



Brochure

# DC switching contactors, type GAF A compact contactor up to 1000 V DC

# The GAF contactor range

## A compact and efficient way of DC switching



The new GAF range contactors are the latest addition to ABB's well established A/AF range. This further extends our offering of contactors for DC switching at voltages up to 1000 V DC. The GAF contactors utilize all the well known features of the existing A/AF range such as modern and compact design. In addition all the benefits from the AF coil technology and reliability of a proven contactor design. These contactors are rated for DC-1 or DC general purpose applications according to IEC 1000 V DC or cULus 600 V DC. The new GAF contactors share the external dimensions of its corresponding standard AF contactor.

The new GAF range,  
the world's first block  
contactors with ratings up  
to 2000 A for 1000 V DC

# Features and benefits

## Powerful

- 1000 V DC switching ratings (IEC).
- UL (508) rated up to 600 V DC.

## Flexible

- Wide control voltage range (e.g. 100-250 V AC/DC) means less versions covering the entire range.
- PLC interface with 24 V DC / 10 mA for GAF/AF400...2050.
- Ideal for remote and fast operation.

## Efficient

- The AF electronic coil interface reduces power consumption 5-10 times at holding compared to conventional contactors.

## Reliable

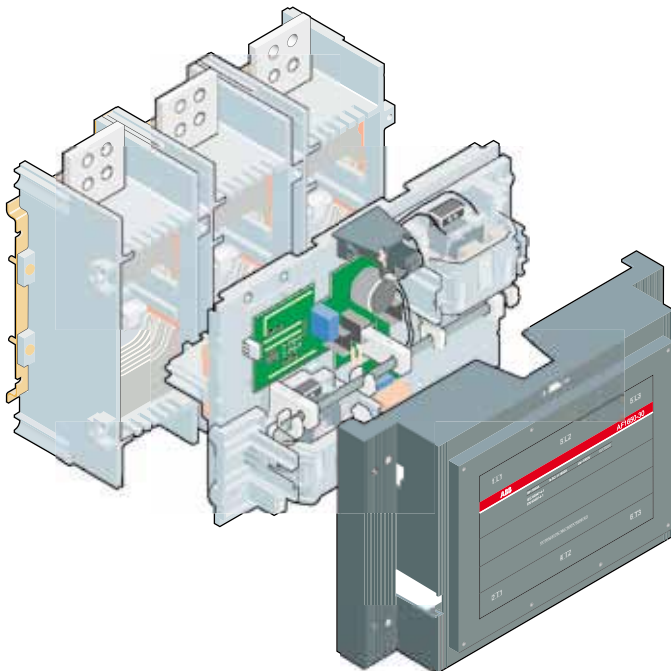
- The GAF contactor is based on the well proven AF contactor.
- Less sensitive to voltage drops due to a drop-out voltage of 55% of the lower nominal value along with 20 ms sag and dip immunity. These features avoid the problems with contactor chattering and welding.
- Elimination of contact bounce and chattering allows for increased reliability and service life.

## Quiet

- DC powered coil makes the contactor virtually noise free.

## Easy

- The external dimensions of the GAF contactors are the same as corresponding AF contactors making it easy to order and install.
- Existing add on accessories for A/AF range of three pole contactors will fit the GAF contactors.



The GAF contactor's ability to break DC up to 2000 A at a voltage up to 1000 V derives from the use of permanent magnets in the arc packages. The magnets enable the contactor to extinguish the powerful electrical arcs that arise between the contact surfaces when breaking DC. Normal AF contactors can break DC up to some extent but since they lack the permanent magnets they will not be able to break DC as a corresponding GAF contactor.

# Applications – solar

## What is PV power?

Photovoltaic (PV) power is a renewable energy source converting sunlight directly into electrical energy using PV cells. Large PV systems often consist of following main components:

- PV cells (combined to strings, generating the power).
- Inverter (one or several, converting the generated DC voltage into AC 50Hz or 60Hz, also including devices for switching, protection and control).
- Combiners (junction boxes, including switching devices, with several cables on input and one cable on output).
- Trackers (mechanical structure to move the angle of PV cells to follow the sun, increasing system efficiency, also including motors, PLC, communication, protection).
- Switching devices and protection devices (to change PV string configuration, protect from over currents, surge voltages and earth faults etc.).
- Distribution transformer (transforming low voltage to high voltage, as grid connection often is done on high voltage level).



### What is the future of PV power?

Solar energy is today the fastest growing segment in renewable energy and is believed to be one of the major energy sources in the future.

Factors that vouch for a bright future of solar energy:

- Growing climate awareness brings more focus on renewable energy.
- Continuously higher legislative demands on increasing the share of green energy.
- Intense research and development of the PV technology in order to make it more efficient and easier to produce.

Decreased production costs due to higher volumes and improved production technique make it possible to produce low cost PV cells which in turn will expand the market.

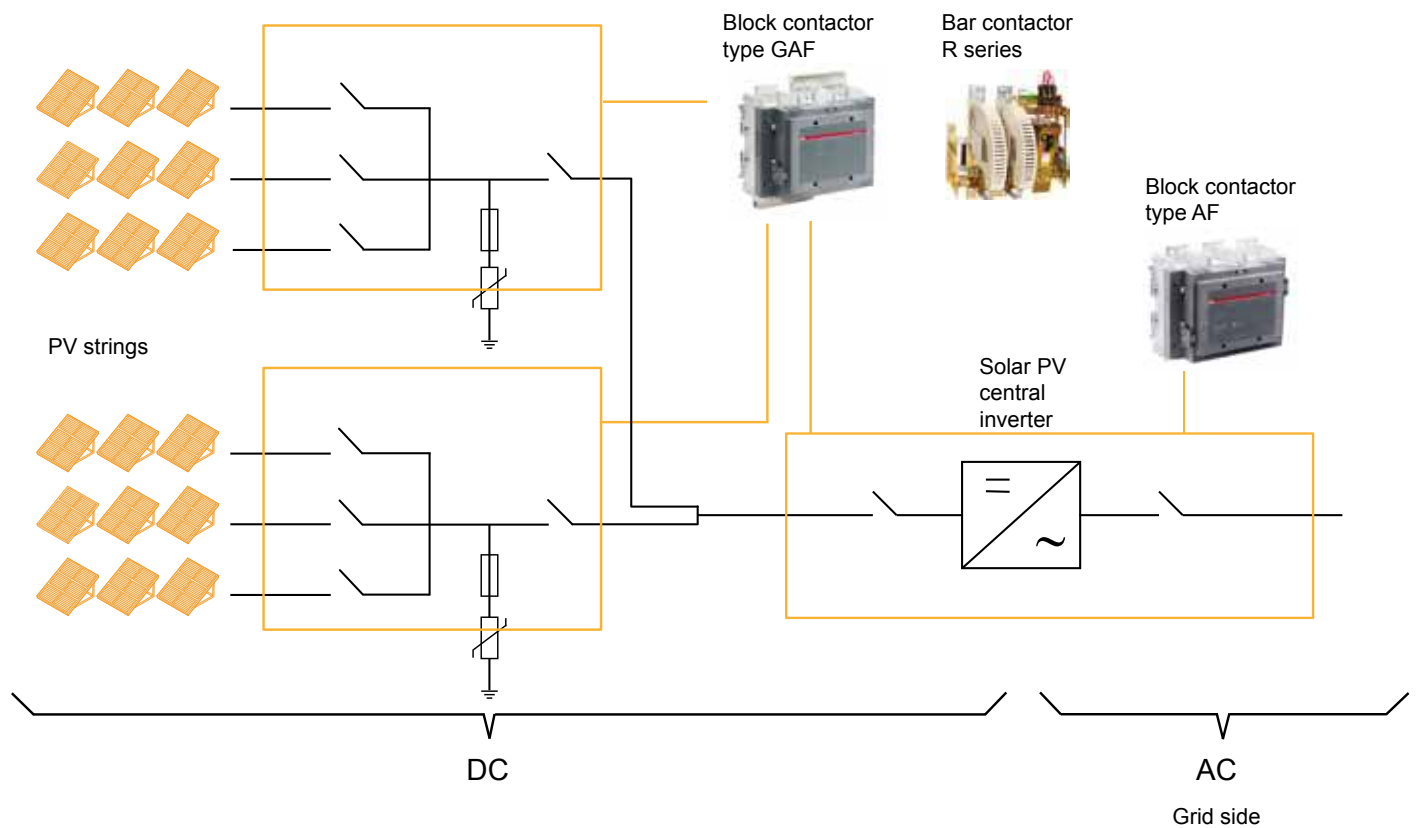
### Why is DC contactors needed?

PV plants contain some major application for DC switching, since the electricity produced by the PV panels is DC. Depending on application requirements, different products can be used for switching. Contactors are typically selected for applications with the need for remote control and switching at least once per day.

### Applications

Main applications where contactors are used for DC switching are:

- Disconnection of the inverter from the PV strings when the output is too low.
- Changing the string configuration, e.g. to increase plant efficiency by diverting one or several PV strings to an optimal number of converters at low output. This makes it possible to constantly optimize the efficiency of the system.



# Applications – other

There are several other DC-applications in which ABB's GAF & AF contactors can be efficiently used.

## Traction

Traction vehicles

- Urban traction vehicles such as trams, subways, commuter trains etc.
- Diesel locomotives
- Heating applications

Traction wayside

- Signaling
- Switchgear
- Power distribution

## Batteries

The accelerating need for mobile energy and protection against power disturbances in distribution networks is driving the market of batteries forward. The number of applications where batteries

can be used is steadily increasing and with that the need of DC switching. Examples of such applications are charging of vehicle batteries, DC storage, UPS installations, backup and control solutions, etc.

## Telecom

The telecom industry is today facing a rapid increase of data transmission which demands larger and more efficient transmission stations. Larger stations may require higher currents and an increase of voltage in order to reduce energy losses. In this kind of setup compact, efficient and reliable DC switching is needed.

## Special industry:

- DC Drives in e.g. metal refining plants.



# Ordering details

## DC switching ratings, 3 contacts in series



1SFC101098F0001



1SFC101099F0001



1SFC101100F0001



1SFC101102F0001



1SFC101104F0001



1SFC101114F0001



1SFC101117F0001

### IEC rated operational current at 1000 V

L/R 1 ms, air temperature close to contactor

					Type	Order code	Pkg qty	Weight (1 pce) kg
40 °C	55 °C	60 °C	65 °C	70 °C				
A								
275	250	230	205	180	GAF185-10-11	1SFL497025R□□11		3.60
500	400	375	350	325	GAF300-10-11	1SFL557025R□□11		6.20
700	600	560	520	480	GAF460-10-11	1SFL597025R□□11		12.00
1050	875	800	760	720	GAF750-10-11	1SFL637025R□□11		15.00
1250	1040	970	920	875	GAF1250-10-11	1SFL647025R□□11		16.00
1650	1450	1380	1325	1270	GAF1650-10-11	1SFL677025R□□11		35.00
2050	1750	1650	1575	1500	GAF2050-10-11	1SFL707025R□□11		35.00

### cULus general purpose ratings at 600 V and IEC rated operational current at max. 850 V

40 °C	UL	40 °C	IEC				
A		A					
250		275		GAF185-10-11	1SFL497025R□□11		3.60
400		500		GAF300-10-11	1SFL557025R□□11		6.20
Use GAF185 ... GAF300				AF145-30-11	1SFL477001R□□11		3.60
				AF185-30-11	1SFL497001R□□11		3.60
				AF210-30-11	1SFL517001R□□11		6.20
				AF260-30-11	1SFL537001R□□11		6.20
				AF300-30-11	1SFL557001R□□11		6.20
				AF400-30-11	1SFL577001R□□11		12.00
				AF460-30-11	1SFL597001R□□11		12.00
				AF580-30-11	1SFL617001R□□11		15.00
				AF750-30-11	1SFL637001R□□11		15.00
				AF1250-30-11	1SFL647001R□□11		16.00
				AF1350-30-11	1SFL657001R□□11		34.00
				AF1650-30-11	1SFL677001R□□11		35.00
				AF2050-30-11	1SFL707001R□□11		35.00

### Connection bar for contactor\*

GAF185, AF145, AF185	LP185	1SFN074712R1000	2	0.30
GAF300, AF210 ... AF300	LP300	1SFN075112R1000	2	0.40
GAF460, AF400, AF460	LP460	1SFN075712R1000	4	0.55
GAF750, AF580, AF750	LP750	1SFN076112R1000	4	0.95
GAF1250, AF1250	LP1250	1SFN076412R1000	2	1.90
GAF1650, GAF2050, AF1350, AF1650, AF2050	LP2050	1SFN076512R1000	4	2.90

\*) Not included with the contactor

### Auxiliary contact blocks, low energy microswitch 0.1 A, N.O or N.C.

AF145...AF2050	N.C.	CEL18-01	1SFN010716R1001		0.05
GAF185...GAF2050	N.O.	CEL18-10	1SFN010716R1010		0.05

### AC / DC coils with electronic coil interface

Contactors GAF185 ... GAF300, AF145 ... AF300					
Voltage		Voltage		Code	
□ □	V - 50/60Hz	V - DC	□ □	□ □	
—		20 ... 60	7	2	
48 ... 130		48 ... 130	6	9	
100...250		100 ... 250	7	0	

Contactors GAF1650, GAF2050, AF1350, AF1650, AF2050					
Voltage		Voltage		Code	
□ □	V - 50/60Hz	V - DC	□ □	□ □	
—		24 ... 60	6	8	
48 ... 130		48 ... 130	6	9	
100 ... 250		100 ... 250	7	0	
250 ... 500		250 ... 500	7	1	

# Technical data

## DC switching ratings AF Contactors

### IEC

		AF145	AF185	AF210	AF260	AF300	AF400	AF460	AF580	AF750	AF1250	AF1350	AF1650	AF2050
<b>Utilization category DC-1</b>		A	A	A	A	A	A	A	A	A	A	A	A	A
Contacts in series	<b>L/R 1 ms</b>													
1 contact	110 V						600	700	800	1050				
2 contacts	110 V	250	275	350	400	450	600	700	800	1050				
3 contacts	220 V	250	275	350	400	450	600	700	800	1050	1250	1350	1650	2050
3 contacts	600 V						600	700	800	1050	1250	1350	1650	2050
3 contacts	850 V							800	1050	1250	1350	1650	2050	
Conductor cross-sectional area	mm <sup>2</sup>	120	150	185	240	300 <sup>1)</sup>	370	480	800 <sup>3)</sup>	1000 <sup>3)</sup>	1000 <sup>2)</sup>	1500 <sup>2)</sup>	2000 <sup>2)</sup>	

### Utilization category DC-3

Contacts in series	<b>L/R 2 ms</b>													
1 contact	110 V						600	700	800	1050				
2 contacts	110 V	250	275	350	400	450	600	700	800	1050				
3 contacts	220 V	250	275	350	400	450	600	700	800	1050				
3 contacts	600 V						600	700	800	1050				
Conductor cross-sectional area	mm <sup>2</sup>	120	150	185	240	300 <sup>1)</sup>	370	480	800 <sup>3)</sup>	1000 <sup>3)</sup>	1000 <sup>2)</sup>	1500 <sup>2)</sup>	2000 <sup>2)</sup>	

### Utilization category DC-5

Contacts in series	<b>L/R 7.5 ms</b>													
1 contact	110 V						600	700	800	1050				
2 contacts	110 V	250	275	350	400	450	600	700	800	1050				
3 contacts	220 V	250	275	350	400	450	600	700	800	1050				
3 contacts	600 V						600	700	800	1050				
Conductor cross-sectional area	mm <sup>2</sup>	120	150	185	240	300 <sup>1)</sup>	370	480	800 <sup>3)</sup>	1000 <sup>3)</sup>	1000 <sup>2)</sup>	1500 <sup>2)</sup>	2000 <sup>2)</sup>	

<sup>1)</sup> For currents above 450 A use 300 mm<sup>2</sup> and terminal extension / enlargement pieces (LW300: see [www.abb.com/lowvoltage](http://www.abb.com/lowvoltage) or local ABB catalog)

<sup>2)</sup> Max connection bar width 100 mm

<sup>3)</sup> Max connection bar width 50 mm

### cULus

		AF145	AF185	AF210	AF260	AF300	AF400	AF460	AF580	AF750	AF1250	AF1350	AF1650	AF2050
<b>Intended device application general purpose</b>														
Contacts in series														
3 contacts	240 V		250				550	650	750	900	1210		1350	1900
3 contacts	600 V						550	650	750	900	1210		1350	1900

### General

- When selecting a contactor for DC switching it is essential to determine the current, the voltage and the L/R time constant of the controlled load.
- The loads are defined by the time constant L/R: non inductive loads such as resistance furnaces (L/R ≈ 1 ms), inductive loads such as shunt motors (L/R ≈ 2 ms) or series motors (L/R ≈ 7.5 ms).
- In addition to the block contactors shown in this document:
  - 1) ABB also offers bar mounted contactors (R-series). Bar contactors can typically be used for higher amps and voltages or other configurations or number of main poles (contacts).
  - 2) For other DC switching contactors e.g. GA/GAE75 see catalog 1SBC100122C0202.



# Technical data

## DC contactors GAF and AF

### Main Technical data

IEC60947-4-1		GAF185		GAF300		GAF460		GAF750		GAF1250		GAF1650		GAF2050	
Contactor type GAF															
Rated operational voltage $U_c$ max	V DC													1000	
IEC 60947-4-1, DC-1, $\theta \leq 40$ °C	A	275		500		700		1050		1250		1650		2050	
Conductor cross-sectional area	mm <sup>2</sup>	150		300 <sup>1)</sup>		480		800 <sup>3)</sup>		1000 <sup>3)</sup>		1500 <sup>2)</sup>		2000 <sup>2)</sup>	

<sup>1)</sup> For currents above 450 A use 300 mm<sup>2</sup> and terminal extension / enlargement pieces (LW300: see [www.abb.com/lowvoltage](http://www.abb.com/lowvoltage) or local ABB catalog)

<sup>2)</sup> Max connection bar width 100 mm

<sup>3)</sup> Max connection bar width 50 mm

### cULus

Contactor type GAF		GAF185		GAF300	
Rated operational voltage $U_c$ max	V DC			600	
Amp-ratings general purpose	A	250		400	

### General Technical data

Contactor type	AF145		GAF185		AF210		AF260		GAF300		AF300		AF400		GAF460		AF460		AF580		GAF750		AF750		GAF1250		AF1250		GAF1650		AF1350		AF1650		GAF2050		AF2050	
	Rated making capacity DC-1	1.5 x $I_c$ acc. to IEC60947-4-1																																				
Rated breaking capacity DC-1	1.5 x $I_c$ acc. to IEC60947-4-1																																					
Short-circuit protection for contactors without thermal O/L relay - Motor protection excluded	On request or see <a href="http://www.abb.com/lowvoltage">www.abb.com/lowvoltage</a> or local ABB catalog																																					
Rated short-time withstand current, $I_{cw}$	On request or see <a href="http://www.abb.com/lowvoltage">www.abb.com/lowvoltage</a> or local ABB catalog																																					
Heat dissipation per pole $I_c$ /DC-1	W	13	16	18	25	32	30	42	32	50	80	80	125																									
Rated impulse withstand voltage, $U_{imp}$	kV	8																																				
Ambient temperature close to contactor - during operation / storage	°C	see "Conditions for use", for control voltage limits and authorized mounting -40 to +70																																				
Operating altitude	m	≤3000 without derating																																				

### Magnet system characteristics

Rated control circuit voltage $U_c$		48 ... 250		48 ... 500		100 ... 250																							
- at 50 Hz and 60 Hz	V																												
- d.c.	V	20 ... 250		24 ... 500		100 ... 250																							
Coil operating limits acc. IEC60947-4-1		0.85 x $U_c$ min. ... 1.1 x $U_c$ max. (at $\theta \leq 70$ °C) Please also refer to "Mounting characteristics"																											
Drop-out voltage in % of $U_c$ min.	%	55																											
Coil consumption																													
Average pull-in value 50 Hz and 60 Hz	VA	430		470		890		850		850		1900																	
d.c.	W	500		520		990		950		950		1700																	
Average holding value 50 Hz and 60 Hz	VA/W	12/3.5		10/2.5		12/4		12/4.5		12/4		48/17																	
d.c.	W	2		2		4		4.5		4		16																	
Operating time coil supply between A1-A2		On request or see <a href="http://www.abb.com/lowvoltage">www.abb.com/lowvoltage</a> or local ABB catalog																											

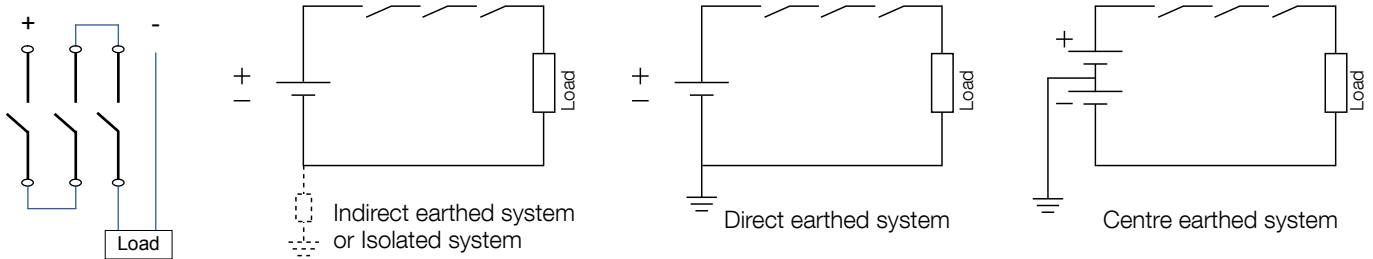
### Mounting characteristics

Mounting positions		- mounting on a vertical plane: any position with a tilt up to $\pm 30^\circ$ - mounting on a horizontal plane: any position with a tilt up to $\pm 30^\circ$ , except up-side down																											
Fixing - by screws (not supplied)		4 x M5								4 x M6								4 x M8											

# Connections

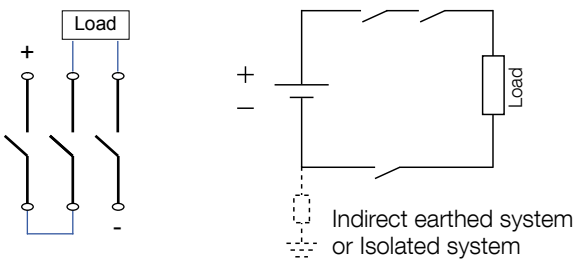
## Recommended connection

All three contacts connected in series without the load in between. This connection is recommended in systems according to the configurations below.



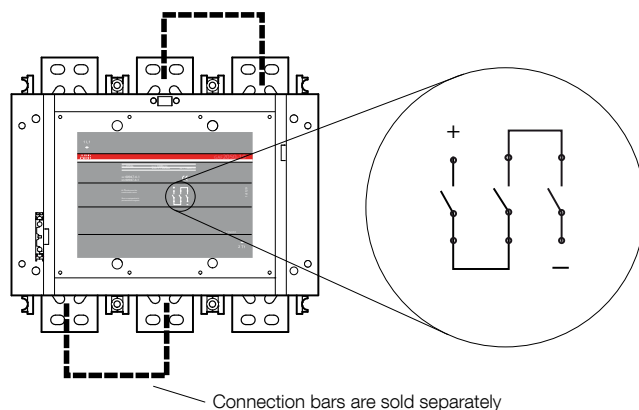
## Alternative connection

The load is placed in between the three contacts in an indirect earthed system or in a fully isolated system. If not connected according to the configuration below, a fault to earth could result in one or two contacts breaking the full load which the contactor is not approved for.

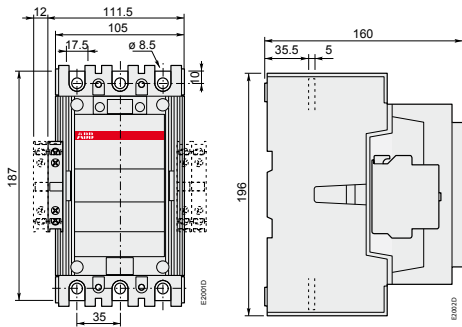


## Points to consider

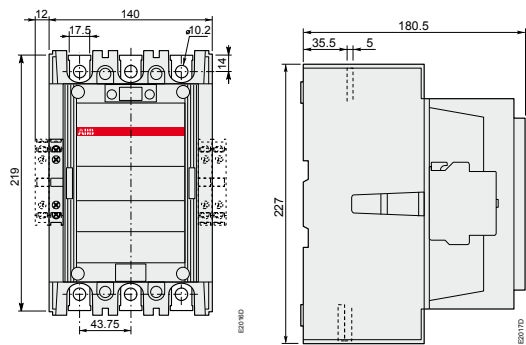
- The above relates to power circuit switching. The SCPD (Short Circuit Protection Device) must comply with applicable protection rules.
- The direction of the current must be as shown on the contactor front label.
- Connection bars for connecting three contacts in series are not delivered with the contactor as standard, but are available as accessories.
- Recommended and Alternative connection is also valid for DC-switching with AF contactors.



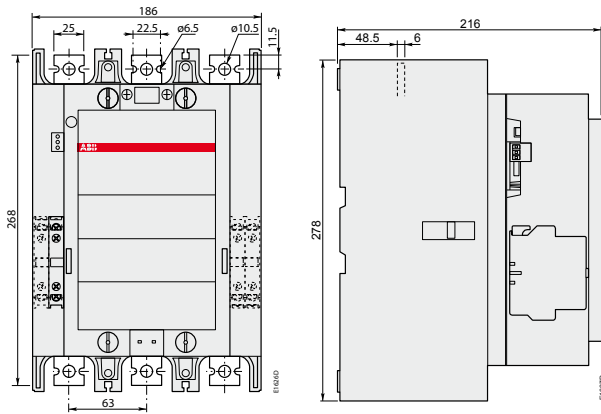
# Dimensions



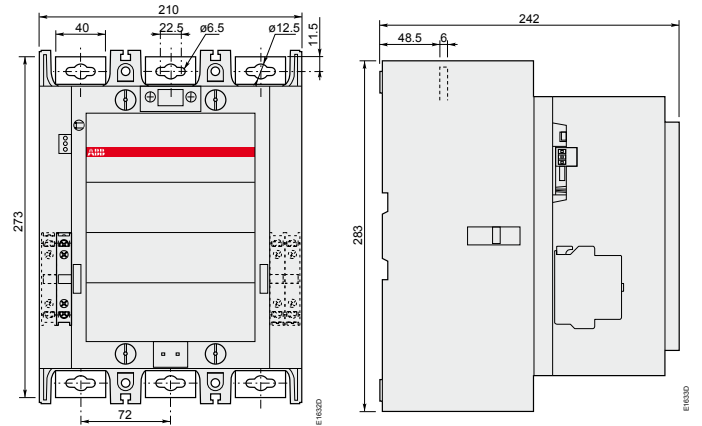
GAF185  
AF145, AF185



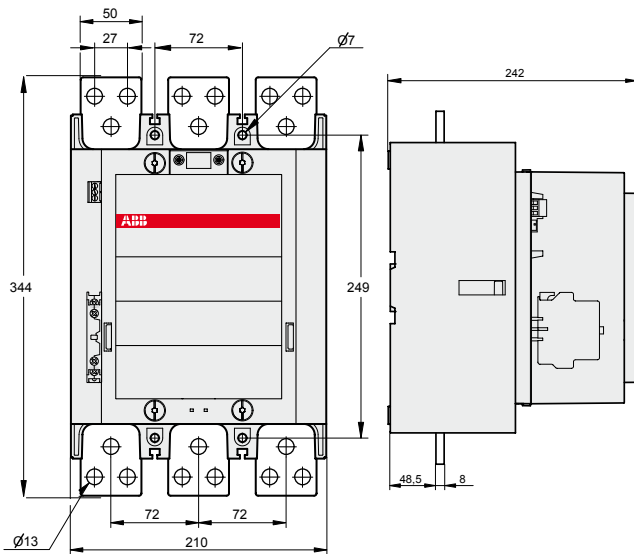
GAF300  
AF210 ... AF300



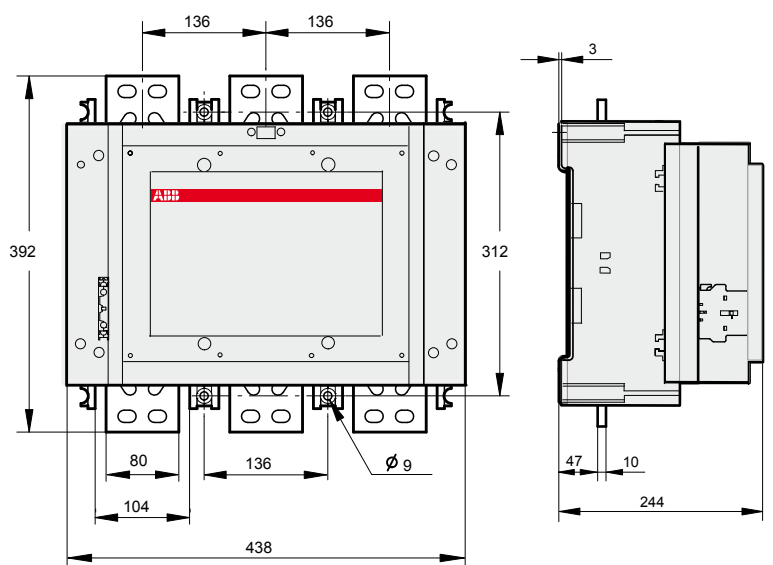
GAF460  
AF400, AF460



GAF750  
AF580, AF750



GAF1250,  
AF1250



GAF1650, GAF2050  
AF1350, AF1650, AF2050

Dimensions in mm  
Inch converter: 1 mm = 0.0394 in

# Contact us

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[www.abb.com/lowvoltage](http://www.abb.com/lowvoltage)

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