/// Plug-in railway relay with 4 C/O contacts

Rugged plug-in relays for extreme reliability, within long endurance applications and harsh environments

TDB4-U200N
Timer relay
Part of D-platform

Description

Plug-in electronic railway timer relay with four change-over contacts for reliable switching of very low currents (1 mA @ 5 VDC) up to currents of 10A @ 110VDC. When the relay is activated there is a delay on pull-in. The delay time is adjustable with a lockable knob. The relay can also be supplied with a fixed time delay (no knob).

The relay is equipped with two LEDs which indicate the presence of power supply and the energizing of the coil.

The built-in magnetic arc blow-out ensures adequate DC breaking capacity resulting in long contact life. The integrated contact separation prevents cross pollution of contacts. On the relay cover the serial number and data matrix code are shown for ease of traceability.

The construction of the relay and choice of materials makes the TDB4-U200N relay suitable to withstand low and high temperatures, shock & vibration and dry to humid environments.

No external retaining clip needed as integrated 'snap-lock' will hold relay into socket under all circumstances and mounting orientations.

Compact design, choice of many options and a wide range of sockets makes the TDB4-U200N relay an easy and flexible solution to use.

Optional greenline version with energy saving of more than 50 % and contact configuration 2 C/O + 2 N/O contacts.

Features

- Time delay relay, delay on pull-in
- Compact plug-in design
- 4 C/O contacts
- Delay time adjustable with a lockable knob
- Also available with fixed time delay
- Magnetic arc blow-out ensuring long contact life
- Two LEDs for status indication, red or green
- Integrated back EMF suppression diode
- Minimum switching current 1 mA
- Maximum continuous current 10 A
- Wide temperature range -40 ºC...+70 ºC
- Mechanical life > 30 million operations
- Electrical life e.g. > 10 million operations at 0.5 A, 24 VDC
- Data matrix code with serial number for traceability
- Integrated snaplock, no external retaining clip needed
- Transparent cover for visual inspection
- Many options and sockets available

Connection diagram
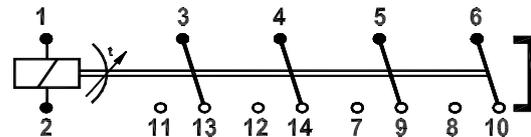
Application

The TDB4-U200N is used in demanding rolling stock applications where a time delay is necessary after activating the relay. Relays continue to play a vital role in reliable train operation. Key functions are galvanic isolation between control (computers/ PLC's) and power circuits providing system isolation, contact multiplication and amplification.

Other unique features are:
- predictable failure behavior (Fail Safe) making system safety validation a lot more simple than using computer based solutions like PLC's
- long term availability (no obsolescence)
- easy maintenance by plug-in feature and transparent cover
- unlike more sensitive electronics, relays are insensitive to EMI

Using these features one can build a hardwired, fail safe control system which is cyber secure and insensitive to electro magnetic disturbances and surges. Relays are ideal to use in trains for signal transfer/repeat, safety interlocking functions (brake - doors), load on-off switching and sub-system isolation.

Railway compliancy

|	
EN 50155: 2017	EN 50121-3-2: 2016
IEC 60571: 2012	EN 45545-2: 2020
IEC 60947-5-1: 2016	NF F16-101/102
IEC 61373: 2010	IEC 60947-5-4: 2002

CE   CCC   UKCA

Timer relay
TDB4-U200N

Options

- Gold plated contacts
- Greenline > 50% energy saving
- IP50 dust protection
- LED indicators green or red
- AgSnO$_2$ contacts, weld resistant for capacitive loads
- Double zener diode
- AC/DC coil
- Double make/double break contacts
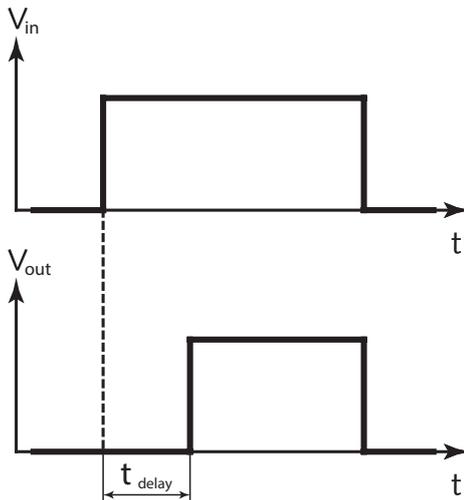- Keying (coding relay to correct socket)

Remark: Not all combinations possible
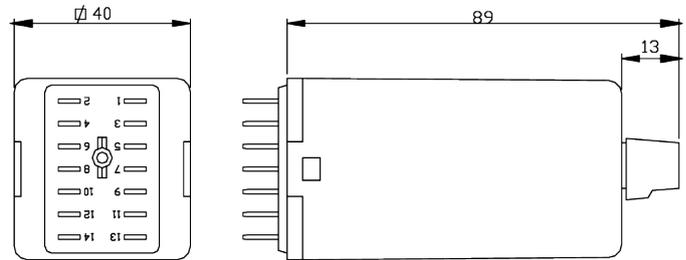
Timing diagram

Dimensions (mm)

Remark: Please note that the physical relay only has numbering on pins 1, 2, 13 and 14.

Weight

~ 145 g

Serializing

Each relay is marked with a unique serial number to which link important information and test results.

The GTIN (Global Trade Item Number) and part number are printed on each relay in both text and data matrix code according the worldwide recognized GS1 standard, being able to scan each relay for logistical and traceability purposes.

Sockets

		Mounting			
		Surface / Wall	35 mm rail	Panel / Flush	PCB
Terminal connection	Screw	V23	V23	-	-
	Screw - wide terminals	V22 BR	V23 BR	-	-
	Spring clamp	V29	V29	V33	-
	Faston	-	-	V31	-
	Crimp	-	-	V26	-
	Solder tag	-	-	V3	-
	PCB	-	-	-	V32

For more information see the respective datasheets

Technical specifications

Time delay characteristics

Time delay function	Delay on pull-in
Available adjustable time ranges	0-1 s 0-3 s 0-6 s 0-10 s 0-30 s 0-60 s 0-180 s 0-6 min 0-10 min 0-30 min 0-60 min
Available fixed time	Any time between 0 s - 60 min (on request)
Accuracy Adjustable time	Maximum deviation between visual setting of the knob and set time is ± 8 % of full scale value
Adjustable time, pre-set in factory	Maximum deviation ± 4 % of full scale value
Fixed time	Maximum deviation ± 0.5 % of fixed time
Repeatability Adjustable time	Maximum deviation ± 2 % of set time
Fixed time	Maximum deviation ± 0.5 % of fixed time
Time variation vs voltage variation	± 0.05 % / % U_{nom}
vs temperature variation	± 0.02 % / K
Pull-in time	Depending on pull-in time setting (xx)
Recovery time[1]	± 0.1 %
Release time	< 30 ms
Maximum permissible ripple	50 %
Example time delay : Time range 0.3...3 s Time delay set on 2 s : delay will be between 1.7 s...2.3 s For example: 2.0 s. The ambient temperature is 40 degrees Celsius which is 20 degrees different compared to the standard 20 degrees Celsius. This results in 0.4 % extra time variation. The applied voltage is 30% lower than the nominal voltage. This results in 1.5 % extra time variation. The total maximum time variation is then 0.5 % (repeatability) + 0.4 % (temperature variation) + 1.5 % (voltage variation) = 2.4 %. In this case every new pulse will be between 1.95 s and 2.05 s.	

[1] Required time between de-activating and re-activating the relay to guarantee correct working

Coil characteristics

Operating voltage range	0.7...1.25 U_{nom}
Nominal power consumption During time delay	< 0.875 W (220 V) < 0.375 W (110 V) Lower voltage = lower power
After time delay	< 3.6 W (220 V) < 3 W (110 V) Lower voltage = lower power

Type	U_{nom} (VDC)	U_{min} (VDC)	U_{max} (VDC)	U_{reset} (VDC)	$U_{drop-out}$ (VDC)
TDB4-U201N-xx	24	16.8	30	11	2.4
TDB4-U207N-xx	36	25.2	45	11	3.6
TDB4-U202N-xx	48	33.6	60	11	4.8
TDB4-U203N-xx	72	50.4	90	11	7.2
TDB4-U205N-xx	96	67.2	120	44	9.6
TDB4-U204N-xx	110	77.0	138	44	11.0

Other types on request

Remarks:
- Umin is the must-operate voltage at which the relay will pick up in all circumstances (worst-case situation), in practice the relay picks up at a lower voltage (take the time delay into account)
- Udrop-out is the must-release voltage at which the relay has dropped-out in all circumstances (worst-case situation), in practice the relay drops out at a higher voltage (Urelease)
- Ureset: Electronic time function resets below this value and LED is OFF below this value
- Always select the nominal voltage as close as possible to the actual voltage in the application

Contact characteristics

Contact configuration		4 C/O
Peak inrush current	NF F 62-002	200 A (withstand > 10 x 200 A @ 10 ms, 1 min) 80 A (withstand > 10 x 80 A @ 200 ms, 1 min) 40 A (withstand > 10 x 40 A @ 500 ms, 1 min) 30 A (withstand > 10 x 30 A @ 1000 ms, 1 min)
Maximum continuous current		10 A
Maximum switching voltage		250 VDC, 440 VAC
Minimum switching voltage*		5 V
Minimum switching current*		1 mA
Maximum breaking capacity (> 50.000 operations)		110 VDC, 10 A (resistive load) 72 VDC, 5 A (L/R ≤ 40 ms) 110 VDC, 0.5 A (L/R ≤ 40 ms)
Contact resistance		≤ 15 mΩ (initial)
Material		Ag standard (optional $AgSnO_2$, Au on Ag)
Contact gap		0.7 mm
Contact force		> 200 mN

* Standard silver contacts tested in lab conditions. However we strongly advise to always use gold plated contacts when switching very low currents, as long time reliable operation depends also on switching frequency and environmental conditions. Take recommendations for long time reliability on page 11 into account.

Contact reliability according IEC 60947-5-4

Contact switching load	Contact material	Failure rate λ_c*	Mean number of operating cycles to contact failure m_c*
1 mA , 5 VDC resistive	Gold (option E)	5×10^{-8}	20.000.000
5 mA , 24 VDC resistive	Gold (option E)	4×10^{-8}	25.000.000
10 mA , 50 VDC resistive	Silver (standard)	2×10^{-8}	50.000.000

*at confidence level 90%

Note: tested in laboratory environment at ambient temperature 20 ºC. To underline the reliability of low current switching in parallel a 1 mA / 5 V test was done using standard silver contacts, resulting in the same reliability. But since real train conditions are far different from lab conditions we strongly advise gold plated contacts for such low contact ratings. Take recommendations for long time reliability on page 11 into account.

Electrical characteristics

Dielectric strength	Pole-pole Cont-coil Open contacts	4 kV, 50 Hz, 1 min 2.5 kV, 50 Hz, 1 min 2.5 kV; 50 Hz; 1 min
Clearance and creepage according IEC 60664-1 / EN 50124-2		
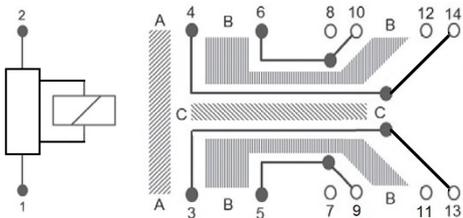
Section	Clearance	Creepage	Material group	Unom*
A	≥ 4.0 mm	≥ 4.0 mm	I (CTI600)	≤ 450 V
B	≥ 3.0 mm	≥ 3.0 mm	I (CTI600)	≤ 300 V
C	≥ 6.1 mm	≥ 6.1 mm	I (CTI600)	≤ 696 V

*For basic insulation, PD2 and OV3

Pulse withstanding	IEC 60255-5	5 kV (1.2/50 µs)
Insulation resistance	EN 50155	> 20 MΩ (test voltage 500 VDC)
EMC	EN 50121-3-2	Compliant

Mechanical characteristics

Torque value screw to lock knob	0.2-0.4 Nm

Environmental characteristics

Vibration	IEC 61373, Category I, Class B, Body mounted
Shock	IEC 61373, Category I, Class B, Body mounted
Operating temperature	-40 °C...+70 °C
Operating temperature class	OT4
Humidity	93%
Maximum altitude	2000 meter. Higher altitudes are possible but have consequences mentioned in IEC 60664 (for example 5000 meter with bigger clearance distance)
Salt mist	IEC 60068-2-11, class ST4
Dry heat	IEC 60068-2-2 test Be
Damp heat	IEC 60068-2-30, Test method Db variant 2
Protection	IEC 60529, IP40 (relay on socket) (with option K: IP50)
Fire & smoke	NF F 16-101, NF F 16-102, EN 45545-2: HL3 for requirements R22, R23, R26
Insulation materials	Cover: polycarbonate Base: nylon
Natural cooling or forced ventilation constraints for the equipment	None: no extra measures necessary, relays can be mounted tightly together to save space
REACH: Registration, Evaluation, Authorisation and Restriction of Chemicals	European Regulation No 1907/2006

RAMS features

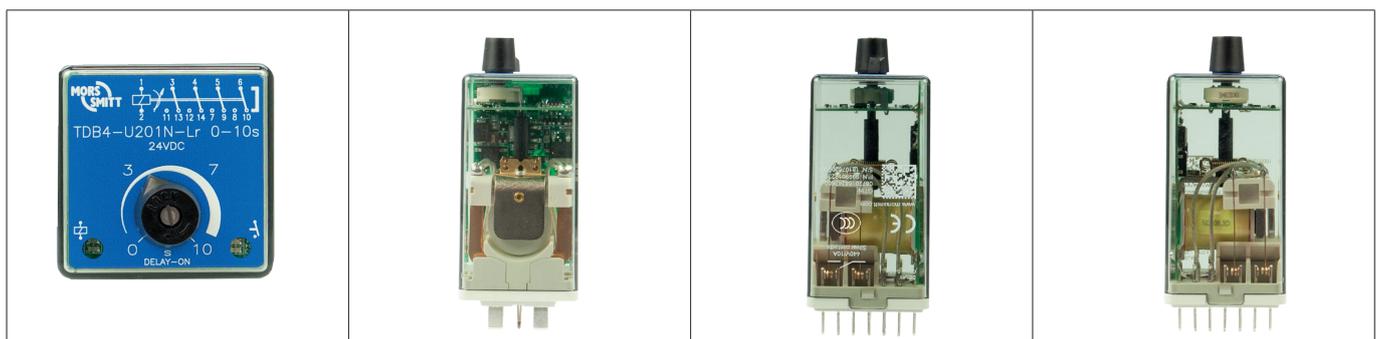| Life class	L4 (Useful life 20 years, take electrical life cycle curves into account)
Repairability	Non-repairable
Maintenance instructions	See inspection/maintenance on page 12

Reliability / lifetime
   Mechanical lifetime
 	
   Low energy electrical lifetime
   High energy electrical lifetime
	> 30 million operations, maximum switching frequency 1 Hz
	(1 million operations at -40 ᵒC)
	5 million operations, maximum switching frequency 1 Hz
	See life cycle curves on page 8

Storage precautions	Storage temperature: -50 °C…+85 °C Store in original packaging Silicon free environment

Product labeling

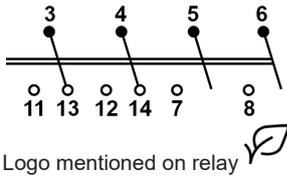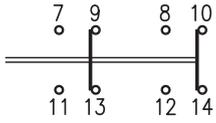| Part number identification	Part number mentioned on top side relay
Serial number identification	Serial number mentioned on top side relay Serial number = Lot number + year + week + reference number
Data matrix code	According GS1 standard, placed on top side relay 01 Global Trade Item Number 240 Part number 21 Serial number Example: 0112345678901232401234567892112345622209001
Revision index identification	Linked to serial number
Terminals	Identification on bottom plate relay Relay to be used with Mors Smitt relay sockets which have clear terminal identification on each socket

Railway compliancy

EN 50155: 2017	Railway applications - Rolling stock - Electronic equipment
IEC 60571: 2012	Railway applications - Electronic equipment used on rolling stock
IEC 60947-5-1: 2016 / IEC 60947-5-4: 2012	Low-voltage switchgear and controlgear
IEC 61373: 2010	Railway applications - Rolling stock equipment - Shock and vibration tests
EN 50121-3-2: 2016	Railway applications - Electromagnetic compatibility
NF F16-101/102	Railway rolling stock - Fire behavior
EN 45545-2: 2020	Railway applications - Fire protection on railway vehicles Part 2: Requirements for fire behavior of materials and components

Options

Code	Description	Remark	Cannot be combined with:
Standard options:			
E*	Au; Gold plated contacts		M
G	Greenline: > 50 % energy saving	2 C/O and 2 N/O contacts Logo mentioned on relay	Y
K	Extra dust protection	IP50 Cat 2 for the relays mounted in a Mors Smitt socket. Application PD1/PD2 and contact load > 0.5 A.	
Lg**	Green LED indicators		
Lr**	Red LED indicators		
Q	Double zener diode over coil	Maximum allowed peak voltage 180 V, higher voltage will damage the diode.	X2
Y	Double make/double break contacts, contact gap 1.4 mm	2 C/O DM/DB	G
Keying	Coil coding relay	Also order socket with keying	
Special options:			
M	AgSnO$_2$; "non-weldable" contacts, used for capacitive loads e.g. LED lighting	Icontact > 100 mA	E
X2	AC/DC coil		Q

| * Gold plated contacts characteristics	
Material	Ag, gold plated
Maximum switching voltage	60 V (higher voltages may be possible, contact Mors Smitt for more information)
Maximum switching current	400 mA (at higher rate gold will evaporate, then the standard silver contact rating of minimum 10 mA and 12 V is valid)
Minimum switching voltage	5 V
Minimum switching current	1 mA
** Lg or Lr must be selected in the ordering scheme to have the correct LED color	

Remark: For application support or technical product support, contact your local Mors Smitt sales office (see contact details on last page).

Electrical life expectancy

Resistive loads

Inductive loads

Inductive loads
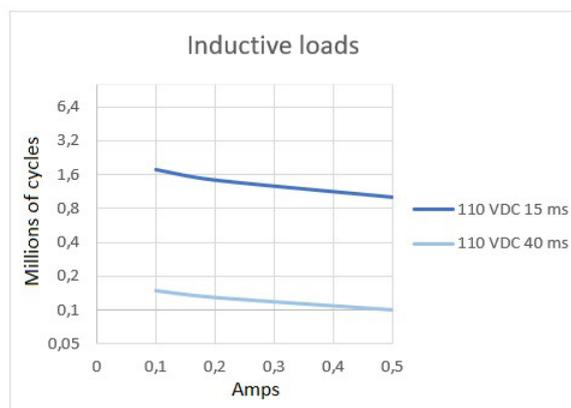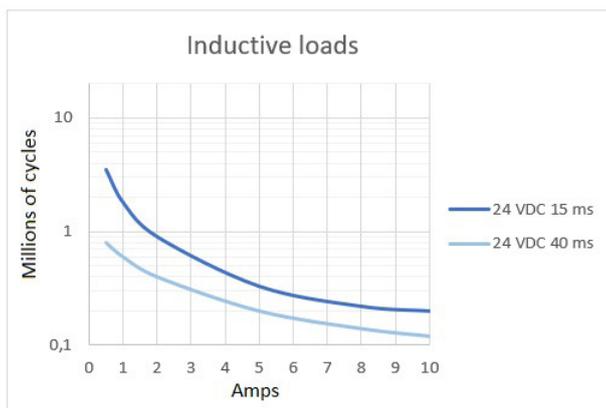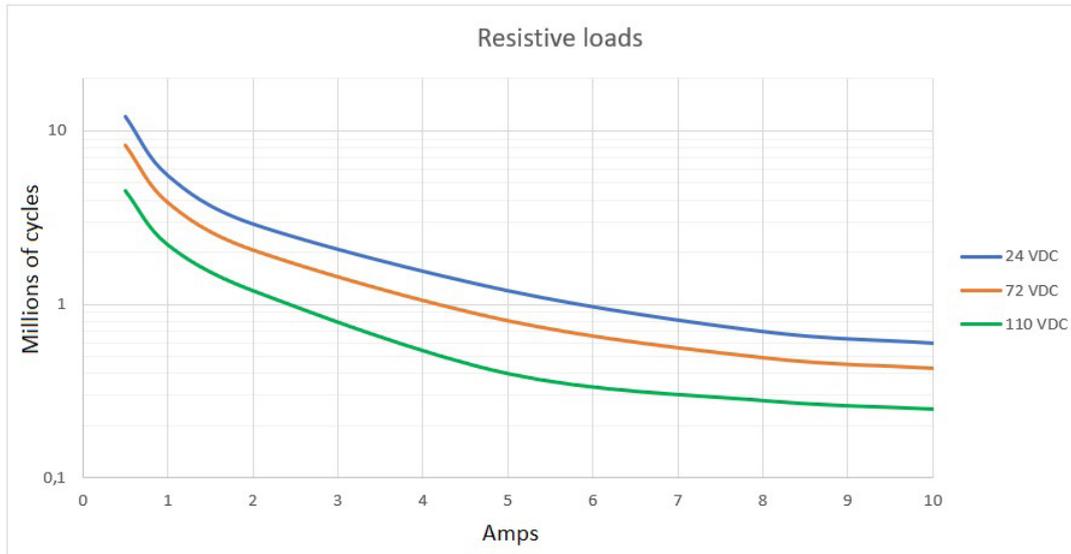
By connecting 2 contacts in series the DC current breaking capacity is increased by 50 %. Electrical lifetime is tested under laboratory conditions with switching frequency 0.33 Hz.

Note: The actual electrical lifetime in the application is affected by the switching frequency, type of contact (N/O or N/C), environmental conditions, etc.

For highly inductive loads Mors Smitt A400/B400 relays with standard double make double break contacts are the optimal solution.

Self-cleaning contacts

Each contact attracts organic molecules. When the surface is loaded with a voltage, like a relay contact, the attracting force is even higher. Therefore on each contact surface there is organic "pollution".

Mors Smitt relays are designed to self-clean during switching of the contacts:

1. Mechanical wiping action: the "pollution" is swept aside.
    The movement of opposing contacts when they make contact: this wiping action cleans the surface of both contacts. Mors Smitt relays are designed for optimal wiping action: enough to clean the surface and not too much to prevent contact wear.
2. Electrical cleaning: the "pollution" is burnt away.
    A current at sufficient level will evaporate organic "pollution". When switching loads (typically of a current >100 mA), the "pollution" is totally burnt away and a clean contact surface is available.

This results in reliable contact operation without interference due to contact pollution.

Mounting possibilities/sockets

V3	V22BR	V23	V23BR	V26
V29	V31	V32	V33	

Surface/wall mounting

338000302	V22BR	Screw socket, wall mount, front connection (9 mm terminals)
338000580	V23	Screw socket, wall mount, front connection (7.5 mm terminals)
338000610	V29	Spring clamp socket, wall mount, front dual connection (2.5 mm^2)

Rail mounting

338000580	V23	Screw socket, rail mount, front connection (7.5 mm terminals)
338000402	V23BR	Screw socket, rail mount, front connection (9 mm terminals)
338000610	V29	Spring clamp socket, rail mount, front dual connection (2.5 mm^2)

Panel/flush mounting

|		
338100100	V3	Solder tag socket, panel mount, rear connection
328400100	V26	Crimp contact socket, panel mount, rear connection, A260 crimp contact
338000560	V31	Faston connection socket, rear dual connection (4.8 x 0.8 mm)
338000670	V33	Push-in terminal socket, panel mount, rear dual connection (3.3 mm^2)

PCB mounting

338000561	V32	PCB soldering socket

No external retaining clip needed as the 'snap-lock' will hold the relay into the socket under all circumstances and mounting directions (according shock & vibration requirements IEC 61373, Category I, Class B, Body mounted). If regulations require external retaining clips, these are available as well.

For more details see datasheets of the sockets on www.morssmitt.com
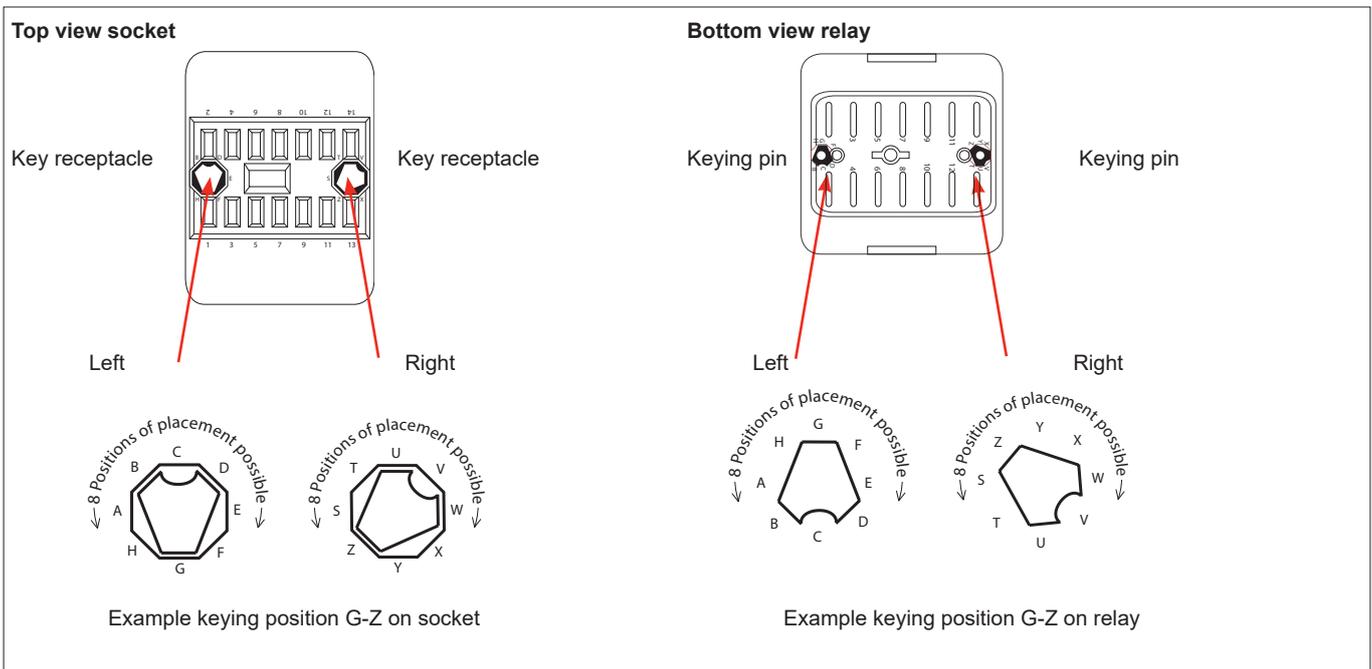
Mechanical keying relay and socket (optional)
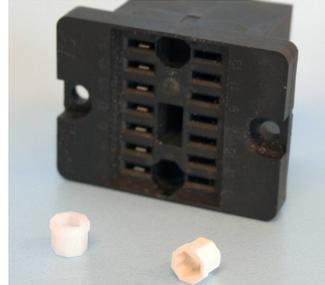
Function:
- To prevent wrong installation
- To prevent damage to equipment
- To prevent unsafe situations

Using keyed relays and sockets prevents a relay is inserted in a wrong socket. For example it prevents that a 24 VDC relay is put in a 110 VDC circuit. Positive discrimination is possible per different function, coil voltage, timing, monitoring, safety and non-safety.

The D relay keying option provides 8 x 8 = 64 possibilities. Upon ordering the customer simply indicates the need for the optional keying. Mors Smitt will assign a code to the relay and fix the pins into the relay. The sockets are supplied with loose key receptacles. Inserting the keys into the socket is very simple and self explanatory.

Remark: Sockets and relay shown are examples.

Top view socket

Key receptacle   Key receptacle

Left   Right

Example keying position G-Z on socket

Bottom view relay

Keying pin   Keying pin

Left   Right

Example keying position G-Z on relay

Remark: Please note that the physical relay only has numbering on pins 1, 2, 13 and 14.

Important for relay selection and operation

Make sure the relay is suitable for the application. For critical applications (for example: green loop applications) relays should be checked for proper operation during periodic inspection.

Contact switching current

Each relay has a range of switching currents in which it performs optimally: the sweet spot. As switching currents are decreasing in field applications, the TDB4-U200N relay has an improved sweet spot compared to its predecessors.

TDB4-U200N with gold contacts
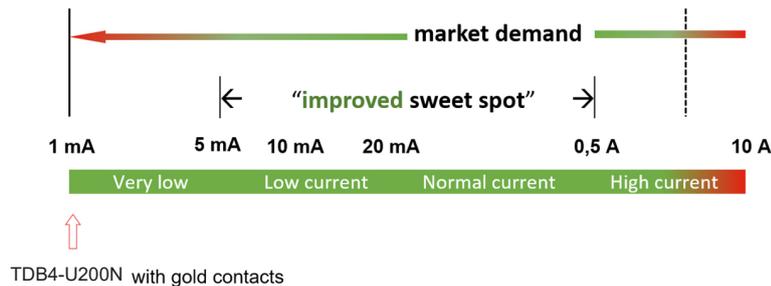
Recommendations for long time contact reliability

For relays to enable failure free performance over a very long operational time, it is important to create the right circumstances. In any relay, contact usage and atmospheric conditions influence the contact surface. To counter this effect it is common practice to use a safety factor of > 2 to ensure long time contact reliability.

Therefore for long time contact reliability we recommend:
- Silver contacts: a minimum contact current of 20 mA per contact
- Gold contacts: a minimum contact current of 10 mA per contact
- Double Make Double Break contacts: a minimum contact current of 40 mA per contact
- When low currents are switched not frequently, e.g. 10 mA once a day, it is advised (next to gold plated contacts) to put similar contacts within the same relay in parallel
- With higher load switching, e.g. 110 VDC and > 1 A, put relay contacts in series
- Rule of thumb: any relay works best with switching currents > 20 mA in DC environment when frequently switched. When not switched frequently a higher switching current like 50 mA is better for a long reliable operational time
- When switching capacitive loads (e.g. LED lighting) always use silver tin oxide contacts (minimal contact current 100 mA)
- Check relays regularly, for example with the Mors Smitt Portable Relay Tester and visually through the transparent cover

Instructions for use

Installation

Before installation or working on the relay: disconnect the power supply first (no hot swapping)! Install socket and connect wiring according to the terminal identification. Plug relay into the socket ensuring there is no gap between the bottom of relay and the socket. Reverse installation into the socket is not possible due to the mechanical blocking snap-lock feature. Check to ensure that the coil connection polarity is not reversed. Relays can be mounted tightly together to save space. When rail mounting is used, always mount the socket in the direction of the UP arrow, to have proper fixation of the socket on the rail.Torque value screw to lock knob: 0.2-0.4 Nm

Warning!
- Never use silicon in the proximity of the relays
- Do not use the relay in the presense of flammable gas as the arc generated from switching could cause ignition
- To remove relays from the socket, employ up and down lever movements. Sideway movement may cause damage to the coil wires
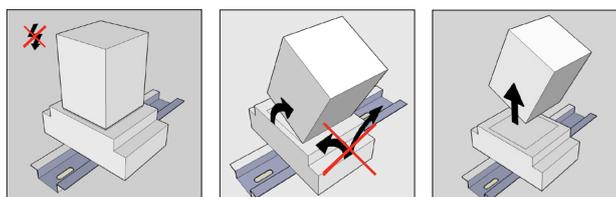
- Relays should never be swapped to other circuit positions when taken out of its socket for inspection or fault finding, always place it back into the original position to prevent contact resistance problems. Contact resistance problems can be created when swapping relays between different circuit loads due the contact wear/condition having changed during its operational life.

Operation

After installation always apply the rated voltage to the coil to check correct operation. Long term storage may corrode the silver on the relay pins. When plugging the relay into the socket, the female bifurcated or trifurcated receivers will automatically cut through the corrosion on the pins and guarantee a reliable connection.

Before actual use of relays, it is advised to switch the load several times with the contacts. The contacts will both be electrically and mechanically cleaned due to the positive wiping action. Sometimes a contact can build up increased contact resistance ($\leq$ 15 mΩ when new). When using silver contacts one can clean the contact by switching a contact load a few times using >24 VDC & ~ 2A. Increased contact resistance is not always problematic, as it depends on circuit conditions. In general a contact resistance of 1 Ω is no problem, consult Mors Smitt for more information.

Condensation inside the relay housing can occur when it moves from a warm (and humid) environment to a colder environment. This is a normal phenomenon and will not affect the function of the relay. Materials in the relay have no hygroscopic properties.

Inspection / maintenance

Correct operation of the relay can easily be checked as the transparent cover provides good visibility of the moving contacts. If the relay does not seem to operate correctly, check for presence of the appropriate coil voltage and polarity using a suitable multimeter. If a LED is fitted, it indicates voltage presence to the coil. If coil voltage is present, but the relay does not operate, a short circuit of the suppression diode is possible (this may have been caused due to reversed coil connection).

Relays can easily be tested with the Mors Smitt Relay Tester. More information on: www.morssmitt.com.

If the relay doesn't work after inspection, replace the relay with a similar model. Do not attempt to open the relay cover or try to repair. Contacts are calibrated and in balance, touching can affect proper operation. Also resoldering may affect correct operation. Since 2009 relays have tamper proof seals fitted and once broken, warranty is void.

Most relay defects are caused by installation faults such as overvoltage, spikes/transients, reversed coil connection, high/short current far exceeding the relay specifications. When returning the relays for investigation, please provide all information on the RMA form. Send defective relays back to the manufacturer for repair or replacement. Normal wear and tear or external causes are excluded from warranty.

RMA procedure see www.morssmitt.com

Ordering scheme

TDB4-U2		N -			Code		

Coil voltages							Cannot be combined with:
	01				24 VDC		
	02				48 VDC		
	03				72 VDC		
	04				110 VDC		
	05				96 VDC		
	07				36 VDC		

Options						Cannot be combined with:
(add as many options as needed, always in alphabetical order)	**E**		Gold plated contacts			M
	G		Greenline > 50 % energy saving			Y
	K		Extra dust protection, IP50			
	Lg*		Green LED indicators*			
* a LED indicator is MANDATORY	**Lr***		Red LED indicators*			
	Q		Double zener diode			X2
	Y		Double make/ double break			G

Special options						
(minimum order quantity: 20)	**M**		AgSnO$_2$ contacts, highly resistant to welding			E
	X2		Coil for both DC and AC			Q

Time range Delay-on					
		0-1 s			
		0-3 s			
		0-6 s			
		0-10 s			
		0-30 s			
		0-60 s			
		0-180 s			
		0-6 min			
		0-10 min			
		0-30 min			
		0-60 min			
		Fixed		No knob	

Keying code (optional, leave blank if not required)

Remark: keying codes are available for all possible coil voltages.

		Standard, silver contacts	
	AS	24 VDC	
	AY	36 VDC	
	AT	48 VDC	
	AU	72 VDC	
	AV	110 VDC	
		Option E, gold contacts	
	DT	24 VDC	
	FV	36 VDC	
	HU	48 VDC	
	AZ	72 VDC	
	HV	110 VDC	
		Option M, silver tin oxide contacts	
	GT	24 VDC	
	HT	36 VDC	
	GU	48 VDC	
	GV	72 VDC	
	GW	110 VDC	

Examples:

TDB4-U201N-LrQY 0-30 s (12 s)
Description: TDB4-U201N relay, Unom 24 VDC, red LED indicators, double zener diode, double make/double break contacts, adjustable time range 0-30 s and preset by factory on 12 s.

TDB4-U203N-LgMX2 24 min code AZ
Description: TDB4-U203N relay, Unom 72 VAC/DC, green LED indicators, AgSnO$_2$ contacts, AC/DC coil, fixed time delay 24 minutes, keying code AZ.

🌍 Over 11 million Mors Smitt relays in use in rail transport applications worldwide!

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