

Solid state relays

Technical data

Standard Series (R111, R115, R112)

Output data	Unit	R111/25 R115/25	R111/45 R115/45	R111/20 R115/20	R111/40 R115/40	R111/90 R115/90	R112/50	R112/90	R112/110
Control element	Thyristor	yes	yes	yes	yes	yes	yes	yes	yes
Operating voltage range U_e (Veff max)	VAC	24-280	24-280	42-530	42-530	42-530	24-690	24-690	24-690
period. peak off-state voltage (Vpeak)	V ss	650	650	1200	1200	1200	1600	1600	1600
Rated load current, AC1 (resistive)	A_{eff}	25	50	25	50	90	50	90	110
AC3 (inductive)	A_{eff}	5	15	5	15	20	15	20	30
Operating frequency	Hz	45-65	45-65	45-65	45-65	45-65	45-65	45-65	45-65
Max. off-state leakage current (at Vmax and T=25°C)	mA	3	3	3	3	3	2	2	5
Minimal load current	mA eff	20	20	20	20	20	20	20	20
Max. surge current I_{TSM} (t=20ms)	A	250	600	250	600	1000	400	1000	1500
Max. load integral $\int i^2 dt$ (t=10 ms)	A²s	310	1800	350	1800	5000	800	5000	11250
Conducting state voltage at I max and T=25°C (Vpeak)	V	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Permissible rate of voltage rise du/dt	V/μs	500	500	500	500	500	500	500	500
Critical current gradient di/dt	A/s	100	100	100	100	100	100	100	100
Max. thermal resistance barrier/case	K/W	1.25	0.65	1.25	0.65	0.3	0.65	0.35	0.3
Max. thermal resistance barrier/ambient	K/W	12	12	12	12	12	12	12	12
Input data		R111		R115			R112		
Control voltage	V	3-32VDC		90-280VAC/DC			4.5-32VDC		
Make voltage, max.	V	3VDC		90VAC/DC			4.5VDC		
Break voltage, min.	V	1VDC		10VAC/DC			1VDC		
Input impedance	kΩ	1.5		44			-		
Input current max. (at Vmax)	mA	-		-			40		
Turn-on time	ms	0.5 period max.		1 period max.			0.5 period max.		
Turn-off time	ms	0.5 period max.		1 period max.			0.5 period max.		

Compact Series (R120, R121, R122, R126, R311, R315)

Output data	Dim.	R120/25	50	R121/25 R126/25	50	75	100	R122/50	75	100	R311/25 R315/-	/55 /55
Control element	Thyristor	yes	yes	yes	yes	yes	yes	yes	yes	yes	Alternistor	
Operating voltage range V_e (Veff max)	VAC	24-265		42-530				42-660			12-530	
Period. peak off-state voltage (Vpeak)	V ss	650		1200				1600			1200	
Rated load current, AC1 (resistive)	A_{eff}	25	50	25	50	75	100	50	75	100	25	55
AC3 (inductive)	A_{eff}	5	15	5	15	20	30	15	20	30	5	15
Operating frequency	Hz	45-65		45-65				45-65			45-65	
Max. off-state leakage current (at Vmax and T=25°C)	mA	3	3	3	3	3	3	3	3	3	10	10
Minimal load current	mA eff	150	150	150	150	150	150	150	150	150	100	200
Max. surge current I_{TSM} (t=10ms)	A	250	600	250	600	1000	1500	600	1000	1500	-	-
Max. surge current I_{TSM} (t=20ms)	A	-	-	-	-	-	-	-	-	-	230	550
Max. overcurrent (t=1s)	A	55	125	55	125	150	200	125	150	200	37	85
Max. load integral $\int i^2 dt$ (t=10 ms)	A²s	310	1800	310	1800	6600	18000	1800	6600	18000	265	1500
Conducting state voltage at I max and T=25°C (Vpeak)	V	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Permissible rate of voltage rise du/dt	V/μs	500	500	500	500	500	500	500	500	500	500	500
Critical current gradient di/dt	A/s	100	100	100	100	100	100	100	100	100	50	100
Max. thermal resistance barrier/case	K/W	0.8	0.5	0.8	0.5	0.2	0.2	0.5	0.2	0.2	0.5	0.2
Max. thermal resistance barrier/ambient	K/W	20	20	20	20	20	15	20	20	15	1.5	0.6
Input data		R120/R121/R122/R126						R311		R315		
Control voltage	V	4-32VDC						10-40VDC		20-265VAC/DC		
Make voltage, max.	V	3.75VDC						10VDC		20VAC/DC		
Break voltage, min.	V	1VDC						3VDC		5VAC/DC		
Input impedance	kΩ	1.5						-		-		
Input current max.. (at Vmax)	mA	10						18mA (at 10VDC) 28mA (at 40VDC)		20mA AC/DC		
Turn-on time	ms	0.5 period max.						0.5 period max.		0.5 period max.		
Turn-off time	ms	0.5 period max.						0.5 period max.		2 period max.		

General characteristics of the solid state relay in standard and compact version

Power factor (cos Phi)		0.5-1 ¹⁾	
Operating temperature	°C	R111, R115: -40 to +100 R112, R311: -20 to + 80 R12x: -20 to + 70	
Storage temperature	°C	-40 to +100	
Proof voltage	V	4000	
Dielectric strength	V	4000	

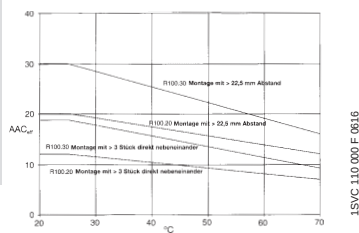
¹⁾ If the threshold values are complied with, the solid state relays are suitable for the switching of inductive loads.

Solid state relays

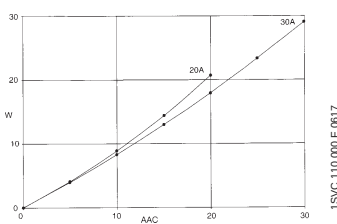
Technical data R 100.xx

	Dim.	R100.20	R100.30 Mom./zero point tripping	R100.45
General technical data				
Switching element		Thyristors	Thyristors	Thyristors
Rated operating voltage U_e (Veff max)	VAC	42-660	42-660	42-660
Period. peak inverse voltage (Vpeak)	Vss	1200	1200	1200
Operating frequency	Hz	45-65	45-65	45-65
Power factor at 600VAC		< 0.5	< 0.5	< 0.5
Approvals		UL, CSA	UL, CSA	UL, CSA
CE marking		yes	yes	yes
Technical Data - Load circuit				
Rated load current				
AC51 at Ta = 25°C	AAC	20	30	45
AC53a at Ta = 25°C	AAC	5	15	20
(see Current Carrying Capacity diagram)				
Minimum load current	mA	350	150	150
Surge current limit value I_{TSM} (25°C, t = 10ms)	A	250	400	1150
Max. overcurrent (t = 1s)	A	< 35	< 125	125
Off-state leakage current				
(at rated voltage and frequency)	mA _{eff}	<3	<3	<3
Limit load integral i^2dt (t=10 ms)	A ² s	310	1800	6600
Forward voltage at I max and T=25°C (Vpeak)	V	1.6	1.6	1.6
Critical current gradient di/dt	A/μs	>=10	>=100	>=150
Critical commutating voltage gradient du/dt	V/μs	500	500	500
Critical static voltage gradient du/dt	V/μs	250	250	500
Thermal Data				
Operating temperature	°C	-30 to +80	-30 to +80	-30 to +80
Storage temperature	°C	-40 to +100	-40 to +100	-40 to +100
Barrier temperature	°C	125	125	125
General characteristics				
Weight	g/lb	250/0.55	250/0.55	490/1.08
Max. connection cross-section				
Input terminals	mm ² / AWG	2x2.5 or 1x4 / 2x14 or 1x	2x2.5 or 1x4 / 2x14 or 1x	2x2.5 or 1x4 / 2x14 or 1x
Output terminals	mm ² / AWG	2x2.5 or 1x4 / 2x14 or 1x	2x2.5 or 1x4	25
Proof voltage	V		4000	
Material Enclosure			self-extinguishing (UL 94 V0)	
Heat sink			Aluminum	

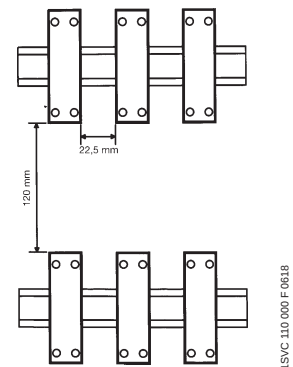
Load current at ambient temperature
R 100.20 / R 100.30



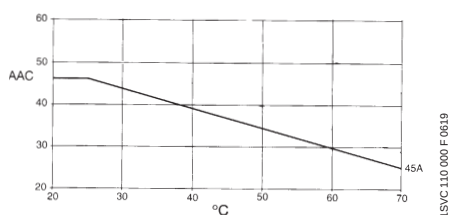
Dissipation at load current
R 100.20 / R 100.30



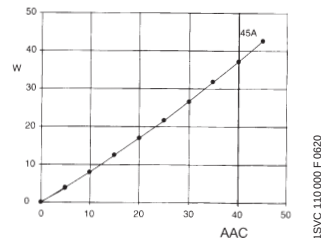
DIN-rail mounting



Load current at ambient temperature
R 100.45



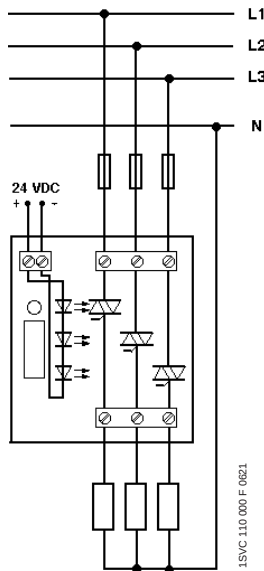
Dissipation at load current
R 100.45



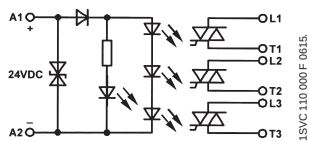
Three-phase solid-state relay HDS R2

Technical data, dimensional drawings

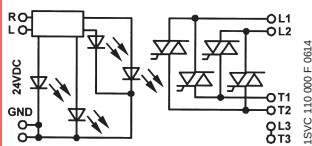
Connection diagram HDS



Circuit diagram HDS

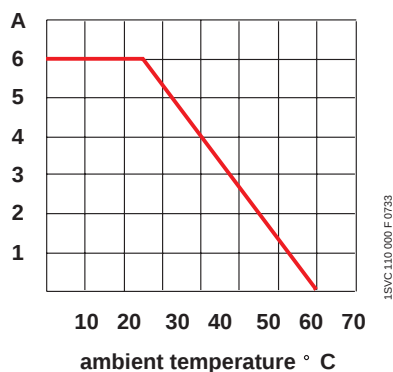


Circuit diagram HDWS



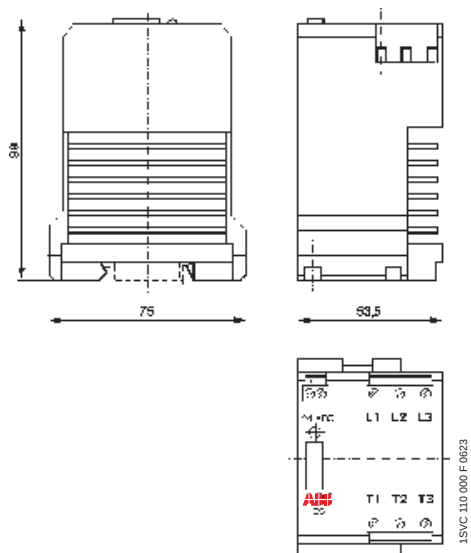
Type	HDS R2	HDWS R2
Ordering number	GHR 302 0004 R0004	GHR 302 1004 R0001
Control-side		
Rated voltage V_N	DC24V	DC24V
Rated voltage range	17 - 30VDC	17 - 30VDC
Rated current (at V_N)	25mA	25mA per channel
Make voltage	> 17V	> 17V
Break voltage	< 8V	< 8V
Status display	Yellow LED	2 yellow LED's
Protective circuitry	Suppressor diode	Varistor/ Reverse polarity protection diode
Rated insulation voltage (prEN50178)	50V Pollution degree 2 Overvoltage category I	50V Pollution degree 2 Overvoltage category I
Load-side		
Switch type	n/o	c/o
Switching voltage, min./max.	min. AC24V (24-460)	min. AC24V (24-460)
Switching current, min./max.	min. 10mA max. 3.4A (at 45°C)	min. 10mA max. 3.4A (at 45°C)
Switching capacity	max. 1500W	max. 1500W
Leakage current at off state output (at V_N)	< 1.7mA per channel	< 1.7mA per channel
Holding current	min. 10mA	min. 10mA
Surge current limit value (10 ms)	AC120A	AC120A
Protective circuitry	VDR	VDR / RC
Switching frequency	10/sec. (resistive load) 5/sec. (inductive load)	5/sec. (resistive load) 1/sec. (inductive load)
Make time	ca. 5.5 ms	ca. 115 ms
Break time	max. 10 ms (1 half wave)	max. 10 ms (1 half wave)
Rated insulation voltage (prEN50178)	500V Pollution degree 2 Overvoltage category I	500V Pollution degree 2 Overvoltage category I

Deratingcurve



Dimensional drawings

Dimensions in mm



Solid-state relays

Solid state relays

Technical data

Dimentioning/sizing of solid state relays and heat sinks

When choosing the suitable heat sinks and determining the dissipation or heating of the devices, answer the following questions:

- 1.) Max. load current?
- 2.) Control voltage?
- 3.) Load voltage?
- 4.) Ambient temperature while operating?
- 5.) Continous duty, clocking?

Example: ■ 30A load current, control voltage of 230VAC, load voltage of 400VAC, 40°C ambient temperature in the panel, continous duty
■ Possible relays: R 115/40, R 115/90, R 126/50, R 126/75, R 126/100
■ R 126/50 chosen

With the maximum load current, the control and load voltage, you can choose the suitable relay. With a load current of 30A, choose a relay with at least 50A rated current. Once you have this value, refer to the diagram of the selected relay (R 126/50).

- The Y axis of the diagram shows the load current in A.

- The X axis shows the ambient temperature in °C.

Follow the curve to the peak of the current (e.g. 30A) to the right up to the intersection point with the ambient temperature (40°C). The right angle in the intersection point comprises the value of the minimum required heat sink. For R 126/50 = 1.65K/W (Kelvin/Watt).

The required heat sink must have at least 1.65 K/W. The lower this number is, the better the heat sink is, i.e. 0.5K/W is better than 1.5K/W.

The corresponding heat sink can now be chosen from the ordering table at page 158. The dissipation of the solid state relay can be read in the right column of the diagram, in our example = 33W.

The choice of the heat sinks affects directly the heating of the device.

Device temperature T = ambient temperature + (dissipation * heat sink value).

The calculated device temperature must not exceed 100°C. There is a danger of fire as well as damage to the device.

Example 1: Heat sink KK-R111-2,1

T = 40°C + (33W + 2.1K/W) = 40°C + 69.3°C = 109.3°C **Too hot!**

Example 2: Heat sink KK-R111-1,5

T = 40°C + (33W + 1.5K/W) = 40°C + 49.5°C = 89.5°C **OK!**

Example 3: Heat sink KK-R111-0,5

T = 40°C + (33W + 0.5K/W) = 40°C + 16.5°C = 56.5°C **OK!**

Example 2 is the best selection because of space and cost.

The calculated values apply for continous duty; during cycling the heating is lower depending on the duty cycle.

Load current related to the ambient temperature, heat sink sizing

Standard Version

load current (A)	thermal resistance (K/W)					power dissipation (W)
25	2	1,7	1,4	1	0,71	0,40
22,5	2,5	2,1	1,8	1,4	1	0,66
20	3,1	2,7	2,3	1,9	1,4	1
17,5	4,0	3,5	3	2,5	2	1,4
15	4,9	4,3	3,7	3,1	2,5	1,9
12,5	6,2	5,4	4,6	3,9	3,1	2,3
10	8,1	7,1	6,1	5,1	4	3
7,5	11,3	9,9	8,5	7,1	5,6	4,2
5	-	15,6	13,3	11,1	8,9	6,7
2,5	-	-	-	-	18,7	14
	20	30	40	50	60	70

15VC 110 000 F 0744

R111/25, R115/25,
R111/20, R115/20

load current (A)	thermal resistance (K/W)					power dissipation (W)
50	0,92	0,76	0,60	0,45	0,29	-
45	1,2	0,99	0,80	0,62	0,44	0,26
40	1,5	1,3	1,1	0,85	0,63	0,42
35	1,9	1,6	1,4	1,1	0,89	0,63
30	2,4	2,1	1,8	1,5	1,2	0,91
25	3	2,7	2,3	1,9	1,5	1,1
20	3,9	3,5	3	2,5	2	1,5
15	5,5	4,8	4,1	3,4	2,7	2,1
10	8,6	7,5	6,4	5,4	4,3	3,2
5	17,9	15,6	13,4	11,2	8,9	6,7
	20	30	40	50	60	70

15VC 110 000 F 0745

R111/45, R115/45,
R111/40, R115/40

load current (A)	thermal resistance (K/W)					power dissipation (W)
90	0,63	0,53	0,42	0,32	-	-
80	0,81	0,69	0,57	0,45	0,33	-
70	1	0,89	0,75	0,61	0,47	0,33
60	1,3	1,2	1	0,83	0,66	0,49
50	1,7	1,5	1,3	1,1	0,85	0,64
40	2,2	1,9	1,7	1,4	1,1	0,83
30	3,1	2,7	2,3	1,9	1,5	1,2
20	4,8	4,2	3,6	3	2,4	1,8
10	10	8,8	7,5	6,3	5	3,8
	20	30	40	50	60	70

15VC 110 000 F 0746

R111/90
R115/90

load current (A)	thermal resistance (K/W)					power dissipation (W)
50	0,92	0,76	0,60	0,45	0,29	-
45	1,2	0,99	0,80	0,62	0,44	0,26
40	1,5	1,3	1,1	0,85	0,63	0,42
35	1,9	1,6	1,4	1,1	0,89	0,63
30	2,4	2,1	1,8	1,5	1,2	0,91
25	3	2,7	2,3	1,9	1,5	1,1
20	3,9	3,5	3	2,5	2	1,5
15	5,5	4,8	4,1	3,4	2,7	2,1
10	8,6	7,5	6,4	5,4	4,3	3,2
5	17,9	15,6	13,4	11,2	8,9	6,7
	20	30	40	50	60	70

15VC 110 000 F 0747

R112/50

load current (A)	thermal resistance (K/W)					power dissipation (W)
90	0,63	0,53	0,42	0,32	-	-
80	0,81	0,69	0,57	0,45	0,33	-
70	1	0,89	0,75	0,61	0,47	0,33
60	1,3	1,2	1	0,83	0,66	0,49
50	1,7	1,5	1,3	1,1	0,85	0,64
40	2,2	1,9	1,7	1,4	1,1	0,83
30	3,1	2,7	2,3	1,9	1,5	1,2
20	4,8	4,2	3,6	3	2,4	1,8
10	10	8,8	7,5	6,3	5	3,8
	20	30	40	50	60	70

15VC 110 000 F 0748

R112/90

load current (A)	thermal resistance (K/W)					power dissipation (W)	thermal protection °C
110	0,54	0,45	0,36	0,27	-	-	112
100	0,66	0,55	0,45	0,35	0,25	-	100
90	0,80	0,69	0,57	0,46	0,34	-	87
80	0,98	0,85	0,72	0,59	0,46	-	76
70	1,2	1,1	0,91	0,76	0,60	-	65
60	1,5	1,3	1,1	0,92	0,74	-	54
50	1,8	1,6	1,4	1,1	0,91	-	44
40	2,3	2	1,8	1,5	1,2	-	34
30	3,2	2,8	2,4	2	1,6	-	25
20	4,9	4,3	3,7	3,1	2,5	-	16
10	10,2	8,9	7,6	6,4	5,1	-	8
	20	30	40	50	60		

15VC 110 000 F 0749

R112/110

Solid state relays

Technical data, dimensional drawings

Load current related to the ambient temperature, heat sink sizing

Compact version

load current (A)	thermal resistance (K/W)					power dissipation (W)	
25,0	2,70	2,34	1,98	1,61	1,25	0,89	28
22,5	3,10	2,69	2,28	1,86	1,45	1,04	24
20,0	3,61	3,13	2,65	2,18	1,70	1,23	21
17,5	4,26	3,70	3,14	2,59	2,03	1,47	18
15,0	5,14	4,47	3,80	3,14	2,47	1,80	15
12,5	6,38	5,56	4,73	3,91	3,09	2,27	12
10,0	8,25	7,19	6,14	5,08	4,02	2,97	9
7,5	11,4	9,94	8,49	7,04	5,59	4,14	7
5,0	17,7	15,4	13,2	11,0	8,74	6,51	4
2,5	-	-	-	-	18,2	13,6	2
							T _a
							ambient temperature [°C]

R120/25, R121/25,
R126/25

load current (A)	thermal resistance (K/W)					power dissipation (W)	
50,0	1,03	0,86	0,70	0,53	0,37	0,20	61
45,0	1,27	1,09	0,90	0,71	0,52	0,33	53
40,0	1,54	1,32	1,10	0,89	0,67	0,45	46
35,0	1,85	1,59	1,34	1,08	0,82	0,57	39
30,0	2,26	1,95	1,65	1,34	1,03	0,72	33
25,0	2,85	2,47	2,08	1,70	1,32	0,94	26
20,0	3,73	3,24	2,75	2,26	1,77	1,27	20
15,0	5,22	4,54	3,86	3,19	2,51	1,83	15
10,0	8,21	7,16	6,11	5,05	4,00	2,95	10
5,0	17,2	15,0	12,9	10,7	8,51	6,33	5
							T _a
							ambient temperature [°C]

R120/50, R121/50,
R126/50, R122/50

load current (A)	thermal resistance (K/W)					power dissipation (W)	
75,0	0,91	0,78	0,65	0,52	0,39	0,26	77
67,5	1,10	0,96	0,81	0,66	0,51	0,36	68
60,0	1,34	1,17	1,00	0,83	0,66	0,49	59
52,5	1,60	1,40	1,20	1,00	0,80	0,60	50
45,0	1,93	1,68	1,44	1,20	0,96	0,72	42
37,5	2,38	2,08	1,78	1,49	1,19	0,89	34
30,0	3,06	2,68	2,30	1,91	1,53	1,15	26
22,5	4,21	3,68	3,16	2,63	2,10	1,58	19
15,0	6,51	5,70	4,88	4,07	3,26	2,44	12
7,5	13,5	11,77	10,09	8,41	6,73	5,04	6
							T _a
							ambient temperature [°C]

R121/75, R126/75,
R122/75

Load current related to the ambient temperature

load current (A)	thermal resistance (K/W)					power dissipation (W)	
100,0	0,54	0,45	0,36	0,27	0,18	0,09	111
90,0	0,68	0,58	0,47	0,37	0,27	0,17	97
80,0	0,86	0,74	0,62	0,50	0,38	0,26	84
70,0	1,08	0,94	0,80	0,66	0,52	0,38	71
60,0	1,37	1,20	1,03	0,85	0,68	0,51	59
50,0	1,70	1,49	1,28	1,06	0,85	0,64	47
40,0	2,21	1,93	1,66	1,38	1,10	0,83	36
30,0	3,06	2,68	2,30	1,91	1,53	1,15	26
20,0	4,78	4,18	3,59	2,99	2,39	1,79	17
10,0	9,98	8,73	7,49	6,24	4,99	3,74	8
							T _a
							ambient temperature [°C]

R121/100, R126/100,
R122/100

load current (A)	thermal resistance (K/W)					power dissipation (W)	thermal protection °C
25	0,46	0,36	0,26	-	-	-	70°C
22,5	0,62	0,50	0,39	0,8	-	-	80°C
20	0,81	0,68	0,55	0,42	0,28	-	90°C
17,5	1,0	0,91	0,76	0,60	0,44	-	
15	1,4	1,2	1,0	0,85	0,66	-	
12,5	1,9	1,6	1,4	1,1	0,95	-	
10	2,4	2,1	1,8	1,5	1,2	-	
7,5	3,4	3,0	2,5	2,1	1,7	-	
5	5,3	4,7	4,0	3,3	2,6	-	
2,5	11,2	9,8	8,4	7,0	5,6	-	
							T _a
							ambient temperature [°C]

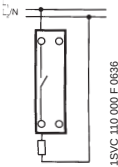
R311/25

load current (A)	thermal resistance (K/W)					power dissipation (W)	thermal protection °C
55	-	-	-	-	-	-	215
50	0,28	-	-	-	-	-	191
45	0,35	0,29	-	-	-	-	167
40	0,45	0,38	0,31	-	-	-	145
35	0,58	0,50	0,42	0,33	0,25	-	123
30	0,75	0,65	0,55	0,46	0,36	-	103
25	0,96	0,84	0,72	0,60	0,48	-	83
20	1,3	1,1	0,93	0,78	0,62	-	65
15	1,8	1,5	1,3	1,1	0,85	-	47
10	2,7	2,4	2,0	1,7	1,4	-	30
5	5,5	4,8	4,1	3,5	2,8	-	15
							T _a
							ambient temperature [°C]

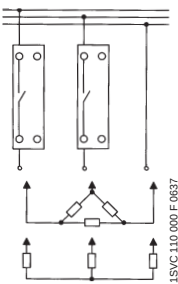
R311/55, R315/55

Examples of applications for 1-phase solid state relays

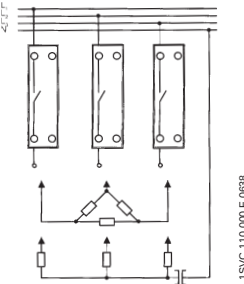
1-pin solid state relay
Single-phase application
Phase neutral, Phase-Phase



Two 1-pin solid state relay
in a 3-phase application
star-delta (economy circuit)

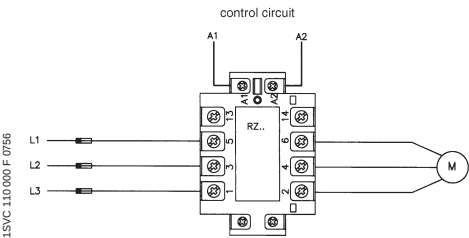


Three 1-pin semi-conductor relays in
a 3-phase application
delta, star, star with neutral



Switching of motors with R311/R315

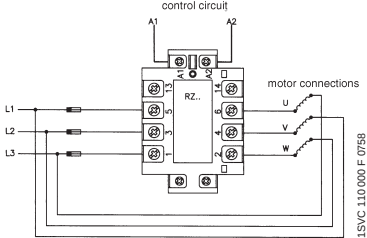
direct start up



Selection table

rated motor power [kW]	solid-state relay type [A]
0,25	0,8
0,37	1,1
0,55	1,5
0,75	1,9
1,1	2,6
1,5	3,5
2,2	4,7
3,0	6,2
4,0	8,1
5,5	10,7
7,5	15,0

delta circuit



Selection table

rated motor power [kW]	solid-state relay type [A]
1,1	1,5
1,5	2,1
2,2	3,0
3,0	4,0
4,0	4,6
5,5	6,2
7,5	8,7
11,0	12,1
15,0	16,2