

ED1G Grip-Style Enabling Devices

Three-position switches for enabling and hold-to-run applications

Original Instructions



Enabling switch (left), and
Enabling switch with integral momentary
pushbutton



- Three-position functionality (OFF-ON-OFF) as required for manual control of a machine
- Provides safety function when user either squeezes or releases the handgrip switch
- Ergonomic design with a detented enable position (position 2)
- Terminal 1-2 and 3-4 contacts will not re-close when released from fully squeezed (position 3)
- Ideally suited for use as an enabling device for robotic cells
- Optional momentary pushbutton switch (depending on model) that can provide hold-to-run, reset, or jogging/inching functions
- Built-in strain relief and M20x1.5 conduit connection
- Meets IP65 or IP66, depending on model
- Insulated device (IEC 60947-5-1) on all models
- Design meets or exceeds:
 - ANSI RIA R15.06 and ISO 10218 Robot safety standard
 - ANSI B11.19 Performance Criteria for Safeguards
 - ANSI NFPA 79 (2007) and IEC 60204-1 (2000) Electrical Requirements for Industrial Machines

Models

Model	Contact Configuration	Additional Switch	Environmental Rating
ED1G-L21SM-1N	2 N.O. + 1 N.C. Aux	—	IP66
ED1G-L21SMB-1N	2 N.O. + 1 N.C. Aux + 1 N.O. Momentary pushbutton	Momentary pushbutton	IP65
ED1G-L20MB-1N	2 N.O. + 2 N.O. Momentary pushbutton		



WARNING: Not a Safeguarding Device

An Enabling Device is not considered a safeguarding device, because it requires an overt action by an individual to stop machine motion. (A safeguarding device limits or eliminates an individual's exposure to a hazard, *without action by the individual or others.*)

Because an individual must actuate the device for it to function, these devices do not fit the definition of a safeguarding device and cannot be substituted for required safeguarding. Refer to the relevant standards to determine those requirements.



Important . . . Read This Before Proceeding!

It is the responsibility of the machine designer, controls engineer, machine builder and/or maintenance electrician to apply and maintain this product in full compliance with all applicable regulations and standards. The product can provide the required safeguarding function only if it is properly installed, properly operated, and properly maintained. This manual attempts to provide complete installation, operational, and maintenance instruction. *Reading the manual completely is highly recommended.* Please direct any questions regarding the application or use of the product to a Banner Engineering Applications Engineer at the locations listed in this document.



WARNING: User Responsibility

The user is responsible for ensuring that all local, state, and national laws, rules, codes, and regulations relating to the use of this product in any particular application are satisfied. Extreme care is urged that all legal requirements have been met and that all installation, operation, and maintenance instructions contained in the product documentation are followed.

Applicable Standards (List is Not All-Inclusive)

U.S. Application Standards

ANSI B11.0 General (Safety) Requirements and Risk Assessment

ANSI B11.19 Performance Criteria for Safeguarding

ANSI NFPA 79 Electrical Standard for Industrial Machinery

ANSI/RIA R15.06 Safety Requirements for Industrial Robots and Robot Systems

ANSI/PMMI B155.1 Package Machinery and Packaging-Related Converting Machinery — Safety Requirements

International/European Standards

ISO 12100-1 & -2 (EN 292-1 & -2) Safety of Machinery – Basic Concepts, General Principles for Design

IEC 60204-1 Electrical Equipment of Machines Part 1: General Requirements

IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems

ISO 62061 Functional Safety of Safety-Related Electrical, Electronic and Programmable Control Systems

ISO 13849-1 (EN 954-1) Safety-Related Parts of Control Systems

ISO 13855 (EN 999) The Positioning of Protective Equipment in Respect to Approach Speeds of Parts of the Human Body

ISO 14121 (EN 1050) Principles of Risk Assessment

These and other standards are available from:

OSHA Documents: <http://www.osha.gov> (Tel: 202.512.1800)

American National Standards Institute (ANSI): <http://www.ansi.org> (Tel: 212.642.4900)

Robotics Industries Association (RIA): <http://www.robotics.org> (Tel: 734.994.6088)

National Fire Protection Association (NFPA): <http://www.nfpa.org> (Tel: 800.344.3555)

NSSN National Resource for Global Standards : <http://www.nssn.org/> (Tel: 212.642.4980)

IHS Standards Store: <http://www.global.ihs.com/> (Tel: 303.397.7956, 800.854.7179)

Document Center: <http://www.document-center.com/home.cfm> (Tel: 650.591.7600)

Overview

An enabling device is a manually operated control device which, when continuously activated and used in conjunction with a separate actuating (start) control, will allow the machine to function in manual operating mode (e.g. inch/jog, slow speed, not automatic/production mode). **The enabling device permits (i.e., enables) the machine to run, but does not start the cycle; a separate signal is needed to start the hazardous motion.** Sometimes called the "live man pendant," the enabling device must initiate an immediate stop of the hazard when released or fully squeezed by the operator.

In operation, the operator holds the three-position switch and presses lightly but firmly to enable the machine to run (position 2). In position 1, the switch is not activated, and in position 3, the switch is pressed beyond the enable position. In positions 1 and 3, the switch opens contacts 1-2 and 3-4, which removes power from the machine control, stopping the machine. Releasing the switch from position 3 to position 1 will not reclose the safety outputs until the switch is actuated from position 1 to position 2.

Models with the momentary switch may be used to control a machine function, such as an inch/jog button, or a hold-to-run control. Hold-to-run control initiates and maintains machine function only as long as the manual control (actuator) is actuated.

For hold-to-run applications, both the three-position switch and the normally open momentary switch must be continually engaged to allow machine operation. If multiple individuals are exposed to the hazard, only a single individual can be in command of the hold-to-run control or other means of starting the machine function or cycle. **All individuals within the hazard area must be provided their own enabling device or otherwise be safeguarded.** Each enabling device must be concurrently operated before machine motion can be initiated.

The enabling device is not considered to be an emergency stop device, but if performing an emergency stop function or if interfaced with the emergency stop circuit, the installation must comply with ANSI NFPA 79, IEC 60204-1 or the relevant regulations/standards. Emergency stop device(s) must be continuously operable and readily accessible, and must not be muted or bypassed.

Only qualified and authorized personnel who have been trained in the use of the device, and hazards associated with the task requiring the use of the device, may be allowed to operate the enabling device. Safe work procedures must include, but are not limited to, the use of the device, the associated hazards, and the task requiring the use of the device.

The enabling device must control all hazards that can be accessed by the individual operating the device. Care must be taken that additional hazards that can be created by the machine's function are controlled and that the individual is aware of these additional hazards, for example: the actuation of the enabling switch and the hold-to-run command causes the movement of a workpiece that causes a part-position sensor to index another workpiece that may not be within the individual's field of view. This situation could result in the individual being struck by the indexing workpiece.

The means to return the machine to production mode must be located outside of, and out of reach from within, the hazardous area, and be guarded against unintended operation. In addition, the reset switch operator must have full view of the entire guarded area and verify that the area is clear of individuals during the reset procedure.

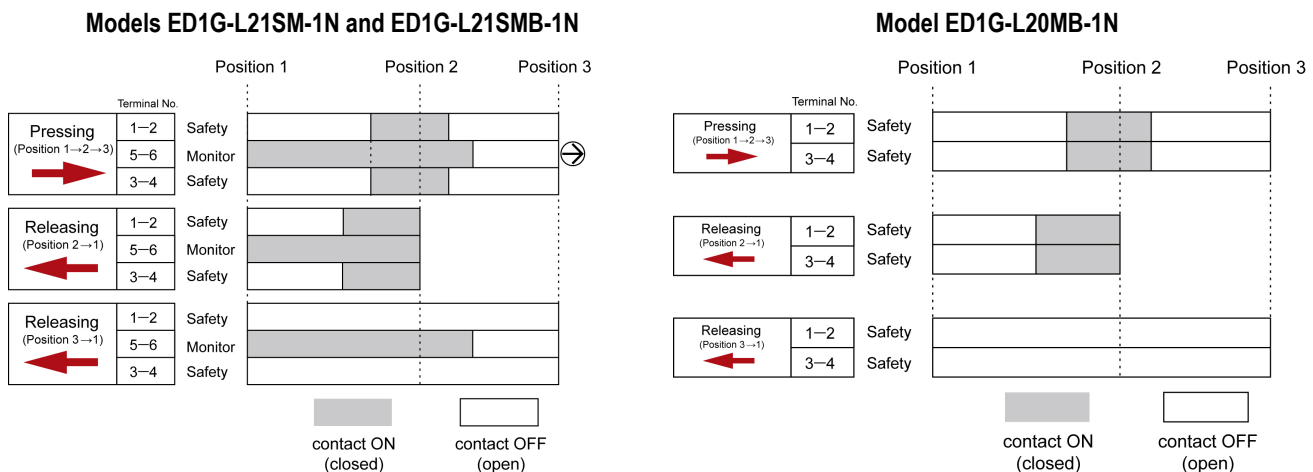


Figure 1. Contact status when grip switch is operated



WARNING: Qualified Personnel

Only qualified and authorized personnel who have been trained in the use of the device, and hazards associated with the task that requires the use of the device, may be allowed to operate the enabling device and must follow safe work procedures.

Bypassing Safeguards

"Bypassing" or "overriding" a safeguarding device is the manual interruption or suspension of the normal function of a safeguard under supervisory control. It is typically accomplished by selecting a bypass mode of operation using a key switch to facilitate machine setup, web alignment/adjustments, robot teach, and process troubleshooting.

Minimum requirements to bypass a safeguarding device include*:

- The bypass function must be temporary.
- The means of selecting or enabling the bypass must be capable of being supervised.
- Automatic machine operation must be prevented by limiting range of motion, speed, or power (e.g., only used in inch, jog, or slow-speed modes). Bypass mode must not be used for production.
- Supplemental safeguarding must be provided. Personnel must not be exposed to hazards.
- The means of bypassing must be within full view of the safeguard to be bypassed.
- Initiation of motion should only be through a hold-to-run type of control.
- All emergency stops must remain active.
- The means of bypassing must be employed at the same level of reliability as the safeguard.
- Visual indication that the safeguarding device has been bypassed must be provided and be readily observable from the location of the safeguard.
- Personnel must be trained in the use of the safeguard and in the use of the bypass.
- Risk assessment and risk reduction (per the relevant standard) must be accomplished.
- The reset, actuation, clearing, or enabling of the safeguarding device must not initiate hazardous motion or create a hazardous situation.

* This summary was derived from the following and other sources: ANSI NFPA79, ANSI/RIA R15.06, ISO 13849-1 (EN954-1), IEC60204-1, and ANSI B11.19.



WARNING: Intentional Defeat

Do not defeat the protective function of the enabling switch. Using tape, string or other means to keep the switch in position 2 without its being actuated by an individual **can create an unsafe condition which could result in serious injury or death.**



WARNING: Emergency Stop Functions

Do not mute or bypass any Emergency Stop device. ANSI NFPA79 and IEC/EN 60204-1 require that the Emergency Stop function remain active at all times.

Lockout/Tagout

In machine maintenance and servicing situations in which the unexpected energization, start up, or release of stored energy could cause injury, OSHA 29CFR1910.147 “The control of hazardous energy (lockout/tagout)” or ANSI Z244.1 “Lockout/Tagout of Energy Sources” must be adhered to. The user must refer to these standards to ensure that bypassing a safeguarding device does not conflict with the requirements that are contained within that standard.



WARNING: Limit Use of Bypass Function

The Bypass function is not intended for production purposes; it is to be used only for temporary or intermittent actions, such as to clear the defined area of a safety light screen if material becomes "stuck". When Bypass is used, it is the user's responsibility to install and use it according to relevant standards (such as ANSI NFPA79 or IEC/EN60204-1).

Mechanical Installation

Provision to secure the enabling device is recommended and may be required as part of ensuring that the operation of the enabling device can be supervised. The enabling device must not be affected by environmental conditions. See Specifications.

Install the enabling device so that it is protected against inadvertent operation (e.g., accidental actuation by being bumped or leaned against). All mounting hardware is user-supplied.

Electrical Installation



WARNING: Shock Hazard and Hazardous Energy

Always disconnect power from the safety system (e.g., device, module, interfacing, etc.) and the machine being controlled before making any connections or replacing any component.

Electrical installation and wiring must be made by Qualified Personnel and must comply with the relevant electrical standards and wiring codes, such as the NEC (National Electrical Code), ANSI NFPA79, or IEC 60204-1, and all applicable local standards and codes.

Lockout/tagout procedures may be required. Refer to OSHA 29CFR1910.147, ANSI Z244-1, or the appropriate standard for controlling hazardous energy.

It is not possible to give exact wiring instructions for a device that interfaces to a multitude of machine control configurations. The following guidelines are general in nature.

Use a risk assessment to determine the method of interfacing this device. At a minimum, use the same level of safety performance (e.g., control reliability, category 3 or 4) for the safeguard being bypassed.

Do not simply connect the contacts of the enabling switch across the contacts of a bypassed safeguarding device (e.g., interlocked guard/gate, safety light screen) in a parallel connection. The enabling device(s) could be rendered ineffective by simply re-establishing the safeguarding device (closing the interlocked guard/gate, clearing the safety light screen).

At a minimum, the machine control must:

- Provide a means for supervising the selection of the enabling device in order to prevent unauthorized use or de-selection (disabling) while in use. Methods include key-operated controls, controls located under lockable covers, controls that require a password, or securing the enabling device(s) within lockable storage.
- Reduce risk to the individual using the enabling device by reducing machine performance (such as reducing speed, reducing power or force, or allowing only an incremental step-by-step operation, e.g., “inch/jog”).
- Provide visual means to indicate that the enabling device/function is active or has been selected.

- Allow only one actuating control to initiate a machine cycle or function when the enabling device is in use, in order to prevent unexpected machine function.
- Require each selected enabling device to concurrently operate before a machine cycle or function can be initiated.
- Cause an immediate stop of the machine or function when the enabling device is released or fully squeezed. The enabling device(s) must be re-actuated for the actuating control to be allowed to re-initiate a machine cycle or function.

The means of returning the machine control to automatic or production mode must be located outside the hazard zone, such that it can not be reached from within the hazard zone, and the reset procedure can not be allowed to occur until the hazard zone is clear of individuals and all safeguards are reestablished (in place and functioning).

Consideration for Reset Switches

The safeguarding device (or safety system) reset switch (if used) must be accessible only from outside, and in full view of, the hazardous area. Reset switches must also be out of reach from within the safeguarded space, and must be protected against unauthorized or inadvertent operation (e.g., through the use of rings or guards). If any areas are not visible from the reset switch(es), additional means of safeguarding must be provided.



WARNING: Reset Routine Required

U.S. and international standards require that a reset routine be performed after clearing the cause of a stop condition (e.g., arming an E-stop button, closing an interlocked guard, etc.). **Allowing the machine to restart without actuating the normal start command/device can create an unsafe condition which could result in serious injury or death.**

Connection of Multiple Switches

Multiple enabling devices connected to one safety module must be series connected (see wiring diagram and the following warning).



WARNING: Multiple Switching Devices

Whenever two or more devices are connected to the same safety module (controller):

- **Contacts of the corresponding pole of each switch must be connected together in series. Never connect the contacts of multiple switches in parallel.** Such a parallel connection defeats the switch contact monitoring ability of the Module and creates an unsafe condition which could result in serious injury or death.
- **Each device must be individually actuated (engaged), then released (or re-armed) and the safety module reset.** This allows the module to check each switch and its wiring to detect faults.

This check must be performed during the prescribed checkouts. **Failure to test each device individually in this manner could result in undetected faults and create an unsafe condition which could result in serious injury or death.**

Normally Open Momentary Pushbutton (on Some Models)

Models with the momentary switch option may be used to control a machine function, as an inch/jog button, or as a hold-to-run control.

Only one actuating control (e.g., the pushbutton) can initiate the machine function while the enabling device(s) is in use. To prevent unexpected machine function, the machine control must disable all other actuating controls such that the individual operating the enabling device has exclusive control.

Hold-to-run control initiates and maintains machine functions only as long as the pushbutton is actuated; release of the pushbutton must initiate an immediate stopping command. For hold-to-run applications, both the three-position switch and the momentary N.O. switch must be continually engaged to allow machine operation. If multiple individuals are within the cell or exposed to the hazard, only a single individual can be in command of the hold-to-run control or the means to initiate machine operation.

Making the Connections: Accessing the Wiring Chamber

To ensure the highest level of reliability, connect both contacts to a monitoring device, such as a safety module.

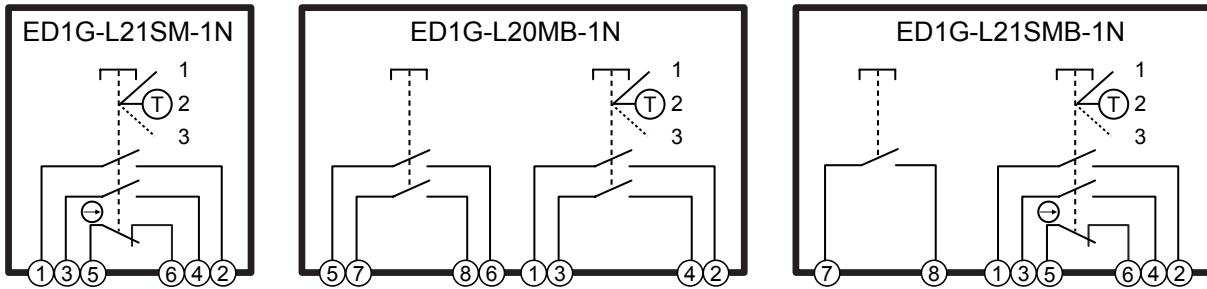


Figure 2. Terminal assignments (dependent on model)

1. Remove the cover from the switch by loosening the three M4 Phillips-head screws on the back of the housing.
2. Detach the cable gland from the housing.
3. Route the cables through the supplied cable gland and into the wiring chamber.
4. Strip the wire as required and secure into the appropriate screw terminals (torque: 0.5 to 0.6 Nm).

	Terminals 1 to 4	Terminals 5 to 8
Wire Length L1, L2	L1 = 40 mm	L2 = 27 mm
Wire Stripping Length L3	L3 = 6 mm	

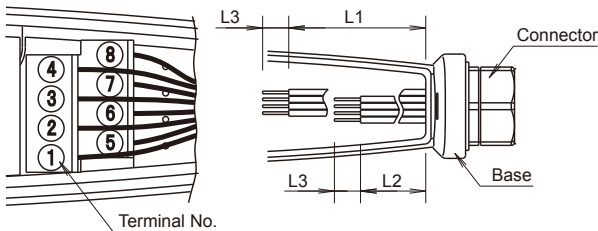


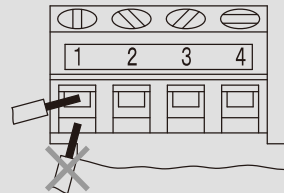
Figure 3. Wire lengths to terminal connections

5. Replace the cover and secure with the three screws (torque: 1.1 to 1.3 Nm).
6. Thread the cable gland onto the housing and manually tighten (torque: 3.7 to 4.3 Nm).



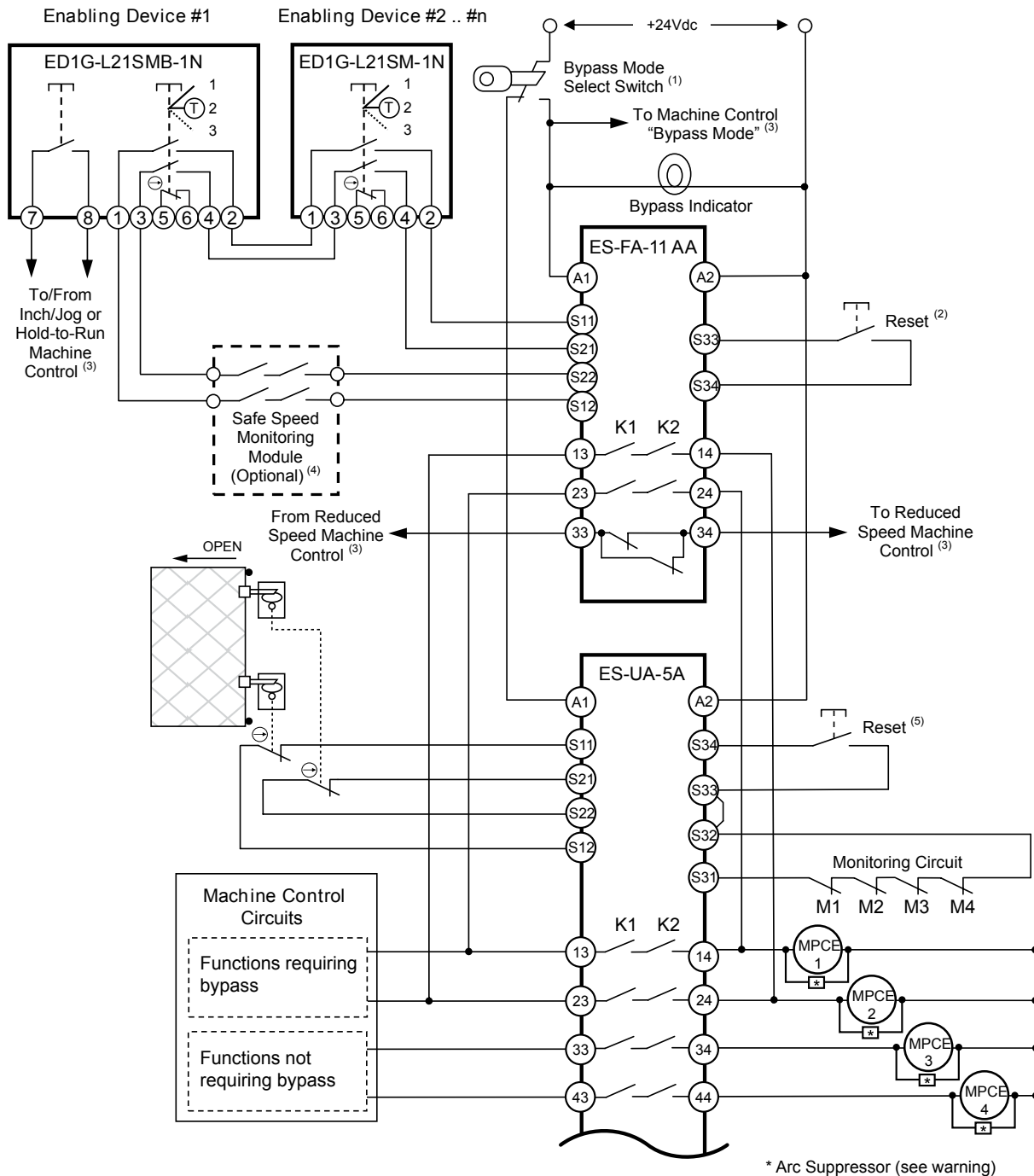
NOTE:

- Applicable cordset/cable outside diameter when used with supplied cable gland: 7 to 13 mm.
- Applicable wire size in terminal: 0.14 to 1.5 mm² (single wire).
- When using stranded wire, make sure that adjoining terminals are not short-circuited with protruding core wires. Use copper wire with a 60°-75° C rating only (UL508).
- When wiring to terminals, make sure to insert wires into the correct openings, as shown. If wired into the wrong openings (as marked with an X at right), the wires will not be properly clamped and electrical connection is not ensured.



Wiring Example; Gate Monitoring and Speed Monitoring Applications

See notes following figure.



1. Selection of the enabling device must be capable of being supervised.
2. In this example, the safety module monitoring the enabling device(s) is configured for manual reset, requiring a separate action before the bypass can occur.
3. Several signals are used to allow the bypass of the safeguard, including:
 - The Bypass Mode Selector switch sends a signal to the machine control to enter a reduced performance mode (e.g., inch/jog, slow speed, etc.),
 - The enabling switch (via the N.C. output of the ES-FA-11A safety module) "enables" the slow/reduced speed machine control function and bypasses the safeguard with the N.O. outputs, and

- The momentary N.O. button on the enabling device initiates the machine function.
4. Additional logic, such as a safe speed / zero speed signal, may be required to ensure that the operator(s) are not exposed to hazards generated from automatic machine operation.
 5. Multiple actions are required to return the machine to automatic or production mode, including closing the guard and resetting the guard-monitoring safety module.



WARNING: Wiring of Arc Suppressors

If arc suppressors are used, they MUST be installed as shown across the actuator coil of the stop control elements (MSCs or MPCEs). **NEVER install suppressors directly across the output contacts of the Safety Device or Module.** It is possible for suppressors to fail as a short circuit. If installed directly across the output contacts, **a short-circuited suppressor will create an unsafe condition which could result in serious injury or death.**

Checkout Procedures

Initial and Daily Checks

Verify the functioning of the enabling device at initial installation (by a *qualified person*), *daily or before each use* (by a *designated person*), and as part of the regular periodic checkout procedure listed below to ensure proper operation.

(A *qualified person* possesses a recognized degree or certificate or has extensive knowledge, training, and experience to be able to solve problems relating to the safety switch installation. A *designated person* is identified in writing by the employer as being appropriately trained to perform a specified checkout procedure.)

1. Inspect the device for breakage or damage and the interconnect cabling for crushing, cuts, or wear.
2. Inspect the device for loosening or damage to the mounting hardware or means of storage.
3. With the enabling device selected (e.g., bypass or maintenance mode, inch/jog) and the safeguard disabled (e.g., interlock gate/guard open), verify that:
 - The bypass indicator illuminates, and
 - Hazardous function(s) can not be initiated when the enabling device is not actuated (position #1).
4. Actuate the enabling device (squeeze to position #2) and initiate hazardous machine function(s). Verify that the hazardous function ceases when the device is released (returned to position #1) or fully squeezed (position #3).
5. **If more than one enabling device is used, perform this procedure individually for EACH device.**

Periodic Checks

A *qualified person* (as defined above) should check for the following on a periodic schedule determined by the user, based upon the severity of the operating environment and the frequency of switch actuations. At a minimum, this should take place once a year (lockout/tagout procedures for controlling hazardous energy may be required):

1. Inspect the wiring chamber for signs of contamination, deterioration, loose connections, or damage.
2. Inspect the sealing at the cable entry and all electrical wiring for continuity and damage.
3. Verify that wiring and installation conforms to the instructions in this document and that there are no signs of tampering or defeat.
4. Perform the initial checkout listed above.

See also the machine manufacturer's recommendations for additional instructions. **If any of these checks cannot be verified, do not attempt to use the enabling device until the defect or problem has been corrected.**

Specifications

Supply Voltage and Current

250V ac/dc

Impulse Withstand Voltage

3-position switch: 2.5 kV

Momentary pushbutton: 1.5 kV

Output Contact Ratings

See table below.

Rated Thermal Current (I_{th}):

2.5 A*

*For the following operating temperatures:

40°C ≤ 50°C: 2 A (4 contacts under load)

50°C ≤ 60°C: 1.5 A (3 contacts under load)

Contact Resistance

100 mohm max.

Insulation Resistance

Live to dead metal parts: 100 Mohm min.

Positive to negative live parts: 100 Mohm min.

Recommended Wire/Cable Size

Wire: 0.14 to 1.5 mm² (25 AWG to 16 AWG)

Cable: ø 7 to 13 mm

M20 conduit

Short Circuit Protection

250V / 10A fast blow fuse (IEC 60127-1)

Conditional short circuit current: 50 A (250V)

Vibration Resistance

Operating extremes: 5 to 55 Hz, half amplitude 0.5 mm minimum

Damage limits: 16.7 Hz, half amplitude 1.5 mm minimum

Shock Resistance

Operating extremes: 150 m/s² (15 G)

Damage limits: 1,000 m/s² (100 G)

Direct Opening

(Terminals 5 and 6 models ED1G-L21SM-1N and ED1G-L21SMB-1N)

Actuating Force: 70 N minimum

Travel: 4.7 mm minimum

Date code format:

YYWWX: 2-digit year, 2-digit week, "X" internal code

Mechanical Life

Positions 1 & 2 only: 1,000,000 operations minimum

Positions 1, 2 & 3: 100,000 operations minimum

Operating frequency: 1,200 operations per hour maximum

Electrical Life

100,000 operations minimum at rated load

Pollution Degree

3

Terminal Pulling Strength

20 N minimum

Terminal Screw Torque

0.5 to 0.6 Nm

Operating Conditions (indoor use only)

Temperature: -10° to +60° C (no freezing)

Humidity: 45 to 85% RH max. (no condensation)

Storage Temperature: -40° to +80° C (no freezing)

Construction

Polyamide housing and cable gland, NBR/PVC polyblend rubber grip switch boot; model **ED1G-L21SM-1N** meets IP66; other models meet IP65

Applicable Standards

Design Standards: IEC 60947-5-1, EN 60947-5-1, JIS C8201-5-1, UL 508, CSA C22.2 No. 14, GS-ET-22

Application Standards: ISO 12100/EN ISO 12100, IEC 60204-1/ EN 60204-1, ISO 11161/EN ISO11161, ISO10218-1/EN ISO10218-1, ANSI/RIA/ISO 10218-1, ANSI NFPA 79, ANSI/RIA R15.06, ANSI B11.19, ISO 13849-1/EN ISO 13849-1

Certifications



Ratings approved by Safety Agencies

TÜV rating: AC-15 250V ac 0.5A; DC-13 125V dc 0.1A; Applicable EC Directives: LOW Voltage Directive (2006/95/EC), Machinery Directive (2006/42/EC); Applicable EC Standard(s): EN60947-5-1, GS-ET-22

UL, c-UL rating: 250V ac, 0.5A Pilot Duty; 125V dc, 0.1A Pilot Duty, Ambient Temperature +40°C, Environmental Rating Type 4X, Indoor Use Only. UL has only investigated this device for shock and fire to UL508.

Output Contact Ratings

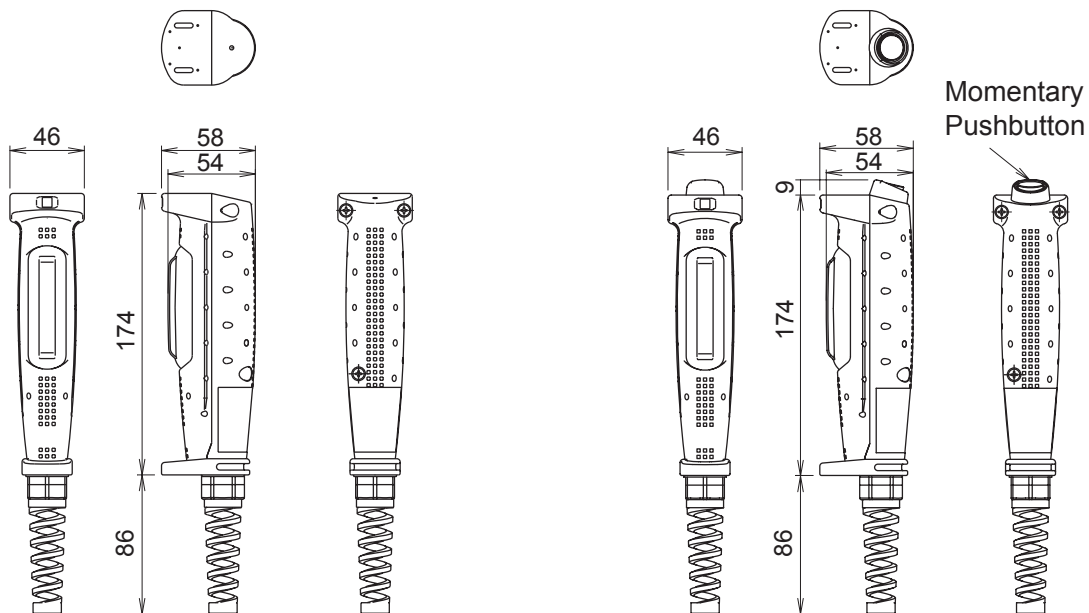
Rated Insulation Voltage (UI)			3-position switch: 250V Momentary pushbutton: 125V		
Rated Thermal Current (Ith)			2.5 A		
Rated Voltage Ue			30V	125V	250V
Rated Current (Ie) 3-position switch Terminals 1-2 and 3-4	AC	Resistive load (AC-12)	—	1 A	0.5 A
		Inductive load (AC-15)	—	0.7 A	0.5 A
	DC	Resistive load (DC-12)	1 A	0.2 A	—
		Inductive load (DC-13)	0.7 A	0.1 A	—
Rated Current (Ie) Monitor switch Terminal 5-6	AC	Resistive load (AC-12)	—	2 A	1 A
		Inductive load (AC-15)	—	1 A	0.5 A
	DC	Resistive load (DC-12)	2 A	0.4 A	0.2 A
		Inductive load (DC-13)	1 A	0.22 A	0.1 A
Rated Current (Ie) Momentary push button switch Terminals 7-8 (model ED1G-L21SMB-1N); 5-6 and 7-8 (model ED1G-L20MB-1N)	AC	Resistive load (AC-12)	—	0.5 A	—
		Inductive load (AC-15)	—	0.3 A	—
	DC	Resistive load (DC-12)	1 A	0.2 A	—
		Inductive load (DC-13)	0.7 A	0.1 A	—

Dimensions

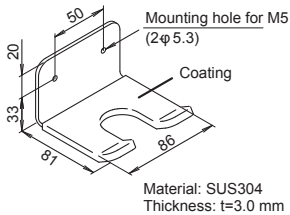
All dimensions in mm

Model ED1G-L21SM-1N

Models ED1G-L21SMB-1N and ED1G-L20MB-1N



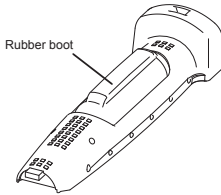
Accessory and Replacement Parts



Model

ED9Z-GH1 Right-angle bracket

Right-angle bracket mounts directly to upright surface, holds enabling switch for easy access when needed. All measurements in mm.



Model

ED9Z-GBK1-1N NBR/PVC gray Polyblend boot

Identical to original boot shipped with enabling device.

EC Declaration of Conformity

Banner Engineering Corp. herewith declares that the ED1G Series Enabling Device is in conformity with the provisions of the Machinery Directive (Directive 2006/42/EC), and all essential Health and Safety Requirements have been met. Download the complete EC Declaration of Conformity as a PDF file at www.bannerengineering.com/Enable_Device

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