TDMB4-U200N

Multi-Function Timer Relay

Features

- Compact plug-in relay, 10 different time delay functions
- Wide time setting ranges from 0.1s to 99 hours
- 3 C/O contacts + 1 N/C time delayed contacts
- Led indication for power and coil energization
- High electromagnetic interference immunity
- Solid and rugged construction for heavy or intensive duty, considerable long-life
- Independent and self-cleaning contacts
- Magnetic arc blow-out ensuring long contact life
- Transparent cover
- Excellent shock and vibration resistance
- Wide range of sockets
- Continuous current: maximum 10A.
- Back EMF protection diode

Functional Description

The TDMB4-U200N is a multi-function relay with electronic time delay, consisting of 3 change-over contacts, and 1 Normally closed contact, for reliable switching of very low currents (1mA @5 VDC) up to currents of 10A @ 110VDC.

A single TDMB4-U200N relay offers 10 different timer functions, freely programmable by the user. The switching time can be selected within a wide range extending from 0.1 seconds to 99 hours. The timer function, the scale, and the switching time are adjustable by means of 4 rotary switches, each having 10 positions, located on the top of the relay. The relay is equipped with two LEDs which indicate the presence of power supply and the energizing of the coil.

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.

Application

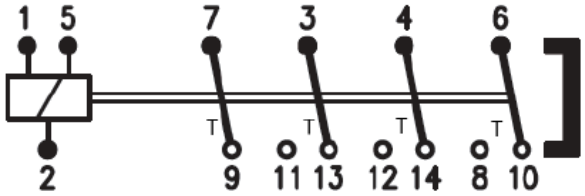
Relays continue to play a vital role in reliable train operation. Key functions are galvanic isolation between control (computers/PLCs) and power circuits, providing system isolation, contact multiplication and amplification.

Other unique features are:

- Predictable failure behavior (Fail Safe) making system safety validation simpler than using computer-based solutions like PLCs.
- Long-term availability (no obsolescence).
- Easy maintenance by plug-in feature and transparent cover.
- Unlike more sensitive electronics, relays are insensitive to Electromagnetic Interference.

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

Connection diagram



1-2: Supply voltage

5: Command voltage

The negative of the Command voltage is common with the supply voltage.

Certain functions require Command voltage to guarantee operation of the time delay.

There are two possibilities for activating the relay:

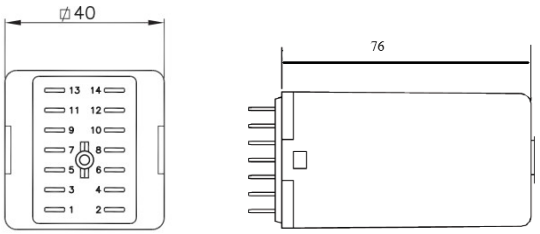
- Close N/O contact between input terminal 5 and positive terminal of the relay supply.
- Supply voltage applied to input terminal 5 with plus on 5 and minus on negative terminal relay supply.

Options

- Gold plated contacts
- IP50 dust protection
- $AgSnO_2$ contacts, weld resistant for capacitive loads
- Double Zener diode
- Double make/double break contacts
- AC/DC coil
- Keying (coding relay to correct socket)

Remark: Not all combinations are simultaneously possible

Product Dimensions



Product weight before mounting is ~158gms

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	-
	Solder tag	-	-	V26	-
	Crimp	-	-	V3	-
	PCB	-	-	-	V32

Contact characteristics

Parameter	Value
Contact configuration	3 C/O + 1 WC
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 VOC, 10 A (resistive load) 72 VOC, 5 A (L/R ≤ 40 ms) 110 VOC, 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

Time delay characteristics

Parameter	Value
Control setting: Function, Range, Timing	4 rotary switches with 10 positions (0-9)
Time Setting Range	100ms-99h
Accuracy, time delay	DC: ±5ms or ±0.5% whichever of two values is greater AC: ±20ms
Time variation vs. voltage variation vs. temperature variation	± 0.05 % / % deviation from U_{nom} ± 0.02 % / K deviation from 20 °C
Command Voltage	>10ms

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Coil data

Nominal Voltages		DC: 24, 36, 48, 72, 96, 110, 125, 145, 220 AC: 25, 96, 110, 120, 220, 230, 240
Operating Voltage		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
Input impedance		Approx. 250 kΩ (72 V)

Type	Unom (VDC)	Umin (VDC)	Umax (VDC)	Udrop-out (VDC)
TDMB4-U201	24	16.8	30	2.4
TDMB4-U207	36	25.2	45	3.6
TDMB4-U202	48	33.6	60	4.8
TDMB4-U203	72	50.4	90	7.2
TDMB4-U205	96	67.2	120	9.6
TDMB4-U204	110	77.0	138	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) take the time delay into account
- To reset the time function, the voltage must drop below Udrop-out
- Always select the nominal voltage as close as possible to the actual voltage in the application

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Contact characteristics

Contact reliability according to 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)	$5x10^{-8}$	20.000.000
5 mA, 24 VDC resistive	Gold (option E)	$4x10^{-8}$	25.000.000
10 mA, 50 VDC resistive	Silver (standard)	$2x10^{-8}$	50.000.000

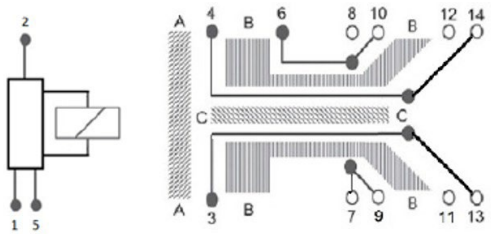
*at confidence level 90%

Note: Tested in laboratory environment at ambient temperature 20 °C. 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	2.5 kV, 50 Hz, 1min 2 kV, 50 Hz, 1min 2 kV, 50 Hz, 1min

Clearance and creepage according to IEC 60664-1/EN 50124-2



Section	Clearance	Creepage	Material group	Unom*
A	≥ 3.0 mm	≥ 3.0 mm	I (CTI600)	≤ 300 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

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)
Dry heat	IEC 60068-2-2 test Be
Damp heat	IEC 60068-2-30, Test method Db variant 2
Salt Mist*	IEC 60068-2-11
Protection	IEC 60529, IP40 (relay on socket) (with option K: IP50)
Fire and 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

* with transparent sticker

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 16
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 °C) 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

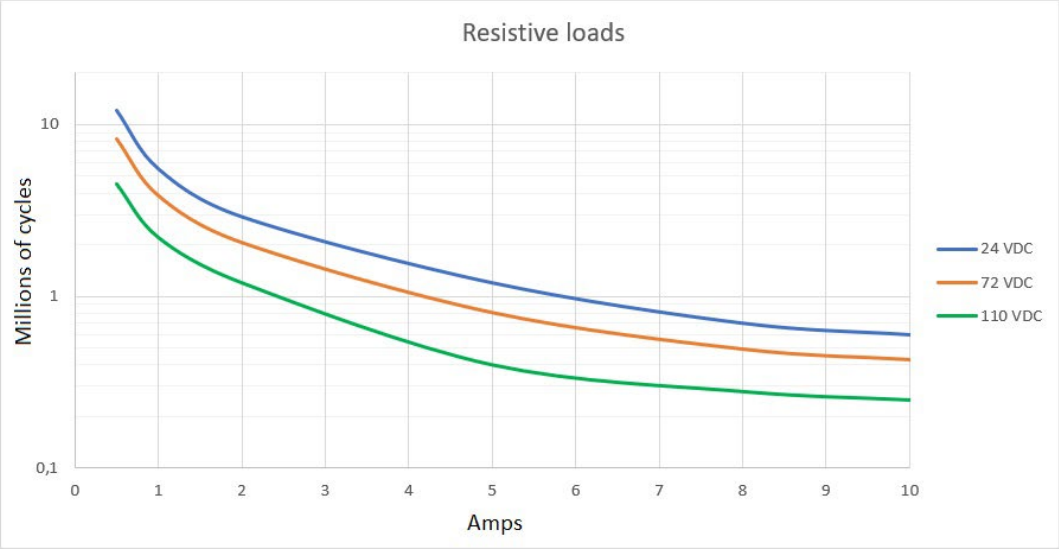
OPTIONS

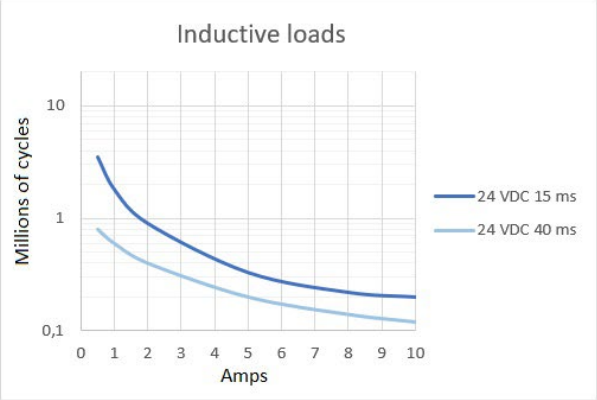
Code	Description	Remark	Cannot be combined with
E*	Au; Gold plated contacts		M
K	Extra dust protection	IP50 Cat 2 for the relays mounted in a Mors Smitt socket. Application PD1/PD2 and contact load > 0.5 A.	
Q	Double zener diode over coil	Maximum allowed peak voltage 180 V, higher voltage will damage the diode.	X2
Y	Double break / double make contacts. Breaking capacity increased by 50% and longer contact life.		
M	$AgSnO_2$; “non-weldable” contacts, used for capacitive loads e.g. LED lighting	I contact > 100 mA	E
Keying	Coil coding relay	Also order socket with keying	

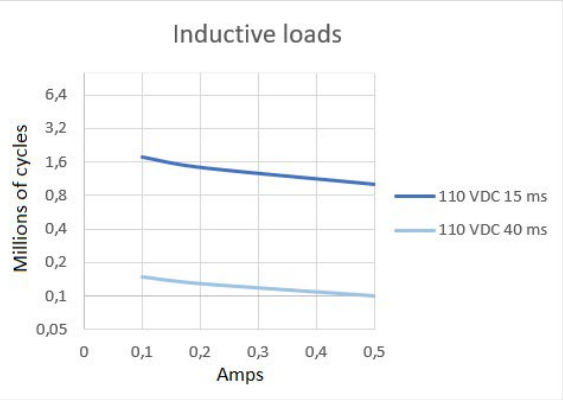
* Gold plated contacts characteristics	
Material	Ag, gold plated
Maximum switching voltage	60 V (higher voltages may be possible, contact Mors Smitt for more information)
Maximum switching current	400 mA (at higher rate gold will evaporate, then the standard silver contact rating of minimum 10 mA and 12 V is valid)
Minimum switching voltage	5 V
Minimum switching current	1mA

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

Electrical life expectancy







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:

- 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.
- 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, wall mount, front connection (7.5 mm terminals)
338000402	V23BR	Screw socket, wall mount, front connection (9 mm terminals)
338000610	V29	Spring clamp socket, wall mount, front dual connection (2.5 mm^2)

Panel/flush mounting		
338100100	V3	Solder tag socket, panel mount, rear connection
338400100	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.

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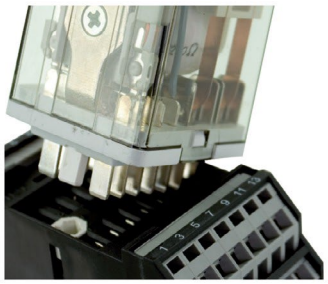
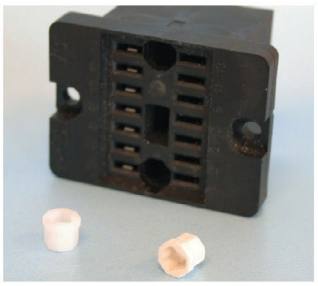
Mechanical keying relay and socket (optional)





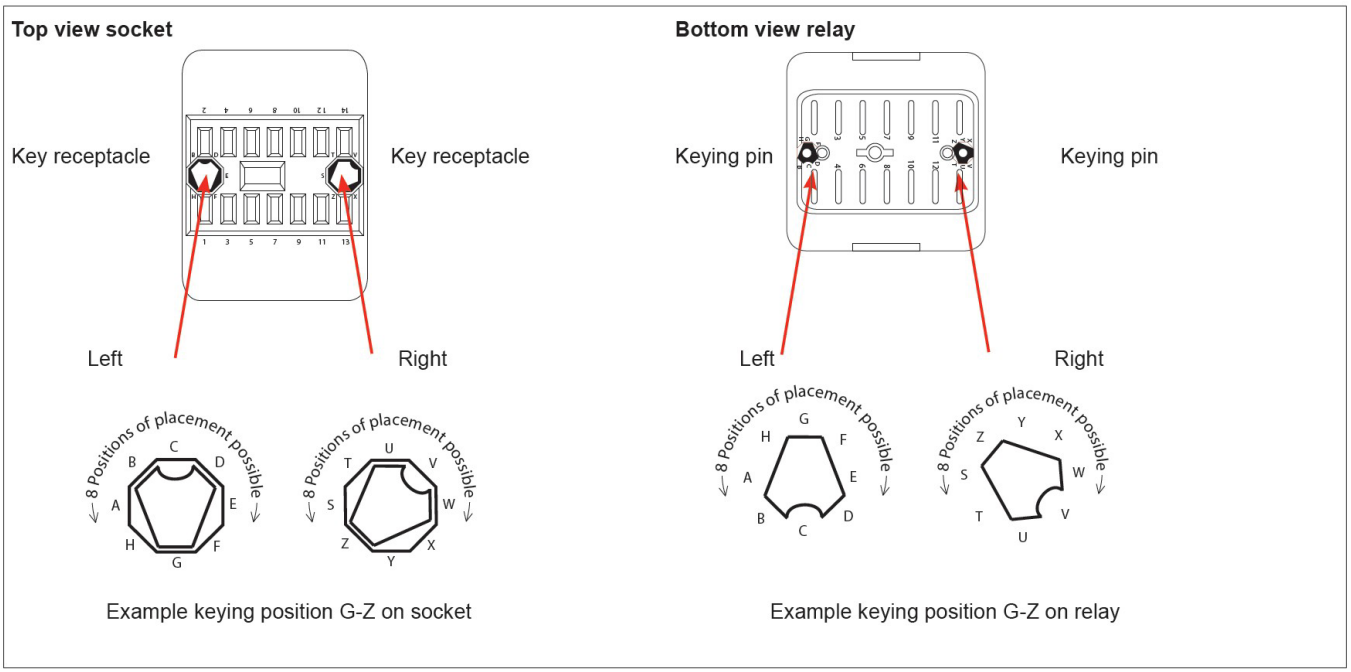
Function:

- 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.



Keying codes

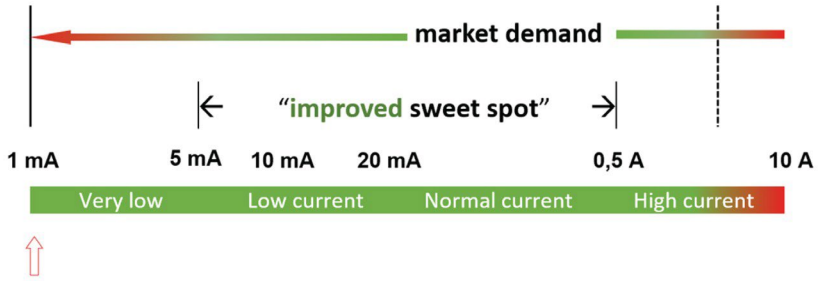
	Coil voltage code				
	U201: 24 VDC	U207: 36 VDC	U202: 48 VDC	U203: 72 VDC	U204: 110 VDC
Silver contacts (standard)	AS	AY	AT	AU	AV
Gold contacts (option E)	DT	FV	HU	AZ	HV
Silver tin oxide (option M)	GT	HT	GU	GV	GW

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 TDMB4-U200N relay has an improved sweet spot compared to its predecessors.



TDMB4-U200N with good 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

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Selector switches

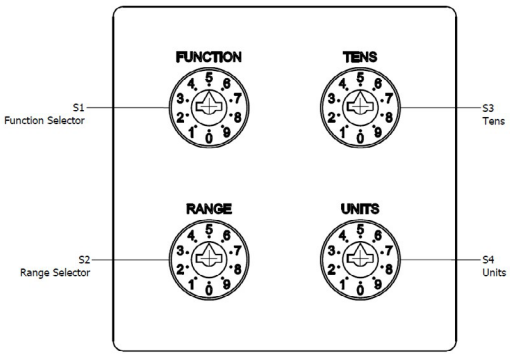
The function and switching time are adjustable via four rotary-switches on the relay's front panel, each with ten positions.

The user can select the time delay settings between 100ms and 99h.

The position of the arrow point on each rotary switch indicates the selected number.

Function selection: S1 Timing

selection: S2, S3, S4



Note: Discrete, incremental adjustments are employed, precluding the availability of intermediate positions.

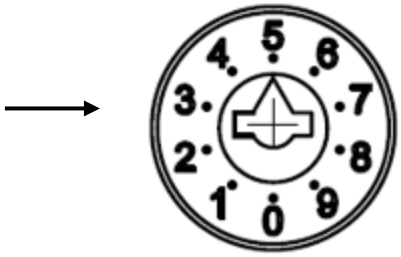
Note: Relay settings must be changed with the relays in the de-energized state. Any changes made to the settings while the relays are energized will not be effective.

Function selection

The function can be selected by aligning the arrow of selector S1 with the number of the desired function.

Function

S1
Function
Selector



Functions	Description
F0	Delay on pick up
F1	Acceleration on pickup timing with external command
F2	Pulse when command voltage disappears
F3	Delay on drop out with command voltage
F4	Flash symmetrical
F5	Flash asymmetrical
F6	One shot with pulse prolongation on command voltage
F7	One shot function on supply voltage with fixed pulse (3s), delayed at pull-in
F8	One shot function on command voltage with fixed pulse (3s)
F9	Step function

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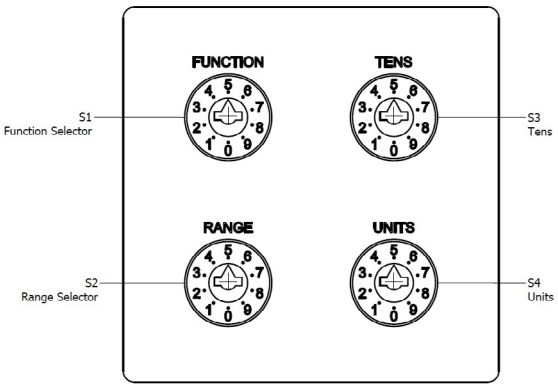
Timing selection



To adjust the switching time (except F5):

- Select the necessary range using S2.
- Select the appropriate switching time value using S3 & S4.
- The final selected time will be time value * range.

Ex: S2=1, S3=2, S4=5 then

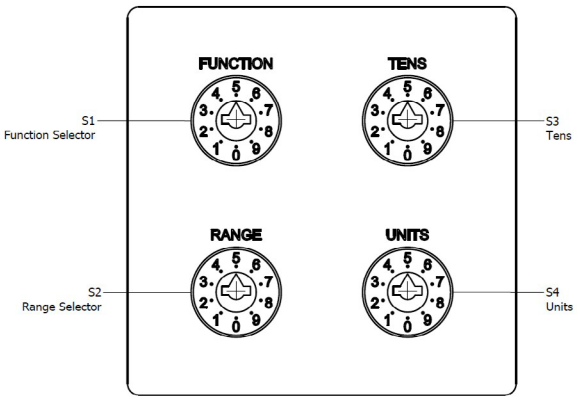
Time value=25[(2*10) +(5*1)]

Final selected time= 25sec [25*1s]

Note: If S3 and S4 combination is selected less than the minimum value of the chosen S2 range, the relay will default to the minimum value of the specified range.

Range	Min value	Max value	Step
0	0.1s	9.9s	100ms
1	1s	99s	1s
2	3s	297s	3s
3	5s	495s	5s
4	10s	990s	10s
5	1min	99min	1min
6	3min	297min	3min
7	5min	495min	5min
8	10min	990min	10min
9	1h	99h	1h

Timing for function F5 and F7



The function F5 can facilitate asymmetrical flash.

The “ON” time and the “OFF” time can be adjusted independently.

“ON” time (t) → selector S3

“OFF” time (T) → selector S4

To adjust the switching time for F5:

- Select the necessary Range using S2.
- ON time can be selected using S3.
- OFF time is selected using S4.

Ex: S2=1, S3=4, S4= 6

Then, t= 4s & T= 6s

To adjust the switching time for F7:

T1 → S3, S4

T2 → 3s

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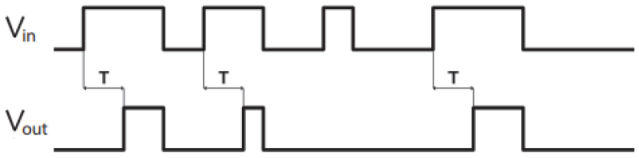
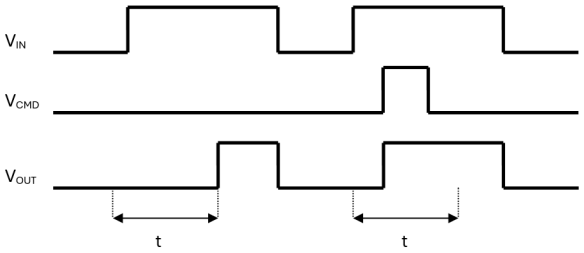
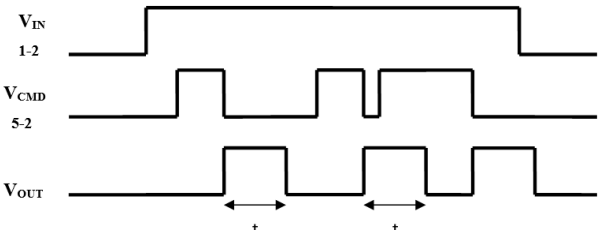
Functions



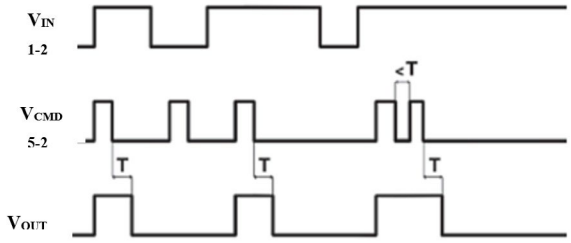
F0-Delay on pick up



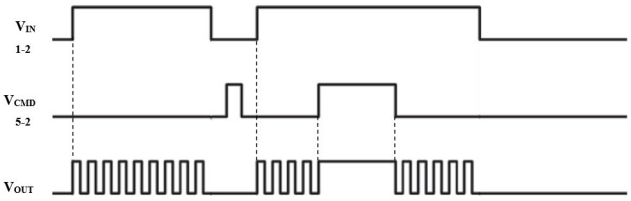
F1: Acceleration on pickup timing with external command



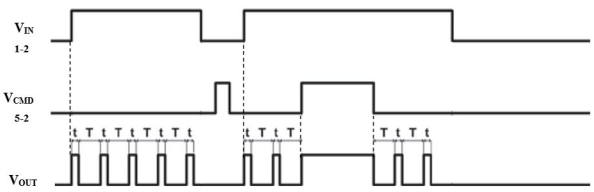
F2- Pulse when command voltage disappears



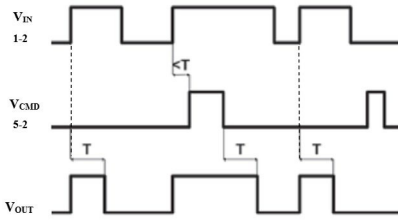
F3 - Delay on drop out with command voltage



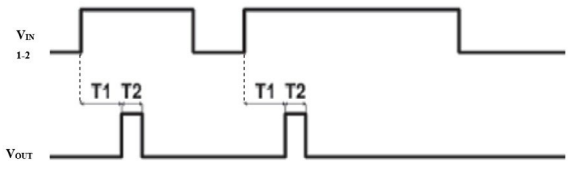
F4 – Flash symmetrical



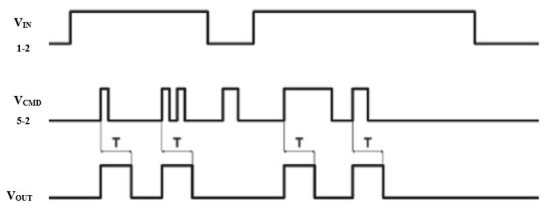
F5 – Flash asymmetrical



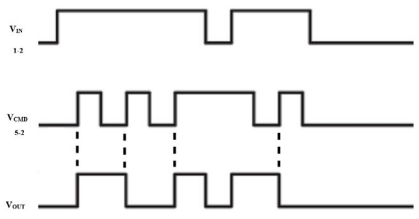
F6 - One shot with pulse prolongation on command voltage



F7 - One shot function on supply voltage with fixed pulse (3s), delayed at pull-in



F8 - One shot function with command voltage



F9 - Step function

Compliancy

EN 50155:2017	Railway applications - Rolling stock - Electronic equipment
IEC 60947-5-1:2016	Low-voltage switchgear and control gear
EN 50121-3-2:2016	Railway applications - Electromagnetic compatibility
EN 45545-2:2015	Railway applications - Fire protection on railway vehicles Part 2: Requirements for fire behavior of materials and components
NF F16-101/102	Railway rolling stock - Fire behavior
IEC 60664-1/ EN 50124-2	Clearance and creepage
IEC 60255-5	Pulse withstanding
IEC 61373:2010	Railway applications - Rolling stock equipment - Shock and vibration tests
EN 61000	Electromagnetic compatibility
IEC 61810 - 1	Electromechanical elementary relays - General and safety requirements

Product warnings / End user care

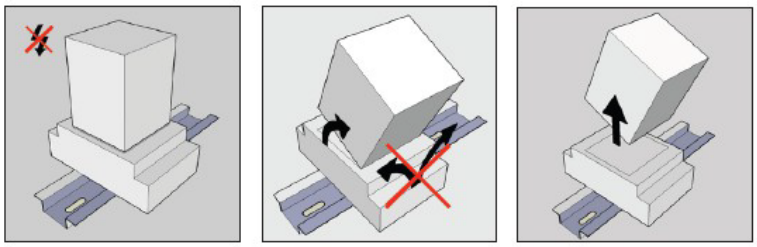
Instructions for use

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.

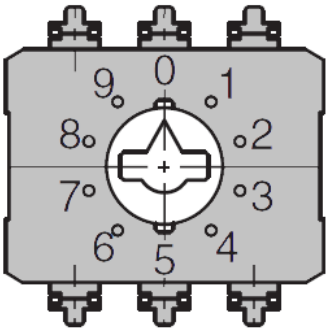
Warning!

- Never use silicon in the proximity of the relays.
- Do not use the relay in the presence of flammable gas as the arc generated from switching could cause ignition.
- To remove relays from the socket. employ up and down lever movements. Sideways 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 contact wear/condition having changed during its operational life.

Setting's changes should be done with relays switched off. Setting's changes with energized relay have no effect.



Warning!

It is important to exercise caution when applying excessive force to alter the switch position.

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 (< 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

Multi-Function Timer Relay
TDMB4-U200N

Ordering scheme

TDMB4-U		N-			Code		
Coil voltages	201					24 VDC	
	207						
	202						
	203						
	205						
	204						
	213						
	301						Cannot be combined with
	308						
Options (add as many options as needed, always in alphabetical order)		E				Gold plated contacts	
		Q				Double Zener diode	
		K				Extra dust protection	
		Y				Double make / Double break contacts	
Special options (minimum order quantity: 20)		M				AgSnO2 contacts, highly resistant to welding	
		X2				AC/DC coil	
			0.1s – 99h				
Keying code (optional, leave blank if not required)						**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	

Remark: keying codes are available for all possible coil voltages

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: 01123456789012324012345678921123456789001
Revision index identification	Linked to serial number
Terminals	Identification on bottom plate relay Relay to be used with Mors Smitt relay socket which have clear terminal identification on each socket