

Applications

Auto-transformer starting is suitable for starting all types of squirrel cage motors: with 3, 6 or even 9 terminals according to North American technology.

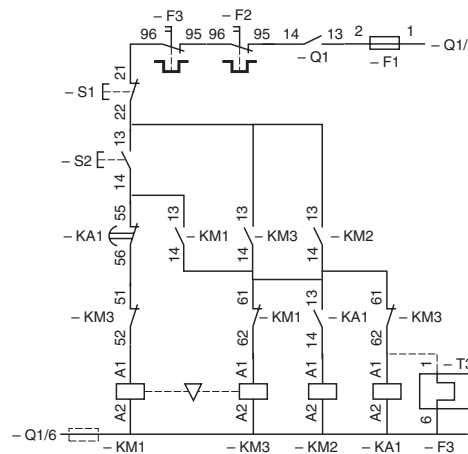
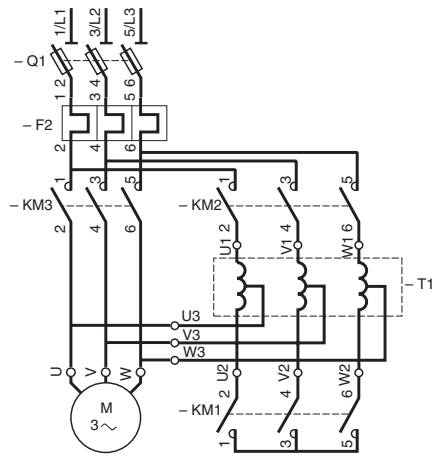
Starting is performed at reduced voltage and produces maximum torque at minimum line current.

It allows the starting torque ($C = f(U)^2$) to be adapted to the resistive torque of the driven machine by means of the 2 or 3 intermediate voltage take-off connections on the auto-transformer (0.65 and 0.8 U_n or 0.5, 0.65 and 0.8 U_n). In general, only one take-off connection is used.

This type of starting is used for high power and/or high inertia machines.

The motor is never disconnected from its power supply during starting (closed transition) and transient phenomena are eliminated.

Recommended wiring scheme



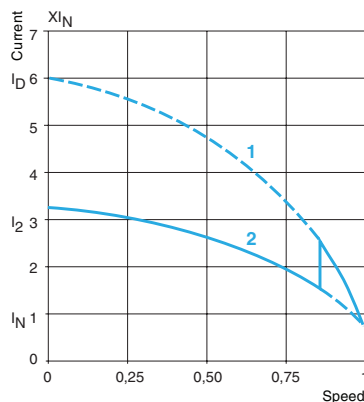
Operation

Starting is performed in 3 stages:

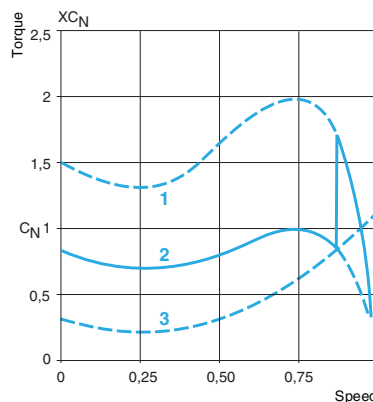
- star connection of the auto-transformer is made by KM1, then contactor KM2 closes and the motor starts under reduced voltage;
- the neutral point is opened by KM1; part of the auto-transformer winding is switched into each phase for a short moment, constituting a stator starting inductance;
- KM3 switches the motor to full mains voltage and causes the auto-transformer to be shunted out of circuit by KM2.

The auto-transformer used generally has an air gap (adjusted or not) in order to obtain, during the second phase of starting, a series inductance whose value is compatible with correct starting.

Operating curves



- 1 Direct switching current
- 2 Current with auto-transformer



- 1 Direct motor torque
- 2 Torque with auto-transformer
- 3 Resistive torque of the machine

Auto-transformer starters from 59 to 900 kW up to 440 V (type 1 coordination)

The components recommended in the table below have been determined according to the following characteristics:

- auto-transformer: on 0.65 U_n connection with non adjusted air gap,
- 3 starts per hour, of which 2 consecutive,
- Motor starting current: $I_d/I_n = 6$,
- $I_q = 70$ kA,
- Transient current on closing of KM3 $\leq 7 \sqrt{2} I_n$,
- Maximum starting time: 30 seconds,
- Ambient temperature $\theta \leq 40$ °C.

Switch-disconnector-fuses: operators and accessories, please consult your Regional Sales Office.

Contactors: 3-pole.

LC1 D: see pages 5/58 and 5/59,

LC1 F: please consult your Regional Sales Office,

LC1 B: please consult your Regional Sales Office.

Auxiliary contact blocks:

- for contactors LC1 D: one LAD N11 (1 N/O + 1 N/C) on KM1,
- for contactors LC1 F: one LAD N22 (2 N/O + 2 N/C) on KM1, KM2 and KM3.

Thermal overload relays:

- LR: see pages 6/16 to 6/19,
- LR9 D: see pages 6/17 to 6/19,
- LR9 F: please consult your Regional Sales Office.

Standard power ratings of 3-phase motors 50/60 Hz in category AC-3					Switch- disconnector- fuse Reference	aM fuses		Contactors			Overload relays	
220/ 230 V	380/ 400 V	415 V	440 V	I_n max		Size	Rating	KM3 LC1	KM2 LC1	KM1 LC1	Reference (1)	Setting range
kW	kW	kW	kW	A			A					A
30	55	59	59	105	GS1 K	22 x 58	125	D115	D115	D3210	LR9 D5369 LRD 4367	90...150 95...120
40	75	80	80	138	GS1 L	T0	160	D150	D115	D5011	LR9 D5369 LRD 4369	90...150 110...140
51	90	90	100	170	GS1 N	T1	200	F185	D115	D5011	LR9 F5371	132...220
63	110	110	110	205	GS1 N	T1	250	F225	D150	D8011	LR9 F5371	132...220
75	132	132	150	245	GS1 N	T1	250	F265	F185	D115	LR9 F5375	200...330
90	160	160	185	300	GS1 QQ	T2	315	F330	F265	D115	LR9 F5375	200...330
110	200	200	220	370	GS1 QQ	T2	400	F400	F330	D115	LR9 F5379	300...500
140	250	257	280	460	GS1 S	T3	500	F500	F400	D115	LR9 F5379	300...500
180	315	355	375	584	GS1 S	T3	630	F630	F400	D185	LR9 F5381	380...630
200	355	375	400	635	GS1 V	T4	800	F800	F500	F185	TC800/1 + LRD 05	505...800
220	400	425	450	710	GS1 V	T4	800	F800	F500	F265	TC800/1 + LRD 05	505...800
250	450	475	500	800	GS1 V	T4	800	F800	F500	F265	TC1000/1 + LRD 05	630...1000
280	500	530	560	900	GS1 V	T4	1000	BM33022	F630	F330	TC1000/1 LRD 05	630...1000
315	560	600	630	1000	GS1 V	T4	1000	BM33022	F630	F400	TC1250/1 LRD 05	790...1250
335	630	670	710	1100	GS1 V	T4	1250	BP33022	F630	F400	TC1250/1 LRD 05	790...1250
400	710	750	800	1260	On base	T4	2 x 800 (2)	BP33022	F780	F400	TC1500/1 LRD 05	945...1500
450	800	800	800	1450	On base	T4	2 x 800 (2)	BP33022	F780	F400	TC1750/1 LRD 05	100...1750
500	900	900	900	1600	On base	T4	2 x 800 (2)	BR33022	F780	F500	TC2000/1 LRD 05	260...2000

(1) For power ratings greater than or equal to 400 kW at 415 V, use one LRD-05 on the current transformer.

(2) Check with the motor manufacturer whether the fuses should be fitted in parallel.