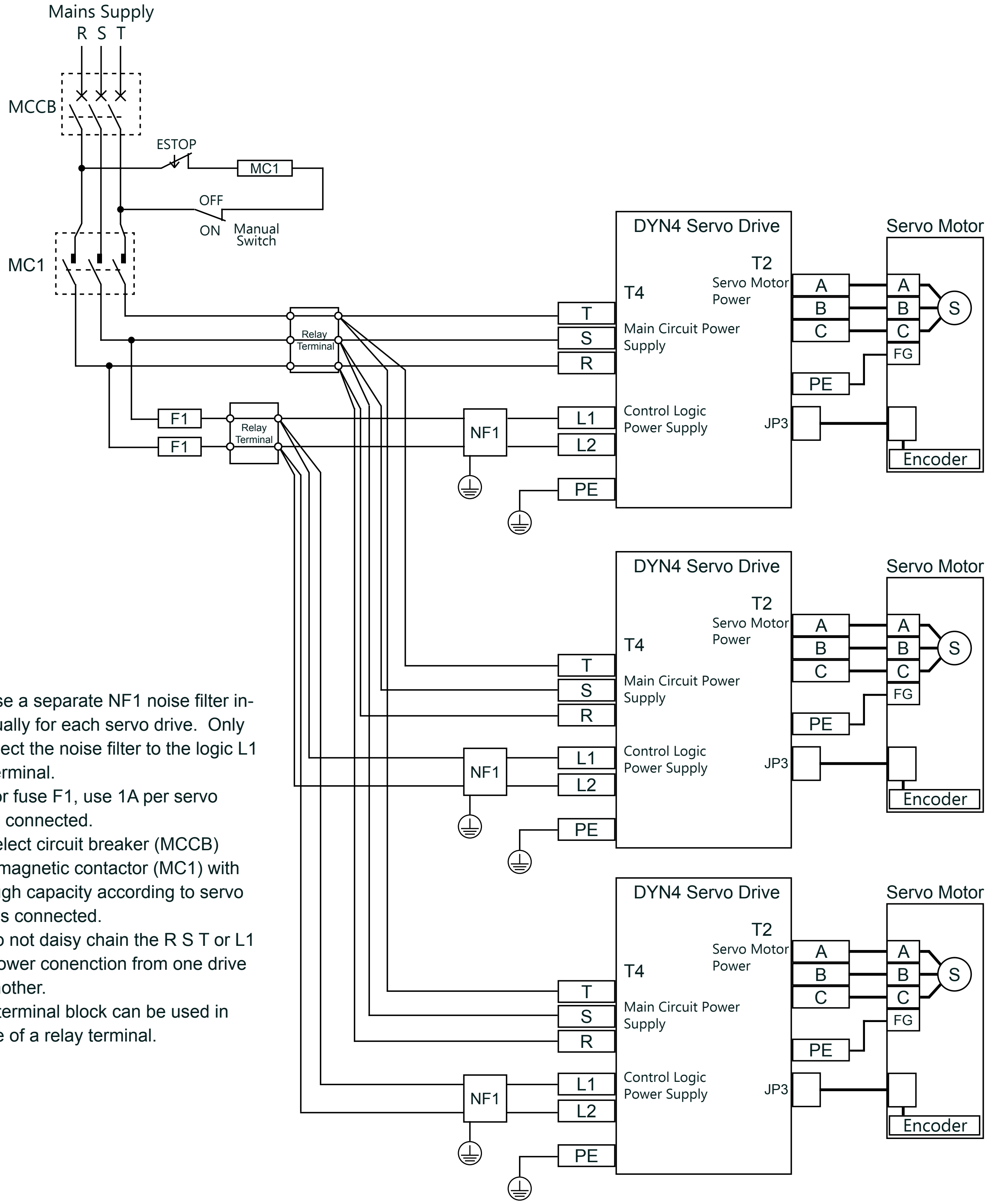


Component	Part	Recommended Component Specifications
MCCB	Molded case circuit breaker	240VAC 50A Rated Current
MC1	Magnetic contactor	240VAC 50A Rated Current
F1	Fuse	1A
NF1	Common mode noise filter	Schaffner FN610-1 or equivalent

Multiple Drives

Multiple drives can share the same mains power supply. Select MCCB, MC1 and F1 size according to number of drives. Example. if 2 servo drives are connected, select a 60A rated MCCB and 2A rated fuse. Use a single point star connection from a single relay or strip terminal to distribute power to each servo drive.

Connect noise filter NF1 individually for each drive.

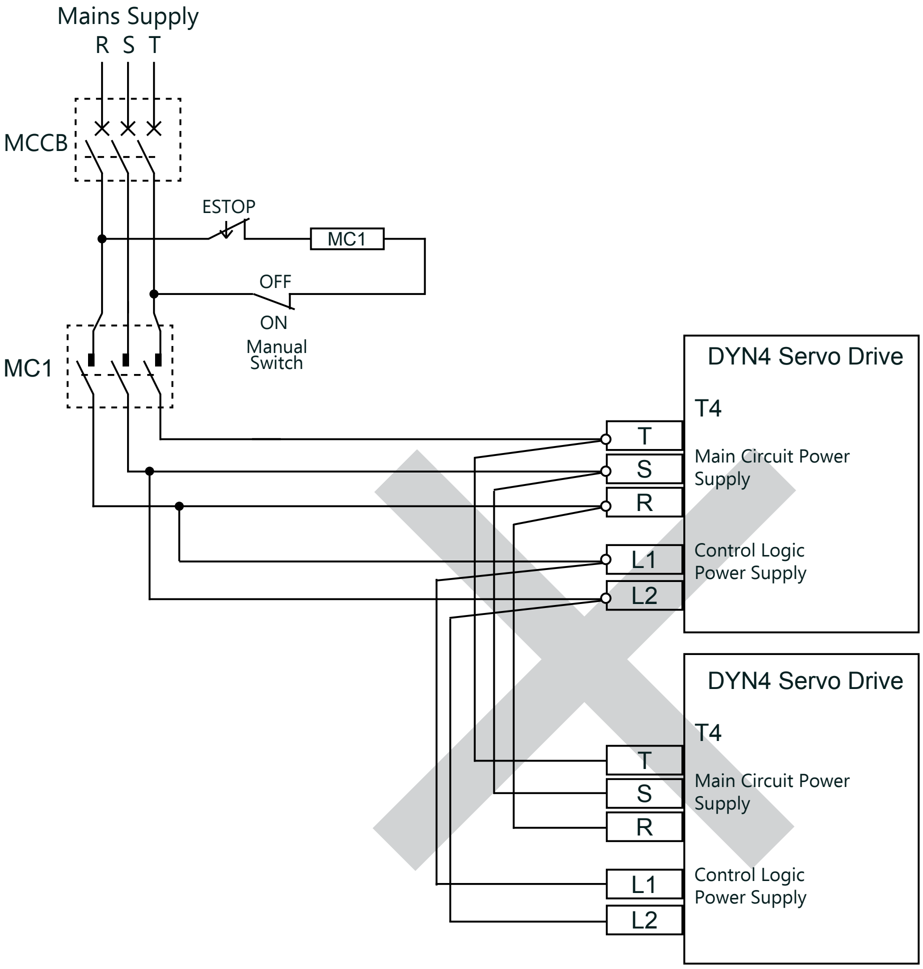


Note

1. Use a separate NF1 noise filter indivitually for each servo drive. Only connect the noise filter to the logic L1 L2 terminal.
2. For fuse F1, use 1A per servo drive connected.
3. Select circuit breaker (MCCB) and magnetic contactor (MC1) with enough capacity according to servo drives connected.
4. Do not daisy chain the R S T or L1 L2 power conenction from one drive to another.
5. A terminal block can be used in place of a relay terminal.

⚠ WARNING

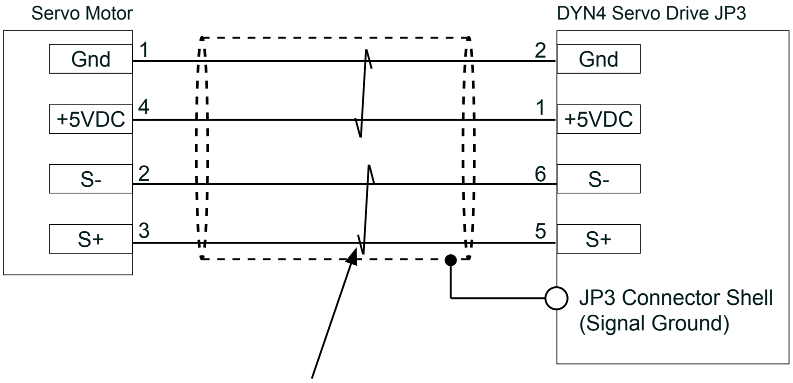
- Do not daisy chain the main power input from one drive to another. The different power levels of each servo drive can cause permanemt damage at power ON or during operation.


Mains Supply
R S T
MCCB
ESTOP
MC1
OFF
ON
Manual Switch
MC1
DYN4 Servo Drive
T4
T
S
R
Main Circuit Power Supply
L1
L2
Control Logic Power Supply
DYN4 Servo Drive
T4
T
S
R
Main Circuit Power Supply
L1
L2
Control Logic Power Supply

⚠ WARNING

• Do not connect encoder cable shielding to earth ground. Connect the encoder cable shielding to the signal ground on the servo drive end.

Encoder Cable



Gnd and +5VDC signals should be twisted pair.
S- and S+ signals should be twisted pair.

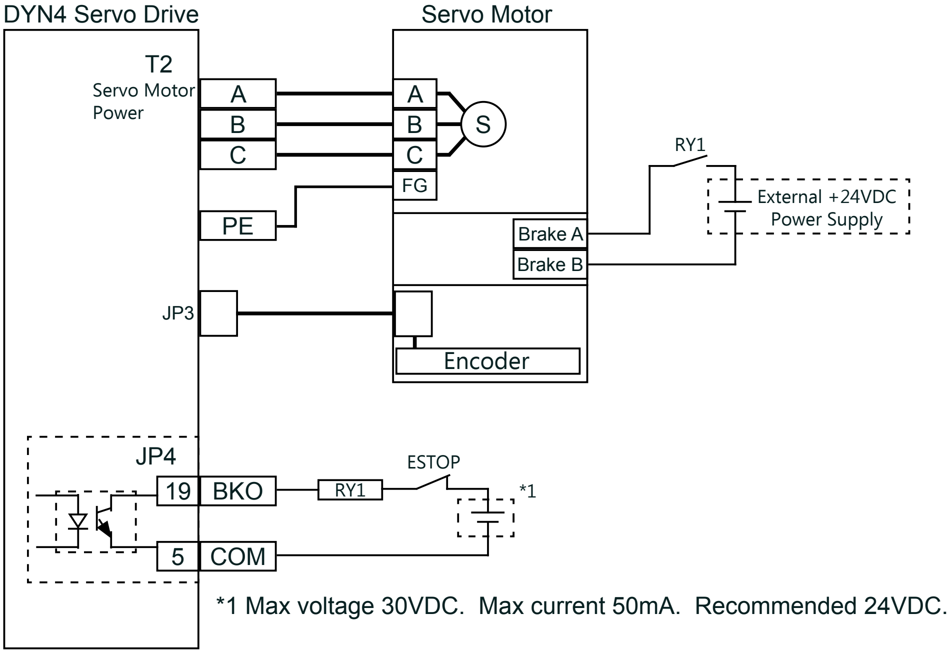
Regenerative Resistor

The DIPM power module unit built into the DYN4 servo drive is designed with a very efficient bus voltage attenuation control circuit. It is much more efficient than conventional servo drives when handling servo motor regenerative energy. Generally, external regenerative resistors are not needed. If the servo drive often throws “Over Voltage“ alarm, contact DMM representative for custom regenerative energy sizing procedures.

2.6 Holding Brake Circuit Wiring

An external relay circuit should be used to control servo motor holding brake. The relay logic should be triggered by the BKO signal [JP4-19]. An e-stop switch should also be able to engage the holding brake in emergency situations. Refer to Section 3.3.2 for the holding brake control timing. BKO logic determined by servo Enable logic. BKO phototransistor ON whenever servo drive is enabled.

The DYN4 servo drive is enable by default upon power ON. If the control logic circuit (L1, L2) is powered ON before the main circuit (R, S, T) the brake motor might fall due to BKO phototransistor ON and motor not energized. In this case, connect an additional relay to control BKO circuit logic.



*1 Max voltage 30VDC. Max current 50mA. Recommended 24VDC.

- Do not use the holding brake to decelerate or stop the servo motor under normal operation.
- Check the servo motor brake connector polarity before operating the brake.
- The holding brake draws higher current than standard I/O signals, use independent DC power supplies for the holding brake and the servo drive I/O control interface power.
- Holding brake inertia will affect servo motor performance. Servo motors with holding brake option will have lower load inertia ratio capacity and angular acceleration.
- Holding brake is servo motor frame size-specific. Contact DMM representative for full specifications.

3 Start - Up

3.1 Preparation and Mounting

■ Unpacking

Remove the servo drive form the box and lining and visually inspect there is no damage to product. Check that the plug connectors for terminals T2, T3 and T4 are included. The servo drive packaging does not include a physical copy of the instruction manual. Take note of the hardware and firmware version labeled and ensure it is the same version as listed on this instruction manual cover.

■ Mounting

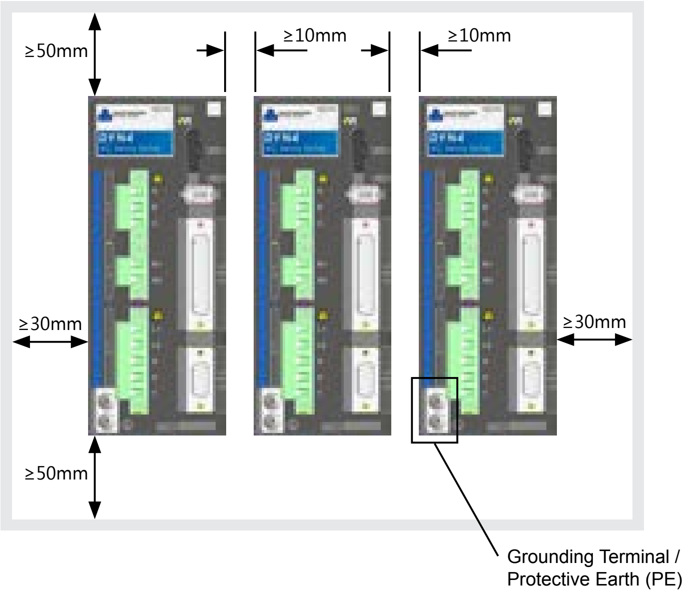
The servo drive can be mounted vertically or horizontally. Ensure that the circulation air flow is parallel to the heat sink blades.

Use 2 x M4 screws to mount the servo drive onto a grounded and electrically conductive surface. See Appendix A for mounting dimensions.

■ Cables and Wire Management

Keep all cables wires as short as possible and avoid loops. Keep high voltage lines including main power input and servo motor power output lines far away from low voltage lines including I / O cables, PC interface cable and encoder feedback cable. Securely route all cables to avoid damage during operation. Ensure none of the cables are pulling on the connectors or terminals. Maintain highest contact surface area.

3.2 Multiple Drive Spacing



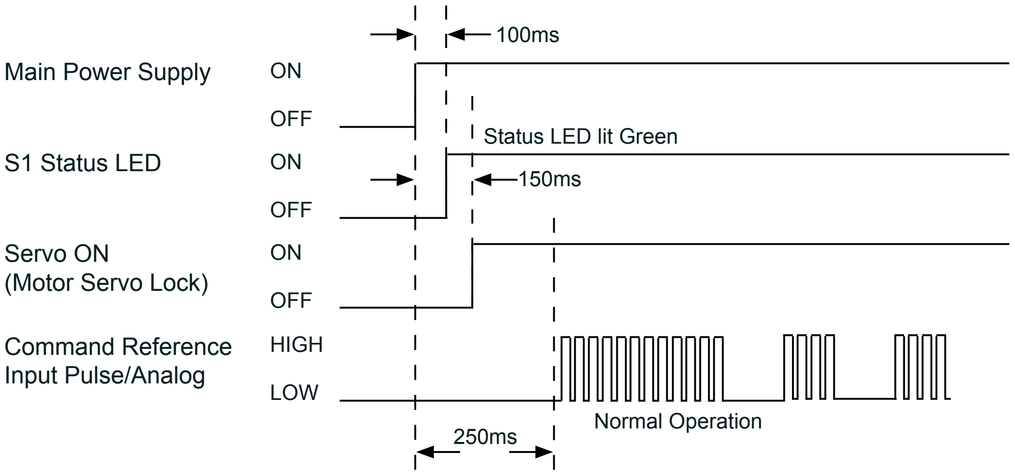
3.3 Grounding

Use a star connection to connect each servo drive grounding terminals to earth at one single point. Do not use daisy chain connection between each servo drive as it may cause noise and interference. Connect power source earth to one terminal and motor frame ground to other terminal.

3.4 Power Up Timing Chart

3.4.1 Power ON Timing

After servo drive power ON, wait at least 150ms before sending pulse, analog or serial command to servo drive.



- ♦ Supply Power Cycle

Do not cycle the main power supply quickly as internal circuit may be permanently damaged. Power to servo drive should be turned on once during each operation cycle.

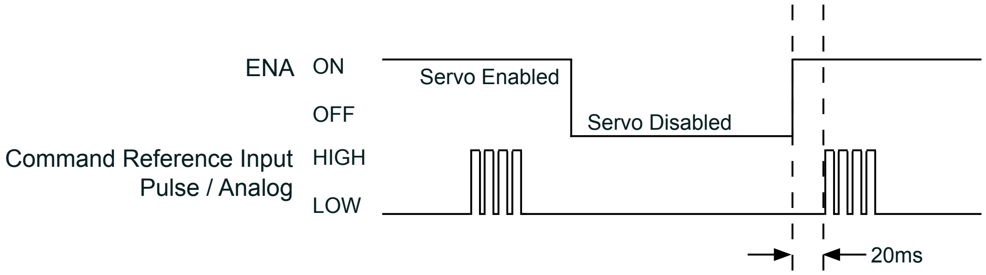
- ♦ Power Off Residual Voltage

After drive power off, the user should wait at least 60 seconds before servicing or touching the servo drive frame. Residual voltage may remain in the circuit after immediate power off. 60 seconds is needed for full discharge.

The residual voltage may cause the servo motor to rotate for a short period even after immediate power off. Consider this effect for emergency situations and take safety precaution to prevent damage to personnel, equipment or machine.

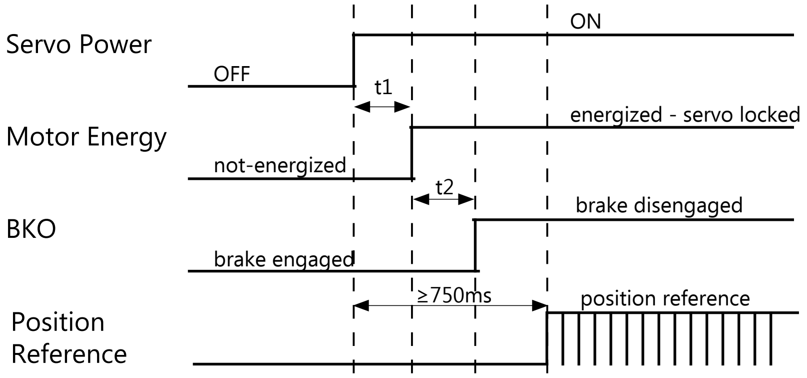
■ Servo Disable / Enable Timing

When using the ENA signal to disable the servo drive to coast servo motor, do not cycle this input rapidly ON/OFF. If the signal is cycled too fast, the servo drive will not have enough time to initialize the control program during Enable and can cause unwanted or dangerous results. Ensure that in the control program, the below timing is satisfied. Once Disabled, do not Enable the servo drive during motor coast or any time motor shaft is rotating, make sure motor rotation has completely stopped before Enable again.



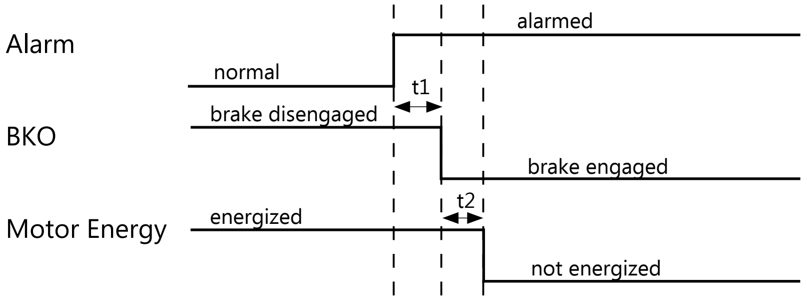
3.4.2 Holding Brake Timing

Timing 1 - Servo Main Power ON



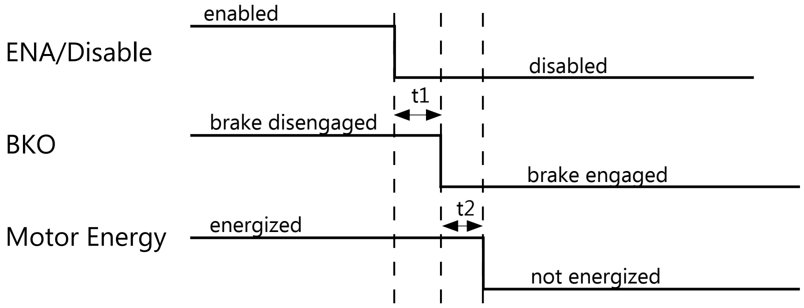
t1 = ≤500ms
t2 = 5ms

Timing 2 - Alarm



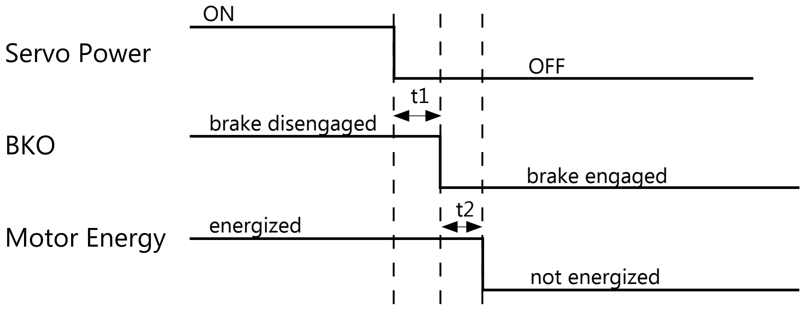
t1 = 5ms
t2 = ≤5ms

Timing 3 - Servo OFF / Disable



t1 = ≤5ms
t2 = ≤5ms

Timing 4 - Servo Main Power OFF



t1 = ≤100ms
t2 = ≤500ms

3.5 Software Communication

3.5.1 DMMDRV Software Communication

♦ PC Requirements

Operating System: Windows XP SP3 or higher
*Recommended: Windows 7 (32-bit / 64-bit)
Processor: Pentium 1 GHz or higher
RAM: 512 MB or more
Framework: .NET Framework 4 or higher
Minimum disk space: 60MB

*See User Manual DSFEN for complete set up instructions:

DMMDRV
Software User Manual

3.5.2 DMMDRV4$^{©}$ Software Communication (Legacy)

♦ PC Running Requirements

Win98/XP/2000/Vista/7
250Mhz CPU
64MB RAM
250MB Hard Disk Space

The servo drive should be powered up with the servo motor encoder feedback and motor power cables connected. The servo motor shaft will be servo-locked when powered ON. Connect the RS232 tuning cable from port JP2 to host PC.

♦ DMMDRV Start Up

1) Open the DMMDRV4.exe executable
2) Select “COMSET“ --> “COM PORT“
3) Change the port number to the servo drive connected RS232 port, then select “OK”
4) Select “SERVO SETTING”
5) Select DYN4 Servo Drive
6) Press Read on the Setting driver parameters and mode dialogue box. After approximately 1~2 seconds, the on-screen parameters will change according to the current internal parameter settings of the connected servo drive. Ensure that the Driver Status indicates ServoOnPos to indicate that the drive has closed the position loop with the motor and is fully operational.

⚠ WARNING

● During Test movement procedures, the servo motor can rotate very quickly in either direction. Ensure that the servo motor is free to rotate and no objects are attached to or is near the motor shaft. Secure the motor by its flange.

♦ Test Movements

1) Select “RS232” under the command input mode option
2) Select “Position Servo” under Servo mode, then click “Save All“ to save this setting.
3) Under the Test Motions menu, the user can select one of 4 test motions to JOG, STEP, SINE or TRIM the servo motor. Only one test motion profile can be run at a time, use the radio buttons below each section to select the movement profile.

♦ Operation

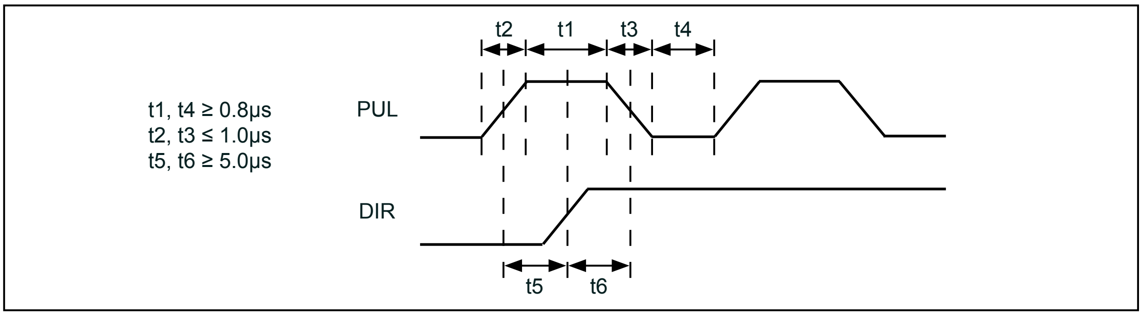
1) Select the command input mode
2) Select the Servo mode
3) Click Save All to save the parameters to the servo drive
4) Refer to the next section (Section 4) for individual operation mode specifications

4.1 Position Servo Mode

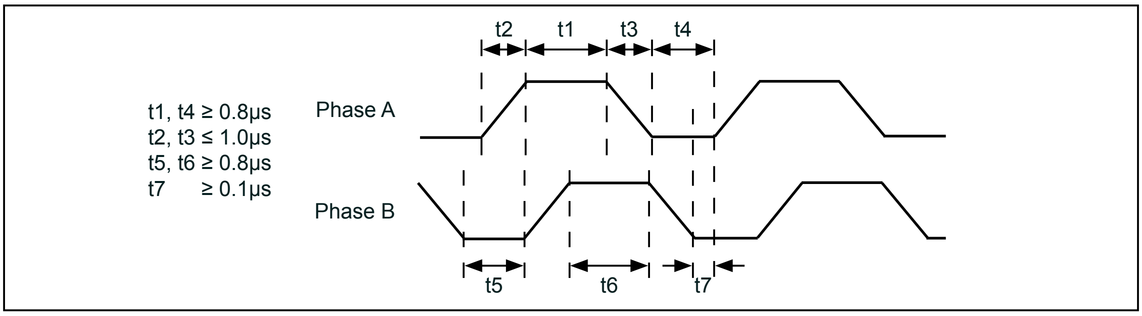
Pulse Specifications

Voltage: +5VDC ± %10 (Contact DMM if higher level such as 12/24VDC is required)
Max pulse frequency: 500kHz
Minimum pulse width: 0.8µs

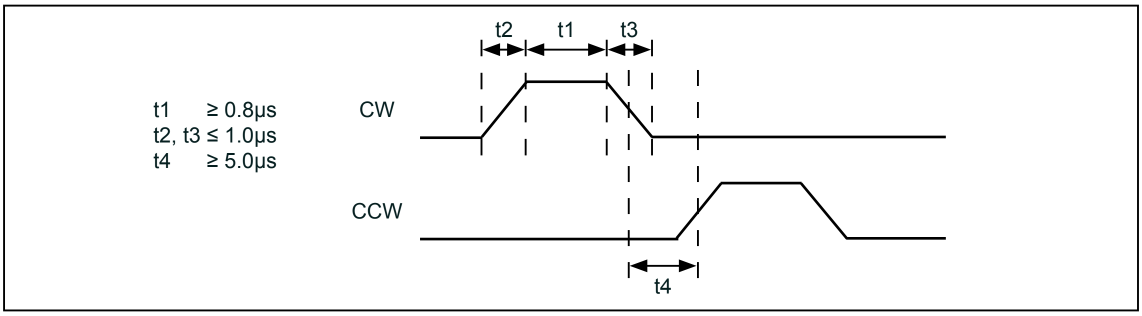
♦ Pulse + Direction



♦ A/B phase quadrature with 90° phase differential



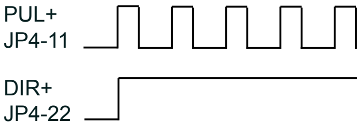
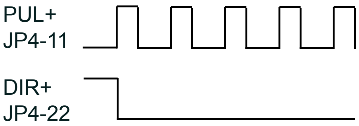
♦ CW + CCW



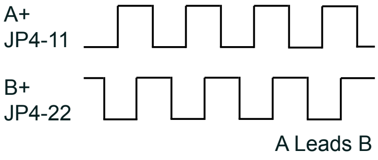
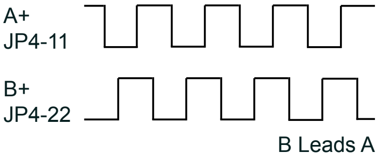
Reference Pulse Format

The DYN4 servo drive accepts FORWARD reference as CLOCKWISE motor shaft rotation as viewed from motor shaft side.

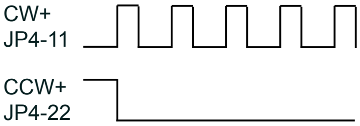
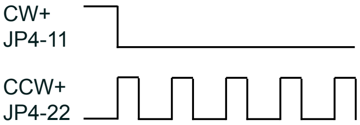
- Pulse + Direction

Forward Reference	Reverse Reference
	

- A/B phase quadrature with 90° phase differential

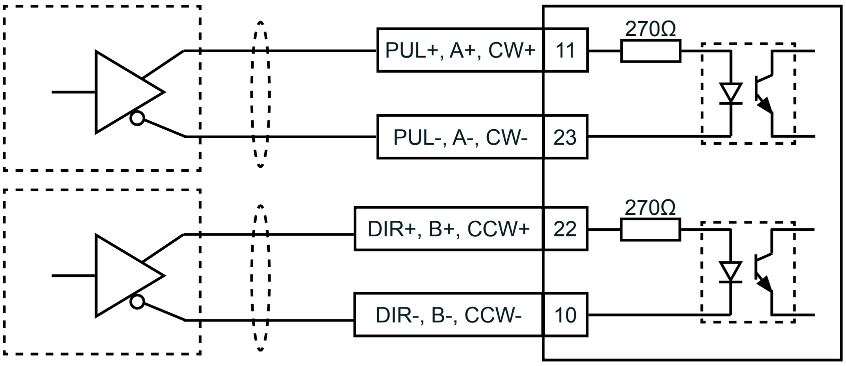
Forward Reference	Reverse Reference
	

- CW + CCW

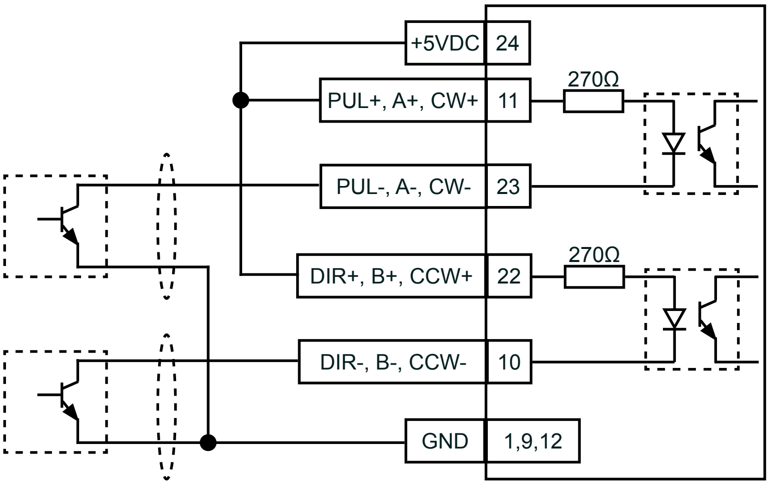
Forward Reference	Reverse Reference
	

Connection Example

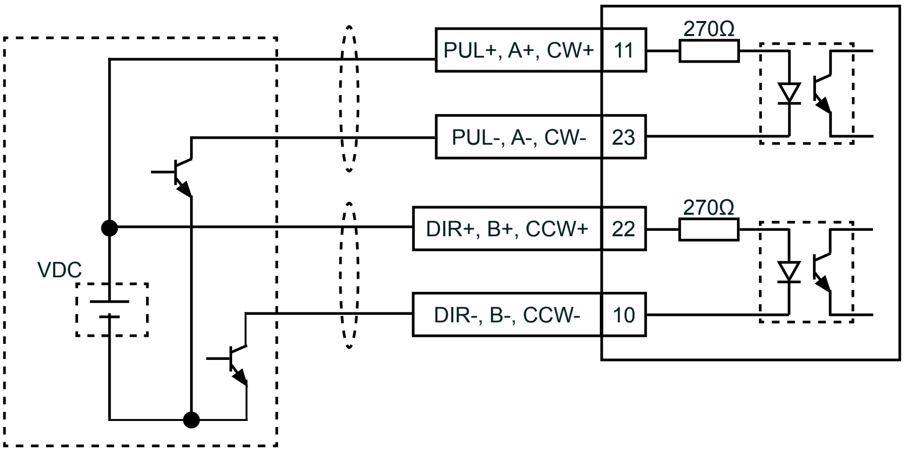
- Line Drive Output



- Open Collector Output - Internal Power Supply



- Open Collector Output - External Power Supply



Electronic Gearing (*GEAR_NUM* Parameter)

Gear number (Gear_Num) is set from 500 to 16,384, default value is 4,096. Gear number provides an electrical gear ratio: 4096 / Gear_Num, from 0.25 ~ 8.192. For example, if Gear number = 4,096, then 16,384 input counts from pulse will turn motor exactly one revolution. If Gear number = 500, 2,000 pulses will turn motor one revolution. Gear number parameter is only applicable to position servo mode.

Analog Input in Position Servo Mode

In position servo mode, the controller can use 0 ~ 10VDC analog input to turn the motor. 0 ~ 10VDC analog input commands motor from 0 ~ 90*4,096/Gear number (degrees). Ex. if Gear_Num=8,192, a 5.5V input will move the motor 24.75degrees.

Servo In Position Output Specifications (*ONPOS)*

On position range is a value used for determining whether the motor has reached the commanded position or not. This on position range is selectable according to customer's requirement. Suppose the Pset is the commanded position, and Pmotor is the real motor position, if

|Pset - Pmotor|<=OnRange

it is said motor is ON the commanded position, otherwise not. That OnRange is set from 1~127. The real position on range is: OnRange * 360(deg)/16,384. The ONPOS output (JP3-9) phototransistor ON if motor in position and OFF if motor off position.

On position range defined as:

*OnPosRange*x4/65,536x360(deg) = "On Position" (deg)

Ex. If *OnPosRange* is set to 24, then:

24x4/65536x360=0.53deg

JP4. Pin 6 Phototransistor becomes ON when motor within 0.53degree of command position.

Servo Position Error Accumulation

The servo drives internal position error decides the status of the On Position signal and the Lost Phase servo drive alarm.

The On Position signal is triggered (LOW) when the servo position error is within the OnPosRange set in the DMMDRV program. The Lost Phase alarm is triggered when the servo motor is physically 90° or more out of position for ~2 seconds.

The servo position error is cleared when the drive is disabled using the ENA input and does not accumulate when the drive is disabled.

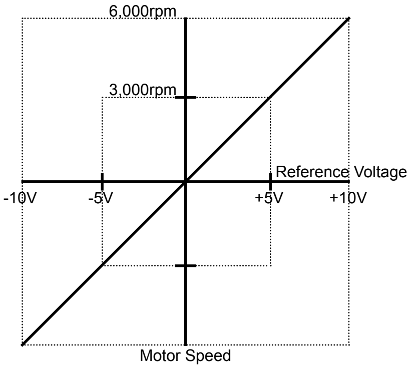
4.2 Speed Servo Mode

In speed servo mode, the DYN4 servo drive takes command from an external ±10VDC analog reference voltage from the host controller to drive a linear proportional motor speed.

In speed servo mode, the torque output depends on the load on the servo motor and determined by the motor feedback position. Design the system so it can withstand the peak torque of the motor in use.

Control Reference

The DYN4 servo drive accepts FORWARD reference as CLOCKWISE motor shaft rotation as viewed from motor shaft side. Positive reference voltage rotates the servo motor in the FORWARD (CLOCKWISE) direction and negative reference voltage rotates the servo motor in the REVERSE (COUNTER CLOCK-WISE) direction.



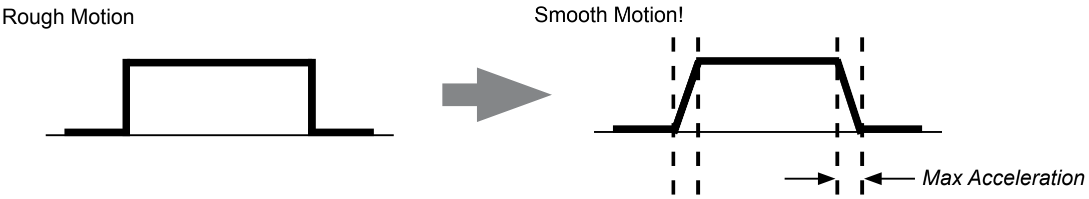
Reference Voltage	Motor Speed	Reference Direction	Motor Direction
+10V	6,000rpm	FWD	CW
+5V	3,000rpm	FWD	CW
-3V	1,800rpm	REV	CCW

Acceleration / Deceleration Soft Start

In Speed Servo Mode, the *Max Acceleration* parameter in the servo drive can be used to soft start/stop the servo motor. If the analog speed command is sent as a step reference, it is often desirable to ramp up/down this command to smooth motor motion. Without soft start, the servo motor can accelerate/decelerate instantaneously. Soft start creates a smooth s-curve motion with conistent acceleration/deceleration.

The relation to physical acceleration / deceleration time is measured as the rise time from 10% of the target speed to 90% of the target speed.

Rise from 10% to 90% time = 59.98/(*Max Acceleration*)^2 seconds
Physical acceleration time = 1.2 * 59.98/(*Max Acceleration*)^2 seconds



Torque Filter Constant

TrqCons is a first order low-pass filter used to smooth torque delivery to improve stability and accuracy of servo motor speed. The bigger value means wider frequency range of that filter. That filter can be expressed as:

a / (S + a), here a = 26*TrqCons ; if TrqCons = 100, then a = 2600.

The filter is used to make the torque sent to the servo torque loop more smooth especially for heavier loads when bigger SpeedGain settings are used. If a very quick response servo with small load is desirable, TrqCons can be increased up to 127 to ensure stability and fast dynamic following.

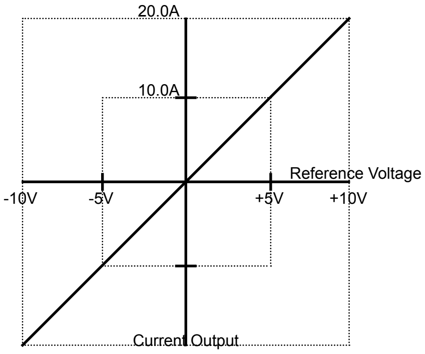
The Torque Filter Constant parameter should only be used in speed and torque servo mode. Leave this parameter at “127” in position servo mode.

4.3 Torque Servo Mode

In torque servo mode, the DYN4 servo drive takes command from an external ±10VDC analog reference voltage from the host controller to drive a linear proportional output current.

█ Control Reference - [H01] Capacity Model: DYN4 - H01

The DYN4 servo drive accepts FORWARD reference as CLOCKWISE motor shaft rotation as viewed from motor shaft side. Positive reference voltage rotates the servo motor in the FORWARD (CLOCKWISE) direction and negative reference voltage rotates the servo motor in the REVERSE (COUNTER CLOCKWISE) direction.



Reference Voltage	Output Current	Reference Direction	Motor Direction
+10V	20.0A	FWD	CW
+5V	10.0A	FWD	CW
-3V	6.0A	REV	CCW

4.4 RS232 Command Input Mode

The RS232 port is always active after power on for DYN-series servo drive. This active RS232 port could be used for reading and setting Drive parameters and status, and also could be used for sending point to point position command.

If the position command input mode is selected as Pulse mode or Analog mode, the RS232 port is still active as mentioned above but it only can be used for reading and setting Drive parameters. The RS232 port could be easily accessed by using the DMMDRV program after the connection between PC and the Drives RS232 port. This is the easiest way to tune up the servo and make test movements. The RS232 port could be accessed by other micro-controller, or DSP if sending and reading data by using DYN Drives RS232 protocol.

The PC or RS232 controller is working as Master and the servo drive is always working as Slave. Several servo drives could be RS485 networked for integrated multi-axis control.

See Section 7 for DYN4 servo drive RS232 protocol definitions.

4.5 Encoder Output

Refer to Section 2.4 for encoder output connection diagram and circuit. This real time emulated encoder output is scalable using the LINE_NUM parameter set in the DMMDRV program. The pulse output per revolution is set according to:

Pulse output per revolution = LINE_NUM * 4

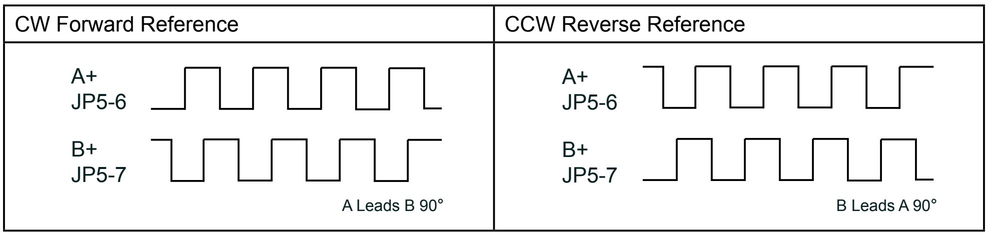
For example, if LINE_NUM = 2,000 then 8,000 pulses will be output per motor revolution. The Z pulse is output once per motor revolution. LINE_NUM can be set from 500 to 2,048.

■ Encoder Pulse Specifications

♦ Pulse Logic: +5VDC

♦ Z Pulse: Width ≥ 0.7us. No phase relation to A/B pulse.

♦ Forward Reference = CW as viewed from motor shaft side

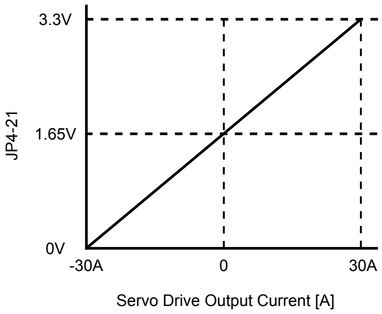


4.6 Servo Drive Monitor Outputs

Current Monitor (JP4-21)

The current monitor outputs an analog signal relative to the real-time current output from the servo drive to the servo motor. The current can be monitored relative to both positive (CCW from motor shaft) and negative (CW from motor shaft) directions.

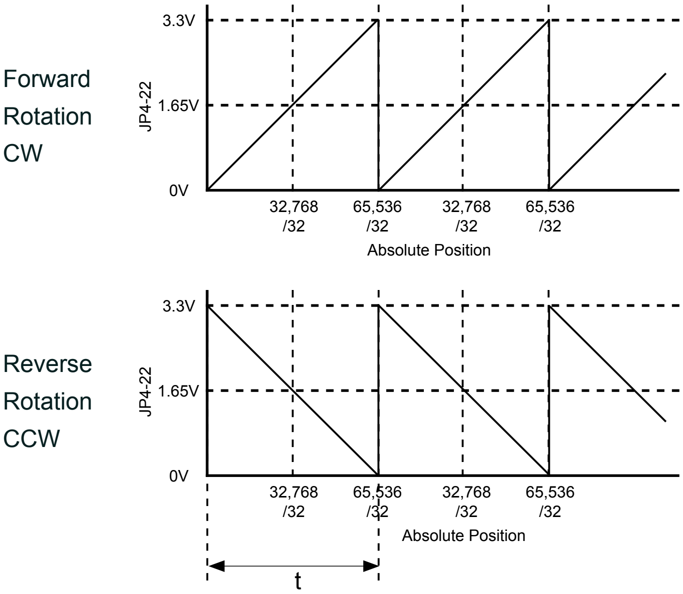
The analog output has a domain of [0V : 3.3V] relative to [-30A : 30A] current output.



Servo Drive Current Output [Ic]	JP4-21 Analog Output
30A	3.3V
0A	1.65V
-30A	0V

Absolute Position Monitor (JP4-22)

The absolute position monitor outputs an analog signal relative to the real-time single turn absolute position of the servo motor. The signal can be used to track servo motor position or can be used to calculate servo motor speed according to the signal period. Can also be used to detect servo motor zero speed. The analog output has a domain of [0V : 3.3V]. Forward direction rotates the servo motor CW as viewed from the shaft. Each servo motor rotation will output 32 cycles.

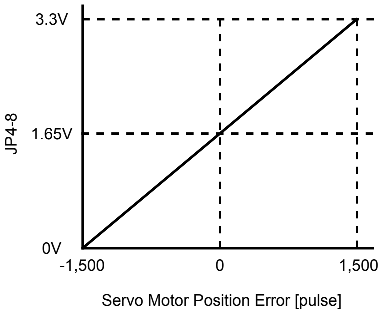


Servo Motor Absolute Position	JP4-22 Analog Output
65,536/32	3.3V
4,096/32	0.21V
0	0V

Time per motor rotation [s] = 32*t
Servo motor rotation speed [rpm] = 1,920/t

Position Error Monitor (JP4-8)

The servo motor position follow error can be monitored from JP4-8. The position error can be monitored relative to both positive (CCW from motor shaft) and negative (CW from motor shaft) directions. The analog output has a domain of [0V : 3.3V].



Servo Motor Position Error	JP4-8 Analog Output
0	1.65V
1,500pulse (8.24°)	3.3V
-1,500pulse (-8.24°)	0V

5 Parameters and Tuning

5.1 Parameters Outline

The following parameters are adjustable by connection through RS232 or USB interface from the servo drive to the PC. No matter the command mode, the JP2 RS232 port is always active for parameter setting and drive configuration.

The Drive Configuration and Servo Status are stored in the EEPROM of servo drive when the save button is pressed or parameter setting is issued through the serial communication.

The guaranteed write cycle for the EEPROM is 1 million times. Do not use serial communication to constantly change the drive parameters as this will decrease servo drive life span. Major parameter change and setting should only be done during initial testing and tuning. Actual drive operation should not require constant parameter changes unless changing servo control modes on the fly through RS232.

Parameter Name	Setting Range	Details	Applicable Servo Mode
Main Gain	[1 : 127]	The main gain for the servo loop, usually to be increased as the motor load increases. The bigger value of MainGain means wider frequency range of servo loop relatively.	Position Speed Torque RS232
Speed Gain	[1 : 127]	The speed gain for the servo loop, usually to be increased as the motor load increases. The bigger value of Speed Gain means narrower frequency range of servo loop relatively. Physically, heavier loads or higher inertia loads should have lower dynamic ability, so the servo loop frequency range should be more narrow by using bigger value of Speed Gain. If the Speed Gain is too high, there will be noise and vibration in servo motor because the torque command will be too coarse, not smooth. For higher Speed Gain settings, a smaller Torque Constant (see TrqCons) setting can be used to attenuate noise and vibration.	Position Speed Torque RS232
Integration Gain	[1 : 127]	There is an integrator in the servo loop to ensure the error between position command and real position be zero during the steady state. Also that integrator will let servo have more ability to attenuate the outside disturbance torque. The bigger value of Integration Gain, the more ability of the servo to attenuate the outside disturbance torque. Integration Gain should be decreased for heavier loads or higher inertia loads.	Position Speed Torque RS232
Torque Constant	[1 : 127]	TrqCons is a first order filter constant, the bigger value means wider frequency range of that filter. That filter can be expressed as : a / (S + a), here a = 26*TrqCons, if TrqCons = 100, then a = 2600. That filter is used to make the torque sent to torque loop more smooth, especially for heavier loads when bigger SpeedGain is used. If a very quick response servo with small load is desirable, a bigger value or even the max value 127 should be used to ensure the dynamic stability.	Speed Torque RS232

Parameter Name	Setting Range	Details	Applicable Servo Mode
Max Acceleration	[1 : 127]	Determines the S-curve acceleration when using RS232 command mode. Also controls the response time of the first order low pass filter in speed and torque servo control (soft start). *Max Acceleration is automatically reset to 12 after power OFF	RS232 Speed Torque
Max Speed	[1 : 127]	Determine the S-curve max speed when using RS232 mode to make point to point motion linear/circular. *Max Speed is automatically reset to 24 after power OFF	RS232
Driver ID	[1 : 126]	Every drive has a unique ID number, which can be assigned. Parameter only settable when *RS485/232 Net* box not set (checked), and there is only one Drive connected through the RS232 port. The default ID number for every Drive is 0. This ID number can be used for the network connection of RS485 or for drive unit identification purposes. When *RS485/232 Net* box is checked and there are more than one Drive connected to the physical RS485/232 network, only the setting for the Drive with the indicated ID number in the DMMDRV ServoSetting module can be read out or saved.	Position Speed Torque RS232/485
On Position Range	[1 : 127]	On position range is a value used for determining whether the motor has reached the command position. On position range is selectable according to user's requirement. Suppose the Pset is the commanded position, and Pmotor is the real motor position, if |Pset - Pmotor|<=*OnPosRange* it is said motor is ON the commanded position, otherwise not. On position range defined as: *OnPosRange*x4/65,536x360(deg) = "On Position" (deg) Ex. If *OnPosRange* is set to 24, then: 24x4/65536x360=0.53deg JP4. Pin 6 Phototransistor becomes ON when motor within 0.53degree of command position.	Position Speed Torque RS232
Gear Num	[500 : 16,384]	The amount of motor travel with reference to the number of input pulses is set using the parameter Gear_Num. The number of reference pulse needed for one complete motor revolution is calculated as, One motor revolution = 4xGEAR_NUM For example, if Gear_Num is set to 4,096, then 16,384 pulses are needed from the host controller for the motor to rotate one complete revolution.	Position RS232
Line Num	[500 : 2,048]	The number of pulse outputs per motor revolution from JP5 encoder output. Number of pulse output calculated as: Pulse output per rev = LINE_NUM * 4 If LINE_NUM = 2,000 then 8,000 pulses will be output per servo motor revolution. Pulse output active for all servo modes.	Position Speed Torque RS232

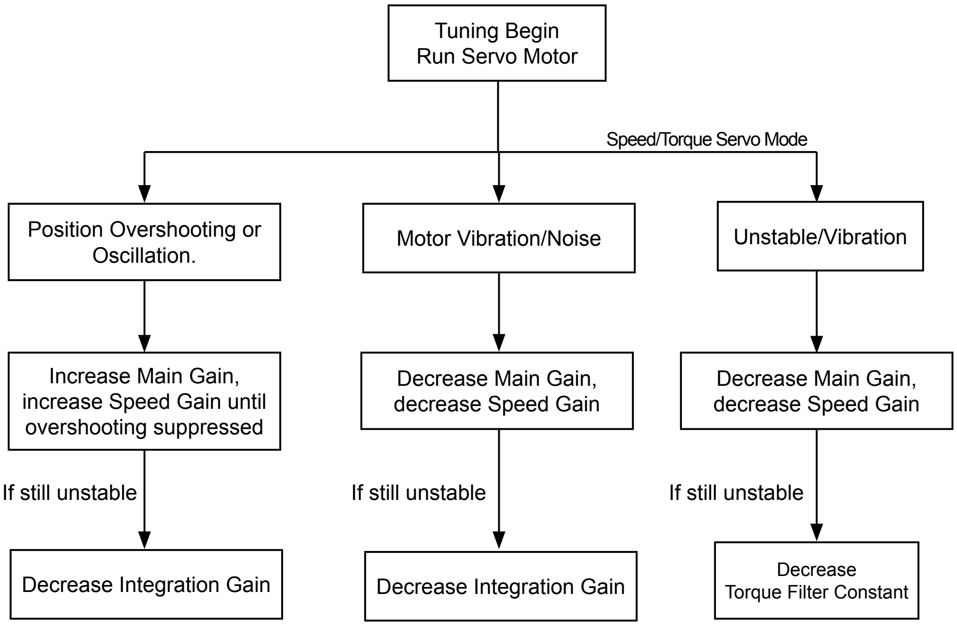
The DYN4 servo drive features simple 3 parameter Gain tuning to achieve optimized smooth performance. The user should adjust the servo gain parameters Main Gain, Speed Gain and Integration Gain until they achieve target response qualities. These parameters are all adjustable using the DMMDRV program, or by eternal controller via RS232 serial communication.

The overall method of Gain tuning follows as load mass or load inertia increase, the Main Gain and Speed Gain parameters should be increased. If these are set too high, the servo may be over-tuned and start vibrating or become noisy. The parameters should be increased/decreased until the motor smoothly follows command without vibration, noise or oscillations. The Integration Gain increase servo response stiffness. Integration Gain should be higher for lower load inertia quick, rapid movements (high acceleration) and lower for higher load inertia slow and sweeping movements (low acceleration). Once the load becomes smooth and stable, the user can then fine tune the parameters to make the motor “harder“ (faster response, more rigid motion) or “softer“ (slower response, smoother motion).

Adaptive Tuning algorithm optimize response time and torque vibration. As long as the 3 gain parameters are close to ideal settings relative to load inertia, the servo will achieve best response.

The servo motor should be coupled to the final machine before tuning. Make sure during tuning, the motor is running the load and speed of the final application. The user should use a trial and error method to achieve the desired servo response.

- Gain Tuning Procedure Flow


Tuning Begin
Run Servo Motor
Speed/Torque Servo Mode
Position Overshooting or Oscillation.
Motor Vibration/Noise
Unstable/Vibration
Increase Main Gain, increase Speed Gain until overshooting suppressed
Decrease Main Gain, decrease Speed Gain
Decrease Main Gain, decrease Speed Gain
If still unstable
If still unstable
If still unstable
Decrease Integration Gain
Decrease Integration Gain
Decrease Torque Filter Constant

Sample Load Type Tunings

♦ Ball Screw

Ball screw systems are mechanically very rigid. If high resolution pitch (e.g. 5mm or 10mm) the default setting could even be used. The servo drive can be easily tuned using Main Gain, Speed Gain, and Integration Gain. Increase Main Gain, Speed Gain and Integration Gain relative to load mass until target response achieved. Decrease Integration Gain if load inertia is big and oscillates when moving or stopping.

♦ Direct Mechanical Drive (Rigid systems, Robots)

Depending on load mass and inertia, increase Main Gain, Speed Gain and Integration Gain until target response achieved. Decrease Integration Gain if load inertia is high and system oscillates. In speed/torque servo mode, if relative load inertia is very high, high Speed Gain can increase motor torque noise, then decrease the Torque Filter Constant to attenuate torque loop noise.

♦ Belt Drive / Pulley

Belt drive or pulley systems are low mechanical rigidity with slower relative response. Main Gain and Speed Gain should be increased with higher load mass and relative load inertia. Integration Gain should be decreased to give the position loop more time to react to the low rigidity belt.

6 Maintenance

6.1 Alarm Specifications

The DYN4 servo drive is protected by 5 fault alarms. The S1 status indicator LED will flash to indicate when an alarm is triggered. The specific alarm status can be read using the DMMDRV program.

♦ Internal Driver Status Readout

(1) Connect the PC to the servo drive JP2 port using RS232 cable
(2) Press Read on the Setting driver parameters and mode main screen.
(3) The Driver Status box will display the current status of the Servo Drive.

Alarm	Cause	Recommended Correction
Over Voltage	The internal DC bus voltage has exceeded the allowed maximum levels. The input DC voltage is too high.	- Check and confirm the connections to the servo motor. - Check that the servo motor is driving a mass appropriate to its size. - Check for any mechanical irregularities that might be preventing the motors to move freely. - Add an external regenerative resistor
Over Temperature	The servo drives protective thermal resistor has detected an unusually high temperature inside the drive. The control power transistor temperature is too high.	- Check that the drives ventilation openings and heat sink are not being blocked. - Consult the servo drives ambient temperature specifications and check if the operation conditions are met.
Lost Phase	The encoder has detected an irresolvable position error in the motor relative to the command signal.	- Check that the encoder feedback cable is securely plugged from the servo motor to the JP3 port of the servo drive. - Check for any mechanical irregularities that might be preventing the motors to move freely.
Over Power	The servo drive has experienced an output power exceeding the rated value relative to the average value.	- Check and confirm the connections to the servo motor. - Check that the servo motor is driving a mass appropriate to its size. - Check for any mechanical irregularities that might be preventing the motors to move freely.
Over Current	Servo drive internal current increased above rated and protection levels.	- Check that the encoder feedback cable is securely plugged from the servo motor to the JP3 port of the servo drive. - Check for any mechanical irregularities that might be preventing the motors to move freely.

♦ Alarm Motor Stop

The power to the servo motor will be stopped when an alarm is triggered. Internal servo control turns off and servo motor shaft becomes free. Power still remains in the logic circuit for drive diagnostic and drive status reading. All commands including pulse, analog and RS232 will be ignored and internal position error will not accumulate.

♦ Alarm Reset

Once servo drive triggers an alarm, the user should use the DMMDRV program to read out the alarm condition then inspect the machine, load or operation for cause to the alarm. The problem should be fixed before re-setting the servo drive and running again. The servo drive main power should be cycled to fully re-set and clear the servo alarm status.

⚠ WARNING

● If the servo motor is coupled to a vertical axis that can drop due to gravity when alarm triggered and the shaft becomes free, take measure to prevent injury or damage when the drive alarm is triggered. A motor with holding brake option may be necessary to stop vertical axis, or any axis acted on by an external force, from dropping or crashing.

6.2 Servo Drive Maintenance

Do not perform maintenance on the servo drive unless instructed to do so by DMM. The servo drive cover or chassis should never be removed as high voltage components can cause electric short, shock or other damage upon contact. Disassembly, repairs or any other physical modification to the servo drive is not permitted unless approved by DMM.

♦ Regular Inspection

Inspect the servo drive regularly for:

- Dirt, dust or oil on the servo drive - make sure the servo drive cooling duct and heat sink are free from debris
- Environment - ambient temperature, humidity and vibration according to servo drive specification
- Loose screws
- Physical damage to servo drive or internal components

7 RS232 Communication Protocol

The RS232 port is always active after power on for DYN series drive. This active RS232 port could be used for reading and setting Drive parameters and status and also can be used for sending point to point position command if the RS232 mode is selected for position command input.

This DYN232M integrated motion command includes point-to-point S-curve, linear, arc and circular interpolation for up to 3-axis of coordinated motion. These profiles can be easily executed using dedicated function codes. The DYN servo drive features the most advanced built in S-Curve Generator in the industry to realize point to point S-Curve motion. Response is extremely fast and motion filters are built in to optimize stability and provide smoothest motor response. Featuring Dynamic Target Position Update (DTPU) technology, target position can be instantaneously changed (without current command completion) and robot movements can be realized with much faster cycle time and higher universal efficiency.

If the position command is selected as other modes, such as PULSE/DIR, CW/CCW, SPI or Analog mode, the RS232 port is still active as mentioned above but only can be used for reading and setting drive parameters and reading and setting drive status registers (Section 7.3).

The RS232 port can be accessed by a variety of host controllers including PC, microcontroller, FPGA, Arduino or motion controller. The host device is working as a master and the servo drive is always working as a slave. Several drives can be linked for a serial network in RS485.

RS232 Functions Include:

- ♦ Reading and changing servo drive parameters
- ♦ Reading and monitoring servo drive status including alarm, busy, in position, enable etc.
- ♦ Reading and monitoring servo drive configuration including servo mode, incremental/absolute mode, command mode, enable etc.
- ♦ Absolute encoder homing
- ♦ Absolute encoder position monitor: 16-bit absolute, 32-bit multi-turn
- ♦ Initiate generic profiles ConstSpeed, Square Wave, Sine Wave
- ♦ DYN232M motion control commands including:
    - ♦ S-Curve point to point
    - ♦ 3-axis coordinated linear motion
    - ♦ 3-axis coordinated circular motion (arc, circle, oval)
    - ♦ Incremental (relative) or absolute modes

Example Host Controllers:
- Microcontroller/Embedded Controller
- PC (windows serial port via C/C++/C#, VB, Java etc.)
- PLC/HMI with serial output
- Arduino

The sample code in Section *7.7A Appendix : C++ Code for Serial Communication Protocol* should be used extensively to efficiently and accurately generate the RS232 data packet. Each subroutine function automatically generates data packet structure for sending command and reading from DYN servo drive.

Never use serial communication to set the Drive configuration or parameters at a fast rate. This will cause servo drive EEPROM busy in writing parameters all the time and also shorten it’s lifetime. The guaranteed parameter writing cycle for EEPROM is 1 million times. Once a group of parameters and configuration are set, use it until next necessary change.

Connector Specifications

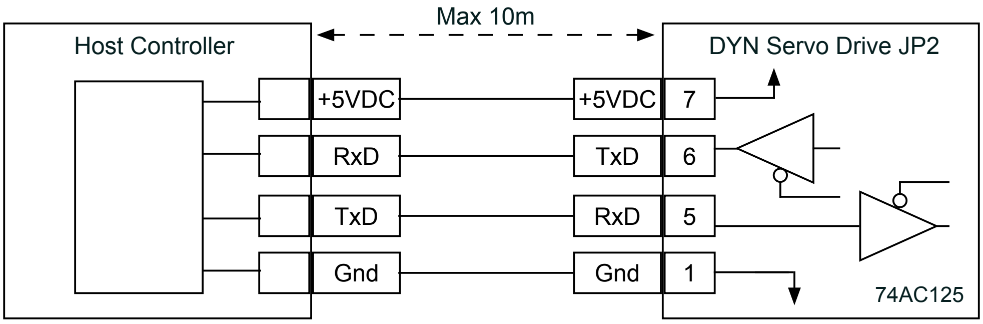
Connection: JP2
Connector Type: 2.54mm Pitch Rectangular
Drive Header: Molex 70553-0041
Plug Connector: Molex 50-57-9407
Recommended Wire Gauge: 0.3mm^2 (AWG22)

In order to connect JP2 with a PC's RS232 port, an intermediate level shift buffer is necessary [buffer component: ADM232]. The CA-MRS232-6 and CA-MTUSB-60 tuning cables has the level shift buffer built-in. RxD and TxD RS232 signal from connector JP2 is TTL/CMOS level.

Do not connect servo drive directly to PC RS232 port without buffer component.

Pin. 1	Gnd
Pin. 2~4	Reserved
Pin. 5	RS232 RxD signal input to Drive, CMOS/TTL level signal
Pin. 6	RS232 TxD signal output from Drive, CMOS/TTL level signal
Pin. 7	+5VDC output from Drive

⚠ WARNING	Pin. 2 ~ 4 are reserved for factory use and are internally connected. Connecting these pins to external devices may result in permanent damage to servo drive.



Communication Format

Baud Rate	38400 (Standard Mode) 312.5k (Fast Mode) [*1]
Start/Stop Bit	1
Odd/Even Verify Bit	No
Data	8-bit
	Full Duplex
	Asynchronous (UART)
Voltage	+5V (TTL/CMOS)

[*1] Fast Mode is custom option - contact DMM for details. All specifications in this manual are referenced in standard mode.

Transmission

The DYN servo drive is always under command from host controller. When a function is called, the servo drive will move the servo motor, return a data packet with the requested information, or set a parameter value. Once a complete data packet has been received, the servo drive will not return any confirmation or acknowledgement code. The command motion will be immediately run, requested data will be returned, or new parameter is saved.

The subroutine in Section 7.5A Appendix should be implemented to automatically generate a full data packet. Otherwise, the host controller must ensure each data packet is complete and accurate before transmission.

Reception

The DYN servo drive follows same data packet format and structure when returning data. Each data packet is sent one byte at a time consisting of 8 data bits and two start stop bits for a total of 10 bits. Each byte will be sent sequentially until complete packet is sent.

The host controller must process received data in shift register as soon as each byte is transmitted to avoid overflow and garbage data. Alternatively, the receiver shift register buffer must have enough address to store complete packet. The DYN servo drive will send each byte immediately after another, so at 38400 baud, each byte will take approximately 260us to transmit - host controller should read or sample at this rate or faster when receiving data.

7.2 Packet Definition

7.2.1 Structure

Byte : consists of 8 bits, represented by b7b6b5b4b3b2b1b0 or b[7:0]. b7 is MSB and b0 is LSB, so called little endian. Each packet consists of several bytes, expressed as:

Packet = Bn Bn-1 Bn-2 .... B1 B0
Packet length = n+1, Total n+1 bytes

Bn is start byte, B0 is end byte, similar to the byte structure, Bn is MSB and B0 is LSB as little endian rule.

The integer n varies as the variation of packet length. Functionally, a packet could be expressed as:

Packet = ID + packetLength + functioncode + data + checksum

ID	One byte (Start byte)
packetLength + functioncode	One byte
data	One to four bytes
checksum	One byte

Minimum packet length is 4 bytes, packet length 4 (n=3), 1 data byte.
Maximum packet length is 7 bytes, packet length 7 (n=6), 4 data byte.

Minimum packet length is 4. There is at least one data byte, for some function code that does not require data, this data byte is meaningless, or called dummy byte which can be set to any value [0~127] and does not affect the overall function of that packet.

7.2.2 Features for the byte inside a packet

The start byte takes form of 0xxxxxxx, or MSB is 0, x for 0 or 1. Any other byte except the start byte takes the form of 1xxxxxxx, where x could be 0 or 1. Most significant bit in a byte can be used for determining if it is a packet's start byte or not.

7.2.3 Start byte Bn

The MSB bit of start byte is always zero, the other seven bits are used for the Drive ID number which is set from 0 ~ 63. The ID number can also be assigned through the DMMDRV software.

ID number 127 is reserved for every drive for broadcasting purposes. In other words, 127 is general ID number. ID numbers 64 ~ 126 are internally reserved.

The communicating servo drive must be set to the same ID number to accept and execute data. The drive ID can only be set if the *RS485/232 Net* check box is not checked (in the DMMDRV software).

7.2.4 Bn-1 byte

The Bn-1 byte is used for representing the packet function and packet length.

Bn-1 = 1 b6 b5 b4 b3 b2 b1 b0

The bit b6 and b5 are for the length of packet, expressed as:

b6	b5	Total packet length(=n+1)
0	0	4
0	1	5
1	0	6
1	1	7

The bit b4~b0 are used for the packet function, expressed as:

Function **(Sent by host)**	b[4:0]	Data (Bytes)	Remarks
Set_Origin	0x00	1(dummy)	Set current position as zero ; See section 7.4.2
Go_Absolute_Pos	0x01	1~4	See section 7.4.1
Make_LinearLine	0x02	1~4	
Go_Relative_Pos	0x03	1~4	See section 7.4.1
Make_CircularArc	0x04	1~4	
Assign_Drive_ID	0x05	1	Assign ID to Drive; See Section 7.6
Read_Drive_ID	0x06	1(dummy)	
Set_Drive_Config	0x07	1	One byte Configuration. See Section 7.3
Read_Drive_Config	0x08	1(dummy)	Read Drive configuration. See Section 7.3
RegisterRead_Drive_Status	0x09	1(dummy)	Ask for Drive status. See Section 7.3
Turn_ConstSpeed	0x0a	1~3	See section 7.4.2
Square_Wave	0x0b	1~3	See section 7.4.2
Sin_Wave	0x0c	1~3	See section 7.4.2
SS_Frequency	0x0d	1~3	See section 7.4.2
General_Read	0x0e	1~4	Read Drive position set
ForMotorDefine	0x0f	1	Internal Function - Not customer accessible
Set_MainGain	0x10	1	
Set_SpeedGain	0x11	1	
Set_IntGain	0x12	1	
Set_TrqCons	0x13	1	
Set_HighSpeed	0x14	1	Set MaxSpd,1~127 ; See section 7.4, 7.5
Set_HighAccel	0x15	1	Set MaxAcl,1~127 ; See section 7.4, 7.5
Set_Pos_OnRange	0x16	1	If |Pset-Pmotor|<= OnRange, then motor on Pos OnRange ;1~127
Set_GearNumber	0x17	2	Gear_Number [500~16,384] ; ; See section 7.4, 7.5
Read_MainGain	0x18	1(dummy)	See section 7.5 Example 11
Read_SpeedGain	0x19	1(dummy)	See section 7.5 Example 11
Read_IntGain	0x1a	1(dummy)	See section 7.5 Example 11
Read_TrqCons	0x1b	1(dummy)	See section 7.5 Example 11
Read_HighSpeed	0x1c	1(dummy)	See section 7.5 Example 11 ; See section 7.4
Read_HighAccel	0x1d	1(dummy)	See section 7.5 Example 11 ; See section 7.4
Read_Pos_OnRange	0x1e	1(dummy)	See section 7.5 Example 11
Read_GearNumber	0x1f	1(dummy)	See section 7.5 Example 11 ; See section 7.4

Functions **(Sent by DYN drive)**	b[4:0]	Data (Bytes)	Remarks
Not used	0x00 ~ 0x0a		*Do not read or write to these addresses
Is_MainGain	0x10	1	Returns [1:127] unsigned data
Is_SpeedGain	0x11	1	Returns [1:127] unsigned data
Is_IntGain	0x12	1	Returns [1:127] unsigned data
Is_TrqCons	0x13	1	Returns [1:127] unsigned data
Is_HighSpeed	0x14	1	Returns [1:127] unsigned data
Is_HighAccel	0x15	1	Returns [1:127] unsigned data
Is_Drive_ID	0x16	1	Returns [1:127] unsigned data
Is_PosOn_Range	0x17	1	Returns [1:127] unsigned data
Is_GearNumber	0x18	2	
Is_Status	0x19	1	
Is_Config	0x1a	1	
Is_AbsPos32	0x1b	1~4	
Is_TrqCurrent	0x1e	1~4	

Functions 0x10 ~ 0x1e are sent from the DYN drive in response to a function to request data. For example, when Read_MainGain 0x18 is sent to the DYN2 drive, Is_MainGain 0x10 is returned as the function with the Main Gain value as the data. See section 7.5 Example 11.

7.2.5 Bn-2 ~ B1 bytes

Bn-2 ~ B1 (n>2) are used for representing the data in the packet. 7bits of a byte is used for containing the data. The first bit MSB is always 1.

n	Data Range	Remark
3	-64 ~ 63	Only B1 is used
4	-8,192 ~ 8,191	Only B2, B1 are used
5	-1,048,576 ~ 1,048,575	B3, B2, B1 are used
6	-134,217,728 ~ 134,217,727	B4, B3, B2, B1 are used

Minimum packet length is 4. There is at least one data byte, for some function code that does not require data, this data byte is meaningless, or called dummy byte which can be set to any value [0~127] and does not affect the overall function of that packet.

7.2.6 B0 Byte

B0 byte is used for check sum, which is calculated from Bn~B1 as:

S = Bn + Bn-1 + Bn-2 +.... B1
B0 = 0x80 + Mod(S , 128), B0 = 0x80 + S - 128*[S/128]
B0 = 128 ~ 255

After receiving a packet, then calculate Temp = Mod(S , 128), if Temp = B0 , there is no error, otherwise there is error during the packet transmission.

Example manual calculation:

Given: Command to rotate ID=8 motor at 50rpm constant speed
Packet Length = 4
n = 3
B3 = 0x08
B2 = 0x8a
B1 = 0xb2

S = B3 + B2 + B1 = 0x144 = 324
B0 = 0x80 + Mod(S , 128)
   = 0x80 + Mod(324, 128)
   = 0x80 + 0x44
B0 = c4

7.3 Drive Configuration and Status Register

Drive configuration such as commnad input mode (RS232, CW/CCW etc.), alarm status, busy status are described by the two register Config and Status which are stored inside Drives EEPROM and can be read or set through RS232 communication.

Drive Status

Driver status is a byte data, lower 7 bit valid for indicating the Drive status, is it in the state of servo, alarm, on position, or free.

Status = x b6 b5 b4 b3 b2 b1 b0

b0 = 0 : On position, i.e. |Pset - Pmotor| < = OnRange
b0 = 1 : motor busy, or |Pset - Pmotor|> OnRange
b1 = 0 : motor servo
b1 = 1 : motor free
b4 b3 b2 = 0 : No alarm
1 : motor lost phase alarm, |Pset - Pmotor|>8192(steps), 180(deg)
2 : motor over current alarm
3 : motor overheat alarm, or motor over power
4 : there is error for CRC code check, refuse to accept current command
5~ 7 : TBD
b5 = 0 : means buit in S-curve, linear, circular motion completed; waiting for next motion
b5 = 1 : means buit in S-curve, linear, circular motion is busy on current motion
b6 : pin2 status of JP3,used for Host PC to detect CNC zero position or others

Drive Configuration

Drive configuration for communication mode, servo mode etc is expressed by Config.

Config = x b6 b5 b4 b3 b2 b1 b0

b1 b0 = 0 : RS232 mode
1 : CW,CCW mode
2 : Pulse/Dir or (SPI mode Optional)
3 : Anlog mode
b2 = 0 : works as relative mode(default) like normal optical encoder
b2 = 1 : works as absolute position system, motor will back to absolute zero or POS2(Stored in sensor) automatically after power on reset.
b4 b3 = 0 : Position servo as default
1 : Speed servo
2 : Torque servo
3 : TBD
b5 = 0 : let Drive servo
b5 = 1 : let Drive free, motor could be turned freely
b6 : TBD

The default Config = x0000000, RS232 communication mode, absolute position sensor works as relative mode, position servo, servo enabled. If the bit 5 of Config register is set to be 1, Drive will let motor shaft free (servo disabled).

7.4.1 Point to Point Movement (S-Curve)

Max Acceleration, Max Speed, and Gear Number are important data parameters for generating the S-Curve. The DYN sevo drive also applies a smoothing filter to the acceleration profile to generate best S-Curve performance. The S-Curve profile is calculated as the following,

$$\text{Gear Ratio} = \frac{4{,}096}{\text{GEAR NUMBER}}$$

$$\text{Maximum Motor Speed [rpm]} = \frac{(\text{MaxSpd}+3)*(\text{MaxSpd}+3)}{16} * 12.21 * \text{Gear Ratio}$$

$$\text{Maximum Motor Acceleration [rpm/s]} = \text{MaxAcl} * 635.78 * \text{Gear Ratio}$$

$$\text{Motor Movement Position} = \text{Command Position} * \text{Gear Ratio} * 4$$

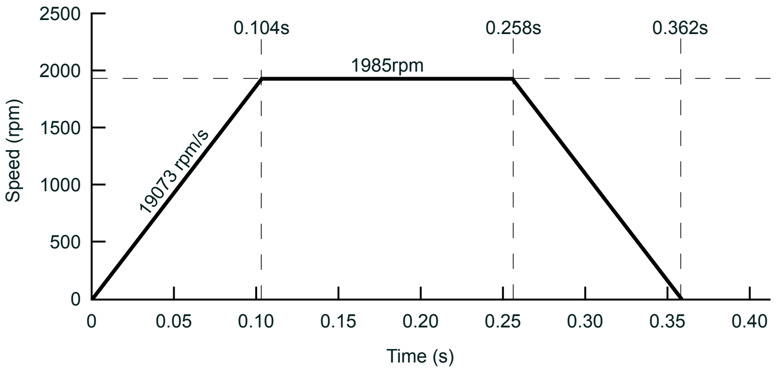
Example:

Set parameter	Output

Gear_Num = 4096
MaxSpd = 48
MaxAcl = 30
Command Position = 140,000
	Gear Ratio = 1
	Maximum Motor Speed = 1985 rpm
	Maximum Motor Acceleration = 19073 rpm/s
	Motor Movement Position = 560,000 positions

S-Curve:

Acceleration Time = 0.104 s
Distance During Acceleration = 1.72 rev
Constant Speed Travel Time = 0.154 s
Total S-Curve Time = 0.362 s



7.4.2 Constant Speed, Square Wave, Sin Wave

Turn Constant Speed

Function **(Sent by host)**	b[4:0]	Data (Bytes)
Turn_ConstSpeed	0x0a	1~3

The servo motor rotates at constant speed according to the rpm speed set by the Data Bytes. The direction of rotation is CW (as viewed from shaft side) for positive speed and CCW for negative speed.

Example:

Set command	Motion

Function = 0x0a (Turn_ConstSpeed)
Data = 0x578 (1,400) (use 2 data bytes B2, B1)
B2 = **1**000 0101 *MSB must be 1
B1 = **1**111 1000 *MSB must be 1
	Servomotor rotates in CW direction (as viewed from shaft side) at 1,400rpm

Function = 0x0a (Turn_ConstSpeed)
Data = 0xff88 (-120) (use 2 data bytes B2, B1)
0xff88 = 0x1111 1111 1000 1000
B2 = **1**111 1111
B1 = **1**000 1000
	Servomotor rotates in CCW direction (as viewed from shaft side) at 120rpm

Square Wave Motion

Function **(Sent by host)**	b[4:0]	Data (Bytes)
Square_Wave	0x0b	1~3
SS_Frequency	0x0d	1~3

The servo motor makes a square wave motion with instantaneous acceleration and deceleration command. The amplitude is set by the Square_Wave function Data and the frequency is set by the SS_Frequency function Data Bytes. The motion is executed as soon as the Square_Wave function is received. Note that Square_Wave and Sin_Wave shares the same SS_Frequency data value. The square waveform is generated internally within the DYN servo drive.

Sine Wave Motion

Function **(Sent by host)**	b[4:0]	Data (Bytes)
Sin_Wave	0x0c	1~3
SS_Frequency	0x0d	1~3

The servo motor makes a sine wave motion with continuous acceleration and deceleration. The amplitude is set by the Sin_Wave function Data and the frequency is set by the SS_Frequency function Data Bytes. The motion is executed as soon as the Sin_Wave function is received. Note that Sin_Wave and Square_ Wave shares the same SS_Frequency data value. The sine waveform is generated internally within the DYN servo drive.

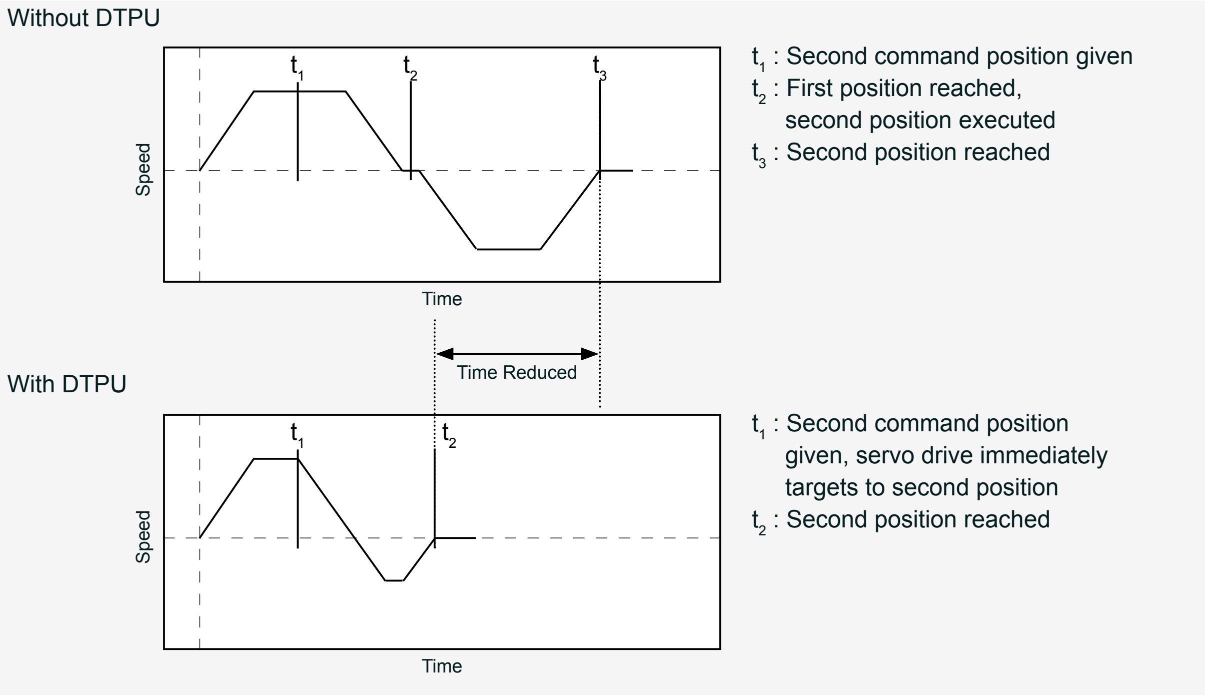
7.5 Dynamic Target Position Update (DTPU)

The DYN servo drive's built in S-Curve generator is able to update the target position instantaneously regardless of whether the current command position has completed or not. As soon as a new command position is received, the servo drive immediately updates the servomotor target to the newest position. This function is applicable to both relative (incremetal) and absolute positioning for all linear, or arc path profiles.

Without Dynamic Target Position Update DTPU technology, the servo drive must wait until the first, or current position command is completed before executing the next one. This limits the rate at which the motor position can be updated and and can also have detrimental effects on safety for the machine and the operator. With DTPU technology, the servo drive is always under active command from the controller, allowing much faster cycle time and higher universal efficiency.

The servo drive also applies a curved acceleration command to the S-Curve to maintain smoothest servo motor motion. At each S-Curve "transition" point, the normally rigid path is curved into smooth speed transitions.

Efficiency



t_1 : Second command position given
t_2 : First position reached, second position executed
t_3 : Second position reached

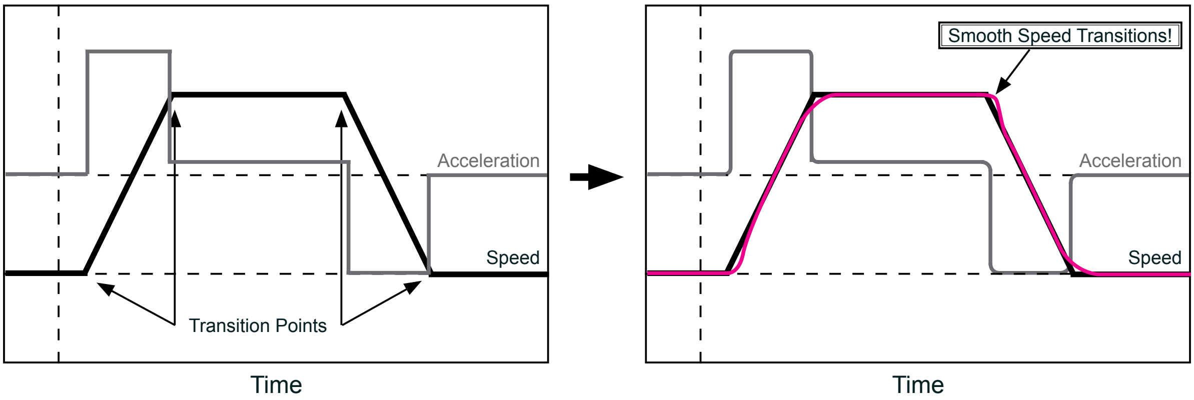
t_1 : Second command position given, servo drive immediately targets to second position
t_2 : Second position reached

When the axis is command to a new position, the servo drive immediately updates the target position and generates new S-Curve profile to reach new target position. Without DTPU technology, the axis must first finish its current command before executing the next one, causing a delay in the overall positioning time.

This also allows more flexibility in programming and path planning as the controller no longer needs to wait until a particular movement is finished before calculating the succeeding one. Robotic movements can be controlled and commanded in real-time, significantly simplifying kinematic motion planning requirements on the controller. Machine-level trajectory planning can almost be eliminated.

Curved Acceleration

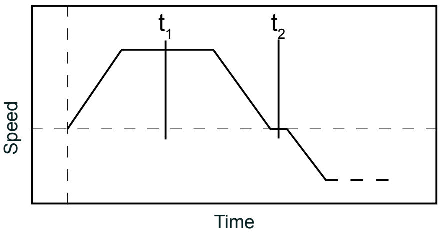
The DTPU algorithm also applies a curved acceleration to maintain smooth motion. At each S-Curve transition point, the acceleration/deceleration is curved at the edges so speed is smoothly changed. This decreases motor vibration. The smoothing is applied relative to total command movement so overall distance and position accuracy is not affected.



Safety

Dynamic Target Position Update DTPU allows the axis to be commanded as soon as a safety hazard or warning is detected. This means protection measures can be executed immediately. Without DTPU, the axis must finish the current positioning before executing protection mesasures.

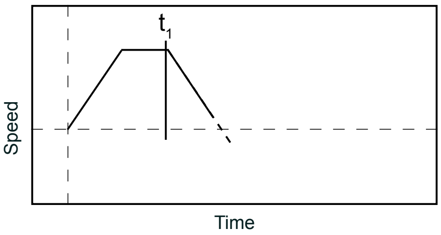
Without DTPU



t_1 : Safety warning/hazard detected, axis commanded to retract

t_2 : Current positioning reached, axis commanded to retract

With DTPU



t_1 : Safety warning/hazard detected, axis commanded to retract

t_2 : Axis immeidately retracts to safe position

7.6 Packet Structure Examples

Sent Packet (to DNY drive)		
Function	Function Code	Data (Bytes)
Set_Drive_Config	0x07	1

Bn	Bn-1	Bn-2	B0
0xxxxxxx	10000111	1 b6 b5 b4 b3 b2 b1 b0	1xxxxxxx
		Drive configuration setting	

Sent Packet (from DYN drive)
None

Sent Packet (to DNY drive)		
Function	Function Code	Data (Bytes)
Read_Drive_Config	0x08	1 (dummy)

Bn	Bn-1	Bn-2	B0
0xxxxxxx	10001000	1 b6 b5 b4 b3 b2 b1 b0	1xxxxxxx
		Dummy bits	

Received Packet (from DYN drive)		
Is_Config	0x1a	1

Bn	Bn-1	Bn-2	B0
0xxxxxxx	10011010	1 b6 b5 b4 b3 b2 b1 b0	1xxxxxxx
	Packet Length = 4 Function = 0x1a	Drive configuration data	

Sent Packet (to DNY drive)		
Function	Function Code	Data (Bytes)
Read_Drive_Status	0x09	1 (dummy)

Bn	Bn-1	Bn-2	B0
0xxxxxxx	10001000	1 b6 b5 b4 b3 b2 b1 b0	1xxxxxxx
		Dummy bits	

Received Packet (from DYN drive)		
Is_Status	0x19	1

Bn	Bn-1	Bn-2	B0
0xxxxxxx	10011001	1 b6 b5 b4 b3 b2 b1 b0	1xxxxxxx
	Packet Length = 4 Function = 0x19	Drive status data	

■ EXAMPLE 1

Condition:

Make 3rd axis motor right now position be the absolute zero. position(= 0), ID = 3. One byte dummy data 0x00, Packet Length = 4.

Method:

B3 = 0x03
B2 = 0x80 + (PacketLenght-4)*32 + Set_Origin =0x80 + 0x00=0x80
B1 = 0x80 + 0x00 = 0x80
S = B3 + B2 + B1 = 0x03 + 0x80 + 0x80 = 0x103
B0 = 0x80 + Mod(S,128) = 0x83

As shown in the Sample Code, by calling the subroutine:

Send_Package(0x03,0), when Global_Func = (char)Set_Origin = 0x00.

The code will generate above B3~B0.

The motor power on position is the default absolute zero position, or it is the position set by using set absolute zero function (0x00).

■ EXAMPLE 2

Condition:

Make 3th axis motor back to absolute zero position(= 0), ID = 3. Move to position 0 = 0x00, One byte data, PacketLenght = 4.

Method:

B3 = 0x03
B2 = 0x80 + (PacketLenght-4)*32 + Go_Absolute_Pos=0x80 + 0x01=0x81
B1 = 0x80 + 0x00 = 0x80
S = B3 + B2 + B1 = 0x03 + 0x81 + 0x80 = 0x104
B0 = 0x80 + Mod(S,128) = 0x84

■ EXAMPLE 3

Condition:

Make 3th axis motor move 120(steps) from right now position, ID = 3.

120 = 0x78 = 0x0111 1000 > 63,Two byte data, high 7bits 000 0000=0x00, lower 7bits = 111 1000 = 0x78. And use function Go_Relative_Pos (=0x03), Packet Length = 5.

Method:

B4 = 0x03
B3 = 0x80 +(PacketLength-4)*32+Go_Relative_PosP = 0x80+0x03 = 0xa3
B2 = 0x80 + 0x00 = 0x80
B1 = 0x80 + 0x78 = 0xf8
S = B4 + B3 + B2 + B1 = 0x03 + 0xa3 + 0x80 + 0xf8 = 0x21e
B0 = 0x80 + Mod(S , 128) = 0x80 + 0x1e = 0x9e

■ EXAMPLE 4

Condition:

Make 3th axis motor move -120(steps) from right now position, ID = 3.

Method:

-120 = 0x88 = 0xff88 < -63,Two byte data.
0xff88 = 0x1111 1111 1000 1000:
Lower 7bits = 000 1000 = 0x08   Higher 7bits = 0111 1111 = 0x7f

Use function Go_Relative_Pos(=0x03), Packet Length = 5.

B4 = 0x03;
B3 = 0x80 +(PacketLength-4)*32 + Go_Relative_Pos = 0x80 +0x04 =0xa3.
B2 = 0x80 + 0x7f = 0xff
B1 = 0x80 + 0x08 = 0x88
S = B4 + B3 + B2 + B1 = 0x03 + 0xa3 + 0xff + 0x88 = 0x22d
B0 = 0x80 + Mod(S , 128) = 0x80 + 0x2d = 0xad

■ EXAMPLE 5

Condition:

Make 2th axis motor turn at 60rpm, ID = 2.

Method:

Speed is 60, One Byte data is enough, 60 = 0x3c. Packet Length = 4.

B3 = 0x02;
B2 = 0x80 +(PacketLength-4)*32 + Turn_ConstSpeed = 0x80 +0x0a = 0x8a
B1 = 0x80 + 0x3c = 0xbc
S = B3 + B2 + B1 = 0x02 + 0x8a + 0xbc
B0 = 0x80 + Mod(S , 128) = 0xc8

■ EXAMPLE 6

Condition:

Make 2th axis motor turn at -60rpm, ID = 2. Speed is -60 = 0xc4 = 0x1100 0100 > -63, One byte data 7bits = 0x0100 0100 = 0x44. Packet Length = 4.

Method:

B3 = 0x02;
B2 = 0x80 +(PacketLength-4)*32 + Turn_ConstSpeed = 0x80+0x40+0x0a = 0x8a
B1 = 0x80 + 0x44 = 0xc4
S = B3 + B2 + B1 = 0x02 + 0x8a + 0xc4 = 0x150
B0 = 0x80 + Mod(S , 128) = 0x80 + 0x50 = 0xd0

■ EXAMPLE 7

Condition:

Make a line on X-Y Plane
Suppose right now position for three motors are(X0,Y0,Z0) = (0,0,0),
and the End point of straight line is (X1,Y1,Z1) = (100,200,0)

Method:

Always use General ID = 0x7f
The Feedrate = 3, could be from 1~127
Global_Func = (char)Make_LinearLine = 0x02;

Then send four packets to the Drives as:
Send_Package(ID,X1 - X0), i.e. Send_Package(0x7f,100)
Send_Package(ID,Y1 - Y0), i.e. Send_Package(0x7f,200)
Send_Package(ID,Z1 - Z0), i.e. Send_Package(0x7f,0)
Send_Package(ID,FeedRate),i.e. Send_Package(0x7f,3)

After the X-Y-Z three Drives received all four packets, they will start to move until the meet the end point of (X1,Y1,Z1). Three motors will meet (X1,Y1,Z1) at the same time.

During the linear or circular interpolation motion, the Read_Drive_Status (=0x09) can used to read Drives status register to check whether b5 = 0 or not, b5 = 0 means the coordinated motion be finished.

Send_Package(ID,Y1 - Y0) is the subroutine in the SAMPLE CODE, it will generate a packet as above examples.

■ EXAMPLE 8

Condition:

Make a circular arc on X-Y Plane

Suppose right now position for three motors are(X0,Y0) = (0,0), and the End point of arc is (X1,Y1) = (200,0) in CW direction. It is easy to know the center of arc is (Xc,Yc) = (100,0)

Method:

The Feedrate = 1, could be from 1~127>0, because in CW direction otherwise be negative value.
The planeNumber = 0 because it is in X-Y plane
TwoBytes = (PlaneNumber<<8) | FeedRate = 0*256 + 1 = 1
Use General ID = 0x7f
Global_Func = (char)Make_CircularArc = 0x04;

Then send five packets to the Drives as:
Send_Package(ID,X0 - Xc), i.e. Send_Package(0x7f,-100)
Send_Package(ID,Y0 - Yc), i.e. Send_Package(0x7f,0)
Send_Package(ID,X1 - Xc), i.e. Send_Package(0x7f,100)
Send_Package(ID,Y1 - Yc), i.e. Send_Package(0x7f,0)
Send_Package(ID,TwoBytes),i.e. Send_Package(0x7f,1)

After the X-Y-Z three Drives received all four packets, Only two of three motors will move and finally will meet (X1,Y1) at the same time. During the linear or circular interpolation motion, the Read_Drive_Status (=0x09) can used to read Drives status register to check whether b5 = 0 or not, b5 = 0 means the coordinated motion be finished.

Two equal half arcs must be made to make a circle.

The following three examples makes use of the sample code in *Section 7.7A Appendix : C++ Code for Serial Communication Protocol*. All contents of the sample code must be copied to the program.

■ EXAMPLE 9

Condition:

Read servo motor absolute position

Method:

Call ReadMotorPosition32() subroutine function
Motor position stored in Motor_Pos32 variable as:
Motor_Pos32 = (long) [-2^27 : 2^27-1] = [-134,217,728 : 134,217,727]

■ EXAMPLE 10

Condition:

Read servo motor torque current

Method:

Call ReadMotorTorqueCurrent() subroutine function
Motor torque current stored in MotorTorqueCurrent variable as:
MotorTorqueCurrent = (short) [-2^15 : 2^15-1] = [−32,767 : 32,766]

MotorTorqueCurrent represents a relative number according to the RMS current output by servo drive. This value is different between each servo motor capacity and varies between the DYN2 and DYN4 servo drive. The customer can measure the change in MotorTorqueCurrent variable to monitor relative current draw. Use servo motor torque constant specification to calculate torque output.

■ EXAMPLE 11

Condition:

Read servo drive Main Gain parameter

Method:

Call ReadMainGain() subroutine function
DYN drive Main Gain stored in MainGain_Read variable

Use the same subroutine format for all Parameter Read functions 0x18~ 0x1f.

Several Drives can be connected by RS485 after every Drive on the RS485 net have been designated an individual, or broadcasting ID number.

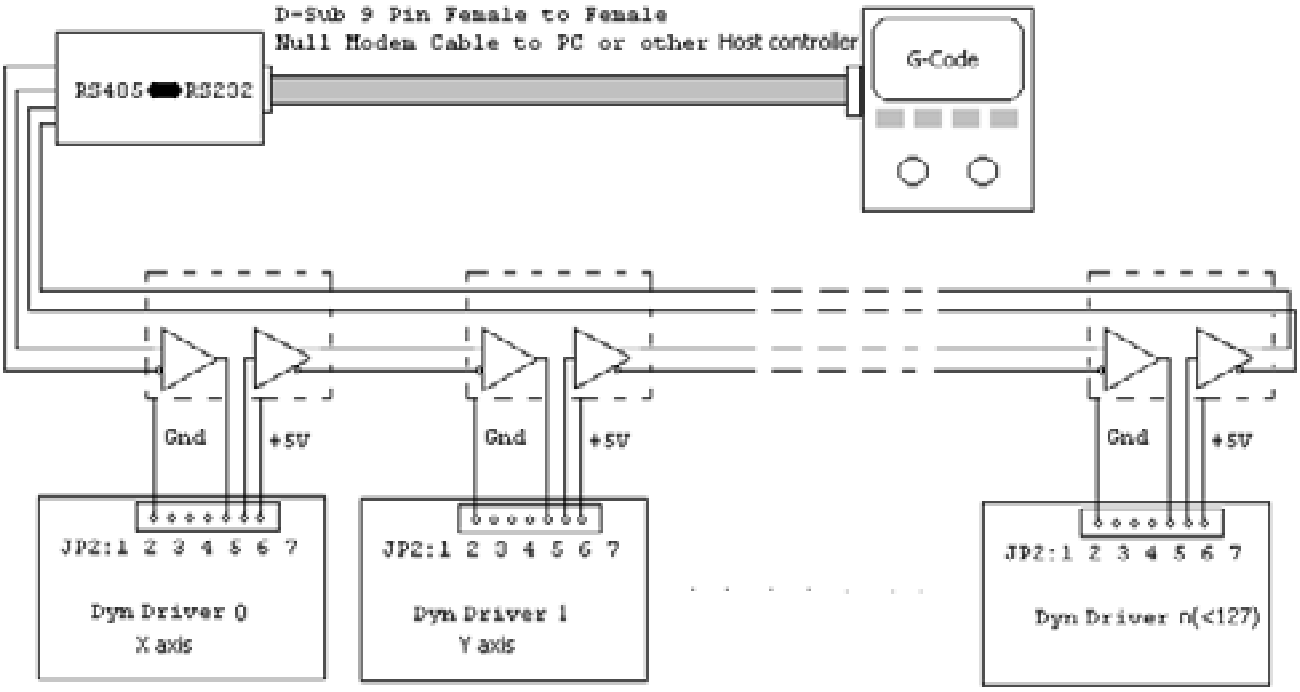
The RS485 check box must be checked if RS485 network is used which means there are at least two or more Drive on the net, then every servo drive status and configuration can be read or set according to the ID number on the servo setting dialog box. The ID number cannot be assigned to a particular Drive if RS485 network is connected.

The Servo Drive ID number CAN ONLY BE SET when there is only ONE drive connected, then assigned a new ID number to that drive without checking the ***RS485/232 Net*** **check box (in the DMMDRV software).**

The RS485 network is a serial network, if there is a packet in the network, one Drive will receive it first, if the packet's ID number is the same as the Drives, that packet will be received and processed by the Drive, otherwise that packet will be relayed to the next Drive.

The Drive ID is contained in the first byte of the packet. When a packet is received, the drive only reads the first byte, it will receive if ID is correct and relay to next drive if ID does not match. Data flow on the serial RS485 net is very fast and efficient.

Every drive has a RS485NET node which contains a RS485 buffer such as LTC491.



The following code shows an example to generate a data packet and call functions in RS232 serial protocol.

Note: in the description of RS232 communication protocol above (Section 7), the last byte of packet is always B0, but in the code of below, the first byte is always B0.

```
#define Go_Absolute_Pos                     0x01
#define Is_AbsPos32                         0x1b
#define General_Read                        0x0e
#define Is_TrqCurrent                       0x1e
#define Read_MainGain                       0x18
#define Is_MainGain                         0x10
        char InputBuffer[256];                              //Input buffer from RS232,
        char OutputBuffer[256];                             //Output buffer to RS232,
        unsigned char InBfTopPointer,InBfBtmPointer;//input buffer pointers
        unsigned char OutBfTopPointer,OutBfBtmPointer;//output buffer pointers
        unsigned char Read_Package_Buffer[8],Read_Num,Read_Package_Length,Global_Func;
        unsigned char MotorPosition32Ready_Flag, MotorTorqueCurrentReady_Flag, MainGainRead_Flag;
        long Motor_Pos32;
        int MotorTorqueCurrent, MainGain_Read;

void DlgRun::ReadPackage()
{
        unsigned char c,cif;

        ReadRS232Port();                        // Include customer code to read from serial port

        while(There is data in the customer hardware RS232 receiving Buffer)
        {
                InputBuffer[InBfTopPointer] = HardwaerRS232ReceiveBuffer;     //Load InputBuffer with received packets
                InBfTopPointer++;
        }

        while(InBfBtmPointer!=InBfTopPointer)
        {
                c = InputBuffer[Comm.InBfBtmPointer];
                InBfBtmPointer++;
                cif = c&0x80;
                if(cif==0)
                {
                        Read_Num = 0;
                        Read_Package_Length = 0;
                }
                if(cif==0||Read_Num>0)
                {
                        Read_Package_Buffer[Read_Num] = c;
                        Read_Num++;
                        if(Read_Num==2)
                        {
                                cif = c>>5;
                                cif = cif&0x03;
                                Read_Package_Length = 4 + cif;
                                c = 0;
                        }
                        if(Read_Num==Read_Package_Length)
                        {
                                Get_Function();
                                Read_Num = 0;
                                Read_Package_Length = 0;
                        }
                }
        }
}
```

C++ Code for Serial Communication - Page 1

```
void DlgRun::Get_Function(void)
{
        char ID, ReceivedFunction_Code, CRC_Check;
        ID = Read_Package_Buffer[0]&0x7f;
        ReceivedFunction_Code = Read_Package_Buffer[1]&0x1f;
        CRC_Check = 0;
        for(int i=0;i<Comm.Read_Package_Length-1;i++)
        {
                CRC_Check += Read_Package_Buffer[i];
        }
         CRC_Check ^= Read_Package_Buffer[Comm.Read_Package_Length-1];
         CRC_Check &= 0x7f;
    if(CRC_Check!= 0){
        //MessageBox("There is CRC error!") - Customer code to indicate CRC error
    }
    else
    {
    switch(ReceivedFunction_Code){
        case  Is_AbsPos32:
                Motor_Pos32 = Cal_SignValue(Read_Package_Buffer);
                MotorPosition32Ready_Flag = 0x00;
                break;
        case  Is_TrqCurrent:
                MotorTorqueCurrent = Cal_SignValue(Read_Package_Buffer);
                MotorTorqueCurrentReady_Flag = 0x00;
                break;
        case  Is_MainGain:
                MainGain_Read = Cal_SignValue(Read_Package_Buffer);
                MainGainRead_Flag = 0x00;
                break;
        default:;
        }
    }
}


/*Get data with sign - long*/
long DlgRun::Cal_SignValue(unsigned char One_Package[8])
{
        char Package_Length,OneChar,i;
        long Lcmd;
        OneChar = One_Package[1];
        OneChar = OneChar>>5;
        OneChar = OneChar&0x03;
        Package_Length = 4 + OneChar;
        OneChar = One_Package[2];                /*First byte 0x7f, bit 6 reprents sign */
        OneChar = OneChar << 1;
        Lcmd = (long)OneChar;                    /* Sign extended to 32bits */
        Lcmd = Lcmd >> 1;
        for(i=3;i<Package_Length-1;i++)
        {
                OneChar = One_Package[i];
                OneChar &= 0x7f;
                Lcmd = Lcmd<<7;
                Lcmd += OneChar;
        }
        return(Lcmd);                            /* Lcmd : -2^27 ~ 2^27 - 1 */
}
```

C++ Code for Serial Communication - Page 2

```
//***************** Every Robot Instruction ******************
// Send a package with a function by Global_Func
// Displacement: -2^27 ~ 2^27 - 1
// Note: in the description of RS232 communication protocol above (Section 7), the last byte of packet is                    //
always B0, but in the code of below, the first byte is always B0.

void DlgRun::Send_Package(char ID , long Displacement)
{
        unsigned char B[8],Package_Length,Function_Code;
        long TempLong;
        B[1] = B[2] = B[3] = B[4] = B[5] = (unsigned char)0x80;
        B[0] = ID&0x7f;
        Function_Code = Global_Func & 0x1f;
        TempLong = Displacement & 0x0fffffff;          //Max 28bits
        B[5] += (unsigned char)TempLong&0x0000007f;
        TempLong = TempLong>>7;
        B[4] += (unsigned char)TempLong&0x0000007f;
        TempLong = TempLong>>7;
        B[3] += (unsigned char)TempLong&0x0000007f;
        TempLong = TempLong>>7;
        B[2] += (unsigned char)TempLong&0x0000007f;
        Package_Length = 7;
        TempLong = Displacement;
        TempLong = TempLong >> 20;
        if(( TempLong == 0x00000000) || ( TempLong == 0xffffffff))
        {//Three byte data
                B[2] = B[3];
                B[3] = B[4];
                B[4] = B[5];
                Package_Length = 6;
        }
        TempLong = Displacement;
        TempLong = TempLong >> 13;
        if(( TempLong == 0x00000000) || ( TempLong == 0xffffffff))
        {//Two byte data
                B[2] = B[3];
                B[3] = B[4];
                Package_Length = 5;
        }
        TempLong = Displacement;
        TempLong = TempLong >> 6;
        if(( TempLong == 0x00000000) || ( TempLong == 0xffffffff))
        {//One byte data
                B[2] = B[3];
                Package_Length = 4;
        }
        B[1] += (Package_Length-4)*32 + Function_Code;
        Make_CRC_Send(Package_Length,B);
}
```

```
void DlgRun::Make_CRC_Send(unsigned char Plength,unsigned char B[8])
{
        unsigned char Error_Check = 0;
        for(int i=0;i<Plength-1;i++)
        {
                OutputBuffer[OutBfTopPointer] = B[i];
                OutBfTopPointer++;
                Error_Check += B[i];
        }
        Error_Check = Error_Check|0x80;
        OutputBuffer[OutBfTopPointer] = Error_Check;
        OutBfTopPointer++;

        while(OutBfBtmPointer != OutBfTopPointer)
        {
                RS232_HardwareShiftRegister = OutputBuffer[OutBfBtmPointer];
                SendRS232Port();                // Include customer code to send to RS232 port
                OutBfBtmPointer++;              // Change to next byte in OutputBuffer to send
        }
}

void DlgRun::ReadMotorTorqueCurrent(void)
{/*Below are the codes for reading the motor torque current */

                                               //Read motor torque current
        char ID = 0;                           //Suppose read 0 axis motor
        Global_Func = General_Read;
        Send_Package(ID , Is_TrqCurrent);

                //Function code is General_Read, but one byte data is : Is_TrqCurrent
                //Then the drive will return a packet, Function code is Is_TrqCurrent
                //and the data is 16bits Motor torque current.


        MotorTorqueCurrentReady_Flag = 0xff;
        While(MotorTorqueCurrentReady_Flag != 0x00)
        ReadPackage();

                //MotorTorqueCurrentReady_Flag is cleared inside ReadPackage() or inside
                //Get_Function() exactly after the MotorTorqueCurrent is updated.
}
```

C++ Code for Serial Communication - Page 4

```
void DlgRun::ReadMotorPosition32(void)
{/*Below are the codes for reading the motor shaft 32bits absolute position */

                                                    //Read motor 32bits position
        char ID = 0;                                //Suppose read 0 axis motor
        Global_Func = General_Read;
        Send_Package(ID , Is_AbsPos32);

                // Function code is General_Read, but one byte data is : Is_AbsPos32
                // Then the drive will return a packet, Function code is Is_AbsPos32
                // and the data is 28bits motor position32.

        MotorPosition32Ready_Flag = 0xff;
        While(MotorPosition32Ready_Flag != 0x00)
        ReadPackage();

                // MotorPosition32Ready_Flag is cleared inside ReadPackage() or inside
                // Get_Function() exactly after the Motor_Pos32 is updated.
}


void MoveMotorToAbsolutePosition32(char MotorID,long Pos32)
{
        char Axis_Num = MotorID;
        Global_Func = (char)Go_Absolute_Pos;
        Send_Package(Axis_Num,Pos32);
}

void ReadMainGain(char MotorID)
{
        char Axis_Num = MotorID;
        Global_Func = (char)Read_MainGain;
        Send_Package(Axis_Num, Is_MainGain);

        MainGainRead_Flag = 0xff;
        while(MainGainRead_Flag != 0x00)
        {
            ReadPackage();
        }
}
```

C++ Code for Serial Communication - Page 5

```
void main(void)
{
          /* (1)  Move motor 2 to absolute position of 321,456 - Method 1*/
          char Axis_Num = 2;
          Global_Func = (char)Go_Absolute_Pos;
          long pos = 321456;
          Send_Package(Axis_Num,Pos);

          /* (2)  Move motor 2 to absolute position of 321,456 - Method 2 - Using subroutine function*/
          MoveMotorToAbsolutePosition32(2,321456);

          /* (3)  Code for reading the motor shaft 32bits absolute position - Method 1
                This method uses a while delay to wait for Send_Package() function to complete
          */
          int i;
          InBfTopPointer = InBfBtmPointer = 0;             //reset input buffer pointers
          OutBfTopPointer = OutBfBtmPointer = 0;           //reset output buffer pointers

          for(i=0;i<8;i++)
                    Read_Package_Buffer[i] = 0;

          Read_Num = Read_Package_Length = 0;

          //Reading motor 32bits position
          char ID = 0; //Suppose read 0 axis motor
          Global_Func = General_Read;
          Send_Package(ID , Is_AbsPos32);

          while(i<10000)                         //10~20ms waiting
          {
                    i++;
          }

          ReadPackage();                         //Motor absolute position stored in Motor_Pos32 variable

          /* (4)  Reading the motor shaft 32bits absolute position - Method 2 using subroutine function*/
          ReadMotorPosition32();                 //Motor absolute position stored in Motor_Pos32 variable

          /* (5)  Reading the motor current using subroutine function*/
          ReadMotorTorqueCurrent();    //Motor torque current stored in MotorTorqueCurrent variable

          /* (6)  Reading the main gain of 8th axis servo drive using subroutine function*/
          ReadMainGain(8);             //Main Gain stored in MainGain_Read variable
}
```

C++ Code for Serial Communication - Page 6

Sample Code Notes:

(1) The sample code uses a ring buffer structure to input and output data packet bytes. Two separate ring buffers are using in the code as *char InputBuffer[256]* and *char OutputBuffer[256]*.

Two position pointers are used in each buffer structure to index the data inside the buffer structure. For example, when a data packet is received from the servo drive, each byte received is sequentially saved into the InputBuffer with the InBfTopPointer incremented each time. This is done until the host hardware RS232 receiver buffer is empty, meaning all packet bytes have been read and stored. Data is processed as first-in-first-out (FIFO) queue and starts at the index of InBfBtmPointer. InBfBtmPointer is incremented each time a byte is processed until InBfBtmPointer=InBfTopPointer, meaning all packet bytes have been processed.

C++ Code for Serial Communication - Page 7

8 Modbus RTU (RS485) Communication

The DYN4-□□□B2-00 servo drive models are compatible with Modbus RTU communication over 2-Wire RS485.

Please refer to the following manual for Modbus communication specification:

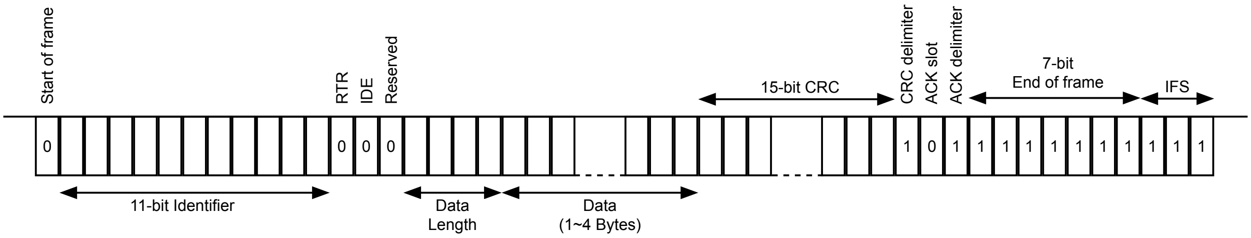
Document Number DYNMB1-BL1645	DYN AC Servo Drive Modbus RTU Specification

9 CAN Communication

The DYN4-□□□C2-00 servo drive models are compatible with CAN 2.0A specification. The data frame format is a proprietary DYN servo drive format with efficient data packaging and high transmission rates up to 1Mbit/s for fastest cycle time.

Please refer to the CAN communication manual for detailed specificaitons.

DYN servo drive CAN Protocol Data Framing:



11-bit Identifier Consists both Drive ID and Command Function Code:

b4~b0 = 5-bit Function Code

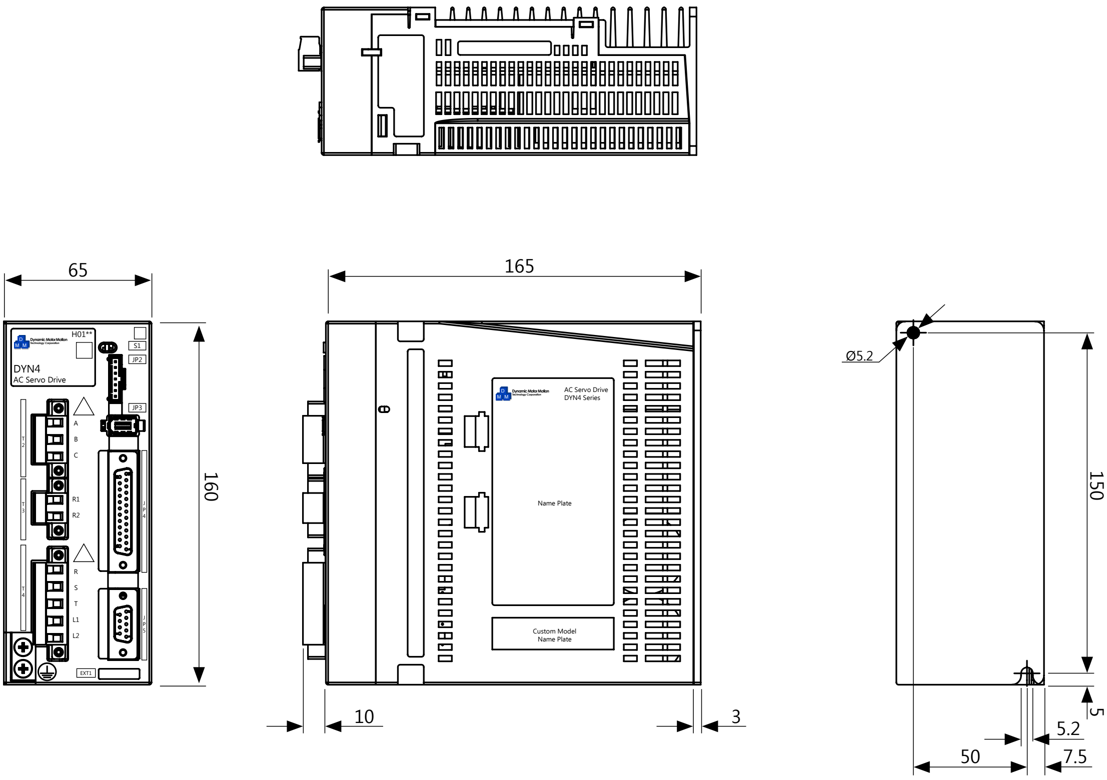
b5~b10 = Drive ID 0~64
0 = Broadcast

Function Code:

#	CAN Command	5-bit Function Code	Data Length (Bytes)
0	Set_Origin	0x00	0
1	Go_Absolute_Pos_PTP	0x01	1~4
2	Make_LinearLine	0x02	1~4
3	Go_Relative_Pos_PTP	0x03	1~4
...	...	...	...

Appendix A - Servo Drive Dimensions

Dimensions common between all DYN4 servo drive L01, H01 and T01 frame sizes.



■ Cable Spacing

Leave at least 80mm space in front of the servo drive for cable spacing. Ensure the cables are not pulling on the connectors or pins.

1) The wires used to connect AC power into logic power L1/L2 and main control power R/S/T should be at least 12AWG (3.5mm2 cross-section area) and have a temperature rating of 75 degree Celsius. Using smaller gauge wires can restrict current flow into the drive and cause dips/spikes in the voltage line.

2) Power ON both logic L1/L2 and control R/S/T circuits simultaneously. Normally, logic L1/L2 can be power up first, then control R/S/T afterwards. But if the input voltage source is unstable, powering R/S/T draws high in-rush current, which can spike the line voltage for L1/L2 and cause over-voltage error.

3) In addition to the noise filter connected to the logic input, also connect an EMI filter at the control R/S/T input to minimize motor PWM noise from affecting other drives or other devices from common and differential mode noise.

Servo Drive Model	Recommended EMI Noise filter at logic L1/L2	Recommended EMI Noise filter at control R/S/T
DYN4-L01	Schaffner FN2030-1-06 Or equivalent single-phase rated 250V / 1A filter	Schaffner FN2030-10-06
DYN4-H01		Schaffner FN2030-20-06
DYN4-T01		Schaffner FN2030-30-08

For three-phase input at control R/S/T, select the appropriate filter depending on Delta or Wye configuration. Use separate noise filters for each servo drive. Do not share the same filter between multiple drives. Ensure the noise filter is properly grounded.

4) If the servo drive commonly faults with over-voltage error during operation, connect a regenerative resistor into R1/R2 terminal. The regenerative circuit can also be activated when the input voltage is too high so take notice of the temperature of the regenerative resistor. If the temperature is unusually high, especially when there is little or no motion on the motor, refer to Point 2, and connect a transformer or input line reactor to the power supply.

5) The servo drive’s max AC voltage input is 240VAC allowed to fluctuate 10%, or up to 264VAC. If the voltage exceeds 260VAC at the input, use a transformer or an Input AC line reactor to stabilize the voltage at 240VAC. Select line reactor current according to rated current of motor.

Servo Motor Model	Motor Rated Current	Recommend Reactor
880-DST (750W)	4.4A	Automation Direct: LR-20P5-1PH (Single Phase) LR-21P0 (Three-Phase) MTE: RL-00402 (Three-Phase)
120-DST (1.8kW)	16.7A	Automation Direct: LR-23P0-1PH (Single-Phase) LR-25P0 (Three-Phase) MTE: RL-01802 (Three-Phase)

6) Use the same power supply voltage for logic L1/L2 and control R/S/T. For example, when using a transformer with 120VAC at the primary voltage and 240VAC at the secondary voltage, connect the 240VAC to both L1/L2 and R/S/T. Do not connect 120VAC into L1/L2 and 240VAC into R/S/T.

Warranty and Liability

Warranty

Products from DMM Technology Corp. are supported by the following warranty.

- 1-year from the date of product received by customer or 14 months from the month of original invoice.

Within the warranty period, DMM Technology Corp. will replace or repair any defective product free of charge given that DMM Technology Corp. is responsible for the cause of the defect. This warranty does not cover cases involving the following conditions:

- The product is used in an unsuitable or hazardous environment not outlined in this manual, resulting in damages to the product.
- The product is improperly handled resulting in physical damage to the product. Including falling, heavy impact, vibration or shock.
- Damages resulting from transportation or shipping after the original factory delivery.
- Unauthorized alterations or modifications that have been made to the product.
- Alterations have been made to the Name Plate of the product
- Damages resulting from usage of the product not specified by this manual.
- Damages to the product resulting from natural disasters.
- The product has cosmetic alterations.
- The product does not conform to the original factory manufactured standards due to unauthorized modifications.

Liability

Use, operation, handling and storage of the DYN4 AC Servo Drive is the sole responsibility of the customer. Any direct or indirect commercial loss, commercial profit, physical damage or mechanical damage caused by the DYN4 AC Servo Drive is not responsible by DMM Technology Corp. The features and functionality of the product should be used with full discretion by the customer.

Product and Manual Disclaimer

Disclaimer

DMM Technology Corp. constantly strive to improve its product performance and reliability. The contents of this manual outlines the latest features and specifications of the DYN4 AC Servo Drive and may be changed at any time to reflect corrections, improvements or changes to the product or information in this manual.

Servo Drive Revision

Frame Size	L01	H01	T01
Hardware Version	PTH1-L01	PTH1-01 HL2	PTH1-T01 L1
Software Version	PTS1-L01	PTH1-01 HL2	PTS1-T01 L1
Release Date	June 2016	Jannuary 2016	June 2016
Version Notes	-	-	-

■ Document Revisions ■

Published	Revision	Int Ref.	Section	Revised Content
September 2017	A1.8A	ZM5	1.2	- Added B and C Command type model number
			1.3	- Updated CE Certification
			2.5	- Added single phase input example
			8	- Modbus RTU (RS485) Communication
			9	- CAN Communication
			Appendix B	- Added Application Note# AP15-48 - DYN4 Servo Drive - AC Power Supply Guidelines
July 2016	A1.7a	ZM1	1.2 1.3 1.6	- Added L01 and T01 model information
			2.5	- Revised wiring diagram - Added encoder cable shield grounding notice
December 2015	A1.5b	05U	7.4.2	Added RS232 specifications
			2.5	- Added multiple drive connection - Regenerative Resistor notes
			2.3.2	Sourcing circuit diagram
			2.3	JP4 I/O corrections and additions
			5.1	- Added Max Acceleration and Max Speed parameter reset after power ON - Parameter detail added
			4.5	Changed PULSE_NUM to LINE_NUM
			3.4.1	New DMMDRV software program information
			1.5	Added ABS-14-00 14-bit encoder option information
			All	Various design and layout improvements
March 2015	A1.5	DR1	7 All	- Added DYN232M Section - Formatting improvements
January 2015	A1.2	M22	4.1 2.2	- Revised command pulse specifications - Added JP3 encoder feedback pinout
December 2014	A1.1	--	--	First Edition

DYN4 Series

AC Servo Drive

AC SERVO DRIVE
INSTRUCTION MANUAL
TYPE A - GENERAL PURPOSE PULSE / ANALOG / DYN232M
TYPE B - MODBUS
MODEL: DYN4 - □□□ A, DYN4 - □□□ B

MANUAL CODE: DYN4MS-ZM5-A18A
REVISION: A1.8A

Electronic Version

Published In Canada A4P

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