HOW TO SELECT THE OPTIMUM SWITCH

O/E/N offers a comprehensive range of wafer switches to meet your every switching requirement.

This bulletin is intended to help the user select the optimum switch for his requirements on the basis of the variety of switch sizes, contact and insulation materials, switching configurations and options available.

ROTARY SWITCH DESIGN CHART

This chart may be used to determine the required switch type by inter-relating the switch function (number of positions and angle of throw), switch size (diameter across switch frame with standard bent terminals), insulation, and JSS classification. For specific details please see respective switch catalogue.

		SWITCH TYPE				
PARAMETERS		**HM**	**ACORN**	**J**	**JC**	**MULTIDEX**
1. Design size of switch frame (diameter across switch frame with standard bent terminals)		17.5 mm (0.68")	27.0 mm (1.062")	40.0 mm (1.562")	40.0 mm (1.562")	46.4 mm (1.609")
2. Insulating material		Diallyl Phthalate	Diallyl Phthalate	Phenolic	Ceramic	Diallyl Phthalate
3. J.S.S. 51207 Classification (US MIL - S - 3786 Type No. in paranthesis		SRW 01 (SR 19)	SRW 02 (SR 05)	SRW 06 (SR 02)	SRW 06 (SR 02)	SRW 05 (SR 32)
4. Number of positions and throw (in degrees)	4 X 90°	—	✓	✓	✓	—
	6 X 60°	—	✓	✓	✓	—
	8 X 45°	—	✓	✓	✓	—
	10 X 36°	—	✓	—	—	—
	12 X 30°	✓	✓	✓	✓	✓ *
	14 X 25.7°	—	—	—	—	✓ *
	16 X 22.5°	—	—	—	—	✓ *
	18 X 20°	—	—	—	—	✓
	20 X 18°	—	—	—	—	✓
	24 X 15°	—	—	—	—	✓
	28 X 12.85°	—	—	—	—	✓ *
	32 X 11.25°	—	—	—	—	✓ *
	36 X 10°	—	—	—	—	✓

*** Require longer delivery/lead times to supply these switches.**

CONTACT MATERIALS

All O/E/N switches use the OAK development constant pressure, double-wiping contacts. The contacts are self-cleaning and require no maintenance during life under normal operating conditions. The self-cleaning action assures a clean, positive contact capable of wiping through accumulated particles of dust, oxides and other contaminants. The contacts are outstanding for long life and efficient operation with minimum contact-resistance variation throughout their lifetime.

Contact material	Suggested Maximum Operating Temperature	Typical life cycles(No load room ambient)	Suggested application	Comments
Silver plated Brass (with protective anti-tarnish coating)	+ 100^0 C	10,000 cycles	Commercial	After plating is worn through, brass-to-brass contact is still made, but contact resistance may become erratic
Silver alloy (with protective anti-tarnish coating)	+ 100^0 C	2,00,000 cycles	Military and long life commercial applications	Provide silver-to-silver contact in excess of 200,000 cycles with relatively consistent contact resistance
Gold flash 0.76 micron (0.00003") thick on silver alloy	+ 100^0 C	Gold to Gold Life: Nominal Silver-to-Silver: inexcess of 200,000 cycles	Long shelf - life before initial use	When initial storage is likely to be long and reliable switching is required readily when used, gold-flash is recommended. Again when storage is likely in corrosive environments, gold flashing will be effective. Gold flashing facilitates soldering
Gold plate 2.5 to 5 microns (0.0001"to 0.0002") thick on silver alloy	+ 100^0 C	50,000 cycles gold-to-gold contact and 200,000 cycles silver-to-silver thereafter.	Dry circuitry minimum contact resistance variation. In frequent use.	When tarnish films cannot be tolerated because of low-level loads or dry switching, gold plating offers an effective solution. Contact resistance will remain essentially constant over life of gold to gold contact. Reliable switching is possible even when used infrequently or used in corrosive environments.

A cycle is defined as a rotation from one stop to the other and return or 360^0 rotation and return if there are no stops.
An operation is normally defined as the making and breaking of an electrical contact.
For current and voltage ratings of contacts, refer to the respective switch catalogue.

INSULATING MATERIALS

The table below lists the types of stator and rotor insulation now available for O/E/N Switches

Insulation Material	MIL Specification	Temperature Range ^{o}C (Non-military)	Comments
Diallyl Phthalate	MIL-M-14	-65^{o} to + 85^{o}	This is a thermo setting moulded insulation with excellent electrical characteristics with high insulation resistance coupled with low dielectric constant. Being moulded, the material allows better contact placement
Phenolic	L-P-513 Type PBE-P	-65^{o} to +100^{o}	This is the most economical insulation material, Not recommended for high voltage circuitry or where high insulation resistance are required.
Ceramic	MIL-1-10 Grade L-422	-65^{o} to+ 150^{o}	Relatively the most expensive insulation material, it is stronger and more rigid than other materials and has higher temperature rating, higher insulation resistance and higher dielectric voltage rating. It has a very low dielectric loss factor and very little change in dielectric constant with temperature or frequency making it suitable for use in critical high frequency circuits.

CONTACT RESISTANCE

Contact Resistance of O/E/N switches ranges from 0.003 ohms to 0.015 ohms measured from one contact to the adjacent contact. If the contacts are 180^{o} apart, the measured resistance will be higher than when they are closer together because of the extra length of rotor blade included in the measured circuit.

Gold flashed or plated contacts will offer a somewhat higher contact resistance typically ranging from 0.010 ohms to 0.020 ohms.

Usually the magnitude of the contact resistance is not important, if it remains substantially constant. For O/E.N Switches, contact resistance is essentially uniform throughout the life of the switch.

SHORTING AND NONSHORTING CONTACTS

Shorting or nonshorting Contacts or configurations involving combinations can be provided at the user's option.

If the switch is to be electrically nonshorting, the contacts will be BREAK BEFORE MAKE type.

If shorting is required in the electrical circuit, the contacts will be MAKE BEFORE BREAK type.

DETENTING TORQUE

Proper detenting torque is necessary to give the right feel to the switch. An approximate torque figure can be obtained when using standard clip and blade thicknesses by adding all the clips which are in contact with the rotor blade(s) , and then adding the maximum number of clips entering in any one detected position. This figure multiplied by 75 gm.cms (or1 in oz) will give an approximate usable torque value.(If silver contacts are used multiply by only half the figure i.e 37.5 gm.cms or 0.5 in oz). In order to mask out this drag the detent mechanism itself must have at least 1 ½ times the torque of the section (s) This means the total switch torque should be atleast 2 ½ times the section torque for a crisp feel. The normal tolerance is ± 30%.

Maximum torque is related to the size and type of knob being used on the front panel. For a comfortable turning force, the following torque values are recommended.

12.7	mm	(½")	dia.	knob	-	600	gm	cms.	to	1125	gm	cms.
19.05	mm	(¾")	dia.	Knob	-	750	gm	cms.	To	1500	gm	cms
25.4	mm	(1")	dia.	Knob	-	1125	gm	cms.	To	2625	gm	cms.
38.1	mm	(1½")	dia.	Knob	-	1500	gm	cms.	To	3750	gm	cms.

(Bar knobs or deeply knurled knobs can be used with higher torques for the same knob size)

GENERAL INFORMATION

PROTECTION OF SILVER SURFACES

Silver surfaces tarnish (turn dark) under normal atmospheric conditions. This is due to the small amount of sulphur present almost everywhere. Unless tarnishing is so severe that it causes corrosion, amount it will not harm the efficiency of O/E/N switches. Tarnish on the terminal lugs, however reduces their solder ability. Switch clips usually are provided with a protective coating to facilitate solder ability.

MOUNTING OF SWITCHES

The rotary wafer switches can all be mounted with the threaded bushing, nut and lockwasher. A locating key keeps the switch from turning.

Mounting hardware is supplied as standard. With all switches being mounted by standard 3/8"-32 thd bushing, this consists of 9.5 mm (3/8") 32 NEF threaded nut and a matching internal toothed lockwasher. Materials and finishes of hardware are compatible with the switch materials and finishes

TESTING OF SWITCHES

O/E/N switches contain certain high friction points that are necessary to produce an efficient and trouble free switch. These high friction points do not lend themselves to the high speed operation of accelerated life testing without special attention. To obtain reasonable life under accelerated test conditions, all high friction surfaces must be generously lubricated. Contact surface and high friction indexing points should be lubricated thoroughly at least every 2500 cycles.

Life tests should be run so that the switch is turned through a cycle at a fast rate and then allowed to rest a short time before being turned again. This allows the lubricant to redistribute. A switch should never be turned continuously at a slow constant speed, for this will simply wear out the parts without obtaining any useful information.

O/E/N rotary wafer switches are not high voltage switches. The actual breakdown voltage for the type J (phenolic) switch where contacts are used on both sides of the section in the off set positions is in the region of 1800 volts peak. The test voltage should not exceed 1000 volts RMS. For the J Ceramic Switch the test voltage is not to exceed 1500 volts RMS. The corresponding test voltage for the Acorn and Multidex switches is 750 volts RMS and for the HM switch 500 volts RMS.

MAINTENANCE OF SWITCHES

Under normal operation, O/E/N switches require no maintenance. As a matter of fact, most maintenance methods are actually harmful and will shorten the life of a switch. Of course, this assumes proper switches application. If a switch is used for purposes other than those for which it was designed, maintenance will not help.

The one this to remember is to leave the switches alone unless maintenance is necessary because of adverse ambient conditions.

NOTES ON SOLDERING SWITCH TERMINALS

Be careful when soldering to the terminals of O/E/ N switches. Apply no more heat than is necessary. Only a 600^{0}F (315^{0}C) soldering iron should be used. And heat should be applied no longer than five seconds. Longer periods of heating will loosen the eyelets in the switches and may even lower the spring pressure of the contacts.

Never clean rosin from soldered connection on the switch with solvent. The solvent merely dissolves the rosin and floats it down to the contact, where it cannot be removed. No amount of contact pressure can cope with a rosin coating. Rosin will do less harm if left on the joints.

METAL PARTS AND FINISHES

DETENT : All O/E/N switches,(but for the HM switch) incorporate the unique OAK patented UNIDEX detent mechanism with dual ball detent indexing on a star wheel. This detent can offer upto 100,000 cycles of mechanical life with torque remaining essentially constant and crisp throughout the life of the switch.

For normal hand operation switches are lubricated with lubricants effective over a temperature range of 65^{0}C to +85^{0}C.

SHAFTS

Standard shaft material is CR steel plated and passivated.

For Military switches passivated Stainless Steel shafts will be provided unless otherwise specified.

SHIELDS

Standard shields are available on request for switches requiring electrostatic shielding between section.

BEARING STRAPS AND BRACKETS

For especially long switches it may be necessary to incorporate bearing straps for additional shaft again support and/or mounting brackets to stabilize rear section. We shall recommend such provisions against specific customer requirements, Standard shields can be provided, when required, for use as mounting plates for rear mounted potentiometers

FINISH

Commercial : All component parts requiring plating are cadmium or zinc- plated and passivated as per our standards.

Military : All component parts requiring plating are cadmium or zinc plated to withstand salt spray testing as per JSS requirements. Stainless steel parts are passivated.

WATER-SEALED MOUNTING

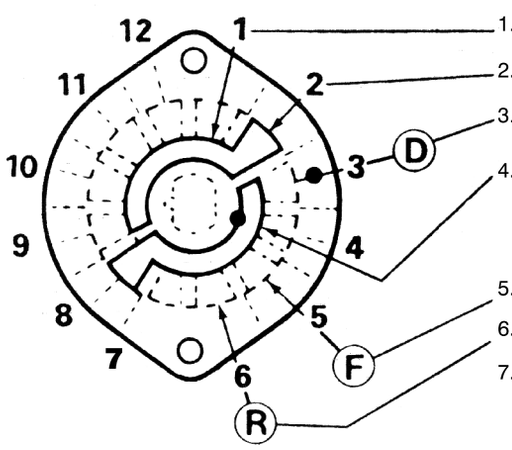
All switches are available on request with 'O' ring sealed shafts and provision for panel sealing. Such switches will be built to meet the relevant JSS requirements.

ROTARY SWITCH ORDERING INFORMATION

O/E/N switches are custom fabricated to your exact specifications. Details on standard dimensions and ciruitry are available from the respective switch catalogue. It is faster if you use the standards shown, when possible, enabling us to use standard stocked parts.

The switches can be ordered in three ways : by description, switch layout sheet or customer drawing.

SYMBOLS USED IN MARKING LAYOUT SHEETS



1. Long Clip
2. Short Clip
3. Dummy Terminal Lug
4. Thru Connection of Rotor Blade on one side to Rotor Blade on opposite. Show on side only.
5. Clip with Flat Lug
6. Clip with Reversed Lug
7. Outline Rotor Blades, as shown, with Switch in extreme counterclockwise

1. You can order by description, using an established description pattern. By using this means of ordering you can save engineering time and money because you will not have to make a drawing or fill out a layout sheet.

   (Note: If non-standard circuitry, dimensions or assembly are required or circuitry varies between sections, a layout sheet must be filled out)

2. To make a switch drawing when you have special circuitry or dimensions, choose or call for the O/E/N switch layout sheet that most nearly fits your requirements. Fill in all detailed information necessary to show your exact specifications. You may request us for free engineering assistance in specifying the optimum switch for your application.

3. When ordering using your drawing, you will find much drafting time can be saved and all necessary details incorporated by reproducing the O/E/N layout sheet in whole or in part on to your format.

SWITCH KITS

We offer switch kits designed to aid regular users and development engineers in prototype work. These kits are offered only as a means of saving your time. Our applications engineering staff and prototype services are available on request. The kits are not intended to be used to make units for production and cannot be sold for that purpose.

The kits include standard index assemblies with different positions and shaft lengths and with wafers of various standard configurations.