General Technical Data

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General Technical Data

Specifications, Standards and Certifying

Definitions

ABB low voltage devices are developed and manufactured according to the rules set out in IEC international publications and in EN European specifications.
In most countries, low voltage apparatus is built according to such rules with checking being the responsibility of the manufacturer. The devices are therefore not subject to any further obligation for approval. A test report from our laboratories can be remitted to our customers, on request, for presentation to different qualified local organizations.

Prescriptions and Standards

● **International Specifications**
The International Electrotechnical Commission, IEC, which is part of the International Standards Organization, ISO, publishes IEC publications which act as a basis for the world market.

● **European Specifications and National Specifications**
The European Committee for Electrotechnical Standardization (CENELEC), which groups together 18 European countries, publishes EN standards. These European standards differ very little from IEC international standards and have similar numbering.
The same applies for national standards which use, without exception, the same numbering and reproduce the texts of these unified standards in their entirety. Contradicting national standards are withdrawn.

● **European Directives**
The guarantee of the free movement of goods within the European Community means that any regulatory differences between member states have been eliminated. The European directives set up common rules that are included in the legislation of each state while contradictory regulations are cancelled.

Three directives are essential:

– Low Voltage Directive 73/23/EEC concerns electrical equipment from 0 to 1000 V a.c. and from 75 to 1500 V d.c.
This specifies that compliance with the requirements that it sets out is acquired if the equipment conforms to the standards harmonized on a European level: EN 60947-1 and EN 60947-4-1 for contactors.

– Machines Directive 89/392/EEC for safety specifications of machines and equipment on complete machines. Machines bearing the CE mark comply with these specifications.

– Electromagnetic Compatibility Directive 89/336/EEC which concerns all devices able to create electromagnetic disturbance.
Standard EN 60947-4-1 does not set out any requirement concerning the level of emission or immunity of contactors which do not have any active electronic components. Owing to this fact, compliance with standard EN 60947-4-1 meets the requirements for CE marking, with respect to this directive.

CE Marking :
CE marking must not be confused with a quality label.
CE marking is proof of conformity with the European Directives concerning the product.
CE marking is part of an administrative procedure and guarantees free movement of the product within the European Community.

● **International Standards**

IEC 60947-1	Low-voltage switchgear and controlgear – Part 1: General rules.
IEC 60947-4-1	Low-voltage switchgear and controlgear – Part 4: Contactors and motor starters. Section 1: Electromechanical contactors and motor starters.
IEC 60947-5-1	Low-voltage switchgear and controlgear – Part 5: Control circuit devices and switching elements. Section 1: Electromechanical control circuit devices.

● **European Standards**

EN 60947-1	Low-voltage switchgear and controlgear – Part 1: General rules.
EN 60947-4-1	Low-voltage switchgear and controlgear – Part 4: Contactors and motor starters. Section 1: Electromechanical contactors and motor starters.
EN 60947-5-1	Low-voltage switchgear and controlgear – Part 5: Control circuit devices and switching elements. Section 1: Electromechanical control circuit devices.

Test Certifying Organizations

ABB Control is a member of the **ASEFA** (Association of French Test Stations for Electrical Apparatus) whose platforms are accredited by **COFRAC** (national test network).
This independent organization is authorized to deliver certificates of testing and conformity with standards, especially IEC. **ASEFA** is one of the signatories of the **LOVAG** (Low Voltage Agreement Group) agreement which ensures reciprocal recognition between the main European certifying organizations for low voltage electrical tests by delivering certificates of **LOVAG** conformity.

Terminology

Altitude
Characterizes the place of use. It is expressed in metres above sea level.

Circuits
– Auxiliary circuit:
All the conductive parts of a contactor designed to be inserted in a different circuit from the main circuit and the contactor control circuits.
– Control circuit:
All the conductive parts of a contactor (other than the main circuit and the auxiliary circuit) used to control the contactor's closing operation or opening operation or both.
– Main circuit:
All the conductive parts of a contactor designed to be inserted in the circuit that it controls.

Rated Operational Current I_e
Current rated by the manufacturer. It is mainly based on the rated operational voltage **U_e**, the rated frequency, the utilization category, the rated duty and the type of protective enclosure, if necessary.

Conventional Free Air Thermal Current I_{th}
Current that the contactor can withstand in free air for a duty time of 8 hours without the temperature rise of its various parts exceeding the maximum values given by the standard.

Electrical Durability
Number of on-load operations that the contactor is able to carry out. It depends on the utilization category.

Mechanical Durability
Number of no-current operations that a contactor is able to carry out.

Switching Frequency
Number of switching cycles per hour.

Coil Operating Limits
Expressed in multiples of the nominal control circuit voltage **U_c** for the upper and lower limits.

Mounting Position
Comply with the manufacturer's instructions.

Rated Breaking or Making Capacity
Root mean square value of the current that the contactor is able to break or make at a given voltage according to the conditions specified by standards and for a given utilization category.

Ambient Temperature
Air temperature close to the contactor.

Time
– Time constant :
Ratio of the inductance to the resistance (L/R = mH/Ω = ms).
– Short-time withstand current **I_{cw}**:
Current that the contactor is able to withstand in closed position for a short time interval and in specified conditions.
– Minimum switching time:
This is the minimum closing or opening order time necessary for the contactor to reach complete closing or opening.
– Closing time:
Time interval between the beginning of the closing operation and the instant the contacts touch on all the poles.
– Opening time:
Time interval between the specified starting instant of the opening operation and the instant the arcing contacts separate on all the poles.

Rated Control Voltage U_c
Control voltage value for which the control circuit is sized.

Rated Operational Voltage U_e
Voltage to which the contactor's utilization characteristics refer. In three-phase it is the phase-to-phase voltage.

Rated Insulation Voltage U_i
Reference voltage for dielectric tests and creepage distances.

Rated Impulse Withstand Voltage U_{imp}
Peak value of an impulse voltage, having a specified form and polarity, which does not cause breakdown in specific test conditions.

Shock Withstand
Requirement for vehicles, crane drives, installations on board ships and plug-in equipment. The contactors must not change position and the overload relays must not trip.

Resistance to Vibrations
Requirements for vehicles, boats and other means of transport. For the specified vibration amplitude and frequency values the device must remain able to operate.

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Utilization Categories

Standards

IEC publications 60941-1, 60947-4-1 and 60947-5-1 should be referred to on an international level with respect to contactors.
A contactor's duty is characterised by the utilization category together with the rated operational voltage and current indicated.

- **Utilization Categories for Contactors According to IEC 60947-4-1**

Alternating current:	**AC-1**	Non-inductive or slightly inductive loads, resistance furnaces.
	AC-2	Slip-ring motors: starting, switching off.
	AC-3	Cage motors: starting, switching off running motors.
	AC-4	Cage motors: starting, plugging, inching.
	AC-5a	Discharge lamp switching.
	AC-5b	Incandescent lamp switching.
	AC-6a	Transformer switching.
	AC-6b	Capacitor bank switching.
	AC-7a	Slightly inductive loads for domestic devices and similar applications.
	AC-7b	Motors for domestic applications.
	AC-8a	Hermetic refrigeration compressor motor control with manual resetting of overload releases.
	AC-8b	Hermetic refrigeration compressor motor control with automatic resetting of overload releases.
Direct current:	**DC-1**	Non inductive or slightly inductive loads, resistance furnaces.
	DC-3	Shunt motors: starting, plugging, inching, dynamic breaking of d.c. motors.
	DC-5	Series motors: starting, plugging, inching, dynamic breaking of d.c. motors.
	DC-6	Incandescent lamp switching.

- **Utilization Categories for the Auxiliary Contacts According to IEC 60947-5-1**

Alternating current:	**AC-12**	Control of resistive loads and static loads with opto-coupler isolation.
	AC-13	Control of static loads with transformer isolation.
	AC-14	Control of weak electromagnetic loads (≤ 72 VA).
	AC-15	Control of electromagnetic loads (> 72 VA).
Direct current:	**DC-12**	Control of resistive loads and static loads with opto-coupler isolation.
	DC-13	Control of d.c. electromagnets.
	DC-14	Control of d.c. electromagnets having economy resistors.

In fact some applications, and the specific criteria characterizing the various loads controlled by contactors, may modify the utilization characteristics of the contactors.

d.c. Power Circuit Switching
Arc suppression is more difficult in direct current than in alternating current and this is all the more true the higher the circuit time constant which is why it is necessary to connect several poles in series in order to improve breaking conditions. (☞ pages **2**/48, **2**/49, **2**/52, **2**/53.)

a.c. High Current Circuit Switching
Possibility of increasing performances by connecting poles in parallel. (Please consult us.)

Influence of the Length of the Conductors used in the Contactor Control Circuit
According to the operational voltages and the coil consumption, take line resistances and capacitances into consideration, for the length and the cross-sectional of the conductors.

Making and Breaking Conditions for Utilization Categories

Utilization category		Durability test conditions						Occasional operation					
		Making conditions			Breaking conditions			Making conditions			Breaking conditions		
		I/I_e	U/U_e	Cos. φ or L/R (ms)	I/I_e	U/U_e	Cos. φ or L/R (ms)	I_c/I_e	U_r/U_e	Cos. φ or L/R (ms)	I_c/I_e	U_r/U_e	Cos. φ or L/R (ms)
Contactors for a.c. circuit switching													
AC-1		1	1	0.95	1	1	0.95	1.5	1.05	0.8	1.5	1.05	0.8
AC-2		2.5	1	0.65	2.5	1	0.65	4	1.05	0.65	4	1.05	0.65
AC-3	$I_e \leq 100$ A	6	1	0.35	1	0.17	0.35	10	1.05	0.45	8	1.05	0.45
	$I_e > 100$ A	6	1	0.35	1	0.17	0.35	10	1.05	0.35	8	1.05	0.35
AC-4	$I_e \leq 100$ A	6	1	0.35	6	1	0.35	12	1.05	0.45	10	1.05	0.45
	$I_e > 100$ A	6	1	0.35	6	1	0.35	12	1.05	0.35	10	1.05	0.35
Contactors for d.c. circuit switching													
DC-1		1	1	1	1	1	1	1.5	1.05	1	1.5	1.05	1
DC-3		2.5	1	2	2.5	1	2	4	1.05	2.5	4	1.05	2.5
DC-5		2.5	1	7.5	2.5	1	7.5	4	1.05	15	4	1.05	15
Auxiliary contacts for a.c. circuit switching													
AC-14	(≤ 72 VA)	–	–	–	–	–	–	6	1.1	0.7	6	1.1	0.7
AC-15	(> 72 VA)	10	1	0.7	1	1	0.4	10	1.1	0.3	10	1.1	0.3

Auxiliary contacts for d.c. circuit switching

	Standard operation						Occasional operation					
	Making conditions			Breaking conditions			Making conditions			Breaking conditions		
	I/I_e	U/U_e	$T_{0.95}$	I/I_e	U/U_e	$T_{0.95}$	I/I_e	U/U_e	$T_{0.95}$	I/I_e	U/U_e	$T_{0.95}$
DC-13	1	1	6 P(1)	1	1	6 P(1)	1.1	1.1	6 P(1)	1.1	1.1	6 P(1)
DC-14	–	–	–	–	–	–	10	1.1	15 ms	10	1.1	15 ms

(1) The value "6 x P" is the result of an empirical relation which is estimated to represent most d.c. magnetic loads up to the highest limit of P = 50 W (6 x P = 300 ms). It is accepted that loads having drawn energy above 50 W are made up of weaker loads in parallel. As a consequence, the 300 ms value must form the highest limit whatever the value of the power drawn.

Key:

U (**I**) = applied voltage (current)
$\mathbf{U_r}$ = recovery voltage
L/R = test circuit time constant
$\mathbf{U_e}$ ($\mathbf{I_e}$) = rated operational voltage (current)
$\mathbf{I_c}$ = making and breaking current expressed in d.c. or in a.c. like the r.m.s. value of the symmetrical components
$\mathbf{T_{0.95}}$ = time required to reach 95% of the current in steady-state conditions, expressed in milliseconds

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Climatic Withstand of Devices

General

The life time and dependability of devices are mainly influenced by a series of climatic factors which cause their corrosion.
In practice, besides climatic conditions, there are other factors which may damage equipment such as fungi, insects (termites), dust, work site dirt and aggressive environment (salty or sulphurous atmosphere, etc.) which can often only be identified at the place of installation.
The entrance of dust, insects, dirt, etc. in devices may be prevented if the appropriate degree of protection according to IEC 60529 is chosen.

ABB contactors have been used for many years in the most varied countries, with hot and humid climates for example: Brazil, Indonesia, India etc. Experience has shown that **ABB** devices can be used in most countries throughout the world.

The climate of the country in which the device is installed is not the determining choice factor.

Account must be taken of:

– the immediate environment of the devices (sheltered, ventilated, temperature),
– the aggressivity of the immediate atmosphere at the place of installation,
– the length and frequency of non operating periods.

In the case of frequent condensation (i.e. the formation of steam caused by rapid changes in temperature), heating resistors must be installed in cubicles (100 to 250 W per m^3 of enclosure).
The table below gives the cases where heating is necessary.

Environment		Operating conditions	Climate	Internal heating of enclosure
Inside premises	No running water No condensation	Continuous or not	All climates	Without
	With running water	Continuous	All climates	Without
		Frequent or long stops	Temperate	Without
			Tropical	With
Outside, sheltered	No running water no condensation	Continuous or not	Temperate	Without
			Tropical	With
Outside or by the seaside	With running water	Continuous	All climates	Without
		Frequent or long stops	Temperate	Without
			Tropical	With

● The standard **R** series contactors are suitable for industrial environment and tropical atmospheres.
Special versions can be supplied, on request, for very corrosive atmospheres.

Notes