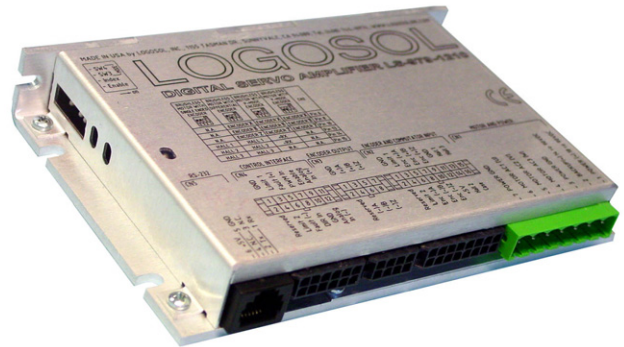


# Logosol Digital Servo Amplifier LS-979

Doc # 713979001 / Rev. C, 10/27/2004



## Features

- ❑ Sinusoidal motor phases commutation
- ❑ Motors supported:
  - Linear and Rotary Brushless motors
  - Panasonic A and S series motors
  - Motors with index coded commutation
- ❑ Up to 20A peak / 12A continuous output current
- ❑ Up to 200V DC power supply
- ❑ Analog and PWM/DIR inputs
- ❑ Direction enable (limit) inputs
- ❑ Independent selectable active level for enable and direction limit inputs
- ❑ Comprehensive motor output short-circuit protection:
  - Output to output
  - Output to ground
- ❑ Adjustable motor current and overload time limits
- ❑ Over/under voltage shutdown
- ❑ Overheating protection
- ❑ PWM frequency 20 kHz

## Description

LS-979 is all digital servo amplifier designed for applications requiring sinusoidal control of Linear or Rotary brushless motors, Panasonic A or S series motors, and motors with index coded commutation, up to 1.5 HP.

LS-979 can be used with digital servo controllers or as standalone drive. Analog or PWM/DIR command modes can be used for flexible interfacing. Control inputs design allows any type of sensors to be used.

LS-979 is equipped with safety features such as short circuit protection for the motor and the drive, limit switch inputs, over/under voltage shutdown and encoder presence control. Peak current, continues current and overload time can be adjusted for better motor protection.

Logosol Digital Amplifier Utility software is provided for complete amplifier setup and tuning. Simple phasing and tuning algorithms allow fast implementation in any design. All parameters are stored in non-volatile flash memory.

# Logosol Digital Servo Amplifier LS-979

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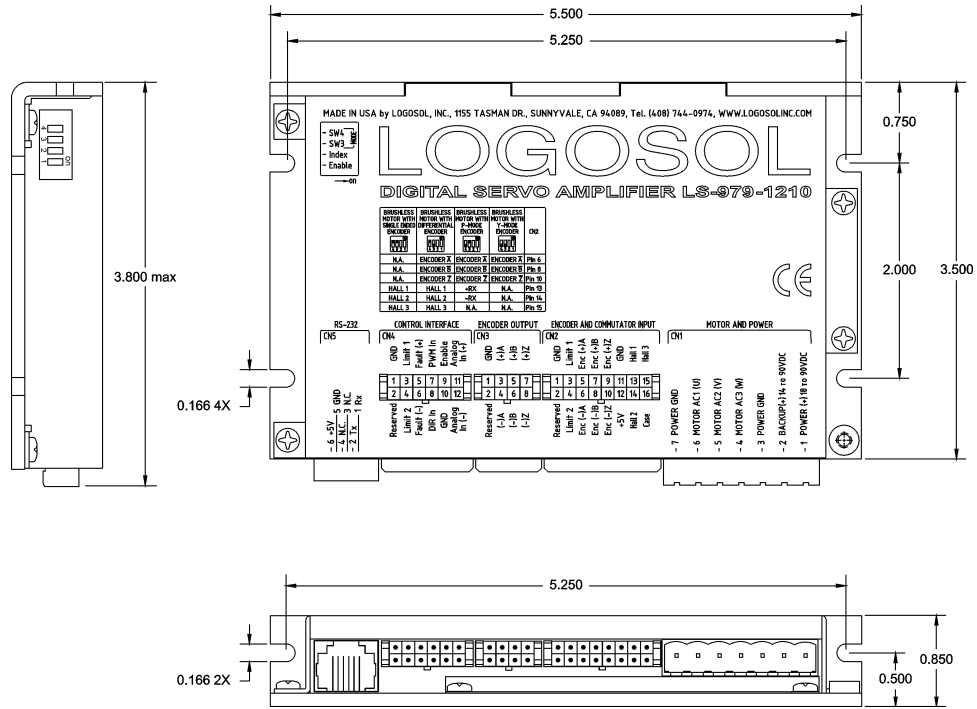
## TECHNICAL SPECIFICATIONS rated at 25°C ambient, POWER (+)=60VDC, Load=250μH motor

MAIN POWER (+) LS-979-1220 LS-979-1210 LS-979-2010	18 to 180 VDC, 200V Absolute Maximum 18 to 90 VDC, 100V Absolute Maximum 18 to 90 VDC, 100V Absolute Maximum			
BACKUP POWER (+) LS-979-1220 LS-979-1210 LS-979-2010	14 to 180 VDC, 200V Absolute Maximum 14 to 90 VDC, 100V Absolute Maximum 14 to 90 VDC, 100V Absolute Maximum			
BACKUP CURRENT	150mA max at 24V 60mA max at 60V 30mA max at 150V			
MAX MOTOR OUTPUT CURRENT Peak LS-979-1220, LS-979-1210 LS-979-2010 Continuous LS-979-1220, LS-979-1210 LS-979-2010	12A 20A  8A 12A			
MIN LOAD INDUCTANCE	200μH			
PWM OUTPUT SWITCHING FREQUENCY	19.5KHz			
ANALOG INPUT CHARACTERISTICS	Differential, ±10V (±20V max), 10K to GND			
DIRIRECTION INPUT	HI ≥ 2V, LO ≤ 0.8V (±30V Abs Max)			
PWM INPUT	HI ≥ 2V, LO ≤ 0.8V (±30V Abs Max 10 to 30KHz input frequency; 4K7 pull-down resistor;			
ENABLE HI ≥ 2V LO ≤ 0.8 (–0.5DC to +30VDC Abs. Max)	SW1=ON pull-down resistor 4K7 HI enables amplifier, LOW (open) inhibits		SW1=OFF pull-up resistor 6K8 LO enables amplifier, HI (open) inhibits	
LIMIT 1 and LIMIT 2 HI ≥ 2V LO ≤ 0.8 (–0.5DC to + 30VDC Abs. Max)	PULL-DOWN limit inputs (pull-down resistor 4K7)		PULL-UP limit inputs (pull-up resistor 4K7)	
	<i>NORMALLY OPEN LIMIT SWITCHES</i> LOW (open) enables the direction HI inhibits	<i>NORMALLY CLOSED LIMIT SWITCHES</i> HI enables the direction LOW (open) inhibits	<i>NORMALLY OPEN LIMIT SWITCHES</i> HI (open) enables the direction LOW inhibits	<i>NORMALLY CLOSED LIMIT SWITCHES</i> LOW enables the direction HI (open) inhibits
FAULT OUTPUT Optocoupler Umax=35V, Imax=8mA	ON when the amplifier operates normally OFF when amplifier is disabled (if "Fault if disabled" option is activated) OFF when motor output is shorted; temperature sensor is activated; power supply is out of range; current limit or encoder error			
ENCODER AND COMMUTATOR INPUTS	HI ≥ 2V, LO ≤ 0.9V (–0.5VDC to + 5.5VDC Abs. Max) Hysteresis TYP. = 0.6V, Pull up to +5V = 2K2			
ENCODER	Quadrature with index and Panasonic encoder mode			
HALL SENSORS	60/120°			
LED ORANGE GREEN	Motor short, Over temperature, Over current, Power supply out of range, Encoder error, Drive OK			
PROTECTION Short circuit Over temperature shut off	Motor output to motor output, Motor output to GND Activated at 80 °C			
POWER DESSIPATION (max)	35W			
THERMAL REQUIREMENTS Storage temperature range Operating temperature range	–30 to +85 °C 0 to 45 °C			
MECHANICAL Size Weight	5.5 x 3.5 x 0.85" in 0.65 lb. (0.3 kg)			
+5V SOURCE Max output current	200mA for all three output pins combined			
MATING CONNECTORS MOTOR AND POWER ENCODER OUTPUT CONTROL INTRFACE ENCODER AND COMMUTATOR INPUT	RECOMMENDED CONNECTOR TYPE Magnum EM2565-07-H or Phoenix: MSTB 2.5/7-ST-5.08 Molex 43025-0800 housing with 43030-0007 (8pcs) Molex 43025-1200 housing with 43030-0007 (12pcs) Molex 43025-1600 housing with 43030-0007 (16pcs)			

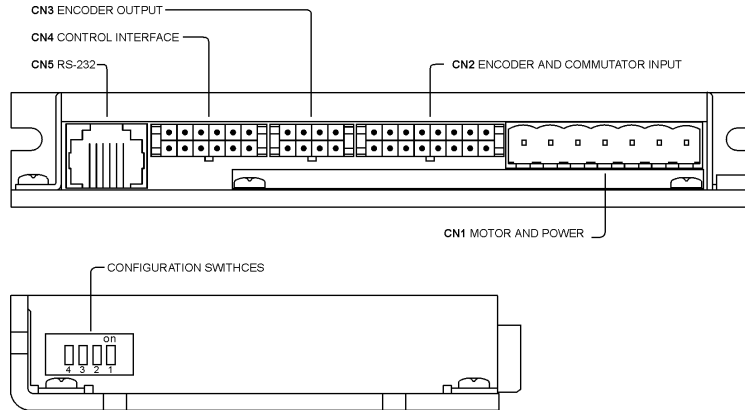
# Logosol Digital Servo Amplifier LS-979

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## OUTLINE DIMENSIONS in inches



## AMPLIFIER LAYOUT

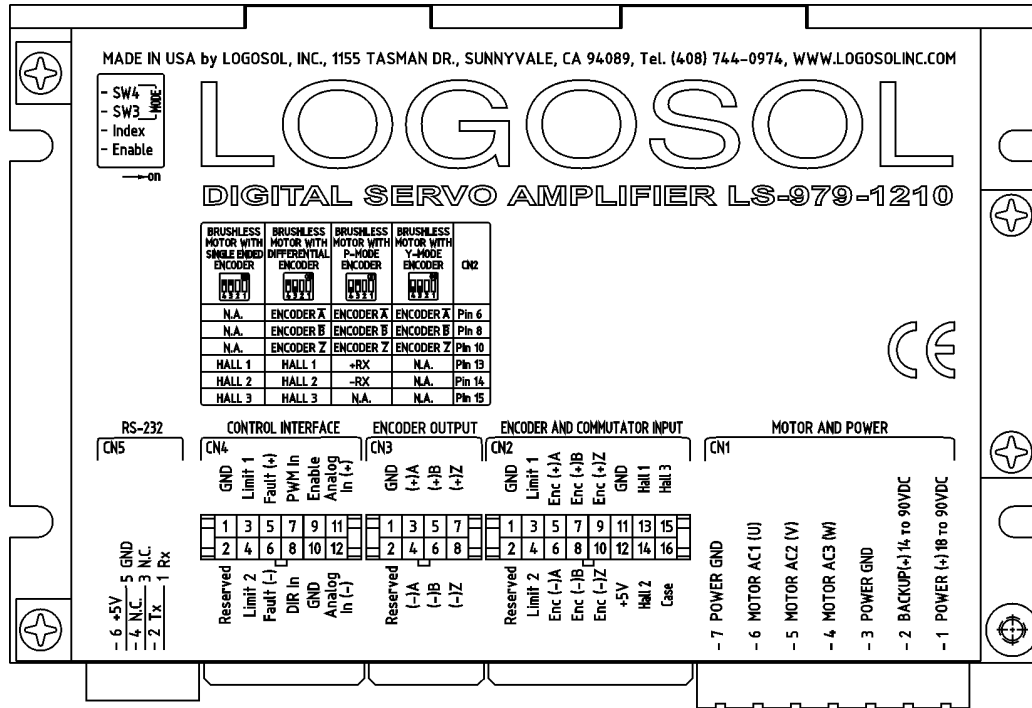


PART NUMBER	MODEL	DESCRIPTION
939979001	LS-979-1210	Digital Servo Amplifier 12A/100V
939979002	LS-979-2010	Digital Servo Amplifier 20A/100V
939979003	LS-979-1220	Digital Servo Amplifier 12A/200V
921801006	LS-884	RJ11 to RS232 adapter with 7' cable
230601040	LS-979-CN	Mating connector kit
230601017	PAN-AS-CN	Mating connector kit for Panasonic A and S series motors
230601027	PAN-ASB-CN	Mating connector kit for Panasonic A and S series motors with brake

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## CONNECTORS AND PINOUTS



## DIP SWITCHES

SW	NAME	DESCRIPTION
SW1	ENABLE	ON=pull-down resistor (active high input); Off=pull-up resistor (active low input)
SW2	INDEX	Commutation Reference: ON=Encoder Index, OFF=Hall sensors
SW4, SW3		SW4=ON, SW3=ON - Motor with single ended (non differential) encoder SW4=ON, SW3=OFF - Motor with differential encoder SW4=OFF, SW3=ON - Panasonic A or S series motor (P-mode) SW4=OFF, SW3=OFF - Motor with index coded commutation

## CN1 - MOTOR AND POWER

PIN	SIGNAL NAME	DESCRIPTION
1	POWER (+) 18 TO 90VDC	Power supply, positive terminal
2	BACKUP (+) 14 TO 90VDC	Backup Power supply, positive terminal
3	POWR GND	Power supply ground <sup>1</sup>
4	MOTOR AC3 (W)	Output to motor Phase 3 terminal for brushless motor Phase W for Panasonic A and S series motors
5	MOTOR AC2 (V)	Output to motor Phase 2 terminal for brushless motor Phase V for Panasonic A and S series motors
6	MOTOR AC1 (U)	Output to motor Phase 1 terminal for brushless motor Phase U for Panasonic A and S series motors
7	POWER GND	Power supply ground <sup>1</sup>

<sup>1</sup> POWER GND and GND are electrically connected. Amplifier case is isolated from the amplifier circuitry and can be grounded externally

# Logosol Digital Servo Amplifier LS-979

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## CN2 - ENCODER AND COMMUTATOR INPUT

PIN	SIGNAL NAME	DESCRIPTION
1	GND	Encoder ground <sup>1</sup>
2	Reserved	Wired to CN3 pin2 and CN4 pin2
3	Limit 1	Negative direction enable input, wired to CN4 pin3
4	Limit 2	Positive direction enable input, wired to CN4 pin4
5	Enc (+) A	Encoder phase A
6	Enc (-) A	Encoder phase A inverted
7	Enc (+) B	Encoder phase B
8	Enc (-) B	Encoder phase B inverted
9	Enc (+) Z	Encoder phase Z
10	Enc (-) Z	Encoder phase Z inverted
11	GND	Encoder ground <sup>1</sup>
12	+5V	Encoder and Hall sensors power supply <sup>2</sup>
13	Hall 1	Hall input #1 for Hall mode Serial data input for Panasonic A and S series motors (+RX) Not connected for motors with index coded commutation
14	Hall 2	Hall input #2 for Hall mode Serial data input for Panasonic A and S series motors (-RX) Not connected for motors with index coded commutation
15	Hall 3	Hall input #3 for Hall mode Not connected for Panasonic A and S series motors Not connected for motors with index coded commutation
16	Case	Amplifier case <sup>1</sup>

## CN3 - ENCODER OUTPUT

PIN	SIGNAL NAME	DESCRIPTION
1	GND	Encoder ground <sup>1</sup>
2	Reserved	Wired to CN2 pin2 and CN4 pin2
3	(+) A	Encoder phase A
4	(-) A	Encoder phase A inverted
5	(+) B	Encoder phase B
6	(-) B	Encoder phase B inverted
7	(+) Z	Encoder phase Z
8	(-) Z	Encoder phase Z inverted

## CN4 - CONTROL INTERFACE

PIN	SIGNAL NAME	DESCRIPTION	
1	GND	Signal ground <sup>1</sup>	
2	Reserved	Wired to CN2 pin2 and CN3 pin2	
3	Limit 1	Negative direction enable input, wired to CN2 pin3	
4	Limit 2	Positive direction enable input, wired to CN2 pin4	
5	Fault (+)	Optocoupler collector	
6	Fault (-)	Optocoupler emitter	
7	PWM in	PWM input	
8	DIR in	Direction input	
9	Enable	<b>SW1=ON</b> - pull-down HI enables amplifier, LOW (open) inhibits	<b>SW1=OFF</b> - pull-up resistor LO enables amplifier, HI (open) inhibits
10	GND	Signal ground	
11	Analog (+)	Positive analog input ±10V	
12	Analog (-)	Negative analog input ±10V	

<sup>1</sup> POWER GND and GND are electrically connected. Amplifier case is isolated from the amplifier circuitry and can be grounded externally

<sup>2</sup> 200mA Max current for all outputs combined

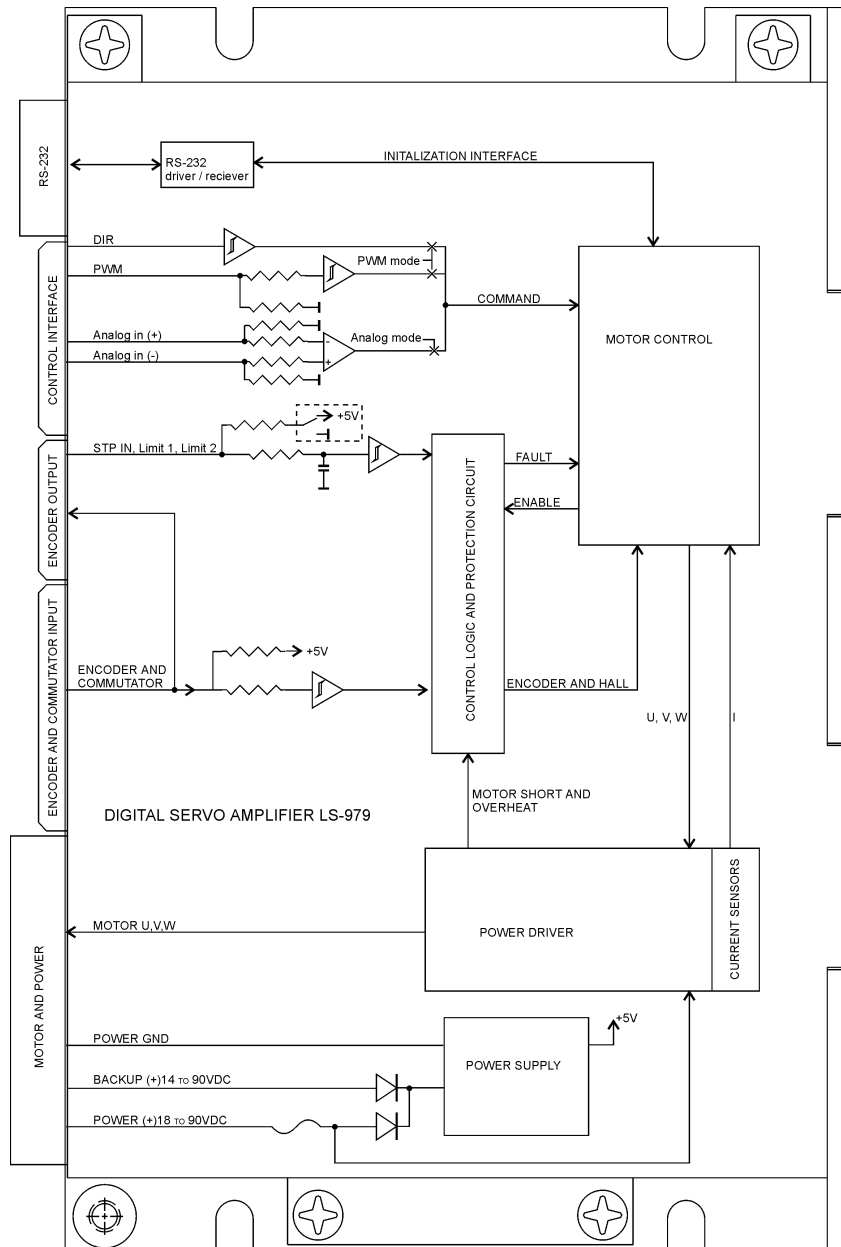
# Logosol Digital Servo Amplifier LS-979

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## CN5 - RS-232

PIN	SIGNAL NAME	DESCRIPTION
1	RX	RS-232 receive terminal
2	TX	RS-232 transmit terminal
3	N.C.	Do not connect
4	N.C.	Do not connect
5	GND	Signal ground <sup>1</sup>
6	+5V	Power supply output <sup>2</sup>

## FUNCTIONAL DIAGRAM



<sup>1</sup> POWER GND and GND are electrically connected. Amplifier case is isolated from the amplifier circuitry and can be grounded externally

<sup>2</sup> 200mA Max current for all outputs combined

# Logosol Digital Servo Amplifier LS-979

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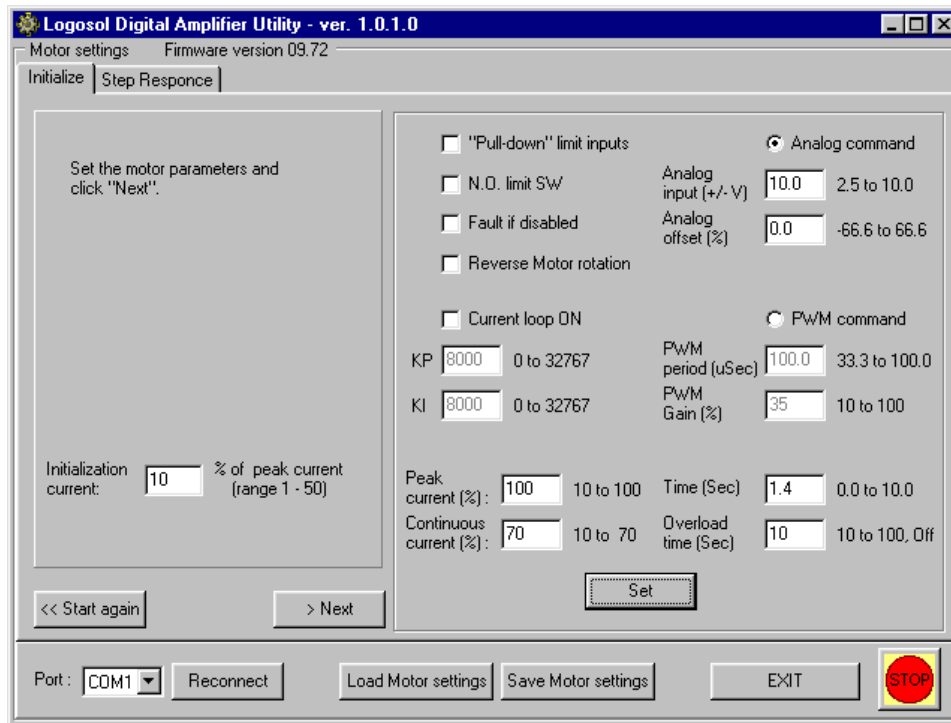
## AMPLIFIER AND MOTOR INITIALIZATION

### Hardware setup

1. Select the motor type using SW3 and SW4.
2. Connect the power supply to LS-979.
3. Connect motor, encoder, hall sensors and any other I/O devices you may have.
4. Connect RS-232 adapter and cable between LS-979 and your computer.

### Software installation

1. Insert Logosol Digital Amplifier Utility installation disk into the floppy drive.
2. Select RUN from the Windows 95/98/2000/NT/XP Start Menu.
3. Type a:\ampsetup and then click OK (a: represents the drive letter).
4. The installation wizard will guide you through the setup process.



### Initial connection to the host

1. Turn on the power supply
2. Run the Logosol Digital Amplifier Utility.
3. Select the proper COM port.
4. Click "Reconnect" button.

### Motor initialization

1. Select limit inputs and Fault characteristics depending on your application.
  - Pull-down limit inputs** –the limit switches will be connected to ground (if checked) or +5V(if is not checked) trough resistor 4K7 depending on the selection.
  - N.O. limit SW** – if checked - the movements will be disabled when the limit switches are closed, otherwise the limit switch opening will disable the movements.
  - Fault if disabled** – if checked - Fault output will be open when the drive is not enabled and if fault (motor short, encoder error... etc) is detected, otherwise disabling the amplifier will not affect the Fault output.
2. Select Analog or PWM command input and set the input parameters.
3. Set the motor parameters

# Logosol Digital Servo Amplifier LS-979

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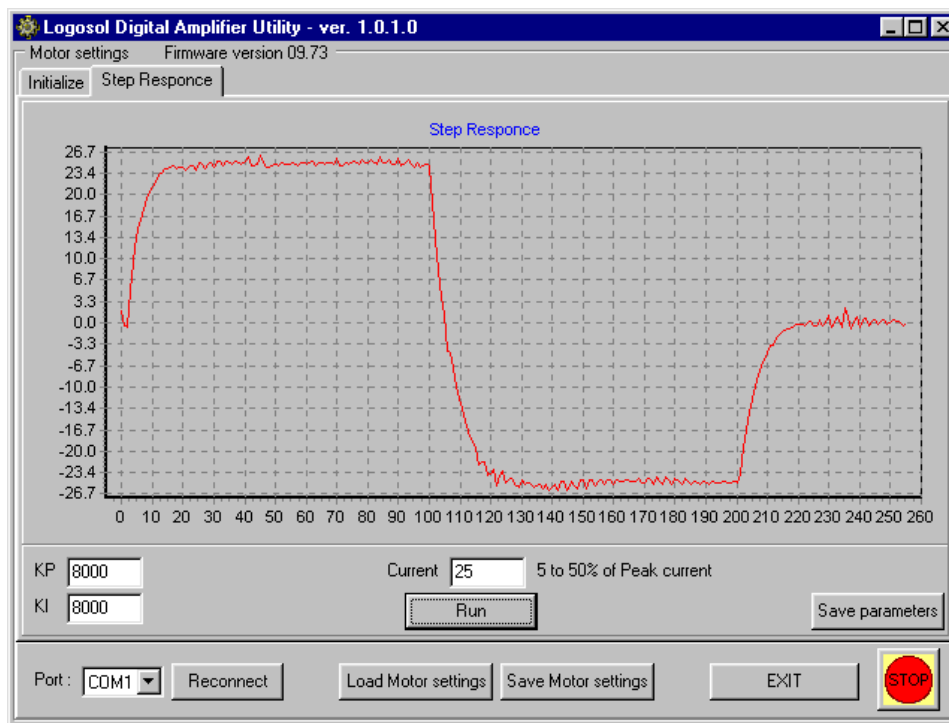
**Peak current, Peak time** – Peak current is % of the MAX MOTOR OUTPUT CURRENT (12A for LS-979-1210 and LS-979-1220, 20A for LS-979-2010). The output current will be limited to the Peak current for Time=Peak time. After that the current will be limited to the Continuous current. Peak current (%) and Peak time should be set depending on **motor and application** parameters.

**Continuous current, Overload time** – the drive output will be limited to this value for overload time. After the expiring of the Overload time the output will be disabled. If “Off” is set the drive output will not be affected. Continuous current (%) and Overload time should be set depending on **motor and application** parameters.

**Initialization current** – motor current will be limited to this value during the **initialization procedure only**. If the current is too low the initialization procedure will not work. Higher values may damage the motor. Start with values 10%-20% and increase or decrease the current depending on the results.

**Current loop ON** – leave Current loop ON unchecked.

4. Click “Next” and follow the instructions on the screen.
5. The initialization procedure is finished after saving the amplifier/motor parameters.
6. Once the initialization is finished you can run the amplifier only by using control interface.



## Current loop ON.

Checking the box **Current loop ON** will activate current loop mode. In this mode **KP** and **KI** parameters have to be selected. To set **KP** and **KI**:

1. Connect the Amplifier to the computer as described above.
2. Run Logosol Digital Amplifier Utility.
3. Select **Step Response** window.
4. Set the current to 15% - 20% of motor peak current.

Setting different values for **KP** and **KI** try to get the current as close as possible to a square wave with minimum overshooting and oscillation<sup>1</sup>.

<sup>1</sup> The motor shaft must be connected to the load.



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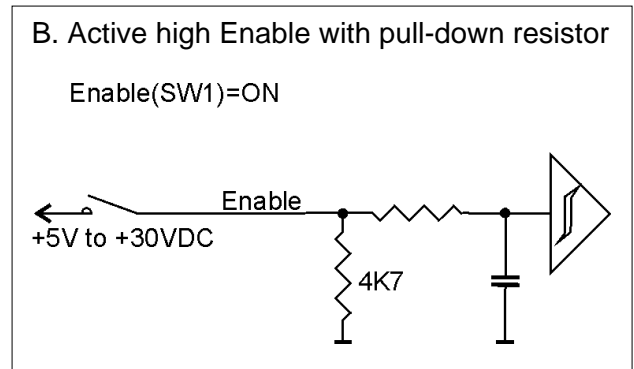
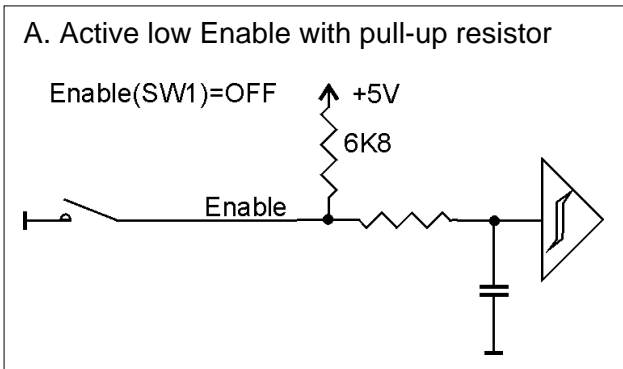
## RS-232

Logosol Digital Amplifier Utility communicate with amplifier through RS-232 interface. LS-884 adapter provides proper wiring between host computer and the amplifier. After motor initialization and selecting the parameters the interface could be removed.

## CONTROL INTERFACE

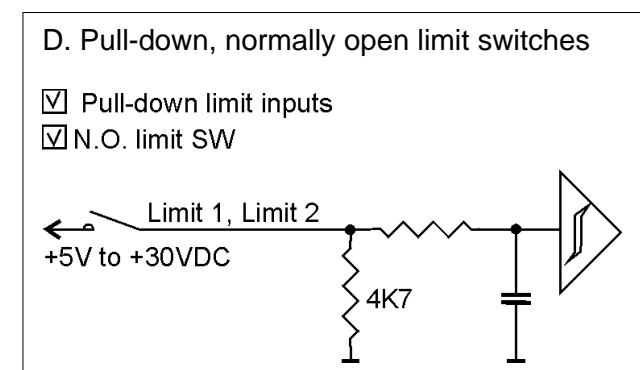
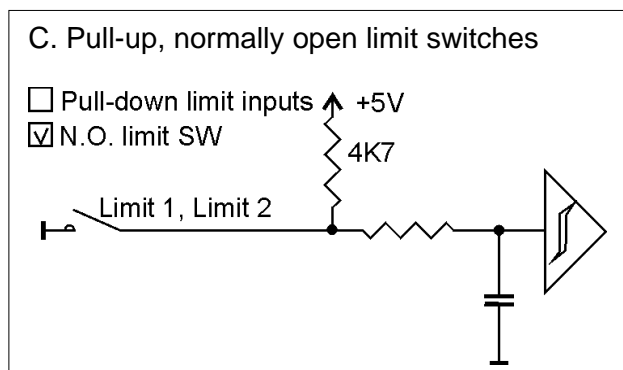
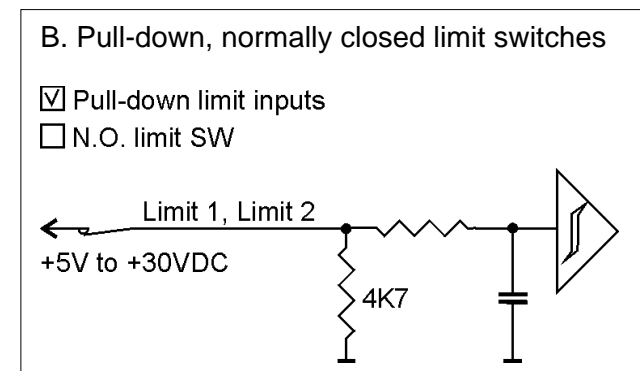
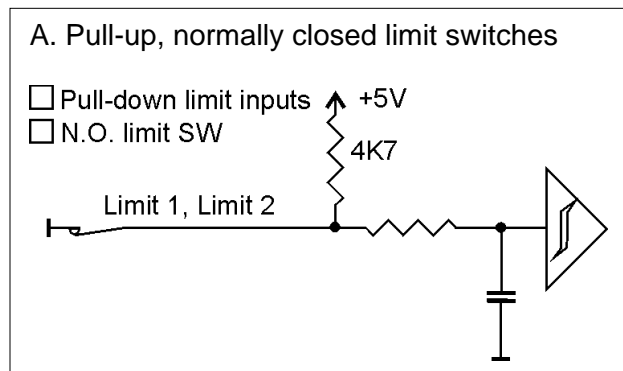
### Enable input

Depending on SW1, Enable input can be active or active low:



### Limit switches

Depending on checkboxes "Pull-down limit inputs" and "N.O. limit inputs" in Logosol Digital Amplifier Utility, the limit inputs have four modes:



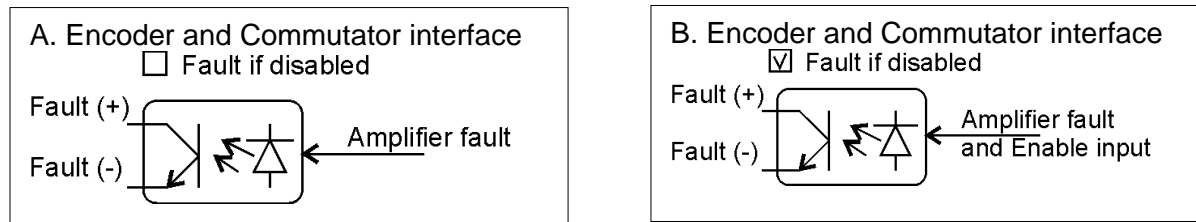
# Logosol Digital Servo Amplifier LS-979

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## Fault output

Amplifier Fault output is open when:

- Under / overvoltage;
- Motor short;
- Overload;
- Over temperature;
- Encoder error (only for motors equipped with differential encoders);
- When the amplifier is disabled if the checkbox "Fault if disabled" is checked.



## PWM and Direction inputs

These inputs are active only when "PWM command" is selected. The input PWM period should be between 33.3uS and 100.0uS (10KHz to 30KHz).

"PWM gain%" is the ratio between PWM command and the motor output. Gain=50% will limit the amplifier's output to 1/2 of its maximum. Default value is "PWM gain%"=100%.

## Analog input

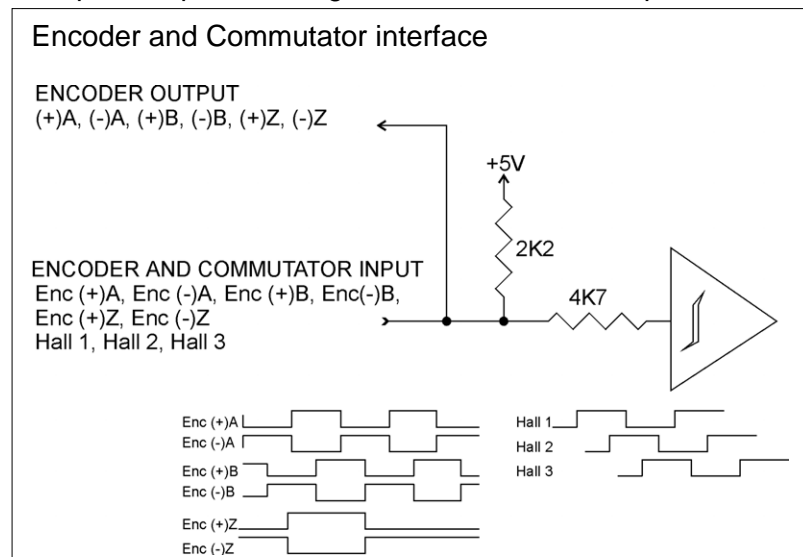
This input is active when "Analog command" is selected. Analog input is differential and may be adjusted between  $\pm 2.5V$  to  $\pm 10.0V$ .

"Analog offset" is a constant added to the amplifier's input control voltage and can be used in applications with asymmetric load.

## ENCODER AND COMMUTATOR INPUT, ENCODER OUTPUT

The Encoder interface accepts two square wave inputs Enc A, Enc B. Ideally these square waves are 50% duty cycle and +/-90 degrees out of phase. The time between encoder state transitions is limited and should not be less than 0.2uS. With ideally formed encoder pulses, this would correspond to a 2500 line encoder (10000 counts/rev) rotating at 30,000 rpm.

Hall sensors provide the motor rotor initial position. They are used to determinate the rotor position after power up and during the motor initialization procedure.



Encoder phases, index and hall sensors are used to generate the sinusoidal motor commutation. The output PWM is synchronized every motor rotation using Reference signal. When the motor is equipped with commutated encoder (encoder and hall sensors are implemented in one device), the Reference signal should be generated from hall data (turn SW2 "Off"). When the motor is equipped with separated encoder and hall sensors and index is present, Encoder Index should be used (turn SW2 "On")

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## STATUS LEDS

Two LEDs show the amplifier status.

### Status table

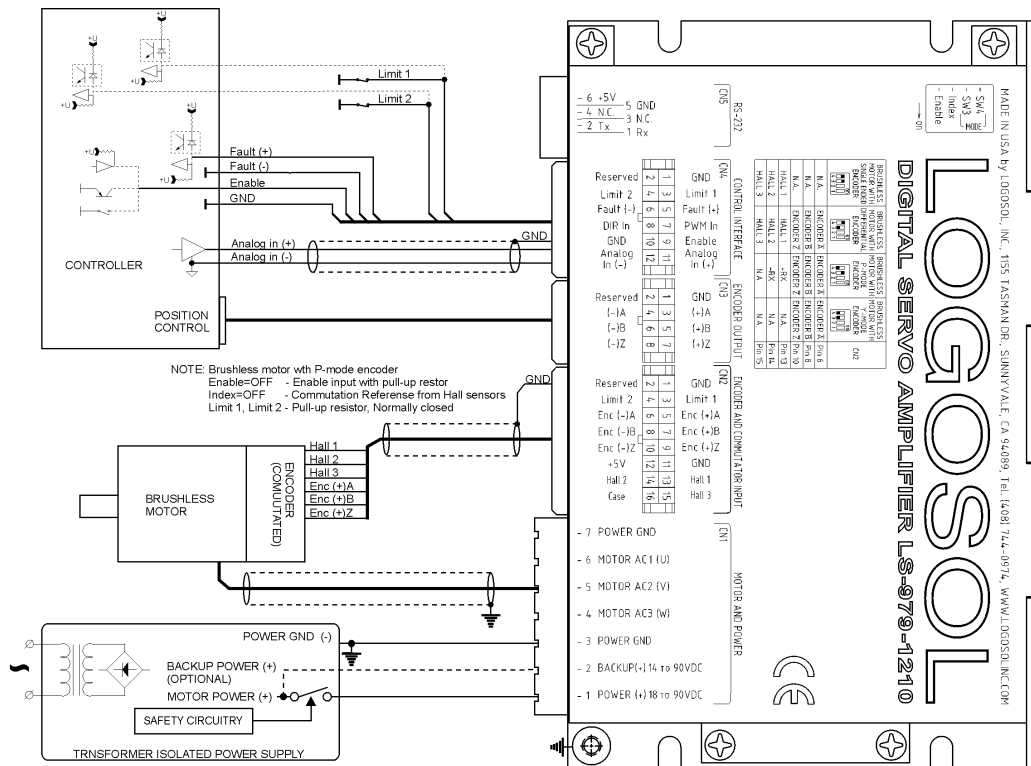
GREEN	ORANGE	DESCRIPTION	FAULT OUTPUT
Blink Slow	Off	Amplifier is disabled and "Fault if disabled" is Off	On
On	Off	Amplifier is disabled and "Fault if disabled is On (checked)	Off
On	Off	Amplifier is enabled and the status is "OK"	On
Blink Fast	Off	Amplifier is enabled and a Limit switch is active	On
On	On	Amplifier is enabled and the current is above the continuous current <sup>1</sup>	On
Off	Blink Fast	Amplifier is enabled and the current is above the continuous current more than Overload time <sup>2</sup> – Overload	Off
Off	On	Under voltage	Off
Off	Blink Slow	Amplifier fault – Encoder error, Motor short, Overvoltage or Overheat	Off

Latched fault conditions: Overload, Encoder error and Motor short.

The normal operation will be restored after switching off Enable input.

For all other fault conditions the normal operation will be restored after their disappearing.

## SAMPLE APPLICATION FOR BRUSHLESS MOTORS WITH SINGLE ENDED ENCODER



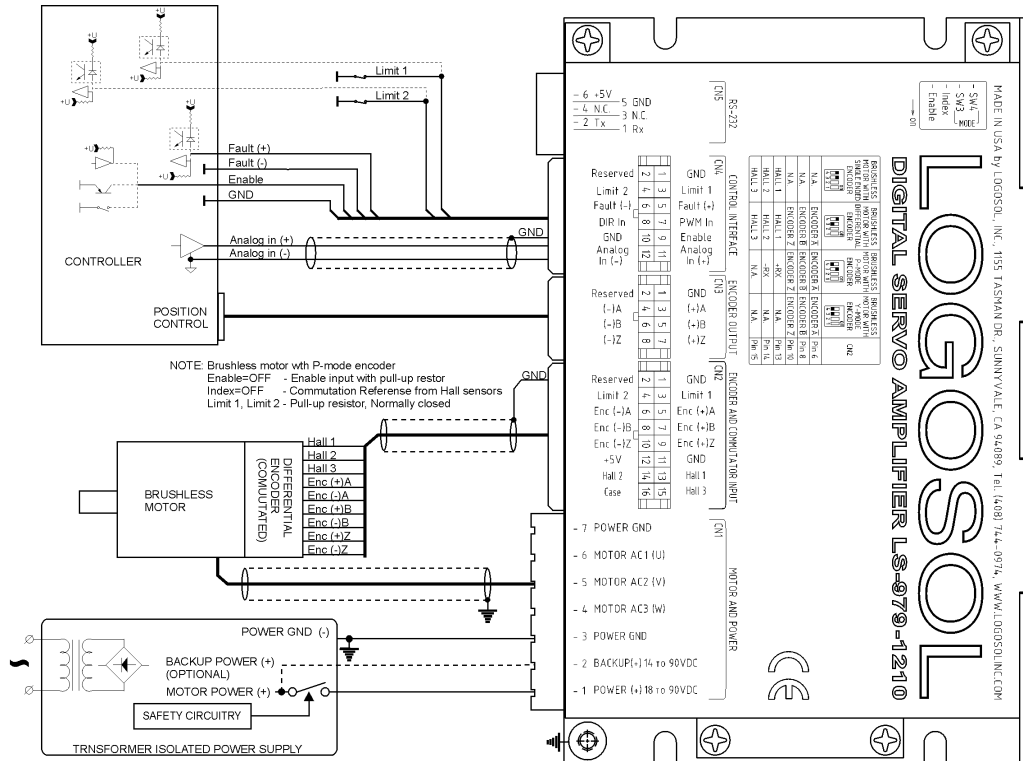
<sup>1</sup> The output current will be limited to the Peak current.

<sup>2</sup> After Peak current time the output current will be limited to continuous for Overload time.

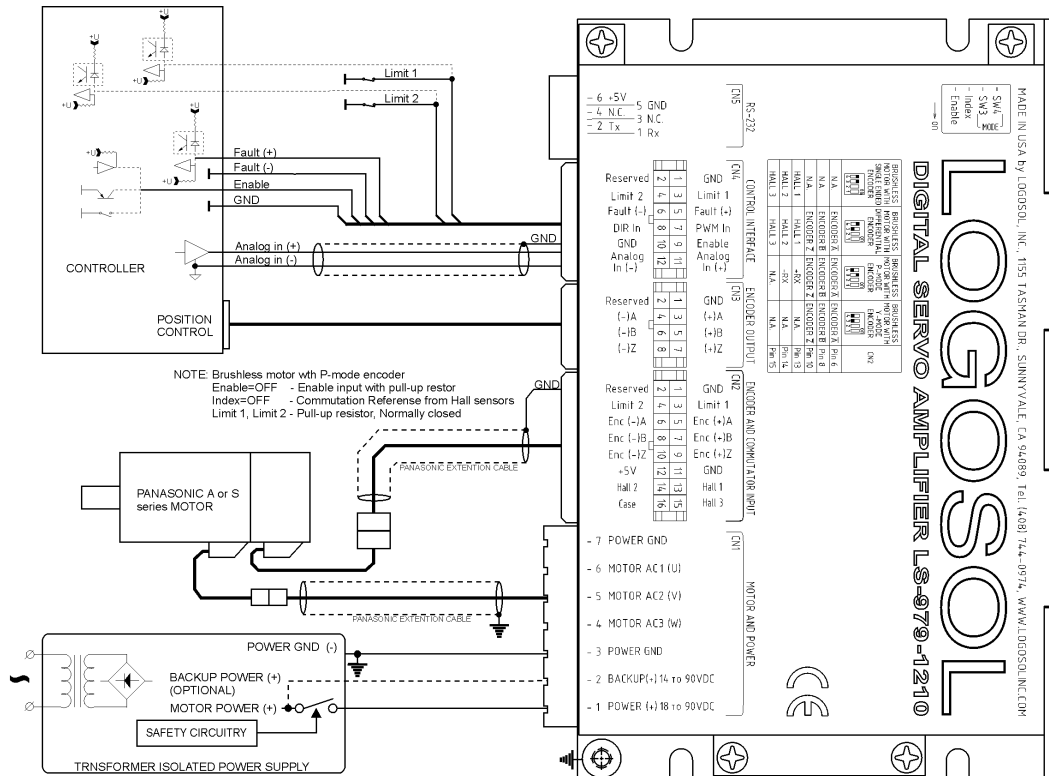
# Logosol Digital Servo Amplifier LS-979

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## SAMPLE APPLICATION FOR BRUSHLESS MOTOR WITH DIFFERENTIAL ENCODER



## SAMPLE APPLICATION FOR PANASONIC A OR S SERIES MOTOR

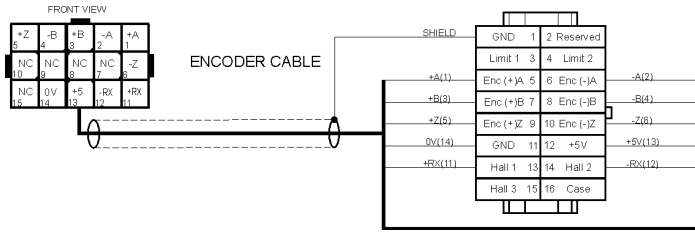


# Logosol Digital Servo Amplifier LS-979

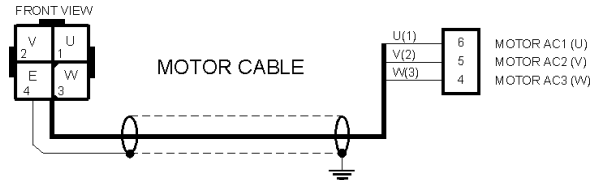
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## Extension cables for PANASONIC A or S series motors

MOTOR CONNECTOR (AMP CAP 172163-1) 10 pins 170365-1		LS-979 connector (AMP 43025-1600) 11 pins 43030-0007	
PIN	SIGNAL	PIN	SIGNAL
1	+A	5	Enc (+) A
2	-A	6	Enc (-) A
3	+B	7	Enc (+) B
4	-B	8	Enc (-) B
5	+Z	9	Enc (+) Z
6	-Z	10	Enc (-) Z
11	+RX	13	Hall 1
12	-RX	14	Hall 2
13	+5V	12	+5V
14	0V	11	GND
15	NC	1	GND (shield)



MOTOR CONNECTOR (AMP CAP 172159-1) 10 pins 170366-1		LS-979 connector (PHOENIX CONTACT) MSTB2.5/3-ST-5.08	
PIN	SIGNAL	PIN	SIGNAL
1	U phase	6	MOTOR AC1 (U)
2	V phase	5	MOTOR AC2 (V)
3	W phase	4	MOTOR AC3 (W)
4	FG=motor frame		



## PANASONIC A and S series motors wiring diagram

ENCODER CONNECTOR		
PIN	SIGNAL NAME	COLLOR
1	+A channel output	Red
2	-A channel output	Pink
3	+B channel output	Green
4	-B channel output	Blue
5	+Z channel output	Yellow
6	-Z channel output	Orange
7	N.C.	NA
8	N.C.	NA
9	N.C.	NA
10	N.C.	NA
11	+RX	Light blue
12	-RX	Purple
13	0V	White
14	+5V	Black
15	FG=motor frame	Black

MOTOR CONNECTOR		
PIN	SIGNAL NAME	COLLOR
1	U-phase	Red
2	V-phase	White
3	W-phase	Black
4	E	Green/Yellow

