GUIDE

Pilot Devices

Modular Plastic, Metal and Compact Range

Foreword

ABB is a pioneering technology leader in electrification products, robotics and motion, and industrial automation, serving customers in utilities, industry and transport, and infrastructure globally. Continuing a history of innovation spanning more than 130 years, ABB today is writing the future of industrial digitalization with two clear value propositions: bringing electricity from any power plant to any plug and automating industries from natural resources to finished products.

ABB offers a wide range of Pilot devices. We realize that with all the standards, rules, listings, and codes, what, when, where, why, and how of Pilot devices can appear complex.

The following information is provided to aid in the proper use of ABB Pilot devices and all their capabilities.

This guide is written to be a general guide for people working with Pilot device applications, but also for those who are simply interested in learning more about the products, standards, and applications. All these are relevant for European applications (based on IEC) and North American applications (UL / CSA).

The guide is neither a complete technical guide nor a manual for all types of ABB's motor starting solutions. It is a complement to the catalog, data sheets and brochures available for our products and will provide a general overview of what to consider when working with Pilot devices.

More information on Pilot devices as well as other ABB products is available at:
https://new.abb.com/low-voltage/products/pilot-devices

All the information provided in this guide is only general and each application must be handled as a specific case. Be sure to always follow all national and local installation regulations/codes for your specific application.

Safety and warnings

	This symbol in conjunction with the signal word "DANGER" indicates an imminent electrical hazard. Failure to observe the related safety note may cause personnel injury or death or equipment damage.
	This symbol in conjunction with the signal word "WARNING" indicates a potentially dangerous situation. Failure to observe the related safety note may cause personnel injury or death or equipment damage.
	This symbol indicates a safety note: "ATTENTION! Hazardous voltage!" Installation by a certified service engineer only."
	This symbol in conjunction with the signal word "NOTE" indicates operator tips, particularly useful or important information for the use of the product. This symbol and wording do not indicate a dangerous situation.
	This symbol indicates a compulsory action: "Reading the instruction manual/booklet before starting work or before operating equipment or machinery.
	Recycle.
	Do not dispose of this in ordinary trash.

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Introduction

ABB Pilot devices are engineered for total reliability. Their innovative design simplifies the entire process, from selection to installation.

1. Standards and approvals for Pilot devices

All ABB low voltage devices are developed and manufactured according to the rules set out in the IEC (International Electrotechnical Commission). The IEC issues publications that acts as a basis for the world market. The applicable standard is the IEC 60947 series for Europe and UL 60947 for North America. All devices are built according to this standard in most countries, they are not subject to any other tests besides the manufacturer's responsibility. In some countries, the law requires additional certification.

1.1 European directives applicable for Pilot devices

There are essential European directives:

- **Low Voltage Directive 2014/35/EU**
  Concerns electrical equipment from 50 to 1000 V AC and from 75 to 1500 V DC.
- **RoHS Directive 2011/65/EU**
  Restriction of the use of Certain Hazardous Substances in Electronical and Electrical Equipment

1.2 CE Marking

When a product is verified according to its applicable EN standard, the product is presumed to fulfill all applicable directives, e.g., the “Low Voltage Directive 2014/35/EU”, and it is allowed to apply the CE marking on the product.

In this case, the CE marking does not cover the “Machinery Directive, Directive 2006/42/EC” which requires a special verification of the installation of the machine. The Pilot device is an electrical device, with mainly electrical risks. It is instead covered by the low voltage directive.

The CE marking is not a quality label, it is a declaration from the manufacturer that the product conforms with all relevant European Directives concerning the product.

1.3 Standards for North America

Specifications for the North American and Canadian markets are similar but differ from IEC standards and European specifications. In Chapter 7. Requirements for North America, this topic will be described in more detail.

The USA - UL Underwriters Laboratories Inc.

Canada - CSA Canadian Standards Association

There are different types of UL certification, including UL listed and UL component recognition. UL Listing means that UL has tested representative samples of the product and determined that it meets UL’s requirements. UL’s component recognition service, however, only covers the evaluation of components or materials intended for use in a complete product or system. All ABB Pilot devices that have UL certification, are UL listed. Pilot devices can also be cULus listed, meaning that they are UL listed to US and Canadian safety standards. All the requirements of both UL and CSA are covered by cULus, so the product is then suitable for use in the US and Canada.

In the U.S., the most common Pilot device sizes are 30 mm (70 %) and 22 mm (25 %). Regardless of the hole size, the operator surfaces are about the same size for either a 30 mm or 22 mm device. The 22 mm devices save panel space, are generally less expensive and are great for OEMs shipping overseas as 22 mm is the international standard. In addition to our 22 mm product size, ABB has a 30 mm adaptor available for using 22 mm devices in a 30 mm application.

1.4 CCC (China Compulsory Certification)

Since the Pilot devices standard is listed according to the CCC regulation in China, it is mandatory to have the product approved and labeled with a CCC mark to be allowed to be put on the Chinese market. The Chinese GB14048.1 GB14048.5 standards are based on the IEC-standard IEC 60947-1 and IEC 60947-5-1.

1.5 Other local approvals based on IEC-standard

In addition to IEC and UL standards, many countries have their local certifications. Some examples of the major ones besides the already mentioned CSA and CCC are listed below:

- **UKCA –** The **UK Conformity Assessment** is the product marking system intended to replace CE marking for the GB market (England, Wales and Scotland)
- **C MIM –** The CMIM MARKING for safety conformity of industrial products and toys in Morocco
- **RCM –** The **Regulatory Compliance Mark** for Australian & New Zealand
- **NOM –** The **Norma Oficial Mexicana**
- **KC –** The **Korea Certification** mark

1.6 Marine approvals

For Pilot devices used on board ships, maritime insurance companies sometimes require different marine certificates of approval. Some examples include DNV GL (Det Norske Veritas together with Germanischer Lloyd), BV (Bureau Veritas), LR (Lloyds Register EMEA) which are based on the IEC standard, or from ABS (the American Bureau of Shipping) which is based on UL standards or some other independent certification organization. Typically, marine approvals have special requirements regarding shock, vibrations, and humidity.

1.7 Applied standards

Following standards are used or partly used for ABB's Pilot devices.

International and European standards

IEC / EN 60947-1	Low-voltage switchgear and controlgear - Part 1: General rules
IEC / EN 60947-5-1	Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices
IEC / EN 60947-5-5	Low-voltage switchgear and controlgear - Part 5-5: Control circuit devices and switching elements - Electrical emergency stop device with mechanical latching function
IEC / EN 60073	Basic and safety principles for man-machine interface, marking and identification - Coding principles for indicators and actuators
IEC / EN 60529	Degrees of protection provided by enclosures (IP Code)
EN 50013	Low Voltage switchgear and controlgear for industrial use, terminal marking and distinctive number for control switches

Standards for North America

UL 508	Industrial control panels

Standards for Canada

CSA C22.2 No 14	Industrial control panels

Applied standards for the Pilot devices

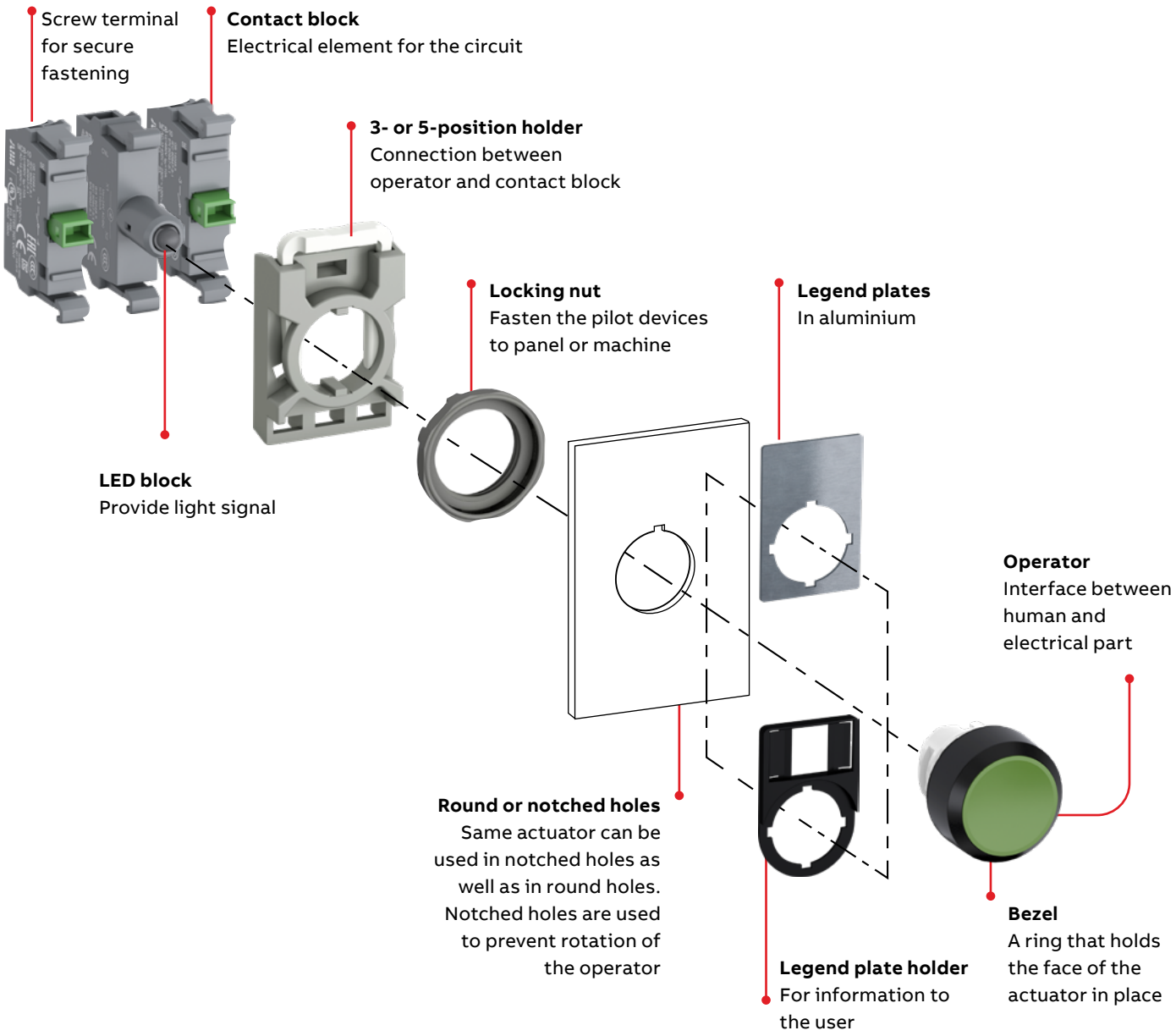
2. General product overview

2.1 Basic function

Pilot devices is one kind of Human Machine Interface. They are commonly used in various industrial applications for control and signal purposes. Pilot devices are a family of various pushbuttons, selector switches, emergency stops, pilot lights, joysticks, toggle switches, and other indicators and signaling devices. It represented by the choice of different mounting diameters like 30mm, 22.5mm. They are designed to be easily actuated, making a convenient and reliable way to control and monitor all types of equipment, processes, and machinery.

2.2 General overview of the design

2.2.1 General overview of the Modular Plastic range



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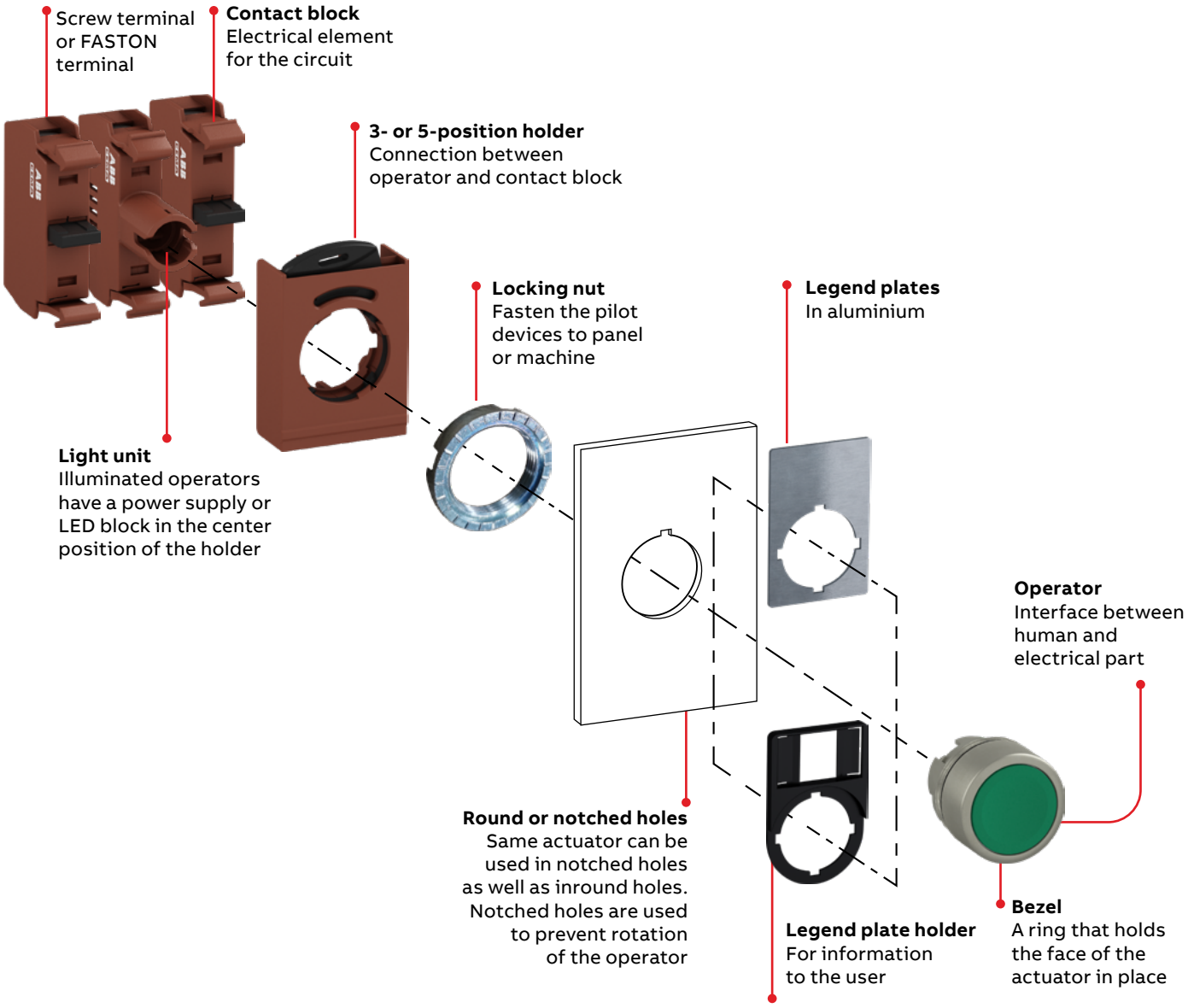
2.2.2 General overview of the Modular Metal range



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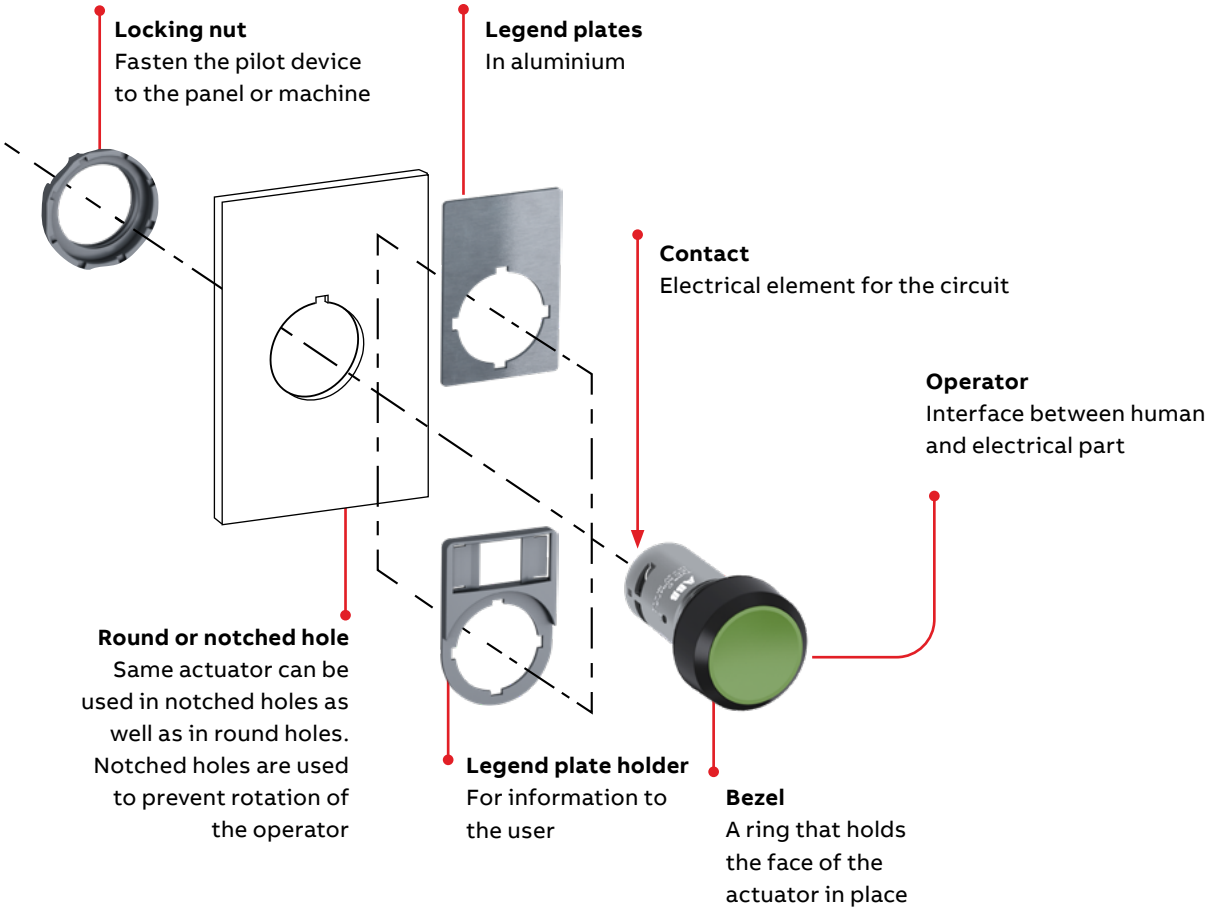
2.2.3 General overview of the Compact range



2.3 Overview of operators

Pilot devices are available in many shapes and sizes based on their functionality and application. Some common Pilot devices and their applications are further discussed below:

	**Pushbutton** - a control switch having an actuator intended to be operated by force exerted by a part of the human body, usually the finger or palm of the hand, and having stored energy (spring) return. Could be non-illuminated or illuminated by incorporating signaling light.
	**Heavy-duty Pushbutton** - a pushbutton for use in cold, hot, damp, oily and other tough environments. Suitable especially for hydraulic lifts, compact pendant controllers and pushbutton stations.
	**Double Pushbutton** – a pushbutton that combines two operators. Could be non-illuminated or illuminated by incorporated signaling light.
	**Mushroom Pushbutton** – a button where the protruding end has an enlarged diameter. Could be non-illuminated or illuminated by incorporating signaling light.
	**Machine stop pushbuttons** – a pushbutton with mechanical latching function. Used to switch off parts of machinery to prevent a dangerous situation to occur.
	**Emergency stop pushbuttons** – a pushbutton with mechanical latching function. Used to switch off machinery in case of emergency or to prevent a dangerous situation to occur.
	**Selector Switch** – a combination of push-button type switching elements having an actuator operated by a manual rotation. Could be non-illuminated or illuminated by incorporating signaling light.
	**Selector pushbutton** – a device that combines pushbutton and selector switch
	**Toggle switches** – A special form of selector switch. Used for multiple commands in one control device, or also when maintained control is desired. The user must flip up and down the switch to the desired position for this.
	**Keyed Selector Switch** – a selector switch where a key is used as the actuator.
	**Joystick** – a control switch having an actuator consisting of a pin or stick projecting essentially at a right angle from the panel or enclosure. The stick can be moved up/down and left/right.
	**Pilot light** – light signal giving information by turning on/off the signaling light.
	**Reset buttons** – buttons, sometimes together with a long shaft, reset a mechanical trip latch without opening the door. These are commonly used on the enclosures of our combination starters to reset a tripped overload relay.
	**Potentiometer** – component for use as a voltage divider with three terminals of which two are connected to the ends of a resistive element and the third is connected to a moving contact which can be moved mechanically along the resistive element

2.4 Color Coding and Marking of actuators

2.4.1 Color Coding

IEC 60204-1 and IEC 60073 give the principles of color coding for pilot devices.

Push-button actuators:

Color	Condition of process	Explanation	Examples
Red	Emergency	Actuated in the event of a Hazardous condition or emergency	Emergency stops
Yellow	Abnormal	Actuated in the event of an abnormal condition	Devices that intervene to suppress an abnormal condition, devices that intervene to restart an interrupted automatic cycle
Green	Normal	Actuated to initiate a normal condition	START/ON
Blue	Mandatory significance	Actuated for a condition requiring mandatory action	Reset function
White	No specific meaning assigned	For general initiation of functions except for emergency stop	START/ON (preferred) STOP/OFF
Black	No specific meaning assigned	For general initiation of functions except for emergency stop	START/ON STOP/OFF (preferred)

Pilot/indicator lights:

Color	Condition of process	Explanation	Examples
Red*	Emergency	Hazardous condition	Immediate action to deal with hazardous conditions (e.g., by operating the emergency-stop)
Yellow	Abnormal	An abnormal condition or impending critical condition	Monitoring and/or intervention (e.g., by reestablishing the intended function)
Green	Normal	Normal condition	Optional
Blue	Mandatory significance	Indication of a condition that requires action by the operator	Mandatory action
White	No specific meaning assigned	Other conditions, may be used whenever doubt exists about the application of other colors	Monitoring

*Note: Some market segments (such as automotive) have adopted a RED “run” Pilot light indicator standard in which red indicator lights illuminate when machinery is operating in a potentially unsafe condition

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2.4.2 Typical colors in applications

START / ON operators
WHITE, GREY and BLACK are the preferred colors for START / ON actuators, which cause the closing of switching devices and the equipment to start, with the main preference being for WHITE. GREEN is also permitted. RED shall not be used.

STOP / OFF operators
WHITE, GREY and BLACK are the preferred colors for STOP / OFF actuators, with the main preference being for BLACK. RED is also permitted, but it is recommended that RED is not used near an emergency stop device.. GREEN shall not be used.

Alternating ON/OFF
WHITE, GREY, or BLACK are the preferred colors for actuators that alternately act as START/ON and STOP/OFF actuators. The colors RED, YELLOW, or GREEN shall not be used.

EMERGENCY-STOP operators
Shall be identified by the color RED. RED color shall not be used for any other push-button.

Reset operators
Shall be BLUE, WHITE, GREY, or BLACK. Where they also act as a STOP/OFF actuator, the colors WHITE, GREY, or BLACK are preferred with the main preference being for BLACK. GREEN shall not be used.

YELLOW is reserved for use in abnormal conditions, for example, in the event of an abnormal condition of the process, or to interrupt an automatic cycle.

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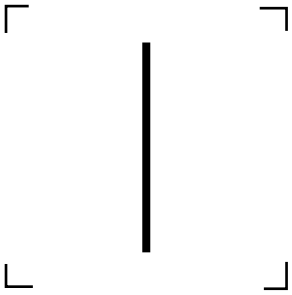
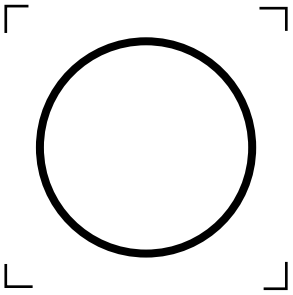
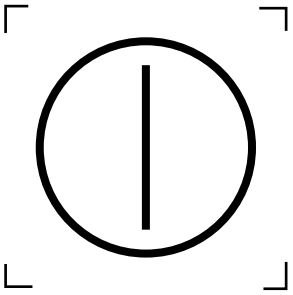
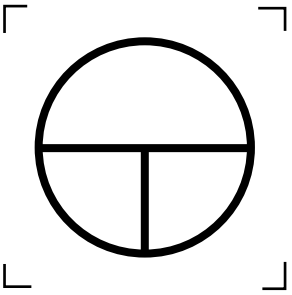
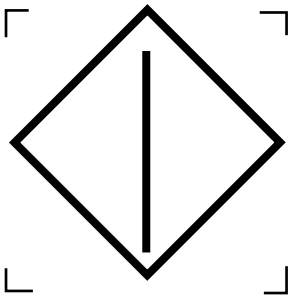
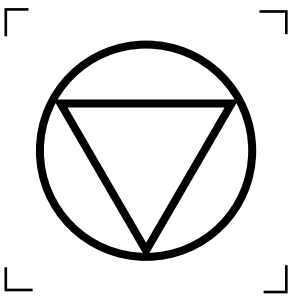
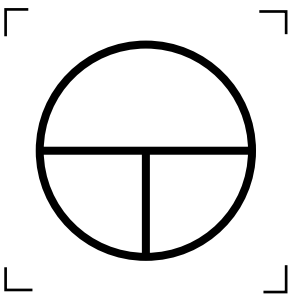
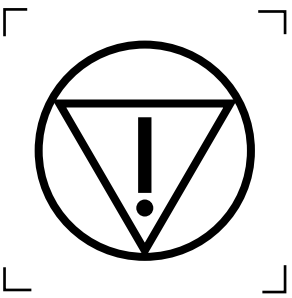
2.4.3 Markings

In cases where suitable graphical symbols are standardized in IEC 60417, mechanical indicators shall be marked with those symbols. If additional symbols are required these shall be consistent with IEC 60417 or with ISO 7000. If no suitable symbol is standardized, the indicator may be marked with a new task-related symbol, or in complete words, or recognized abbreviations.

Some of the symbols that are recommended to be placed near to or preferably directly on certain actuators are given below.

Power			
ON	**OFF**	**ON/OFF (push on-push off)**	**ON (hold-to-turn)**
IEC 60417-5007 (2002-10)	**IEC 60417-5008 (2002-10)**	**IEC 60417-5010 (2002-10)**	**IEC 60417-5011 (2002-10)**
			

Symbols for actuators used for Machine operation

Machine operation			
START	**STOP**	**HOLD-TO-RUN**	**EMERGENCY STOP**
IEC 60417-5104 (2006-08)	**IEC 60417-5110A (2004-06)**	**IEC 60417-5011 (2002-10)**	**IEC 60417-5638 (2002-10)**
			

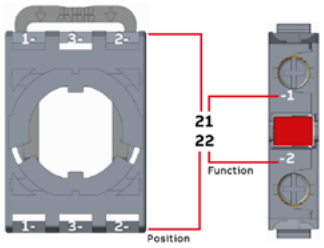
Colors on mechanical indicators with graphical symbols or words have no specific meaning and are only used to create a contrast between graphical symbols or letters of words and their background to give good readability.

2.4.4 Terminals marking

Terminal marking, distinctive number and distinctive letter for control circuit devices are prescribed by the IEC 60947-5-1 Annex M. Terminal marking is based, in principle, on a two-digit number. The first digit is an ascending sequence number independent of the contact function. Terminals belonging to the same contact are marked with the same sequence digit. The second digit indicates the individual terminals on a single contact block.

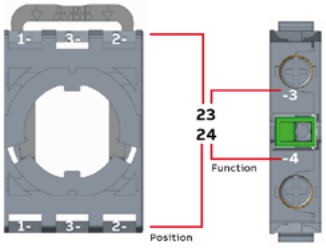
Modular range provides clear marking indication on the holder and contact blocks to identify a terminal marking number of a contact element.

Example below shows two contacts of NO contact 13 and 14. First digit 1 comes from the MCBH-00 holder. The second digit 3 and 4 comes from the MCB-10 contact block.



Combined markings

11	31	21
12	32	22



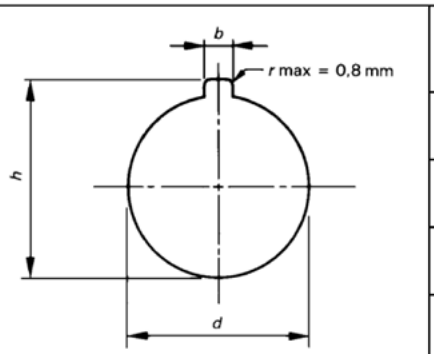
Combined markings

13	33	23
14	34	24

For compact range, the terminal marking is printed on cable entry point (See image to the right).

2.4.5 Mounting of single mounted device

The single hole mounted pushbuttons and indicator lights are in a circular hole of the panel, which may have a rectangular recess for a key. The standardized position of the key is in the up position (12 o'clock) and associated with the b dimension on the given below table. The Compact, Modular plastic and Modular metal ranges have D22 mounting size and they are equipped with a pin to be fitted with the key, however they also fit a circular hole without the key.



Size	Mounting hole diameter, *d* mm	Key recess (if any)	
		Height, *h* mm	Width, *b* mm
D30	$30,5^{+0,5}_{0}$	$33,0^{+0,5}_{0}$	$4,8^{+0,2}_{0}$
D22	$22,3^{+0,4}_{0}$	$24,1^{+0,4}_{0}$	$3,2^{+0,2}_{0}$
D16	$16,2^{+0,2}_{0}$	$17,9^{+0,2}_{0}$	$1,7^{+0,2}_{0}$
D12	$12,1^{+0,2}_{0}$	$13,8^{+0,2}_{0}$	$1,7^{+0,2}_{0}$

Mounting hole diameter and dimensions of the key recess (if any)

When several devices of the sizes given in the table above are mounted in rows on a panel, the distances a between the mounting centers in the same row and b between the center lines of the rows shall be not less than those given in the table below. Distances a and b may be interchanged.

Size	*a* mm	*b* mm
D30	50	65
D22	30	50
D16	25	25
D12	20	20

Minimum preferred distances between centers of mounting holes

2.5 Protection degrees of the enclosure

2.5.1 Ingress Protection IP Code according to IEC-Standard

The IEC 60529 standard describes a system for classifying the degrees of protection provided by the enclosures of electrical equipment with a rated voltage not exceeding 72.5 kV, and introduces the International Protection Code (IP code). The IP Code indicates the level of ingress an electrical device is protected against. The first digit defines degrees of protection against solid particles. The second digit indicates the degree of protection provided by enclosures with respect to harmful effects on the equipment due to the ingress of water.

If there is an X in the IP code, this means that no statement is made for this subrange. Example: IPX5 means that the device is protected against water jets, whether there is protection against contact is not known. For solid objects the protection is cumulative, eg., a higher degree of protection includes the protection given by lower numbers. For liquids the protection is not cumulative beyond level 6. IPX7, protection against submersion, does not include protection against splashing water and water jets.

Ingress Protection against solid foreign objects	I	P	Ingress Protection against water
omitting first characteristic numeral means	x	x	omitting second characteristic numeral means
no protection	0	0	no protection
protected against access with the back of the hand (diameter > 50 mm, 2.0 in)	1	1	protection against vertically dripping water
protected against access with a finger (diameter > 12.5 mm, 0.49 in)	2	2	protection against falling dripping water 15° tilted
protected against access with a tool (diameter > 2.5 mm, 0.098 in)	3	3	protected against water sprayed at an angle up to 60°
protected against access with a wire (diameter > 1 mm, 0.039 in)	4	4	protection against splashing water from any direction (shower tube with up to 150 kPa pressure)
dust-protected	5	5	protection against water jets from any direction (nozzle 6.3 mm diameter, 30 kPa)
dust-tight	6	6	protection against powerful water jetting from any directions (nozzle 12.5 mm diameter, 100 kPa)
		7	protection against temporary immersion (30 min., 1 m)
		8	protection against continuous immersion in water
		9	protection against high pressure and temperature water jet from any directions (fan jet nozzle, 80 ˚C, distance 175 mm)

In addition to the IEC 60529 standard, more protection degree Codes were introduced by ISO 20653. The ISO 20653 is a “Road vehicles – Degrees of protection (IP code) – Protection of electrical equipment against foreign objects, water, and access” standard.

The IP codes used in ISO 20653 International Standard are in accordance with IEC 60529, except in the case of codes “K”, which describe special requirements for road vehicles that are not covered by IEC 60529.

Ingress Protection against solid foreign objects	I	P	Ingress Protection against water
dust in quantities which do not impair performance and safety	5K	4K	protection against splashing water with increased pressure from any direction (approx. 400 kPa)
dust does not penetrate	6K	6K	protection against high-velocity water jetting with increased pressure from any directions (nozzle 6.3 mm diameter, 1000 kPa)
		9K	protection against high pressure / steam-jet cleaning water from any directions (fan jet nozzle, min. 8000 kPa pressure, 80 ˚C, distance 150mm)

In this table:
- 4K refers to an engine compartment open and exposed underneath locations, external attachments of the passenger, commercial, special vehicles, motor buses, road tractors and trailers.
- 6K refers to the locations which are hit by very strong water jets (e.g. during cleaning before repairs, services) of the commercial, special vehicles, motor buses, road tractors and trailers.
- 9K refers to all type of vehicles with the any mounting location except passenger compartment. Cleaning process with high pressure / steam jet cleaning is expected.

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2.5.2 Enclosure Types according NEMA, UL, and CSA Ratings

The NEMA, UL and CSA standards provide a scheme for classifying the degrees of protection offered by enclosures for electrical equipment. Their classifications are based on similar application specifications and performance requirements. Both UL and CSA require that enclosures be tested by qualified testers. NEMA, meanwhile, does not require independent testing and leaves compliance entirely up to the manufacturer.

Enclosure Rating	NEMA **NEMA Standard 250**	**UL 50 and UL 508**	**Standard C22.2 No. 94**
Type 1	These enclosures are intended for indoor use and are primarily intended to provide some protection against contact with the enclosed equipment or in locations where unusual conditions do not exist.	Indoor use, primarily to protect against contact with enclosed equipment and against a limited amount of falling debris.	General purpose housing. Protects against accidental contact with live parts.
Type 2	These enclosures are designed for indoor use and are primarily intended to provide some protection against a limited amount of falling water and dirt.	Indoor use provides some protection against a limited amount of falling water and debris.	Indoor use to provide some protection against drips and light splashes of non-corrosive liquids and falling debris.
Type 3	These enclosures are intended for outdoor use and are primarily intended to provide some protection against windblown dust, rain, and sleet; the enclosure shall not freeze.	Outdoor use to provide some protection against windblown dust and windblown rain that is not affected by the formation of ice on the housing.	Indoor or outdoor use, provides some protection against rain, snow, and windblown dust, impervious to external ice formation on housing.
Type 3R	These enclosures are designed for outdoor use and are primarily intended to provide some protection against falling rain and sleet without interfering with the formation of ice on the enclosure.	Outdoor use to provide some protection against dust and rain, which is not damaged by ice formation on the housing.	Indoor or outdoor use, provides some protection against rain and snow, undamaged by external ice formation on the housing.
Type 4	These enclosures are intended for indoor or outdoor use and are primarily intended to provide a degree of protection against dust, rain, splashing water, and water jets that is not compromised by the formation of ice on the enclosure.	Indoor or outdoor use to provide some protection against falling rain, splashing water and spray without damaging the ice formation on the housing.	Indoor or outdoor use provides some protection against rain, snow, windblown dust, splashing water and spray, undamaged by external ice formation Ice formation on the housing.
Type 4X	These enclosures are intended for indoor or outdoor use and are primarily intended to provide some protection against corrosion, dust, rain, splashing water and ice formation on the enclosure.	Indoor or outdoor use to provide some protection against falling rain, splashing water and spray, undamaged by ice formation on the housing, corrosion resistant.	Indoor or outdoor use provides some protection against rain, snow, windblown dust, splashing and jetting water, undamaged by external ice formation on the housing, corrosion resistant.
Type 6	These enclosures are designed for indoor or outdoor use where they are occasionally submerged. limited depth, undamaged by ice formation on the enclosure surface.	Indoor or outdoor use to provide a degree of protection against the ingress of water during temporary submersion at a limited depth without causing damage from external ice formation. Ice formation on the housing.	Indoor or outdoor use provides some protection against water ingress during temporary submersion at a limited depth. Undamaged by external ice formation Ice formation on the housing, corrosion resistant.
Type 12	These enclosures are intended for indoor use and are primarily intended to provide some protection against dust, falling debris, and dripping non-corrosive liquids.	Indoor use to provide some protection against dust, dirt, flying fibers, dripping water and condensation from non-corrosive liquids.	Indoor use, provides some protection against dust, lint, fibers, and flies, dripping water and light and minor splashes of non-corrosive liquids, not for breakouts.
Type 13	These enclosures are intended for indoor use and are primarily intended to provide some protection against dust, splash water, oil and water, oil and non-corrosive coolants.	Use indoors to provide some protection against lint, dust, condensation from outside and splashes of water, oil, and non-corrosive liquids.	Indoor use provides some protection from flying dust, lint, fibers and flies, seepage and spraying of non-corrosive liquids, including oils and coolants.

2.5.3 Comparison of Specific Non-Hazardous Applications Outdoor Locations

Provides a Degree of Protection Against the Following Environmental Conditions	Type of Enclosure						
	3	3R*	3S	4	4X	6	6P
Incidental contact with the enclosed equipment	X	X	X	X	X	X	X
Rain, snow, and sleet[1]	X	X	X	X	X	X	X
Sleet[2]			X				
Windblown dust	X		X	X	X	X	X
Hoedown				X	X	X	X
Corrosive agents					X		X
Occasional temporary submersion						X	X
Occasional prolonged submersion							X

[1]External operating mechanisms are not required to be functional when the housing is covered with ice.
[2]External operating mechanisms are functional when the housing is iced over.
*These enclosures can be ventilated.

2.5.4 Comparison of Specific Non-Hazardous Applications Indoor Locations

Provides a Degree of Protection Against the Following Environmental Conditions	Type of Enclosure										
	1*	2*	4	4X	5	6	6P	11	12	12K	13
Incidental contact with the enclosed equipment	X	X	X	X	X	X	X	X	X	X	X
Falling dirt	X	X	X	X	X	X	X	X	X	X	X
Falling liquids and light splashing		X	X	X		X	X	X	X	X	X
Dust, lint, fibers, and flying's[1]			X	X	X	X	X		X	X	X
Hoedown and splashing water			X	X		X	X				
Oil and coolant seepage									X	X	X
Oil or coolant spraying and splashing											
Corrosive agents				X			X	X			
Occasional temporary submersion						X	X				
Occasional prolonged submersion							X				

* These housings can be ventilated. However, Type 1 may not provide protection against small debris particles if the top of the enclosure is vented.
[1] These fibers and chips are not hazardous materials and are not considered Class II flammable fibers or flammable chips.
For Class III flammable fibers or flammable chips. See National Electrical Code Section 500-6(a).

2.5.5 Enclosure Type Rating vs. IP Rating

Electrical enclosures are classified by type (NEMA 250 / UL 50) and/or IP rating (IEC 60529) depending on the degree of protection. Type assignments and IP assignments have only the following in common:

1. A degree of protection for persons from hazardous components inside the enclosure
2. A degree of protection for equipment inside the enclosure from ingress of solid foreign objects, including dust
3. A degree of protection for equipment inside the enclosure from ingress of water

The NEMA 250 and UL 50 type approval documents define additional requirements that a type of approved enclosure must meet. These include:

- Mechanical impact on enclosure walls
- Gasket aging and oil resistance
- Corrosion resistance
- Door and cover latching requirements
- Sheet metal gauge construction requirements

Electrical enclosures that have only an IP rating are not designed for the additional requirements of type approval. The cross-reference table below provides a guide for converting from NEMA Enclosure Type Numbers to IP Ratings. The table should not be used to convert from IP Rating to NEMA, and the indicated IP Rating should be verified by test. ABB Pilot Devices are verified both in NEMA type rating and IP rating.

2.5.6 Cross-Reference NEMA, UL, CSA, vs. IEC Enclosure Type

Conversion of NEMA Enclosure Type Ratings to ANSI/IEC 60529-2020 Enclosure Classification Designations (IP)
(Cannot Be Used to Convert IEC Classification Designations to NEMA Type Ratings)

IP First Character	NEMA Enclosure Type																NEMA Ancillary Rating		IP Second Character
	1		2		3, 3X, 3S, 3SX		3R, 3RX		4, 4X		5		6		6P		12, 12K, 13		_PW		
IP0_																					IP_0
IP1_																					IP_1
IP2_																					IP_2
IP3_																					IP_3
IP4_																					IP_4
IP5_																					IP_5
IP6_																					IP_6
																					IP_7
																					IP_8
																					IP_9
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	

GUIDE FOR TABLE USE

A shaded block in column "A" indicates that the NEMA enclosure type exceeds the requirements for the respective ANSI/IEC 60529-2020 IP first character designation for the protection against access to hazardous parts and solid foreign objects. A shaded block in column "B" indicates that the NEMA enclosure type exceeds the requirements for the respective ANSI/IEC 60529-2020 IP second character designation for the protection against the ingress of water.

For more information regarding comparison of NEMA 250 and IEC60529, please refer the publication by NEMA: A Brief Comparison of NEMA 250 and IEC 60529.

2.6 Temperatures

2.6.1 Ambient air temperature compensation

According to the standards IEC 60947-1, IEC 60947-5-1, UL 60947-5-1 and CAN/CSA-C22.2 no. 60947-5-1 it is required to test and validate relevant electrical data (e.g. rated currents, rated frequencies, rated voltages, etc.), typically at operating ambient air temperatures of -5 °C up to max. 40 °C according to the standard, but the ABB Pilot devices can handle -25 up to +70 °C in operation and -40 up to +85 °C in storage.

2.6.2 Temperature rise of the Pilot device

ABB tests the Pilot devices according to the Standard IEC 60947-1 table 2 and 3. This table indicates the maximum allowed temperature rise of the Pilot devices. These tables show how many Kelvin [K] the devices may heat up, distinguishing between the different components and materials of a device:

Enclosure Rating Accessible parts	Temperature-rise limits[a] in Kelvin [K]
Manual operating means:	
Metallic	15
Non-metallic (example: operator, …)	20
Parts intended to be touched but not hand-held:	
Metallic	30
Non-metallic	40
Parts that need not be touched during normal operation b:	
Exteriors of enclosures adjacent to cable entries:	
Metallic	40
Non-metallic	50
The exterior of enclosures for resistors	200[b]
Air issuing from ventilation openings of enclosures for resistors	200[b]

a: Different values may be prescribed by product standards for different test conditions and devices of small dimensions but not exceeding by more than 10 K the values of this table.

b: The equipment shall be protected against contact with combustible materials or accidental contact with personnel. The limit of 200 K may be exceeded if so, stated by the manufacturer. Guarding and location to prevent danger is the responsibility of the installer.

Table 3 from IEC 60947-1 Temperature-rise limits of accessible parts.

2.7 Terms and ratings

2.7.1 Terminology

Push-button	A control switch having an actuator intended to be operated by force exerted by a part of he human body, usually the finger or palm of the hand
Actuator	Part of the actuating system which is actuated by a part of the human body
Button	Is the external end of the actuator of a push-button, to which the actuating force is applied
Bezel	The rim of an actuator holding the button within in position
Actuating system	Mechanical part which transmits the actuating force to the contact element
Contact element	The parts, fixed and movable, conducting and insulating, of a control switch necessary to close and open one single conducting path of a circuit
Contact block	The part of a Pilot device that encapsulates the contact. Blocks are held to the back of a device with a contact block holder.
Lightening block	The part of a Pilot device that holds lightening element and activates the light when it receives the appropriate signal.
Maintained	A circuit that remains closed after pressure is released from the button.
Momentary	A closed-circuit that lasts only if pressure is maintained on the button.
Flush push-button	A button which is substantially level with the adjacent fixed surrounding surface when in its initial position and is below this surface when it is operated
Extended push-button	Same as flat but internal button surface protrudes even more above the bezel level.
Machine	Assembly of linked parts or components, at least one of which moves, with the appropriate machine actuators, control and power circuits, joined together for a specific application, in particular for the processing, treatment, moving or packaging of a material.

2.7.2 Terms

Rated operational voltage (Ue)

The rated operational voltage of a Pilot device is a value of phase-to-phase or phase-to-neutral voltage which determines the possible application of the Pilot device. This voltage needs to be considered in combination with a rated operational current.

Rated Insulation Voltage (Ui)

The rated insulation voltage of a device is the voltage value to which the dielectric tests and creepage distances refer. At no point may the maximum value of the rated operating voltage be higher than the rated insulation voltage.

Rated Impulse Withstand Voltage (Uimp)

The peak value of an impulse voltage of specified form and polarity which the electrical device is capable of withstanding without failure under specified test conditions and from which the values of the clearances are related. The rated impulse withstand voltage of electrical equipment shall be equal to or greater than the values specified for the transient overvoltage occurring in the circuit in which the equipment is installed.

Rated operational current (Ie)

The permissible continuous current flow through the device. This current is specified by the manufacturer and considers the rated operating voltage, the rated frequency, the rated duty cycle, and the utilization category.

Rated Frequency (f)

The rated frequency is an AC supply voltage for which a device is designed. The same device may have one or more values, and a range of rated frequencies. Furthermore, that may be designed for both AC and DC.

2.8 Mechanical and electrical durability

Due to product design characteristics, pilot devices vary regarding the number of electrical and mechanical operations which can be sustained over the product life. Below is a comparison between the different ranges of Pilot Devices. These values are typical values from the market.

Rating		Modular Plastic	Modular Metal	Compact range
Mechanical durability	Pushbutton	2,000,000	3,000,000	500,000
	Double pushbutton	500,000	-	-
	Key pushbutton	-	500,000	-
	Toggle switch	1,000,000	500,000	-
	Selector switch	500,000	1,000,000	500,000
	Key selector switch	500,000	1,000,000	500,000
	Selector pushbutton	-	1,000,000	-
	Momentary mushroom pushbuttons	2,000,000	3,000,000	500,000
	Emergency stop	100,000	-	50,000
	Joystick	500,000	500,000	-

For mechanical durability of specific products, please refer to the catalog.

Molded case circuit-breakers are designed to protect circuits and loads rather than control them, hence the mechanical and electrical durability of these devices is quite low. Contactors that are designed specifically for load control have very high mechanical and electrical durability. Pilot devices that are designed to provide both control and protection are rated higher than general circuit-breaker types.

Rating	Pilot devices	Contactors < 100 Amps	Circuit-breakers
Mechanical durability	>500,000	>10,000,000	25,000
Electrical durability	>200,000	>1,000,000	8,000

Examples of mechanical and electrical durability

The mechanical durability of a control circuit device is defined as the number of no-load operating cycles which will be attained or exceeded by 90 % of all devices tested without repair or replacement of any part.

The electrical durability of a control circuit device is defined as the number of on-load operating cycles which will be attained or exceeded by 90 % of all devices tested, without repair or replacement of any part.

The preferred numbers of operating cycles declared for any type of durability are the following: 0,01 – 0,03 – 0,1 – 0,3 – 1 – 3 – 10 – 30 or 100 millions.

The test procedure is described in the IEC 60947-5-1 Annex C.

3. Product offering

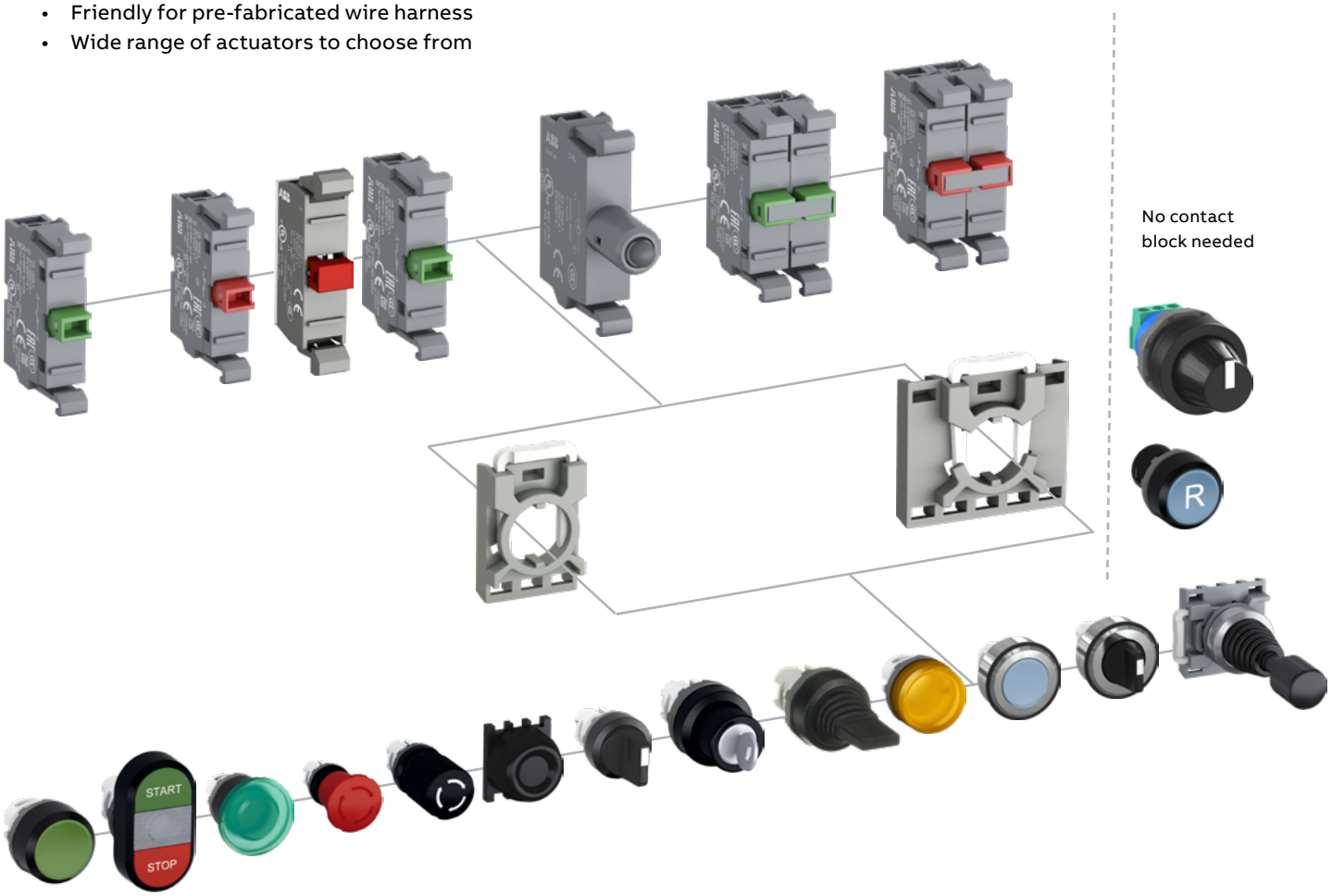
ABB provides a comprehensive offer of the Pilot devices. Depending on the market applications, regional habits and regulations, product availability and requirements there are three series complementing the whole portfolio.

3.1 Main features and benefits

Modular Plastic

The Modular Plastic range is flexible and premium core offer. Designed for professional employment in a wide number of electrical applications and segments. Engineered and tested for success in industrial environment, offering modularity as the main feature and benefit. By combining several basic components, many different configurations may be assembled. The range consists of pushbuttons, emergency stop pushbuttons, double pushbuttons, selector switches, mushroom pushbuttons, pilot lights, potentiometers, joysticks, toggle switches, reset buttons, and special definite-purpose operators. Some benefits include:

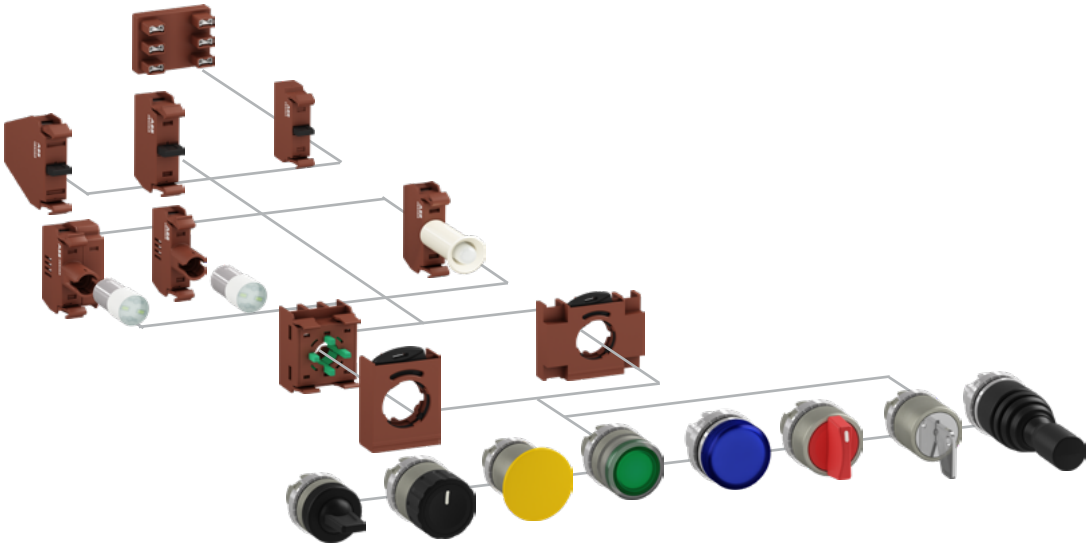
- Modular and easy to assemble
- Friendly for pre-fabricated wire harness
- Wide range of actuators to choose from



Modular Metal

The Modular Metal range is robust and custom. Designed for demanding applications and environment. It offers special features such as: metal bezel, separate maintaining mechanism, middle position contact, PCB (printed circuit board) adapter for FASTON termination or early make and late break contact blocks. It complements Modular Plastic range in niche or custom installations. Among the benefits:

- Robust industrial design
- Applications oriented
- Customization possible



Compact range

This monolithic product line represents pragmatical cost-effective and reliable series. It is created for simplicity and productivity and with no quality compromise. It has all-in-one practical design feature. Tailored to meet the most common industrial requirements on a push-button switch. The entire functionality is condensed into one unit. There is no possibility to expand the number of available contacts and its configuration, it is always limited to up to 2. But on the other hand, it offers complete, error free, single-unit device which has no need for further configuration: one device - one code logic. The range has demonstrated its high relevance, and today it is the favorable choice of many customers. The Compact range consists of pushbuttons, emergency-stop buttons, selector switches and pilot lights that include an integrated LED. The front design of the Compact range is identical to the Modular Plastic range. Therefore, mixing both does not compromise the appearance of the control panel. The main features include:

- Reliable and durable design
- Ready to install, one device - one code logic
- Stock optimization friendly

3.2 Technical details

	 Modular Plastic	 Modular Metal	 Compact
Ratings according to IEC 60947-5-1			
Rated insulation voltage, U_i	690 V AC	690 V AC	300 V AC
Rated thermal current, I_{th}	10 A	10 A	5 A
Rated operational current, I_e Utilization category AC 15	8 A (120 V) 6 A (230 V) 4 A (400 V) 2 A (690 V)	10 A (24 V) 10 A (48 V) 10 A (60 V) 6 A (110 V) 3 A (220 V) 2 A (380 V) 1.5 A (500 V) 1.2 A (600 V	2 A (240 V)
Rated operational current, I_e Utilization category DC 13	5 A (24 V)	2.5 A (24 V) 1.4 A (48 V) 1 A (60 V) 0.55 A (110 V) 0.27 A (220 V) 0.2 A (300 V)	0.3 A (24 V) 0.2 A (125 V)
Number of electrical contacts	Up to. 6	Up to. 8	Up to. 2
Number of different operators approx.	200	180	180
Degree of protection in the front (IEC)	IP66	IP66	IP66, IP67 and IP69K
Degree of protection in the front (UL)	Type 1, 3R, 4, 4X, 12, 13	Type 1, 3, 3R, 3S, 4, 4X, 12, 13	Type 1, 3R, 4, 4X, 12, 13
Degree of protection contact block (IEC)	IP20	IP20	IP20
Suitable for illumination	yes	yes	yes
For drillings with a size of	22.3 mm 0.88 inch	22.5 mm 0.93 inch	22.3 mm 0.88 inch
Ambient temperature during operation	-25 to +70 °C	-25 to +70 °C	-25 to +70 °C
Storage temperature	-40 to +85 °C	-40 to +85 °C	-40 to +85 °C

3.3 Available actuators and blocks

Each range has its unique features and purpose. Overview of available actuators is given below.

	Modular Plastic	Modular Metal	Compact
Push-button			
Flush momentary non-illuminated	x	x	x
Flush maintained non-illuminated	x	x	x
Flush momentary illuminated	x	x	x
Flush maintained illuminated	x	x	x
Extended momentary non-illuminated	x	x	x
Extended maintained non-illuminated	x	x	x
Extended momentary illuminated	x	x	x
Extended maintained illuminated	x	x	x
30 mm flush mounted	x		x

	Modular Plastic	Modular Metal	Compact
Double Push-button			
Flush non-illuminated	x		
Flush illuminated	x		
Extended non-illuminated	x		
Extended illuminated	x		
Mushroom			
Non-illuminated Ø30 momentary		x	
Non-illuminated Ø40 momentary	x	x	x
Non-illuminated Ø60 momentary	x	x	
Illuminated Ø40 momentary	x	x	
Illuminated Ø60 momentary	x		
Non-illuminated Ø30 maintained		x	
Non-illuminated Ø40 maintained		x	
Illuminated Ø40 maintained		x	
Emergency stop			
Non-illuminated Ø30, Twist	x		x
Non-illuminated Ø30, Pull	x		x
Non-illuminated Ø30, Key	x		x
Non-illuminated Ø40, Twist	x		x
Non-illuminated Ø40, Pull	x		x
Non-illuminated Ø40, Key	x		x
Non-illuminated Ø60, Twist	x		
Non-illuminated Ø60, Pull	x		
Illuminated Ø40, Twist	x		
Illuminated Ø40, Pull	x		
Illuminated Ø60, Twist	x		
Illuminated Ø60, Pull	x		
Machine stop pushbuttons			
Non-illuminated Ø30, Twist	x		x
Non-illuminated Ø30, Pull	x		x
Non-illuminated Ø30, Key	x		x
Non-illuminated Ø40, Twist	x		x
Non-illuminated Ø40, Pull	x		x
Non-illuminated Ø40, Key	x		x
Selector switch			
Non-illuminated 2 pos. short	x	x	x
Non-illuminated 2 pos. long	x	x	x
Non-illuminated 3 pos. short	x	x	x
Non-illuminated 3 pos. long	x	x	x
Non-illuminated 3 pos. short "Center"	x		
Non-illuminated 4 pos. short	x	x	
Non-illuminated 4 pos. long	x	x	
Non-illuminated 5 pos. short		x	
Illuminated 2 pos. short	x	x	
Illuminated 2 pos. long	x	x	
Illuminated 3 pos. short	x	x	
Illuminated 3 pos. long	x	x	
30 mm flush mounted	x		x
Key-operated selector switches			
2 position	x	x	
3 position	x	x	
4 position		x	

	Modular Plastic	Modular Metal	Compact
Joystick			
Without latching 2 directions	x	x	
Without latching 4 directions	x	x	
With latching 2 directions	x	x	
With latching 4 directions	x	x	
Toggle switch			
2 position	x	x	
3 position	x	x	
Selector pushbutton			
2 position		x	
3 position		x	
Other			
Heavy duty	x		x
Pilot lights	x	x	x
Potentiometer	x		
Reset	x		
Marked	x	x	x
Buzzers			x

Modular Plastic and Metal series have constructional differences and differ in the contact blocks´ offer:

Standard contact block	Scheme	Modular Plastic	Modular Metal
Single NO	10	MCB-10	P9B10VN
Single NC	01	MCB-01	P9B01VN
Double side 1NO+1NC	11	MCB-11	
Double side 2NO	20	MCB-20	
Double side 2NC	02	MCB-02	
Double stack 1NO+1NC	11		P9B11VN
Double stack 2NO	20		P9B20VN
Double stack 2NC	02		P9B02VN
Gold plated contact block			
Single NO	10	MCB-10G	
Single NC	01	MCB-01G	
Double 1NO+1NC	11	MCB-11G	
Double 2NO	20	MCB-20G	
Double 2NC	02	MCB-02G	
Micro switch contact blocks			
Single NO	10	MCBL-10	
Single NC	01	MCBL-01	
Special			
Single FASTON NO	10		P9B10FN
Single FASTON NC	01		P9B01FN
Single NO early make	10		P9B10VA
Single NC late break	01		P9B01VR
Holders			
3 position		MCBH-00	P9ACFS3
5 position		MCBH5-00	P9ACFS5

3.4 Control stations

A control station is an assembly of one or more control switches/push-buttons fixed on the same panel or located in the same enclosure. ABB offers a range of plastic enclosures for the application, widely used in industrial applications for simplified motor starting operation. ABB enclosures feature a unique design in which the contact blocks snap onto the base while the actuators are mounted onto the lid of the enclosure. The contact blocks are held in place to be activated when the lid is installed, though the blocks never touch the operator. This allows for simple maintenance and wiring, since if the lid is removed, the blocks and wiring stay in place.

3.4.1 Range overview

Modular plastic enclosures

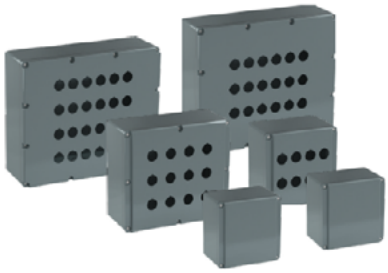
Enclosure can fit both Modular plastic and Compact range components with the unique possibility to mount up to 5 contact blocks assigned to one actuator. Degree of protection: IP66 UL/NEMA Type 1, 3R, 4, 4X, 12, 13. It is offered with the capacity up to 6-seat actuators station and is available in dark grey/light grey or yellow/light grey colors. Yellow option is needed in case an emergency stop is mounted among the pilot devices. According to the safety of machinery EN / ISO 13850 emergency stop pushbuttons should have a yellow background.

Compact plastic enclosure

The Compact enclosure is one of the smallest on the market intended only for Compact operators. Degree of protection: IP66, 67, 69K UL/NEMA Type 1, 3R, 4, 4X, 12, 13. 1-seat enclosure is offered in both dark grey/light grey and yellow/light grey colors. It is perfect for any application where space savings is a must!

Metal enclosures

ABB offers a range of extensive metal enclosures, from one seat to 24 seats. It is compatible with compact range, modular plastic range and modular metal range. Degree of protection is IP66 and IP69K. UL/NEMA Type 1, 3, 3R, 3S, 4, 4X, 12, 13 for one to six seats. Various choice makes it easy to be used in different installation applications.



Assembled stations

ABB offers assembled stations as a standard in combination with both Modular and Compact ranges.

Brief features of the plastic enclosure and control stations

- 1-, 2-, 3-, 4-, and 6-seat available; one of the largest varieties among market leaders
- Up to 5 contact blocks can be used per operator for some combinations
- Environmental ratings: NEMA Type 1, 3R, 4, 4X, 12, and 13; IP66 rated , perfect for indoor and outdoor usage
- UL/CSA/CCC certifications
- High impact strength polycarbonate, which withstands light acid solutions and other chemicals
- External material with f1 grade, perfect for against UV light
- Shrouds with weep holes to eliminate moisture collection
- Base-mounted contacts allow for easy removal of operator cover; wiring remains with base

—

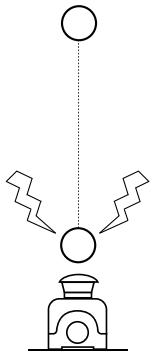
3.4.2 Special tests on enclosures according to UL

UL 50 Enclosures for Electrical Equipment
This specifies environmental protection ratings based on NEMA Type codes. ABB's products are approved up to Type 4X

UL Types 1, 3R, 12, 13, 4, 4X
A full description of each of the NEMA Type ratings can be found in the Appendix. NEMA 4X: protection against water and corrosion. Tested by spraying low-pressure, high volume (65 gal/min) at the enclosure at a distance of 10-12 ft. from the object.

UL 746C Standard for Polymeric Enclosure
This specifies some additional protection requirements for enclosures.

Ball impact test
Steel ball, diameter 2 in, weight 1.18 lb. Dropped from height of 50 in onto enclosure. Impact = 5.0 ft-lbs.



The enclosure shall withstand the impact without making uninsulated live parts accessible to contact, producing a condition that might affect the mechanical performance of the equipment, or producing a condition that would increase the possibility of an electric shock.

Cold ball impact test
Steel ball, diameter 2 in, weight 1.18 lb, cooled to -31 °F. Dropped from height of 50 in onto enclosure. Impact = 5.0 ft-lbs.

The enclosure shall withstand the impact without making uninsulated live parts accessible to contact, producing a condition that might affect the mechanical performance of the equipment, or producing a condition that would increase the possibility of an electric shock.

Five-inch flame test
A 5-inch flame is applied 5 times, over a period of 5 seconds.

The material shall not continue to burn for longer than 1 minute. Drops shall not ignite cotton below the specimen. The material shall not be destroyed to such extent that the integrity is affected.

3.5 Indicator light

The light emitting technology in our indicator lights is LED.

LED (light-emitting diode) offer the greatest value by providing the longest service life and the best resistance to shock and vibration. They last over 50,000 hours — that's about 6 years of 24-hour continuous usage before losing 50% of the illumination! LED color is determined by the wavelength of light that is emitted (in nanometers, nm).

Our range of Pilot lights is available both as empty bases (which can accept BA9S LEDs) or with "Integrated LEDs". These LEDs have been tested to last over 50,000 hours without needing to be replaced.

3.6 Legend plates

ABB offers both standard and customized aluminum legend plates for all Pilot devices. Custom-engraved legend plates are easy to order.

Legend plate features include:

- Legend plate holders with brushed aluminum inserts
- For plastic enclosures: legend plate holders or solid-piece legend plates
- Legend plates available for emergency stops

ABB offers the ability to mark directly onto the button surface. We have some standard products available in our catalog with this direct marking method, but custom markings are another solution.

3.7 Special operators and accessories

We offer a complete line of accessories to make our Pilot devices more competitive in the market.

Accessories include:

- Tools for changing lamps and tightening locking nuts
- Square-shaped bezels
- 30 mm hole adaptors
- DIN-rail adaptor
- Hole plugs
- Locks, guards, and protective silicone covers
- Cable glands for enclosures

3.8 Contact block configuration

3.8.1 Contact block configuration Modular Plastic range

Maximum number of electrical contacts

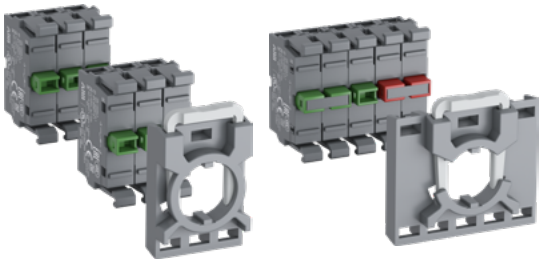
Holder	Standard 3 position	Optional 5 positions
Momentary and maintained pushbutton	6	5
Illuminated momentary and maintained pushbutton	4	4
Momentary mushroom pushbutton	6	5
Illuminated momentary mushroom pushbutton	4	4
Non-illuminated & illuminated double pushbutton	4	4
Non-illuminated & illuminated selector switches, key operated selector	4	4
Toggle switches, center block operating selector switches	6	5
Heavy duty pushbutton[1]	6	-
Emergency stop, machine stop	6	-
Illuminated emergency stop, machine stop	4	-
Joystick[2]	8	-
Selector switches 4 position[2]	4	-

1) 3 position holder included in the operator

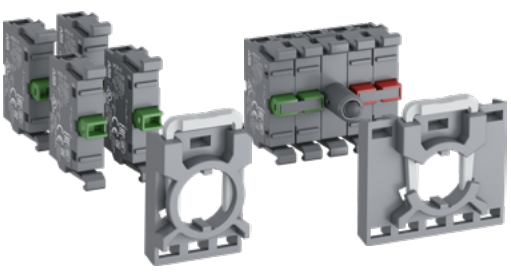
2) 4 position holder included in the operator

Pushbuttons - Mushroom pushbuttons

Non-illuminated

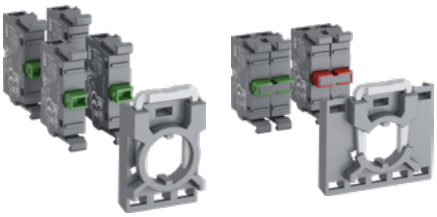


Illuminated

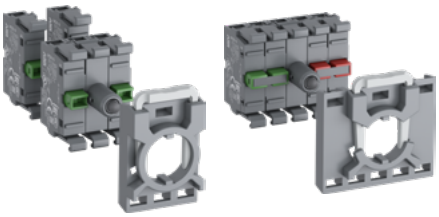


Double pushbuttons

Non-illuminated

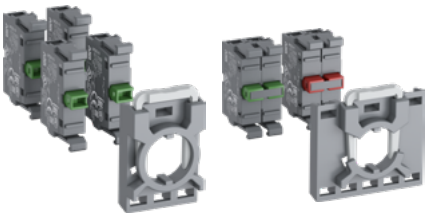


Illuminated

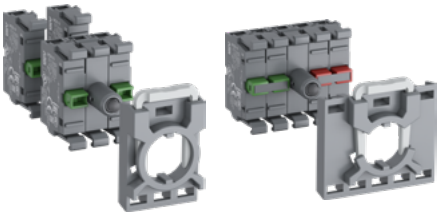


Selector switches

Non-illuminated

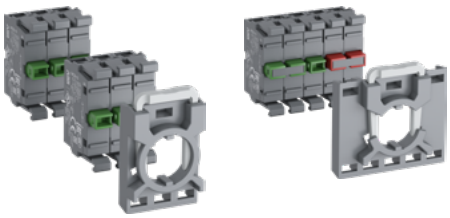


Illuminated

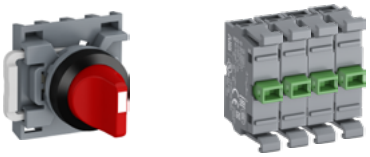


Center block operating selector switches

Non-illuminated

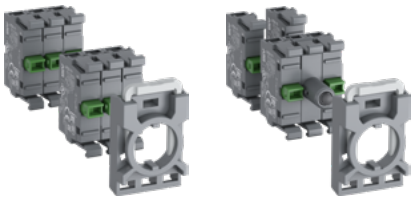


4 position selector switches



Emergency stop pushbuttons - Machine stop pushbuttons

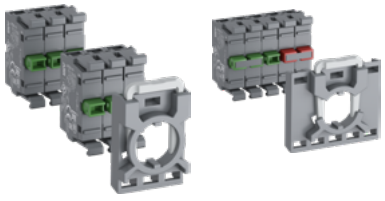
Non-illuminated



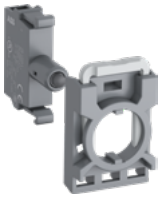
Illuminated

Toggle switches

Non-illuminated



Pilot lights



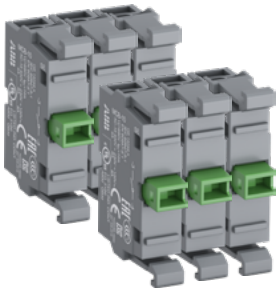
Joystick

Note: Locking nut included with all operators

Holder is included for joystick

Heavy duty pushbutton

Non-illuminated



Holder included in heavy duty pushbutton

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3.8.2 Contact block configuration Modular Metal range

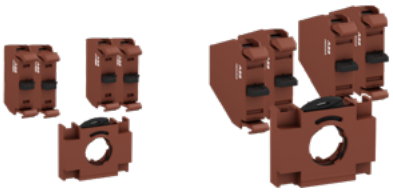
Maximum number of electrical contacts

Holder	Standard 3 positions	Optional 5 positions
Momentary pushbuttons Momentary mushroom pushbuttons	6	8
Standard selector switches Key selector switches	4	8
Selector pushbuttons Toggle switches	4	-
Maintained mushroom pushbuttons	4	-
Illuminated pushbuttons Illuminated momentary mushroom pushbuttons Illuminated selector switches	4	4
Illuminated maintained mushroom pushbuttons	2	2

Momentary pushbuttons

Non illuminated

Single or double blocks can be used in position 1-3.



Single or double blocks can be in position 1-4.

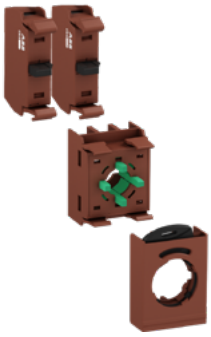
Illuminated

LED block or lamp block in position 3. Single or double blocks can be used in position 1-2.

LED block in position 5, single or double blocks can be used in position 1-4.

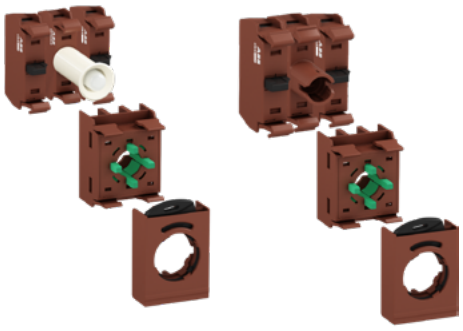
Maintained pushbuttons

Non illuminated



Only possible with contact blocks P9B01VN, P9B01VR, P9B10VA and P9B01FN in position 1-2.

Illuminated



LED block in position 3. Only possible with contact blocks P9B01VN, P9B01VR, P9B10VA and P9B01FN in position 1-2.

Momentary mushroom pushbuttons

Non illuminated

Single or double contact blocks can be used in position 1-2.

Illuminated

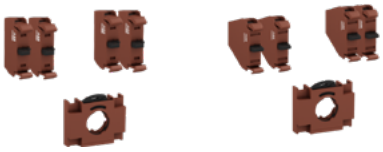
LED block or lamp block in position 3. Single or double contact blocks can be used in position 1-2.

LED block or lamp block in position 5. Single or double contact blocks can be used in position 1-4.

Selector switches and key operated selector switches

Non illuminated

Single or double blocks can be used in position 1-2.



Single or double blocks can be used in position 1-4.

Illuminated

LED block or lamp block in position 3. Single or double blocks can be used in position 1-2.

LED block in position 5. Single or double blocks can be used in position 1-4.

Joysticks, selector pushbuttons, toggle switches

Single or double blocks can be used in position 1-2.

Emergency stop pushbuttons

Single or double blocks can be used in position 1-2.

3.9 Emergency Stops

This chapter describes the basic features of our emergency stops, and what the general requirememnts are for emergency stops.

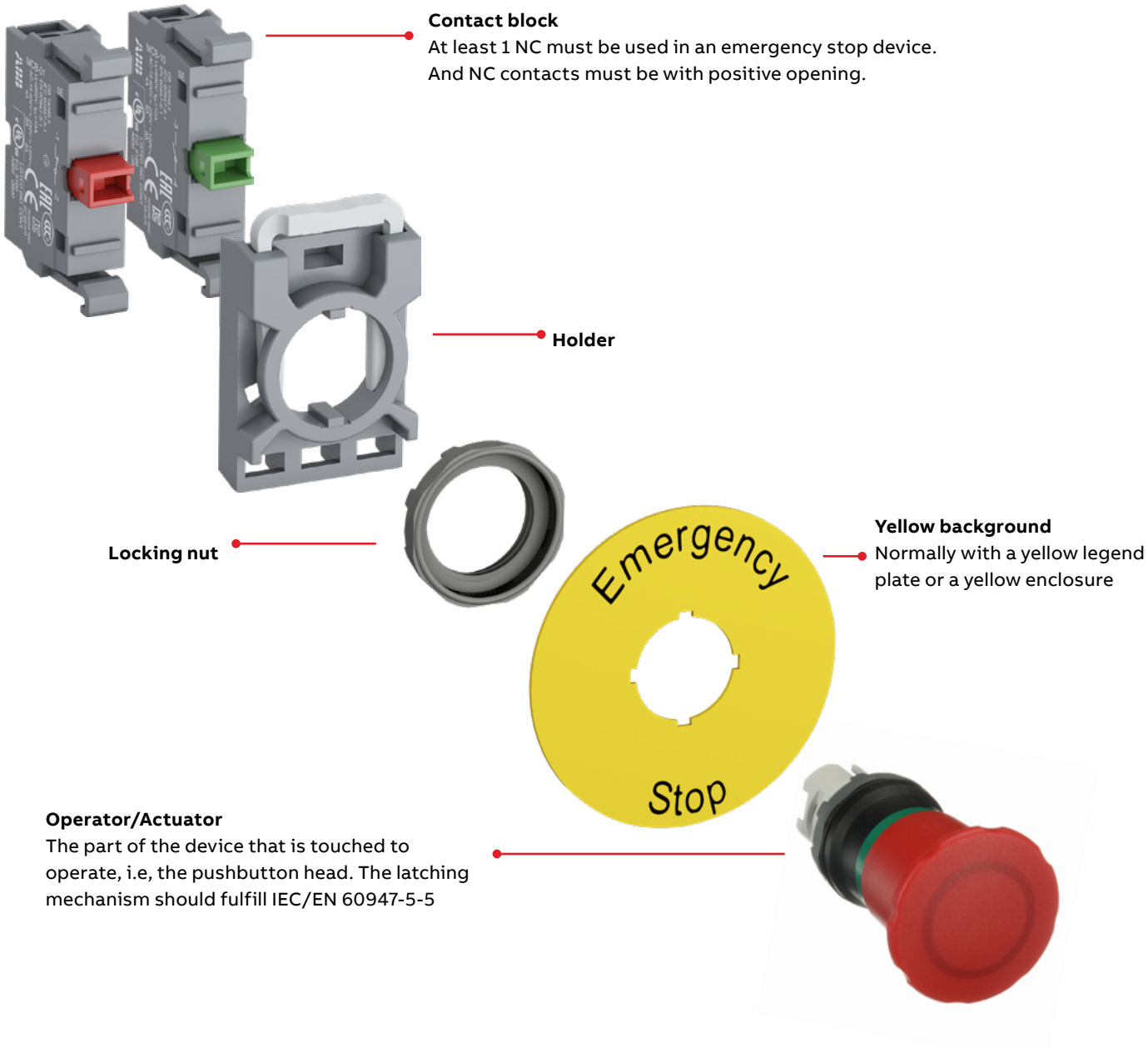
3.9.1 Product definition

Anemergency stop device is a manually operated control circuit device used to initiate an emergency stop function, which is intended:

- to avert or to reduce hazards to persons, damage to machinery or to work in progress.
- to be initiated by a single human action.

Emergency stops are different from a typical “OFF” button in that they must pass a rigorous line of testing and meet a long list of specifications. Many of these specifications will be described later in this chapter.

Knowledge of some basic pilot device terminology will help you gain a better understanding of Emergency Stop devices:



Contact block
At least 1 NC must be used in an emergency stop device.
And NC contacts must be with positive opening.

Holder

Locking nut

Yellow background
Normally with a yellow legend plate or a yellow enclosure

Operator/Actuator
The part of the device that is touched to operate, i.e, the pushbutton head. The latching mechanism should fulfill IEC/EN 60947-5-5

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3.9.2 Applicable industries and markets

Emergency stop devices can be found in any industry—and we really mean anywhere: industrial manufacturing, commercial industries, and even public facilities. They are not only important to the safety of the machinery and people in an industrial environment, but they are also quite often required to be present, usually within the line of sight of workers. Furthermore, several emergency stops may be necessary to control a single machine, as they are commonly required to be mounted as frequently as every 6 feet along a production line!

Some of many industries with emergency stop needs:

- Material handling – packaging, moving
- Oil & gas mining/extracting, refining, processing
- Food & beverage packaging, distribution
- HVAC(R)
- Water/wastewater
- Manufacturing – automotive/heavy equipment, marine/aviation, glass & plastics
- Metals – mining, refining, processing, forming
- Commercial applications
- Amusement park rides
- And many, many more!

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3.9.3 Standards for Emergency Stops

ABB's emergency stop products are tested and approved according to:

- The International Standards: IEC 60947-1, IEC 60947-5-1 and IEC 60947-5-5
- The European Standards: EN 60947-1, EN 60947-5-1 and EN 60947-5-5 Machinery directive 2006/42/EC
- North American Standards and Canada: cULus, UL 508 ,UL 60947-1, UL60947-5-5 CSA: C22.2 No. 14
- CCC GB/T14048.5
- Marine Classifications: DNV

Certificates for major approvals are available online. Please visit our product website at:
https://new.abb.com/low-voltage/low-voltage/products/pilot-devices

An overview of the standards applicable to Emergency Stops:

General standards	Design, Function and Testing	Installation
Machinery directive 2006/42/EC	IEC 60947-1	IEC 60204-1
ISO 13850	IEC 60947-5-1	
	IEC 60947-5-5	

General Standards

Machinery directive 2006/42/EC

The objectives of the Machinery Directive 2006/42/EC, are to maintain, increase and equalize the safety level of machines within the members of the European Community.

This directive provides the requirements on emergency stop devices in machinery based on the following principles

- Detailed solutions and technical specifications are found in harmonised standards.
- Standards are voluntary to apply, but products designed according to the harmonised standards will fulfill the basic safety requirements in the Machinery Directive.

ISO 13850 Safety of machinery — Emergency stop function — Principles for design

This standard specifies design principles for emergency stop equipment for machinery.
No account is taken of the nature of the energy source.

- Once the emergency stop command has been generated during actuation of the Emergency Stop device, the command shall be maintained by latching means. The emergency stop command shall be maintained until the device is reset (disengaged). It shall not be possible for the device to engage without generating the stop command.
- In case of a failure in the emergency stop device (including the engagement means), generation of the stop command shall have priority over the engagement means.
- The actuator of the emergency stop shall be colored RED, the background shall be colored YELLOW.

Design, function & testing

IEC 60947-1

Low Voltage Switchgear and Control Gear: General Rules. This is the general standard giving requirements for all low voltage control gear. Requirements specific to E-stops are found a few sections later in the IEC 60947 document.

IEC 60947-5-1

Control-Circuit Devices and Switching Elements, Electromechanical Control Circuit Devices. This specifies the electrical characteristics of electromechanical control circuit devices.

IEC60947-5-5

Control-Circuit Devices and Switching Elements, Electrical Emergency Stop Device with Mechanical Latching Function

IEC 60947-5-5 deals specifically with emergency stop devices with a mechanical latching function and gives electrical and mechanical requirements in addition to those given in previously described International Standards (ISO 13850, IEC 60204-1, IEC 60947-5-1), “The Emergency Stop function is intended to be initiated by a single human action”. Extra testing requirements specified by IEC 60947-5-5 include:

1. Operating durability test

Approximal 6 050 operations to test the durability of latching parts. This is not a test of mechanical life, which is 100 000 operations.

2. Robustness

A force of 113 N is applied in three axes.
M=0,1xDhole =2,2 Nm
F = 5xDhole =113 N A

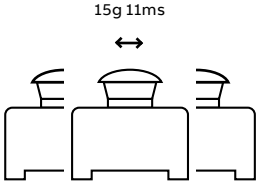
3. Conditioning

Verifying function after exposure to:

- 96 hours of 70 °C hot, dry atmosphere (IEC60068-2-2 and IEC60721-3-3 class 3K7)
- 96 hours of changing moist and warm atmosphere, 25 °C/55 °C, 97%/93% RH, (IEC60068-2-30 and IEC60721-3-3 class 3K7)
- 96 hours of -40 °C cold atmosphere (IEC60068-2-1 and IEC60721-3-3 class 3K7)
- 96 hours of 35 °C in a solution of 5% NaCl, saltwater (IEC60068-2-11 and IEC60721-3-3 class 3K7)

4. Shock test

Acceleration 15 g ≈ 150 m/s² over 11 ms in the three mutually perpendicular axes.
During the test, the closed contacts shall not open, the open contacts shall not close, and the latching mechanism shall not latch/unlatch.
Opening and closing of contacts longer than 0.2 ms shall be detected.

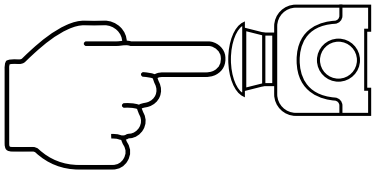


5. Vibration test

Frequency: 10-500 Hz
Duration: 2 hours
Max accel: 50 m/s²
Amplitude: 0.35 mm

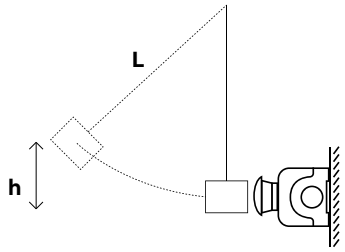
6. Latching - Contact opening test

The actuator of the emergency stop device shall be moved slowly just to the point where latching occurs. The normally closed contacts shall then be opened, verified by an impulse voltage test at 2 500 V.



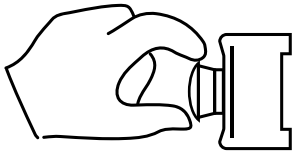
7. Latching - Forceful closing test

To simulate a normal human action, the emergency stop is mounted in front of a 1.6 kg hammer. After the strike, the latching mechanism shall be latched. (For 22 mm pilot devices, h=75 mm, L=1000 mm)



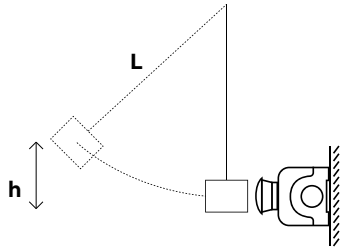
8. Resetting test

If the reset is by pulling, the pulling force shall be less than 50 N. If the actuator is reset by turning, the torque shall be less than 1 Nm.



9. Impact test

Three strikes with the 1.6 kg hammer (see #7). After each strike, the emergency stop shall be latched. After three strikes, the actuator shall not be damaged. (h=310 mm, L=1000 mm)



10. Durability test

Test shall consist of 6 050 cycles in which latching and resetting of the actuator occurs during each cycle at relative utilization categories.

Installation

The IEC 60204-1 gives additional requirements for an emergency stop function realized by the electrical equipment of a machine, specifically installation methods and location requirements.

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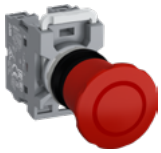
3.9.4 Product description

Emergency stops are available in many shapes and sizes based on their functionality and application. Both IEC and NEMA standards dictate some of the requirements for emergency stops. In addition, many markets and industries have their own industry-accepted specifications, which may call for more specific requirements to be met. For example, the Semiconductor Manufacturing Industry requires that emergency stop buttons be “mushroom” shaped and marked with EMO.

Some basic products and their applications are listed below:

	**Pull release** – the operator is pushed in and locks into stop, resetting by pulling the actuator. Indicated by the circle symbol on the head.
	**Twist-release** – the operator is pushed in and locks into stop, resetting by rotating the actuator. Indicated by the circular arrows on the head.
	**Key-release** - the operator is pushed in and locks into position to stop, resetting by rotating a key.
	**Emergency stop with EMO marking** – an emergency stop for semiconductor manufacturing industry.
	**Shroud or Guard** – a collar that surrounds a pilot device, to prevent inadvertent activation.
	**Enclosure** – a protective box (plastic or metal) that encloses the contacts of a control switch. E-stop enclosures are usually yellow to indicate their “emergency” importance. These are rated according to the amount of protection they provide (dust, water, oil, etc.)
	**Emergency stop station** – an enclosure assembly including the E-Stop button, which can be mounted onto any surface where an emergency off switch should be located

4. Load types

For general electrical engineering, the utilization categories are specified by IEC standards and specify the type of electrical load and the duty cycle of the loads to facilitate the selection of the components.

The characteristic operating conditions for switchgear such as contactors, circuit breakers, fuse, pilot devices, auxiliary contactors, etc., specify the utilization categories for low-voltage switchgear. Depending on the electrical loads and different operating conditions, these devices have been designed.

Switchgear requirements and their correct selection for the intended application are determined by the characteristics of the load to be switched or controlled. In particular, the stress on the switching path due to current and voltage during switch-on and switch-off is of enormous importance. For example, the switch-on and switch-off current for resistive loads corresponds to the continuous operating current, while squirrel-cage motors, for example, draw many times the rated operating current during switch-on and in the acceleration phase. Here a short overview of the important utilization categories for industrial products:

Utilization categories for ABB Pilot devices	**Utilization categories for contactors < 100 Amps**
AC-15 Control of A.C electromagnetic loads	AC-15 Control of A.C electromagnetic loads
DC-13 Control of D.C electromagnetics	DC-13 Control of D.C electromagnetics
	AC-3 / AC-3e: Squirrel-cage motors: starting,
	switches off motors during the running time
	AC-5a: Electric discharge lamps (ballast)
	AC-5b: Incandescent lampes
	AC-8a: Hermetic refrigerant compressors
	DC-1: General use — DC Motors

4.1 Utilization categories AC-15 and DC-13

The utilization categories AC-15 for alternating current and DC-13 for direct current consider the specific load of switchgear for the switching of control circuits with semiconductors or electromagnetic loads. For switching electromagnets, e.g., contactor coils, the increased making load due to the inrush current of the magnets and the increased breaking load due to the high inductance of the opening magnets must be particularly considered. These utilization categories are defined in IEC 60947-5-1, here is an overview:

	Category	Typical applications
AC (alternating current)	AC-12	Control of resistive loads and solid-state loads with isolation by optocouplers
	AC-13	Control of solid-state loads with transformer isolation
	AC-14	Control of small electromagnetic loads (≤72 VA)
	AC-15	**Control of electromagnetic loads (>72 VA)**
DC (direct current)	DC-12	Control of resistive loads and solid-state loads with isolation by optocouplers
	DC-13	**Control of electromagnets**
AC-14	DC-14	Control of electromagnetic loads having economy resistors in a circuit

According to the standard, the test conditions for the different utilization categories are defined so that the ratings are defined and comparable depending on the utilization category. In the utilization category also the rated voltage and the rated current or the rated apparent power are specified. When evaluating devices, these data should be compared with those of the load to be switched.

4.2 Switching contactors

4.2.1 Alternating current

Normal alternating current magnets

Alternating current (AC) magnetic contactors are characterized by a high pick-up current, which flows when closing the circuit and the magnetic system and is determined by the low coil impedance (large air gap). This effect the utilization categories AC-14 and AC-15 take this characteristic into account. The high pick-up current surge thermally stresses the coil and limits the maximum switching frequency.

Especially at small control voltages with large contactors, attention must be paid to voltage drops in the control circuit to ensure reliable switching. When contactors are switched off, the inductance is large because of the small size of the residual air gap. This results in a corresponding arcing of the control contacts and switching transients. External overvoltage protection measures may be required.

Electronic coil control

Electronic circuits can be used to optimize the operating conditions for contactor solenoid systems and optimally adapt operation to the user's needs. For example, the solenoid system can be decoupled from voltage fluctuations so that the current drawn is optimized and the pick-up and drop-out values are clearly defined. Depending on the user's preference, control can be conventional by applying a con-trol voltage or by a PLC signal, either directly or via a control input.

4.2.2 Direct current

For direct current (DC), bigger magnet systems with specially designed poles are required to provide the necessary forces to retract the contactors and to keep the holding energy optimized. Firstly, this results in a large clamping depth, smoother switching on and compar-atively low current consumption during retraction. The pull-in power is equal to the holding power. It should be considered that the load on the control contacts at switch-off is relatively high due to the high inductance of the coils. All these properties are considered by the utilization category DC-13.

Double winding coils

DC contactors with double winding coils are contactors with AC magnets, but with a pull-in and an additional holding coil. The design dimensions are the same as those of the AC contactors. The contactors switch through a pull-in winding with low impedance and a higher pull-in current accordingly. After closing the magnetic circuit of the pull-in coil, the excitation is switched to the lower holding power of the holding coil by an auxiliary switch. The auxiliary switch is integrated with the device in most cases.

Electronic coil control

For contactors with a DC power supply, there is also an electronic coil control, the characteristics and advantages are equal to those of the AC power supply.

5. Selection criteria

5.1 ABB e-Configure

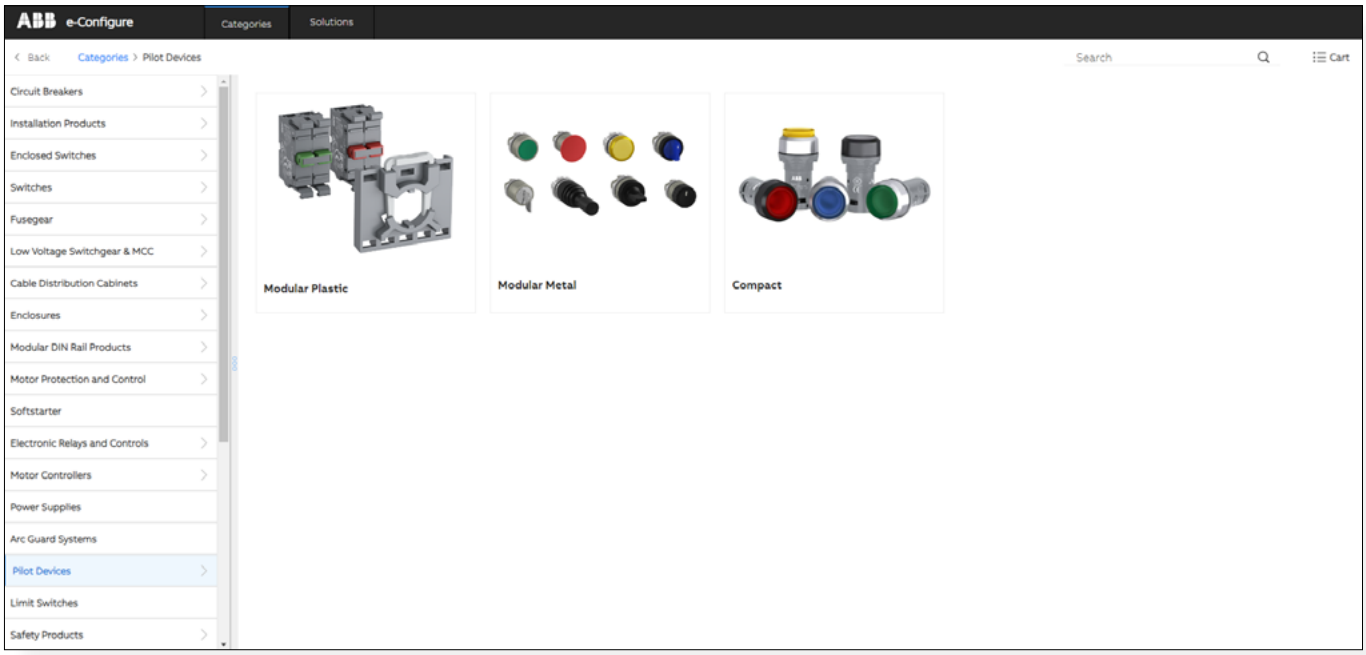
ABB's e-Configure online product catalog helps customers search, find, and individually configure low-voltage products. It covers ABB's entire low-voltage product portfolio.

e-Configure leverages ABB's engineering and product expertise for user guidance, enabling intuitive navigation through our product portfolio. If needed, the tool offers recommendations during the selection process to make the process as efficient as possible. Customers can search by part number, type, or description, as well as make selections based on product categories and filtering options.

To make the work as clear as possible, there is the possibility to easily create new BOMs or adapt existing lists, these can be exported as Excel or PDF files. Your advantages:

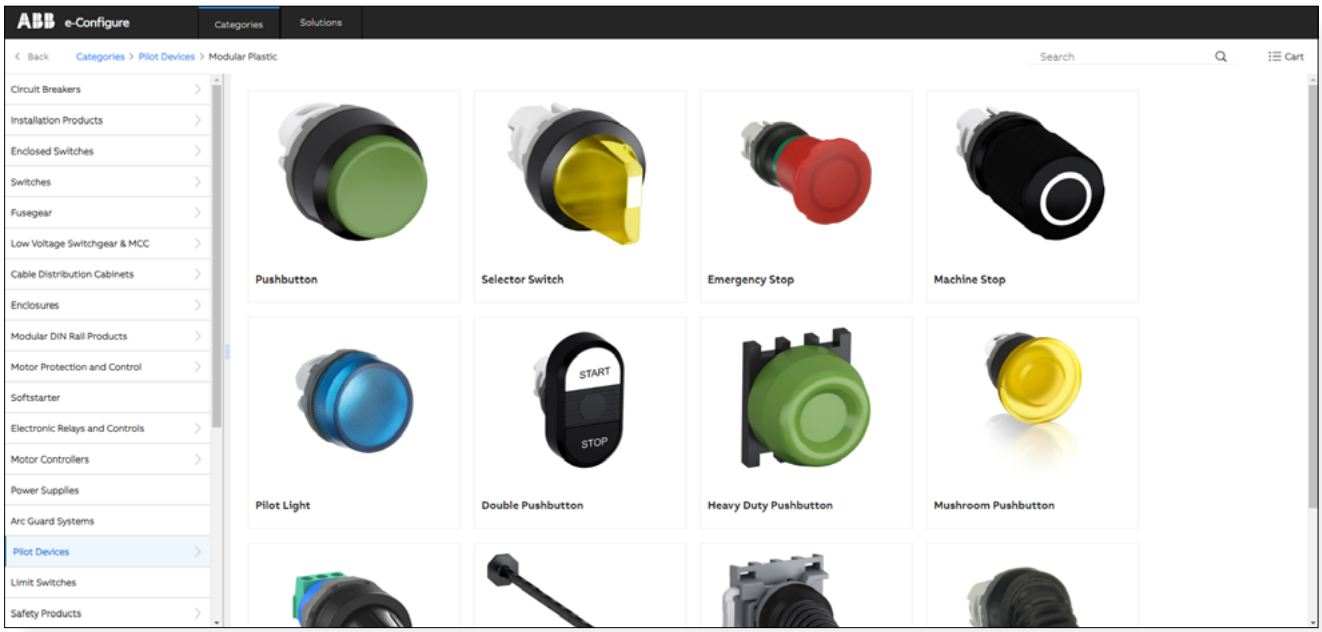
- More than 100 000 low-voltage products and systems are in the online product catalog.
- With just a few clicks, devices and accessories can be selected from the ABB portfolio and customized, as assembly-friendly solutions configured
- Only suitable accessories can be selected
- Export the configuration as Excel or PDF file

By integrating the ABB e-Configure platform into the EPLAN Data Portal, ABB components can be easily selected and configured within EPLAN projects.



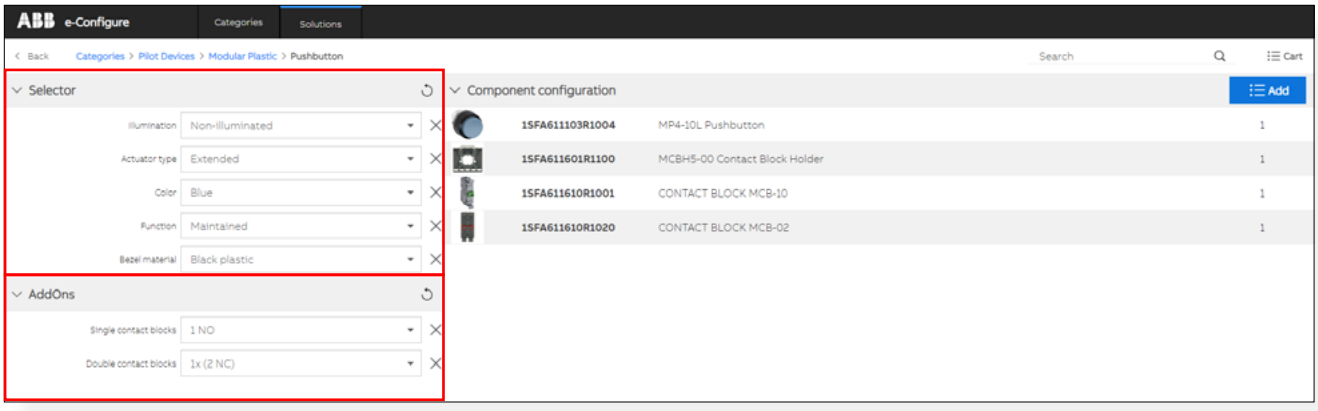
Screenshot from e-Configure

The customer can create a special configuration suitable for his application. The program guides the user intuitively through the product selection and already provides the possible configurations. After the selection of the range: Modular Plastic, Modular Metal or Compact, the possible configurations of the Control and Signaling Devices follow. Here the customer gets a quick overview of the various control and signaling devices and can make his selection at the same time. Afterward, the customer-specific control and signaling devices can be freely created.



After the selection of the range: Modular Plastic, Modular Metal or Compact, the possible configurations of the Pilot and signaling devices follow. Here the customer gets a quick overview of the various Pilot and signaling devices and can make his selection at the same time. Afterward, the customer-specific Pilot and signaling devices can be freely created.

Depending on the product, the customer can select the needed constellations from the Pilot device in the selector area, where the customer can choose his desired characteristics, like Illuminated, the actuator type, etc. In the Add-ons area, the type and number of contact blocks are selected, and automatically, if necessary, contact block holders are added.



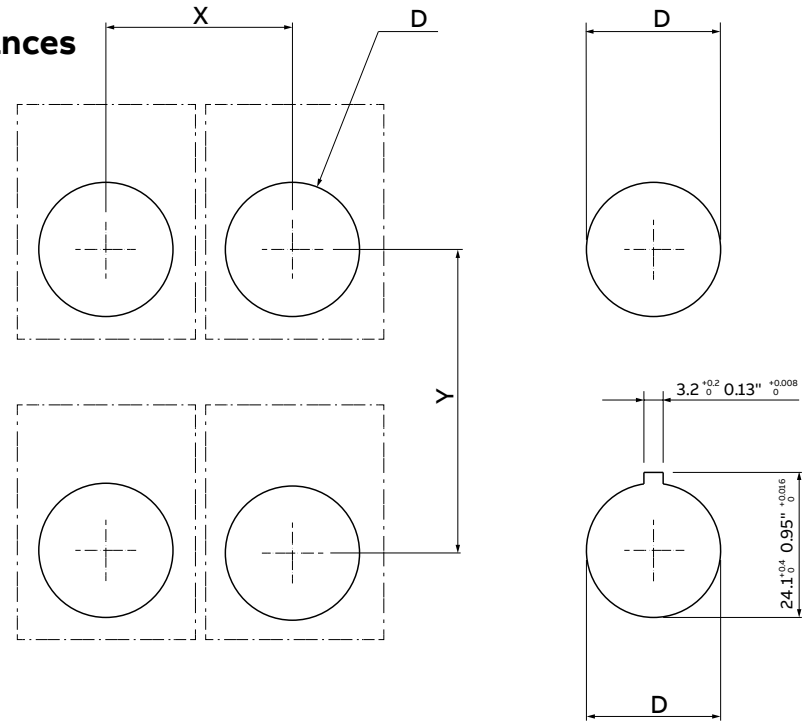
6. Installation and commissioning

6.1 Installation

For up-to-date installation information, please scan the following QR code or click on the link 1SFC151011M0201.

6.2 Drilling plan and minimum distances

The following tables show the necessary holes that are required to enable mounting.



Modular Plastic range

Panel thickness: 1.5-6 mm (0.06-0.24")

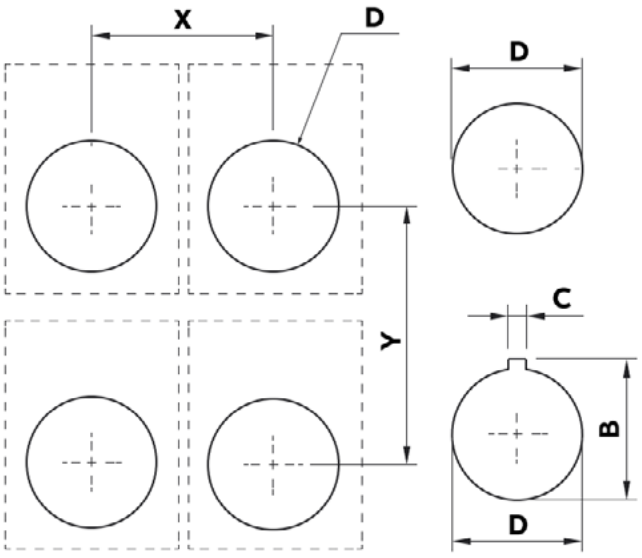
Description	X		Y		D	
	mm	inch	mm	inch	ø mm	inch
Pushbutton, pilot light, 2 and 3 position selector switch, potentiometer, toggle switch, 30 mm emergency stop, 30 mm machine stop, key-operated selector switch	31	1.22"	50	1.97"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
Pushbutton, pilot light, 2 and 3 position selector switch (with legend plate)	31	1.22"	55	2.17"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
Mushroom pushbutton, emergency stop, machine stop (40 mm)	45	1.77"	50	1.97"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
Mushroom pushbutton, emergency stop, machine stop (60 mm)	65	2.56"	70	2.76"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
Double pushbutton	31	1.22"	55	2.17"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
Double pushbutton (with legend plate)	31	1.22"	95	3.74"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
Heavy duty pushbutton*	50	1.97"	50	1.97"	ø 30.5 $^{+0.50}_{0}$	1.22 $^{+0.020}_{0}$
Potentiometer (with legend plate)	51	2.01"	50	1.97"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
Toggle switch (with legend plate)	31	1.22"	66	2.60"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
Joystick (with or without legend plate)	100	3.94"	100	3.94"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
5 position holder	51	2.01"	50	1.97"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
4 position selector switch	50	1.97"	45	1.77"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$

*Panel thickness for heavy duty pushbutton is 2-5 mm (0.08-0.20"). Hole with key recess is not applicable for heavy duty pushbutton.

Modular Metal range

Panel thickness 1-6 mm (0.04-0.24")

Description	X		Y		D	
	mm	inch	mm	inch	ø mm	inch
Pilot light, pushbutton, selector switch, key operated selector switch, toggle switch, selector pushbutton, 28 mm mushroom pushbutton	30	1.18"	50	1.97"	ø 23.5	0.93"
40 mm mushroom pushbuttons, 40 mm emergency stop	45	1.77"	59	1.97"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
Joystick	80	5.15"	80	5.15"	ø 22.3 $^{+0.4}_{0}$	0.88 $^{+0.016}_{0}$
Holder with 5 position	50	1.97"	50	1.97"	ø 23.5	0.93"



Accessories	X	Y	D		B		C	Panel thickness
			ø mm	inch	ø mm	inch		
5 block holder	51 2.01"	50 1.97"	Ø 22.3 $^{+0.4}_{0}$	0.88" $^{+0.016}_{0}$	24.1 $^{+0.4}_{0}$	0.95" $^{+0.016}_{0}$	3.2 0.13"	1.5 0.06" - 6 0.24"
30 mm adaptor	42 1.65"	52 2.05"	Ø 30.5 $^{+0.5}_{0}$	1.20" $^{+0.02}_{0}$	33 $^{+0.5}_{0}$	1.30" $^{+0.02}_{0}$	5 0.20"	2 0.08" - 7 0.28"

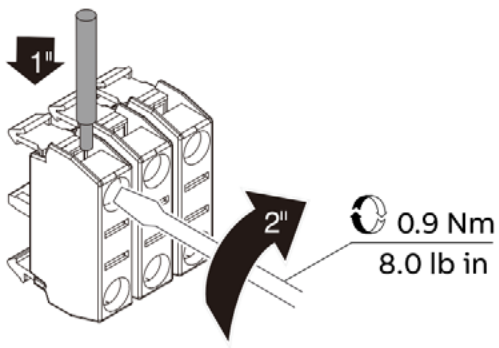
Compact range
Panel thickness: 1.5-6 mm (0.06-0.24")

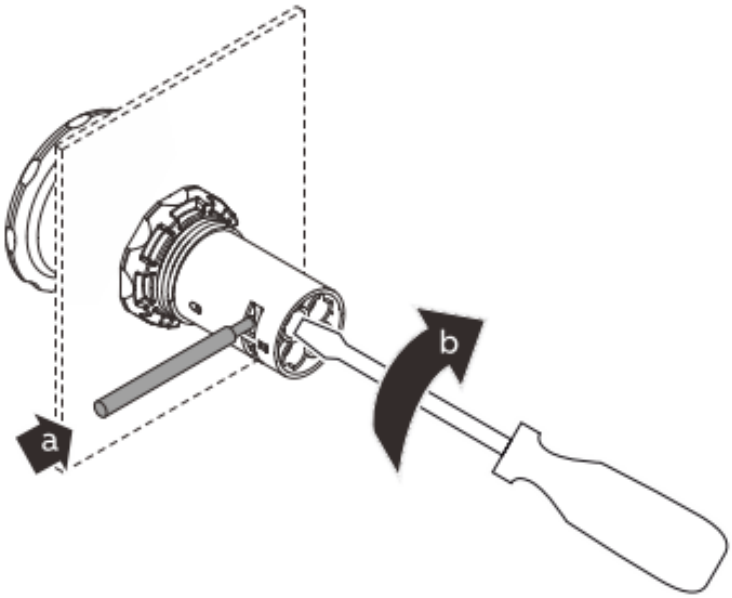
Description	X mm	X inch	Y mm	Y inch	D ø mm	D inch
Pushbutton, pilot light, selector switch, buzzer, 30 mm emergency stop/machine stop	31	1.22"	50	1.97"	22.3 $^{+0.40}$	0.88 $^{+0.0160}$
Pushbutton, Pilot light, Selector switch, Buzzer (with legend plate)	31	1.22"	55	2.17"	22.3 $^{+0.40}$	0.88 $^{+0.0160}$
40 mm mushroom pushbutton, heavy duty pushbutton, 40 mm emergency stop/machine stop	41	1.61"	55	2.17"	22.3 $^{+0.40}$	0.88 $^{+0.0160}$

6.3 Connection

The pilot device is available with screw terminals. The following diagram shows the assembly of a cable in a contact block:

1. Insert the cable into the opening provided after the cross-sections.
2. Using the screwdriver provided for this purpose, tighten the screw to 0.9 Nm (8.0 lb in).





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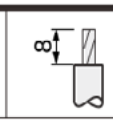
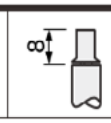
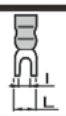
6.3.1 Connection cross-sections for screw connection technology

The following tables show the permissible conductor cross-sections for the connections.

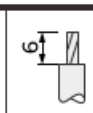
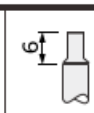
For Modular plastic range:

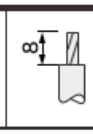
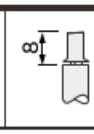
Type							
MCB, MLBL	Ø6	Pozidriv. Z2	A=8 1 x 0,75 ... 2,5 mm² 1 x AWG 18 ... 14 2 x 0,75 ... 2,5 mm² 2 x AWG 18 ... 14				l > 3,5 mm L ≤ 7,0 mm
MCBL	Ø6	Pozidriv. Z2	A=6 1 x 0,5 ... 1,5 mm² 1 x AWG 22 ... 14 2 x 0,5 ... 1,5 mm² 2 x AWG 22 ... 14				l > 3,0 mm L ≤ 5,9 mm

For Modular metal range:

Type							
P9B,P9PL,P9PD	Ø6	Pozidriv. Z2	1 x 0,75 ... 2.5 mm² 2 x 0,75 ... 2.5 mm² 1 x AWG 18 ... 14 2 x AWG 18 ... 14				l > 3,5 mm L ≤ 7,0 mm

For compact range:

Type								
CP C2SS C3SS CPM3 CE	M3 0.8 N.m 7.1 lb in	Ø6	Pozidriv. Z2	1 x 0,5 ... 1,5 mm² 2 x 0,5 ... 1,5 mm² 1 x AWG 22 ... 14 2 x AWG 22 ... 14				l > 3,0 mm L ≤ 5,9 mm

Type								
CL CB	M3.5 0.9 N.m 8.0 lb in	Ø6	Pozidriv. Z2	1 x 0,75 ... 2,5 mm² 2 x 0,75 ... 2,5 mm² 1 x AWG 18 ... 14 2 x AWG 18 ... 14				l > 3,5 mm L ≤ 7,0 mm

6.4 Installation instructions

Installation instructions for Pilot devices can be accessed from the ABB Download Center https://library.abb.com.
All Categories > Products > Low Voltage Products and Systems > Control Product > Pilot devices

6.5 2D drawings and 3D models

2D and 3D drawings for Pilot devices and accessories can be accessed from the ABB CAD download portal:
http://abb-control-prod-ucts.partcommunity.com/portal/portal/abb-control-products

6.6 EPLAN

Most pilot devices are managed in EPLAN, whose data can be found here:
https://dataportal.eplan.com/parts/list?manufacturer=ABB&page=1&sort=-download_count&catalog-manufacturer=L0_2790263505.L1_317511331.L2_1876865613

7. Useful links to further documents

Title	Document number	
Pilot Devices the complete offering. Main Catalogue	1SFC151007C0201	Link
Functional safety and reliability data for Motor starting and protection, B10 and B10D values	1SBC100226M0201	Link
Low voltage control and protection products in high altitudes	1SAC200234W0001	Link
Control and protection products for Household Applications	1SBC101441D0201	Link

8. Glossary

AC	Alternating current
Active power	The power consumed by the motor is converted into mechanical action.
Ambient temperature	Ambient temperature is the temperature of the water, air or surrounding medium where the equipment is used or stored.
DC	Direct current
Delta connection	The connection type of a motor where the windings are connected in a delta.
Efficiency	The ratio between mechanical output and electrical input. The percentage given indicates how effective the motor is at converting electrical energy to mechanical energy.
Frequency	The number of periodic cycles per unit of time.
Ie	The tripping characteristic of the instantaneous short-circuit releases is based on the rated operational current Ie, which, in the case of the Pilot device, is the same as the upper value of the setting range.
LED	Light-emitting diode
Operational voltage	The voltage that is fed to the motor, is usually 3-phase.
Ue	Rated operation voltage, see also Chapter: 2.7.2 Rated operational voltage (Ue).

ABB Electrification Sweden AB
Motor Starting and Safety
721 61 Västerås, Sweden

You can find the address of your local sales organization on the ABB home page

http://www.abb.com/contacts -> Low-voltage products

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1SFC151011C0201 revA June 2024