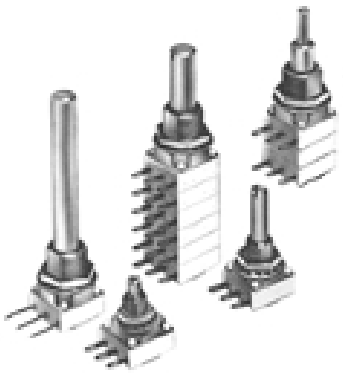
Modular Potentiometers with Cermet (P11) or Conductive Plastic Elements (PA11)



FEATURES

- CECC 41300
- MIL-R-94
- GAM T1
- P11 version for industrial and military applications
- PA11 version for professional audio applications
- Trimmer version T11/TA11 (see document No. 51024)
- Miniature module size : 12.5 mm square - low current compatibility
- Five shaft diameters and 12 terminal styles
- Multiple assemblies - up to seven modules
- Shaft and panel sealed version
- Up to twenty-one indent positions
- Switch modules
- Concentric shafts
- Motorized version
- Custom designs

VERSATILE	MODULAR	COMPACT	ROBUST

ELECTRICAL SPECIFICATIONS

		PA11	P11
Resistive Element		Conductive plastic	Cermet
Electrical Travel		270° ± 10°	270° ± 10°
Resistance Range*	**Linear Law**	1kΩ to 1MΩ	10Ω to 10MΩ
	Non Linear Law	470Ω to 500KΩ	100Ω to 2.2MΩ
Tolerance	**Standard**	± 20%	± 20%
	On Request	–	± 5% or ± 10%
Power Rating	**Linear Law**	0.5 W at + 70°C	1 W at + 70°C
	Non Linear Laws	0.25 W at + 70°C	0.5 W at + 70°C
	Multiple Assemblies	0.25 W at + 70°C per module	0.5 W at + 70°C per module
Temperature Coefficient		± 500 ppm/°C typical	± 100 ppm/°C (R ≥ 100Ω)
Limiting Element Voltage		350 V	350 V
Contact Resistance Variation	**Linear Law**	1%	2% or 3Ω
End Resistance (Typical)		2Ω	2Ω
Independent Linearity (Typical)	**Linear Law**	± 3%	± 3%
Insulation Resistance		10^6MΩ min.	10^6MΩ min.
Dielectric Strength		1500 V RMS min.	1500 V RMS min.
Attenuation		90 dB max. and 0.05 dB min.	–
Mechanical Rotational Life		50 000 cycles	50 000 cycles

*Consult Vishay Sfernice for other ohmic values

MECHANICAL SPECIFICATIONS PA11 AND P11

Mechanical Travel: 300° ± 5°

Operating Torque, Single and Dual Assemblies:
3mm, 4mm (1/8") dia. Shafts 0.5 to 1.3 Ncm max. (0.7 to 1.8 oz-inch max.)
6mm (1/4") dia. Shafts 0.7 to 1.5 Ncm max. (1 to 2.1 oz-inch max.)

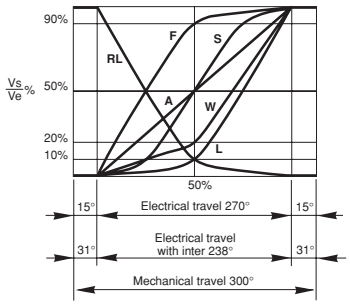
Three to Seven Modules (per module: 0.2 to 0.3 Ncm max. (0.3 to 0.45 oz-inch max.)

End Stop Torque:
3mm, 4mm (1/8") dia. Shafts 35 Ncm max. (3 lb-inch max.)
6mm (1/4") dia. Shafts 80 Ncm max. (6.8 lb-inch max.)

Tightening Torque:
6mm, 7mm (1/4") dia. bushings 150 Ncm max. (13 lb-inch max.)
10mm (3/8") dia. bushings 250 ncm max. (21 lb-inch max.)

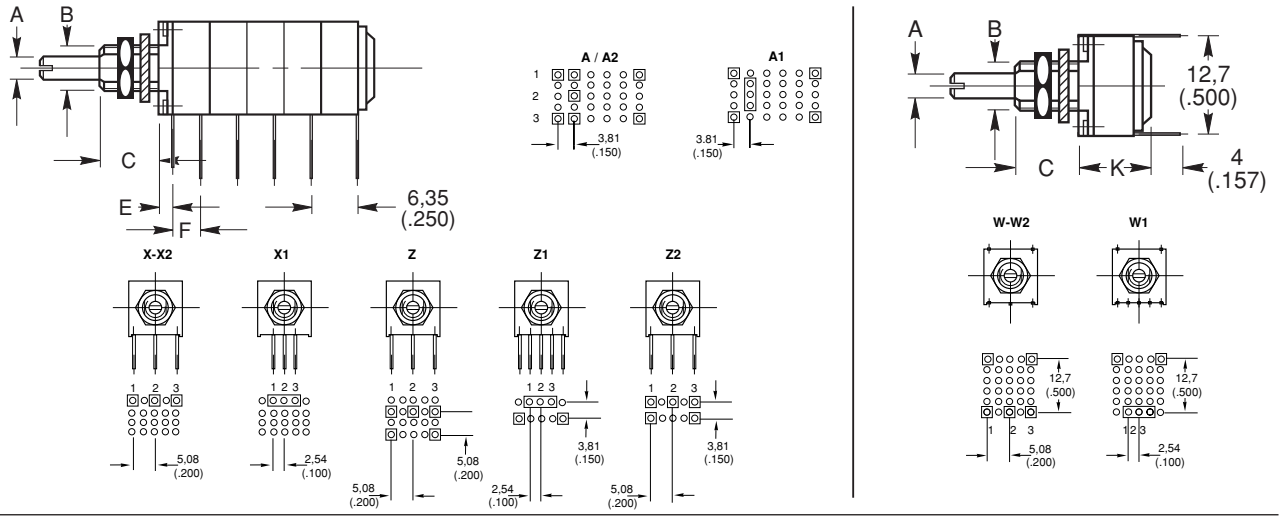
Weight 7g to 9g per module (0.25 to 0.32 oz)

VARIATION LAWS

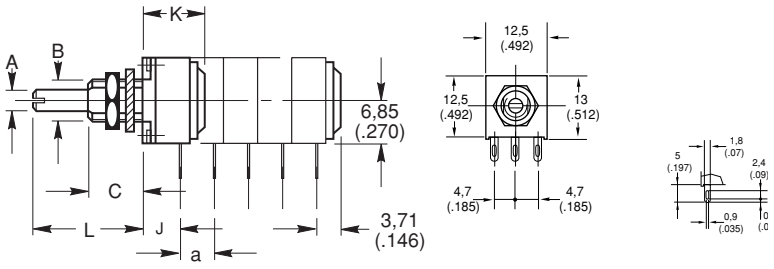


DIMENSIONS in millimeters [inches]

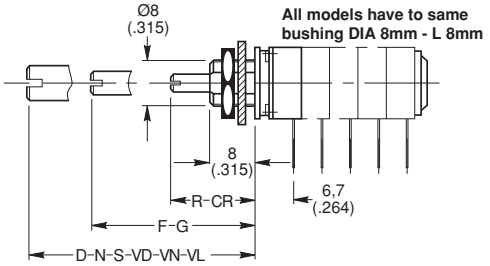
PCB PIN OUT A - A_1 - A_2 / X - X_1 - X_2 / Z - Z_1 - Z_2 / W - W_1 - W_2



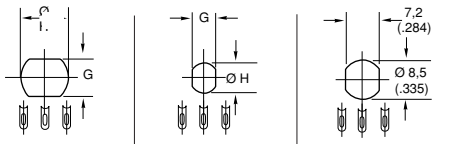
SOLDER LUGS Y



PANEL AND SHAFT SEALED TP / QP / VP / 2P / 7P



PANEL CUT OUT

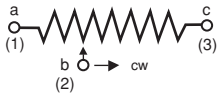


V 2 0 CC

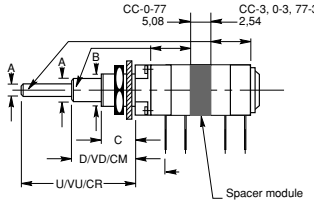
T Q 7 77

TP - QP - VP
2P - 7P
same bushing
Ø 8 mm - L 8 mm

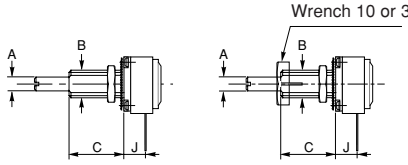
CIRCUIT DIAGRAM



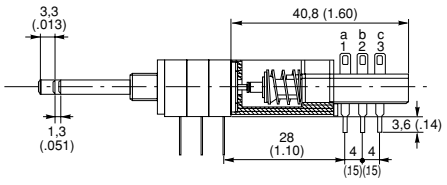
CONCENTRIC SHAFT VERSIONS Y, X



P11/PA11 71 P11/PA11 71H
P11/PA11 72 P11/PA11 72H **with spindle baking nut**



SWITCH : MOMENTARY PUSH OR PUSH-PUSH



The position of each module is free

Shafts	T	Q	V	CC	7	71	72	2	0	77
	dimensions mm ± 0.5				dimensions inches ± (0.01)					
A Shafts Ø	3	4	6	3/6	1/8"	1/8"	1/8"	1/4"	1/8" 1/4"	.07 1/8"
B Bushing Ø	6	7	10	10	1/4 "	1/4"	1/4"	3/8"	3/8"	1/4"
C L	8	8	9.5	9.5	1/4 "	3/8"	1/2"	3/8"	3/8"	1/4"
J versions Y, X, X_1, X_2	5	5	7	7	.200	.200	.200	.278	.278	.200
K	9.1	9.1	11.1	–	.357	.357	.357	.436	–	–
E version Z	1.8	1.8	3.8	3.8	.071	.071	.071	.150	.150	.071
E versions Z_1, Z_2, A, A_1, A_2	1.6	1.6	3.6	3.6	.063	.063	.063	.14	.14	.063
F	version Z : 5.08 (.200)				versions A- A_1-A_2-Z-Z_1-Z_2 : 3.81 (.150)					
G Panel	5.2	6.2	8.2	8.2	.197	.197	.197	.323	.323	.197
H Cutout Ø	6.5	7.5	10.5	10.5	.268	.268	.268	.394	.394	.268
a	variable 5.08 (.200) 7.62 (.300) 10.16 (.400)									
Thread	M 0.75				32 threads/inch					
Nut	8	10	12	12	.313	.313	.313	.500	.500	.313
Shaft lengths L	Measurement from the mounting face, see ordering procedures									

ENVIRONMENTAL SPECIFICATIONS

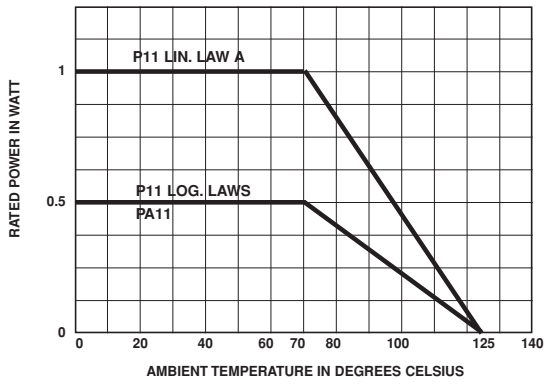
	PA11	P11
Temperature Range	– 55°C + 125°C	– 55°C + 125°C
Climatic Category	55/125/21	55/125/56
Sealing	IP64	IP64

PLASTIC MATERIALS USED ARE UL 94 class VO
GOLD PLATED CONTACTS

STANDARD RESISTANCE ELEMENT DATA

STANDARD RESISTANCE VALUES	P11 CERMET						PA11 CONDUCTIVE PLASTIC LINEAR LAW			CT – 55°C + 125°C	
	LINEAR LAW			NON LINEAR LAW							
	MAX. POWER AT 70°C	MAX. WORKING VOLTAGE	MAX. CUR. THROUGH WIPER	MAX. POWER AT 70°C	MAX. WORKING VOLTAGE	MAX. CUR. THROUGH WIPER	MAX. POWER AT 70°C	MAX. WORKING VOLTAGE	MAX. CUR. THROUGH WIPER	P11	PA11
Ω	W	V	mA	W	V	mA	W	V	mA	ppm/°C	
22	1	4.69	213.2							± 200	
47		6.85	145.8								
100		10	100								
200		14.8	67.4	0.5							
470		21.6	46.1		15.3	32.7					
1k		31.6	31.6		22.4	22.4	0.5	22.4	22.4		
2.2k		46.9	21.3		33.2	15.1		33.2	15.1		
4,7k		63.5	14.5		48.5	10.3		48.5	10.3	± 100	± 1000
10k		100	10		79.7	7.07		79.7	7.07		
22k		148.3	6.7		105	4.77		105	4.77		
47k		216.7	4.6		153	3.26		153	3.26		
100k	1	316.2	3.16	0.5	224	2.24	0.5	224	2.24		
220k	0.56	350	1.59	0.26	332	1.51	0.5	332	1.51		
470k	0.26	350	0.75	0.12	350	0.74	0.26	350	0.74		
1M	0.12	350	0.35		350	0.35					
2.2M	0.05	350	0.16								
4.7M	0.02	350	0.07								

POWER RATING CHART



MULTIPLE ASSEMBLIES

Standard assemblies can comprise up to 7 modules in addition to the shaft and bushing module.

Detents module (CV)

Switch modules (RS or RSI)

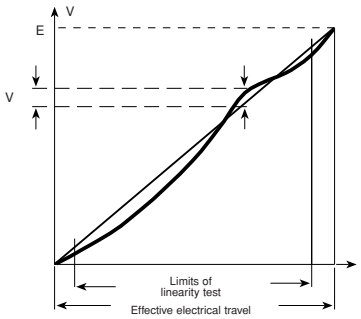
Potentiometer modules

Spacer module (EV) to increase the distance between rows of pins from 5.06 mm (0.200) to 10.16 mm (0.400).

Screening module, with ground terminal.

The position of each module is free except the push/push, momentary push and motor which has to be the last module.

LINEARITY - CONFORMITY



The independent linearity (conformity for the non linear laws) is the maximum gap ΔV between the actual variation curve and the theorical variation curve the nearest to it. The linearity and the conformity are expressed in percentage of the total applied voltage E

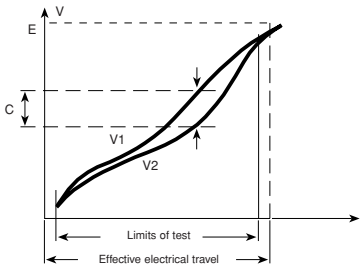
$$\text{linearity / conformity} = \pm \frac{\Delta V \text{ max.}}{E} \%$$

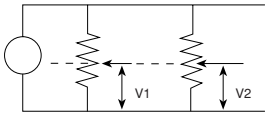
They are measured over 90% of actual electrical travel (centered).

On request linearity can be guaranteed in linear law.

For example: linearity ± 2 % + J 145 option (see ordering procedure).

INTERLINEARITY - INTERCONFORMITY





It is the maximum deviation between the actual voltage outputs of 2 or more pot modules in the same assembly. It is expressed as a percentage of the total applied voltage, or preferably in dB attenuation.

Interlinearity is measured between 2 pot modules, over 10 to 90% of the attenuation.

The interlinearity or interconformity is expressed as a percentage of the total applied voltage :

$$I\% = \frac{ICI}{E}$$

Or in decibels by comparison between outputs V_1 and V_2

$$I\ dB = 20 \log \frac{V_1}{V_2}$$

PERFORMANCE

TESTS	CONDITIONS	TYPICAL VALUES AND DRIFTS	P11 CERMET	PA11 CONDUCTIVE PLASTIC
Load Life	1000 h at + 70°C (90'/30')	total resistance shift	± 2%	± 10%
		contact resistance variation	± 4%	± 5%
Temperature Cycle	5 cycles – 55°C to 125°C	total resistance shift	± 0.2%	± 0.5% typical
Moisture	+ 40°C 93% relative humidity	total resistance shift insulation resistance	56 days ± 2% >1000 MΩ	21 days ± 5% >10 MΩ
Rotational Life	P11 / PA 11 : 50 000 cycles	total resistance shift contact resistance variation	± 5% ± 5%	± 6% ± 2%
Climatic Sequence	Dry heat + 125°C / Damp heat Cold – 55°C / Damp heat 5 cycles	total resistance shift	± 1%	–
Shock	50 G 11 ms 3 shocks - 3 directions	total resistance shift resistance setting change	± 0.2%, ± 0.5%	± 0.2% ± 0.5% typical
Vibration	10 - 55 Hz 0,75 mm or 10 G 6 hours	total resistance shift voltage setting change	± 0.2 % ± 0.5% typical	± 0.2 % ± 0.5% typical

OPTIONS
MODULES: RS ON/OFF SWITCH RSI CHANGEOVER SWITCH

The position of each module is free.

RS and RSI rotary switches are housed in a standard P11 module size 12.7 x 12.7 x 5.08 mm (.5" x .5" x .2"). They have the same terminal styles as the assembled electrical modules.

CAUTION : Because of the switch actuation travel, the potentiometer total electrical travel is reduced to 240° ± 10°.

Switch actuation is described as seen from the shaft end.

D: means actuation in maximum CCW position

F: means actuation in maximum CW position

The switch actuation travel is 25° with a total mechanical travel of 300° ± 5°.

MODULES :
PUSH/PUSH SWITCH RSPP
MOMENTARY/PUSH SWITCH RSMP

The switches are manufactured by ITT, F.U. series (NE18 series available on request).

They have to be the last element of potentiometer and are linked to electrical module by an interface.

RSPP and RSMP switches are available only with P11/PA11 T-Q or 7 series not with P11/PA11 V or 2 series.

Options :

2 reversing switches F2 4 reversing switches F4

6 reversing switches F6 8 reversing switches F8

Available with shafts R(T), G (Q), CR (7) others shafts on request.

Not available with panel sealed option.

Number of modules before the switch limited to 3 modules.

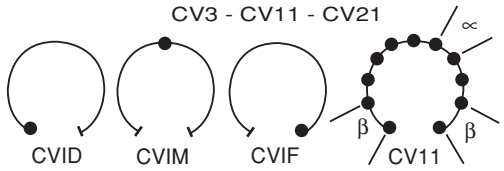
VALLEY DETENTS

The valley detents mechanism is housed in a standard P11 module. Up to 21 detents position available.

Count detents as follows : 1 for CCW position, 1 for full CW position, plus the other positions forming **equal resistance increments** (linear taper) - **not equal angles**.

Available now : CVID - CVIF - CVIM

CV3 - CV11 - CV21



$$\propto = \frac{270°}{n - 1}$$

$$\beta = \propto + 15°$$

RSD SINGLE POLE SWITCH, NORMALLY OPEN

In full CCW position, the contact between 1 and 3 is open. It is made at the beginning of the travel in CW direction.

RSF SINGLE POLE SWITCH, NORMALLY OPEN

In full CW position, the contact between 1 and 3 is open. It is made at the beginning of the travel in CCW direction.

RSID SINGLE POLE CHANGEOVER

In full CCW position, the contact is made between 3 and 2 and open between 3 and 1. Switch actuation (CW direction) reverses these positions.

RSIF SINGLE POLE CHANGEOVER

In full CW position, the contact is made between 1 and 2 and open between 1 and 3. Switch actuation (CCW direction) reverses these positions.

RSPP F2 : PUSH/PUSH SWITCH WITH TWO REVERSING SWITCHES

Idle position : the contact is made between 1 and 2 and a and b. It is open between 2 and 3 and b and c.

Pushed position: the contact is made between 2 and 3 and b and c. It is open between 1 and 2 and a and b.

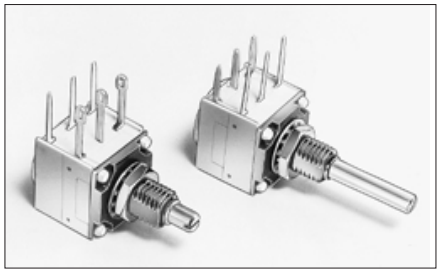
Not available on P11V and P11-2.

On request for P11Q and P11-7.

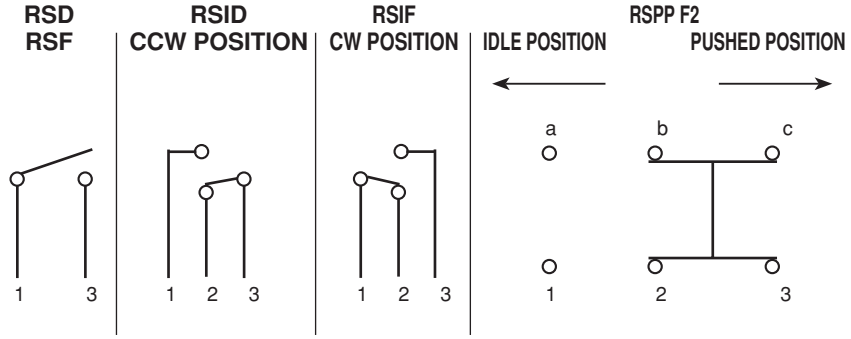
SWITCH SPECIFICATIONS

MODEL		RS - RSI	F2 to F8
Switching Power max.		62.5 VA ↭ 15 VA ⎓	50 VA ↭
Switching Current max.		0.25 A 250 V↭ 0.5 A 30 V ⎓	0.5 A ↭
Max. Current Through Element		2 A	2 A
Contact Resistance		30mΩ	100mΩ
Dielectric Strength	Terminal to Terminal	1000 V RMS	1500 V RMS
	Terminal to Bushing	2000 V RMS	2000 V RMS
Max. Voltage Operation		250 V ↭ 30 V ⎓	250 V ↭
Insulation Resistance Between Contacts		10^6MΩ	10^3MΩ
Life at P max.		10 000 actuations	100 000 actuations
Minimal Travel		25°	3.3 mm to 4.7 mm
Operating Temperature		- 40°C to + 85°C	- 20°C + 70°C

SWITCH MODULES



ELECTRICAL DIAGRAM



CENTER TAP "J"

The extra terminal is a solder lug connected at 50% of electrical travel and situated in the potentiometer module opposite the terminals.

Center tap short circuit 11° of travel.

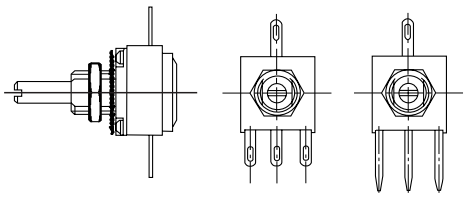


Fig. 7

SHAFTS (see Ordering Information)

The shaft lengths are always measured from the mounting face.

Standard shafts are designed by a letter code (one or two digits). Shafts slots are aligned to ±10° of the wiper position.

CONCENTRIC SHAFTS

The CC or 0 or 77 concentric shaft versions allies the total flexibility of the P11/PA11 modular system to the advantage of having two separate shafts.

The outer 6 mm or 1/4" or 1/8" dia. shaft drives the modules situated immediately behind the panel, before the spacer module.

The inner 3 mm or 1/8" or .07" dia. shaft drives the modules situated after the spacer module.

Spacer is available with a choice of two spacer thickness :

5.08 mm designations : CC, 0, 77

2.54 mm designations : CC-3, 0-3, and 77-3. See dimensional drawings on second page of this datasheet

CUSTOM SHAFTS

When special shafts are required - flat, threaded ends, special shaft lengths, etc. a drawing is required.

SPLINED SHAFT "I"

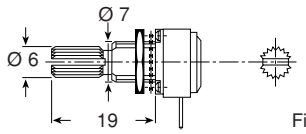


Fig 8

FLATTED SHAFT

PA11/P11 - 2 = VHM

PA11/P11 - 7 = CDM

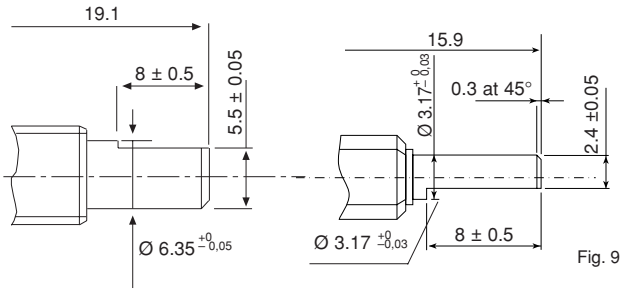


Fig. 9

OPTION: ELECTRICAL MODULE ONLY

Application: positioning transducer.

Solution: single electrical module without shaft bushing assembly.

Option:
- 300° electrical travel (equal to mechanical travel)
- better linearity of variation law (taper).

Benefits:
- economical
- for servo mounting, small dimensions allow use in tight places or difficult to access locations.

NEUTRAL MODULE "EN"

Neutral or screen module is housed in a standard P11 module. It is used as a screen between two electrical modules. The leads can be connected to ground.

LOCATING PEGS (Anti-rotation lugs)

The locating peg is provided by a plate mounted on the bushing and positioned by the module sides.

Four set positions are available, clock face orientation : 12, 3, 6, 9.

All P11 bushings have a double flat. When panel mounting holes have been punched accordingly, an anti-rotation log is not necessary.

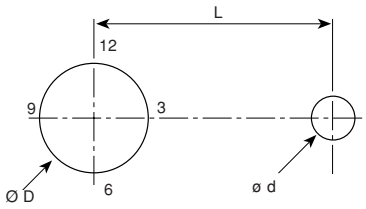


Fig. 10

Table 5

CODE	P11 - PA11					EFFECTIVE HIGH PEG
	VERSION	T-7	V-CC	Q	2-0	
B24	øD mm	6.5	10.5	7.5	10	0.7
	ød mm	2	2	2	2	
	L mm	6.2	6.2	6.2	6.2	
B30	ød mm	2	2	2	2	0.7
	L mm	7.75	7.75	7.75	7.75	
B53	ød mm	–	3.5	–	3.5	1.1
	L mm	–	13.5	–	13.5	

TRIMMERS T11

See data sheet document No. 51021

MARKING

POTENTIOMETER MODULE

VISHAY logo, nominal ohmic value (Ω, kΩ, MΩ), two stars identify PA11 version, tolerance in % - variation law, manufacturing date (four digits), "3" for the lead 3.

SWITCH MODULE

Version, manufacturing date (four digits), "c" for common lead.

INDENT MODULE

Version, manufacturing date (four digits).

ORDERING INFORMATION

P11 Cermet element — **PA11** Conductive plastic element

SERIES

SINGLE SHAFT	Bushing Dia.	Length	Shaft Dia.
T	6	8	3
Q	7	8	4
V	10	9,5	6
2	3/8"	3/8"	1/4"
7	1/4"	1/4"	1/8"
71	1/4"	3/8"	1/8"
72	1/4"	1/2"	1/8"
CONCENTRIC SHAFT			
CC	10	9,5	3-6
O	3/8"	3/8"	1/8"-1/4"
77	1/4"	1/4"	.07" - 1/8"

* All panel sealing versions have a bushing of 8 mm dia, and 8 mm length

SHAFT AND BUSHING

Y	Solder lugs - radial 5.08 mm (.200") pin spacing
X	PCB pins - radial
Z	PCB pins - radial with front support plate
A	PCB pins - radial with front and back support plates
W	PCB pins - axial with 2 extra pins - 1 module only
–	5.08 mm (.200") pin spacing for X, Z, W. pins section 0.9 x 0.3 mm² (.035" x .012")
1	2.54 mm (.100") pin spacing for X, Z, W. pins section 0.6 x 0.3 mm² (.024" x .012")
2	5.08 mm (.200") pin spacing for X, Z, W. pins section 0.6 x 0.3 mm² (.024" x .012")
–	5.08 mm (.200") space between modules
3	7.62 mm (.300") space between modules
4	10.16 mm (.400") space between modules

TERMINAL STYLES

B24	Distance from shaft center of 6.2 mm (.244") for all models. Plate thickness of 0.4 mm (.015").
B30	Distance from shaft center of 7.75 mm (.305") for all models. Plate thickness of 0.4 mm (.015").
B53	Distance from shaft center of 13.5 mm (.531") for V, 2, CC and O models. Plate thickness of 0.8 mm (.031").

Locating pegs can be placed at 12, 3, 6 or 9 o'clocks. Not available with panel and shaft sealing option P.

LOCATING PEGS

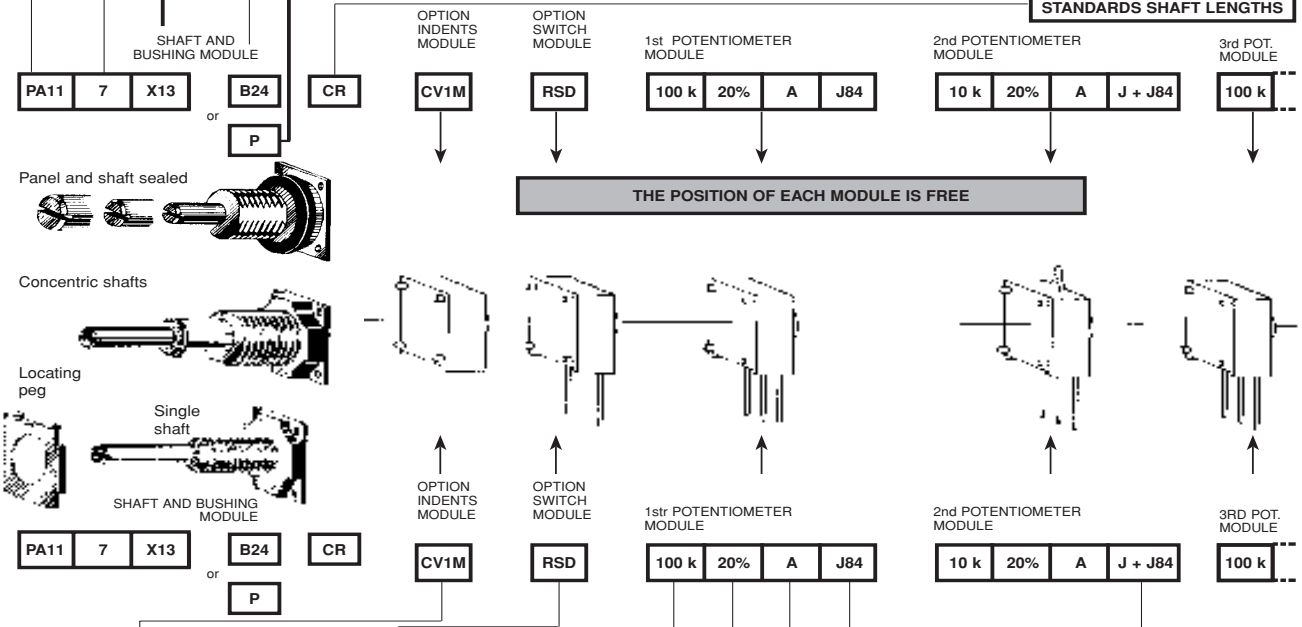
P All panel sealing versions have a bushing of 8mm dia. and 8 mm length. The shafts K - M - E - CK -CM -CD - CH are not-standard.

PANEL-SHAFT SEALING

OPTION

FROM MOUNTING FACE		Dia.	Length	End shaft
T	**K**	3	9.5	slotted
	M	3	12.5	
	R	3	22	
Q	**E**	4	9.5	slotted
	F	4	12.5	
	G	4	22	
	I	6	19	splined
V	**D**	6	16	slotted
	N	6	25	
	S	6	50	
AP		Custom - specify or. quote drawing.		
		Dia.	Length	End shaft
7	**CDM**	1/8"	5/8"	flat
7	**CK**	1/8"	3/8"	slotted
71	**CM**	1/8"	1/2"	
72	**CD**	1/8"	5/8"	
	CH	1/8"	3/4"	
	CR	1/8"	7/8"	
2	**VD**	1/4"	5/8"	slotted
	VR	1/4"	7/8"	
	VN	1/4"	1'	
	VL	1/4"	1.1/2"	
	VHM	1/4"	3/4"	flat
CC **CC-3**	**D**	6	16	plain
	U	3	28.5	
77 **77-3**	**CM**	1/8"	1/2"	plain
	CR	.07"	.874"	
0 **0-3**	**VD**	1/4	5/8"	plain
	VU	1/8"	9/8"	

STANDARDS SHAFT LENGTHS



OPTION

INDENT MODULE

CV1M	1 indent at half travel
CV1D	1 indent CCW position
CV1F	1 indent CW position
CV3	3 indents inc.CW & CCW
–	–
–	–
–	–
CV11	11 indents
–	–
–	–
–	–
–	–
CV21	21 indents etc.

Former CRN version (N-1 equal mechanical angles) available on request.

OPTION

SWITCH MODULE

RSD	Single pole open switch in CCW position - 2 pins
RSF	Single pole open switch in CW position - 2 pins
RSID	Single pole chargeover switch in CCW position - 3 pins
RSIF	Single pole chargeous switch in CW position - 3 pins

An assembly can comprise 1 or more switch modules. Pin out RS and RSI is the print out as other assemblied modules.

OHMIC VALUE

Quote clearly multipliers K - M

10Ω to 10 MΩ
A linear law - cermet

100Ω to 2.2 MΩ
L, F, S non linear laws -cermet

Conductive plastic
1KΩ to 1MΩ
A linear law

470Ω to 500KΩ
non-linear laws

TOLERANCE

±20 %	Standard
±10 %	Optional
±5 %	Optional (cermet only)

VARIATION LAW

A	Linear
L	CW log 10 %
F	CW reverse log
S	Audio S shape symetrical log
W	CW log 20%
RL	CCW log

OPTIONS

J	Center tap
J41	Panel sealed bushing 10 mm dia.
J44	Interlinearity ±2 % (linear law)
J84	Accuracy of center point of CV1M to ±2 % (except S law)
J123	Linearity ±3 % (linear law)
J145	Linearity ±2 % (linear law)
J152	Marking part number
EN	Empty module with screen
EV	Spacer module without pin
M	Motorized assembly
RSPP	Push Push switch
RSMP	Momentary Push switch
Servo	Electrical travel 300°

Standard assemblies can comprise up to 7 modules, in addition to the shaft and bushing assembly.