



Medium-Voltage
Equipment

Catalog HG 11.21
2002

Supersedes:
Catalog HG 11.21 · 1997

3TL Vacuum Contactors

SIEMENS

3TL Vacuum Contactors
General Description

3TL81 Vacuum Contactors
as Economy Contactors

3TL6 Vacuum Contactors
as Universal Contactors

3TL71 Vacuum Contactors
as Special Vacuum Contactors



General Description

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Application

3TL vacuum contactors are 3-pole contactors with electromagnetically-operated mechanism for medium-voltage switchgear.

They are load-break switchgear with a limited short-circuit making and short-circuit breaking capacity and are used for high switching frequencies (> 10,000 operating cycles).

The vacuum contactors are suitable for operational switching of AC loads in indoor and can perform, for example, the following switching duties:

- Switching of three-phase motors in AC-3 and AC-4 operation
- Switching of transformers
- Switching of reactors
- Switching of ohmic loads (e.g. arc furnaces)
- Switching of capacitors

With reversing contactor combinations, only one contactor is required for each direction of rotation, if HV HRC fuses are used for short-circuit protection.

Application examples

- Conveyor and lift systems
- Pump stations
- Ventilation and heating
- Systems for reactive-power compensation

for the following branches of industry:

- Mining
- Steel
- Gas and petrochemicals
- Paper
- Cement

General Description

Application

Versions

3TL81 vacuum contactor

as economy contactor

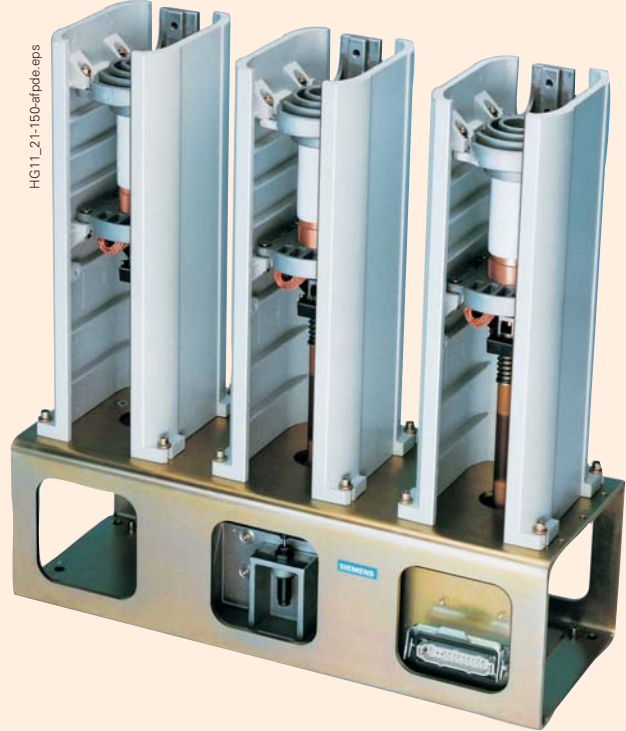
- Up to 1 mill. mechanical operating cycles
- Up to 7.2 kV



3TL71 vacuum contactor

as special contactor

- Up to 1 mill. mechanical operating cycles
- Up to 24 kV







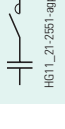
3TL6 vacuum contactor

as universal contactor

- Up to 3 mill. mechanical operating cycles
- Up to 12 kV



Fields of application

Application, switching of loads	Symbols	For operating voltage and normal current	Vacuum contactor type, mechanical operating cycles	Application examples
Medium-voltage three-phase motors	 HG11_21-2547-agipde.eps	<ul style="list-style-type: none"> up to 7.2 kV/400 A up to 12 kV/450 A up to 24 kV/800 A 	<ul style="list-style-type: none"> 3TL81, 1 mill. 3TL6, 3 mill. 3TL71, 1 mill. 	Conveyor and lift systems, compressors, pump stations, ventilation and heating
Transformers	 HG11_21-2548-agipde.eps	<ul style="list-style-type: none"> up to 7.2 kV/400 A up to 12 kV/450 A up to 24 kV/800 A 	<ul style="list-style-type: none"> 3TL81, 1 mill. 3TL6, 3 mill. 3TL71, 1 mill. 	Secondary distribution switchgear, industrial network distribution systems
Reactors	 HG11_21-2549-agipde.eps	<ul style="list-style-type: none"> up to 7.2 kV/400 A up to 12 kV/450 A up to 24 kV/800 A 	<ul style="list-style-type: none"> 3TL81, 1 mill. 3TL6, 3 mill. 3TL71, 1 mill. 	Industrial network distribution systems, DC link reactors, reactive-power compensation systems
Ohmic loads	 HG11_21-2550-agipde.eps	<ul style="list-style-type: none"> up to 7.2 kV/400 A up to 12 kV/450 A up to 24 kV/800 A 	<ul style="list-style-type: none"> 3TL81, 1 mill. 3TL6, 3 mill. 3TL71, 1 mill. 	Heating resistors, arc furnaces
Capacitors	 HG11_21-2551-agipde.eps	<ul style="list-style-type: none"> up to 7.2 kV/250 A up to 12 kV/250 A up to 24 kV/400 A 	<ul style="list-style-type: none"> 3TL81, 1 mill. 3TL6, 3 mill. 3TL71, 1 mill. 	Reactive-power compensation systems, capacitor banks

Features

Quality standard

DIN EN ISO 9001

3TL vacuum contactors are routine tested to specifications that go beyond those laid down by the relevant standards:

- Continuous testing during manufacturing processes
- Several operating cycles per routine test
- Current measured-value acquisition - such as, for example, operating speed and contact travel - compared with the values from the long-term tests.

Other features:

- Stable measured values with tight tolerances
- Low power loss
- Constant long-term thermal stability.

Environmental compatibility

DIN EN ISO 14001

3TL vacuum contactors are

- Environmentally compatible with respect to the materials used and manufacturing processes
- Environmentally neutral with respect to how they operate and during switching operations
- Simple to dispose of at the end of their service life.

Freedom from maintenance

3TL vacuum contactors are maintenance-free

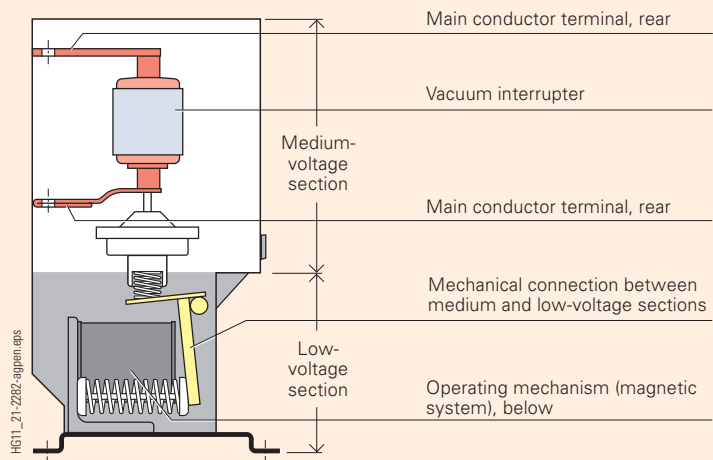
- Under normal ambient conditions according to IEC 60694 and DIN EN 60694 in the temperature range stated
- Through to the end of the vacuum interrupters' service life.

General Description

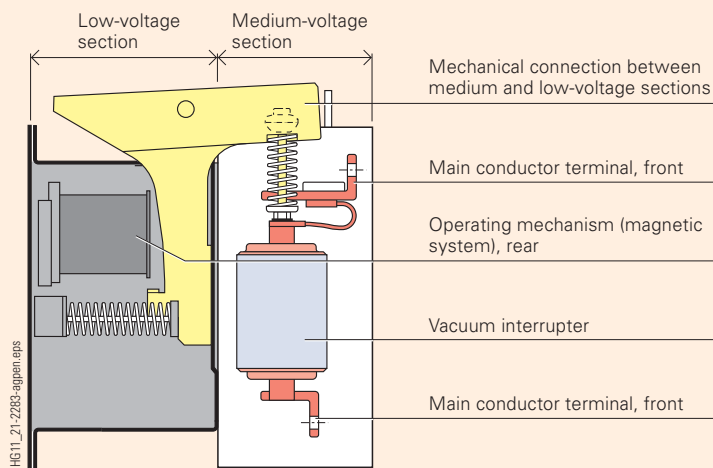
Construction principle in comparison

The 3TL vacuum contactors are made up of the following modules:

- Medium-voltage section with
 - Vacuum interrupters
 - Main conductor terminals
- Low-voltage section with
 - Operating mechanism (magnetic system)
 - Electronic module (electronic economy circuit)
 - Mechanical closing latching
 - Auxiliary contact block.

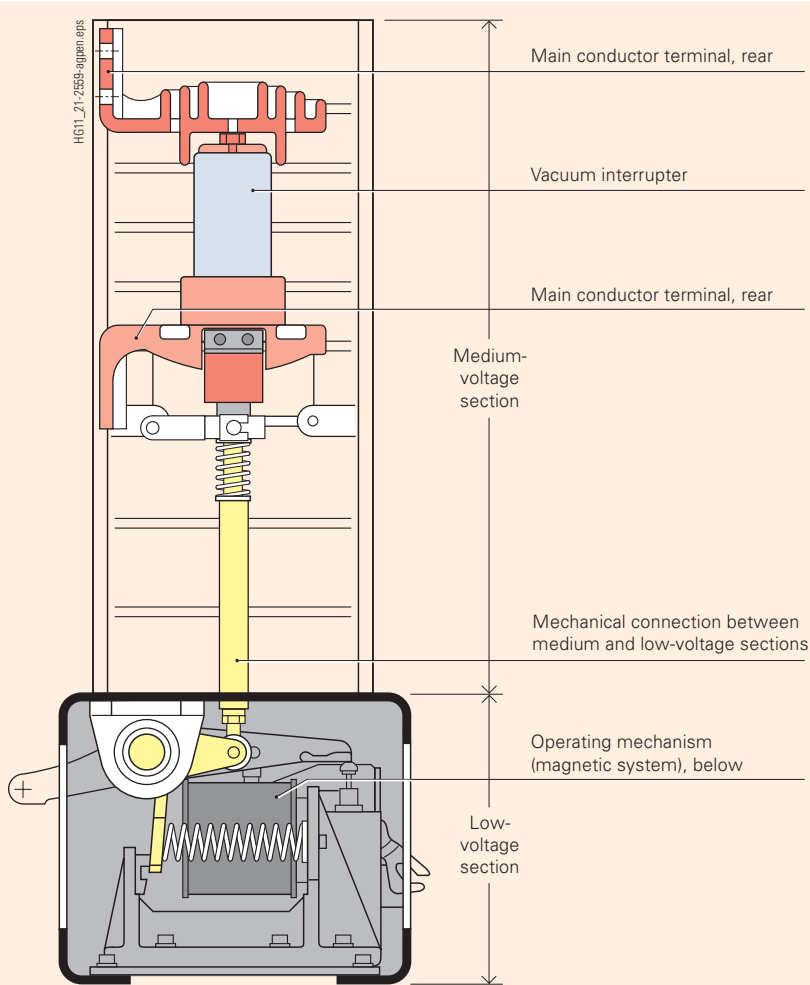


3TL8 vacuum contactor (side view)



3TL6 vacuum contactor (side view)

Construction principle in comparison



3TL71 vacuum contactor (side view)

General Description

Vacuum interrupter

Arc-quenching system

As the contacts open, the current that is to be interrupted initiates a metal-vapor arc discharge. Current continues flowing through the metal-vapor plasma until the next current zero. The arc extinguishes at approximately current zero. The metal vapor loses its conductivity within a few microseconds, which very quickly reestablishes the dielectric strength of the contact gap.

A certain minimum current is needed in order to maintain the metal-vapor arc discharge. The arc will be chopped before the natural current zero if the current falls below this value.

In order to prevent impermissible overvoltages when performing switching operations in inductive circuits, the chopping current must be limited to the lowest possible value. Due to the use of a special contact material, the chopping current in the vacuum contactors 3TL is only ≤ 5 A.

Due to the rapid recovery of the dielectric strength of the contact gap, the arc is safely quenched even in cases where contact separation occurs immediately before a current zero. Consequently, the arcing time of the last poles to clear is no more than 15 ms.

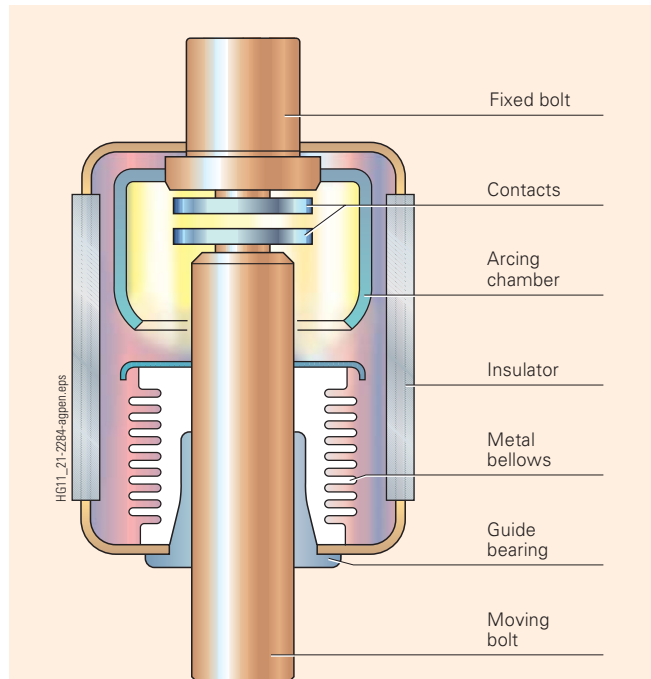
With AC circuit-breakers, the actual task of the arc-quenching system is to deionize the contact gap immediately after current zero.

In the cases of all the conventional methods of arc-quenching this means that the arc is being cooled even before the minimum quenching gap and the subsequent current zero are reached. As a result, the arc power is unintentionally increased to a considerable degree.

With the vacuum contactors, on the other hand, the arc is not cooled. The metal-vapor plasma has a high conductivity which results in an extremely low arc voltage with values from only 20 to 50 V.

For this reason, and due to the short arcing times, the amount of energy conversion in the contact gap is very low. This relatively low stress level means that the quenching system is maintenance-free and allows up to 1 million electrical operating cycles.





Due to the very low pressures of less than 10^{-9} bar in the interrupter under steady-state conditions, contact gaps of only 5 to 7 mm are required to achieve a high dielectric strength in 3TL vacuum contactors.



Vacuum interrupter
(example)

Technical data in comparison

	3TL81 vacuum contactor	3TL6 vacuum contactor	3TL71 vacuum contactor
Rated voltage	up to 7.2 kV	up to 12 kV	up to 24 kV
Rated normal current	400 A	up to 450 A	800 A
Switching frequency	up to 1200 operating cycles/h	up to 1200 operating cycles/h	up to 60 operating cycles/h
Service life - contactor - vacuum interrupter	operating cycles mech. service life: 1 mill. mech. service life: 0.25 mill. electr. service life: 0.25 mill.	operating cycles mech. service life: 3 mill. mech. service life: 2 mill. electr. service life: 1 mill.	operating cycles mech. service life: 1 mill. mech. service life: 1 mill. electr. service life: 0.5 mill.
Chopping current	≤ 0.6 A	< 5 A	< 5 A
Electronic economy circuit	classification into voltage ranges 24 V 48 V to 60 V 110 V to 250 V irrespective of DC or AC operation	none	none
Auxiliary contacts	positively driven auxiliary contacts 4 NO, 4 NC	positively driven auxiliary contacts 6 NO, 5 NC	positively driven auxiliary contacts 8 NO, 8 NC
Operating mechanism	underneath to the vacuum interrupters	at rear to the vacuum interrupters	underneath to the vacuum interrupters
Type of construction	slimline	compact	slimline
Main conductor terminals	at rear on the vacuum interrupters	at front on the vacuum interrupters	at rear on the vacuum interrupters
Auxiliary conductor terminals	direct tapping at the terminals (optional: wiring of the auxiliary contacts on the central terminal block)	terminal block with testing options in installed state (optional: withdrawable terminal block)	wiring of the auxiliary contacts on the central plug connector
Additional modules	mechanical closing latching, long operating mechanism shaft for powerless, external built-on accessories	mechanical closing latching, mechanical closing lock-out, extension or reduction of the break time	on request

SIEMENS				
3TL8100-1BA00		Nr.S 3TL8/00001867		
I_{th} 400 A		40...60 Hz		
   	U_e	I_e		
	IEC 470	7,2 kV	AC3/AC4	400 A
	BS 775	7,2 kV	AC3/AC4	400 A
	UL 347	7,2 kV		360 A
CSA C22.2	5,0 kV		360 A	
Control voltage $U_c = AC/DC 110...250 V$				
Interrupting capacity		5,0 kV	7,2 kV	
Contactor with fuses sym. MVA				
SIEMENS FM 24R		350	-	
SIEMENS 3GD2 151		400	500	
Wiring 60/75 °C		Year of manufacture 1997		
MADE IN GERMANY				

HG11_21-2503-01pde.eps

Nameplate

General Description

Switching duties

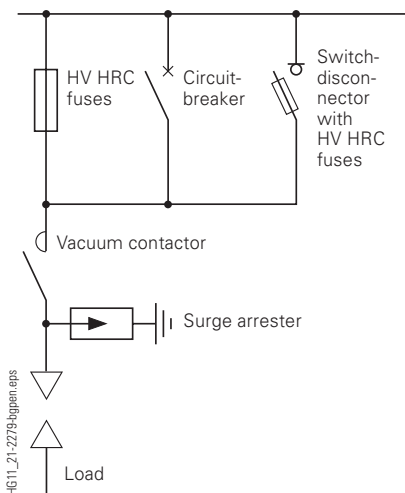
Switching duties

Cases of switching line and load-side operating states

Switching of inductive circuits	Unloaded transformers (neutral earthing transformers) Loaded transformers Overloaded transformers Transformers in rush Furnace transformers Motors during operation Motors starting up
Switching of capacitive circuits	Capacitors Back-to-back switching of capacitors
Switching in case of short-circuit	Fault making ¹⁾ Locked rotor motor
Switching under earth-fault conditions	Fault on the line side: - unloaded cables, overhead lines - loaded cables, overhead lines Fault on the load side: - unloaded cables, overhead lines - loaded cables, overhead lines

1) Limited fault breaking capacity.

Switchgear used with vacuum contactors



Switching of motors

3TL vacuum contactors are particularly suitable for frequent switching of motors. As the chopping current of the contactors is ≤ 5 A, no impermissibly high overvoltages occur in the operational switching of started-up motors. If, however, high-voltage motors with a starting current of ≤ 600 A are switched off during start-up, overvoltages may occur. The level of these overvoltages can be reduced to safe values by means of special surge limiters.


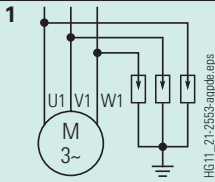
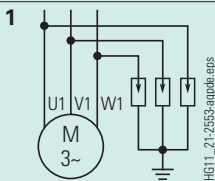
The 3EF surge limiters are preferably arranged in the cable connection compartment parallel to the cable sealing end.

The surge limiters are made up of non-linear discharge resistors (SIOV metal-oxide varistors) and a series-connected spark gap.

Care must be taken during installation that for mechanical reasons the surge limiter is connected flexibly on one side.

Switching duties

Circuit examples for overvoltage protection for three-phase motors with starting current $\leq 600A$

Circuit diagram	Operating mode
	Operating mode Switching of started-up motors
	Occasional switching of motors just started-up (on fault)
	Frequent switching during AC-4 operation

Legend: **1** with surge limiter

Switching of transformers

In case of switching of inductive currents, current chopping at the contact gap may give rise to overvoltages. However due to the special contact material used in 3TL contactors, the chopping current is limited to $\leq 5 A$. This means that no dangerous overvoltages develop when unloaded transformers are switched off.

Switching of capacitors

3TL vacuum contactors can, at rated voltages up to 12 kV, cut off capacitive currents of up to 250 A without restrike and therefore without overvoltages.

Overvoltage protection by means of limiters

Overvoltages can be caused by multiple re-ignition or virtual current chopping, for example when switching stalled motors or motors in the course of start-up.

Endangered are motors under switching of a starting current of $\leq 600 A$.

Surge limiters assure positive protection against overvoltage; see above for circuit examples.

General Description

Switching duties

Short-circuit protection

The 3TL vacuum contactors are not designed to switch short-circuit currents. It is therefore absolutely essential to provide short-circuit protection.

The best protection is provided by HV HRC fuses, but circuit-breakers can also be used subject to the described conditions "short-circuit protection by means of circuit-breakers".

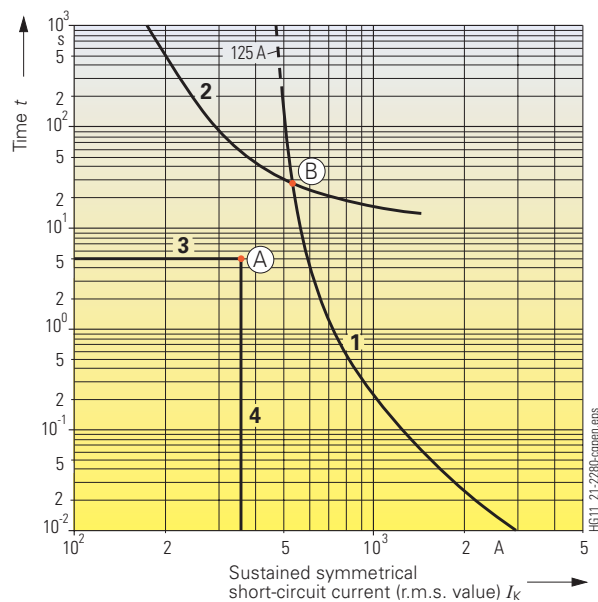
Short-circuit protection by means of HV HRC fuses

HV HRC fuses have a current-limiting effect with high short-circuit currents, i.e. the fuse limits the short-circuit current to the cut-off current.

When the fuses are selected, the type of load must be taken into account, for example, motor, transformer or capacitors.

For an example of coordination of an HV HRC fuse with overcurrent-time protection, see the chart below.

Example for coordination of a 125 A HV HRC fuse characteristic with a motor characteristic



Legend

- 1 Characteristic of HV HRC fuse 3GD1125-4D
- 2 Characteristic of maximum-current/time protection device
- 3 Motor starting time
- 4 Motor starting current

Coordination of the motor circuit components

- The time/current characteristic must be at the right of the motor starting current (point A).
- The rated current of the HV HRC fuse link must exceed the normal current of the motor.
- The current that prevails at the point of intersection B of the HV HRC fuse link's characteristic and the characteristic of the maximum-current/time protection device must be greater than the lowest breaking current of the HV HRC fuse link.
- If this cannot be achieved, make sure that overload currents lower than the lowest breaking current of the HV HRC fuse link are cut off by the switchgear by means of the striker. This prevents thermal overloading of the HV HRC fuse link, which would otherwise destroy it.
- The HV HRC fuse link selected limits the sustained symmetrical short-circuit current I_k to the cut-off current I_D which must be taken from the current limiting characteristic chart (for I_D as a factor of I_k for the HV HRC fuse links of different rated currents). The maximum permissible cut-off current is $I_D = 50$ kA.

Requirements

- The cut-off current I_D must not exceed 50 kA at 7.2 kV.
- With an LV power supply via a control power transformer, short-circuit currents must be interrupted between the switching capacity limit (5 kA) and $30 \times I_e$ (12 kA) within 80 ms. This stipulation does not apply if
 - there is mechanical latching or
 - the opening times have been extended so much that in the above-mentioned current range the contactor cannot open until the fuse has interrupted the current.
- When the motors are energized, the HV HRC fuse is loaded most by the motor starting current that occurs. It must neither blow nor become damaged under these loads.
- Other factors that influence loading of the HV HRC fuses are the starting time and starting frequency of the motors.

Switching duties

Short-circuit protection for "Class E2 controller" in accordance with UL / CSA C22.2

When using 3TL vacuum contactors as "Class E2 controllers" for 7.2 kV, Siemens fuses of type 3GD1 150-4D (7.2 kV/250 A) or other fuses with a comparable current/time characteristic must be used to provide short-circuit protection.

If 2 fuse links are connected in parallel, the symmetrical short-circuit current measured is divided by 2 and this value is used to determine the cut-off current for one fuse link. This value must then be multiplied by 2 in order to arrive at the total cut-off current, which must not exceed the permissible value for the vacuum contactor.

Parallel connection should be configured such that the resistance in the two branches is, if possible, identical.

When the fuses blow, this must result in the vacuum contactor being opened. An appropriate device that is actuated by the release bolt of the HV HRC fuse link must be installed.

Fuse monitoring

The fuse bases can be supplied with a fuse monitor in order to prevent a three-phase load (e.g. a motor) from being supplied on only two phases when a fuse blows. This fuse monitor can be used either to initiate an alarm signal or to open the vacuum contactor.

Short-circuit protection by means of circuit-breakers

Loads for which no suitable fuses are available can also be protected by means of circuit-breakers.

Due to the longer break time of the circuit-breakers (maximum permissible 120 ms), the short-circuit current must not exceed the maximum permissible value for the vacuum contactor (20 kA at 7.2 kV, 15 kA at 12 kV).

As a result of the longer break time, the interrupters must be replaced immediately in the case where the maximum permissible short-circuit current value has been reached, since this causes a severe reduction in their service life.

Utilization categories

Utilization categories	Typical applications
AC-3	Squirrel-cage motors: starting, de-energizing while running
AC-4	Squirrel-cage motors: starting, braking by plugging ¹⁾ , reversing ¹⁾ , jogging ²⁾

- 1) The terms "braking by plugging" and "reversing" of the motor refer to rapid braking or reversing of the direction of rotation by swapping over two supply wires while the motor is running.
- 2) "Jogging" refers to one-off or repeated brief energizing of a motor in order to actuate small movements of machines.

Overload protection

It is possible to use thermally delayed overload relays in conjunction with suitable current transformers for protecting high-voltage motors against overload.

Trip-free mechanism

All the switching contacts of the vacuum contactors operate trip-free.

The "OPEN" command interrupts the "CLOSE" command, i.e. the moment of the "OPEN" command determines whether the contacts close or not.

General Description

Standards

Design

3TL vacuum contactors are of an open design, degree of protection IP00 according to DIN EN 60529 and IEC 60529.

They comply with the standards for high-voltage AC contactors of between 1 kV and 12 kV:

- IEC 60470 - 2000
- DIN EN 60470
- UL Standard 347
- CSA C22.2
- Vacuum contactors 3TL71 are carried out following the standards for high-voltage AC contactors of between 1 kV and 12 kV according to IEC 60470 - 2000, DIN EN 60470.

Tests

We have our own accredited test bays which we can use to develop and type-test high-capacity switchgear in accordance with the relevant standards:

- High power electrical testing
- Testing of:
 - Mechanical operation
 - Reliability
 - Insulating capacity
 - Temperature rise
 - Climatic withstand capability.

Extensive series of tests are carried out for the type-tests specified in the relevant standards in order to achieve reliable results.

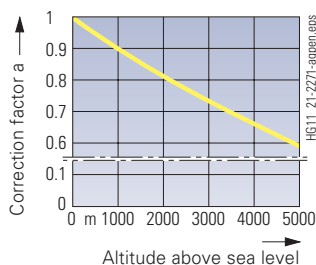
If a customer requests tests that are to be conducted in test bays not owned by Siemens, there are other accredited testing institutes available.

The tests encompass switching capacity, current-carrying capacity and, where applicable, insulating capacity. The fees for these tests are charged by PEHLA according to their current price schedule.

Insulating capacity

3TL vacuum contactors are suitable for site altitudes between 1250 m below sea level and 2500 m above sea level.

The specified insulating capacity values are referred to sea level. When installed at altitudes above 1000 m, an allowance must be made for the resulting decrease in insulating capacity (see correction factor a in the diagram below).



The following expression thus applies for the selection of the devices and equipment:

$$\text{Rated lightning impulse withstand voltage to be selected}^{1)} \geq \frac{\text{Required rated lightning impulse withstand voltage}^{1)}}{1.1 \cdot a}$$

1) Rated lightning impulse withstand voltage; rated power-frequency withstand voltage.

2) Lightning impulse withstand voltage; power frequency withstand voltage.

If, however, the actual insulating capacity must be determined at the installation site - the withstand voltage - the reduction of the insulating capacity from that for an altitude of 0 m (sea level) must be calculated as follows:

Withstand voltage²⁾ = a x rated withstand voltage¹⁾ of the selected device

Definitions:

Rated.....withstand voltage¹⁾

= target value according to VDE, IEC etc. referred to sea level.

.....withstand voltage²⁾

= actual value at the respective height.

Ambient conditions

Vacuum contactors can be used in buildings with low thermal insulation or low heat storage capacity, heated or cooled, without temperature monitoring. The heating or cooling may fail for a period of several days.

The vacuum contactors fulfill the following ambient conditions in accordance with IEC 60721- 1996:

- Climatic:
 - Class 3K4 (minimum temperature limit -25 °C)
 - Class 3K6 (without ice formation and wind-driven precipitation)
 - Class 3Z2
 - Class 3Z5
- Biological:
 - Class 3B1
- Chemically active materials:
 - Class 3C2 (without occurrence of saline fog with simultaneous moisture condensation)
- Mechanically active materials:
 - Class 3S2 (restriction acc. to operating instructions: clean insulating components)
- Mechanical:
 - Class 3M2.

Ambient temperature

Temperature value	for vacuum contactor		
	3TL81	3TL6	3TL71
Maximum value	+ 65 °C	+ 80 °C	+ 55 °C
Maximum value of 24-hour mean	+ 60 °C	+ 75 °C	+ 50 °C
Minimum value	- 25 °C	- 25 °C	- 5 °C

Relative humidity (measured averages):

- Over 24 hours: max. 95 %
- Over 1 month: max. 90 %.

Condensation may occasionally occur under these conditions.

Occasional exposure to condensation once per month for approximately 2 hours is permitted (tested according to DIN 50016, FW24).

The ambient air must not be contaminated with excessive amounts of dust, smoke, corrosive or flammable gases, vapors or salt.

For further information regarding the ambient conditions, see "Technical data".

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**Application**

3TL81 vacuum contactors are 3-pole contactors with electromagnetically-operated mechanism for medium-voltage switchgear.

They are load-break switchgear with a limited short-circuit making and short-circuit breaking capacity and are used for high switching frequencies (> 10,000 operating cycles).

The vacuum contactors are suitable for operational switching of AC loads in indoor switchgear and can perform, for example, the following duties:

- Switching of three-phase motors in AC-3 and AC-4 operation
- Switching of transformers
- Switching of reactors
- Switching of ohmic loads (e.g. arc furnaces)
- Switching of capacitors

With reversing contactor combinations, only one contactor is required for each direction of rotation, if HV HRC fuses are used for short-circuit protection.

Application examples

- Conveyor and lift systems
- Pump stations
- Ventilation and heating
- Systems for reactive-power compensation

for the following branches of industry:

- Mining
- Steel
- Gas and petrochemicals
- Paper
- Cement

Features

- Rated voltage up to 7.2 kV
- Maintenance-free through to the end of the vacuum interrupters' service life
- Mechanical service life of the contactor: 1 mill. operating cycles
- Suitable for switching, for example:
 - Transformers
 - Capacitors
 - Filter circuits
 - Motors
 - Reactors
 - Ohmic loads

as Economy Contactors

Construction and mode of operation

Construction

The 3TL81 vacuum contactor consists of:

- Medium-voltage section with
 - Insulating plastic housing (1)
 - Vacuum interrupters (2)
 - Main conductor terminals (8 and 9)
- Low-voltage section with
 - Magnetic system (11)
 - Electronic economy circuit (14)
 - Auxiliary contact blocks (12 and 13)
 - Mechanical closing latching (6) as an additional module

Mode of operation

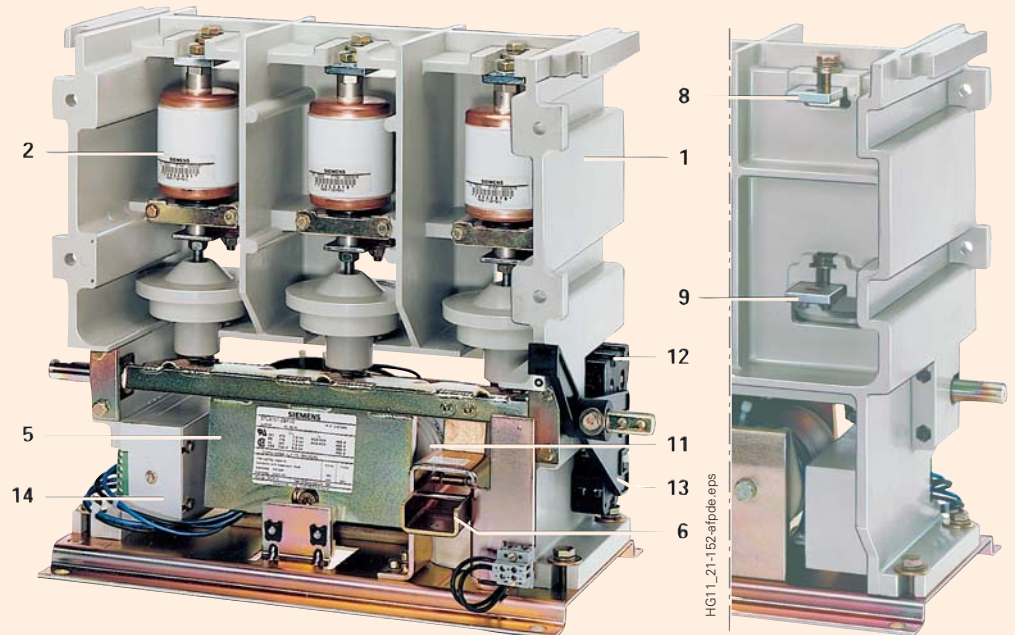
The magnetic system (11) of the 3TL81 vacuum contactor opens and closes the contacts of the vacuum interrupters (2). Due to the use of the electronic economy circuit (14), the magnetic system (11) is independent of the voltage type and level across a wide range.

Mechanical closing latching

The mechanical closing latching (6) holds the vacuum contactor in the closed position even without excitation of the magnetic system (11).

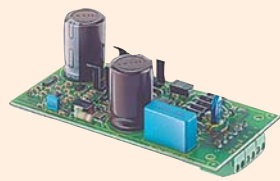
The latching module of the mechanical closing latching (6) is fitted inside the mechanism housing (5). When the magnetic system (11) is excited, the vacuum interrupter (2) is latched mechanically by means of a lever and roller system into the "CLOSED" position. The contactor is unlatched electrically by means of an unlatching solenoid or mechanically by means of a release bolt (the coupling has to be provided by the customer).

The command duration for the unlatching solenoid must be between 100 ms and 1 s. An external command ending unit must be provided.



3TL8 vacuum contactor
7.2 kV / 400 A

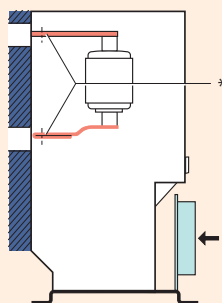
Main conductor terminals located at rear (1 pole shown)



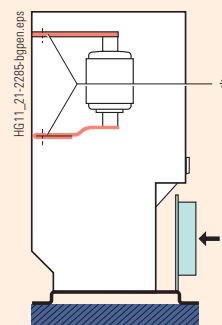
Electronic module (14)



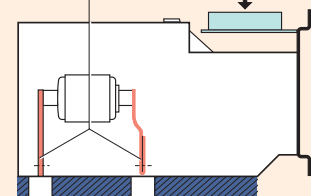
Mechanical closing latching (6)



Wall assembly
vertical layout



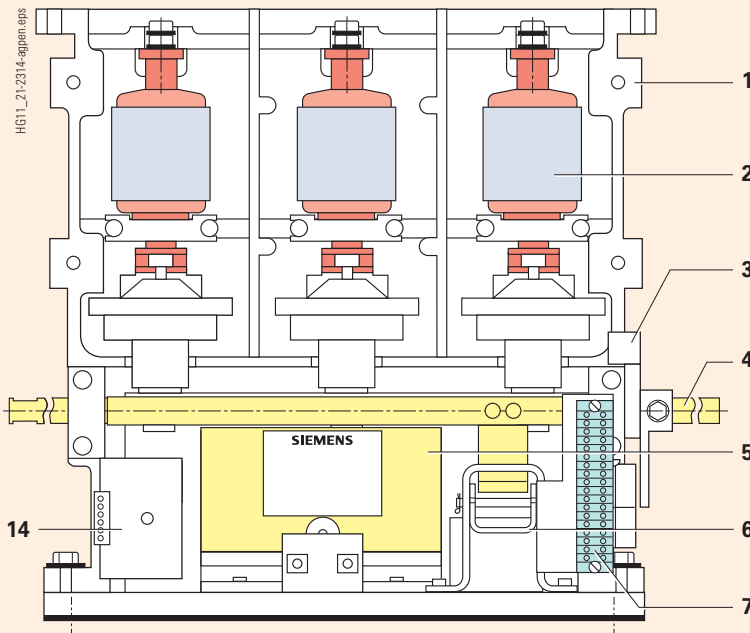
Floor assembly
vertical layout



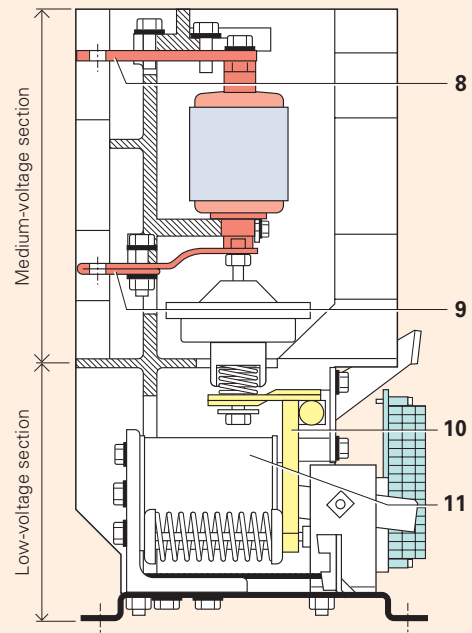
horizontal layout

* Position of the main conductor terminals
➡ Position of the terminal block

Construction and mode of operation



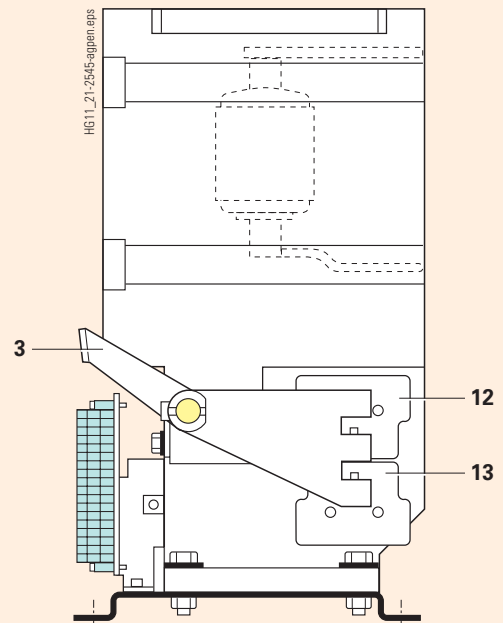
Structure of the 3TL8 vacuum contactor (front view)



Side view from left (sectional view)

Legend

- 1 Insulating plastic housing
- 2 Vacuum interrupter*
- 3 Position indicator O - I
- 4 Operating shaft (short or long version)
- 5 Mechanism housing
- 6 Mechanical closing latching * (optional) with rectifier module * for AC operation
- 7 Terminal block (optional)
- 8 Top main conductor terminal
- 9 Bottom main conductor terminal
- 10 Mechanical connection between medium and low-voltage sections
- 11 Magnetic system (solenoid *)
- 12 Top auxiliary contact block *
- 13 Bottom auxiliary contact block *
- 14 Electronic module * (electronic economy circuit) with terminals



Side view from right

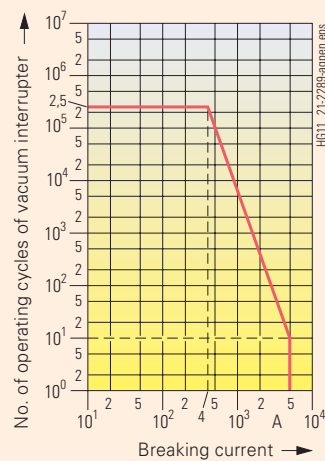
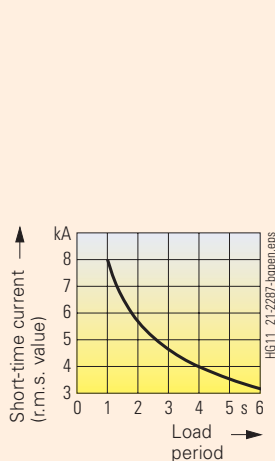
* Also available as spare part.

as Economy Contactors

Technical data

Medium-voltage section

Rated voltage U_r	7.2 kV
Rated frequency	50 to 60 Hz
Rated continuous current I_{th} according to DIN EN 60470, IEC 60470	400 A
Rated operational current I_e according to utilization categories AC-1, AC-2, AC-3 and AC-4 At ambient temperatures up to + 55 °C At ambient temperatures up to + 65 °C	400 A 360 A
Switching capacity according to utilization category AC-4 (p.f. = 0.35) Rated making current Rated breaking current	4000 A 3200 A
Max. permissible switching capacity	5 kA
Rated short-time withstand current 1 s (r.m.s. value); (for short-time current for longer periods, see short-time current load-period characteristic)	8 kA
Switching of capacitors Rated capacitor current Max. permissible making current peak	250 A 10 kA
Switching frequency (AC and DC operation) without mechanical closing latching	1200 operating cycles/h
Mechanical service life of the contactor	1 mill. operating cycles
Mechanical service life of the vacuum interrupter	0.25 mill. operating cycles
Electrical service life of the vacuum interrupter at rated operational current	0.25 mill. operating cycles
Dielectric strength Rated lightning impulse withstand voltage (according to DIN EN 60694, IEC 60694): To earthed parts and between poles Across the open contact gap Rated power-frequency withstand voltage 50 Hz (r.m.s.) To earthed parts and between poles Across the open contact gap	60 kV 40 kV 20 kV 20 kV
Cross-sections of the main conductor terminals Terminal screw Stranded conductors with cable lug Copper rail to DIN 43671 Aluminum rail to DIN 43670	M10 50 to 240 mm ² 30 x 5 mm 20 x 10 mm



Low-voltage section

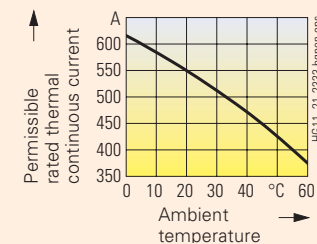
Power consumption of the solenoid (AC and DC operation) Pickup power Holding power	600 W 90 W
Voltage range of the solenoid Operating voltage (AC and DC operation)	0.85 to 1.1 U_a
Minimum closing command for the solenoid	300 ms
Make time ¹⁾ (AC and DC operation 110 V to 250 V)	200 ms at 0.85 x 110 V 150 ms at 1.0 x 110 V 50 ms at 1.1 x 250 V
Break time ²⁾ (AC and DC operation 110 V to 250 V) depending on the electronic economy circuit	325 ± 75 ms or ≤ 50 ms ³⁾
Mechanical closing latching (optional) (AC and DC operation) Service life Switching frequency ⁴⁾ Power consumption of unlatching solenoid Voltage range of unlatching solenoid Tripping pulse (by external circuit provided by customer) Break time	100,000 operating cycles 60 operating cycles/h 900 W 0.85 to 1.1 U_a 0.2 to max. 1 s < 50 ms

Auxiliary contacts

Number of auxiliary contacts	2NO/2NC or 4NO/4NC
Rated continuous current I_{th}	10 A
Rated operational current I_e Utilization category for AC-11 at rated voltage Utilization category for DC-11 at rated voltage	125 V AC, 10 A 230 V AC, 10 A 500 V AC, 4 A 600 V AC, 2 A 24 V DC, 10 A 110 V DC, 5 A 125 V DC, 0.9 A 220 V DC, 0.45 A 440 V DC, 0.25 A 600 V DC, 0.2 A
Cross-sections of the auxiliary contacts according to DIN EN 60947 Part 1 (screw terminal, two-wire connection possible) Solid Finely stranded with end sleeve	0.6 to 4 mm ² 0.5 to 2.5 mm ²

Ambient conditions

Ambient temperature Storage Operation	at - 40 to + 65 °C at - 5 to + 65 °C at - 25 to - 5 °C	20 years 1 mill. operating cycles 0.5 mill. operating cycles
Site altitude	200 m below sea level to 1250 m above sea level	
Shock resistance (square impact)	5 x g, 10 ms or 10 x g, 5 ms	



2) Break time = Time from the instant of application of the OPEN control pulse to the instant of contact separation.

3) Possible by means of external circuit with contactor relay suitable for ampacity 10 A.

4) 24 up to 48 V
6 operating cycles/h.

1) Make time = Time from the instant of application of a control pulse (command) to the instant when the contacts touch.

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Selection and ordering data



HG11_21-084_1-afpde.tif

Versions



Short operating shaft



Long operating shaft

HG11_21-091-afpde.tif
HG11_21-092-afpde.tif

Rated voltage U_r	Rated lightning impulse withstand voltage		Rated power-frequency withstand voltage	Rated operational current I_e	Order No.	Order code
kV	to earth kV	across open contact gap kV	kV	A		
7.2	60	40	20	400	3TL8 10 □ - □ □ □ □ - □ □ □ □	
Versions						
Short operating shaft					0	
Long operating shaft for powerless external built-on accessories					1	
Auxiliary contacts, additional modules						
2 NO + 2 NC, without auxiliary contact wiring/without additional modules					0	
4 NO + 4 NC, without auxiliary contact wiring/without additional modules					1	
4 NO + 4 NC, with closing latching/without auxiliary contact wiring					2	5
4 NO + 4 NC, with closing latching, auxiliary contacts wired to terminal strip					3	5
4 NO + 4 NC, auxiliary contacts wired to terminal strip, without closing latching					5	
Operating voltages for solenoid						
24 V AC/DC						A
110 to 250 V AC/DC						B
48 to 60 V AC/DC						D
Operating voltages for releasing the mechanical closing latching						
Without mechanical closing latching						A
24 V DC						B
30 V DC						C
48 V DC						D
60 V DC						E
110 V DC						F
125 V DC						G
220 to 250 V DC						H
110/115 V AC, 50/60 Hz						L
120/127 V AC, 50/60 Hz						M
220/240 V AC, 50/60 Hz						N
380 V AC, 50/60 Hz						P
Break time						
Without mechanical closing latching 325 ± 75 ms						0
With mechanical closing latching 50 ms, (external auxiliary contactor provided by the customer)						5
Operating instructions/language						
Without routine test certificate German / English						0
Without routine test certificate French / Spanish						1
With routine test certificate German / English						5
With routine test certificate French / Spanish						6
Special version						
Conductors halogen-free and flame-resistant						Z A 1 0

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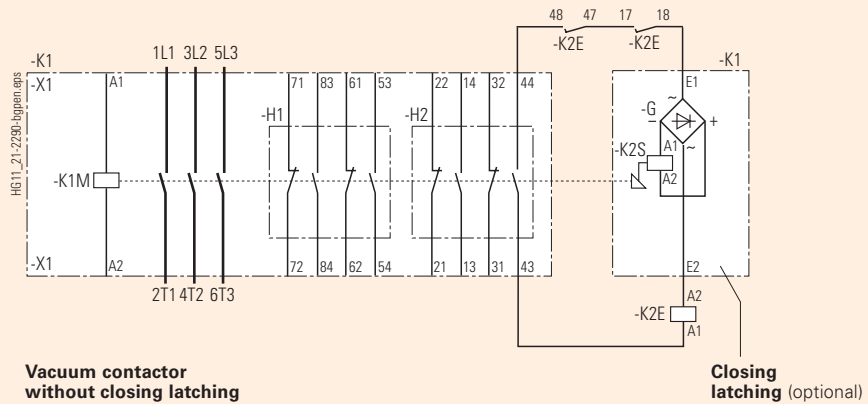
Spare parts and accessories (When ordering, please also state type and serial number of the vacuum contactor)

	Scope of delivery	Operating voltage or contacts	Order No.
Vacuum interrupter	 HG11_21-107-afpde.eps		3TY5 810 -0AA0 (up to serial No. 31 670 935) 3TY5 810-1AA0 (as of serial No. 31 670 936)
Auxiliary contact block	 HG11_21-098-afpde.eps	top 2 NO + 2 NC bottom 2 NO + 2 NC	3TY7 561 -1SA0 3TY7 561 -1NA0
Solenoid	 HG11_21-106-afpde.eps	24 V AC/DC 48 V - 60 V AC/DC 110 V - 250 V AC/DC	3TY5 811 -0AA0 3TY5 811 -0DA0 3TY5 811 -0BA0
Electronic module	 HG11_21-093-afpde.eps	24 V AC/DC 48 V - 60 V AC/DC 110 V - 250 V AC/DC	3TY5 812 -0AA0 3TY5 812 -0DA0 3TY5 812 -0BA0
Mechanical closing latching (accessory)	 HG11_21-109-afpde.eps	110 V - 115 V AC, 50/60 Hz 120 V - 127 V AC, 50/60 Hz 220 V - 240 V AC, 50/60 Hz 380 V AC, 50/60 Hz 24 V DC 30 V DC 48 V DC 60 V DC 110 V DC 125 V DC 220 V - 250 V DC	3TY5 892 -0AG7 3TY5 892 -0AL7 3TY5 892 -0AN7 3TY5 892 -0AQ2 3TY5 892 -0BB4 3TY5 892 -0BC4 3TY5 892 -0BD4 3TY5 892 -0BE4 3TY5 892 -0BF4 3TY5 892 -0BG4 3TY5 892 -0BM4
Rectifier module (accessory) for mechanical closing latching	 HG11_21-106-afpde.eps	-	3AX15 25 -1F

Internal connection diagrams

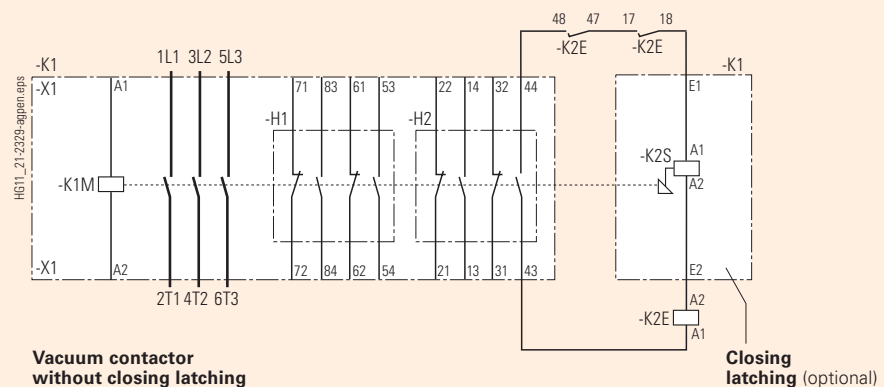
AC operation

- Voltage range
 - 24 V to 250 V AC
- Without mechanical closing latching:
 - Opening delay ≤ 50 ms by means of external circuit
 - Opening delay 325 ± 75 ms
- Auxiliary contact block
 - 2 NO + 2 NC
 - Optional: 4 NO + 4 NC
- Optional: with mechanical closing latching (-K2S) (only in conjunction with auxiliary contact block 4 NO + 4 NC and with rectifier



DC operation

- Voltage range
 - 24 V to 250 V DC
- Without mechanical closing latching:
 - Opening delay ≤ 50 ms by means of external circuit
 - Opening delay 325 ± 75 ms
- Auxiliary contact block
 - 2 NO + 2 NC
 - Optional: 4 NO + 4 NC
- Optional: with mechanical closing latching (-K2S) (only in conjunction with auxiliary contact block 4 NO + 4 NC)



Legend

- G Rectifier module
- H1 Bottom auxiliary contact block
- H2 Top auxiliary contact block (optional)
- K1 Vacuum contactor
- K1M Solenoid-operated mechanism for vacuum contactor
- K2E External contactor relay
- K2S Unlatching solenoid (optional)
- X1 Terminal block for auxiliary conductor connection

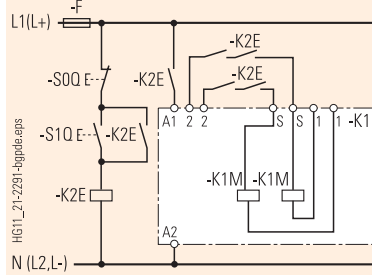
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Circuit diagrams (examples)

AC and DC operation

- Without mechanical closing latching
- Opening delay
 – ≤ 50 ms by means of external circuits
 – 325 ± 75 ms

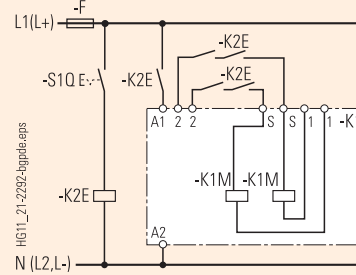
Momentary-contact control



Without time-delay relay for minimum motor starting time, opening delay ≤ 50 ms

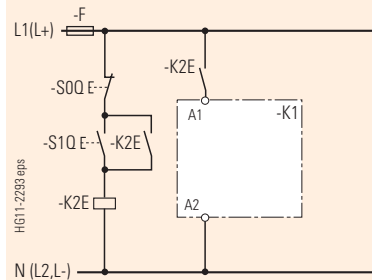
Fig. 1

Maintained-contact control



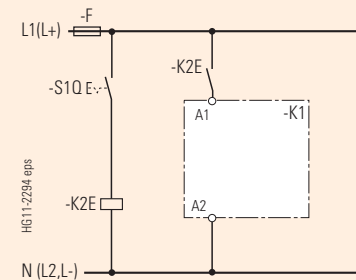
Without time-delay relay for minimum motor starting time, opening delay ≤ 50 ms

Fig. 2



Without time-delay relay for minimum motor starting time, opening delay 325 ± 75 ms

Fig. 3



Without time-delay relay for minimum motor starting time, opening delay 325 ± 75 ms

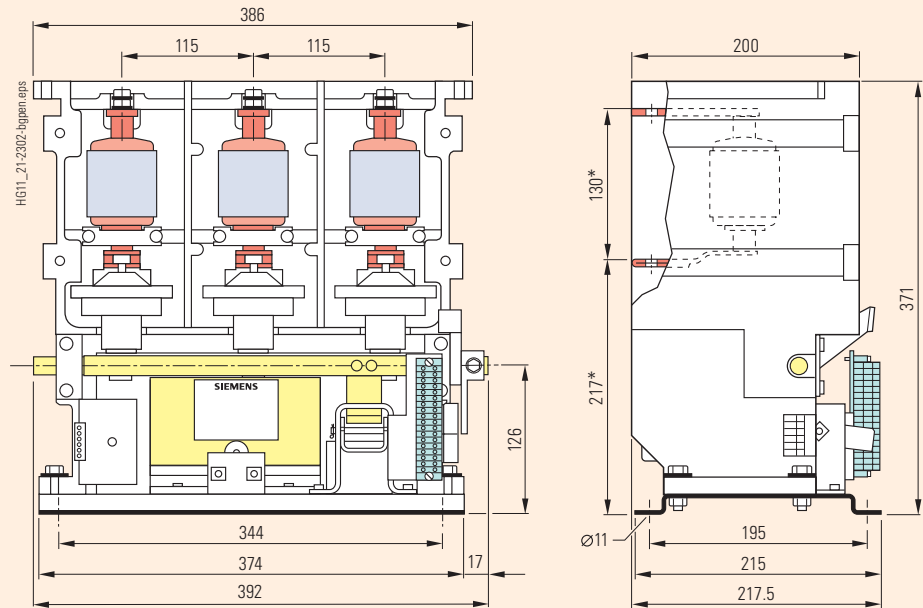
Fig. 4

Legend

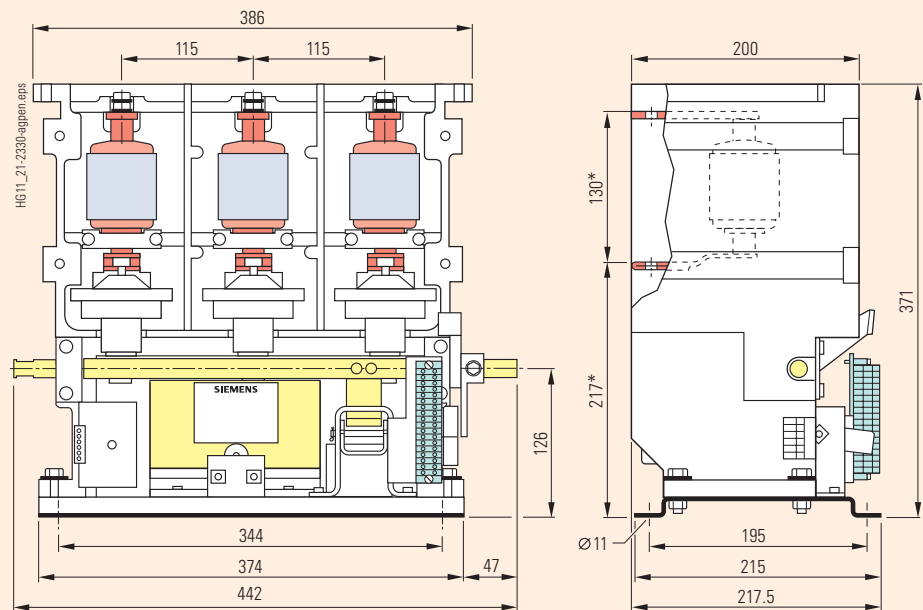
- F Fuse
- K1 Vacuum contactor
- K2E External contactor relay
- K1M Solenoid-operated mechanism
- S0Q External "OPEN" pushbutton
- S1Q External "CLOSED" pushbutton

Dimensions and weights

- For AC and DC operation
- Weight 30 kg



3TL8 100 vacuum contactor with short operating shaft



3TL8 101 vacuum contactor with long operating shaft

* Fixing dimensions

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Shipping

Packaging

The 3TL81 vacuum contactors are packed in accordance with the customer's order specifications and shipped anywhere in the world in the mode determined by the customer.

If the customer has not specified the manner of packaging and mode of shipping, the most economic option is chosen depending on the size of the lot ordered.

Package type	Destination			
	Germany	Europe	Overseas	Overseas/ Europe
	Shipping by means of truck / rail	Shipping by means of truck / rail	Shipping by means of sea freight	Shipping by means of air freight
Individual package	x / -	x / -	x	x
Lot-size package	- / x	- / x	x	x
Cardboard box with inner box to suit unit	x / x	x / x	-	x
Cardboard box with sealed packaging and inner box to suit unit	- / -	x / x	x	x
Skeleton container with cardboard boxes and inner box to suit unit	- / x	- / -	-	-
Plywood box + cardboard boxes with sealed packaging and inner box to suit unit	- / -	x / x	x	x

x = Preferred package type

Shipping dimensions and weights

Shipping by truck and rail

Package type	for no. of vacuum contactors	Length / Width / Height mm / mm / mm	Volume m ³	Gross weight kg
Cardboard box with inner box to suit unit	1	490 / 300 / 400	0.059	32
	2	800 / 780 / 670	0.42	62
	3 - 4	1020 / 620 / 670	0.42	100 - 130
Cardboard box with sealed packaging and inner box to suit unit	1 - 2	800 / 780 / 670	0.42	45 - 70
	3 - 4	1020 / 620 / 670	0.42	105 - 135
Skeleton container with cardboard boxes and inner box to suit unit	3 - 12	1200 / 800 / 800	0.77	125 - 360
Plywood box + cardboard boxes with sealed packaging and inner box to suit unit	1 - 3	920 / 620 / 720	0.41	50 - 100
	7 - 10	1020 / 1020 / 1020	1.06	240 - 310

Shipping by sea freight

Package type	for no. of vacuum contactors	Length / Width / Height mm / mm / mm	Volume m ³	Gross weight kg
Cardboard box with inner box to suit unit	-	-	-	-
Cardboard box with sealed packaging and inner box to suit unit	1 - 2	800 / 780 / 670	0.42	45 - 70
	3 - 4	1020 / 620 / 670	0.42	105 - 135
Skeleton container with cardboard boxes and inner box to suit unit	-	-	-	-
Plywood box + cardboard boxes with sealed packaging and inner box to suit unit	1 - 3	920 / 620 / 720	0.41	50 - 100
	7 - 10	1020 / 1020 / 1020	1.06	240 - 310

Shipping by air freight

Package type	for no. of vacuum contactors	Length / Width / Height mm / mm / mm	Volume m ³	Gross weight kg
Cardboard box with inner box to suit unit	1	490 / 300 / 400	0.059	32
	2	800 / 780 / 670	0.42	62
	3 - 4	1020 / 620 / 670	0.42	100 - 130
Cardboard box with sealed packaging and inner box to suit unit	1 - 2	800 / 780 / 670	0.42	45 - 70
	3 - 4	1020 / 620 / 670	0.42	105 - 135
Skeleton container with cardboard boxes and inner box to suit unit	-	-	-	-
Plywood box + cardboard boxes with sealed packaging and inner box to suit unit	1 - 3	920 / 620 / 720	0.41	50 - 100
	7 - 10	1020 / 1020 / 1020	1.06	240 - 310

Contents



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Application

3TL6 vacuum contactors are 3-pole contactors with electromagnetically-operated mechanism for medium-voltage switchgear.

They are load-break switchgear with a limited short-circuit making and short-circuit breaking capacity and are used for high switching frequencies (> 10,000 operating cycles).

The vacuum contactors are suitable for operational switching of AC loads in indoor switchgear and can perform, for example, the following duties:

- Switching of three-phase motors in AC-3 and AC-4 operation
- Switching of transformers
- Switching of reactors
- Switching of ohmic loads (e.g. arc furnaces)
- Switching of capacitors

With reversing contactor combinations, only one contactor is required for each direction of rotation, if HV HRC fuses are used for short-circuit protection.

Application examples

- Conveyor and lift systems
- Pump stations
- Ventilation and heating
- Systems for reactive-power compensation

for the following branches of industry

- Mining
- Steel
- Gas and petrochemicals
- Paper
- Cement

Features

- Rated voltages up to 12 kV
- Maintenance-free through to the end of the vacuum interrupters' service life
- Mechanical service life of the contactor up to 3 mill. operating cycles
- Suitable for switching, for example:
 - Transformers
 - Capacitors
 - Filter circuits
 - Motors
 - Reactors
 - Ohmic loads

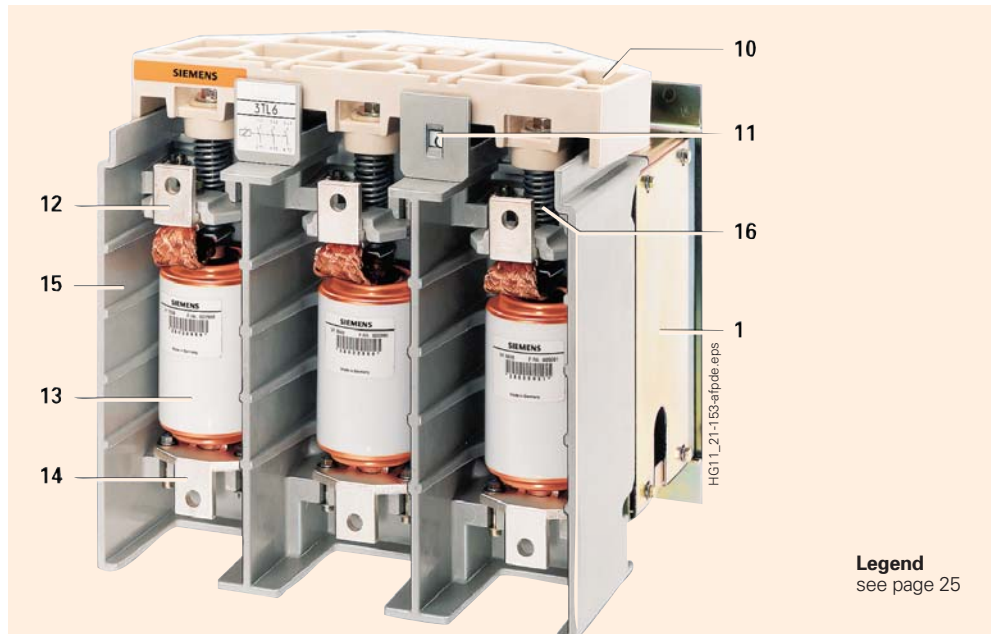
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Construction and mode of operation

Construction

The 3TL6 vacuum contactor consists of:

- Medium-voltage section:
 - Insulating housing (15)
 - Vacuum interrupters (13)
 - Main conductor terminals (12 and 14)
- Low-voltage section:
 - Mechanism housing (1) made of sheet steel
 - Magnetic system (2)
 - Central terminal block (3) for auxiliary and control circuits
 - Contactor relay (external)
 - Auxiliary contact blocks
 - Mechanical closing latching (7 to 9) and mechanical closing lock-out (5) as additional modules
 - Integral rocker (10) as connection between the magnetic system and the vacuum interrupters.



3TL6 vacuum contactor
7.2 kV/450 A

Legend
see page 25

Mode of operation

The atmospheric pressure exerts a force on the metal bellows of the vacuum interrupter. Without the influence of the operating mechanism, the contact gap would close. The opening springs (6) keep the moving contact piece in the open position by means of the integral rocker (10).

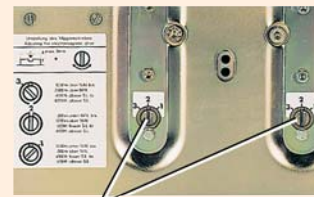
To close the vacuum contactor, the pressure force of the opening springs (6) is overcome by the magnetic system (2). The solenoid armature (4) is attracted and thereby moves the integral rocker (10) which releases the moving interrupter contact piece from the open position. The atmospheric pressure closes the contact pieces. The integral rocker (10) then presses the contact pressure springs (16) together and produces the necessary contact force.

After de-energization of the electromagnetic excitation, the opening springs (6) open the contact gap by means of the integral rocker (10) and the moving interrupter contact piece.

The DC magnetic system functions as an economy circuit. This leads to a longer mechanical service life and reduces pickup and holding power.

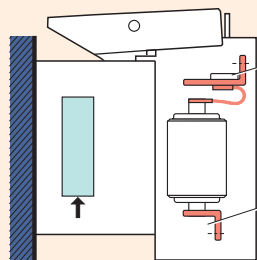


Terminal block (3)
(Optional: withdrawable from side)

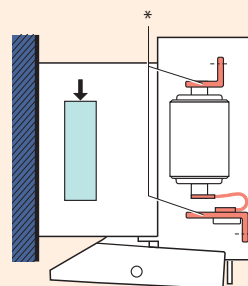


Adjusting controls (at rear of unit) for adapting to a side altitude between 1250 m below and 2500 m above sea level

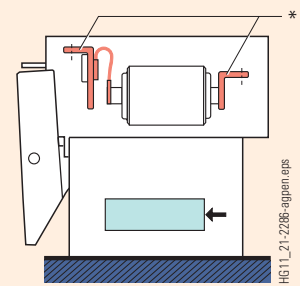
Permissible installation positions



Wall assembly
vertical layout



vertical layout
(rotated through 180°)



Floor assembly
horizontal layout

* Position of the main conductor terminals
➡ Position of the terminal block

Construction and mode of operation (continued)

Adapting to the site altitude

The vacuum contactor is factory-set for a site altitude between 200 m below and 1250 m above sea level. If it is to be used at altitudes not within this range, the altitude range must be adapted by means of adjusting controls at the rear of the end unit.

Adjusting ranges above sea level:

- + 1250 m to + 2500 m
- - 200 m to + 1250 m
- - 1250 m to + 200 m.

Mechanical closing latching

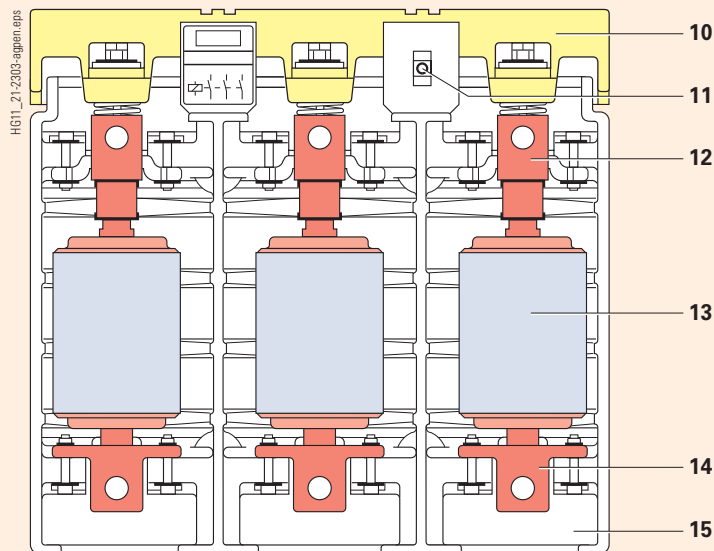
The latching lever (7) holds the vacuum contactor in the closed state even without excitation of the magnetic system. When the magnetic system is excited, the integral rocker is latched mechanically by means of a lever and roller system into the "CLOSED" position. The contactor is unlatched electrically by means of an unlatching solenoid (9) or mechanically by means of the release bolt (8).

Mechanical closing lock-out

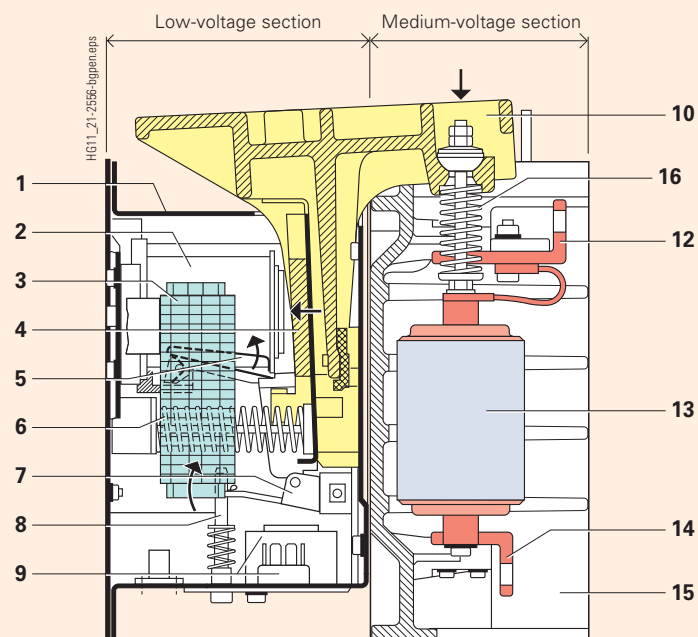
The mechanical closing lock-out (5) prevents unintentional closing of the vacuum contactor, for example, due to vibrations or whenever the withdrawable unit is moved. This lock remains inoperative during operational switching.

Blocking element for interlocking of two contactors

A mechanically functioning blocking element is available on request (for rated voltages up to 7.2 kV only) for mutual interlocking of two contactors in reversing operation. The blocking element is fixed between the two contactors and intervenes in a mutually controlling and blocking manner in the movement of the integral rocker of both contactors. This rules out a phase short-circuit as a result of simultaneous activation of both directions of rotation in the event of mechanical impact and electrical maloperations.



Design of a 3TL6 vacuum contactor
Front view



Design of a 3TL6 vacuum contactor in the "OPEN" position

Side view from left (sectional view)
the arrows show the "CLOSED" direction of movement

Legend

- | | |
|---|--|
| 1 Mechanism housing | 9 Unlatching solenoid * with rectifier and varistor modules * (optional) |
| 2 Magnetic system (solenoid *) with rectifier* (optional) and economy resistor* | 10 Integral rocker |
| 3 Terminal block (optional: withdrawable from side) | 11 Position indicator O - I |
| 4 Solenoid armature | 12 Top main conductor terminal |
| 5 Mechanical closing lockout * | 13 Vacuum interrupter * |
| 6 Opening spring | 14 Bottom main conductor terminal |
| 7 Latching lever | 15 Insulating plastic housing |
| 8 Release bolt | 16 Contact pressure spring |

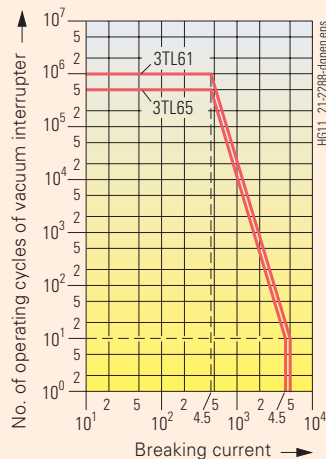
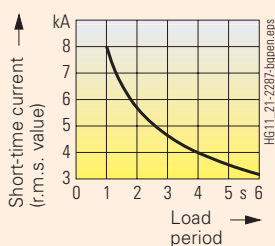
* Also available as spare part.

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Technical data

Medium-voltage section

	Vacuum contactor type	
	3TL61	3TL65
Rated voltage U_r	7.2 kV	12 kV
Rated frequency	50 to 60 Hz	50 to 60 Hz
Rated continuous current I_{th} to DIN EN 60470, IEC 60470	450 A	400 A
Rated operational current I_e according to utilization categories AC-1, AC-2, AC-3 and AC-4 at ambient temperatures up to + 55 °C + 80 °C	450 A 315 A	400 A 315 A
Switching capacity according to utilization category AC-4 (p.f. = 0,35) Rated making current Rated breaking current	4500 A 3600 A	4000 A 3200 A
Max. permissible switching capacity	5 kA	4.5 kA
Rated short-time withstand current 1 s (r.m.s. Value); (for short-time current for longer periods, see short-time current load-period characteristic)	8 kA	8 kA
Switching of capacitors Rated capacitor current Max. permissible making current peak	250 A 10 kA	250 A 10 kA
Switching frequency (AC and DC operation) without mechanical closing latching	1200 operating cycles/h	600 operating cycles/h
Mechanical service life of the contactor	3 mill. operating cycles	1 mill. operating cycles
Mechanical service life of the vacuum interrupter	2 mill. operating cycles	1 mill. operating cycles
Electrical service life of the vacuum interrupter at rated normal current	1 mill. operating cycles	0.5 mill. operating cycles
Dielectric strength Rated lightning impulse withstand voltage (according to DIN EN 60694, IEC 60694): to earthed parts and between poles across the open contact gap Rated power-frequency withstand voltage 50 Hz (r.m.s.) to earthed parts and between poles across the open contact gap	60 kV 40 kV 20 kV 20 kV	75 kV 60 kV 28 kV 28 kV
Cross-sections of the main conductor terminals Terminal screw Stranded conductors with cable lug Copper rail to DIN 43671 Aluminium rail to DIN 43670	M10 50 to 240 mm ² 30 x 5 mm 20 x 10 mm	M10 50 to 240 mm ² 30 x 5 mm 20 x 10 mm



Low-voltage section

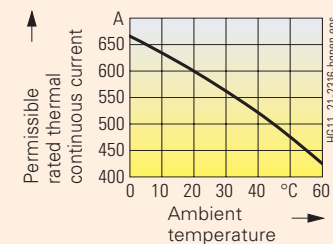
	Vacuum contactor type	
	3TL61	3TL65
Power consumption of the solenoid (AC and DC operation) Pickup power Holding power	650 W 90 W	
Voltage range of the solenoid Operating voltage (AC and DC operation)	0.8 to 1.1 U_a	
Minimum closing command for the solenoid	100 ms	
Make time ¹⁾ (AC and DC operation)	100 ms at 0.85 x U_a 80 ms at 1.0 x U_a 60 ms at 1.1 x U_a	
Break time ²⁾ (AC and DC operation), other opening delay times possible as special version	30 ms at 0.8 x U_a 50 ms at 1.0 x U_a 50 ms at 1.1 x U_a	
Mechanical closing latching (optional) (AC and DC operation) Service life Switching frequency Power consumption of unlatching solenoid Voltage range of unlatching solenoid Tripping pulse (by external circuit provided by customer) Break time	100,000 operating cycles 60 operating cycles/h 900 W 0.85 to 1.1 U_a 0.2 to max. 1 s < 45 ms	

Auxiliary contacts

Number of auxiliary contacts	4 NO + 3 NC (optional: 6 NO + 5 NC)	
Rated continuous current I_{th}	10 A	
Rated operational current I_e Utilization category for AC-11 at rated voltage	125 V AC, 10 A 230 V AC, 10 A 500 V AC, 4 A 600 V AC, 2 A	
Utilization category for DC-11 at rated voltage	24 V DC, 10 A 110 V DC, 5 A 125 V DC, 0.9 A 220 V DC, 0.45 A 440 V DC, 0.25 A 600 V DC, 0.2 A	
Cross-sections of the auxiliary contacts according to DIN EN 60947 Part 1 (screw terminal, two-wire connection possible) Solid Finely stranded with end sleeve	0.6 to 4 mm ² 0.5 to 2.5 mm ²	

Ambient conditions

Ambient temperature Storage at - 40 to + 65 °C Operation at - 5 to + 55 °C at + 55 to + 80 °C at - 25 to - 5 °C	operating cycles operating cycles operating cycles	20 years 2 mill. 1 mill. 0.5 mill.	20 years 1 mill. 1 mill. 0.25 mill.
Site altitude (adjustable)	1250 m below sea level to 2500 m above sea level		
Shock resistance (square impact)	5 x g , 10 ms or 10 x g , 5 ms		



- 1 Make time = Time from the instant of application of a control pulse (command) to the instant when the contacts touch.
- 2 Break time = Time from the instant of application of the "OPEN" control pulse to the instant of contact separation.

Selection and ordering data



Rated voltage U_r	Rated lightning impulse withstand voltage		Rated power-frequency withstand voltage	Rated operational current I_e	Order No.	Order code
	to earth	across open contact gap				
kV	kV	kV	kV	A		
7.2	60	40	20	450	3TL6 1 □ 3 - □ □ □ □ - □ □ □ □	
12	75	60	28	400	3TL6 5 □ 5 - □ □ □ □ - □ □ □ □	
Terminal strip				Auxiliary contacts		
Central				4 NO + 3 NC	1	
Central				6 NO + 5 NC	2	
Withdrawable				6 NO + 5 NC	3	
Additional modules				Auxiliary contacts		
Without additional modules					0	
Mechanical closing latching				1 NO assigned	1	
Mechanical closing lock-out					2	
Closing latching and closing lock-out				1 NO assigned	3	
Type of operation for solenoid and mechanical closing latching						
AC operation					A	
DC operation					B	
Operating voltages for solenoid and mechanical closing latching						
110 V AC, 50/60 Hz					G 2	
115 V AC, 50/60 Hz					J 2	
120 V AC, 50/60 Hz					K 2	
220 V AC, 50/60 Hz					N 2	
230 V AC, 50/60 Hz					L 2	
240 V AC, 50/60 Hz					P 2	
24 V DC					B 4	
60 V DC					E 4	
110 V DC					F 4	
125 V DC					G 4	
220 V DC					M 4	
Other operating voltages for solenoid and mechanical closing latching ¹⁾					Z 0	K 1 Y
Operating instructions						
German / English (standard)						
French / Spanish					Z L 0 1	
Routine test certificate						
German / English ²⁾					Z F 2 0	
Special versions						
Break time						
≤ 40 ms					Z G 0 1	
≤ 120 ms					Z G 0 2	
250 ± 70 ms					Z G 0 3	
300 ms					Z G 0 4	
120/50 ms					Z G 0 8	
Overvoltage protection circuitry in secondary circuit						
Varistor module					Z A 0 0	
Rectifier module					Z A 0 1	
Wiring						
Conductors halogen-free and flame-resistant					Z A 1 0	

1) Ordering data: in addition to the Order No., state the required operating voltage from the above table in plain text (please make inquiry).

2) Other languages on request.

Note!

Due to a lack of space the internal command ending unit cannot be installed in 3TL6 vacuum contactors with withdrawable terminal strip.
Order number: 3TL6 133 and 3TL6 535.

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Spare parts and accessories (When ordering, please also state type and serial number of the vacuum contactor)

	Scope of delivery	Operating voltage or contacts	Order No.	Operating voltage or contacts	Order No.
Vacuum interrupter	 HG11_21-097-afpde.eps	7.2 kV, 450 A, VS 7202 12 kV, 400 A, VS 12003	3TY5 610 -2AA0 3TY5 650 -1AA0		
Auxiliary contact block	 HG11_21-098-afpde.eps	left 2NO + 2NC left 3NO + 3NC right 2NO + 2NC right 3NO + 3NC	3TY7 561 -1NA0 3TY7 561 -1QA0 3TY7 561 -1PA0 3TY7 561 -1RA0		
Solenoid from year of manufacture 10.90 from serial No. 31 375 035	 HG11_21-101-afpde.eps	110/115 V AC, 50/60 Hz 120 V AC, 50/60 Hz 125/127 V AC, 50 Hz 220 V AC, 50/60 Hz 230/240 V AC, 50/60 Hz 380 V AC, 50 Hz 400/415 V AC, 50 Hz 440 V AC, 50/60 Hz	3TY5 651 -0AG7 3TY5 651 -0AL7 3TY5 651 -0AL7 3TY5 651 -0AN2 3TY5 651 -0AN7 3TY5 651 -0AQ2 3TY5 651 -0AR7 3TY5 651 -0AR7	500 V AC, 50 Hz 24 V DC 60 V DC 110 V DC 125 V DC 220 V DC	3TY5 651 -0AU7 3TY5 651 -0BB4 3TY5 651 -0BE4 3TY5 651 -0BF4 3TY5 651 -0BG4 3TY5 651 -0BM4
Resistor for economy circuit (accessory) from year of manufacture 10.90 from serial No. 31 375 035	 HG11_21-100-afpde.eps	110/115 V AC 120/125/127 V AC 220 V AC 230/240 V AC 380 V AC 400/415/440 V AC	3TY5 664 -1DA0 3TY5 664 -1EA0 3TY5 664 -1FA0 3TY5 664 -1GA0 3TY5 664 -1HA0 3TY5 664 -1JA0	500 V AC 24 V DC 60 V DC 110 V DC 125 V DC 220 V DC	3TY5 664 -1KA0 3TY5 664 -0AA0 3TY5 664 -0CA0 3TY5 664 -0DA0 3TY5 664 -0EA0 3TY5 664 -0FA0
Contactor relay	 HG11_21-102-afpde.eps		Ident No. SW-Berlin		Ident No. SW-Berlin
		110 V AC, 50/60 Hz 115 V AC, 50/60 Hz 120 V AC, 50/60 Hz 125/127 V AC, 50/60 Hz 220 V AC, 50/60 Hz 230 V AC, 50/60 Hz 240 V AC, 50/60 Hz 400 V AC, 50 Hz 415 V AC, 50 Hz 440 V AC, 50/60 Hz	SWB: 47496 SWB: 47497 SWB: 47498 SWB: 47491 SWB: 47502 SWB: 47501 SWB: 47503 SWB: 47493 SWB: 47494 SWB: 47504	500 V AC, 50 Hz 24 V DC 30 V DC 60 V DC 110 V DC 125 V DC 220 V DC	SWB: 47495 SWB: 48273 SWB: 54639 SWB: 47506 SWB: 47507 SWB: 47508 SWB: 47509
Mechanical closing latching (accessory)	 HG11_21-103-afpde.eps	110/115 V AC, 50/60 Hz 120 V AC, 50/60 Hz 125/127 V AC, 50 Hz 220 V AC, 50/60 Hz 230/240 V AC, 50/60 Hz 380 V AC, 50/60 Hz 400/415 V AC, 50 Hz 440 V AC, 50/60 Hz	3TY5 692 -0AG7 3TY5 692 -0AL7 3TY5 692 -0AL7 3TY5 692 -0AN2 3TY5 692 -0AN7 3TY5 692 -0AQ2 3TY5 692 -0AR7 3TY5 692 -0AR7	500 V AC, 50 Hz 24 V DC 30 V DC 60 V DC 110 V DC 125 V DC 220 V DC	3TY5 692 -0AU7 3TY5 692 -0BB4 3TY5 692 -0BC4 3TY5 692 -0BE4 3TY5 692 -0BF4 3TY5 692 -0BG4 3TY5 692 -0BM4
Mechanical closing lock-out (accessory)	 HG11_21-104-afpde.eps	-	3TY5 693 -0AA0		
Blocking element (accessory for mechanical interlocking of two 3TL6 contactors up to 7.2 kV)	 HG11_21-105-afpde.eps	-	3TX5 111 -0AA0		
Rectifier module with varistor (accessory)	 HG11_21-106-afpde.eps	-	3AX15 25 -1F		
Varistor module (accessory)		-	3AX15 26 -0F		
Rectifier		-	3TY5 694 -2AA0		

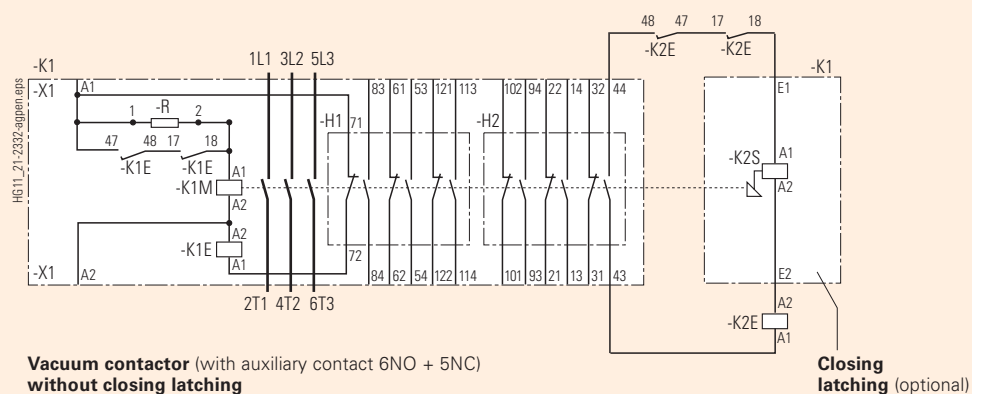
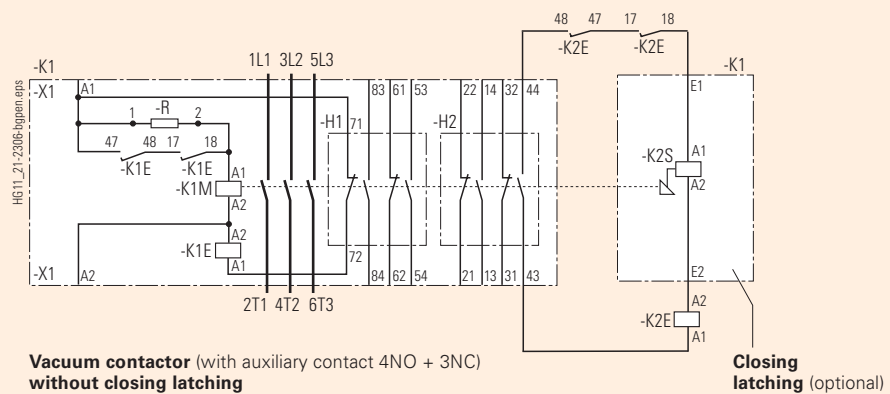
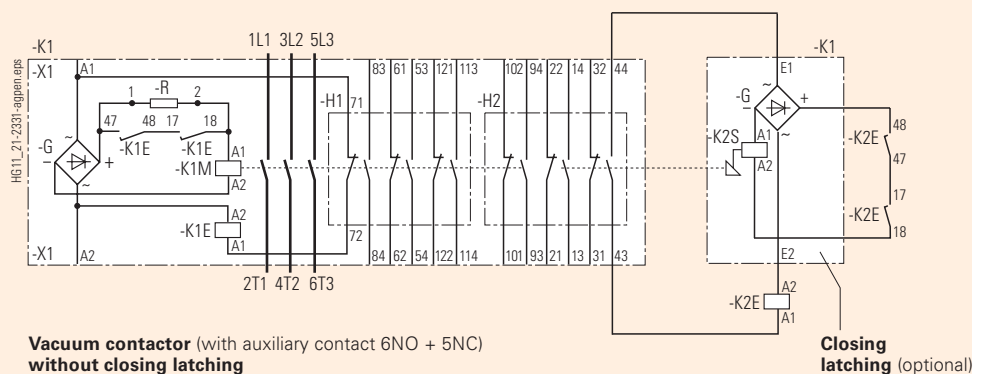
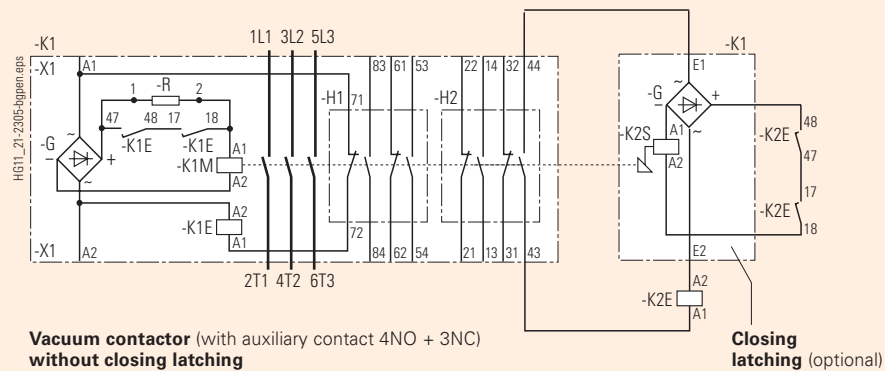
Internal connection diagrams

AC operation

- Voltage range
110 V to 500 V AC
50/60 Hz
- Opening delay
– ≤ 40 ms
– approximately 50 ms
– 250 ± 70 ms
- Rectifier
- Resistor for economy circuit
- Auxiliary contact block
– 4 NO + 3 NC or
– 6 NO + 5 NC
- Optional: rectifier module
- Optional: with mechanical closing latching

DC operating

- Voltage range
24 V to 220 V DC
- Operating delay
– ≤ 40 ms
– approximately 50 ms
– 250 ± 70 ms
- Resistor for economy circuit
- Auxiliary contact block
– 4 NO + 3 NC or
– 6 NO + 5 NC
- Optional: with mechanical closing latching
- Optional: ≥ 60V DC with varistor module



Legend

-G	Rectifier module	-K1M	Solenoid-operated mechanism for vacuum contactor
-H1	Right-hand auxiliary contact block	-K2E	External contactor relay
-H2	Left-hand auxiliary contact block	-K2S	Unlatching solenoid (optional)
-K1	Vacuum contactor	-R	Economy resistor
-K1E	Contacting relay for economy circuit	-X1	Terminal block for auxiliary conductor connection

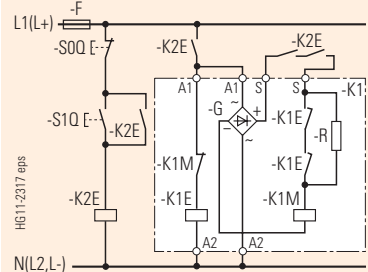
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Circuit diagrams (examples)

AC operation

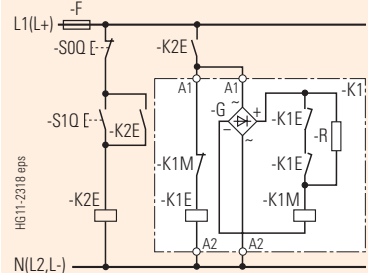
- Without mechanical closing latching
- Opening delay
– ≤ 40 ms
– approximately 50 ms
– 250 ± 70 ms
- Rectifier
- Resistor for economy circuit

Momentary-contact control



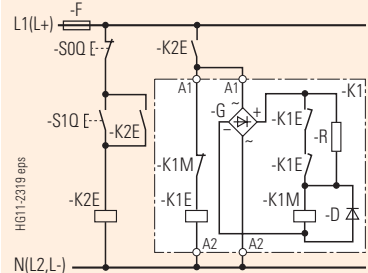
Without time-delay relay for minimum motor starting time; opening delay ≤ 40 ms

Fig. 1



Without time-delay relay for minimum motor starting time; opening delay approx. 50 ms

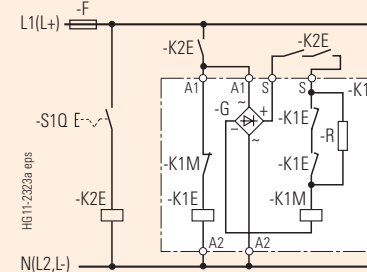
Fig. 2



Without time-delay relay for minimum motor starting time; opening delay 250 ± 70 ms

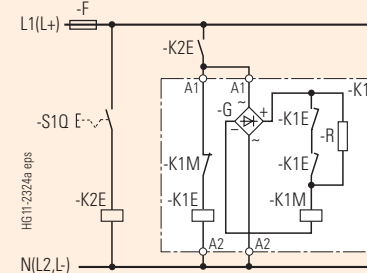
Fig. 3

Maintained-contact control



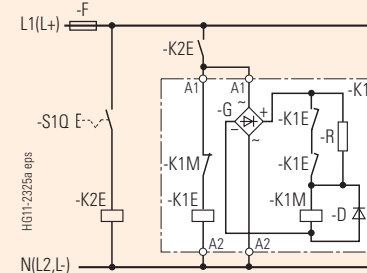
Without time-delay relay for minimum motor starting time; opening delay ≤ 40 ms

Fig. 4



Without time-delay relay for minimum motor starting time; opening delay approx. 50 ms

Fig. 5

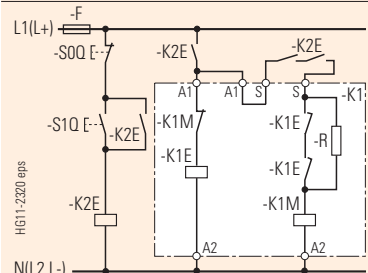


Without time-delay relay for minimum motor starting time; opening delay 250 ± 70 ms

Fig. 6

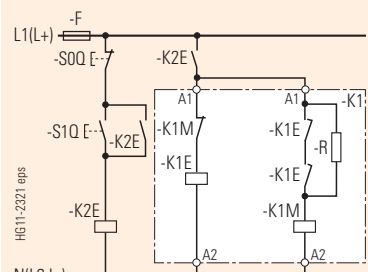
DC operation

- Without mechanical closing latching
- Opening delay
– ≤ 40 ms
– approximately 50 ms
– 250 ± 70 ms
- Optional: $\geq 60V$ DC with varistor module
- Resistor for economy circuit



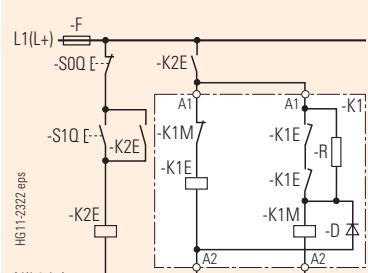
Without time-delay relay for minimum motor starting time; opening delay ≤ 40 ms

Fig. 7



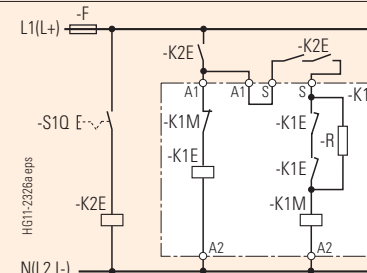
Without time-delay relay for minimum motor starting time; opening delay approx. 50 ms

Fig. 8



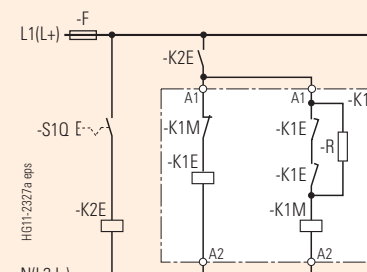
Without time-delay relay for minimum motor starting time; opening delay 250 ± 70 ms

Fig. 9



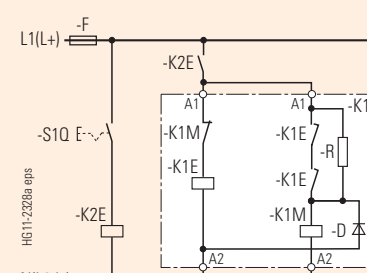
Without time-delay relay for minimum motor starting time; opening delay ≤ 40 ms

Fig. 10



Without time-delay relay for minimum motor starting time; opening delay approx. 50 ms

Fig. 11



Without time-delay relay for minimum motor starting time; opening delay 250 ± 70 ms

Fig. 12

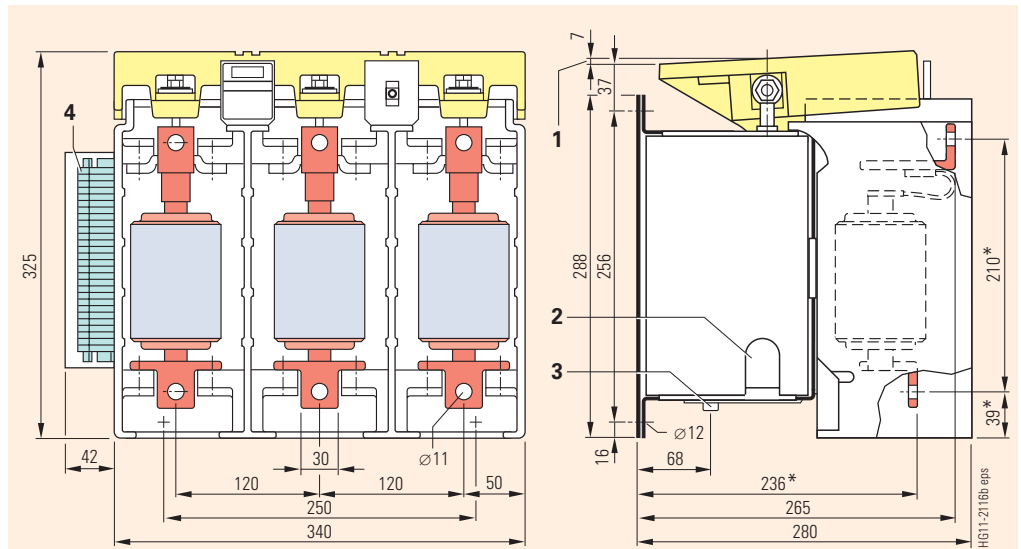
Legend

- F Fuse
- K1 Vacuum contactor
- K2E External contactor relay
- K1E Internal contactor relay
- K1M Solenoid-operated mechanism
- R Economy resistor
- G Rectifier
- D Free-wheeling diode
- S0Q External "OPEN" pushbutton
- S1Q External "CLOSED" pushbutton

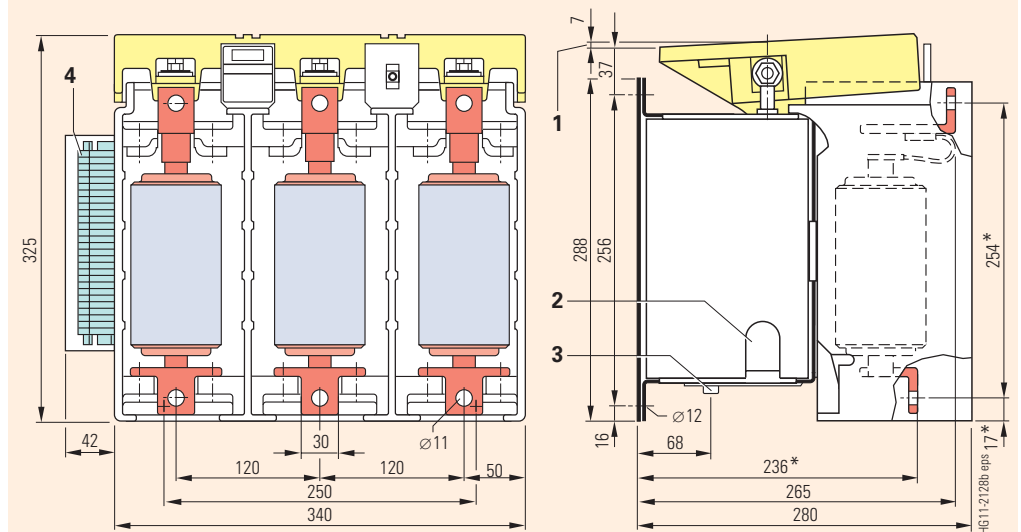
Dimensions and weights

Weights

Rated voltage kV	Vacuum contactor type	Weight approx. kg
7.2	3TL61	28
12	3TL65	30



3TL61 Vacuum contactor



3TL65 Vacuum contactor

*) Fixing dimensions

Legend

- 1 Travel of the integral rocker during switching operation for external interlock and position indicator; max. permissible counterforce 10 N.
- 2 Opening for insertion of auxiliary wires into central terminal block.
- 3 Mechanical unlatching, bolt with internal thread M5 x 10.
- 4 Terminal block withdrawn.

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Shipping

Packaging

The 3TL61 and 3TL65 vacuum contactors are packed in accordance with the customer's order specifications and shipped anywhere in the world in the mode determined by the customer.

If the customer has not specified the manner of packaging and mode of shipping, the most economic option is chosen depending on the size of the lot ordered.

Package type	Destination			
	Germany	Europe	Overseas	Overseas / Europe
	Shipping by means of truck / rail	Shipping by means of truck / rail	Shipping by means of sea freight	Shipping by means of air freight
Individual package	x / -	x / -	x	x
Lot-size package	- / x	- / x	x	x
Cardboard box with inner box to suit unit	x / x	x / x	-	x
Cardboard box with sealed packaging and inner box to suit unit	- / -	x / x	x	x
Skeleton container with cardboard boxes and inner box to suit unit	- / x	- / -	-	-
Plywood box + cardboard boxes with sealed packaging and inner box to suit unit	- / -	x / x	x	x

x = Preferred package type

Shipping dimensions and weights

Shipping by truck or rail

Package type	for no. of vacuum contactors	Length / Width / Height mm / mm / mm	Volume m ³	Gross weight kg
Cardboard box with inner box to suit unit	1	500 / 400 / 400	0.08	32
	2	840 / 570 / 640	0.3	87
	3 - 4	920 / 820 / 930	0.7	137 - 170
	5 - 8	1120 / 820 / 950	0.87	197 - 293
Cardboard box with sealed packaging and inner box to suit unit	1 - 2	840 / 570 / 640	0.3	92
	3 - 4	920 / 820 / 930	0.7	142 - 175
	5 - 8	1120 / 820 / 950	0.87	202 - 298
Skeleton container with cardboard boxes and inner box to suit unit	3 - 8	1200 / 800 / 800	0.77	176 - 333
Plywood box + cardboard boxes with sealed packaging and inner box to suit unit	1 - 2	920 / 620 / 670	0.38	59 - 91
	3 - 4	920 / 820 / 930	0.7	141 - 173
	5 - 8	1120 / 860 / 960	1.0	205 - 305

Shipping by sea freight

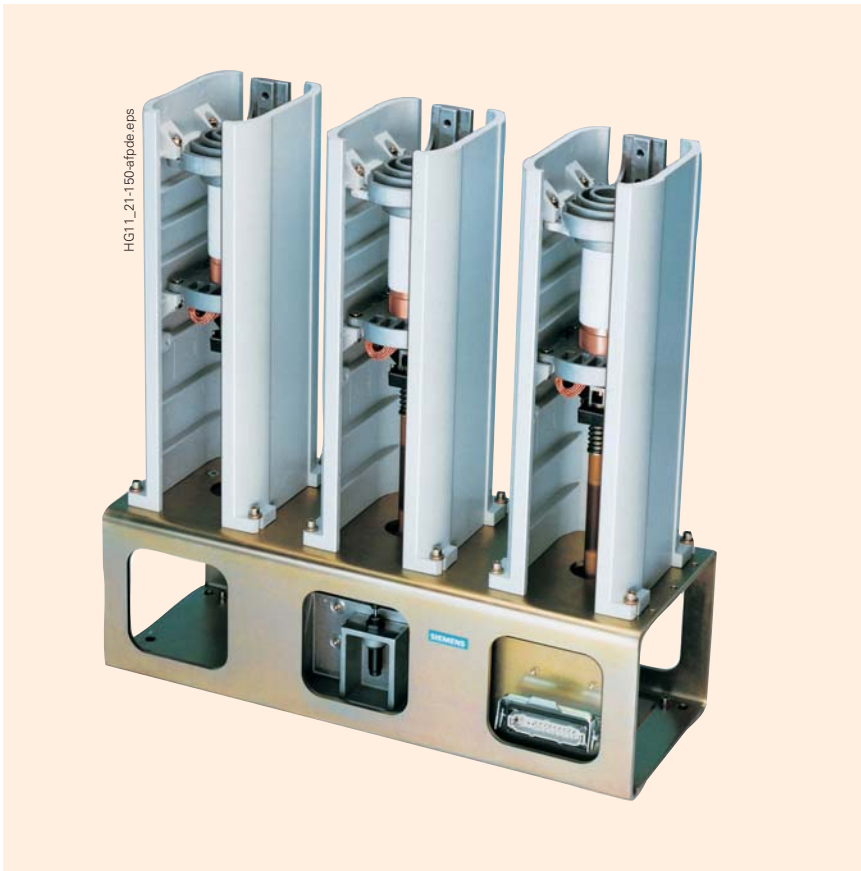
Package type	for no. of vacuum contactors	Length / Width / Height mm / mm / mm	Volume m ³	Gross weight kg
Cardboard box with inner box to suit unit	-	-	-	-
Cardboard box with sealed packaging and inner box to suit unit	1 - 2	840 / 570 / 640	0.3	92
	3 - 4	920 / 820 / 930	0.7	142 - 175
	5 - 8	1120 / 820 / 950	0.87	202 - 298
Skeleton container with cardboard boxes and inner box to suit unit	-	-	-	-
Plywood box + cardboard boxes with sealed packaging and inner box to suit unit	1 - 2	920 / 620 / 670	0.38	59 - 91
	3 - 4	920 / 820 / 930	0.7	141 - 173
	5 - 8	1120 / 860 / 960	1.0	205 - 305

Shipping by air freight

Package type	for no. of vacuum contactors	Length / Width / Height mm / mm / mm	Volume m ³	Gross weight kg
Cardboard box with inner box to suit unit	1	500 / 400 / 400	0.08	32
	2	840 / 570 / 640	0.3	87
	3 - 4	920 / 820 / 930	0.7	137 - 170
	5 - 8	1120 / 820 / 950	0.87	197 - 293
Cardboard box with sealed packaging and inner box to suit unit	1 - 2	840 / 570 / 640	0.3	92
	3 - 4	920 / 820 / 930	0.7	142 - 175
	5 - 8	1120 / 820 / 950	0.87	202 - 298
Skeleton container with cardboard boxes and inner box to suit unit	-	-	-	-
Plywood box + cardboard boxes with sealed packaging and inner box to suit unit	1 - 2	920 / 620 / 670	0.38	59 - 91
	3 - 4	920 / 820 / 930	0.7	141 - 173
	5 - 8	1120 / 860 / 960	1.0	205 - 305

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Application

3TL71 vacuum contactors are 3-pole contactors with electromagnetically operated mechanism for medium-voltage switchgear.

They are load-break switchgear with a limited short-circuit making and short-circuit breaking capacity and are used for high switching frequencies (> 10,000 operating cycles).

The vacuum contactors are suitable for operational switching of AC loads in indoor switchgear.

Applications for switching of, e.g.

- Filter circuits
- Motors
- Reactors
- Ohmic loads
- Reactive-power compensation systems
- Transformers and capacitors

Application examples

- Conveyor and lift systems, pump stations
- Secondary distribution switchgear, industrial network distribution systems
- DC link reactors, stators
- Heating resistors
- Capacitor banks

Features

- High number of operating cycles thanks to their proven vacuum switchgear technology
- Unrestricted ON duration
- Maintenance-free through to the end of the vacuum interrupters' service life
- Universal application for many switching duties, particularly for capacitors
- Can be mounted on different switchgear racks in almost all mounting positions
- Rated voltage up to 24 kV
- Mechanical service life of the contactor up to 1 mill. operating cycles
- High reliability and availability
- Compact, rugged design

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Construction and mode of operation

Construction

The 3TL71 vacuum contactor has slimline pole shells positioned above the operating mechanism. The vacuum interrupters are secured between two pole half-shells.

This type of construction means that the unit can be mounted easily and universally on the various frames.

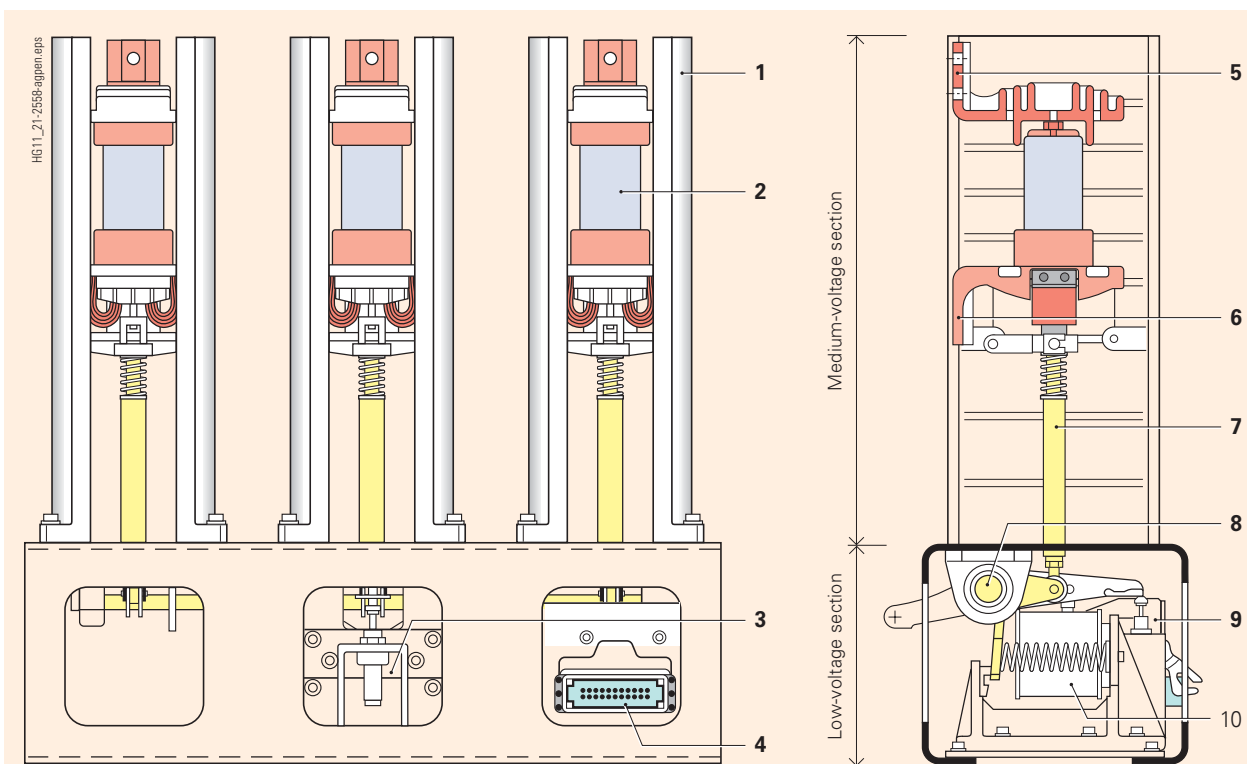
The low-voltage section contains the electromagnetically-operated mechanism, contactor relay and auxiliary contacts. A mechanical latch can be installed as an expansion module.

Mode of operation

The electromagnetically-operated mechanism of the 3TL71 vacuum contactor opens and closes the contacts of the vacuum interrupters. Thanks to the use of a special double coil, the electromagnetically operated mechanism is designed for closing and holding operation.

Mechanical latch between the withdrawable module and the vacuum contactor:

A link is attached to the operating shaft used to transmit signaling commands, in order to create a mechanical latching mechanism between the withdrawable switchgear module and the vacuum contactor.



Structure of the 3TL71 vacuum contactor (front view)

Side view from left (sectional view)

Legend

- 1 Pole
- 2 Vacuum interrupter
- 3 Operating part
- 4 Auxiliary plug
- 5 Top main conductor terminals
- 6 Bottom main conductor terminals
- 7 Mechanical connection between medium and low-voltage section
- 8 Operating shaft
- 9 Auxiliary contact block
- 10 Magnetic system (solenoid)

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Technical data

Medium-voltage section

Rated voltage U_f	24 kV
Rated frequency	50 to 60 Hz
Rated continuous current I_{th} according to DIN EN 60470, IEC 60470	800 A
Rated operational current I_e according to utilization categories AC-1, AC-2, AC-3 and AC-4 At ambient temperatures up to + 55 °C	800 A
Switching capacity according to utilization category AC-4 (p.f.= 0.15)	
Rated making current	4500 A
Rated breaking current	3600 A
Max. permissible switching capacity	7 kA
Rated short-time withstand current 1 s (r.m.s. value); (for short-time current for longer periods, see short-time current load-period characteristic)	8 kA
Switching of capacitors Rated capacitor current	200 A
Switching frequency (AC and DC operation) without mechanical closing latching	60 operating cycles/h
Mechanical service life of the contactor	1 mill. operating cycles
Mechanical service life of the vacuum interrupter	1 mill. operating cycles
Electrical service life of the vacuum interrupter at rated operational current	0.5 mill. operating cycles
Dielectric strength	
Rated lightning impulse withstand voltage (according to DIN EN 60694, IEC 60694): To earthed parts and between poles Across the open contact gap	95 kV 75 kV
Rated power-frequency withstand voltage 50 Hz (r.m.s.) To earthed parts and between poles Across the open contact gap	50 kV 50 kV
Cross-sections of the main conductor terminals	
Terminal screw	M12
Stranded conductors with cable lug	50 to 240 mm ²
Copper rail to DIN 43671	60 x 8 mm

Low-voltage section

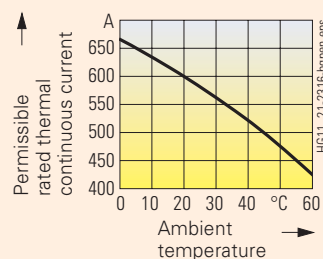
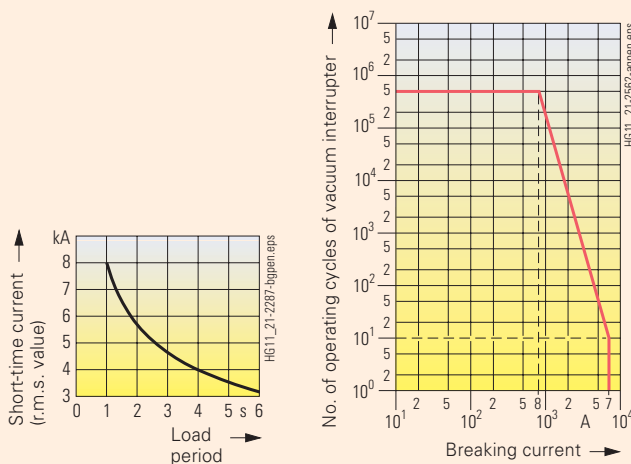
Power consumption of the solenoid (AC/DC operation)	
Pickup power	1.2 kW
Holding power	200 W
Voltage range of the solenoid Operating voltage (AC and DC operation)	0.85 to 1.1 U_a
Minimum closing command for the solenoid	300 ms
Make time (AC and DC operation)	50 to 100 ms
Break time	≤ 100 ms

Auxiliary contacts

Number of auxiliary contacts	4 NO + 4 NC 6 NO + 6 NC 8 NO + 8 NC
Rated operational current I_e	
Utilization category for AC-11 at rated voltage	24 V AC, 10 A 48 V AC, 10 A 60 V AC, 9 A 110 V AC, 5 A 220 V AC, 2.5 A
Utilization category for DC-11 at rated voltage	24 V DC, 10 A 48 V DC, 9 A 60 V DC, 7 A 110 V DC, 4 A 220 V DC, 2 A
Cross-sections of the auxiliary contacts according to DIN EN 60947 Part 1 (screw terminal, two-wire connection possible)	
Solid	0.6 to 4 mm ²
Finely stranded with end sleeve	0.5 to 2.5 mm ²

Ambient conditions

Ambient temperature	
Storage at - 40 to + 65 °C	20 years
Operation at - 5 to + 65 °C at + 5 to - 25 °C	1 mill. operating cycles 0.5 mill. operating cycles
Site altitude	50 m below sea level to 1250 m above sea level
Degree of protection according to DIN EN 60529 and IEC 60529	IP00



as Special Vacuum Contactors

Selection and ordering data






Rated voltage U_r	Rated lightning impulse withstand voltage to earth	Rated lightning impulse withstand voltage across open contact gap	Rated power-frequency withstand voltage	Rated operational current I_e	Order No	Order code
kV	kV	kV	kV	A		
24	95	75	50	800	3TL71 2 □ - 0 □ □ □ □ - □ □	
Rated voltage 24 kV					↑	
Rated operational current 800 A					↑	
Auxiliary contacts						
4 NO + 4 NC					5	
6 NO + 6 NC					6	
8 NO + 8 NC					8	
Type of operation						
AC operation					A	
DC operation					B	
Operating voltage for solenoid¹⁾						
110 V AC, 50 Hz					G	0
230 V AC, 50 Hz					L	2
110 V DC					F	4
120/125 V DC					G	4
220 V DC					M	4
Operating instructions						
German / English						0
Design / Version						
Standard						0
With insulating board						1
Site altitude²⁾						
0 to 1250 m above sea level						A

1) Other voltages on request.

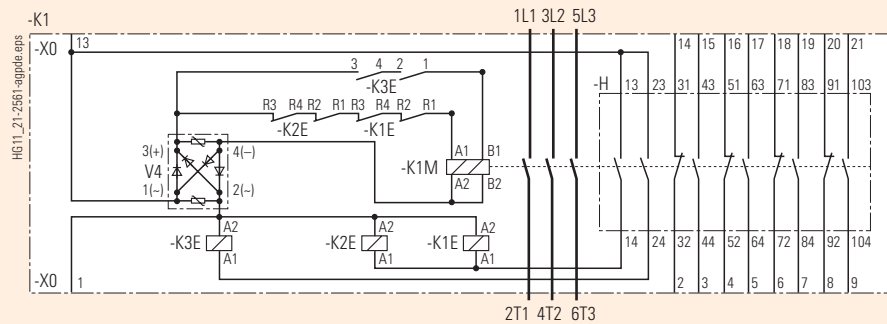
2) Note!
Reduction of insulation capacity (!)
Other site altitudes on request.

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Spare parts and accessories

	Scope of delivery	Operating voltage or contacts	Order No.
Auxiliary contact block	 HG11_21-098-afpde.eps	5 NC/5 NO	3SV9911 - 2AA0
Solenoid	 HG11_21-108-afpde.eps	110 V AC, 50/60 Hz 230/240 V AC, 50/60 Hz 110 V DC 120/125 V DC 220 V DC	3TY5741 - 0AG2 3TY5741 - 0AL2 3TY5741 - 0BF4 3TY5741 - 0BG4 3TY5741 - 0BM4
Rectifier module	 HG11_21-106-afpde.eps	-	3AX1526 -1F

Internal connection diagram



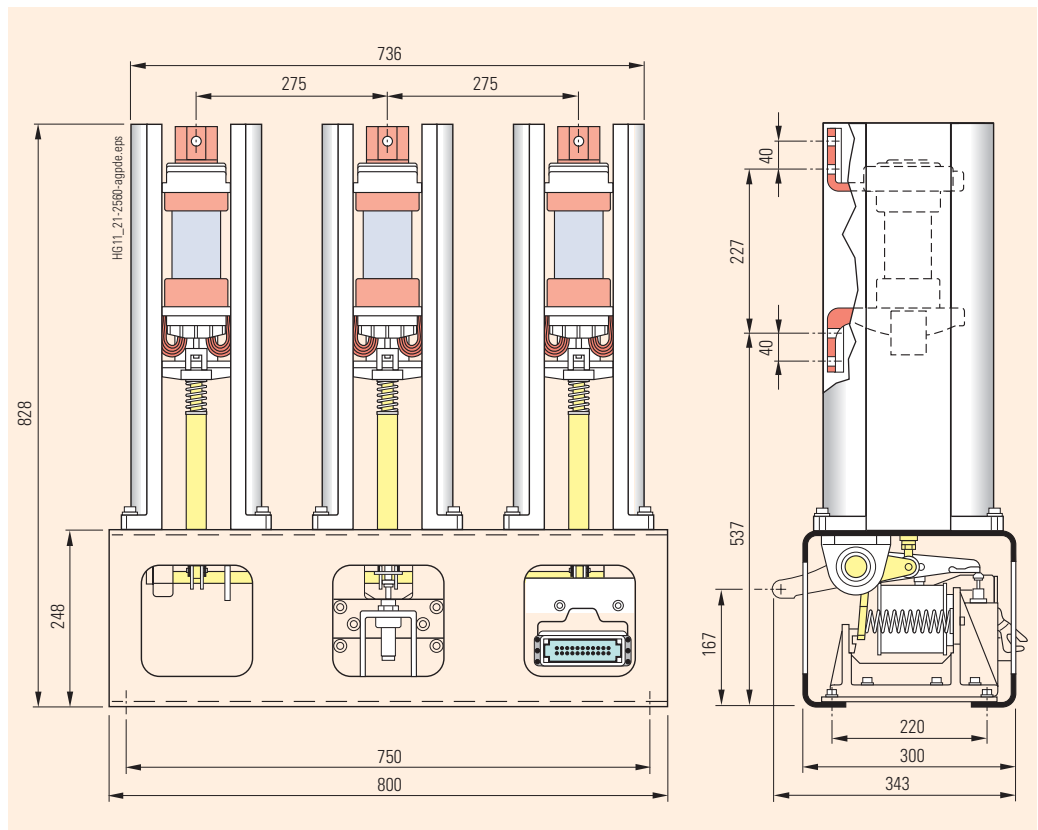
Legend

- H Auxiliary switch
- K1 Vacuum contactor
- K1E, K2E Contactor relay for pick-up coil
- K3E Contactor relay for closing coil
- K1M Solenoid-operated mechanism for vacuum contactor
- V4 Rectifier module
- X0 Plug for auxiliary conductor connection

as Special Vacuum Contactors

Dimensions and weights

Weight 80 kg



Shipping

Packaging

The 3TL71 vacuum contactors are packed in accordance with the customer's order specifications and shipped anywhere in the world in the mode determined by the customer.

If the customer has not specified the manner of packaging and mode of shipping, the most economic option is chosen depending on the size of the lot ordered.

Package type	Destination			
	Germany Shipping by means of truck / rail	Europe Shipping by means of truck / rail	Overseas Shipping by means of sea freight	Overseas/Europe Shipping by means of air freight
Individual package	x / -	x / -	x	x
Lot-size package	- / x	- / x	x	x
Cardboard box with inner box to suit unit	x / x	x / x	-	x
Cardboard box with sealed packaging and inner box to suit unit	- / -	x / x	x	x
Skeleton container with cardboard boxes and inner box to suit unit	- / x	- / -	-	-
Plywood box + cardboard boxes with sealed packaging and inner box to suit unit	- / -	x / x	x	x

x = Preferred package type

Shipping dimensions and weights on request

Notes

If not stated otherwise on the individual pages on this catalog, we reserve the right to include modifications, especially regarding dimensions and weights.

Drawings are not binding.

All product designations used are trademarks or product names of Siemens AG or other suppliers.

If not stated otherwise, all dimensions in this catalog are given in mm.

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Published by
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Power Transmission and Distribution
Medium Voltage Division
Postfach 32 20
91050 Erlangen
Germany