Handling, Processing, Testing and Use

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 removed 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 attention 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 mechanical 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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Handling, Processing, Testing and Use (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 subsequently 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. These 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.

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Handling, Processing, Testing and Use (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 liquid, 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 alcohol (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 > 'Cleaning, ultrasonic'
- 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 and in addition it may cause coil wire breaks. If ultrasonic cleaning cannot be avoided, it is on user's own responsibility and must be completed as quickly as possible.
For gold plated contacts ultrasonic cleaning is NOT recommended at all 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 dissipation 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.

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