Features

- Motors supported:
  - Brushless 60°/120° commutated (AC)
  - Brush-commutated (DC)
- Motor type auto detection
- Single voltage supply 11÷91 VDC
- 8A continuous, 12A peak output current
- Selectable modes of operation:
  - Current (Torque)
  - Velocity (Tach)
  - Analog position
- 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-BL servo amplifier is designed for applications using brushless or brush-commutated DC motors up to 3/4 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-BL 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 onboard full range reference signal.

A configurable component carrier holding 6 resistors and 2 capacitors is used to select the operation mode and to customize the amplifier for specific motor parameters. 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.
AMPLIFIER LAYOUT

- LED FAULT INDICATOR
- P3 OFFSET
- P2 LOOP GAIN
- P1 REF GAIN
- CN1 POWER AND MOTOR
- CN2 COMMUTATOR
- CN3 TACH AND CONTROLS
- CN4 INPUT SIGNALS AND CONTROLS

CONFIGURABLE COMPONENT CARRIER

- AMPLIFIER BOTTOM VIEW WITHOUT COVER
- CONFIGURABLE COMPONENT CARRIER (REMOVABLE)
- VIC
- CIR
- CIC
- PCR
- CCR
- PTR
- TGR
- OER
- VOLTAGE INTEGRATOR CAPACITOR
- CURRENT INTEGRATOR RESISTOR
- CURRENT INTEGRATOR CAPACITOR
- PEAK CURRENT RESISTOR
- CONTINUOUS CURRENT RESISTOR
- PEAK TIME RESISTOR
- TACH GAIN RESISTOR
- OFFSET RANGE RESISTOR
### POTentiometer Functions

<table>
<thead>
<tr>
<th>POT.</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>REF GAIN</td>
<td>Adjusts the ratio between input signal and servo amplifier output</td>
</tr>
</tbody>
</table>
| P2   | LOOP GAIN | 1. Adjusts voltage to current transfer ratio in current mode  
2. Adjusts loop gain and bandwidth in velocity mode |
| P3   | OFFSET   | ORR = 3.0M – adjusts the imbalance in input signal or in servo amplifier (low range)  
ORR = 300K – works as an on board reference signal source driving servo amplifier output up to ±100% (max range) |

### Connectors and Pinouts

#### CN1 – Power and Motor Connector

<table>
<thead>
<tr>
<th>PIN</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+HV</td>
<td>11 to 91VDC (100V Abs Max)</td>
</tr>
<tr>
<td>2 and 3</td>
<td>POW GND*</td>
<td>Power Supply Return and Amplifier GROUND</td>
</tr>
</tbody>
</table>
| 4   | MOTOR AC3 or NC | 1. Amplifier Output to Motor phase 3 for brushless motors  
2. Not connected for brush motors |
| 5   | MOTOR AC2 or DC( -) | 1. Amplifier Output to Motor phase 2 for brushless motors  
2. Amplifier Output to Motor ( - ) terminal for brush motors |
| 6   | MOTOR AC1 or DC( +) | 1. Amplifier Output to Motor phase 1 for brushless motors  
2. Amplifier Output to Motor (+) terminal for brush motors |

#### CN2 – Commutator Connector

<table>
<thead>
<tr>
<th>PIN</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Signal and power GND for motor commutator</td>
</tr>
</tbody>
</table>
| 2   | SENSOR 1 | 1. Amplifier input for brushless commutation SENSOR 1  
2. NC for DC brush motors |
| 3   | SENSOR 2 | 1. Amplifier input for brushless commutation SENSOR 2  
2. NC for DC brush motors |
| 4   | SENSOR 3 | 1. Amplifier input for brushless commutation SENSOR 3  
2. NC for DC brush motors |
| 5   | POWER (+5V) | Power source output for motor commutator 5V/100mA |

#### CN3 – Tach and Control Connector

<table>
<thead>
<tr>
<th>PIN</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1   | NEG ENABLE | Negative direction enable input  
LO (GND) if direction is enabled  
HI (OPEN) if direction is disabled  
Internally wired to CN4-PIN1 |
| 2   | POS ENABLE | Positive direction enable input  
LO (GND) if direction is enabled  
HI (OPEN) if direction is disabled  
Internally wired to CN4-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 |
CN4 – INPUT SIGNAL AND CONTROL CONNECTOR

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NEG ENABLE</td>
<td>This pin is wired to CN3-PIN1 and transfers NEG ENABLE to the control system. LO (GND) if direction is enabled. HI (OPEN) if direction is disabled.</td>
</tr>
<tr>
<td>2</td>
<td>POS ENABLE</td>
<td>This pin is wired to CN3-PIN2 and transfers POS ENABLE to the control system. LO (GND) if direction is enabled. HI (OPEN) if direction is disabled.</td>
</tr>
<tr>
<td>3</td>
<td>FAULT</td>
<td>TTL output. LO if output is shorted, amplifier is disabled or power supply is out of voltage range.</td>
</tr>
<tr>
<td>4</td>
<td>CURRENT MONITOR</td>
<td>Current monitor output ±1V = ±5A.</td>
</tr>
<tr>
<td>5</td>
<td>GND*</td>
<td>Signal GROUND</td>
</tr>
<tr>
<td>6</td>
<td>AMP ENABLE</td>
<td>Amplifier enable input. LO (GND) enables amplifier. HI (OPEN) disables amplifier.</td>
</tr>
<tr>
<td>7</td>
<td>REF INPUT (–)</td>
<td>Negative reference input. Connect to signal GROUND at reference voltage source.</td>
</tr>
<tr>
<td>8</td>
<td>REF GND*</td>
<td>Reference cable shield</td>
</tr>
<tr>
<td>9</td>
<td>REF INPUT (+)</td>
<td>Reference input ±10V.</td>
</tr>
</tbody>
</table>

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

PHASING A BRUSHLESS MOTOR

<table>
<thead>
<tr>
<th>CN2 Signal</th>
<th>Motor manufacturer signal names</th>
</tr>
</thead>
<tbody>
<tr>
<td>SENSOR 1</td>
<td>R U A S1</td>
</tr>
<tr>
<td>SENSOR 2</td>
<td>S V B S2</td>
</tr>
<tr>
<td>SENSOR 3</td>
<td>T W C S3</td>
</tr>
</tbody>
</table>

Phasing procedure:
- Replace configurable components CIC and VIC with wire jumpers (SHORT). Replace ORR with 1.0M resistor. Connect the motor commutation sensors to CN2 using the table with the most popular manufacturers signal names. Connect the commutator power leads to GND and +5V.

Connect the three motor leads to AC1, AC2, and AC3 to CN1 using the same order as commutation sensor signals. Power and enable the amplifier. Rotate amplifier OFFSET potentiometer CW and CCW. If the motor is phased properly it will rotate smoothly in both directions. If motor runs slower in one direction needs help to start or vibrates the phasing is incorrect. There are five more ways to connect the three motor wires. The best way is to try all six combinations the right one should be quite obvious. If the motor is phased properly the rotation direction can be reversed interchanging SENSOR 1/SENSOR 3 and AC1/AC2.
CONFIGURABLE COMPONENTS SETTING

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

The values of these components are 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 by putting jumper wire instead of **VIC**. 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 \( \pm 1V/20 \div 50Hz \) to amplifier **REF INPUT**. Use an oscilloscope to measure the signal at current monitor (**CN4**-Pin4). Output signal is approximately 200mV/A. Enable the amplifier **AMP ENABLE**=LOW. Rotate **P1** CW to set \( \pm 100mV \) square wave signal at the oscilloscope screen. Select **CIR** for best transient response (lowest risetime 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.

<table>
<thead>
<tr>
<th>LOAD INDUCTANCE</th>
<th>CIC</th>
<th>CIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2 ÷ 0.6mH</td>
<td>4.7nF</td>
<td>100K</td>
</tr>
<tr>
<td>0.7 ÷ 1.9mH</td>
<td>10nF</td>
<td>100K</td>
</tr>
<tr>
<td>2 ÷ 6mH</td>
<td>22nF</td>
<td>100K</td>
</tr>
<tr>
<td>7 ÷ 20mH</td>
<td>47nF</td>
<td>100K</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>I peak</th>
<th>I cont</th>
<th>PCR</th>
<th>CCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>12A</td>
<td>8A</td>
<td>SHORT</td>
<td>SHORT</td>
</tr>
<tr>
<td>12A</td>
<td>6A</td>
<td>SHORT</td>
<td>10K</td>
</tr>
<tr>
<td>10A</td>
<td>6A</td>
<td>4.7K</td>
<td>6.2K</td>
</tr>
<tr>
<td>10A</td>
<td>5A</td>
<td>4.7K</td>
<td>13K</td>
</tr>
<tr>
<td>8A</td>
<td>4</td>
<td>11K</td>
<td>22K</td>
</tr>
<tr>
<td>7A</td>
<td>3.5A</td>
<td>16K</td>
<td>24K</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I peak</th>
<th>I cont</th>
<th>PCR</th>
<th>CCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>6A</td>
<td>3A</td>
<td>22K</td>
<td>30K</td>
</tr>
<tr>
<td>5A</td>
<td>2.5A</td>
<td>30K</td>
<td>39K</td>
</tr>
<tr>
<td>4A</td>
<td>2A</td>
<td>43K</td>
<td>47K</td>
</tr>
<tr>
<td>3A</td>
<td>1.5A</td>
<td>62K</td>
<td>68K</td>
</tr>
<tr>
<td>2A</td>
<td>1A</td>
<td>100K</td>
<td>120K</td>
</tr>
<tr>
<td>1A</td>
<td>0.5A</td>
<td>220K</td>
<td>220K</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>PEAK TIME</th>
<th>PTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 sec</td>
<td>OPEN</td>
</tr>
<tr>
<td>2 sec</td>
<td>510K</td>
</tr>
<tr>
<td>1.5 sec</td>
<td>330K</td>
</tr>
<tr>
<td>1 sec</td>
<td>150K</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PEAK TIME</th>
<th>PTR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 sec</td>
<td>68K</td>
</tr>
<tr>
<td>0.25 sec</td>
<td>33K</td>
</tr>
<tr>
<td>0.1 sec</td>
<td>15K</td>
</tr>
<tr>
<td>0.05 sec</td>
<td>SHORT</td>
</tr>
</tbody>
</table>

Note: * indicates factory standard setting. Contact Logosol customer support for specific settings.
VIC is the voltage integrator capacitor. For current mode this capacitor is replaced by a wire jumper or 0 Ohm resistor. Change of the wire jumper with a capacitor sets the amplifier in velocity mode. This mode is applicable only for motors with brush tachometers.

Optimization procedure:
- Proceed with CIR and CIC optimization as described above. Set the amplifier in velocity mode putting VIC = 10nF. Set P1 fully CCW. Connect motor and tachometer. Power and enable the amplifier. Rotate motors shaft slightly. If the tachometer, polarity is wrong motor will "Run away". If this happens, reverse tachometer wires (+) and (−). With correct tachometer polarity motor will resist the manual rotation of its shaft. Apply square wave signal ± 1V/5 ÷ 20 Hz to amplifier REF INPUT. Move the oscilloscope probe to TACH(−) signal (CN3 - Pin4). DC offset at this pin is approximately 2.15V. For easy measurement the oscilloscope can be used in AC Input Mode. Rotate P1 CW to set ± 1V square wave signal at the oscilloscope screen. Find the best response (lowest rise time with minimum overshoots) by changing VIC 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 \( \frac{V_{\text{tach}}}{V_{\text{ref}}} \) ratio requirements.

ORR is the offset range resistor.

Its value changes the range of regulation with the OFFSET potentiometer. For 100% regulation set the ORR = 300K. To reduce the regulation range increase the resistor. Factory setting ORR = 3.0M gives enough range for input imbalance adjustment. All values between 300K and ∞ can be used.

ORDERING GUIDE

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>MODEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>923060001</td>
<td>LS-5Y-BL</td>
<td>AC/DC Servo Amplifier</td>
</tr>
<tr>
<td>230601001</td>
<td>LS-5Y-BL-CN</td>
<td>Mating Connector Kit</td>
</tr>
</tbody>
</table>
**Logosol AC/DC Servo Amplifier LS-5Y-BL**

**Logosol, Inc.**  
1155 Tasman Drive  
Sunnyvale, CA 94089  
Tel: (408) 744-0974  
www.logosolinc.com

---

**TECHNICAL SPECIFICATIONS**  
rated at 25°C ambient, +HV=80VDC, Load=250µH motor

<table>
<thead>
<tr>
<th><strong>DC SUPPLY VOLTAGE</strong></th>
<th>11 to 91VDC (100VDC Abs. Max)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OUTPUT POWER</strong></td>
<td></td>
</tr>
<tr>
<td>Peak power</td>
<td>±12A at 80V</td>
</tr>
<tr>
<td>Continuous power</td>
<td>±8A at 80V</td>
</tr>
<tr>
<td><strong>OUTPUT CONTINUOUS CURRENT</strong></td>
<td></td>
</tr>
<tr>
<td>Convection cooled, no conductive cooling</td>
<td>±4A at 35°C max, ambient</td>
</tr>
<tr>
<td>With forced air cooling or heatsink maintaining 60°C max</td>
<td>±8A at 60°C max</td>
</tr>
<tr>
<td><strong>OUTPUT VOLTAGE</strong></td>
<td>( V_{out} = 0.96(HV) - 0.21(I_{out}) )</td>
</tr>
<tr>
<td><strong>MINIMUM LOAD INDUCTANCE</strong></td>
<td>200µH</td>
</tr>
<tr>
<td><strong>SMALL SIGNAL BANDWIDTH</strong></td>
<td>2.5Hz with 250µH load</td>
</tr>
<tr>
<td><strong>PWM SWITCHING FREQUENCY</strong></td>
<td>25KHz</td>
</tr>
<tr>
<td><strong>ANALOG INPUT CHARACTERISTICS</strong></td>
<td></td>
</tr>
<tr>
<td><strong>GAINS</strong></td>
<td>Current mode 1A/V as delivered. Adjustable 0 to 10A/V</td>
</tr>
<tr>
<td><strong>POTENTIOMETERS</strong></td>
<td></td>
</tr>
<tr>
<td>REF GAIN</td>
<td>Attenuates REF/INPUT from x 1 to Zero</td>
</tr>
</tbody>
</table>
| LOOP GAIN | 1. Increases A/V gain in current mode  
2. Controls bandwidth in velocity mode  
3. ORR = 3M – adjusts the imbalance in the input signal or in the servo amplifier  
4. ORR = 300K – can be used as on board reference signal driving servo amplifier output up to ±100% |
| OFFSET | |
| **COMMITATION** | 60/120 degree with automatic detection  
Hysteresis TYP. = 1.0V, Pull up to +5V = 5.1K |
| **COMMUTATOR INPUTS** | |
| HI: ≥ 2.6V, LO: ≤ 1.6V (–0.5VDC to +5.5VDC Abs. Max)  
LO enables amplifier  
HI enables positive direction rotation, HI inhibits |
| **TACHOMETER INPUT** | ±3V to ±50VDC (±60V Abs.Max)  
HI enables negative direction rotation, HI inhibits |
| **LOGIC INPUTS** | |
| AMP ENABLE | HI: ≥ 2.5V, LO: ≤ 1.0V (–0.5VDC to +5.5VDC Abs. Max)  
LO enables amplifier  
HI enables positive direction rotation, HI inhibits |
| POS ENABLE | |
| NEG ENABLE | |
| **POWER UP DELAY** | 100msec |
| **FAULTY OUTPUT** | |
| TTL level | HI when operating normally  
LO if output is shorted, amplifier is disabled or power supply (+HV) is out of tolerance |
| HI = 3V min at 10mA, LO = 0.5V max at 10mA | |
| **INDICATOR (LED)** | GREEN when operating normally  
RED if output is shorted, amplifier is disabled or power supply (+HV) is out of tolerance |
| **CURRENT MONITOR** | |
| 10K, 10nF RC filter | ± 2.4V at ±12A (5A/V) |
| **PROTECTION** | |
| Output short (output to output, output to ground, output to +HV) | Shutdown when output is shorted with self resume  
Shutdown at +HV < 11VDC with self resume  
Shutdown at +HV > 91VDC with self resume |
| Power supply voltage too low (undervoltage) | Shutdown at +HV < 91VDC with self resume  
Shutdown at 75°C internal temperature with self resume |
| Power supply voltage too high (overvoltage) | |
| Overtemperature | |
| **FIRE SAFETY** | 10A Quick blow |
| **POWER DISSIPATION** | Minimum power consumption at 0A output, 12V supply  
1W  
Power dissipation at 5A output, 80VDC supply  
15W  
Power dissipation at 10A output, 80VDC supply  
31W |
| **THERMAL REQUIREMENTS** | Storage temperature range  
–30 to +85°C  
Operating temperature range  
0 to 75°C |
| **MECHANICAL** | |
| Size | 5.00 x 3.30 x 0.85 in. (127 x 84 x 22 mm) |
| Weight | 0.5 lb. (0.23 kg) |
| **CONNECTORS** | |
| Power & motor | Magnum EM2565-06-4L or Phoenix: MSTB 2.5/6-25-508  
Molex: 22-01-3097 housing with 08-50-0114 pins (9pcs)  
Molex: 22-01-3067 housing with 08-50-0114 pins (6pcs)  
Molex: 22-01-3057 housing with 08-50-0114 pins (5pcs) |
| Signal and control | |
| Tach. and direction limits | |
| Commutator | |
In current mode the amplifier produces motor current proportional to the voltage applied to the **REF INPUT**. DC motor shaft 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 must be optimized. **CAUTION!** Without controller this mode can produce motor “RUN AWAY”.

In *TYPICAL CURRENT (TORQUE) MODE APPLICATION FOR BRUSHLESS MOTOR* and *TYPICAL CURRENT (TORQUE) MODE APPLICATION FOR BRUSH MOTOR*, the amplifier is shown with a motion controller and encoder power connections. The amplifier is configured to control the motor current based on the voltage applied to the REF INPUT. The motion controller and encoder power components are integrated with the amplifier for precise control and feedback.
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.
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 optimized. 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).
In this configuration the amplifier drives a motor-tachometer pair keeping constant speed. Motor speed is adjustable with \textbf{P3 OFFSET}. \textbf{P1 REF GAIN} has no effect if \textbf{REF INPUT (+)} and \textbf{REF INPUT (-)} are grounded, otherwise set \textbf{P1 REF GAIN} fully CCW. All remaining settings are the same as described for typical velocity mode application.