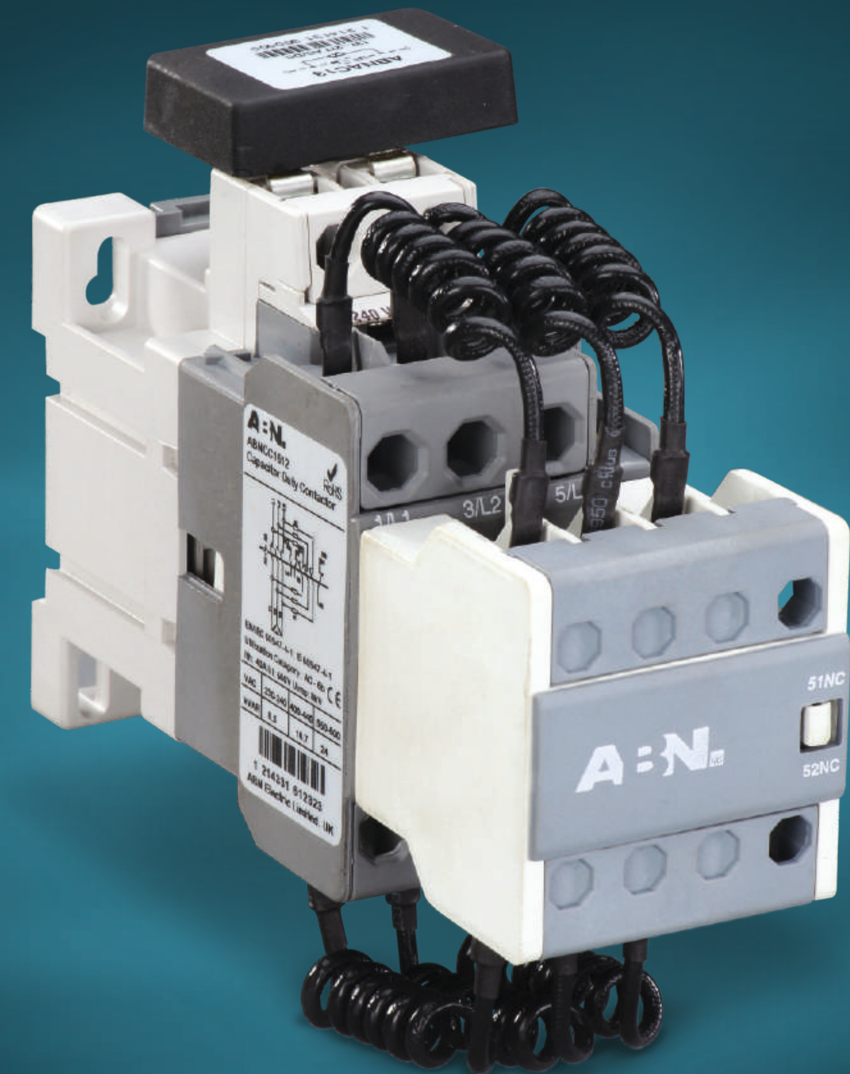
C/13

Capacitor Duty Contactors



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ROVE Electric

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Electricity is the most indispensable source of energy in this modern era. ABN Electric excel in the specialized manufacturing, servicing and exporting of low voltage Switchgear, controlgear, Power Busbars & Diesel Gensets. since its establishment, the company is a fully self contingent, where every component is formulated, developed, processed and manufactured to latest requirements.

"We Make Ideas Work"

ABN electric hold an excellent technical infrastructure and highly skilled team of professionals. The R&D wing constantly work on innovations and determine to transform conventional products to new generation products.

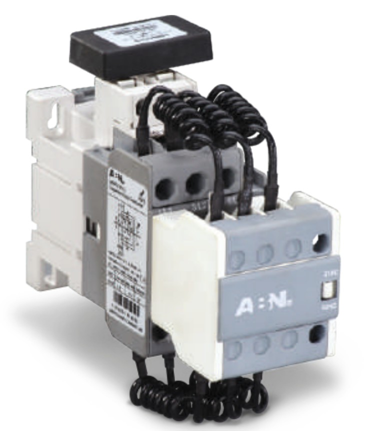
"Conviction"

Our products are accredited with Global Standards which stand as a testimony to our strict and vigilant quality control. We are committed to quality and innovation besides prompt after sales service.

ROVE Electric

Capacitor Duty Contactor

Introduction



When Switched on a capacitor can function as short circuit element. The capacitor inrush or charging current magnitude depends on AC voltage at turn on and on the impedance of connection cable and power supply transformer.

In case of individual capacitor load charging peaks that are 30 times greater than rated capacitor current. In case of multi stage capacitor the inrush current can exceed 180 times rated capacitor current. Such strong current occur from power supply network and capacitor is already connected.

Such inrush current is undesirable since main contacts of standard duty contactors are likely to weld.

ABN capacitor duty contactor is designed meet the requirements of capacitor duty application.

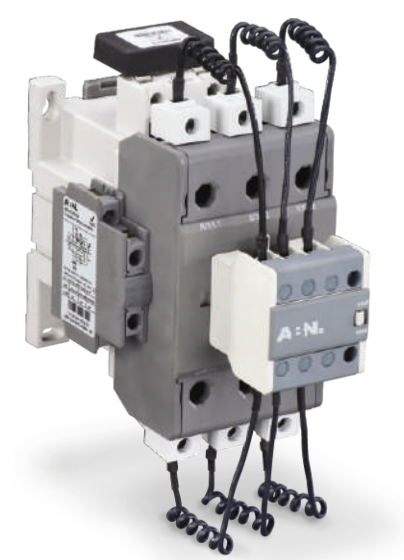
Concepts of Operation

Capacitor duty contactor connected the capacitor loads series with resistor for the duration of 5 to 10 milli seconds. After lapse of 10 milli seconds these resistance wire permanently isolate from the supply and main contacts share the load until the coil supply interrupted.

The purpose of adding resistance wire in the capacitor circuit is to limit the heavy inrush current of capacitor and avoid contact welding. This was achieved by specially made integral pre-contacts and fiber glass teflon coated resistance wire.

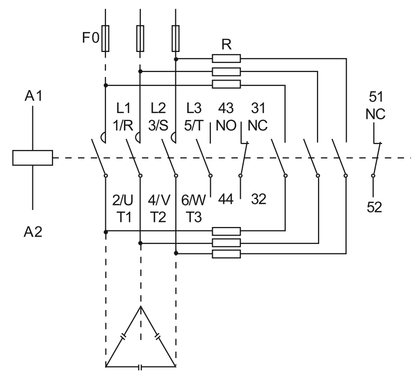
All capacitor duty contactors are fitted with coil suppressor across the coil terminal to suppress the surge voltage that occurs due to self-inductance of the coil during interruptions. By providing suppressor the malfunction of APFC controller would be totally eliminated, resulting in a better life of the contactor and capacitor.

Three pole capacitor duty contactors from 5 kVAR to 75 kVAR available in 10 ratings complying with the International standard EN/IEC 60947-4-1and IS:60947-4-1

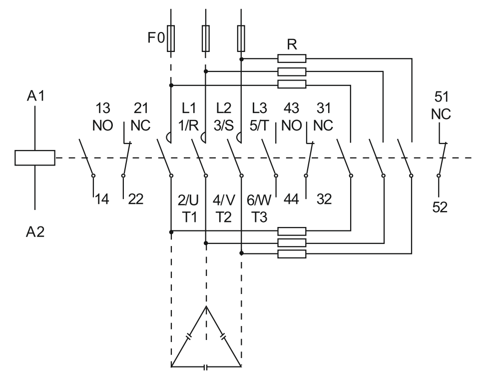


Circuit Diagram

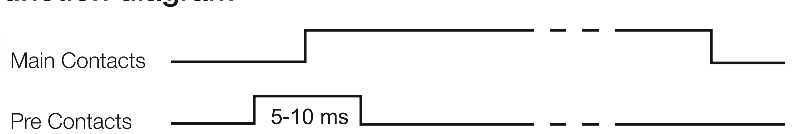
RVCC07...CC25



RVCC33...CC75



Function diagram



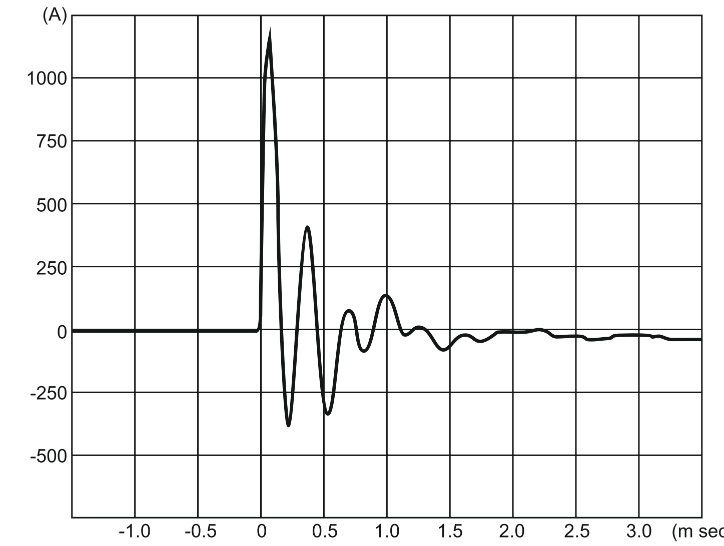
Case Studies

Case studies with different condition

1) Normal contactor

Make - normal contactor
RVAC1803 with 12.5kVAR (18A / 400V)

The picture shows a make current peak is about 1200A which shows higher amplitude of inrush current.

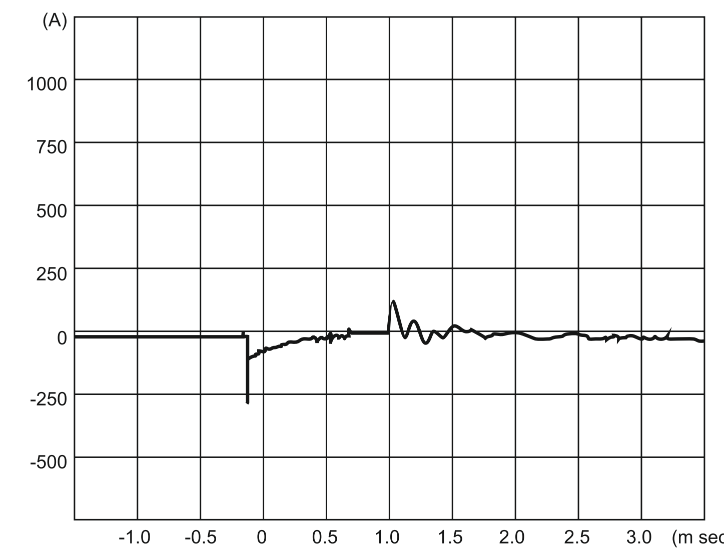


Practical function - Oscillogram

2) Capacitor duty contactor

Make - capacitor duty contactor
RVCC12 with 12.5kVAR (18A / 400V)

First current peak is due to make of pre-contacts with resistance Second current peak due to closing the main-circuit, which shows lower amplitude of inrush current

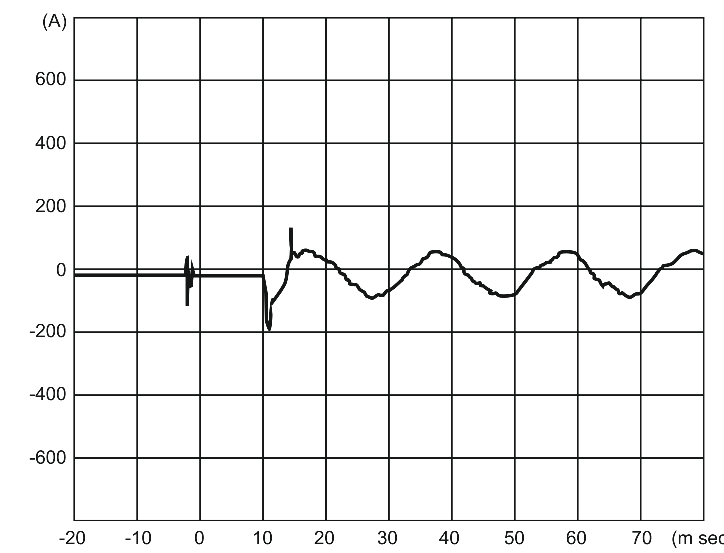


Practical function - Oscillogram

3) Capacitor duty contactor with choke

Make- capacitor duty contactor with chokes
RVCC50 with 50kVAR (72A / 400V)

In this case the influence of chokes and the Capacitor contactor, the peak is reduced to approx. 200A.
Also the sine wave is very clear by the influence of chokes due to reduced harmonic frequencies.



Practical function - Oscillogram

Products are conforms to CE RoHS

Technical Data for RVCC 5 Kvar – RVCC 75 Kvar

		Rating	kVAR	5	12.5	16.7	20	25	33	40	50	60	75
		Contactor type		RVCC0512	RVCC1212	RVCC1612	RVCC2012	RVCC2512	RVCC3323	RVCC4023	RVCC5023	RVCC6023	RVCC7523
Technical data according to IEC-60947-4													
Rated Insulation voltage	Pollution degree 3		V	660	660	660	660	660	660	660	660	660	660
Rated Impulse voltage			kV	8	8	8	8	8	8	8	8	8	8
Operating temp			Deg. C	-10...+60	-10...+60	-10...+60	-10...+60	-10...+60	-10...+60	-10...+60	-10...+60	-10...+60	-10...+60
Rated thermal current Ith			A	25	40	50	50	60	80	80	100	110	135
Rated frequency			Hz	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
Rated power AC- 6b		220-240V	kVAR	2.7	6.7	8.5	10.7	15	17.7	22	27	34	40
		400-440V	kVAR	5	12.5	16.7	20	25	33	40	50	60	75
		550-600V	kVAR	7.3	18	24	30	36	48	58	72	86	108
No of auxiliary contact			N.O.	1	1	1	1	1	2	2	2	2	2
			N.C.	2	2	2	2	2	3	3	3	3	3
Electrial durability AC- 6b		Ue ≤440V	Oper.	300000	300000	300000	300000	300000	300000	300000	300000	300000	300000
		500V ≤ Ue≤600V	Oper.	150000	150000	150000	150000	150000	150000	150000	150000	150000	150000
Mechanical durability			Oper. Million	10	10	10	10	10	10	10	10	10	10
Short circuit protection	gG type fuse		A	1.5 ...1.8 times of rated capacitor current									
Cable size	Power terminal		mm^2	1.5...6.0	1.5...6.0	1.5...6.0	2.5...16.0	2.5...16.0	6.0...50	6.0...50	6.0...50	6.0...50	6.0...50
	control terminal		mm^2	1.5...4.0	1.5...4.0	1.5...4.0	1.5...4.0	1.5...4.0	1.5...4.0	1.5...4.0	1.5...4.0	1.5...4.0	1.5...4.0
Tightening torque	Power terminal		Nm.	1.8...2.5	1.8...2.5	1.8...2.5	3.0...4.0	3.0...4.0	4.0...6.5	4.0...6.5	4.0...6.5	4.0...6.5	4.0...6.5
	control terminal		Nm.	1.5...2.0	1.5...2.0	1.5...2.0	1.5...2.0	1.5...2.0	1.5...2.0	1.5...2.0	1.5...2.0	1.5...2.0	1.5...2.0
Degree of protection				IP20	IP20	IP20	IP20	IP20	IP10	IP10	IP10	IP10	Ip10
Coil voltage				12V, 24V, 48V, 110V, 220-24V, 400v, 415V, 440V, 500V, 600, 660V 50/60Hz *									
	Pick up voltage		V	minimum 65% of rated voltage									
	Drop out voltage		V	20% to 35% of rated voltage									
	Pick up / hold on VA		VA	100/10	100/10	100/10	100/10	100/10	240/21	240/21	240/21	240/21	240/21
Weight of Contactors			Kg.	0.5	0.5	0.5	0.5	0.62	0.62	1.42	1.42	1.42	1.42

* other coil voltages are available on request

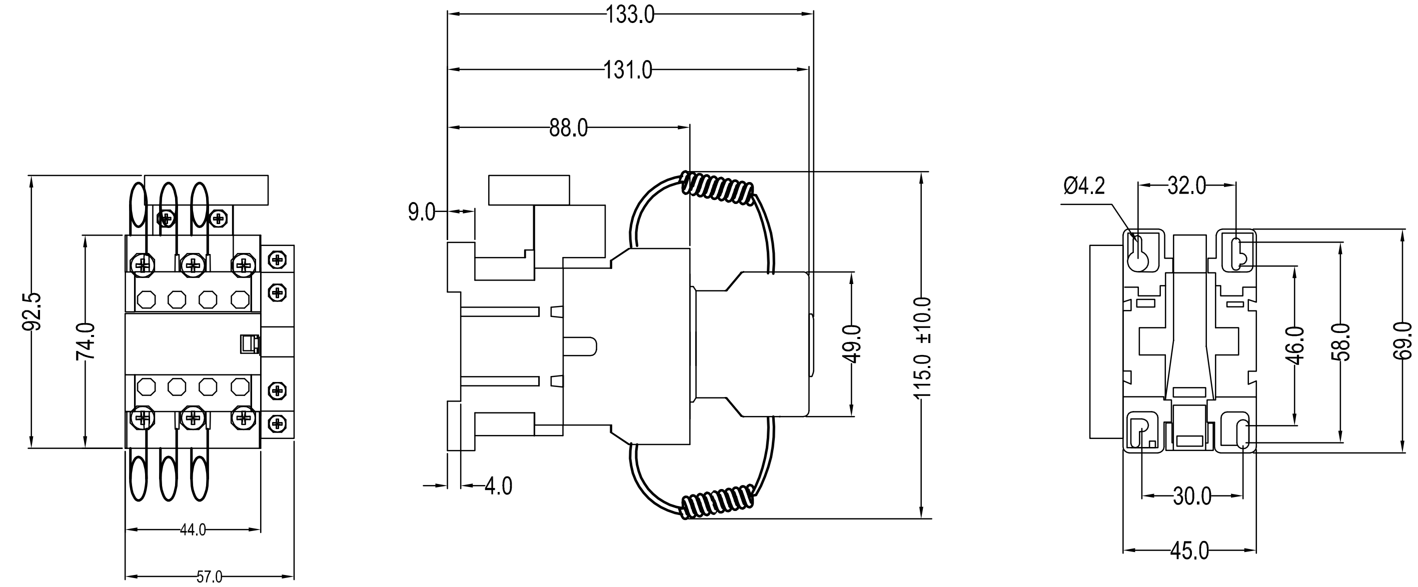
Capacitor Duty Contactor

Ordering Information and Mounting Dimension

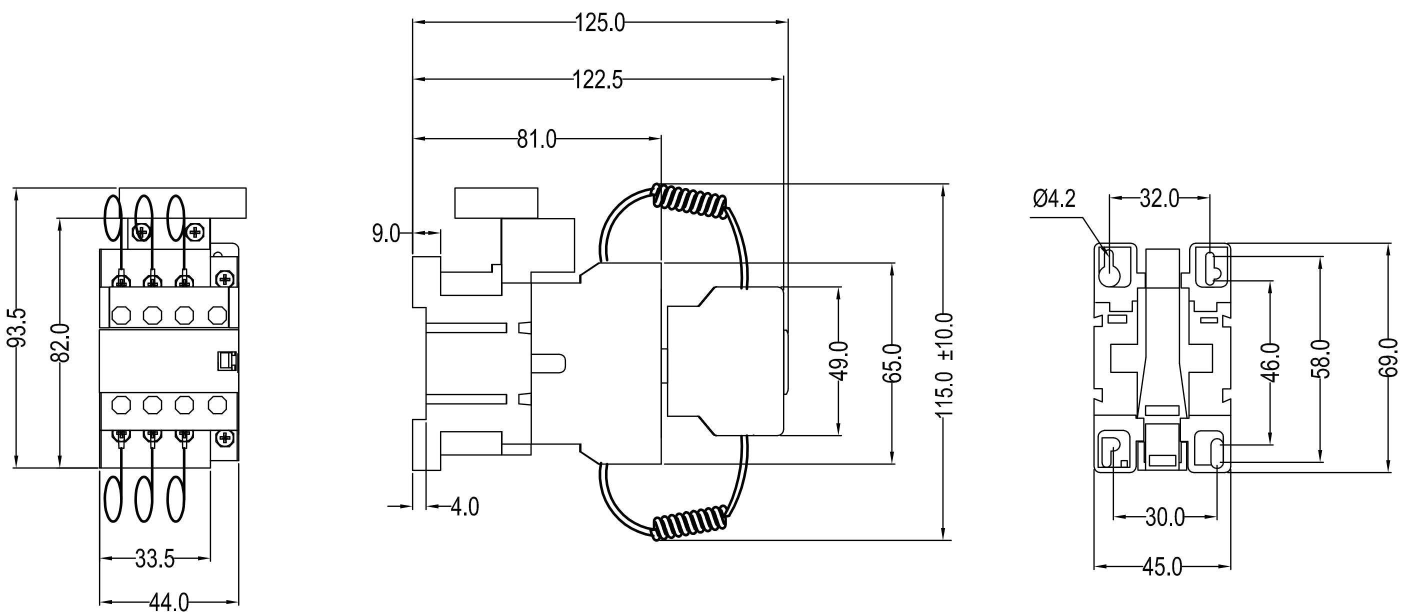
kVAR rating 220-240V	kVAR rating 400-440V	kVAR rating 550-600V	Type	Order No.	Delivery batch	weight Kgs.
2.7	**5**	7.3	RVCC0512	RVECC0512□□□VAC	50	27
6.7	**12.5**	18	RVCC1212	RVECC1212□□□VAC	50	27
8.5	**16.7**	24	RVCC1612	RVECC1612□□□VAC	50	27
10.7	**20**	30	RVCC2012	RVECC2012□□□VAC	50	27
15	**25**	36	RVCC2512	RVECC2512□□□VAC	50	32
17.7	**33**	48	RVCC3323	RVECC3323□□□VAC	50	32
22	**40**	58	RVCC4023	RVECC4023□□□VAC	20	30
27	**50**	72	RVCC5023	RVECC5023□□□VAC	20	30
37	**60**	94	RVCC6023	RVECC6023□□□VAC	20	30
40	**75**	108	RVCC7523	RVECC7523□□□VAC	20	30

□□□ - Indicate coil voltage, Eg. 25 Kvar -110V AC = RVECC2512110VAC

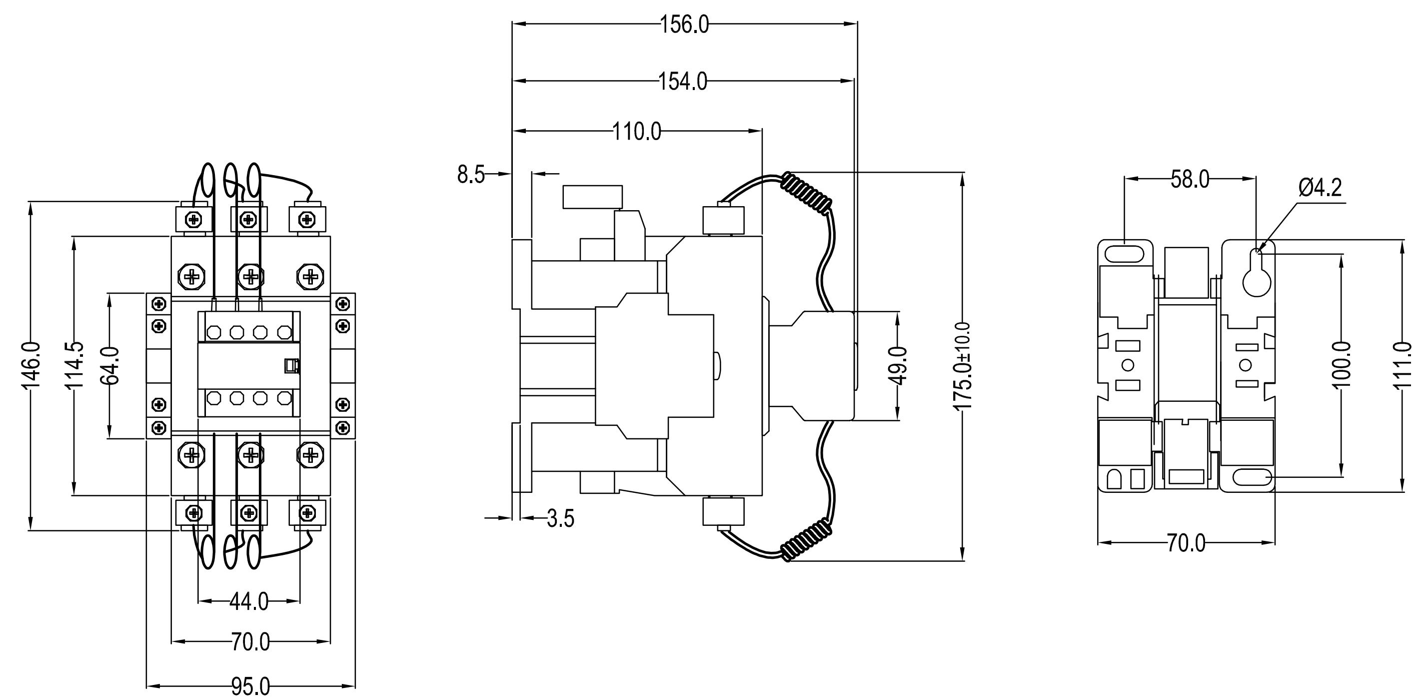
RVCC20 & RVCC25



RVCC05...RVCC16.7



RVCC33...RVCC75



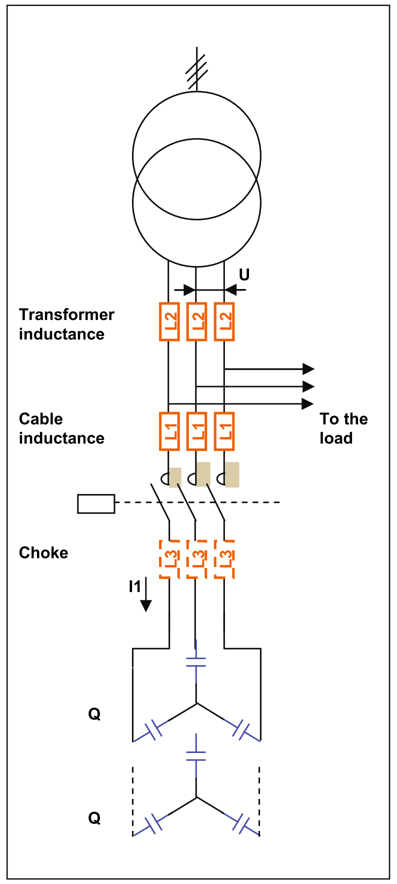
Selection of normal contactors for capacitor application

Above 75 kVAR you can choose normal contactor in association with choke inductance to work bank capacitors up to 1000 kVAR. This document is made to choose a ABN contactors for bank capacitors.

The Three last pages is a guide line to choose the right inductance. We do not have inductance offer in our products range but we will explain you how to select the right value of inductance.

Method of calculation

Consider switching a single step bank of three phase capacitors (according to the circuit diagram, below); the following details must be known :
Q = Power of the capacitor bank in kVAR,
U = voltage between phases in Volts,
S = apparent power of the supply in kVA,
Usc = Short circuit voltage in %,
δ = ambient temperature around the contactor in °C



- Step 1 : Determine the line current I1 using the formula :

$$I1 = \frac{Q}{U\sqrt{3}}$$

Q = in VAR (in both Y and D)
U = in Volts
I1 = in Amps

- Step 2 : Use a safety factor (standard) to take harmonics into account, this gives :
  Ie (Contactor) =11x1,43
  (standards IEC 70, VDE 560)

- Step 3 : Select a contactor with Ith at δ°C equal to or immediately greater than Ie (contactor).

- Step 4 : Having selected the rating, check the making capacity of the contactor given in the appendix and calculate the peak current at capacitor switch on using the formula :

$$\hat{I}(kA) = \frac{\text{making capacity (in A) x k}}{1000}$$

where :
k = 2,7 for RVAC09...RVAC85A contactors
k = 2,2 for RVAC100...RVAC800A contactors

- Step 5 : Determine the line total inductance LT needed per phase to limit the current peak at switch on.

$$L_T = \frac{Q}{0,5\hat{I}^2}$$

Q = kVAR,
I = in kA (corresponding to Î of the capacitor),
L = in μH

- Step 6 : This inductance is made up as follows :
  L_T = L1 (inductance, conductors, cables)
  \+ L2 (transformer loss inductance)
  \+ L3 (choke inductance if required)

- Step 7 : whence L3(choke induct) =L_T(L1+ L2)
  In practice, a choke can be made up on site by winding a few turns of closely coiled wire.

Appendix

I peak in kA for capacitor switching	Type of contactor	Making capacity of contactor A	Ith at 40°C in A
0,4	RVAC0903	250	25
0,56	RVAC1203	250	25
0,85	RVAC1803	300	40
1,6	RVAC2203	450	40
1,9	RVAC3203, 4003	550	50,60
2,16	RVAC5003	900	80
3,04	RVAC6503	1000	100
3,04	RVAC7503, 8503	1100	110,135
3,1	RVAC10003	1100	150
3,1	RVAC12503	1360	150
3,3	RVAC15003	1660	200
4	RVAC1803	2160	230
4	RVAC22003	2640	260
6,5	RVAC30003	3000	350
8	RVAC40003	4000	420
10	RVAC60003	6000	660
12	RVAC80003	8000	900

Calculation of example

Select a contactor for switching a single step bank of three phases capacitors of 50 kVAR fed by an MV/LV transformer 30 kV / 400 V-50 Hz.

S = 2000 kVA,
Usc = 6%
ambient temperature = 40°C

Solution :

- Step 1 : Calculate the line current I1 :

$$I1 = \frac{Q}{U\sqrt{3}} = \frac{50000}{400 \times 1{,}732} = 72A$$

- Step 2 : Calculate the operating current Ie (contactor) :
  $Ie = 72 \times 1{,}43 = 103A$

- Step 3 : From the appendix select on RVAC8503 with Ith at 40°C = 135 A

- Step 4 : From the appendix value of making current is 1100 A, giving :
  Î peak for capacitor switching =1100 x 2,7 @ 2970A

- Step 5 : The total value of inductance LT to be connected in series to limit the peak current to 2970 A is given by :

$$L_T = \frac{Q}{0{,}5\hat{I}^2} = \frac{50000}{400 \times 1{,}732} = 11{,}3\mu H$$

- Step 6 : To determine whether it is necessary to insert a further choke in the circuit, use :
  $L3 = L_T - (L1 + L2)$

The inductance of the transformer L2 = 15 μH. Also L1, adds even further to the inductance value (typical value for a three phase cable @ 0,3 to 0,7μH/meters)

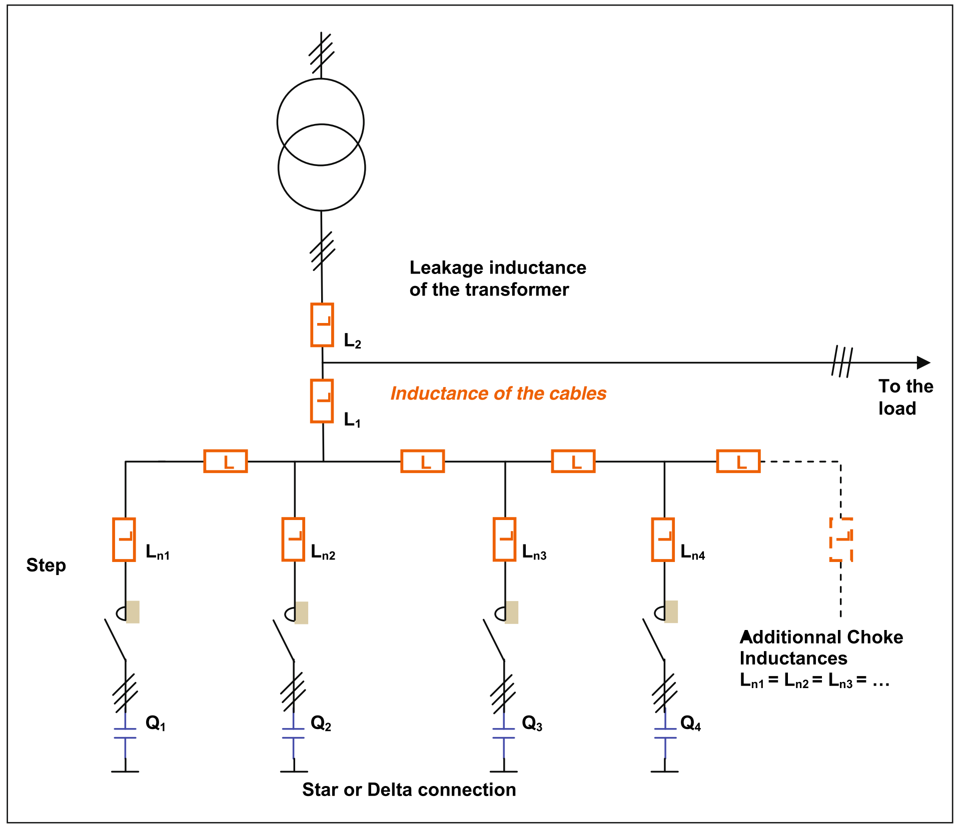
Conclusion
No additional choke is required for this application.

The Problem

Consider switching a multi step bank of three phase capacitors with steps of equal power (according to the circuit diagram, below).

The following details must be known :
Q_T = total power of the capacitor bank in kVAR,
n = number of identical steps (n1, n2, n3, ... n_n)
Ue = operational voltage between phases in volts,
δ = ambient temperature in °C.

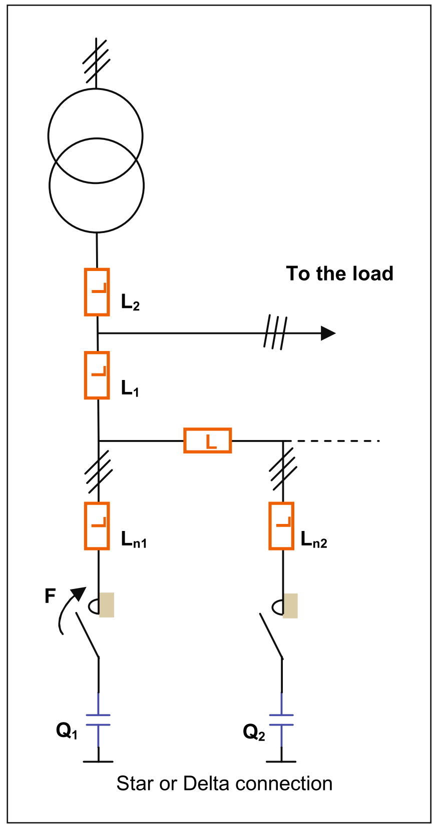
The capacitor bank is associated with a three phase distribution transformer with :
S = apparent power in VA,
Us = secondary voltage between phases (almost identical to Ue),
Usc = short circuit voltage in %,
f = mains frequency in Hz



$Q1 = Q2 = Q3 = Qn$
$Q_T = \Sigma Q1 + \Sigma Q2 + \Sigma Q3 + ... Qn$ giving $Qn = \frac{Q_T}{n}$

The Problem

-1[st] Stage



On the first switching operation, the peak current is limited almost by the leakage inductance of the transformer L2.

Note : it should be remembered that at the initial switch on, during the first microseconds, as discharged capacitor is almost equivalent to a short circuit.

It is therefore more practical to consider the total inductance LT which will limit the value given as peak for the making capacity of the contactor selected. This avoids the welding of the contactor.

The total inductance is given by the formula :

$$LT = \frac{QT}{0,5\hat{\imath}^2 \, x \, n}$$

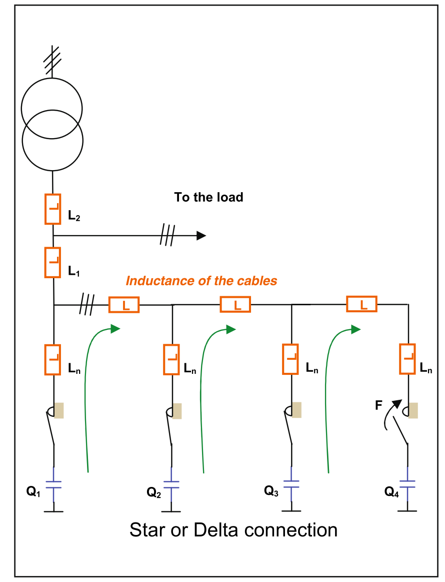
L_T = total inductance in μH
Q_T = total power of the bank in kVAR Î
Î = making capacity of the contactor in kA
n = number of steps

Next check that :

$L_T \leq$ L2 Leackage induct. of the transformer
+ L1 Induct. of the cables or conductors
+ L_{n1} Choke Induct.,to be calculated later
(see following page)

Note : in practice this first stage rarely presents a problem as the value of L2 is often greater than LT.

-2[nd] Stage



As one or more steps are already connected, the peak current caused by the discharge of these capacitors when switching in the next stage is only limited by the inductance of the cables plus the choke inductance if one is required.

In this particular case, the leakage inductance of the transformer L2 is no longer a factor.
Calculation of the choke inductance Ln according to the formula :

$$L_n = \frac{665 \, x \, Q_T \, x \left(\frac{n-1}{n}\right)^2}{\omega x \, \hat{I}^2 \, x \, n}$$

where :
L_n = choke inductance in μH
Q_T = total power of the bank in kVAR
Î = making capacity at peak current of the selected contactor in kA
n = number of steps
ω = angular frequency = 2πf = 314 at 50 Hz (= 376 at 60 Hz)

The above relationship brings out two interesting aspects of this application. For a given bank of capacitors of power OT, the choke inductance Ln will be all the lower (and therefore less expensive):

a) The fewer the number of steps

In effect $\left(\frac{n-1}{n}\right)^2$ is equal to 0, 56 for 4 steps (0, 69 for 6 steps and 0, 76 for 8 steps)

b) The higher the rating of the contactor selected, as it will then have a higher peak making capacity

- In short
If the customer has not settled on a fixed number of capacitor bank steps, a technical design study can lead to an economic choice between:
- The number of steps (to avoid welding problem we suggest to do not exceed 6 to 8 steps)
- The ratings of the contactors
- The cost of the choke inductance

Calculation of example

Power factor improvement for an installation with the following characteristics :

- Distribution transformer	S = 1250 kVA
- Short circuit voltage	Usc = 5,5 To
- Secondary voltage between phases	Us = 400 V
- Maximum ambient temperature	δ = 40°C
- Frequency	f = 50 Hz
- Total power of the capacity bank	OT = 360 kVAR
- Operating voltage	Ue = 380 V
- Number of steps	n = 6

Determination of the contactor rating

Value of the line current 11

$$I1 = \frac{Q1}{Ue\sqrt{3}\ x\ n} = \frac{360000}{380\sqrt{3}\ x 6} = 91A$$

Q_T = in var

Ue = in volts

n = number of steps

Value of the contactor operational current Ie

Ie =11 x 1,43 which gives 90 x 1,43 = 130A

From the appendix select the RV AC 12503 which has:

Ith at 40°C = 150A

Making capacity =1360A

Conformity to IEC 158.1

Peak current calculation at switch on :

I= 1360 x 2,2 ©2992 or 3.0kA

- 1[st] Stage

Decide whether or not a choke inductance is required for the initial switch on:

$$L_T = \frac{Q_T}{0{,}5\hat{I}^2 x\ n} = \frac{360}{0{,}5 \text{ x } 2{,}75^2 \text{ x } 6} = 15{,}8\ \mu H$$

L_T = total inductance in μH

Q_T = total power of the bank in kA

Î= making capacity of the contactor in kA

n = number of steps

CONCLUSION = NO

In effect, a 1250 kVA transformer with Us : 400 V, Usc : 5,5 % has an inherent leakage inductance of 25 μH.

As 25 μH > 15, 8 μH the peak current will be limited in proportion and there will therefore be no danger of the contactor welding.

- 2 Stage

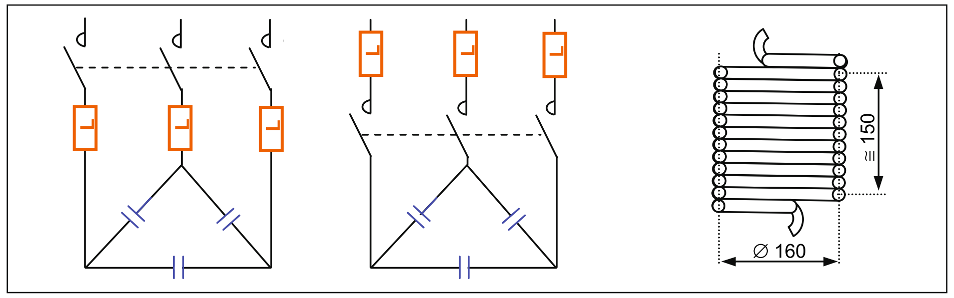
For switching the next steps a choke inductance will be required at each step with a value of :

$$L_n = \frac{665\ x\ Q_T\ x \left(\frac{n-1}{n}\right)^2}{\omega x\ \hat{I}^2\ x\ n} = \frac{665\ x\ 360\ x \left(\frac{6-1}{6}\right)^2}{314\ x\ 2{,}75^2\ x\ 6} = 11{,}6\ \mu H$$

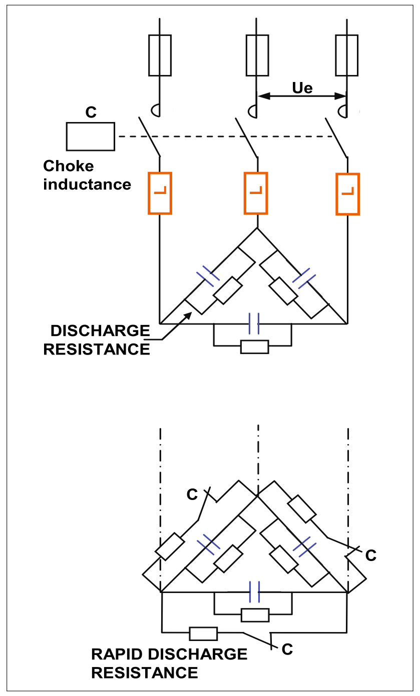
Practical installation of choke inductances

These are placed in each phase upstream or downstream of the contactor and can simply comprise a number of turns in connecting cables.

In the above example, the operational current Ie is 130 A. 50 mm2 cable could be used, approximately 12 turns would be required at a mean diameter of 160 mm.



Precautions relating to the sequence of operation



To conform to IEC70, NFC54100 and VDE0560, capacitors should be fitted with a discharge device (resistance) to reduce the residual voltage from peak upto 50 volts in a time of :

- one minute for Ue ≤ 660 V

- five minutes for Ue > 660 V

As a result, in order to avoid premature reclosing of the contactors on to capacitors charged in phase opposition, the contactors should be delayed on reclosing. The operating rate is therefore low and presents no problem.

Nevertheless if a faster operating sequence is required, then fast discharge resistors should be used, connected as shown in the circuit diagram on the right.

The contactor should be fitted with three suitably rated N/C contacts.

Electrical life

At present a standard test circuit does not exist for this application. It is therefore suggested that, based on the above selection methods, the following figures can be given :

RVAC09...RVAC85 : 100 000 electrical operating cycles

RVAC100...RVAC800 : 300 000 electrical operating cycles

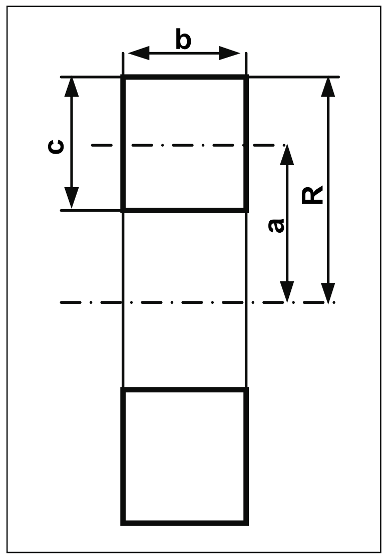
Short circuit protection

This is normally provided by g1 distribution fuses rated for 1.5 to 1.8 Ie.

Calculation of inductance using the brooks and turner formula

General

This formula enables calculation of the approximate value of the inductance of the tightly wound cylindrical coils (+/- 5%). It can be applied to long or short coils, single or multiple turn and with one or more layers.



$$L = \frac{10^{-4} \; x \; 4 \; x \; \pi^2 \; x \; a^2 \; x \; N^2}{b \; x \; c \; x \; R} = F' \; x \; F''$$

L = in μH
a, b, c, R = in mm
N = number of turns

F' and F" are coefficients which depend on the shape of the coil. They are given by the following formula which enables the geometry of the coil to be taken into account :

$$F' = \frac{10b \; x \; 12c \; x \; 2R}{10b \; x \; 10c \; x \; 1{,}4R}$$

$$F'' = 0{,}5 \log_{(10)} \left(100 + \frac{14R}{2b + 3c} \right)$$

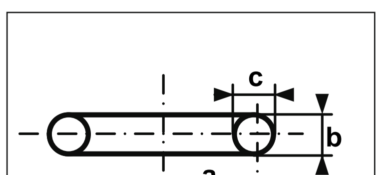
b, c and R being expressed in the same units

Calculation of inductance using the brooks and turner formula

For a long coil

If b ^{3} 4R, F' and F" are close to unity, therefore F' x F" ≅ 1

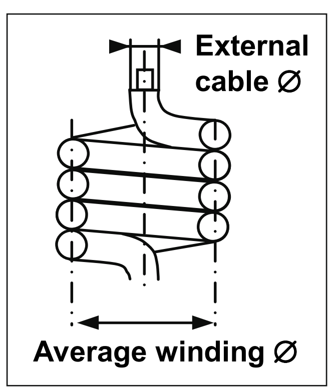
For a single turn coil



b=c=0 of the wire
a is the radius of the turn
Suppose the wire diameter to be very small compared with a (radius of the choke).

For choke inductance

Choke inductances are normally made from coils of the connecting cable wound in a single layer side by side.



We need to know the following values :

- the inductance L in μH
- the cross section of wire in mm^2 (this value depends on the operating current Ie at a given ambient temperature)
- the external diameter of the wire in mm (determined by the rating of the installation).

Nevertheless to avoid calculations and the consequent risk of error, a table of precalculated values is given below to cover the most common cases.

Inductance (µH)
Single Core cable U 1000 R02V

Average winding Ø (mm)		80	100	160	200	250	300	80	100	160	200	250	300	80	100	160	200	250	300
Ext cable	c.s.a.	5 turns						10 turns						15 turns					
6.4	1.5	2.1	3.0					5.9	8.5					10.2	15.0				
6.8	2.5	2.1	2.9					5.7	8.2					9.7	14.3				
7.2	4	2.0	2.8					5.4	7.9					9.3	13.7				
8.2	6		2.6	5.4					7.2	15.6					12.5	27.9			
9.2	10		2.5	5.1					6.7	14.6					11.4	25.8			
10.5	16		2.3	4.8	6.6				6.1	13.4	19.3				10.3	23.5	34.3		
12.5	25			4.3	6.1					12.0	17.3					20.7	30.4		
13.5	35			4.1	5.9	8.2				11.4	16.5	23.7				19.5	28.8	42.1	
15	50			3.9	5.5	7.8	10.2			10.6	15.4	22.2	29.8			18.0	26.7	39.1	53.2
17	70				5.2	7.3	9.6				14.1	20.5	27.6				24.3	35.8	48.9
19	95				4.8	6.9	9.1				13.1	19.1	25.8				22.3	33.0	45.2
23	150					6.2	8.2					16.7	22.7					28.6	39.4
28.5	240						7.2						19.6						33.4

Average winding Ø (mm)		80	100	160	200	250	300	80	100	160	200	250	300	80	100	160	200	250	300
Ext cable	c.s.a.	20 turns						25 turns						30 turns					
6.4	1.5	15	22					19	29					24	36				
6.8	2.5	14	21					18	28					23	34				
7.2	4	13	20					18	26					22	33				
8.2	6		18	41					24	55					29	69			
9.2	10		16	38					22	50					27	63			
10.5	16		15	34	51				19	45	68				24	57	85		
12.5	25			30	44					39	59					49	74		
13.5	35			28	42	62				37	55	83				46	69	104	
15	50			26	39	57	79			34	51	76	105			42	64	95	132
17	70				35	52	72				45	69	96				57	86	120
19	95				32	48	66				42	63	88				52	78	110
23	150					41	57					54	75					67	94
28.5	240						48						63						78

Note : the winding diameter should be less than 10 to 12 times the external diameter of the cable, according to the cable manafucterer's specifications

Instruction

Useful informations at user end

⚠ If you are using 220/240V coil by giving single phase supply (Phase and neutral) to the capacitor duty contactors through controller, please ensure a proper termination and connection at the neutral terminals, both at panel and main supply. Any weak neutral / loose connections would result in low voltage and lead to coil melting and resistance wire burn out. In such cases please incorporate low voltage monitoring option, to isolate the supply at the coil terminals

⚠ We suggest using 415/440V coils, to eliminate the coil melting due to weak neutral and to obtaintrouble free operation of the capacitor duty contactors.

⚠ Please check the main terminal connection at least once in two months, to avoid melting and short circuit in the power terminals of the capacitor duty contactors.

⚠ Use proper lugs at the correct side of the main terminals of the contactor as per our recommendation in the instruction sheet. Preferably use fork/round type lugs for easy wiring connection and proper grip in the termination.

⚠ Don't try to manually push and hold the contact carrier either in the contactor or in the aux. block when power is on, which may result in burning of resistance wire.

⚠ Whenever the coil is changed in the contactor or remounting of aux. block for whatever reason, please checks manually for the free movement of contact carrier before switch on power supply.

⚠ Do not tamper with resistance wire connections.

⚠ Ensure the use of proper VA burden to the coil in case you are using control transformer. To calculate VA burden of the transformer consider the pickup VA of the highest rated contactor in the system plus the sum of the holding VA of all other contactors together.

Third Party Type test

ABNCC capaciotr duty contactors were tested at UL Lab for electrical life test as per IEC 60947-4-1 for AC-6b (capaciotor loads) up to 1 lakh operations with severe condition. After 1 lakh operations the conditions of the test is only 30 % eroded and it can work further 2 lakhs operations.

Test Report

REPORT NUMBER: 4787519965-OTHERS-S1

PROJECT NUMBER: 4787519965

Location (a)
UL India Lab,
UL India Pvt Limited,
Laboratory building,
Kalyani Platina
Campus, Sy.no.129/4,
EPIP Zone, Phase II,
Whitefield,
Bangalore – 560 066
P:91-80-41384400

Location (b)
UL India Pvt Limited,
413 Sector-8, IMT
Manesar, Gurgaon.P:
91-124-22990246

REPORT NUMBER: 4787519965-OTHERS-S1

3. Test results:

CLAUSE	REQUIREMENT TEST		Required	Actual
	Sample No: 432546-2			
	TEST SEQUENCE II			
9.3.3.6	OPERATIONAL PERFORMANCEE CAPABILITY			
	UTLIZATION CATEGORY		AC-6b	
	Rated operational voltage		400V , 50 Hz	400V , 50 Hz
	Rated operational capacitive load(kVar)		12.5	13.7
	Test voltage	L1	400	416
		L2	400	412
		L3	400	415
	Test current	L1	18	19.1
		L2	18	18.9
		L3	18	19.1
	Cable size in Sq. mm		4	4
	Cable length in M.		1	1
	Torque in N-M		2.6	2.6
	On time		1 sec	1 sec
	Off time		9 sec	9 sec
	Number of operating cycle		1,00,000	1,00,000
9.3.3.6.6	Behavior and condition during and after test			
	Permanent arcing		-	No
	Flash over between poles		-	No
	Blowing of the fusible element in the earth circuit		-	No
	Welding of contacts		-	No
	The contacts shall operate when the contactor or starter is switched by the applicable method of control		-	Yes
	Dielectric verification			
	Test voltage(2 Ue/ min 1000V) for 1 min(V)		1000	Withstood

Note: Sample complies with the above requirement.

Reviewed by Signature:

12-LO-F0852, Issue 4.0

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REPORT NUMBER: 4787519965-OTHERS-S1

Test results (Cont.....):

IEC 60947-4-1

CLAUSE	REQUIREMENT TEST		Required	Actual
	Sample No.		432547-2	
	TEST SEQUENCE II			
9.3.3.6	OPERATIONAL PERFORMANCEE CAPABILITY			
	UTLIZATION CATEGORY		AC-6b	AC-6b
	Rated operational voltage		400V , 50 Hz	400V , 50 Hz
	Rated operational capacitive load(kVar)		25	26.42
	Test voltage	L1	400	418
		L2	400	412
		L3	400	409
	Test current	L1	36	37.4
		L2	36	36.9
		L3	36	36.6
	Cable size in Sq. mm		10	10
	Cable length in M.		1	1
	Torque in N-M		3.5	3.5
	On time		1 sec	1 sec
	Off time		9 sec	9 sec
	Number of operating cycle		1,00,000	1,00,000
9.3.3.6.6	Behavior and condition during and after test			
	Permanent arcing			No
	Flash over between poles			No
	Blowing of the fusible element in the earth circuit			No
	Welding of contacts			No
	The contacts shall operate when the contactor or starter is switched by the applicable method of control			Yes
	Dielectric verification			
	Test voltage(2 Ue/ min 1000V) for 1 min(V)		1000	Withstood

Note: Sample complies with the above requirement

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REPORT NUMBER: 4787519965-OTHERS-S1

Test results (Cont.....):

IEC 60947-4-1

CLAUSE	REQUIREMENT TEST		Required	Actual
	Sample No.		432548-1	
	TEST SEQUENCE II			
9.3.3.6	OPERATIONAL PERFORMANCEE CAPABILITY			
	UTLIZATION CATEGORY		AC-6b	AC-6b
	Rated operational voltage		400V , 50 Hz	400V , 50 Hz
	Rated operational capacitive load(kVar)		75	79.21
	Test voltage	L1	400	412
		L2	400	416
		L3	400	408
	Test current	L1	108	111.1
		L2	108	112.3
		L3	108	110.6
	Cable size in Sq. mm		35	35
	Cable length in M.		2	2
	Torque in N-M		5	5
	On time		1 sec	1 sec
	Off time		9 sec	9 sec
	Number of operating cycle		1,00,000	1,00,000
9.3.3.6.6	Behavior and condition during and after test			
	Permanent arcing			No
	Flash over between poles			No
	Blowing of the fusible element in the earth circuit			No
	Welding of contacts			No
	The contacts shall operate when the contactor or starter is switched by the applicable method of control			Yes
	Dielectric verification			
	Test voltage(2 Ue/ min 1000V) for 1 min(V)		1000	Withstood

Note: Sample complies with the above requirement.

Reviewed by Signature:

12-LO-F0852, Issue 4.0

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