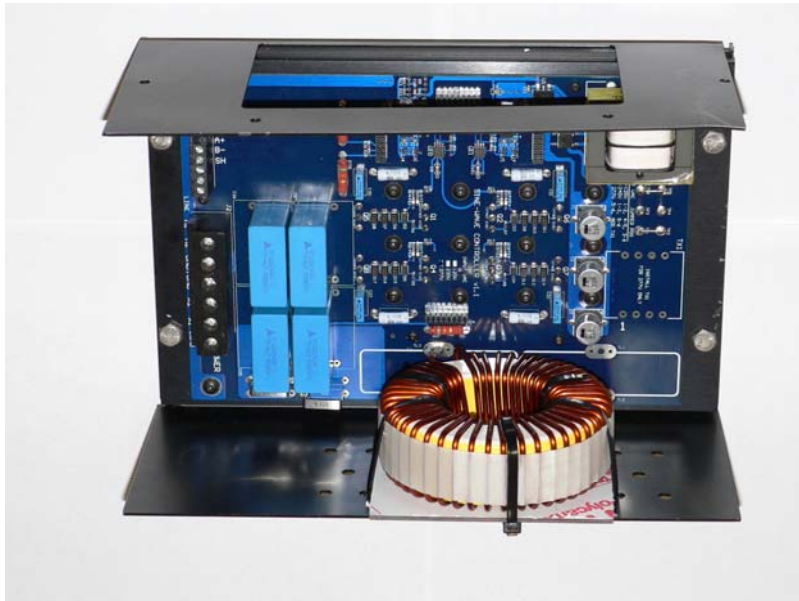




ESD Series



Sinewave Dimmers for High Intensity Discharge (HID) Dimming

Installation, Operating, Maintenance Manual

Read and Save these instructions!

ESD Series Dimmers



WARNINGS

HAZARDOUS VOLTAGE!

Turn off and lock out power before servicing.

There is a potential danger of electric shock when working on electrical equipment! Make sure power is off before installation. Replace all covers before energizing the ESD units.

Installation should only be performed by a licensed electrical technician, and must be according to all local and national electrical codes, which supersede any instructions in this manual.

The ESD is to be installed in a ventilated enclosure per the instructions in this manual.

The ESD is a high power electrical device designed to vary the outgoing voltage to produce a reduction in wattage and subsequent dimming of ballasted HID (High Intensity Discharge) lamps. The ESD may not be used for any purpose other than those expressly stated in this manual. Use of the ESD for any unauthorized purpose may result in injury or death and is expressly forbidden. Use of the ESD for any unauthorized purpose will void any and all warranties.

Check the electrical data label on the ESD to be sure it matches the field voltage that will be applied. Failure to insure a proper electrical match may result in damage to the unit and possible injury or death.

Check all components for damage. If damage is found, immediately contact the freight carrier and file a claim for the damages, and contact Sinewave Energy Technologies to determine if the part should be replaced. NEVER install a damaged device as this could result in fire, injury or death. Sinewave Energy Technologies assumes no liability for any damaged devices that are installed and operated.

WARNING: The ESD series dimmers work by reducing the line voltage to the lamp ballasts. The ESD dimmer will not work with ballasts having an “active front end”. The active component of these ballasts will try to boost the power to the lamps when the ESD dimmer tries to reduce the power to dim them. Operating the ESD with “active” electronic ballasts will not produce any energy savings, and may present an electrical hazard due to over-amping of the circuit. If you are unsure if your ballasts have active front ends, call Sinewave Energy Technologies with the ballast make and model numbers.

CAUTION: There may be more than one disconnect switch to an enclosure. Make sure all power is off to all devices in an enclosure before servicing.

Table Of Contents

WARNINGS	2
1. How the ESD works.....	3
2. Installation.....	4
2.1 Ambient criteria	4
2.2 Mounting the enclosure.....	4
2.3 Mounting the ESD units inside the enclosure	5
3. Electrical wiring.....	6
3.1 Power wiring.....	6
3.1.1 Circuit level wiring	7
3.2 Control wiring	8
3.2.1 Recommended control sequences.....	8
3.2.2 Control wiring schemes	8
4. Installation checklist.....	10
5. Startup procedures	10
6. Operating instructions.....	11
7. Maintenance instructions.....	11
8. Trouble-shooting instructions	11
9. Parts list	12
10. Technical specifications.....	12
11. Suggested Engineering Specifications.....	13
12. Warranty Terms & Conditions	15
13. Sinewave Energy Technologies Product Registration Form.....	15

1. How the ESD works

Most dimmers “chop” the electrical sine wave either at the start or end of the cycle by simply cutting the power for part of the cycle as shown in Figure 1-1. This approach creates vibration in incandescent elements, causing an annoying hum, add to lamp-killing harmonic distortion, and interfere with other electronic devices in the area. This type of device CANNOT be used with HID lamps, as the “chopping” of the phase causes a restrike of the lamp’s arc.

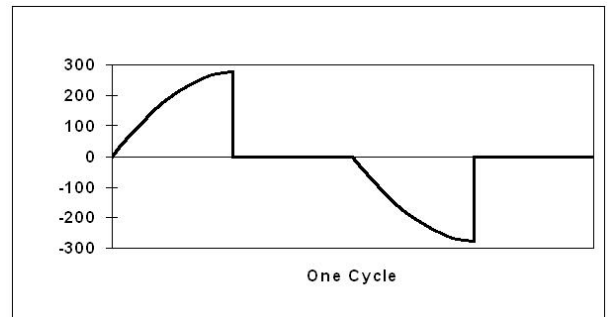


Figure 1-1

The ESD is a true sine wave modulating dimmer that works by changing the amplitude of the sine wave. This maintains the integrity of the true electrical sine wave, reduces harmonic distortion and works well with HID lamps. Figure 1-2 shows a sine wave at 100% power, at 50% power, and at 30% power. It is easy to see that the sine wave remains complete and only the amplitude (height and voltage) changes. The load side power is actually somewhat more pure than the line side power.

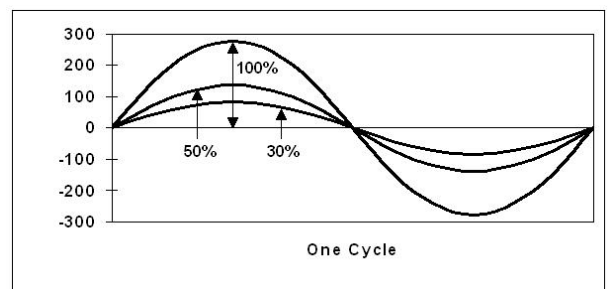


Figure 1-2

WARNING: The ESD series dimmers work by reducing the line voltage to the lamp ballasts. The ESD dimmer will not work with ballasts having an “active front end”. The active component of these ballasts will try to boost the power to the lamps when the ESD dimmer tries to reduce the power to dim them. If you are unsure if your ballasts have active front ends, call Sinewave Energy Technologies with the ballast make and model numbers.

ESD Series Dimmers

2. Installation

The ESD unit is supplied in a protective shipping carton. It must be installed in a suitable, ventilated sheet metal enclosure that can maintain the conditions per section 2.1 of this manual. Sinewave Energy Technologies offers suitable enclosures in sizes for 2, 4 and 8 units. Custom enclosures available on request.

2.1 Ambient criteria

The ESD units must be maintained in a clean, dry environment, such as a ventilated metal enclosure able to maintain the following conditions:

Temperature Range: 32°F to 104°F (0°C to 40°C)
Humidity Range: 0% to 85%RH non-condensing

2.2 Mounting the enclosure

The enclosure may be mounted anywhere convenient, but bear in mind that the line wiring into the enclosure will come from the lighting circuit breakers and contactors, and the load wiring out of the enclosure will go to the lights. Generally the enclosure is easiest to mount near the circuit breakers and contactors in a mechanical equipment room. Sinewave Energy Technologies' enclosures have the dimensions listed in Table 2.2-1, referenced by Figure 2.2-1.

Enclosure model	Cabinet Dimensions (Figure 2.1-1)	Weight Empty	Weight with ESDs
ENC-2-*-0 (for 1-2 ESD units)	20" H x 20" W x 8.78" D	42 lbs.	57 to 72 lbs.
ENC-4-*-0 (for 3-4 ESD units)	36" H x 24" W x 8.78" D	88 lbs.	133 to 148 lbs.
ENC-8-*-0 (for 5-8 ESD units)	36" H x 36" W x 8.78" D	141 lbs.	216 to 261 lbs.
	Mounting Holes (4)		
ENC-2-*-0	18.5" B x 18.5" A		
ENC-4-*-0	34.5" B x 22.5" A		
ENC-8-*-0	34.5" B x 34.5" A		

Table 2.2-1

Mount the enclosure according to local and national electrical codes and to a secure wall or beam capable of bearing the weight.

WARNING: Cut any conduit entry holes into the enclosure before mounting the ESD units to avoid metal shavings on the circuit boards. If the enclosure is provided to you with the ESD units already mounted, cover them to prevent metal shavings from falling onto them. Thoroughly clean out the enclosure before installing the ESD units.

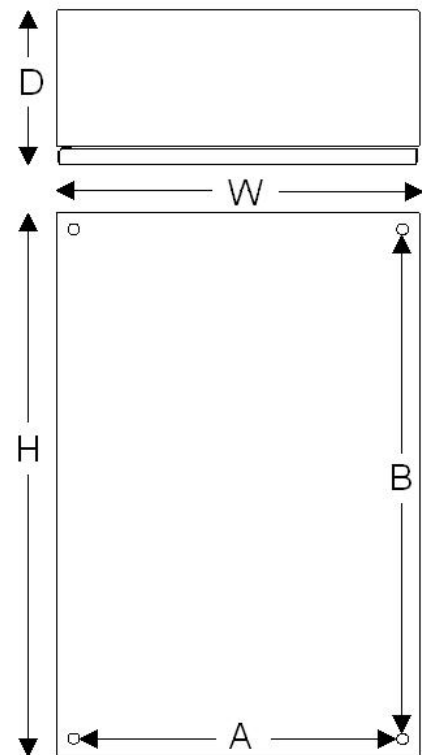


Figure 2.2-1

2.3 Mounting the ESD units inside the enclosure

Each ESD has 4 – 1/4" diameter corner mounting holes for mounting the unit onto the mounting studs in the enclosure, if supplied by Sinewave Energy Technologies. Figure 2.3-1 shows the layout of the 4 mounting holes, which form a rectangle, 4 inches wide by 10.25 inches high.

A minimum of 1 inch clearance must be maintained all the way around the ESD unit and in front, when mounted in an enclosure. All ESD units are mounted horizontal so that their wiring terminals are to the right side of the enclosure.

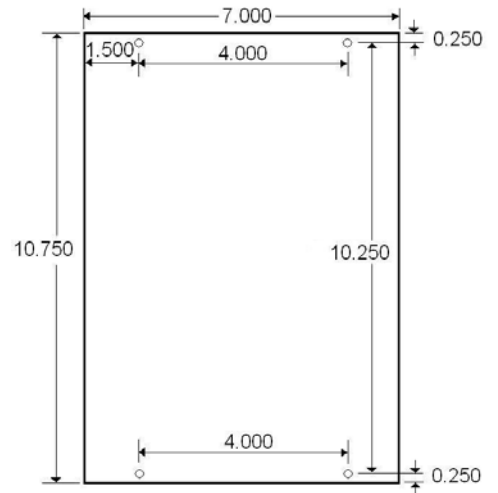


Figure 2.3-1

Once the enclosure is secured to a hard surface or post and the inside has been cleaned of any installation debris, the ESD units may be installed. For each ESD unit, there is a pattern of 4 threaded inserts installed on the backplate of the enclosure. Each ESD is placed on top of this pattern and secured by 4 bolts (supplied) as shown in Figure 2.3-1.

Figure 2.3-2 shows the typical enclosure design with ESD dimmers mounted.

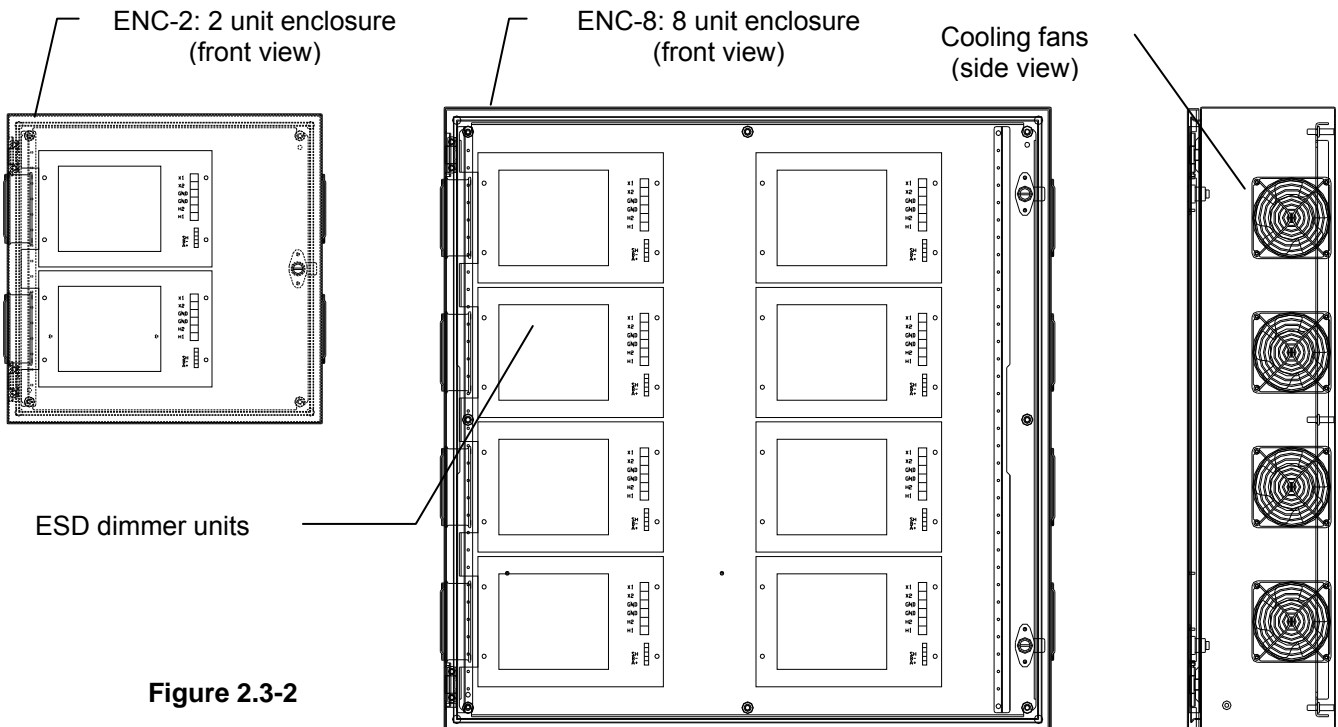


Figure 2.3-2

WARNING: Be careful to keep the minimum 6" clearances on both sides of the enclosure to allow proper air circulation through the enclosure. DO NOT block the cooling fans or ventilation openings, or serious damage may occur to the ESD units.

ESD Series Dimmers

3. Electrical wiring

The ESD dimmer must be installed after the lighting circuit breakers and contactors, and before the lighting loads. Insure that the proper size circuit breakers and contactors are used, rated properly for the full load as shown in Table 3-1. The ESD should only be installed by a licensed electrician.

All wiring connections to the ESD dimmer are made to a set of terminal connectors at the one end of the main circuit board, labeled J1 and J2. All wiring must be accordance with local and national electric codes.

The ESD must be properly connected to earth ground.

The Line input of multiple ESD units may be connected in parallel to the Line Power. **NEVER connect multiple ESD units in series to the Line Power.**

Multiple lamps, up to the maximum wattage in Table 3-1 may be connected in a single parallel circuit to the Load Power of a single ESD. **NEVER connect the Load Power of multiple ESD units in series or in parallel.**

Maximum Amps:	ESD-5540 = 20 Amps ESD-8310 = 30 Amps	
Maximum Watts:	ESD-5540 (20A)	ESD-8310 (30A)
ESD-*-A 120 Vac:	2400 Watts	3600 Watts
ESD-*-B 208 Vac:	4160 Watts	6240 Watts
ESD-*-B 220 Vac:	4400 Watts	6600 Watts
ESD-*-B 240 Vac:	4800 Watts	7200 Watts
ESD-*-B 277 Vac:	5540 Watts	8310 Watts

Table 3-1

3.1 Power wiring

Each ESD unit comes preconfigured from the factory for the proper voltage as ordered. The absolute check of the voltage that the ESD is wired for is determined by the soldered jumpers between pins TP1 through TP6 located next to the small power transformer on the main circuit board as shown in Figure 3.1-1 and Figure 3.1-2. Voltage is NOT to be changed in the field.

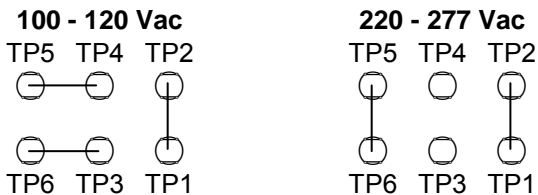


Figure 3.1-1

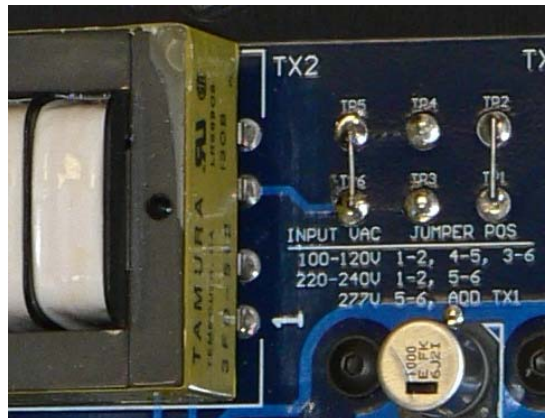


Figure 3.1-2

Line power in from the electrical panel is connected to the H1 and H2 terminals found on the J2 connector at the end of the ESD main circuit board. A ground wire must also be connected to the J2 terminal labeled GND as shown in Figure 3.1-3.

Load power out to the lights is connected to the X1 and X2 terminals found on the J2 connector at the end of the ESD main circuit board. A ground wire must also be connected to the J2 terminal labeled GND as shown in Figure 3.1-3

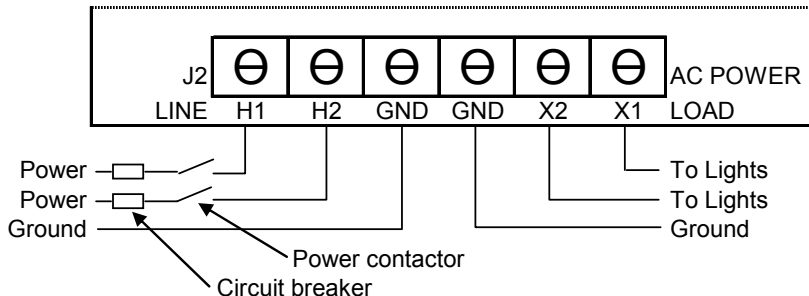


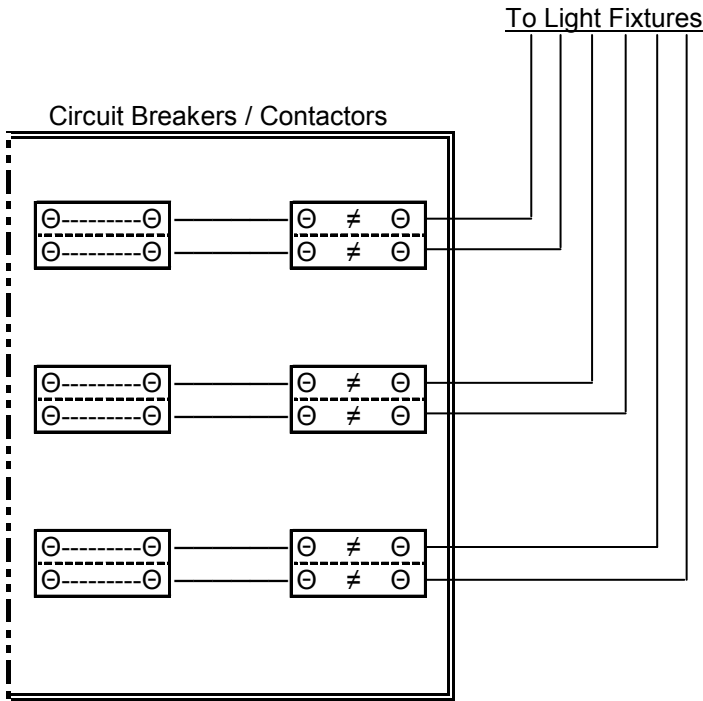
Figure 3.1-3

The J2 terminal block will accept wire sizes from #12 to #10 AWG solid or stranded copper wire, and has a maximum current rating of 30 Amps. It is recommended to use #10 AWG copper wire on both the Line and Load wiring to minimize resistance.

NOTE: The J2 terminals must be tightened to 12 in. lbs. (1.36 Nm) torque using a suitable screwdriver.

3.1.1 Circuit level wiring

The Sinewave ESD Series dimmers are designed to dim the lighting by reducing the voltage on the power line to the lighting fixtures. The best and most convenient location for the Sinewave enclosure is right next to the existing electrical lighting panels having the circuit breakers and contactors.



In most installations, there are existing circuit breakers and power contactors wired to the lighting fixtures, as shown in Figure 3.1.1-1.

Figure 3.1.1-1

Typically the line wiring from the contactors to the lighting fixtures is simply rerouted to the ESD dimmers, and then to the lighting fixtures, as shown in Figure 3.1.1-2.

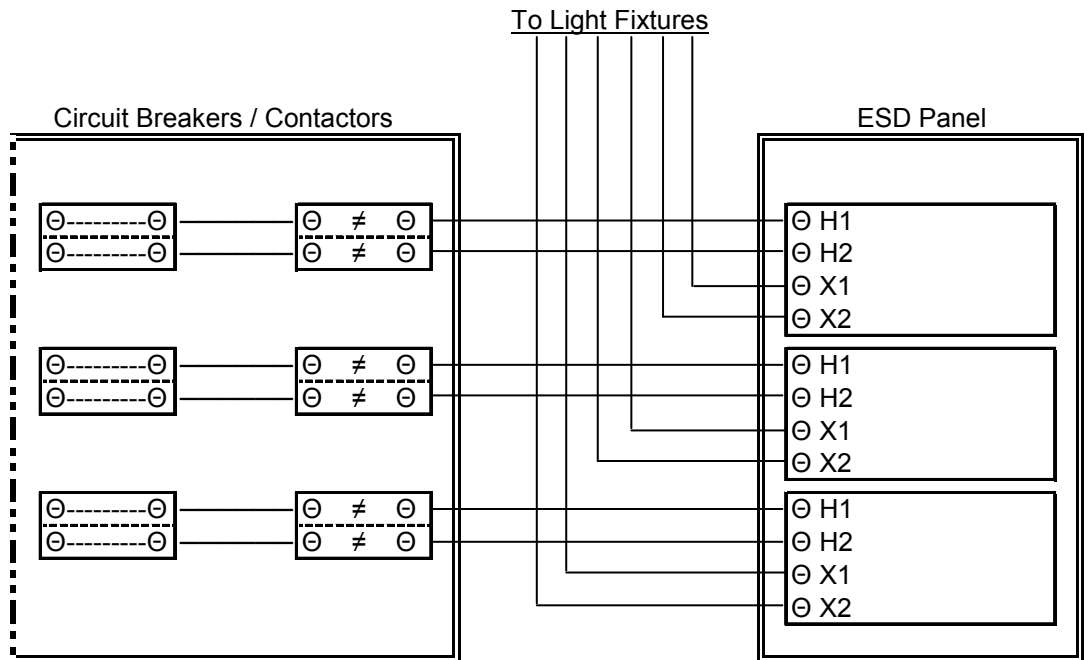


Figure 3.1.1-2

ESD Series Dimmers

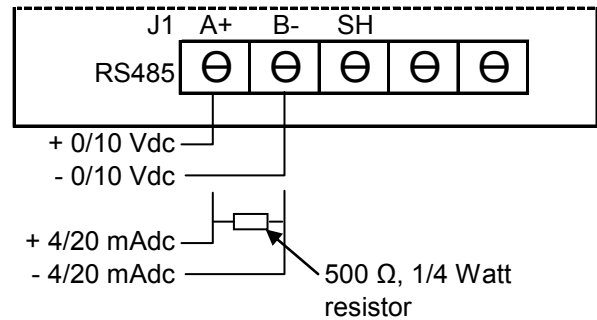
3.2 Control wiring

The ESD will accept two standard control signals: 0/10 Vdc or 4/20 mAdc (with a 500 ohm, 1/4 Watt resistor).

WARNING: All low voltage control wiring should be shielded wire and should NOT be run in the same conduit with high power wires. It is generally good practice to keep low voltage and high voltage wiring separate.

0/10 Vdc: When connecting to a 0/10 Vdc control signal, connect the positive signal wire to terminal A+ on the J1 connector of the ESD main circuit board, and connect the negative signal wire to terminal B- on the J1 connector as shown in Figure 3.2-1.

4/20 mAdc: When connecting to a 4/20 mAdc control signal, connect the positive signal wire to terminal A+ on the J1 connector of the ESD main circuit board, and connect the negative signal wire to terminal B- on the J1 connector as shown in Figure 3.2-1. Add a 500 ohm, 1/4 Watt resistor across terminals A+ and B- as shown. This converts the 4/20 mAdc control signal to a 2/10 Vdc signal at the ESD main circuit board.



The J1 terminal block will accept wire sizes from #22 to #18 AWG solid or stranded copper wire, and has a maximum current rating of 10A. Input impedance of the ESD is 10 K-ohms.

NOTE: The J1 terminals must be tightened to 5 in. lbs. (0.57 Nm) of torque, using a suitable screwdriver.

3.2.1 Recommended control sequences

The ESD responds directly to the 0/10 Vdc or 4/20 mAdc input signal, ramping the HID lights from 50% (30% with sodium lamps) to 100% in direct relationship to the control signal. The response to the input signal is scaled, so that a 0 Vdc input signal = 50% power (30% with sodium lamps), and a 10 Vdc signal = 100% power.

In most applications, a combination of timers, daylight sensors, and motion detectors are used to determine when to dim the lights to save energy and when to return them to full power in response to occupancy.

Simple Hi-Lo control schemes can be implemented using a power supply and relay, as the ESD interprets a lack of a signal as being a 0 Vdc input.

To achieve a minimum 10% energy savings, many applications can be set so that the maximum output is always 90%. This 10% reduction in lighting power is generally not detectable by humans.

3.2.2 Control wiring schemes

Example: Open parking garage.

During daylight hours, dim the lights to as low as 50% (30% with sodium lamps) and take advantage of the daylight. During occupied non-daylight hours, dim the lights to 50% (30% with sodium lamps) and return them to 90% on motion detection.

Motion detectors would be installed at all egress points for automobiles, and at all elevator and stairway doors. These would detect the presence of anyone coming onto the floor.

If the garage is open to the outside, then daylight sensors would also be used to dim the lights when daylight is available.

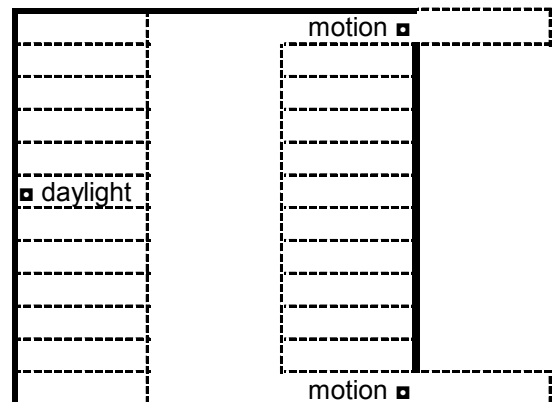


Figure 3.2.2-1

Example: Athletic facility – tennis club.

When a court is not in use, dim to 50% (30% with sodium lamps) to save on energy and prevent the need for restrike when the court is needed. When the court is to be used, motion detectors can automatically bring the power to 90%, allowing play but still saving 10% of the original energy (10% reduction in lighting is undetectable to humans). During tournament play, the lights can be manually set to 100%. During routine cleaning and maintenance times, a manual setting of 50% can also be used to save energy.

Motion detectors would be used at both ends of the court to automatically detect the presence of players. The same scheme is used for basketball courts, swimming pools, and exercise rooms.

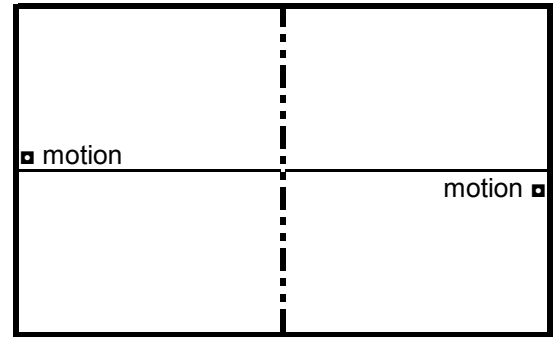


Figure 3.2.2-2

Example: Circuit level Hi-Lo control.

Most standard “Hi-Lo” schemes involve rewiring the ballasts of existing fixtures to use the multi-tap voltage inputs. With the ESD dimmer, this is more simply done, and at the circuit level. When the ESD receives a 0 Vdc input signal or absence of a signal, it will automatically operate at the minimum power output setting. A simple SPST relay can be used to switch a standard 10 to 12 Vdc power supply On or Off to the ESD dimmer. When On, the ESD will go to the setting consistent with the input signal. When Off, the ESD will go to the minimum setting. See Figure 3.2.2-3.

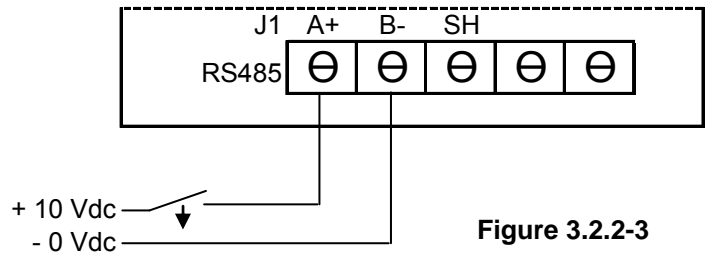


Figure 3.2.2-3

The minimum and maximum power output of the ESD dimmer can also be controlled by the minimum and maximum signal switched to the ESD dimmer using a SPDT relay, per Figure 3.2.2-4 at right. In this case, the relay when powered would give the ESD a 10 Vdc input causing it to go to full power output. When the relay switched, it would give the ESD a 5 Vdc input, causing it to go to 75% power in the case of the HID setting (0 Vdc input being 50% power), or 65% of power in the case of the FL setting (0 Vdc input being 30% of power).

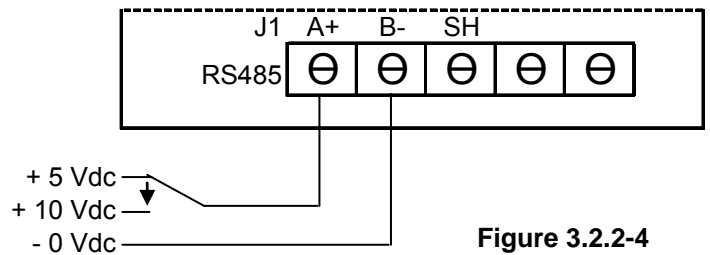


Figure 3.2.2-4

Sinewave Energy Technologies will be happy to consult with you regarding possible control schemes.

ESD Series Dimmers

4. Installation checklist

Once installed and before startup, the following checks should be made:

1. All ESD units are properly mounted in a ventilated enclosure per instructions in this manual.
2. Enclosure ventilation openings are open and clear of any obstructions.
3. Proper clearances are maintained entirely around the enclosure.
4. Line power into terminals H1 & H2 matches the power input listed on the data label on the ESD.
5. Load power from terminals X1 & X2 is connected to single lighting circuits of the same voltage.
6. External control signal is connected and checked for proper polarity.
7. If external control signal is 4/20 mAdc, a 500 ohm, ¼ Watt resistor has been installed between terminals A+ & B- on the ESD.

Checks conducted by: _____ Date: _____

NOTE: If factory startup has been purchased, the above checklist must be completed, signed, dated, and faxed to Sinewave Energy Technologies prior to a technician coming on site. If items on this checklist are found not to be complete or ready at start-up time, you may be assessed for additional startup time and expenses if required.

5. Startup procedures

The ESD dimmer should begin operating as soon as power is applied and the 15 minute startup cycle is completed. However, each ESD unit should be checked out according to the following procedure to insure proper operation.

1. Review each step in the installation checklist in this manual and insure all steps have been followed.
2. Set the external control signal to 0% (0 Vdc or 4 mAdc).
3. Apply line voltage to the ESD unit. Load voltage should go to 100% and the attached lights should strike and begin to operate. This can be confirmed by measuring the voltage across terminals X1 & X2 on the ESD, which should be equal to the line voltage.
4. At power up, the ESD will go to full power output for 15 minutes to allow all lamps to properly strike, start and warm up. After the 15 minute warm-up period, the ESD should go to minimum setting (50% for HID lamps, and 30% for sodium lamps). This can be confirmed by measuring the voltage across terminals X1 & X2 on the ESD, which should equal approximately 70% of the line voltage for HID lamps and approximately 55% of line voltage for sodium lamps.
5. Set the external control signal to 100% (10 Vdc or 20 mAdc). This can be confirmed by measuring the voltage across terminals A+ & B- on the ESD. The lights should go to 100% of wattage. This can be confirmed by measuring the voltage across terminals X1 & X2 on the ESD, which should now be at the same as line voltage in.
6. Varying the external control signal up and down should now cause the lights to ramp up and down in direct response to the signal. Note that the power output is scaled to the input signal so that a 0 Vdc input signal = 50% power (30% with sodium lamps), and a 10 Vdc signal = 100% power.

Startup is complete.

6. Operating instructions

The ESD responds to a direct, external, standard 0/10 Vdc control signal. Varying this external control signal from 0 to 10 Vdc will result in the ESD increasing its dimming power from 50% to 100% of output wattage (in the case of sodium lamps, the range is 30% to 100%). Likewise, reducing the external control signal from 10 to 0 Vdc should result in the ESD reducing its dimming power from 100% to minimum.

The ESD should be installed in the power wiring after the circuit breakers and lighting contactors, and before the lighting fixtures. Opening and closing the lighting contactors will serve the function of turning the lighting on and off.

On power-up, the ESD will go to full power for 15 minutes to permit the lamps to strike and warm up. Then the ESD will begin to dim in direct response to the control input signal.

On a loss of control signal, the ESD will go to 50% dimming for HID lamps, and 30% for sodium lamps.

7. Maintenance instructions

There are no maintainable parts on the ESD unit. However, the unit must be kept clean, dry and ventilated for proper cooling. The following maintenance routines are recommended:

- Periodically, the ESD unit should be cleaned by using compressed air or computer cleaning gas as needed to prevent dust or dirt buildup.
- The enclosure ventilation fan should be checked for proper operation, oiled and cleaned if necessary.
- Any filters should be checked and cleaned as needed to allow proper enclosure ventilation.
- Installation and maintenance of items not manufactured by Sinewave Energy Technologies must be in accordance with each manufacturer's manuals and guidelines. Sinewave Energy Technologies assumes no responsibility or liability for the proper installation, maintenance and operation of devices not manufactured by Sinewave Energy Technologies.

8. Trouble-shooting instructions

This trouble-shooting guide is meant to be a guide and is not necessarily all-inclusive.

Problem Symptoms	Possible Causes	Checks	Possible Remedies
1. ESD unit remains at 50% dimming and will not change.	<ul style="list-style-type: none"> • Loss of input control signal. • Bad signal polarity. • 4/20 mAdc control signal connected without 500 ohm load resistor. 	<ul style="list-style-type: none"> • Use a multi-meter to check the voltage between terminals A+ and B-. • Disconnect external signal wires and check polarity. • If control signal is 4/20 mAdc, connect 500 ohm, ¼ Watt resistor across terminals A+ & B-. 	<ul style="list-style-type: none"> • Trace control system and restore signal integrity. • Switch wires if polarity is reversed. • Install 500 ohm, ¼ Watt resistor if signal is 4/20 mAdc.
2. ESD unit remains at 100% and will not dim in response to the control signal.	<ul style="list-style-type: none"> • Control signal at 100% and not modulating. • 4/20 mAdc control signal connected without 500 ohm load resistor. 	<ul style="list-style-type: none"> • Use a multi-meter to check the voltage between terminals A+ and B-. • Disconnect external signal wires and check polarity. • If control signal is 4/20 mAdc, connect 500 ohm, ¼ Watt resistor across terminals A+ & B-. 	<ul style="list-style-type: none"> • Trace control system and restore signal integrity. • Switch wires if polarity is reversed. • Install 500 ohm, ¼ Watt resistor if signal is 4/20 mAdc. • Replace ESD controller board.
3. ESD unit does not turn on lights.	<ul style="list-style-type: none"> • No line power. • No load power. • Blown circuit breaker. 	<ul style="list-style-type: none"> • Check terminals H1 & H2 for line voltage. • Check terminals X1 & X2 for load voltage. • Check circuit breaker 	<ul style="list-style-type: none"> • If no voltage between H1 & H2, restore line power. • If not voltage between X1 & X2, replace ESD unit. • Fix or replace circuit breaker.

Table 8-1

ESD Series Dimmers

9. Parts list

The ESD dimmer is a single device supplied in one piece. There are no field replaceable nor field repairable parts. On failure, the entire ESD unit is replaced. The replacement part should have the exact same or updated model number as originally supplied. Failure to replace and ESD with an exact replacement may result in fire, injury or death and will void any and all warranties. Sinewave Energy Technologies assumes no liability for improperly replaced parts or any field attempts to repair the parts without written authorization.

ESD Series Lighting Dimmers:

ESD	8310	A	0	F	0	Weight
Series designator	Model Number: 5540 = 5540 Watts (20 Amps) 8310 = 8310 Watts (30 Amps)	Voltage: A = 100 to 120 Vac B = 208 to 277 Vac Notes: - preset at factory	Reserved	Power Setting: F = Na (30% min.) H = HID (50% min.) Notes: - preset at factory	Reserved	15 lbs.

Table 9-1

Enclosures:

ENC	2	A	0	Weight (empty)	Weight with ESDs
Enclosure designator	Enclosure Size: 2 = 1 to 2 ESD (20x20x8) 4 = 3 to 4 ESD (36x24x8) 8 = 5 to 8 ESD (36x36x8)	NEMA Rating: A = NEMA 1 (Indoor) B = NEMA 4 (Outdoor)	Options: 1 = Bypass switches 2 = 20 A circuit breakers 3 = Volt / Amp displays	42 lbs. 88 lbs. 141 lbs.	57 to 72 133 to 148 216 to 261

Table 9-2

10. Technical specifications

ESD dimmer units:

Specification	Data	
Voltage:	100 to 277 Vac, 50/60 Hz	
Maximum Amps:	ESD-5540 = 20 Amps ESD-8310 = 30 Amps	
Efficiency:	> 95%	
Maximum Watts:	ESD-5540 (20A)	ESD-8310 (30A)
ESD-*-A 120 Vac:	2400 Watts	3600 Watts
ESD-*-B 208 Vac:	4160 Watts	6240 Watts
ESD-*-B 220 Vac:	4400 Watts	6600 Watts
ESD-*-B 240 Vac:	4800 Watts	7200 Watts
ESD-*-B 277 Vac:	5540 Watts	8310 Watts
Dimensions:	10.75" long x 7" wide x 6" deep	
Weight:	15 lbs.	
Temperature limits:	32°F to 104°F (0°C to 40°C)	
Humidity limits:	0 to 85%RH non-condensing	
Control signals:	0 to 10 Vdc / 4 to 20 mAdc	
Input impedance:	10 K-ohms	

Table 10-1

Enclosures:

Enclosure model	Cabinet Dimensions (Figure 2.1-1)	Weight Empty	Weight with ESDs
ENC-2-*-0 (for 1-2 ESD units)	20" H x 20" W x 8.78" D	42 lbs.	57 to 72 lbs.
ENC-4-*-0 (for 3-4 ESD units)	36" H x 24" W x 8.78" D	88 lbs.	133 to 148 lbs.
ENC-8-*-0 (for 5-8 ESD units)	36" H x 36" W x 8.78" D	141 lbs.	216 to 261 lbs.
Mounting Holes (4)			
ENC-2-*-0	18.5" B x 18.5" A		
ENC-4-*-0	34.5" B x 22.5" A		
ENC-8-*-0	34.5" B x 34.5" A		

Table 10-2

11. Suggested Engineering Specifications

ESD Series Lighting Dimmers

16570: DIMMING CONTROL

I. General

A. Scope

1. Furnish and install as indicated on the drawings and plans, digital electronic sinewave lighting dimmers capable of dimming HID lamps.
2. Furnish owner's manuals covering installation, start-up, maintenance and operating instructions, complete in every way to permit efficient operation and maintenance of the dimmers.
3. Manufacturer shall warrant the dimmers to be free from defects in materials and workmanship for a period of 2 years after the sale.

II. Product

A. Lighting Dimmers

1. The lighting dimmers shall be of the digital sinewave type using an ultra-high speed PWM system to create an accurate and infinitely variable sinewave output. Each lighting dimmer shall check and adjust the power output a minimum of 20,000 times per second. Preprogrammed PWM schemes are unacceptable as they cannot adjust automatically to power fluctuations.
2. SSR and SCR type dimmers are unacceptable, as they cannot work with HID lighting. Variac or auto-transformer type dimmers are unacceptable. Step type dimming schemes are unacceptable as they provide no flexibility for lighting requirements.
3. Each lighting dimmer shall use a PIC controller with pin connectors to allow the resident software to be upgraded in the field if required, with future changes to the lighting system or dimmer.
4. Each lighting dimmer shall have a series of LEDs on the dimmer that show the power output of the dimmer in binary terms for accuracy.
5. Each lighting dimmer shall have board mounted terminals for connection of the line and output power and control signal inputs. Each dimmer shall accept a standard 0-10 Vdc control signal input, or a 4-20 mAdc signal with a load resistor.
6. Each lighting dimmer shall have field changeable jumpers to permit hard setting of minimum power output to 0%, 30% (for sodium lamps) or 50% (for HID lamps). The lighting dimmer shall then modulate from the hard minimum power setting to the maximum power setting linearly with the control input signal. There shall also be field changeable jumpers to permit a hard setting of maximum power output at 85% so that it will qualify for energy savings tax credits and utility rebates.
7. Each lighting dimmer shall have a minimum 10 ms power override so that high-speed switching UPS systems can be used without interruption of lighting.
8. Lighting dimmers shall be UL and cUL compliant, and shall meet FCC and CE standards for control of EMI and RF emissions and harmonic distortion.

B. System Controls [Options]

1. Connect to the existing lighting control system. Lighting control contractor to provide 0-10 Vdc control signals to the lighting dimmers.

ESD Series Dimmers

2. Supply a lighting control system providing a 0-10 Vdc control signal to the lighting dimmers, complete with sensors for:
 - a) daylight harvesting – to dim the lighting when sufficient daylight is available;
 - b) lumen maintenance – to maintain a constant lumen output even as lamps age;
 - c) motion detection – to dim the lighting when there is no occupancy of the space;
 - d) door entry switches – to brighten the lighting when someone enters the area;
 - e) timers – to dim the lighting on a preset schedule;
3. Install and connect control system according to the specifications and drawing for this project.

C. Operating Sequence

1. On initial power-up, each lighting dimmer shall go to 100% power output for 15 minutes to permit the lamp ballasts to strike and warm up the lamps.
2. After the initial 15 minute power-up, each dimmer shall then modulate it's power output from minimum power output to maximum power output linearly with the 0 to 10 Vdc control signal.
3. On loss of the control signal, the dimmers will go to their programmed minimum power settings to maintain lighting, but warn of a control signal failure.
4. Dimmer software shall contain algorithms to control the proper ramp up and down times to stay within manufacturer's recommendations for proper dimming of the lighting loads.
5. Specific operating control schemes:

III. Installation

A. General

1. All lighting dimmers shall be mounted in appropriate UL listed enclosures properly sized and ventilated in accordance with the dimmer manufacturer's specifications.
2. Lamp ballasts on the circuit to be dimmed by the ESD sinewave dimmers shall be of the magnetic or electronic type having a "passive" front end. "Active" front end ballasts shall not be used.
3. All wiring shall be in accordance with local and national electrical codes and manufacturer's recommendations.
4. All installation and wiring must be done by a qualified, licensed electrical contractor.

IV. Execution

A. General

1. Install the lighting dimmers as detailed in the installation drawings and schedules and/or as recommended by the manufacturer.
2. Manufacturer to furnish complete operating manuals with the product.
3. Start up of the system shall be by a qualified, factory trained representative or qualified, licensed contractor, and shall include a training session for owner's maintenance personnel if requested.
4. Lighting dimmers shall be the ESD series Sinewave dimmers as manufactured by:

Sinewave Energy Technologies, LLC
400 East Lancaster Avenue, Suite 300
Wayne, PA 19087
Ph: (610) 795-7436
Fax: (610) 646-0790
Email: info@sinewaveenergy.com

12. Warranty Terms & Conditions

These terms and conditions of Sinewave Energy Technologies' (Sinewave) warranty service ("Warranty Service") apply to machines that Sinewave has accepted for Warranty Service and that were originally purchased from Sinewave or a Sinewave remarketer.

The Warranty Service is automatically activated after Sinewave receives a completed warranty registration form within 30 days after installation. Sinewave warrants registered products to be free from defects in materials and workmanship in the course of normal and reasonable use for a period of 2 years from the date of installation or 2 years and 1 month from the date of shipment, whichever comes first, so long as the product has been installed and operated in accordance with all appropriate manuals and wiring diagrams, and installed and started up by a qualified and licensed electrician. No warranties, expressed or implied, will apply after this period.

To obtain Warranty Service, the Customer must contact Sinewave and receive a return authorization number and then promptly return the machine at the Customer's expense to Sinewave following Sinewave's instructions as to if, when and where to ship the machine. Failure to follow this procedure voids this warranty.

Replacement of Product, Limits of Liability

Upon a customer obtaining a return authorization number, Sinewave will ship an exchange machine to the customer, either upon receipt of a returned machine or prior to its return, at Sinewave's option. Should Sinewave evaluate a returned machine and determine in its reasonable sole judgment that the returned machine (i) is functional within its specifications, (ii) was defaced, altered, or damaged, or (iii) was not installed and operated in accordance with all appropriate manuals and wiring diagrams, then the Customer shall be liable for the full price of the exchange machine. Sinewave reserves the right to examine all failed products and to be the sole judge as to whether any products are defective and covered under this warranty.

The foregoing shall constitute the sole and exclusive remedy of the customer and the sole and exclusive liability of Sinewave, except that if economic damages are recovered by customer, they shall not exceed the original purchase price of the machine in question. NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE IS MADE OR IS TO BE IMPLIED. Sinewave will not, under any circumstance, whether as a result of breach of contract or warranty, tort, or otherwise, be liable for any incidental, special or consequential damages, including lost profits or revenues or any other costs or damages.

When exchange service is used, the returned machine becomes the property of Sinewave. At Sinewave's option, exchange machines may be new, repaired, or may be another new or repaired machine of equal or greater capabilities. The exchange machine becomes the property of the customer when the machine to be returned has been received by Sinewave, and the exchange machine assumes the remainder of the Warranty Service from the returned machine.

Copy and complete the following form. Then mail or fax to Sinewave Energy Technologies to register your warranty. This form is also available on-line at www.sinewaveenergy.com

13. Sinewave Energy Technologies Product Registration Form

Please photocopy the form below and use it to register any installation featuring Sinewave Energy Technologies products. The form is also available online at www.sinewaveenergy.com. The warranty coverage begins from the date of installation, but each Customer must register at installation in order to receive Warranty Service.

Installation Information:

Location Name: _____ Installation Date: _____

Address: _____

City, State, Zip: _____

Operating Hours: _____ hours/day _____ days/year Occupancy Sensors: Yes No

Send Registration Confirmation To:

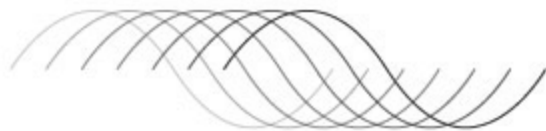
Contact Name: _____ Phone: _____ Email: _____

Address: _____

City, State, Zip: _____

All information on this form is kept strictly confidential and will not be sold or given to any third party.

ESD Series Dimmers



S I N E W A V E
ENERGY TECHNOLOGIES

400 East Lancaster Avenue
Suite 300
Wayne, PA 19087

610.795.7436
610.646.0790 fax
www.sinewaveenergy.com

Form: SET-IOM1-011408UL