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APPLICATION NOTE

Contactor-based Automatic Transfer Switch solutions

Implementation tips for IEC markets



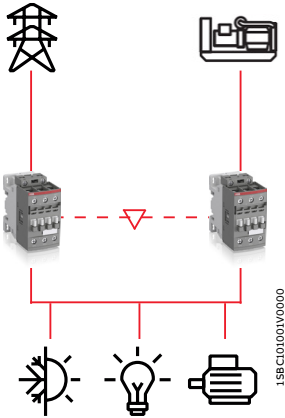
In most cases, a power outage can lead to economic losses associated with downtime and the failure of process equipment, loss of information and, in some extreme cases, it can even threaten people's lives.

An Automatic Transfer Switch (ATS) is a piece of equipment that contains one or more switching devices for disconnecting load circuits from one supply and connecting to another in order to keep problems caused by faulty conditions in the public network to a minimum.

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1. Introduction



As outlined in the document "How to select an Automatic Transfer Switch class. A guide for IEC markets" [1], the ATS equipment can be based on low voltage circuit breakers, contactors, and switch technology. ABB offers more than one type of ATS solution to provide you flexibility to meet the exact needs of your project or product and even to go beyond the requirements with ABB's new generation ATS solutions. The complete overview of ABB transfer switch solutions can be found in the document "Keeping the world's power flowing. Transfer switch solutions" [2].

In this document, we will look at contactor-based ATS solutions in more detail. This is a very common ATS type, because it provides the following benefits to the equipment manufacturer:

- Simplicity in ATS logics implementation. Contactors only require one signal to operate, i.e. voltage applied to the coil, making it easy to design and build the ATS panel
- Relatively high speed of switching from one source to another. Contactors are solenoid operated devices, which allow very fast switching compared to switch-based solutions with electromechanical motors (gear box) or molded case circuit breakers
- High number of electrical operations. Contactors can perform millions of operations. Therefore, ATS solutions based on contactors can be used in very unstable grids, which require frequent switching between power sources

The purpose of this document is to give examples and tips on implementing automatic transfer switch solutions based on contactors with relay control logic. Implementation examples include:

- List of control and switching devices that are required to implement ATS solutions
- Wiring diagrams of contactors, voltage monitoring relays and other complementary products
- Tips for selection of control and switching components for ATS with four-pole contactors and rated currents: 40, 60 and 145 A

All ATS examples assume that the controls are placed on the enclosure door. These consist of warning lights, buttons, and switches. Designed in this way, the control panel reflects the current state of the switching devices and the presence of voltage from the power sources.

In the following chapters, we will look at the components of contactor-based ATS solutions for two power supply configurations: where both power sources are from a utility (main-main), and where one power source is the utility and the second a diesel generator set (main-gen).

DISCLAIMER

The schematics have the purpose to provide generic examples of contactors-based automatic transfer switch solutions. It might not be compliant with local electrical installation requirements. Please note that selection of control and switching equipment, cabling and setting of electronic relays depend on specific project and local electrotechnical regulations.



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2. ATS components

ATS solutions based on contactors usually consist of the following components:

2.1. Power contactors

Contactors are intended for switching power supplies on and off according to be pre-defined relay-based logic. In the following pages, there are ATS implementation examples with only four-pole contactors for three-phase networks with neutral. However, three-pole contactors can also be used if required for three-phase networks. Contactors must be equipped with electromechanical interlocking to prevent the simultaneous closing of two contactors.



AF contactors pair

ABB offers three- and four-pole AF contactors with integrated electronically-controlled coils that offer multiple benefits over conventional alternatives:

- Optimized logistics with fewer product variants to handle. Only 4 coils cover 24 V–500 V AC and 20 V–500 V DC
- Wide control voltage range: the 100 ... 250 V AC/DC coil covers all standard network voltages
- A reduction of the coil's energy consumption by 80 % lets you save energy
- Secure your uptime by letting the AF technology overbridge voltage drops and sags

For more information scan the QR code or visit:

<https://new.abb.com/low-voltage/products/contactors-and-contactor-relays>



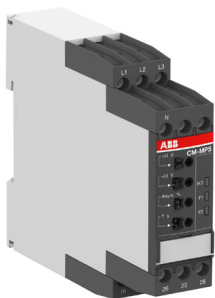
2.2. Voltage monitoring relays

Three-phase voltage monitoring relays are intended to detect power supply abnormalities and to protect loads against undervoltage, overvoltage, phase failure, etc. Voltage monitoring relays send closing or opening signals to the contactors' coils according to the condition of the power supplies.

For the automatic transfer switching purpose, the following range of voltage monitoring relays can be used in three-phase networks with neutral:

CM-S range: Universal and multifunctional range

- Only 22.5 mm wide housing
- Output contacts: 2 c/o (SPDT) contacts
- Setting and operation via front-face operating controls
- Adjustment of threshold values and switching hysteresis via direct reading scale
- Monitoring functions: over/undervoltage, phase unbalance, phase sequence, phase failure as well as an interrupted neutral
- The tripping delay is adjustable over a range of instantaneous tripping to 30 s (0, 0.1 – 30 s)
- Integrated and snap-fitted front-face marker
- CM-MPS.21S (order code: 1SVR730885R3300) is offered in this document as an option for application in an ATS scheme



Voltage monitoring relay CM-MPS.21S



Voltage monitoring relay CM-PVE

CM-E range: Economy range

- Only 22.5 mm wide housing
- Output contacts: 1 n/o contact
- Cost-efficient solution for OEM applications
- Monitoring of single- or three phase over- and undervoltage, phase loss, with neutral connection
- Fixed thresholds for monitoring functions
- Fixed timing functions for tripping delay
- CM-PVE (order code: 1SVR550870R9400) is offered in this document as an option for application in ATS scheme

For more information scan the QR code or visit:

<https://new.abb.com/low-voltage/products/electronicrelays/monitors/three-phase-monitoring-relays>



2.3. Time relays

Time relays are used in the main-gen power supply configuration for making a time delay before connecting the load to the generator and, when the normal power source returns, before connecting the load to the source. For the purpose of the implementation examples shown in this document, the CT-C time relays range is selected. However, universal and multifunctional timers such as the CT-S range, can also be used.



Time relay CT-ERC.22

CT-C range: Compact range

- Housing only 17.5 mm wide
- Output contacts: 2 c/o (SPDT) contacts
- Timing functions range from 0.05 seconds to 100 hours
- The range offers a choice of 11 devices, including single and multi-functional types
- Wide voltage range
- CT-ERC.22 (order code: 1SVR508100R0100) is offered in this document as an option for application in ATS scheme. This device has ON-delay function and 24-48 V DC / 24-240 V AC power supply

For more information scan the QR code or visit:

<https://new.abb.com/low-voltage/products/electronicrelays/electronic-timers>



2.4. Mini contactor relay



Mini contactor relay K6-22Z-80

Mini contactor relays are used in the ATS implementation examples of power supply configurations with a priority source or with the option to select the priority source. As will be shown in the next chapter of this document, in case of availability of both power sources, the mini contactor relays will supply only the coil of the priority source power contactor.

For the purpose of the ATS implementation examples shown in this document, K6-22Z-80 (order code: GJH1211001R8220) has been selected. It is a compact four-pole contactor relay (2 x NO and 2 x NC contacts) with screw terminals. The rated control circuit voltage is 220 ... 240 V AC.

For more information scan the QR code or visit:

<https://new.abb.com/low-voltage/products/motor-protection/contactor-relays-for-auxiliary-circuit-switching>



2.5. Pilot devices



Pilot devices range

Pilot lights are needed for indication of power contactors' state. In the implementation examples shown in this document, green pilot lights from the compact range are used. If the scheme allows selection of priority source T1 or T2, selector switches from the modular range could be used for that purpose.

For more information scan the QR code or visit:

<https://new.abb.com/low-voltage/products/pilot-devices/operators-and-pilot-lights>



2.6. Circuit breakers



Tmax XT circuit breakers

Circuit breakers are used to protect circuits, components and consumers in case of overload and short-circuit. The user of this document must select protection devices for power and control circuits according to the nominal current, minimum and maximum values of short circuit current at the point of installation.

For more information scan the QR code or visit:

<https://new.abb.com/low-voltage/products/circuit-breakers>



3. Implementation examples

This document includes the most common power supply configurations used on the contactors in the applications with the rated current up to 145 A, in particular:

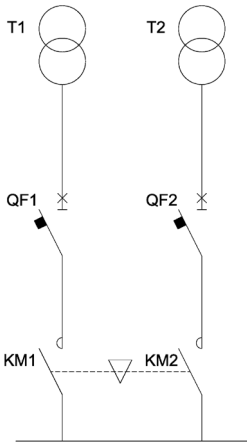
1. Main-main with priority on the first power source
2. Main-main with selection of priority source
3. Main-gen with priority on the utility source

3.1 Main-main with priority on the first source

3.1.1 Operational principle

The electrical circuit for the main-main power sources configuration consists of the following components:

- Voltage monitoring relays KV1
- Circuit breakers for power circuit QF1 and QF2
- Circuit breakers for control circuit SF1 and SF2
- Contactors for power circuit KM1 and KM2
- Mini contactor relay for control circuit K1
- Signal lamps HL1, HL2



The priority source for this scheme is source T1. When commissioning this circuit, the voltage from the main source T1 must be supplied earlier than from the backup source T2.

In normal operating conditions (power source T1 is available), the voltage monitoring relay KV1 closes the power supply circuit of the intermediate mini contactor relay K1, which closes the power supply circuit of contactor KM1 and breaks the power supply circuit of contactor KM2. Thus, contactor KM2 opens and contactor KM1 closes. The load is powered by the source T1 through contactor KM1.

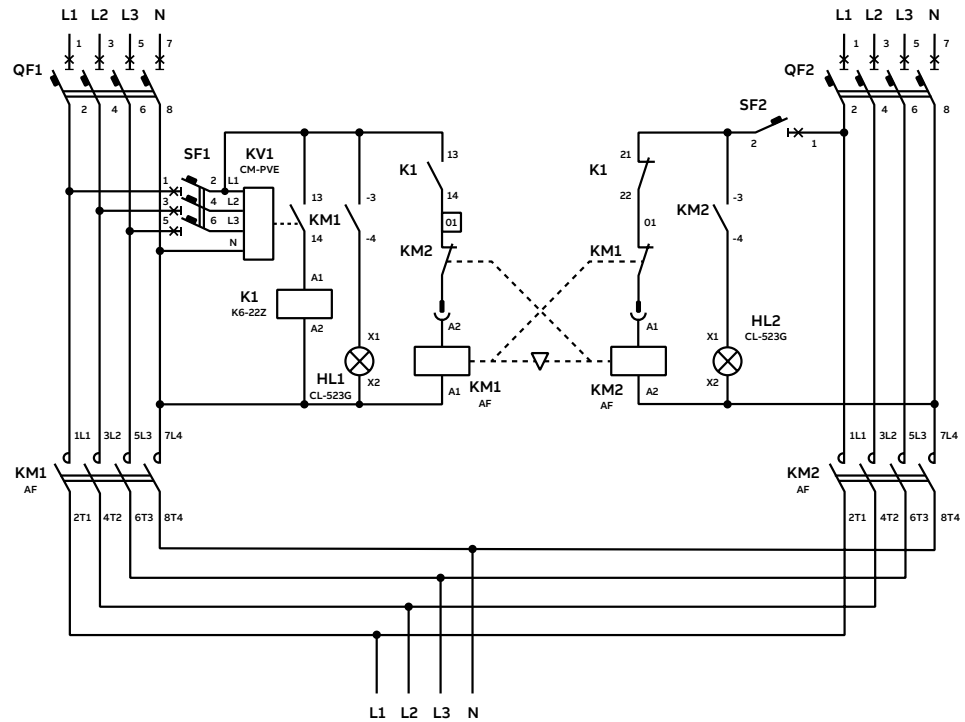
In abnormal operating conditions (power source T1 is not available and T2 is available), the contactor KM1 opens due to absence of the control circuit power supply. In the meantime, contactor KM2 closes due to the presence of the control circuit power supply from the source T2. Therefore, the load is powered by the source T2 through contactor KM2.

Signal lamps HL1 and HL2 show the connected sources (closed contactors). A situation where none of the lamps are lit indicates the absence of voltage from both power sources and open contactors.

Operation logic main-main priority on the first source

T1	T2	KM1	KM2
0	0	0	0
1	0	1	0
0	1	0	1
1	1	1	0

3.1.2 Rated current up to 40 A: Electrical diagram example and tips for product selection



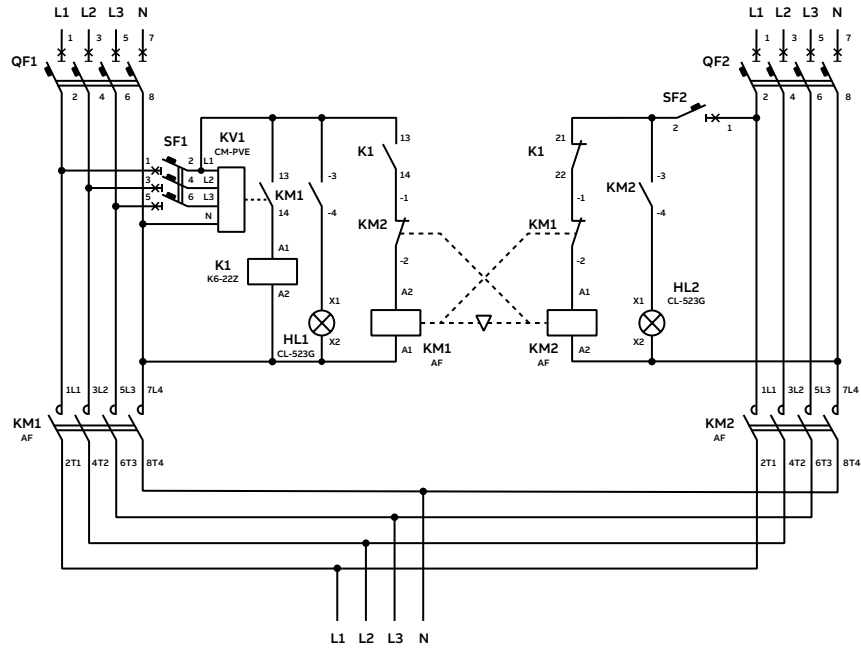
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Control and switching products for rated current up to 40 A (up to 26 A, AC-3)

Index	Name	Order Code	Description	Quantity
1	KM1, KM2 ¹⁾	1SBL237201R1300	AF26-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
2		1SBN010110R1010	CA4-10 Auxiliary Contact Block	2
3		1SBN030111R1000	VEM4 Mechanical and Electrical Interlock Unit	1
4	KV1	1SVR550870R9400	CM-PVE Phase monitoring relay 1 n/o, L1,2,3-N=185-265 V AC	1
5	K1	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz	1
6	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
7	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

1) Do not install the connection bus A2-A2 for contactor coils from the VEM4 kit.

3.1.3 Rated current up to 145 A: Electrical diagram example and tips for product selection



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Control and switching products for rated current up to 60 A (up to 40 A, AC-3)

Index	Name	Order Code	Description	Quantity
1	KM1, KM2	1SBL347201R1300	AF40-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
2		1SBN033405T1000	VM96-4 Mechanical Interlock Unit	1
3		1SBN010120R1011	CAL4-11 Auxiliary Contact Block	2
4	KV1	1SVR550870R9400	CM-PVE Phase monitoring relay 1 n/o, L1,2,3-N=185-265 V AC	1
5	K1	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz	1
6	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
7	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

Control and switching products for rated current up to 100 A (up to 80 A, AC-3)

Index	Name	Order Code	Description	Quantity
1	KM1, KM2	1SBL397201R1300	AF80-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
2		1SBN033405T1000	VM96-4 Mechanical Interlock Unit	1
3		1SBN010120R1011	CAL4-11 Auxiliary Contact Block	2
4	KV1	1SVR550870R9400	CM-PVE Phase monitoring relay 1 n/o, L1,2,3-N=185-265 V AC	1
5	K1	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz	1
6	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
7	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

Control and switching products for rated current up to 145 A (up to 116 A, AC-3)

Index	Name	Order Code	Description	Quantity
1	KM1, KM2	1SFL427101R1300	AF116-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
2		1SFN030300R1000	VM19 Mechanical Interlock Unit	1
3		1SFN010820R1011	CAL19-11 Auxiliary Contact Block	2
4	KV1	1SVR550870R9400	CM-PVE Phase monitoring relay 1 n/o, L1,2,3-N=185-265 V AC	1
5	K1	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz	1
6	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
7	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

3.2 Main-main with selection of priority source

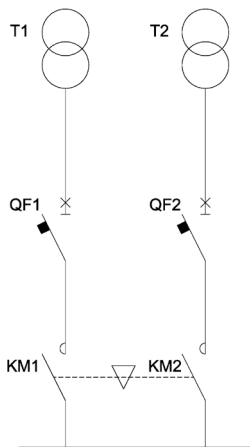
3.2.1 Operational principle

The electrical circuit for the main-main power sources configuration consists of the following components:

- Voltage monitoring relays KV1 and KV2
- Circuit breakers for power circuit QF1 and QF2
- Circuit breakers for control circuit SF1 and SF2
- Contactors for power circuit KM1 and KM2
- Mini contactor relays for control circuit K1 and K2
- Selector switch SA1
- Signal lamps HL1, HL2

The priority source is selected using the selector switch SA1. In case of voltage presence from both sources, the first connected source will be the one for which priority is selected (position A – the first source, position C – the second source, position B – both sources are disabled).

In normal operating conditions (power source T1 is available), the voltage monitoring relay KV1 closes the power supply (control) circuit of the intermediate mini contactor relay K1 and if the priority for the first source T1 is selected or there is no voltage on the second source T2, then the power contactor KM1 closes and the load is supplied from the first source T1. In the meantime, the electromechanical interlock opens the power supply circuit of the contactor KM2. If the second source T2 is selected as a priority, then in the presence of voltage at the second source T2, the KM2 contactor closes and the load is supplied from the second source. In the absence of voltage at the second source T2, even despite the selected priority, the power contactor KM1 closes and the load is powered by the first source T1.



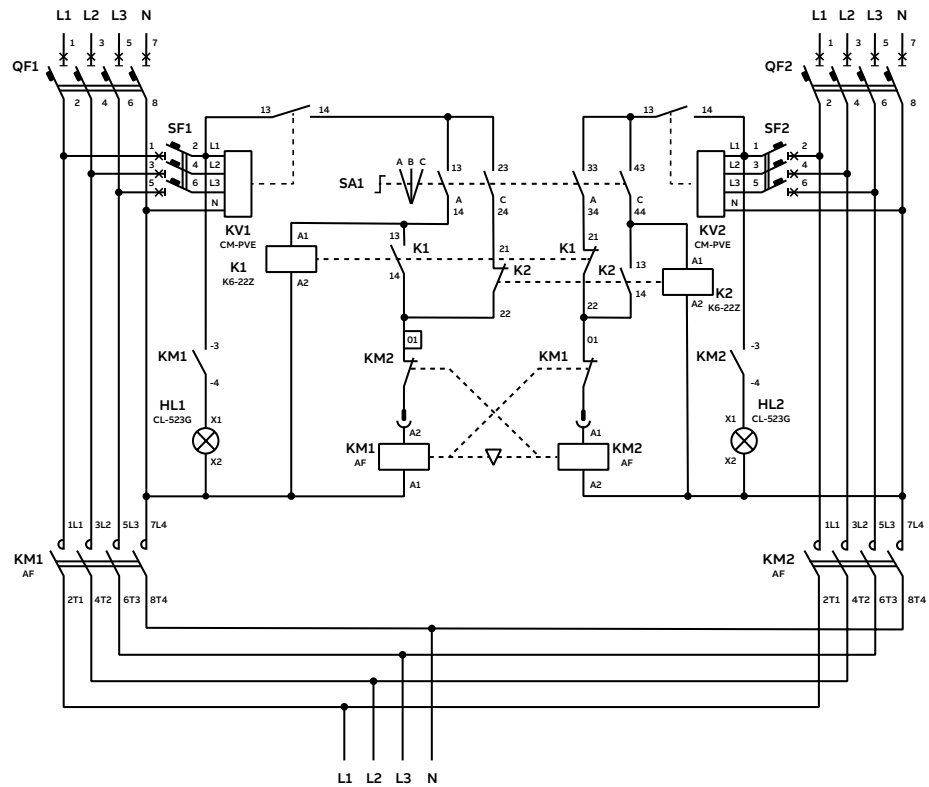
In abnormal operating conditions (power source T1 is not available and T2 is available), the control circuit of the intermediate mini contactor relay K1 opens and the control circuit of the power contactor KM2 closes, so that the power contactor KM2 closes and the load is powered by the second source T2.

Signal lamps HL1 and HL2 show the connected sources (closed contactors). A situation in which none of the lamps is lit indicates the absence of voltage from both power sources and open contactors.

Operation logic main-main with selection of priority source

T1	T2	KM1	KM2	Comments
0	0	0	0	
1	0	1	0	
0	1	0	1	
1	1	1	0	If selected priority source is T1 (position A of SA1)
1	1	0	1	If selected priority source is T2 (position C of SA1)

3.2.2 Rated current up to 40 A: Electrical diagram example and tips for product selection



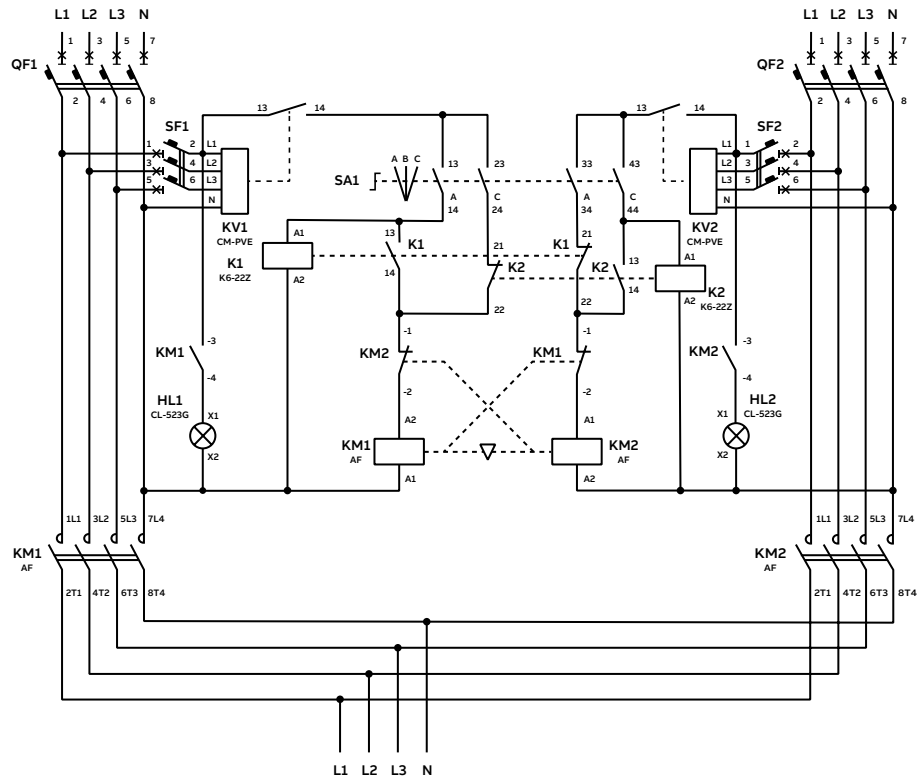
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Control and switching products for rated current up to 40 A (up to 26 A, AC-3)

Index	Name	Order Code	Description	Quantity
1	SA1	1SFA611210R2006	M3SS1-20B Selector Switch	1
2		1SFA611605R1100	MCBH-00 Contact Block Holder	1
3		1SFA611610R1001	MCB-10 Contact Block	4
4	KM1, KM2 ¹⁾	1SBL237201R1300	AF26-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
5		1SBN010110R1010	CA4-10 Auxiliary Contact Block	2
6		1SBN030111R1000	VEM4 Mechanical and Electrical Interlock Unit	1
7	KV1, KV2	1SVR550870R9400 or 1SVR730885R3300	CM-PVE Phase monitoring relay 1 n/o, L1,2,3-N=185-265 V AC or CM-MPS.21S Three-phase monitoring relay 2 c/o, 0,0.1-30s, L1-L2-L3-N=3x180-280 V AC	2
8	K1, K2	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz	2
9	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
10	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

1) Do not install the connection bus A2-A2 for contactor coils from the VEM4 kit.

3.2.3 Rated current up to 145 A: Electrical diagram example and tips for product selection



Control and switching products for rated current up to 60 A (up to 40 A, AC-3)

Index	Name	Order Code	Description	Quantity
1	SA1	1SFA611210R2006	M3SS1-20B Selector Switch	1
2		1SFA611605R1100	MCBH-00 Contact Block Holder	1
3		1SFA611610R1001	MCB-10 Contact Block	4
4	KM1, KM2	1SBL347201R1300	AF40-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
5		1SBN033405T1000	VM96-4 Mechanical Interlock Unit	1
6		1SBN010120R1011	CAL4-11 Auxiliary Contact Block	2
7	KV1, KV2	1SVR550870R9400 or 1SVR730885R3300	CM-PVE Phase monitoring relay 1 n/o, L1,2,3-N=185-265 V AC or CM-MPS.21S Three-phase monitoring relay 2 c/o, 0,0.1-30s, L1-L2-L3-N=3x180-280 V AC	2
8		K1, K2	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz
9	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
10	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

Control and switching products for rated current up to 100 A (up to 80 A, AC-3)

Index	Name	Order Code	Description	Quantity
1	SA1	1SFA611210R2006	M3SS1-20B Selector Switch	1
2		1SFA611605R1100	MCBH-00 Contact Block Holder	1
3		1SFA611610R1001	MCB-10 Contact Block	4
4	KM1, KM2	1SBL237201R1300	AF80-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
5		1SBN010110R1010	VM96-4 Mechanical Interlock Unit	1
6		1SBN030111R1000	CAL4-11 Auxiliary Contact Block	2
7	KV1, KV2	1SVR550870R9400 or 1SVR730885R3300	CM-PVE Phase monitoring relay 1 n/o, L1,2,3-N=185-265 V AC or CM-MPS.21S Three-phase monitoring relay 2 c/o, 0,0.1- 30s, L1-L2-L3-N=3x180-280 V AC	2
8	K1, K2	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz	2
9	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
10	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

Control and switching products for rated current up to 145 A (up to 116 A, AC-3)

Index	Name	Order Code	Description	Quantity
1	SA1	1SFA611210R2006	M3SS1-20B Selector Switch	1
2		1SFA611605R1100	MCBH-00 Contact Block Holder	1
3		1SFA611610R1001	MCB-10 Contact Block	4
4	KM1, KM2	1SFL427101R1300	AF116-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
5		1SFN030300R1000	VM19 Mechanical Interlock Unit	1
6		1SFN010820R1011	CAL19-11 Auxiliary Contact Block	2
7	KV1, KV2	1SVR550870R9400 or 1SVR730885R3300	CM-PVE Phase monitoring relay 1 n/o, L1,2,3-N=185-265 V AC or CM-MPS.21S Three-phase monitoring relay 2 c/o, 0,0.1-30s, L1-L2-L3-N=3x180-280 V AC	2
8	K1, K2	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz	2
9	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
10	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

3.3 Main-gen with diesel generator set (DGS)

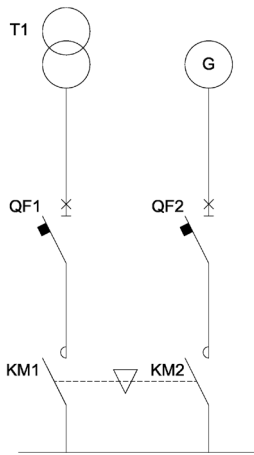
3.3.1 Operational principle

The electrical circuit for the main-gen power sources configuration consists of the following components:

- Voltage monitoring relays KV1 and KV2
- Circuit breakers for power circuit QF1 and QF2
- Circuit breakers for control circuit SF1 and SF2
- Contactors for power circuit KM1 and KM2
- Mini contactor relays for control circuit K1 and K2
- Time relays KT1 and KT2
- Signal lamps HL1, HL2

The priority source for this scheme is source T1.

In the normal operating conditions (power source T1 is available), voltage monitoring relay KV1 closes power supply control circuit of intermediate mini contactor relay K1, which closes power supply control circuit of the power contract KM1 and opens the power supply circuit of KM2. Thus, the load is supplied from the source T1 through power contactor KM1.



In the abnormal operating conditions (power source T1 is not available), the voltage monitoring relay KV1 closes a DGS start circuit. After starting the generator, the voltage monitoring relay KV2 closes its output contact and supplies the time relay KT2 with ON-delay timing function. The delay between starting the generator and connecting the load is necessary for the generator to reach a steady-state operating condition. After the end of timing, the relay closes its output contacts and supplies the power contactor KM2 on the generator side. Thus, the load is powered by the DGS.

When the voltage at the first source T1 is restored, the voltage monitoring relay KV1 closes its output contacts and supplies the time relay KT1 with ON-delay timing function. This relay is required to delay the return transfer to the main power source to ensure it is stable. After the end of timing, the time relay closes the intermediate mini contactor relay K1, which in turn closes the power supply circuit of the KM1 contactor and opens the power supply circuit of the contactor KM2. In addition, at the end of the timing, the generator power supply circuit opens. Thus, the load is powered by the main power source T1.

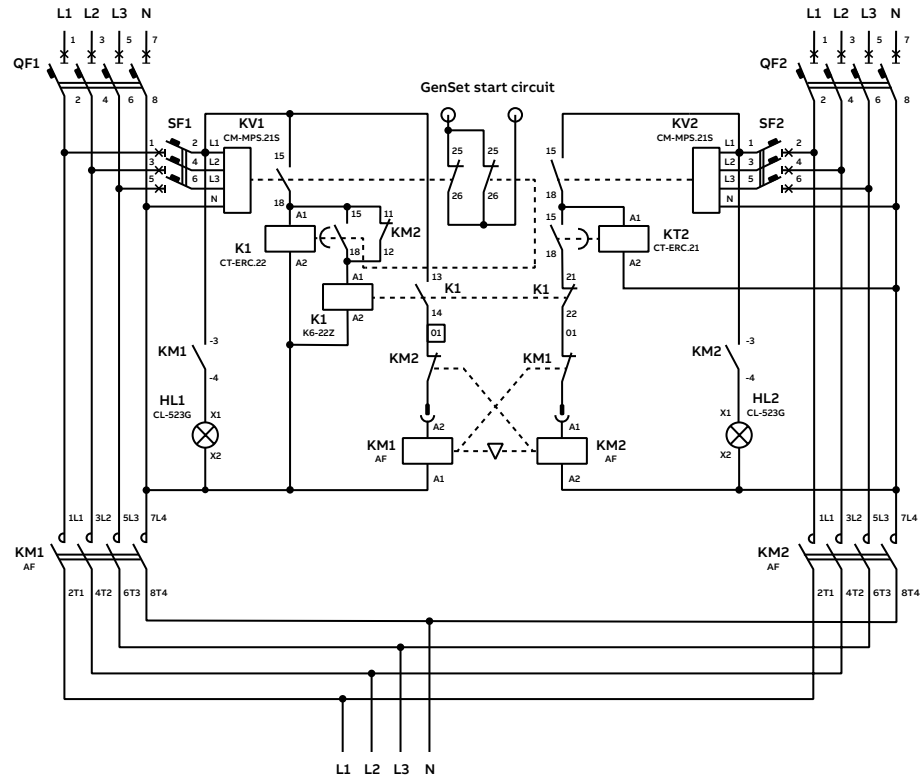
Signal lamps HL1 and HL2 show the connected sources (closed contactors). A situation where none of the lamps are lit indicates the absence of voltage from both power sources and open contactors.

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Operation logic main-gen

T1	G	KM1	KM2
0	0	0	0
1	0	1	0
0	1	0	1
1	1	1	0

3.3.2 Rated current up to 40 A: Electrical diagram example and tips for product selection



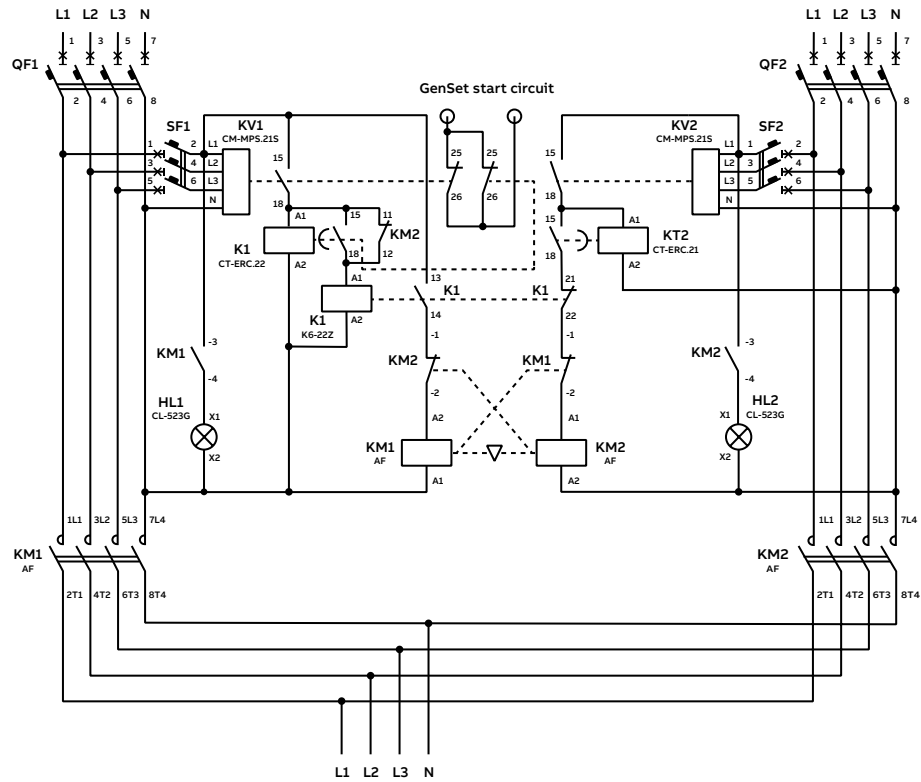
2CDC1201410021_4-1

Control and switching products for rated current up to 40 A (up to 26 A, AC-3)

Index	Name	Order Code	Description	Quantity
1	KM1, KM2 ¹⁾	1SBL237201R1300	AF26-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
2		1SBN010110R1010	CA4-10 Auxiliary Contact Block	2
3		1SBN030111R1000	CA4-01 Auxiliary Contact Block	1
4		1SBN030111R1000	VEM4 Mechanical and Electrical Interlock Unit	1
5	KV1, KV2	1SVR730885R3300	CM-MPS.21S Three-phase monitoring relay 2 c/o, 0,0.1-30s, L1-L2-L3-N=3x180-280 V AC	2
6	K1	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz	1
7	KT1	1SVR508100R0100	CT-ERC.22 Time relay, ON-delay 2 c/o, 24-48 V DC / 24-240 V AC	1
8	KT2	1SVR508100R0000	CT-ERC.12 Time relay, ON-delay 1 c/o, 24-48 V DC / 24-240 V AC	1
9	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
10	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

1) Do not install the connection bus A2-A2 for contactor coils from the VEM4 kit.

3.3.3 Rated current up to 145 A: Electrical diagram example and tips for product selection



ZDC0212015V0021_4-2

Control and switching products for rated current up to 60 A (up to 40 A, AC-3).

Index	Name	Order Code	Description	Quantity
1	KM1, KM2	1SBL347201R1300	AF40-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
2		1SBN033405T1000	VM96-4 Mechanical Interlock Unit	1
3		1SBN010110R1010	CA4-10 Auxiliary Contact Block	2
4		1SBN010110R1001	CA4-01 Auxiliary Contact Block	3
5	KV1, KV2	1SVR730885R3300	CM-MPS.215 Three-phase monitoring relay 2 c/o, 0,0,1-30s, L1-L2-L3-N=3x180-280 V AC	2
6	K1	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz	1
7	KT1	1SVR508100R0100	CT-ERC.22 Time relay, ON-delay 2 c/o, 24-48 V DC / 24-240 V AC	1
8	KT2	1SVR508100R0000	CT-ERC.12 Time relay, ON-delay 1 c/o, 24-48 V DC/ 24-240 V AC	1
9	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
10	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

Control and switching products for rated current up to 100 A (up to 80 A, AC-3)

Index	Name	Order Code	Description	Quantity
1	KM1, KM2	1SBL397201R1300	AF80-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
2		1SBN033405T1000	VM96-4 Mechanical Interlock Unit	1
3		1SBN010110R1010	CA4-10 Auxiliary Contact Block	2
4		1SBN010110R1001	CA4-01 Auxiliary Contact Block	3
5	KV1, KV2	1SVR730885R3300	CM-MPS.21S Three-phase monitoring relay 2 c/o, 0,0.1-30s, L1-L2-L3-N=3x180-280 V AC	2
6	K1	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz	1
7	KT1	1SVR508100R0100	CT-ERC.22 Time relay, ON-delay 2c/o, 24-48 V DC / 24-240 V AC	1
8	KT2	1SVR508100R0000	CT-ERC.12 Time relay, ON-delay 1c/o, 24-48 V DC / 24-240 V AC	1
9	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
10	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

Control and switching products for rated current up to 145 A (up to 116 A, AC-3)

Index	Name	Order Code	Description	Quantity
1	KM1, KM2 ¹⁾	1SFL427101R1300	AF116-40-00-13 100-250 V 50/60 HZ-DC Contactor	2
2		1SFN030300R1000	VM19 Mechanical Interlock Unit	1
3		1SFN010820R1011	CAL19-11 Auxiliary Contact Block	2
4		1SFN010820R3311	CAL19-11B Auxiliary Contact Block	1
5	KV1, KV2	1SVR730885R3300	CM-MPS.21S Three-phase monitoring relay 2 c/o, 0,0.1-30s, L1-L2-L3-N=3x180-280 V AC	2
6	K1	GJH1211001R8220	K6-22Z-80 Mini Contactor Relay 220-240 V 40-450 Hz	1
7	KT1	1SVR508100R0100	CT-ERC.22 Time relay, ON-delay 2 c/o, 24-48 V DC / 24-240 V AC	1
8	KT2	1SVR508100R0000	CT-ERC.12 Time relay, ON-delay 1 c/o, 24-48 V DC / 24-240 V AC	1
9	HL1, HL2	1SFA619403R5232	Compact Pilot Light Green LED 230 V AC	2
10	QF1, QF2, SF1, SF2	-	Circuit breakers for control and power circuits protection shall be selected by the user of this document according to the rated current, max. and min. short circuit current.	4

1) Do not install the connection bus A2-A2 for contactor coils from the VEM4 kit.

4. Additional Information

4.1 Listing of related documents

Ref #	Document Kind, Title	Document No.
[1]	How to select an Automatic Transfer Switch class. A guide for IEC markets	1SCC303022C0201
[2]	Keeping the world's power flowing. ABB Transfer switch solutions overview	1SCC303024K0201

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