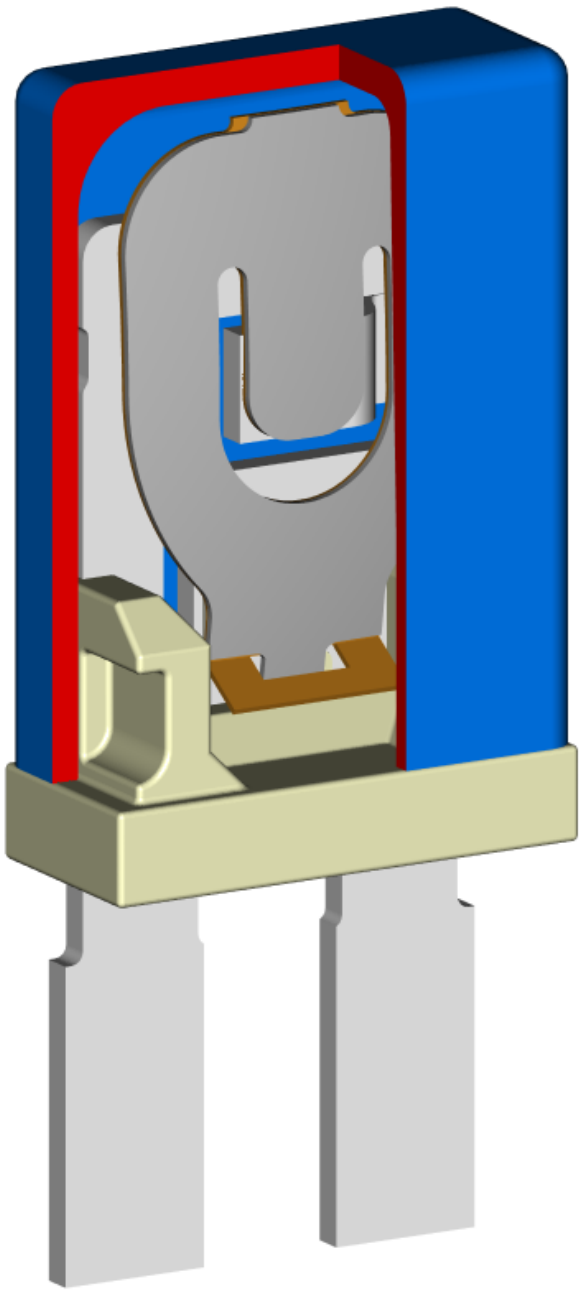
the PBA series
cut-out



compact motor protector

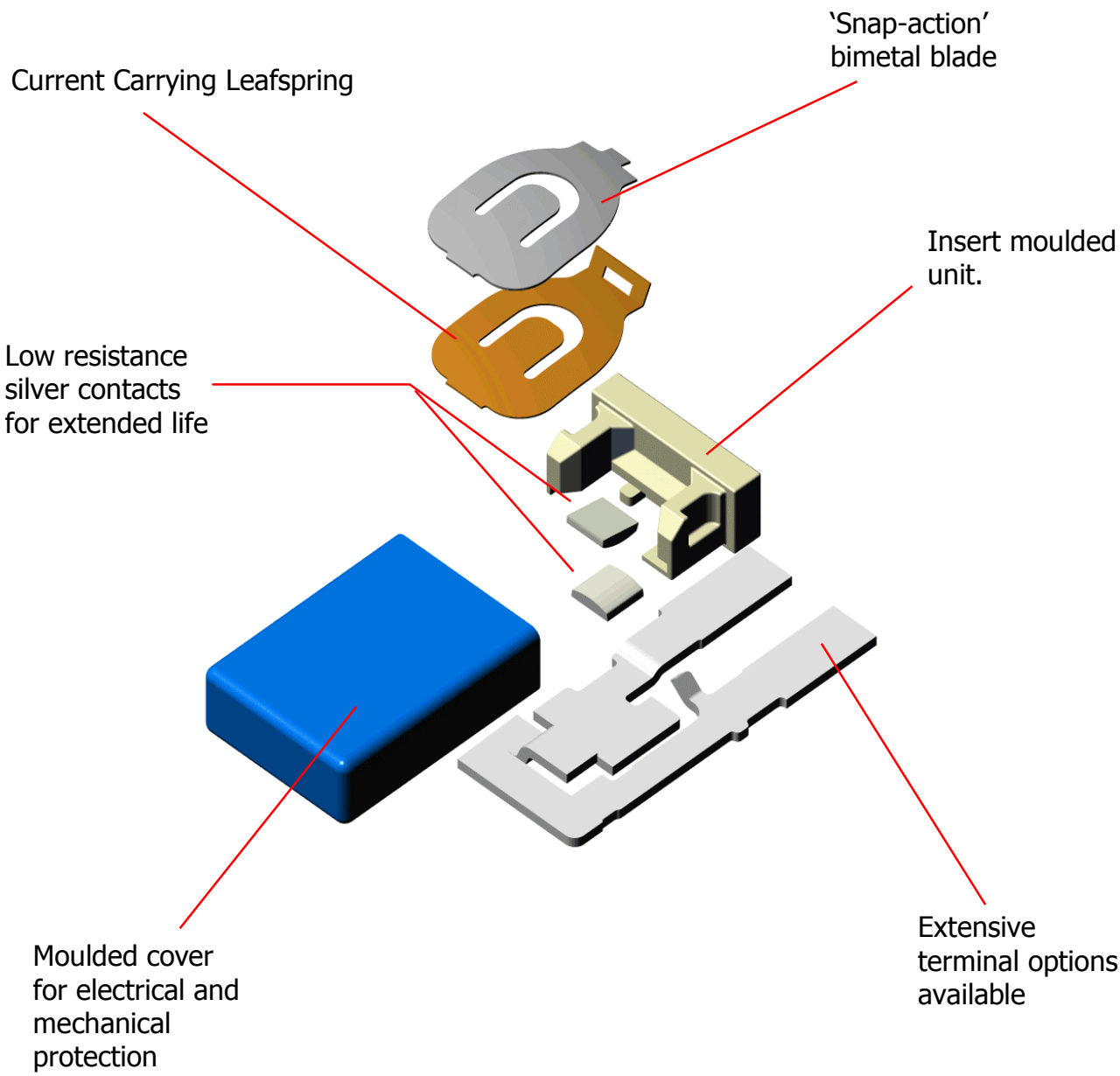
Otter®

Issue 5

08/04/03

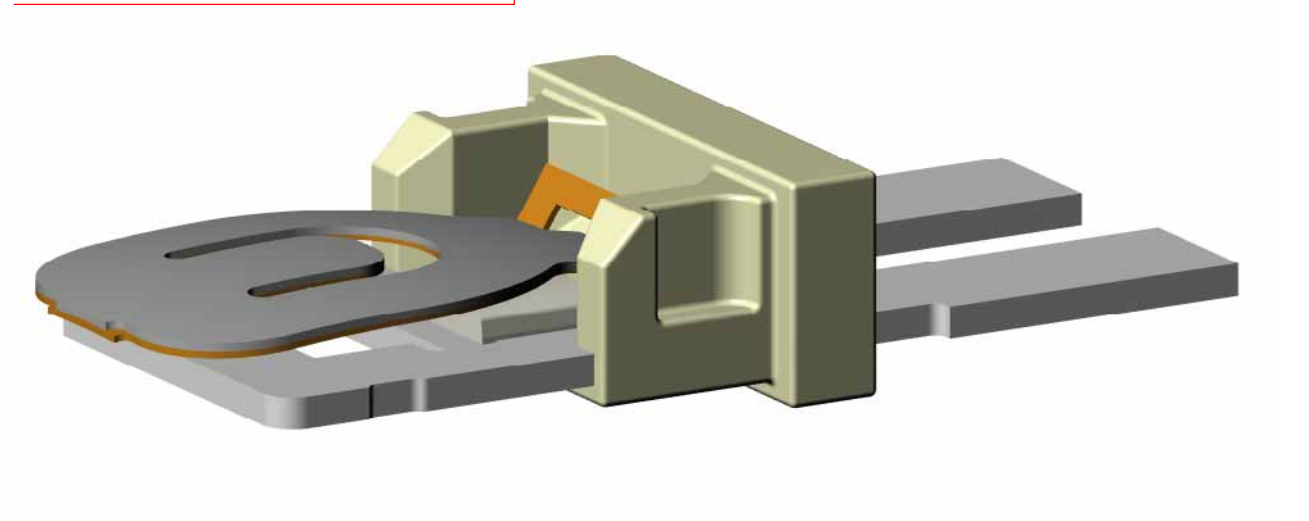
PBA series design

The PB is the smallest high performance cut-out on the market. Its unique design gives an excellent on to off switching ratio, resulting in reduced motor winding temperatures



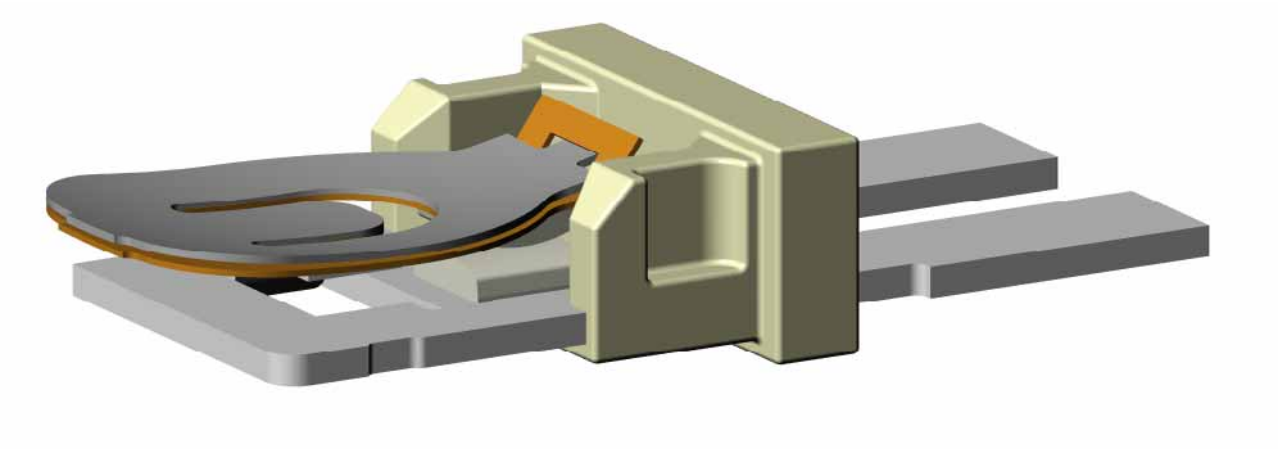
By altering the material of the current carrying leafspring, see Engineering Specification for list of materials, the PBA series offers extended operating characteristics within a single compact package.

PBA contacts closed



Current flows through low resistance leafspring with the bimetal blade heated indirectly. When a fault condition occurs, the increased current flow through the leafspring increases the temperature in the blade, which snaps open breaking the circuit.

PBA contacts open



Circuit is broken, allowing motor winding temperature to cool to a safe level before the blade snaps back and the contacts close.

PBA engineering specification

The following data gives a brief overview of the specification/capabilities of the PBA series.

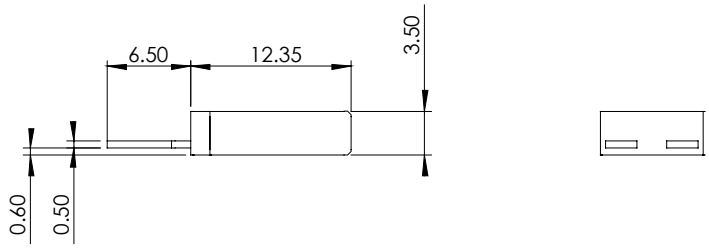
1.	Normal operating voltage:	12V: [9 - 15V]
2.	Rated switching current:	12V: [6 - 40A*]
3.	Operating ambient temperature range:	- 40 to +80ºC
4.	Operating characteristics at 20°C:	See. T/C curves over page for full operating range. Continuously rated current up to 20Amps.
5.	Remake characteristics:	above 60 ºC [to customer requirement]
6.	Voltage drop:	max 200mV or less @ 3/6 Amps*
7.	Insulation resistance:	1MΩ min. at 500V
8.	Terminal materials:	PBA31 – Brass CZ108 [65% Cu, Rem Zn] PBA41 – Nickel Silver NS107 [55% Cu, 18% Ni, Rem Zn] PBA61 – Ferry Alloy [55% Cu, Rem Ni]
9.	Leafspring materials:	Beryllium Copper [0.5% Be, 0.60% Co, Rem Cu] /SICLANIC TH4 [97% Cu, 2.5% Ni, 0.6% Si] Phosphor Bronze [7.5% Sn, 0.4% P, Rem Cu] Nickel/Silver [55% Cu, 18% Ni, Rem Zn] Ferry Alloy [55% Cu, Rem Ni]
10.	Unit material:	30% Glass filled PA46 [Stanyl TE250F6]
11.	Cover material:	30% Glass filled PA66 [Technyl A216 V30]
12.	Contact material:	99.9% Ag or 90%Ag/10%Ni* [Surface] CuNi30Fe [Backing]
13.	Endurance:	1. 48 hour stall test in motor 2. Capable of 35,000 cycles at rated current up to 27A [DC]* 3. PBA31-TN type capable of 15,000 cycles at 40A [DC]

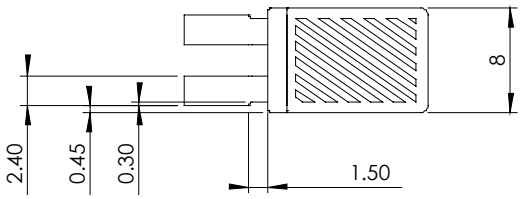
All testing has been carried out in accordance to standard Otter production polarity
*Dependant on PBA type

Full material content IMDS data is held at www.mdsystem.com. Please contact imds@ottercontrols.com for details.

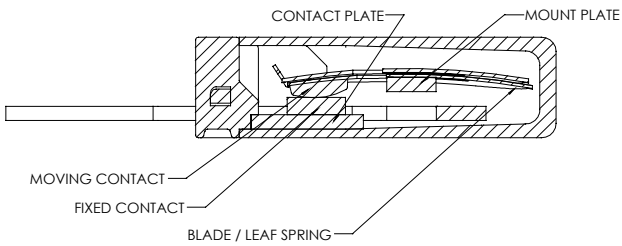
PBA outline

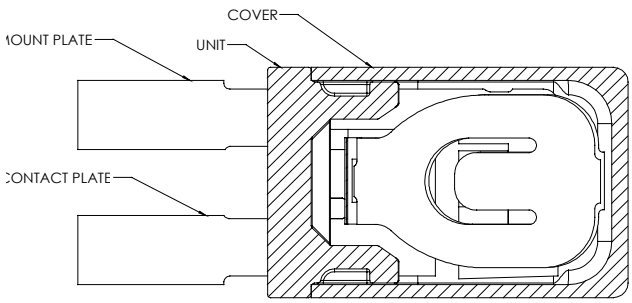
The PBA cut-out can be supplied with a range of terminal options to optimise installation. The views below describe the basic cut-out, with terminal options shown on following page.





Sectional Views showing Otter terminology for main parts/features for PBA cut-out.





PBA nomenclature

PBA nomenclature

1	2	3	4	5	6	7		8	9	10
Switch Range			Unit Metal	Cover Type	Leafspring Material	Terminal Arrangement†		Unit Termination	Special Features	
						Terminal 1	Terminal 2			
P	**B**	**A**	**3** Brass	**1** Standard	**C** Copper	**0** No fold or crop	No fold or crop	**S** Terminals same end	**0** Standard	**0** Standard
			4 Nickel Silver		**F** Ferry	**A** No crop, 90° fold	No crop, 90° fold		**T** 0.127mm leafspring	**N** 10% Nickel contacts
			6 Ferry		**P** Phosphor Bronze	**C** Straight crop, no fold	Straight crop, no fold			
					N Nickel Silver	**D** Detail crop, no fold	Straight crop, 90° fold			
					S Stainless Steel	**E** Straight crop, 90° fold	Straight crop, 90° fold			
						F Straight crop, 27° fold	Straight crop, No fold			
						H Straight crop, no fold	Straight crop, no fold			
						J Detail crop, 90° fold	Detail crop no fold			
						M No crop, 90° fold	No crop, 90° fold			
						N Straight crop, no fold	Straight crop, no fold			
						P Straight crop, parallel fold	Straight crop, no fold			
						R Inside leg crop, no fold	Inside leg crop, no fold			
						S Straight crop, Dimple on terminal	Straight crop, Dimple on terminal			

PBA production specifications

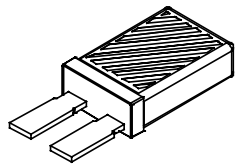
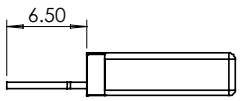
Production specifications available to meet all applications. Selection included below, other available dependent on application, please contact Sales Office. All values at 20°C.

Type	Part No.	Current [amps]	Break [Sec]			Remake	Terminal	Leafspring
			Mid	Low	High			
PBA31C0STN	31CTN	40	*5.1*	**4.6**	**5.6**	2 - 9	Brass	Copper*
PBA31C0S00	31CT1		*3.4*	**2.8**	**4.0**	2 - 7	Brass	Copper
	31CT2		*4.7*	**4.2**	**5.2**			
PBA41C0S00	41CT1	27	*4.3*	**3.5**	**5.0**	5 - 15	Nickel/ Silver	Copper
	41CT2		*4.8*	**4.0**	**5.5**			
PBA41P0S00	41PT1	20	*4.7*	**3.8**	**5.6**	2 - 10	Nickel/ Silver	Phosphor/ Bronze
	41PT2		*5.2*	**4.3**	**6.1**			
PBA41N0S00	41NT1	14	*4.3*	**3.5**	**5.0**	2 - 7	Nickel/ Silver	Nickel/ Silver
	41NT2		*4.8*	**4.0**	**5.5**			
PBA61C0S00	61CT1	27	*3.3*	**2.8**	**3.8**	6 - 18	Ferry	Copper
	61CT2		*3.7*	**3.2**	**4.2**			
PBA61P0S00	61PT1	20	*3.8*	**3.0**	**4.6**	2 - 12	Ferry	Phosphor/ Bronze
	61PT2		*4.2*	**3.4**	**5.0**			
PBA61N0S00	61NT1	14	*3.8*	**3.0**	**4.5**	2 - 7	Ferry	Nickel/ Silver
	61NT2		*4.3*	**3.5**	**5.0**			
PBA61F0S00	61FT1	12	*3.7*	**2.7**	**4.7**	2 - 7	Ferry	Ferry

*Increased Leafspring thickness

terminal variations

The PBA series can be produced with a range of folded and cropped terminal options. Contact Sales Office to confirm availability.

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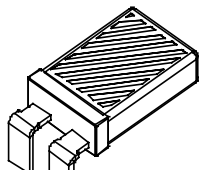
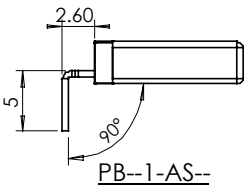
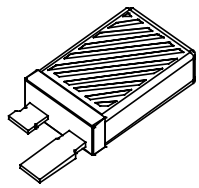
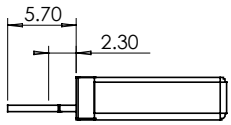



PB--1-AS--

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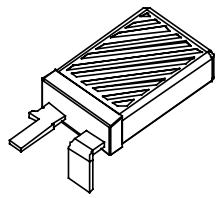
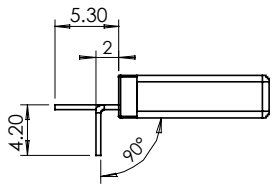

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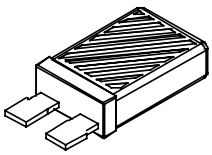
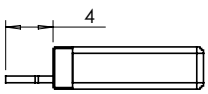

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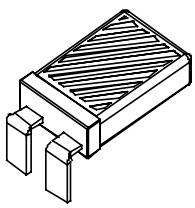
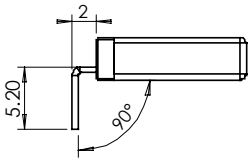

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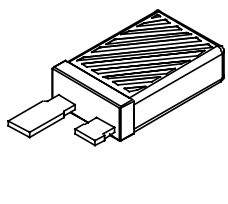
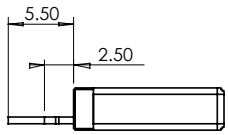

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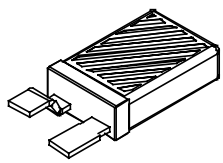
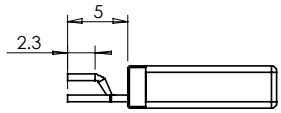

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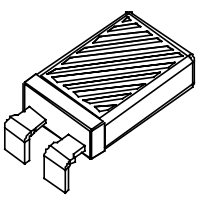
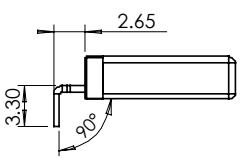

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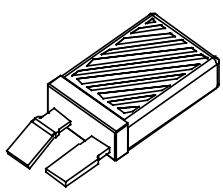
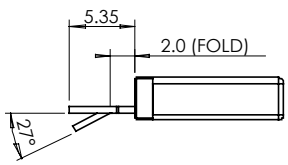

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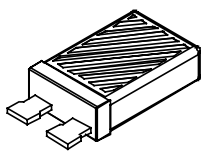
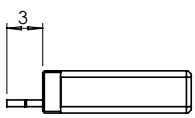



PB--1-QS--

Contact the Sales Office for detailed drawings.

PBA type data

The information on the following three pages is included to allow the choice of PBA type to be narrowed to the application.

Otter provides a complete service, including test work and cut-out selection, with initial samples supplied free of charge and all in complete confidentially. Just ask for assistance!

PBA Type Preliminary Selection

The table below designed to optimise choice to correct selection of a PBA type for each application. Nb. The temperature refers to the ambient around the cut-out.

Brk: This column shows the maximum current to give a minimum 4 second break time for the cut-out.
Carry: This column shows the maximum current that the cut-out can carry without breaking.

To use this data simply match the initial stall current of the motor in the **Brk** column. If the value in the **Carry** column is above the running load current of the motor, the PBA type is suitable for initial application test work.

If you have any questions with any of this data, please contact the Otter sales office nearest to you for immediate response.

Selection included to the right, others available dependent on application, please contact Sales Office or local distributor for motor test questionnaire.

Type	20°C		80°C	
	Brk	Carry	Brk	Carry
31CTN	49	24.0	38	18.5
31CT2	45	22.3	34	16.6
31CT1	42	21.0	30	14.7
41CT2	30	10.8	22	8.2
41CT1	28	10.2	20	7.4
61CT2	25	8.0	19	5.9
61CT1	24	7.5	17	5.3
41PT2	23	7.6	17	5.7
41PT1	22	7.3	15	5.3
61PT2	21	7.4	16	5.6
61PT1	20	6.9	14	4.9
41NT2	15	7.2	11	5.4
61NT2	15	6.3	11	4.8
41NT1	14	6.8	10	4.8
61NT1	14	6.0	10	4.2
61FT1	11	5.1	8	3.6

These figures/graphs are for guidance only and are intended to show product range. Additional factors within the application such as positioning of the cut-out should be considered.

PBA Characteristic Graphs

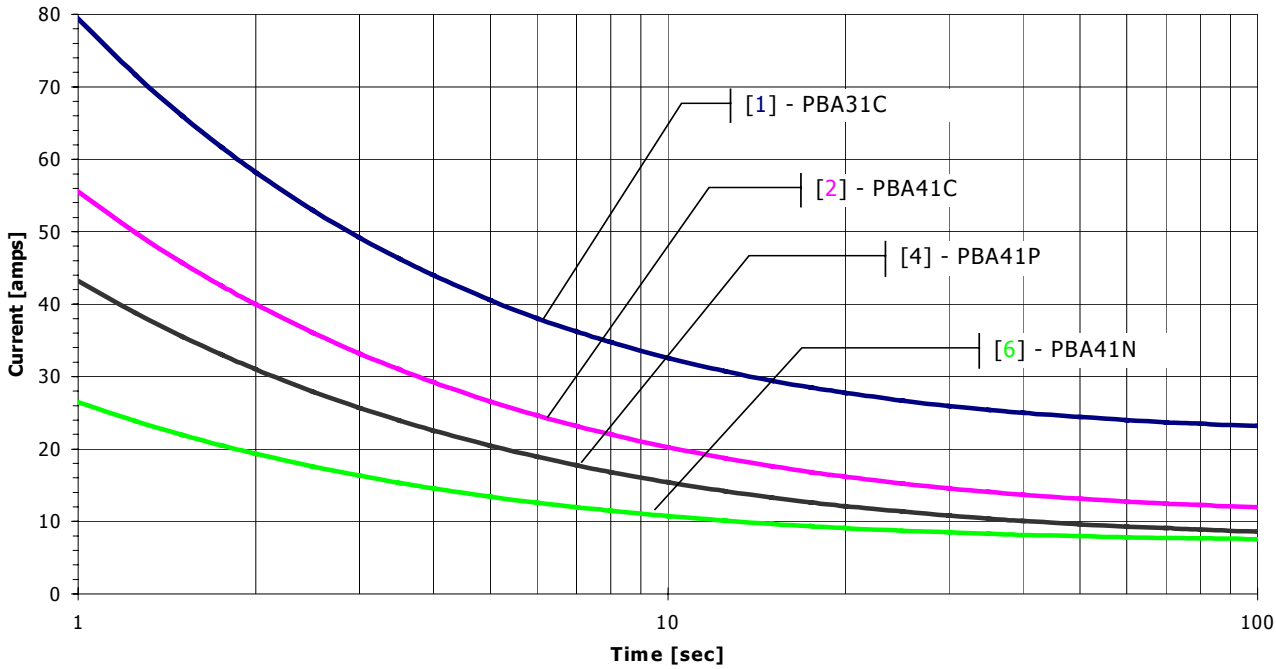
The following two pages show the characteristic curves for the PBA series. For ease of reference terminal types 31 and 41 are on page 7, and type 61 on page 8.

Time/Current Curves [TCC] - these graphs represent the initial break time for a specified current for each cut-out type [graph shown at 20°C ambient].

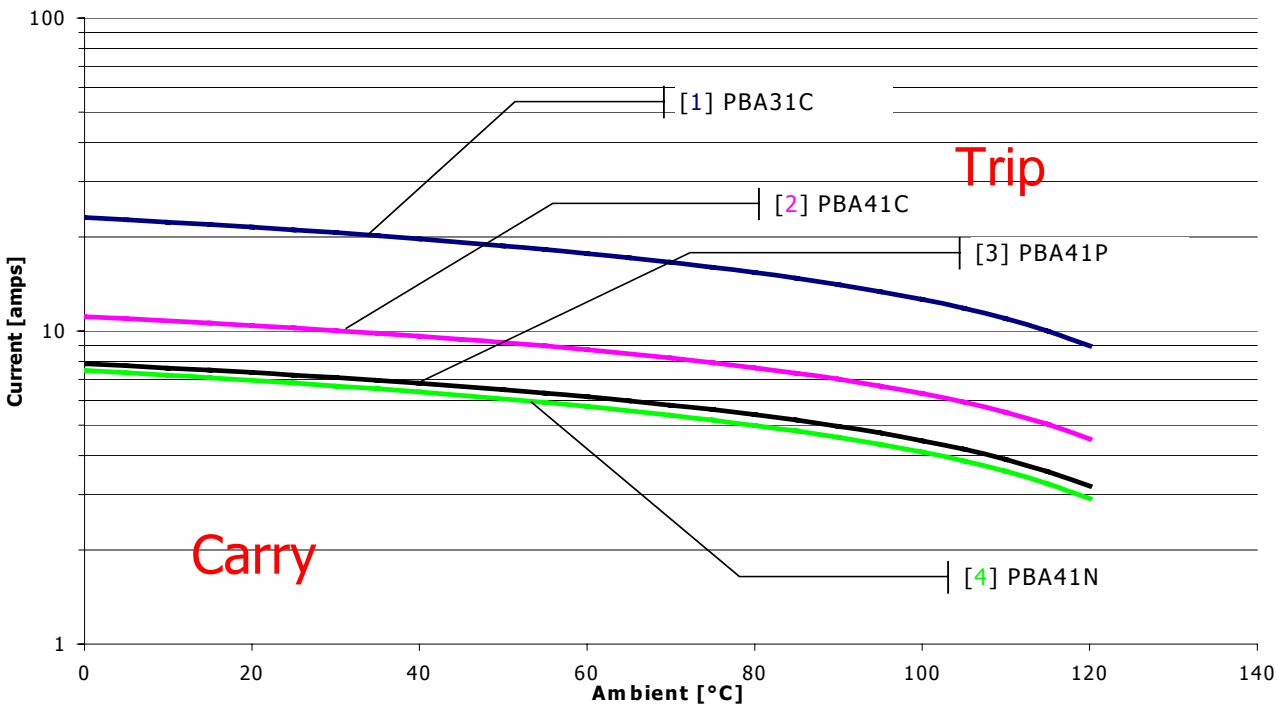
Ultimate Trip Curves [UTC] - these graphs represent the maximum current that a PBA cut-out type can carry at a given ambient.

PBA type 31 & 41 selection data

Time/Current Curves



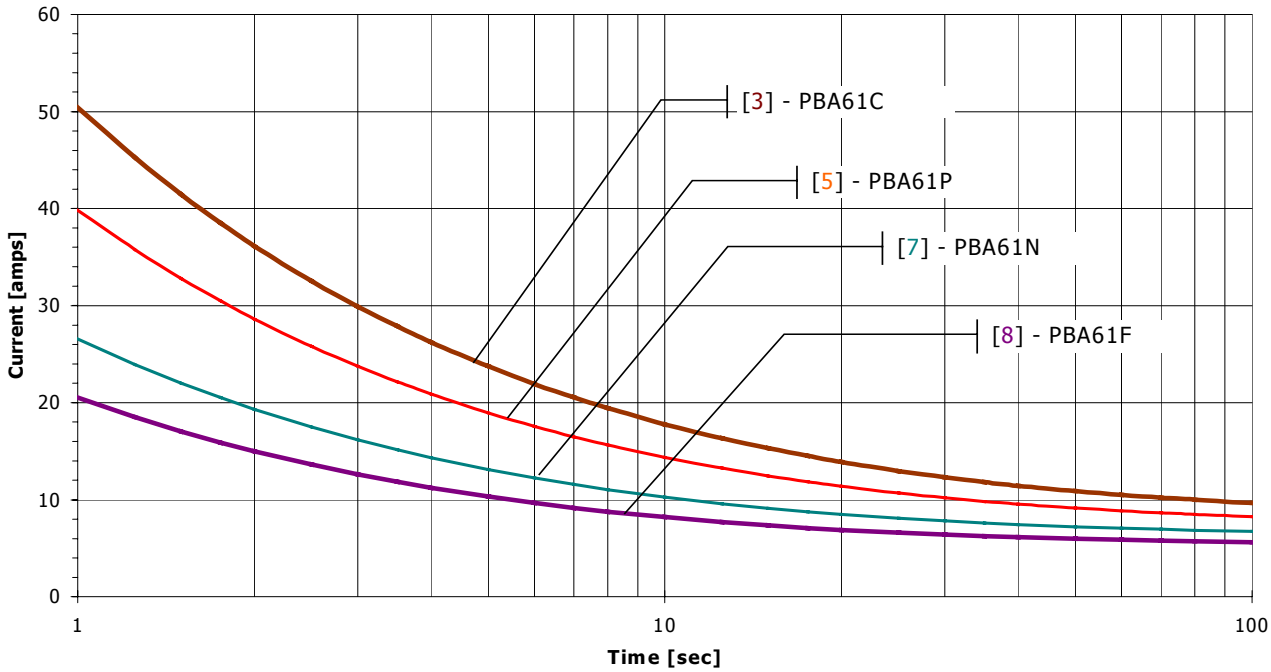
Ultimate Trip Current vs. temperature



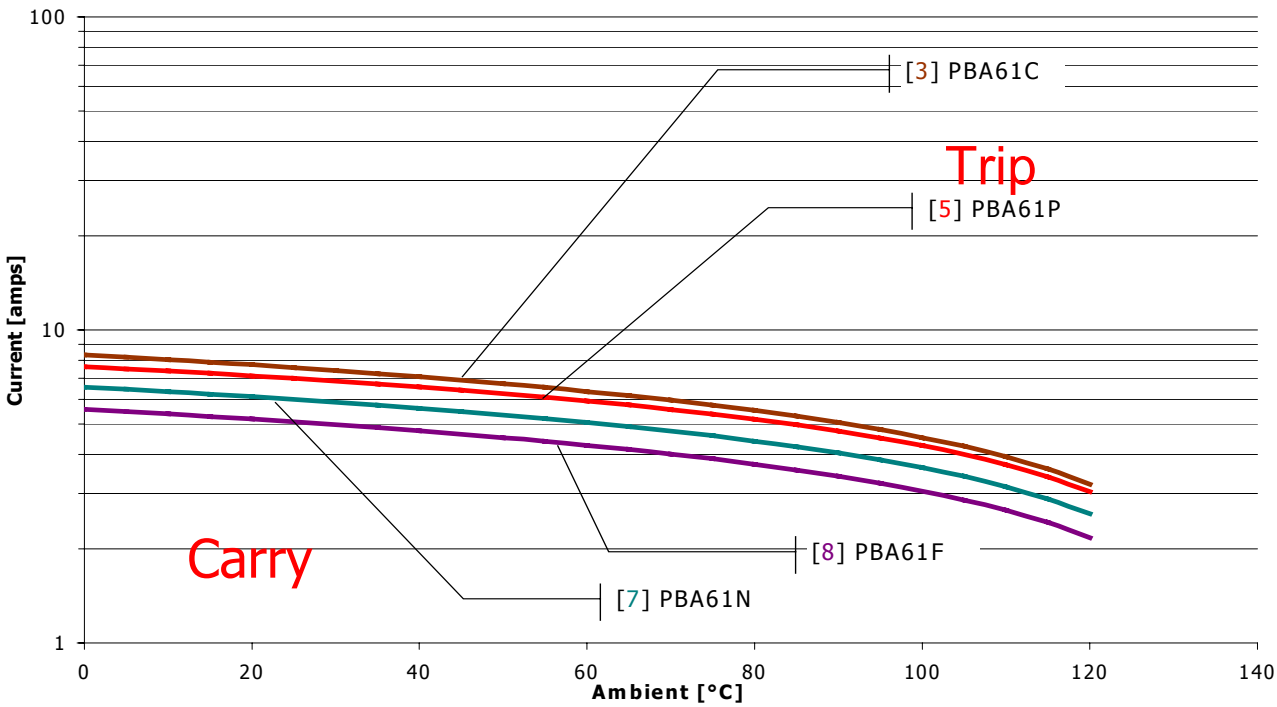
These curves are for guidance only and are intended to show product range.

PBA type 61 selection data

Time/Current Curves



Ultimate Trip Current vs. temperature



These curves are for guidance only and are intended to show product range.

Measuring time/current response of PBA series cut-out using a constant current power supply

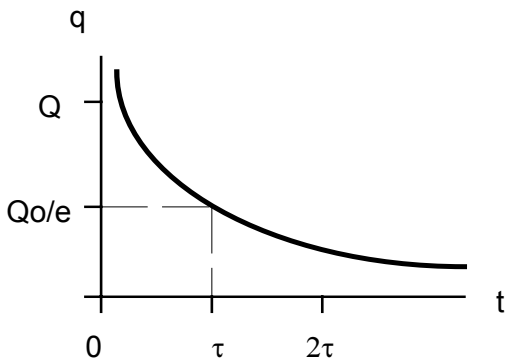
Introduction

Most Power supplies feature an additional smoothing circuit on the output. When used in switching applications the discharge of these reservoir capacitors used in the smoothing circuit can result in critical damage to the cut-out.

Effect of Power Supply Characteristics

We recommend the use of a resistive load to dissipate the energy present in the power supply's smoothing capacitors (*Ref. Graph 1 + note*). Without this additional circuit resistance the rapid discharge of these capacitors, as the contacts close results in a very high intensity arc, which can weld or permanently damage the cut-out contacts.

Graph 1: *Power Supply Capacitor Discharging*



Where, τ **=RC**

Therefore, for a fixed Capacitance (C), if the Resistance (R) is small then the discharge is extremely rapid, which is the condition created with just a cut-out across the supply. Including a resistance lengthens this Time, effectively smoothing the output.

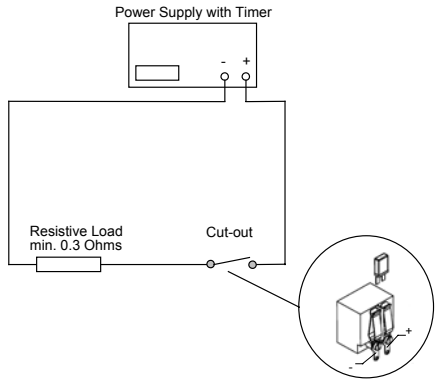
If a motor, or load is connected in series with the supply, this energy (both on Break/ and Remake) is effectively absorbed/ dissipated and does not create an arc of such high intensity or time period. This minimises any potential damage and is closer to the conditions seen within an application.

Measuring T/C performance with additional Circuit Resistance

In order to correctly measure the Time/Current response of a PBA series cut-out using a Constant Current power supply it is essential to ensure the inclusion of resistive load in series: **min: 0.3Ω** (*Ref. Figure 1*).

Note: *DC motor resistance's are typically between 0.3-0.5.* Ω

Fig 1: Testing Cut-out with additional circuit resistance



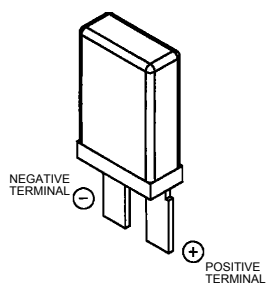
By including a load resistance in series with the cut-out (Ref. figure 1) the rate at which the power supply capacitors discharge is extended, and will ensure more consistent and repeatable Time/Current readings by avoiding damage to contact surface.

Additional factors:

Ensure correct orientation of cut-out.

Due to the phenomena associated with current flow through junctions of dissimilar metals variations in cut-out break times can occur. To avoid this it is necessary to ensure consistent orientation of the cut-out (Ref. Figure 2).

Fig 2: Correct Orientation of PBA for T/C testing



Use a suitable low resistance connection method.

To reduce T/C variation it is also necessary to ensure consistent low resistance connection (avoid the use of crocodile clips or other none repeatable method). We would recommend a typical connection method as Otter Drg: P971005

Completion of the above will minimimise any error resulting from the measurement procedure, ensuring T/C break times which closely correspond to Otter Production specification.

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