

Technical information

SPECIFICATIONS

Dimensions, specifications and data shown in this catalogue are subject to change without notice. Consequently, they are not contractual in any case. Electrical, mechanical and endurance specifications are based upon in-house tests made by APEM. These tests are conducted using internationally recognised procedures. In the event of a product being used under different conditions, the user must ensure the product's suitability for use under those conditions. Incorrect storage, handling, operation or application of the product may result in damage to the product or equipment.

The negative value indicated under "Operating temperature" is given for normal usage conditions (products free of moisture, which could generate frost or ice and block the mechanism).

The specifications give the technical performances of the switches. If the equipment on which our products are mounted is submitted to safety standards, the customer should select approved models or models conforming to the standards (marked CE only). Consult factory for details of models that can be marked CE.

DRAWINGS

Products are shown with their standard actuator (for other actuators, see options).

Scale : drawings in this catalogue are to different scales : ask for a data sheet if you need other dimensions for a specific part number.

TOLERANCES

Unless otherwise specified, the general tolerance for dimensions in this catalogue is $\pm 0,3$ (.012).

Overall dimension tolerance is $\pm 0,5$ (.020). Ask for a data sheet for further information.

PART NUMBERS

To order a switch model, every option has to be specified. However, for the S series toggle switches and 18000 series pushbutton switches, we continue to accept former part numbers using default options. If the actuator is not specified, we will supply lever or plunger -13.

SOLDERING CONDITIONS

Hand soldering with iron : 300°C, 3 seconds max.

SEALING OF TERMINALS

Due to the new generations of active flux, epoxy sealing of terminals is preferred, to prevent any risk of switch contamination.

ROHS COMPLIANCE

The new RoHS directive 2002/95/EC of the European parliament and of the Council of 27 January 2003 about the restriction of the use of certain hazardous substances in electrical and electronic equipment:

. Mercury (Hg), Cadmium (Cd), Hexavalent Chrome (Cr+6), Polybrominated biphenyls (PBB) and Polybrominated diphenyl ethers (PBDE), Lead (Pb)

is applicable to our products and will apply before July 2006.

APEM is working on this subject in order to manufacture RoHS compliant components.

Road map:

. Standard products manufactured by APEM are already and will remain in compliance with the restriction of the marketing and use of the above mentioned substances imposed by such directive.

. Switches for printed circuit boards with tin/lead plated terminals (SnPb) have been replaced by components with pure tin plating.

. For specific options using LED illumination, wires are soldered with lead-free solder.

There is no change of part number for RoHS compliant products.

Some specific products or options can still be supplied in non-RoHS version with customer's agreement.

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Contacts and ratings

CONTACT MATERIALS

Several contact technologies are available depending on models :

For miniature switches

- A** End contacts : silver.
Center contacts and terminals : brass, silver plated.
For high ratings at 125VAC - 250VAC or over 0,1A 30VDC (levels III and IV).
- AD** End contacts : silver with gold plating over nickel barrier.
Center contacts and terminals : brass, gold plated.
For low level applications (levels I and II).
Can be used for high ratings (level IV),
the gold layer being considered only as a protection against oxidation during storage.
- CD** Contacts and terminals : brass with gold plating over nickel barrier.
- or LD** For low level applications up to 20mA 20VDC or 80mA 5VDC (levels I and II).
- X780** Silver rivet, gold plated (11000 and 12000 series).

For industrial switches

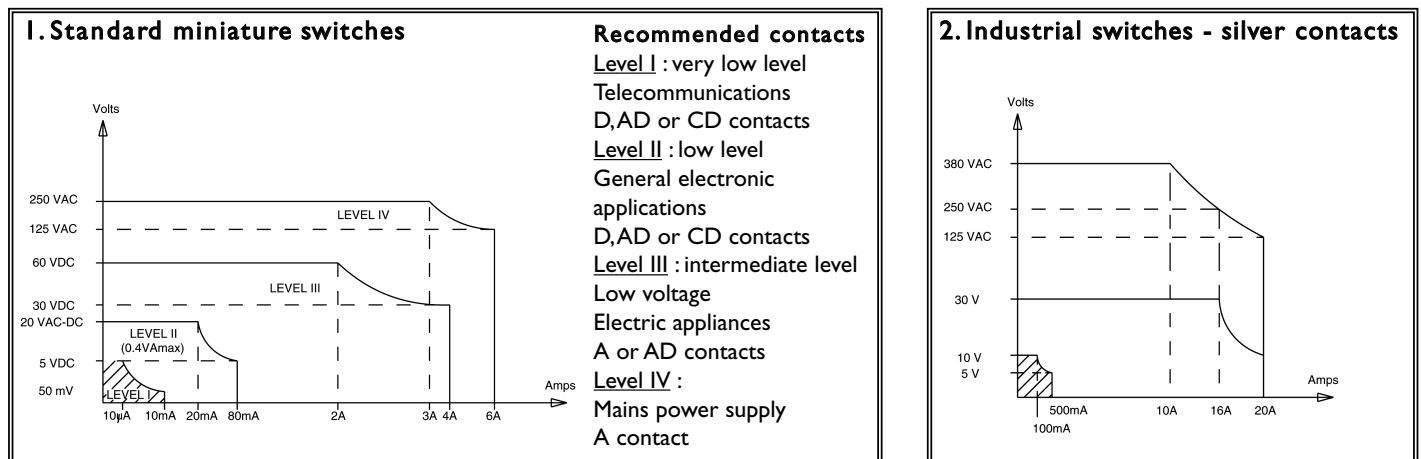
- A** End contacts : silver rivet or silver inlay.
If not specified in model number, the contact material is indicated in the specifications of each series.
- C** Silver plated copper or brass.

Silver cadmium oxide contacts (**S**) which used to be available on the 4000 - 600H - 600NH and 2600 series, are discontinued and will be replaced by silver tin oxyde contacts before 2005.

HIGH INRUSH CURRENTS

Special contact materials and switch constructions allow particularly high inrush currents to be taken by some models of the 5000, 11000 and 12000 series.

ELECTRICAL LEVELS



The above curves feature all the ratings available in our product range. Hatched areas show minimum ratings. Maximum ratings are indicated in the specifications of each series. Note that max. current is given for standard life expectancy. For specific applications, higher currents can be applied, resulting in reduced life expectancy and vice-versa. Consult factory.

LOW CURRENT OR DRY CIRCUIT (level I)

The quality of the gold plating (hardness, porosity, adherence) and the design of the contacts (pressure or sliding contact) allow the use of very low currents down to 10µA 5V or 10mA 50mV depending on models, measurable according to IEC 512-2, test 2a.

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Positions and connections for 3-way switches

Function 4

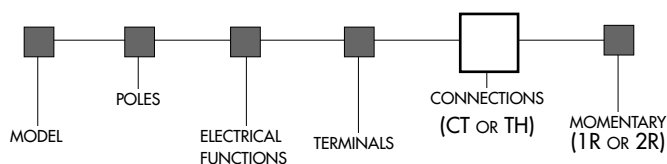
MINIATURE SWITCHES

5000 and 7000 series are available with CT or TH connections.

Desired connections are to be specified in enlarged box of model structure.

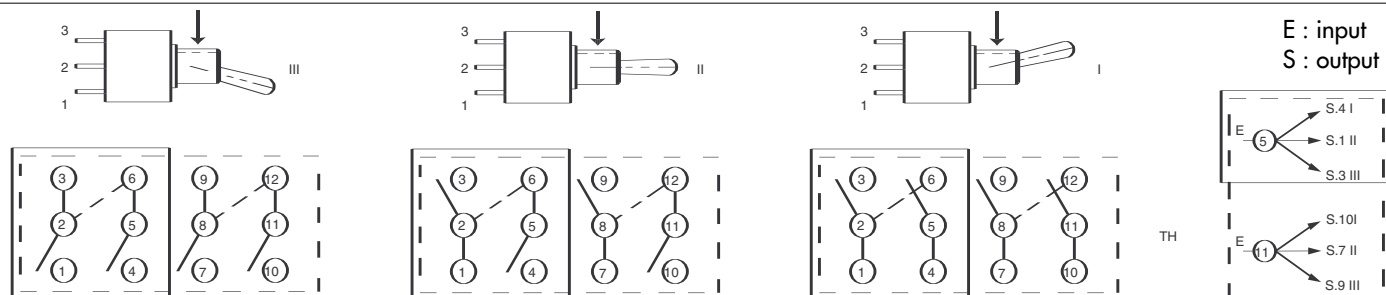
12000 and S series are available with TH connections only.

Model structure 5000 and 7000 series

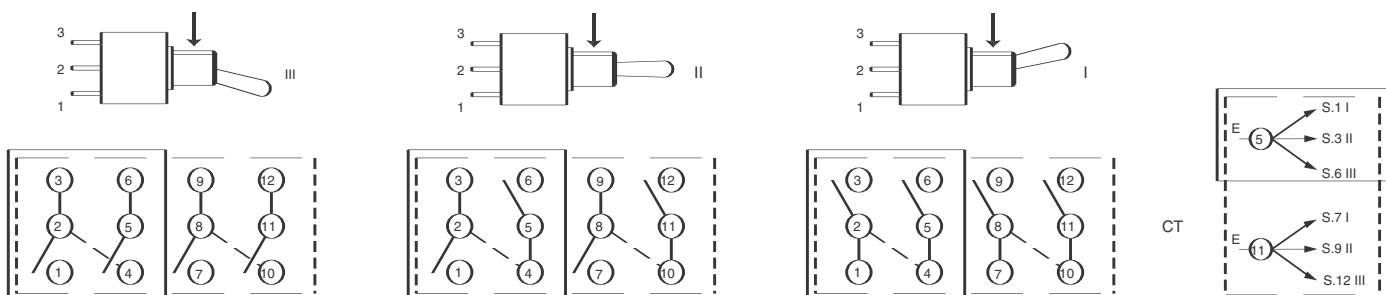


FUNCTION 4 - TYPE TH (preferred) - 5000 - 7000 - 12000 - S - SR - 10600 series

→ Keyway



FUNCTION 4 - TYPE CT (reversed) - 5000 - 7000 series



Single pole switches in a double pole case
Double pole switches in a four pole case

□ SP

□ DP



Dotted line between poles : jumper to be wired by the user.

INDUSTRIAL SWITCHES : 600 600H - 3600NF - 6000 AND 2600 SERIES

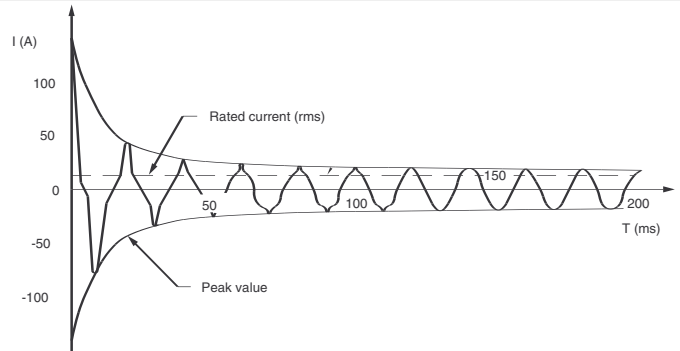
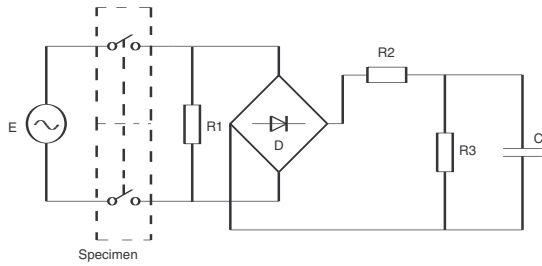
FUNCTION 4			FUNCTION 4-1R (momentary one side)			FUNCTION 4-2R (momentary both sides)		
ON 5-6 2-3	ON 5-6 2-1	ON 5-4 2-1	MOM 5-6 2-3 ▲	ON 5-6 2-1	ON 5-4 2-1	MOM 5-6 2-3 ▲	ON 5-6 2-1	MOM 5-4 ▲ 2-1
4 5 6 1 2 3	4 5 6 1 2 3	4 5 6 1 2 3	4 5 6 1 2 3	4 5 6 1 2 3	4 5 6 1 2 3	4 5 6 1 2 3	4 5 6 1 2 3	4 5 6 1 2 3
<p>• Common ° Maintained ▲ Momentary</p> <p>Terminals 2 and 6 must be connected by the user for a 3 way switch. Single pole switches in a double pole case.</p>								
ON			ON			ON		
5 3 O 1 O 4			5 3 O 1 O 4			5 3 O 1 O 4		

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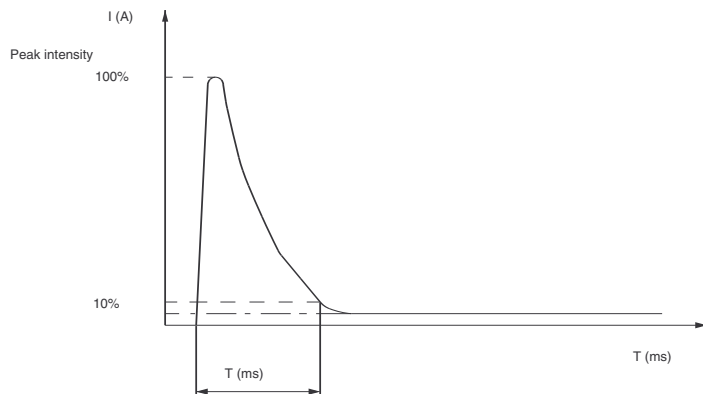
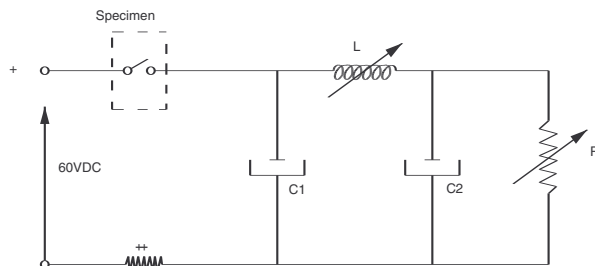
Switches for peak currents

- For switching power supplies, DC-DC converters, motors ...
- Peak current with 125/250VAC according to IEC 1058 (Fig 1) and direct current 60VDC (Fig 2)
- 2 maintained positions

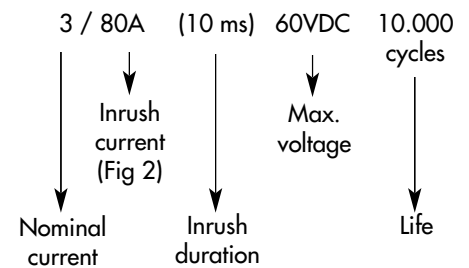
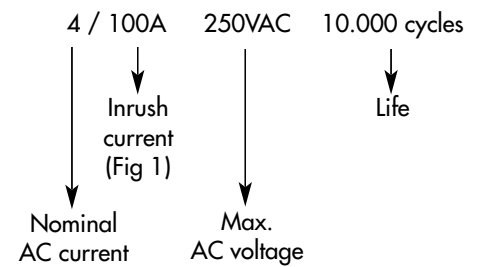
Testing circuit AC voltage
Figure 1



Testing circuit DC voltage
Figure 2



Current/voltage rating examples :



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Degrees of protection : IP and IK codes

The degree of protection is indicated by 2 letters and 2 numbers.

Example : IP 65


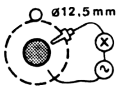
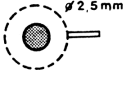
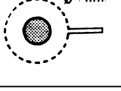
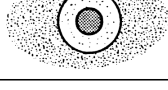



protection against water
protection against dust





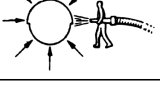
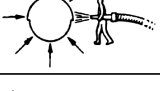
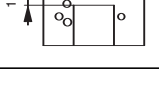
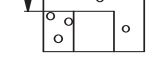
IP•• degree of protection provided by the enclosures of electric appliances according to IEC 529 and DIN 40050.

IK•• degree of protection provided by the enclosures of electric appliances against external mechanical impacts according to EN 50102 (NFC 20-015).

1st number : protection against ingress of solid objects

IP	tests	
0		Non-protected
1		Protected against solid objects of 50 mm (1.968) and greater
2		Protected against solid objects of 12,5 mm (.492) and greater
3		Protected against solid objects of 2,5 mm (.098) and greater
4		Protected against solid objects of 1 mm (.039) and greater
5		Dust-protected (no harmful ingress)
6		Dust-tight (no ingress)

2nd number : protection against liquids

IP	tests	
0		Non-protected
1		Protected against vertically falling water drops
2		Protected against vertically falling water drops when enclosure tilted up to 15°
3		Protected against water sprayed vertically at an angle up to 60°
4		Protected against splashing water
5		Protected against water jets from any direction
6		Protected against powerful water jets
7		Protected against the effects of temporary immersion in water
8		Protected against the effects of continuous immersion in water (depth x to be specified)

IK code : mechanical protection

The degree of mechanical protection is now defined by the **letters IK** according to EN 50102 of June 1995 (NFC 20-015)

It is only applicable to the "Anti-vandal" models of the AV series.
See section B .

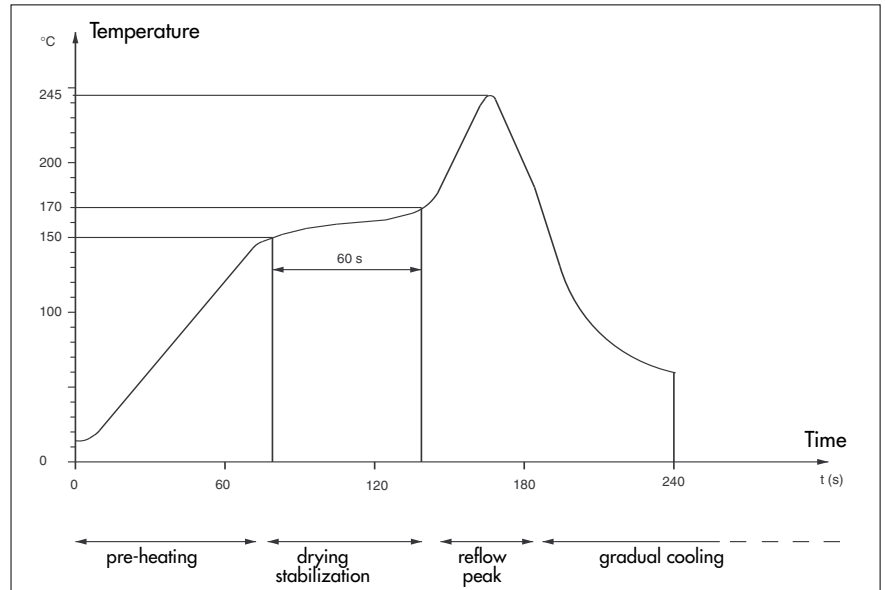
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Surface mount

TYPICAL SMT REFLOW PROFILE

The P.C. board, carried by a conveyor belt, goes through the different areas of a reflow soldering oven :

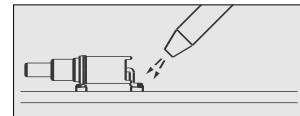
- pre-heating (maximum 170°C, 60 secs)
- reflow peak (maximum 245°C)
- final cleaning (optional)



BOARD REWORK TECHNIQUE

Hot air reflow technique is preferred. Avoid use of a traditional soldering iron.

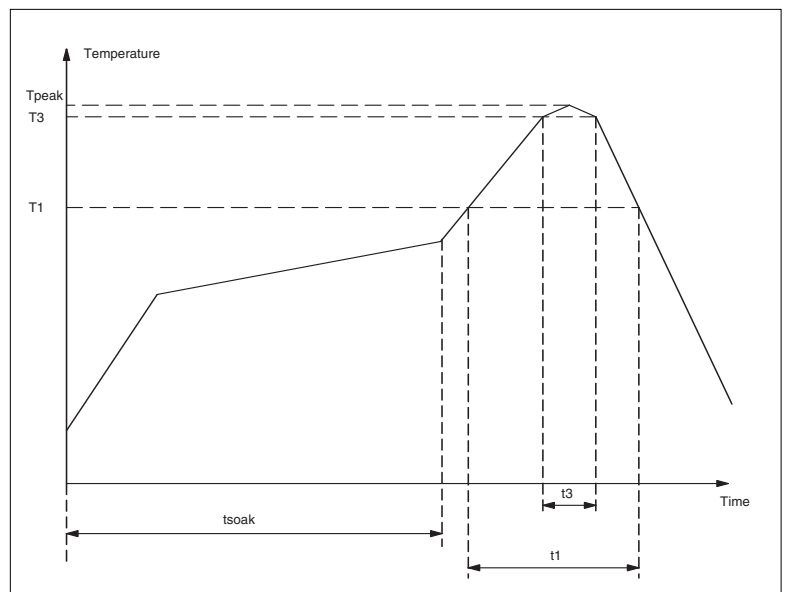
Caution : Excessive and/or repeated high temperature exposure may affect switch performance and reliability.



TYPICAL LEAD-FREE SMT REFLOW PROFILE

Complying with the ROHS directive.

Example of Pb-free profile requirements for soldering heat resistance		
Parameter	Reference	Specification (small case)
Temperature gradient in preheating		3°C/s max.
Soak time	t_{soak}	2-3 minutes
Time above 217°C	t_1	60-150 seconds
Time within 5°C of actual peak temperature	t_3	20-40 seconds
Peak temperature in reflow	T_{peak}	260°C (+0/-5°C)
Temperature gradient in cooling		6°C/second max.
Time 25°C to peak temperature		8 minutes max.



AC : Alternating current; electric current that continually reverses direction at a fixed frequency (see VAC).

ACTION FORCE : (Operating Force) : The force required to change the actuator of a switch from one position to another. Torque for rotary products.

ACTUATOR : A movable part of a switch which causes a change in the electrical configuration of the switch. e.g. : Toggle, Rocker, Slider, Paddle, Pushbuttons, Shaft

ALLOY : A metal created by combining two or more metals to obtain a specific physical property

ALTERNATE ACTION : Push to close and push to open the switch. A given circuit condition remains after removal of actuating force. Also known as "push-push switching action". Typically, alternate action pushbuttons do not visually indicate the position of the contacts. Contrast to latching action.

ANGLE OF THROW : Indicates total travel arc on toggle or rocker switches. Unit of measure : degrees

ANTISTATIC : An antistatic device will withstand a specified potential without conducting between the actuator and any conducting element. Usually the terminals or bushing. Unit of measure : typical value 8-20 kilovolts DC.

ANSI : American National Standard Institute; a standard-setting agency of the United States which approves the design and/or performances of electronic/electrical components distributed in the world market.

ARCING : The flow of electric current between switch contacts during opening or closing of the contacts. This current flow can be damaging to the contacts of a switch.

BIFURCATED CONTACT : A wiping movable contact consisting of spring fingers that grip fixed contacts. Typically found in slide switches. Self cleaning action.
See Wiping Contact.

BOUNCE : The repeated rebounding of the moveable contact during the transfer from one throw to the next.

BRASS : An alloy of zinc and copper

BREAK-BEFORE-MAKE (Non shorting - B.B.M.) : On actuation, the movable contact breaks contact with one fixed contact before making contact with another fixed contact. Contrast with make-before break. Typical of toggle and pushbutton switches.

BUTT CONTACT : A contact mechanism in which the movable contact makes contact with the fixed (stationary) contact without wiping motion between the surfaces. Typical of toggle and pushbutton switches. See Wiping Contact.

CAPACITIVE LOAD : A load in which the initial current on making (closing) of the contacts is higher than the steady state current. Current leads voltage in capacitive loads. See Resistive Load, Inductive Load, Power Factor, Inrush.

CARRYING CURRENT : The maximum current that can be passed through the already closed contacts of a switch. Contrast with "Contact Rating".

CLEARANCE (spacing) : Distance through air between electrically live parts of opposite polarity or to ground.

CONTACT (Contact area) : The metal surfaces that come into physical contact to complete an electrical circuit. These surfaces are found on movable contacts (see) and terminals (see).

CONTACT BLOCK : A switching element which is added singly or in groups to an operator to make a complete switch. Typically used with industrial controls (APEM

CONTACT BOUNCE (Bounce) : The time during switching in which electrical instability (bounce) caused by the rebound of the contacts is observed. Relative mass of the contacts, forces and frequency of supporting members are all components that determine the extent of bounce. Total transfer time consists of the time for the contacts to close plus bounce. Transfer time should be rapid so natural bounce time is short.

CONTACT GAP : The distance between a stationary contact and a movable contact in the open position.

CONTACT RATING (Switching rating) : The capacity to switch (connect or interrupt) an electrical load.
Load characteristic (resistive, inductive, capacitive, power factor).
Contrast with non-switching rating.

CONTACT RESISTANCE : The resistance across the two closed contacts : contact interface and terminals.

CREEPAGE : The unwanted flow of electrical current from one conductive part to another.

CSA : Canadian Standard Association

CYCLE : The complete sequence of indexing through all successive switch positions and returning to the original position.

DC : Direct Current : electric current that flows only in one direction (see VDC).

DETENT : A mechanical stop that holds the contacts in a given position after the actuation force is removed or prevents the changing of contact position at less than a specified actuation force. Can also be referred to as tactile feel.

DIELECTRIC STRENGTH : The ability of an insulating material to withstand a voltage without arcing across its surface. The standard voltage that can be applied between two open terminals or between a terminal and ground without causing short. Most often applied to insulator between switch terminals and metal exposed to operator of the switch. Also known as Dielectric Withstanding Voltage, DWV, Leakage resistance, Breakdown Voltage.

DIFFERENTIAL TRAVEL : The distance an actuator moves between the point where contacts snap over and where they snap back, or when contact is made and then brakes.

DIP : DIP-in-line Package (in Europe also, DIL : Dual-in-line) refers to a component with two rows of PC terminals. The terminals are most commonly on a 0,100" pitch with 0,300" between rows.

DOUBLE-BREAK CONTACTS : A contact mechanism using two sets of contacts to make or break a given circuit. The contact gap opens twice as fast, reducing the arc duration, contact surface temperature and material erosion. This improves heat dissipation and provides better power handling capacity for a longer switch life. Typical of high power industrial switches and DC Circuit application. See Single-Break Contacts.

DP : Double pole. See pole.

DRY CIRCUIT : An application in which power level do not cause arcing melting, or softening of the contacts . Typically requires gold plated contacts for reliable switch operation. At such low levels, and since no arc occurs, silver contacts would not be self-cleaned and would be less reliable. Typical Definition : for ex. 0.4VA max. 20 V DC or peak AC max. Also known as "Low Energy", "Logic Level", TTL.

DWV : Dielectric Withstanding Voltage. See Dielectric Strength.

DT : Double Throw. See Throw.

Glossary

DUST TIGHT : Sealed switch will withstand sand and dust contamination.

ELECTRICAL LIFE : The number of operations at a given electrical load that does not result in a degradation of any electrical or mechanical parameter beyond the standard set by the applicable end-of-life criteria.

END OF LIFE CRITERIA : Those specifications that a switch must meet at the end of its specified electrical life. Typically contact resistance and/or heat rise of contacts at full rated load at end of life.

ENVIRONMENTAL SEAL : A seal that totally encapsulates the switch providing a specified level of protection against intrusion of solids, liquids or gases into the body of the device.

ESD : Electrostatic discharge.

FIXED CONTACT (Stationary contact) : The non-moving contact. Typically integral to the end of the terminal inside the switch body.

FLASH PLATING : A very thin or "instant" plating (usually less than 0.25 microns in thickness).

FLUX : Chemical used for cleaning metal surfaces for welding. Fluxes turn contaminated metal surfaces into clean, solderable part.

GOLD FLASH : A plating of gold typically less than 10 micro-inches (millionths) thick. Used only as a barrier to oxidation or corrosion of terminals to maintain solderability.

GULL WING : A type of surface mount terminal which extends from the side of the switch and has a L-shaped bend at its end (terminals are formed away from the switch body).

HEAT RISE : An indirect measurement of contact resistance used by rating agencies. The temperature rise over ambient of a contact set carrying a prescribed current is measured to determine whether it falls within safe limits.

IEC : International Electrotechnical Commission

IECQ : IEC's Quality Assessment system for Electronic Components, created in 1983 to facilitate national and international trade in certified electronic components. A worldwide certification system which provides a method whereby electronic components made and handled by approved manufacturers and distributors can be used anywhere without further testing.

INDUCTIVE LOAD : A load in which the initial current on making (closing) of the contacts is lower than steady state and rises slowly. On breaking (opening) of the contacts, the current is greater than steady state. The stored energy of the inductor provokes a long and severe arcing time. Current lags voltage in inductive loads. Motors are the most common inductive load. Inductive loads are the most troublesome of circuit conditions. See Resistive Load. Capacitive Load.

INFRARED REFLOW : A method of mass soldering Surface Mount Devices with Infra Red (IR) thermal radiation heating the PCB solder paste and components.

INRUSH : The initial transitory high-level of current at contact closing (making). A characteristic of capacitive and some resistive loads. The inrush currents can be large and long enough to cause severe degradation of the contacts. See Resistive Load. Capacitive Load. Power Factor.

INSERT MOLD : In switches and relays used to refer to terminations that are placed in the mold so that plastic is molded around the terminations. The chief benefit is an inherent seal against the intrusion of flux into the body of the device. Therefore no epoxy terminal seal is required.

INSULATION RESISTANCE : The electrical resistance between two normally

insulated parts measured at a specified DC voltage.

IP : An industrial specification (Part of the IEC529 standard) used worldwide to indicate the degree of protection provided by components against accidental contact, penetration of solids or liquids into or through the component. See NEMA.

LAMP LOAD (Tungsten) : A load characterised by a high inrush current at make (approximately 10 to 16 times the steady state).

LATCHING ACTION : See alternate action (or push-push). Actuator position typically indicates contact position.

LEAKAGE BARRIER : A ridge or web molded into a switch housing between terminals or contacts to increase the surface distance between them.

LEAKAGE RESISTANCE : Dielectric strength

LED : Light Emitting Diode. Long life and low consumption illumination

LIFE : See Electrical life, Mechanical Life.

LOGIC LEVEL : Refers to power levels typical of solid state electronic circuits (TTL, CMOS, etc.). Levels at which no arcing, melting or softening of the contacts occur. Typically require gold contacts for reliability since no arcing occurs to self clean the contacts. See Dry circuit. Also referred to as low energy

LOW ENERGY : See Dry circuit.

MAINTAINED : A position of a switch which remains unchanged when actuation force is removed from switch actuator. Contrast with Momentary.

MAKE-BEFORE-BREAK (shorting, MBB) : Movable contacts make the next circuit before breaking the first circuit. Typically found in slide switches. Contrast with Break-before-make.

MAKE AND BREAK : Opening one circuit before completing another on the same pole

MECHANICAL LIFE : The number of operations of a switch without electrical load that does not result in a degradation of parameters beyond the standard set by the applicable end-of-life criteria.

MOISTURE PROOF : Sealed switch will withstand high humidity and limited exterior environment such as rain.

MOMENTARY ACTION : Mechanically returning from a temporary switch position to the normal switch position

MOVABLE CONTACT : The contact moved by the switch actuator into and away from contact with a fixed contact thus forming the electrical circuits possible for a given device.

NC : See Normally Closed

NEMA : National Electrical Manufacturers' Association. A US Standards setting group. For switch products most often applied to switches mounted in various enclosures offering specified degrees of protection against intrusion of liquids, dust, corrosive elements, etc. NEMA ratings are common in industrial or outdoor applications. See IP.

NO : See Normally Open.

NON-SHORTING : See Break-Before-Make

NON-SWITCHING RATING : The power carrying capacity of a switch after contact closure and end of contact bounce. Typically far higher than the contact

rating (switching rating) of a switch.

NORMALLY CLOSED (NC) : Normally closed contacts are closed when the switch actuator is in its unactuated position (e.g., the plunger is in the resting position in the case of a pushbutton switch).

NORMALLY OPEN (NO) : Normally open contacts are open when the switch actuator is in its unactuated or resting position.

OIL-TIGHT : A generic term for a panel seal (see) commonly used in industrial settings. Defined by NEMA (see) standard.

OPEN FRAME : Typical to slide switches ; open frame construction allows for automatic solder process and post solder cleaning. Contrast with "washable".

OPERATING FORCE : See Actuation Force.

OPERATING TEMPERATURE : The range of temperature within which the device may be used.

OPERATOR : A panel-mounted mechanical device (pushbutton, selector, keylock, etc.) without contacts to which one or more contact blocks may be added to make a complete switch (See APEM A01-A02 Series).

OVERTRAVEL : The distance the actuator may move between initial electrical contact position and the extreme mechanical position of the actuator. See Travel, Pretravel.

PANEL SEAL : A panel seal provides a defined level of protection against penetration of liquids through the switch and switch-to-panel interface to the rear of a panel.

PCB : Printed circuit board

POLE : Single common electrical input having one or more outputs. The number of separate circuits that can be active through a switch at any one time. A single-pole switch allows one closed circuit at a time. A double-pole switch allows two closed circuits, etc.

POWER FACTOR (PF) : A measure of the inductive or capacitive character of an electrical load.

PRETRAVEL : The distance the actuator moves from a rest position (or free position) to electrical make at another position. See Travel, Overtravel.

PUSH-ON / PUSH-OFF : See Alternate Action.

PUSH-PUSH : See Alternate Action.

QUICK-CONNECT TERMINAL : Flat tab or blade style terminals designed to accept push-on female wire connectors (instead of soldering). The most popular sizes are : 0.250". 0.187". 0.110" wide.

RATING : See contact rating

RESISTIVE LOAD : Current and voltage are in steady state on opening or closing the switch. See capacitive load, Inductive load, Power factor, Inrush.

SEMKO : Svenska Elektriska Materielkontrollanstalten of Sweden

SEV : Schweizerischer Elektrotechnischer Verein of Switzerland

SHORTING CONTACT : Contacts which make-before-break.
See Make-before-Break

SILICON RUBBER : Rubber made from silicone elastomers which keeps its high level of flexibility, resilience and tensile strength over a wide temperature range.

SINGLE BREAK CONTACTS : A contact mechanism using one set of contacts to make or break a given circuit. Typical of electronic or low power switches.

See Double-Break Contacts.

SNAP ACTION : The fast transfer of contacts from one position to another, this action is rather independent of the speed of actuator travel

SPACING : See Clearance

SPDT : Single pole double throw. See Pole, See Throw.

SPLASHPROOF : Sealed switch will withstand heavy rain or stream of water.
See Panel Seal.

SPRING RETURN : See momentary.

STORAGE TEMPERATURE : The range of temperature within which the device may be stored. Typically this is a wider range than operating temperature.

SURFACE MOUNT DEVICES (SMD) : Components that are compatible with surface mount PC board technology. Holes are not used for component mounting. Component leads are soldered to pads on the surface of the PC board (on the same side as the components). For switches, typically defined by surface mount terminations (e.g., J-Bend, L-Bend, butt, etc.) and compatibility with surface mount soldering (e.g., vapor phase reflow, infrared, etc.) and cleaning processes.

SURFACE MOUNT TECHNOLOGY (SMT) : See SMD

TACTILE FEEL (FEEDBACK) : The switching action felt by the operator of the switch (same as click action or positive action). Audible or "feel" snap or click that indicates contact movements.

TERMINAL : The metal portion of a switch, exterior to the body, that is used to connect the switch to an electrical circuit. Example : PC, wire lug, quick-connect, wire-wrap, etc.

THROW : The number of circuits that can be controlled by any one pole of a switch. Example : In a single-pole-double-throw (SPDT) switch, only one circuit may be completed at a time. However, there are two possible circuits (throws) that can be made.

TRANSLUCENT : Transmitting light so that objects lying beyond cannot be seen distinctly.

TRANSPARENT : Transmitting light so that objects lying beyond can be seen distinctly.

TRAVEL : The total distance the actuator can move. See Pretravel, Overtravel.

TWO CIRCUITS : A circuit in which one circuit is completed in one position and another separate circuit is completed in an other position.

UL : Underwriters laboratories Inc.

VAC : Voltage, alternating current (see AC)

VDC : Voltage, direct current (see DC)

VDE : Verband Deutscher Elektrotechniker of Germany

WASHABLE : Applied to PC board mounted devices indicating compatibility with cleaning processes used after soldering. No degradation of electrical or mechanical parameters occurs. The switch is sealed to keep contaminants out of the contact area.

WAVE SOLDERING : A method of soldering in which a wave of molten solder contacts the components on the PCB as the PC Board with the components is