Universal printed circuit board relay
Mono- or bistable

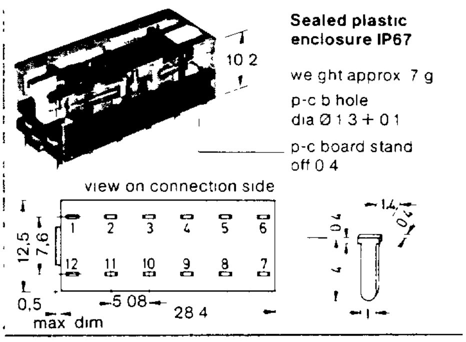
S-Relay

SUPERB RELAY TECHNOLOGY

177-231
To
177-254

- Power switching range from 1 nW to 1 KVA
- New 5 layered twin linear contacts
- Volumetric/contact resistance approx 30/20 mΩ
- Highly efficient
- Good → HF and → capacitance value 1 5 pF
- Low → thermovoltage approx 2 or < 1 uV
- 100 A (1 ms) short circuit capability
- Long → operational life (up to 2x10[8] operations)

The arrows refer to more specific information in the text



Data sheet

Ratings

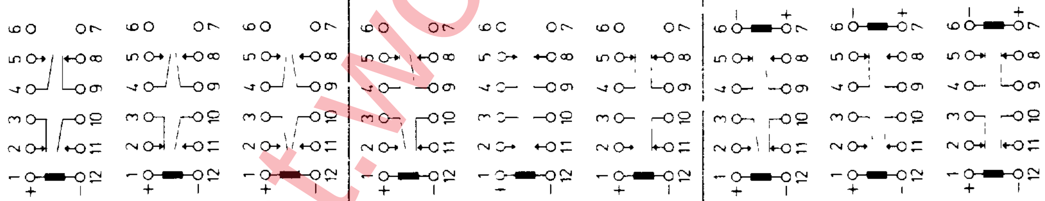
Max current make/const/break	A	20 / 5 / 5	Test voltage contact/contact/coil	V_{eff}	750 / 1500
Max break voltage	V	250	Upper temp limit (max storage temp)	C	+ 85
Max break power without → contact protection	W(VA)	100 (1000)	Permissible ambient temp for 100% utilisation	C	-55 / +65
Shock/vibration resistance	g-g/Hz	50–20 / 1000	Thermal resistance	K/W	65
Pick up/drop out/bounce time S2 | S3 S4	ms	8/5/1 | 9/5/2 | 10/5/2	Life 0 1 A, 10 V d c / 4 A 250 V a c	operations	2 10^8 / 10^5
Pick up/operating power, bi/monostable	mW	50–100 / 100–200	Life at various loadings (see fig 4)		
Insulation resistance 500 V d c	Ω	10^{10}	Efficiency η = max switching power x no of contacts (VA) / operating power (W) x relay volume (cm)	at 10^5 operations	5700 (11400)

Type

Type	S2	S3	S4	S2-L	S3-L	S4-L	S2-L2	S3-L2	S4-L2
Contact arrangement	2NO+2NC (2CO)	3NO+1NC (2NO+1CO)	4NO	2NO+2NC (2CO)	3NO+1NC (2NO+1CO)	4NO	2NO+2NC (2CO)	3NO+1NC (2NO+1CO)	4NO

Connection diagram
viewed from wiring side
Attention to polarity!

The contact configuration given in brackets is achieved by p-c-board connection of pins 3/4 on S3 or 3/4 and 9/10 on S2 Parallel switching of contacts increases permissible current Series switching increases voltage capability



Switching parameters

S2, S3, S4: Monostable relay, shown de-energised Switched by application of correct polarity

S2-L … S4-L2: Bistable relay with 1 or 2 coils Contact operation after or during excitation by indicated polarity Switched after impulse (8 ms) or permanent excitation of a coil with opposite polarity or C-circuit (fig 10)

Coilvoltage

rated voltage V	pick up voltage at 20 C V	drop out voltage at 20 C V	S2/S3/S4 Coil- permissible voltage at 40 °C V	resistance ± 10% Ω	no of turns	inductance ± 10% H	S2-L/S3-L/S4-L Coil- permissible voltage at 40 C V	resistance ± 10% Ω	no of turns	inductance ± 10% H	S2-L2/S3-L2/S4-L2 Coil- permissible voltage at 40 C V	resistance per coil ± 10% Ω	no of turns coil I	no of turns coil II	inductance per coil ± 10% H
1 5	1 1	0 15	2 7	11 3	700	0 006	4 2	22 5	810	0 009	3 6	11 3	400	400	0 002
3	2 1	0 3	5 9	45	1400	0 023	8 4	90	1700	0,04	5 9	45	800	800	0 01
5	3 5	0 5	10 1	130	2350	0 065	15 3	300	3100	0 14	10 1	130	1500	1500	0 031
6	4 2	0 6	11 9	180	2800	0 093	16 8	360	3100	0 14	11 9	180	1700	1700	0 04
9	6 3	0 9	17 7	400	4050	0 194	25 0	800	4700	0 31	17 7	400	2500	2500	0 087
12	8 4	1 2	23 7	720	5600	0 37	33 7	1450	6500	0 6	23 7	720	3500	3500	0 17
16	11 2	1 6	29 7	1130	7550	0 673	41 9	2250	7700	0 85	31 6	1280	4350	4350	0 235
24	16 8	2 4	47 2	2850	11000	1 427	66 7	5700	12000	2 05	47 2	2850	7000	7000	0 68
48	33 6	4 8	81 5	8500	17000	3 41	111 0	16000	25000	8 9	71 3	6500	9500	10000	1 25/1 39

Ordering example

S2-L – 12 V

type (see connection diagram)
coil voltage

Prices (excl VAT) in £/pce in qtys of

		1	50	100	500	1000	5000	10000
S2-/S3-/S4-	1 5, 3, 5, 6, 9 12 V							
	16 24 V							
	48 V							
S2-L-/S3-L-/S4-L-	1 5, 3, 5, 6 V							
	9 12 V							
	16, 24 V							
	48 V							
S2-L2-/S3-L2-/S4-L2-	1 5, 3, 5 6 V							
	9, 12 V							
	16, 24 V							
	48 V							
Plug-in socket type S-SS, S-NS								
Active plug-in socket type S-NS –	12, 24 V							

Approvals:

UL-approval E 43028
CSA LR 26550
VDE 0435/0110
Insulation class C to 250 V a c (300 V d c) for circuits not connected to the main system network
Insulation class B to 125 V a c (150 V d c) for circuits connected to the main system network

Patents:

A 357622 AUS 472096, 496595, 502682, BR 7308012, CDN 1008904, 1027155, 1037532, CH 571273 599679, CSSR 185214, D 2345638, 2454967, DDR 109766 117562, E 421697, F 2225827, 2271654, GB 1456861, 1456862, 1456863, 1506284, I 995850, 1038135 IRL 39962, R 76316, S 396503, 407305, UDSSR 704483 778718, USA 3946347, 3993971, ZA 73/9725

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All statements and data have been carefully tested by modern methods There could, however, be some deviation due to product tolerance spread Unless agreed in writing, all statements are nonbinding We reserve the right to make changes as deemed necessary Our Terms and Conditions of Sale apply

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S relay – Reliability and operational life – features

The S relay is an example of how the quality of a relay type can be dramatically improved by close attention to design and manufacturing detail Both purchase price and operational costs have been reduced whilst efficiency and life expectancy have been dramatically increased

A higher contact pressure with lower exc'tation has been achieved by combining a permanent flux and the excitation flux with four armature airgaps

The stored permanent magnetic force in the contact springs has increased the contact quality and efficiency

The twin linear contact configuration as shown in fig 1 guarantees low → constant contact resistance and → capacitance, fixed contact dimensions during a long → operational life, a high short circuit capability of 100 A (1 ms), and hence exceptionally high contact reliability

A new 5 layered contact design (fig 2) permits the switching of all loads between 1 μA and 5 A at 1 mV to 250 V d c or a c up to 100 W (or 1 kVA) and ensures a long operational life

Compared to the point contact style of contact, the twin linear contact configuration offers an approximately 5-fold increase in wear resistance due to its 5μ solid gold layer Hence the S relay is suitable for up to 10^5 operations at loads of 2 A, 15 V What is more on 40 test cycles each of 10^4 operations at 15 V, 2 A and 10^5 operations at 30 mV a c, 10μA, it gave in total 4 4 x 10^6 fault-free switching operations

The contact configuration has reduced the contact → bounce time (fig 3) to, on average, below 0 1 ms

The contact resistance of the sealed S relay remained during test below 20 mΩ after 1000 hours' immersion in 3–5 ppm H_2S at 40°C and 95% relative humidity The sealing consistency test complying with AQL 1 5 was carried out by submersing the relay in Flour-Carbon at 70°C for 3 Minutes This resulted in no bubble formation The test thus satisfied condition Qc2 of din 40046, page 15, point 3 3

- The minimum creepage path of the dual-in -line mounting pins is 3 7 mm and this fulfils insulation group C up to 250 V
- The strong mounting of the armature bearing on its shaft guarantees high shock and vibration resistance
- The pick-up and drop-out values remain in tolerance during the operational life (See diagram on pick-up/drop-out times on page 3)

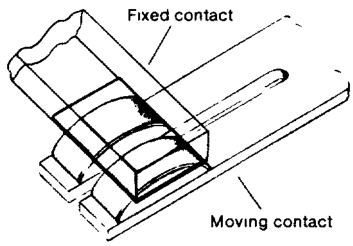


fig 1 Twin linear contact

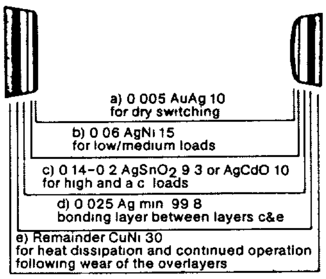


fig 2 New design of 5 layer contact

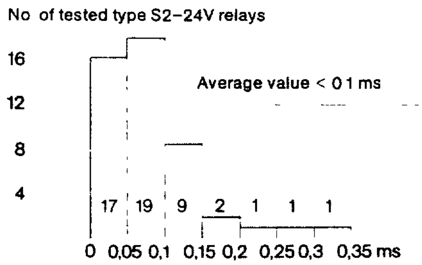


fig 3 Histogram of bounce times

Life duration

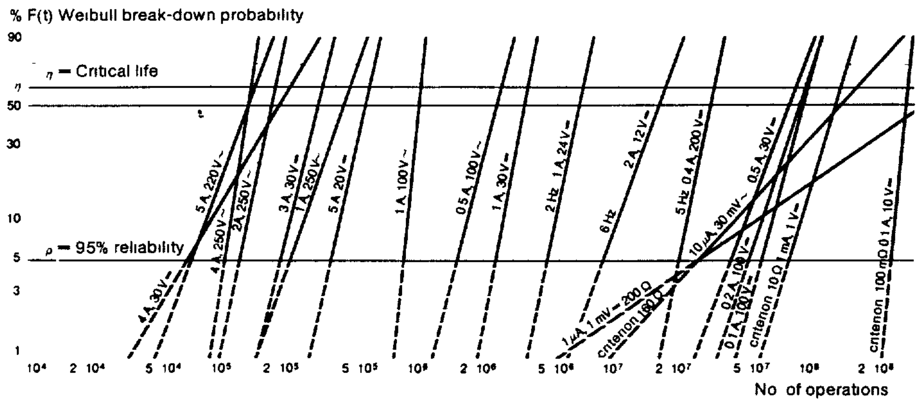
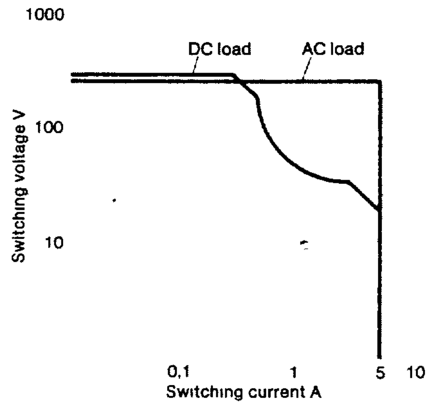


fig. 4 Weibull reliability data for various contact loadings with a critical break point at 100 mΩ, unless stated otherwise

Load-limite-curve



Contact resistance during operational life

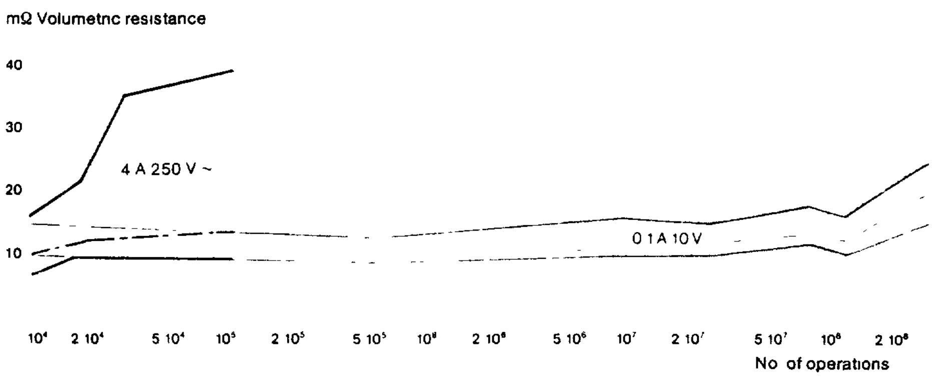


fig 5 Contact resistance conditions at 4 A, 250 V a.c After 18000 operations the volume resistance (contact + line resistance) amounted to 20 mΩ and after 10000 operations it increased to 38 mΩ At low loads the contact resistance remained practically constant during the 10^8 operations

S relay – The multi featured relay

HF characteristics

The relatively good HF characteristics of this S relay are due to the following

Low → capacitance

Short twin contact finger springs

High through power

Low contact resistance

Contacts shielded from armature

By series connection of the contacts the cross-talk attenuation can be improved

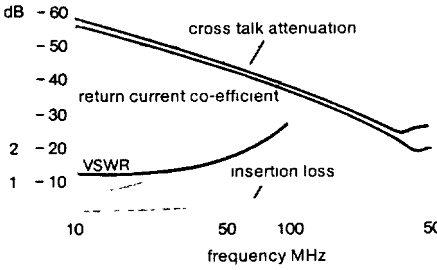


fig 6 HF characteristics of the S relay

Capacitance values ± pF

contact ungrounded	0,7
contact (coil grounded)	0,35
coil/fixed contact	1,15
coil/fixed contact (moving contact grounded)	0,9
coil/moving contact	1,4
coil/moving contact (fixed contact grounded)	1,15
contact set/contact set	0,6
contact set/contact set (coil grounded)	0,1

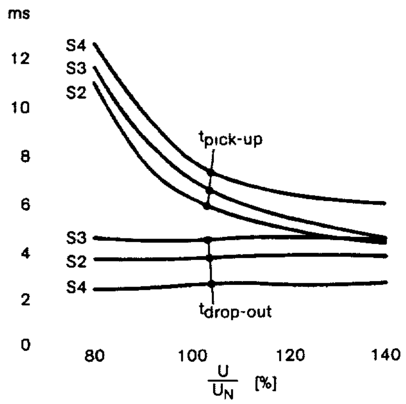
Thermovoltage

At normal coil excitation after 30 min at 25 – 29°C and 60 – 75% relative humidity

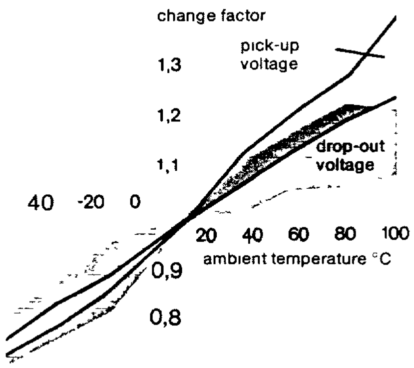
type S2	Connections	4–5	10–11		
	U_{th} [µV]	1,3 ± 0,6	2 ± 1		
type S4	Connections	2–3	4–5	8–9	10–12
	U_{th} ± 0,3 [µV]	2,3	1,5	1,8	1,9

With impulse operation of bistable S relays or switching via a C switching network (fig 10) the thermovoltage < 1 µV

Pick-up/drop-out times ± 20%

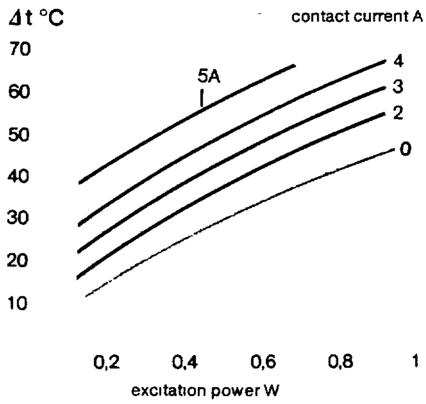


Temperature influence



Example A relay with a pick-up voltage of 8 V (20°C) picks up at 1 2 x 8 = 9 6 V at 60°C and at –40°C at 0 8 x 8 = 6 4 V

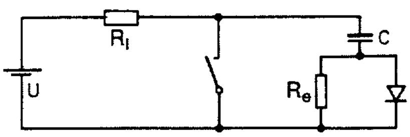
Coil heating (after 30 min switching)



If 4 contacts are simultaneously carrying 5 A then with normal excitation of 0 2 W, the max ambient temperature can be 50°C

Contact protection for d.c. operation

The following contact protection circuit is recommended to increase the contact life when switching high loads



R_l = Load resistance
R_e = Discharge resistor

Thus it is then possible to switch loads considerably in excess of 100 W To completely suppress an arc the value of the capacitor should be approx. 1 µF per ampère of switch-off current Thus with a current of 5 A a 4 7 µF capacitor should be used

The size of the discharge resistor R_e depends on the switching voltage and frequency Generally care should be taken that charging current + contact current are kept below 20 A. The overload current capacity of the diode must exceed the switching current.

Historical experience with the S relay

At „Electronica 74" the S relay was still the „Relay of the future" In October 1975 the first unit was delivered and today it has become one of the most specified relays on the world market

The S relay is unique in many respects, for its high efficiency, the switching range of between 1 nW to 1 kVA or its universal acceptability for mono- or bistable switching requirements with 4 contacts of various configurations

Since additionally it is hermetically sealed, has good HF characteristics and a low thermovoltage as well as being energy saving and highly reliable in operation, it finds wide use in such fields as measurement, control, information, signal and process technologies

S relays can also be used as coupling and linking elements within electronic circuits as well as interface relays for microprocessors or as storage elements

The rejection rate has sunk from an initial value of 1% to the current level of below 0 01% Only the sales price has in real terms, fallen by 15% since 1975 The supply is secured since S relays are now manufactured in West Germany, Japan and soon also in the USA

Due to the surface characteristics of the high quality gold contact assembly it is recommended that ultrasonic cleaning methods be avoided

Operation of the S relays

The S relay has a rotating armature
A permanent magnetic field is superimposed with the excitation flux across 4 air gaps This results in high efficiency and contact pressure at low energising power With monostable S relays the opposite pole faces are dissimilar Fig 8 shows the switching operation with mono or bistable configurations with one or two coils depending on the polarity of the exciting voltage
Thus at any given time a NO and a NC contact are linked like a changeover contact For NO contacts, the top half, and for NC contacts the bottom half of the time axis is used The excitation pulses ABEFHJL indicate that a monostable polarised relay with constant polarity applied operates in normal circumstances like an un-polarised relay Changing over the polarity at the coil does not affect the contact operation Bistable relays change the contact position with the applied voltage polarity and remain in that state even when the excitation voltage is interrupted

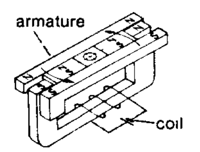
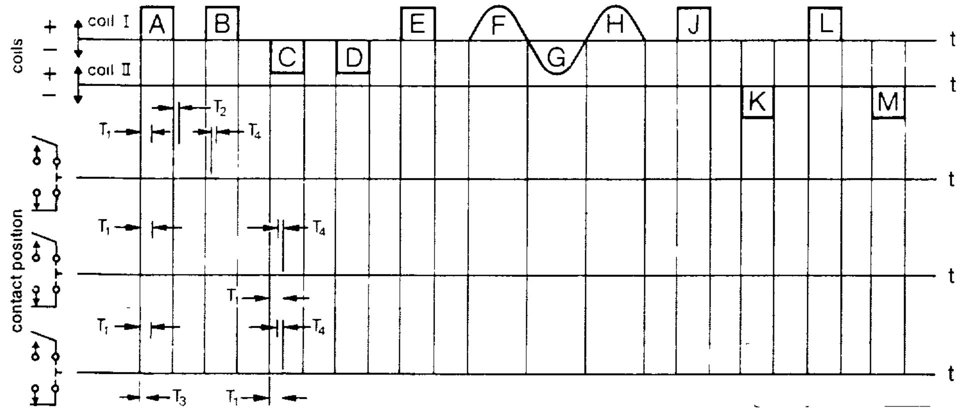


fig 7 Magnet system of the S relay

Uses Amplifiers, choppers changing sine waveform into rectilinear pulses (FGH)
Bistable relays with two coils permit particulary elegant efficient solutions to switching problems e g If a coil is pulsed for > 4 ms then a contact will open or close as appropriate until the other coil is pulsed with the opposite polarity



Excitation voltage on coil I

Excitation voltage on coil II

Monostable S relay
type S2 (2NO, 2NC contacts)
type S3 (3NO, 1NC contacts)
type S4 (4NO, contacts)
also see relays with C switching

Bistable S relay with I coil
type S2 (2NO, 2NC contacts)
type S3 (3NO, 1NC contacts)
type S4 (4NO contacts)

Bistable S relay with 2 coils
type S2 (2NO, 2NC contacts)
type S3 (3NO, 1NC contacts)
type S4 (4NO contacts)

fig 8 Switching mode of various S relays with an example of a NO and NC contact or alternatively of a combined changeover pair

T_1 = pick-up time T_2 = drop-out time
T_3 = response time T_4 = transition time

Special user examples of the S relay

As [illegible] relay

If the electronic switching element shown in fig 9 is connected with a relay of type S2-L2, S3-L2 or S4-L2, then the relay assumes the properties of a latch relay e g with an impulse of the same polarity the relay switches momentarily in the opposite sense
A relay contact is used in this control circuit
All other data on the S relay remains the same

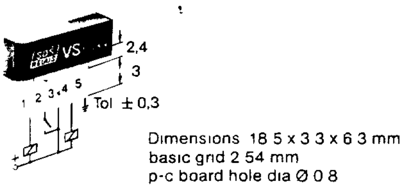
As ultra-modern relay

- 99% saving of energising power
- Thermovoltage < 1 µV at 100% operation
- Pick-up/drop-out time approx 3 or 2 ms
- Ratio, pick-up/drop-out voltage approx 1 2

The C switching circuit shown in fig 10 bestows monostable operation on bistable relays so that only during the pick-up time is there any power consumed
(See SDS IC data sheet)

As time relay

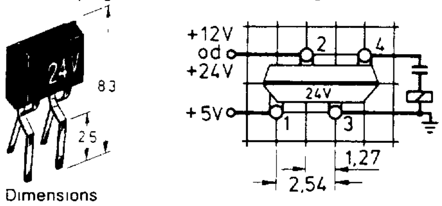
By using the C switching circuit and parallel switching of the capacitor at the input to the IC module, it is possible to increase the drop-out time to approx. 30 s The achievable drop-out time delays are then
≈ 0 26 s/µF



Dimensions 18 5 x 3 3 x 6 3 mm
basic grid 2 54 mm
p-c board hole dia Ø 0 8

fig 9 VS Electronic module

See also plug-in socket with C switching



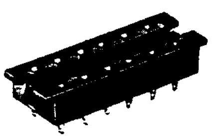
Dimensions
l x b x h = 5 x 1 8 x 4 mm

p-c board hole dia Ø 0 8

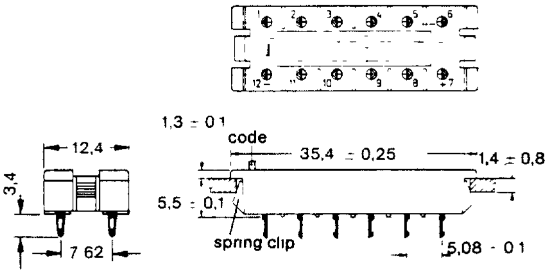
fig 10 IC for C switching

Plug-in socket type S-NS

For p-c board or chassis mounting

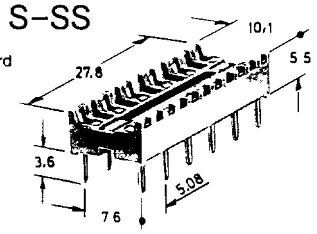


p-c board hole dia 1 3 + 0 1
chassis punching 12 6 x 33 1 ± 0 1



Plug-in type S-SS

p-c board hole dia 1 mm



Plug-in circuit with C switching circuit

The S–NS is also available with an in-built C switching circuit to become an active plug-in socket for, 12 V and 24 V coil voltages. It bestows monostable switching capability on single coil bistable relays whose rated coil voltage is approx. 50% less. e.g. relay S2-L-6 V for plug-in socket S-NS-12 V excitation voltage. → Ultra modern relay.
The internal connection of the C switching circuit are shown in blue. Control is made via connections 7 (+) and 12 (–).
When using the active S–NS in existing p-c boards which have been designed for S2- and S4-relays the S–NS socket must be turned in relation to the p-c board by 180°.

Distributor