Logosol DC Servo Amplifier LS-5Y Series

Doc # 713050001 / Rev. 1.3, 03/04/2002

Features

- **Single voltage supply 18÷75 VDC or 9÷25 VDC**
- **6A continuous, 10A peak output current**
- **Built-in capacitor allowing for long wires to the power source**
- **Jumper selectable modes:**
  - **Current (Torque)**
  - **Velocity (Tach)**
  - **Voltage**
  - **IR compensation**
  - **Analog position loop**
- **Individual continuous, peak and peak-time configurable current limits**
- **Comprehensive short-circuit protection:**
  - **Output to output**
  - **Output to ground**
  - **Output to power**
- **Over/under voltage shutdown**
- **Internal fast blowing fuse for maximum safety**
- **No integrator windup during power-up or amplifier disabled**
- **Four quadrant regenerative operation**
- **Small footprint, low cost, easy to use**
- **Conservative 100% through-hole design for high reliability**

Description:

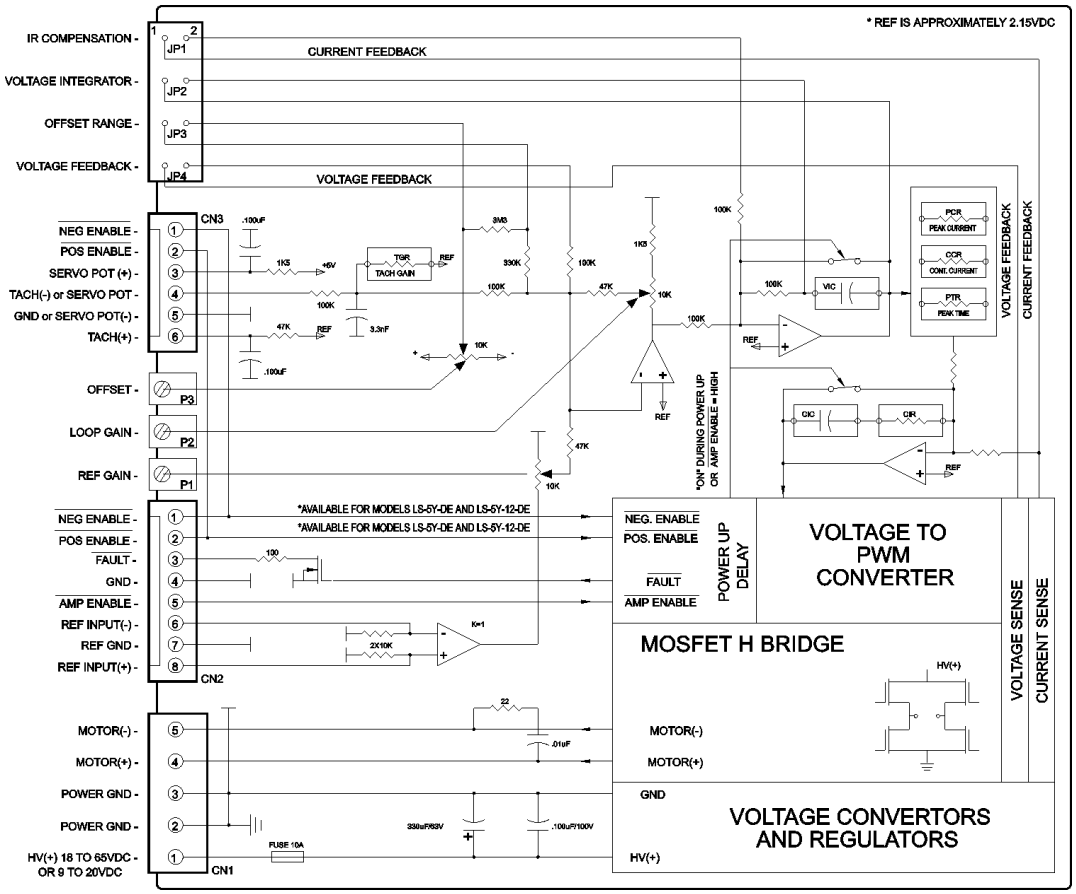
LS-5Y PWM servo amplifier is designed for applications using DC brush type motors up to 1/2 HP. It provides a full set of features for motor control including remote inhibit/enable, directional enable inputs for connection to limit switches and all necessary protections for motor and amplifier. LS-5Y can be used in conjunction with digital servo controllers or as a stand-alone drive.

Loop gain, input gain and offset can be adjusted with multi-turn potentiometers. The offset potentiometer can also be used as on-board full range reference signal.

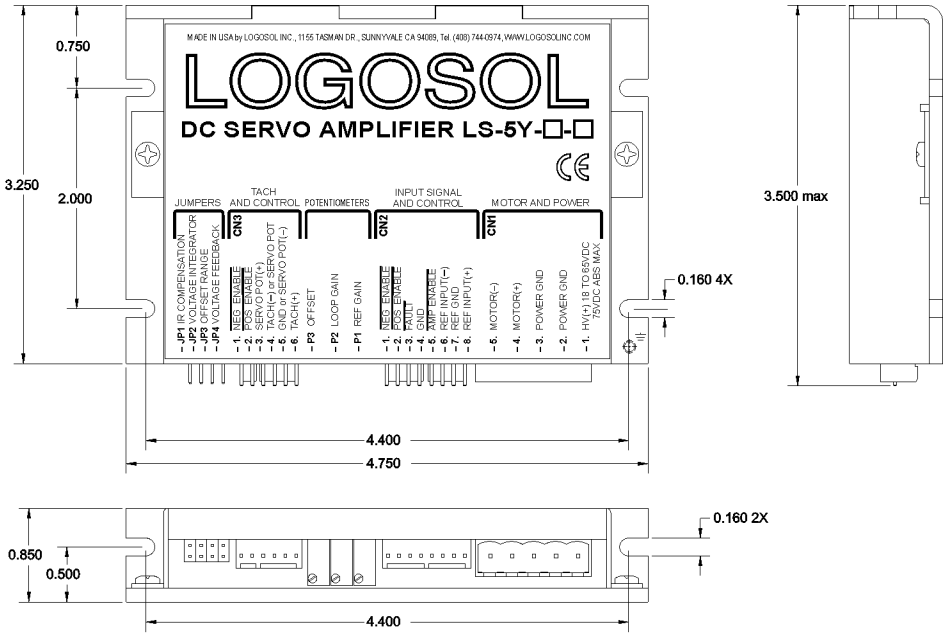
A configurable component carrier holds 5 resistors and 2 capacitors for setting of various gain and current parameters to customize the amplifiers for different loads. Individual peak and continuous current limits allow high acceleration without sacrificing protection against continuous overloads. Peak current time can be adjusted from 3 to 0 sec.

LS-5Y is available in 4 different models to address application requirements for specific supply voltage range and directional enable inputs functionality.

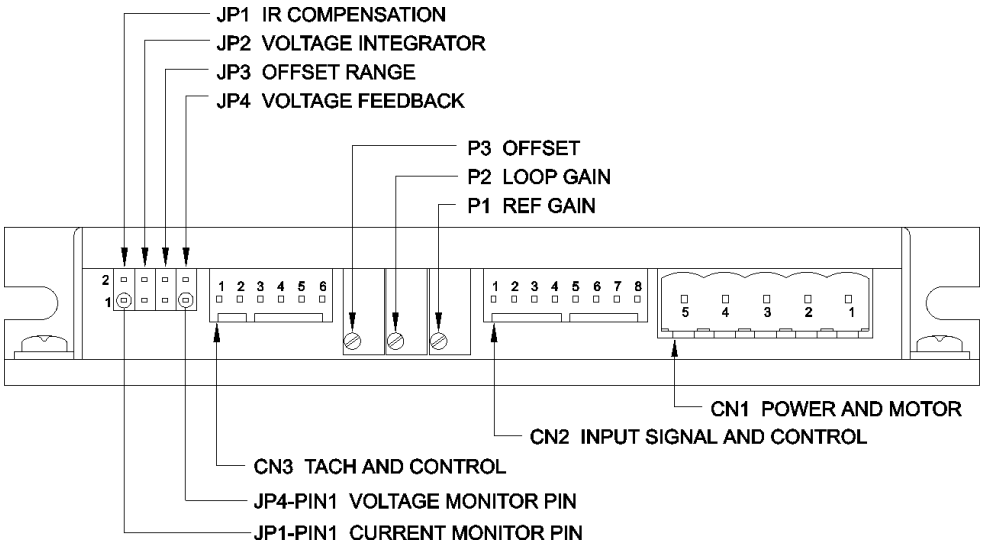
FUNCTIONAL DIAGRAM



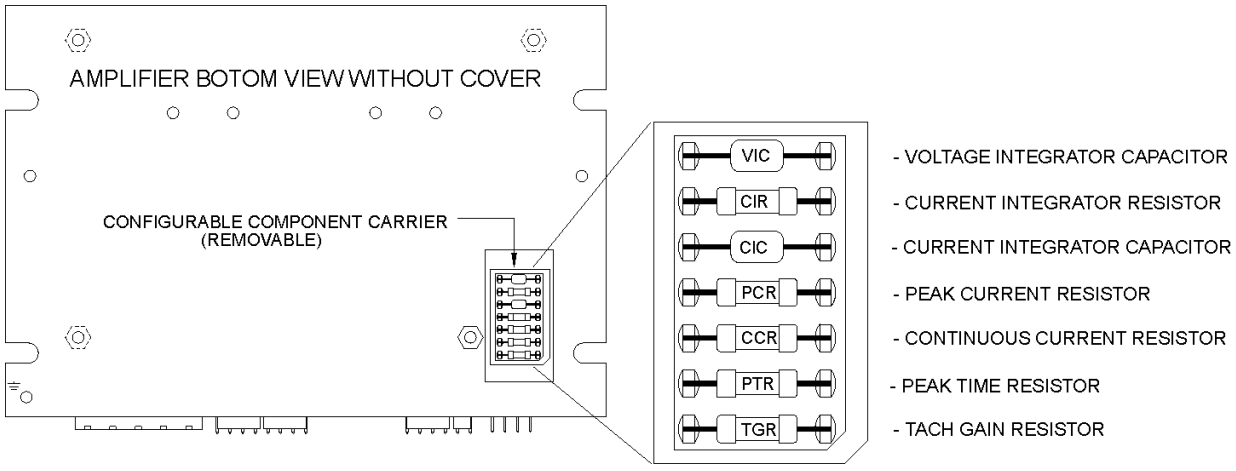
OUTLINE DIMENSIONS in inches



AMPLIFIER LAYOUT



CONFIGURABLE COMPONENT CARRIER



CONNECTORS AND PINOUTS

CN1 – POWER AND MOTOR CONNECTOR

PIN	SIGNAL	DESCRIPTIONS
1	+HV	DC Power Supply Input 18 to 65VDC – LS-5Y, 75V Abs Max 9 to 20VDC – LS-5Y-12, 25V Abs Max
2 and 3	POW GND*	Power Supply Return and Amplifier GROUND
4	MOTOR (+)	Amplifier Output to Motor
5	MOTOR (–)	Amplifier Output to Motor

CN2 – INPUT SIGNAL AND CONTROL CONNECTOR

PIN	SIGNAL	DESCRIPTIONS
1	$\overline{\text{NEG ENABLE}}$**	This pin is wired to CN3-PIN1 and transfers $\overline{\text{NEG ENABLE}}$ to the control system LO (GND) if direction is enabled HI (OPEN) if direction is disabled
2	$\overline{\text{POS ENABLE}}$**	This pin is wired to CN3-PIN2 and transfers $\overline{\text{POS ENABLE}}$ to the control system LO (GND) if direction is enabled HI (OPEN) if direction is disabled
3	$\overline{\text{FAULT}}$	Open collector output with 100Ω in series LO if output is shorted, amplifier is disabled or power supply is out of voltage range
4	GND*	Signal GROUND
5	$\overline{\text{AMP ENABLE}}$	Amplifier enable input LO (GND) enables amplifier HI (OPEN) disables amplifier
6	REF INPUT (–)	Negative reference input. Connect to signal GROUND at reference voltage source
7	REF GND*	Reference cable shield
8	REF INPUT (+)	Reference input ±10V

CN3 – TACH AND CONTROL CONNECTOR

PIN	SIGNAL	DESCRIPTIONS
1	$\overline{\text{NEG ENABLE}}$**	Negative direction enable input LO (GND) if direction is enabled HI (OPEN) if direction is disabled Internally wired to CN2-PIN1
2	$\overline{\text{POS ENABLE}}$**	Positive direction enable input LO (GND) if direction is enabled HI (OPEN) if direction is disabled Internally wired to CN2-PIN2
3	SERVO POT (+)	+5V REF voltage with 1K5 resistor in series. Used as potentiometer +REF in analog position mode
4	TACH (–) or SERVO POT	1. Tachometer input in velocity mode 2. Potentiometer feedback pin in analog position mode
5	GND* or SERVO POT (–)	1. Signal GROUND. Tachometer cable shield in velocity mode 2. Potentiometer (-REF) in analog position mode
6	TACH (+)	Tachometer positive input

* POW GND, GND and REF GND are electrically connected. Amplifier case is isolated from the amplifier circuitry and can be grounded externally.

** Direction enable function is available for models LS-5Y-DE and LS-5Y-12-DE only. The wiring CN2-PIN1 to CN3-PIN1 and CN2-PIN2 to CN3-PIN2 is available for all models.

JUMPER FUNCTIONS

JP1 – IR compensation – **SHORT** activates function
JP2 – Voltage integrator – **OPEN** activates integrator
JP3 – Offset range – **SHORT** increases offset potentiometer range to ±100%
JP4 – Voltage feedback – **SHORT** closes voltage feedback

MODE	JP1	JP2	JP3	JP4
Current mode	OPEN	SHORT	OPEN or SHORT	OPEN
Voltage mode	OPEN	OPEN	OPEN or SHORT	SHORT
IR compensation mode	SHORT	OPEN	OPEN or SHORT	SHORT
Velocity mode	OPEN	OPEN	OPEN or SHORT	OPEN
Analog position mode	OPEN or SHORT	OPEN	OPEN or SHORT	SHORT

CONFIGURABLE COMPONENTS SETTING

CIC is the current integrator capacitor.
CIR is the current integrator resistor.

The value of these components is related to the amplifier bandwidth and have to be configured depending on the motor inductance and power supply voltage.
Optimization procedure:
- Set the amplifier in current mode (**JP1**=OPEN, **JP2**=SHORT, **JP3**=OPEN, **JP4**=OPEN). Replace **CIC** with a wire jumper (SHORT). Set **P1** and **P2** fully CCW. Connect the motor and power supply to the amplifier. Apply a square wave signal ±1V/20 ÷ 50Hz to amplifier REF INPUT. Use an oscilloscope to measure the signal at current monitor pin (**JP1**-PIN1). DC offset at this pin is approximately 2.15V. Output signal is approximately 100mV/A. For easy measurement the oscilloscope can be used in AC input mode. Enable the amplifier **AMP ENABLE**=LOW. Rotate **P1** CW to set ±100mV square wave signal at the oscilloscope screen. Select **CIR** for best transient response (lowest rise time with minimum overshoot). After **CIR** has been set choose the lowest value of **CIC** that does not result in additional overshoot or degradation of the pulse response.
The table below shows some approximate values of the current integrator resistor and capacitor depending of motor inductance.

	LOAD INDUCTANCE	CIC	CIR
	0.2 ÷ 0.6mH	10nF	100K
*	0.7 ÷ 1.9mH	4.7nF	200K
	2 ÷ 6mH	4.7nF	430K
	7 ÷ 20mH	10nF	430K

Note: * indicates factory standard setting. Values in table are for 24VDC power supply voltage. For higher voltages **CIR** should be decreased and **CIC** increased.

PCR is the adjusting resistor for peak current limit
CCR is the adjusting resistor for continues current limit.

The table below shows component values for the most used continuous and peak current combinations.

	I_{PEAK}	I_{CONT}	PCR	CCR
*	10A	6A	SHORT	SHORT
	10A	5A	SHORT	7.5K
	8A	5A	5.6K	2.2K
	8A	4A	5.6K	12K
	7A	4A	9.1K	9.1K
	7A	3A	9.1K	24K

I_{PEAK}	I_{CONT}	PCR	CCR
6A	3A	13K	20K
5A	2.5A	20K	27K
4A	2A	30K	36K
3A	1.5A	47K	56K
2A	1A	82K	100K
1A	0.5A	180K	180K

Note: * indicates factory standard setting.
Contact Logosol customer support for specific settings.

PTR is adjusting resistor for the **PEAK TIME**.
The table below shows some basic settings.

	PEAK TIME	PTR	PEAK TIME	PTR
*	3 sec	OPEN	0.5 sec	68K
	2 sec	510K	0.25 sec	33K
	1.5 sec	330K	0.1 sec	15K
	1 sec	150K	0.05 sec	SHORT

Note: * indicates factory standard setting.
Contact Logosol customer support for specific settings.

VIC is the voltage integrator capacitor.
For current mode this capacitor is shorted by **JP2** and its value doesn't effect amplifier parameters. It becomes very important component for voltage, velocity and analog position modes. Proceed with **CIR** and **CIC** optimization procedure as described above. Disable the amplifier **AMP ENABLE**=HIGH. Put the amplifier in voltage mode (**JP1**=OPEN, **JP2**=OPEN, **JP3**=OPEN, **JP4**= SHORT). Set **P1** fully CCW and **P2** fully CW. Apply a square wave signal ±1V/5 ÷ 20Hz to amplifier REF INPUT. Move the oscilloscope probe to the voltage monitor pin(**JP4**-PIN1).
DC offset at this pin is approximately 2.15V. Output signal is approximately 20mV/V. For easy measurement the oscilloscope can be used in AC input mode. Enable the amplifier **AMP ENABLE** = LOW. Rotate **P1** CW to set ±100mV square wave signal at the oscilloscope screen. Find the best transient response (lowest risetime with minimum overshoots) by changing **VIC** (factory setting VIC=4.7nF) and adjusting **P2** LOOP GAIN.

TGR is an adjustment resistor affecting amplifier in velocity (tachometer) and analog position modes.
For analog position mode the value of this resistor supposed to be **33K** (as delivered). The value of this resistor changes amplifier tachometer input sensitivity between ZERO (**TGR=0**) and MAX (**TGR=**OPEN). Choose the value of **TGR** depending on your tachometer parameters and V_{tacn}/V_{ref} ratio requirements.

POTENTIOMETER FUNCTIONS

POT.	FUNCTION	DESCRIPTION
P1	REF GAIN	Adjusts the ratio between input signal and servo amplifier output
P2	LOOP GAIN	1. Adjusts voltage to current transfer ratio in current mode 2. Adjusts loop gain and bandwidth in voltage and velocity modes
P3	OFFSET	JP3 = OPEN – adjusts the imbalance in input signal or in servo amplifier (low range) JP3 = SHORT – regulates an on board reference signal source driving servo amplifier output up to ±100% (high range)

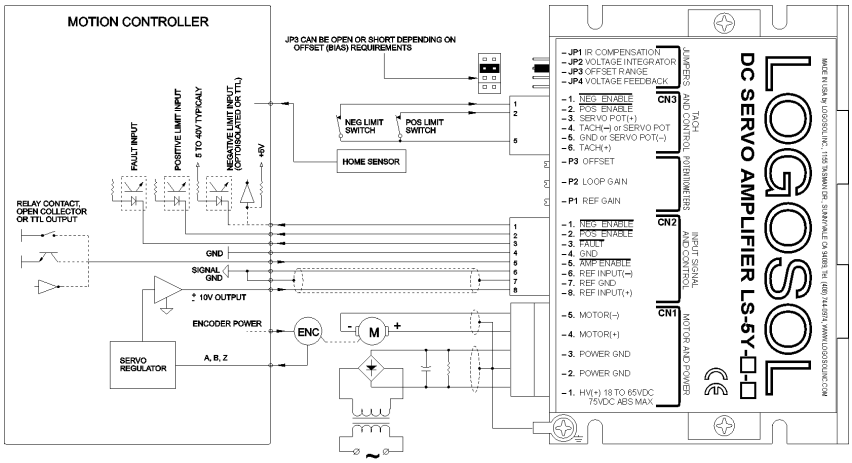
ORDERING GUIDE

PART NUMBER	MODEL	DESCRIPTION
923050003	LS-5Y-DE	18 to 65VDC **with** direction enable function
923050004	LS-5Y-12-DE	9 to 20VDC **with** direction enable function
923050005	LS-5Y	18 to 65VDC **without** direction enable function
923050006	LS-5Y-12	9 to 20VDC **without** direction enable function
230601002	LS-5Y-CN	Mating Connector Kit

TECHNICAL SPECIFICATIONS rated at 25°C ambient, +HV=60VDC, Load=250µH motor

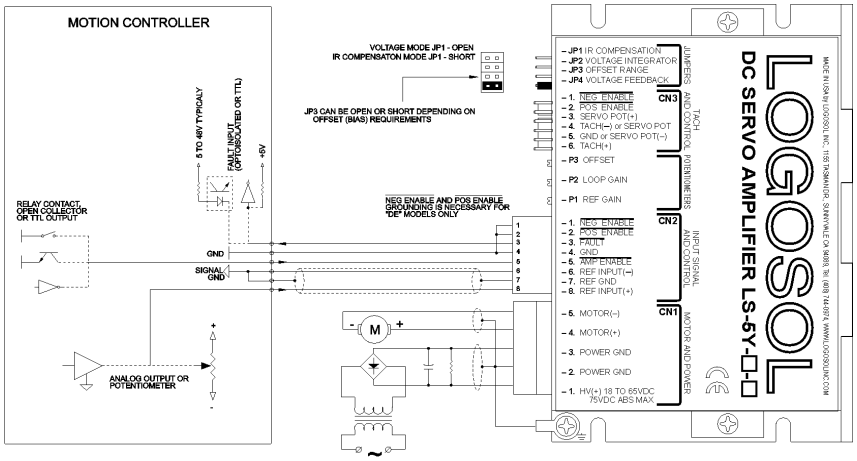
DC SUPPLY VOLTAGE	
Model LS-5Y	+HV = 18 to 65VDC, 75V Abs. Max
Model LS-5Y-12	+HV = 9 to 20VDC, 25V Abs. Max
OUTPUT POWER	
Peak power	±10A at 60V
Continuous power	±6A at 60V
OUTPUT CONTINUOUS CURRENT	
Convection cooled, no conductive cooling	±3A at 35°C max, ambient
With forced air cooling or heatsink maintaining 55°C max	±6A at 55°C max
OUTPUT VOLTAGE	V_{out}= 0.96(HV) – 0.33(I_{out})
MINIMUM LOAD INDUCTANCE	200µH
SMALL SIGNAL BANDWIDTH Note: actual bandwidth will depend on supply voltage, load inductance and configurable components	2.5Hz with 250µH load
PWM SWITCHING FREQUENCY	25KHz
ANALOG INPUT CHARACTERISTICS	Differential, ±10V (±20V max), 20K between inputs
GAINS	
Current mode - all models	1A/V as delivered. Adjustable 0 to 10A/V
Voltage mode - model LS-5Y	5V/V as delivered. Adjustable 0 to 10V/V
- model LS-5Y-12	2V/V as delivered. Adjustable 0 to 10V/V
POTENTIOMETERS	
REF GAIN	Attenuates REF INPUT from x 1 to Zero
LOOP GAIN	1. Increases A/V gain in current mode 2. Controls bandwidth in voltage mode
OFFSET	1. JP3 = OPEN – adjusts the input signal or servo amplifier imbalance 2.JP3 = SHORT – can be used as on board reference signal driving servo amplifier output up to ±100%
TACHOMETER INPUT	±3V to ±50VDC (±60V Abs.Max)
LOGIC INPUTS	
Logic threshold voltage	HI: ≥ 2.5V, LO: ≤ 1.0V
Logic Abs. Max range	–5VDC to + 75VDC between input and GND
AMP ENABLE	LO enables amplifier
POS ENABLE (Available for models LS-5Y-DE and LS-5Y-12-DE)	LO enables positive output polarity, HI inhibits
NEG ENABLE (Available for models LS-5Y-DE and LS-5Y-12-DE)	LO enables negative output polarity, HI inhibits
POWER UP DELAY	100mSec
FAULT OUTPUT – Open Collector (48Vmax, 24mA)	HI when operating normally LO if output is shorted, amplifier is disabled or power supply (+HV) is out of tolerance
PROTECTION	
Output short (output to output, output to ground, output to +HV)	Shutdown when output is shorted with self resume
Power supply voltage too low (undervoltage) - model LS-5Y	Shutdown at +HV < 18VDC with self resume
- model LS-5Y-12	at +HV < 9VDC with self resume
Power supply voltage too high (overvoltage) - model LS-5Y	Shutdown at +HV > 65VDC with self resume
- model LS-5Y-12	at +HV > 20VDC with self resume
FIRE SAFETY – internal fuse	10A Quick blow
POWER DESSIPATION	
Minimum power consumption	1.5W
Power dissipation at 5A output, 65VDC supply	10W
Power dissipation at 10A output, 65VDC supply	35W
TERMAL REQUIREMENTS	
Storage temperature range	–30 to +85°C
Operating temperature range	0 to 75°C
MECHANICAL	
Size	4.75 x 3.25 x 0.85 in.(120.65 x 82.55 x 21.59 mm)
Weight	0.44 lb. (0.2 kg)
CONNECTORS	
Power & motor	Magnum EM2565-05-VL or Phoenix: MSTB 2.5/5-ST-5.08 or Weidmuller:BL-125946
Signal and control	Molex: 22-01-3087 housing with 08-50-0114 pins (8pcs)
Tach. and direction limits	Molex: 22-01-3067 housing with 08-50-0114 pins (6pcs)

TYPICAL CURRENT (TORQUE) MODE APPLICATION



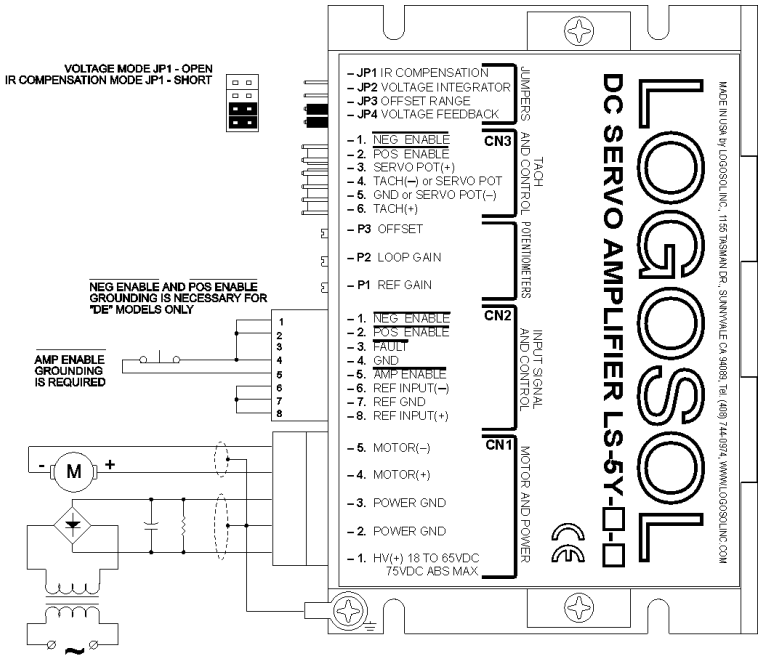
In current mode the amplifier produces motor current proportional to the voltage applied to the **REF INPUT**. DC motor torque is proportional to the motor current. Current mode gives best results (motor stiffness) if the servo amplifier is used with a digital position controller. **P1** REF GAIN and **P2** LOOP GAIN adjust the ratio between the input signal and amplifier output current. Set **P1** REF GAIN fully CW and **P2** LOOP GAIN fully CCW. To increase the gain turn **P2** CW. To decrease it turn **P1** CCW. In this mode, only **CIC** and **CIR** are important.
CAUTION! Without controller this mode can produce motor "RUN AWAY".

TYPICAL VOLTAGE AND IR COMPENSATION MODE APPLICATION



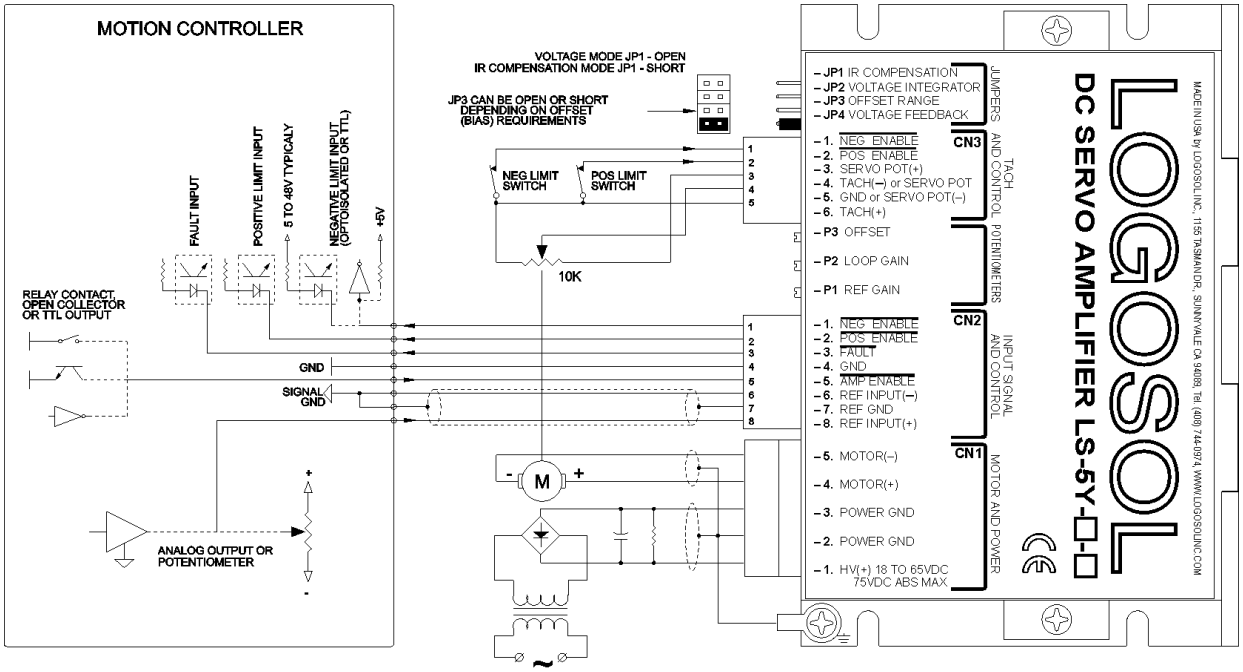
In voltage mode the motor voltage is proportional to the reference input voltage, regardless of power supply voltage variations. The schematic above works in voltage mode if **JP1** IR COMPENSATION is open. The load torque variation during the motor rotation changes motor current (torque is proportional to the motor current). Because of the motor winding resistance, the actual motor voltage is reduced by the product of the motor current and resistance resulting in motor speed variations (motor speed is proportional to the effective motor voltage and equals to **Um** minus **I.R**, where **Um** = motor terminal voltage, **I** = motor current, **R** = motor internal resistance).To compensate the internal motor voltage drop, a voltage proportional to the motor current can be added to the input reference signal in IR compensation mode (JP1 – SHORT). In this mode the configurable components **CIC**, **CIR** and **VIC** must be adjusted. **P1** REF GAIN adjusts the ratio between reference input voltage and motor rotation speed. **P2** LOOP GAIN adjusts positive to negative feedback balance. Start the adjustment by setting **P2** fully CW. Rotate **P2** CCW until motor oscillations appear and turn back two rotations.

STAND ALONE VOLTAGE AND IR COMPENSATION MODE APPLICATION



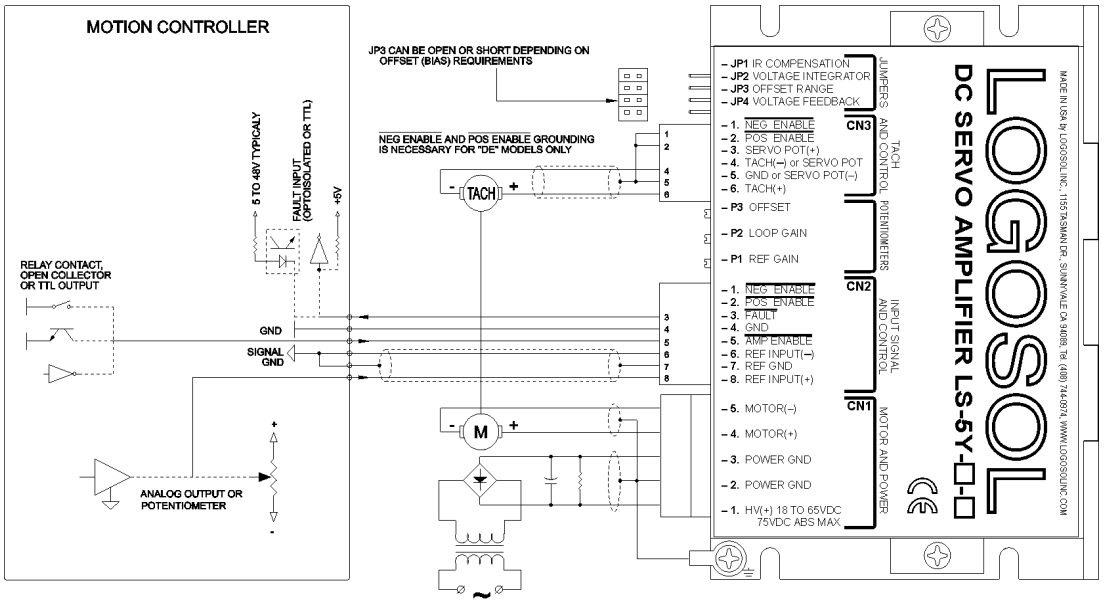
This application is the same as described in the previous paragraph but amplifier has no external control. Instead of **REF INPUT** it is controlled by **P3** OFFSET potentiometer. **P1** REF GAIN has no effect if **REF INPUT(+)** and **REF INPUT(-)** are grounded, otherwise **P1** REF GAIN must be set fully CCW. All remaining settings are the same as described for typical voltage and IR compensation mode application.

TYPICAL ANALOG POSITION MODE APPLICATION



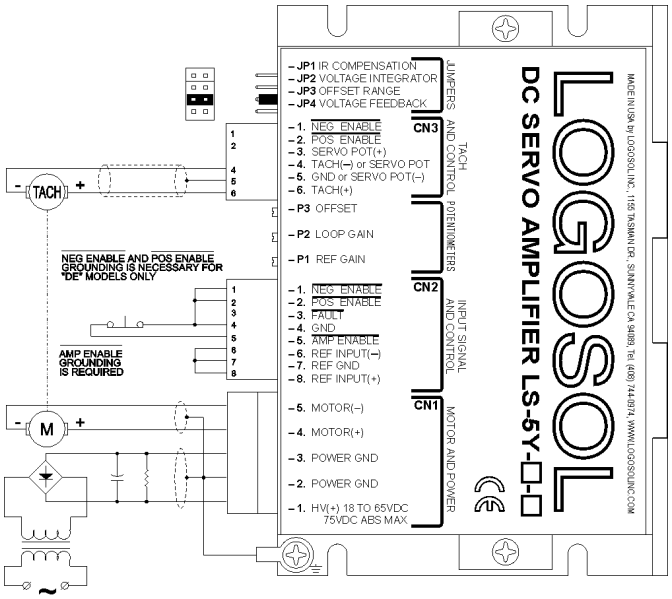
In analog position mode, an analog 10K potentiometer is mechanically coupled to the positioned object. The potentiometer supplies voltage proportional to its position. This voltage is used as a feedback signal, which drives the motor keeping the potentiometer position proportional to the reference input voltage.

TYPICAL VELOCITY (TACH) MODE APPLICATION



Velocity mode is only applicable for motors with tachometers. A tachometer produces a voltage proportional to the motor shaft speed. By using this voltage as a feedback, the amplifier keeps motor shaft speed proportional to the reference voltage applied to the **REF INPUT**. Set **P1** REF GAIN fully CCW and **P2** LOOP GAIN fully CW. Power and enable the amplifier. Spin the motor shaft manually. If the motor "runs away", reverse tachometer or motor polarity. In this mode the configurable components **CIC**, **CIR**, **VIC** and **TGR** must be adjusted. **P1** REF GAIN adjusts the ratio between **REF INPUT** voltage and motor rotation speed. **P2** LOOP GAIN adjusts amplifier loop gain and bandwidth (system stability).

STAND ALONE VELOCITY (TACH) MODE APPLICATION



In this configuration the amplifier drives a motor-tachometer pair keeping constant speed. Motor speed is adjustable with **P3** OFFSET. **P1** REF GAIN has no effect if **REF INPUT (+)** and **REF INPUT (-)** are grounded, otherwise set **P1** REF GAIN fully CCW. All remaining settings are the same as described for typical velocity mode application.