

# AH16 TYPE COMMAND SWITCHES

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## I. FOREWORD

Man-machine interface is playing an important role in the increasing size, complexity, and automation of facilities. The numerous control switches and pilot lamps used in this interface must meet the following requirements:

### 1) Miniaturization

Displaying all the necessary information in front of the operator and performing operation locally are vital for skillful, accurate processing of the increasing volume of information. Therefore, the control switches and pilot lamps must be miniaturized as much as possible within the range that does not sacrifice reading ease and operability.

### 2) Human engineering considerations

Human engineering considerations such as elimination of operator anxiety and fatigue, suitable judgement, and ease of operation are vital with man-machine interface apparatus. Moreover, skillful use is also necessary.

### 3) Application to electronics

Since many control switches are used as the input to electronic apparatus, they must be highly reliable and applicable to the low energy category.

From the above trend, fields have appeared in which the existing Type RCa470, AHE, and AHC command switches mainly used by mounting them in industrial machines for general use, switchgear and control gear, etc. are not applicable. Therefore, the Type AH16 command switches used with a  $\phi 16.5$  mounting hole matched to the above needs have been developed.

## II. FEATURES

### 1. Contact Section

#### 1) Excellent operating feeling

Since a snap action system is employed, contact operation is sensed at the operators finger. The snap action system is shown in Fig. 5.

#### 2) Contact reliability

Initial failure and reliable electrical contact stability are necessary at the contacts. Gold-plated silver contacts, sliding contact, stabilization of contact force by snap action system, etc. have been adopted.

#### 3) Reduction of wiring time

Table 1 Mounting hole of switch

Size	Mounting hole diameter (mm)	Standards			Reference	
		IEC	JIS	JEM	Europe	Fuji
$\phi 30$	$\phi 30.5$	○	○	○	○	○
$\phi 25$	$\phi 25.5$		○	○		○
$\phi 22$	$\phi 22.5$	○	○	○	○	
$\phi 16$	$\phi 16.5$		○	○	○	
$\phi 12$	$\phi 12.5$		○	○	○	
$\phi 6$	$\phi 6.5$		○			
		IEC Pub. 337	JIS C 4521	JEM 1248		

Terminals with easy contact of the soldering iron are used as soldering terminals. The surface of the terminals have a superior solderability, long term stability gold plating. The results of soldering performance confirmation are summarized in the test results of Table 3.

### 4) Wiring work and maintenance and inspection are simple.

A dust protection cover is installed at the rear of the contact block to prevent the entry of wiring chips into the contact block. The device number drawing sheet can also be attached to the dust protection cover. Therefore, the position is clear and distinct, even when densely mounted. Resistance to soldering heat has been taken into consideration by adopting thermo-setting plastics at the contact block housing.

## 2. Operating Section and Overall Construction

### 1) Type corresponding to the application can be selected.

The design of the part exposed at the panel is available in a round bezel type, square bezel type, and rectangular bezel type, and can be used according to the application. There is also a large type pushbutton.

### 2) Pushbutton and lens color are easy to change.

The Type AH16 command switches are available in a wide range of colors which can be easily changed. For this reason, a fitting system employing the elasticity of plastic is employed.

### 3) Simple, bright legend lettering

The legend lettering stamped or printed on the special

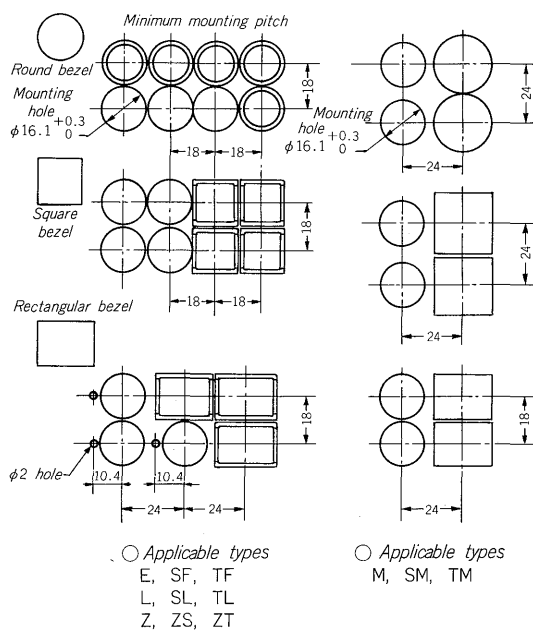


Fig. 1 Minimum mounting space

name sheet can be pasted to the top of the pushbutton.

4) Numerous switches can be mounted in a small space.

Since the space of the contact block is smaller than the mounting hole diameter, the switches can be densely mounted as shown in Fig. 1.

5) Lamp illumination identification is bright.

Abundant brightness is obtained through the use of incandescent lamps. Stable quality miniature lamps for aircraft JIS C 7522 type P base is used for long life.

6) Lamp replacement is simple.

When replacing the lamp, a special replacement tool is unnecessary and the lamp can be easily removed with screw driver for split bolt.

7) Consideration of prevention of erroneous operation at dense mounting.

In the case of the arrangement of Fig. 2, a barrier is installed at the round bezel and rectangular bezel types to prevent erroneous operation of adjacent buttons and operation by unexpected external force.

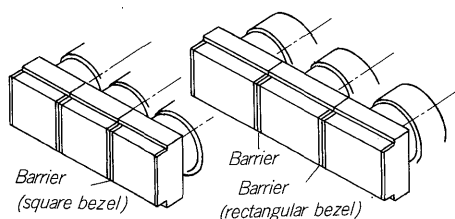


Fig. 2 Barrier of switch

### III. RATINGS

- 1) Rated insulation voltage  
AC, DC 250V. However, rated insulation voltage of

illuminated pushbutton switch and pilot lamp is AC, DC 60V.

- 2) Rated thermal current  
AC, DC 5A
- 3) Rated operational voltage and operational current  
AC 110V 1A, 220V 0V 0.5A  
(resistive rating)  
DC 24V 1A, 110V 0.2A  
(resistive rating)
- 4) Ambient temperature of service  
-20~70°C. However, -20~40°C for illuminated pushbutton switch and pilot lamp.
- 5) Switching life  
Mechanical life-Momentary action: 500,000 operations or more  
Alternate action: 100,000 operations or more
- 6) Dielectric strength  
AC 200V for 1 min (between terminals and earth, between terminals of opposite polarity). However, AC 1000V for 1 minute for illuminated pushbutton switch and pilot lamp.
- 7) Insulation resistance  
100MΩ or greater
- 8) Temperature-rise  
50°C or less (ambient temperature 40°C) terminals
- 9) Protection provided by enclosure (operator)  
Enclosed type

### IV. TYPES AND CONSTRUCTION

#### 1. Types

The newly developed φ16 command switches Type AH16 are basically available in four types of illuminated pushbutton switch, pushbutton switch (nonilluminated, exterior is the same as the illuminated pushbutton switch), large type pushbutton switch (non-illuminated), and pilot lamps.

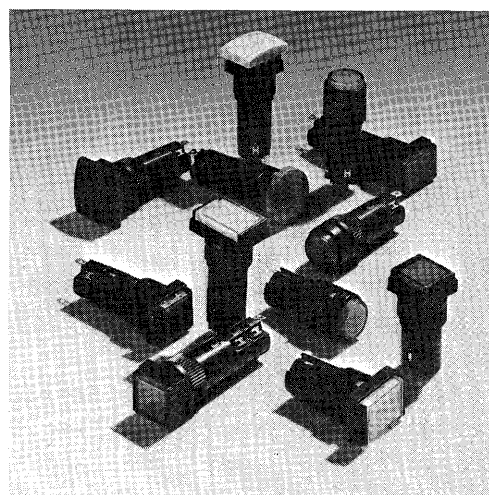


Fig. 3 AH16 type command switch

Table 2 Kinds of AH16 type command switch

	Name	Construction	with 1NO + 1NC	with 2NO + 2NC	with 3NO + 3NC							
Illuminated pushbutton	Round bezel	Momentary	AH16-L■11○	AH16-L■22○	AH16-L■33○							
		Alternate	AH16-L5■11○	AH16-L5■22○								
	Square bezel	Momentary	AH16-SL■11○	AH16-SL■22○	AH16-SL■33○							
		Alternate	AH16-SL5■11○	AH16-SL5■22○								
	Rectangular bezel	Momentary	AH16-TL■11○	AH16-TL■22○	AH16-TL■33○							
		Alternate	AH16-TL5■11○	AH16-TL5■22○								
Pushbutton	Round bezel	Momentary	AH16-E□11	AH16-E□22	AH16-E□33							
		Alternate	AH16-E5□11	AH16-E5□22								
	Square bezel	Momentary	AH16-SF□11	AH16-SF□22	AH16-SF□33							
		Alternate	AH16-SF5□11	AH16-SF5□22								
	Rectangular bezel	Momentary	AH16-TF□11	AH16-TF□22	AH16-TF□33							
		Alternate	AH16-TF5□11	AH16-TF5□22								
Large pushbutton	Round bezel	Momentary	AH16-M□11	AH16-M□22	AH16-M□33							
		Alternate	AH16-M5□11	AH16-M5□22								
	Square bezel	Momentary	AH16-SM□11	AH16-SM□22	AH16-SM□33							
		Alternate	AH16-SM5□11	AL16-SM5□22								
	Rectangular bezel	Momentary	AH16-TM□11	AH16-TM□22	AH16-TM□33							
		Alternate	AH16-TM5□11	AH16-TM5□22								
Pilot lamp	Round bezel		AH16-Z■○	□ symbol	Symbol	G	R	B	Y	W	O	S
					Color	Green	Red	Black	Yellow	White	Orange	Blue
	Square bezel		AH16-ZS■○	■ symbol	Symbol	G	R		Y	W	O	S
					Color	Green	Red		Yellow	White	Orange	Blue
	Rectangular bezel		AH16-ZT■○	○ symbol	Symbol	A	B	E	F			
					Accessory lamp	6V	14V	28V	48V			

Since the exterior appearance (round bezel, square bezel, rectangular bezel), switch operation momentary, alternate), pushbutton color, number of contacts, lamp voltage, etc. are different, they are summarized in Table 2. Momentary operation mentioned above means that the switch is immediately reset when pushed and released and alternate action means that the switch is locked when pushed once and is reset when pushed again.

The newly developed  $\phi 16$  command switches are shown in Fig. 3.

## 2. Construction

The construction of the switch is illustrated in Fig. 4 (taking an illuminated pushbutton switch as an example). The contact section is mounted by attaching the lamp terminals protruding from the rear of the pushbutton to the last stage with a screw through the contact section. The number of contact blocks is up to a maximum of 3 contact blocks of 3NO + 3NC for momentary operation and up to a maximum of 2 contact blocks of 2NO + 2NC for alternate action.

The contact section employs the snap action mechanism shown in Fig. 4. This mechanism consists of a moving contact, lever, and reversing spring formed into a triangular shape and contacts the fixed contact (NC contact) at the bottom. When the sliding frame holding the moving contact is pushed, the three parts mentioned above are inverted on straight line to form a reverse triangle and contact the fixed contact (NO contact) at the top. When the pushing force is

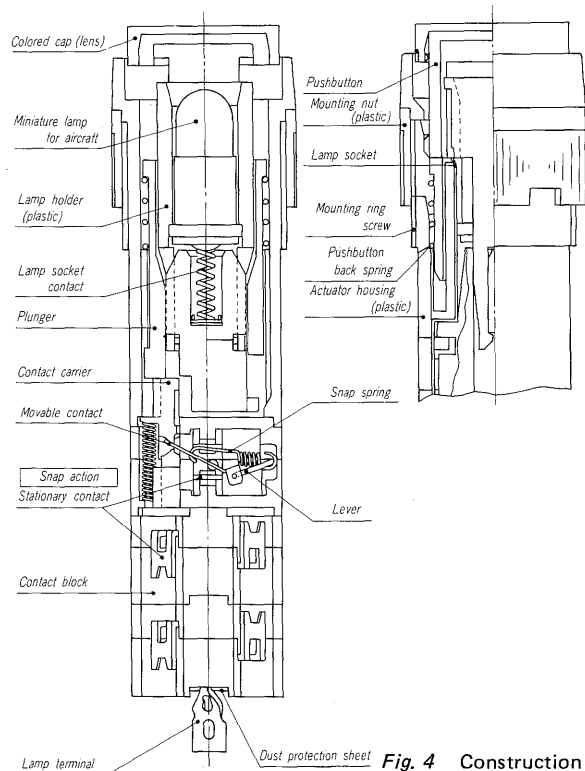
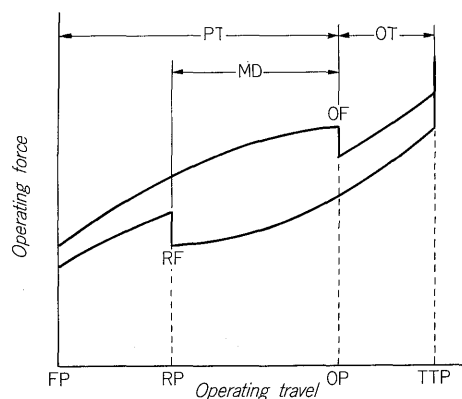


Fig. 4 Construction of switch

removed, the sliding frame is returned by the force of the back spring and inverted. The above operating characteristic is given in Fig. 5.



OF : Operating force  
 RF : Release force  
 PT : Pre-travel  
 OT : Over-travel  
 MD : Movement differential  
 FP : Free position  
 OP : Operating position  
 TTP : Total travel position  
 RP : Release position

Fig. 5 Operation diagram

Table 3 Test data

No.	Test item	Target value	Result	Remarks
1	Strength	(1) No abnormalities when 250N applied for 1 minute in the pushbutton operating direction. (2) No abnormalities when 12N applied for 1 minute to the contact terminals.	(1) No deformation or damage of any part. (2) No damage or other trouble.	JIS C 4509
2	Operating force	Operating force of 50N or less applied (5.1kg)	Approx 5.9N (600g) with momentary action 3NO + 3NC	JIS C 4521
3	Temperature rise	(1) 50°C or less (terminals) while passing 5A. (2) 30°C or less at surface of button of illuminated pushbutton switch.	(1) 50°C or less (2) 30°C or less	JIS C 4520
4	Insulation resistance	100MΩ or greater	100MΩ greater	JIS C 4520 when new.
5	Dielectric strength	(1) Shall withstand AC 2000V applied for 1 minute to ground and between terminals of the same polarity. (2) Shall withstand AC 1,000V applied for 1 minute between contact and between lamp terminals.	(1) Withstands AC 2,000V for 1 minute. (2) Withstands AC 1,000V for 1 minute.	JIS C 4520 when new
6	Contact resistance	(1) 50mΩ or less by DC 6V 1A voltmeter-ammeter method. (2) Measured with YHP as reference.	(1) NO contacts 7.3~10mΩ NC contacts 6.9~10.1mΩ (2) NO contacts 7.8~16.5mΩ NC contacts 7.5~10.4mΩ	Measured after lead wire soldered to terminals. $n = 20$ JIS C 4509
7	Making capacity	CO performed at 1.1 times rated operating voltage and current (AC 13 class, DC 13 class).	No problem	JIS C 4520
8	Electrical life	100,000 operations or greater at rated operating voltage and current (resistance load).	No problem	JIS C 4520
9	Mechanical life	Momentary action 500,000 operations or greater Alternate action 100,000 operations or greater	Both 500,000 operations or greater.	JIS C 4520
10	Contact chattering	5ms or less	NO contacts 0.2~1.0ms NC contacts 0.2~2.2ms	$n = 15$
11	Shock	(1) Functional 98m/s <sup>2</sup> (10G) or greater (2) Survival 490m/s <sup>2</sup> (50G) or greater	(1) No erroneous operation contact chattering up to 392m/s <sup>2</sup> (40G) (2) No pushbutton separation, damage or locking misses at alternate action.	5 operations in each of 3 directions JIS C 0912
12	Vibration	(1) Resonance No erroneous operation at frequency of 10~500Hz, fixed acceleration of 9.8m/s <sup>2</sup> (1G). (2) Steady-state vibration No erroneous operation and damage by frequency 16.7Hz, amplitude 4mm vibration applied for 1 hour.	(1) No erroneous operation. (2) No erroneous operation or damage.	For reference, the frequency when the amplitude and erroneous operation limit frequency were studied were as follows: 90Hz at 1mm 70Hz at 2mm 60Hz at 3mm 50Hz at 4mm JIS C 0911
13	Protection of operators	Must not reach the live part from the button when a φ1mm copper wire pushed with a force of 1N.	Good	Since it is a buried type, this is the protection of operators from the front of the panel JIS C 4520
14	Solderability	Confirmation of limit	As follows from the standpoints of solder flux immersion and construction: Soldering iron 30W (tip length 20mm or greater) within 5s Soldering iron 20W (tip length 20mm or greater) within 10s	Reference Temperature of soldering iron (20mm iron) 30W Approx 356°C 20W Approx 256°C

Stable contact is assured by plating the contacts with sulfide resistant and oxidation resistant gold and taking initial failure countermeasures.

## V. TEST RESULTS

Since there are no pertinent standards, tests were mainly based on JIS C 4520 (General Rules for Control Switches) and JIS C 4521 (Button Control Switches). The results are given in *Table 3*.

## VI. APPLICATIONS

These switches have a wide range of applications, and

their functions can be amply displayed by suitable use.

## VII. CONCLUSION

The AH16 Type command switches are matched to automation and electronics as described in the above. Since they are applicable to low level of 5V, several mA and are also applicable to AC 200V class general control applications, they will have a wide range of applications in the future. Therefore, we plan to expand the series.

