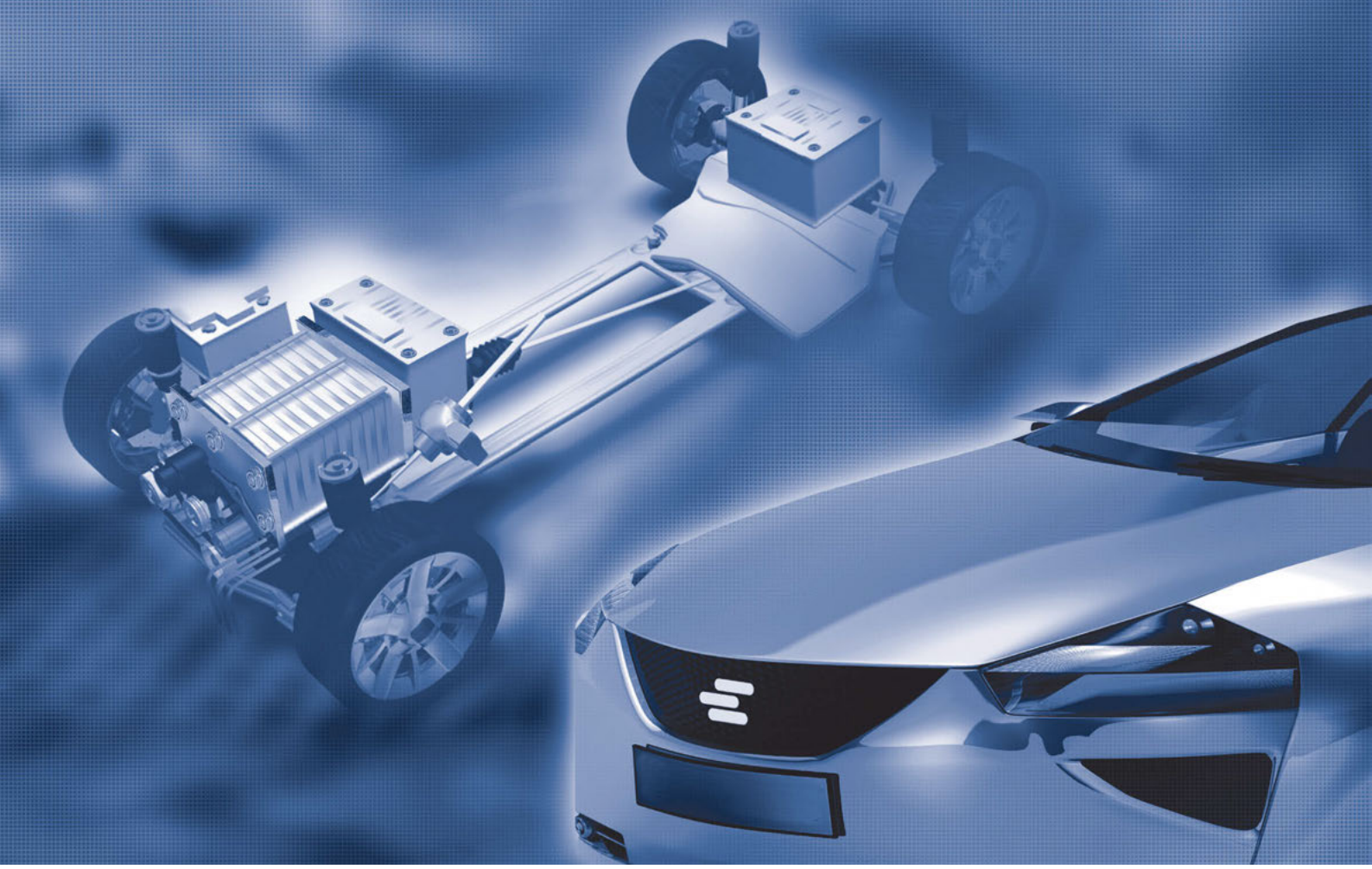
Relay Products
Automotive Catalog

TE connectivity
RELAY PRODUCTS



Automotive

With design, production and support locations around the globe, TE Relay Products is one of the world's leading manufacturers of relays. TE Relay Products not only offers standard relays of consistently high quality, but also develops individually tailored innovative products and system solutions. All are supported by outstanding applications consulting and services worldwide. Highly motivated and qualified employees work with great understanding of customer needs, experience and dedication to improve our products and production processes – even those that are already best in class. The passion, excellence and expertise of the personnel at TE Relay Products is evident. "We do not just build relays– we live for them with the goal of strengthening market and technology leadership".

This catalog focuses on relays for automotive applications. These range from basic electromechanical relays to special function relays including signal relays for automotive applications and switching solutions for alternative power vehicles.

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PCB Relays

Power K (V23133/V23076)

- **Limiting continuous current 45A (V23076/133)**
- **High current/open version Power K-S (V23071): 70/50A at 23°/85°C, very low voltage drop[1)]**
- **Wide voltage range**
- **24VDC versions available**

Mini K (V23072-A/C)

- **Limiting continuous current 20A**
- **24VDC versions with special contact gap**
- **Various contact arrangements and materials**

DMR (V23084)

- **Limiting continuous current 30A**

Contact Data					
Contact arrangement	1 form A/C, 1 NO/CO	1 form A, 1 NO	1 form C, 1 CO	1 form U, 2 NO	2 form C, 2 CO
Rated voltage	12, (24)VDC[6)]	12, (24)VDC[6)]			12VDC
Limiting continuous current at 23/85°C	NO/NC 45/30A / 30/25A	15/10A	(NO/NC) 15/10A / 10/5A	2x10/2x6A	20/15A both systems
Limiting making current	100/30A	60A	60/12A	2x40A	35A
Limiting breaking current	60/30A	20A	20/10A	2x20A	35A
Limiting short-time current, overload current, ISO 8820-3: rated current: 1.35x rated current, t 2.00x rated current, t 3.50x rated current, t 6.00x rated current, t					
Operate/release time max. (typ.)	5/3ms	3/1.5ms			3/1.3ms
Coil Data					
Rated coil voltage	12, 24VDC	12, 24VDC			12VDC
Rated coil power	1.6W	1.1W			0.56/0.81W
Other Data					
Ambient temperature	-40 to +85°C	-40 to +85°C			-40 to +85°C
Category of environmental protection	Open or sealed	Open or sealed			Sealed
Terminal type	PCB	PCB			PCB
Mounting					
Dimensions lwh	Open: 24x19.25x18.5mm Sealed: 26.5x21.5x21.5mm	Open: 16x13.2x18mm Sealed: 17.2x15x19.5mm			17.6x17x13.4mm
Accessories					

1) Please contact TE Connectivity application engineering support for details concerning Power Relay K-S. 2) Please contact TE Connectivity application engineering support for higher current (LCC). 3) QC=quick connect. 4) For products V23086-C1021-A502 / V23086-C1001-A602 lamp load/flasher. 5) Current and time are compatible with circuit protection by a typical automotive fuse. Relay will make, carry and break the specified current. 6) Given data only valid for 12VDC systems; for 24VDC versions please refer to datasheets.

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PCB Relays

PK2 THT/THR (V23201-C/R)

- **Wave and reflow solderable versions**
- **60% volume reduced Power K at increased performance**
- **PCB area requirements minimized by 50% to 293mm²**
- **Limiting cont. current 40A[2)]**
- **High shock and vibration resistance**
- **For bistable version refer to PK2 Latching THT/THR (V23201-L/T)**

1 form A, 1 NO
12VDC
40/33A
200A
40A
3/1.5ms
12VDC
0.8W
-40 to +105°C
Sealed/vented
PCB
18.5x16.2x16.1mm

Micro K THT/THR (V23086-C1/R1/C2/R2)

- **Wave (THT) and reflow (THR/pin-in-paste) solderable versions**
- **Single and twin versions**
- **Small power relay**
- **Limiting continuous current 30A**
- **Minimal weight**
- **Low noise operation**

1 form A, 1 NO	1 form C, 1 CO	2 form C, 2 CO
12VDC		
30/20A	NO/NC 30/25A	NO/NC 20/15A
40A (100A)[4)]	40A	
30A	30A	
3/1.5ms		
12VDC		
0.55W	0.57W	
-40 to +105°C		
Sealed/Vented		
Single: 13.2x12.2x10.1 (10.4mm THR) Double: 23.8x13.2x10.1 (10.4mm THR)		

Mini ISO

- **Pin assignment similar to ISO 7588 part 1**
- **Plug-in or PCB terminals**
- **Available for 42VDC applications**
- **Customized versions on request: 24VDC versions with 0.8mm contact gap, integrated components, customized marking/color, special covers, various contact arrangements and materials**

1 form A, 1 NO 1 form A, 1 NO (2 x 87)	1 form C, 1 CO	1 form U, 2 NO
12, (24)VDC[6)]		
60/40A	NO/NC 60/45A / 40/30A	2x32/ 2x35A
120A	120/45A	2x100A
60A	60/40A	2x40A
40A 54A, 1800s 80A, 5s 140A, 0.5s 240A, 0.1s		
7/2ms		
12, 24VDC		
typ. 1.6W		
-40 to +125°C		
Dustproof		
Plug-in, QC[3)], PCB		
Bracket optional		
26.2x26.2x25.2mm 28.0x28.0x25.5mm 28.5x28.5x25.3mm		
Connectors for Mini ISO Relays		

Maxi ISO

- **Latching version on request**
- **Pin assignment similar to ISO 7588 part 1**
- **Plug-in or PCB terminals**
- **Customized versions on request: 24VDC versions with 0.8mm contact gap, integrated components (e.g. resistor, diode), customized marking/color, special covers (e.g. notches, release features, brackets)**

1 form A, 1 NO
12, (24)VDC[6)]
70/50A
240A
70A
50 A 67A, 1800s 100A, 5s 175A, 0.5s 300A, 0.1s
7/2ms
12, 24VDC
typ. 2.0W
-40 to +125°C
Dustproof
Plug-in, QC[3)], PCB
Bracket optional
26.2x26.2x25.2mm
Connectors for Maxi ISO Relays

Plug-in Relays

Micro ISO

- **High current version with limiting cont. current 30A at 85°C**
- **ISO plug-in terminals, pin assignment according to ISO 7588 part 3**
- **Customized versions on request: 24VDC versions with special contact gap, integrated components, customer marking, special covers**

Micro Low Noise (V23145)

- **Noise level below 50dBA**
- **Pin assignment according to ISO 7588 part 3**
- **Plug-in terminals**
- **Customized versions on request: special marking, special covers (e.g. notches, release features)**

Mini/Maxi Shrouded Relays

- **Protection class IP67 to IEC 529 (EN 60 529) if used with special connector**
- **Plug-in terminals**
- **Pin assignment according to ISO 7588 part 1**
- **Bracket**
- **Customized versions on request: integrated components (e.g. diode), customized marking**

Contact Data								
Contact arrangement	1 form A, 1 NO	1 form C, 1 CO	High Current 1 form A, 1 NO	1 form A, 1 NO	1 form C, 1 CO	1 form A, 1 NO (Mini)	1 form C, 1 CO (Mini)	1 form A, 1 NO (Maxi)
Rated voltage	12, (24)VDC[6]			12VDC		12VDC		
Limiting continuous current at 23/85°C	30/25A	NO/NC 30/20A / 25/15A	35A/30A	20/15A	NO/NC 20/15A / 15/10A	60A/40A	NO/NC 60/45A / 40/30A	70/50A
Limiting making current	120A	120/40A	120A	100A	40A	120A	120/45A	240A
Limiting breaking current	30A	30/15A	30A	30A	30A	60A	60/40A	70A
Limiting short-time current, overload current, ISO 8820-3; rated current[5]:	25A		30A	20A		40A		50A
1.35x rated current, t	34A, 1800s		40A, 1800s	27A, 1800s		54A, 1800s		67A, 1800s
2.00x rated current, t	50A, 5s		60A, 5s	40A, 5s		80A, 5s		100A, 5s
3.50x rated current, t	87A, 0.5s		105A, 0.5s	70A, 0.5s		140A, 0.5s		175A, 0.5s
6.00x rated current, t	150A, 0.1s		180A, 0.1s	120A, 0.1s		240A, 0.1s		300A, 0.1s
Operate/release time max. (typ.)	5/3ms			3/2ms	3/4ms	8.5/4ms		
Coil Data								
Rated coil voltage	12, 24VDC		12VDC	12VDC		12VDC		
Rated coil power	1.4W		typ. 1.1W	0.9W	0.6W	1.5W	1.5W	1.8W
Other Data								
Ambient temperature	-40 to +125°C			-40 to +125°C		-40 to +125°C		
Category of environmental protection	Dustproof			Dustproof		Shrouded: protection class IP67 if used with special connector		
Terminal type	Plug-in, QC[3]			Plug-in, QC[3]		Plug-in, QC[3]		
Mounting						Bracket		
Dimensions lwh	23x15.5x25.4mm 23x15.5x26.0mm			23x15.5x25.4mm		32.7x35.5x54.2mm 32.0x32.0x39.0mm		
Accessories	Connectors for Micro ISO Relays			Connectors for Micro ISO Relays		Connectors for Mini ISO Relays		

1) Please contact TE Connectivity application engineering support for details concerning Power Relay K-S. 2) Please contact TE Connectivity application engineering support for higher current (LCC). 3) QC=quick connect. 4) For products V23086-C1021-A502 / V23086-C1001-A602 lamp load/flasher. 5) Current and time are compatible with circuit protection by a typical automotive fuse. Relay will make, carry and break the specified current. 6) Given data only valid for 12VDC systems; for 24VDC versions please refer to datasheets.

High Current Solutions

SPR (V23135)

- **Full, symmetric star-point disconnection of an electric power steering motor**
- **Limiting continuous current 90A**
- **Disconnection of high over-currents up to 200A in 12VDC and up to 60A in 36VDC power nets**
- **Optimized dimensions**

1 form 3, 3 NO
12, (24)VDC[6]
-/90A (60A at 125°C)
200A/>10 cycles
<20/<10ms
12, 24VDC
1.5W
-40 to +125°C
Sealed
Welding assembly
32.3x18.3x18.8mm

HCR 75 (V23232)

- **Limiting continuous current 75A**
- **Dustproof and sealed versions**

1 form A, 1 NO	1 form A, 1 NOBI (bifurcated contact)
12, (24)VDC[6]	
75/50A	75/50A
75A	150A
75A	100A
<15/<15ms	
12, 24VDC	12VDC
7.2, 4.4W	3.1W
-40 to +125°C	
Dustproof	
Plug-in, QC[3] (coil)/ Screw terminals (load)	
44x36x39mm	

HCR 150 (V23132)

- **Limiting continuous current 150A at 85°C**
- **Current switching ability up to 300A**
- **Suitable for voltage levels up to 42VDC**
- **Heat moisture and vibration resistant**
- **Minimal contact resistance**
- **Dustproof and sealed versions**

1 form A, 1 NO 1 form B, 1 NC 1 form C, 1 CO[7]	1 form X (NO-DM)
12, (24)VDC[6]	
180A with cable 25mm²/ 130A with cable 25mm²	170A with cable 25mm²/ 120A with cable 25mm²
300A	
300A	
<30/<15ms	
12VDC	24VDC
4.1W	4.1W
-40 to +125°C	
Dustproof/Sealed	
Plug-in, QC[3] (coil)/ Screw terminals (load)	
63x40x71mm	

HCR 200 (V23230)

- **Limiting continuous current 175A at 85°C**
- **Current switching ability up to 200A**
- **Heat moisture and vibration resistant**
- **Minimal contact resistance**
- **Protection class IP64**

1 form B, 1 NC
12VDC
255A with cable 50mm²/ 175A with cable 50mm²
200A
120A
<25/<20ms
12VDC
3.9W
-40 to +110°C
Sealed
Plug-in, QC[3] (coil)/ Screw terminals (load)
72x35.5x64.5mm

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High Current and Latching*) Solutions

BDS-A (V23130)

- **Limiting continuous current 190A at 85°C**
- **Electrically settable and resettable ON/OFF bistable device**
- **Suitable for voltage levels up to 42VDC**
- **High peak current carrying capability up to 1500A**

Mini ISO Latching (V23141-L)

- **Magnetically latched Mini ISO plug-in relay**
- **70A (Maxi) version available on request**
- **Two coils with set and reset function**
- **Pin assignment similar to ISO 7588 part 1**
- **Customized versions on request: special marking, special covers (e.g. notches, release features, brackets)**

PK2 Latching THT/THR (V23201-L/T)

- **50A at 125°C, due to reduced coil power consumption (2 coil system)**
- **60% volume reduced Power K at increased performance**
- **PCB area requirements minimized by 50% to 293mm²**
- **High shock and vibration resistance**
- **No change of switching state version at breakdown of battery voltage**
- **For monostable version refer to PK2 THT/THR (V23201-C/R)**

Contact Data			
Contact arrangement	1 form X (NO-DM)	1 form A, 1 NO	1 form A, 1 NO
Rated voltage	12, (24)VDC[6]	12VDC	12VDC
Limiting continuous current at 23/85°C	260/190A	40/30A	50/40A
Limiting making current	1500A (>5ops.)	200A	200A
Limiting breaking current	1500A (>5ops.)	40A	40A
Operate/release time max. (typ.)	<15/<15ms	1.5/1.5ms	1.5ms
Coil Data			
Rated coil voltage	12, 24VDC	12VDC	12VDC
Rated coil power	(only impulse needed)	(only impulse needed)	(only impulse needed)
Other Data			
Ambient temperature	-40 to +120°C	-40 to +125°C	-40 to +125°C
Category of environmental protection	Dustproof/Weatherproof	Dustproof	Sealed/Vented
Terminal type	Plug-in, QC (coil)/ Screw terminals (load)	Plug-in, QC[3]	PCB
Mounting			
Dimensions lwh	36x33x60mm	30.1x30.1x31.1mm	18.5x16.2x16.1mm
Accessories		Connectors for Mini ISO Relays	

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High Voltage Precharge Relays

Mini K HV (V23700-C/F)

- **Compact high voltage relay for precharge applications up to 450V**
- **Precharge currents up to 20A**
- **Limiting break currents up to 20A**
- **Available with PCB and plug-in terminals**

1 form X (NO-DM)
400VDC
n/a[7)]
20A (make, >10^5ops.)
20A (break, >10ops.)[8)]
2.5/1ms
12VDC[7)]
2.9W[7)]
-40 to +85°C
Sealed
Plug-in, QC[3)], PCB
25.6x20.7x19.3mm (PCB version) 29.8x29.8x51.4mm (plug-in version)

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Automotive Relays

Terminals: PCB	Terminals: THT	Terminals: THR	Terminals: Plug-in	Terminals: ISO	Terminals: Screw	Coil: Bistable	Relay type	Page	Contacts: CO contacts	Contacts: NO contacts	Contacts: Other contacts	Limiting making current [A]
			■	■			Micro Relay A / VFMA	15	x	x		0-100
			■	■			Micro Relay Low Noise	19	x	x		0-100
■	■		■	■			Power Relay F4	22	x	x	x	0-100
			■	■			Shrouded Power Relay F4 A	26	x	x		0-100
			■	■			Power Relay B	33	x	x		0-100
			■	■			VF4A (Standard, Shrouded and Weatherproof)	29	x			0-100
			■	■		■	Mini Relay Latching	37		x		0-100
■	■		■	■			Power Relay F7	39		x		0-100
			■	■			Shrouded Power Relay F7 A	43		x		0-100
■	■	■					Micro Relay K (THT – THR)	47	x	x		0-100
■	■						Mini Relay K (Open – Sealed)	52	x	x	x	0-100
■	■	■					Power Relay PK2 (THT – THR)	56		x		100-500
■	■	■				■	Power Relay PK2 Latching (THT – THR)	59		x		100-500
■	■						Power Relay K (Open – Sealed)	62	x	x		100-500
■	■						Power Relay K-S	66		x		100-500
■	■	■					Double Micro Relay K (THT - THR)	68	x			0-100
■	■						Double Mini Relay DMR	72	x			0-100
			■		■		High Current Relay 75	79		x	x	0-100
			■		■		High Current Relay 150	82	x	x	x	100-500
			■		■		High Current Relay 200	85			x	100-500
			■		■	■	Battery Disconnect Switch BDS-A (Latching)	87			x	1300-1700
			■				Basic Module Relay F4	91	x	x		100-500
■	■		■	■			Mini K HV	100			x	0-100

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Signal Relays for Automotive Applications

Terminals: PCB	Terminals: THT	Terminals: SMT	Coil: Bistable	Relay type	Page	Contacts: CO contacts	Contacts: NO contacts	Contacts: Other contacts	Limiting making current [A]
■	■	■		IM Relay	104	x	x		5
■	■	■		P2 Relay	110	x	x		5
■		■		HF3S Relay	116	x	x	x	2
■		■		HF6 Relay	121	x	x		2

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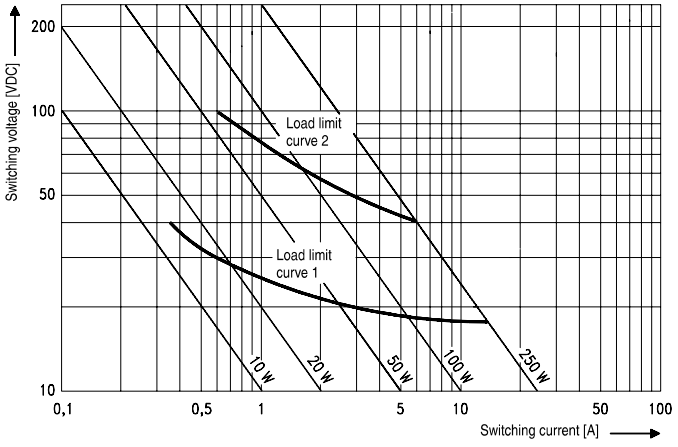
Micro Relay A/VFMA

- **High current version with limiting continuous current 30A at 85°C**
- **Pin assignment according to ISO 7588 part 3**
- **Customized versions on request**
  - **– 24VDC versions with special contact gap**
  - **– Integrated components (e.g. diode)**
  - **– Customized marking**
  - **– Special covers (e.g. notches, release features)**
  - **– For latching version refer to Micro Relay Latching**
  - **– For low noise version refer to Micro Relay Low Noise**
  - **– For high current version refer to part number table**

Typical applications
Cross carline up to 30A for example: ABS control, blower fans, cooling fan, door control, door lock, fuel pump, heated front screen, immobilizer, interior lights, seat control, seatbelt pretensioner, sun roof, trunk lock, valves, window lifter, wiper control.

Contact Data	Form A – Standard		Form C		Form A – HC
Contact arrangement	1 form A, 1 NO	1 form A, 1 NO	1 form C, 1 CO	1 form C, 1 CO	1 form A, 1 NO
Rated voltage	12VDC	24VDC	12VDC	24VDC	12VDC
Limiting continuous current, form A/form B		NO/NC	NO/NC		
23°C	30A	30A	30/20A	30/20A	35A
85°C	25A	25A	25/15A	25/15A	30A
125°C	10A	10A	10/8A	10/8A	15A
Limiting making current[1)2)], A/B (NO/NC)	120A	120A	120/40A	120/20A	120A
Limiting breaking current	30A	20A	30/15A	20/10A	30A
Limiting short-time current, overload current, ISO 8820-3[3)]	1.35 x 25A, 1800s 2.00 x 25A, 5s 3.50 x 25A, 0.5s 6.00 x 25A, 0.1s		1.35 x 25A, 1800s 2.00 x 25A, 5s 3.50 x 25A, 0.5s 6.00 x 25A, 0.1s		1.35 x 30A, 1800s 2.00 x 30A, 5s 3.50 x 30A, 0.5s 6.00 x 30A, 0.1s
Jump start test	24VDC for 5min conducting nominal current at 23°C				
Contact material	silver based				
Min. recommended contact load[4)]	1A at 5VDC				
Initial voltage drop					
NO contact at 10A, typ./max.	15/200mV				
NC contact at 10A, typ./max.	20/250mV				
Frequency of operation	6 ops./min (0.1Hz)				
Electrical endurance[5)]					
resistive load at 14VDC	>1x10^5 ops. 25A		>1x10^5 ops. 25A (NO)		>1x10^5 ops. 30A
resistive load at 28VDC		>1x10^5 ops. 15A		>1x10^5 ops. 15A (NO) >1x10^5 ops. 10A (NC)	
Mechanical endurance	typ. 10^7 ops.				

Max. DC load breaking capacity



1) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 13.5VDC for 12VDC or 27VDC for 24VDC load voltages.
2) For a load current duration of maximum 3s for a make/break ratio of 1:10.
3) Current and time are compatible with circuit protection by a typical automotive fuse. Relay will make, carry and break the specified current.
4) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
5) Electrical endurance data are only valid for the variants with resistor.

Load limit curve 1: arc extinguishes during transit time (CO contact).
Load limit curve 2: safe shutdown, no stationary arc (NO contact).
Load limit curves measured with low inductive resistors verified for 1000 switching events.

Micro Relay A/VFMA (Continued)

Coil Data

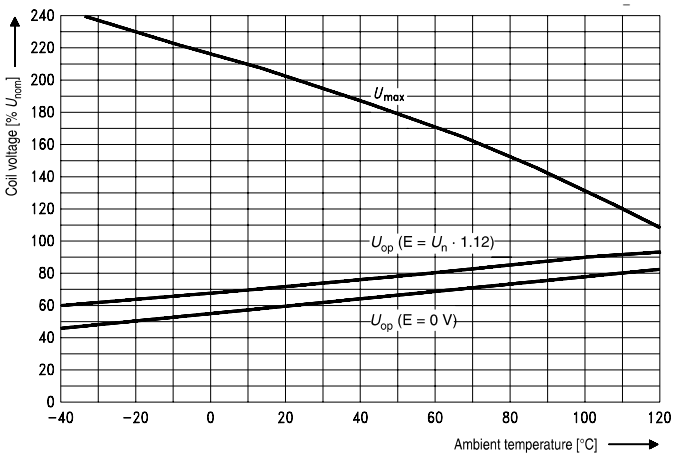
Coil voltage range	12/24VDC

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance[6] Ω±10%	Rated coil power[6] W
001	12	7.2	1.6	119	1.20
002	24	14.4	3.6	430	1.34
005	12	7.2	1.6	144	1.00
F	12	7.2	1.2	90	1.60
H	24	14.4	3.6	430	1.34

All figures are given for coil without pre-energization, at ambient temperature +23°C.
6) Without components in parallel.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization.

Insulation Data

Initial dielectric strength	
between open contacts	500VAC$_{rms}$
between contact and coil	500VAC$_{rms}$
Load dump test	
ISO 7637-1 (12VDC), test pulse 5	Vs=+86.5VDC
ISO 7637-2 (24VDC), test pulse 5	Vs=+200VDC

Other Data

EU RoHS/ELV compliance	compliant
Ambient temperature	-40 to +125°C
Climatic cycling with condensation,	
EN ISO 6988	6 cycles, storage 8/16h
Temperature cycling,	
IEC 60068-2-14, Nb	10 cycles, -40/+85°C (5°C/min)
Damp heat cyclic,	
IEC 60068-2-30, Db, Variant 1	6 cycles, upper air temp. 55°C
Damp heat constant,	
IEC 60068-2-3 (78), Ca	56 days
Category of environmental protection,	
IEC 61810	RT I – dustproof
Degree of protection, IEC 60529	IP54
Corrosive gas	
IEC 60068-2-42	10±2cm^3/m^3 SO_2, 10 days
IEC 60068-2-43	1±0.3cm^3/m^3 H_2S, 10 days
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep)	10 to 500Hz min. 5g[7]
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	min. 20g 11ms[7]
Drop test, free fall, IEC 60068-2-32	1m onto concrete
Terminal type	plug-in, QC
Cover retention	
axial force	150N
pull force	150N
push force	200N
Terminal retention	
pull force	100N
push force	100N
resistance to bending	10N[8]
force applied to side	10N[8]
torque	0.3Nm
Weight	approx. 16 to 20g (0.5 to 0.7oz)
Packaging unit	
Micro A	480 pcs.
VFMA	600 pcs.

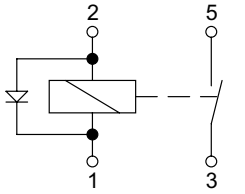
7) No change in the switching state >10µs. Valid for NC contacts, NO contact values significantly higher.
8) Values apply 2mm from the end of the terminal. When the force is removed, the terminal must not have moved by more than 0.3mm

Accessories

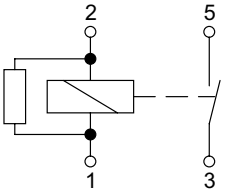
For details see datasheet	Connectors for Micro ISO Relays

Terminal Assignment

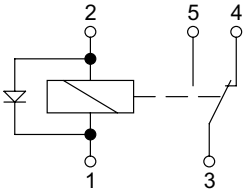
NOD
1 form A, 1 NO with diode



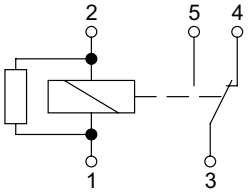
NOR
1 form A, 1 NO with resistor



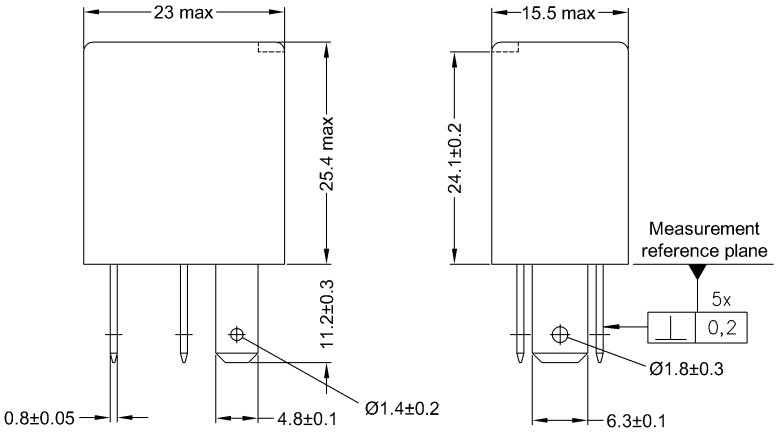
COD
1 form C, 1 CO with diode



COR
1 form C, 1 CO with resistor

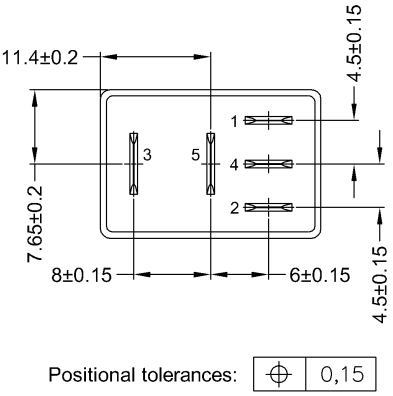


Micro Relay A/VFMA (Continued)



Quick connect terminal similar to ISO 8092-1.
Micro A: Terminals without holes

View of the terminals (bottom view)



Positional tolerances: ⌖ 0,15

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Micro Relay A/VFMA (Continued)

Product code structure — Typical product code: **V23074 -A 1 001 -A4 02**

Type
V23074 Micro Relay A

Version
A Standard **H** High current

Coil suppression
1 Resistor **2** Diode

Coil
001 12VDC **002** 24VDC **005** 12VDC for high current version

Contact material
-A4 Silver based **-A5** Silver based for high current version

Contact arrangement
02 1 form A, 1 NO **03** 1 form C, 1 CO

Product code structure — Typical product code: **VFMA -1 1 F 4 1 -S01**

Type
VFMA VFMA Series

Version
1 Standard

Contact arrangement
1 1 form A, 1 NO **5** 1 form C, 1 CO

Coil
F 12VDC **H** 24VDC

Contact material
4 Silver based **7** Silver based for high current version

Terminals
1 Plug-in

Coil suppression
S01 Resistor

Product code	Equivalent to	Version	Coil suppr.	Circuit[1)]	Coil	Arrangement	Terminals	Part number
V23074-A1001-A402	VFMA-11F41-S01	Standard	Resistor 680Ω	NOR	12VDC	1 form A, 1 NO	Plug-in, QC	1393292-5 9-1414992-1
VFMA-11F41-S01	V23074-A1001-A402							9-1393292-9
V23074-A1001-A403	VFMA-15F41-S01			COR		1 form C, 1 CO		8-1393292-4
VFMA-15F41-S01	V23074-A1001-A403							1393293-8
V23074-A2001-A402			Diode	NOD		1 form A, 1 NO		5-1393292-8
V23074-A2001-A403				COD		1 form C, 1 CO		6-1419137-4
V23074-H1005-A502	VFMA-11F71-S01	High current	Resistor 1000Ω	NOR		1 form A, 1 NO		2-1414971-4
VFMA-11F71-S01	V23074-H1005-A502		Resistor 680Ω					1432885-1
V23074-A1002-A402	VFMA-11H41-S01	Standard	Resistor 1800Ω		24VDC			8-1393292-9
VFMA-11H41-S01	V23074-A1002-A402							6-1415008-2
V23074-A1002-A403				COR		1 form C, 1 CO		3-1393292-8
V23074-A2002-A402			Diode	NOD		1 form A, 1 NO		6-1393292-2
V23074-A2002-A403				COD		1 form C, 1 CO		6-1393292-3

1) See terminal assignment diagrams.

Other types on request.

This list represents the most common types and does not show all variants covered by this datasheet.

Micro Relay Low Noise

- **Noise level below 50dBA**
- **Pin assignment according to ISO 7588 part 3**
- **Plug-in terminals**
- **Customized versions on request**
  - **– Special marking**
  - **– Special covers (e.g. notches, release features)**

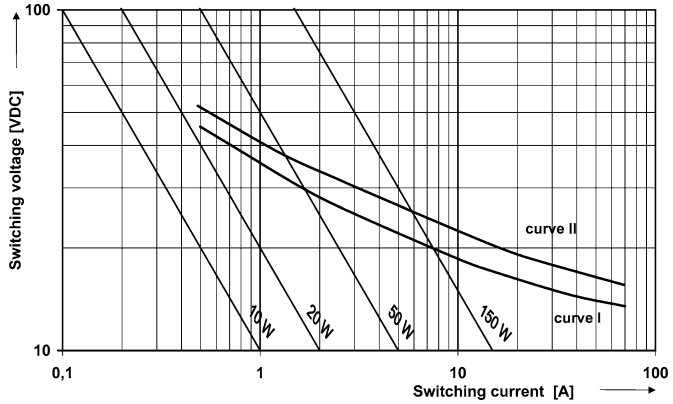
Typical applications
Cross carline up to 20A for example: front and rear wiper, air condition, interior fan.

Contact Data

Contact arrangement	1 form A, 1 NO	1 form C, 1 CO
Rated voltage	12VDC	12VDC
Limiting continuous current		NO/NC
23°C	20A	20/15A
85°C	15A	15/10A
125°C	8A	8/5A
Limiting making current[1)]	100A	40A
Limiting breaking current[1)]	30A	30A
Limiting short-time current overload current, ISO 8820-3[2)]	1.35 x 20A, 1800s 2.00 x 20A, 5s 3.50 x 20A, 0.5s 6.00 x 20A, 0.1s	
Jump start test	24VDC for 5min, conducting nominal current at 23°C	
Contact material	silver based	
Min. recommended contact load[3)]	1A at 5VDC	
Initial voltage drop		
NO contact at 10A, typ./max.	15/300mV	50/300mV
NC contact at 10A, typ./max.	-	50/300mV
Frequency of operation	6 ops./min (0.1Hz)	
Electrical endurance, resistive load at 14VDC		
15A	$>1x10^5$ ops.	
120W lamp (+ on terminal 5)	$>1x10^5$ ops.	
Mechanical endurance	typ. 10^6 ops.	

1) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 13.5 VDC for 12VDC nominal voltages.
For a load current duration of maximum 3s for a make/break ratio of 1:10.
2) Current and time are compatible with circuit protection by a typical automotive fuse. Relay will make, carry and break the specified current.
3) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/

Max. DC load breaking capacity



Coil Data

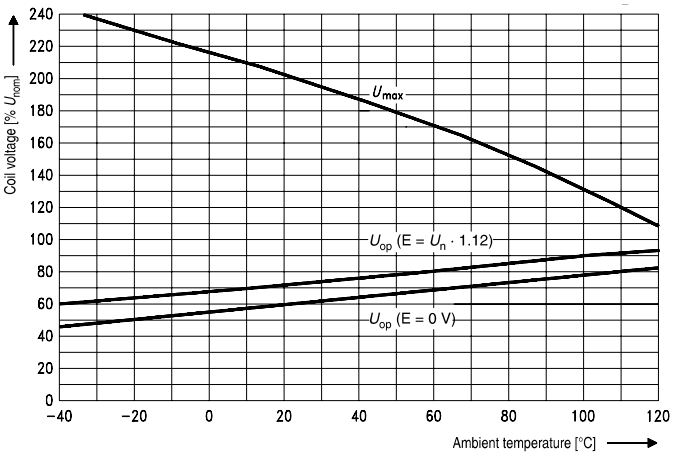
Rated coil voltage	12VDC

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance[4)] Ω±10%	Rated coil power[4)] mW
*01-402	12	7.2	1.4	181	796
*01-403	12	7.2	1.4	254	567

4) Without components in parallel.
All figures are given for coil without pre-energization, at ambient temperature +23°C.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization.

Insulation Data

Initial dielectric strength	
between open contacts	$500VAC_{rms}$
between contact and coil	$500VAC_{rms}$
Load dump test	
ISO 7637-1 (12VDC), test pulse 5	Vs=+86.5VDC

Load limit curve 1: arc extinguishes uring transit time
Load limit curve 2: safe shutdown, no stationary arc

Micro Relay Low Noise (Continued)

Other Data	
EU RoHS/ELV compliance	compliant
Ambient temperature	-40 to +125°C
Climatic cycling with condensation, EN ISO 6988	6 cycles, storage 8/16h
Temperature cycling, IEC 60068-2-14, Nb	10 cycles, -40/+85°C (5°C/min)
Damp heat cyclic, IEC 60068-2-30, Db, Variant 1	6 cycles, upper air temp. 55°C
Damp heat constant, IEC 60068-2-3, Ca	56 days
Category of environmental protection, IEC 61810	RT I – dustproof
Degree of protection, IEC 60529	IP54
Corrosive gas	
IEC 60068-2-42	10±2cm³/m³ SO_2, 10 days
IEC 60068-2-43	1±0.3cm³/m³ H_2S, 10 days
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep)	10 to 500Hz min.5g[5]
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	min. 30g 6ms[5]
Drop test, free fall, IEC 60068-2-32	1m onto concrete

Other Data (continued)	
Terminal type	plug-in, QC
Cover retention	
axial force	150N
pull force	150N
push force	200N
Terminal retention	
pull force	100N
push force	100N
resistance to bending	10N[6]
force applied to side	10N[6]
torque	0.3Nm
Weight	approx. 15g (0.5oz)
Packaging unit	240 pcs.

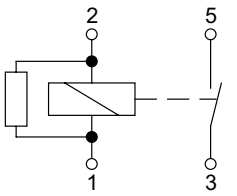
5) No change in the switching state >10µs. Valid for NC contacts, NO contact values significantly higher.

6) Values apply 2mm from the end of the terminal. When the force is removed, the terminal must not have moved by more than 0.3mm.

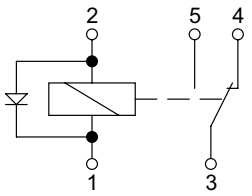
Accessories	
For details see datasheet	Connectors for Micro ISO Relays

Terminal Assignment

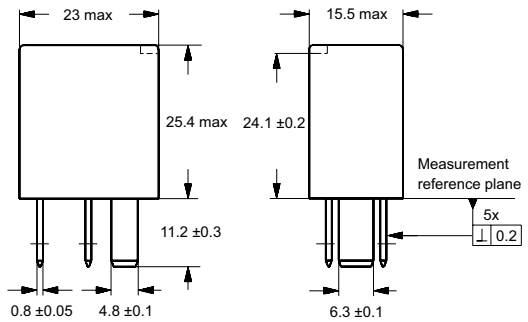
NOR
1 form A, NO with resistor



COD
1 form C, 1 CO with diode

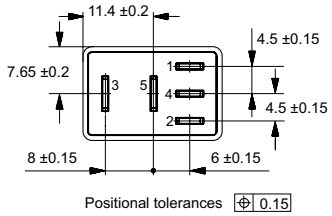


Dimensions



Quick connect terminal similar to ISO 8092-1

View of the terminals (bottom view)



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Micro Relay Low Noise (Continued)

Product code structure Typical product code **V23145 -A 1 1 01 -A 4 02**

Type
V23145 Micro Relay Low Noise

Form
A 1 form C, 1 CO **B** 1 form A, 1 NO

Design
1 Standard

Coil suppression
1 Standard suppression

Coil
01 12 VDC

Version
A Standard

Contact material
4 Silver based

Contact arrangement
02 1 form A, 1 NO **03** 1 form C, 1 CO

Product code	Arrangement	Coil suppr.	Circuit[1)]	Coil	Version	Cont. material	Terminals	Part number
V23145-B1101-A402	1 form A, 1 NO	Resistor	NOR	12VDC	Standard	Silver based	Plug-in, QC	3-1414773-5
V23145-A1101-A403	1 form C, 1 CO	Diode	COD					on request

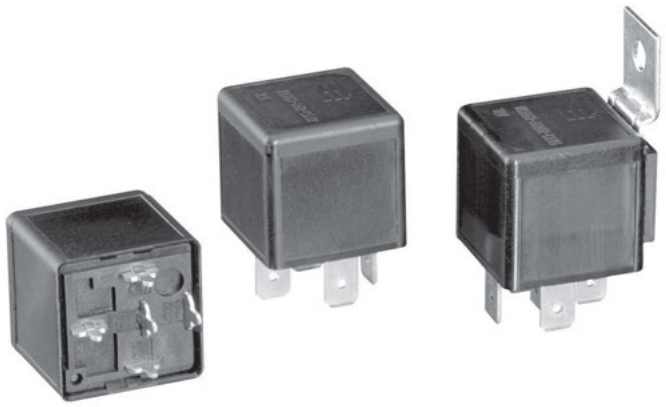
1) See terminal assignment diagrams.
Other types on request.
This list represents the most common types and does not show all variants covered by this datasheet.

Power Relay F4

- **Pin assignment similar to ISO 7588 part 1**
- **Plug-in or PCB terminals**
- **Also available for 42VDC applications**

Customized versions on request

- **– 24VDC versions with contact gap >0.8mm**
- **– Integrated components (e.g. resistor, diode)**
- **– Customized marking/color**
- **– Special covers (e.g. notches, release features, brackets)**
- **– Various contact arrangements and materials**
- **– For latching (bistable) version refer to Mini Relay Latching**
- **– For shrouded/weatherproof dust cover versions refer to Shrouded Power Relay F4 A and VF4 A**



Applications
Cross carline up to 40A for example: ABS control, blower fans, car alarm, cooling fan, Electric Power Steering, energy management, engine control, fuel pump, heated front screen, lamps: front, rear, fog light, main switch/ supply relay, valves, wiper control.

Contact Data	**1 form A**		**1 form U**		**1 form C**		
Contact arrangement	1 form A, 1 NO/1 NO (2x87)		1 form U, 2 NO		1 form C, 1 CO		
Contact gap							>0.8mm
Rated voltage	12VDC	24VDC	12VDC	24VDC	12VDC	24VDC	24VDC[1]
Limiting continuous current	NO		NO		NO/NC		
23°C	60A		2x32A		60/45A		
85°C	40A		2x25A		40/30A		
125°C	17A		2x11A		17/12A		
Limiting making current[2] NO/NC	120A	120A	2x100A	2x100A	120/45A	120/45A	120/45A
Limiting breaking current NO/NC	60A	20A	2x40A	2x15A	60/40A	20/15A	30/20A
Limiting short-time current overload current, ISO 8820-3[3]:	1.35 x 40A, 1800s 2.00 x 40A, 5s 3.50 x 40A, 0.5s 6.00 x 40A, 0.1s						
Jump start test ISO 16750-1	24VDC for 5min conducting nominal current at 23°C						
Contact material	silver based						
Min. recommended contact load[4]	1A at 5VDC						
Initial voltage drop NO contact at 10A, typ./max.	15/200mV	15/200mV	2x15/200mV	2x15/200mV	15/200mV	15/200mV	15/200mV
NC contact at 10A, typ./max.					20/250mV	20/250mV	20/250mV
Frequency of operation at nominal load	6 ops./min (0.1Hz)						
Operate/release time typ.	7/2ms[5]						
Electrical endurance resistive load at 14 VDC	>2x10^5 ops. 40A		>2x10^5 ops. 2x25A		>2x10^5 ops. 40A (NO)		
resistive load at 28VDC		>1x10^5 ops. 20A		>1x10^5 ops. 2x15A		>1x10^5 ops. 20A (NO)	>1x10^5 ops. 30A (NO) >5x10^5 ops. 10A (NC)
Mechanical endurance DC coil	>1x10^{7}ops.						

1) Special high performance 24VDC version with contact gap >0.8mm, part number V23134-A0056-X432/-X433 (see part number table).
2) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 14VDC for 12VDC or 28VDC for 24VDC load voltages. For a load current duration of maximum 3s for a make/break ratio of 1:10.
3) Current and time are compatible with circuit protection by a typical automotive fuse. Relay will make, carry and break the specified current.
4) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
5) For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding.

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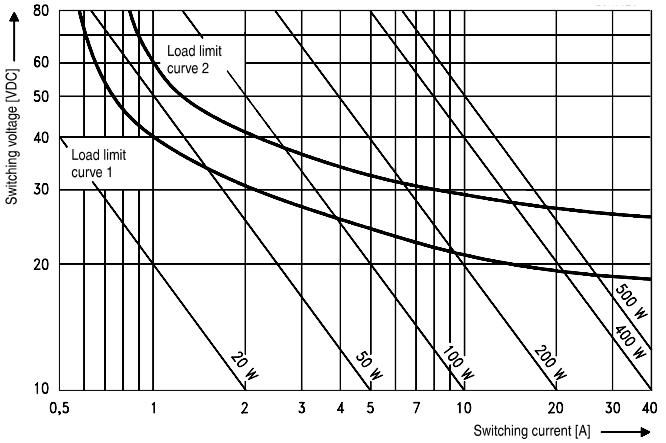
Power Relay F4 (Continued)

Max. load DC breaking capacity



Load limit curve 1: arc extinguishes during transit time (CO contact).
Load limit curve 2: safe shutdown, no stationary arc (NO contact).
Load limit curves measured with low inductive resistors verified for 1000 switching events.

Coil Data

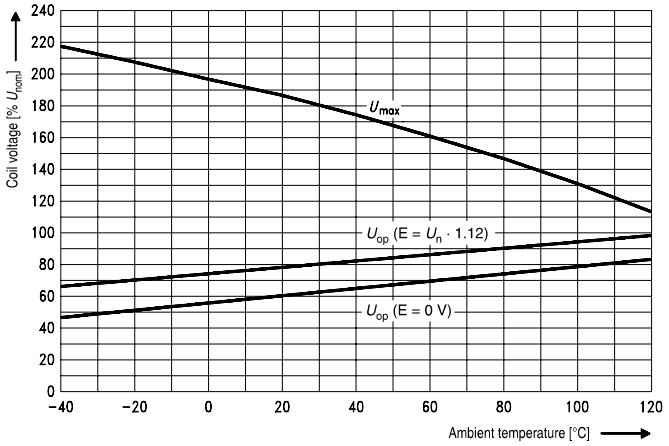
Rated coil voltage	12/24VDC

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance[6] Ω±10%	Rated coil power[6] W
052	12	7.2	1.6	90	1.6
053	24	14.4	3.2	324	1.8
056	24	16	4	268	2.1

All figures are given for coil without pre-energization, at ambient temperature +23°C.
6) Without components in parallel.

Coil operating range



Does not take into account the temperature rise due to the contact current E=pre-energization..

Insulation Data

Initial dielectric strength	
between open contacts	500V_{rms}
between contact and coil	500V_{rms}
between adjacent contacts	500V_{rms}
Load dump test	
ISO 7637-1 (12VDC), test pulse 5	Vs=+86.5VDC
ISO 7637-2 (24VDC), test pulse 5	Vs=+200VDC

Other Data

EU RoHS/ELV compliance	compliant
Ambient temperature DC coil	-40 to +125°C
Protection to heat and fire	UL94-HB or better[7]
Climatic cycling with condensation	
EN ISO 6988	6 cycles, storage 8/16h
Temperature cycling	
IEC 60068-2-14, Nb	10 cycles, -40/+85°C (5°C/min)
Damp heat cyclic	
IEC 60068-2-30, Db, Variant 1	6 cycles, upper air temp. 55°C
Damp heat constant	
IEC 60068-2-3, Ca	56 days
Category of environmental protection,	
IEC 61810	RTI – dustproof, RT III – sealed
Degree of protection, IEC 60529	IP54 (dustproof), IP67 (sealed)
Corrosive gas	
IEC 60068-2-42	10±2cm^3/m^3 SO_2, 10 days
IEC 60068-2-43	1±0.3cm^3/m^3 H_2S, 10 days
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep)	10 to 500Hz, > 5g[8]
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	11ms, >20g[8]
Drop test, free fall	
IEC 60068-2-32	1m onto concrete
Terminal type	plug-in, QC/ PCB
Cover retention	
axial force	150N
pull force	150N
push force	150N
Terminal retention	
pull force	100N
push force	100N
resistance to bending, force applied to front[9]	10N
resistance to bending, force applied to side[9]	10N
torque	0.3Nm
Weight	approx. 35g (1.2oz)
Packaging unit	
plug-in/PCB	315 pcs.
plug-in with bracket	200 pcs.

7) Refers to used materials.
8) No change in the switching state >10µs. Valid for NC contacts, NO contact values significantly higher.
9) Values apply 2mm from the end of the terminal. When the force is removed, the terminal must not have moved by more than 0.3mm.

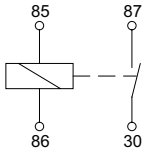
Accessories

For details see datasheet Connectors for Mini ISO Relays

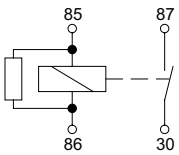
Power Relay F4 (Continued)

Terminal Assignment

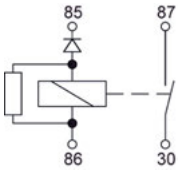
NO
1 form A, 1 NO



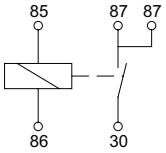
NOR
1 form A, 1 NO
with resistor



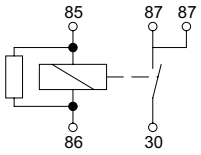
NOR_SD
1 form A, 1 NO
with resistor



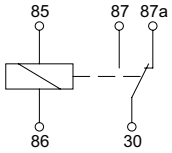
NO_2x87
1 form A, 1 NO (2x87)



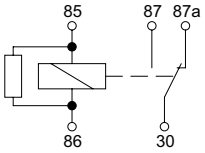
NOR_2x87
1 form A, 1 NO (2x87)
with resistor



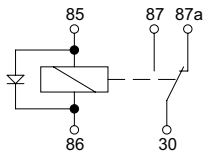
CO
1 form C, 1 CO



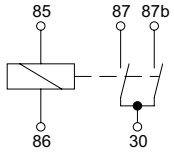
COR
1 form C, 1 CO
with resistor



COD
1 form C, 1 CO
with diode

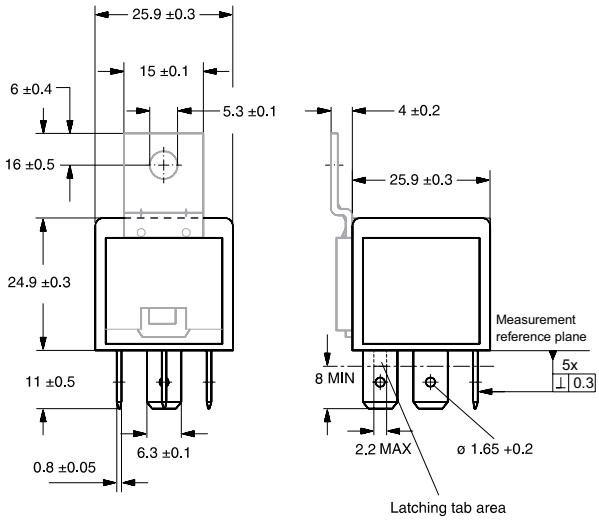


DNO
1 form U, 2 NO



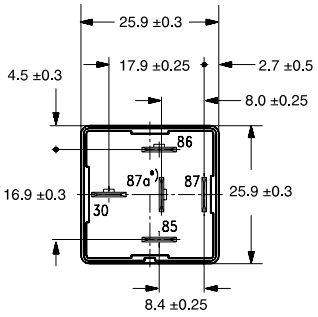
Dimensions

Power Relay F4 with quick connect (QC) terminals



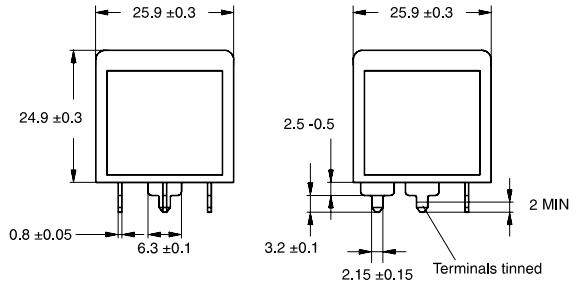
Quick connect terminal similar to ISO 8092-1

View of the terminals (bottom view)

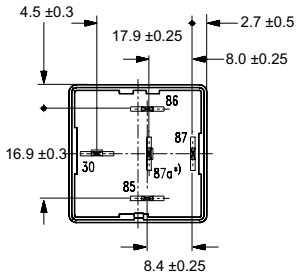


For the make contact (2x87), pin 87a = 87;
for the double make contact, pin 87a = 87b.

Power Relay F4 with PCB terminals

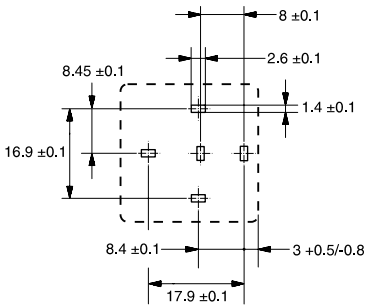


View of the terminals (bottom view)



For the make contact (2x87), pin 87a = 87;
for the double make contact, pin 87a = 87b.

Mounting hole layout (bottom view)



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Power Relay F4 (Continued)

Product code structure Typical product code **V23134 -A 0 052 -C642**

Type
V23134 Power Relay F4

Contact arrangement
A 1 form C, 1 CO
B 1 form A, 1 NO
M 1 form U, 2 NO
C 1 form A, 1 NO (2x87)
K 1 form A, 1 NO (non ISO)

Cover
0 Standard
2 Bracket at terminal 86 ISO
1 Bracket at terminal 30 ISO

Coil
052 12VDC
056 24VDC (contact gap >0.8mm)
053 24VDC

Terminal/arrangement
C642 Plug-in/NO
G242 PCB/NO
Xnnn Customized (nnn: version number)
C643 Plug-in/CO
G243 PCB/CO

Product code	Arrangement	Version	Coil suppr.	Circuit[1)]	Coil	Arrangement	Terminals	Part number
V23134-A0052-C643	1 form C, 1 CO	Standard		CO	12VDC	Silver based	Plug-in, QC	2-1393302-2
V23134-A0052-G243							PCB	2-1393302-3
V23134-A0052-X205[2)]			D (cathode 86)	COD			Plug-in, QC [2)]	3-1393302-6
V23134-A0052-X278			R 560Ω	COR			Plug-in, QC	4-1393302-1
V23134-A0053-C643				CO	24VDC			5-1393302-1
V23134-A0053-G243							PCB	5-1393302-2
V23134-A0056-X432[3)]			D (cathode 86)	COD			Plug-in, QC	1-1414167-0
V23134-A0056-X433[3)]			R 1200Ω	COR				1-1414168-0
V23134-A1052-C643		Bracket		CO	12VDC			5-1393302-8
V23134-A1052-X294			R 560Ω	COR				6-1393302-0
V23134-A1053-C643				CO	24VDC			6-1393302-3
V23134-A1053-X295			R 1200Ω	COR				6-1393302-4
V23134-B0052-C642	1 form A, 1 NO	Standard		NO	12VDC			7-1393302-5
V23134-B0052-G242							PCB	7-1393302-7
V23134-B0052-X270			R 680Ω	NOR			Plug-in, QC	1-1414099-0
V23134-B0052-X506			R 560Ω	NOR_SD[4)]				4-1414992-3
V23134-B0053-C642				NO	24VDC			1393303-9
V23134-B1052-C642		Bracket			12VDC			3-1393303-4
V23134-B1053-C642					24VDC			3-1393303-7
V23134-B1053-X296			R 1200Ω	NOR				3-1393303-8
V23134-C0052-C642	1 form A, 1 NO (2x87)	Standard		NO_2x87	12VDC			3-1393303-9
V23134-C0053-C642					24VDC			4-1393303-4
V23134-C1052-C642		Bracket			12VDC			4-1393303-7
V23134-C1052-X280			R 560Ω	NOR_2x87				4-1393303-8
V23134-C1053-C642				NO_2x87	24VDC			5-1393303-0
V23134-K1052-X399	1 form A, 1 NO		R 560Ω	NOR non ISO	12VDC		Plug-in, QC/non ISO	1-1393305-1
V23134-M0052-C642	1 form U, 2 NO	Standard		DNO			Plug-in, QC	5-1393304-6
V23134-M0052-G242							PCB	5-1393304-7
V23134-M0053-C642					24VDC		Plug-in, QC	6-1393304-7
V23134-M0053-G242							PCB	6-1393304-8
V23134-M1052-C642		Bracket			12VDC		Plug-in, QC	7-1393304-1
V23134-M1053-C642					24VDC			7-1393304-4

1) See terminal assignment diagrams.
2) Load terminal without galvanic surface.
3) Special feature: contact gap >0.8mm.
4) Serial diode.
Other types on request.
This list represents the most common types and does not show all variants covered by this datasheet.

Shrouded Power Relay F4 A

- **Pin assignment similar to ISO 7588 part 1**
- **Plug-in terminals**
- **Customized versions on request**
  - **– Integrated components (e.g. resistor, diode)**
  - **– Customized marking/color**
  - **– Special cover with bracket**

Typical applications
Cross carline up to 40A for example: ABS control, blower fans, cooling fan, energy management, engine control, fuel pump, heated front screen, lamps: front, rear, fog light, main switch/supply relay, wiper control.

Contact Data

Contact arrangement	1 form A, 1 NO	1 form C, 1 CO
Rated voltage	12VDC	12VDC
Limiting continuous current	NO	NO/NC
23°C,form A/form B	60A	60/45A
85°C,form A/form B	40A	40/30A
125°C,form A/form B	17A	17/12A
Limiting making current[1)]		
form A/form B	120A	120/45A
Limiting breaking current,		
form A/form B	60A	60/40A
Limiting short-time current		
overload current, ISO 8820-3[2)]	1.35 x 40A, 1800s 2.00 x 40A, 5s 3.50 x 40A, 0.5s 6.00 x 40A, 0.1s	
Jump start test, ISO 16750-1	24VDC for 5min, conducting nominal current at 23°C	
Contact material	Silver based	
Min. recommended contact load[3)]	1A at 5VDC	
Initial voltage drop,		
form A (NO) at 10A, typ./max.	15/300mV	15/300mV
form B (NC) at 10A, typ./max.	-	25/300mV
Frequency of operation at nominal load	6 ops./min (0.1Hz)	
Operate/release time typ.	8.5/4ms[4)]	
Electrical endurance	>2x10^{5}ops	>1x10^{5}ops
resistive load at 14VDC	40A (NO)	40A (NO)

Contact Data (continued)

Mechanical endurance	>1x10^{7}ops

1) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 14VDC for 12VDC or 28VDC for 24VDC load voltages. For a load current duration of maximum 3s for a make/break ratio of 1:10.
2) Current and time are compatible with circuit protection by a typical automotive fuse. Relay will make, carry and break the specified current.
3) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
4) For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding.

Coil Data

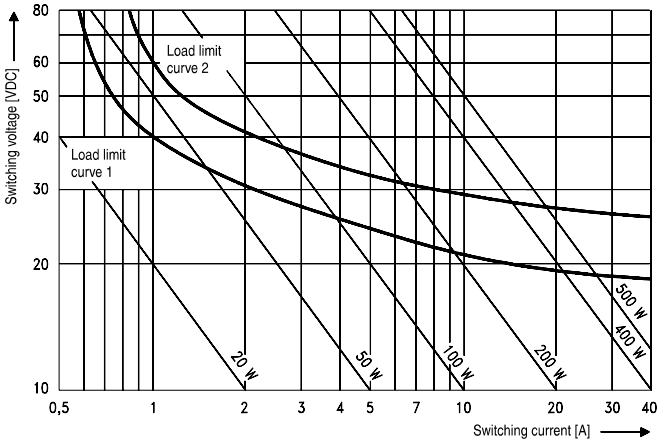
Rated coil voltage	12VDC

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance[5)] Ω±10%	Rated coil power[5)] W
001	12	7.2	1.6	114	1.3

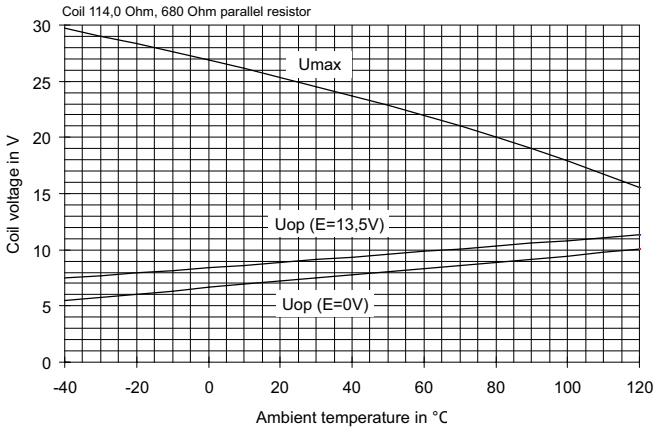
5) Without components in parallel.
All figures are given for coil without pre-energization, at ambient temperature +23°C.

Max. DC load breaking capacity



Load limit curve 1: arc extinguishes during transit time (changeover contact).
Load limit curve 2: safe shutdown, no stationary arc (make contact).
Load limit curves measured with low inductive resistors verified for 1000 switching events.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization.

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Shrouded Power Relay F4 A (Continued)

Insulation Data	
Initial dielectric strength	
between open contacts	500V_{rms}
between contact and coil	500V_{rms}
between adjacent contacts	500V_{rms}
Load dump test	
ISO 7637-1 (12VDC), test pulse 5	V_s=+86.5VDC
ISO 7637-2 (24VDC), test pulse 5	V_s=+200VDC

Other Data	
EU RoHS/ELV compliance	compliant
Protection to heat and fire according UL94	HB or better[6)]
Ambient temperature	-40 to 125°C
Climatic cycling with condensation	
EN ISO 6988	6 cycles, storage 8/16h
Temperature cycling	
IEC 60068-2-14, Nb	10 cycles, -40/+85°C (5°C/min)
Damp heat cyclic	
IEC 60068-2-30, Db, Variant 1	6 cycles, upper air temp. 55°C
Damp heat constant, IEC 60068-2-3, Ca	56 days
Category of environmental protection,	
IEC 61810	RT III – sealed
Degree of protection, IEC 60529	IP67 (sealed) only with special connector
Corrosive gas	
IEC 60068-2-42	10±2cm^3/m^3 SO_2, 10 days
IEC 60068-2-43	1±0.3cm^3/m^3 H_2S, 10 days
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep)	10 to 500Hz, min. 5g[7)]
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	11ms, min. 20g[7)]
Drop test, free fall, IEC 60068-2-32	1m onto concrete

Other Data (continued)	
Terminal type	plug-in, QC/ PCB
Cover retention	
axial force	150N
pull force	200N
push force	200N
Terminal retention	
pull force	100N
push force	100N
Weight	approx. 60g (2.1oz)
Packaging unit	108 pcs.

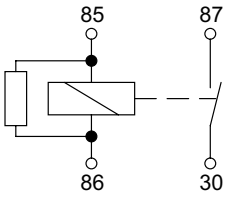
6) Refers to used materials.
7) No change in the switching state >1µs. Valid for NC contacts, NO contact values significantly higher.

Accessories

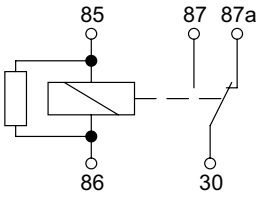
For fitting connectors please contact us via online Support Center

Terminal Assignment

NOR
1 form A, NO with resistor



COR
1 form C, CO with resistor



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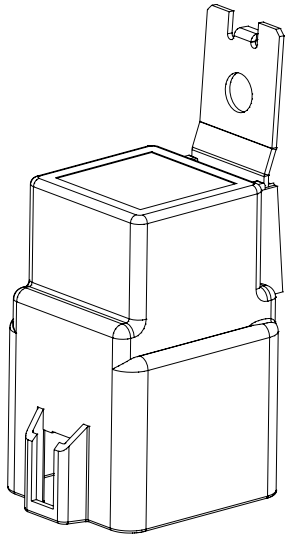
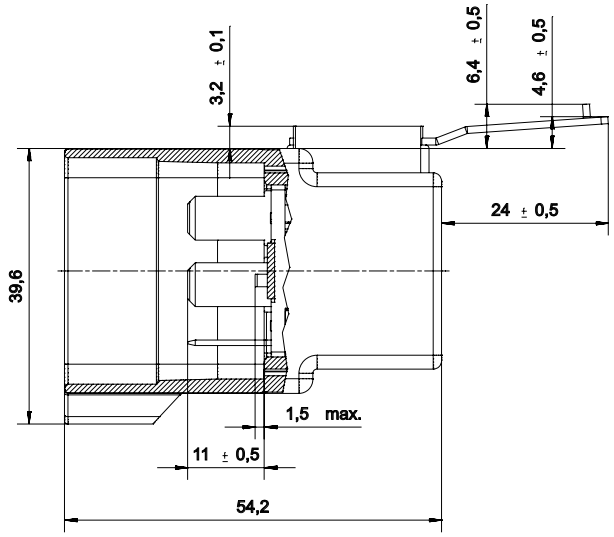
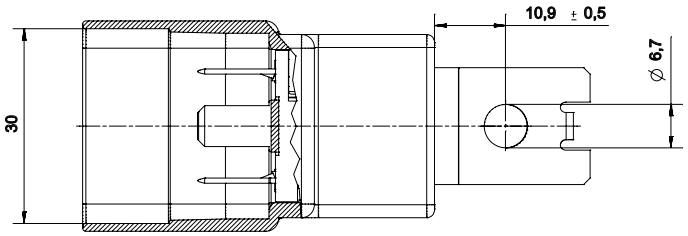
Shrouded Power Relay F4 A (Continued)

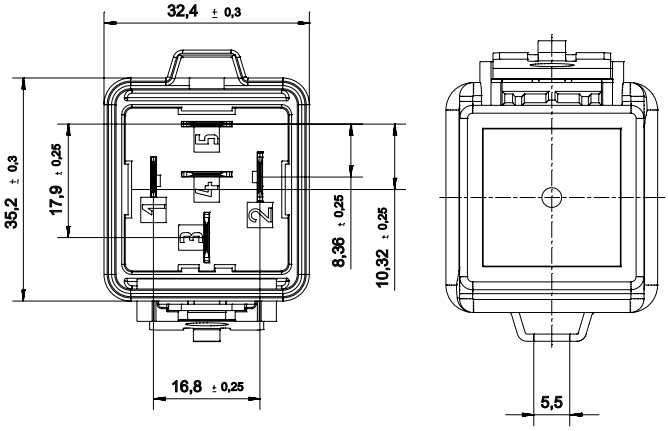
Dimensions







View of the terminals (bottom view)



Product code structure

Typical product code: **V23136** **-A** **1** **001** **-X057**

Type
V23136 Power Relay F4 A

Contact arrangement
A 1 form C, 1 CO **B** 1 form A, 1 NO

Cover
1 Bracket at terminal 30 ISO

Coil
001 12VDC

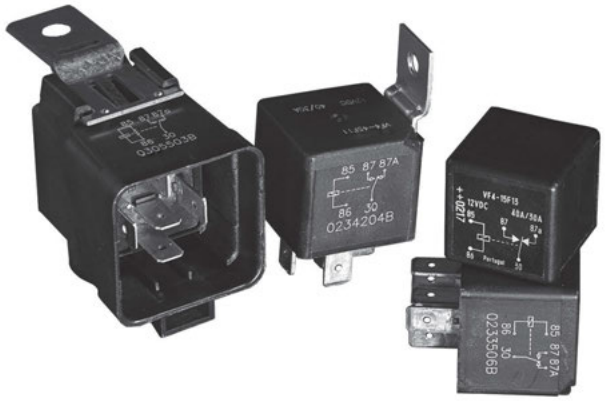
Terminal/arrangement
Xnnn Customized (nnn: version number)

Product code	Arrangement	Cover	Coil suppr.	Circuit[1)]	Coil	Cont. material	Terminals	Part number
V23136-A1001-X057	1 Form C, 1 CO	Shrouded	Resistor 680Ω	COR	12VDC	Silver based	Plug-in, QC	1-1414552-0
V23136-B1001-X051	1 Form A, 1 NO			NOR				1-1414121-0

1) See terminal assignment diagrams.
Other types on request.
This list represents the most common types and does not show all variants covered by this datasheet.

VF4A (Standard, Shrouded and Weatherproof)

- **Pin assignment similar to ISO 7588 part 1**
- **Plug-in terminals**
- **Customized versions on request**
  - **Integrated components (e.g. resistor, diode)**
  - **Customized marking**
  - **Special covers (e.g. brackets, shrouded)**

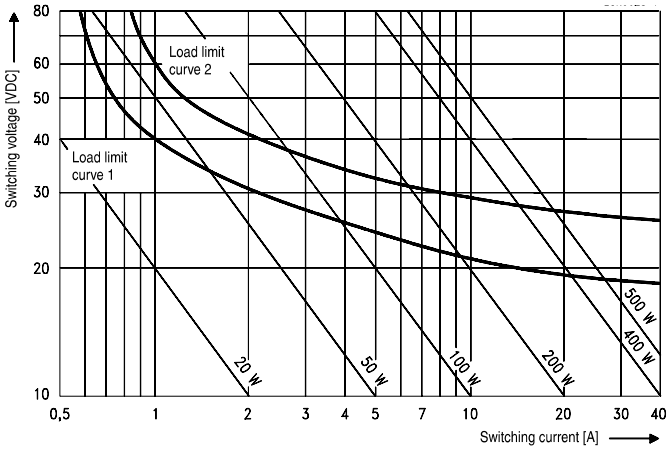


Typical applications
Cross carline up to 40A for example: ABS control, blower fans, car alarm, cooling fan, Electric Power Steering, energy management, engine control, fuel pump, heated front screen, lamps: front, rear, fog light, main switch/ supply relay, valves, wiper control.

Contact Data

Contact arrangement	1 form C, 1 CO
Rated voltage	12VDC
Limiting continuous current,	
form A/form B	NO/NC
23°C	60/45A
85°C	40/30A
125°C	17/12A
Limiting making current[1], form A/form B	120/45A
Limiting breaking current, form A/form B	60/40A
Limiting short-time current	
overload current, ISO 8820-3[2]	1.35 x 40A, 1800s 2.00 x 40A, 60s 6.00 x 40A, 1s
Jump start test, ISO 16750-1	24VDC for 5min, conducting nominal current at 23°C
Contact material	silver based
Min. recommended contact load[3]	1A at 5VDC
Initial voltage drop,	
form A (NO) contact at 40A, typ./max.	60/200mV
form B (NC) contact at 30A, typ./max.	60/250mV
Frequency of operation at nominal load	6 ops./min (0.1Hz)
Operate/release time typ.	7/2ms[4]
Electrical endurance	>1x10^5 ops.
resistive load, form A (NO) contact	40A, 14VDC
resistive load, form B (NC) contact	30A, 14VDC

Max. DC load breaking capacity



Load limit curve 1: arc extinguishes during transit time (changeover contact).
Load limit curve 2: safe shutdown, no stationary arc (make contact).
Load limit curves measured with low inductive resistors verified for 1000 switching events.

Contact Data (continued)

Mechanical endurance	>1x10^6 ops.

1) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 14VDC for 12VDC or 28VDC for 24VDC load voltages. For a load current duration of maximum 3s for a make/break ratio of 1:10.
2) Current and time are compatible with circuit protection by a typical automotive fuse. Relay will make, carry and break the specified current.
3) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
4) For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding.

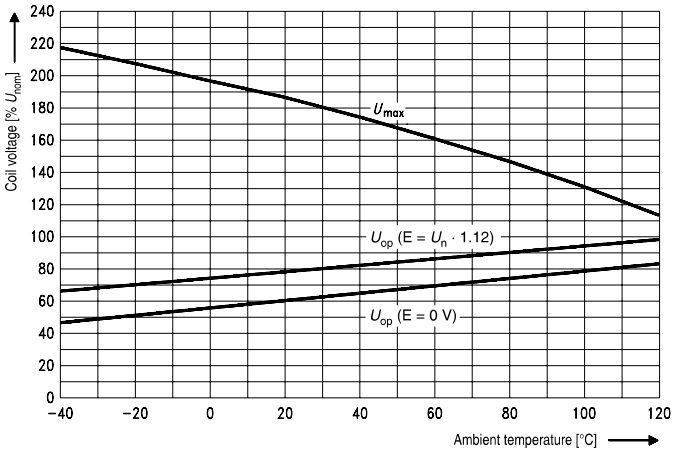
Coil Data

Rated coil voltage	12/24VDC
Coil versions, DC coil	

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance[5] Ω±10%	Rated coil power[5] W
F	12	7.2	1.2	90	1.6
H	24	14.4	2.4	360	1.6

5) Without components in parallel.
All figures are given for coil without pre-energization, at ambient temperature +23°C.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization.

VF4A (Standard, Shrouded and Weatherproof) (Continued)

Insulation Data	
Initial dielectric strength	
between open contacts	500V_{rms}
between contact and coil	500V_{rms}
between adjacent contacts	500V_{rms}

Other Data	
EU RoHS/ELV compliance	compliant
Protection to heat and fire according UL94	UL94-HB or better
Ambient temperature	-40 to 125°C
Category of environmental protection, IEC 61810	RT I (dustproof), RT III (sealed/sealed – shrouded)
Degree of protection, IEC 60529	IP54 (dustproof), IP67 (sealed) IP67 (sealed – shrouded), only with special connector
Vibration resistance (functional) IEC 60068-2-6 (sine sweep)	10 to 500Hz, min. 5g[6)]
Shock resistance (functional) IEC 60068-2-27 (half sine)	11ms, min. 20g[6)]
Drop test, free fall, IEC 60068-2-32	1m onto concrete

Other Data (continued)	
Terminal type	plug-in, QC
Cover retention	
axial force	150N
pull force	200N
push force	200N
Terminal retention	
pull force	100N
push force	100N
resistance to bending	10N[7)]
force applied to side	10N[7)]
torque	0.3Nm
Weight	approx. 35 to 60g (1.2 to 2.1oz)
Packaging unit	
cover type VF4-1	357 pcs.
VF4-4	200 pcs.
VF4-5, VF4-6	110 pcs.

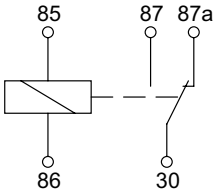
6) No change in the switching state >1ms. Valid for NC contacts, NO contact values significantly higher.

7) Values apply 2mm from the end of the terminal. When the force is removed, the terminal must not have moved by more than 0.3mm.

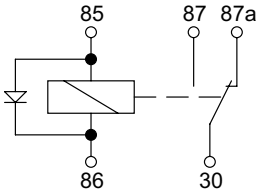
Accessories	
For details see datasheet	Connectors for Mini, Mini (Shrouded) and Maxi ISO Relays

Terminal Assignment

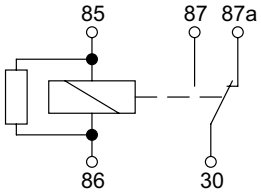
CO
1 form C, 1 CO



COD
1 form C, 1 CO with diode

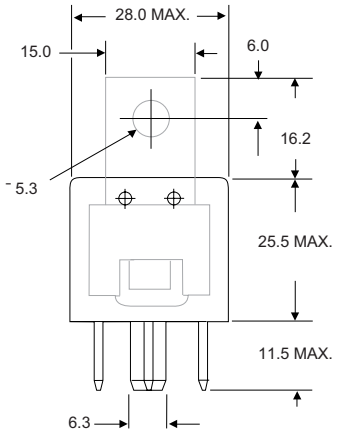


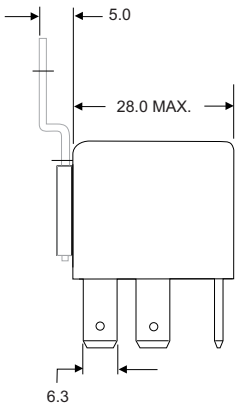
COR
1 form C, 1 CO with resistor



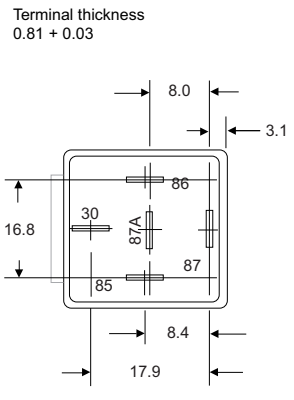
Dimensions

VF4A with dust cover
VF4-1**** (without bracket) and VF4-4**** (with bracket)





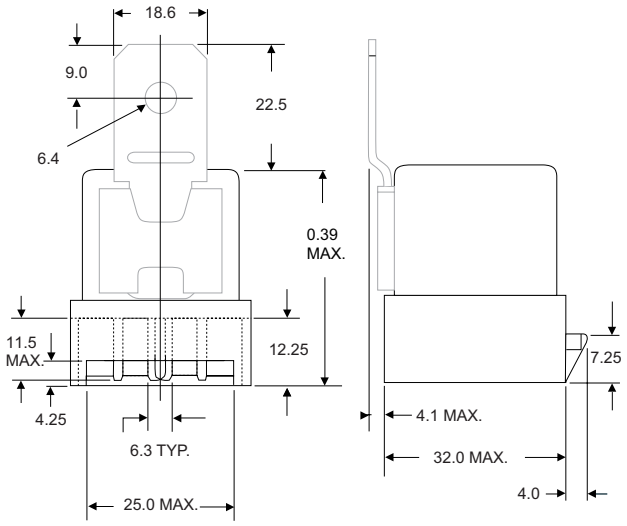
View of the terminals (bottom view)



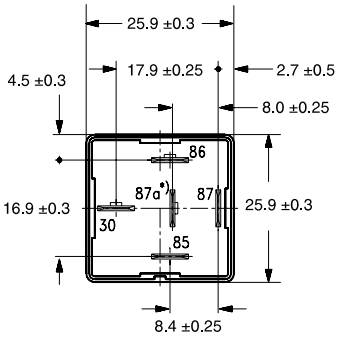
VF4A (Standard, Shrouded and Weatherproof) (Continued)

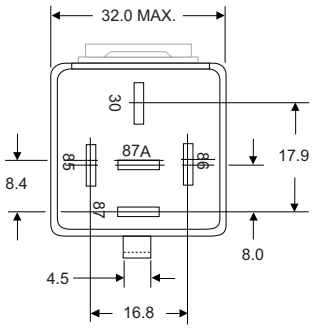
Dimensions

VF4A with shrouded dust cover
VF4-2**** (without bracket) and VF4-5**** (with bracket)

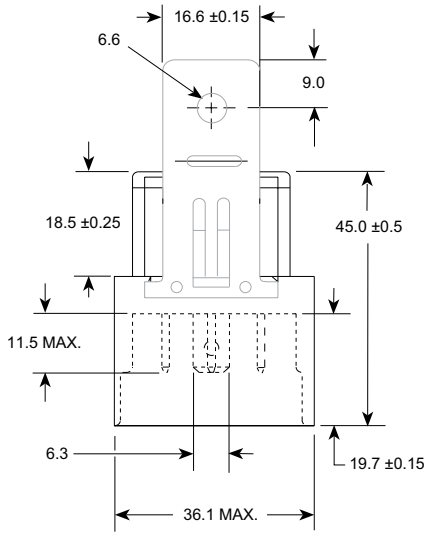


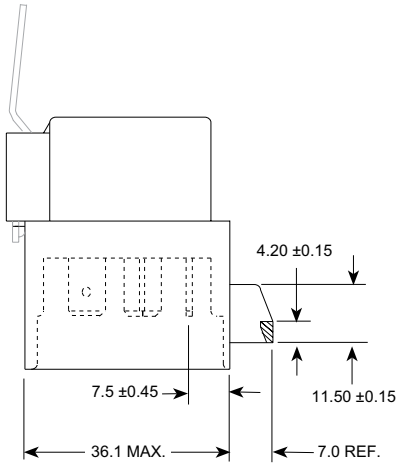
View of the terminals (bottom view)



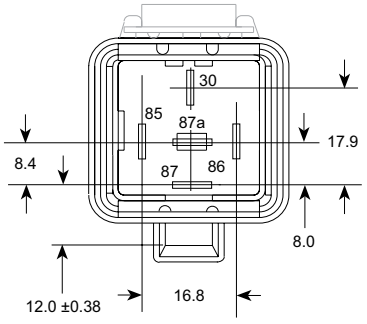


VF4A with weatherproof cover
VF4-3**** (without bracket) and VF4-6**** (with bracket)





View of the terminals (bottom view)



VF4A (Standard, Shrouded and Weatherproof) (Continued)

Product code structure

	Typical product code	VF4	-1	5	F	11	-S01

Type
VF4A VF4A

Cover type

1	Dust cover standard	**2**	Shrouded dust cover standard
3	Weatherproof cover standard	**4**	Dust cover with bracket
5	Shrouded dust cover with bracket	**6**	Weatherproof cover with bracket

Contact arrangement
5 1 form C, 1 CO

Coil

F	12VDC	**H**	24VDC

Contact material

11	Silver based	**21**	Silver based for capacitive loads

Coil suppression

S01	Resistor in parallel (680Ω)	**S05**	Diode in parallel (cathode 86)
S08	Resistor in parallel (2700Ω)		

Product code	Arrangement	Cover	Coil suppr.	Circuit[1)]	Coil	Cont. material	Terminals	Part number
VF4A-15F11	1 form C, 1 CO	Standard		CO	12VDC	Silver based	Plug-in, QC	6-1393298-0
VF4A-15F11-S01			Resistor 680Ω	COR				6-1393298-4
VF4A-15F11-S05			Diode (cathode 86)	COD				6-1393298-5
VF4A-15F21-S01			Resistor 680Ω	COR		Silver based[2)]		7-1393298-3
VF4A-15H11				CO	24VDC	Silver based		8-1393298-1
VF4A-15H11-S08			Resistor 2700Ω	COR				5-1393305-7
VF4A-45F11		Bracket		CO	12VDC			8-1393298-8
VF4A-45F11-S01			Resistor 680Ω	COR				1-1393302-0
VF4A-45H11				CO	24VDC			1-1393302-1
VF4A-55F11-S01		Shrouded	Resistor 680Ω	COR	12VDC			8-1393305-7
VF4A-65F11-S01		Weatherproof						9-1393305-5
VF4A-65H11-S08			Resistor 2700Ω		24VDC			9-1393305-9

1) See terminal assignment diagrams.
2) Special contact material for capacitive loads.
Other types on request.
This list represents the most common types and does not show all variants covered by this datasheet.

Power Relay B

- **Pin assignment similar to ISO 7588 part 1**
- **Plug-in terminals**
- **Customized versions on request**
  - **– 24VDC versions with contact gap >0.8mm**
  - **– Integrated components (e.g. resistor, diode)**
  - **– Customized marking/color**
  - **– Special covers (e.g. notches, release features, brackets)**
  - **– Various contact arrangements and materials**

Typical applications
Cross carline up to 35A for example: rear window defogger, battery disconnection, power distribution (clamp 15).

Contact Data	1 A	1 A	1 C	1 C
Contact arrangement	1 form A, 1 NO	1 form A, 1 NO	1 form C, 1 CO	1 form C, 1 CO
Rated voltage	12VDC	24VDC	12VDC	24VDC
Limiting continuous current form A/form B (NO/NC)				
23°C	50A	50A	50/35A	50/35A
85°C	35A	35A	35/25A	35/25A
125°C	15A	15A	15/10A	15/10A
Limiting making current[1] A/B (NO/NC)	120A	120A	120/45A	120/45A
Limiting breaking current, A/B (NO/NC)	30A	20A	30/20A	20/10A
Limiting short-time current overload current, ISO 8820-3[2]	1.35 x 35A, 1800s 2.00 x 35A, 5s 3.50 x 35A, 0.5s 6.00 x 35A, 0.1s			
Jump start test, ISO 16750-1	24VDC for 5min, conducting nominal current at 23°C			
Contact material	Silver based			
Min. recommended contact load[3]	1A at 5VDC			
Initial voltage drop, at 10A, typ./max.				
form A (NO)	15/300mV	15/300mV	15/300mV	15/300mV
form B (NC)	-	-	20/300mV	20/300mV
Frequency of operation, at nominal load	6 ops./min (0.1Hz)			
Operate/release time typ.	10/10ms[4]			
Electrical endurance, ops.				
resistive load, A (NO)	>2.5x10^5 30A, 14VDC	>2.5x10^5 20A, 28VDC	>2.5x10^5 30A, 14VDC	>2.5x10^5 20A, 28VDC
resistive load, B (NC)	-	-	>1x10^5 20A, 14VDC	>2.5x10^5 10A, 28VDC
Mechanical endurance	typ. 1x10^6 ops.			

1) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 14VDC for 12VDC or 28VDC for 24VDC load voltages. For a load current duration of maximum 3s for a make/break ratio of 1:10.
2) Current and time are compatible with circuit protection by a typical automotive fuse. Relay will make, carry and break the specified current.
3) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
4) For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding.

Coil Data	
Rated coil voltage	12/24VDC

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance[5] Ω±10%	Rated coil power[5] W
001	12	8	1.5	85	1.7
002	12	6.5	1	75	1.9
004	24	16	3	255	2.3

5) Without components in parallel.
All figures are given for coil without pre-energization, at ambient temperature +23°C.

Insulation Data	
Initial dielectric strength	
between open contacts	500V$_{rms}$
between contact and coil	500V$_{rms}$
between adjacent contacts	500V$_{rms}$
Load dump test	
ISO 7637-1 (12VDC), test pulse 5	V_s=+86.5VDC
ISO 7637-2 (24VDC), test pulse 5	V_s=+200VDC

Other Data	
EU RoHS/ELV compliance	compliant
Protection to heat and fire according UL94	HB or better[6]
Ambient temperature	-40 to 125°C
Climatic cycling with condensation, EN ISO 6988	6 cycles, storage 8/16h
Temperature cycling, IEC 60068-2-14, Nb	10 cycles, -40/+85°C (5°C/min)
Damp heat cyclic, IEC 60068-2-30, Db, Variant 1	6 cycles, upper air temp. 55°C
Damp heat constant, IEC 60068-2-3, Ca	56 days
Category of environmental protection, IEC 61810	RT I – dustproof
Degree of protection, IEC 60529	IP54
Corrosive gas	
IEC 60068-2-42	10±2cm^3/m^3 SO_2, 10 days
IEC 60068-2-43	1±0.3cm^3/m^3 H_2S, 10 days
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep)	10 to 500Hz, min. 5g[7]
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	11ms, min. 20g[7]
Drop test, free fall, IEC 60068-2-32	1m onto concrete

Power Relay B (Continued)

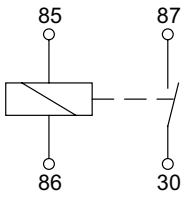
Other Data (continued)	
Terminal type	plug-in, QC
Cover retention	
axial force	150N
pull force	200N
push force	200N
Terminal retention[8)]	
pull force	100N
push force	100N
resistance to bending	10N
force applied to side	10N
torque	0.3Nm
Weight	approx. 35g (1.2oz)
Packaging unit	200 pcs.

6) Refers to used mateials.
7) No change in the switching state >10µs. Valid for NC contacts, NO contact values significantly higher.
8) Values apply 2mm from the end of the terminal. When the force is removed, the terminal must not have moved by more than 0.3mm.

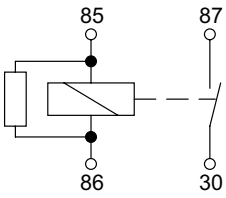
Accessories	
For details see datasheet	Connectors for Mini ISO Relays

Terminal Assignment

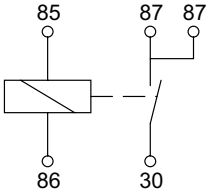
NO
1 form A, NO



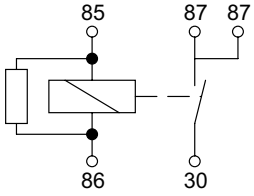
NOR
1 form A, NO with resistor



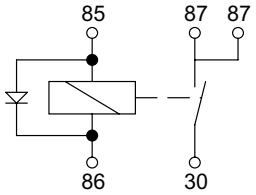
NO_2x87
1 form A, 1 NO (2x87)



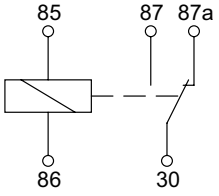
NOR_2x87
1 form A, 1 NO (2x87) with resistor



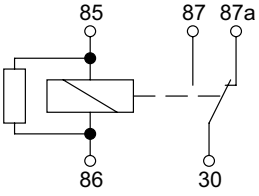
NOD_2x87
1 form A, 1 NO (2x87) with diode



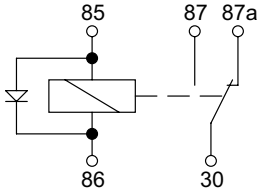
CO
1 form C, CO



COR
1 form C, CO with resistor



COD
1 form C, CO with diode



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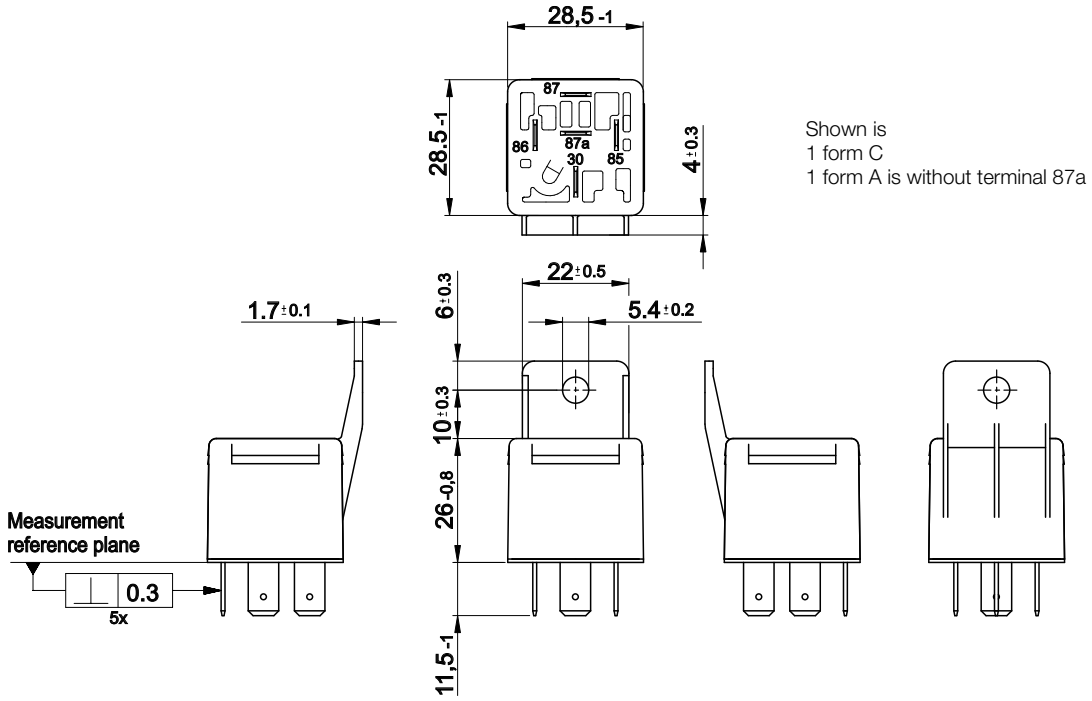
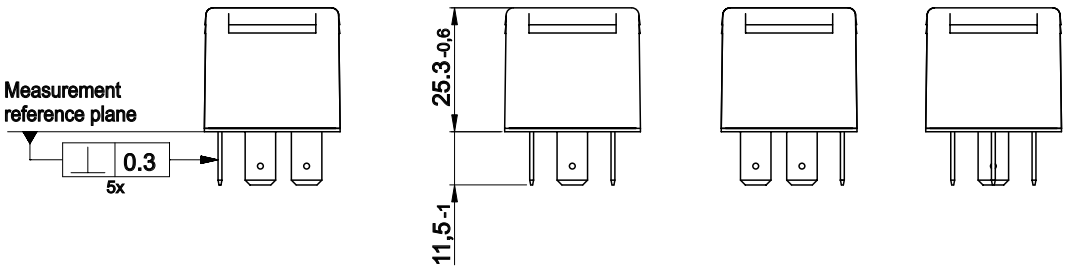
Power Relay B (Continued)

Dimensions

Power Relay B with bracket

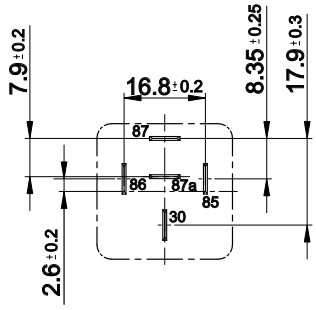


Power Relay B without bracket

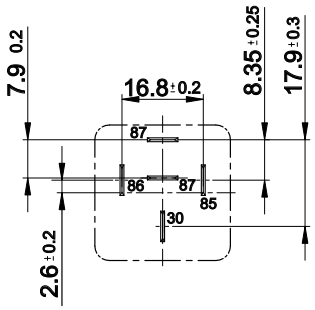


View of the terminals (bottom view)

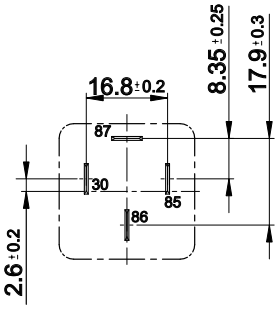
1 form C
1 form A is without 87a



1 form A (2x87)



1 form A non ISO
(Terminals 30 and 86 changed position)



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Power Relay B (Continued)

Product code structure	Typical product code	V23234	-A	0	001	-X040

Type
V23234 Power Relay B

Contact arrangement

A	1 form C, 1 CO	**B**	1 form A, 1 NO
C	1 form A, 1 NO (2x87)	**K**	1 form A, 1 NO (non ISO)

Cover
0 Standard
1 Bracket near terminal 30 ISO

Coil

001	12VDC	**002**	12VDC
004	24VDC		

Terminal/arrangement
Xnnn Customized (nnn: version number)

Product code	Arrangement	Cover	Coil suppr.	Circuit[1)]	Coil	Cont. material	Terminals	Part number
V23234-A0001-X032	1 form C,	Standard	Resistor 680Ω	COR	12VDC	Silver based	Plug-in, QC	1-1904020-2
V23234-A0001-X038	1 CO		Diode (cathode 86)	COD				1-1904020-5
V23234-A0001-X040				CO				4-1904020-7
V23234-A0004-X055					24VDC			2-1904025-6
V23234-A0004-X051			Diode (cathode 86)	COD				2-1904025-3
V23234-A0004-X053			Resistor 1400Ω	COR				2-1904025-5
V23234-A1001-X033		Bracket	Resistor 680Ω		12VDC			1-1904022-1
V23234-A1001-X036				CO				3-1904022-2
V23234-A1001-X041			Diode (cathode 86)	COD				2-1904022-3
V23234-A1004-X050				CO	24VDC			1-1904027-1
V23234-A1004-X054			Resistor 1400Ω	COR				3-1904027-2
V23234-B0001-X001	1 form A,	Standard	Resistor 680Ω	NOR	12VDC			5-1904006-1
V23234-B0002-X012	1 NO			NO				1-1904008-2
V23234-B1001-X004		Bracket	Resistor 680Ω	NOR				1-1904007-1
V23234-B1001-X010				NO				1-1904007-2
V23234-C0001-X003	1 form A,	Standard	Diode (cathode 86)	NOD_2x87				2-1904011-1
V23234-C0001-X006	1 NO (2x87)			NO_2x87				2-1904011-2
V23234-C0004-X018			Resistor 1400Ω	NOR_2x87	24VDC			2-1904015-1
V23234-C0004-X020				NO_2x87				1-1904015-3
V23234-C1001-X005		Bracket			12VDC			5-1904012-1
V23234-C1004-X017					24VDC			5-1904014-1
V23234-C1004-X085			Resistor 1400Ω	NOR_2x87				1904015-5
V23234-K1001-X024	1 form A, 1 NO		Resistor 680Ω	NOR (non ISO)	12VDC		Plug-in, QC /non ISO	5-1904018-1

1) See terminal assignment diagrams.
Other types on request.
This list represents the most common types and does not show all variants covered by this datasheet.

Mini Relay Latching

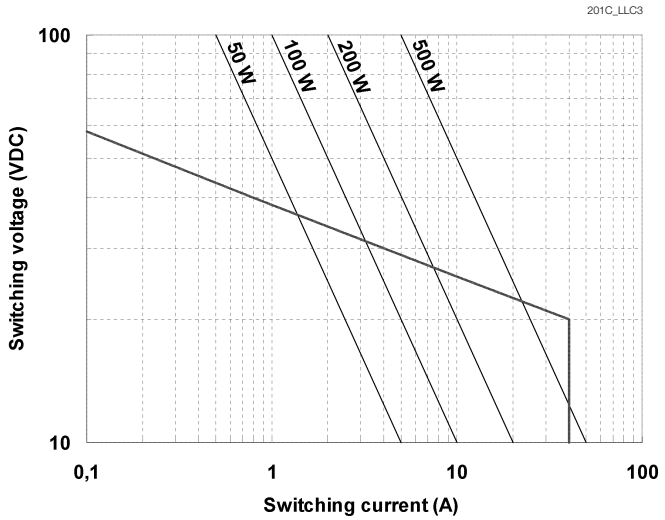
- **Magnetically latched, ISO plug-in relay**
- **Two coils with set and reset function**
- **Pin assignment similar to ISO 7588 part 1**
- **Plug-in terminals**

Typical applications
Active power management, disconnection of power outlets and all applications that require a quiescent current of 0A.

Contact Data

Contact arrangement	1 form A, 1 NO
Rated voltage	12VDC
Limiting continuous current	
23°C	40A
85°C	30A
125°C	10A
Contact material	silver based
Min. recommended contact load	1A at 5VDC
Initial voltage drop, form A (NO) contact at 10A, typ./max.	50mV
Frequency of operation	6 ops./min (0.1Hz)
Operate/release time max.	typ. 1.5/1.5ms
Electrical endurance cyclic temperature:-40°C, +23°C, +85°C resistive load at 14VDC	>1x10^5 cycles 40A on/off
Mechanical endurance	typ. >10^6 cycles

Max. DC load breaking capacity



Load limit curve: safe shutdown, no stationary arc/make contact.

Coil Data

Magnetic system	bistable (two coil system)
Rated coil voltage	12VDC, pulsed
Max. coil temperature	155°C

Coil versions, bistable 2 coils

Coil code	Rated voltage VDC	Set voltage VDC	Reset voltage VDC	Coil resistance Ω±10%	Rated coil power W
0001	12	6.9	6.9	20	7.2[1)]

1) Set pulse 10ms <pulse width <100ms.
All figures are given for coil without pre-energization, at ambient temperature +23°C.

Insulation Data

Initial dielectric strength between contact and coil	500VAC$_{rms}$

Other Data

EU RoHS/ELV compliance	compliant
Ambient temperature	-40°C to +125°C
Cold storage, IEC 60068-2-1	1000h, -40°C
Dry heat, IEC 60068-2-2	1000h, as per BA at 125°C
Temperature cycling, IEC 60068-2-14, Nb	10 cycles, -40/+85°C (5°C/min)
Damp heat cyclic, IEC 60068-2-30, Db, Variant 1	6 cycles, upper air temp. 55°C
Damp heat constant, IEC 60068-2-3, Ca	56 days
category of environmental protection, IEC 61810	RT I – dustproof
Degree of protection, IEC 60529	IP54 (dustproof)
Corrosive gas	
IEC 60068-2-42	10±2cm^3/m^3 SO_2, 10 days
IEC 60068-2-43	1±0.3cm^3/m^3 H_2S, 10 days
Vibration resistance (functional) IEC 60068-2-6 (sine sweep)	30 to 500Hz >10g[2)]
Shock resistance (functional) IEC 60068-2-27 (half sine)	6 ms >30g[2)]

Mini Relay Latching (Continued)

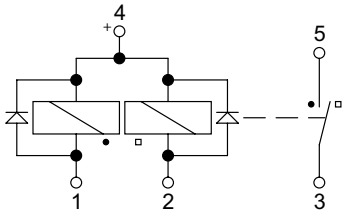
Other Data (continued)	
Terminal type	plug-in, QC
Cover retention	
axial force	150 N
pull force	150 N
push force	200 N
Terminal retention	
pull force	100 N
push force	100 N
resistance to bending[3]	10 N
force applied to side[3]	10 N
torque	0.3 Nm
Weight	approx. 30g (1.1oz)

2) No change in the switching state >10µs. Valid for NC contacts, NO contact values significantly higher.
3) Values apply 2mm from the end of the terminals. When the force is removed, the terminals must not have moved by more than 0.3mm.

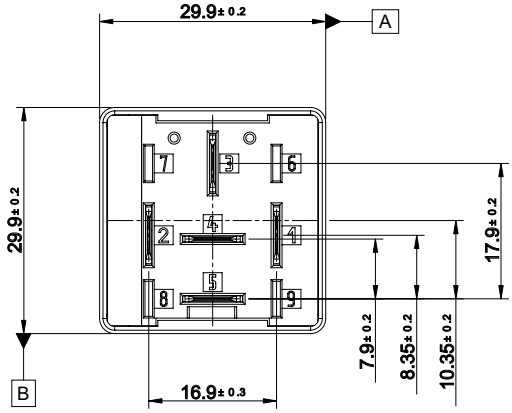
Accessories	
For details see datasheet	Connectors for Mini ISO Relays

Terminal Assignment

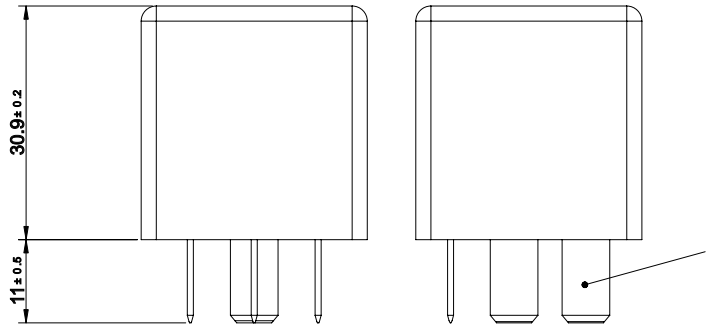
NO2D
1 form A, 1 NO



View of the terminals (bottom view)



Dimensions



Product code structure

Typical product code: **V23141** **-L** **0001** **-X** **039**

Type
V23141 Mini Relay Latching

Magnetic system
L Bistable

Coil
001 12VDC

Terminals
X Plug-in, QC version

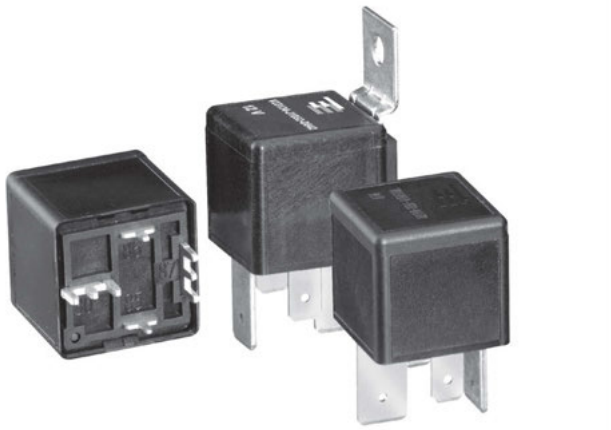
Contact material
039 Silver based
X050 Customized: resistor 560Ω

Product code	Arrangement	Coil	Coil system	Coil suppr.	Circuit[1]	Contact material	Terminals	Part number
V23141-L0001-X039	1 form A, 1 NO	12VDC	Bistable (2 coils)	Diode	NO2D	Silver based	Plug-in, QC	3-1414968-6

1) See terminal assignment diagrams.

Power Relay F7

- **Pin assignment similar to ISO 7588 part 1**
- **Customized versions on request**
  - **– 24VDC versions with contact gap >0.8mm**
  - **– Integrated components (e.g. resistor, diode)**
  - **– Customized marking/color**
  - **– Special covers (e.g. notches, release features, brackets)**



Typical applications
Cross carline up to 70A for example: ABS control, cooling fan, energy management, engine control, glow plug, heated front screen, ignition, lamps: front, rear, fog light, main switch/supply relay.

Contact Data

Contact arrangement	1 form A, 1 NO	1 form A, 1 NO	1 form A, 1 NO
Contact gap	-	-	>0.8mm
Rated voltage	12VDC	24VDC	24VDC[1)]
Limiting continuous current			
23°C	70A	70A	70A
85°C	50A	50A	50A
125°C	30A	30A	30A
Limiting making current[2)]	240A	240A	240A
Limiting breaking current	70A	25A	40A
Limiting short-time current overload current, ISO 8820-3[3)]	1.35 x 50A, 1800s 2.00 x 50A, 5s 3.50 x 50A, 0.5s 6.00 x 50A, 0.2s		
Jump start test, ISO 16750-1	24VDC for 5min, conducting nominal current at 23°C		
Contact material	Silver based		
Min. recommended contact load[4)]	1A at 5VDC		
Initial voltage drop, form A (NO) contact at 10A, typ./max.	10/300mV		
Frequency of operation at nominal load	6 ops./min (0.1Hz)		
Operate/release time typ.	7/2ms[5)]		
Electrical endurance			
resistive load at 14VDC	>1x10^5 ops. 70A	-	-
	>2x10^5 ops. 50A	-	-
resistive load at 28VDC	-	>1x10^{5}ops. 25A	>1x10^5 ops. 50A

Contact Data (continued)

Mechanical endurance	>1x10^{7}ops.

1) Special high performance 24VDC version with contact gap >0.8mm, part number V23134-A0056-X408 (see part number table).
2) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 14VDC for 12VDC or 28VDC for 24VDC load voltages. For a load current duration of maximum 3s for a make/break ratio of 1:10.
3) Current and time are compatible with circuit protection by a typical automotive fuse. Relay will make, carry and break the specified current.
4) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
5) For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding.

Coil Data

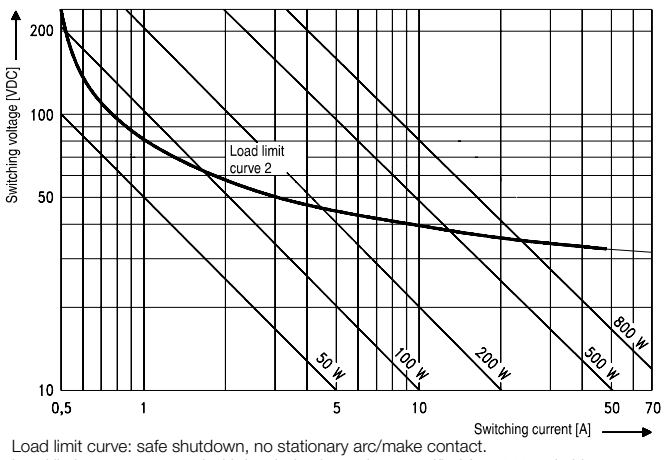
Rated coil voltage	12VDC, 24VDC

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance[6)] Ω±10%	Rated coil power[6)] W
052	12	7.2	1.6	90	1.6
053	24	14.4	3.2	324	1.8
056	24	16.0	4.0	268	2.1
065	24	14.4	2.4	288	2.0

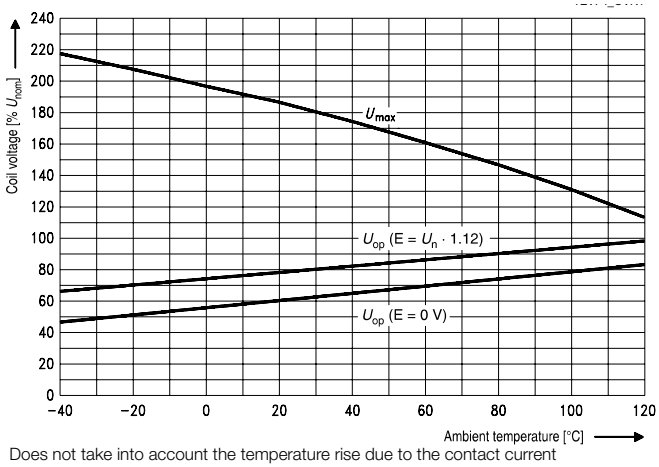
6) Without components in parallel.
All figures are given for coil without pre-energization, at ambient temperature +23°C.

Max. DC load breaking capacity



Load limit curve: safe shutdown, no stationary arc/make contact.
Load limit curve measured with low inductive resistors verified for 1000 switching events.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization.

Power Relay F7 (Continued)

Insulation Data	
Initial dielectric strength	
between open contacts	500V_{rms}
between contact and coil	500V_{rms}
between adjacent contacts	500V_{rms}
Load dump test	
ISO 7637-1 (12VDC), test pulse 5	V_s=+86.5VDC
ISO 7637-2 (24VDC), test pulse 5	V_s=+200VDC

Other Data	
EU RoHS/ELV compliance	compliant
Protection to heat and fire according UL-94	HB or better[7)]
Ambient temperature	-40 to 125°C
Climatic cycling with condensation	
EN ISO 6988	6 cycles, storage 8/16h
Temperature cycling,	
IEC 60068-2-14, Nb	10 cycles, -40/+85°C (5°C/min)
Damp heat cyclic,	
IEC 60068-2-30, Db, Variant 1	6 cycles, upper air temp. 55°C
Damp heat constant, IEC 60068-2-3, Ca	56 days
Category of environmental protection,	
IEC 61810	RTI – dustproof, RT III – sealed
Degree of protection, IEC 60529	IP54 (dustproof), IP67 (sealed)
Corrosive gas	
IEC 60068-2-42	10±2cm^3/m^3 SO_2, 10 days
IEC 60068-2-43	1±0.3cm^3/m^3 H_2S, 10 days
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep)	10 to 500Hz, min. 5g[8)]
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	6ms, min. 30g.[8)]
Drop test, free fall	
IEC 60068-2-32	1m onto concrete

Other Data (continued)	
Terminal type	plug-in, QC/ PCB
Cover retention	
axial force	150N
pull force	150N
push force	150N
Terminal retention	
pull force	100N
push force	100N
resistance to bending	10N[8)]
force applied to side	10N[8)]
torque	0.3Nm
Weight	approx. 38g (1.3oz)
Resistance to soldering heat THT	
IEC 60068-2-20	260°C, 10s
Packaging unit	
plug-in:	210 pcs.
plug-in with bracket:	208 pcs.
PCB	315 pcs.

7) Refers to used materials.

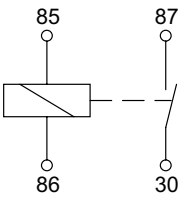
8) No change in the switching state >1µs. Valid for NC contacts, NO contact values significantly higher.

8) Values apply 2mm from the end of the terminal. When the force is removed, the terminal must not have moved by more than 0.3mm.

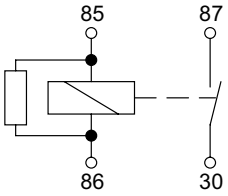
Accessories	
For details see datasheet	Connectors for Maxi ISO Relays

Terminal Assignment

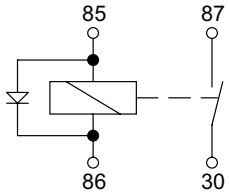
NO
1 form A, NO



NOR
1 form A, NO with resistor



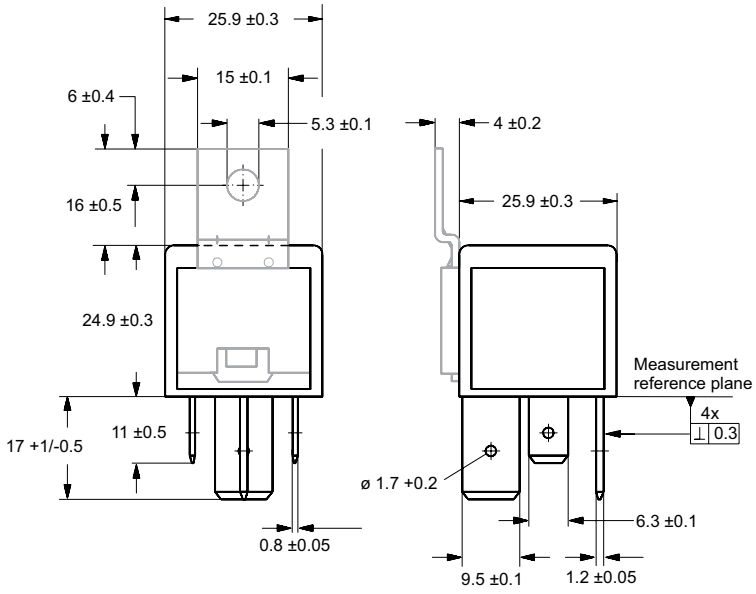
NOD
1 form A, NO with diode



Power Relay F7 (Continued)

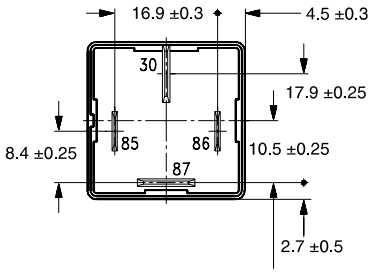
Dimensions

Power Relay F7 with quick connect terminals

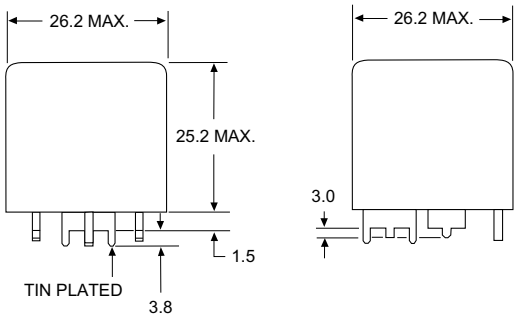


Quick connect terminal similar to ISO 8092-1

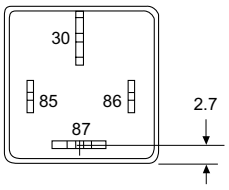
View of the terminals (bottom view)



Power Relay F7 with PCB terminals

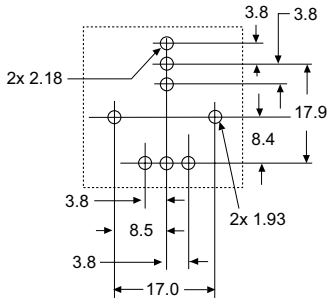


View of the terminals (bottom view)



PCB Layout

Bottom view on solder pins



Power Relay F7 (Continued)

Product code structure — Typical product code: **V23134 -J 0 052 -D642**

Type
V23134 Power Relay F

Contact arrangement
J 1 form A, 1 NO

Cover
0 Standard
1 Bracket near terminal 30 ISO

Coil
052 12VDC
053 24VDC
056 24VDC (contact gap >0.8mm)
065 24VDC

Terminal/arrangement
D642 Plug-in/NO
Xnnn Customized (nnn: version number)

Product code	Arrangement	Cover	Coil suppr.	Circuit[1)]	Coil	Cont. material	Terminals	Part number
V23134-J0052-D642	1 form A,	Standard		NO	12VDC	Silver based	Plug-in, QC	7-1393303-3
V23134-J0052-X429	1 NO		Resistor 680Ω	NOR				1-1414147-0
V23134-J0052-X439			Diode (cathode 86)	NOD				1-1414286-0
V23134-J0052-X455			Resistor 470Ω	NOR			PCB	1-1414478-0
V23134-J0052-X511				NO				3-1415001-2
V23134-J0052-X461			Resistor 560Ω	NOR			Plug-in[3)]	1-1414469-0
V23134-J0053-D642				NO	24VDC		Plug-in, QC	9-1393303-7
V23134-J0056-X408[2)]			Resistor 1200Ω	NOR				0-1393304-5
V23134-J0065-X497[4)]				NO			PCB	3-1414937-3
V23134-J1052-D642		Bracket			12VDC		Plug-in, QC	0-1393304-9
V23134-J1052-X281			Resistor 560Ω	NOR				1-1393304-0
V23134-J1053-D642				NO	24VDC			1-1393304-1
V23134-J1053-X282			Resistor 1200Ω	NOR				1-1393304-2

1) See terminal assignment diagrams.
2) Special feature: contact gap >0.8mm.
3) Special feature: 14.5mm load terminals.
4) Packed in tray with 300 pcs. per unit.
Other types on request.
This list represents the most common types and does not show all variants covered by this datasheet.

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Shrouded Power Relay F7 A

- **Pin assignment similar to ISO 7588 part 1**
- **Customized versions on request**
  - **– Integrated components (e.g. resistor, diode)**
  - **– Customized marking/color**
  - **– Special cover with bracket**

Typical applications
Cross carline up to 70A for example: ABS control, blower fans, cooling fan, energy management, engine control, fuel pump, heated front screen, ignition, lamps: front, rear, fog light, main switch/supply relay, wiper control.

Contact Data

Contact arrangement	1 form A, 1 NO
Rated voltage	12VDC
Limiting continuous current	
23°C	70A
85°C	50A
125°C	30A
Limiting making current[1)]	240A
Limiting breaking current	70A
Limiting short-time current	
overload current, ISO 8820-3[2)]	1.35 x 50A, 1800s 2.00 x 50A, 5s 3.50 x 50A, 0.5s 6.00 x 50A, 0.1s
Jump start test, ISO 16750-1	24VDC for 5min, conducting nominal current at 23°C
Contact material	Silver based
Min. recommended contact load[3)]	1A at 5VDC
Initial voltage drop, form A (NO) contact at 10A, typ./max.	15/300mV
Frequency of operation at nominal load	6 ops./min (0.1Hz)
Operate/release time typ.	8.5/4ms[4)]
Electrical endurance resistive load, NO contact	>2x10^5 ops. 50A, 14VDC

Contact Data (continued)

Mechanical endurance	>1x10^7 ops.

1) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 14VDC for 12VDC or 28VDC for 24VDC load voltages. For a load current duration of maximum 3s for a make/break ratio of 1:10.
2) Current and time are compatible with circuit protection by a typical automotive fuse. Relay will make, carry and break the specified current.
3) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
4) For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding.

Coil Data

Rated coil voltage	12VDC

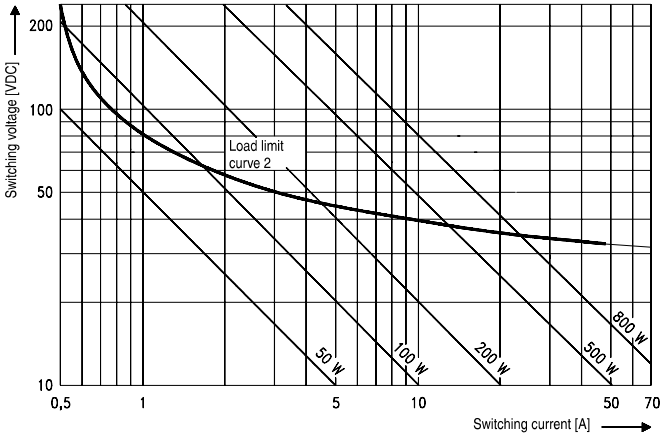
Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance[5)] Ω±10%	Rated coil power[5)] W
004	12	7.2	1.6	90	1.6

5) Without components in parallel.

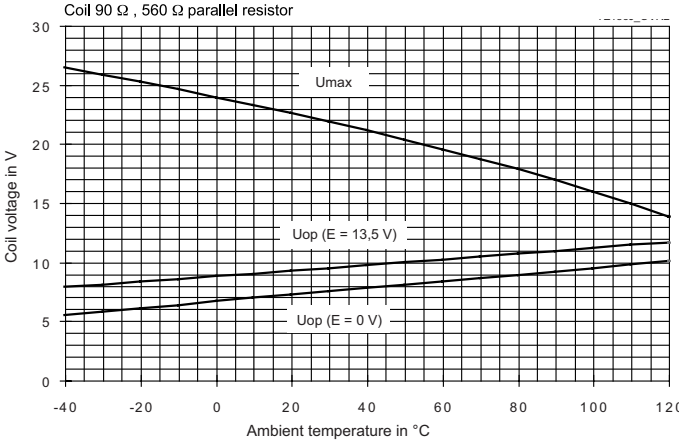
All figures are given for coil without pre-energization, at ambient temperature +23°C.

Max. DC load breaking capacity



Load limit curve 1: arc extinguishes during transit time (changeover contact).
Load limit curve 2: safe shutdown, no stationary arc (make contact).
Load limit curves measured with low inductive resistors verified for 1000 switching events.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization.

Shrouded Power Relay F7 A (Continued)

Insulation Data	
Initial dielectric strength	
between open contacts	500V_{rms}
between contact and coil	500V_{rms}
between adjacent contacts	500V_{rms}
Load dump test	
ISO 7637-1 (12VDC), test pulse 5	V_s=+86.5VDC
ISO 7637-2 (24VDC), test pulse 5	V_s=+200VDC

Other Data	
EU RoHS/ELV compliance	compliant
Protection to heat and fire according UL94	HB or better[6)]
Ambient temperature	-40 to 125°C
Climatic cycling with condensation, EN ISO 6988	6 cycles, storage 8/16h
Temperature cycling, IEC 60068-2-14, Nb	10 cycles, -40/+85°C (5°C/min)
Damp heat cyclic, IEC 60068-2-30, Db, Variant 1	6 cycles, upper air temp. 55°C
Damp heat constant, IEC 60068-2-3, Ca	56 days
Category of environmental protection, IEC 61810	RT III – sealed
Degree of protection, IEC 60529	IP67 (sealed) only with special connector
Vibration resistance (functional) IEC 60068-2-6 (sine sweep)	10 to 500Hz, min. 10g[7)]
Shock resistance (functional) IEC 60068-2-27 (half sine)	6ms, min. 30g[7)]
Drop test, free fall, IEC 60068-2-32	1m onto concrete

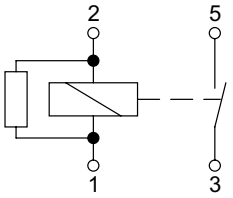
Other Data (continued)	
Terminal type	plug-in, QC/ PCB
Cover retention	
axial force	150N
pull force	200N
push force	200N
Terminal retention[8)]	
pull force	100N
push force	100N
Weight	approx. 60g (2.1oz)
Packaging unit	108 pcs.

6) Refers to used materials.
7) No change in the switch.ing state >10µs. Valid for NC contacts, NO contact values significantly higher.
8) Values apply 2mm from the end of the terminal. When the force is removed, the terminal must not have moved by more than 0.3mm.

Accessories
For fitting connectors please contact us via online Support Center

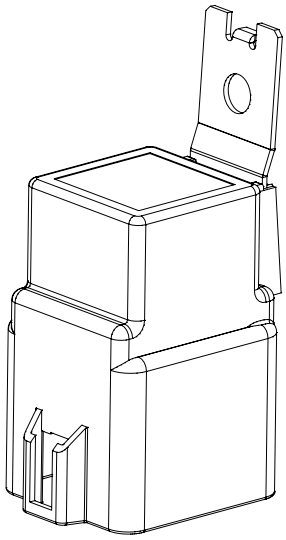
Terminal Assignment

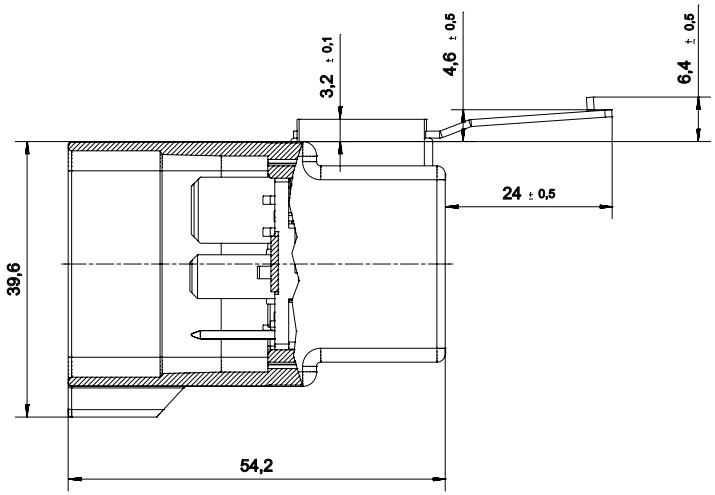
NOR
1 form A, NO with resistor

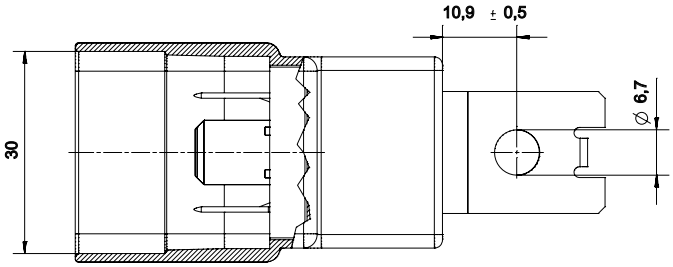


Shrouded Power Relay F7 A (Continued)

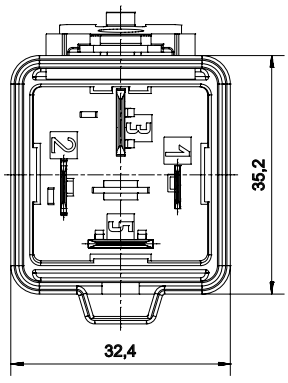
Dimensions

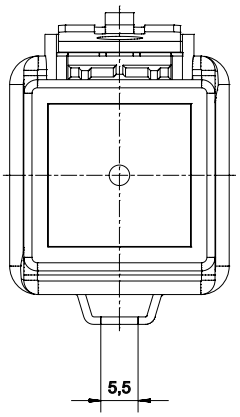






View of the terminals (bottom view)





Product code structure

Typical product code: **V23136** **-J** **1** **004** **-X050**

Type
V23136 Power Relay F7 A

Contact arrangement
J 1 form A, 1 NO

Cover
1 Bracket at terminal 30 ISO

Coil
004 12VDC

Terminal/arrangement
X050 Customized: resistor 560Ω

Product code	Arrangement	Cover	Coil suppr.	Circuit[1)]	Coil	Contact material	Terminals	Part number
V23136-J1004-X050	1 Form A, 1 NO	Standard	Resistor 560Ω	NOR	12VDC	Silver based	Plug-in, QC	1-1414122-0

1) See terminal assignment diagrams.
Other types on request.
This list represents the most common types and does not show all variants covered by this datasheet.

Contents

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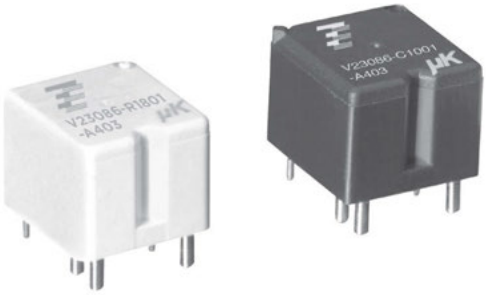
Micro Relay K (THT – THR)

- **Small power relay**
- **Limiting continuous current 30A**
- **Minimal weight**
- **Low noise operation**
- **Wave (THT) and reflow (THR/pin-in-paste) solderable versions**
- **For twin version refer to Double Micro Relay K**

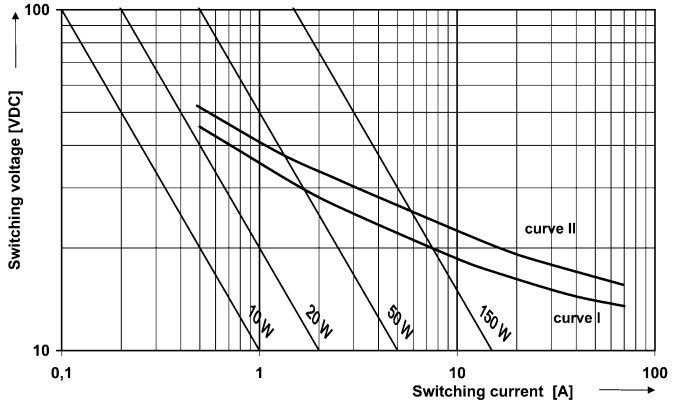


Typical applications
Car alarm, door control, door lock, hazard warning signal, heated front/rear screen, immobilizer, lamps front/rear/fog light, interior lights, seat control, sun roof, turn signal, window lifter, wiper control.

Contact Data

Typical applications	Resistive/inductive load V23086-*100*-A403	Wiper load V23086-*1*02-A803	Lamp load[5] V23086-***21-A502
Contact arrangement	1 form C, 1 CO	1 form C, 1 CO	1 form A, 1 NO
Rated voltage	10/12VDC	10/12VDC	10/12VDC
	NO/NC	NO/NC	
Rated current	30/25A	30/25A	30A
Limiting continuous current			
23°C	30/25A	30/25A	30A
85°C	20/15A	20/15A	20A
Limiting making current	40A[1]	40A[1]	100A[2]
Limiting breaking current	30A	30A	30A
Contact material		$AgSnO_2$	
Min. recommended contact load		1A at 5VDC[3]	
Initial voltage drop at 10A, typ./max.		30/300mV	
Operate/release time		typ. 3/1.5ms[4]	
Electrical endurance			
cyclic temperature -40°C, +25°C, +85°C			
form C contact (CO) at 14VDC	motor reverse blocked, 25A, 0.77mH $>1x10^5$ ops.	wiper, 25A make/5A break, generator peak, 20A on NC,1mH $>1x10^6$ ops.	
form A contact (NO) at 14VDC	resistive 20A $>3x10^5$ ops.		lamp 100A inrush, 10A steady state $>1x10^5$ ops.[5]
Mechanical endurance		$>5x10^6$ ops.	

Max. DC load breaking capacity



Load limit curve 1: arc extinguishes, during transit time (changeover contact).
Load limit curve 2: safe shutdown, no stationary arc (make contact).
Load limit curves measured with low inductive resistors verified for 1000 switching events.

1) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 13.5VDC for 12VDC load voltages. For a load current duration of maximum 3s for a make/break ratio of 1:10.
2) Corresponds to the peak inrush current on initial actuation (cold filament).
3) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
4) Measured at nominal voltage without coil suppression unit. A low resistive suppression device in parallel to the relay coil increases the release time and reducesthe lifetime caused by increased erosion and/or higher risk of contact tack welding.
5) Be aware of using right polarity, see Terminal Assignment. Wrong polarity will reduce endurance.

Micro Relay K (THT – THR) (Continued)

Coil Data

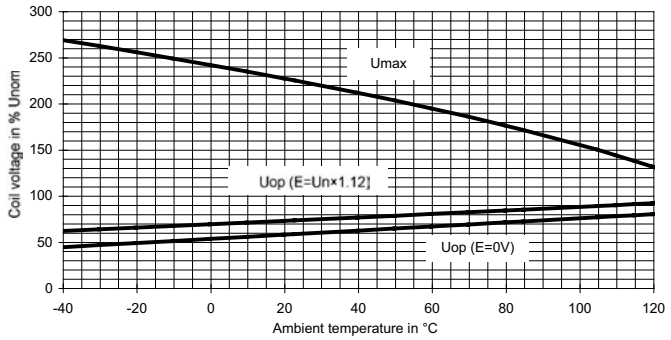
Rated coil voltage	12VDC

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power mW
001/801	12	6.9	1.5	254	567
002/802	10	5.7	1.25	181	552
021/821	10	6.9	1.5	181	552

All figures are given for coil without pre-energization, at ambient temperature +23°C.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization

Insulation Data

Initial dielectric strength	
between open contacts	500VAC$_{rms}$
between contact and coil	500VAC$_{rms}$

Other Data

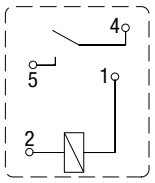
EU RoHS/ELV compliance	compliant
Ambient temperature, DC coil	-40 to +105°C
Cold storage, IEC 60068-2-1	1000h; -40°C
Dry heat, IEC 60068-2-2	1000h; +125°C
Climatic cycling with condensation, EN ISO 6988	20 cycles, storage 8/16h
Temperature cycling (shock), IEC 60068-2-14, Na	100 cycles; -40/+125°C
Temperature cycling, IEC 60068-2-14, Nb	35 cycles; -40/+125°C
Damp heat cyclic, IEC 60068-2-30, Db, variant 1	6 cycles 25°C/55°C/93%RH
Damp heat constant, IEC 60068-2-3 method Ca	56 days 40°C/95%RH
Degree of protection	
THT:	RT III (61810), IP67 (IEC 60529)
THR:	RT II (61810), IP56 (IEC 60529)
Sealing test, IEC 60068-2-17: THT	Qc, method 2, 1min, 70°C
Corrosive gas	
IEC 60068-2-42	10 days
IEC 60068-2-43	10 days
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep)	10 to 500Hz; 6g[6]
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	6ms, up to 30g[6]
Terminal type	PCB:THT, THR
Weight	approx. 4g (0.14oz)
Solderability (aging 3: 4h/155°C) THT	
IEC 60068-2-20	Ta, method 1, hot dip 5s, 215°C
Solderability THR	
IEC60068-2-58	hot dip 5s 245°C
Resistance to soldering heat THT	
IEC 60068-2-20	Tb, method 1A, hot dip 10s, 260°C with thermal screen
Resistance to soldering heat THR	
IEC 60068-2-58	260°C; preheating min 130°C
Storage conditions	according IEC 600688[7]
Packaging unit	2000 pcs.

6) Depending on mounting position: no change in the switching state >10µs.
7) For general storage and processing recommendations please refer to our Application Notes and especially to Storage in the Definitions or at http://relays.te.com/appnotes/

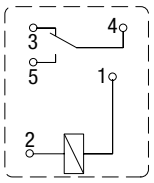
Micro Relay K (THT – THR) (Continued)

Terminal Assignment
Bottom view on solder pins

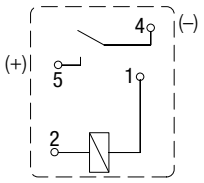
1 form A, 1 NO



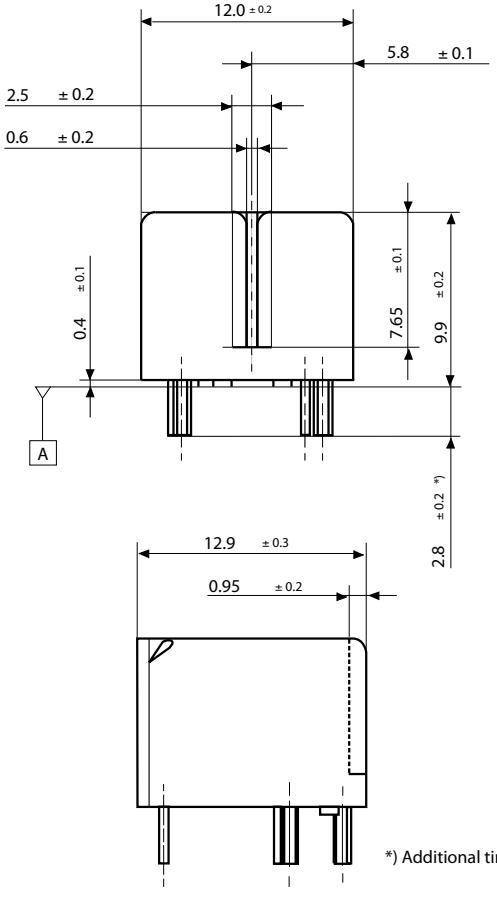
1 form C, 1 CO



1 form A, 1 NO (lamp load)

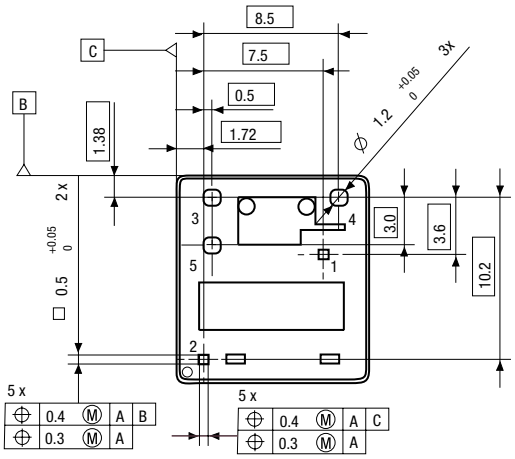


Dimensions
Micro Relay K, THT version



*) Additional tin tops max. 1mm

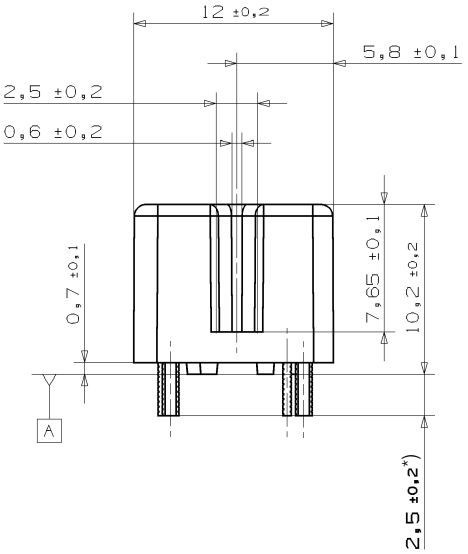
Mounting Hole Layout
Bottom view on solder pins

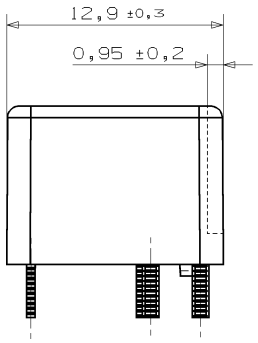


Remark: Positional tolerances according to DIN EN ISO 5458

Micro Relay K (THT – THR) (Continued)

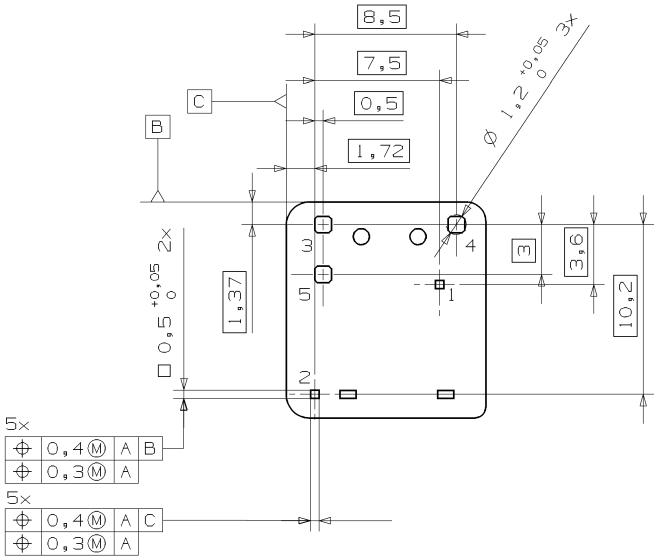
Micro Relay K, THR version



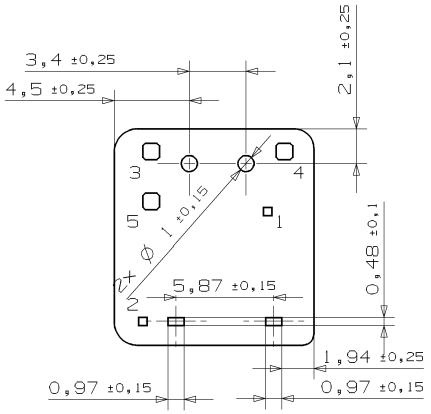


*) Additional tin tops max. 1mm

Mounting Hole Layout
Bottom view on solder pins



View of Stand-Offs
Bottom view on solder pins



Micro Relay K (THT – THR) (Continued)

Product code structure Typical product code **V23086 -C 1 001 -A 4 03**

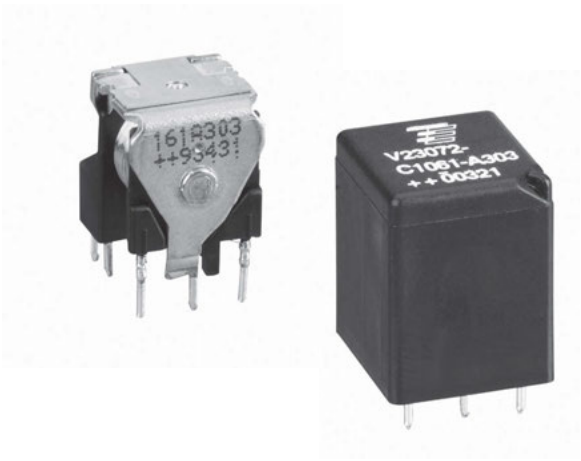
Type			
V23086	Micro Relay K (THT – THR)		
Terminal and enclosure			
C	PCB version THT, sealed	**R**	PCB version THR, vented
Design			
1	Single relay		
Coil			
001	Standard (THT)	**002**	Sensitive (THT)
801	Standard (THR)	**802**	Sensitive (THR)
021	Special (THT)	**821**	Special (THR)
Contact type			
A	Single contact		
Contact material index			
4	$AgSnO_2$ standard	**8**	$AgSnO_2$ wiper load
5	$AgSnO_2$ lamp load		
Contact arrangement index			
02	NO	**03**	CO

Product code	Version	Design	Coil	Contact	Cont. material	Arrangement	Part number
V23086-C1021-A502	PCB THT,	Single	Standard	Single	$AgSnO_2$	1 form A, 1 NO (lamp)	8-1416000-7
V23086-C1001-A403	cleanable					1 form C, 1 CO (standard)	0-1393280-6
V23086-C1002-A803			Sensitive			1 form C, 1 CO (standard)	2-1414987-3
V23086-R1801-A403	PCB THR,		Standard			1 form C, 1 CO (standard)	6-1414920-0
V23086-R1802-A803	vented		Sensitive			1 form C, 1 CO (wiper)	7-1414967-8
V23086-R1821-A502			Standard			1 form A, 1 NO (lamp)	6-1414918-8

This list represents the most common types and does not show all variants covered by this datasheet.
Other types on request.

Mini Relay K (Open – Sealed)

- **Limiting continuous current 20A**
- **24VDC coil versions available**



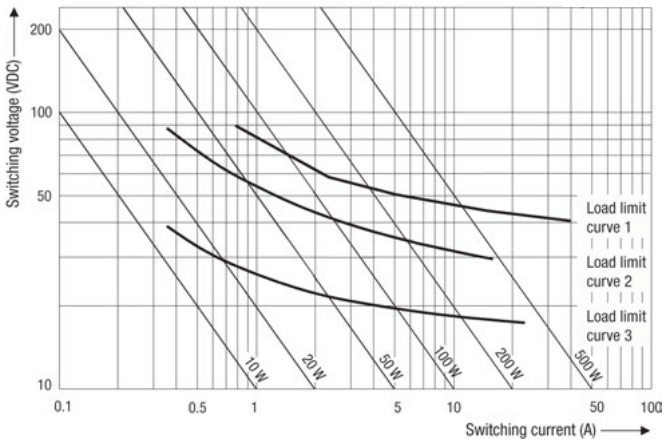
Typical applications
Car alarm, hazard warning signal, heated rear screen, immobilizer, lamps front/rear, fog light, interior lights, sun roof, turn signal, wiper control.

Contact Data

Load	resistive/inductive load V23072-C10**-A302	resistive/inductive load V23072-C10**-A303	resistive/inductive load V23072-C10**-A308	head/indicator lamp V23072-C1061-A402	head/indicator lamp V23072-C1061 A408
Contact arrangement	1 form A, 1 NO	1 form C, 1 CO	1 form U/X, 2 NO	1 form A, 1 NO	1 form U/X, 2 NO
Rated voltage	12VDC	12VDC	12VDC	12VDC	12VDC
Rated current	15A	10/15A	2x10A	12A	2x6A
Limiting continuous current					
23°C	15A	10/15A	2x10A	12A	2x6A
85°C	10A	5/10A	2x6A	10A	2x5A
Limiting making current[1)2)]	60A	NC/NO 12/60A	2x40A	60A[3)]	120A[3)]
Limiting breaking current	20A	10/20A	2x20A	6A	12A
Contact material	AgNi0.15	AgNi0.15	AgNi0.15	AgSnO.2	AgSnO.2
Min. recommended contact load [4)]	1A at 5VDC	1A at 5VDC	1A at 5VDC	1A at 5VDC	1A at 5VDC
Initial voltage drop at 10A, typ./max.		50/300mV	50/300mV	2x50/300mV	150/300mV
150/300mV					
Operate/release time max.			typ. 3/1.5ms[5)]		
Electrical endurance	>2x10^5 ops. at 13.5VDC, 10A	>2x10^5 ops. at 13.5VDC, 10A	>2x10^5 ops. at 13.5VDC, 10A	>1x10^6 ops. up to 6x21W >1.5x10^5 ops. 100A (on), 10 A (off) high beam	>1.5 x 10^6 ops. up to 6x21W >7.5x10^5 ops. 100A (on), 10A (off) high beam

1) The values apply to a resistive load or inductive load with suitable spark suppression and at maximum 13.5VDC for 12VDC and 27VDC for 24VDC load voltages.
2) For a load current duration of maximum 3s for a make/break ratio of 1:10.
3) Corresponds to the peak inrush current on initial actuation (cold filament).
4) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes
5) For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding (monostable version only).

Max. DC load breaking capacity



Load limit curve 1: safe shutdown, connected as form X, load on pin 5 and 7.
Load limit curve 2: safe shutdown, no stationary arc (NO contact).
Load limit curve 3: arc extinguishes during transit time (CO contact).
Load limit curves measured with low inductive resistors verified for 1000 switching events.

Mini Relay K (Open – Sealed) (Continued)

Coil Data

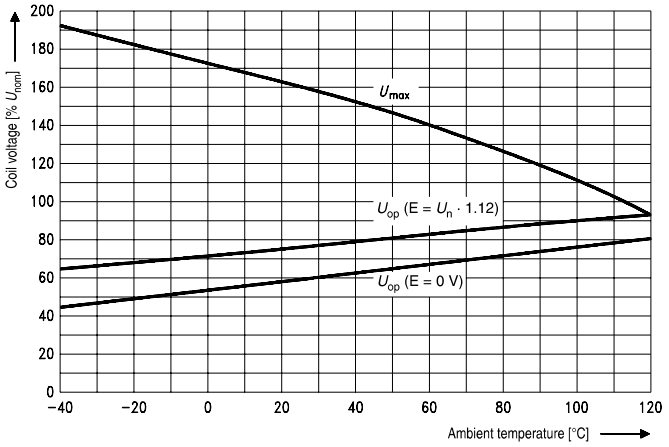
Rated coil voltage	12VDC, 24VDC

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power W
061	12	6.9	1.2	130	1.1
062	24	14.1	2.4	520	1.1

All figures are given for coil without pre-energization, at ambient temperature +23°C.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization.

Other Data

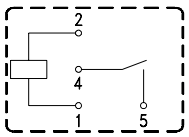
EU RoHS/ELV compliance	compliant
Degree of protection	
IEC 61810	RT II – open (V23072-A), RT III – imm. cleanable (V23072-C)
Climatic cycling with condensation	
EN ISO 6988	20 cycles, storage 8/16h
Temperature cycling (shock)	
IEC 60068-2-14, Na	720 cycles, -40/+85°C (dwell time 1h)
Damp heat constant	
IEC 60068-2-3, Ca	56 days, upper air temperatue 55°C
Corrosive gas	
IEC 60068-2-42	10 days
IEC 60068-2-43	10 days
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep), 10 to 200Hz,	23 to 35g[6]
Shock resistance (functional)	
IEC 60068-2-27 (half sine), 4 to 6ms	23 to 280g[6]
Terminal type	PCB
Weight, open/sealed	approx. 8/9g (0.28/0.32oz)
Solderability (aging 3: 4h/155°C)	
IEC 60068-2-20	Ta, method 1, hot dip 5s, 215°C
Sealing, IEC 60068-2-17	Qc, method 2, 1min/70°C
Storage conditions	according IEC 600688[7]
Packaging unit	
open	600 pcs.
sealed	504 pcs.

6) Values weekest direction. Depending on mounting position: no change in the switching state >10µs.

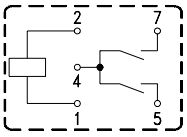
7) For general storage and processing recommendations please refer to our Application Notes and especially to Storage in the Definitions or at http://relays.te.com/appnotes/

Terminal Assignment (Open and Sealed version)
Bottom view on solder pins

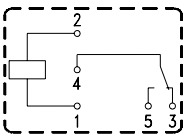
1 form A, NO



1 form U/X, 2 NO



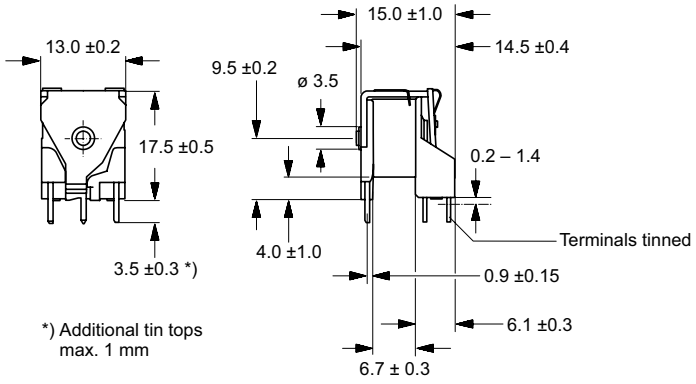
1 form C, CO



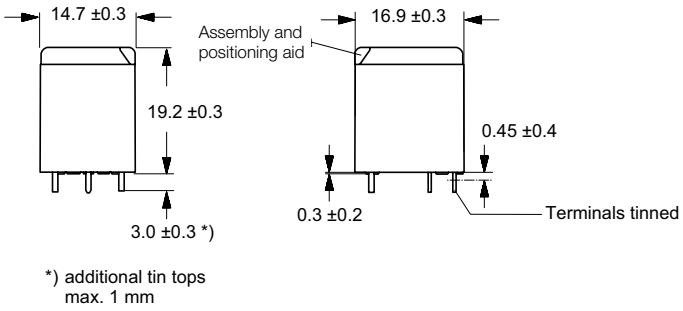
Mini Relay K (Open – Sealed) (Continued)

Dimensions

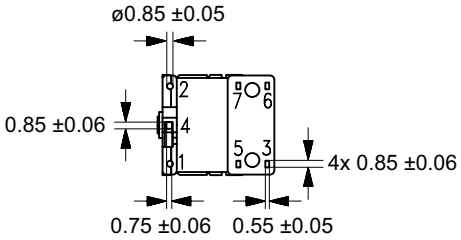
Mini Relay K Open Version



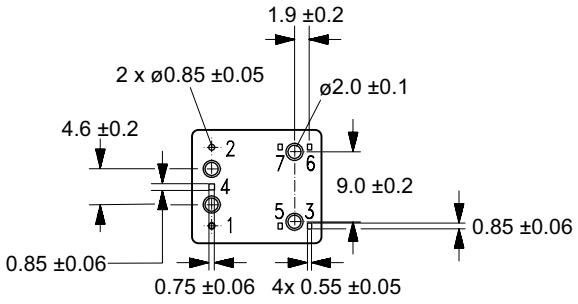
Mini Relay K Sealed Version



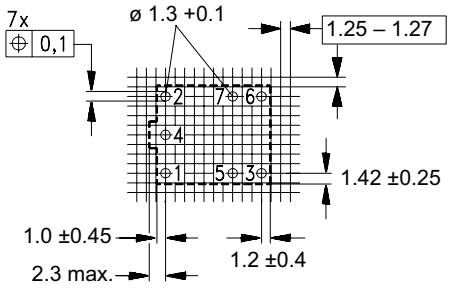
View of the terminals (bottom view)



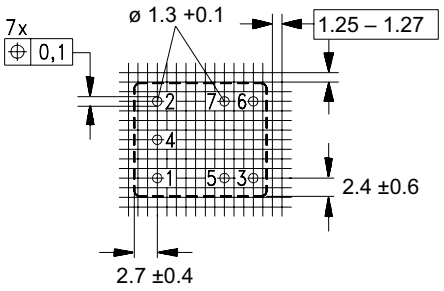
View of the terminals (bottom view)



PCB Layout
Bottom view on solder pins, grid 1.25 to 1.27mm



PCB Layout
Bottom view on solder pins, grid 1.25 to 1.27mm



Mini Relay K (Open – Sealed) (Continued)

Product code structure Typical product code **V23072 -A 1 061 -A 30 2**

Type
V23072 Mini Relay K (Open – Sealed)

Terminal and enclosure
A PCB, open (RT II) **C** PCB, sealed (RT III – immersion cleanable)

Design
1 Standard

Coil
061 12 VDC **062** 24 VDC

Contact type
A Standard

Contact material
30 AgNi0.15 **40** $AgSnO_2$

Contact arrangement
2 1 form A, NO **3** 1 form C, CO **8** 1 form U/X, 2 NO

Product code	Terminal/Encl.	Design	Coil	Contact type	Cont. material	Arrangement	Part number
V23072-A1061-A303	PCB, open	Single relay	12VDC	Standard	AgNi0.15	1 form C, CO	3-1393272-2
V23072-A1062-A303			24VDC				5-1393272-2
V23072-A1061-A308			12VDC			1 form U/X, 2 NO	3-1393272-6
V23072-A1062-A308			24VDC				5-1393272-3
V23072-C1061-A302	PCB, sealed		12VDC			1 form A, NO	4-1393273-9
V23072-C1062-A302			24VDC				7-1393273-6
V23072-C1061-A303			12VDC			1 form C, CO	5-1393273-6
V23072-C1062-A303			24VDC				7-1393273-8
V23072-C1061-A308			12VDC			1 form U/X, 2 NO	6-1393273-0
V23072-C1062-A308			24VDC				8-1393273-2
V23072-C1061-A402			12VDC		$AgSnO_2$	1 form A, NO[8)]	2-1416001-0
V23072-C1061-A408						1 form U/X, 2 NO[8)]	1-1416001-4

8) Flasher/Lamp

Power Relay PK2 (THT – THR)

- **60% volume reduced Power K at increased performance**
- **PCB area requirements minimized by 50% to only 293mm²**
- **Size optimized to lwh (mm) 18.3x16x15.9**
- **Limiting continuous current 40A**
- **Maximum switch on current 200A**
- **Increased ambient temperature 105°C**
- **Design allows highest reliability**
- **High shock and vibration resistance**
- **Wave (THT) and reflow (THR/pin-in-paste) solderable versions**
- **For latching (bistable) version refer to Power Relay PK2 Latching**

Typical applications
ABS control, blower fans, cooling fan, engine control, fuel pump, glow plug, hazard warning signal, switched power supply.

Contact Data

Contact arrangement	1 form A, 1 NO
Rated voltage	12VDC
Rated current	40A[1)]
Limiting continuous current	
23°C	40A[1)]
85°C	33A[1)]
105°C	22A[1)]
Limiting making current	200A[2)]
Limiting breaking current	40A[2)]
Contact material	$AgSnO_2$
Min. recommended contact load	1A at 5VDC[3)]
Initial voltage drop at 10A, typ./max.	30/300mV
Frequency of operation at nominal load	6 ops./min (0.1Hz)
Operate/release time max.	typ. 3/1.5ms[4)]
Electrical endurance	
at cyclic temperature -40/+23/+85°C	
and 13.5VDC and 120ms (on), 4.88s (off)	
Inductive load: L=0.5mH, 60A (on)/35A (off)	>1x10⁵ ops.[5)]
resistive load: 40A (on)/40A (off)	>1x10⁵ ops.[5)]
capacitive load 200A (on)/20A (off)	>1x10⁵ ops.[5)]

Contact Data (continued)

Mechanical endurance	>2x10⁶ ops.

1) Measured on 70x70x1.5mm epoxy PCB FR4 with 52cm² (double layer 140µm) copper area.
2) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 13.5VDC for 12VDC load voltages.
3) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
4) For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding (monostable version only).
5) Be aware of using right polarity, see Terminal Assignment. Wrong polarity will reduce endurance.

Coil Data

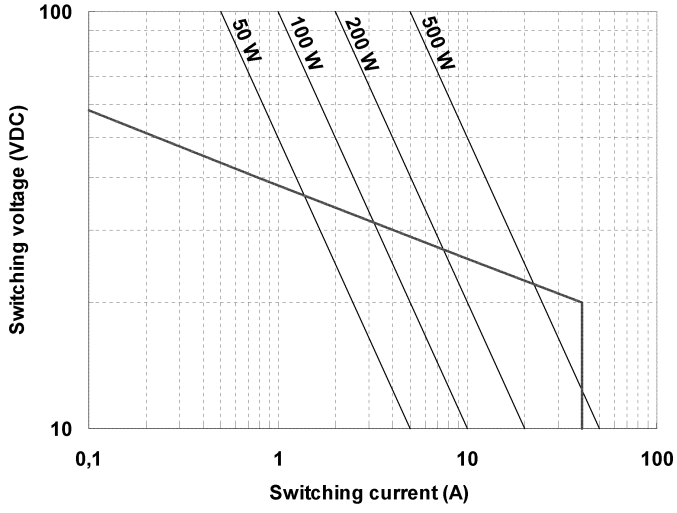
Rated coil voltage	12VDC

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power mW
001/005	12	6.9	1.5	176	818
009	10	5.6	1.3	120	833

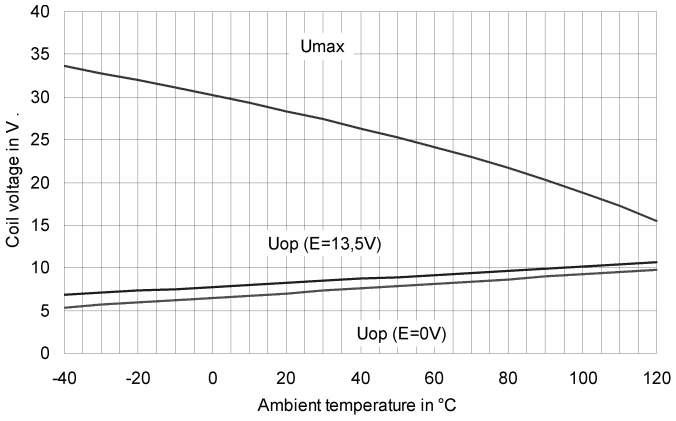
All figures are given for coil without pre-energization, at ambient temperature +23°C.
Other coil voltages on request.

Max. DC load breaking capacity



Load limit curve: safe shutdown, no stationary arc/make contact.
Load limit curves measured with low inductive resistors verified for 1000 switching events.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization.

Power Relay PK2 (THT – THR) (Continued)

Insulation Data

Initial dielectric strength	
between contact and coil	500VAC$_{rms}$

Other Data

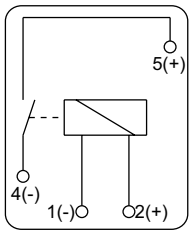
EU RoHS/ELV compliance	compliant
	THT: sealed type washable
	THR: sealed type vented
Ambient temperature, DC coil	-40 to +105°C[6]
Cold storage, IEC 60068-2-1	1000h; -40°C
Dry heat, IEC 60068-2-2	1000h; +125°C
Temperature cycling (shock),	
IEC 60068-2-14, Na	1000 cycles, -40/+125°C, dwell time 15min
Category of environmental protection,	
IEC 61810	RT II - flux proof, RT III - immersion cleanable
Sealing test, IEC 60068-2-17	
THT	Qc, method 2, 1min, 70°C
THR	vented
Vibration resistance (functional),	
IEC 68-2-6 (sine pulse form), 30 to 440Hz,	
no change in the switching state >10µs	>20g
Shock resistance (functional),	
IEC 68-2-27 (half sine form single pulses)	
open NO contact will not close >10µs,	6ms >30g
closed NO contact will not open >10µs	11ms >100g
Terminal type	PCB THT, PCB THR
Weight	approx. 11g (0.39oz)
Solderability (aging 3: 4h/155°C)	
IEC 60068-2-20, THT	Ta, method 1, hot dip 5s, 215°C
IEC 60068-2-58, THR	Ta, method 1, hot dip 5s, 245°C
Resistance to soldering heat THT	
IEC 60068-2-20	Tb, method 1A hot dip 10s, 260°C with thermal screen
Resistance to soldering heat THR	
IEC 60068-2-58	Tb, method 1A hot dip 10s, 260°C preheating min.130°C
Washing	THT version
Storage conditions	according to IEC 600688[7]
Packaging unit	600 pcs.

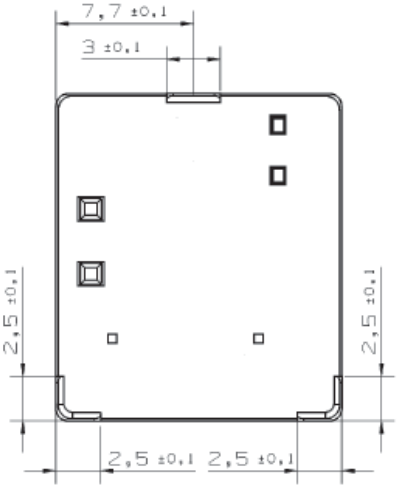
6) See graph: coil operating range.

7) For general storage and processing recommendations please refer to our Application Notes and especially to Storage in the Definitions or at http://relays.te.com/appnotes/

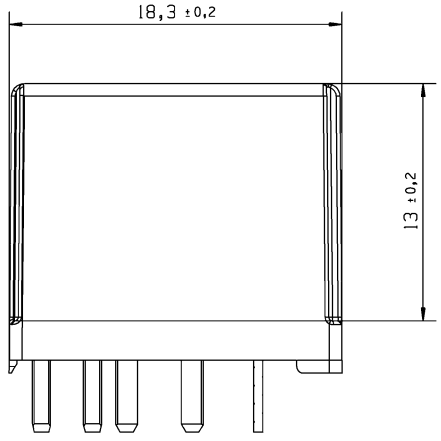
Terminal Assignment
Bottom view on solder pins

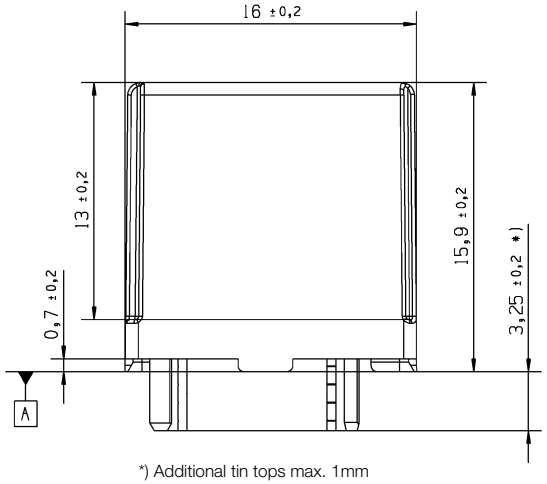
1 form A, 1 NO





Dimensions

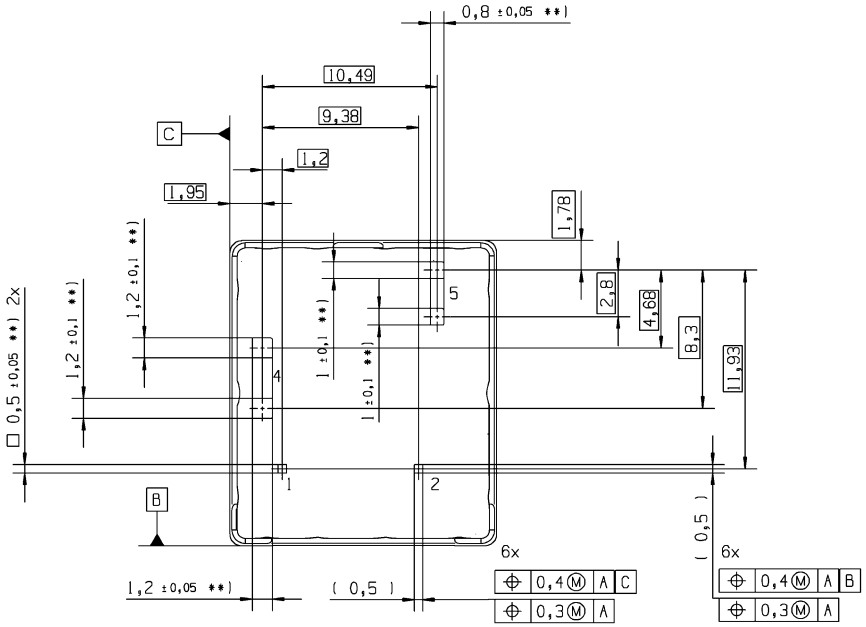




*) Additional tin tops max. 1mm

Power Relay PK2 (THT – THR) (Continued)

PCB Layout
Bottom view on solder pins



Remark: Positional tolerances according to DIN EN ISO 5458
**) without tinning (hot dip)

Product code structure — Typical product code: **V23201 -C/R 1 001 -A 5 02**

Type
PK2 Power Relay PK2 (THT - THR)

Terminals and enclosure
C Sealed **R** Reflow vented

Design
1 Single relay

Coil
001 Standard (THT) **005** Reflow (THR) **009** Reflow, sensitive THR

Contact type
A Single contact

Contact material
5 $AgSnO_2$

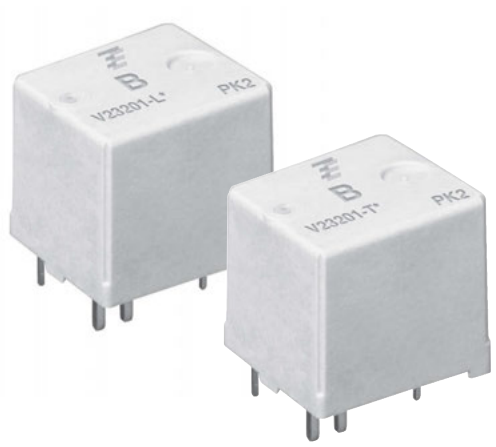
Contact arrangement
02 1 form A, 1 NO

Product code	Terminal/Encl.	Design	Coil	Contact type	Cont. material	Arrangement	Part number
V23201-C1001-A502	PCB, sealed	Single relay	Standard (THT)	Single	$AgSnO_2$	1 form A, 1 NO	5-1414782-7
V23201-R1005-A502	PCB, vented		Reflow (THR)				6-1414932-3
V23201-R1009-A502			Ref., sens. (THR)				4-1414989-5

Power Relay PK2 Latching (THT – THR)

- **Reduced coil power consumption of latching version allows higher limiting continuous current (50A) and increased ambient temperature (125°C)**
- **Maximum switch on current 200A**
- **60% volume reduced Power K at increased performance**
- **PCB area requirements minimized by 50% to only 293mm²**
- **Size optimized to L x W x H 18.3x16x15.9mm**
- **Design allows highest reliability**
- **High shock and vibration resistance**
- **No change of switching state version at breakdown of battery voltage**
- **For monostable version refer to Power Relay PK2 (THT – THR)**

Typical applications
Energy management, engine control, ignition, main switch/supply relay, preheating system, quiescent current management.

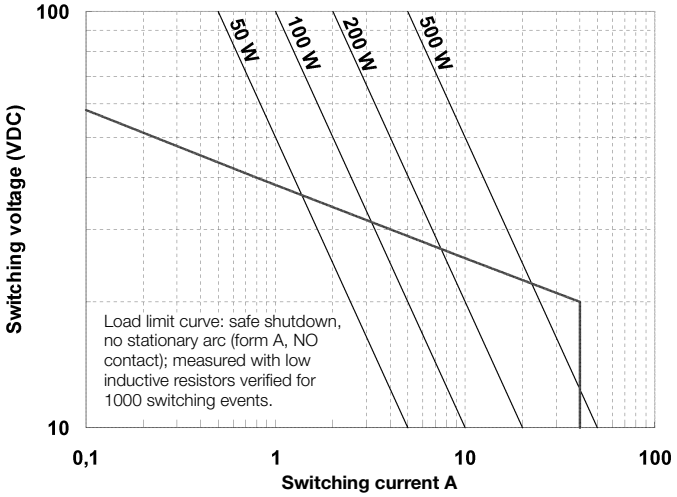


Contact Data

Contact arrangement	1 form A, 1 NO
Rated voltage	12VDC
Rated current	50A[1)]
Limiting continuous current	
23°C	50A[1)]
85°C	40A[1)]
125°C	30A[1)]
Limiting making current, pin 4-5, THT/THR	200A[2)3)]
Limiting breaking current, pin 4-5, THT/THR	40A[2)]
Contact material	$AgSn0_2$
Min. recommended contact load	1A at 5VDC[4)]
Initial voltage drop at 10A, typ./max.	30/300mV
Frequency of operation at nominal load	6 ops./min (0.1Hz)
Operate/release time	typ. 1.5ms
Electrical endurance	
at cyclic temperature -40/+23/+85°C, 13.5VDC, 120ms (on), 4.88s (off),	
motor load: L=0.5mH, 60A (on)/35A (off)	>1x10⁵ ops.[5)]
resistive load: 40A (on)/40A (off)	>1x10⁵ ops.[5)]
capacitive load 200A (on)/20A (off)	>1x10⁵ ops.[5)]
Mechanical endurance	>2x10⁶ ops.

1) Measured on 70x70x1.5mm epoxy PCB FR4 with 52cm2 (double layer 140µm) copper area. The load circuit shall withstand current applied until 40A ATO fuse blows.
2) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 13.5VDC for 12VDC load voltages.
3) Corresponds to a capacitive peak inrush current on initial actuation (cold filament).
4) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
5) Be aware of using right polarity, see Terminal Assignment. Wrong polarity will reduce endurance.

Max. DC load breaking capacity



Coil Data

Magnetic system	bistable (two coil system)			
Coil voltage range				
23°C (set - reset)	28/18VDC[6)]			
Rated coil voltage	12VDC			
Polarity for set/reset energization	set		reset	
	- pin 1	+ pin 6	- pin 2	+ pin 6

Coil versions, bistable 2 coils

Coil code	Rated voltage VDC	Set voltage VDC	Reset voltage VDC	Set/reset coil resistance Ω±10%	Impulse lenght ms
004/006	12	6.9	6.9	20/19	10 – 100

All figures are given for coil without preenergization, at ambient temperature +23°C.
6) Overvoltage according to ISO 16750-2 functional status C. In case of a reset latch pulse U>18VDC contact may reclose, but will not remain closed (no latching function). The delay between driving impulses at cyclic energizing at TAmb=85°C must be at least 10s.

Insulation Data

Initial dielectric strength between contact and coil	500VAC$_{rms}$

Other Data

EU RoHS/ELV compliance	compliant, THT: sealed type washable THR: sealed type vented
Ambient temperature	-40 to +125°C
Cold storage, IEC 60068-2-1	1000h; -40°C
Dry heat, IEC 60068-2-2	1000h; +125°C
Temperature cycling (shock), IEC 60068-2-14, Na	1000 cycles, -40/+125°C, dwell time 15min
Degree of protection	
THT:	RT III (IEC 61810), IP67 (IEC 60529)
THR:	RT II (IEC 61810), IP56 (IEC 60529)
Sealing test, IEC 60068-2-17	
THT:	Qc, method 2, 1min, 70°C
Vibration resistance (functional), IEC 68-2-6 (sine pulse form), 30 to 440Hz, no change in the switching stte >10µs	>20g
Shock resistance (functional), IEC 68-2-27 (half sine form single pulses)	
open NO contact will not close >10µs	6ms >30g
closed NO contact will not open >10µs	11ms >100g

Power Relay PK2 Latching (THT – THR) (Continued)

Other Data (continued)	
Terminal type	PCB THT, THR
Weight	approx. 11g (0.39oz)
Solderability (aging 3: 4h/155°C)[7]	
THT, IEC 60068-2-20	Ta, method 1, hot dip 5s, 215°C
THR, IEC 60068-2-58	hot dip 5s, 245°C
Resistance to soldering heat THT	
IEC 60068-2-20	Tb, method 1A hot dip 10s, 260°C, with thermal screen
Resistance to soldering heat THR	
IEC 60068-2-58	hot dip 10s 260°C, preheating min. 130°C
Storage conditions	according IEC 600688[8]
Packaging unit and delivery[9]	600 pcs.

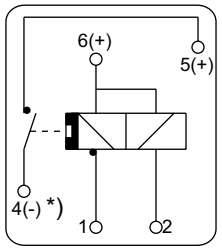
7) For leaded process (Tm = 183°C), for Pb-free process (Tm = 217°C).

8) For general storage and processing recommendations please refer to our Application Notes and especially to Storage in the Definitions or at http://relays.te.com/appnotes/

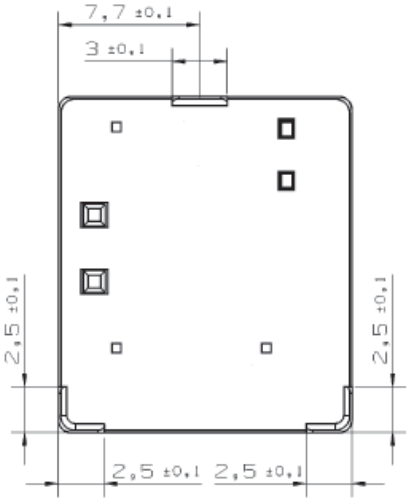
9) Bistable relays are delivered in the reset position. Due to mechanical impacts while transportation, we advise to check the contact status after the incoming. Before entering the product into the reflow soldering process, please make sure that the relay is unlatched, in order to maintain its performance. Latching (Delivery status "ex works").

Terminal Assignment
Bottom view on solder pins

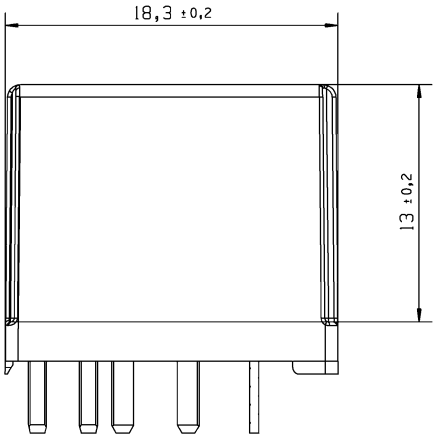
1 form A, NO

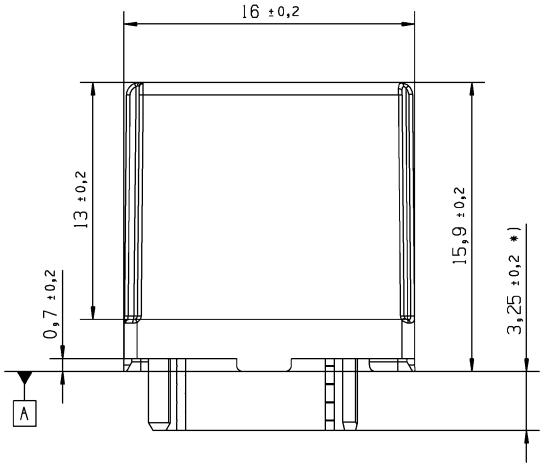


*) Polarity as stated is compulsory



Dimensions

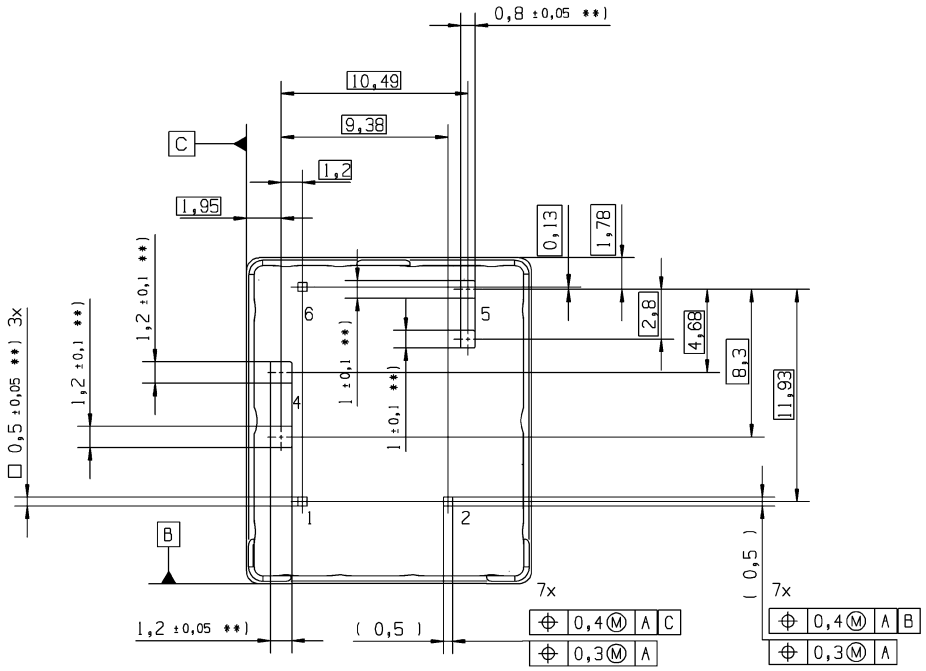




*) Additional tin tops max. 1mm

Power Relay PK2 Latching (THT – THR) (Continued)

View of the terminals
Bottom view on solder pins



Remark: Positional tolerances according to DIN EN ISO 5458
**) without tinning (hot dip)

Product code structure	Typical product code	V23201	-L	1	004	-A	5	02

Type
PK2 Power Relay PK2 Latching (THT – THR)

Terminal and enclosure
L Latching (sealed) **T** Latching (vented)

Design
1 Single relay

Coil
004 12VDC (THT) **006** 12VDC (THR)

Contact type
A Single contact

Contact material
5 $AgSnO_2$

Contact arrangement
02 1 form A, 1 NO

Product code	Terminal/Encl.	Design	Coil	Cont. material	Arrangement	Part number
V23201-L1004-A502	PCB, sealed	Single relay	Latching (THT)	$AgSnO_2$	1 form A, 1 NO	4-1414915-9
V23201-T1006-A502	PCB, vented		Latching (THR)			1-1414974-3

This list represents the most common types and does not show all variants covered by this datasheet.
Other types on request.

Power Relay K (Open – Sealed)

- **Limiting continuous current 45A**
- **Wide voltage range**
- **24VDC coil versions available**
- **For high current version refer to Power Relay K-S**

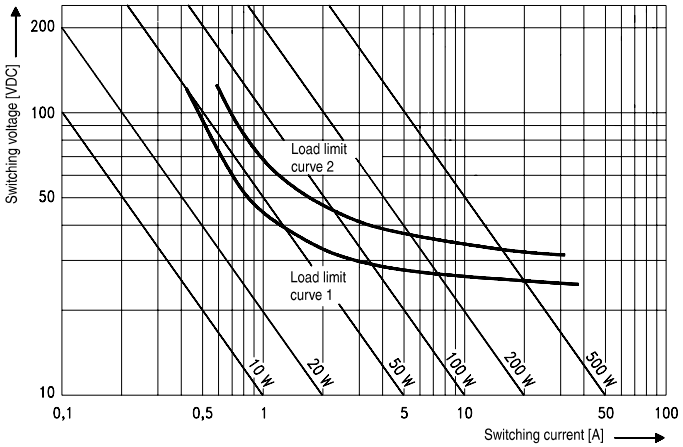
Typical applications
ABS control, blower fans, car alarm, cooling fan, engine control, fuel pump, hazard warning signal, heated front screen, heated rear screen, ignition, lamps front/rear/fog light, interior lights, main switch/supply relay, seat control, seatbelt pretensioner, sun roof, turn signal, valves, window lifter, wiper control.

Contact Data

Typical applications	Resistive/inductive loads	Resistive/inductive loads	Indicator lamps	Headlights, capacitive loads	Headlights capacitive loads
Contact arrangement	1 form A, 1 NO	1 form C, 1 CO	1 form A, 1 NO	1 form A, 1 NO	1 form C, 1 CO
Rated voltage	12VDC	12VDC	12VDC	12VDC	12VDC
		A/B (NO/NC)			A/B (NO/NC)
Rated current	45A	45/30A	30A	40A	40/25A
Limiting continuous current					
23°C	45A	45/30A	30A	40A	40/25A
85°C	30A	30/25A	25A	25A	25/20A
Limiting making current[1]	100A	100/30A	120A[3]	180A	180/60A
Limiting breaking current[2]	60A	60/30A	60A	60A	60/30A
Contact material	AgNi0.15	AgNi0.15	$AgSnO_2$	$AgSnO_2$	$AgSnO_2$
Min. recommended contact load		1A at 5VDC[4]			
Initial voltage drop, at 10A, typ./max.		20/300mV			
Operate/release time		typ. 5/3ms[5]			
Electrical endurance	>2x10^5 ops. at 13.5VDC, 40A	>2x10^5 ops. at 13.5VDC, 40A	>2.2x10^6 ops. up to 8x21W	>10^5 ops. up to 4x60W	>10^5 ops. up to 4x60W
Mechanical endurance, DC coil		>10^7 ops.			

1) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 13.5VDC for 12VDC or 27VDC for 24VDC load voltages.
2) For a load current duration of maximum 3s for a make/break ratio of 1:10.
3) Corresponds to a peak inrush current on initial actuation (cold filament).
4) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
5) For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding.

Max. DC load breaking capacity



Load limit curve 1: arc extinguishes, during transit time (changeover contact).
Load limit curve 2: safe shutdown, no stationary arc (make contact).
Load limit curves measured with low inductive resistors verified for 1000 switching events.

Power Relay K (Open – Sealed) (Continued)

Coil Data

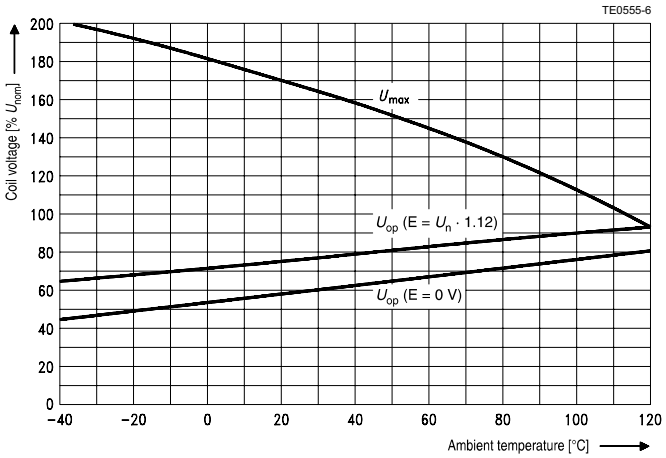
Rated coil voltage	12VDC / 24VDC

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power W
001	12	6.9	1.2	90	1.6
022	24	14.1	2.4	362	1.6

All figures are given for coil without pre-energization, at ambient temperature +23°C.
Other coils on request.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization

Insulation Data

Initial dielectric strength	
between open contacts	500VAC$_{rms}$
between contact and coil	500VAC$_{rms}$

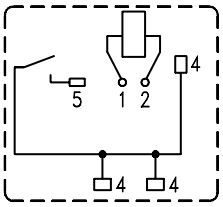
Other Data

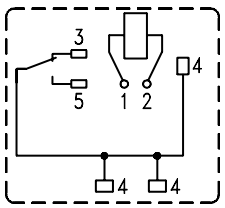
EU RoHS/ELV compliance	compliant
Ambient temperature, DC coil	-40 to +105°C[6]
Climatic cycling with condensation,	
EN ISO 6988	3 cycles, storage 8/16h
Temperature cycling (shock),	
IEC 60068-2-14, Na	20 cycles, -40/+85°C (dwell time 1h)
Damp heat cyclic,	
IEC 60068-2-30, Db, Variant 1	6 cycles, upper air temperature 55°C
Damp heat constant,	
IEC 60068-2-3, method Ca	56 days, upper air temperature 55°C
Degree of protection, IEC 61810	RT 0/II – open version RT III – immersion cleanable version
Corrosive gas,	
IEC 60068-2-42	10 days
IEC 60068-2-43	10 days
Vibration resistance (functional),	
IEC 60068-2-6 (sine pulse form),	
acceleration, acc. to position	10 to 200Hz, 20 to 40g[7]
Shock resistance (functional),	
IEC 60068-2-27 (half sine form single pulses),	
acceleration, acc. to position	8ms 30g[7]
Terminal type	PCB
Weight	
sealed version	approx. 22g (0.77oz)
open version	approx. 19g (0.67oz)
Solderability (aging 3: 4h/155°C)	
for leaded process (Tm = 183°C),	
for Pb-free process (Tm = 217°C),	
IEC 60068-2-20	Ta, method 1, hot dip 5s, 215°C
Storage conditions	according IEC 600688 [8]
Packaging unit	
sealed version	300 pcs.
open version	500 pcs.

6) See coil operating range DC.
7) No change in the switching state >10µs.
8) For general storage and processing recommendations please refer to our Application Notes and especially to Storage in the Definitions or at http://relays.te.com/appnotes/

Terminal Assignment (Open and Sealed Version)
Bottom view on solder pins

1 form A, 1 NO



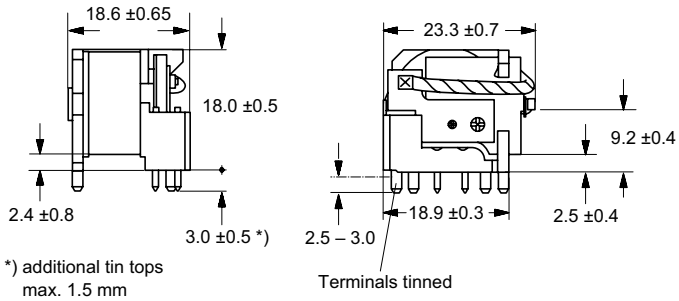


*) Terminal 4 to be bridged

Power Relay K (Open – Sealed) (Continued)

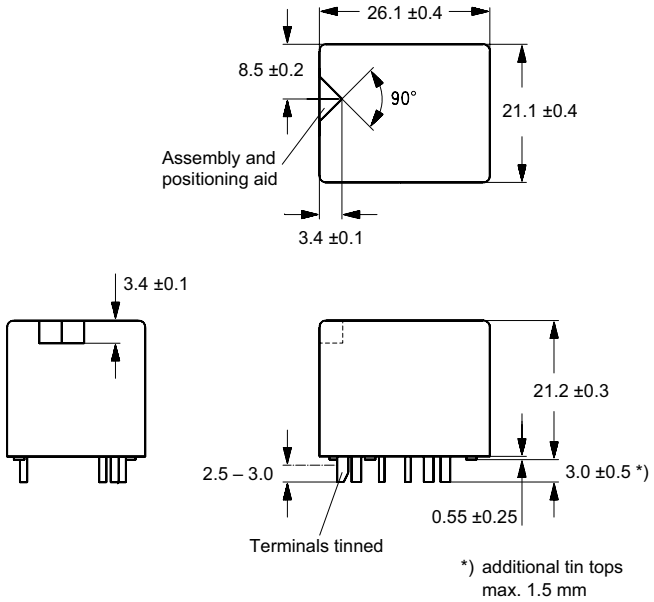
Dimensions

Power Relay K open version



*) additional tin tops max. 1.5 mm

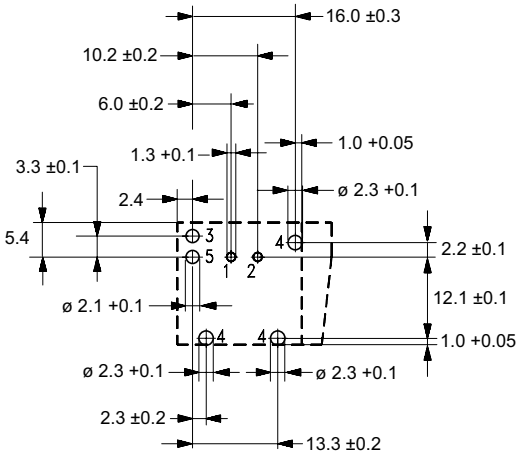
Power Relay K sealed version



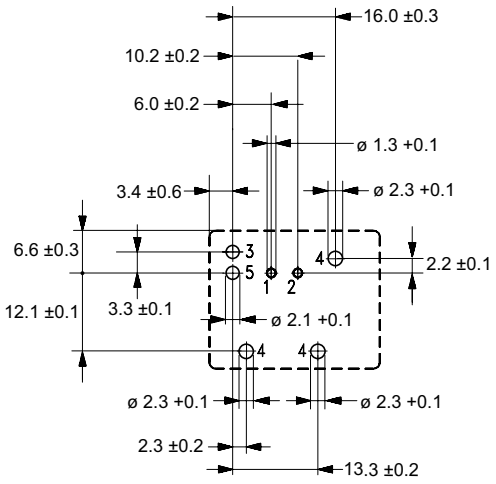
Mounting Hole Layout

Bottom view on solder pins

Power Relay K open version



Power Relay K sealed version



Power Relay K (Open – Sealed) (Continued)

Product code structure Typical product code **V23076 -A 1 022 -C 13 3**

Type
- **V23076** Power Relay K, sealed
- **V23133** Power Relay K, open

Terminal
- **A** PCB

Design
- **1** Single relay
- **3** Single relay

Coil
- **001** 12VDC
- **022** 24VDC

Contact type
- **C** Single contact
- **D** Single contact

Contact material
- **13** AgNi0.15
- **14** $AgSnO_2$
- **15** $AgSnO_2$ (Special)

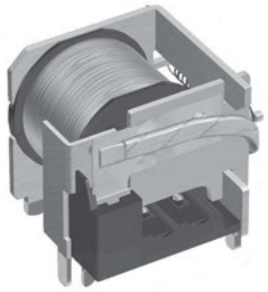
Contact arrangement
- **2** 1 form A, 1 NO
- **3** 1 form C, 1 CO

Product code	Terminal/Encl.	Design	Coil	Contact	Cont. material	Arrangement	Part number
V23076-A1001-C133	PCB, sealed	Single relay	12VDC	Single	AgNi0.15	1 form C, CO	1393277-4
V23076-A1001-D143					$AgSnO_2$		1393277-6
V23076-A3001-C132					AgNi0.15	1 form A, NO	1-1393277-4
V23076-A3001-D142					$AgSnO_2$		1-1393277-7
V23076-A3001-D152[1)]					$AgSnO_2$ special		1-1414175-0
V23076-A1022-C133			24VDC		AgNi0.15	1 form C, CO	1393277-8
V23076-A1022-D143					$AgSnO_2$		1393277-9
V23076-A3022-C132					AgNi0.15	1 form A, NO	1-1393277-8
V23076-A3022-D142					$AgSnO_2$		1-1393277-9
V23133-A1001-C133	PCB, open		12VDC		AgNi0.15	1 form C, CO	1393278-7
V23133-A1001-D143					$AgSnO_2$		1-1393278-3
V23133-A3001-C132					AgNi0.15	1 form A, NO	5-1393278-7
V23133-A3001-D142					$AgSnO_2$		5-1393278-9
V23133-A3001-D152[1)]					$AgSnO_2$ special		1-1414173-0
V23133-A1022-C133			24VDC		AgNi0.15	1 form C, CO	3-1393278-7
V23133-A1022-D143					$AgSnO_2$		3-1393278-9
V23133-A3022-C132					AgNi0.15	1 form A, NO	7-1393278-1
V23133-A3022-D142					$AgSnO_2$		7-1393278-2
V23133-A3022-D152[1)]					$AgSnO_2$ special		1-1414174-0

1) For indicator lamps.

Power Relay K-S

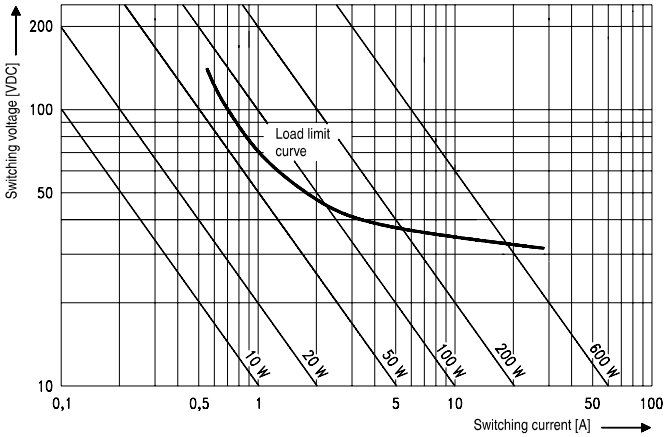
- **Very low voltage drop**
- **Wide voltage range**



Typical applications
ABS control, blower fans, cooling fan, engine control, glow plug, heated rear screen, ignition, main switch/supply relay, preheating system, valves, wiper control.

Contact Data	12VDC	24VDC
Contact arrangement	1 form A, 1 NO	
Rated voltage	12VDC	24VDC
Rated current	70A	
Limiting continuous current		
23°C	70A	
85°C	50A	
Limiting making current	300A[1)2)]	150A[1)2)]
Limiting breaking current	70A[1)]	35A[1)]
Contact material	AgNi0.15	
Min. recommended contact load	1A at 5VDC[3)]	
Initial voltage drop at 10A, typ./max.	10/300mV	
Frequency of operation	20 ops./s[4)]	
Operate/release time max.	typ. 4/3ms[5)]	
Electrical endurance		
resistive load,	>5x10^4 ops. at 13.5VDC, 50A	>1x10^5 ops. at 27.5VDC, 15A
Mechanical endurance	>10^6 ops.	

Max. DC load breaking capacity



Max. DC load breaking curve: safe shutdown, no stationary arc.
Load limit curves measured with low inductive resistors verified for 1000 switching events.

1) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 13.5VDC for 12VDC or 27VDC for 24VDC load voltages.
2) For a load current duration of maximum 3s for a make/break ratio of 1:10.
3) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
4) With load the values depend on PCB layer design and max. environmental temperature.
5) For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding (monostable version only).

Coil Data	
Rated coil voltage	12VDC, 24VDC[6)]

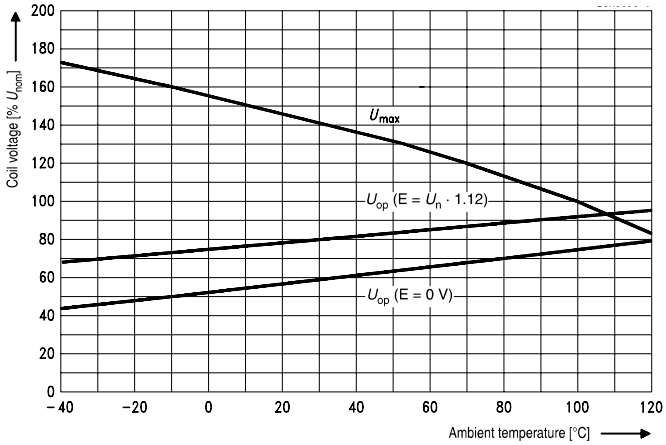
6) Other nominal voltages available on request.

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power W
009	12	6.9	1.2	64	2.3
010	24	14.1	2.4	234	2.5

All figures are given for coil without pre-energization, at ambient temperature +23°C.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization.

Insulation Data	
Initial dielectric strength	
between contact and coil	500VACrms

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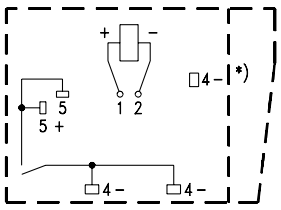
Power Relay K-S (Continued)

Other Data	
EU RoHS/ELV compliance	compliant
Ambient temperature	-40 to +85°C[6)]
Category of environmental protection, IEC 61810	RT II – fluxproof
Vibration resistance (functional) IEC 68-2-6 (sine pulse form), 10 to 200Hz no change in the switching state >10µs	20 to 40g
Shock resistance (functional) IEC 68-2-27 (half sine form single pulses), 8ms open form A (NO) contact will not close >10µs	30g
Terminal type	PCB
Weight	approx. 19g (0.68oz)
Resistance to soldering heat THT IEC 60068-2-20, Tb, method 1A,	10s+/-1s with shielding
Storage conditions	according IEC 60068[7)]
Packaging unit	400 pcs.

6) See graph: coil operating range.
7) For general storage and processing recommendations please refer to our Application Notes and especially to Storage in the Definitions or at http://relays.te.com/appnotes/

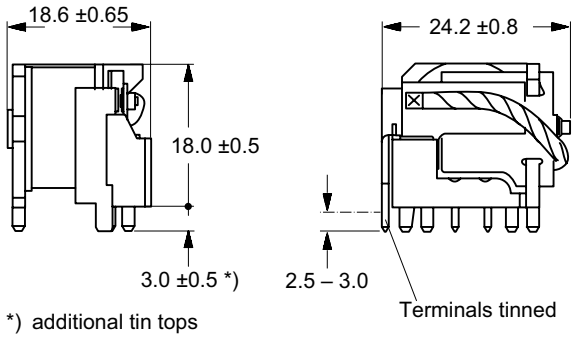
Terminal Assignment
Bottom view on solder pins

1 form A, 1 NO



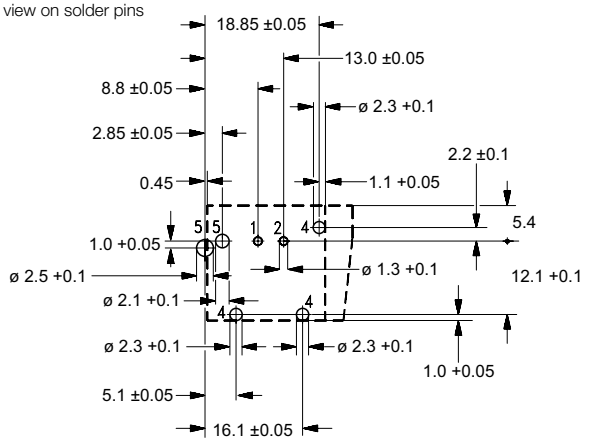
Note:
Check polarity and frame connection (ground)
* For mounting only, not for electrical connection.

Dimensions



*) additional tin tops max. 1.5 mm

PCB Layout
Bottom view on solder pins



Product code structure

Typical product code: **V23071** **-A** **1** **009** **-A** **13** **2**

Type
V23071 Power Relay K-S
Terminal and enclosure
A PCB, open (RT II)
Design
1 Single relay
Coil
009 12VDC **010** 24VDC
Contact type
A Single contact
Contact material
13 AgNi0.15
Contact arrangement
2 1 form A, 1 NO

Product code	Terminal/Encl.	Design	Coil	Contact type	Cont. material	Arrangement	Part number
V23071-A1009-A132	PCB, open	Single relay	12 VDC	Single contact	AgNi0.15	1 form A, 1 NO	1393276-3
V23071-A1010-A132			24 VDC				1393276-7

Double Micro Relay K (THT – THR)

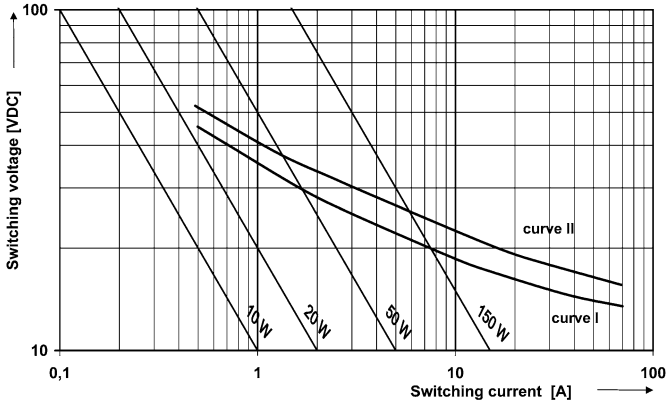
- **Small power relay**
- **Limiting continuous current 30A**
- **Minimal weight**
- **Low noise operation**
- **Wave (THT) and reflow (THR/pin-in-paste) solderable versions**
- **For single version refer to Single Micro Relay K**

Typical applications
Car alarm, door control, door lock, hazard warning signal, heated front/rear screen, immobilizer, lamps front/rear/fog light, interior lights, seat control, sun roof, turn signal, window lifter, wiper control.

Contact Data

Contact arrangement	2 form C, 2 CO
Rated voltage	10/12VDC
Rated current, form A/form B	NO/NC
	30A/25A
Limiting continuous current, form A/form B	
23°C	30/25A
85°C	20/15A
Limiting making current	40A[1)]
Limiting breaking current	30A
Contact material	$AgSnO_2$
Min. recommended contact load	1A at 5VDC[2)]
Initial voltage drop at 10A, typ./max.	30/300 mV
Operate/release time	typ. 3/1.5ms[3)]
Electrical endurance	
-40°C, +25°C, +85°C and 14 VDC,	
form C (CO), cyclic temperature	
motor reverse blocked, 25A, 0.77mH	>1x10^5 ops.
wiper 25A make/5A break,	
generator peak -20A on NC, L=1.0mH	>1x10^6 ops.
form A contact (NO), cyclic temperature	
resistive 20A	>3x10^5 ops.

Max. DC load breaking capacity



Load limit curve I: safe shutdown, arc extinguishes during transit time.
Load limit curve II: safe shutdown, no stationary arc.
Load limit curves measured with low inductive resistors verified for 1000 switching events.

Contact Data (continued)

Mechanical endurance	> 5x10^6 ops.

1) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 13.5VDC for 12VDC load voltages.For a load current duration of maximum 3s for a make/break ratio of 1:10.
2) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
3) Measured at nominal voltage without coil suppression unit. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding

Coil Data

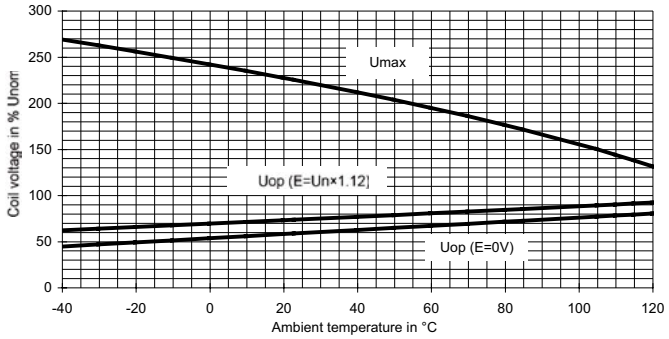
Rated coil voltage	12VDC

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power mW
001	12	6.9	1.5	254	567
002	10	5.7	1.25	181	552

All figures are given for coil without pre-energization, at ambient temperature +23°C.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization

Insulation Data

Initial dielectric strength	
between open contacts	500VAC$_{rms}$
between contact and coil	500VAC$_{rms}$

Double Micro Relay K (THT – THR) (Continued)

Other Data

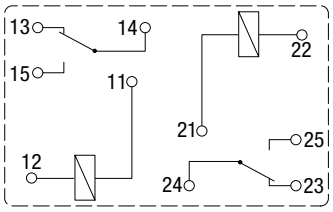
EU RoHS/ELV compliance	compliant
Ambient temperature	-40 to +105°C
Cold storage, IEC 60068-2-1	1000h; -40°C
Dry heat, IEC 60068-2-2	1000h; +125°C
Climatic cycling with condensation, EN ISO 6988	20 cycles, storage 8/16 h
Temperature cycling (shock), IEC 60068-2-14, Na	100 cycles; -40/+125°C
Temperature cycling, IEC 60068-2-14, Nb	35 cycles; -40/+125°C
Damp heat cyclic, IEC 60068-2-30, Db, Variant 1	6 cycles 25°C/55°C/93%RH
Damp heat constant, IEC 60068-2-3 method Ca	56 days 40°C/95%RH
Degree of protection	
THT:	RT III (61810), IP67 (IEC 60529)
THR:	RT II (61810), IP56 (IEC 60529)
Corrosive gas, IEC 60068-2-17: THT	Qc, method 2, 1min, 70°C
IEC 60068-2-42	10 days
IEC 60068-2-43	10 days
Vibration resistance (functional) IEC 60068-2-6 (sine sweep)	10 to 500Hz; 6g[6]
Shock resistance (functional) IEC 60068-2-27 (half sine)	6ms, up to 30g[6]
Terminal type	PCB:THT, THR
Weight	approx. 8g (0.28oz)
Solderability (aging 3: 4h/155°C) THT, IEC 60068-2-20	Ta, method 1, hot dip 5s, 215°C
Resistance to soldering heat THT, IEC 60068-2-20	Tb, method 1A, hot dip 10s, 260°C, with thermal screen
Resistance to soldering heat THR, IEC 60068-2-58	260°C; preheating min 130°C
Storage conditions	according IEC 600688 [7]
Packaging unit	990 pcs.

6) Depending on mounting position: no change in the switching state >10µs.

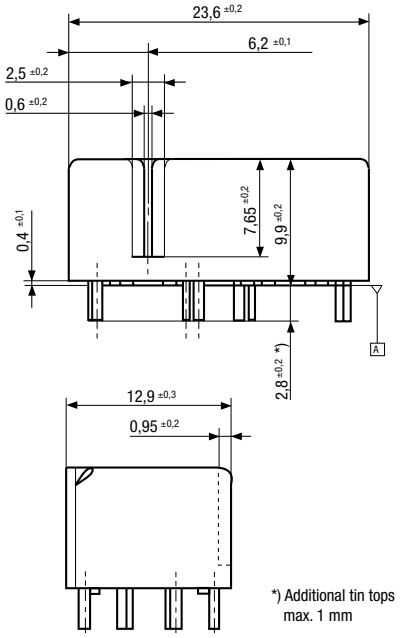
7) For general storage and processing recommendations please refer to our Application Notes and especially to Storage in the Definitions or at http://relays.te.com/appnotes/

Terminal Assignment
Bottom view on solder pins

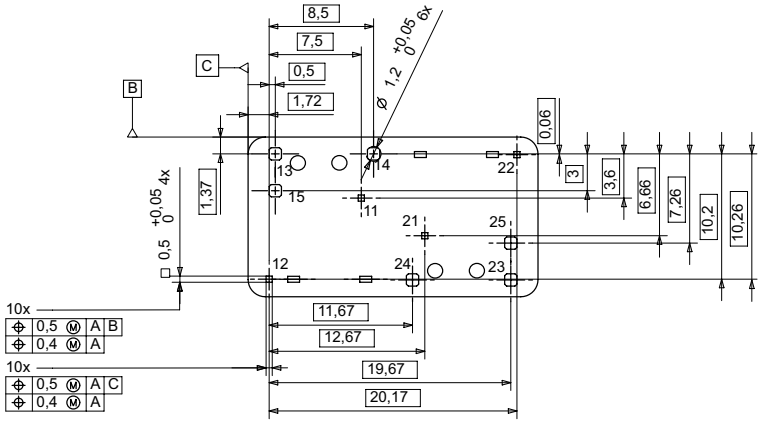
2 form C, 2 CO



Dimensions
Double Micro Relay THT



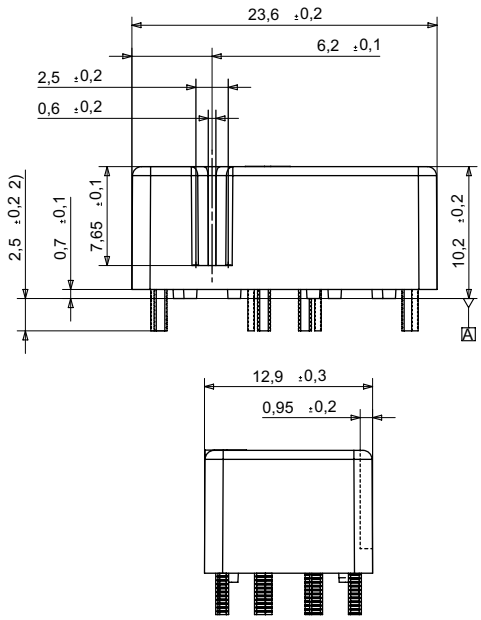
View of the Terminals
Bottom view on solder pins



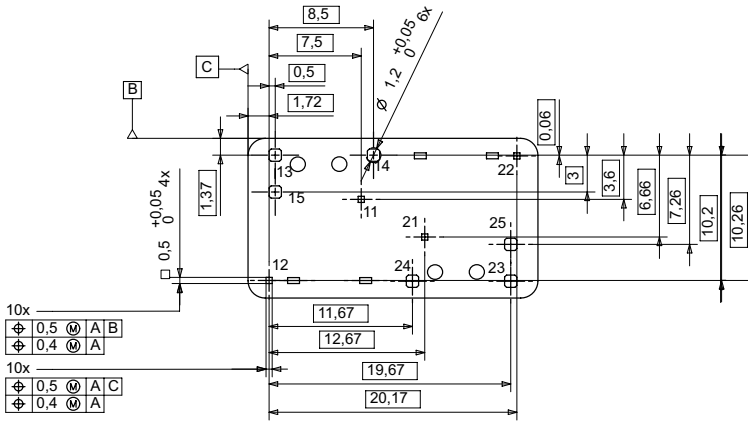
Remark:
Positional tolerances according to DIN EN ISO 5458

Double Micro Relay K (THT – THR) (Continued)

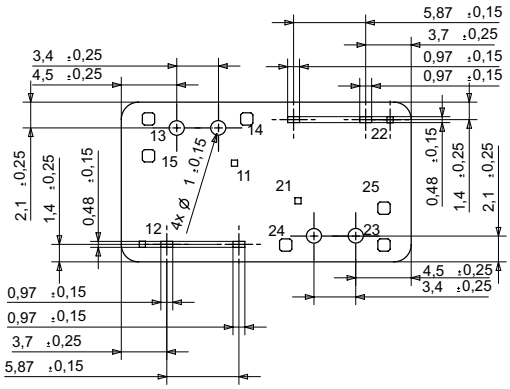
Dimensions
Double Micro Relay THR



View of the Terminals
Bottom view on solder pins



View of Stand-Offs
Bottom view on solder pins



Double Micro Relay K (THT – THR) (Continued)

Product code structure

Typical product code: **V23086 -C 20 01 -A 4 03**

Type
V2086 Micro Relay K (THT-THR)

Terminal and enclosure
C PCB version THT, sealed
R PCB version THR, vented

Design
20 Double relay (THT)
28 Double relay (THR)

Coil
01 Standard
02 Sensitive

Contact type
A Single contact

Contact material index
4 AgSnO2 standard
8 Wiper load

Contact arrangement index
03 form C (CO)

Product code	Terminal/Encl.	Design	Coil	Contact	Cont. material	Arrangement	Part number
V23086-C2001-A403	PCB THT,	Double	Standard	Single	$AgSnO_2$	2 form C, 2 CO (standard)	1413009-9
V23086-R2801-A403	imm., cleanable	relay					6-1414920-1
V23086-R2802-A803	PCB THR, vented		Sensitive			2 form C, 2 CO (wiper load)	8-1414964-5

This list represents the most common types and does not show all variants covered by this datasheet.
Other types on request.

Double Mini Relay DMR

■ Limiting continuous current 30 A

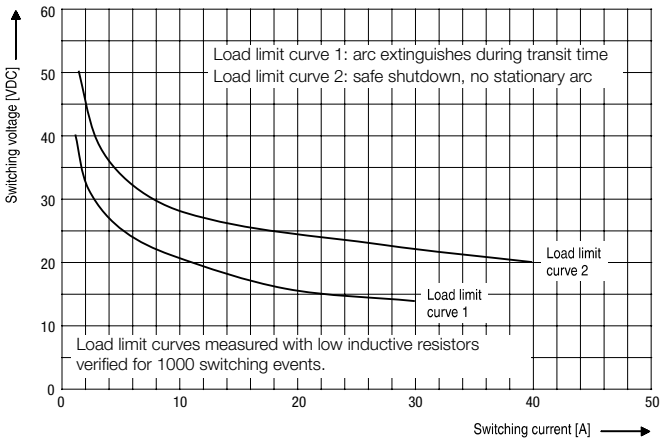
Typical applications
Car alarm, door control, door lock, immobilizer, seat control, sun roof, window lifter, wiper control.

Contact Data

Contact arrangement	2 form C, 2 CO			
Rated voltage	12VDC			
Rated current	both systems 20/20A	motor reverse[1)2)] 30/30A	both systems 18/18A	motor reverse[1)2)] 30/30A
Limiting continuous current				
at 23°C	20/20A	30/30A[2)]	18/18A	30/30A[2)]
at 85°C	15/15A	30/30A	12/12A	30/30A
Limiting making current[1)]	35A	35A	35A	35A
Limiting breaking current[1)]	35A	35A	35A	35A
Contact material	AgNi0.15	AgNi0.15	$AgSnO_2$	$AgSnO_2$
Min. recommended contact load	1A at 5VDC[3)]			
Initial voltage drop at 10A, typ./max.	30/300mV			
Operate/release time max. at nominal voltage	typ. 3 /1.3ms[4)]			
Electrical endurance				
at cyclic temperature -40/+23/+85°C and 13.5VDC, both systems AgNi0.15, motor reverse blocked, 25A, 0.77mH inductive	$>10^5$ ops.			
$AgSnO_2$, lamp load, 45A (on), 8A (off), 80°C	$>2x10^5$ ops.			
$AgSnO_2$, resistive load, 20A, 80°C	$>2x10^5$ ops.			
Mechanical endurance	$>10^7$ operations			

1) The values apply to a resistive or inductive load with suitable spark suppression and at maximum 13.5VDC for 12VDC load voltages.
2) At 50% ON period: max. make time 15s.
3) See chapter Diagnostics of Relays in our Application Notes or consult the internet at http://relays.te.com/appnotes/
4) For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding.

Max. DC load breaking capacity



Coil Data

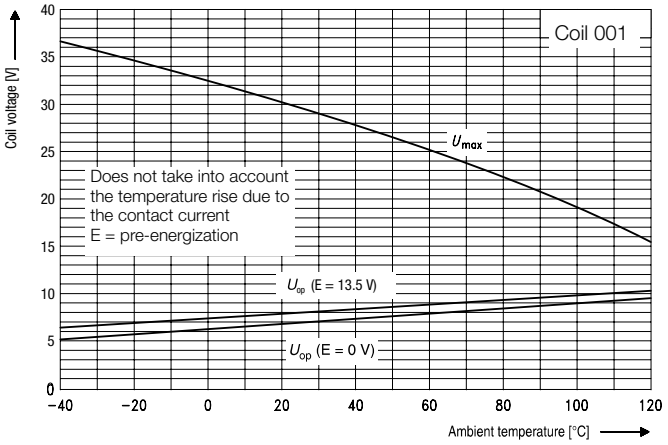
Coil voltage range	-40 to +85°C
Rated coil voltage	12VDC

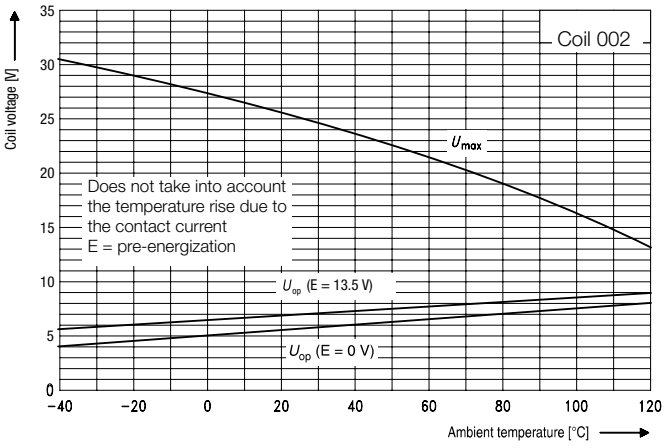
Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power mW
001	12	6.9	1.0	255	565
002	12	5.8	0.8	178	809

All figures are given for coil without pre-energization, at ambient temperature +23°C.

Coil operating range





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Double Mini Relay DMR (Continued)

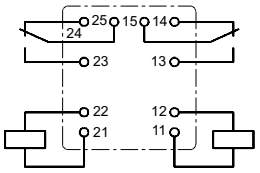
Insulation Data	
Initial dielectric strength	
between open contacts	500VAC$_{rms}$
between contact and coil	500VAC$_{rms}$

Other Data	
EU RoHS/ELV compliance	compliant
Ambient temperature	-40 to 85°C
Cold storage, IEC 60068-2-1	1000h; -40°C
Dry heat. IEC 60068-2-2	1000h; +125°C
Temperature cycling (shock)	
IEC 60068-2-14, Na	1000 cycles; -40/+125°C
Temperature cycling	
IEC 60068-2-14, Nb	35 cycles; -40/+125°C
Damp heat cyclic	
IEC 60068-2-30, Db, Variant 1	6 cycles 25°C/55°C/93%RH
Damp heat constant	
IEC 60068-2-3, Ca	56 days 40°C/95%RH[5)]
Category of environmental protection,	
IEC 61810	RT III - immersion cleanable
Sealing test	
IEC 60068-2-17	Qc, method 2, 1min, 70°C
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep)	10 to 200Hz; 6to 30g[6)]
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	6ms; 30g[6)]
Shock resistance (destructive)	
IEC 60068-2-29 (half sine)	30g: 6ms, 105 shocks 100g: 2ms, 10 shocks
Terminal type	PCB
Weight	approx. 10g (0.35oz)
Solderability (aging 3: 4h/155°C)	
IEC 60068-2-20	Ta, method 1, hot dip 5s, 215°C
Resistance to soldering heat THT	
IEC 60068-2-20	Tb, method 1A, hot dip 10s, 260°C with thermal screen
Packaging unit	600 pcs.

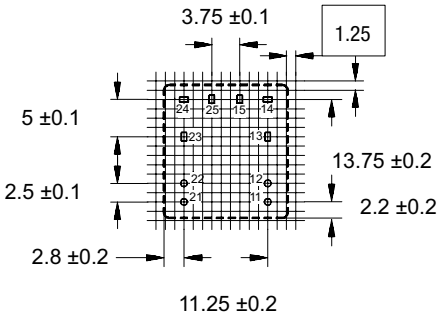
5) Relays have to be dried at 85°C for 24 hours after test.
6) depending on mounting position: no change in the switching state >10µs.

Terminal Assignment
Bottom view on solder pins

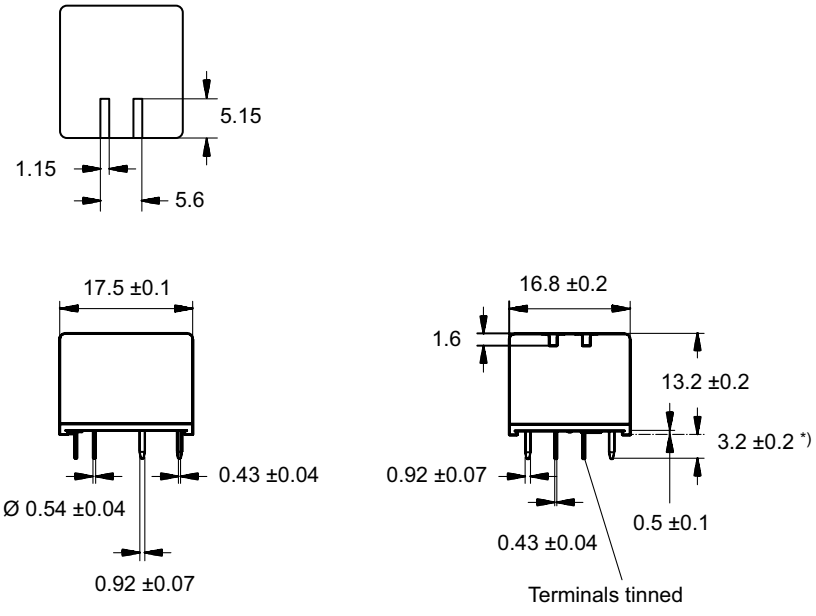
2 form C contacts, 2 CO



PCB Layout
Bottom view on solder pins



Dimensions



*) Additional tin tops max. 1mm

Double Mini Relay DMR (Continued)

Product code structure

Typical product code	V23084	-C	2	001	-A	4	03

Type
V23084 Double Mini Relay DMR

Terminal and enclosure
C PCB version, sealed

Design
2 Double relay

Coil
001 Standard (THT) **002** Sensitive (THT)

Contact type
A Single contact

Contact material
3 AgNi015 **4** $AgSnO_2$

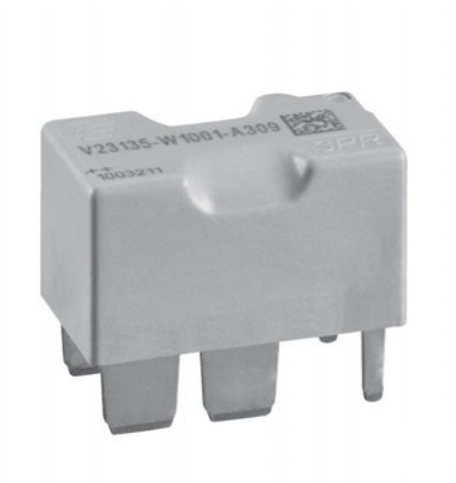
Contact arrangement
03 1 form C, 1 CO

Product code	Terminal/Encl.	Design	Coil	Contact type	Cont. material	Arrangement	Part number
V23084-C2001-A303	PCB,	Double relay	Standard (THT)	Single	AgNi0.15	2 form C, 2 CO	0-1393267-2
V23084-C2002-A303	immersion		Sensitive (THT)				1-1393267-0
V23084-C2001-A403	cleanable		Standard (THT)		$AgSnO_2$		0-1393267-6
V23084-C2002-A403			Sensitive (THT)				1-1393267-2

Contents

Star Point Relay SPR

- **Full, symmetric star-point disconnection of an electric power steering motor**
- **Limiting continuous current 90A at 85°C**
- **Disconnection of high over-currents up to 200A in 12VDC and up to 60A in 36VDC power nets**
- **Contact arrangement fulfills 42VDC power net requirements**
- **Optimized dimensions: lhw (in mm) 32x18.5x18**
- **Resistant against high ambient temperature up to 125°C**
- **Contact resistance typ. <2mΩ per path for load current 20A after fritting**



Typical applications
All EPA/EPS applications.

Contact Data

Contact arrangement	1 form 3, 3 NO	
Rated voltage	12VDC	24VDC
Max. switching voltage	depends on load parameters[A)]	
Rated current	120A	
Limiting continuous current[1)]		
23°C	120A	
85°C	90A	
125°C	60A	
Limiting breaking current	200A[2)]	60A[2)]
Breaking capacity max.	>10 ops. at 200A	>10 ops. at 60A
Contact material	AgNi0.15	
Contact style	triple	
Min. recommended contact load[5)]	1A at 5VDC	
Initial voltage drop, after fritting with 90A for 30s	<180mV at 90A	
Operate/release time max.[3)]	<20/10ms	
Bounce time max.[3)]	see footnote[3)]	
Electrical endurance		
120A, dry switching[4)] at 23°C, 500ms on/off	>2x10^5 ops.	
Mechanical endurance	>10^6 ops.	

Contact Data (continued)

A) Please contact TE relay application engineer.
1) Max. terminal temperatures up to 180°C are allowed. Final temperatures depend on the leadframe layout.
2) Without relay coil voltage: suppression component (see Application Note "Automotive Applications".
3) Release and bounce time depend on component in parallel to the coil, please contact application support.
4) Load only carried, not switched!
5) See Application Note "Diagnostics of Relays"

Coil Data

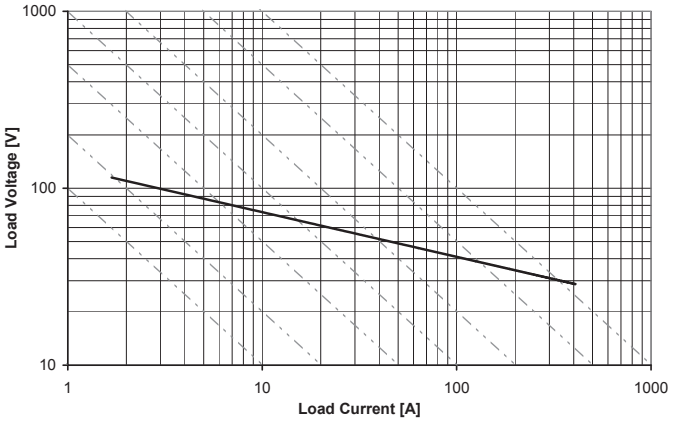
Coil voltage range	12VDC, 24VDC
Max. coil power	see coil table
Max. coil temperature	<180°C

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power W
001	12	6.4	1	150	0.96
002	10	5.2	0.8	97	1.03

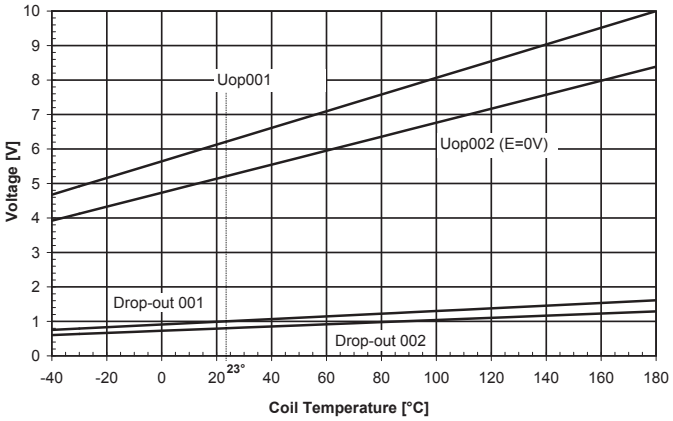
All figures are given for coil without preenergization, at ambient temperature +23°C.

Max. DC load breaking capacity



Load limit Curve II: valid for load path through pin 4 and pin 5, no coil suppression used.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization

Star Point Relay SPR (Continued)

Insulation Data

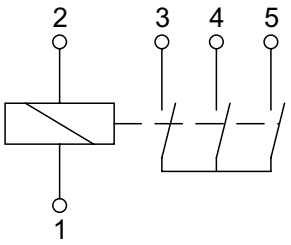
Initial dielectric strength	
between contact and coil	500VAC$_{rms}$

Other Data

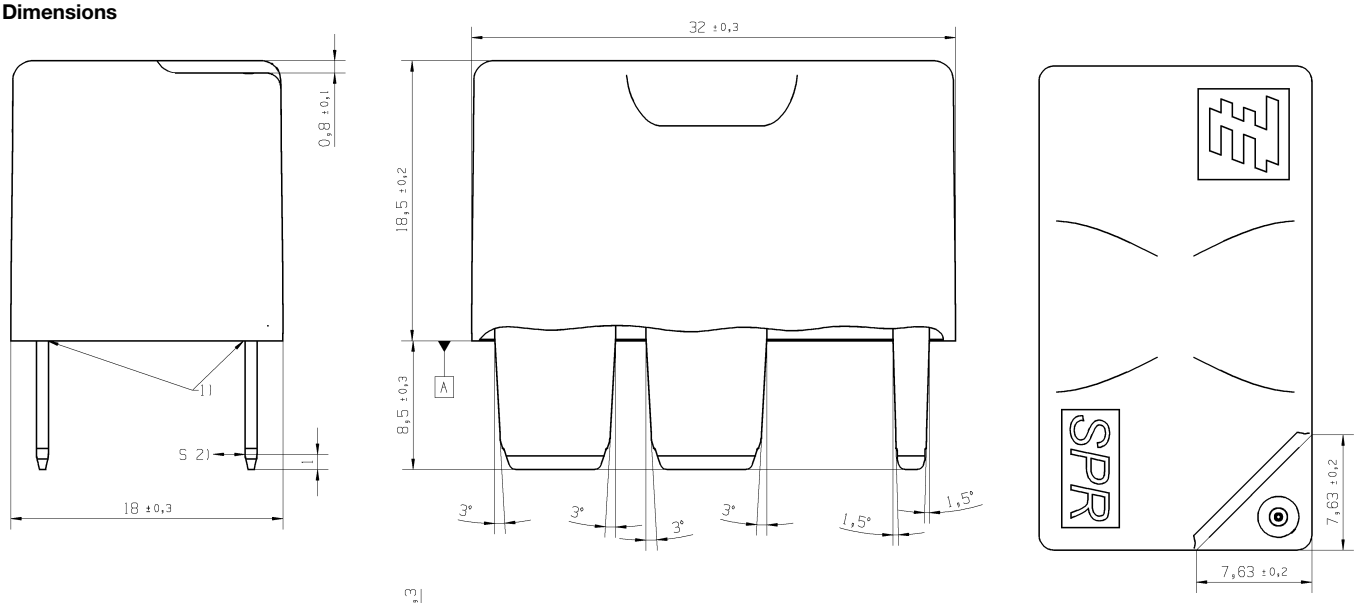
EU RoHS/ELV compliance	compliant
Ambient temperature	-40°C to 125°C
Cold storage, IEC 60068-2-1	2000h; -40°C
Dry heat, IEC 60068-2-2	500h; +135°C
Temperature cycling (shock),	
IEC 60068-2-14, Na	500 cycles; -40/+135°C
Damp heat cyclic,	
IEC 60068-2-30, Db, Variant 1	83 cycles (2000h) 25°C/55°C/93%RH
Flowing mixed gas corrosion test,	
IEC 60068-2-60, Ke, method 1	10 days
Degree of protection	IP67 (IEC 60529), RT III (IEC 61810)
Vibration resistance (functional),	
IEC 60068-2-64 (random) energized	20 to 1000Hz >6g ms
IEC 60068-2-64 (random) not energized	20 to 1000Hz >4g ms
Shock resistance (functional),	
IEC 60068-2-27 (half sine) 6ms, energized	>40g
IEC 60068-2-27 (half sine) 6ms, not energized	>10g
Mounting	welding process on leadframe
Weight	approx. 30g (1.06oz)
Packaging unit	357 pcs.

Terminal Assignment

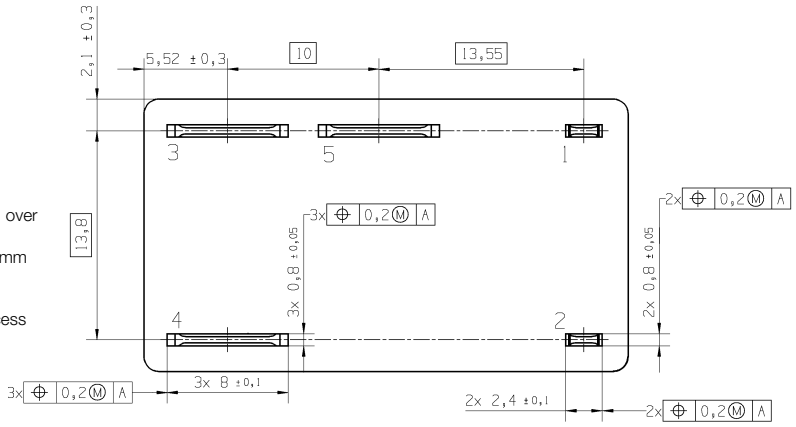
1 form 3, 3 NO



Dimensions



View of the terminals
Bottom view



1) Epoxy at terminals exceeds max. 0.9mm over coverage.
2) Permanent acceptable deformation 0.25mm respectively 0.5mm temporarily.

Maximum permissible thermal load of the terminals during the resistance welding process depends on leadframe design.

Star Point Relay SPR (Continued)

Product code structure

Typical product code: **V23135 -W 1 001 -A3 09**

Type
V23135 Star Point Relay

Terminal and enclosure
W Welding version, sealed

Design
1 Single relay

Coil version
001 Standard **002** Sensitive

Contact type and material
A3 Standard, AgNi0.15

Contact arrangement
09 Standard (triple make)

Product code	Terminal and enclosure	Design	Coil	Contact	Arrangement	Part number
V23135-W1001-A309	Welding version, sealed	Single relay	12VDC	Standard, AgNi0.15	1 form 3, 3 NO	1-1414704-0
V23135-W1002-A309			10VDC			1-1414705-0

High Current Relay 75

- **Limiting continuous current 75A at 23°C**
- **Current switching ability up to 150A**
- **Suitable for voltage levels up to 24VDC**
- **Minimal contact resistance**
- **Dustproof versions**

Typical applications

Engine control, glow plug, heated front- and rear - screen, preheating systems (e.g. for diesel engines, catalytic converters), switches for loading ramps, power distribution (clamp15).

Contact Data	Form A bifurcated	Form A
Contact arrangement	1 form A, 1 NO (bifurcated)	1 form A, 1 NO
Rated voltage	12VDC	24VDC
Max. switching voltage	depends on load parameter[A)]	
Rated current	50A at 12VDC	30A at 24VDC
Limiting continuous current		
23°C	75A	50A
85°C	50A	30A
105°C	20A	8A
Jump start test, ISO 16750-1	24VDC for 5 min, conducting nominal current at 23°C	
Contact material	silver based	
Contact style		
NO bifurcated:	double make contact bifurcated	
NO:	single contact	
Min. recommended contact load	1A at 5VDC	
Initial voltage drop, typ. at 100A	<50mV	<100mV
Operate/release time typ. at nominal voltage	7/2ms	
Electrical endurance		
form A contact (NO), resistive load	>1x10^5 ops. 75A, 13.5VDC	>5x10^4 ops. 50A, 27VDC
Mechanical endurance	>1x10^{6}ops.	

A) Please contact TE relay application engineer.

Coil Data	Form A bifurcated	Form A
Rated coil voltage	12/24VDC	
Rated coil power	3.1W	4.4W
Max. coil temperature	155°C	

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power W
0001	12	8.8	1.5	46	3.1
0002	24	19.0	1.0	130	4.4

All figures are given for coil without pre-energization, at ambient temperature +23°C

Insulation Data	
Initial dielectric strength between contact and coil	500VAC$_{rms}$
Load dump test	
ISO 7637-1 (12VDC), test pulse 5	Vs=+86.5VDC
ISO 7637-2 (24VDC), test pulse 5	Vs=+200VDC

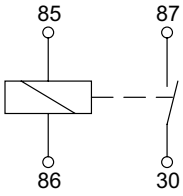
Other Data	
Ambient temperature	-40°C to +125°C
Climatic cycling with condensation, EN ISO 6988	6 cycles, storage 8/16h
Damp heat cyclic, IEC 60068-2-30, Db, Variant 1	6 cycles, upper air temp. 55°C
Damp heat constant, IEC 60068-2-3, Ca	56 days
Degree of protection	
dustproof:	IP54 (IEC 60529), RT I (IEC 61810)
sealed:	sealing in accordance with IEC 68
immersion cleanable:	IP67 (IEC 60529), RT III (IEC 61810)
Corrosive gas	
IEC 60068-2-42	10 days, 10 +/- 2cm^3/m^3 SO_2
IEC 60068-2-43	10 days, 1 +/- 0.3cm^3/m^3 H_2S
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep)	10-500Hz, > 5g[1)]
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	11 ms >20g[1)]
Cover retention	
pull force	200N
push force	200N
Terminal retention	
pull force	100N
push force	100N
torque	0.3Nm
Weight	38g (1.3oz)
Packaging unit	50 pcs.

1) No change in the switching state >10µs.

High Current Relay 75 (Continued)

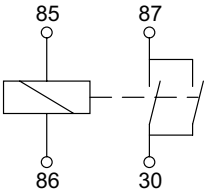
Terminal Assignment

NO
1 form A, 1 NO

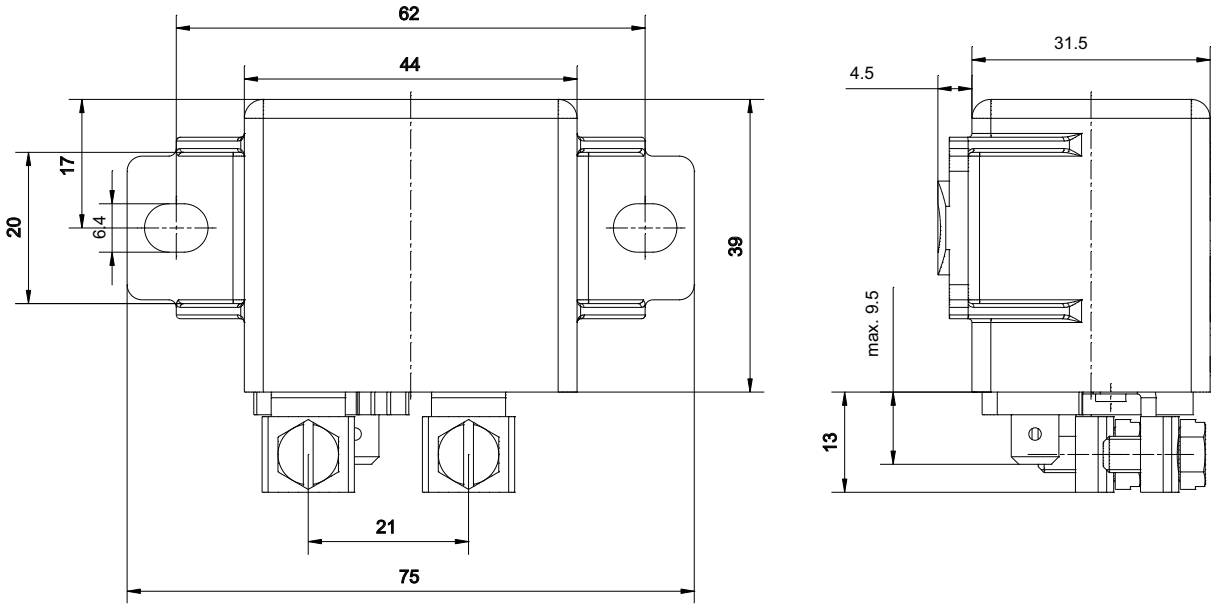


Polarity for all HCR 75:
Terminals 30 and 86 on +

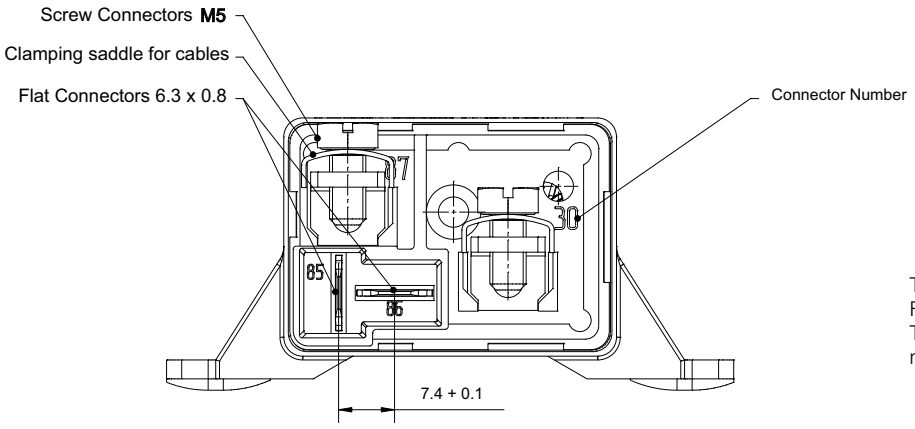
NOBI
1 form A (double make contact), 1 NO (bifurcated)



Dimensions



View of the terminals
Bottom view



Torque on each M5 screw must be ≤ 2.8 Nm.
Fitting connector for coil terminals 85 and 86 is Tyco Electronics' 2 way FF receptacle housing part number 180907.

08-2012, Rev. 0812
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High Current Relay 75 (Continued)

Product code structure Typical product code **V23232 -A 0001 -X001**

Type
V23232 High Current Relay 75

Contact arrangement
A 1 form A, 1 NO
D 1 form A, 1 NO (bifurcated)

Coil
0001 12VDC
0002 24VDC

Contact arrangement index
X001 1 form A, 1 NO at 12VDC (bifurcated)
X008 1 form A, 1 NO at 24VDC

Product code	Arrangement	Coil	Circuit	Coil suppr.	Protection	Cont. material	Terminals	Part number
V23232-D0001-X001	1 form A, 1 NO (bif.)	12VDC	NOBI		IP54	Silver based	Screw	1904000-1
V23232-A0002-X008	1 form A, 1 NO	24VDC	NO					1904001-4

This list represents the most common types and does not show all variants covered by this datasheet.
Other types on request.

High Current Relay 150

- **Limiting continuous current 130A at 85°C**
- **Current switching ability up to 300A**
- **Suitable for voltage levels up to 24VDC**
- **Heat, moisture and vibration resistant**
- **Minimal contact resistance**
- **Dustproof and sealed versions**

Typical applications
Engine control, glow plug, heated front screen, preheating systems (e.g. for diesel engines, catalytic converters), switches for loading ramps, start/stop.

Contact Data

Contact arrangement	1 form A, 1 NO 1 form B, 1 NC 1 form C, 1 CO 1 form X, 1 NO DM
Rated voltage	12VDC/24VDC
Max. switching voltage	depends on load parameters[A)]
Rated current, cable 25mm²	130A at 85°C
Limiting continuous current	
23°C, load cable 16mm²	130A
85°C, load cable 16mm²	120A
125°C, load cable 16mm²	60A
23°C, load cable 25mm²	180A
85°C, load cable 25mm²	130A
125°C, load cable 25mm²	70A
Limiting making current, load current max. 3s on, make/break ratio 1:10	300A
Limiting breaking current	300A
Contact material	$AgSnO_2$
Min. recommended contact load[4)]	1A at 5VDC
Initial voltage drop, typ. at 100A	70mV
Frequency of operation, with/without load	6 ops./min
Operate/release time typ. at nominal voltage	25/8ms
Electrical endurance form A contact (NO), resistive load, cyclic temperature:+23°C	>5x10⁴ cycles at 300A, 13.5VDC
Mechanical endurance	>10⁷ ops.

A) Please contact TE relay application engineer.

Coil Data

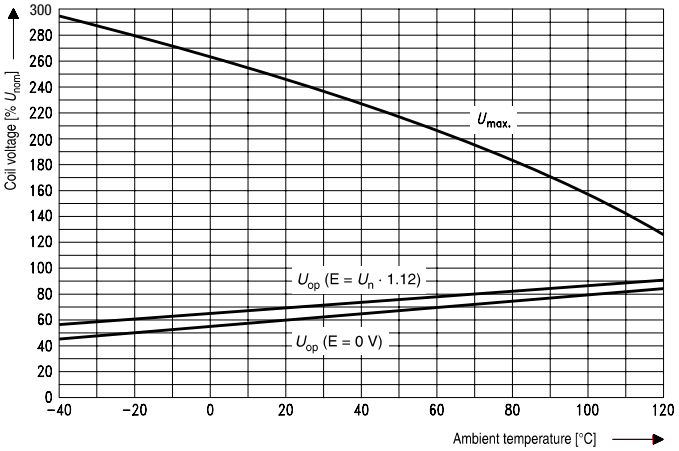
Rated coil voltage	12/24VDC
Rated coil power	3.3W[1)]
Max. coil temperature	155°C

Coil versions, DC coil[1)]

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power W
001	12	7.2	1.2	37	3.9
002	24	14.4	2.4	141	4.1

1) With resistor.
All figures are given for coil without preenergization, at ambient temperature +23°C.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization

Insulation Data

Initial dielectric strength between contact and coil	1000VAC_{rms}
Load dump test	
ISO 7637-1 (12VDC), test pulse 5	Vs=+86.5VDC
ISO 7637-2 (24VDC), test pulse 5	Vs=+200VDC

High Current Relay 150 (Continued)

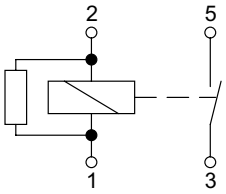
Other Data	
EU RoHS/ELV compliance	compliant
Ambient temperature	-40°C to +125°C
Dry heat, IEC 60068-2-2	500h at 100°C
Damp heat constant,	
IEC 60068-2-3 (78), Ca	500h, 40°C, 93% RH
Degree of protection	
dustproof:	IP54 (IEC 60529), RT I (IEC 61810)
sealed:	sealing in accordance with IEC 68
immersion cleanable:	IP67 (IEC 60529), RT III (IEC 61810)
Corrosive gas	
IEC 60068-2-42	10 days
IEC 60068-2-43	10 days
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep)	10 to 200Hz >5g[2)]
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	6ms >20g[2)]
Drop test, free fall	
IEC 60068-2-32	1m onto concrete

Other Data (continued)	
Terminal type	screw
Cover retention	
pull force	500N
push force	500N
Terminal retention	
pull force	150N
push force	150N
resistance to bending	20N
force applied to side	20N
torque	5Nm
Weight	approx. 220g (7.8oz)
Packaging unit	50 pcs.

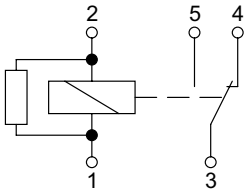
2) No change in the switching state >10µs.

Terminal Assignment

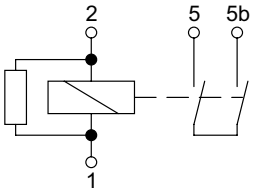
NOR
1 form A, 1 NO with resistor



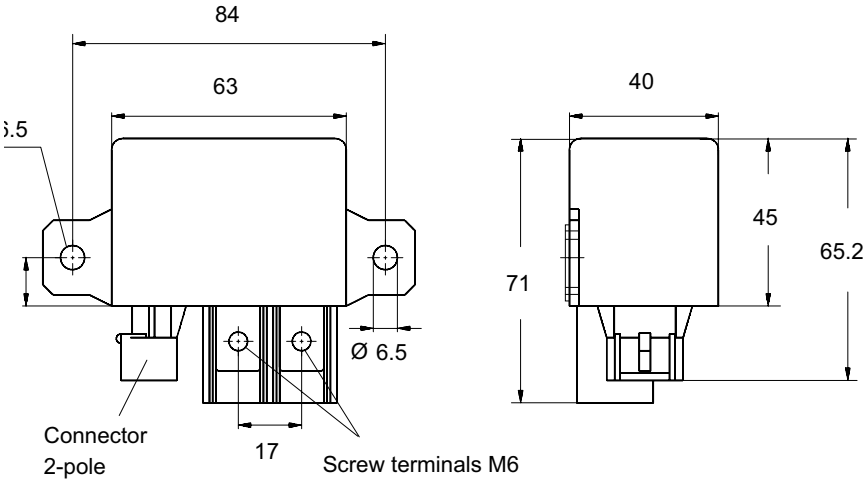
COR
1 form C, 1 CO with resistor



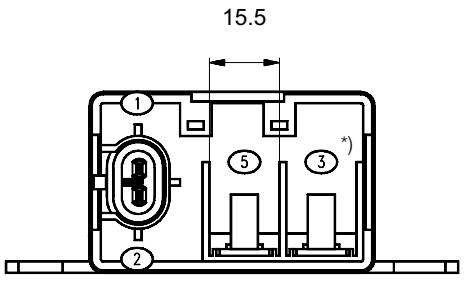
NOBRR
1 form X, 1 NO DM with resistor



Dimensions
NO and NO DM version



View of the terminals
Bottom view



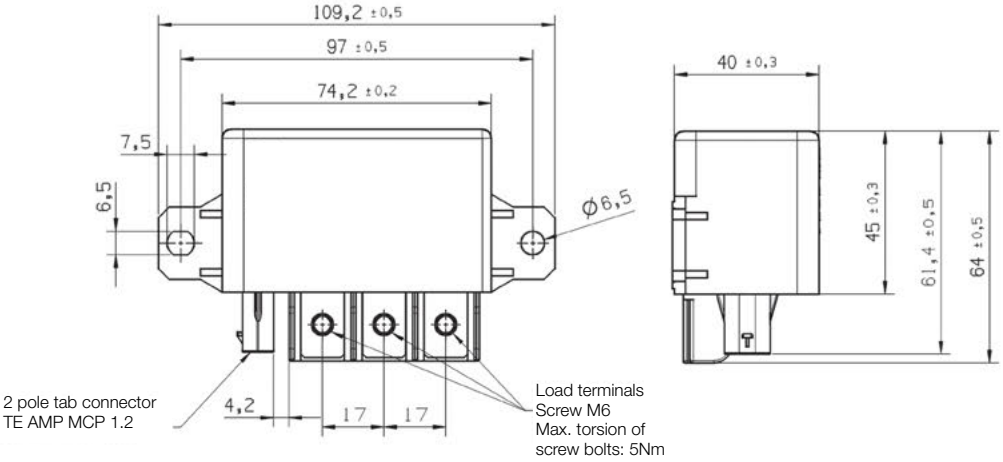
*) Alternatively 5b for form X, 1 NO DM with resistor.

Connector Information
AMP SUPERSEAL 1.5 SERIES
Coil side
- Receptacle connector 282080-1
- Single wire seal 281934-2
- Contact 282110-1

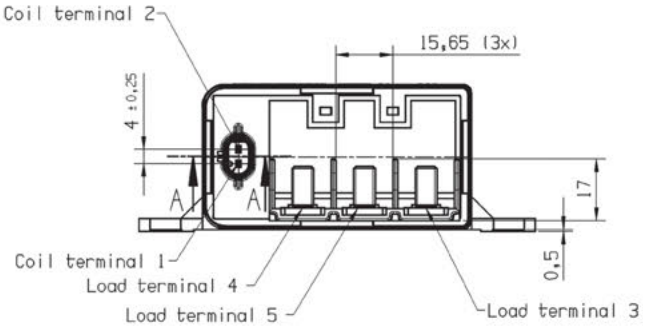
Load side
- Cable lug M6, maximum cable section 25 mm²

High Current Relay 150 (Continued)

Dimensions
CO version



View of the terminals
Bottom view



Product code structure Typical product code **V23132 -A2 001 -A 2 00**

Type
V23132 High Current Relay 150

Contact arrangement

A2	1 form A, 1 NO	**D2**	1 form B, 1 NC
B2	1 form X, 1 NO DM	**E2**	1 form C, 1 CO

Coil

001	12VDC	**002**	24VDC

Protection class

A	IP54	**B**	IP67

Contact material
2 $AgSnO_2$

Standard version
00 Standard

Product code	Arrangement	Coil	Circuit	Coil suppr.	Protection	Cont. material	Terminals	Part number
V23132-A2001-A200	1 form A, 1 NO	12VDC	NOR	Resistor	IP54	$AgSnO_2$	Screw	1393315-2
V23132-A2001-B200					IP67			1416010-1
V23132-B2002-A200	1 form X, 1 NO DM	24VDC	NOBRR		IP54			1393315-9
V23132-B2002-B200					IP67			1-1393315-1
V23132-D2001-B200	1 Form B, 1 NC	12VDC	NCR					on request
V23132-E2001-A200	1 form C, 1 CO	12VDC	COR		IP54			9-1415001-5

This list represents the most common types and does not show all variants covered by this datasheet.
Other types on request.

High Current Relay 200

- **Normally closed contact**
- **Limiting continuous current 175A at 85°C**

Typical applications
Energy management, battery coupling, start/stop.

Contact Data

Contact arrangement	1 form B, 1 NC
Rated voltage	12VDC
Max. switching voltage	depends on load parameter set A)
Rated current, cable 50mm²	175A at 85°C
Limiting continuous current	
23°C, load cable 35mm²	245A
85°C, load cable 35mm²	165A
110°C, load cable 35mm²	120A
23°C, load cable 50mm²	255A
85°C, load cable 50mm²	175A
110°C, load cable 50mm²	130A
Limiting making current	200A at <5VDC
Limiting breaking current	200A at <5VDC
Limiting short-time current	depends on load parameter set A)
Contact material	$AgSnO_2$
Contact style	single contact
Min. recommended contact load	1A at 5V
Initial voltage drop	100mV at 100A
Operate/release time typ. at nominal voltage	25/6ms 1)
Bounce time max.	2)
Electrical endurance	
50A (on), 30A (cont.), 50A (off):	48000 cycles
80A (on), 30A (cont.), 120A (off):	1000 cycles
200A (on), 120A (cont.), 120A (off): repeated until 800000 cycles are reached 3)	1000 cycles
Mechanical endurance	$>10^7$ ops.

1) With diode in parallel.
2) Release and bounce time depend on component in parallel to the coil, please contact application engineering support.
3) Validated with a load voltage of 5VDC.
A) Please contact TE relay application engineering.

Coil Data

Rated coil voltage	12VDC
Max. coil power	3.3W 1)
Max. coil temperature	155°C

1) With diode in parallel.

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power W
1001	12	7.2	1.2	37	3.9
2001	12	7.2	1.2	43	3.3

All figures are given for coil without pre-energization, at ambient temperature +23°C.

Insulation Data

Initial dielectric strength	
between open contacts	500VDC
between contact and coil	500VDC
Load dump test	
ISO 7637-1 (12VDC), test pulse 5	no switching allowed during load dump
ISO 7637-2 (24VDC), test pulse 5	no switching allowed during load dump

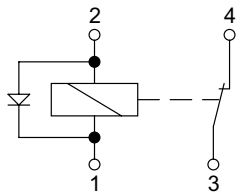
Other Data

EU RoHS/ELV compliance	compliant
Ambient temperature	-40°C to +110°C
Climatic cycling with condensation, EN ISO 6988	240h (-10 to +65°C), 93% RH
Temperature cycling (shock), IEC 60068-2-14, Na	600h (-40 to +110°C), <30s
Degree of protection splash water proof:	IP64 (IEC 60529), RT III (IEC 61810)
Corrosive gas	5 ±1%NaCl, 96h, 35°C
Vibration resistance (functional), IEC 60068-2-64 (random)	10 to 2000Hz, min. 5g effective
Shock resistance (functional), IEC 60068-2-27 (half sine)	11ms min. 30g
Drop test, free fall	1m onto concrete
Terminal type	connector, screw
Weight	approx. 230g (8.1oz)
Packaging unit	on request

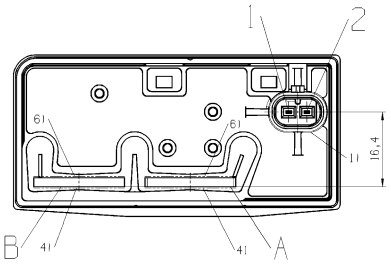
High Current Relay 200 (Continued)

Terminal Assignment

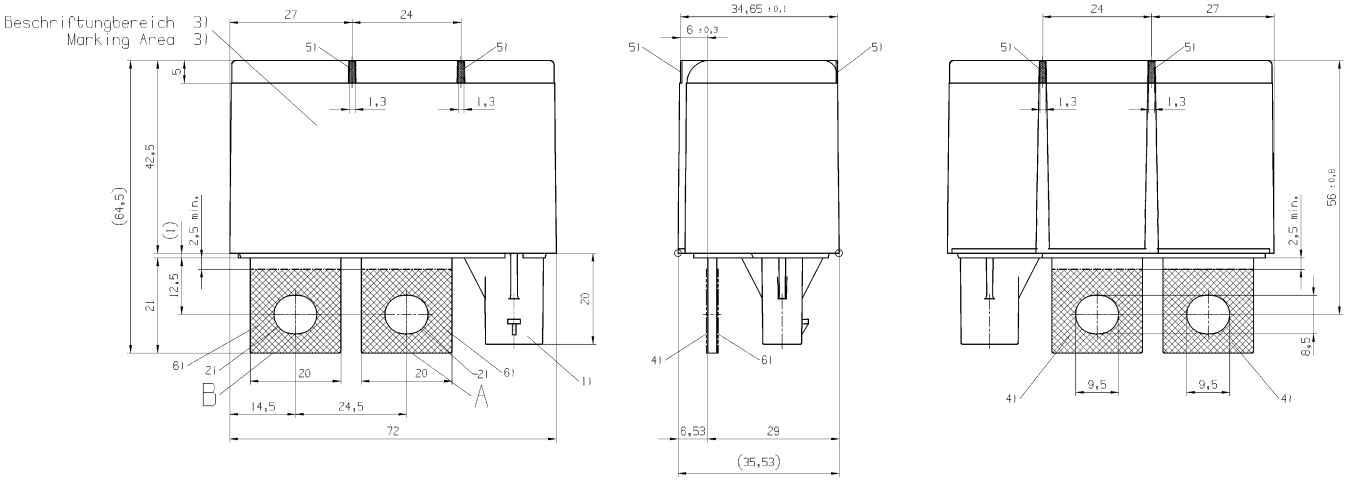
NCD
1 form B, NC with diode



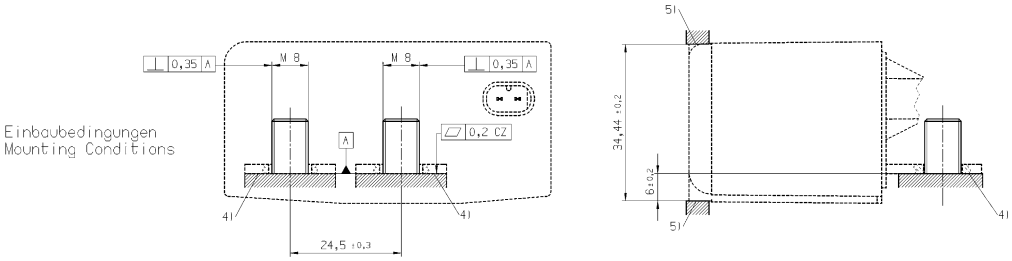
View of the terminals (bottom view)



Dimensions



Mounting



Product code structure

Typical product code	V23230	-D	1	001	-B	2	00

Type
V23230 High Current Relay 200

Contact arrangement
D 1 form B, 1 NC

Coil Suppression
1 Resistor
2 Diode

Coil
001 12VDC

Protection class
B IP64

Contact material
2 $AgSnO_2$

Standard version
00 Standard

Product code	Arrangement	Coil suppr.	Circuit[1)]	Coil	Enclosure	Cont. material	Terminals	Part number
V23230-D2001-B200	1 form B, 1 NC	Diode	NCD	12VDC	IP64	$AgSnO_2$	Screw	1-1414995-0
V23230-D1001-B200		Resistor						5-1415009-7

1) See Terminal assignment diagrams.

Battery Disconnect Switch BDS-A (Latching)

- **Limiting continuous current 190A at 85°C**
- **Electrically settable and resettable ON/OFF bistable device**
- **Suitable for voltage levels up to 42VDC**
- **High peak current carrying capability up to 1500A[1)]**

Typical applications
Preheating systems (e.g. for diesel engines, catalytic converters), battery disconnection to prevent fire caused by short circuits during an accident, dual battery applications provide the start reliability by a separate starter battery, keeps the power net in balance and to control and secure the health of the energy storage systems, seasonal, service and transport deactivation, high current switching, energy management, battery coupling.

1) Important: please pay attention to load current direction.

Contact Data	12VDC	24VDC
Contact arrangement	1 form X, 1 NO DM (bridge)	
Rated voltage	12VDC	24VDC
Max. switching voltage	depends on load parameter[2)]	
Rated current		
load current from Terminal B to A, cable 50mm²	260A	
Limiting continuous current		
23°C, load cable 50mm²	260A	
85°C, load cable 50mm²	190A	
125°C, load cable 50mm²	88A	
Limiting making current, resistive load, cable 50mm², 23°C, ton/toff=0.5s/10min	1500A, >5 ops.	
Limiting breaking current, resistive load, cable 50mm², 23°C, ton/toff=0.5s/10min	1500A, >5 ops.	
Limiting short-time current, overload current at 23°C, cable 50mm², 1000A,1s - 0A, 9s	50x10³ ops.[3)]	
Contact material	$AgSnO_2$	
Contact style	bridge contact	
Initial voltage drop	at 100A<40mV post 1min	
Operate/release time typ.	5ms at 14VDC (coil voltage)	
Electrical endurance inductance 0.1mH, temperature change (-40/25/120°C) 2h each; cable 35mm²		
180A, ton/off	>13x10³ ops., 1.5/5s.	
100A, ton/off	>50x10³ ops., 1.5/5s	
150A, ton/off		>25x10³ ops., 0.5/5s
100A, ton/off		>70x10³ ops., 0.5/5s
Mechanical endurance	>150x10³ ops.	

2) Please contact TE relay application engineer.
3) Values are influenced by system temperature and load current. For further details please consult TE relay application engineers.

Coil Data	
Magnetic system	bistable (two coil system)
Rated coil voltage	12/24VDC
Max. coil power	approx. 7W at 20°C for Uon/Uoff
Max. coil temperature	155°C

Coil versions, bistable 2 coils

Coil code	Rated voltage VDC	Set voltage VDC	Reset voltage VDC	Coil resistance Ω±10%	Impulse length ms
2021	12	6	6	4.7	15 to 100
2421	24	12	12	19.9	15 to 100

All figures are given for coil without preenergization, at ambient temperature +23°C.

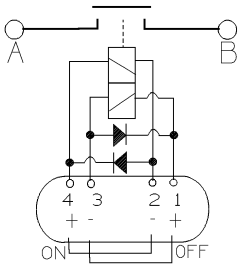
Insulation Data	
Initial dielectric strength	
between open contacts	$500V_{rms}$
between contact and coil	$500V_{rms}$

Other Data	
Ambient temperature	-40°C to +120°C
Degree of protection	
dustproof/splash water proof:	IP54 (IEC 60529), RT I (IEC 61810)
Vibration resistance (functional)	
IEC 60068-2-6 (sine sweep)	22 to 500Hz, min. 10g.
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	11ms, min. 40g[4)]
Terminal type	connector and screw
Weight	approx. 210g (7.4oz)
Packaging unit and delivery[5)]	24 pcs.

4) No change in the switching state >10µs.
5) Bistable relays are delivered in the reset position (open contacts). Due to mechanical impacts during transportation, we advise to check the contact status on receipt. Latching (delivery status "ex works").

Terminal Assignment

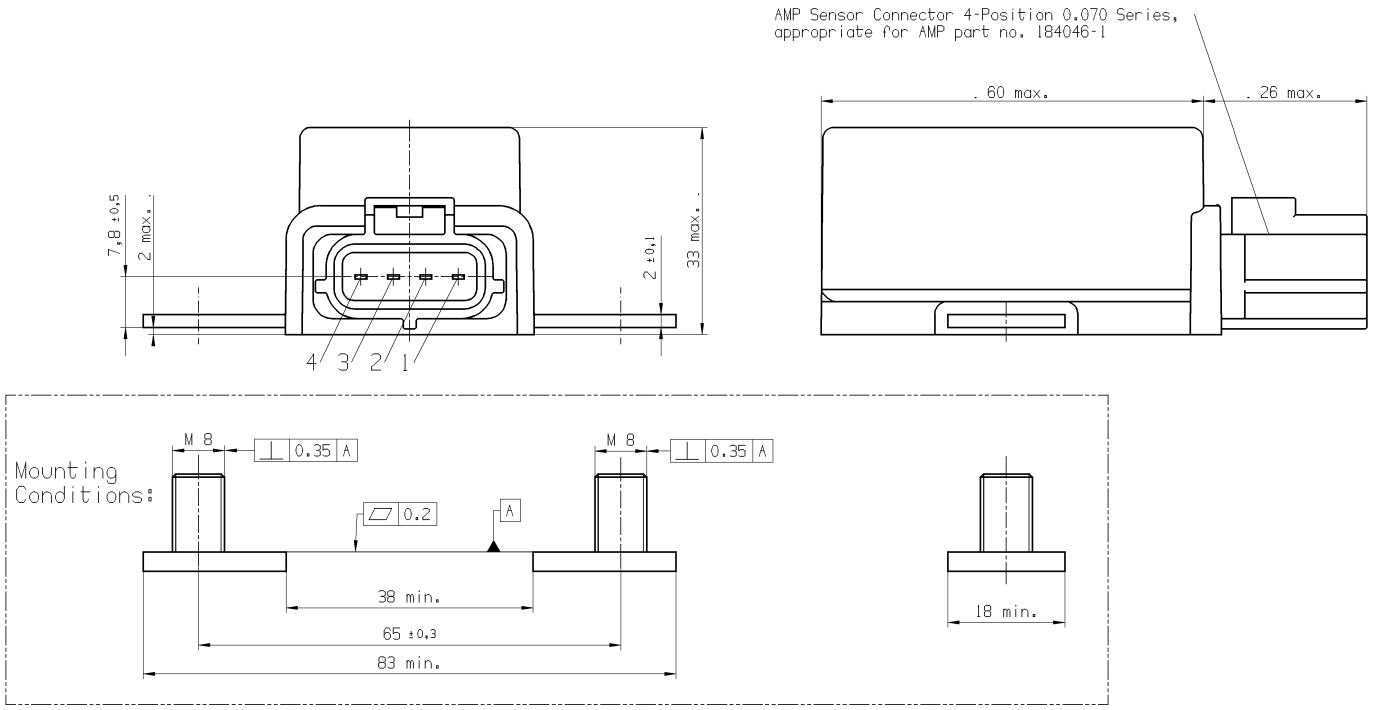
X2D2C
1 form X, 1 NO DM (bridge),
with 2 coils and 2 diodes

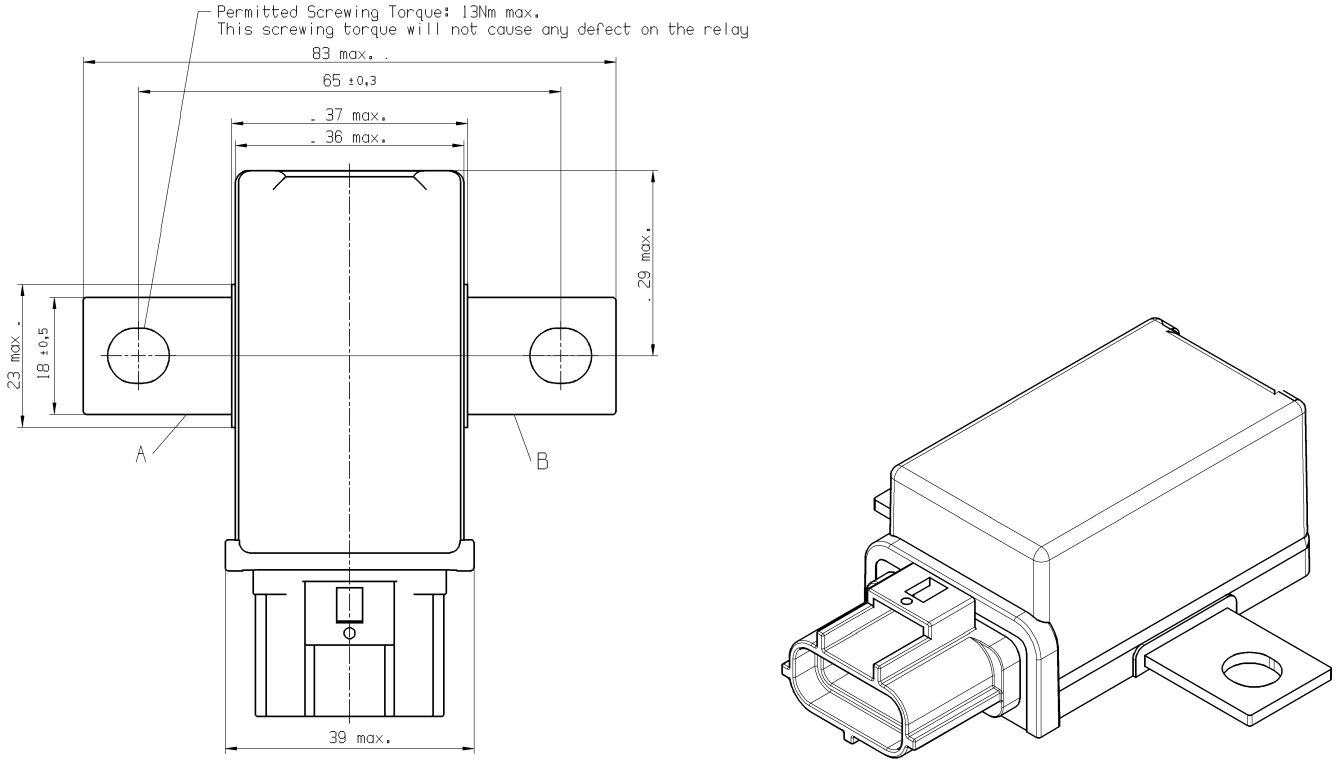


Terminal	Function
4	Set Coil (+)
3	Reset Coil (-)
2	Set Coil (-)
1	Reset Coil (+)
A	Load Terminal
B	Load Terminal

Set = A and B get connected

Battery Disconnect Switch BDS-A (Latching) (Continued)





Battery Disconnect Switch BDS-A (Latching) (Continued)

Product code structure

Typical product code: **V23130** **-C** **2021** **-A** **4** **00**

Type
V23130 Battery Disconnect Switch BDS-A

Contact arrangement
C 1 form X, 1 NO DM

Coil
2021 12VDC (bistable) **2421** 24VDC (bistable)

Protection class
A IP54

Contact material
4 AgSnO2

Standard version
00 Standard

Product code	Arrangement	Coil	Circuit	Coil suppr.	Protection	Terminals	Feature	Part number
V23130-C2021-A412	1 form X,	12VDC	X2D2C	Diode	IP54	Screw +	Bracket	1-1414939-4
V23130-C2421-A431	1 NO DM (bridge)	24VDC				connector		7-1414778-3

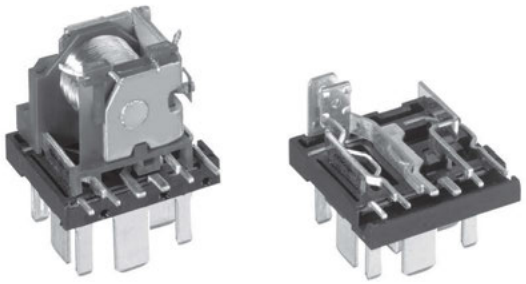
This list represents the most common types and does not show all variants covered by this datasheet.
Other types on request.

Contents

Basic Module Relay F4

- **Modular unit based on Power Relay F4 to be customized with one or more relays, electronics or further components.**
- **Limiting continuous current up to 40A at 85°C**
- **Pin assignment according to ISO 7588 part 1**
- **Terminals 1, 2, 6, 7, 8, 9 are optional. Terminals 3, 4, 5 are fixed in function (make or changeover contacts)**
- **Terminals prepared for soldering to an integrated PCB**
- **For relay operation a printed circuit board or leadframe is required**
- **Mounting bracket or clip on request**

Typical applications
Customer specific solutions, especially programmable timer relay. Automatic wash/ wiper control, battery disconnection, cooling fan controls, energy distribution, fuel/water pump control unit, flexible control unit functions, light control applications, motor antennas, over voltage protection, power management/outlet control/window actuator, rear window defogger, seat adjustment/stationary heating, timer, wiper control.

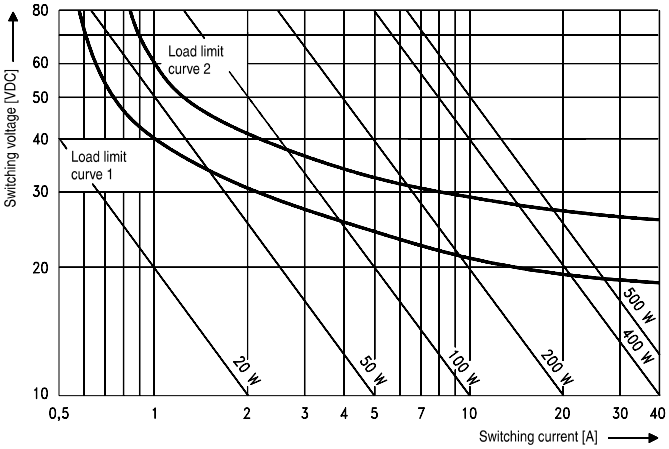


Contact Data

Contact arrangement	1 form A, NO	1 form C, CO
Rated voltage	12VDC	24VDC
Rated current	40A at 85°C	20A at 85°C
Limiting continuous current, form A/form B (NO/NC)		
23°C	60A	60/45A
85°C	40A	40/30A
125°C	17A	12/12A
Jump start test	24VDC for 5min, conducting nominal current at 23°C	
Contact material	AgNi0.15	
Min. recommended contact load	1A at 5VDC	
Initial voltage drop, form A (NO) contact at 10A, typ./max.	15/20mV	
Operate/release time max.	7/2ms[3)]	
Electrical endurance		
resistive load, form A (NO) contact	>2x10^5 ops., 40A, 14VDC	>1x10^5 ops., 20A, 28VDC
resistive load, form B (NC) contact	>1x10^5 ops. 40A, 14VDC, at NO	>1x10^5 ops. 20A, 28VDC, at NO
Mechanical endurance, DC coil, without load	>1x10^{7}ops.	

3) Without component in parallel.
For unsuppressed relay coil. A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime caused by increased erosion and/or higher risk of contact tack welding.

Max. DC load breaking capacity



Load limit curve I: safe shutdown, arc extinguishes during transit time.
Load limit curve II: safe shutdown, no stationary arc.
Load limit curves measured with low inductive resistors verified for 1000 switching events.

Coil Data

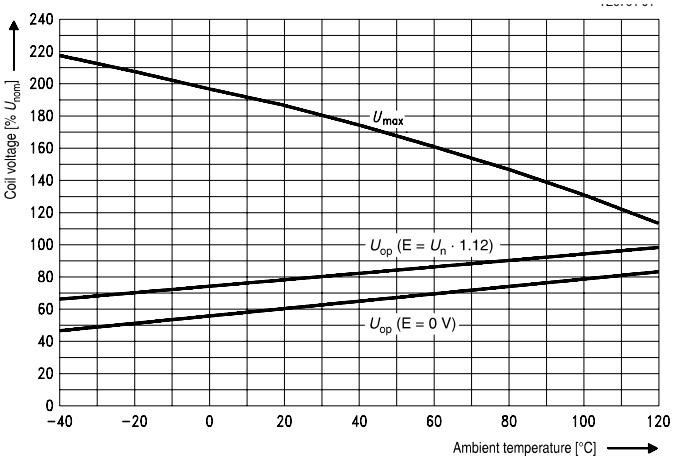
Rated coil voltage	12VDC, 24VDC
Max. coil temperature	155°C

Coil versions, DC coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power W
052	12	7.2	1.6	90	1.6
053	24	14.4	3.2	324	1.8

All figures are given for coil without preenergization, at ambient temperature +23°C.

Coil operating range



Does not take into account the temperature rise due to the contact current
E = pre-energization

Insulation Data

Initial dielectric strength between contact and coil	500VAC$_{rms}$
Load dump test	
ISO 7637-1 (12VDC), test pulse 5	Vs=+86.5VDC
ISO 7637-2 (24VDC), test pulse 5	Vs=+200VDC

Basic Module Relay F4 (Continued)

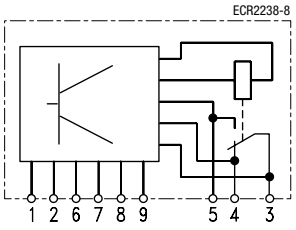
Other Data	
EU RoHS/ELV compliance	compliant
Protection to heat and fire	according UL94HB or better[4]
Ambient temperature	-40°C to +125°C
Climatic cycling with condensation, EN ISO 6988	6 cycles, storage 8/16h
Temperature cycling, IEC 60068-2-14, Nb	10 cycles, -40/+85°C (5°C/min)
Damp heat cyclic, IEC 60068-2-30, Db, Variant 1	6 cycles, upper air temp. 55°C
Damp heat constant, IEC 60068-2-3 (78), Ca	56 days
Degree of protection, dustproof:	IP54 (IEC 60529), RT I (IEC 61810)
Corrosive gas	
IEC 60068-2-42	10±2cm³/m³ SO_2, 10 days
IEC 60068-2-43	1±0.3cm³/m³ H_2S, 10 days
Vibration resistance (functional), IEC 60068-2-6 (sine sweep)	10 to 500Hz, > 5g[5]
Shock resistance (functional), IEC 60068-2-27 (half sine)	11ms, >20g[5]
Drop test, free fall, capable of meeting specification after drop onto cocrete	1m onto concrete
Terminal type	plug-in, QC
Cover retention	
axial force	150N
pull force	200N
push force	200N
Terminal retention	
pull force	100N
push force	100N
torque	0.3Nm
Weight	
Power F4	approx. 35 (1.2oz)
Storage conditions	according IEC 600688[6]
Packaging unit	
base	300 pcs.
cover	144 pcs.

5) No change in the switching state >10µs. Valid for NC contacts, NO contact values significantly higher.

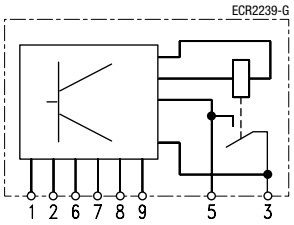
6) For general storage and processing recommendations please refer to our Application Notes and especially to Storage in the Definitions or at http://relays.te.com/appnotes/

Terminal Assignment

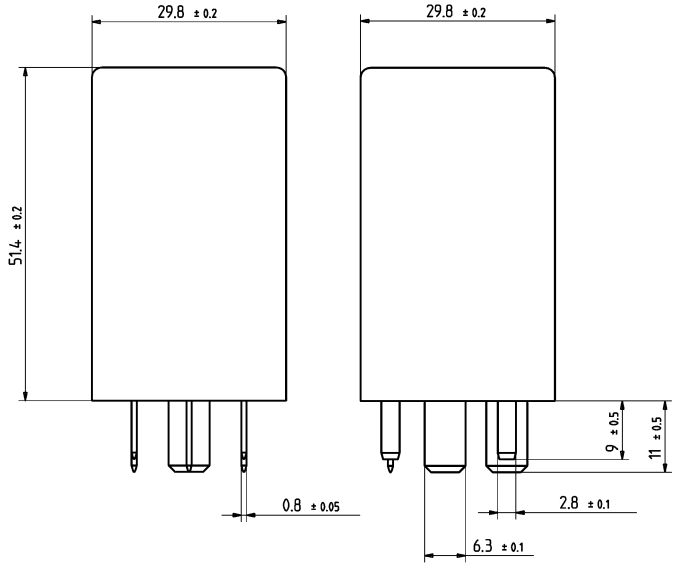
1 form C, 1 CO
Load terminals according to ISO 7880



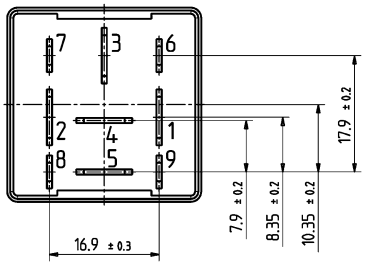
1 form A, 1 NO
Load terminals according to ISO 7880



Dimensions



View of the terminals
Bottom view



For the make contact (2x87), pin 4=5.
For the double make contact, pin 4=5b.

Connector Information
Connector 929102
Fitting FASTIN-FASTON Contacts
2.8 FF e.g. 160655-2 for 0.5-1.5mm²
6.3 FF e.g. 6-160448-5 for 1.0-2.5mm²

Basic Module Relay F4 (Continued)

Product code structure

Typical product code: **V23140 -A 0 052 -C 642**

Type
V23140 Basic Module Relay F4

Contact arrangement
A 1 form C, 1 CO contact
B 1 form A, 1 NO contact
Z without relay, only base with 9 terminals

Version
0 Standard

Coil
052 12VDC
053 24VDC

Cover
C Cover height 51.4mm
X Cover height 30.9mm

Terminal/arrangement
643 Plug-in/form C (CO)
642 Plug-in/form A(NO)

Product code	Arrangement	Coil	Terminals	Cont. material	Cover height	Assignment	Part number
V23140-A0052-C643	1 form C, 1 CO	12VDC	Plug-in, QC	AgNi0.15	51.4mm	Special CO	1-1414672-0
V23140-B0052-C642	1 form A, 1 NO					Special NO	1-1414676-0
V23140-B0052-X028					30.9mm		1-1414995-1
V23140-A0053-C643	1 form C, 1 CO	24VDC				Special CO	1-1414673-0
V23140-B0053-C642	1 form A, 1 NO				51.4mm	Special NO	1-1414675-0

Product code	Components	Description	Terminals	Contact	Cover height	Part number
V23140-Z0000-X023	Base	Base, ledge and all 9 terminals only (without relay)	Plug-in	None	Without	1-1414548-0
V23140-Z0000-X024	Cover	Cover, black	Without		51.4mm	1-1414546-0
V23140-Z0000-X025		Cover, black, release feature, notches				1-1414547-0
V23140-Z0000-X026					30.9mm	1-1414690-0

Contents

Connectors for Micro ISO Relays

Connectors in 3 different versions

■ **PCB Socket**

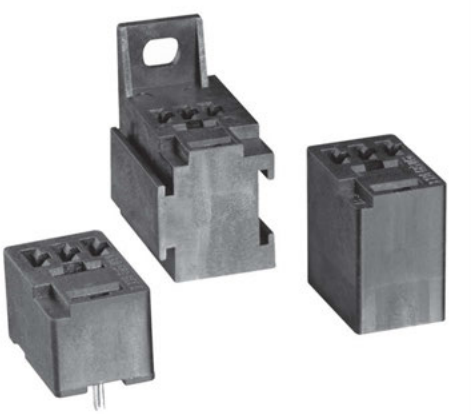
With the solderable connector Micro ISO relays with plug-in terminals can be mounted on leadframes. This allows easy and reasonable replacement in case of service.

■ **Connector**

5 pole connector with snap-in pin to lock in frame.

■ **Connector with mounting flap**

5 pole connector that can be mounted individually or interlocked. The connector has a snap-in pin to lock in frame. The mounting bracket also allows screw-on.



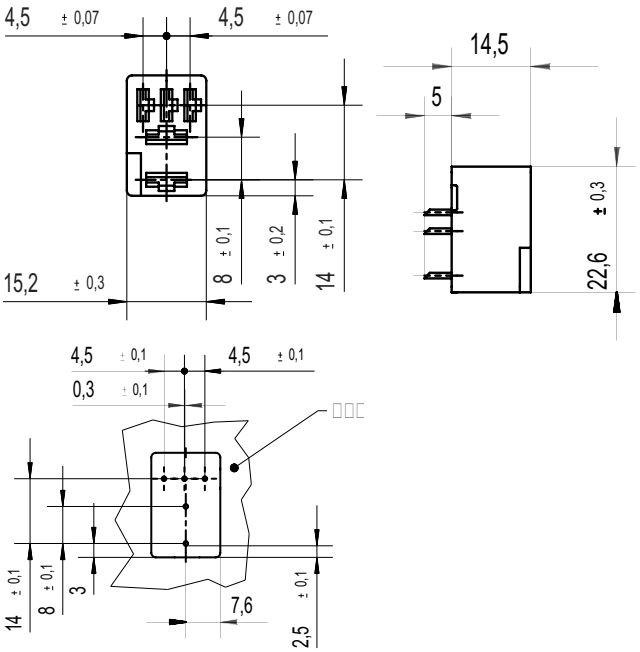
Technical Data

Weight	
PCB socket	approx. 5.9g (0.21oz)
Connector	approx. 5.4g (0.19oz)
Connector with mounting flap	approx. 11.9g (0.42oz)
Storage conditions	according to IEC600688[1)]
Packaging/unit	
PCB socket (V23333-Z0002-B049)	800 pcs.
Connector (V23333-Z0001-B046)	400 pcs.
Connector with mounting flap (V23333-Z1001-B045)	150 pcs.

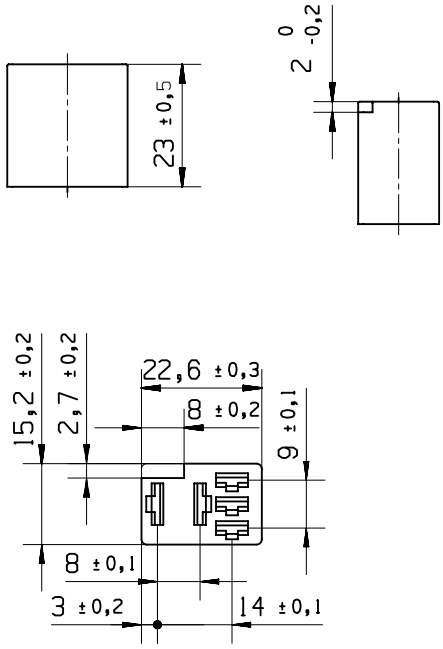
1) For general storage and processing recommendations please refer to the Application Notes and especially to storage in our Definitions or at http://relays.te.com/appnotes/

Dimensions

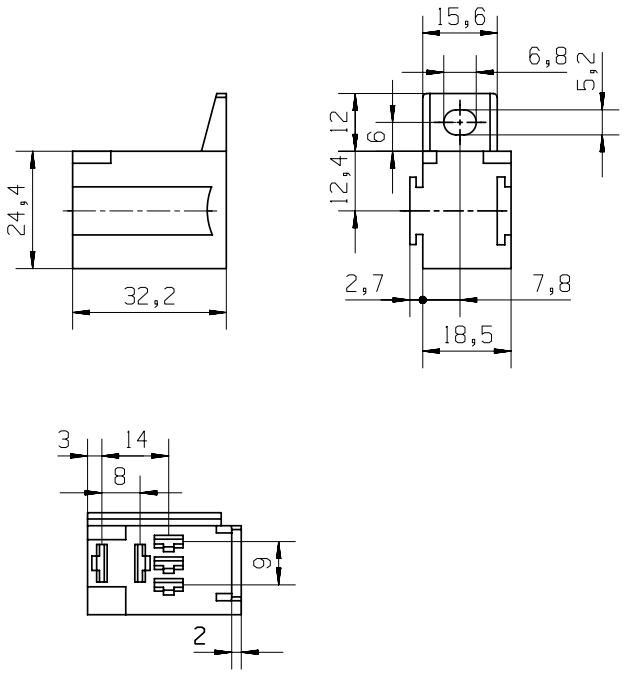
PCB socket V23333-Z0002-B049
Mounting recommendation: to keep insertion force away from the PCB the soldering of the socket to the PCB should be done with already inserted relay.



Connector V23333-Z1001-B046
Terminals to be ordered separately.



Connector with mounting flap V23333-Z1001-B045
To be mounted individually or can be interlocked.
Terminals to be ordered separately.



Part numbers for connectors		Selection of fitting crimp terminals[1]) (Ph. bronze tin plated)[2])							
		Terminal size	Wire mm²	Use for	Quantity required		Use in cavities		Part number for crimp terminals
Product code	Part number				Form A	Form C	Form A	Form C	
V23333-Z0002-B049	2-1904045-7	–	–	–	–	–	–	–	–
V23333-Z0001-B046	1-1904045-6	4.8 x 0.8	0.5 - 1.5	Coil	2	2	1 and 2	1 and 2	280919-4
		4.8 x 0.8	1.0 - 2.5	Load	–	1	–	4	281197-2
		6.3 x 0.8	1.0 - 2.5	Load	2	2	3 and 5	3 and 5	160927-4
V23333-Z1001-B045	1-1904045-5	4.8 x 0.8	0.5 - 1.5	Coil	2	2	1 and 2	1 and 2	280919-4
		4.8 x 0.8	1.0 - 2.5	Load	–	1	–	4	281197-2
		6.3 x 0.8	1.0 - 2.5	Load	2	2	3 and 5	3 and 5	160917-2

1) Crimp terminals to be ordered separately.
2) Mentioned crimp terminals are delivered in strip-form, loose pieces and hand tool available on request.

Connectors for Mini ISO Relays

Connectors in 3 different versions

■ **PCB Socket**

With the solderable connector Mini ISO relays with plug-in terminals can be mounted on leadframes. This allows easy and reasonable replacement in case of service.

■ **Connector**

5 pole connector with snap-in pin to lock in frame.

■ **Connector with mounting flap**

5 pole connector that can be mounted individually or interlocked. The connector has a snap-in pin to lock in frame. The mounting bracket also allows screw-on. The mounting bracket also allows screw-on.

Technical Data

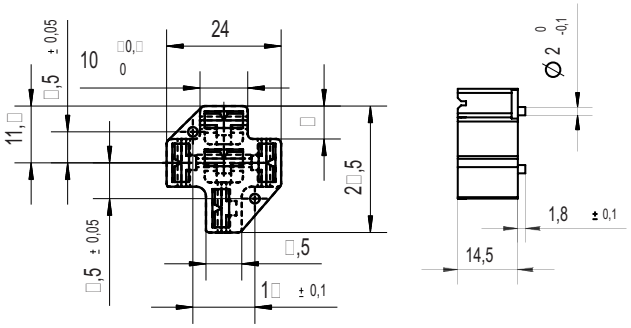
Weight	
PCB socket	approx. 7.0g (0.25oz)
Connector	approx. 3.9g (0.14oz)
Connector with mounting flap	approx. 20.6g (0.73oz)
Storage conditions	according to IEC600688[1)]
Packaging/unit	
PCB socket (V23333-Z0002-B041)	500 pcs.
Connector (V23333-Z0001-A007)	500 pcs.
Connector with mounting flap (V23333-Z1001-A008)	200 pcs.

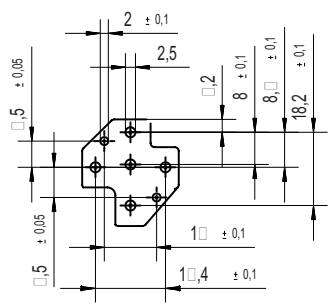
1) For general storage and processing recommendations please refer to the Application Notes and especially to storage in our Definitions or at http://relays.te.com/appnotes/

Dimensions

PCB socket V23333-Z0002-A041

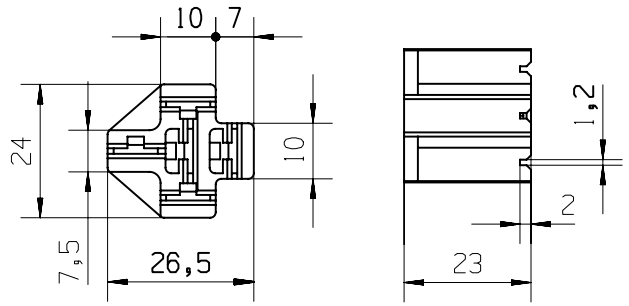
Mounting recommendation: to keep insertion force away from the PCB the soldering of the socket to the PCB should be done with already inserted relay.





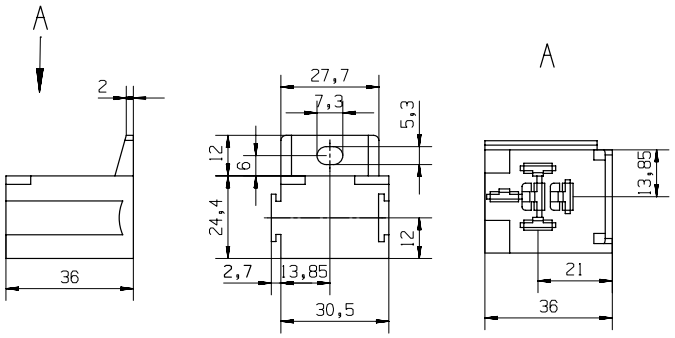
Connector V23333-Z0001-A007

Terminals to be ordered separately.



Connectors for Mini ISO Relays

Connector with mounting flap V23333-Z1001-A008
To be mounted individually or can be interlocked.
Terminals to be ordered separately.



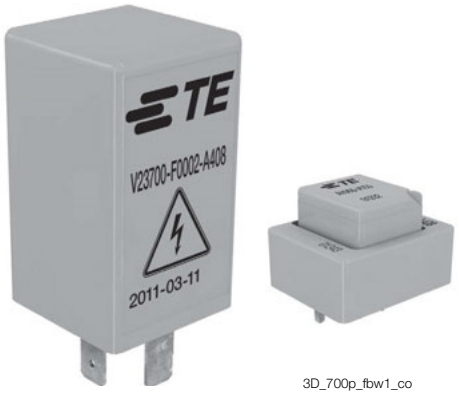
Part numbers for connectors		Selection of fitting crimp terminals[2] (Ph. bronze tin plated)[3]							
		Terminal size	Wire mm²	Use for	Quantity required		Use in cavities		Part number for crimp terminals
Product code	Part number				Form A	Form C	Form A	Form C	
V23333-Z0002-A041	2-1904045-4	–	–	–	–	–	–	–	–
V23333-Z0001-A007	1-1904045-1	6.3 x 0.8 6.3 x 0.8	0.5 - 1.5 1.0 - 2.5	Coil Load	2 2	2 3	1 and 2 3 and 5	1 and 2 3,4 and 5	5-160526-9 160927-4
V23333-Z1001-A008	1-1904045-2	6.3 x 0.8 6.3 x 0.8	0.5 - 1.5 1.0 - 2.5	Coil Load	2 2	2 3	1 and 2 3 and 5	1 and 2 3,4 and 5	5-160526-9 160927-4

2) Crimp terminals to be ordered separately.
3) Mentioned crimp terminals are delivered in strip-form, loose pieces and hand tool available on request.

Contents

Mini K HV

- **Suitable for voltage levels up to 450VDC**
- **Precharge currents up to 20A**
- **Limiting break currents up to 20A**
- **Available with PCB and plug-in terminals**



3D_700p_fbw1_co

Typical applications

DC high voltage pre-charge applications in hybrid, full battery electric vehicles and fuel-cell cars.

Available by end 2012. All data preliminary.

Contact Data

Contact arrangement	1 form X (NO DM)
Rated voltage	400VDC
Max. switching voltage[1] / power	450VDC / 9kW
Limiting switching current[2]	
normal operation	20A on/0A off: min. 10^5 ops.
fault break operation[3]	20A on/20A off: min. 10 ops.[3][4]
Initial contact voltage drop at 10A	typ. 150mV, max. 300 mV
Operate time at nominal voltage	typ. 2.5ms
Release time[5]	typ. 1ms
Mechanical endurance	$>10^7$ ops.

1) Consult TE Connectivity for insulation compatibility with higher voltages.
2) Load circuit: L/R <14µs.
3) After 10 fault break operations relay must be replaced.
4) Test conditions: on-time 100ms, off-time 10s.
5) Valid for recommended 250Ω suppression resistor.

Note: A low resistive suppression device in parallel to the relay coil increases the release time and reduces the lifetime due to increased erosion and / or higher risk of contact tack welding.

Coil Data

Nominal voltage	12V
Min./Max. energization duration	max. 2s[6]
Max. coil temperature	155°C

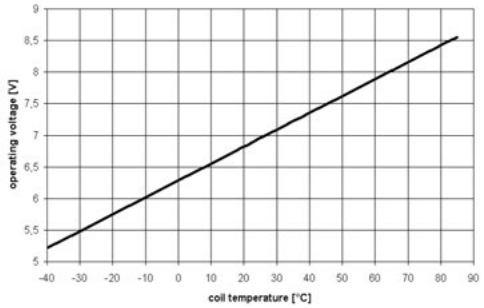
6) Max. continuous activation time is limited and depends on operating conditions. Please contact TE Connectivity for details.

Coil versions

Coil code	Rated voltage VDC	Operate voltage VDC[7]	Release voltage VDC[7]	Coil resistance Ω±10%	Rated coil power mW
001	12	6.9	1.2	50	2.9
002[8]	12	6.9	1.2	41.6	3.5

7) All values are given for coil without pre-energization, at ambient temperature +23°C.
8) Coil suppression resistor already included in the relay. No additional suppression component allowed.

Coil operating range



Insulation Data[1]

Initial dielectric strength	
between open contacts	2800 VDC/1mA
between contact and coil	2800 VDC/1mA
Insulation resistance after 10 fault break ops. (20A)	
between open contacts	>200MΩ
between contact and coil	>200MΩ
Max. altitude	4000m
Clearance / creepage	
acc. IEC60664-1 (2007) for	over voltage category I, pollution degree 2

Other Data

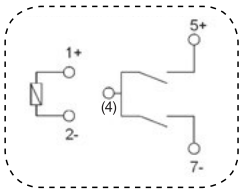
EU RoHS/ELV compliance	compliant
Flammability of plastic material	acc. UL94-HB
Ambient temperature range	-40°C to +85°C
Climatic cycling with condensation	
EN ISO 6988	6 cycles, storage 8/16h
Temperature cycling (shock)	
IEC 60068-2-14, Na	10 cycles, -40/+85°C (5°C per min)
Damp heat constant	
IEC 60068-2-3, Ca	56 days, upper air temperature 40°C
Degree of protection PCB version	
IEC 61810	RT III – immersion cleanable
Corrosive gas	
IEC 60068-2-42	10 days
IEC 60068-2-43	10 days
Wide-band noise	
IEC 60068-2-64	10 to 1000Hz, 30.8 m/s^2 [9]
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	11ms, 20g[9]
Terminal type	PCB and plug-in/QC
Weight	
PCB version:	approx. 17g (0.6oz)
Plug-in version:	approx. 39g (1.4oz)
Solderability (aging 3: 4h/155°C) PCB version	
IEC 60068-2-20, Ta, method 1	hot dip 5s, 215°C
Resistance to soldering heat PCB version	
IEC 60068-2-20, Tb, method 1A	hot dip 10s, 260°C with thermal screen
Sealing, IEC 60068-2-17 PCB version	Qc, method 2, 1min/70°C
Storage conditions	according IEC 60068[10]

9) No change in the switching state >10µs.
10) For general storage and processing recommendations please refer to our Application Notes and especially to Storage in the Definitions or at http://relays.te.com/appnotes/

Mini K HV (Continued)

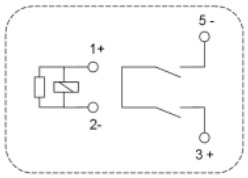
Terminal Assignment

1 form X (NO DM)
PCB version

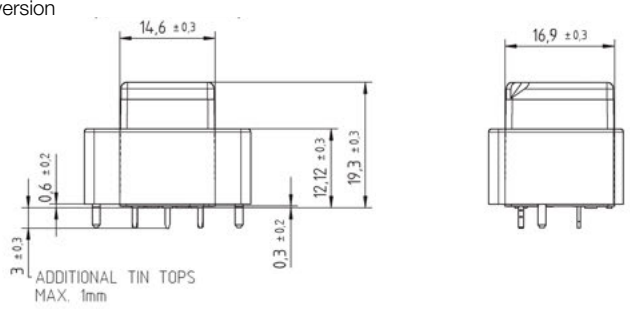


Terminal Assignment

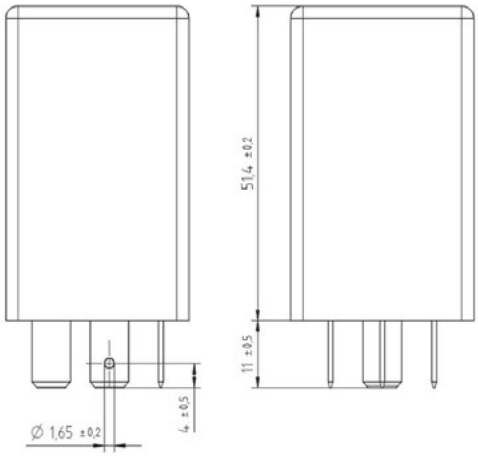
1 form X (NO DM) with resistor
Plug-in version



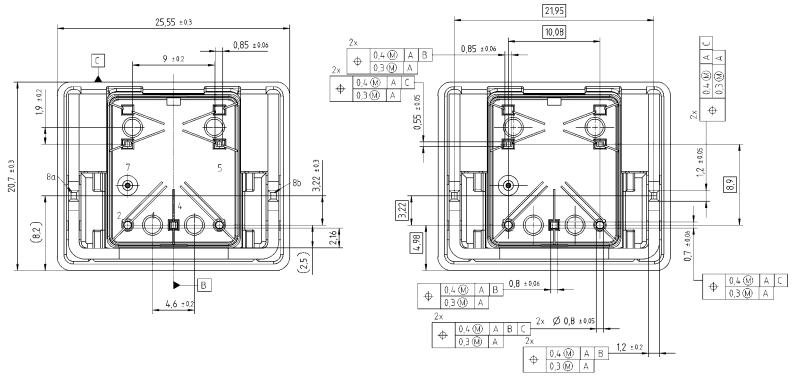
Dimensions
PCB version



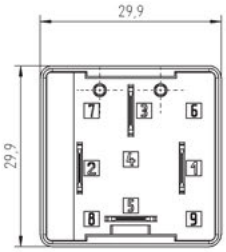
Dimensions
Plug-in version



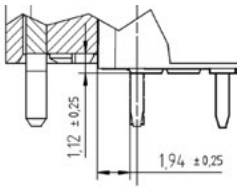
View of the Terminals (bottom view)



View of the Terminals (bottom view)



Detail: Minimum clearance requirements (see note below)



Notes regarding PCB-layout and terminal assignment:
- Pin 4 must not be electrically connected, no solder eye at that pin is allowed, only a drill-hole without via
- Potential assignment of pins:
  - pins 1; 2: low voltage (LV)
  - pins 5; 7; 4(*): high voltage (HV)
  - pin 8a; 8b: no potential but internally connected
  (*) pin 4 is on HV potential in ON-state of relay only.

Notes regarding clearance and creepage distances:
- The required clearance and creepage distances between HV and LV potential must be ensured.
- Layout of the PCB has to ensure min. clearance and creepage distances of conducting relay parts and relay terminal 1 and conducting relay parts and terminal 2 respectively. Refer to detail drawing.

Minimum distance to neighboring ferruginous parts: 3mm.

Mini K HV (Continued)

Product code structure Typical product code **V23700 -C 0 001 -A 40 8**

Type
V23700 Mini K HV

Terminal and enclosure
C PCB **F** Plug-in

Design
0 Standard

Coil
001 without parallel resistor **002** with parallel resistor

Contact type
A Standard

Contact material
40 Silver based

Contact arrangement
8 1 form X (NO DM)

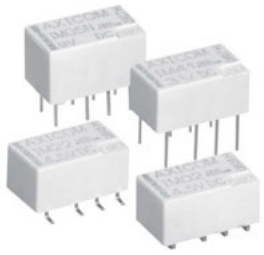
Product code	Terminal/Encl.	Design	Coil	Contact type	Contact mat.	Arrangement	Part number
V23700-C0001-A408	PCB, sealed	Standard	no parallel resistor	Standard	Silver based	1 form X (NO DM)	2-1904058-5
V23700-F0002-A408	Plug-in, QC		parallel resistor				2-1904058-7

Consult TE Connectivity for prototype availability.

Contents

IM Relay

- **Slim line 10x6mm, low profile 5.65mm and min. board-space 60mm²**
- **Switching current 2/5A, switching power 60W/62.5VA and switching voltage 220VDC/250VAC**
- **Low coil power consumption, 140mW standard, 100mW for high sensitive version, 50mW for ultra high sensitive version and 100mW for bistable version**
- **High dielectric and surge capability up to 2500Vrms between open contacts and 3000Vrms between coil and contacts**
- **High mechanical shock resistance up to 300g functional**



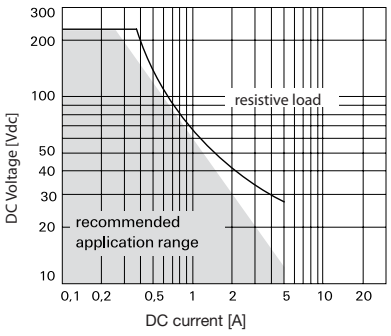
Typical applications
Telecommunication, access and transmission equipment, optical network terminals, modems, office and business equipment, consumer electronics, measurement and test equipment, industrial control, medical equipment, automotive applications.

Approvals

UL 508 File No. E 111441
Technical data of approved types on request

Contact Data	standard, C	D	P
	standard and high dielectric version	high current version	high contact stability version
Contact arrangement	2 form C, 2 CO		
Max. switching voltage	220VDC, 250VAC	220VDC, 250VAC	220VDC, 250VAC
Rated current	2A	5A	2A
Limiting continuous current	2A	5A	2A
Switching power	60W, 62.5VA		
Contact material	PdRu +Au covered	AgNi +Au covered	PdRu +Au covered
Contact style	twin contacts		
Minimum switching voltage	100µV		
Initial contact resistance	<50mΩ at 10mA/20mV		
Thermoelectric potential	<10µV		
Operate time	typ. 1ms, max. 3ms		
Release time			
without diode in parallel	typ. 1ms, max. 3ms		
with diode in parallel	typ. 3ms, max. 5ms		
Bounce time max.	typ. 1ms, max. 5ms		

Max. DC load breaking capacity



Contact Data (continued)

Electrical endurance	
at contact application 0	
(≤30mV/≤10mA)	min. $2.5x10^6$ operations
cable load open end	min. $2.0x10^6$ operations
resistive, 125VDC / 0.24A - 30W	min. $5x10^5$ operations
resistive, 220 VDC / 0.27A - 60W	min. $1x10^5$ operations
resistive, 250VAC / 0.25A - 62.5VA	min. $1x10^5$ operations
resistive, 30VDC / 1A - 30W	min. $5x10^5$ operations
resistive, 30VDC / 2A - 60W	min. $1x10^5$ operations
Contact ratings, UL	220VDC, 0.24A, 60W 125VDC, 0.24A, 30W 250VAC, 0.25A, 62.5VA 125VAC, 0.5A, 62.5VA 30VDC, 2A, 60W
Mechanical endurance	10^8 operations

Coil Data

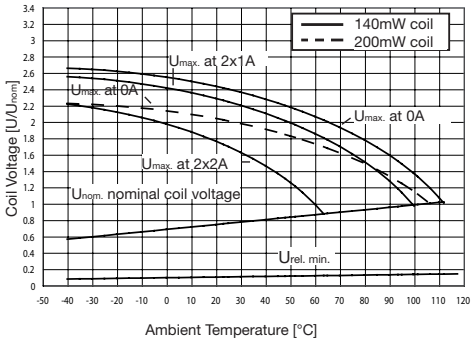
Magnetic system	monostable, bistable
Coil voltage range	1.5 to 24VDC

Coil versions, standard version, monostable, 1 coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power mW
00	1.5	1.13	0.15	16	140
08	2.4	1.80	0.24	41	140
01	3	2.25	0.30	64	140
02	4.5	3.38	0.45	145	140
03	5	3.75	0.50	178	140
04	6	4.50	0.60	257	140
05	9	6.75	0.90	579	140
06	12	9.00	1.20	1029	140
07	24	18.00	2.40	2880	200

All figures are given for coil without pre-energization, at ambient temperature +23°C

Coil operating range, standard version



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IM Relay (Continued)

Coil Data (continued)

Coil versions, sensitive version, monostable, 1 coil

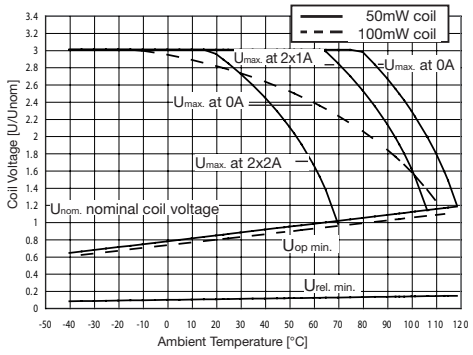
Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power mW
11	3	2.40	0.30	91	100
12	4.5	3.60	0.45	194	100
13	5	4.00	0.50	234	100
16	12	9.60	1.20	1315	110
17	24	19.20	2.40	4120	140

Coil versions, ultra high sensitive version, monostable, 1 coil

Coil code	Rated voltage VDC	Operate voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power mW
21	3	2.55	0.30	180	50
22	4.5	3.83	0.45	405	50
23	5	4.25	0.50	500	50
26	12	10.20	1.20	2880	50

All figures are given for coil without pre-energization, at ambient temperature +23°C

Coil operating range, sensitive and ultra high sensitive coil

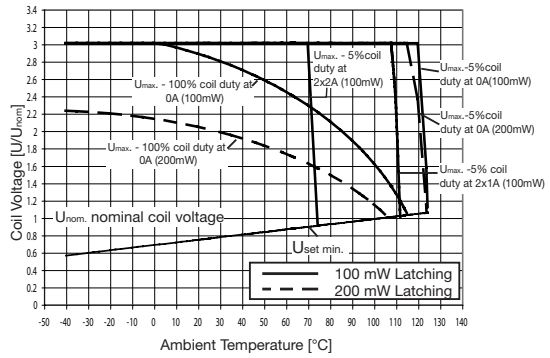


Coil versions, standard, bistable 1 coil

Coil code	Rated voltage VDC	Set voltage VDC	Reset voltage VDC	Coil resistance Ω±10%	Rated coil power mW
40	1.5	1.13	-1.13	23	100
48	2.4	1.80	-1.80	58	100
41	3	2.25	-2.25	90	100
42	4.5	3.38	-3.38	203	100
43	5	3.75	-3.75	250	100
44	6	4.50	-4.50	360	100
45	9	6.75	-6.75	810	100
46	12	9.00	-9.00	1440	100
47	24	18.00	-18.00	2880	200

All figures are given for coil without pre-energization, at ambient temperature +23°C

Coil operating range, bistable 1 coil



Insulation Data	standard	C	D,P
	standard, sensitive, ultra high sensitive version	high dielectric version	high current, high contact stability version
Initial dielectric strength			
between open contacts	1000V_{rms}	1500V_{rms}	750V_{rms}
between contact and coil	1800V_{rms}	1800V_{rms}	1500V_{rms}
between adjacent contacts	1000V_{rms}	1800V_{rms}	750V_{rms}
Initial surge withstand voltage			
between open contacts	1500V	2500V	1000V
between contact and coil	2500V	2500V	2000V
between adjacent contacts	1500V	2500V	1000V
Initial insulation resistance			
between insulated elements	>10^9Ω	>10^9Ω	>10^9Ω
Capacitance			
between open contacts		max. 1pF	
between contact and coil		max. 2pF	
between adjacent contacts		max. 2pF	

RF Data

Isolation at 100MHz/900MHz	-37.0dB/-18.8dB
Insertion loss at 100MHz/900MHz	-0.03dB/-0.33dB
Voltage standing wave ratio (VSWR)	
at 100MHz/900MHz	1.06/1.49

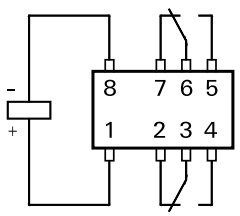
Other Data

Material compliance: EU RoHS/ELV, China RoHS, REACH, Halogen content refer to the Product Compliance Support Center at www.te.com/customersupport/rohssupportcenter	
Ambient temperature	-40°C to +85°C
Thermal resistance	<150K/W
Category of environmental protection	
IEC 61810	RT V - hermetically sealed
Degree of protection, IEC 60529	IP 67, immersion cleanable
Vibration resistance (functional)	20g, 10 to 500Hz
Shock resistance (functional), half sinus 11ms	50g
Shock resistance (destructive), half sinus 0.5ms	500g
Mounting position	any
Weight	max. 0.75g
Resistance to soldering heat THT	
IEC 60068-2-20	265°C/10s
Resistance to soldering heat SMT	
IEC 60068-2-58	265°C/10s
Moisture sensitive level, JEDEC J-Std-020D	MSL3
Ultrasonic cleaning	not recommended
Packaging/unit	
THT version	tube/50pcs., box/1000 pcs.
SMT version	reel/1000 pcs., box/1000 or 5000 pcs.

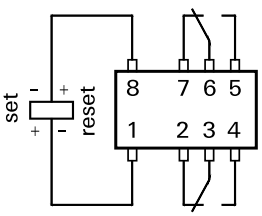
Terminal assignment

TOP view on relay

Monostable version
rest condition



Bistable version, 1 coil
reset condition



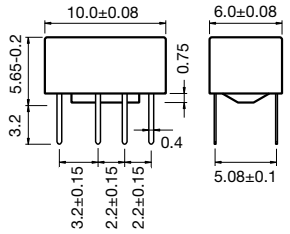
Contacts are shown in reset condition. Contact position might change during transportation and must be reset before use.

IM Relay (Continued)

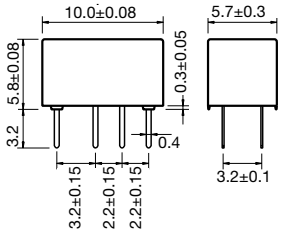
Dimensions

THT version

Standard version

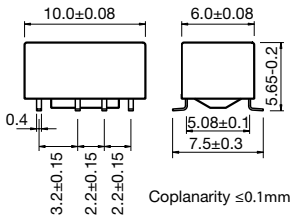


Narrow version

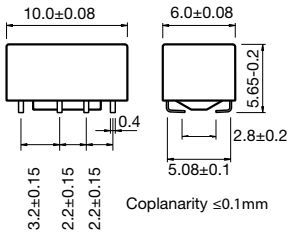


SMT version

Gull wings



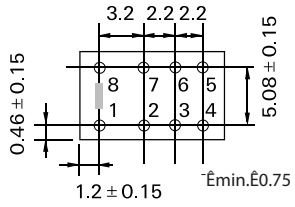
J-legs



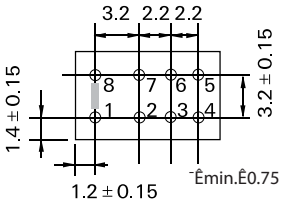
PCB layout

TOP view on component side of PCB

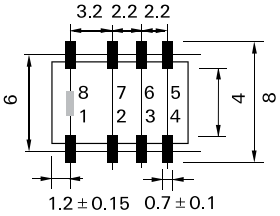
Standard version



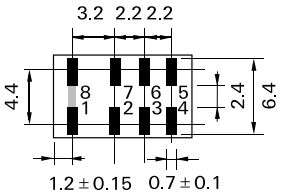
Narrow version



Gull wings



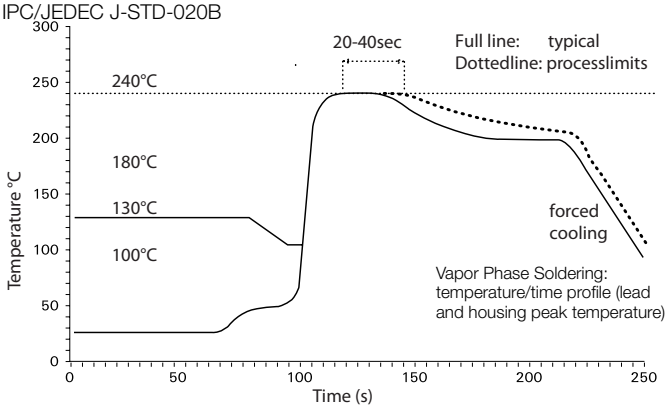
J-legs



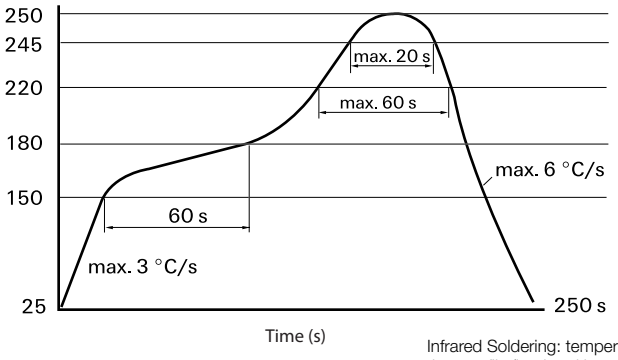
Processing

Recommended soldering conditions

Soldering conditions according IEC 60058-2-58 and IPC/JEDEC J-STD-020B

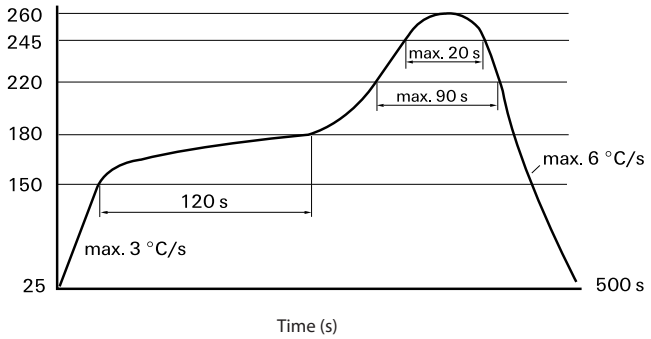


Recommended reflow soldering profile



Infrared Soldering: temperature/ time profile (lead and housing peak temperature)

Resistance to soldering heat - Reflow profile



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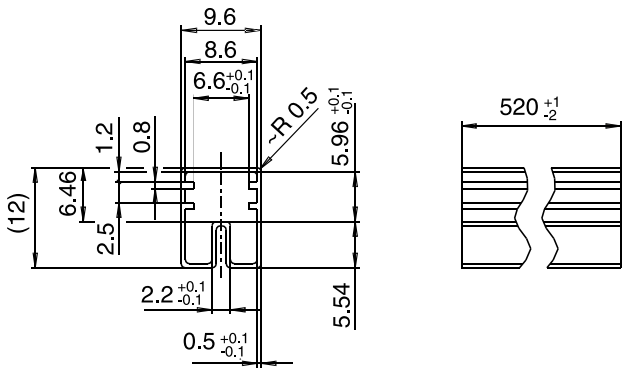
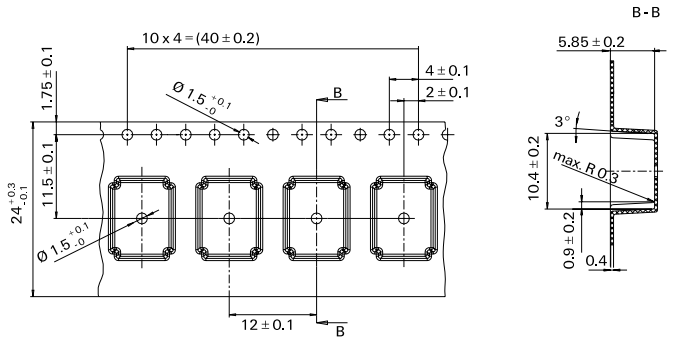
IM Relay (Continued)

Packing

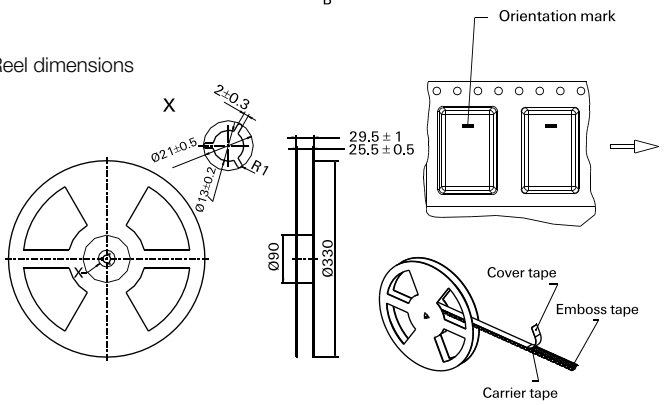
Tube for THT version
50 relays per tube, 1000 relays per box



Tape and reel for SMT version
1000 relays per reel, 1000 or 5000 relays per box



Reel dimensions



Product code structure	Typical product code	IM	03	G	R

Type
IM Signal Relays IM Series

Contact arrangement
Blank 2 form C, 2 CO

Coil
Coil code: please refer to coil versions table

Performance type
Blank Standard version
C High dielectric version
D High current version
P High contact stability version

Terminals
T THT - standard
N THT - narrow version
J SMT - J-leg
G SMT - gull wing

Packing
S Tube
R Reel

IM Relay (Continued)

Product code	Arrangement	Perf. type	Coil	Coil type	Coil	Terminals	Part number
IM00GR	2 form C,	Standard	1.5VDC	Monostable	Standard	SMT gull wing	3-1462037-7
IM00JR	2 CO					SMT J-leg	3-1462037-9
IM00NS	contacts					THT narrow	1-1462038-0
IM01GR			3VDC			SMT gull wing	1462037-1
IM01JR						SMT J-leg	4-1462037-0
IM01NS						THT narrow	1-1462038-1
IM01TS						THT standard	1462037-4
IM02GR			4.5VDC			SMT gull wing	1462037-9
IM02JR						SMT J-leg	1-1462037-1
IM02NS						THT narrow	1-1462038-2
IM03GR			5VDC			SMT gull wing	1-1462037-4
IM03JR						SMT J-leg	1-1462037-6
IM03NS						THT narrow	1-1462038-3
IM03TS						THT standard	1-1462037-8
IM04GR			6VDC			SMT gull wing	4-1462037-2
IM04JR						SMT J-leg	4-1462037-4
IM04NS						THT narrow	1-1462038-4
IM05GR			9VDC			SMT gull wing	3-1462037-4
IM05JR						SMT J-leg	4-1462037-5
IM05NS						THT narrow	1-1462038-5
IM05TS						THT standard	2-1462037-2
IM06GR			12VDC			SMT gull wing	2-1462037-3
IM06JR						SMT J-leg	4-1462037-6
IM06NS						THT narrow	1-1462038-6
IM07GR			24VDC			SMT gull wing	4-1462037-7
IM07JR						SMT J-leg	4-1462037-8
IM07NS						THT narrow	1-1462038-7
IM08GR			2.4VDC			SMT gull wing	6-1462039-3
IM11GR			3VDC		High sens.		9-1462038-5
IM12GR			4.5VDC				1462039-3
IM13GR			5VDC				1462039-4
IM16GR			12VDC				1462039-5
IM17GR			24VDC				1462039-6
IM17TS						THT standard	4-1462039-6
IM21GR			3VDC		Ultra	SMT gull wing	2-1462039-6
IM21TS					high	THT standard	1-1462039-5
IM22GR			4.5VDC		sensitive	SMT gull wing	2-1462039-7
IM22TS						THT standard	2-1462039-8
IM23GR			5VDC			SMT gull wing	2-1462039-9
IM23TS						THT standard	3-1462039-0
IM25GR			9VDC			SMT gull wing	3-1462039-5
IM25TS						THT standard	3-1462039-6
IM26GR			12VDC			SMT gull wing	3-1462039-1
IM26TS						THT standard	3-1462039-2
IM40GR			1.5VDC	Bistable	Standard	SMT gull wing	5-1462037-1
IM40JR						SMT J-leg	5-1462037-2
IM40NS						THT narrow	1-1462038-8
IM40TS						THT standard	5-1462037-0
IM41GR			3VDC			SMT gull wing	5-1462037-4
IM41JR						SMT J-leg	5-1462037-5
IM41NS						THT narrow	1-1462038-9
IM41TS						THT standard	5-1462037-3
IM42GR			4.5VDC			SMT gull wing	3-1462037-1
IM42JR						SMT J-leg	5-1462037-7
IM42NS						THT narrow	2-1462038-0
IM42TS						THT standard	5-1462037-6
IM43GR			5VDC			SMT gull wing	5-1462037-9
IM43JR						SMT J-leg	6-1462037-0
IM43NS						THT narrow	2-1462038-1
IM43TS						THT standard	5-1462037-8
IM44GR			6VDC			SMT gull wing	6-1462037-2
IM44JR						SMT J-leg	6-1462037-3
IM44NS						THT narrow	2-1462038-2
IM44TS						THT standard	6-1462037-1
IM45GR			9VDC			SMT gull wing	6-1462037-4
IM45JR						SMT J-leg	6-1462037-5
IM45NS						THT narrow	2-1462038-3
IM46GR			12VDC			SMT gull wing	6-1462037-7
IM46JR						SMT J-leg	6-1462037-8
IM46NS						THT narrow	2-1462038-4
IM46TS						THT standard	6-1462037-6
IM47GR			24VDC			SMT gull wing	7-1462037-0
IM47JR						SMT J-leg	7-1462037-1
IM47NS						THT narrow	2-1462038-5
IM47TS						THT standard	6-1462037-9
IM48GR			2.4VDC			SMT gull wing	1462039-8

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IM Relay (Continued)

Product code	Arrangement	Perf. type	Coil	Coil type	Coil	Terminals	Part number
IM01CGR	2 form C	High	3VDC	Monostable	Standard	SMT gull wing	1462038-4
IM01CTS	2 CO	dielectric				THT standard	9-1462038-6
IM02CGR	contacts		4.5VDC			SMT gull wing	1462038-1
IM03CGR			5VDC			SMT gull wing	1462038-2
IM03CJR						SMT J-leg	4-1462039-8
IM03CTS						THT standard	4-1462039-7
IM05CGR			9VDC			SMT gull wing	1462038-3
IM06CGR			12VDC			SMT gull wing	9-1462037-9
IM06CJR						SMT J-leg	3-1462039-4
IM06CTS						THT standard	4-1462037-9
IM07CGR			24VDC			SMT gull wing	1462039-2
IM07CTS						THT standard	1462039-1
IM17CGR					High sens.	SMT gull wing	1462039-7
IM41CGR			3VDC	Bistable	Standard		4-1462039-2
IM42CGR			4.5VDC				4-1462039-1
IM43CGR			5VDC				9-1462038-7
IM02DGR		High	4.5VDC	Monostable	Standard		9-1462038-8
IM03DGR		current	5VDC				9-1462038-9
IM03DJR						SMT J-leg	3-1462039-3
IM05DGR			9VDC			SMT gull wing	1-1462039-7
IM06DGR			12VDC				1-1462039-8
IM06DJR						SMT J-leg	7-1462039-0
IM06DTS						THT standard	3-1462039-8
IM07DGR			24VDC			SMT gull wing	3-1462039-7
IM07DJR						SMT J-leg	7-1462039-4
IM07DTS						THT standard	7-1462039-2
IM22DTS			4.5VDC		U.h.sens.		7-1462039-6
IM41DGR			3VDC	Bistable	Standard	SMT gull wing	6-1462039-8
IM42DGR			4.5VDC				1-1462039-9
IM42DNS						THT narrow	1-1462039-6
IM46DNS			12VDC				1-1462039-2
IM47DJR			24VDC			SMT J-leg	7-1462039-5
IM48DGR			2.4VDC			SMT gull wing	1462039-9
IM49DGR			2VDC				2-1462039-2
IM02PGR		High	4.5VDC	Monostable	Standard		5-1462039-4
IM02PNS		contact				THT narrow	5-1462039-8
IM03PGR		stability	5VDC			SMT gull wing	5-1462039-5
IM03PJR						SMT J-leg	6-1462039-6
IM03PNS						THT narrow	5-1462039-9
IM06PGR			12VDC			SMT gull wing	5-1462039-6
IM06PNS						THT narrow	6-1462039-0
IM42PGR			4.5VDC	Bistable	Standard	SMT gull wing	5-1462039-7
IM42PNS						THT narrow	7-1462039-8
IM43PGR						SMT gull wing	7-1462039-3
IM46PNS			12VDC			THT narrow	6-1462039-1

P2 Relay V23079

- **Standard telecom relay (ringing and test access)**
- **Slim line 15x7.5mm (.590x.295")**
- **Switching current 5A**
- **2 form C bifurcated contacts (2 changeover contacts, 2 CO)**
- **Immersion cleanable**
- **High sensitivity for low power consumption 140mW/ 70mW**
- **Single coil version with surge voltage resistance between contact and coil: 2.5kV (2/10µs) meets the Telcordia Requirement GR-1089, 1.5kV (10/160µs) meets FCC Part 68**

Typical applications
Communications equipment linecard application (ringing and test access), PABX, voice over IP, office equipment, measurement and control equipment, automotive equipment as CAN bus, keyless entry, speaker switch, medical equipment, consumer electronics, set top boxes, HiFi.

Approvals

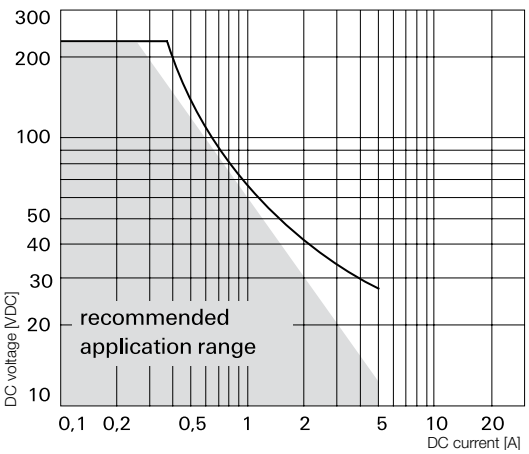
UL 508 File No. E 111441, UL 60950, IEC/EN60950 IEC Ref. Cert. No. 327

Technical data of approved types on request

Contact Data

Contact arrangement	2 form C (CO)
Max. switching voltage	220VDC, 250VAC
Rated current	2A
Limiting continuous current, 85°C	2A
Contact material	AgNi, gold-covered
Contact style	bifurcated contact
Min. recommended contact load	10mA at 20mV
Minimum switching voltage	100µV
Initial contact resistance	<50mΩ at 10mA, 20mV
Frequency of operation, without load	50 operations/s
Operate/release time max.	4 ms
Set/reset time max.	4 ms
Bounce time max.	3 ms
Electrical endurance	
at 12V / 10mA	typ. $5x10^7$ operations
at 6V / 100mA	typ. $1x10^7$ operations
at 60V / 500mA	typ. $5x10^5$ operations
at 30V / 1000mA	typ. $1x10^6$ operations
at 30V / 2000mA	typ. $2x10^5$ operations
Contact ratings, UL	110VDC / 0.3A - 33W 30VDC / 2.0A - 60W 120VAC / 0.5A - 60VA 240VAC / 0.25A -60VA
Mechanical endurance	typ. $100x10^6$ operations

Max. DC load breaking capacity



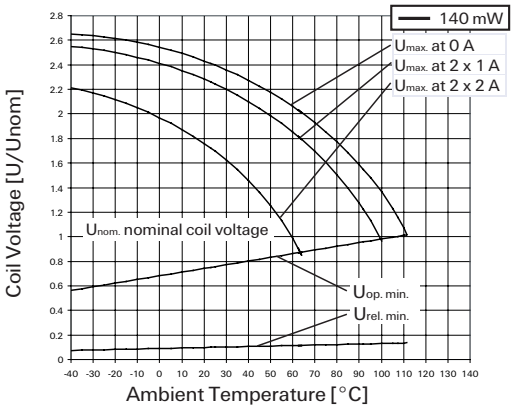
Coil Data

Magnetic system	polarized
Coil voltage range	2 to 24VDC
Max. coil temperature	125°C
Thermal resistance	< 125K/W

Coil versions, monostable

Coil code	Rated voltage VDC	Operate voltage VDC	Limiting Voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power mW
008	3.00	2.25	6.50	0.30	64	140
016	4.00	3.00	8.70	0.40	114	140
011	4.50	3.38	9.80	0.45	145	140
001	5.00	3.75	10.90	0.50	178	140
002	6.00	4.50	13.00	0.60	257	140
006	9.00	6.75	19.60	0.90	578	140
003	12.00	9.00	26.15	1.20	1029	140
005	24.00	18.00	52.30	2.40	4114	140

All figures are given for coil without pre-energization, at ambient temperature +23°C.
Other coil voltages on request.



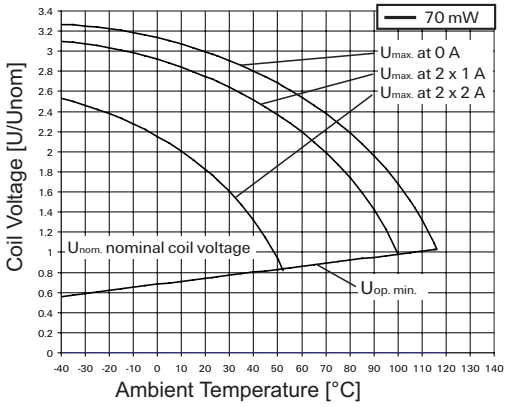
P2 Relay V23079 (Continued)

Coil Data (continued)

Coil versions, bistable

Coil code	Rated voltage VDC	Set voltage VDC	Limiting Voltage VDC	Reset voltage VDC	Coil resistance Ω±10%	Rated coil power mW
Bistable, 1 coil						
108	3.00	2.25	9.2	-2.25	128	70
111	4.50	3.38	13.85	-3.38	289	70
101	5.00	3.75	15.33	-3.75	357	70
102	6.00	4.50	18.5	-4.50	514	70
106	9.00	6.75	27.75	-6.75	1157	70
103	12.00	9.00	37	-9.00	2057	70
105	24.00	18.00	74	-18.00	8228	70
Bistable, 2 coil						
219	2.00	1.50	4.33	1.50	28	140
218	2.40	1.80	5.2	1.80	41	140
208	3.00	2.25	6.5	2.25	64	140
211	4.50	3.38	9.8	3.38	145	140
201	5.00	3.75	10.9	3.75	178	140
202	6.00	4.50	13	4.50	257	140
206	9.00	6.75	19.6	6.75	578	140
203	12.00	9.00	26.15	9.00	1029	140
205	24.00	18.00	52.3	18.00	4114	140

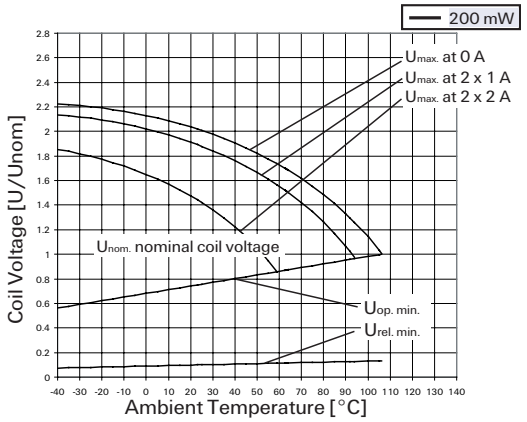
All figures are given for coil without pre-energization, at ambient temperature +23°C.
Other coil voltages on request.



Coil versions, high dielectric version, monostable, overmolded

Coil code	Rated voltage VDC	Operate voltage VDC	Limiting Voltage VDC	Release Voltage VDC	Coil resistance Ω±10%	Rated coil power mW
008	3.00	2.25	12.00	0.30	45	200
001	5.00	3.75	12.00	0.50	125	200
002	6.00	4.50	12.00	0.60	180	200
006	9.00	6.75	12.00	0.90	405	200
003	12.00	9.00	12.00	1.20	720	200

All figures are given for coil without pre-energization, at ambient temperature +23°C.
Other coil voltages on request.



Insulation Data	Standard	HDV
Initial dielectric strength		
between open contacts	$1000V_{rms}$	$1500V_{rms}$
between contact and coil	$1500V_{rms}$	$1500V_{rms}$
between adjacent contacts	$1000\ V_{rms}$	$1500V_{rms}$
Initial surge withstand voltage		
according to Telcordia TR-NWT-001089 (2/10µs)		
between open contacts	2000V	2500V
between contact and coil	2500V	2500V
between adjacent contacts	2500V	2500V
according to (10/700 µs IEC 60950)		
between open contacts	2000V	2500V
between contact and coil	2500V	2500V
between adjacent contacts	2500V	2500V
Initial insulation resistance at 500 Vdc	$> 10^9\Omega$	
Capacitance		
between open contacts	max. 1pF	
between contact and coil	max. 2pF	
between adjacent contacts	max. 1.5pF	
Clearance /creepage		
according to IEC / EN 60950	1.3/2.5mm	

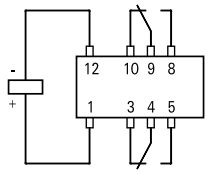
Other Data

Material compliance: EU RoHS/ELV, China RoHS, REACH, Halogen content refer to the Product Compliance Support Center at www.te.com/customersupport/rohssupportcenter	
Ambient temperature	-40 to +85°C
Category of environmental protection	
IEC 61810	RT III - wash tight
Degree of protection, IEC 60529	IP 67
Vibration resistance (functional)	35g, 10 to 1000Hz
Shock resistance (functional)	
IEC 60068-2-27 (half sine)	50g
Terminal type	PCB-THT, SMT long and short terminals
Weight	max. 2.8 g
Resistance to soldering heat THT	
IEC 60068-2-20	265°C/10s
Resistance to soldering heat SMT	
IEC 60068-2-58	see Resistance to soldering heat
Moisture sensitive level, JEDEC J-Std-020D	MSL3
Ultrasonic cleaning	not recommended
Packaging/unit	
THT	box/2000 pcs.
SMT	reel/2000 pcs. or 2500 pcs.

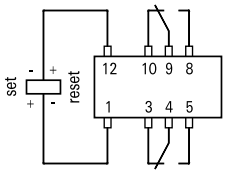
P2 Relay V23079 (Continued)

Terminal assignment
TOP view on component side of PCB

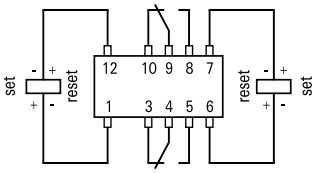
Monostable version



Bistable version, 1-coil



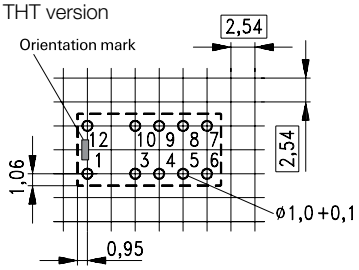
Bistable version, 2-coils



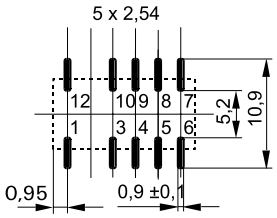
Contacts are shown in reset condition.
Both coils can be used as either set or reset coils.
Contact position might change during transportation and must be reset before use.

PCB layout
TOP view on component side of PCB

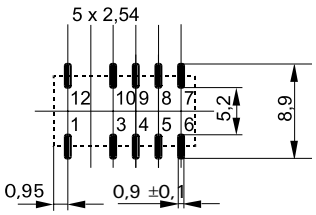
THT version



SMT, long terminals



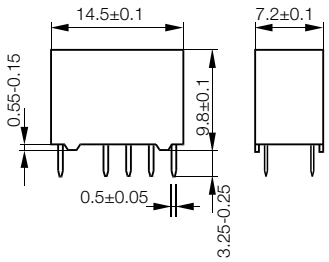
SMT, short terminals



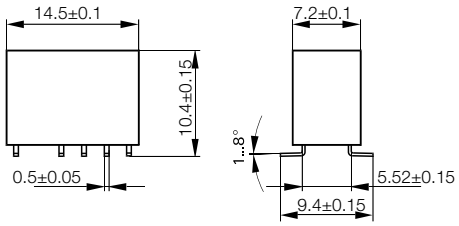
Dimensions

Standard coil

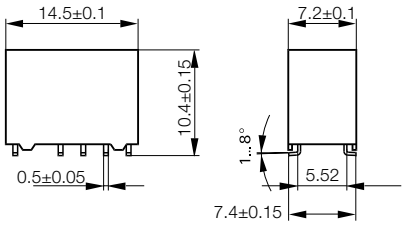
THT version



SMT, long terminals

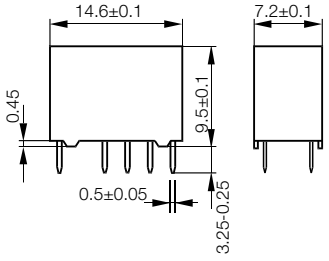


SMT, short terminals

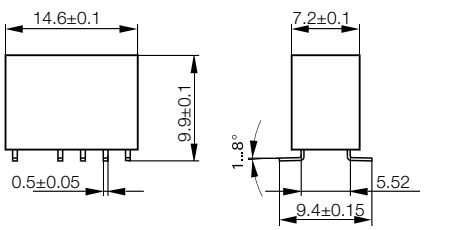


Overmolded coil, high dielectric version

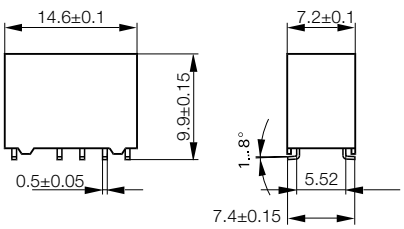
THT version



SMT, long terminals



SMT, short terminals



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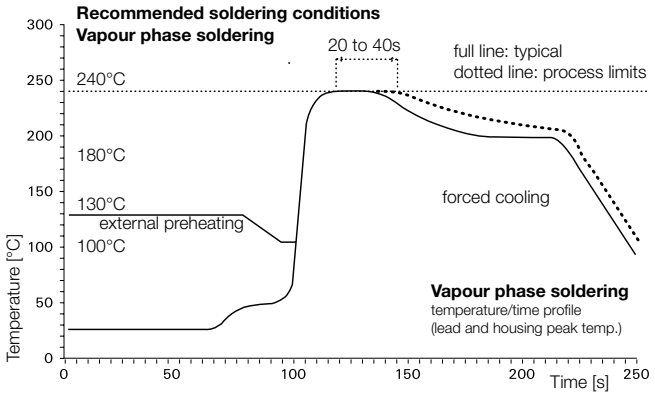
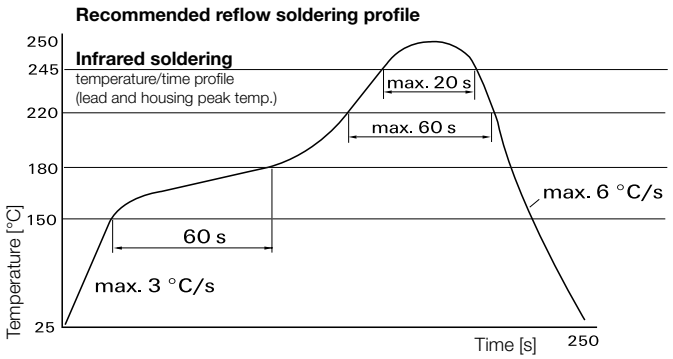
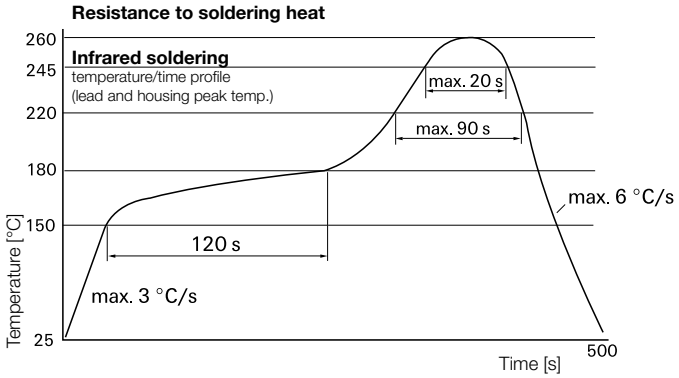
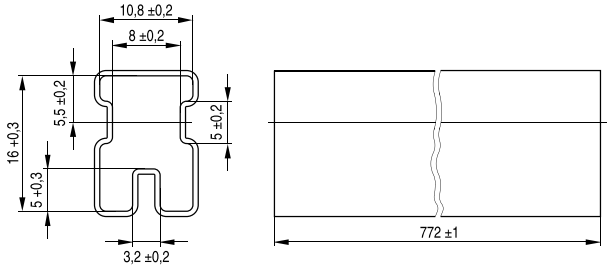
Processing

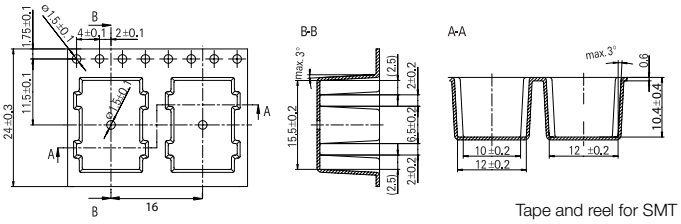


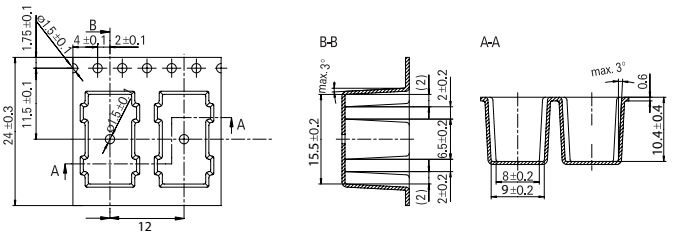




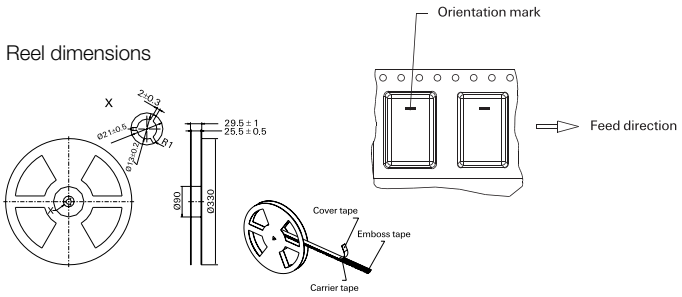
Packing







Reel dimensions



P2 Relay V23079 (Continued)

Product code structure

Typical product code	V23079	A	1	001	B	301

Type
V23079 Signal Relay P2 Series

Version

A	THT, monostable	**D**	SMT, monostable, long term.	**G**	SMT, monostable, short term.
B	THT, latching, 2 coils	**E**	SMT, latching, 2 coils long term.	**H**	SMT, latching, 2 coils short term.
C	THT, latching, 1 coil	**F**	SMT, latching, 1 coil long term.	**J**	SMT, latching, 1 coil short term.

Coil design
1 Standard coil (not for high dielectric version)
2 Overmolded coil

Coil
Coil code: please refer to coil versions table

Version
B Standard version
X High dielectric version

Contacts for standard versions
301 2 form C contacts (2 CO), AgNi +Au
201 2 form C contacts (2 CO), AgPd +Au; on request only

Product code	Coil design	Version	Coil type	Coil voltage	Part number
V23079-A1008-B301	THT	Standard	Monostable	3VDC	2-1393788-2
V23079-A1016-B301				4VDC	2-1393788-9
V23079-A1011-B301				4.5VDC	2-1393788-4
V23079-A1001-B301				5VDC	1393788-3
V23079-A1002-B301				6VDC	1393788-8
V23079-A1006-B301				9VDC	2-1393788-0
V23079-A1003-B301				12VDC	1-1393788-1
V23079-A1005-B301				24VDC	1-1393788-6
V23079-A2008-B301		Overmolded		3VDC	6-1419120-6
V23079-A2011-B301				4.5VDC	3-1393789-9
V23079-A2001-B301				5VDC	3-1393789-5
V23079-A2002-B301				6VDC	3-1393789-6
V23079-A2006-B301				9VDC	3-1393789-8
V23079-A2003-B301				12VDC	3-1393789-7
V23079-B1218-B301		Standard	Bistable, 2 coils	2.4VDC	1422002-8
V23079-B1208-B301				3VDC	4-1393788-1
V23079-B1211-B301				4.5VDC	4-1393788-2
V23079-B1201-B301				5VDC	3-1393788-3
V23079-B1202-B301				6VDC	3-1393788-5
V23079-B1206-B301				9VDC	3-1393788-9
V23079-B1203-B301				12VDC	3-1393788-6
V23079-B1205-B301				24VDC	3-1393788-7
V23079-B2219-B301		Overmolded		2VDC	1-1422002-2
V23079-B2218-B301				2.4VDC	1-1422002-1
V23079-B2208-B301				3VDC	1-1422002-0
V23079-B2201-B301				5VDC	1422002-9
V23079-C1108-B301		Standard	Bistable, 1 coil	3VDC	5-1393788-3
V23079-C1111-B301				4.5VDC	5-1393788-4
V23079-C1101-B301				5VDC	4-1393788-5
V23079-C1102-B301				6VDC	4-1393788-7
V23079-C1106-B301				9VDC	5-1393788-1
V23079-C1103-B301				12VDC	4-1393788-8
V23079-C1105-B301				24VDC	5-1393788-0

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P2 Relay V23079 (Continued)

Product code	Version	Coil design	Coil type	Coil voltage	Part number
V23079-D1008-B301	SMT, long pins		Monostable	3VDC	6-1393788-1
V23079-D1011-B301				4.5VDC	6-1393788-2
V23079-D1001-B301				5VDC	5-1393788-5
V23079-D1002-B301				6VDC	5-1393788-6
V23079-D1006-B301				9VDC	5-1393788-9
V23079-D1003-B301				12VDC	5-1393788-7
V23079-D1005-B301				24VDC	5-1393788-8
V23079-D2008-B301		Overmolded		3VDC	4-1393789-7
V23079-D2011-B301				4.5VDC	4-1393789-8
V23079-D2001-B301				5VDC	4-1393789-3
V23079-D2002-B301				6VDC	4-1393789-4
V23079-D2006-B301				9VDC	4-1393789-6
V23079-D2003-B301				12VDC	4-1393789-5
V23079-E1219-B301		Standard	Bistable, 2 coils	2VDC	1-1422007-0
V23079-E1218-B301				2.4VDC	1422007-5
V23079-E1208-B301				3VDC	7-1393788-1
V23079-E1211-B301				4.5VDC	7-1393788-2
V23079-E1201-B301				5VDC	6-1393788-8
V23079-E1202-B301				6VDC	1393789-5
V23079-E1206-B301				9VDC	1393789-9
V23079-E1203-B301				12VDC	6-1393788-9
V23079-E1205-B301				24VDC	7-1393788-0
V23079-E2219-B301				2VDC	1422007-6
V23079-F1108-B301			Bistable, 1 coil	3VDC	7-1393788-5
V23079-F1111-B301				4.5VDC	1-1393789-4
V23079-F1101-B301				5VDC	7-1393788-3
V23079-F1102-B301				6VDC	1-1393789-0
V23079-F1106-B301				9VDC	1-1393789-2
V23079-F1103-B301				12VDC	7-1393788-4
V23079-F1105-B301				24VDC	1-1393789-1
V23079-G1008-B301	SMT, short pins		Monostable	3VDC	8-1393788-0
V23079-G1001-B301				5VDC	7-1393788-6
V23079-G1002-B301				6VDC	1-1393789-5
V23079-G1006-B301				9VDC	1-1393789-6
V23079-G1003-B301				12VDC	7-1393788-7
V23079-G1005-B301				24VDC	7-1393788-8
V23079-G2008-B301		Overmolded		3VDC	5-1393789-4
V23079-G2016-B301				4VDC	1393790-5
V23079-G2011-B301				4.5VDC	5-1393789-5
V23079-G2001-B301				5VDC	4-1393789-9
V23079-G2002-B301				6VDC	5-1393789-0
V23079-G2006-B301				9VDC	5-1393789-3
V23079-G2003-B301				12VDC	5-1393789-1
V23079-H1208-B301		Standard	Bistable, 2 coils	3VDC	2-1393789-4
V23079-H1211-B301				4.5VDC	8-1393788-4
V23079-H1201-B301				5VDC	2-1393789-0
V23079-H1202-B301				6VDC	2-1393789-1
V23079-H1206-B301				9VDC	2-1393789-3
V23079-H1203-B301				12VDC	8-1393788-3
V23079-H1205-B301				24VDC	2-1393789-2
V23079-J1108-B301			Bistable, 1 coil	3VDC	2-1393789-9
V23079-J1111-B301				4.5VDC	3-1393789-0
V23079-J1101-B301				5VDC	2-1393789-5
V23079-J1102-B301				6VDC	2-1393789-6
V23079-J1103-B301				12VDC	2-1393789-7
V23079-J1105-B301				24VDC	2-1393789-8
V23079-G2008-X079		High dielectric	Monostable	3VDC	1422006-5
V23079-G2001-X071				5VDC	1422006-1
V23079-G2002-X072				6VDC	1422006-2
V23079-G2006-X073				9VDC	1422006-3
V23079-G2003-X074				12VDC	1422006-4
V23079-A2003-X074				12VDC	1422025-7
V23079-A2008-X079				3VDC	1-1422025-1

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HF3 S Relay

- **Y-Design**
- **Frequency range DC to 3GHz**
- **Impedance 50Ω / 75Ω**
- **Small dimensions (15x7.6x10.6mm)**
- **1 form C contact (1 changeover contact)**
- **Immersion cleanable**
- **Low power consumption (≤140mW)**

Typical applications
Cable modems and linecards/ CATV, Tabs, measurement and test equipment ATE, satellite / audio / video tuners, wireless base stations and antennas, power stages.

Contact Data

Contact arrangement	1 form C, 1 CO
Max. switching voltage	220VDC, 250VAC
Rated current	2A
Limiting continuous current, 23°C	2A
Switching power	60W, 62.5VA, 50W (2.5GHz)
Max. Continuos RF-Power, at 20°C., VSWR <1.2	100W @ 3GHz[1)] 150W @ 2GHz[1)]
Breaking capacity max.	300W[1)]
Contact material	Ag, Au covered
Minimum switching voltage	100µV
Initial contact resistance	<100mΩ at 10mA/20mV
Operate time	typ. 3ms, max. 5ms
Release time	
without diode in parallel	typ. 2ms, max. 5ms
with diode in parallel	typ. 4ms, max. 6ms
Bounce time max.	typ. 1ms, max. 3ms
Mechanical endurance	10^7 operations

1) with appropriat cooling only

Coil Data

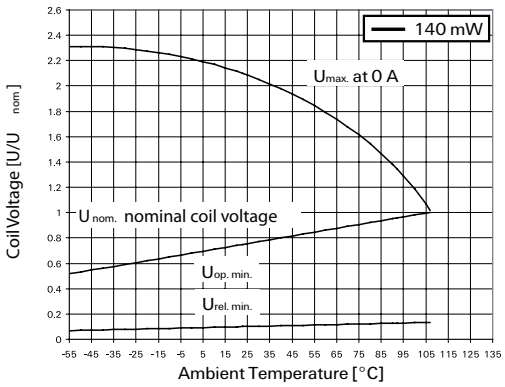
Coil voltage range	3 to 24VDC

Coil versions, monostable

Coil code	Rated voltage VDC	Operate voltage VDC	Limiting voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power mW
50Ω version, monostable, 1 coil						
51	3	2.25	6.50	0.30	64	140
52	4.5	3.38	9.80	0.45	145	140
53	5	3.75	10.90	0.50	178	140
56	12	9.00	26.10	1.20	1028	140
57	24	18.00	52.30	2.40	4114	140
75Ω version, monostable, 1 coil						
01	3	2.25	6.50	0.30	64	140
02	4.5	3.38	9.80	0.45	145	140
03	5	3.75	10.90	0.50	178	140
05	9	6.75	19.60	0.90	574	140
06	12	9.00	26.10	1.20	1028	140

All figures are given for coil without pre-energization, at ambient temperature +23°C.

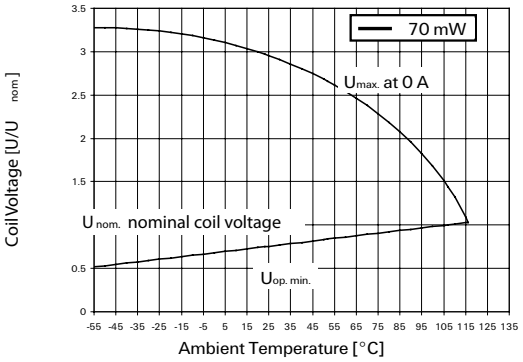
Coil Data (continued)



Coil versions, bistable

Coil code	Rated voltage VDC	Set voltage VDC	Limiting voltage VDC	Reset voltage VDC	Coil resistance Ω±10%	Rated coil power mW
50Ω version, bistable, 1 coil						
73S	5	3.75	15.30	-3.75	357	70
50Ω version, bistable, 2 coils						
91S	3	2.25	6.50	2.25	64	140
92S	4.5	3.38	9.80	3.38	145	140
93S	5	3.75	10.90	3.75	178	140
96S	12	9.00	26.10	9.00	1028	140
75Ω version, bistable, 2 coils						
41S	3	2.25	6.50	2.25	64	140
42S	4.5	3.38	9.80	3.38	145	140
43S	5	3.75	10.90	3.75	178	140
46S	12	9.00	26.10	9.00	1028	140

All figures are given for coil without pre-energization, at ambient temperature +23°C.



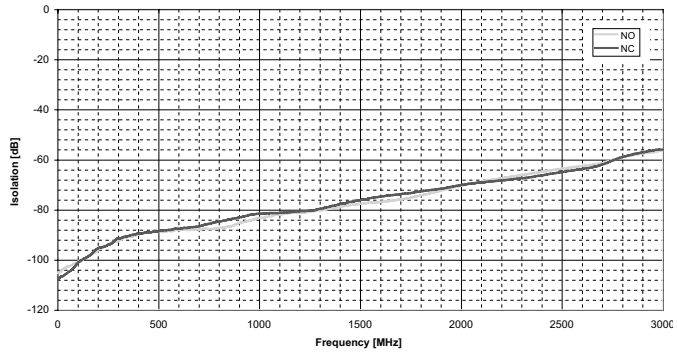
HF3 S Relay (Continued)

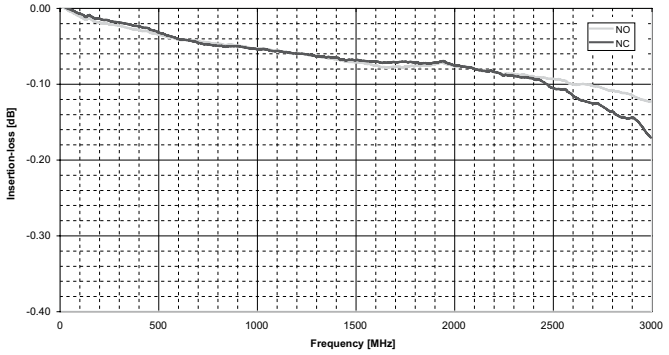
Insulation Data	50Ω version	75Ω version
Initial dielectric strength		
between open contacts	$600V_{rms}$	
between contact and coil	$1000V_{rms}$	
Initial surge withstand voltage		
between open contacts	1000V	
between contact and coil	1500V	

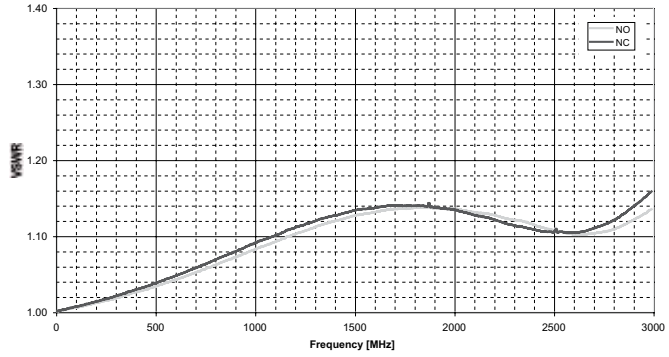
RF Data		
Isolation		
at 100MHz/900MHz	-95dB/-80dB	-96dB/-80dB
at 3GHz	-55dB	-50dB
Insertion loss		
at 100MHz/900MHz	-0.03dB/-0.12dB	-0.03dB/-0.12dB
at 3GHz	-0.30dB	-0.30dB
Voltage standing wave ratio (VSWR)		
at 100MHz/900MHz/3GHz	1.05/1.10/1.25	1.05/1.20/1.30

Other Data	
Material compliance: EU RoHS/ELV, China RoHS, REACH, Halogen content refer to the Product Compliance Support Center at www.te.com/customersupport/rohssupportcenter	
Ambient temperature	-55°C to +85°C
Thermal resistance	<165K/W
Category of environmental protection IEC 61810	RT III - wash tight
Degree of protection, IEC 60529	IP 67, immersion cleanable
Vibration resistance (functional)	35g, 10 to 1000Hz
Shock resistance (functional), half sinus 11ms	50g
Shock resistance (destructive), half sinus 0.5ms	150g
Terminal type	SMT
Weight	max. 3g
Resistance to soldering heat SMT IEC 60068-2-58	265°C/10s
Moisture sensitive level, JEDEC J-Std-020D	MSL3
Ultrasonic cleaning	not recommended
Packaging/unit, SMT	reel/250 pcs., box/250 pcs.

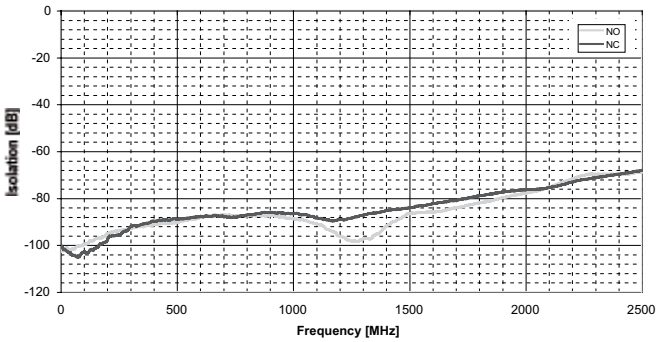
RF performance, 50Ω version

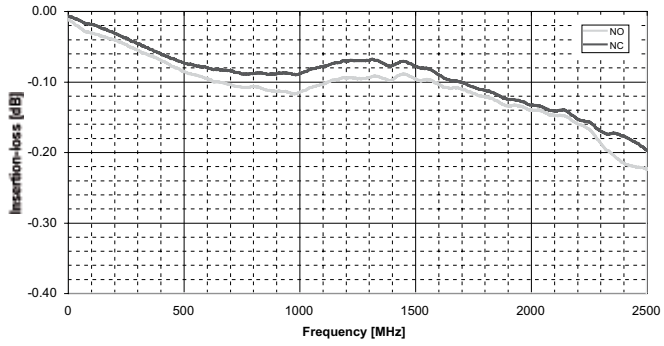


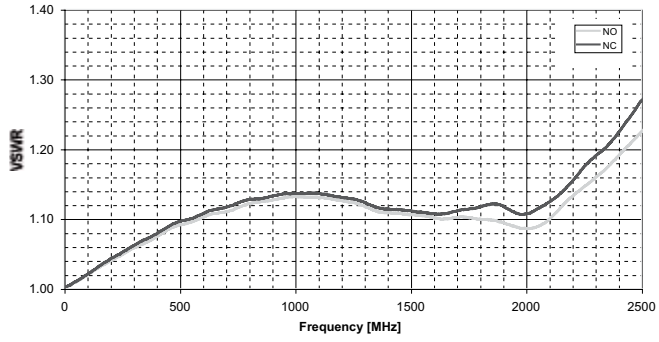




RF performance, 75Ω version







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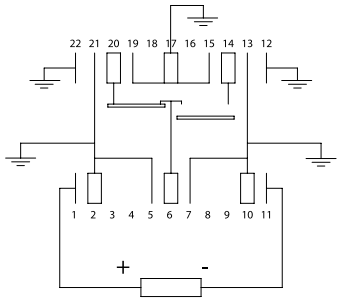
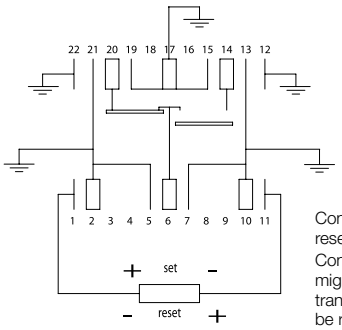
HF3 S Relay (Continued)

Terminal assignment
TOP view on component side of PCB

Monostable

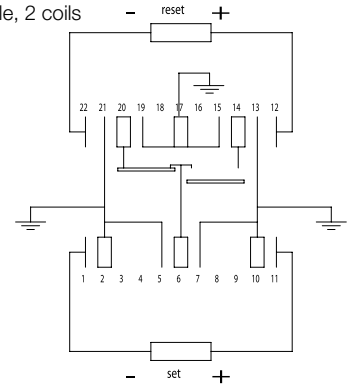


Bistable, 1 coil



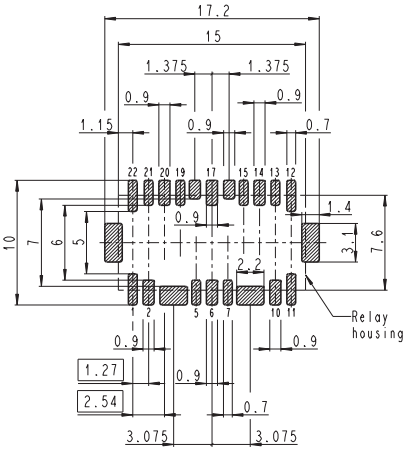
Contacts are shown in reset condition. Contact position might change during transportation and must be reset before use.

Bistable, 2 coils

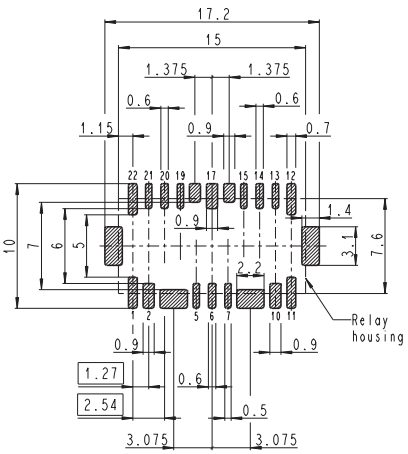


PCB layout
TOP view on component side of PCB

50Ω version

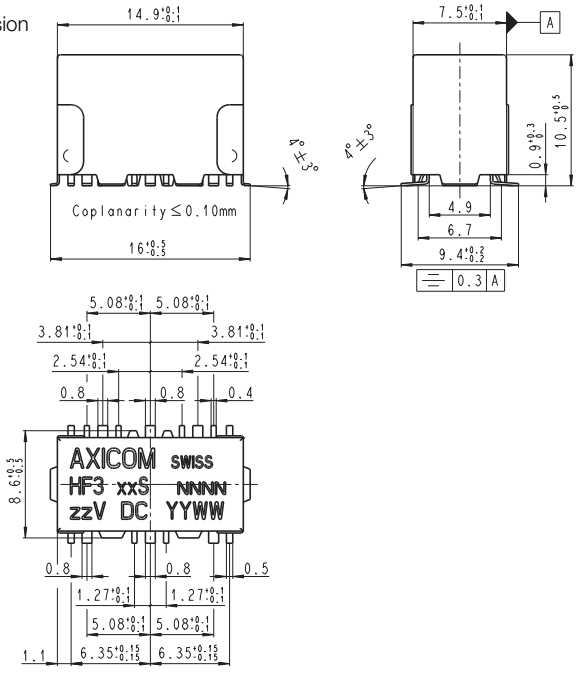


75Ω version

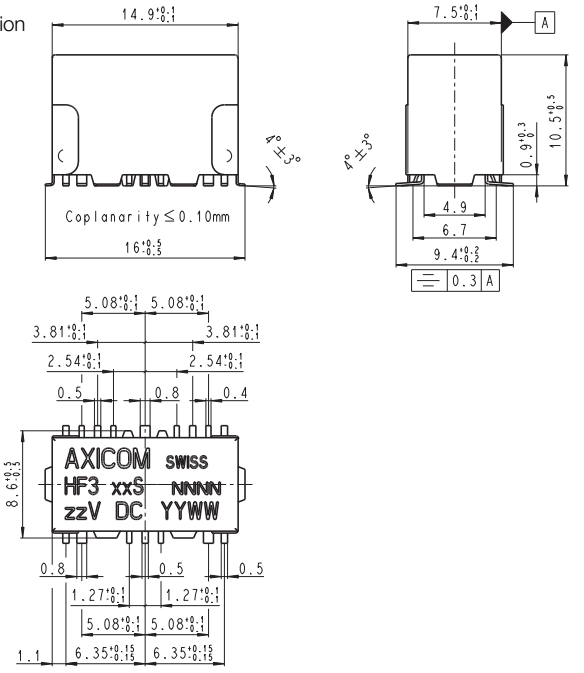


Dimensions

50Ω version

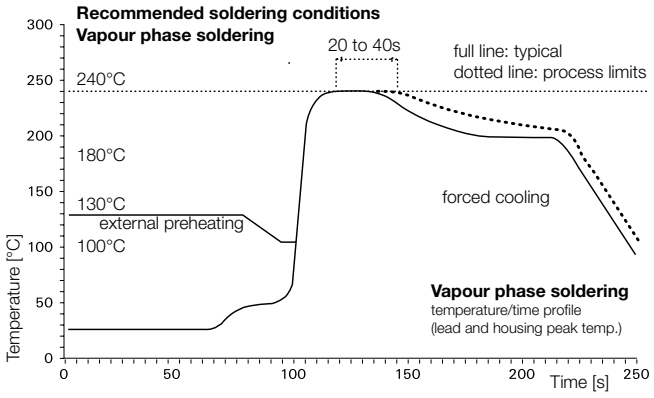


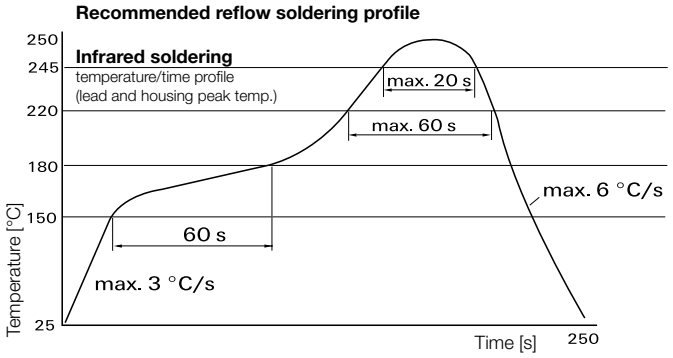
75Ω version

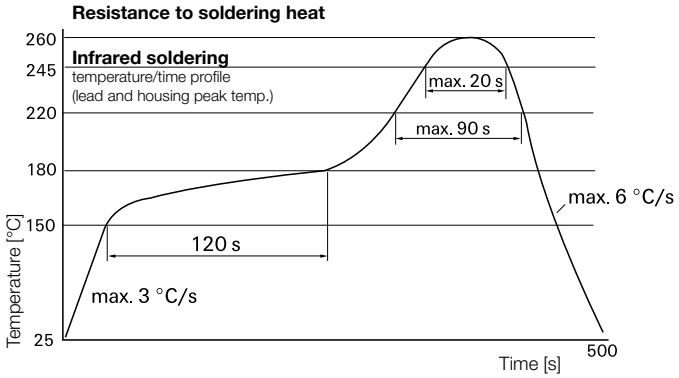


HF3 S Relay (Continued)

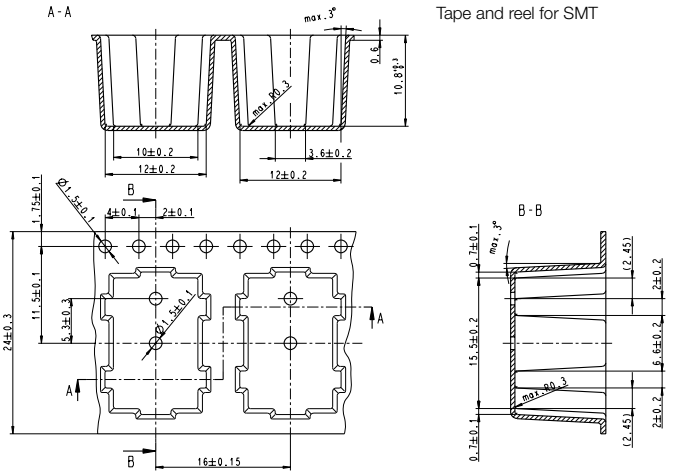
Processing

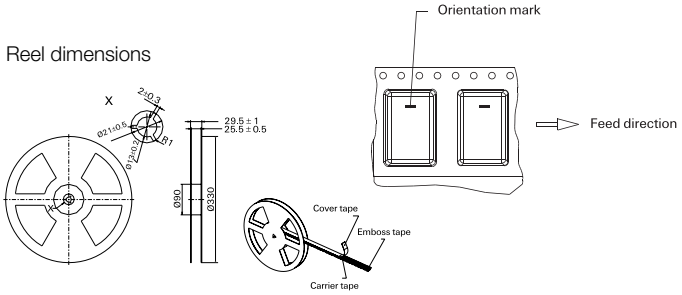






Packing





HF3 S Relay (Continued)

Product code structure

Typical product code: **HF3 53 S**

Type
HF3 High Frequency Relays HF3S Series
1 form C, 1 CO

Coil
Coil code: please refer to coil versions table
Performance type

5x	50Ω version, monostable 1coil	**0x**	75Ω version, monostable 1coil
7x	50Ω version, bistable 1coil	**2x**	75Ω version, bistable 1coil
9x	50Ω version, bistable 2coils	**4x**	75Ω version, bistable 2coils

Type
S High performance

Product code	Arrangement	Version	Coil	Coil type	Part number
HF3 53S	1 form C (1 CO)	50ohm	5VDC	Monostable	2-1462051-3
HF3 56S			12VDC		3-1462051-1
HF3 57S			24VDC		2-1462051-2
HF3 92S	1 form C (1 CO)	50ohm	4.5VDC	Bistable 2 coils	2-1462051-5
HF3 93S			5VDC		2-1462051-4
HF3 96S			12VDC		2-1462051-6
HF3 03S	1 form C (1 CO)	75ohm	5VDC	Monostable	2-1462050-2
HF3 05S			9VDC		3-1462050-3
HF3 06S			12VDC		3-1462050-7
HF3 41S	1 form C (1 CO)	75ohm	3VDC	Bistable 2 coils	3-1462050-2
HF3 42S			4.5VDC		3-1462050-3

This list represents the most common types and does not show all variants covered by this datasheet.
Other types on request.

HF6 Relay

- **Y-Design**
- **Frequency range DC to 6GHz**
- **Impedance 50Ω**
- **Small dimensions (16x7.6x10mm)**
- **1 form C contact (1 changeover contact)**
- **Immersion cleanable**
- **Low power consumption (≤140mW)**

Typical applications
Measurement and test equipment ATE, wireless base stations and antennas, wireless infrastructure, RF power amplifier.

Contact Data

Contact arrangement	1 form C, 1 CO
Max. switching voltage	220VDC, 250VAC
Rated current	2A
Limiting continuous current	2A
Switching power	60W, 62.5VA, 50W (2.5GHz)
Max. continuos RF-power at 20°C.	50W (2.5GHz)
Contact material	Ag, Au covered
Minimum switching voltage	100µV
Initial contact resistance	<100mΩ at 10mA/20mV
Operate time	typ. 3ms, max. 5ms
Release time	
without diode in parallel	typ. 2ms, max. 5ms
with diode in parallel	typ. 4ms, max. 6ms
Bounce time max.	typ. 1ms, max. 3ms
Mechanical endurance	10^7 operations

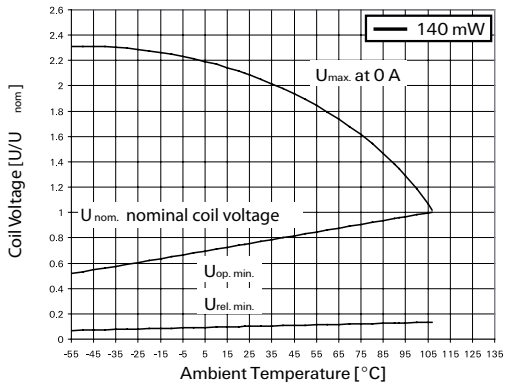
Coil Data

Coil voltage range	3 to 24VDC

Coil versions, 50Ω version, monostable

Coil code	Rated voltage VDC	Operate voltage VDC	Limiting voltage VDC	Release voltage VDC	Coil resistance Ω±10%	Rated coil power mW
51	3	2.25	6.50	0.30	64	140
52	4.5	3.38	9.80	0.45	145	140
53	5	3.75	10.90	0.50	178	140
54	6	4.50	13.00	0.60	257	140
55	9	6.75	19.60	0.90	574	140
56	12	9.00	26.10	1.20	1028	140
57	24	18.00	52.30	2.40	4114	140

All figures are given for coil without pre-energization, at ambient temperature +23°C.

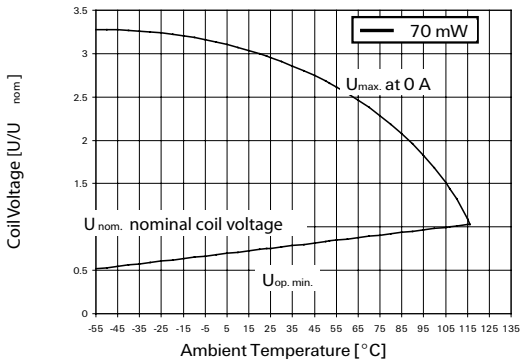


Contact Data (continued)

Coil versions, bistable

Coil code	Rated voltage VDC	Set voltage VDC	Limiting voltage VDC	Reset voltage VDC	Coil resistance Ω±10%	Rated coil power mW
50Ω version, Bistable, 1 coil						
71	3	2.25	9.20	-2.25	128	70
72	4.5	3.38	13.85	-3.38	289	70
73	5	3.75	15.30	-3.75	357	70
74	6	4.50	18.50	-4.50	514	70
75	9	6.75	27.70	-6.75	1157	70
76	12	9.00	37.00	-9.00	2057	70
77	24	18.00	74.00	-18.00	8228	70
50Ω version, bistable, 2 coils						
91	3	2.25	6.50	2.25	64	140
92	4.5	3.38	9.80	3.38	145	140
93	5	3.75	10.90	3.75	178	140
94	6	4.50	13.00	4.50	257	140
95	9	6.75	19.60	6.75	574	140
96	12	9.00	26.10	9.00	1028	140
97	24	18.00	52.30	18.00	4114	140

All figures are given for coil without pre-energization, at ambient temperature +23°C.



HF6 Relay (Continued)

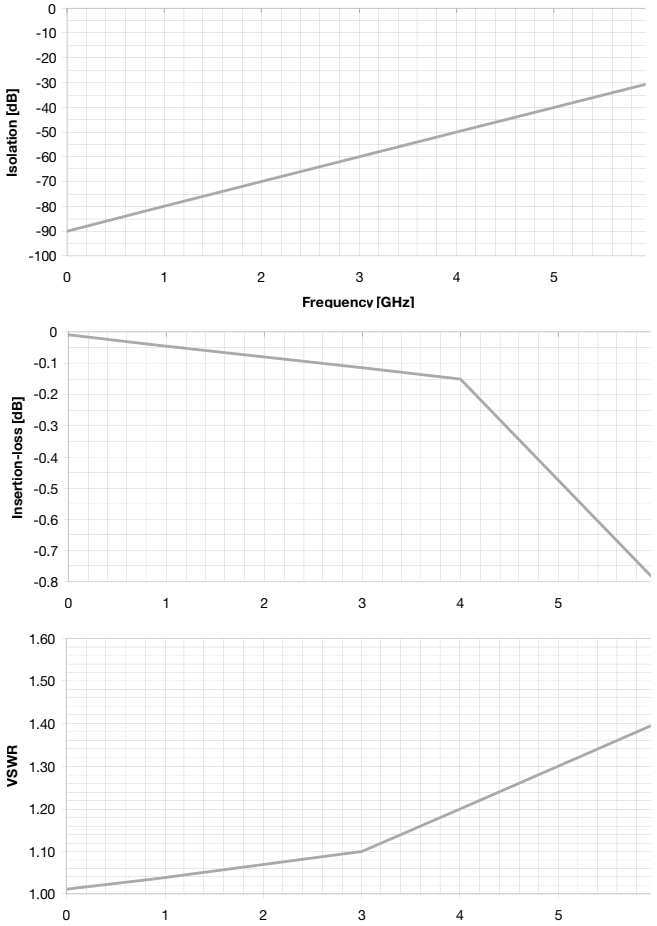
Insulation Data

Initial dielectric strength	
between open contacts	600Vrms
between contact and coil	1000Vrms
Initial surge withstand voltage	
between open contacts	1000V
between contact and coil	1500V

RF Data

Isolation at 900MHz/3GHz/6GHz	-80dB/-60dB/-30dB
Insertion loss at 900MHz/3GHz/6GHz	-0.05dB/-0.15dB/-0.80dB
Voltage standing wave ratio (VSWR)	
at 900MHz/3GHz/6GHz	1.05/1.10/1.40

Typical RF performance, 50Ω version

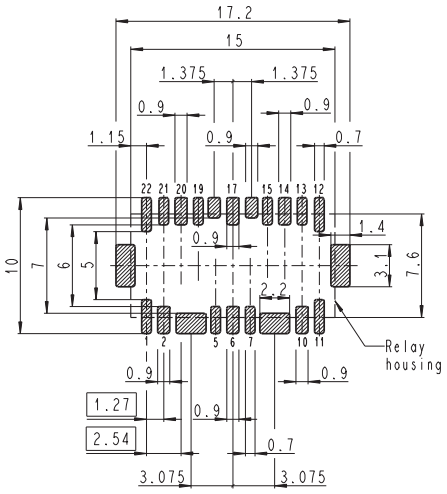


Other Data

Material compliance: EU RoHS/ELV, China RoHS, REACH, Halogen content refer to the Product Compliance Support Center at www.te.com/customersupport/rohssupportcenter	
Ambient temperature	-55°C to +85°C
Thermal resistance	<165K/W
Category of environmental protection IEC 61810	RT III - wash tight
Degree of protection, IEC 60529	IP 67, immersion cleanable
Vibration resistance (functional)	35g, 10 to 1000Hz
Shock resistance (functional), half sinus 11ms	50g
Shock resistance (destructive), half sinus 0.5ms	150g
Terminal type	SMT
Weight	max. 3g
Resistance to soldering heat SMT	IEC 60068-2-58265°C/10s
Moisture sensitive level, JEDEC J-Std-020D	MSL3
Ultrasonic cleaning	not recommended
Packaging/unit, SMT	reel/250 pcs., box/250 pcs.

PCB layout

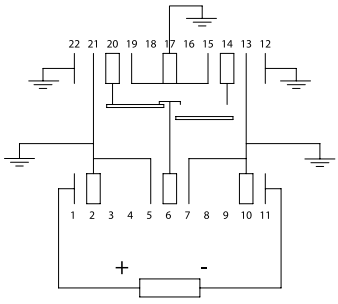
TOP view on component side of PCB



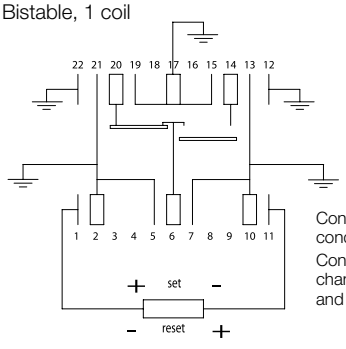
Terminal assignment

TOP view on component side of PCB

Monostable



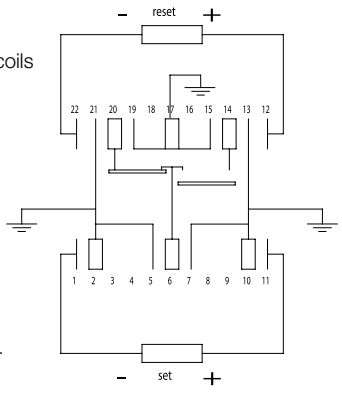
Bistable, 1 coil



Contacts are shown in reset condition.

Contact position might change during transportation and must be reset before use.

Bistable, 2 coils



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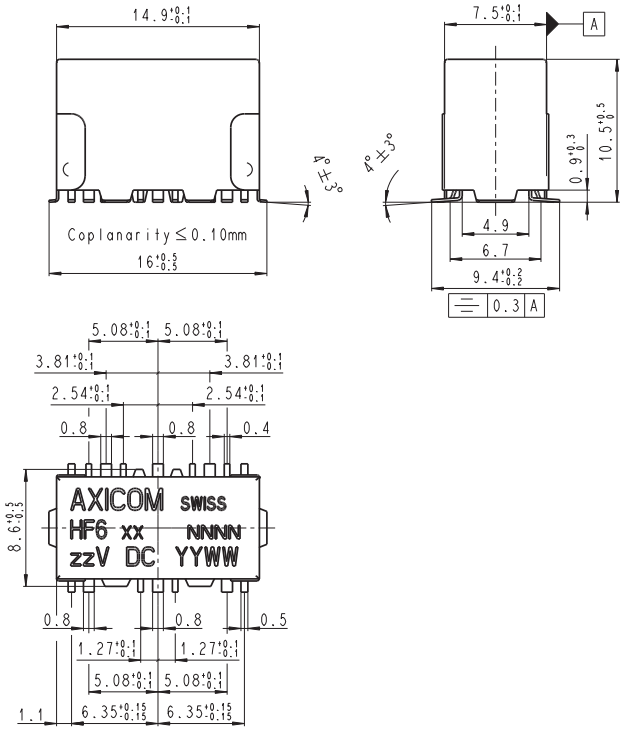
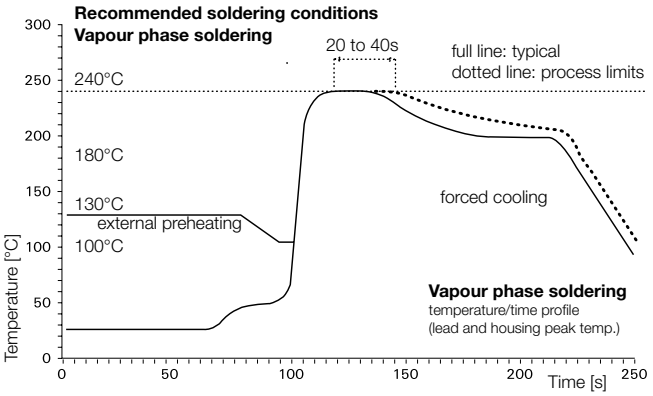
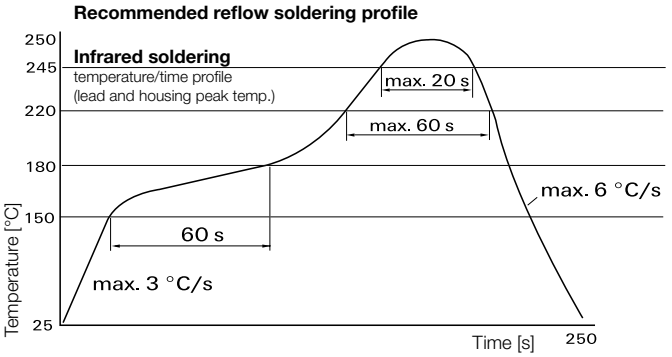
HF6 Relay (Continued)

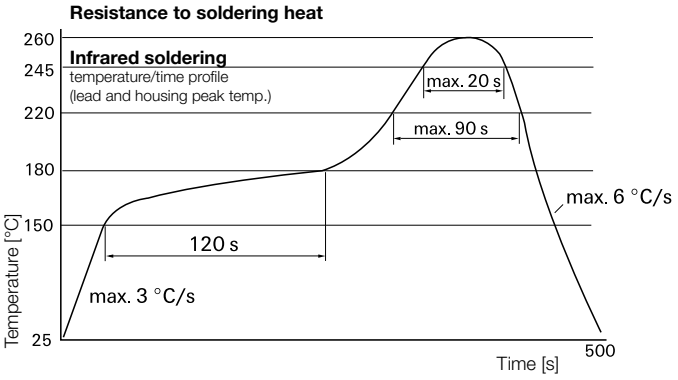
Dimensions



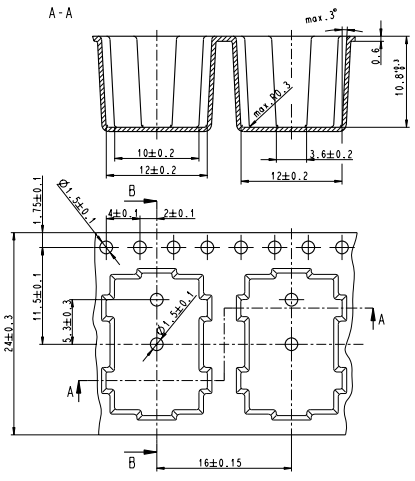
Processing





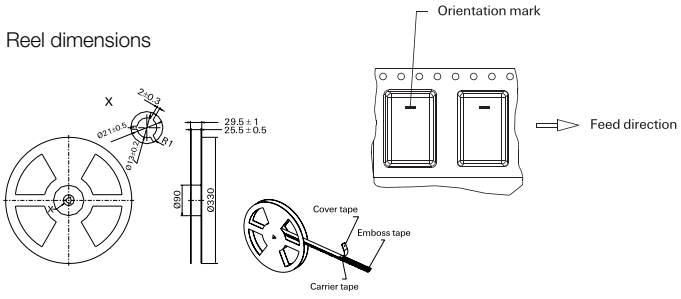


Packing



Tape and reel for SMT

Reel dimensions



HF6 Relay (Continued)

Product code structure

Typical product code **HF6** **53**

Type

HF6 High Frequency Relays HF6 Series
1 form C, 1 CO

Coil

Coil code: please refer to coil versions table
Performance type
5x 50 Ohm version, monostable 1coil
7x 50 Ohm version, bistable 1coil
9x 50 Ohm version, bistable 2coils

Product code	Arrangement	Version	Coil	Coil type	Part number
HF6 51	1 form C (1 CO)	50ohm	3VDC	Monostable	1462052-1
HF6 53			5VDC		1462052-3
HF6 56			12VDC		1462052-6
HF6 73	1 form C (1 CO)	50ohm	5VDC	Bistable 1 coil	1-1462052-0
HF6 93	1 form C (1 CO)	50ohm	5VDC	Bistable 2 coils	1-1462052-7
HF6 96			12VDC		2-1462052-0

This list represents the most common types and does not show all variants covered by this datasheet.
Other types on request.

Contents

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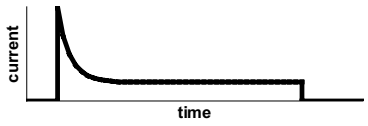
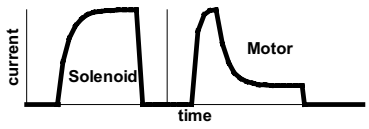
Catalog and product specification according to IEC 61810-1 and to be used only together with the 'Definitions' section.

Catalog and product data is subject to the terms of the disclaimer and all chapters of the 'Definitions' section, available at http://relays.te.com/definitions

Catalog product data, 'Definitions' section, application notes and all specifications are subject to change.

Automotive Applications

Typical Automotive Applications

Load	Application examples	Typical current curve
Resistive Loads	- Heatings (rear window heating, seat heating glow plug, air/water preheating)	
Capacitive Loads	- Lamps (front and rear beam, fog lights, flasher) - Filter capacitors in electronic modules (engine management module, ABS module)	
Inductive Loads	- Solenoids (vales, clutches, relay coils) - Motors and pumps (power window, central lock, cooling fan)	

Introduction

The range of applications can be classified into resistive loads, capacitive loads and inductive loads. The current curve of resistive loads is specified by the load voltage and load resistance. Capacitive loads have a high inrush current and a low steady current. Therefore lamps are counted to the capacitive loads, because the cold filament has a significantly lower resistance, than the hot filament. Inductive loads are characterized by an exponential current increase and a remarkable switch off arc, induced by the demagnetization of the magnetic circuit of the load. Power supply relays (clamp relays) can switch or feed a mixture of different loads.

The circuit design of resistive and capacitive loads is usually a simple switch on and switch off. Motor load circuits are often more complex. The most typical circuits are described hereafter.

Short-Circuit Brake

The short-circuit brake is used, wherever an electric motor must be braked (e.g. wiper). The short-circuit brake transforms the rotational energy of the motor into electrical energy. The short-circuit brake can be critical at higher load voltages. If the switch-off arc does not extinguish during the transition time of the movable contact, the arc creates a direct shortage of the power source. Particularly in 24VDC systems, the resulting extremely high arc current could cause almost instantly severe damage to the contacts and could destroy the entire relay.

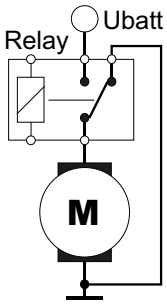


Fig. 1 Short-circuit brake

Motor-Reverse Circuit (H-Bridge)

The H-bridge is used to operate a motor in two directions (e.g. door lock, steering lock, power window, seat adjustment, etc.). The operation time is typically very short compared to the thermal time constant of the relay (e.g. door lock <1s, power window <10s). This means, H-bridge relays must be designed for high current-switching-capability, but not for high current-carrying-capability. Higher load voltages can be critical, due to possible short-circuit-arcs (see also short-circuit brake).

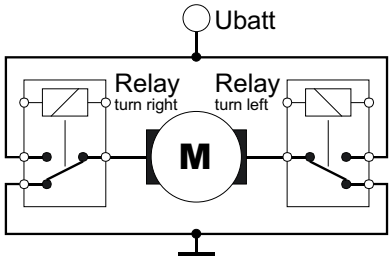


Fig. 2 H-bridge

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Automotive Applications

Wiper Circuits

To stop the wiper in the correct position, a short-circuit brake is used. This can be done either by an internal slipring (usually used for rear wiper) or with the normally closed contact of the relay (usually used for front wiper). This requires a high switching capability of the N/C-contact, especially in combination with intermittent wipe function or rain sensor control. Dual speed wipers have two windings, which are commuted by a second relay. There are also wiper systems without mechanical gear, which are electrically reversed with a H-bridge circuit.

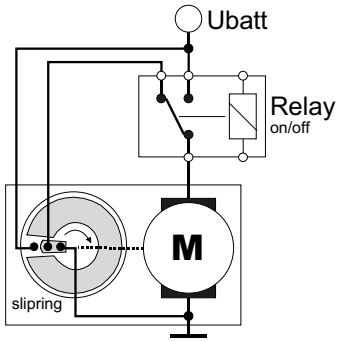


Fig. 3 Wiper with slipring

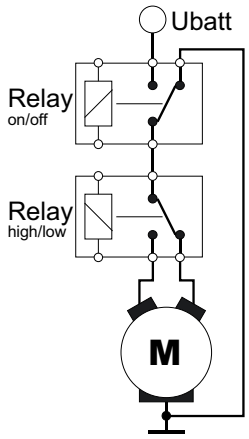


Fig. 4 Dual speed wiper-circuit

Cooling Fan Circuits

Depending on the size of the engine, either one or two fans are used to cool the engine. There are different possibilities to control the speed of the fans. Single fan systems are usually controlled by one or more serial resistors. The disadvantage is the electrical power loss of the resistors. Double fan systems are normally controlled by switching them either in series (low speed) or in parallel (high speed). If more speed steps are needed, additional serial resistors are used. A more sophisticated method is a PWM-controlled brushless motor. In commercial vehicles the cooling fan is mostly driven directly by the motor shaft.

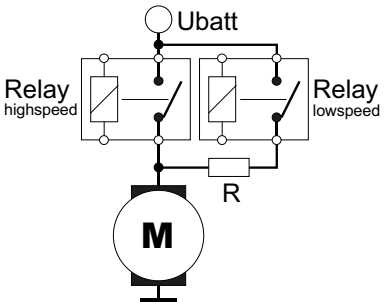


Fig. 5 Single fan circuit

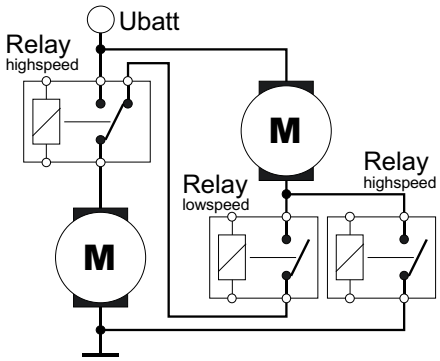


Fig. 6 Double fan circuit

Automotive Applications

Coil Suppression Circuits

The disconnection of the relay coil generates a transient voltage peak, which is only limited by the parasitic inductivity and capacity of the electrical system. In most of the cases it is necessary to suppress the transient voltage peak to typically 60VDC – 100VDC for the protection of the relay driver or the vehicle electrical system. Any voltage suppression of the relay coil influences the dynamics of the electromechanical system and can reduce the lifetime.

The best protection method for the driver is a diode in parallel to the relay coil. But this method has the worst influence on lifetime of the relay. Typical suppression methods are a resistor in parallel to the coil (preferably as internal component in plug-in relays) or a Zener diode in parallel to the relay driver (preferably for PCB relays).

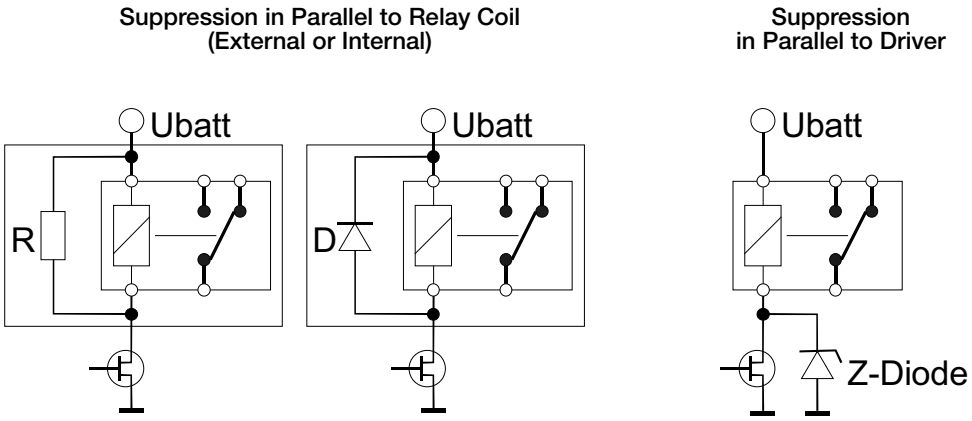


Fig. 7 Coil suppression circuits

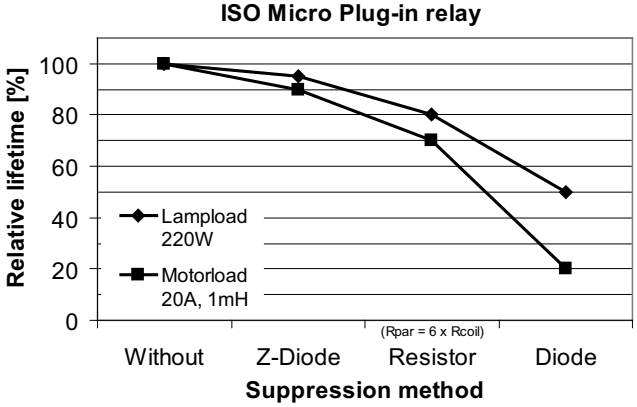


Fig. 8 Influence of coil suppression on the lifetime

Diagnostics of Relays

Introduction

With the increase of electronic circuits and safety requirements in cars, more and more switching contacts are monitored by diagnostic routines. Similar routines are used by the system suppliers before, during and after the assembly processes (In-Circuit and End-Of-Line tests) as well.

Automotive relays are originally designed to switch real automotive applications (e.g. motors, lights, heating, etc.) with a load voltage of 12VDC (or 24VDC or 42VDC) and load currents above 1A. Lower diagnostic current and voltage levels can result in wrong interpretations of the state of the relay contact.

This paper explains the technical background of the relay contact system, coil system and dynamic behavior and gives recommendations for applicable diagnostic routines.

Contact System

The most common contact materials for automotive relays are fine grain silver (AgNi0.15) and silver tin oxide ($AgSnO_2$). Both materials are affected by sulfidation and oxidation. These layers of oxides, sulfides and other compounds will be formed on the surface of metal-contacts by absorption of gas molecules from the ambient atmosphere within a very short time. The layers will increase the contact resistance. The resistance of such layers depends on the thickness of the layer, effective contact area and the specific resistance of the contact material/layer. To get a reliable electric contact these layers have to be destroyed. This can be done by mechanical, electrical or thermal destruction. A mechanical destruction requires high contact forces. With the very high degree of miniaturization of automotive relays, those contact forces cannot be safely achieved, especially for normally-closed contacts. An electrical destruction requires a specific breakdown voltage and current. This destruction process is called A-fritting.

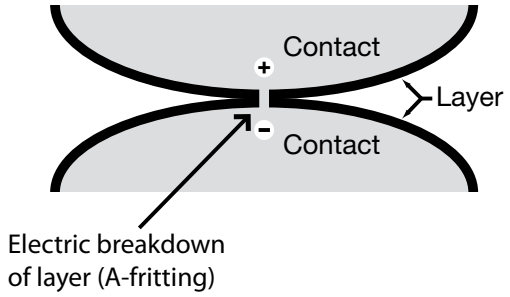


Fig. 1 Contact layers

The breakdown voltage depends on the thickness and specific resistance of the layer and can reach theoretically some hundred volts. In the practice of automotive relays the breakdown voltage can be up to 3VDC. A current of min. 10mA is needed to start the A-fritting. After the electrical breakdown a small current is forced through very thin channels in the layer. The resulting local high current density heats the conducting channels up quickly, destroying the layers, until finally (within a few ms) a metal to metal bridge is established. This process is called B-fritting. The B-fritting voltage depends again on the thickness and specific resistance of the layer and can reach in the practice of automotive relays up to 300mV.

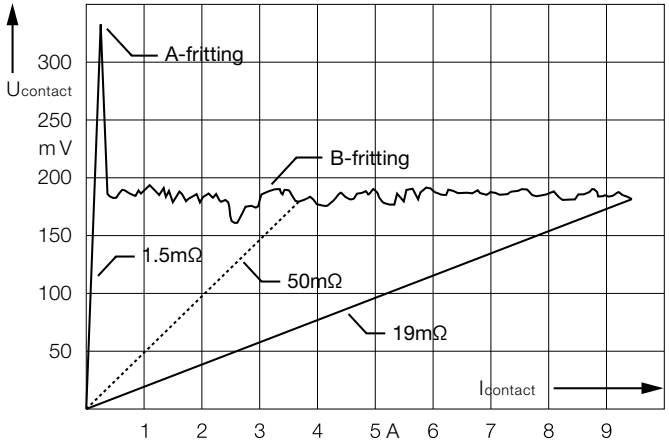


Fig. 2 Fritting of a relay contact

A thermal destruction requires high temperatures, which will only be generated by high contact currents or electric arcs (disconnecting inductive loads). The thermal destruction can only take place, after an electrical destruction.

Coil System and Dynamic Behavior

Automotive relay coils are designed for DC-voltages. The switching times (i.e. operate time or switch-on time and release time or switch-off time) are usually in the low millisecond-range. The operate time depends on the applied coil voltage. Fig. 3 shows the relation of the operate time and coil voltage, related to the actual pull-in voltage. The nominal voltage in the displayed case is 170% of the actual pull-in voltage at an ambient temperature of 23°C (e.g. 7VDC pull-in voltage at 12VDC nominal voltage). Higher coil temperatures increase the pull-in voltage and subsequently increase the operate time at the same applied coil voltage. Including possible contact bouncing, the operate time can be three times as high as the typical values shown in the datasheets.

Diagnostics of Relays

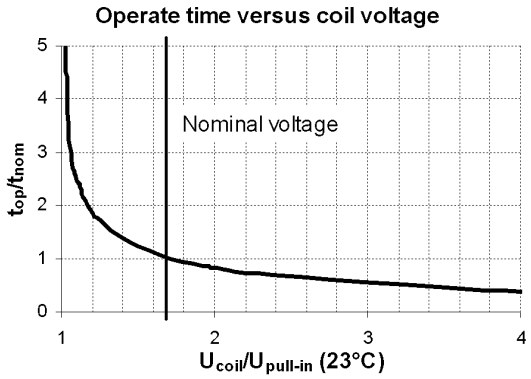


Fig. 3 Operate time

The release time depends mainly only on the used coil suppression. A low ohmic device (e.g. a diode) in parallel to the relay coil can increase the release time by a factor of up to 4 compared to the typical values shown in the datasheets.

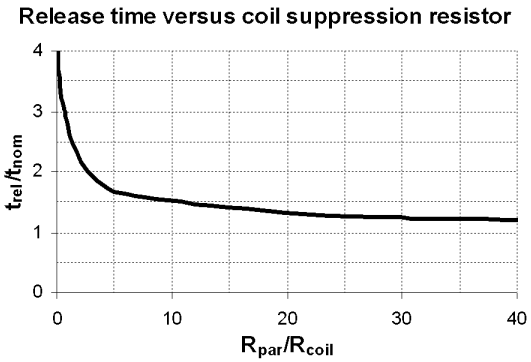


Fig. 4 Release time

Coil Resistance

The inductivity of automotive relay coils can exceed (in the unsaturated range) 1H. This results in time constants tau between 1 to 50ms for the exponential inductive current increase (jump response). If the ohmic coil resistance is measured with a 4-pole measurement, the resistance value will be wrong, if it is measured during the inductive current increase after switch on.

Recommendations for Diagnostic Routines

A contact diagnostic routine must:

Take into account, that the contact resistance may be non-linear. Due to the explained fritting phenomena, the contact resistance can be non-linear. This means, that the contact resistance, measured at low voltage and current levels (e.g. standard multimeter) can be significantly higher than the contact resistance under real conditions (e.g. supplying a 100W load). We recommend to perform the diagnostic routine with the real application and real board net voltage connected.

Supply a sufficient voltage and current to force the A-fritting. If the diagnostic routine cannot be performed with real application and voltage, the measurement voltage level must secure an electrical breakdown of possible layers. We recommend a voltage level of min. 5VDC and current of min. 100mA for min. 1ms.

Accept, that the voltage drop can be 300mV. The B-fritting is a physical phenomenon, which can occur on all silver based contacts. For signal-applications, special signal relays are available. We recommend to set the diagnostic threshold voltage to 500mV per relay contact (important for H-bridges or serial contact arrangements).

Regard the maximum possible switching times. If the status of the contact has to be changed for the diagnostic routine (energize or de-energize relay), the routine must wait until the intended contact status is reached. Depending on ambient conditions (temperature, voltage levels, coil circuits) the times can be significantly longer than the specified typical times. We recommend a delay time of min. 10 times of the typical switching times or min. 20ms after first contact status change at min. 110% pull-in voltage.

A coil diagnostic routine must:

Secure, that the status of the contact does not change during the diagnostic. If the coil driver is monitored by a watchdog routine, the energizing/de-energizing time of the coil must not result in an unintended closing or opening of the contacts. We recommend times of max. 0.5ms.

Remarks

1. During the lifetime of the car, the relay parameters can alter due to ageing processes like contact erosion, fretting corrosion and relaxation. Moreover the environmental requirements (temperature, vibration etc.) in the car are higher than in IC- or EOL-tests. Therefore we recommend for diagnostic routines in the car a higher threshold voltage (approx. 3VDC) and higher delay times (min. 15 times of the typical switching times).
2. Most of the applications, switched by relays, are not safety related. If a potential relay failure is detected, we recommend to not block any further activation of the relay but to write the occurrence into the error memory.

Pulse Width Modulation (PWM) and Relays

Introduction

Efficient energy management is one of the main goals in automotive industry Regulating actuators by Pulse Width Modulation (PWM) is a widespread means of improving efficiency. There has been an increasing penetration of PWM controlled applications like heater blowers, lamps, EPAS. Once a PWM controller is available in the car it could be used for several applications.

Heat dissipation of monostable relay coils is one source of high temperatures in relay boxes, distribution and switching modules. That limits not only the relay performance, but the performance of the whole unit, too. These heat sources could be removed by using latching relays or at least be reduced by use of high resistive coils and / or by applying PWM controlled driver circuits. This application note summarizes key aspects, which have to be taken into account when using PWM strategy for the relay coil driver.

Relay Status

The best way to regulate the relay coil power consumption would be a DC current driver, since the main electrical parameters of a relay (pull-in, pull-through and holding currents) are to a certain extent temperature independent. But relay coils are usually voltage driven. Thus those characteristics translate into the temperature dependent voltages for pull-in, pull-through and holding. The reason is the temperature depending resistance of the coil wire material, i.e. copper.

Once the relay has pulled through, it keeps its status (armature keeps to its position on the core) unless the coil current falls below the holding current. For shock and vibration resistance there is an additional excess current required, which depends on the relay type, further relay parameters and shock and vibration requirements.

PWM controlled drivers regulate the effective applied voltage by changing the duty ratio of DC voltage normally at a given frequency. Inductive systems like relay coils respond in presence of parallel components to a negative going edge with a current decrease.

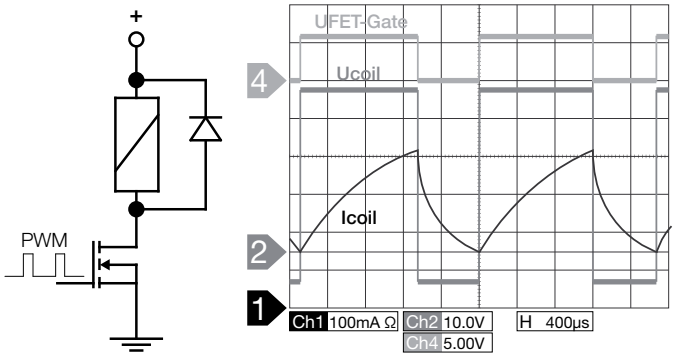


Figure 1: Current response to PWM voltage step with parallel diode

This ripple around the effective current depends on the coil inductance, coil suppression, PWM frequency, voltage level and duty ratio.

It is always recommended to start with 100% PWM duty ratio until the relay pullsthrough and settles. The necessary time depends on excess voltage, relay type, etc…, but 500ms should be sufficient. Otherwise it will take some time for the relay current to settle around the effective current.

In order to warrant a good relay performance with PWM it has to be made sure, that under all circumstances the coil current does not undercut the level of holding current plus the excess current for shock and vibration. Otherwise the armature and the contacts might open. Then the relay has to pull-in and pull-through again to settle. Repeated opening and closing the armature might cause humming noise. Unintended opening and closing the armature and contacts under load might cause contact welding.

Inductance

Relay coil inductances are in general relatively high, which result in comparatively small current ripples. But these values are not constant and vary strongly within one relay family or one type. The relay coil inductance depends among others on quite a few parameters, which are not under focus in a standard relay manufacturing process. Furthermore it heavily depends on the coil current (saturation) and status of the relay (armature open or closed).

Coil Suppression

In DC coil drivers coil suppression is done for protecting the relay driver from high coil switch-off voltage peaks. There are several options for this (see figure 2). For PWM coil drivers suppression is even more crucial, since the coil switch off occurs at PWM frequencies, i.e. up to several thousand times per second. Furthermore coil suppression reduces the ripple coil current, and thus the potential for dropping out since the coil current takes longer to decrease. Therefore from this perspective the stronger the suppression the better, i.e. best with parallel diode (upper circle in figure 2). On the other hand this case is exactly the worst for relay switching capability. For single drivers the best compromise is probably an anti parallel low voltage (3…9VDC) Z-diode (lower circle in figure 2). A Zener diode in parallel to the driver would cause a varying voltage clamp across the relay coil during switch-off due to varying supply voltage.

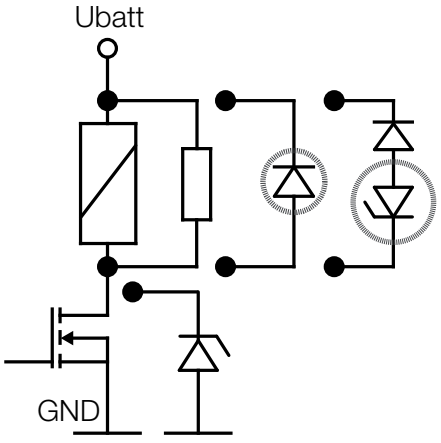


Figure 2: Relay coil low side driver with coil suppression options

Pulse Width Modulation (PWM) and Relays

Frequency:

As could be seen in figure 3 the higher the frequency the lower is the ripple current. Therefore the effective coil voltage could be chosen to be lower with keeping all the other parameters constant. We recommend a PWM frequency of minimum 20kHz.

PWM 12VDC, 558Hz, 10 kHz, 20 kHz 67%, Tamb. 23°C, Tco il: 50°C

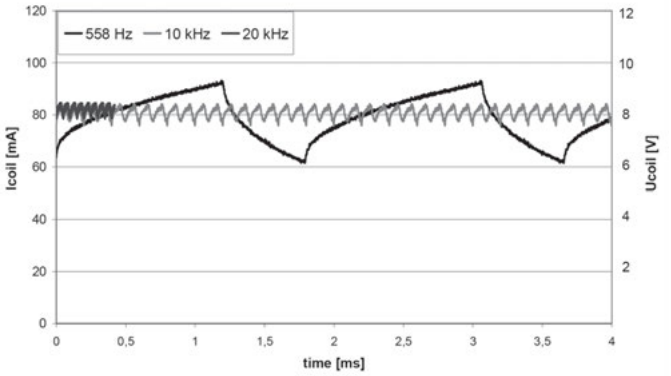


Figure 3: Effect of different PWM frequencies on ripple coil current on Power F relay with parallel diode

Duty Ratio

The effective coil voltage is the product of PWM duty ratio and supply voltage. However the supply voltage varies due to changes in system load (e.g. cranking) and alternator and battery status. Therefore the PWM duty ratio should be regulated according to the supply voltage. A tight regulation would be optimal for efficiency. But slight variation on the supply side would cause a continuous regulation of the PWM duty ratio. Furthermore regulation response time would need to be faster than 1ms to ensure, that the effective coil voltage does not undercut the required voltage limit.

Figures 4 and 5 show a PWM concept for a requirement of 8VDC effective coil voltage using a duty ratio regulation with 2VDC steps of the supply voltage.

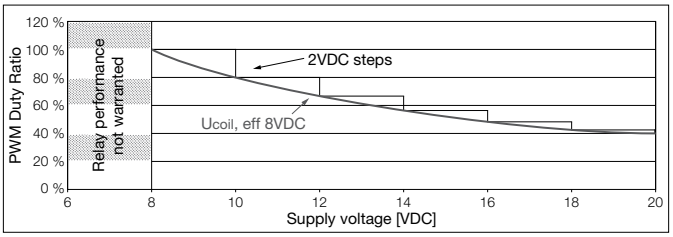


Figure 4: PWM duty ratio as a function of supply voltage with 2VDC step regulation

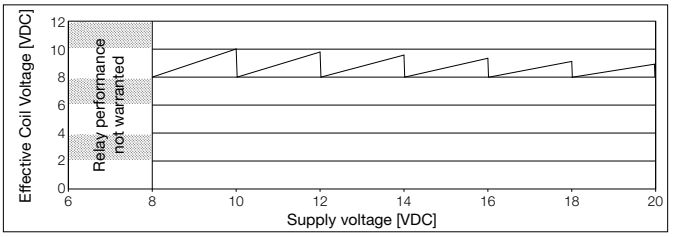


Figure 5: Effective coil voltage as function of supply voltage with 2VDC step regulation

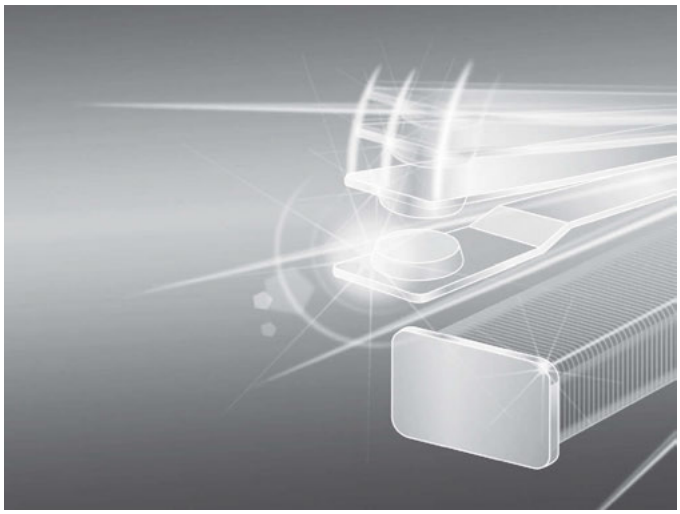
Disturbing Noises

The application of PWM voltage across the relay coil causes magnetostriction of the iron within the relay magnetic system (core/frame/armature). The result is a slight audible noise if the relay was freely suspended. However when the relay soldered or welded onto a rigid lead frame that noise might be amplified. This depends on the lead frame (suspension, dimension, etc.) and the sound propagation and damping within the car. Choosing 20kHz PWM avoids disturbing noises for human beings but might cause problems to animals.

EMC (Electromagnetic Compatibility)

Due to the steep voltage and current edges EMC problems are possible. Therefore electromagnetic compatibility tests of the whole unit are necessary.

Definitions



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Catalog and product specification according to IEC 61810-1 and to be used only together with the 'Definitions' section.

Catalog and product data is subject to the terms of the disclaimer and all chapters of the 'Definitions' section, available at http://relays.te.com/definitions

Catalog product data, 'Definitions' section, application notes and all specifications are subject to change.

Definitions (Continued)

General
While TE Connectivity and its affiliates have made every reasonable effort to confirm the accuracy of the information contained in datasheets and catalogs, TE Connectivity cannot assure that this information is error free. For this reason TE Connectivity does not make any representation or offer any guarantee that such information is accurate, correct, reliable or current or does not infringe any intellectual property rights. TE Connectivity reserves the right to make any adjustments to the information at any time.
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Technical data
Unless otherwise stated, the stated technical data are based on laboratory tests under standardized conditions and are within the conditions of normal use for these components. The vast number of influencing factors does not allow TE to test its products for all imaginable applications and processes. Furthermore, the large number of possible variations within a relay family makes it impossible to give a comprehensive description of the different characteristics for all variants in one datasheet. Typical data are derived from the standard versions.
The decision on the suitability of a specific component is solely responsibility of the user. To ensure the suitability of the product for a specific application the user has to test these products before the use under the most stringent conditions they will be exposed to in the actual application. Taking into consideration the aspects of operational availability and safety, the user has to rate the actual service life in an adequate relation to the expected life of the relay.
The use of the relay beyond its specified characteristics or beyond sufficiently tested life expectancy bears the risk of dangerous conditions; the user has to prevent such conditions by adequate measures, being entirely responsible in case of non-observance.

All product data are intended for users with knowledge and experience in the application of such specifications. The utilization is at the entire risk of the user.
The user has to verify the accordance with existing regulations and relevant standards for the application; in particular with reference to the insulation requirements as function of applied voltages and ambient conditions.
The standards (e.g. IEC 61810 'Electrical endurance') are based on the principal assumption of occurences of malfunctions such as malfunction to make contact, malfunction to break or as insufficient dielectric strength. Such malfunctions have to be taken into consideration and must not generate risks. Depending on the specific load, its characteristics and power in the contact set, a relay malfunction situation may generate various risks such as malfunction of the equipment and its controls, electrical shock, the risk of excessive heat and fire and others. It is in the entire responsibility of the user to provide for additional precautions against such possible effects according to the relevant application standards.
Protection against risks under all operation conditions even in case of malfunction can only be ensured by the design of the equipment as well as by application instructions for the end user; it is the responsibility of the manufacturer of the equipment to take the appropriate measures. Incorrect connections by the user may lead to risks, faulty operation and abnormal heating or fire. It is also the responsibility of the manufacturer of the equipment to take appropriate measures to avoid potential danger of electrical shock by preventing access to live parts of the relay including parts as terminals and accessories.

Specification
In order to improve performance and quality, we continuously develop our products. We reserve the right to change technical parameters and product specifications. The technical data listed are for description purposes of the components only and are not an agreement and do not guarantee specific characteristics and parameters; for detailed questions, please contact our application support. Drawings, photos data and descriptions are subject to change without prior notice.

Availability
The databooks and datasheets list a broad range of products and the descriptive part code structure (product code) does allow a large number of possible variations, but not all possible variations are defined as standard types in the current product portfolio (product code) and thus may not be included in the product range. Some products are normally maintained in stock for immediate delivery, or are available within 'normal leadtimes for industry'; however, there may be extended leadtimes for some non-stock items. Special versions to customer specifications may be supplied. Additionally, minimum quantity requirements apply and these requirements may differ from indicated packaging units. Please consult with your TE sales organization or authorized distributor regarding availability and minimum order requirements.
Right to change the availability and delivery conditions reserved.

'Definitions', datasheets, product data, application notes and all specifications are subject to change.

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TE Connectivity, TE connectivity (logo), TE (logo), TE Tyco Electronics (logo), AXICOM, OEG, P&B, Potter & Brumfield, PRODUCTS UNLIMITED and SCHRACK are trademarks.

Definitions (Continued)

AC-coil
Relays for direct energization with AC supply. If not otherwise stated, the data is given as V_{rms} for 50 Hz supply.

Adjacent contacts
Insulation parameters between two adjacent contact circuits (poles of a relay), which do not have a conductive connection. The level of insulation depends on the relays design, rated voltage and ambient conditions.

Ambient temperature (function, in operation)
The temperature in the vicinity of the relay (distance according to IEC 61810-1).The minimum ambient temperature is the miniumum operating temperature, the maximum ambient temperature is the maximum operating temperature for the use of the relay or accessory when operated. This temperature range should not be exceeded; within the indicated temperature range the ambient temperature does influence the electrical endurance. Ambient temperature range according to IEC 61810-1 and indicated in °C. Unless otherwise stated data is referred to an ambient temperature of 23°C.

Approvals
With the approval label the independent approval agency and/or test house confirms the compliance with the relevant product standards and/or certain product characteristics.

NOTE: the ordering code structure does allow a large number of possible variations, but not all variations are defined as standard types (ordering codes) and thus some relays may not be included in the list of approved relays. It is recommended that users also seek the pertinent approval files of the agencies/laboratories and review them to ensure that the selected product is filed and meets the requirements. Technical data and approved types on request.

	BEAB	British Electrotechnical Approvals Board, England
	CE	Conformité Européenne, marking for specific products relating to product safety in accordance to European Laws
	CQC	China Quality Certification Center, Peoples Republic of China
	CSA	Canadian Standards Association, Canada
	DEMKO	Danmarks Elektriske Materielkontrol, Denmark
	FIMKO	Sähkötarkastuskeskus Elinspektionscentralen, Finnland
	KEMA	Naamloze Vennootschap tot Keuring van, Electrotechnische Materialien, Netherlands
	LLOYD's	Lloyd's Register of Shipping
	NEMKO	Norges Elektriske Materiellkontroll, Norway
	ÖVE	Österreichischer Verband für Elektrotechnik, Austria
	SEMKO	Svenska Elektriska Materiellkontrollanstalten AB, Sweden
	SEV	Eidgenössisches Starkstrominspektorat, Switzerland
	TÜV	Technischer Überwachungs-Verein, Germany
	UL	Underwriters Laboratories, Inc., USA; UL Component Recognition Mark for the United States
	UL	UL Component Recognition Mark for Canada
	UL	UL Component Recognition Mark for the United States and Canada
	VDE	VDE-Prüfstelle, certificate of conformity with factory surveillance, Germany

Bandwidth
The range of frequencies for which the performance falls within the specified limits.

Bifurcated contact
See > 'Twin contact'.

Bistable relay, latching relay
In a bistable or latching relay the contacts remain in the last switching position once the coil input voltage is disconnected.
Bistable relays only require a short set respectively reset pulse and do not need any energization once the switching position changed. Unless otherwise stated the bistable relays can endure a permanent energization.
NOTE: for some relay series a permanent coil power supply is not permitted; in this case the maximum energization duration or the required coil power reduction is indicated in the respective datasheet.

Bistable relay, switching characteristics
In a bistable relay, the contacts remain in the last switching position after the input voltage is disconnected.
NOTE: Unlike monostable relays which return to their predefined contact rest state in case of power supply break down and thus might be showing a fail safe behaviour, bistable relays do not automatically return to such predefined position. Therefore the application and relay control has to be designed to cover such situations and bistable relays should not be used in applications that are rated according to ISO/TS 16949 7.5.3 'Product Identification and Traceability'.
NOTE: Even though the bistable relays are leaving production preferrably in reset contact position, the position of the contact (set position/reset position) is not defined at delivery unless otherwise stated. The user needs to check the contact position and to set/reset the relay to the required position.

Bounce
An unintentional phenomenon that can occur during the making or breaking of a contact circuit when the contact elements touch successively and separate again before they have reached their final position.

Bounce time
The time from the first to the last closing or opening of a relay contact. Unless otherwise stated the indicated times are maximum values and are for energization with rated voltage, without any components in series or parallel to the coil, and at reference temperature. Also see > 'Relay cycles' .

Breaking capacity max.
Product of the switching current and switching voltage (in W for direct current, in VA for alternating current). Also see > 'DC breaking capacity'

Bridging contact
Double contact configuration, where two movable contacts are mechanically connected and operate simultaneously. In a bridge configuration, the load current flows from one stationary contact via the bridge to a second stationary contact. See also table 'Contact arrangement'.
See > 'Form X contact', 'Form Y contact', 'Form Z contact'.

Definitions (Continued)

Category of protection (IEC 61810)
The ´Relay Technology Categories´ (IEC 61810) describe the degree of sealing of the relay case or its contact unit:

RT 0: unenclosed relay
Relay not provided with a protective case.
RT I: dust protected relay
Relay provided with a case which protects its mechanism from dust.
RT II: flux proof relay
Relay capable of being automatically soldered without allowing the migration of solder fluxes beyond the intended areas. These are the contacts, movable parts of the magnetic system and their immediate environment.
RT III: wash tight (washable) relay
Relay capable of being automatically soldered and subsequently undergoing a washing process to remove flux residues without allowing the ingress of flux or washing solvents.
The test to evaluate the sealing of the case for wash tight relays is performed according to the IEC 60068-2-17, Qc test.

NOTE - Please refer to the 'Processing' section for additional information.
In service this type of relay is sometimes vented to the atmosphere after soldering or washing process; in this case the requirements with respect to clearances and creepage distances can change.

RT IV: sealed relay
Relay provided with a case which has no venting to the outside atmosphere, and having a time constant better than $2x10^4$s in accordance with IEC 60068-2-17.
RT V: hermetically sealed relay
Sealed relay having an enhanced level of sealing, assuring a time constant better than $2x10^6$s in accordance with IEC 60068-2-17.

Changeover contact, CO contact
See > 'Form C contact, CO contact, changeover contact'

China RoHS compliance
See > 'Material substance specification' on TE's Website:
www.te.com/customersupport/rohssupportcenter.

Clearance distance
Shortest distance in air between two conductive parts or between a conductive part and the accessible surface of the relay.

Coil data
The coil data is specified according to IEC 61810-1.
Unless otherwise indicated the data is given for
- ambient temperature 23°C,
- coil temperature equal to ambient temperature (cold coil, without pre energization),
- 50Hz for AC supply,
- no other devices (e.g. diode) in parallel or in series to the coil
- single mounting of relays.

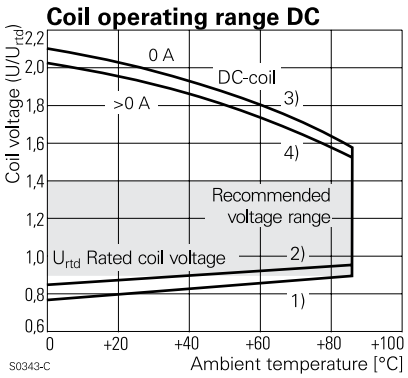
Indicated data for the operative range class, is given for the minimum allowed mounting distance.
Unless otherwise stated a duty factor of 100% (permanently operated) is permissible.

Coil inductivity
The inductivity is a nonlinear parameter due to saturation effects and depends, amongst others, on the position of the armature. The value of the relay coil inductivity depends on the measurement method and its parameters. Therefore the inductivity is not a generally guaranteed parameter; for technical questions, please contact our technical support.

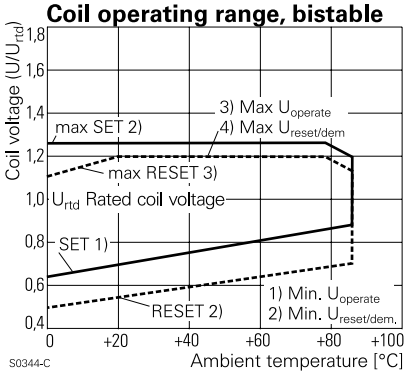
Coil insulation system according to UL1446
These requirements cover test procedures to be used in the evaluation of electrical insulation systems intended for connection to branch circuits rated 600V or less. This standard refers to insulation systems and does not cover individual insulating materials.

Coil Operative range (graph)
Admissible range of energizing voltage with respect to the ambient temperature. The upper limit is the maximum coil voltage, the lower limit is the operate voltage U_{min} (coil without pre-energization) and/or the operate voltage U_1 (pre-energized coil).
The diagrams are valid for single mounting of relays without thermal interference and connection wiring according to IEC 61810-1; unless otherwise stated the data is indicated without contact load, thus not taking into account the temperature rise due to the contact current.
The use of a relay with an energizeing voltage other than the rated coil voltage may lead to reduced electrical life (mechanical and dynamic effects).
In case the application requires an energization with other than the rated coil voltage and a recommended voltage range is indicated, the coil voltage should be within the recommended voltage range (shaded area) to keep the effects on electrical life to a minimum.

curve 1: operate-/minimal voltage U_0 (without pre-energization)
curve 2: operate-/minimal voltage U_1 (pre-energized coil)
curve 3: maximum voltage at contact current = 0 A
curve 4: limiting voltage U_2 at rated contact current I_{rated}
recommended voltage range (shaded area):
the coil voltage should be within the recommended voltage range to keep adverse effects on electrical life to a minimum.



Coil operative range for bistable relays
curve 1: operate voltage at coil temperature equal to ambient temperature
curve 2: minimum reset voltage
curve 3: maximum operate voltage
curve 4: maximum reset voltage
For bistable relays, all curves are given for pulse energization (short energization duration).



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Definitions (Continued)

Coil power
Power consumption of the coil at rated coil voltage and coil resistance, with coil temperature at 23°C, given as rated typical value.

Coil resistance
Electrical resistance of the relay coil at reference temperature; this value is indicated for the coil without any other devices in parallel (e.g. coil suppression, diode, etc.).

Coil suppression circuit
Circuit to reduce the inductive switch off voltage peak of the relay coil (EMC protection, switch off voltage peak). Most of such circuits reduce the armature release speed, which may decrease the relay lifetime, especially valid for diodes in parallel to the coil.
Note: unless otherwise specified the indicated relay data refers to coils without any components in parallel or in series to the coil.

Coil voltage
Voltage applied across the coil terminals.

Coil voltage range
Voltage range at which the relay displays the operating characteristics. These specified operating characteristics are given for a constant DC supply or sinusoidal AC supply. Other operating conditions (e.g. pulse control, ramp voltage, half wave rectifying, etc.) may lead to characteristics other than specified.

Coil-contact circuit data
Insulation parameters between the coil system and the contact circuit/system.

Combination of relay and socket, insulation requirements
The relay standard IEC 61810-1 has an important impact on the combination of a relay and the respective socket. The relay sockets have to comply with the requirements of IEC 61984 and the insulation reqirements of the IEC 61810-1. Even if the socket alone fullfills or exceeds the insulation reqirements as clearance/creepage for the relay, the combination of a relay with a socket may reduce the creepage and lead to a lower rated insulation voltage. Hence restrictions for the combination relay-socket may be the consequence, e.g. a reduction of the voltage range or of the pollution degree. Especially for miniature multi-pole relay and respective sockets with small distance between the contact circuits, these restrictions have a big impact.
Apart from the insulation properties, the thermal characteristics of the combination relay and socket are of utmost importance (see > 'Derating curves'). As sockets from different sources are not directly comparable, the compliance with the technical specification can only be confirmed for an approved combination relay-socket. As design details and characteristics for non TE products are beyond our control, confirmations for technical parameters and characteristics regarding such combinations is not possible. Risks as reduced dielectric strength, fire hazard, etc. due to use based on unclear or omitted data, limitations or restrictions must not be underestimated.
NOTE: We only confirm the characteristics and parameters for the approved combinations of relays and sockets as indicated in the catalog and datasheets.

Contact arrangement
Different applications require specific switching functions of the relay contacts; various contact arrangements are specified and described in different ways.

The most common are:

	Form description	Short description	NARM designator	Circuit symbol
Make contact	Form A	NO	SPST-NO	
Break contact	Form B	NC	SPST-NC	
Changeover contact	Form C	CO	SPDT	
Double make on armature	Form U		SPST-NO DM	
Double break on armature	Form V		SPST-NC DB	
Double make contact	Form X		SPST-NO DM	
Double break contact	Form Y		SPST-NC DB	
Double break, double make contact	Form Z		SPDT-NC-NO DB-DM	
Triple make contact	Form 3			

Examples for descriptions of multi- pole configurations:

Multi pole configurations	Form description	Short description	NARM designator	Circuit symbol
2 Make contacts	2 Form A	2 NO	DPST-NO	
3 Break contacts	3 Form B	3 NC	3PST-NC	
4 Changeover contacts	4 Form C	4 CO	4PDT	

Abbreviations
NO: normally open, NC: normally closed, CO: changeover
SPST: single pole, single throw, SPDT: single pole, double throw, DPST: double pole, single throw

Contact current
See >
- 'Rated current'
- 'Limiting making current'
- 'Limiting continuous current'
- 'Limiting short-time current'
- 'Limiting breaking current'.

Contact gap
Shortest distance between the open contact points.

Contact material
The list gives an overview of the most important plating- and contact materials and their use in signal-, automotive and general purpose relays.
The switching capacity of the contacts and the respective electrical endurance depends not only on the contact material but also to a high degree on the relay design. Decisive for the application therefore is the optimal combination of the mechanical system and the contact material. The characteristics for certain relay types cannot be transferred to other designs, nor can these values be used as given limits for existing products.

Definitions (Continued)

1) Plating materials:
Fine gold
- best corrosion resistance, not used as solid material because too soft, high tendency towards cold-welding, not used or only used in combina tion with a material with resistance against cold welding. Gold alloys (AuNi, AuAg, AuPd, AuCo)
- gold platings ≤ 1 µm (hv), only as storage protection, no protection against aggressive atmosphere. Hard gold plated (htv)
- very good corrosion resistance, low and stable contact resistance at lowest loads, low tendency to cold welding
- dry-circuit switching (switching without current/voltage), recommended range of application ≥ 1 V, 1 mA, 50 mW.

2) Contact materials:
Silver-Palladium
- high resistance against material transfer in signal DC circuits, low wel ding tendency, higher contact resistance than Ag
- circuits with medium loads, DC- and AC-circuits, recommended for telecommunication applications.

Palladium-Ruthenium
- highest resistance against material transfer in signal DC-circuits, low welding tendency, higher contact resistance than Ag
- circuits with medium loads, DC- and AC-circuits, recommended for telecommunication applications.

Silver-Nickel AgNi90/10
- high resistance against electrical wear, low welding tendency, higher contact resistance than AgNi0.15
- circuits with medium to high loads, DC- and AC-circuits, recommended range of application ≥ 12 V, 10 mA.

Fine-grain silver AgNi0.15
- relatively low contact resistance, low resistance against aggressive atmosphere
- universally applicable in medium and low load range, especially in DC-circuits, recommended range of application ≥ 12 V, 10 mA.

Silver-Tin-Oxide $AgSnO_2$
- low welding tendency, high wear resistivity with heavy loads, low mate rial transfer
- circuits with high requirements to make- and break currents, DC- and AC loads, recommended range of application ≥ 12 V, 100 mA.

Tungsten W
- highest melting point, for high switching rates and low ON-time
- as prerun contact in circuits with highest make loads.

Silver-Cadmium-Oxide AgCdO
- compliant with RoHS directive (Directive 2002/95/EC) only under time limited exception, therefore not recommended for new designs
- low welding tendency, high wear resistance
- for switching of inductive loads, AC-circuits, ≥ 12 V, 100 mA.

Contact materials for the use in automotive applications:

Current range	Automotive load type (DC load)	Recommended contact material
Switching and carrying 0.5 A < I < 10 A at 12 V	In low power applications	AgNi0.15 or $AgSnO_2$
Periodical switching and approx. 10^6 ops, 1 A < I < 10 A at ≥ 12 V	Long-life indicator switches	$AgSnO_2$
Switching and carrying I > 10 A capacitive load	Lamps, Capacitors	$AgSnO_2$
Switching and carrying I > 10 A resistive and inductive load	Motors, Valves	AgNi0.15 or $AgSnO_2$
Switching high inrush I > 100 A	Lamp (e.g. H4), Spark plugs, short circuit	$AgSnO_2$ in special cases: AgNi20 or Tungsten pre-contact

Contact protection circuits
The effect of an electrical arc causes primarily local contact erosion resulting in contact wear and migration and as secondary effect the generation of adverse atmosphere inside the relay (see > 'Electrical arc' and 'Vent hole' in processing section). These effects eventually lead to the end of the useful life of a relay. To reduce the negative effect of the electrical arc and thus prolong the life of a relay, contact protection circuits are recommended. This is especially important for switching of DC applications (e.g. automotive applications). The user has to ensure the correct design of the protection circuit in the respective application, as unless designed correctly, the protection circuit may even generate adverse effects.

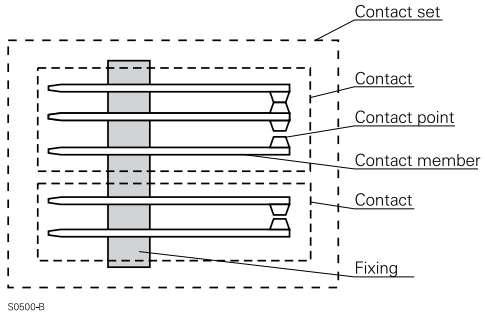
Contact rating
In context of our datasheets this term is primarily used in context with ratings as tested/approved by external approval agencies whereas the term 'electrical endurance' is used primarily for internal test results. See > 'Electrical endurance'.
Indicated contact ratings for direct wiring of relays (according IEC 61810-1); for relays mounted on sockets or when using connectors deratings may apply.

Contact resistance
Electrical resistance between the relay terminals of a closed contact, measured with indicated measuring current and indicated source voltage. The specified contact resistance is reached reliably only above a particular load. Considerably increased contact resistances can occur with smaller loads. After a prolonged period of a steady state operate/release position or storage of the relay a certain number of cycles are recommended before measurement of the contact resistance.
According to IEC 61810-7 the following measurement parameters are applied (for general purpose relays category CC2 is applicable):

Category	Load		Measurement	
	V	A	V	A
CC0	0.03	0.01	0.03	0.01
CC1	without electrical arc		10	0.1
CC2	with electrical arc		30	1

Contact style
On one side indicates the design of the contact point itself , see >
- 'Single button contact'
- 'Twin contact, bifurcated contact'
  indicating the contact function, see >
- 'Forcibly guided contact'
  as well as the total configuration of the contacts within a relay
- number of poles and
- contact arrangement (see > 'Contact arrangement').

Contact terms



Creepage distance
Depending on the insulation design, usually the shortest distance along the surface of the insulating material between conductive parts according to IEC 61810-1.

Cross talk
Signal interference between adjacent conductors caused by the pick-up of stray energy.

Definitions (Continued)

CTI
See > 'Tracking index'.

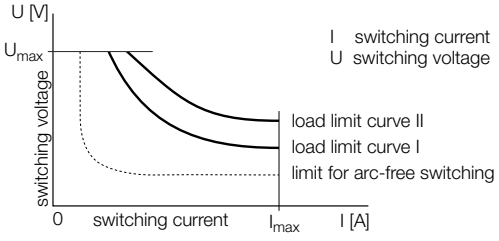
Cycle
Operation/set and subsequent release/reset of a relay.

Cycle time
Sum of ON and OFF time (make, break and bounce time) of a contact. See also > 'Duty factor'.

dBm
Relative measure of signal power where the reference 0 dBm is equal to one milliwatt. See also > 'Decibels'.

DC breaking capacity
Switching of loads at voltage and current below the max. DC load breaking capacity curve is possible for a limited number of switching operations, the arc is extinguished. Unless otherwise stated, the indicated curves in the DC breaking capacity diagram represent the load limit curve II (the arc extinguishes within 10ms at resistive load). The breaking capacity curve is affected in both position and shape by the contact material and relay design (contact distance, break speed of the contacts, etc.). No statement on the electrical endurance can be derived from these curves. For practical use it is recommended to keep a distinct margin from the DC load breaking capacity curve.

- Load limit curve (II) The switching arc for loads below this curve extinguishes within 10 ms (the relay is already in release position). Un less otherwise stated the indicated curve for DC breaking capacity relates to the load limit curve II
- Load limit curve (I) The switching arc of loads below this load limit curve extinguishes during the transit time of the moving contact. This limit is especially important for change over relays, when the NC and NO contacts are at different voltage levels; if the arc does not extinguish before reaching the other contact, the arc will establish a short circuit, a situation that may lead to the destruction of the relay and equipment.
- Load limit curve for arc-free switching. Load voltage/current combina tions below this load limit curve in general cause no arc or an arc with max. duration of 1ms.
  Unless otherwise stated the curves in the graphs refer to a 'load limit curve II'.



Decibel, dB
A relative and dimensionless unit calculated as ten times the logarithm to the base of 10 of a power ratio.

Degree of protection (IEC 60529)
Degrees of protection provided by enclosures (IP Code) for electrical equipment.
Under certain circumstances this data is relevant for industrial relays and accessories. For relays as components (e.g. PCB relays) the IP classification is generally not used, see > Category of protection; there is no direct correlation between the IP-code and the RT-category, see > Category of protection.

Definition of degree of protection (IP code) IEC 60529 outlines an international classification system for the sealing effectiveness of enclosures of electrical equipment against the intrusion into the equipment of foreign bodies (i.e., tools, dust, fingers) and moisture. This classification system utilizes the letters IP (Ingress Protection) followed by two digits.

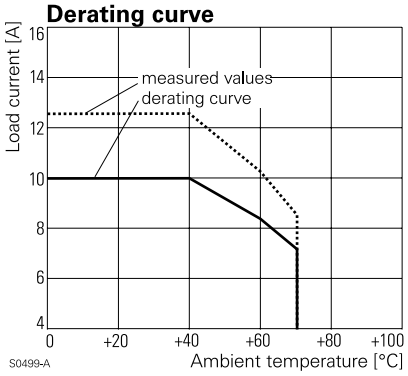
Degree of protection - First digit:
The first digit of the IP code indicates the degree that connection is protected against contact with moving parts and the degree that equipment is protected against solid foreign bodies intruding into an enclosure.

0 No special protection
1 Protection from a large part of the body such as hand or from solid objects greater than 50 mm in diameter
2 Protection against objects not greater than 80 mm in length and 12 mm in diameter
3 Protection from entry by tools, wires, etc., with a diameter or thickness greater than 2.5 mm
4 Protection from entry by solid objects with a diameter or thickness greater than 1.0 mm
5 Protection from the amount of dust that would interfere with the operati on of the equipment
6 Dust-tight.

Degree of protection - Second digit:
Second digit indicates the degree of protection of the equipment inside the enclosure against the harmful entry of various forms of moisture (e.g. dripping, spraying, submersion, etc.)

0 No special protection
1 Protection from vertically dripping water
2 Protection from dripping water when tilted up to 15°
3 Protection from sprayed water
4 Protection from splashed water
5 Protection from water projected from a nozzle
6 Protection against heavy seas, or powerful jets of water
7 Protection against temporary immersion
8 Protection against complete continuous submersion in water (up to 1 meter deep for 15 minutes).

Derating curve (sockets and relay-socket sets)
EN61984:2001 table 12: according to this standard the derating curve given for a specific combination relay-socket and its accessories - indicates the maximum permissible continuous current (limiting continuous current) of a socket, loaded on all contact circuits, unless otherwise stated supplied with rated coil voltage, over the entire temperature range, measured in dense packing (usually 3 relay-socket sets).
In case of reduced duty factor of the contact load or with higher mounting distance up to single mounting, a higher load current is permissible. Please contact our technical support for specific data. According to the standards the derating curve is derived from the measured curve by applying a reduction factor of 0.80.



Other standards: the test conditions (e.g. UL508) differ from the EN standard, hence under these conditions other temperature/current combinations may be permissible; please contact our technical support for details.
In case no derating curves are given, the indicated temperature and load current refer to the approved standards for the specific product and not to the EN61984.

Definitions (Continued)

Dimensions
Dimensions are indicated in mm and/or inches and are shown for reference purposes only.
PCB pin dimensions are indicated without solder (pre-tinning).

Dimensions, drawings
Technical drawings for product dimensions are using both ISO projections (ISO Method E or ISO Method A) according to ISO/R 128. In cases of ambiguity the projection is defined by the respective international symbol (see below).


ISO Method E projection - symbol


ISO Method A projection - symbol

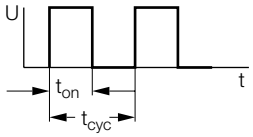
DIN-rail
Unless otherwise stated, our products for DIN-rail mounting are designed and tested for DIN-rails according to TH35-7.5 / EN60175.
Use of other rails (e.g. according to TH35-15) is neither tested nor approved.
When mounting the sockets on a DIN-rail, assembling the socket accessories and mounting/dismounting relays provide an adequate temperature (unless otherwise stated -10°C to +40°C) during the mounting process.

Drop test, free fall
Relays are dropped from a specified height onto a solid ground; this simulates the resistance to bad handling e.g. fall from a table. The test is to verify that the component meets its specification. However we strongly recommend to scrap dropped relays.

Dry switching
Defined as contact category 0 (CC0) according to IEC61810-1: a contact characterized by a maximum contact voltage of 30mV and a maximum contact current of 10mA. See also chapter 'Testing / diagnostics of relays'.

Dust-proof relay
Relay with a case to protect against penetration of dust. See > 'Category of environmental protection (IEC 61810)' - RT I.

Duty factor, duty cycle
Ratio of the duration of energization to the total period in which intermittant or temporary operation of the relay place. Duty factor is expressed as percentage of the total period at a specified frequency of operation; e.g. 30% duty cycle means that the relay is operated for 30% during a cycle time.



$$df = \frac{t_{on}}{t_{cyc}} \times 100\ (\%)$$

df	Duty factor
t_{on}	On time
t_{cyc}	Cycle time

Electrical arc
Is an electric phenomenon caused by plasma current flow between opening and closing relay contacts. An arc is generated by the electric energy of the load circuit (turn off spark) or the voltage gradient at closing contacts, ionizing the gas between the contacts and thus establishing an electrical conductive path. The stability of the arc depends on various parameters such as contact material, air pressure, contact gap, etc.
Apart from positive effect of the electrical arc as limitation of overvoltage when switching of inductive loads, reduction and dissipation of electrical load energy and electrical cleaning of contact surfaces, the arc locally produces high temperature and causes contact erosion (also see > 'contact protection circuits'). Special consideration has to be given to DC and high frequency AC-circuits where, depending on the conditions (e.g. contact gap) an arc of extended or infinite duration could occur; in this case the relay may be destroyed due to the extreme thermal stress. Also the switching of different voltages with a generation of an electrical arc and the switching of reverse polarity on adjacent contact circuits of a multi-pole relay may lead to non-extinguishing arcs.

Electrical endurance
Number of cycles a relay can perform with electrical contact load defined under specified conditions according IEC 61810-1 and IEC 61810-2. Unless otherwise specified the electrical endurance refers to:
- NO contact
- AC mains, 50 Hz for general purpose relays (schematic for contact loading A) ; 12 VDC for automotive relays
- duty factor 50%
- rated frequency of operation
- resistive load
- rated voltage (coil)
- contact opening and/or closing not synchronized to line frequency
- ambient temperature 23°C
- no failsafe behaviour (see > 'Failsafe')
- category of protection RTII - flux proof
- individual mounting of relays without thermal interference and connec tion wiring according to IEC 61810-1, table 12.
- relay in upright position (terminals of a print relay pointing downwards).
- direct wiring of relays (according IEC 61810-1); for relays mounted on sockets or when using connectors deratings may apply.

Unless otherwise stated, the electrical endurance is specified according to severity level B according IEC 61810-2. For relay failure modes see also > Failure criteria. Any use beyond the specified electrical endurance is not in scope of the specified data, the avoidance of such situation requires consideration by the user.

Electrical endurance graph
The electrical endurance graph indicates the typical electrical endurance with resistive load and 250 VAC rated voltage as “Mean Cycles to Failure” (MCTF) according Weibull distribution. These statistical data do not guarantee a minimum value; this data can be used to estimate the MCTF value.
Please note:
- the graph for electrical endurance is only valid for the indicated contact material (in case no contact material is specified, it is valid for the con tact materials as listed in the respective datasheet), it is not permissible to deduce electrical endurance information for other contact materials.
- it is not permissible to deduce electrical endurance information by extra polation beyond the range indicated by the curve. This applies especially to the range below 0.5 A as at this level the contact wear is small and other failure modes are dominant.
  For details please contact our technical support. Also see > 'Electrical endurance'.

ELV compliance
See > 'Material substance specification' on TE's Website:
www.te.com/customersupport/rohssupportcenter.

Endurance
Electromechanical components as relays, are subject to wear (mechanical and electrical). For the reliability the typical bath-tub curve applies, hence singular statistical failure events below typical reliability values may occur.

Environmental data and tests
Relays undergo extensive environmental tests. The selection of tests depends on the product group and the intended application fields; e.g. for automotive relays, common environmental tests are:
- cold storage test, IEC 600 68-2-1
- dry heat, IEC 600 68-2-2
- climatic cycling with condensation. EN ISO 6988
- temperature cycling, IEC 600 68-2-14 Na (shock), IEC 600 68-2-14 Nb
- damp heat cycling, IEC 600 68-2-30 Db variant1
- operational humidity, IEC600 68-2-38
- corrosive gas, IEC 600 68-2-42
- flowing mixed gas corrosion, IEC 600 68-2-60 Ke method 54
- drop test, free fall, IEC 600 68-2-32.

Environmental endurance
Generic term for the relay endurance under different climatic conditions. Appropriate test conditions are classified in IEC 60068.

Definitions

Failure criteria
Set of rules used to decide whether an observed event constitutes a failure. A contact failure is the occurence of break and/or make malfunctions of a contact under test, exceeding a specified number.

Failure mode
The IEC 61810 defines a relay failure as occurrence of malfunctions, exceeding a specified number:
- malfunction to make
- malfunction to break (contact bridging on a CO contact as a special form of malfunction to break), or as
- insufficient dielectric strength.

Such malfunctions have to be taken into consideration and must not generate risks. Depending on the specific load, its characteristics and power in the contact set, a relay malfunction situation may generate various risks such as malfunction of the equipment and its controls, electrical shock, the risk of excessive heat and fire and others. It is in the responsibility of the user to provide for additional precautions against such possible effects according to the relevant application standards.
Standards (e.g. IEC 695-1-1'Guidance for assessing fire hazard of electrotechnical products') are based on the principal assumption of heating effects and risk of fire in case electrical currents of certain magnitude being conducted and switched. Our relays are manufactured with self extinguishing plastics corresponding to the up-to-date technology and standards requirements. Protection against excessive heat and possible spread of fire under all operation conditions even in case of malfunction can only be ensured by the design of the equipment as well as by application instructions for the end user; it is the responsibility of the manufacturer of the equipment to take the appropriate measures. Incorrect connections by the user may lead to risks, faulty operation and abnormal heating or fire. It is also the responsibility of the manufacturer of the equipment to take appropriate measures to avoid potential danger of electrical shock by preventing access to live parts of the relay including parts as terminals and accessories.
NOTE: Relays normally do not have a failsafe behaviour. See > 'Failsafe'

Failsafe
Failing behaviour with definite failing characteristic, e.g. component always fails with contacts do not open. Electromechanical relays normally do not have a failsafe behaviour

Flux proof/suitable for processing on soldering lines
See > 'Category of environmental protection (IEC 61810)' - RT II.

Force guided contact
Contact configuration according to EN 50205 with at least one NO contact, one NC contact and a mechanically linked system, designed that the NO and NC contacts within the complete contact set are never closed at the same time, even in case of malfunction. These relays are implemented in the control of safety technology for the protection against damage to persons or objects.
See > 'Relays with force guided contacts'.

Form 3 contact, triple make contact
Three make contacts configuration with three electrically connected movable contacts operating simultaneously. There is no external connection to the armature. See also table 'Contact arrangement'.

Form A contact, NO contact, normally open contact
A contact that is open when the relay is in its release condition (unenergized position for monostable relays) and which is closed when the relay is in its operate condition. For circuit schematic see table 'Contact arrangement'.

Form B contact, NC contact, normally closed contact
A contact that is closed when the relay is in its release condition (unenergized position for monostable relays) and which is open when the relay is in its operate condition. For circuit schematic see table 'Contact arrangement'.

Form C contact, CO contact, changeover contact
Compound contact consisting of Form A (NO, make) contact and a Form B (NC, break) contact with a common terminal. On changing the switch position, the contact previously closed opens first followed by the closing of the contact that was previously open. For circuit schematic see table in 'Contact arrangement'.
Note: in case of a switching arc the NO and NC contact may be temporarily electrically connected.

Form U contact
Two make contact configuration, with two electrically connected movable contacts which operate simultaneously. As special version main contact with pre-contact. See also table 'Contact arrangement'.

Form V contact
Two break contact configuration, with two electrically connected movable contacts which operate simultaneously. See also table 'Contact arrangement'.

Form X contact
Two make contact configuration with two electrically connected movable contacts operating simultaneously. There is no external connection to the armature. Also called bridge contact.

Form Y contact
Two break contact configuration with two electrically connected movable contacts operating simultaneously. There is no external connection to the armature. Also called bridge contact.

Form Z contact
A contact configuration with
- two make contacts and
- two break contacts

with two electrically connected movable contacts each operating simultaneously. There is no external connection to the armature. Also called bridge contact.

Frequency of operation
Number of operation cycles (opening and closing of contacts) per unit of time. The switching rate is usually indicated for switching under rated load; unless otherwise stated at ambient temperature 23°C and without any circuitry in parallel to the coil (no coil suppression circuit, e.g. diode). With contact loads considerably below rated load a higher frequency of operation may be admissible. This has to be tested for the specific application. For further assistance please contact our application support.

Full disconnection
Contact separation for the disconnection of conductors so as to provide the equivalent of basic insulation between those parts intended to be disconnected. NOTE: there are dielectric strength and dimensional requirements regarding the relay design but also referring to the connection, wiring and design on the outside of the relay.

Halogen content
See > 'Material substance specification' on TE's Website:
www.te.com/customersupport/rohssupportcenter.

Immersion cleanable/sealed relays
See > 'Category of protection (IEC 61810)' - RT III.
Relays which are sealed against the penetration of specified PCB cleaners or protection lacquers; for more information refer to chapter 'Processing Information'.

Impedance, Z0
Characteristic property of a transmission line describing the ratio between electric and magnetic fields.

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Definitions (Continued)

Industrial relays and accessories
Relays and accessories are designed for use in closed and electrically secure switching cabinets. In these applications lower standard requirements of the insulating properties of components could apply.
CAUTION: These products are to be handled by trained personnel only.

Initial contact resistance
Contact resistance measured at the time of production/final testing. Prolonged storage and adverse environmental conditions (e.g. gases) can lead to increased resistance values. The effect of electrical cleaning due to sufficient load can bring the contact resistance back to lower levels.
See > 'Contact resistance'.

Initial dielectric strength
Voltage (rms value in AC voltage, 50 Hz 1 min) the insulation can withstand between relay elements that are insulated from one another, measured at the final production test.

Initial insulation resistance
Electrical resistance (initial product condition) measured by applying a DC voltage of 500 V between two elements of a component that are insulated from one another as measured at the final production test.
The requirements according to IEC 61810-1 are:
- for functional insulation > 2 MOhm
- for basic insulation > 2 MOhm and
- for reinforced insulation > 7 MOhm.

Initial pulse withstand voltage, initital surge voltage resistance
Amplitude of a voltage impulse of short duration with a specified impulse form (e.g. 1.2/50µs) and polarity applied to test insulation paths in a relay, especially where relays are subject to overvoltage situations (e.g. effects of lightning).

Insertion cycles
The symbol A indicates that the insertion and extraction must be done without any load current on the relay/socket contacts.
Unless otherwise stated the accessories are designed for max. 10 insertion cycles, insertion and extraction without load; A (10).

Insertion loss
The loss in load power due to the insertion of a component at some point in a transmission system. Generally expressed in decibels as the ratio of power received at the load before insertion of the apparatus to the power received at the load after insertion.

Insulation
Unless otherwise stated, the insulation characteristics are indicated for the relay component, the design of the application, mounting and wiring also has to provide for required insulation properties.
In general, the relays are designed to be used within enclosures; the relay surfaces are not to be accessible for direct contact by the end user. Specific insulation requirements of the equipment and protection egainst environmental effects need special consideration.

Jump start test
Short time relay use at higher system voltages (like car start after flat vehicle battery).

Latching relay
See > 'Bistable relay'.

Limiting breaking current
The max switching current the contact is intended to break under specified load conditions. The switching current must not exceed the indicated rated current. For DC switching also see > 'DC breaking capacity'.

Limiting continuous current
Is the highest steady state load current a relay or an accessory can withstand continuously while satisfying specified temperature rise requirements; it is identical with the limiting continuous thermal current I_{th}.
NOTE that this is not necessarily the current that can be switched over the specified lifetime. Unless otherwise stated the data for relays is given under following condition: all contacts equally loaded with the respective current, input voltage 110% of nominal coil voltage, max ambient temperature, minimum allowed mounting distance, test conditions according to the heat test arrangement IEC EC 61810-1 Annex B. In combinations with accessories/ sockets the limiting continuous current is specified by the derating curve (see > 'Derating curve').

Limiting making current, inrush current
The limiting making current expressed as a current with a power factor of 1.0 (resistive load) a contact is able to make under specified conditions; for 20 ms data expressed as peak value, for 4 s data expressed as rms value. Unless othwerwise stated the data refers to the Form A contact (NO contact), rated voltage and a current for a duration of max. 20 ms for at least 100 cycles or 4 s with duty factor of 10%.
Inrush current for some loads can be significantly higher than its specified steady state current. For these load types the inrush current has to be within the limits for the limiting making current. Typical examples for loads with high inrush currents are all type of lamps (incandescent, halogen, fluorescent, etc.) as well as motors, solenoids, transformers and capacitive loads.

Limiting short-time current, Overload current
This test is done to confirm, that our relays withstand normal overload conditions, e.g. withstand short circuit conditions until a fuse opens.

For automotive applications, current and time are compatible to circuit protection by a typical automotive fuse according to ISO 8820-3 (2002) as shown in the table below. Relay will carry the specified currents at 23°C (Irated = rated current as given in contact data section for each relay).

Test current in A	Operating time in seconds	
	Minimum	Maximum
6.00 * I_{rated}	0.02 s	0.20 s
3.50 * I_{rated}	0.08 s	0.50 s
2.00 * I_{rated}	0.25 s	5.00 s
1.35 * I_{rated}	0.75 s	1800 s
1.10 * I_{rated}	100 h	No requirement

For mains fuses and fuses other than automotive, customers have to refer to the respective standards (mains condition, prospective short circuit, etc.) to test for their application.

Limiting voltage (coil)
The highest permissible input voltage (coil voltage) at the reference temperature at which the relay, with continuous energization and, unless otherwise stated under rated contact load, heats up to its max. permissible coil temperature.

Load dump
Short relay use at overvoltage (disconnection of the battery during running engine).

Load dump test
Short relay use under overvoltage conditions (simulated disconnection of the battery with charging alternator).

Magnetic system
Magnetic systems can be categorized by the switching characteristic
- monostable relays return automatically to the rest position (release state) after the coil is de-energized.
- bistable relays maintain their switching position after the energization or input voltage is disconnected. See > bistable relays and the design of the magnetic circuit:
- neutral (non-polarized) relays operate independently of the polarity of the applied voltage (coil voltage)
- polarized relays use an additional magnet within the magnetic circuit and therefore only operate with a specific polarity of energization.
- remanent bistable relays adopt a particular switching position following an energizing direct current in any direction and are then held in this position by the remanence in the magnetic circuit.

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Definitions

Make-before-break contacts
Contact mechanism where Form A contacts (normally open contacts) close before Form B contacts open (normally closed contacts).

Material group of insulation parts
Categorization of insulation materials according to their tracking indices, according to IEC 60664-1.

Material substance specification
For material information regarding ELV, China RoHS compliance, European RoHS compliance, Halogene and REACH refer to product specific information on TE's Website: www.te.com/customersupport/rohssupportcenter.

Max. coil power
The highest permissible input power at the reference temperature at which the relay, with continuous energization, heats up to its max. permissible coil temperature. Unless otherwise stated the data is indicated without contact load.

Max. coil temperature
As general term refers to the max. approved coil temperature, measured by change of resistance method.
UL classifies max. coil temperatures according to UL1446; this standard refers to insulation systems and does not cover individual insulating materials:
- class B - max. 130°C
- class F - max. 155°C.

Maximum energization duration
Maximum duration a coil may be energized with rated DC voltage; energization beyond the indicated duration will overheat the coil system and the relay.

Max. insertion force total
The force during the insertion of the relay into the socket has to be applied in insertion direction (no tilting) and equally on all connections. The maximum applied force must not exceed the indicated max. insertion force.

Max. operate/reset duration
Maximum duration a bistable coil may be energized with rated DC voltage.

Max. switching voltage
Maximum voltage that may occur between the switching contacts before closing or after opening the contact. Data given for AC refer to V_{rms} in a mid-point earthed 3-phase supply system.

Maximum energization duration
Maximum duration a coil may be energized with rated DC voltage; energization beyond the indicated duration will overheat of the coil system and the relay.

Maximum voltage (coil), U_{max}
The highest permissible input voltage (coil voltage) at the reference temperature at which the relay, with continuous energization and without contact load, heats up to its max. permissible coil temperature.
Also see > 'Limiting voltage'.

MCTF - Mean cycles to failure
Expected value of the distribution of operations to failure, average number of operations according to Weibull.

Mechanical endurance
Number of cycles without contact load during which the relay remains within the specified characteristics.
NOTE that the failure criteria for mechanical endurance are not the same as for electrical endurance, therefore the value for mechanical endurance has no relation and cannot be directly compared to electrical endurance for very low loads!

Mechanical life
See > 'Mechanical endurance'.

Minimum energization duration
Minimum duration the coil needs to be energized with rated DC voltage. Unless otherwise stated the proposed minimum energization duration is 100 ms.

Minimum recommended contact load
The minimum contact load a relay can reliably switch/carry depends on the relay design and used materials; there is no physical limit as for the definition of a minimum switching voltage or current. The indicated value is a recommendation, it is influenced by switching frequency, required contact resistance and its stability over time and ambient conditions. Low contact resistance is reached reliably only above a particular load, considerably increased contact resistance can occur with lower loads.
- Signal relays are capable to carry and switch minimum contact loads in the range of the thermoelectric potential which is approx. 100µV.
- General purpose relays are designed for category CC2 loads according IEC61810; basically these relays are designed for switching loads with the effect of switching arcs. Specific insulation requirements however may call for the use of general purpose relays in applications with low signal loads or for dry switching (switching without the generation of an electrical arc).

NOTE that increased contact resistance may occur if the load conditions are not in scope of the test conditions for category CC2 according IEC61810.
Also see the minimum contact loads recommended for the different contact materials.
- Automotive relays usually are switching higher DC loads with switching voltages above the fritting voltage and with switching power within the contact cleaning effect of an electrical arc.

Minimum recommended switching power
Product of switching current and switching voltage for reliable switching. Low contact resistance is reached reliably only above a particular load, considerably higher contact resistances can occur with smaller loads.

Minimum set/reset duration
Minimum duration a bistable coil needs to be energized with rated DC voltage.

Minimum voltage (coil)
For
- monostable relays see > 'Operate voltage'
- bistable relays see > 'Set voltage' and 'Reset voltage'.

Monostable, neutral relay, non-polarized relay, polarized relay
A relay is called monostable when its contacts return automatically to the rest position (release state) after the coil is de-energized.
Non-polarized relays operate independently of the polarity of the applied voltage (coil voltage) whereas polarized monostable relays only operate with a specific polarity of energization.

Mounting
Describes specific mounting options of the relay. See >
- 'Through-hole-technology (THT)'
- 'Through-hole-reflow (THR)'
- 'Surface mount technology (SMT)
- for Mounting on DIN-rail (relays and accessories) see > 'DIN-rail'.

See also > 'Mounting' in the processing section.

Mounting distance
The distance between two adjacent relays in parallel and unidirectional mounting according to IEC 61810-1 or distance to other electrical components including the pc-board. Insulation requirements may stipulate an increase to the minimum distance between the relays or to choose a different placement.
If not otherwise stated the product data refers to relays in 'single mounting'.
In addition to this definition we use:
- dense packing: relays mounted at minimum distance; this minimum distance is defined by the requirements of the insulation coordination at rated voltage 230 VAC, and/or by mechanical requirements for the mounting of the relay (e.g. use of sockets)
- single packing: relays mounted at a distance without any thermal im pact of adjacent relays or components.

Definitions (Continued)

Mounting position / Placement
Unless other restrictions are stated the relays can be mounted in any direction. The relay connections have to be fully contacted and with adequate cross-sections to ensure the current flow and heat dissipation.
For the arrangement of the relays the insulation requirements, heat dissipation and the magnetic interrelation have to be taken into consideration.

MTBF - Mean time between failure
Expected value of the distribution of the time between failure. For components with limiting failures due to wear (e.g. contact wear), see > 'MCTF-Mean cycles to failure'.

Nominal power (coil)
See > 'Rated coil power'.

Nominal voltage (coil)
See > 'Rated coil voltage'.

Normally closed contact, NC contact
See > 'Form B contact, NC contact, normally closed contact'.

Normally open contact, NO contact
See > 'Form A contact, NO contact, normally open contact'.

Open contact circuit data
Insulation parameters of the contact circuit.

Operate
Process in which a relay shifts from the release/rest condition to the operate condition.

Operate state, operate condition
For a monostable relay, specified condition of the relay when it is energized by the specified energizing quantity and has responded to that energization. For a bistable relay, it refers to the condition other than the release/reset condition as declared by the manufacturer.

Operate time (DC coils)
The time interval that elapses from energizing a monostable relay in the rest state with the rated voltage (pulse or square signal) at an ambient temperature of 23°C to the moment when the last output circuit is closed or opened (bounce time not included). The operate time varies with the applied coil voltage and the ambient/coil temperature.
This definition refers to DC-coils only, due to the dependency of the phase angle considerably longer operate times may occur with AC magnetic systems.

Operate voltage
Value of coil voltage at which a monostable relay operates. For bistable relays see > 'Set voltage'.

Operate voltage U_1
Value of the coil voltage at which a relay operates, having previously been energized at the same voltage and with rated contact load (thermal equilibrium has to be achieved).
Operate voltage without preenergizing U_0
Minimum permissible input voltage at which the relay operates, for a coil temperature equal to the reference temperature (23°C coil temperature without preenergizing).

Operation
One switching cycle including energizing and de-energizing of the relay coil.

Operative range
According to IEC 61810-1.
Class 1: 80%..110% of the rated coil voltage (or range)
Class 2: 85%..110% of the rated coil voltage (or range)
For diagram specification see > 'Coil operative range'.

Packaging unit
Minimum delivery quantity (e.g. per carton/plastic bar) and quantity per box. Additionally, minimum quantity requirements apply and these requirements may differ from indicated packaging units. Please consult with your TE sales organization or authorized distributor.

PCB
Printed circuit board.

Peak inrush current
See > 'Limiting making current'.

Pre-contact, pre-make contact
Contact with two operating contact points usually of different material, with one contact switching prior to the other one. Pre-make contacts are used mainly for high inrush currents.

Product code
The ordering code structure does allow a large number of possible variations, but not all possible variations are defined as standard types (ordering codes) and thus not included in the product range.
Special versions to customer specifications can be supplied. Please contact your local sales organization.

Product date code
Printed on the product. Indicates the date of production of the product; the most common format is 'year+week', 'yymm' (e.g. 0412 indicates production in 2004 week 12); this code may be followed by additional related information.

Product marking/specials

	'Caution' - this symbol indicates a general possible cause of risk - refer to the specification/data sheet for details.
	'Read instructions' - this symbol refers to important information in the respective data sheets or specification
	Symbol for a NO contact
	Symbol for a NC contact
	Symbol for a CO contact
	Symbol for a forcibly guided contact set
	Symbol for coil information

For information on production date code see > 'Product date code'.

Protection class
See > 'Degree of protection (IEC 60529)'.

Protection to heat and fire
Data of the flammability class according to the UL 94 (Underwriters Laboratories, Inc., USA) specification.
UL 94 flammability testing, conducted on plastic materials to measure flammability characteristics, determines the material's tendency either to extinguish or to spread the flame once the specimen has been ignited.
According to IEC61810-1, all plastic materials have to fulfil the Glow Wire test requirements with min. 650°C.

PTI
See > 'Tracking index'.

Push-to-test button, test tab
For manual operation of the relay. The test button is to be used for test purposes of an equipment or installation. The push-to-test button is not de-

Definitions (Continued)

signed for standard ON/OFF operations, for continuous electrical operation in the manually set ON state, and is not to be used as a switch.
Before operating the test tab, the operator has to make sure that the load and any other connected item will operate safely.
As safety functions of the equipment might be bypassed and reduced insulation requirements apply, the test button is to be operated by trained personnel only.

Quick connect terminals (spade terminals)
The connectors indicated in the datasheet may be used for the connection to the relay. When using this connector type the given plug cycles and the maximum permissible current have to be taken into consideration. The connector and wire cross section have to be selected so that under the current load the increase of the temperature at the connector point must not exceed 45 K. For high contact currents it is recommended to solder the connection.
Furthermore the correct insulation of the connectors/plugs have to be respected.

Rated coil power
Product of coil current and voltage at rated coil voltage (in mW or W for DC-coils and in VA for AC-coils)

Rated coil voltage, Nominal voltage (coil)
Rated voltage at which the relay displays the operating characteristics, given for a constant DC supply or sinusoidal AC supply. Other operating conditions (e.g. pulse control, ramp voltage, half wave rectifying, etc.) may lead to characteristics other than specified.

Rated current
Current a relay can switch on and off and a relay or accessory can carry under specified conditions. Unless otherwise defined the rated current covers:
- contact current, switching current
- limiting continuous current: For a relay the specified conditions are defined under contact ratings; see > contact ratings. For accessories the rated current is specified for a duty factor of 50% at rated frequency of operation and at ambient temperature 23°C; the respective derating curves should be followed.

Rated values
Standard values the relay is designed for. Values are used to classify relays.

Rated voltage (contacts)
Voltage between the switching contacts before closing or after opening of the contact.

REACH SvHC compliance
See > 'Material substance specification' on TE's Website:
www.te.com/customersupport/rohssupportcenter.

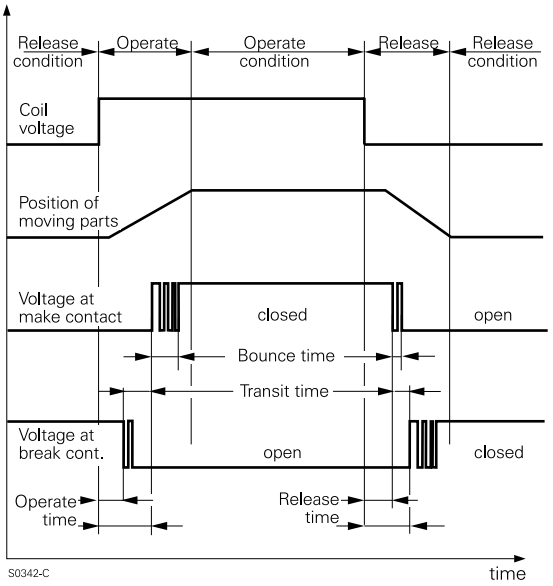
Reference temperature
Unless otherwise indicated the reference temperature refers to an ambient temperature of 23°C ('room temperature'). Also see > 'Coil data'.

Reference values
Reference values for all tests according to IEC 61810-1.

Reflection loss, Return loss
The part of a signal which is lost due to the reflection of power at a line of discontinuity.

Reinforced insulation
A single insulation system applied to live parts which provides a degree of protection against electric shock, comparable to a system comprising basic insulation and supplementary insulation (refer to IEC 61810-1, Type of insulation).

Relay cycles
Due to the self induction of the coil and the inertia of the parts to be moved, on activating a relay the operations do not take place suddenly. The function diagram below shows the different cycles for the most important relay configurations of undelayed power relays. Unless otherwise stated the indicated times are maximum values, the cycles specified apply to DC-coils energized with rated voltage (without any components in series or parallel to the coil) and at the reference temperature.
See
- 'Operate time'
- 'Release time', 'Reset time'
- 'Bounce time'
- 'Minimum energization duration'



Relay with force guided contacts
The compliance with regulations for the safety of persons and material is imperative in our technical world. National and international regulations take various risks into account. These safety standards also make demands on components which share with their function the safety level of a plant, machine or the equipment. For relays being used for safe contact monitoring purposes the contacts have to be linked mechanically in a way, that NO and NC contacts must not be closed at the same time. It has to be ensured, that over the entire life and even in case of malfunction (e.g. contact welding) the open contact gap will be at least 0.5 mm. Relays with force guided contacts comply with the requirements of EN 50205.

Release
Process in which a monostable relay shifts from the operate state back to the rest state.

Release state (normal position)
Switch position of a non-energized monostable relay.

Release time
The time interval that elapses from the point of time at which a monostable relay in the operating state has the rated voltage disconnected to the point of time at which the last output circuit has closed or opened (not including the bounce time). Unless otherwise stated the indicated times are maximum values and are valid for energization with rated voltage, without any components in series or parallel to the coil, and at reference temperature.

Release voltage
The input voltage at or below which a monostable relay releases to the rest state at the reference temperature.

Reliabilty
Electromechanical components as relays, are subject to wear (mechanical and electrical). For the reliability the typical bath-tub curve applies, hence singular statistical failure events below typical reliability values may occur.

Definitions (Continued)

Reset
Process in which a bistable relay returns from the operate state back to the rest state.

Reset state
Switch position of a bistable relay as specified by the manufacturer. Unless otherwise stated the reset state is the contact position where the normally open contacts (form A, NO contact) are open and the normally closed contacts (form B, NC contact) are closed. Please note that the contact position for bistable relays is not defined at delivery.

Reset time
The time interval that elapses from the point of time at which a bistable relay in the operating state has the rated voltage (applied in the opposite direction for 1-coil systems and to the reset coil for 2-coil systems) to the point of time at which the last output circuit has closed or opened (not including the bounce time).

Reset voltage
The input voltage to a bistable coil for reset to the rest state at the reference temperature. Please note the wiring diagram and the polarity (see > 'Bistable relay').
- Reset voltage max.
  The input voltage that must not be exceeded to a bistable coil for reset to the rest state at the reference temperature.
- Reset voltage min.
  The input voltage that has to be applied to a bistable coil for reset to the rest state at the reference temperature.

Resistance to soldering heat
According to IEC 60068-2-20, method 1A.

Rest state
Switch position of a monostable relay in the unenergized state.
For bistable relays see> 'Reset state'.

RoHS - Directive 2002/95/EC, EU RoHS compliance
Directive on the Restriction of Hazardous Substances (Directive 2002/95/EU, RoHS directive) restricting the use of certain materials as Lead (Pb), Cadmium (Cd), Mercury (Hg), hexavalent Chromium (Cr6), polybrominated Biphenyls (PBB) and polybrominated Diphenylethers (PBDE).
'Compliant'
indicates that the entire product group is compliant with the RoHS directive and none of the above materials is intentionally added and/or below the limits set forth in the directive.
'Compliant versions'
indicates that certain products within the respective product group are compliant with the RoHS directive. The RoHS compliant selection is indicated together with the information on the RoHS compliance. Some products of that product group however do contain materials (e.g. Cd) listed above and thus are not compliant with the RoHS directive.

Safety relay
See > 'Relay with force guided contacts'.

Sealed relay
See > 'Category of protection (IEC 61810)' - RT IV and RT V.

Set time
The time interval that elapses from operating a bistable relay with the rated voltage (pulse or square signal) at an ambient temperature of 23°C to the moment when the last output circuit is closed or opened (bounce time not included). The operate time varies with the applied coil voltage and the ambient/coil temperature.

Set voltage
Value of coil voltage at which a bistable relay operates. For monostable relays see > 'Operate voltage'.

Shock resistance (destruction)
This test is used to evaluate the resistance of the relay to heavy mechanical shocks leading to a permanent damage to the relay. This test is performed according to the IEC 60068-2-27, Ea test.

Shock resistance (function)
This test is used to evaluate the resistance of the relay to mechanical shocks such as those that could occur in transport or during operation (no opening of closed relay contacts with a duration >10 µs). This test is performed according to the IEC 60068-2-27, Ea test.
Data valid for all relay axes unless otherwise stated. Nevertheless it is recommended to avoid shock especially in armature and contact movement direction.

Single contact
Contact system with one contact point per contact member (contact blade).

Single/double throw contact
A single throw contact connects one common line (movable contact) to one load line (stationary contact). See > 'Form A contact' and 'Form B contact'.
A double throw contact switches one common line between two stationary contacts, for example between a NO contact and a NC contact. See > 'Form C contact, CO contact, changeover contact'.

Single/double/multi pole
A single pole relay connects one common line (movable contact) to one load line (stationary contact).
A double pole relay switches two, electrically disconnected common lines with two electrically independent load lines (like two separate make relays); the same stands for multi-pole relays, the number of poles indicate the number of independently switches load lines.

Switching of different potentials on adjacent contact circuits of a multi-pole relay is permitted as long as the sum of applied voltages does not exceed the rated insulation voltage.
The switching of different voltages with the generation of an electrical arc and the switching of reverse polarity on adjacent contact circuits of a multi-pole relay without contact separated chambers however is not permitted. The contact load has to be connected to the same contact side.

Sockets and accessories
All listed sockets and accessories have been tested and approved only with the indicated relays from the TE product range.
For combinations of sockets with other relays with similar design and pinning TE cannot take responsibility for any malfunction.
Also see > 'Combination of relay and socket'.

Soldering temperature/time, IEC 60068-2-20
See > 'Resistance to soldering heat'.

Solid insulation
Solid insulating material between two conductive parts.

Steady state current limit
See > 'Limiting continuous current'.

Stripline
A type of transmission line configuration which consists of a single narrow conductor parallel and equidistant to two parallel ground planes.

Switching capacity
See > 'Switching power'.

Switching current
See >
- 'Rated current'
- 'Limiting making current'
- 'Limiting breaking current'.

Definitions (Continued)

Switching power
Product of the switching current and switching voltage (in W for direct current, in VA for alternating current).

Switching rate
See > 'Frequency of operation'.

Switching voltage
See > 'Rated voltage (contacts)'.

Switching voltage max.
See > 'Max. switching voltage'.

Terminal assignment
For historical reasons and due to typical application nomenclature (e.g. relays in automotive applications) different terminal assignment schemes are used:
Terminal assignment to IEC 67
The terminals are identified by consecutive numbers. Please note that two digit identifiers exist in both the IEC 67 and the EN 50005 identification systems and may have different meaning.
Terminal assignment to EN 50005: the terminals are defined by a two digit code:
for the coil terminals 'A1', 'A2' are used
for contacts the first number indicates the pole, the second number indicates the function
1 for the movable form C, CO contact,
2 for the form B, NC contact,
4 for the form A, NO contact
e.g. a terminal '24' indicates the form A, NO contact of the second pole of a relay.
Automotive relays
Quick connect style coil and load terminals ISO relays may be numbered according to two different standards, the terminals have the same location and function. The respective numbers are:
1 or 86 for the first coil pin;
2 or 85 for the second coil pin;
3 or 30 for the common load pin;
4 or 87a for the form B, NC load pin;
5 or 87 for the form A, NO load pin.

NOTE that the terminal assignment graphs are indicated either 'bottom view' (as seen from the solder wave side of pcb's, pin side of the relays) or 'top view' (as seen from the component side of single sided pcb's or the cover side of a relay).

Terminal torque, screw type terminals
For screw type terminals the maximum indicated screw torque must not be exceeded.
No torque must be applied to any other terminal types of relays or accessories.

Test voltage/dielectric test voltage/dielectric strength
Voltage applied during dielectric (high voltage) tests between intentionally not electrically connected parts of the relay.

Thermal resistance
Relay parameter measured in Kelvin per Watt, which relates the consumed power with the respective temperature increase in the state of thermal equilibrium measured without load and without components in parallel or in line to the coil. Multiplied with its power consumption (at the actual coil temperature) it indicates the temperature rise of the coil above ambient temperature.

Thermoelectric potential
Voltage at the relay terminals of a closed contact resulting from a temperature difference of the different metal junctions (terminal, spring, contacts,...) inside the relay.

Through-hole reflow (THR)
An assembly process, where THT components are soldered in a reflow process instead of traditional wave soldering (also referred to as pin-in-paste). For details see chapter Processing Information.

Through-hole technology (THT)
An assembly process for mounting components where terminals are passed through supported (plated through) or unsupported (bare) holes in an interconnection substrate. Normally, traditional wave soldering is used with THT components.

Tracking
Progressive degradation of a solid insulating material by local discharges to form conducting or partially conducting paths.

Tracking index
- PTI - Proof tracking index - numerical value of the proof voltage expressed in volts which a material in test can withstand without tra cking under specified conditions (according IEV 212-01-45).
- CTI - Comparative tracking index - numerical value of the maximum voltage expressed in volts which a material in test can withstand wit hout tracking under specified conditions (according IEV 212-01-45).

Transit time
The movement time of the armature after opening of one contact set (e.g. NC) before closing of the other (e.g. NO) of a changeover relay. See > 'Relay cycles'.

Twin contact, bifurcated contact
Contact with two simultaneously operating contact points. Twin contacts increase the contact reliability considerably, especially when switching low currents and voltages (dry circuits) and/or are used for reduction of contact resistance. Bifurcated contacts are twin contacts with the two contact points on one contact member (contact blade).

U_{rtd}
See > 'Rated voltage'.

Vibration resistance (destructive)
This test is used to evaluate the resistance of the relay to heavy mechanical vibration leading to a permanent damage to the relay. This test is performed according to the IEC 60068-2-27, Ea test.

Vibration resistance (functional)
This test is used to evaluate the resistance of the relay to harmonic mechanical oscillations such as those that could occur in transport or during operation. No opening of closed relay contacts or closing of open relay contacts with a duration >10 µs is allowed to occur during the test. This test is performed according to the IEC 60068-2-6, Fc test. Unless otherwise stated the values refer to a frequency range 30...150 Hz.

Voltage drop
Effect of contact resistance, measured as voltage drop across closed contacts. See > 'Contact resistance'.

VSWR
Abbreviation for 'Voltage Standing Wave Ratio'. The ratio of the maximum to the minimum voltage set up along a transmission by reflections.

Wash tight/immersion cleanable
See 'Category of protection (IEC 61810)' - RT III.
Relays that can be cleaned together with the printed circuit board after soldering. The washing requires a suitable solvent. The term „immersion cleanable/wash tight“ is not identical with „hermetically sealed“!
Unless otherwise stated the relays are wash tight according to Qc2 IEC 60068-2-17, tested with a water immersion test at max. ambient temperature for 1 minute.
Contact our technical support for suitable solvents and washing parameters. The user needs to verify the compatability of lacquer, solvants and drying process.

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Definitions (Continued)

Electromechanical relays are one of the most robust and reliable components. To achieve the specified performance some precautions must be taken during transportation, storage, handling, processing and testing.
CAUTION: ANY TRANSPORT, PACKAGING, HANDLING OR USE DIFFERENTLY THAN HEREIN RECOMMENDED BY TE MAY CAUSE RISKS AND IN THIS SITUATION SHALL BE ENTIRELY BORNE BY USER.

Handling / Logistics

Transport
During transport, care has to be taken to avoid excessive shock and vibration. Mechanical stress can lead to changes in operating characteristics or to internal damage of the relay (see > 'Vibration and shock resistance'). When a potential excess of mechanical stress is suspected (e.g. damaged packaging, dropped packages or relays, etc.), the relays should be checked and tested before use.

Packaging
Depending on the relay type and design and with regard to specific requirements various packaging types and technolgies are used for shipment of our products.
- THT and THR relays
  are packed in trays, cardboard or plastic tubes with stoppers on both sides of the tubes. For unpacking from plastic tubes the plugs on both sides shall be removed to prevent any relays sticking to the plugs and possible falling down onto the pick place.
- SMT relays
  the standard packing are blisters tapes wound on a reel (tape & reel) and dry packed in order to prevent the relays from humidity. The SMT relays should be kept in these containers for storage and should be re moved from the box just only before the assembly process preferrably at the SMT assembly line. The boxes are equipped with shock absorbers, which protect the relays from mechanical impacts.
- Industrial relays are packed in trays or in tubes.

Handling
Modern relays are high precision components, sensitive to mechanical stress and abusive handling. Care must be taken when handling the relay during all stages of production.
- special attention must be paid, not to apply mechanical shock, e.g. by dropping relays onto the floor or other hard surfaces (e.g. assembly tables). Once dropped, relays should not be used anymore and shall be scrapped. In case of relays assembled to long wires or harnesses any mechanical shock due to whiplash effect has to be avoided.
- care has to be taken when opening tubes to prevent relays from falling out or during splicing of reels, where the loose end of the tape should not drop to the floor.
- special care must be taken, that the terminals of the relays are not bent. Straightening of bent terminals and pins is not allowed.
- handling or processing of relays in bulk is not permitted.

Storage
Generally TE's products should not be exposed to extreme high temperatures, high humidity or damaging media such as sulphurous, acid or basic atmospheres. Unless other specific requirements are documented, TE recommends in accordance with IEC 60068-1 a standard atmospheric conditions a storage temperature between 15 and 35°C (59 to 95°F) and a relative humidity between 25 and 75 %.

Dry packed SMT relays: when the packing is opened, the relays must be soldered within a defined time frame, indicated by the moisture sensitive level MSL (max time from opening the bag to soldering). When the open time is exceeded, remaining relays shall be dry repacked, or the relays must be dried before soldering.

For more information, refer to our application notes in the internet.

Processing

Testing
For electrical incoming inspection tests refer to sections > 'Contact resistance', 'Diagnostics of relays' and 'Storage'.
During incoming inspection and respective handling, special care has to be taken not to bend the relay terminals. The degradation of sealing properties up to internal failures (e.g. breaking of coil wires) could be the consequence.

Handling during processing
Relays are high precision components, sensitive to mechanical stress and abusive handling. Care must be taken when handling the relay during all stages of production. Do not exert any pressure on the pins.

Manual handling
- the relays have to be removed from the packaging in on orderly way
- processing of relays in bulk is not permitted
- when relays are manually handled and placed on PCB's, special attetion must be paid, not to drop relays onto the floor or other hard surfaces (e.g. assembly tables). Once dropped, there is a risk of high mechanical shock and potential damage of the relay; these relays should not be used anymore. In case of relays assembled to long wires or harnesses any mechanical shock due to whiplash effect has to be avoided.
- open packages, tubes or splice reels with care: after prolonged storage at higher temperature there is a risk of relays sticking to the stopper plugs of tubes and for reels the loose end of the tape shall not drop to the floor.
- special care must be taken, that the terminals of the relays are not bent. Straightening of bent terminals and pins is not allowed.
- do not exert undue force (e.g. by hand tools) when inserting the relays onto a pcb or into a socket.
  Automatic handling
- the mechanical stress caused by handling and/or force of automatic feeders or robots has to be adjusted to avoid mechanical damage (e.g. cracking of the relay case, detaching cap from relay base).
- the clamping force shall not exceed the values given for x, y, z direction, in order to provide for the proper internal function of the relay. The force shall be applied in the largest possible area. Picking in the dashed area would be preferred. Unless otherwise stated the clamping force should not exceed 5 N in any of x/y/z direction.
- do not excert undue force when inserting the relays onto a pcb or into a socket.

Mounting on PCB's
- the relays have to be removed from the packaging in an orderly way, processing of relays in bulk is not permitted. Dimensions and pcb layout indicated in the datasheet are indicated for the manual placement on the pcb's. For automated pick-and-place we refer to detailled component drawings.
- unless otherwise stated the relay can be mounted in any position. The relays can be further processed in the industry standard commercial soldering and cleaning (for suitable products) plants.
- when inserting the relay into the PCB, do not exert any pressure or use undue force or torque on the pins as this may compromise the pin seal or affect the integrity of the coil connections.
- no pressure should be exerted on the relay cover and terminal pins after the relay has been inserted in the printed circuit board.
- after insertion in the printed circuit board, the terminal pins must not be bent or twisted for fixation or attachment. Bending or applying mechan cal stress to the pins may affect the relay parameters. Bending the terminal pins of sealed relays (wash-tight, immersion proof, sealed) may damage the sealing. However, if fixing must be carried out before soldering, please contact our application support. Also see > 'Clinching'.

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Definitions (Continued)

Mounting of relays and accessories on sockets and DIN-rails
When inserting the relay onto sockets, do not exert undue force on the relay and/or pins (e.g. indicated max. insertion force).
Reduced ambient temperature ranges may apply for mounting and handling of sockets and accessories (mounting on DIN-rail, assembly of retaining clips, mounting/dismounting of relays etc.); unless otherwise stated provide a temperature of -10°C to +40°C for ambient and parts for such mounting processes.

Clinching
Terminals should not be bent to hold the relay in place on the PCB to aid flow soldering. Bending or cutting the pins after insertion generates extreme mechanical stress, especially in the case of rectangular PCB terminals. Neither the relay performance nor sealing of flux resistant and plastic or hermetically sealed relays can be guaranteed if the terminals have been bent.
Also see > 'Mounting on PCB's'

Fluxing
Fluxing has to be carefully considered depending on the type of relay.

- Sealed relays, wash-tight relays:
  these relays may be processed on all standard commercial fluxing, solder and cleaning equipment for this type of electrical and electromechanical components.

- Unsealed relays, open relays, dust-proof relays:
  should be hand soldered to avoid flux contamination of the relay. Flux should be used sparingly and evenly and joints examined after soldering. If flow soldering is used however, the flux level has to be set so that it merely touches the bottom of the PCB and only wets the underside of the printed circuit board. It must not flood onto the upper surface of the PCB. This is particularly critical if multilayer PCB are used and there are unused holes under the body of the unsealed relay, the flux should only be visible as foam flux through any open perforations in the printed circuit board. If the printed circuit board is flooded by flux, bursting flux bubbles can lead to contamination in open relays and, consequently, to failures. To protect against corrosion, no acidiferous flux should be used.The recommended flux types are 1.1.3, 1.2.3 or 2.2.3 according to DIN EN 29454 T.1 or type F-SW 32 to 34 to EN 29454-1 (ISO 9454-1).

If there is any doubt about the fluxing process, sealed relays (wash-tight, plastic or hermetically sealed) should be used.

Acidic fluxes are not suitable for open relays due to the risk of corrosion, especially inside the coil.

Preheating
During preheating for common wave soldering processes, the temperature of the upper surface of the printed circuit board should not exceed 130°C (EN61760-1). Excessive exposure to high temperatures may affect the relay characteristics. NOTE that any not completely dried flux might evaporate in an explosive reaction and sputter; ensure that no flux penetrates the insides of open relays.

Soldering
The soldering process has to be controlled carefully in order not to impair the performance of the relays. No external force to be applied on the pins during the soldering process.

Our relays can be processed in commercial soldering and washing installations (if classified as washable). They cover the following regulations:
Flux tight type relays; open relays without cover:
- Solderability according to IEC 60068-2-20, Test Ta, method 1, aging 3: 4 hours at 155°C, dewetting
- Resistance to soldering heat according to IEC 60068-2-20, test Tb, test method 1A

Sealed type open vent hole relays:
- Solderability according to IEC 60068-2-58; dewetting
- Resistance to soldering heat according to IEC 60068-2-58

Sealed type washable relays:
- Such relays are capable of being automatically soldered and subse quently undergoing a washing process to remove flux residues without allowing the ingress of flux or washing solvents
- Sealing complies to IEC 60068-2-17; Test Qc: method 2, the relay will withstand a bubble test at 70°C for 1 min
- See also > 'Chemical Cleaning'
- Avoid designs with considerable thermal mass below the relay (e.g. high number of solder filled interlayer connections).

Soldering, wave soldering
The automated soldering process has to be controlled carefully in order not to impair the performance of the relays. Flux resistant and sealed relays can be used with most dip or wave soldering processes. The solder level has to be adjusted so that it does not flood the printed circuit board surface. The pre-soldered pins are suited for standard soldering processes with Pb-solder as well as for Pb-free solder processes.
Leadfree processing:
- for processing of relays under leadfree conditions refer to the indicated 'resistance to soldering heat', exceeding the limit may have negative impact on relay parameters. We recommend that leadfree processes should be carried out using SnAgCu-solder. The solder bath temperature for i.e. double wave soldering should be in the range of 250 to 260°C.
- the solder bath temperature should not exceed
  - 270°C for 10 s for flux-proof relay versions (RT II)
  - 260°C for 5 s for wash-tight and sealed relays (RT III and higher).
- for other bath temperatures and solder time (e.g. higher solder bath temperature with reduced dipping time) contact our technical support.
  SnPb processing
- for this process refer to maximum permissible temperatures at the terminals according to CECC 00802. For SnPb Eutectic Process we recommend a maximum peak temperature Tp < 225°C. For Pb-free processing we recommend a maximum temperature Tp < 245°C. The se soldering temperature profiles indicate the Pad/Pin temperature.

Soldering, reflow soldering
Unless otherwise stated the soldering should be carried out according to the recommendation of IEC 60068-2-58 and according to the recommendations of CECC 00802.

Please note that in some cases the ambient temperature may be considerably higher on top area of the relay component. In this case the component temperature should not exceed 260°C. Check for specific mounting conditions. In addition the time, parameter t_L (time span for temperature above preheating temperature) should be below 150 s.

In general, electromechanical relays should be soldered at the lower process limits of a soldering process.

Soldering, manual soldering
The relay programme offers products with various terminal styles. Some products with solder lugs are specifically designed for manual soldering whereas some products (e.g. with quick connect terminals) are not intended to be soldered. Most PCB mount relays are designed for processing in a wave soldering process. For manual soldering and repair the soldering time should be kept to a minimum and no mechanical force or torque must be applied to the relay terminals.
Unless otherwise stated we recommend for manual soldering a soldering temperature of 300 to 350°C for a maximum soldering time of 3 s.

Cooling
After wave or reflow soldering, the assemblies should be cooled in order to reduce thermal stress and to minimize the pressure difference between inside of the relay and ambient. Do not change the temperature suddenly, especially avoid thermal shock for the hot relay. Do not cool down by using cold liquids or aerosols. In case of thermal shock, the relay sealing could break and through micro-cracks cleaning fluid with dissolved flux might be sucked inside the relay; such ingress of liquids into the relay can lead to failures in operation.

Definitions (Continued)

Cleaning, chemical
Preferrably a non clean flux process should be used; in this case there is no need to wash the PCB and we recommend avoiding washing processes in order to protect the environment. If cleaning is necessary, certain precautions have to be taken:

Flux tight type relays and sealed relays with open vent hole:
- immersion cleaning is not possible with these types of relays. Only the soldered side of the PCB (THT) should be cleaned and care has to be taken not to allow washing solution to flood the PCB surface to prevent penetration of solvent and dissolved flux into the relay. Any other cleaning method involving potential contamination of unsealed relays must be avoided.

Sealed relays (wash-tight, sealed and hermetically sealed), closed vent-hole:
- do not stress the terminals mechanically before or during the mounting, soldering or cleaning process
- the PCB should be allowed to cool prior to the washing process to avoid thermal shock and potential damage to the seal as well as a pressure difference (see > 'Cooling')
- the printed circuit must be washed in a timely manner after the soldering process
- do not lower the temperature while the relay is in contact with any li quid, e.g. some residue of cleaning medium can be between relay and PCB
- modern cleaning equipment uses water or alkaline solutions, if other cleaning solvents are used, ensure that the chemicals are suitable for the relay. The use of unsuitable solvents can cause cracking or discoloring of the plastic parts. Suitable solvents include isopropyl alchol (alcohol-based solvents), water with wetting agents.
  Unsuitable solvents are, e.g., acetone, ethyl acetate, aqueous alkalines, phenolic combinations, thinner-based solvents, chlorosenebased solvents, trichlene-based solvents and chlorine.
- when using high pressure cleaning processes, special care has to be taken to avoid any ingress into the relay as liquids under high pressure can damage the seal of the relay. Do not use jet pressure higher than 1,5 bar or ultrasonic pressure higher than 0,5 bar.
- avoid and do not use any ultrasonic pressure for relays with gold plated contacts. See > 'Ultrasonic cleaning'
- special care must be taken on the temperature of the cleaning and rinsing liquid; their temperature shall be similar and not deviate by more than 10°C.
- the individual wash stations must be separate from one another to prevent cross-contamination!
- after the final washing process, the printed circuit boards must be cleaned again using a clean washing medium!

Cleaning, ultrasonic
Ultrasonic cleaning is generally not recommended as this can cause friction welding of the contacts, especially in the case of gold-plated contacts. If ultrasonic cleaning cannot be avoided, it must be completed as quickly as possible.
For gold plated contacts ultrasonic cleaning is NOT recommended as this might result in cold welding of the gold contacts.

Protective coating
Relays with a category of protection II and below are not suited for coating processes. Relays with category of protection III and higher are suitable for washing processes but not all relays are necessarily suited for coating processes. In this case, please contact our application support for recommended relay versions and processes.
In case relays with insufficient protection are coated, there is a high risk that resin will enter the relay and destroy the relay. Sealed relays with an opened vent hole can only be partly coated.
- for the protective lacquering and varnishing of the mounted printed circuit boards, we recommend single-component lacquer (epoxy-based). Suitable are Epoxy, Urethane and Fluorine coatings. Silicon containing laquer or potting compound must not be used!
- we recommend a coating technology that avoids uncured varnish in the surrounding of the relay.
- the maximum drying temperature should be 70°C.
- the user has to conduct thorough testing with their processes, used lacquers, coatings or casting compound. Solvants may damage the component case or compromise their sealing properties.
- do not allow de-varnishing of PCB for repair, if unavoidable the relay has to be replaced.

NOTE:
- Lacquer or potting compound containing silicon MUST NOT be used!
- Coatings, especially potting compounds may impact the heat dissipati on of the relay. Therefore it is necessary to conduct thermal tests of relays in potted assemblies.

Vent hole, nip-off pin, opening
Most PCB relays, reflow solderable relays as well as THR and SMD relays, are provided with a closed vent hole on top of the cover (removable sealing pin on relay cover).
Inside a sealed relay certain load conditions (e.g. heavy loads with generation of pronounced arcing) and/or extreme ambient conditions can generate aggressive atmosphere (diffusion, arc ionization), corrosive condensate or overpressure. To avoid such conditions and a possible reduction of electrical endurance a gas exchange with the atmosphere is advised. To allow the gas exchange, break off the vent hole or nip-off pin.

Silicone
Materials containing silicone or its derivatives must not be used in any form in or near to processing and packaging of subcomponents and the final relay assembly. Silicone and its derivatives are not allowed in the material of any component in the vicinity of the relays.
Silicone atmosphere can diffuse through the relay housing and cause contact failures, siliceous compound deposits can create an insulating abrasive layer on the contact surface.
Contamination can occur with all silicone-based materials before and after cure (contain silicone volatiles), silicone aerosols, silicone fluids, grease and hand cream, etc..
Some types of signal relays are suited for application in Silicone environment, however the suitability MUST be verified; please contact our application support.

Testing

Testing
During incoming inspection, special care has to be taken not put mechanical stress on the relays and terminals and not to bend the relay terminals; internal failure or long term effects as a result of a degradation of sealing properties could be the consequence.

Bistable relay, incoming and in-process testing
In a bistable or latching relay the contacts maintain the last switching position when the coil input voltage is disconnected.
NOTE that even though the bistable relays are leaving production preferrably in reset contact position, the position of the contact (set position/ reset position) is not defined at delivery or after transport. Thus, at the time of incoming and in-line testing, the customer needs to check the contact position and to set/reset the relay to the required position.

Definitions (Continued)

Testing conditions, automated testing/diagnose
With higher integration and use of highly complex electronic circuits and resulting quality and safety requirements (e.g. cars), relays undergo stringent incoming tests and in-circuit testing during and at the end of the assembly process (end-of-line tests).
Special considerations have to be given for the selection of testing parameters, the respective test limits and development of embedded diagnostic routines:
- testing of contact resistance
- testing of magnetic system
- testing of dynamic characteristics.

The most common contact materials contain silver alloys and thus are affected by sulfidation and oxidation. Layers of oxides, sulfides and other compounds will form on the surface of metal contacts within a very short time by absorption from the ambient atmosphere. These layers increase the contact resistance, depending on the thickness of the layer, the effective contact area and the specific resistance of the used contact material and layer. To establish a reliable electric contact these layers have to be destroyed. This can be done by mechanical, electrical or thermal destruction:
- mechanical destruction: high contact pressure and mechanical switching impact
- electrical destruction: requires a specific breakdown voltage and current. This destruction process is called A-fritting. The breakdown voltage depends on the thickness and specific resistance of the layer. For practical testing refer to the values according IEC 61810-7 as indi cated above; e.g. for automotive relays the breakdown voltage can be up to 3 V to start the A-fritting.
- thermal destruction: a thermal destruction requires high temperatures, usually generated by
  1) after the electrical breakdown (A-fritting) a small current is forced through very thin channels in the layer. The resulting local high current density heats the conducting channels up quickly, destroying the layers, until finally (within a few ms) a metal to metal bridge is established. This process is called B-fritting. The B-fritting voltage depends on the con tact material. For practical testing refer to the values according IEC 61810-7 as indicated above.
  2) generated by high contact currents and/or electric arcs (e.g. disconnecting inductive loads, switching on capacitive loads).

Icing
Under very special environmental conditions (below 0°C) and operational, temporary relay switching failures can occur. Moisture condenses on the surface of the cold contact and forms a thin layer of ice, causing a temporary interruption of the electrical contact.

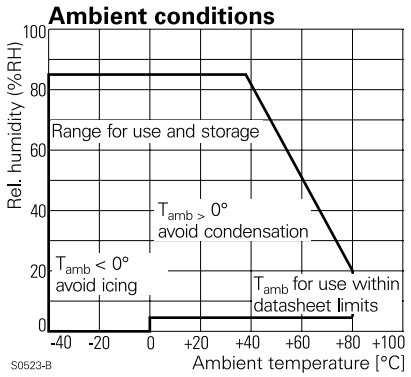
Magnetic system, coil resistance
For testing the inductivity of relay coils may need consideration (e.g. the inductivity for coils in automotive relays can exceed 1 H in the unsaturated range). This results in a time constants between 1 to 50 ms for the exponential inductive current increase (pulse response). In case the ohmic coil resistance is measured with a 4-pole measurement, the resistance value may be wrong, if measured during the inductive current rise after energization.

Dynamic characteristics
The switching times (e.g. operate time and release time) for DC-coils are usually in the low millisecond-range:
- the operate time depends on the applied coil voltage and coil temperature. Voltages higher than the rated coil voltage generally leading to reduced operate times whereas higher coil temperature and the resulting higher coil resistance leading to increased operate times. A fast dynamic response (e.g short operate and release time) also impacts the bounce time and can increase the bounce time considerably.
- the release time depends mainly on whether a coil suppresion circuit is used and on the type of the used circuit. A low ohmic device (e.g. a diode) in parallel to the relay coil can increase the release time by a considerable factor compared to the typical values shown in the datasheets.

Diagnostics of relays, recommendations
For the development of diagnostic routines these effects need to be considered:
- the contact resistance may be higher than indicated in the datasheet and due to the fritting phenomena (see above > 'testing'), also may show a non-linear characteristic. This implies, that the contact resistance, measured at too low voltage and current levels (e.g. standard tester and multimeter) can be significantly higher than the contact resistance under real application conditions (e.g. supplying a 100 W load). We recommend to perform the diagnostic routine with the actual application load and voltage (e.g. mains or board net voltage) connected to the contacts. If the diagnostic routine cannot be performed with actual application load and voltage, the measurement voltage level must secure an electrical breakdown of possible layers. We recommend a voltage level according to IEC 61810-7.
- the voltage drop can be up to 300 mV. The B-fritting is a physical phenomenon, which can occur on all metal and silver based contacts. For low level and signal applications, special signal and general purpose relays are available. For automotive applications it is recommended to set the diagnostic threshold voltage to min. 500 mV per relay contact (important for H-bridges or serial contact arrangements).
- effects like icing (see > 'Icing').
- consider the maximum possible switching times (due to, e.g., operate voltages other than the rated coil voltage, bounce time effects, ambient temperature and coil suppression circuits). If the status of the contact has to be changed for the diagnostic routine (energize or de-energize relay), the routine must wait until the intended contact status is established. Depending on electrical and ambient conditions (temperature, voltage levels, coil circuits) the times can be significantly longer than the indicated times in the datasheet. We recommend a delay time of min. 10 times of the typical switching times.
- a coil diagnostic routine must secure that the status of the contact does not change during the diagnostic cycle. If the coil driver is monitored by a watchdog routine, the energizing/de-energizing time of the coil must not result in an unintended closing or opening of the contacts. We recommend times of max. 0.5 ms.

Use

Operational humidity / Condensation
Standard conditions:
Annual mean relative air humidity ≤ 75% at ambient temperature 23°C, on 30 complete days distributed naturally over the year 95% at ambient temperature ≤ 25°C, on the remaining days occasionally 85% at 23°C. No condensing or freezing allowed (storage and/or use).
For use and storage at other conditions, condensation or freezing due to temperature changes has to be avoided. Use and storage within the limits as stated in the datasheet and as indicated in the graph.



NOTE: For use conditions the temperature limits as indicated in the datasheets apply.

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Contents

Industry Applications / Product Lines		Technical Features	Alternative Energy	Alternative Power Vehicle / Charging	Appli
AUTOMOTIVE	 Low Power PCB Relays	1 and 2 poles 10 to 45A DC and bistable		✓	
	 Low Power Plug-In Relays	20 to 70A up to 125°C		✓	
	 High Power High Current Devices	1 pole, star point up to 255A up to 125°C		✓	
	 High Power High Voltage Relays	900VDC up to 200A DC and bistable	✓	✓	
GENERAL PURPOSE	 Low Power PCB Relays	1 and 2 poles 250VAC 0 to 16A DC, AC, bistable	✓	✓	✓
	 High Power Relays	1 and 2 poles 250 to 400VAC 20 to 30A	✓	✓	✓
	 High Power Latching Relays	250VAC up to 120A DC, bistable			
	 Solar Relays	up to 277VAC up to 35A	✓		
	 Force Guided Relays	2 to 6 poles 250VAC 6 to 8A			
	 Panel / Plug-In Relays	1 to 4 poles up to 400VAC 0.5 to 30A (50A) DC, AC, bistable	✓		
	 Circuit Breakers	1 to 4 poles up to 250VAC (480VAC) 0.2 to 50A			✓
SIGNAL	 Signal Relays	1 to 2 (8) poles up to 250VAC/VDC 0 to 5A		✓	✓
	 High Frequency Relays/Switches	220VAC/250VDC up to 2A 70 to 140mW			

This Line Card provides a further brief overview of key product lines available from TE Relay Products. More complete details on the products described above, as well as specialty relays, contactors, timers, solid state relays and power transformers, can be found in our datasheets at http://relays.te.com and at www.te.com.

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ance	Automotive	Building Equipment / Lighting	Communication	Industrial	Power Metering
	✓				
	✓				
	✓				
✓		✓	✓	✓	✓
✓		✓		✓	
		✓			✓
		✓		✓	
		✓		✓	
✓		✓	✓	✓	
✓	✓	✓	✓	✓	
	✓		✓	✓	

Product images shown above are not in proportion with one another, and each is only representative of one product within a given product line.

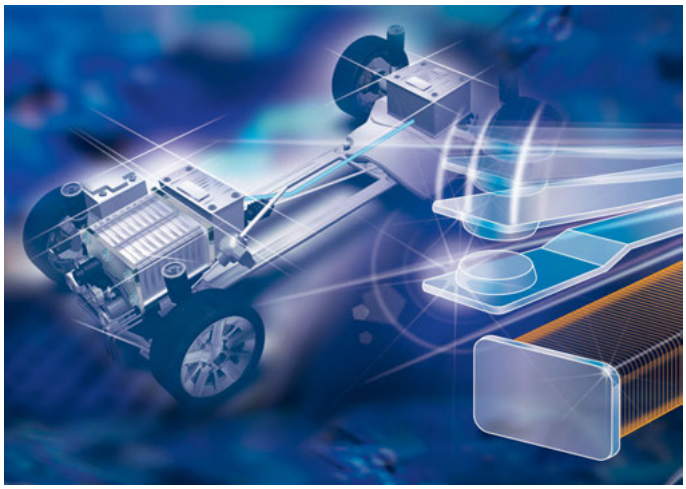
Industry Overview

Alternative Energy

Relays meeting the specific requirements for use in power inverters are among the switching components offered by TE Relay Products for alternative energy applications.

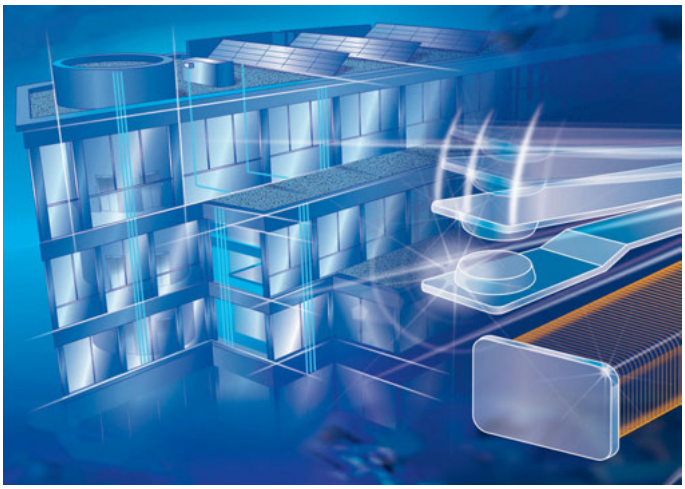
Automotive

TE Relay Products supplies many different switching products for automotive applications. These range from basic electromechanical relays to special function relays, contactors and hybrid modules.



Alternative Power Vehicle/Charging

From miniature relays for PCB mounting to large power contactors, TE Relay Products offers an array of switching solutions for alternative power vehicles and the associated infrastructure.



Building Equipment

TE Relay Products provides a broad range of products for use in building equipment such as elevators, HVAC systems, alarms and more.

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Industry Overview

Appliance

Among the many switching products TE Relay Products provides to appliance manufacturers are signal relays, general purpose relays and circuit breakers.

Industrial

Whether the application is a basic pump control circuit, a complex interface with a programmable logic controller or a safety circuit, industrial machinery designers specify components from TE Relay Products.

Power Metering (ANSI[1)] Style)

TE Relay Products is developing a global line of specialized high current relays for the expanding power metering market.

Communication

From high frequency relays for antenna switching to power control relays for end-user equipment, TE Relay Products offers the vast communications market an array of components.

of Business (http://www.te.com/aboutus/tandc.asp). The dimensions in this catalog are for reference purposes only and are subject to change without notice. Specifications are subject to change without notice. Consult TE for the latest dimensions and design specifications.

1) ANSI is a trademark of American National Standards Institute.

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