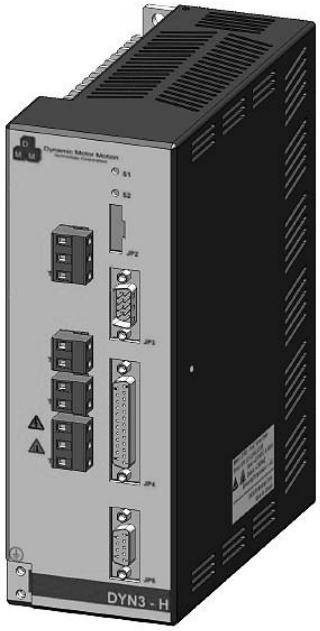
Dynamic Motor Motion
Technology Corporation

AC Servo Drive
DYN3 Series

User Manual



Rev. 1.14b
December, 2012

About This Manual

Thank you for purchasing the DYN3-Series AC Servo drive from DMM Technology Corp. Before the servo drive is installed or used, the contents of this manual should be read by the operator to ensure that the equipment is used and operated properly and safely. This manual contains comprehensive information regarding the use of the DYN3 servo drive including installation, wiring, tuning and troubleshooting.

The equipment operator or user should keep this manual in a location readily accessible whenever reference is needed.

General Safety Precautions

The above symbols indicate critical situations where careful precautions must be taken. Failure to follow these precautions can lead to damage of the product and related equipment or even physical injury or death.

The following precautions must be observed and followed before and during all servo drive operations.

- The Servo System must be installed and operated in a clean environment free from water, corrosive, flammable, and combustible materials and direct sunlight.
- Before the servo is turned on, ensure that an external emergency circuit is in place so that power can be immediately shut off.
- Properly ground the earth terminal of the servo drive and motor. See *Section 3.2 Overall Wiring Configuration* for grounding connection details.
- Disconnect all power sources to the servo before performing major maintenance or modifications to the servo drive.
- Do not quickly and repeatedly turn on and off the power to the servo drive.
- Do not subject the servo drive or any connected cables to excessive force or weight.
- As some internal components of the servo drive will be electrically charged, wait 60 seconds after immediate power off before physically handling the servo drive or attached components.

Warning

- Do not touch the servo drive's heat sink during operation.
- Ensure that there are no foreign objects blocking the heat ventilation openings on the servo drive's enclosure. See *Section 2.4.3 Mounting* for proper spacing requirements.
- After the power to the servo drive is turned off, wait 60 seconds before physically handling the servo drive.
- Do not open or remove any of the enclosures of the servo drive. Contact DMM Technology Corp. directly for repairs, maintenance or inspection.
- The servo drive should be treated as industrial waste during disposal.

Product Warranty

Products from DMM Technology Corp. are supported by the following warranty and return policies:

- 1-year warranty from the date of purchase or 14 months from the month of original manufacture.
- 14-day return period from the date of purchase.

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, or shock.
- Damages resulting from transportation or shipping after the original factory delivery.
- Unauthorized alterations or modifications have been made to the product.
- Alterations have been made to the Name Plate of the product
- Damages resulting in usage of the product not specified by this manual.
- Damages to the product resulting from natural disasters

Within the 14-day return period, DMM Technology Corp. will refund the full amount of original factory product cost. This policy does not cover cases involving the following conditions:

- The product has experienced cosmetic alterations or irreversible electronic modifications.
- The product does not conform to the original factory manufactured standards.
- Factory components included in the purchased package such as cables, software, or accessories of the product is missing.
- Alterations have been made to the Name Plate of the product.

Contents of this Manual

Section 1. Before Using the Product

1.1 Unpacking the Contents

Upon opening the product packaging of your new DYN3 AC Servo drive, please observe and ensure the following:

- Check that the servo drive model corresponds with your order. See section *1.2.2 Model Number Designation* to verify that the model is correct.
- Make sure that the package contains all components that was included in the order including:

  - ✓ Servo Drive
  - ✓ Servo Motor
  - ✓ Cables
  - ✓ Software
  - ✓ Accessories

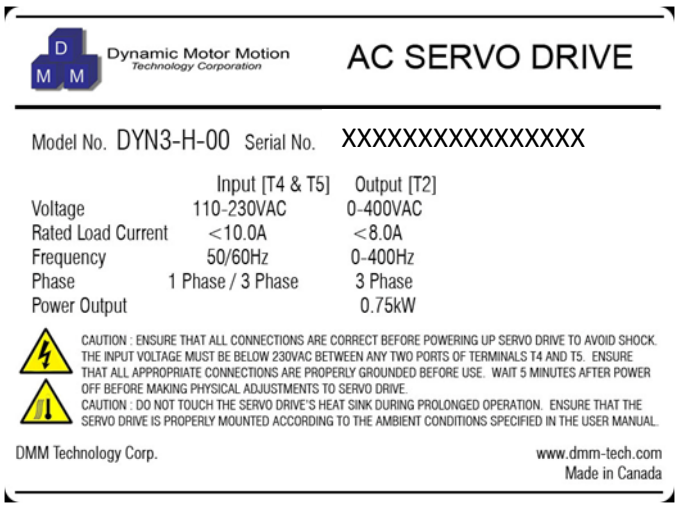
- Inspect all products to see if anything was damaged during transportation.

***Contact your dealer immediately if you find any inaccuracies or inconsistencies above.*

1.2 Model Designation

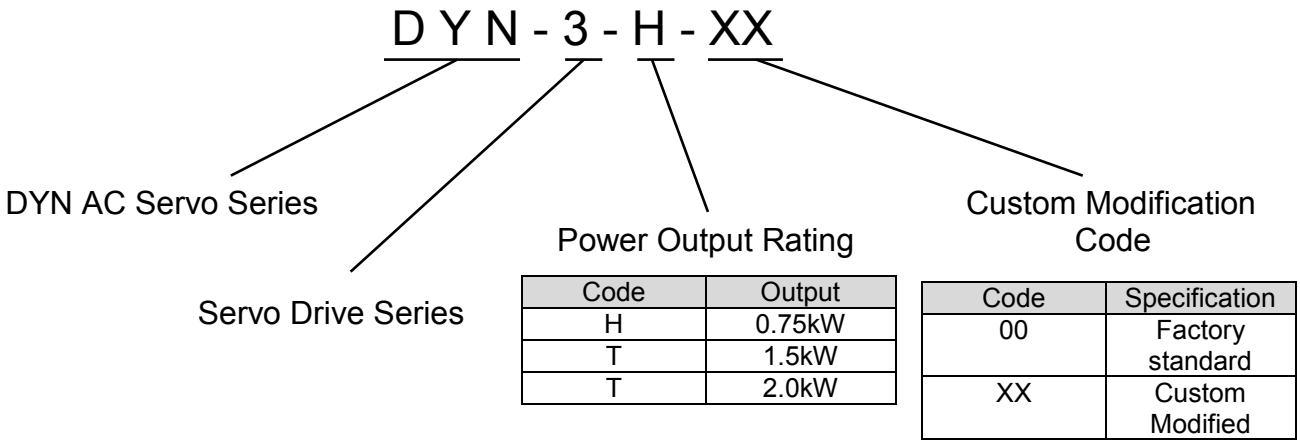
1.2.1 Name Plate Information

The DYN3 AC Servo drive's nameplate is located on the right panel of the device.



*Sample Name Plate for standard DYN3-H, 0.75kW Servo Drive

1.2.2 Model Number Designation



Code	Output
H	0.75kW
T	1.5kW
T	2.0kW

Code	Specification
00	Factory standard
XX	Custom Modified

1.3 DHT Series Servo Motor Pair

Servo Drive	Servo Motor	Power Supply	Rated Output	Rated Speed
DYN3-H	60EM-DHT-36	AC	0.4W	3000rpm
		DC		
	92M-DHT-72	AC	0.75W	
		AC		
DYN3-T	31M-DHT-15	AC	1.5kW	
	32M-DHT-28	AC	2.0kW	2500rpm

Section 2. Product Description and Preparation

2.1 Technology and Performance Features

The DYN3 AC Servo drive features simplicity in servo integration and high performance while maintaining industry standard motion control methods and compatibility. In addition to the Velocity, Position and Torque servo modes, the drive can be programmed in RS232 mode using simple predefined software and prepackaged code to program control methods of motion that offer dynamic accuracy and versatility suitable for all applications.

Tuning and monitoring the servo's behaviour is simplified through the use of a Graphical User Interface. The drive can be easily configured for seamless integration with a variety of host controllers such as PLC's or dedicated motion controllers.

2.2 Servo Drive Specifications

2.2.1 General Specifications

General Specifications							
Output Power		0.75kw		1.5kw		2.0kw	
AC input voltage		110~230Vac +/-5%, 50/60Hz +/-5%					
Input Type		110VAC	230VAC	110VAC	230VAC	110VAC	230VAC
Power current (RMS)	1-Phase	6.82A	3.26A	N/A	6.52A	N/A	8.69A
	3-Phase	3.94A	1.88A	7.87A	3.76A	10.49A	5.02A
Inrush current		40A		50A		60A	
Feedback		14-bit Absolute Encoder					
Control input		1-phase 110/220Vac, 50mA					
Cooling method		Convection					
Communication		RS232 for tuning, also position/speed/torque input					
Regeneration Control		External power thermal resistor					
		50~100Ω, 1.0 – 2.0kW					
Altitude		<2000m (6562ft) from sea level					
Operating temperature		0 to 60(deg)(32 to 140F)					

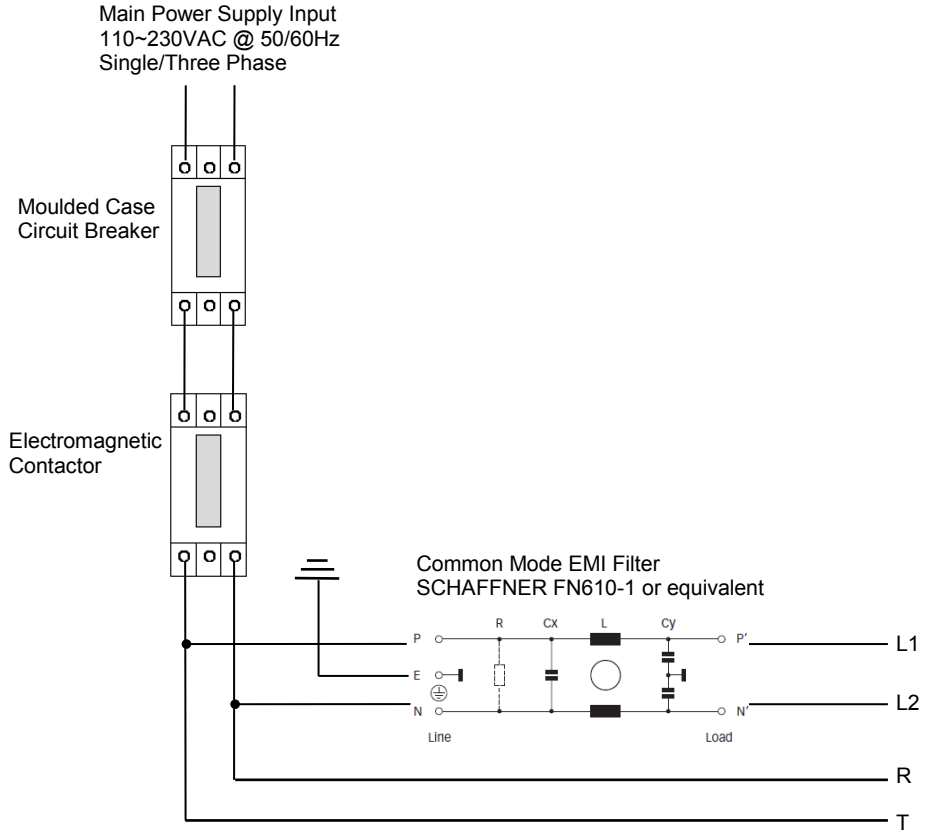
Storage temperature	-20 to 80(deg)(-4 to 176F)
Humidity	0 to 90% (non-condensing)
Vibration	1G
UL/CE	TBA
Weight	1.5kg
Pulse direction input	CMOS/TTL compatible +5V line drive or open collector Max pulse frequency 500kHz
Analog input -10V to +10V	Input resistor 25k(ohm), input RC filter 20kHz 12bits AD converter

2.2.2 Power and Control Noise Filters

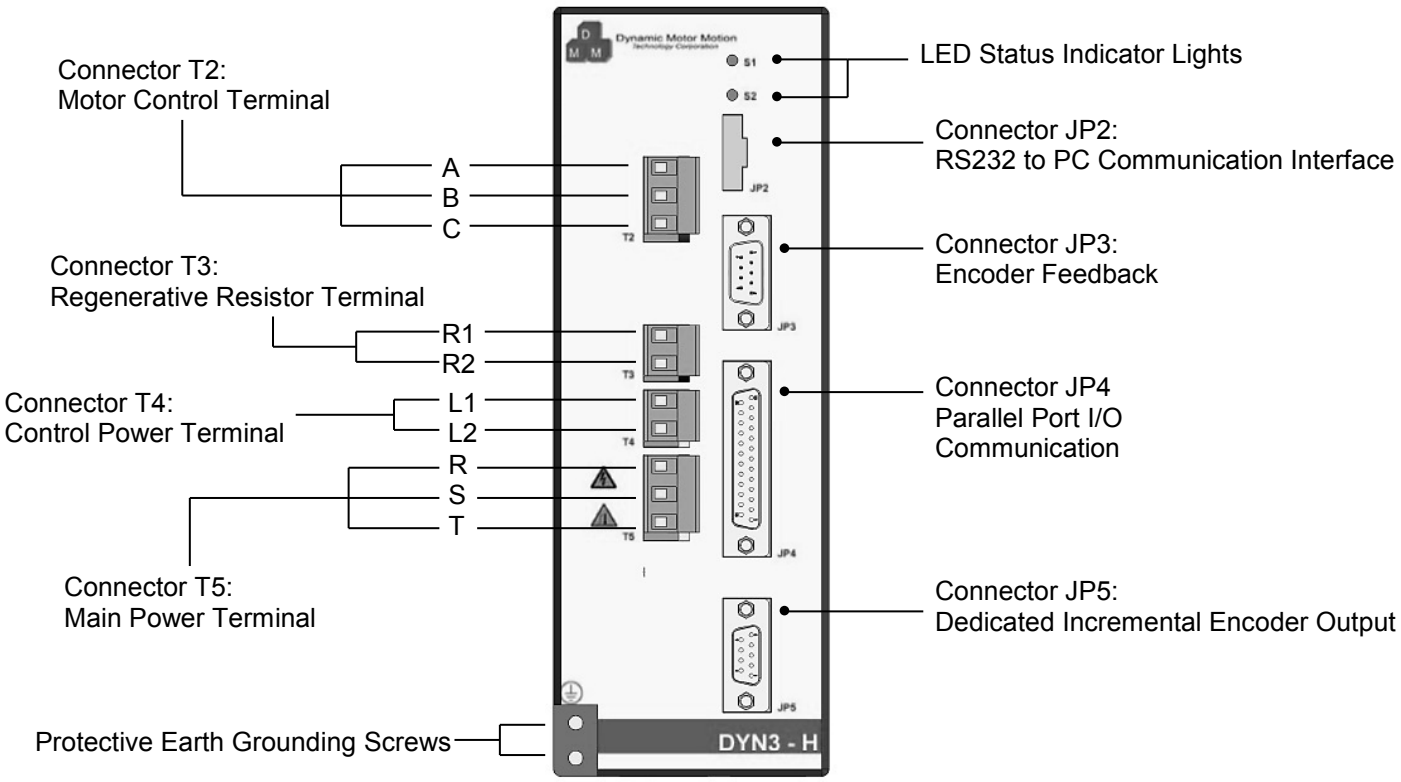
The power input into the DYN3 servo drive's control and logic power terminals are put through an RC filter to attenuate the input power switching noise. This filter is active for both single or three phase inputs and is used to smooth out the power source before reaching key electronic components and hardware inside the servo drive.

An external noise filter can also be installed before the control and logic power inputs to eliminate noise and disturbances in the connection lines.

Example Connection to External Filter



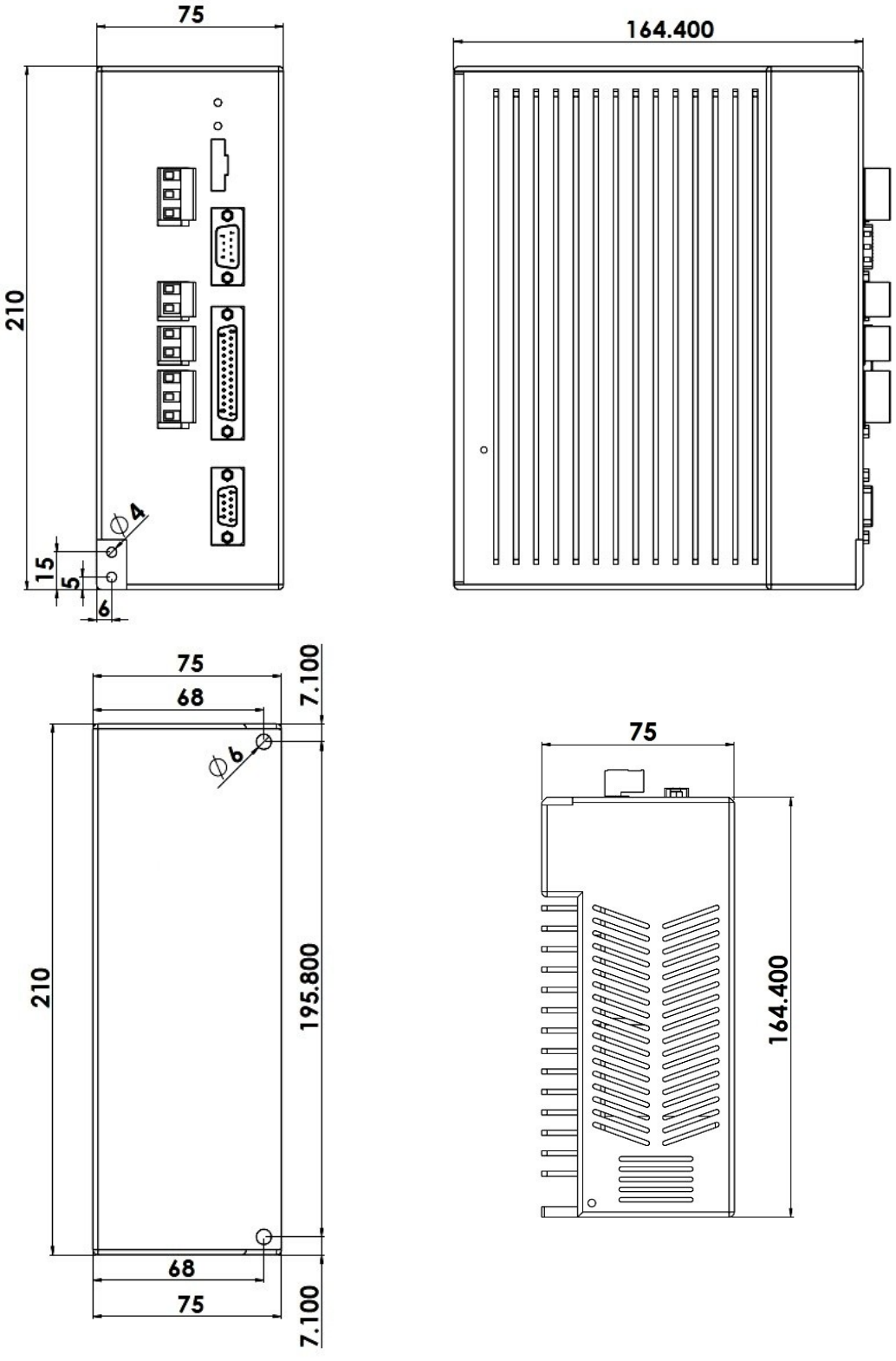
2.3 Servo Drive Component Description



2.4 Installation and Mounting

2.4.1 Servo Drive Dimensions

DYN3-H / T AC Servo Drive
Units: [mm]



2.4.2 Installation Requirements

Warning

To avoid personal injury or damage to the product, the user should review the general safety precautions outlined in page.3 of this manual. Improper installation and mounting of the product can also cause personal injury or damage to the product.

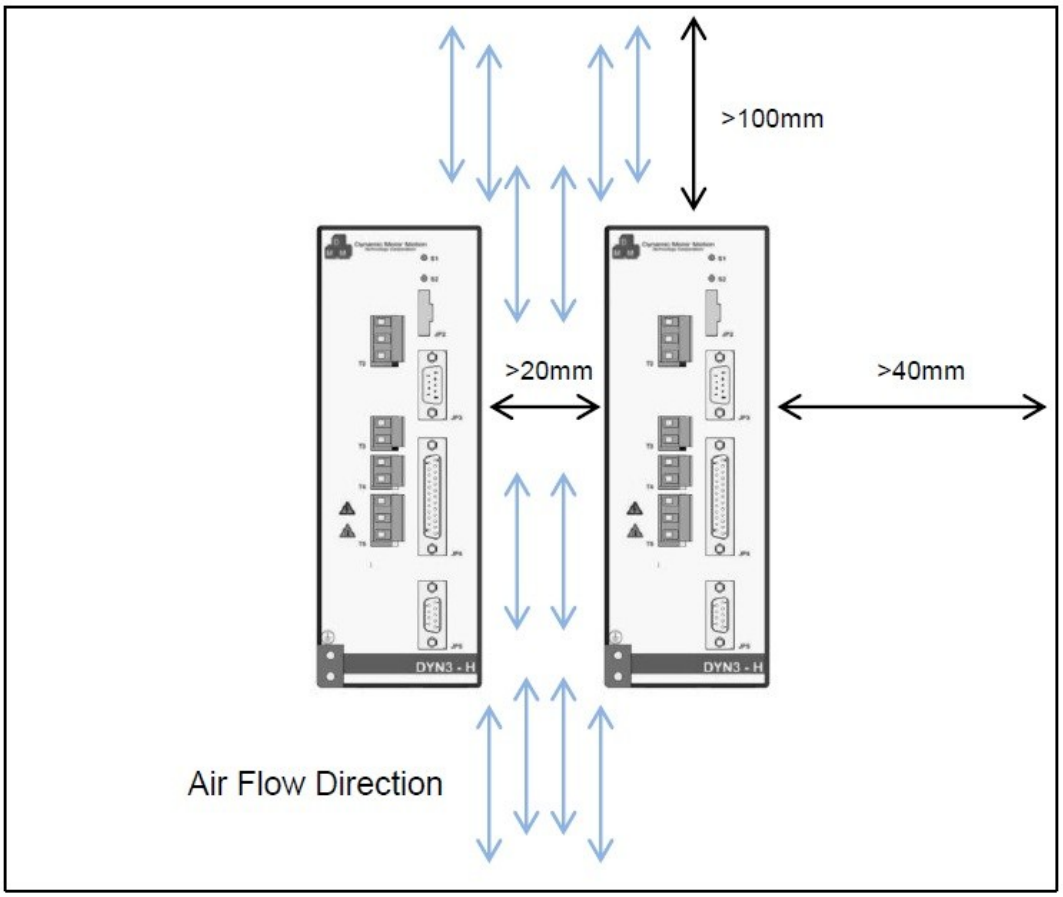
- Install and mount the servo drive in an environment free of hazardous substances such as flammable fluids or gases, corrosive chemical fluids or gases, water, or direct sunlight.
- Ensure that the servo drive will not be subject to splashes of cooling fluid, oil, or residual metal chips from the machinery.
- If possible, install and mount the servo drives in a NEMA rated control panel or enclosure to protect from hazardous foreign conditions or objects.
- Ensure that the heat sink is not in direct contact with any surrounding objects. The large amounts of heat generated during prolonged operation may damage surrounding objects or cause the servo drive to overheat.
- In general, the servo drive should be installed and mounted in a well ventilated, low humidity area that will not be subject to vibration or shock.

2.4.3 Mounting

The servo drive should be securely mounted using two M6-sized screws through the mounting bracket on the back of the drive.

The DYN3 AC Servo drive utilizes convection cooling through the heat sinks on the left side of the servo drive. In order to maximize heat dissipation, the drive must be mounted in a position with the air flowing along the vertical axis. The drive also has openings on the side panels for additional low pressure heat dissipation benefits. Cooling fans should be installed at locations on top of and below the servo drive to force air circulation and promote ventilation.

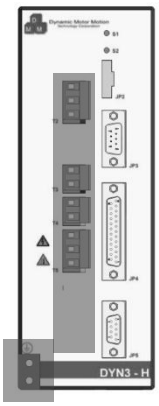
Since most of the weight of the servo drive rests on the metal heat sink and back panel, the drive should be held by these metal parts and not by the plastic part.



Section 3. Wiring and I/O Connections

3.1 Terminal Circuit Specifications

3.1.1 Power Circuit Terminals



Terminal Name	Pin Number	Specification
T2 Motor Control Power	A	0 - 400VAC @ 0 - 20A Peak
	B	
	C	
T3 Regenerative Resistor	R1	50 - 100Ω 1.0 - 2.0kW
	R2	
T4 Logic Control Power	L1	110~230VAC +/-5%, 50/60Hz +/-5%
	L2	
T5 Main Control Power	R	110~230Vac +/-5%, 50/60Hz +/-5% Voltage between any two terminals ≤230VAC
	S	
	T	
Grounding Terminals		

3.1.2 Control Circuit Terminals

Terminal Name	Pin Number	Specification
JP2 RS232 to PC Communication Interface	1	GND
	2	NC
	3	NC
	4	NC
	5	TTL/CMOS Input
	6	TTL/CMOS Output
	7	Internal +5VDC Power
JP3 Encoder Feedback*	1	Serial data in for both UART and SPI, input-
	2	Serial data in for both UART and SPI, input+
	3	Clock signal for SPI input-
	4	Clock signal for SPI input+
	5	+5VDC
	6	NC
	7	Serial data out for both UART and SPI, output-
	8	Serial data out for both UART and SPI, output+
	9	Gnd
JP4 Main Control I/O Terminal	*See Section 3.1.3 for details	
JP5 Encoder Output*	1	NC
	2	A- Phase
	3	B- Phase
	4	Z+ Phase
	5	GND
	6	A+ Phase
	7	B+ Phase
	8	Z- Phase
	9	NC

* All encoder feedback and output signals utilize TTL/CMOS format

3.1.3 Control Terminal I/O Details

Terminal JP2 I/O Mapping

Pin	Description	Pin	Description
1	DIG	15	DI2
2	DI3	16	Ext. +24VDC Input
3	DI1	17	Int. +14VDC Output
4	Ext. +14VDC Input	18	DO4 +
5	DO4 -	19	DO3 +
6	DO3 -	20	DO2 +
7	DO2 -	21	DO1 +
8	DO1 -	22	SIGN +
9	A-REF Ground	23	PULS -
10	SIGN -	24	Int. +5VDC Output
11	PULS +	25	NC
12	A-REF Ground		
13	A-REF		
14	DI4		

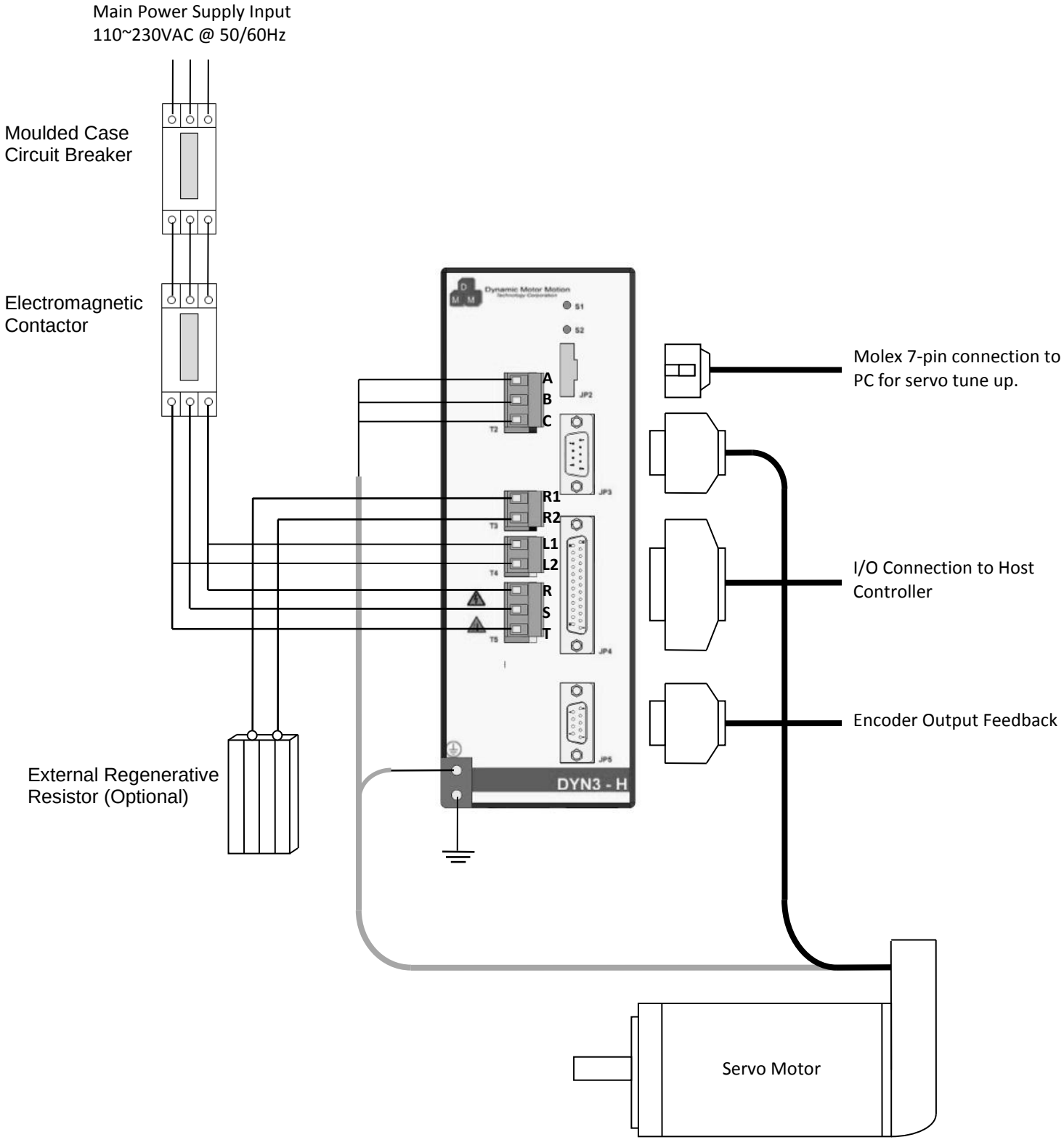
- Terminal JP2 detailed specifications

Pin	Name	Function	Specification
1	DIG	Digital Input Common Ground	
2	DI3	Absolute Encoder Auto Home	Open/Closed Signal or 1 - 24VDC Input
3	DI1	Servo Enable	
4	Ext. +14VDC Input		Current < 10mA
5	DO4 -	Servo Alarm	Open Collector Output – Emitter Side
6	DO3 -	Servo On Position	
7	DO2 -	Optional Digital Output*	
8	DO1 -	Servo Ready	
9	A-REF Ground		
10	SIGN -	Reference Sign Input	Accepts Pulse + Direction and CW + CCW pulse train inputs. +5VDC TLL/CMOS Logic Frequency <500kHz
11	PULS +	Reference Pulse Input	
12	A-REF Ground		
13	A-REF	Analog Reference Input Voltage	Voltage ±10VDC Analog *Relative to pin12
14	DI4	Optional Digital Input*	Open/Closed Signal or 1 - 24VDC Input
15	DI2	Servo Hold	
16	Ext. +24VDC Input		Current < 10mA
17	Int. +14VDC Output		Source Current < 10mA
18	DO4 +	Servo Alarm	Open Collector Output – Collector Side Voltage 5 - 24VDC Current >25mA
19	DO3 +	Servo On Position	
20	DO2 +	Optional Digital Output	
21	DO1 +	Servo Ready	
22	SIGN +	Reference Sign Input	Accepts Pulse + Direction and CW + CCW pulse train inputs. +5VDC TLL/CMOS Logic Frequency <500kHz
23	PULS -	Reference Pulse Input	
24	Int. +5VDC Output		Source Current < 10mA
25	NC		

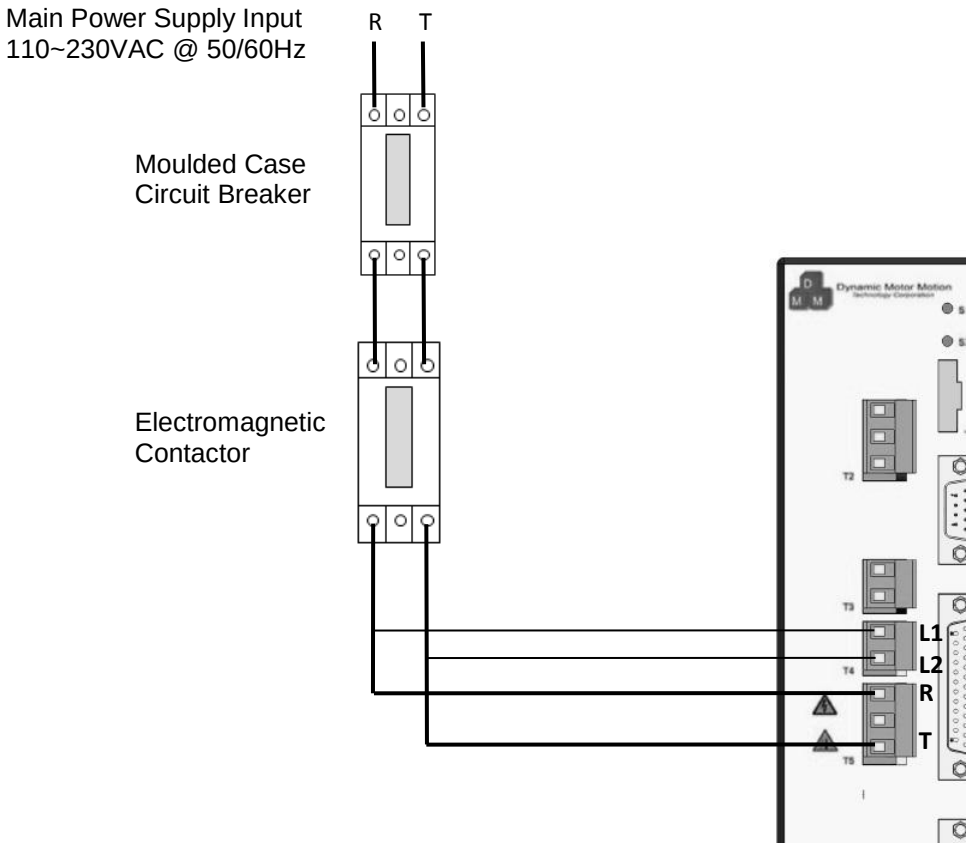
* The optional digital input pin14 and optional digital output pin20 can be programmed with custom applications or allocations.

3.2 Overall Wiring Configuration

3.2.1 Three Phase Input



3.2.2 Single Phase Input

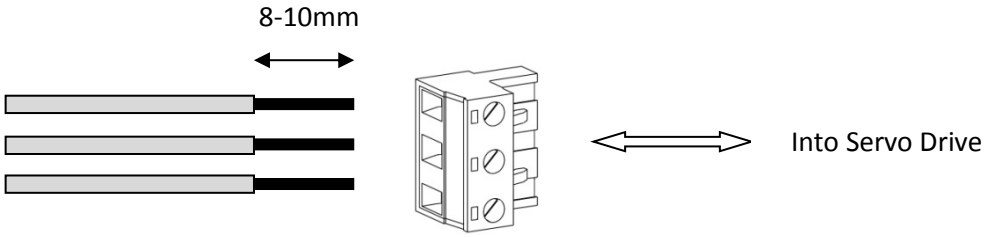


Warning

- Ensure that the power supply wires are not live when performing wiring procedures or modifications.
- When connecting the power supply wires (R,S,T) to the servo drive, leave the motor wires (A,B,C) disconnected. There may be residual power in the wires or power supply that can momentarily actuate the servo drive and motor and cause damages.
- Do not touch the R,S,T or L1,L2 power terminals of the servo drive during operation. As residual power in the drive may cause electrical shock, wait 60 seconds after power off before adjusting the connections.
- Ensure that no part of the conductors in the cable is protruding from the terminal block housings. Severe electrical shock or damages can occur if two different connections are shorted.

- Wiring and inserting the Terminal Block Connectors

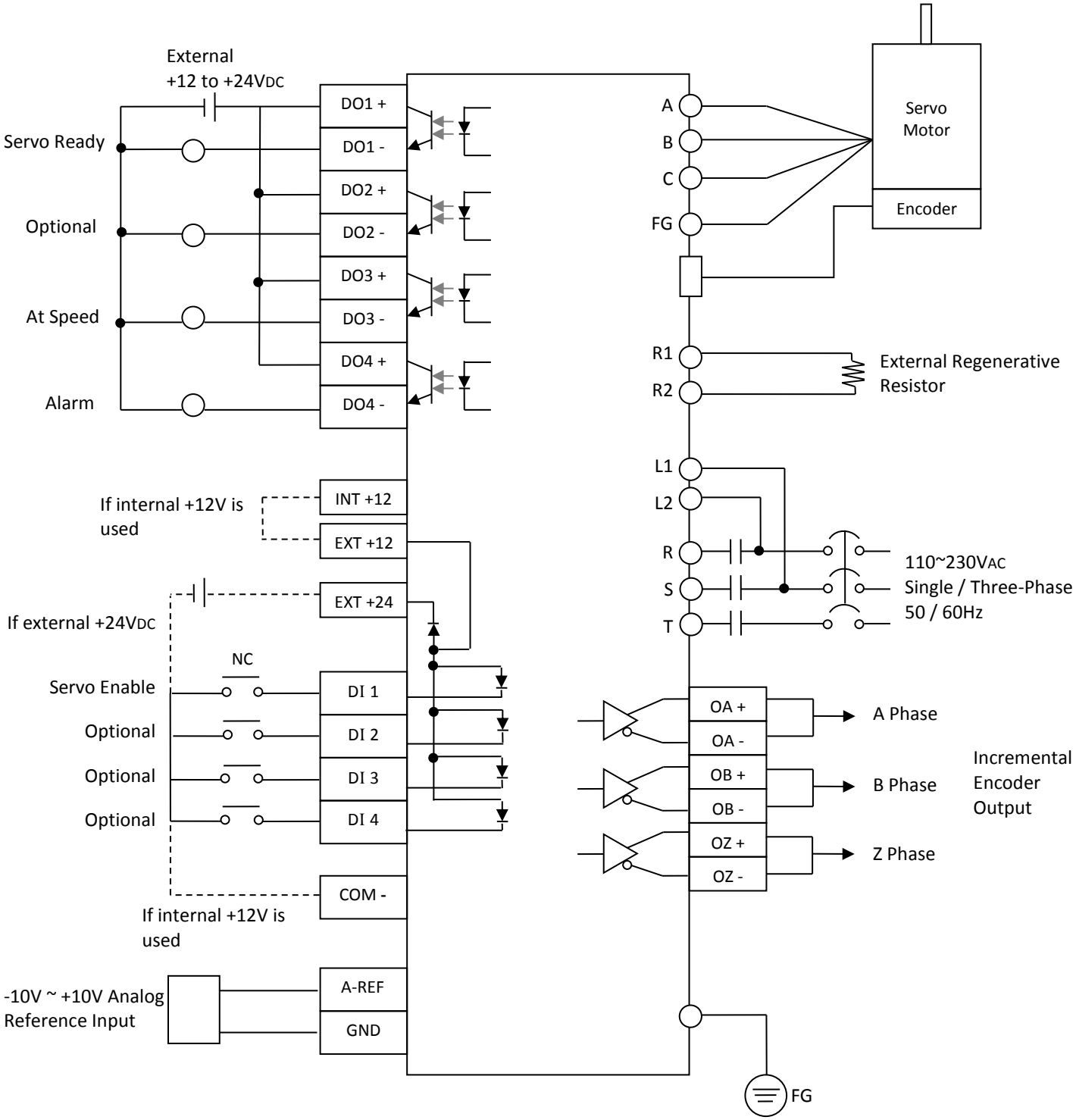
The terminal blocks should be removed from the servo drive when making wiring modifications. Strip the wires so that 8~10mm of the conducting portion can be used then twist and solder together the tip and insert into the terminal block housings. Alternatively, a wire ferrule with an 8~10mm conducting portion can be attached and inserted into the terminal block housings. With the cable in place, tighten the terminal block screws to secure the connection, then insert back into the servo drive.



3.3 Control Wiring Configuration

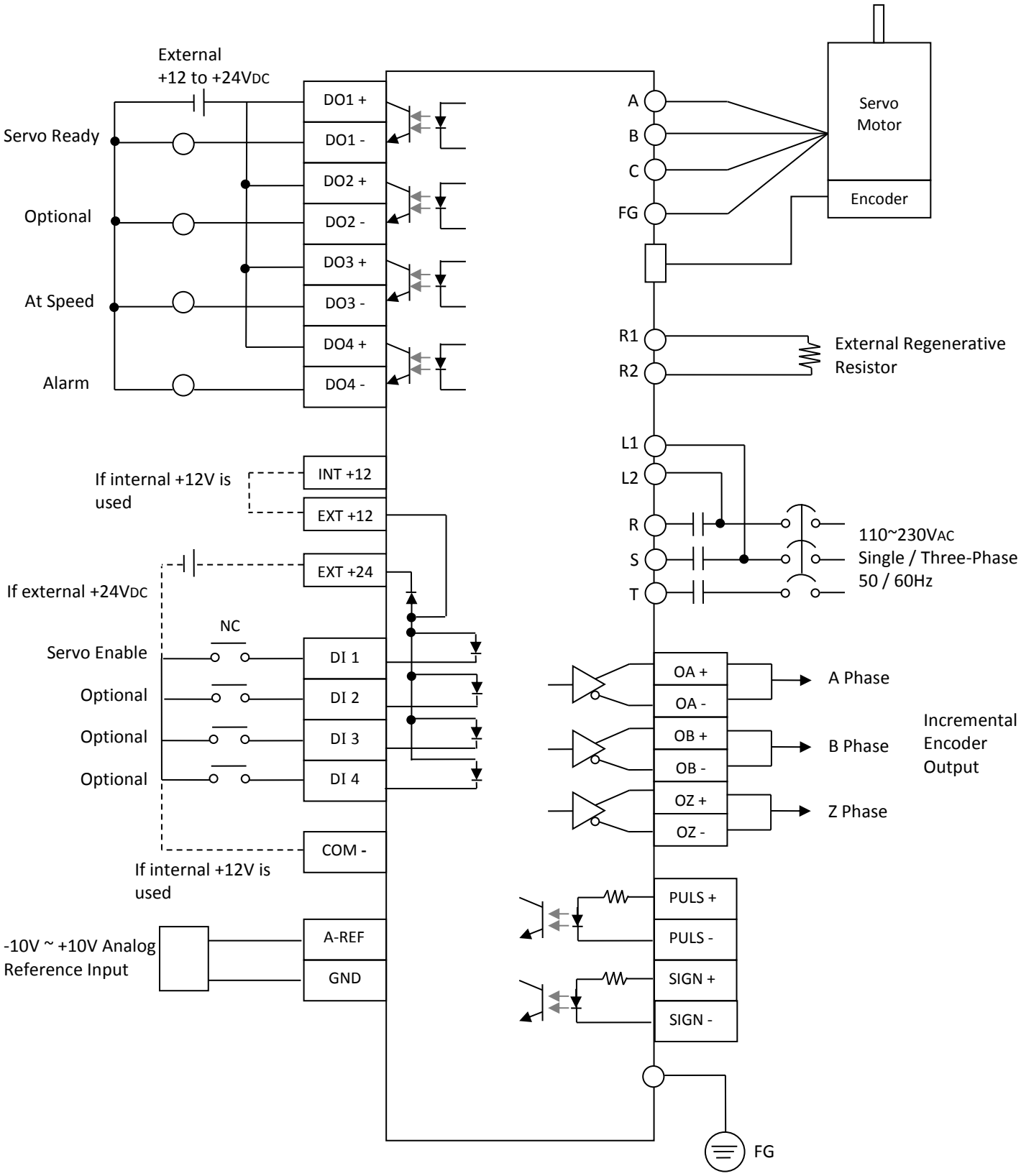
3.3.1 Wiring for Speed / Torque Servo Control

The following is a connection example for the DYN3 AC Servo drive in Velocity Servo Control Mode.



3.3.2 Wiring for Position Servo Control

The following is a connection example for the DYN3 AC Servo drive in Velocity Servo Control Mode.



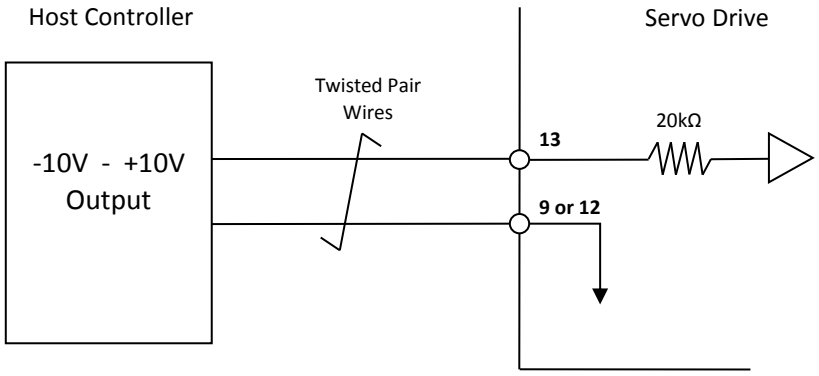
3.4 Wiring Configuration Details

3.4.1 Inputs

The reference and digital inputs into the DYN3 servo drive should be connected to the host controller as follows:

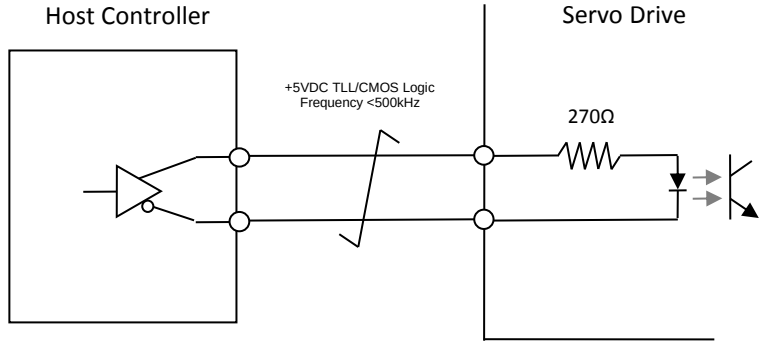
- Reference Input

Analog Input Circuit

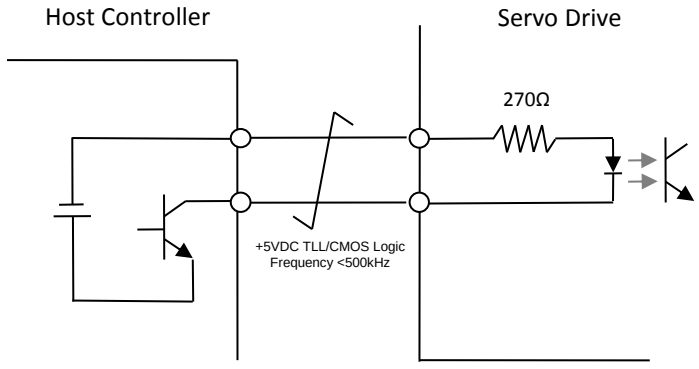


Position Reference Input Circuit (Reference Pulse Train Input)

Line Driver Output

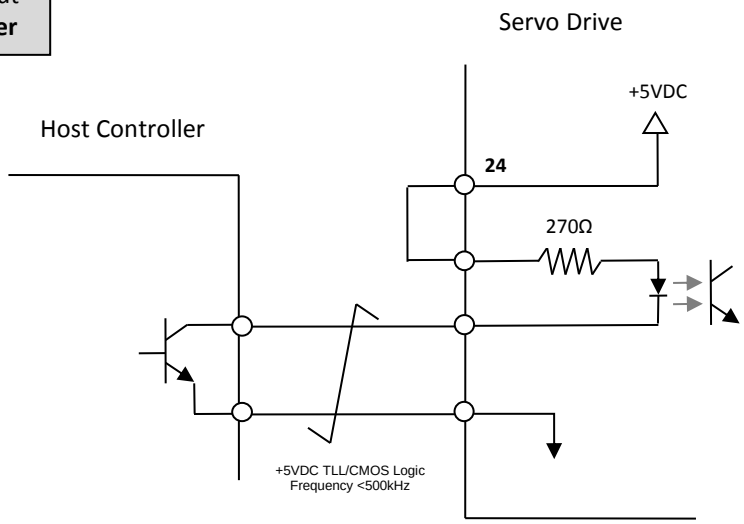


Open Collector Output
External Power



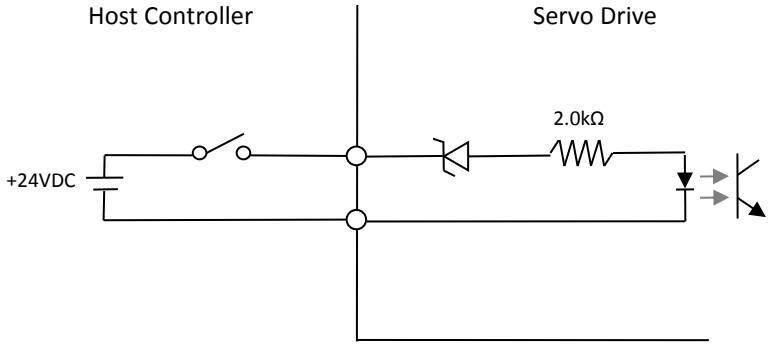
Position Reference Input Circuit (Reference Pulse Train Input)

Open Collector Output
Internal +5VDC Power

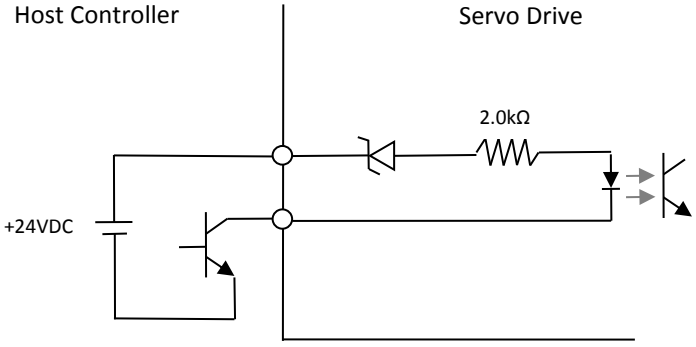


- Digital Input

Relay Circuit



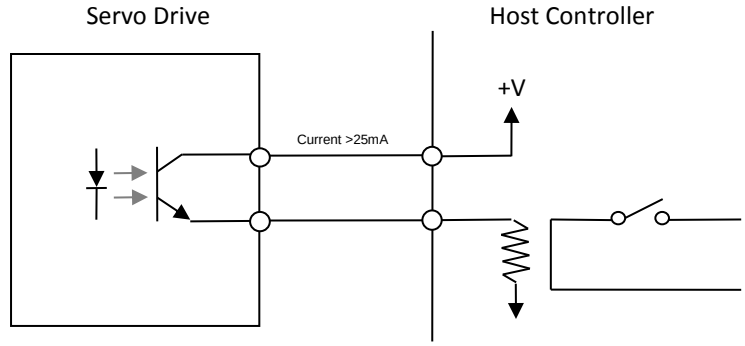
Open Collector Circuit



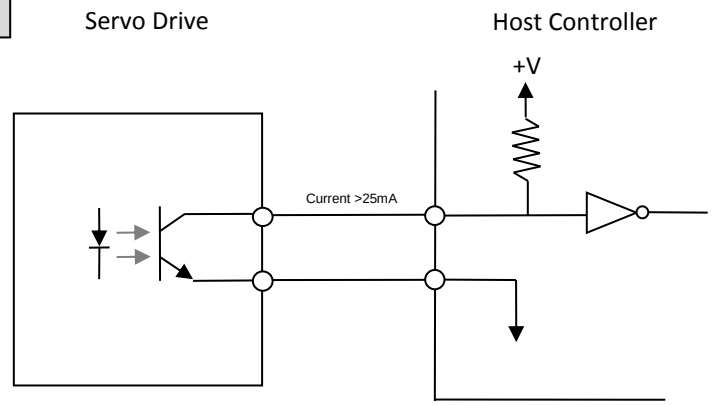
3.4.2 Outputs

The digital outputs from the DYN3 servo drive are all configured as photocoupler outputs and should be connected to the host controller as below. A **Relay** or **Gate Receiver** circuit should be used at the host controller.

Photocoupler Output
Relay at Host Controller



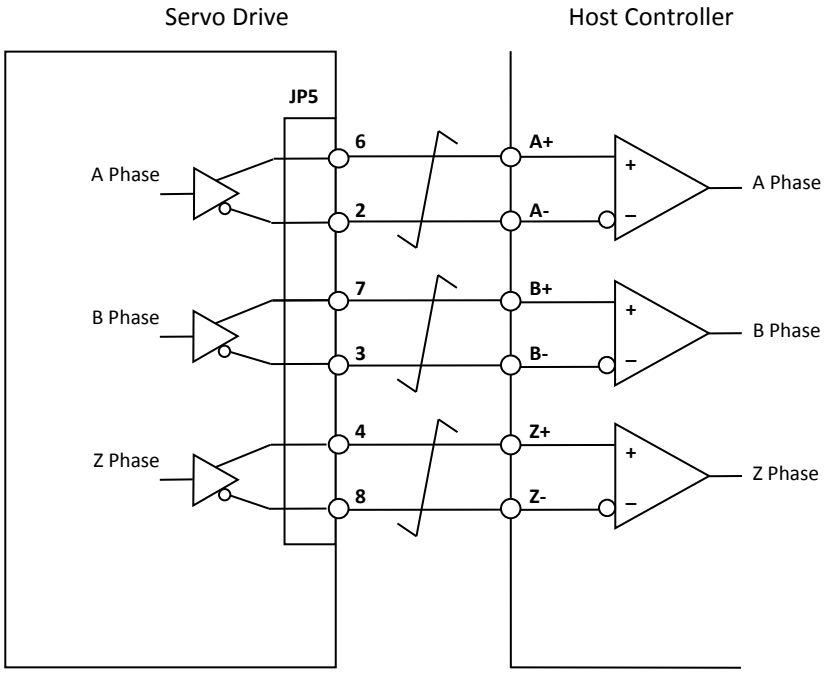
Photocoupler Output
Gate Receiver at Host Controller



3.4.3 Encoder Output

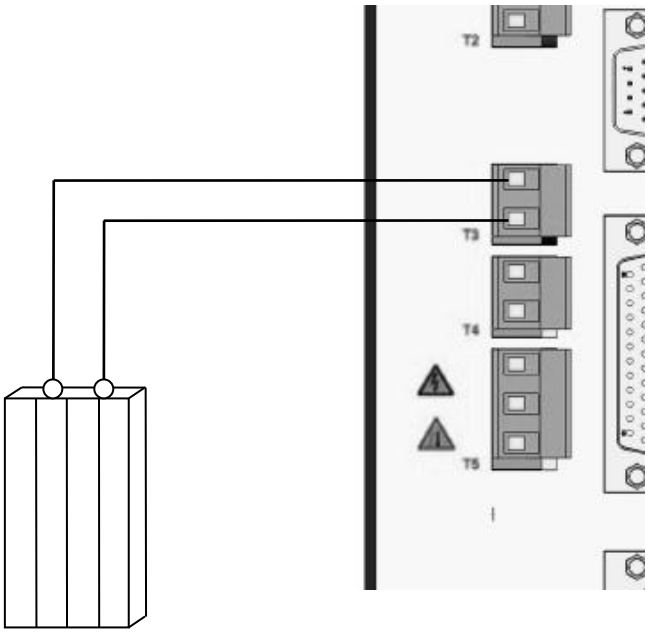
The encoder output from terminal JP5 of the DYN3 servo drive utilizes line-driver output circuits. The host controller should use a Line Receiver circuit.

Line Drive Output
Line Receiver at Host Controller



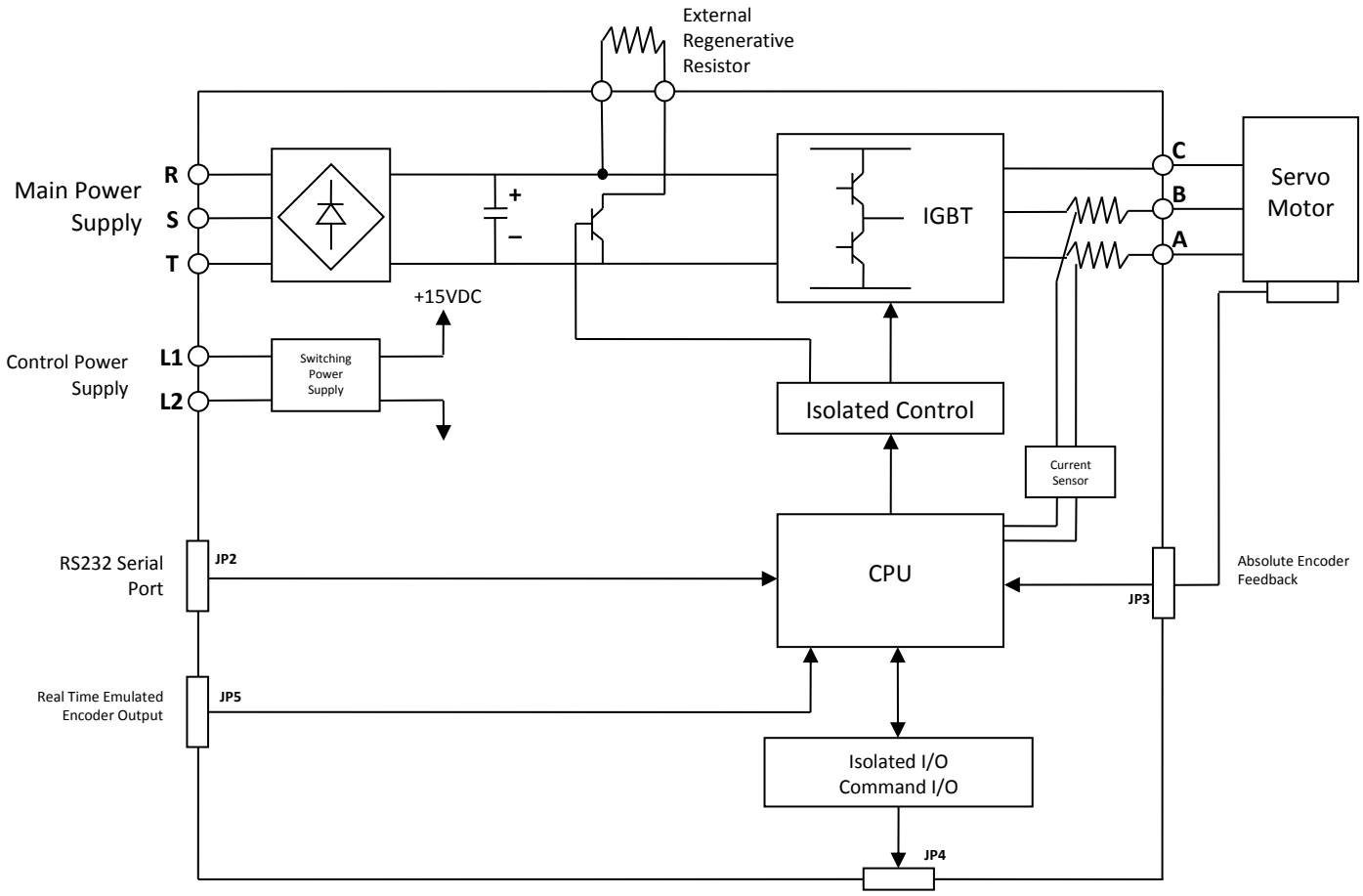
3.4.4 Regenerative Resistor

An external regenerative resistor can be connected between pins R1, and R2 of terminal T3. The regenerative resistor is recommended for the DYN3-T AC Servo Drive paired with the 31M-DHT-15 (1.5kW capacity) or 32M-DHT-28 (2.0kW capacity) servo motors.



Regenerative Resistor

3.5 Control Block Diagram

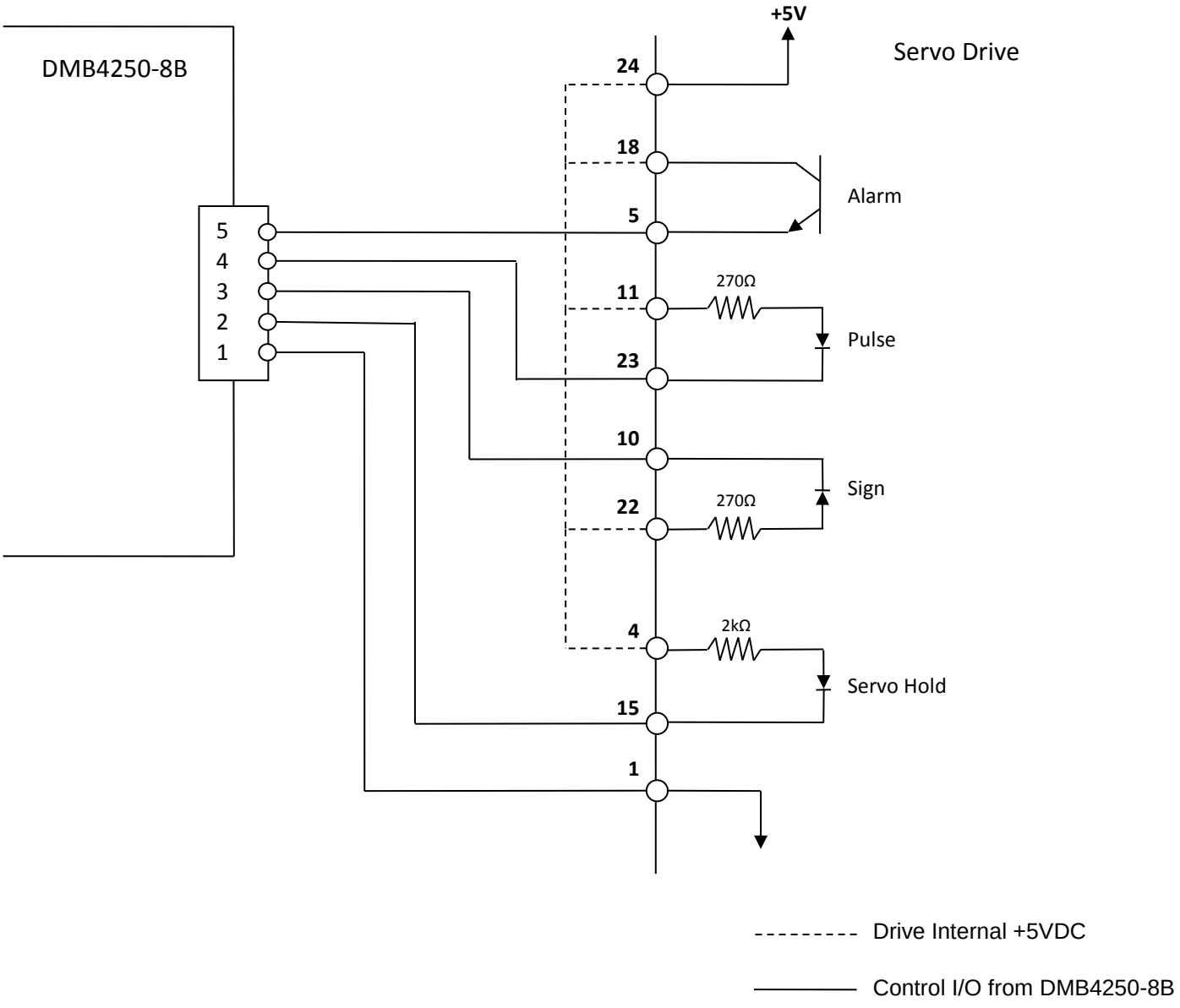


3.6 Example Connections to Host Controller

3.6.1 DMB4250-8B

- Pulse Train Configuration

**This connection method should be followed for communication with all external devices using single-ended pulse train outputs.



Section 4. Operation

4.1 Software Configuration

The DYN3 AC Servo drive utilizes the dmmdyn3.exe application program for tuning, testing and programming. The full dynamic movement range of the DYN3 AC Servo drive can easily be actuated using this program.

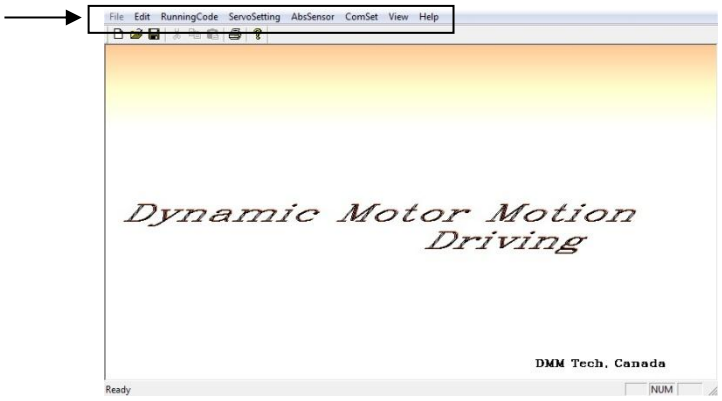
- Set up DMMDrv.exe

System Requirements: Windows 98 / XP / 2000 / Vista / 7
CPU Speed > 250MHz
RAM > 64MB
Hard Disk > 250MB

[1] On the OEM DMM CD, locate the file named “PCtool_ForDyn” folder and copy the entire folder onto your hard drive into the directory of your choice.

[2] Inside the “PCtool_ForDyn” folder, locate the “DMMDRV.exe” executable icon and double click to launch.

- Toolbars



The toolbars on the home screen are utilizes as follows:

Edit	DYN servos feature an integrated point to point S-curve function, and can use 2 or 3 motors to coordinate linear/circular interpolation functions built into the drive. These functions can be programmed and run in the RS232 command input mode. The edited programs are saved as Program1.txt ~ Program5.txt The edit tab is used to edit those instructions, as well as G codes to let a single, or multiple axis move together. The DMM program allows simultaneous configuration of 5 independent programs.

Running Code	Main operation screen for Running Codes #1~5.
Servo Setting	From this tab, select Dyn3-Driver, the servo setting dialog box will now be presented. The primary servo parameters such as Command Mode, Gain, Torque Limit, Acceleration Limit, Gear Ratio and Pulse Ratio is set here.
AbsSensor	After power on, the 14bits absolute magnetic encoder is automatically in a RS232 communication mode, the AbsSensor option is used to read / save the encoder position. *This option will not work if no RS232/UBS connection exists from the PC to the encoder.
ComSet	Use this option to select the communication port from COM1 ~ COM8 for both physical RS232 port (COM1, COM2) and USB virtual COM port (COM3~COM8) on the user's PC.

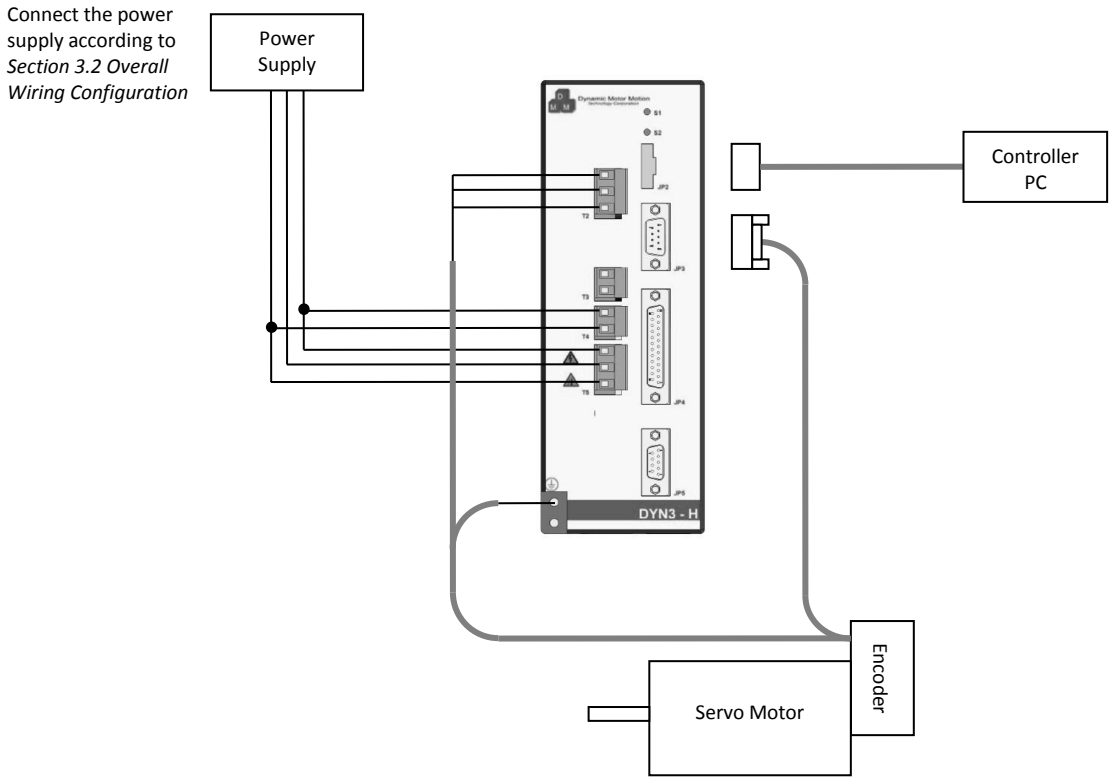
4.2 Pre-Operation Checks

Warning

Review the General Safety Precautions on p.3 of this manual before proceeding with any operations with the servo drive.

- Ensure that all the wiring to the servo drive and servo motors are correct according to Section 3 of this manual.
- Ensure that all appropriate wiring and connections are grounded.
- Check for loose or frayed cables and wires.
- Since the motor may be run at high speeds during the test operations, ensure that the rotor is not attached to any loose objects that may swing or fly out.
- Let the motor run freely (with nothing attached to the shaft) during test operations.
- Tightly secure or mount the motors at its flange.

4.2.1 Connection for JOG operation



The servo motor's control cables should be connected as follows:

Servo Motor Model	Connection	Rated Motor Output
92M-DHT-72	A – Red B – Blue C – Black	0.75 kW
31M-DHT-15	A – Red B – Blue C – Black	1.5 kW
32M-DHT-28	A – Red B – Blue C – Black	2.0 kW

4.3 JOG Operation and Test Movements

** The JOG operation and Test Movements should only be used to verify the servo drive and motor's operation. Do not use these movements to actuate any machinery or equipment.

[1] Connect the host PC to the servo drive's JP2 port.
[2] Connect the Main Power (R,S,T) and control power (L1,L2) to the servo drive.
[3] Connect the servo motor and encoder to the servo drive.
[4] Turn on the power to the servo drive. The status/charge lamp S2 is now lit and the servo motor's position is locked.
[5] Launch dmmdyn3.exe. Select *ComSet* → *ComPort* then select which communication port the host PC is connected to.
[6] Select *Servo Setting* → *DYN3-Driver*.
[7] Press *Read* on the *Setting driver parameters and mode* main screen. The Driver Status should now read ServoOnPosition to indicate that the servo drive is operating normally and in standby for commands.
[8] If the servo drive is not in RS232 command input mode, select the RS232 command input mode, then click "Save All".
[9] The JOG operation and Test Movements can now be executed by selecting the appropriate radio button corresponding to the movements.

Warning

The 4 Test Movement functions including Trimming, Sinusoidal, Step, and Constant Speed (JOG) can command the servo motor to rotate or vibrate extremely fast. Ensure that the servo motor is securely mounted at its flange to avoid damage to the equipment, machinery or any physical bodies.

Command	Motor Movement Description
Trimming	The absolute position of the servo motor can be trimmed from 1 to 4096. Since the ABS-14-0 absolute encoder has a resolution of 16,384ppr, this corresponds to a maximum of 90° movement when trimming.
Sinusoidal	The motor moves along an oscillated smooth sinusoidal S-curve. The frequency parameter controls the frequency of oscillation and the amplitude parameter controls the travel amplitude per oscillation period.

Step	The motor moves along an oscillated rough "stepped" S-curve. The frequency parameter controls the frequency of oscillation and the amplitude parameter controls the travel amplitude per oscillation period.
Constant Speed (JOG)	The motor is run at a constant speed defined by the parameter. The direction of rotation is controlled by the "Reverse Turn" selection and the rate of acceleration/deceleration during reverse turn is controlled by the Max Acceleration parameter. Note that the servo drive will throw a "Lost Phase" protective alarm if the motor is commanded to run above its maximum speed.

Section 5. Servo Control Modes

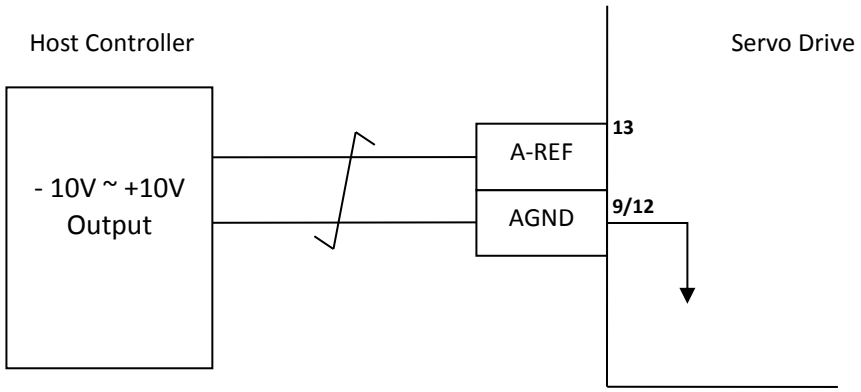
5.1 Speed Servo Mode

In speed servo mode, the DYN3 servo drive utilizes an external analog reference voltage from the host controller to calculate a proportional motor control speed. The motor speed is feedback into the DYN3 servo drive to achieve the servo control loop.

The reference voltage input mode can be analog, RS232 or through a potentiometer.

- Input wiring for Speed Servo Mode

  * Refer to *Section 3.3.1 Wiring for* Speed / *Torque Servo Control* to see the complete wiring details for speed servo mode.



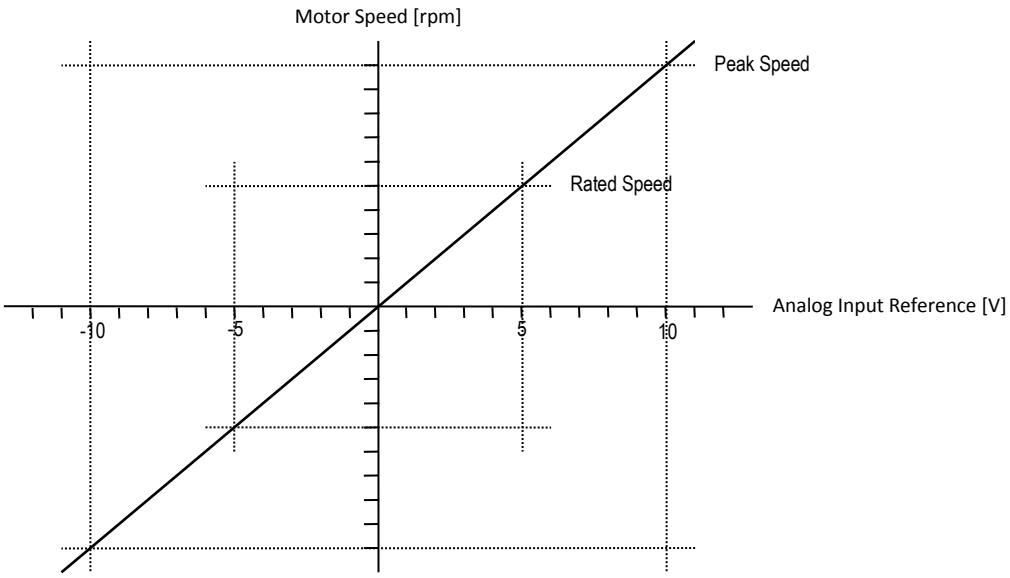
- Setting

  [1] Open the *Setting driver parameters and mode* main screen
  [2] Under the *Servo Mode* option box, select *Speed Servo* by clicking on the corresponding radio button.
  [3] Under the *Command Input Mode* option box, select either *RS232*, or *Analog*.
  [4] Click *Save All* to save these changes into the servo drive's EEPROM memory.

  The servo drive is now in speed servo mode.

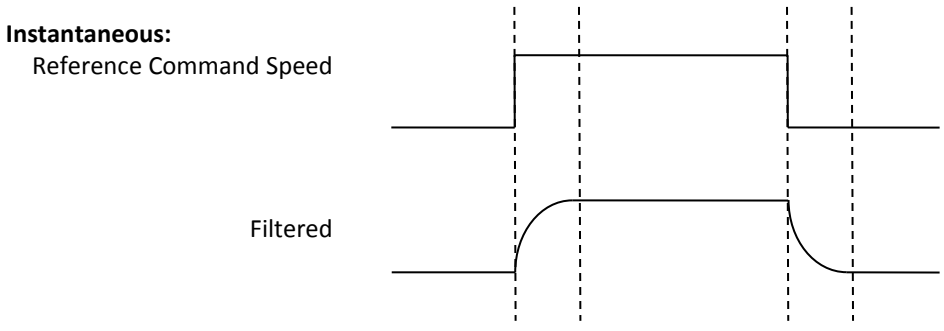
- Control

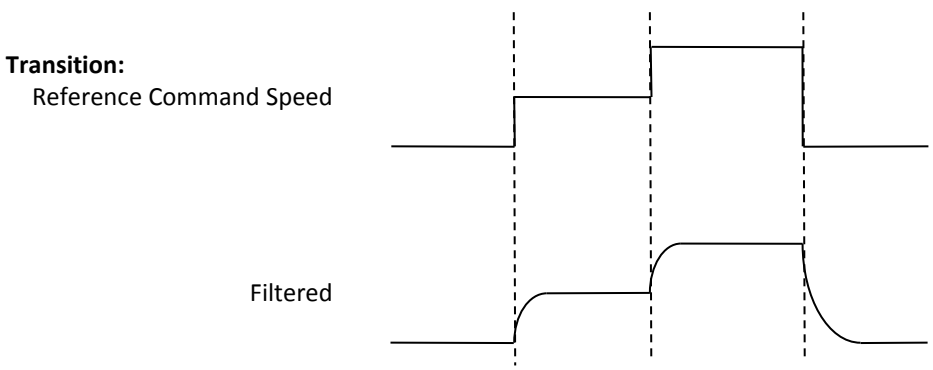
The reference input voltage corresponds to the commanded motor speed according to the servo motor's peak rotational speed. A reference input of 0V corresponds to zero speed, positive voltage corresponds to a CCW direction of rotation and negative input corresponds to CW direction.



- S-Curve Filter and Transition

The DYN3 servo drive's control loop actively applies a first order low pass filter during speed commands. This filter smoothes out the servo motor's dynamics of motion and eliminates internal/external noise in the reference command signal. The response time is applied in proportion to the maximum acceleration setting of the servo drive. The filter is factory programmed to an optimal setting for all applications and does not require adjustment.

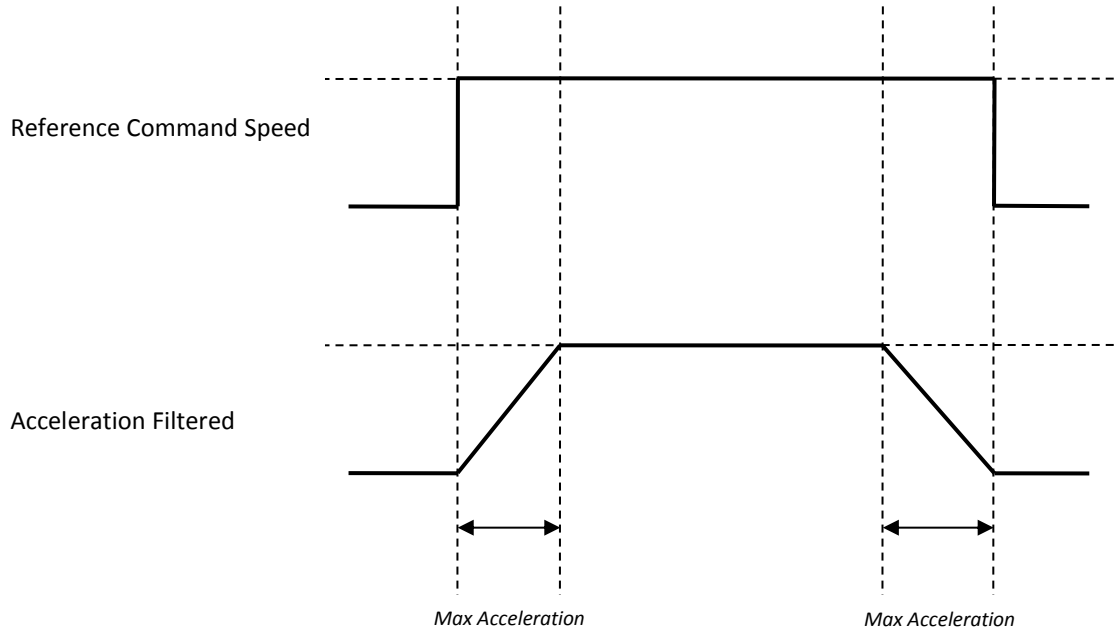




- Acceleration / Deceleration (Soft Start)

Once the servo drive is given a reference voltage input from the host controller, the rate of acceleration and deceleration can be controlled. Since the velocity command is sent as a rough step reference, it is often desirable to smooth out the servo motor's movement dynamics. These parameters modify the motor's S-curve profile by changing the acceleration and deceleration time constants when executing the target command speed. This function allows the servo motor to move in a smooth or rough manner as needed.

Parameter	Range	Unit	Function
Max Acceleration	1 to 127	1	Modifies the acceleration / deceleration time constant of the motor's response to a speed command. Also controls the response time of the first order low pass filter.



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.

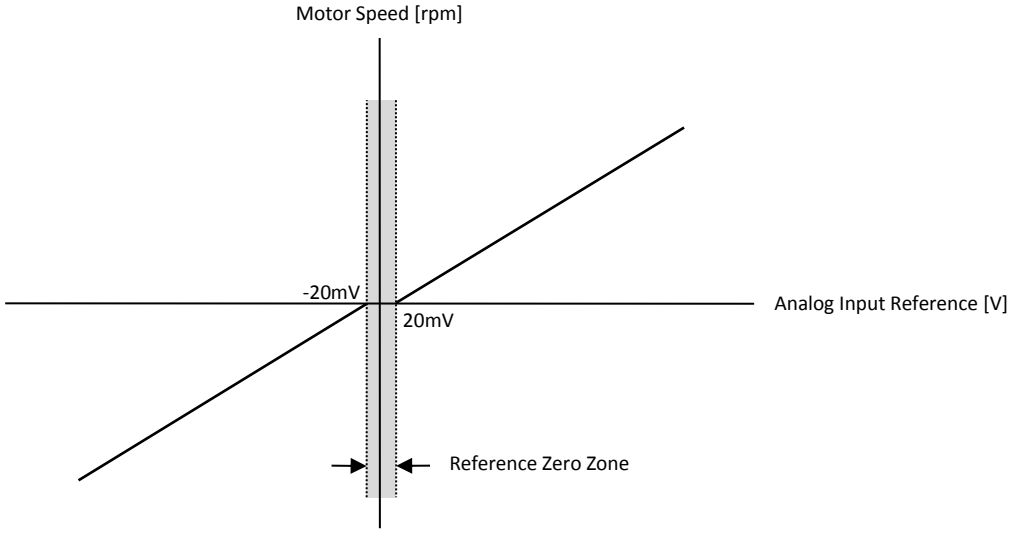
$$\text{Rise from 10\% to 90\% Time} = \frac{59.98}{(Max\ Acceleration)^2}\ \text{Seconds}$$

$$\text{Physical Acceleration Time} = 1.2\ \text{x}\ \frac{59.98}{(Max\ Acceleration)^2}\ \text{Seconds}$$

- Reference Voltage Zero Zone

  The servo drive's analog reference voltage input might be offset by a small voltage due to internal or external disturbances or latent voltage in the wiring. Since this can cause the servo motor to rotate slowly even at 0V input, the DYN3 servo drive is programmed to attenuate and eliminate these noise offsets.

  Reference voltages within the range of -20mV to 20mV are treated as offset noise and the servo motor will not rotate within this input range. Outside this range, the servo motor's response follows the normal linear reference behaviour.



- Encoder Output

  When the servo drive is commanded in Speed Servo Mode, the position servo loop should be achieved in the host controller.

  Refer to *Section 5.4 Encoder Output* for more details.

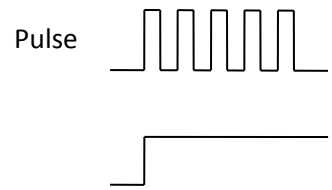
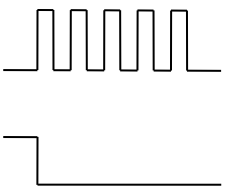
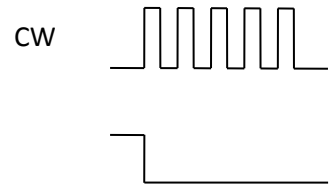
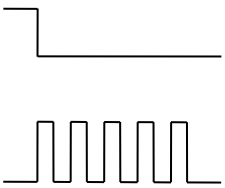
5.2 Position Servo Mode

The DYN3 servo drive accepts 4 types of command input modes for position servo control.

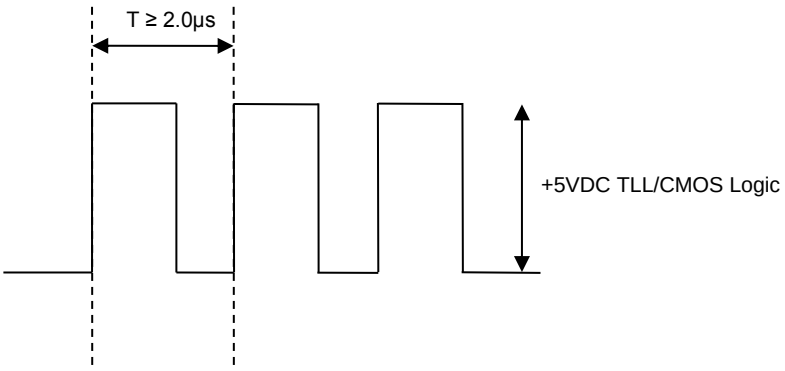
- Pulse / Sign
- CW / CCW
- Analog
- SPI (Optional)

5.2.1 Pulse / Sign and CW / CCW Pulse Train

The Pulse / Sign and CW / CCW pulse train command modes have the following form:

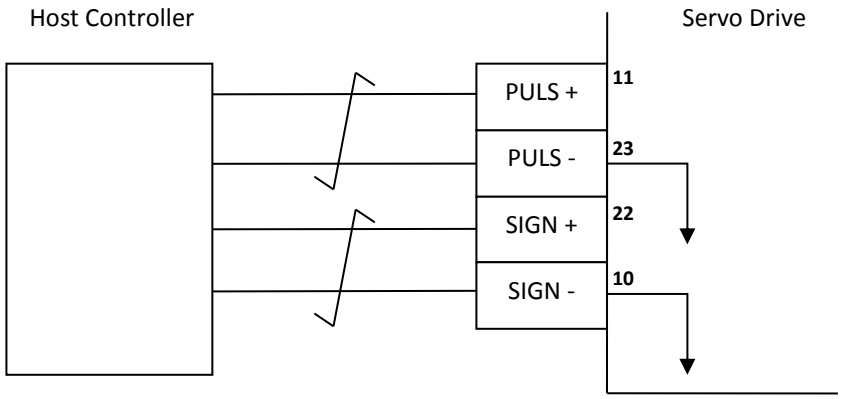
Pulse Form	Forward Direction	Reverse Direction
Pulse / Sign		
CW / CCW		

- Pulse Train Specifications



- Input wiring for Pulse Train Position Servo Mode

  * Refer to *Section 3.3.2 Wiring for Position Servo Control* to see the complete wiring details for position servo mode.



- Setting

  [1] Open the *Setting driver parameters and mode* main screen
  [2] Under the *Servo Mode* option box, select *Position Servo* by clicking on the corresponding radio button.
  [3] Under the *Command Input Mode* option box, select either *Pulse/Dir*, or *CW/CCW*.
  [4] Click *Save All* to save these changes into the servo drive's EEPROM memory.

  The servo drive is now in position servo mode with Pulse / Sign or CW / CCW pulse train command.

- Control

  The up edge of the pulse train is active for counting. For every reference pulse received from the host controller, the amount of motor rotation is determined by the Electronic Gear Number parameter in the DYN3 drive. The speed of motor rotation is determined by the frequency at which the pulse train is sent from the host controller.

- Electronic Gear Number

  The amount of motor travel with reference to the number of input pulses is set using the parameter *Gear_Num*. The number of reference pulses needed for one complete motor revolution is calculated as,

$$\text{One Complete Revolution} = 4 \text{ x } Gear\_Num \text{ Pulses}$$

  For example, if *Gear_Num* is set to 4096, then 16,384 pulses are needed from the host controller for the motor to make one complete revolution.

Parameter	Range	Unit	Function
Gear_Num	500 to 4096	1	Electronic gear ratio multiplier used to scale the motor travel with reference to the number of input pulses from the host controller.

The speed of the servo motor can be controlled using this parameter in accordance with the output frequency of the host controller. For example, if the host controller outputs pulse trains at 100kHz and Gear_Num is set to 500:

$$\text{Motor Speed} = \frac{100{,}000\ \text{pulse/sec}}{4\ \text{x}\ 500\ \text{pulse/ rev}} = 50\ \text{rev/ sec} = 3000\text{rpm}$$

If *Gear_Num* is set to 4096 with 200kHz pulse train:

$$\text{Motor Speed} = \frac{200{,}000\ \text{pulse/sec}}{4\ \text{x}\ 4096\ \text{pulse/ rev}} = 12.2\ \text{rev/ sec} = 732\text{rpm}$$

5.2.2 Analog Input

For 5V analog input, motor will turn 90*4096 / Gear_Num (deg) in the CW direction in position servo mode if the pin11 of JP4 is high or open, otherwise will turn in CCW direction if the pin11 of JP4 is low. If the pin11 of JP4 is high or open, motor will turn in CW direction, otherwise will turn in CCW direction.

5.2.3 SPI Input

JP4 can be used as a clock input (into servo drive) for SPI. Port JP4 is used for data input and data output.

For every input byte, suppose it be SPI_in8, must be between -127 ~ +127, i.e. SPI_in8 = 0x81~0x7f. The motor position will increase SPI_in8*4096/Gear_Number counts for every received byte. The output byte is the content of Drive Status Register. This mode can be designed for special user requirements. Contact DMM Technology Corp. for more details.

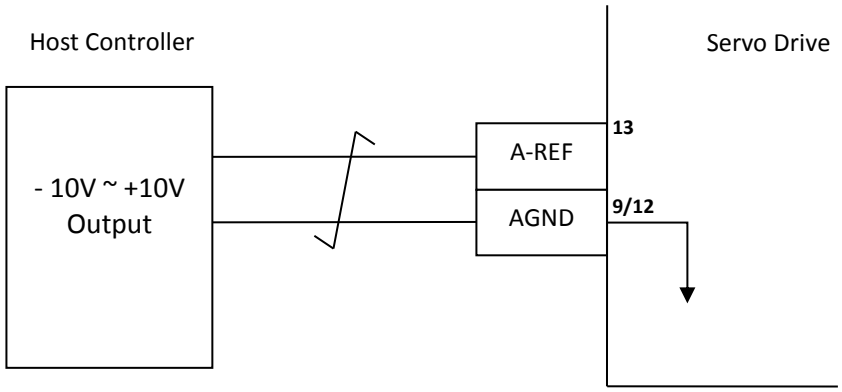
5.3 Torque Servo Mode

In torque servo mode, the DYN3 servo drive utilizes an external analog reference voltage from the host controller to calculate a proportional motor control torque. Internal parameters of the drive controls the speed, acceleration and deceleration of the motor when actuating the torque command.

The reference voltage input mode can be analog, RS232 or through a potentiometer.

- Input wiring for Speed Servo Mode

  * Refer to *Section 3.3.1 Wiring for Speed / Torque Servo Control* to see the complete wiring details for speed servo mode.



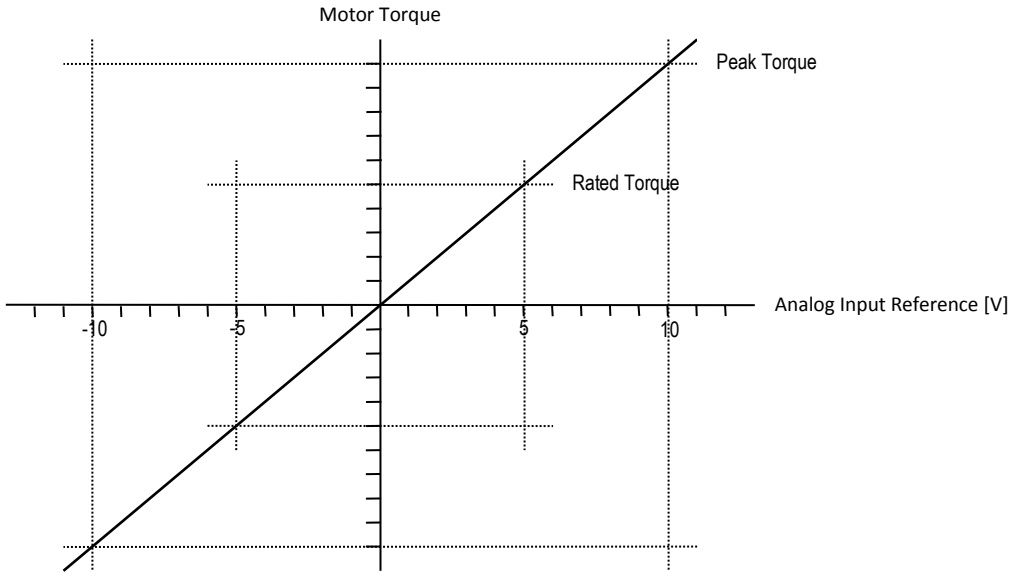
- Setting

  [5] Open the *Setting driver parameters and mode* main screen
  [6] Under the *Servo Mode* option box, select *Torque Servo* by clicking on the appropriate radio button.
  [7] Under the *Command Input Mode* option box, select either *RS232*, or *Analog*.
  [8] Click *Save All* to save these changes into the servo drive's EEPROM memory.

  The servo drive is now in torque servo mode.

- Control

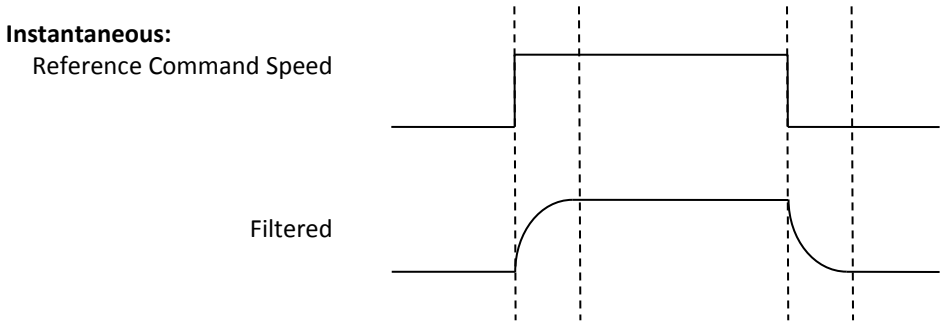
The reference input voltage corresponds to the commanded motor torque according to the servo motor's rated peak torque.



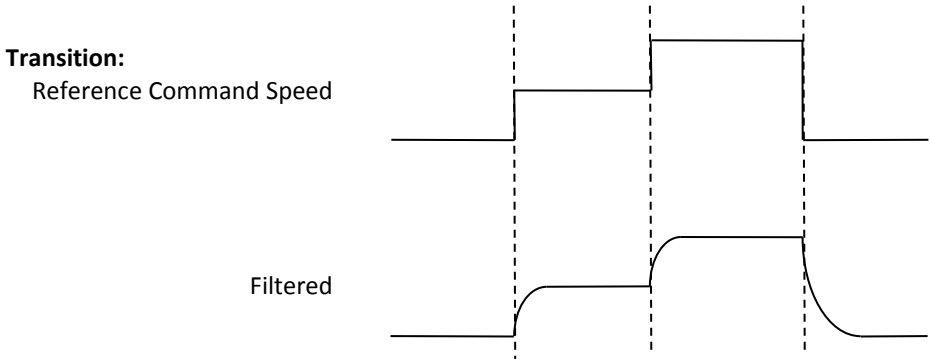
- S-Curve Filter and Transition

The DYN3 servo drive's control loop actively applies a first order low pass filter during speed commands. This filter smoothes out the servo motor's dynamics of motion and eliminates internal/external noise in the reference command signal. The response time is applied in proportion to the maximum acceleration setting of the servo drive. The filter is factory programmed to an optimal setting for all applications and does not require adjustment.

Instantaneous:



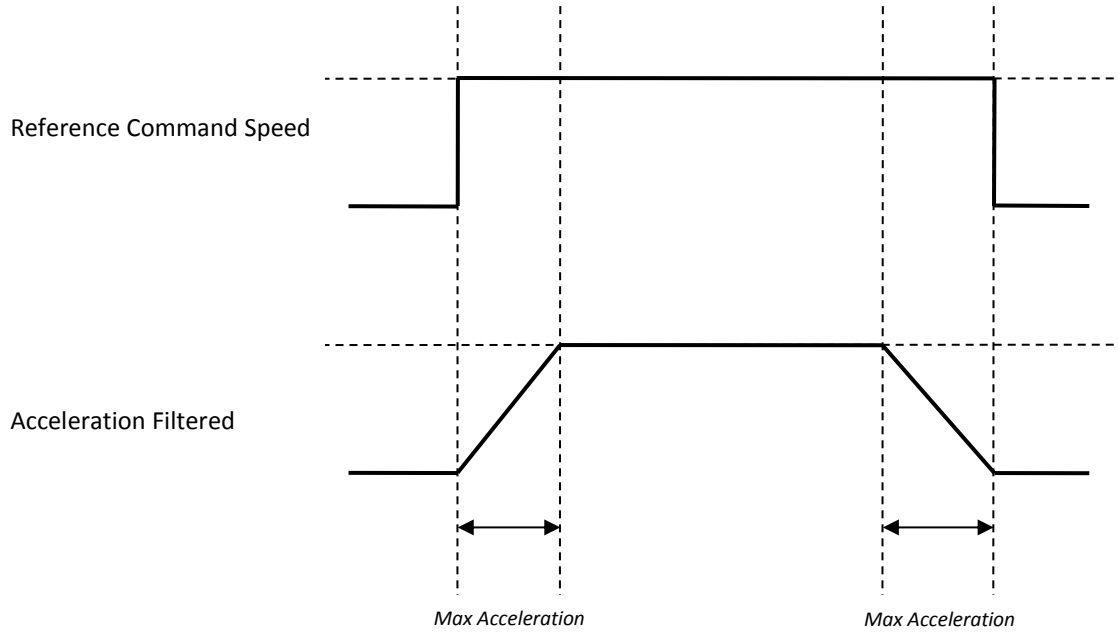
Transition:



- Acceleration / Deceleration (Soft Start)

Once the servo drive is given a reference voltage input from the host controller, the rate of acceleration and deceleration can be controlled. Since the velocity command is sent as a rough step reference, it is often desirable to smooth out the servo motor's movement dynamics. These parameters modify the motor's S-curve profile by changing the acceleration and deceleration time constants when executing the target command torque. This function allows the servo motor to move in a smooth or rough manner as needed.

Parameter	Range	Unit	Function
Max Acceleration	1 to 127	1	Modifies the acceleration / deceleration time constant of the motor's response to a movement command. Also controls the response time of the first order low pass filter.



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.

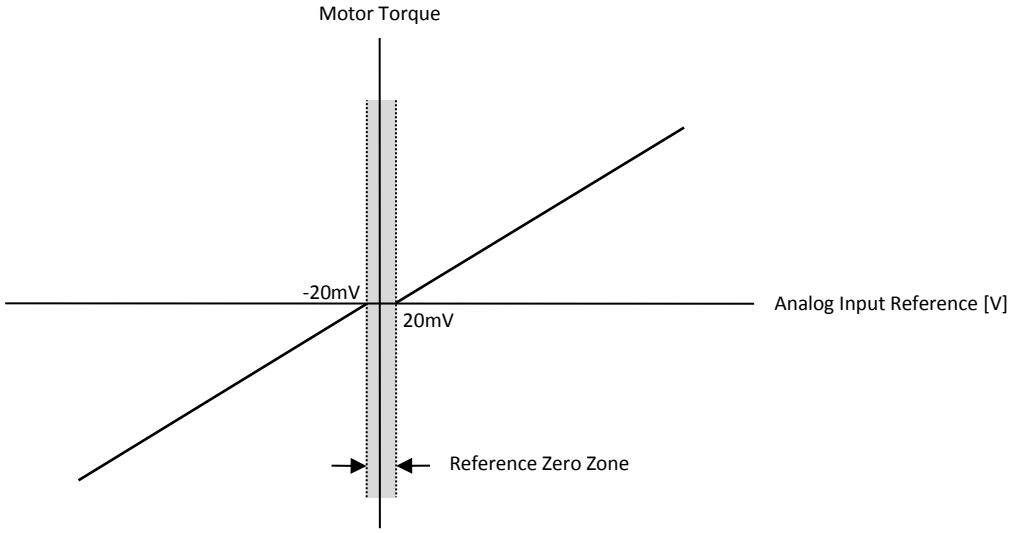
$$\text{Rise from 10\% to 90\% Time} = \frac{59.98}{(Max\ Acceleration)^2}\ \text{Seconds}$$

$$\text{Physical Acceleration Time} = 1.2\ \text{x}\ \frac{59.98}{(Max\ Acceleration)^2}\ \text{Seconds}$$

- Reference Voltage Zero Zone

  The servo drive's analog reference voltage input might be offset by a small voltage due to internal or external disturbances or latent voltage in the wiring. Since this can cause the servo motor to rotate slowly even at 0V input, the DYN3 servo drive is programmed to attenuate and eliminate these noise offsets.

  Reference voltages within the range of -20mV to 20mV are treated as offset noise and the servo motor will not rotate within this input range. Outside this range, the servo motor's response follows the normal linear reference behaviour.



- Encoder Output

  When the servo drive is commanded in Torque Servo Mode, the position servo loop should be achieved in the host controller.

  Please refer to *Section 5.4 Encoder Output* for details.

5.4 Encoder Output

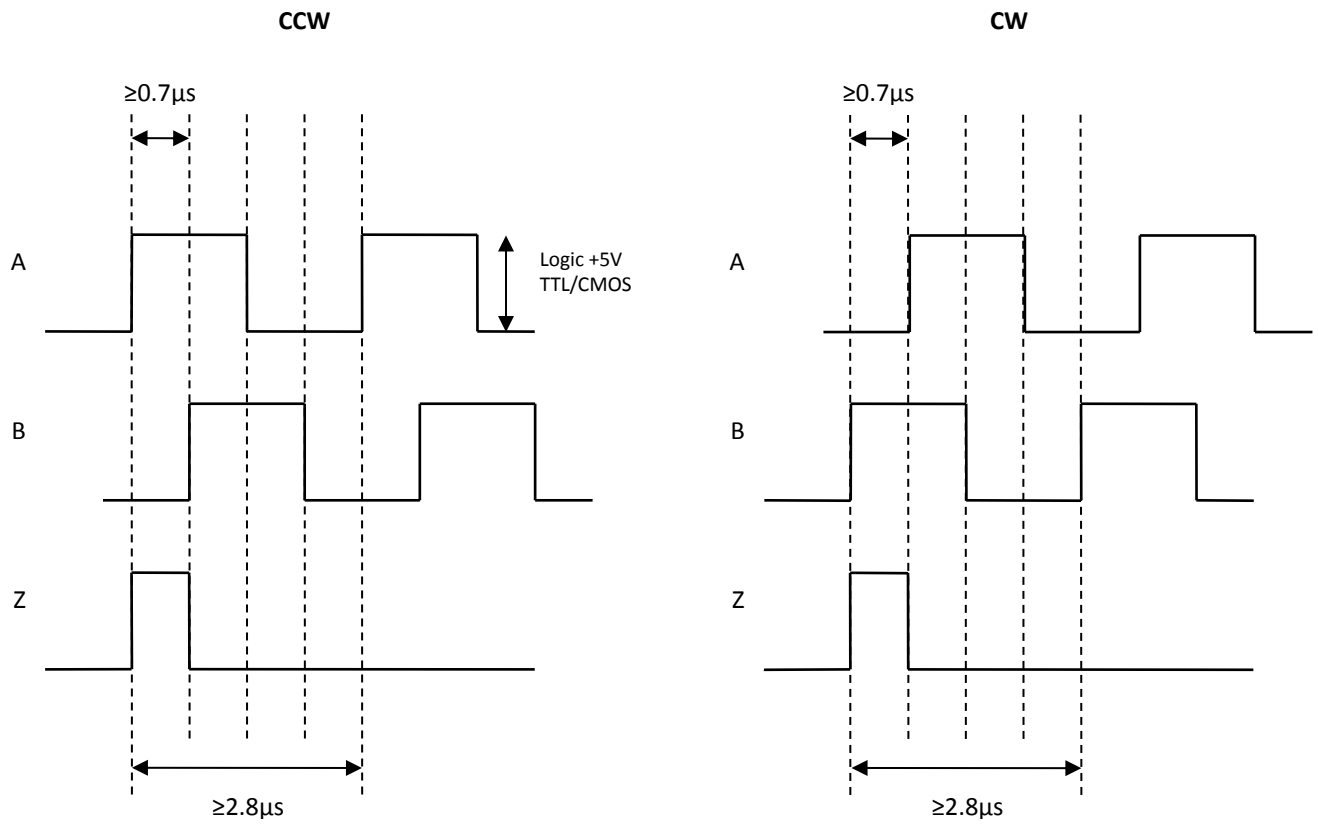
In Speed or Torque servo mode using analog reference command input, the encoder output signal should be used to make a position feedback to the host controller. The host controller makes a PID servo loop then sends the analog reference signal to the servo drive.

The real time emulated incremental encoder signal output with scalable equivalent line number is adjustable through the dmmdyn3.exe program.

Parameter	Range	Unit	Function
Pulse_Num	500 to 2048	1	Scale of output pulse number for the emulated incremental encoder output signal.

The output pulse number is adjustable from 500 to 2048 per motor shaft revolution, and the total quadrature counter number is 4*Pulse_Num per motor shaft revolution. This is equivalent to 2000 to 8056 quadratures per revolution.

The output phases include A/-A, B/-B, and Z/-Z from port JP5. Refer to *Section 3.4.3 Encoder Output* for wiring details.



Section 6. Servo Tuning

As the inertia load on the servo motor varies from application to application, the servo drive should be tuned and optimized according to the dynamic response, feedback, and performance requirements of the system. The DYN3 AC Servo drive's range of programmable parameters and variables allows for maximum system optimization, while maintaining simplicity and reliability.

The DYN3 servo drive's internal parameters are programmed using the DMMDrv.exe program under the *Servo Setting* menu.

6.1 Overview of Parameters

Name	Range	Units	Default	Applicable Control Modes Speed (S) / Position (P) / Torque (T)
Main Gain	1 ~ 127	1	38	S/P/T
Speed Gain	1 ~ 127	1	38	S/P/T
Integration Gain	1 ~ 127	1	38	S/P/T
Torque Constant	1 ~ 127	1	127	S/P/T
Max Acceleration	1 ~ 127	1	8	S/P/T
Max Speed	1 ~ 127	1	20	S/P/T
Driver ID	1 ~ 126	1	38	S/P/T
On Position Range	1 ~ 127	1	4	S/P/T
Gear Num	500 ~ 4096	1	500	S/P/T
Pulse_Num	500 ~ 2048	1	500	S/P/T

6.2 Details of Parameters

Parameter Name	Details
Main Gain	The main gain for the servo loop, should be increased as the load increases. The bigger value of Main Gain means relatively wider frequency range of servo loop.
Speed Gain	The main gain for the servo loop, should be increased as the load increases. The bigger value of Speed Gain means relatively wider frequency range of servo loop. Physically, the heavier load 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 set too high for bigger loads, there will be some loud noise because the torque command is too coarse and not smooth. A smaller setting of Trqcons (see TrqCons) could be used to attenuate this noise.
Integration Gain	The integrator in the servo loop to ensure the error between position command and real position be zero during the steady state operations. Also this integrator will let the 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 and smooth out the motion.
Torque Constant	Torque Constant is a first order filter constant, the bigger value means wider frequency range of that filter. The filter can be expressed as: $$\frac{a}{(S+a)}$$ Where a = 26*TrqCons, i.e. if TrqCons = 100, then a = 2600. This filter is used to smooth out the torque sent to the torque servo loop, especially for the heavier loads when a bigger Speed Gain setting is used. If a very quick response servo with small load is desirable, the bigger value even such as 127 should be used to ensure the required stability and dynamic response.
Max Acceleration	Determine the S-curve acceleration when using RS232 mode to make point to point motion. Also controls the response time of the first order low pass filter in speed and torque servo control.
Max Speed	Determine the S-curve max speed when using RS232 mode to make point to point Motion.

On Position Range	On position range is a value used for determining whether the motor have reached the commanded position or not. That 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, $$\text{Pset} - \text{Pmotor} <= OnRange$$ it is said motor is on the commanded position, otherwise not. That OnRange is from 1~127. The real position on range is, $$\text{OnRange} * 360(\text{deg})/16384$$
Gear Num	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, $$\text{One Complete Revolution} = 4 \text{ x } Gear\_Num \text{ Pulses}$$ For example, if *Gear_Num* is set to 4096, then 16,384 pulses are needed from the host controller for the motor to make one complete revolution. The speed of the servo motor can be controlled using this parameter in accordance with the output frequency of the host controller. For example, if the host controller outputs pulse trains at 200kHz and Gear_Num is set to 500, $$\text{Motor Speed} = \frac{200{,}000 \text{ pulse/sec}}{4 \text{ x } 500 \text{ pulse/ rev}} = 100\text{rpm}$$ If *Gear_Num* is set to 4096, $$\text{Motor Speed} = \frac{200{,}000 \text{ pulse/sec}}{4 \text{ x } 4096 \text{ pulse/ rev}} = 12.2\text{rpm}$$
Pulse_Num	Scale of output pulse number for the emulated incremental encoder output signal. The output pulse number is adjustable from 500 to 2048 per motor shaft revolution, and the total quadrature counter number is 4*Pulse_Num per motor shaft revolution. This is equivalent to 2000 to 8056 quadratures per revolution.
Driver ID	Every drive has an unique ID number, which can be assigned or read out by using ServoSetting dialog box **WHEN RS485NET BOX NOT CHECKED** and there is **only one Drive** connected through the RS232 port. The default ID number for every Drive is 0. That ID number can be used for the network connection of RS485 or for drive identification purposes. **WHEN RS485NET BOX is CHECKED** and there are **more than one Drive** connected to the RS485/232 network, only the setting for the Drive with the indicated ID number in the ServoSetting dialog box can be read out or saved.

6.3 Gain Tuning

The 3 Gain Parameters and the Torque Constant of the servo drive must be tuned and optimized according to the system response requirements. These parameters are internally co-dependent and should be set relatively close to one another to avoid noise. The optimal value of these parameters depends on the characteristics of the load coupled to the servo motor including,

- Mass
- Inertia
- Friction
- Rigidity
- Stiffness

In general, the Gain settings should be increased as the above conditions increase. If the system's servo gain is set too high, it will create unwanted vibration, and noise. The system should be tested by observing the physical system's response and drive dynamics to a particular setting. For systems with a high degree of coefficients for resonance (for example, belt drives/pulleys) the Integration Gain parameter should be decreased to avoid resonance amplification.

Together, these parameters control how tightly the motor's position is maintained and how quickly the motor follow its command position from the host controller. Thus the servo system's smoothness, rigidity and precision can be greatly optimized by tuning the servo gain.

Section 7. Troubleshooting

7.1 Error Code Diagnosis

7.1.1 Driver Status S1 and S2

During operation, protective alarms can be triggered in the servo drive in accordance with the faults detected in the system. The DYN3 servo drive's external status LED's S1 and S2 can be immediately read to diagnose the driver status. Upon initial power-up and during all normal operation, the S2 light will always be lit to indicate that the system is charged. When a protective alarm is triggered, the external status LED's will indicate the type of alarm triggered.

S1 (Red)	S2 (Green)	Alarm
ON	BLINK	Over Voltage
ON	ON	Over Temperature
BLINK	OFF	TBD
BLINK	BLINK	Lost Phase
BLINK	ON	TBD
OFF	BLINK	Over Power
OFF	ON	Over Current

7.1.2 Internal Driver Status Readout

The alarm status of the drive can also be read using the dmmdyn3.exe program.

[1] Connect the host PC to the servo drive's JP2 port.
[2] Press *Read* on the *Setting driver parameters and mode* main screen.
[3] The Driver Status icon will display the current status of the Servo Drive.

7.1.3 System Response and Reset

Once the DYN3 servo drive's protective alarms are triggered, power to the servo motor is immediately stopped and the shaft becomes free.

The servo drive is reset by turning the input power off, then on again. Any parameter or setting changes made to the servo drive will be retained no matter what alarm is triggered.

7.2 Troubleshooting

Alarm	Causes and Corrections	Corrections
Over Voltage	The internal DC link voltage has exceeded the allowed maximum levels.	-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 drive's protective thermal resistor has detected an unusually high temperature inside the driver.	-Check that the drive's ventilation openings and heat sink are not being blocked. -Consult the servo drive's 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	The servo motor cannot move to its command position and there is a backlog of current in the servo drive to try to move the servo motor.	-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.

7.3 After Sale Services and Repair

For services or repair inquiries, contact your sales dealer or directly contact DMM Technology Corp.

Warning

Do not attempt to make modifications to the servo drive without the consultation of your dealer or DMM Technology Corp. Unauthorized modification to the servo drive will void the warranty agreements.

As some internal components of the servo drive will be electrically charged, wait 60 second after immediate power off before physically handling the servo drive components.

- Returns and Repairs

Users with products to be returned or repaired should first contact DMM Technology Corp. Our sales representatives will direct your requests accordingly.

We strive to keep this manual as current and accurate as possible, but small inconsistencies may occur. Contact DMM Technology Corp. directly for any questions or concerns.