

# Logosol AC/DC Programmable Servo & Logic Controller LS-151

Doc #712151001 / Rev. A 04/18/2003

## Features

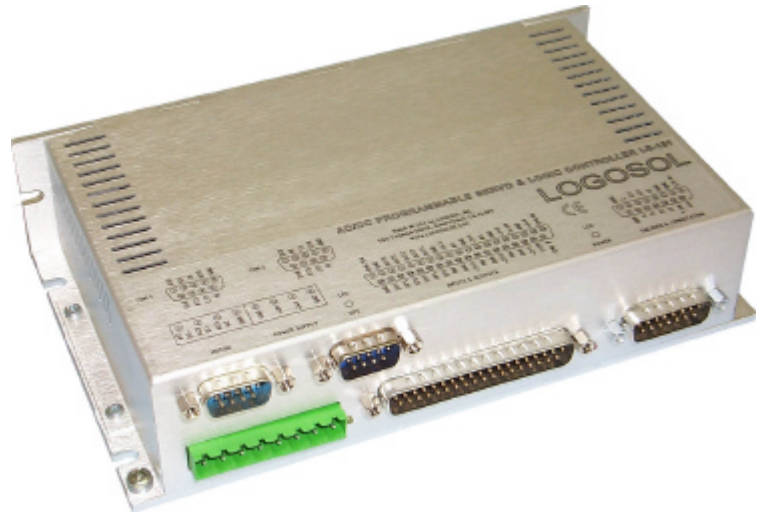
- ❑ **Motors supported**
  - Panasonic A and S series motors
  - Yaskawa SGM and SGMM series
  - Brushless 60/120° commutated (AC)
  - Brush-commutated (DC)

- ❑ **12A peak, 8A continuous output current**

- ❑ **18 to 91V motor power supply**

### **Relay commutated motor power supply**

- ❑ **PC/104 CPU board**
- ❑ **Two RS-232C ports**
- ❑ **512KB flash disk to store user programs**
- ❑ **7 general purpose inputs 8mA/24V**
- ❑ **5 general purpose open collector outputs 1A/24V with short-circuit protection**
- ❑ **Comprehensive motor output short-circuit protection:**
  - Output to output
  - Output to ground
  - Output to power
- ❑ **Programmable motor current limit**
- ❑ **Over/under voltage shutdown**
- ❑ **Overheating protection**
- ❑ **Emergency stop input**
- ❑ **Forward and reverse overtravel limit switch inputs**
- ❑ **S-curve velocity profile**
- ❑ **Windows 95/98/NT programming and diagnostic software**



## Description

LS-151 is a single axis, stand-alone servo controller with integrated amplifier for applications using Panasonic A and S series motors, Yaskawa SGM and SGMM series motors, standard brushless (AC), or brush (DC) type motors up to 1 HP. No jumpers or setup is required to switch between both types of motors. Trapezoidal brushless motor commutation is performed automatically if hall sensors are connected to the controller. In addition to the motion control, LS-151 offers general-purpose digital I/O lines. LS-151 communicates with the host computer through RS-232C serial port. The controller may run in stand-alone mode after downloading a program into its user memory, or the host may control the target device using a simple but powerful set of commands. The onboard 386 CPU features enough computing power and memory to implement even most sophisticated motion control.

LS-151 is equipped with various safety features like short circuit protection for the motor and digital outputs, overtravel limit switch inputs, emergency stop input, control for the presence of the encoder and I/O connectors, over and undervoltage protection. The maximum motor output current may be limited. The limit is under software control and may be changed on the fly. No special skills are required to program LS-151 servo drive. Logosol Motion Control Center includes terminal emulation, sophisticated diagnostic and optimizing tools. Drag-and-drop style of Motion Composer utility offers a user-friendly environment for rapid application development, eliminating the need of low-level programming.

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

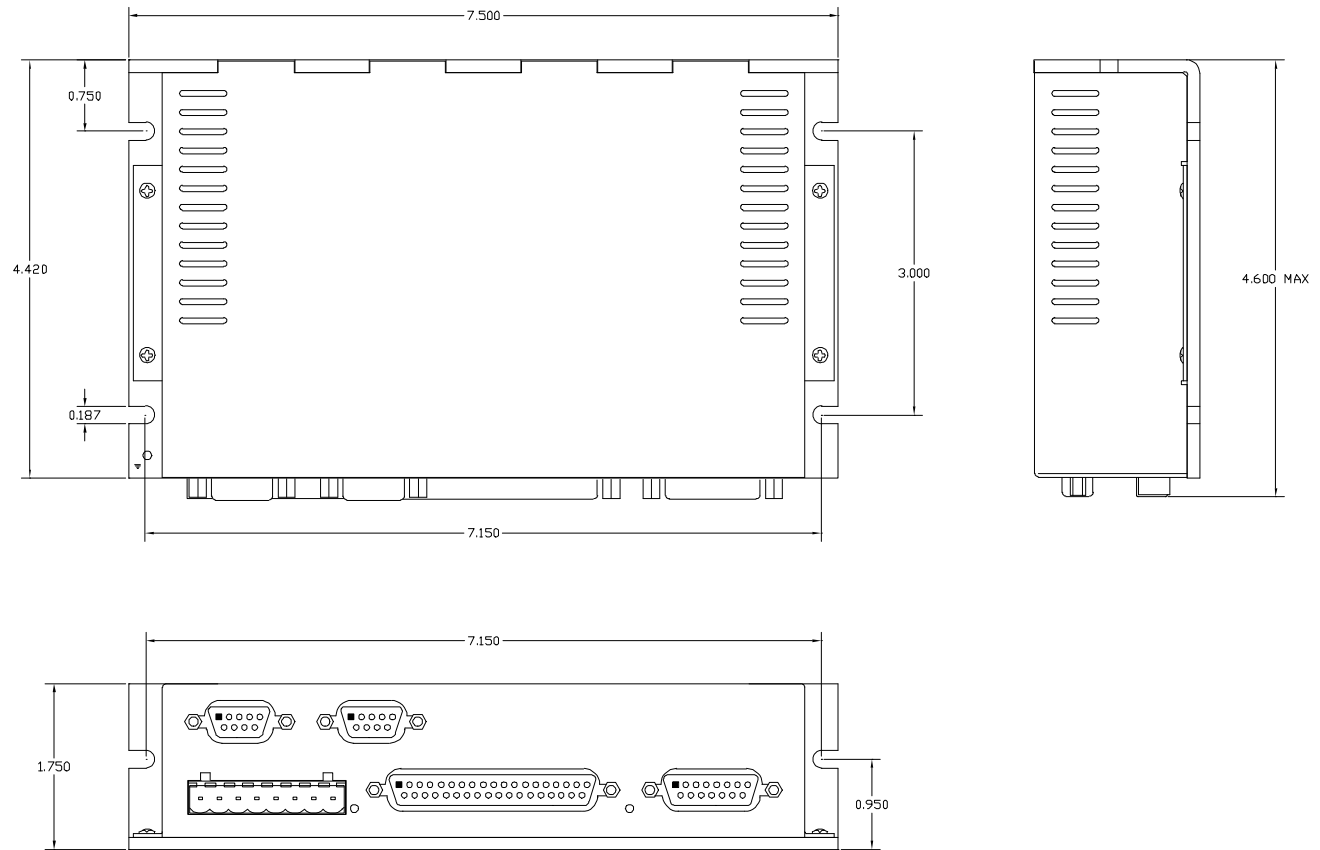
POWER SUPPLY VOLTAGE MOTOR POWER (+UM) OPERATING POWER (+24V)	+UM = 18 to 91 V DC, 100V Absolute Maximum 18 to 31 V DC, 35V Absolute Maximum
MAX MOTOR OUTPUT CURRENT Peak Continuous	12A 8A
MAX MOTOR OUTPUT VOLTAGE	$V_{out} = 0.96(UM) - 0.17(I_{out})$
MIN LOAD INDUCTANCE	200uH
PWM SWITCHING FREQUENCY	16KHz
DIGITAL OUTPUTS Type  Max voltage applied to output Max current load	Open Collector with protective diode to +24V for inductive loads 24V 1A per output
INPUTS Encoder & Commutation Digital Inputs	TTL level, open collector or line driver 24V, 8mA, 50% threshold
ENCODER	Quadrature with index
COMMUTATION	Hall sensors 60/120°
INDICATORS Red LED Yellow LED	Computer power supply is ON SPS is ON
PROTECTION Short circuit  Over heating Warning Amplifier shut off	Motor output to motor output Motor output to GROUND Motor output to +UM Digital output to SPS*  Activated at 70 °C Activated at 80 °C
FIRE-SAFETY Internal fuse on +UM, +24V	10A, 5A Quick blow
THERMAL REQUIREMENTS Storage temperature range Operating temperature range	-30 to +85 °C 0 to 40 °C
MECHANICAL Size Weight	L=7.50", H=4.40", D=1.75" 1.5 lb. (0.680 kg)
MATING CONNECTORS Power & Motor Inputs & Outputs Encoder & Commutation	Magnum EM2565-08-VL or Phoenix MSTB 2.5/8-ST-5.08 D-sub 37 pin, female Pan Pacific D37F Crimp Housing DH-37HS/T D-Sub 15 pin, female Pan Pacific D15F Crimp Housing DH-15HS/T

\* Connections between Digital Output and Motor terminal or +UM are absolutely NOT allowed, unless one power source is used both for +UM and +24V.

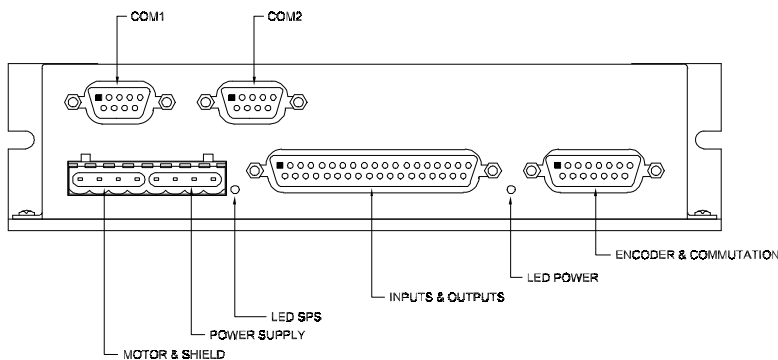
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## DIMENSIONAL DRAWING (in inches)



## CONNECTOR LAYOUT



## ORDERING GUIDE

PART NUMBER	MODEL	DESCRIPTION
912151001	LS-151	AC/DC Programmable Servo & Logic Controller
912151005	LS-151P	Supports Panasonic A and S series motors
912151003	LS-151Y	Supports Yaskawa SGM and SGMM series motors
230601003	LS-151-CN	Mating connector kit

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## CONNECTORS AND PINOUTS

### CN1 – POWER AND MOTOR CONNECTOR

PIN	SIGNAL	DESCRIPTION
1	AC1 DC+	Output to Motor. For brushless type motor – phase 1 terminal For brush type motor – positive terminal
2	AC2 DC-	Output to Motor. For brushless type motor – phase 2 terminal For brush type motor – negative terminal
3	AC3 NC	Output to Motor. For brushless type motor – phase 3 terminal For brush type motor – not connected
4	GND	Motor cable shield
5	GND	Motor power supply return
6	+UM	Motor power supply
7	+24V	Powers LS-151 and user sensors, valves
8	GND	24V return

### CN2 – INPUTS AND OUTPUTS CONNECTOR

PIN	SIGNAL	DESCRIPTION
1	EMG SW	Emergency stop switch should be connected between this pin and GND (pin #2)
2, 8, 11, 14, 17, 20, 28, 31, 34	GND	Ground of 24V power supply
3	OUT0	Output #0
4	OUT1	Output #1
5	OUT2	Output #2
6	OUT3	Output #3
7	OUT4	Output #4 / Motor brake
9, 12, 15, 18, 29, 32, 35	+24V	Power supply for user sensors
10	IN1	Input #1
13	IN3	Input #3
16	R LIM	Input #5 / Reverse limit input
19	EMG IN	Emergency stop input. Must be wired to pin #37 (EMG JP) for connector presence control
21, 22, 23, 24, 25, 26	SPS	Power supply for user relay, valves connected to the outputs
27	IN0	Input #0
30	IN2	Input #2
33	IN4	Input #4 / High speed motor position latch strobe
36	F LIM	Input #6 / Forward limit input
37	EMG JP	Must be wired to pin #19 (EMG IN) for connector presence control

### CN3 – ENCODER AND COMMUTATION CONNECTOR

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PIN	SIGNAL	DESCRIPTION
1, 6, 7, 9	GND	Signal Ground
2	Z	Encoder index input
3	+5V	Encoder power supply
4	+5V	Hall sensors power supply
5	S2	Hall sensor #2 input
8	STP IN	Stop input – should be connected to pin #1 for connector presence control
10	A	Encoder phase A input
11	B	Encoder phase B input
12	S1	Hall sensor #1 input
13	S3	Hall sensor #3 input
14	T SW	Optional motor overheating sensor input
15	+5V	Spare +5V power supply

## CN4 – RS-232C COM1 CONNECTOR

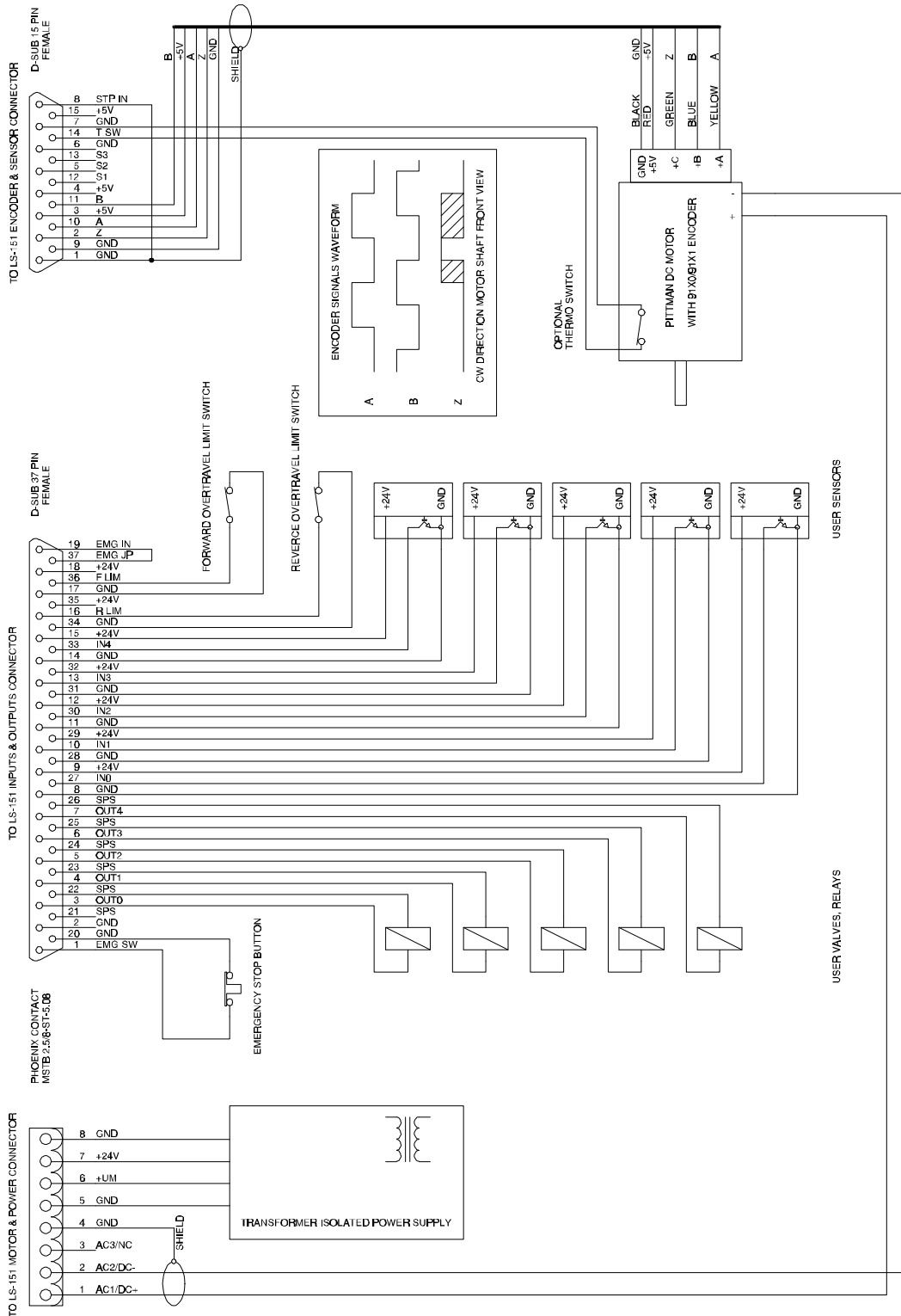
## CN5 – RS-232C COM2 CONNECTOR

PIN	SIGNAL	DESCRIPTION
1	DCD	Data Carrier Detect
2	RX	Receive Data
3	TX	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Signal Ground
6	DSR	Data Set Ready
7	RTS	Request To Send
8	CTS	Clear To Start
9	RI	Ring Indicator

# Logosol AC/DC Programmable Servo & Logic Controller LS-151

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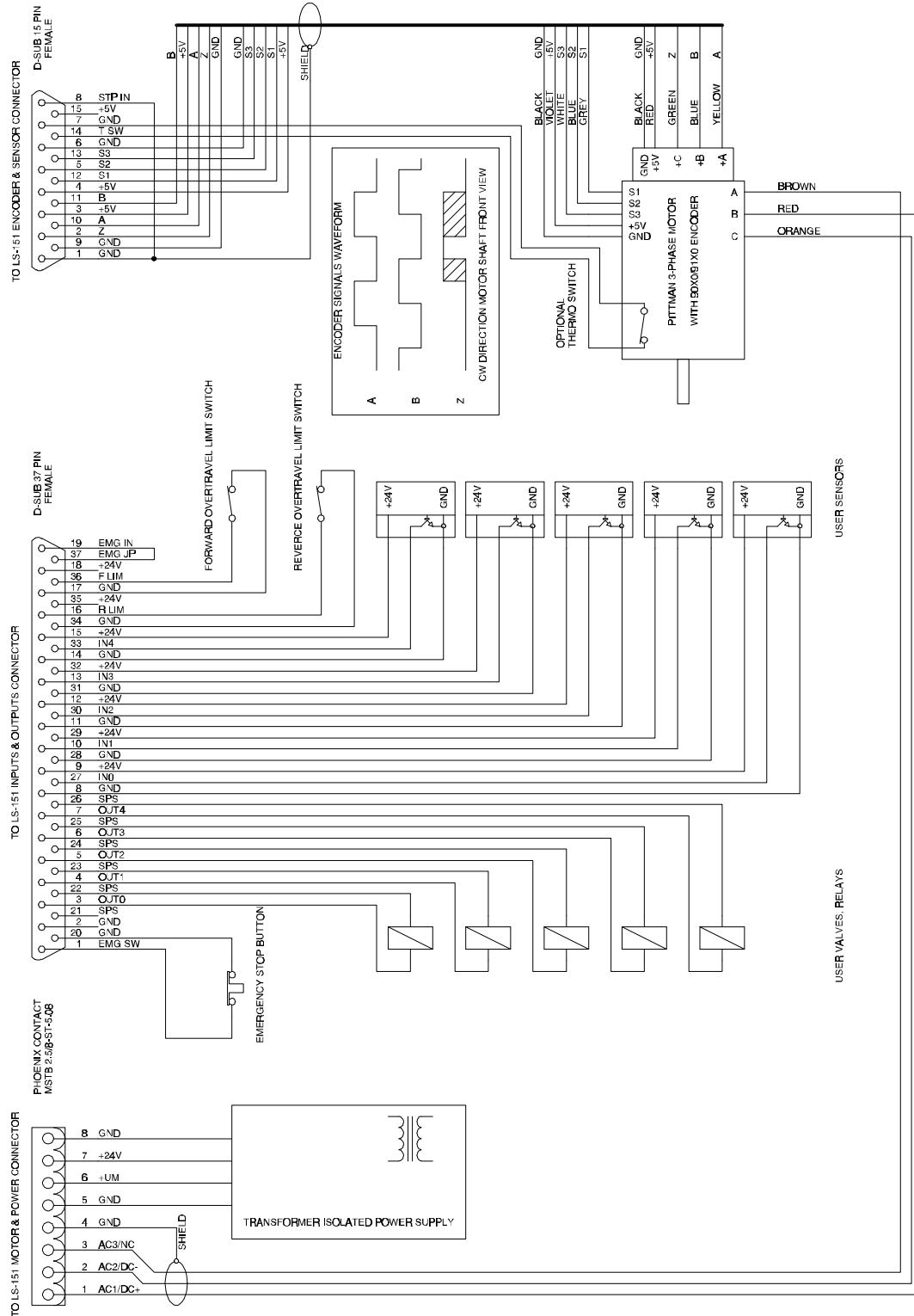
## SAMPLE APPLICATION using DC (brush) motor



# Logosol AC/DC Programmable Servo & Logic Controller LS-151

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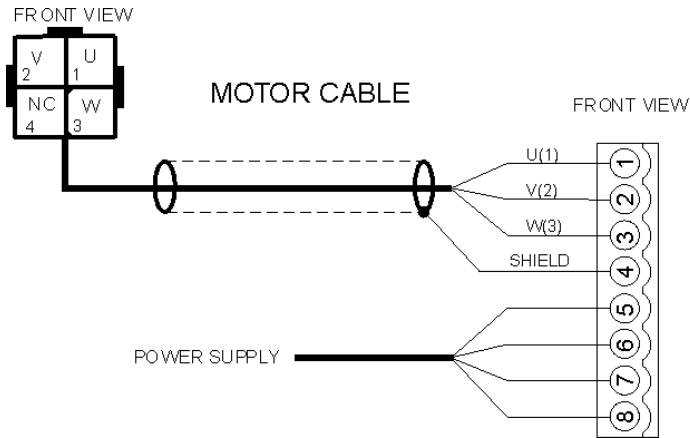
## SAMPLE APPLICATION using AC (brushless) motor



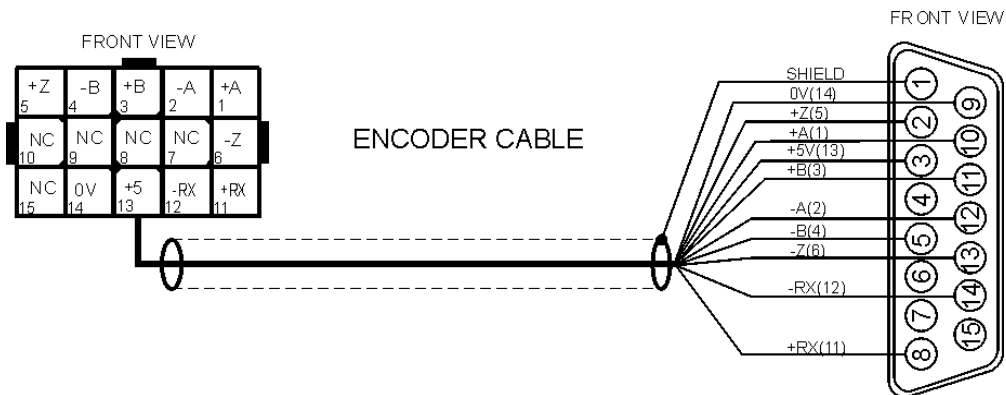
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## Panasonic A or S series motors to LS-151P controller wiring



MOTOR SIDE CONNECTOR (AMP CAP 172159-1, 3 pins 170366-1) TO MOTOR PLUG		CONTROLLER SIDE CONNECTOR (PHOENIX CONTACT MSTB2.5/8-ST-5.08) TO MOTOR & POWER SUPPLY CONNECTOR	
PIN#	SIGNAL NAME	PIN#	SIGNAL NAME
1	U phase	1	U
2	V phase	2	V
3	W phase	3	W
		4	GND (SHIELD)

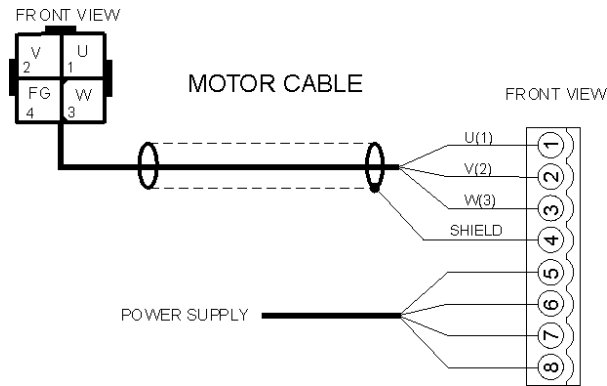


MOTOR SIDE CONNECTOR (AMP CAP 172163-1, 10 pins 170365-1) TO ENCODER PLUG		CONTROLLER SIDE CONNECTOR (D-SUB 15 PIN FEMALE) TO ENCODER & COMMUTATION CONNECTOR	
PIN#	SIGNAL NAME	PIN#	SIGNAL NAME
1	+A channel output	10	+A
2	-A channel output	12	-A
3	+B channel output	11	+B
4	-B channel output	5	-B
5	+Z channel output	2	+Z
6	-Z channel output	13	-Z
11	+Rx	8	+Rx
12	-Rx	14	-Rx
13	+5V (encoder power supply)	3	+5V
14	0V (encoder power ground)	9	GND
		1	GND (SHIELD)

# Logosol AC/DC Programmable Servo & Logic Controller LS-151

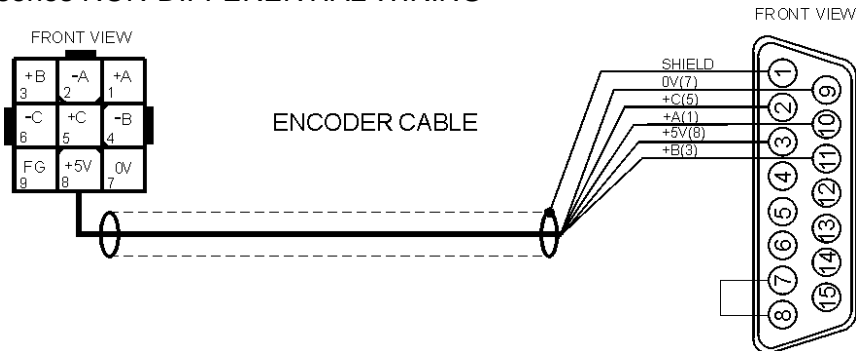
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## Yaskawa SGM servo motors to LS-151Y controller wiring



MOTOR SIDE CONNECTOR (AMP CAP 172159-1) TO MOTOR PLUG		CONTROLLER SIDE CONNECTOR (PHOENIX CONTACT MSTB2.5/8-ST-5.08) TO MOTOR & POWER CONNECTOR	
PIN#	SIGNAL NAME	PIN#	SIGNAL NAME
1	U phase	1	U
2	V phase	2	V
3	W phase	3	W
4	N.C.	4	GND (SHIELD)

## SGM series NON-DIFFERENTIAL WIRING

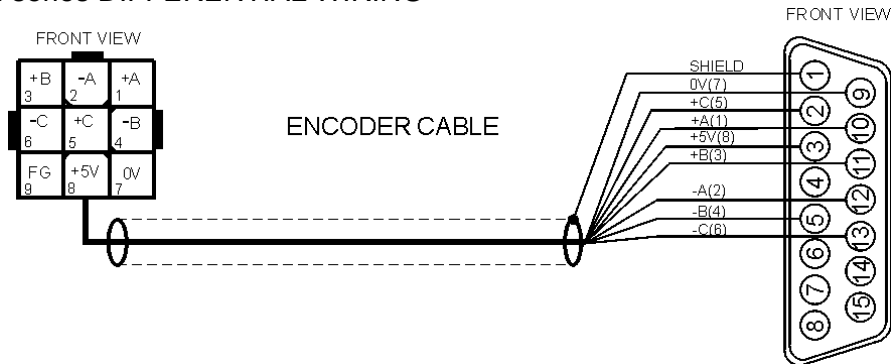


MOTOR SIDE CONNECTOR (AMP CAP 172161-1) TO ENCODER PLUG		CONTROLLER SIDE CONNECTOR (D-SUB 15 PIN FEMALE) TO ENCODER & COMMUTATION CONNECTOR	
PIN#	SIGNAL NAME	PIN#	SIGNAL NAME
1	A channel output	10	+A
3	B channel output	11	+B
5	C channel output	2	+Z
7	0V (power supply)	9	GND
8	+5V (power supply)	3	+5V
9	N.C.	1	GND (SHIELD)
		7	Shorted for connector presence control
		8	

# Logosol AC/DC Programmable Servo & Logic Controller LS-151

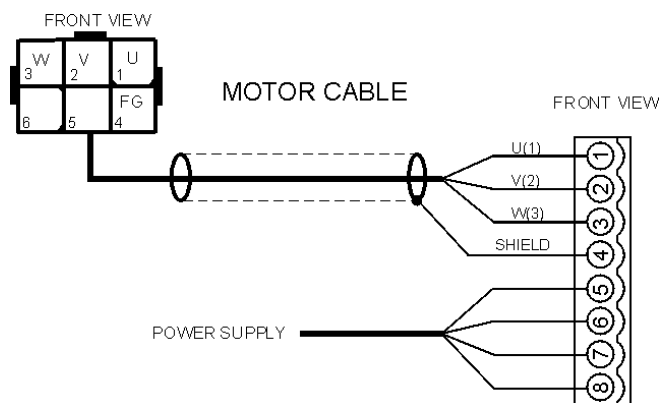
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## SGM series DIFFERENTIAL WIRING



MOTOR SIDE CONNECTOR (AMP CAP 172161-1) TO ENCODER PLUG		CONTROLLER SIDE CONNECTOR (D-SUB 15 PIN FEMALE) TO ENCODER & COMMUTATION CONNECTOR	
PIN#	SIGNAL NAME	PIN#	SIGNAL NAME
1	+A channel output	10	+A
2	-A channel output	12	-A
3	+B channel output	11	+B
4	-B channel output	5	-B
5	+C channel output	2	+Z
6	-C channel output	13	-Z
7	0V (power supply)	9	GND
8	+5V (power supply)	3	+5V
9	N.C.	1	GND (SHIELD)

## Yaskawa SGM servo motors to LS-151Y controller wiring

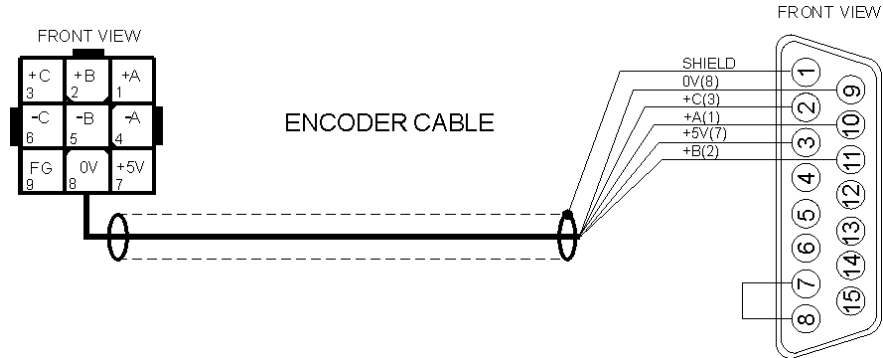


MOTOR SIDE CONNECTOR (AMP CAP 172160-1) TO MOTOR PLUG		CONTROLLER SIDE CONNECTOR (PHOENIX CONTACT MSTB2.5/8-ST-5.08) TO MOTOR & POWER CONNECTOR	
PIN#	SIGNAL NAME	PIN#	SIGNAL NAME
1	U phase	1	U
2	V phase	2	V
3	W phase	3	W
4	N.C.	4	GND (SHIELD)

# Logosol AC/DC Programmable Servo & Logic Controller LS-151

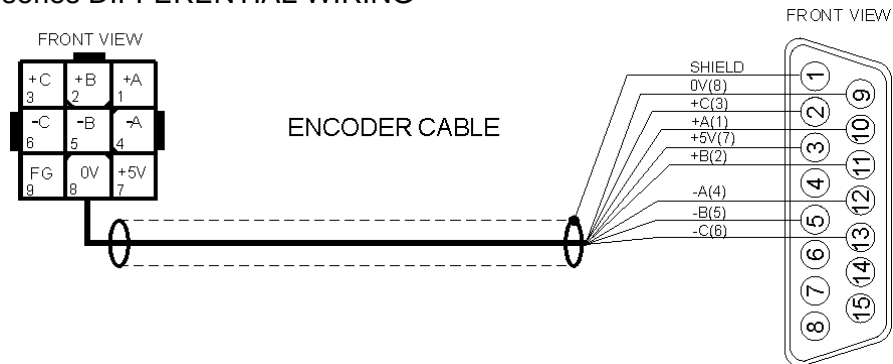
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## SGMM series NON-DIFFERENTIAL WIRING



MOTOR SIDE CONNECTOR (AMP CAP 172161-1) TO ENCODER PLUG		CONTROLLER SIDE CONNECTOR (D-SUB 15 PIN FEMALE) TO ENCODER & COMMUTATION CONNECTOR	
PIN#	SIGNAL NAME	PIN#	SIGNAL NAME
1	A channel output	10	+A
2	B channel output	11	+B
3	C channel output	2	+Z
7	+5V (power supply)	3	+5V
8	0V (power supply)	9	GND
9	FG (Frame Ground)	1	GND (SHIELD)
		7	Shorted for connector presence control
		8	

## SGMM series DIFFERENTIAL WIRING

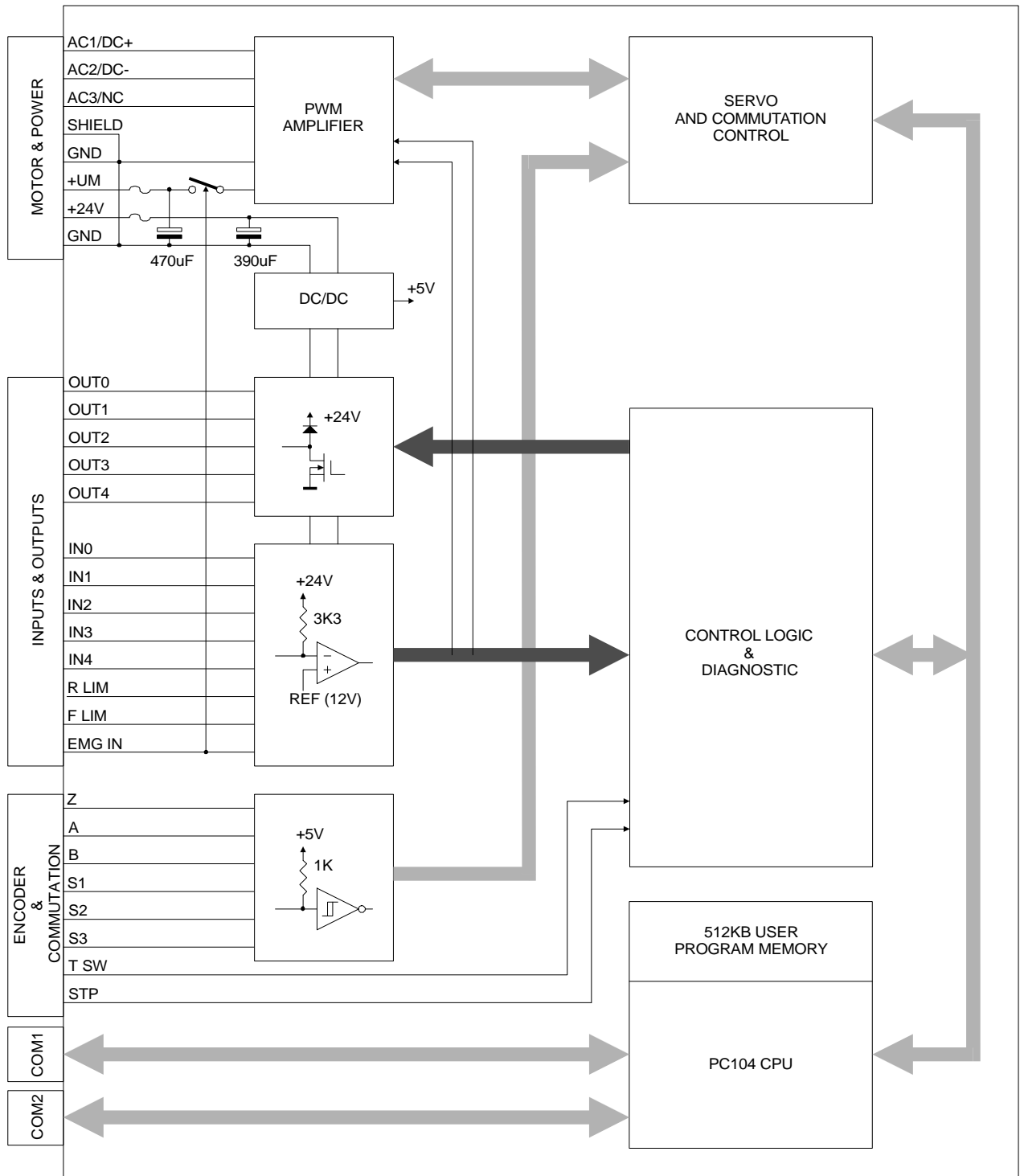


MOTOR SIDE CONNECTOR (AMP CAP 172161-1) TO ENCODER PLUG		CONTROLLER SIDE CONNECTOR (D-SUB 15 PIN FEMALE) TO ENCODER & COMMUTATION CONNECTOR	
PIN#	SIGNAL NAME	PIN#	SIGNAL NAME
1	+A channel output	10	+A
2	+B channel output	11	+B
3	+C channel output	2	+Z
4	-A channel output	12	-A
5	-B channel output	5	-B
6	-C channel output	13	-C
7	+5V (power supply)	3	+5V
8	0V (power supply)	9	GND
9	N.C.	1	GND (SHIELD)

# Logosol AC/DC Programmable Servo & Logic Controller LS-151

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## FUNCTIONAL DIAGRAM



# Logosol AC/DC Programmable Servo & Logic Controller LS-151

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## Overview

Logosol's AC/DC programmable servo and logic controller LS-151 consists of several functional modules including servo control with integrated power amplifier, digital inputs and outputs, protection circuits and powerful integrated PC/104 computer running DOS. LS-151 may work in stand-alone mode or may be controlled online by a host computer using RS-232C interface. To program LS-151 it has to be connected to a laptop or desktop computer, running Logosol Motion Control Center – an MS Windows based program. Programming LS-151 is easy and user friendly. No special programming skills are required. There is no need even to learn the set of commands that is used to program LS-151. Logosol Motion Control Center (MCC) features graphical user interface with drag-and-drop mechanism for generating the program. It also incorporates diagnostic tools and automatic PID-optimizer. Once created, the motion control program is loaded into LS-151 internal flash disk and the controller is ready to operate completely stand-alone.

## Servo Control

The servo control is based on National Semiconductor's precision motion processor LM629. It features 32-bit position, velocity and acceleration registers and programmable PID-filter with 16-bit coefficients. Sophisticated software running inside LS-151 enhances many of the LM629 functions and adds some new like Bernstein-Bezier S-profile velocity generator. An integrated power amplifier amplifies the PWM output from LM629. The amplifier is protected against short circuit between motor terminals, and between motor terminal and ground or plus of the power supply.

## Connecting with Brush or Brushless Type Motor

LS-151 is capable to drive brushless commutated (AC) and brush (DC) type motors. No jumpers or other setting are required. If there are no Hall sensors connected to Encoder & Sensor Connector, LS-151 drives the motor as brush (DC) type. The positive motor lead should be connected to AC1/DC+ terminal and negative to AC2/DC- terminal of Motor & Power Connector. If Hall sensors are detected, LS-151 performs commutation according to their state.

Usually, the right brushless motor phasing is a tough job because of the different terms and signal names, which the manufactures are using. Here is a simple procedure that may be used.

Connect the motor commutation sensors to LS-151 Encoder & Sensor Connector according to the next table with most common manufacture signal names.

LS-151 Encoder & Sensor Connector signal	Motor manufacture signal name			
S1	R	U	A	S1
S2	S	V	B	S2
S3	T	W	C	S3

Connect the commutator power leads to GND and +5V. Connect the encoder and its power lines to the same connector. Connect the three motor leads to AC1/DC+, AC2/DC-, AC3/NC of LS-151 Motor & Power Connector using the same order as for the commutation sensors. Power on LS-151. Initialize the controller. Rotate motor shaft CW by hand and check if the motor position is increasing. If motor position is not changing or it is decreasing, check encoder connection. See sample applications further in this manual for desired encoder signals waveform. Set a low speed for the motor – for example 1 revolution per second. Close the servo loop. Jog the motor in positive direction. If the phasing is correct the motor shaft should rotate CW smoothly without any jerks. Otherwise try different motor leads connection. There are only six combinations and it is recommended to try all of them. Usually only one works fine. If you find more than one, try to run the motor at higher speed. If the motor runs away in CCW direction try to exchange S1 with S3 and AC1 with AC2.

## Programmable Motor Current Limit

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A protection circuit monitors the output current delivered to the motor and limits it to a value set by the software. If the motor is overloaded for less than 10 seconds, the output current is limited to the selected level. For the time the current limitation lasts, the Current Limit Status bit CL0 is set HIGH. If the overloading continues more than 10 subsequent seconds, the servo loop will be broken - the amplifier will be automatically shut down, OUT4 output will be turned off and the Current Limit Status bit CL0 will go HIGH. CL0 will stay HIGH until the servo loop is closed again. MCL command SERVO clears CL0 and enables the amplifier. CL0 is available to the software if declared in the INPUT section of SYSTEM.INI file. There are 16 steps with 0.75A increments to choose from. The MCL command CLIMIT is used to set the current limit. To provide more efficient use of the motor and to allow 200-300% short-term overloading, MCL offers a special Current Limit Algorithm. For details see the Appendix A in the end of this manual.

## Digital Inputs

There are 7 general-purpose digital inputs IN0 to IN6. To activate an input the corresponding sensor must be able to sink 8mA@24V. All inputs are wired to Input & Output connector. 24V power for user sensors is provided.

The inputs are available to the software if they are declared in SYSTEM.INI file. Their status may be read using IN command. Some of the inputs have additional function.

## OverTravel Limit Switches

Two of all seven general-purpose digital inputs may be configured as overtravel limit inputs – one for forward direction (F LIM) and one for reverse direction (R LIM). Activating F LIM switch will automatically disable the power amplifier to drive the motor in forward (positive) direction. F LIM has no effect on driving the motor in reverse (negative) direction. R LIM disables driving the motor backward and doesn't affect driving it forward. Both F LIM and R LIM inputs are available to the software and may be accessed as IN6 and IN5 respectively. Overtravel Limit function is under software control. LS-151 outputs OUT5 and OUT6 control enable and polarity of the limit switches.

OUT6	OUT5	R LIM and L LIM Limit Function	R LIM and L LIM active level
X	OFF	Disabled	No effect on motor amplifier
OFF	ON	Enabled	Must be OFF to limit amplifier
ON	ON	Enabled	Must be ON to limit amplifier

By default, if OUT5 and OUT6 are not declared in SYSTEM.INI file, Overtravel Limit function is disabled.

## High-speed Position Capture

LS-151 is able to record the current motor position using the encoder index line as a strobe. Input. IN4 may be configured to serve as an additional strobe instead of encoder index. Either low (input is closed to the ground) or high (input is open) level may be selected to trigger the capture. The software command STROBE [SELECT] followed by LATCH command controls the strobe source and polarity.

SELECT	Strobe Source	Strobe Polarity
0	IN4	LOW
1	IN4	HIGH
2	Encoder index line	HIGH
3	Encoder index line	HIGH

The captured position may be read using INDEX command.

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## Digital Outputs

LS-151 features 5 general-purpose digital outputs OUT0 to OUT4 designed with high current open collector FET transistors. The outputs are equipped with protective diodes for inductive loads. Each output is capable to sink 1A@24V. All outputs are protected against short circuit to 24V power source. In case of short circuit, all outputs are automatically turned off, the motor amplifier is disabled and the Operating Power Failure/ Output Shorted status bit OPF is set. OPF is available to the software if declared in SYSTEM.INI file. Once disabled the outputs will remain in this state until the amplifier is enabled and servo loop closed again. The outputs may be written and read back, but their actual status will be OFF.

The output OUT4 is intended to control motor brake and has a special feature. To activate the OUT4, the software must turn it on AND the motor amplifier must be enabled as well. This way it is guaranteed that if the amplifier is disabled due to overcurrent, overheating or other reason, OUT4 automatically goes off and associated brake locks the motor. The rest of the outputs are independent of the amplifier enable.

System Power Supply (SPS) for powering user relays, brakes and other circuits is provided. SPS is derived from 24V power supply and available immediately after the controller initialization. SPS is protected with internal resettable 2.5 A fuse.

All outputs are wired to Input & Output connector along with SPS.

## Safety Features

To protect both the user device and the controller, LS-151 is equipped with various safety features.

### Emergency Stop

For safety reasons LS-151 is equipped with dedicated input for Emergency Stop Button. In order to operate LS-151, a normally closed button should be connected between EMG SW and ground (GND). The actual emergency input is wired to pin#19 (EMG IN) of Inputs and Outputs connector and pin #19 must be jumped to pin #37 (EMG JP). This complex wiring insures that the Emergency Stop signal will be generated not only if the Emergency Stop Button is pressed, but also in case the user connector is not attached to LS-151 or if it is tilted in its place. Pressing the Emergency Stop Button, i.e. disconnecting EMG IN from the ground will automatically:

- Disable the amplifier and turn motor power supply relay off
- Turn all digital outputs off
- Shut System Power Supply (SPS) off.

Emergency Stop doesn't affect user sensors power supply (+24V) thus allowing device status to be checked in emergency situation. If Emergency Stop Input is declared in SYSTEM.INI file, it may be accessed using IN command as any other general-purpose input.

### Encoder Connector Presence Control

Additional safety feature prevents motor runaway in case of accidental encoder disconnecting. A stop input STP IN is located at Encoder & Sensor Connector. To operate LS-151, STP IN must be tied to the ground. Disconnecting STP IN from the ground will disable the amplifier. The digital outputs and SPS power supply will not be affected. STP IN status is also available to the software if declared in SYSTEM.INI file.

### Undervoltage/Overvoltage Protection

LS-151 is protected against power supply under/overvoltage. In case the motor power supply is missing or is out of 18÷91V range, the power amplifier is disabled and Motor Power Failure status bit MPF is set. If MPF bit is declared in SYSEYEM.INI file it may be read using IN command. In case 24V power supply is less than 15V, the amplifier is disabled and Operating Power Failure status bit OPF is set. If OPF is declared in SYSTEM.INI file it may be checked using IN command.

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Note that 24V is used to power the onboard CPU and if it drops below 9V, the computer is reset and the communication with LS-151 will be lost.

## Relay Controlled Motor Power Supply

In case of emergency a relay disconnects the motor power supply.

## Overheating Control

LS-151 is protected against overheating. There are two levels of protection. If the inside temperature raises above 70°C, the Overheat Input OVH goes high and may be used by the software for warning. If the temperature reaches 80°C, the amplifier will be disabled automatically. For motors equipped with their own overheating sensors, an additional input T SW is provided. It is located at Encoder & Sensors Connector. The status of T SW input is available to the software. Changing the state of T SW has no other effect on LS-151. OVH and T SW may be read using IN command, provided they are declared in SYSTEM.INI file.

## Fire safety

LS-151 is equipped with internal quick blowing fuses on both the motor power and 24V power inputs.

## Power Supply

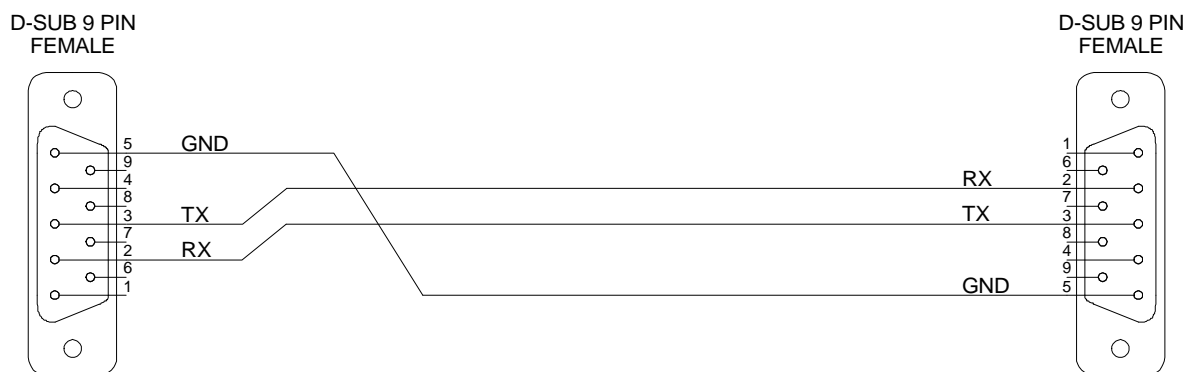
LS-151 requires two external power supplies.

- 24V power supply is used for the controller itself. It is also the power source for SPS and +24V located on Inputs & Outputs Connector intended for user sensors, relays and other circuits.
- 18 to 91V power supply is used to power the motor.

For 24V motor applications a single 24V power supply may be used for both circuits. The power supply ground is common for the controller including the computer and serial ports. Because of that, the power supply **must be transformer isolated** to insure isolation from the AC power line.

## Connecting to the Host

A simple serial cable with twisted data wires and no handshaking signals (Null modem) is required to connect LS-151 to the Host computer.

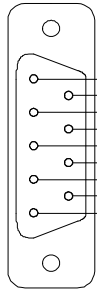


Connecting LS-151 to Host RS-232C port using 9-pin connector

# Logosol AC/DC Programmable Servo & Logic Controller LS-151

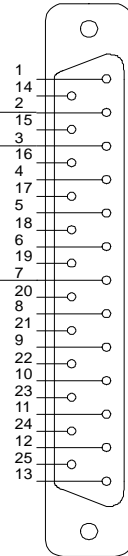
Doc #712151001 / Rev. A 04/18/2003

D-SUB 9 PIN  
FEMALE



LS-151 SIDE

D-SUB 25 PIN  
FEMALE



COMPUTER SIDE

**Connecting LS-151 to Host RS-232C port using 25-pin connector**

## APPENDIX A

### Current Limit Algorithm

#### Effective:

Software: MCL Ver. 2.53 and higher  
Hardware: LS-151

#### General description

The new Current Limit Algorithm is intended for more efficient motor control. It allows to set a low continuous current limit and have a short time overloading with user-defined parameters. The output motor current limit for LS-151 can be set to sixteen different levels using MCL command:

**Climit** *Axis\_name* = *Nlimit*,

where:

*Axis\_name* is the name of the designated axis  
*Nlimit* is a number between 0 and 15, representing desired level of current limit. 15 corresponds to the maximum allowed controller current - 12A for LS-151 and 0 corresponds to 1/16 of that current.

The new algorithm is defined with three additional parameters set by: **Tmax**, **Tlim**, **Cmax** commands.

**Tmax** = *time\_max*,

where *time\_max* is specified in milliseconds

**Tlim** = *time\_lim*,

where *time\_lim* is specified in milliseconds

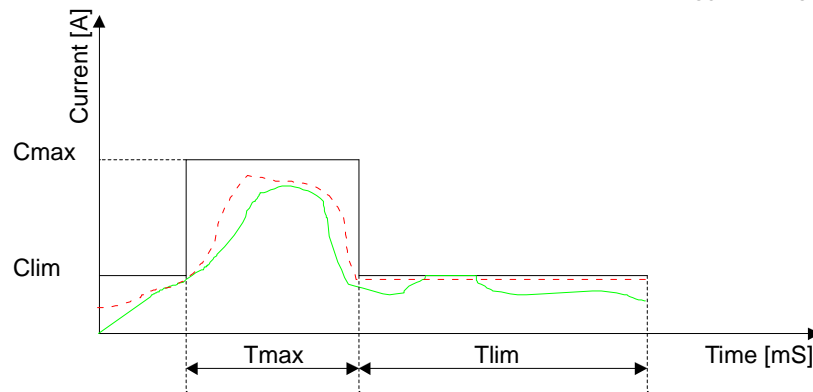
**Cmax** *Axis\_name* = *Nmax*,

**Cmax** has the same format as **Climit**:

NOTE: The sum of *time\_max* and *time\_lim* must be less than 10 seconds, otherwise the algorithmic current limit control will be overridden by hardware protection circuit and the system servo loop will be turned off.

#### Algorithm description

The continuous current limit is set using **Climit** command. The first time motor current reaches the limit, the limit is changed automatically to **Cmax** value. This value is kept for **Tmax** time. After **Tmax** is over, the limit is restored to **Climit** value. For time defined with **Tlim**, the current limit is polled on every time slice (typically 5ms). If the motor current is found to be lower than the limit at least twice during that period (the green solid line on the figure bellow), the algorithm returns to its start point, waiting for new overloading.



**Figure 1**

If during **Tlim** period the motor current is found constantly trying to exceed the limit (the red dashed line), the system servo loop is turned off, the motor amplifier is disabled and the system status shows current overload condition. To restore the normal operation MCL command **Servo** should be issued.

Sample setting:

Climit X=2 ; normal, long term current limit - aprox. 1.5A  
Cmax X=6 ; overload, short term limit – aprox. 4.5 A (300% overload)  
Tmax = 2000 ; set overload time to 2 seconds  
Tlim = 3000 ; set current limit time to 3 seconds

If Climit, Cmax, Tmax, Tlim are not defined the algorithm works with default set of parameters:

Default values:

Climit X=8  
Cmax X=8  
Tmax = 50  
Tlim = 50