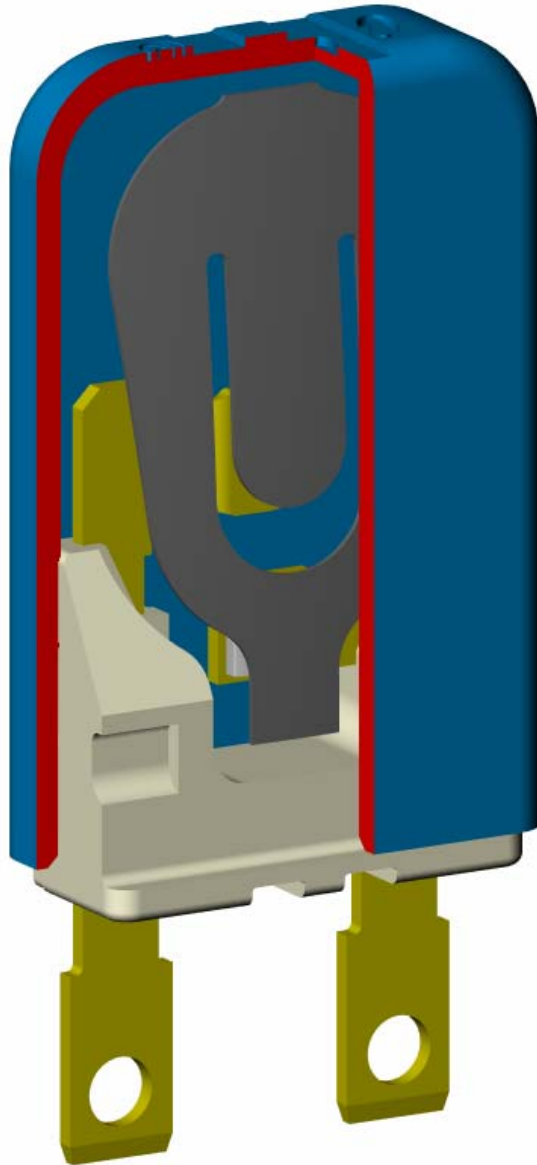

the Q/QR series cut-out



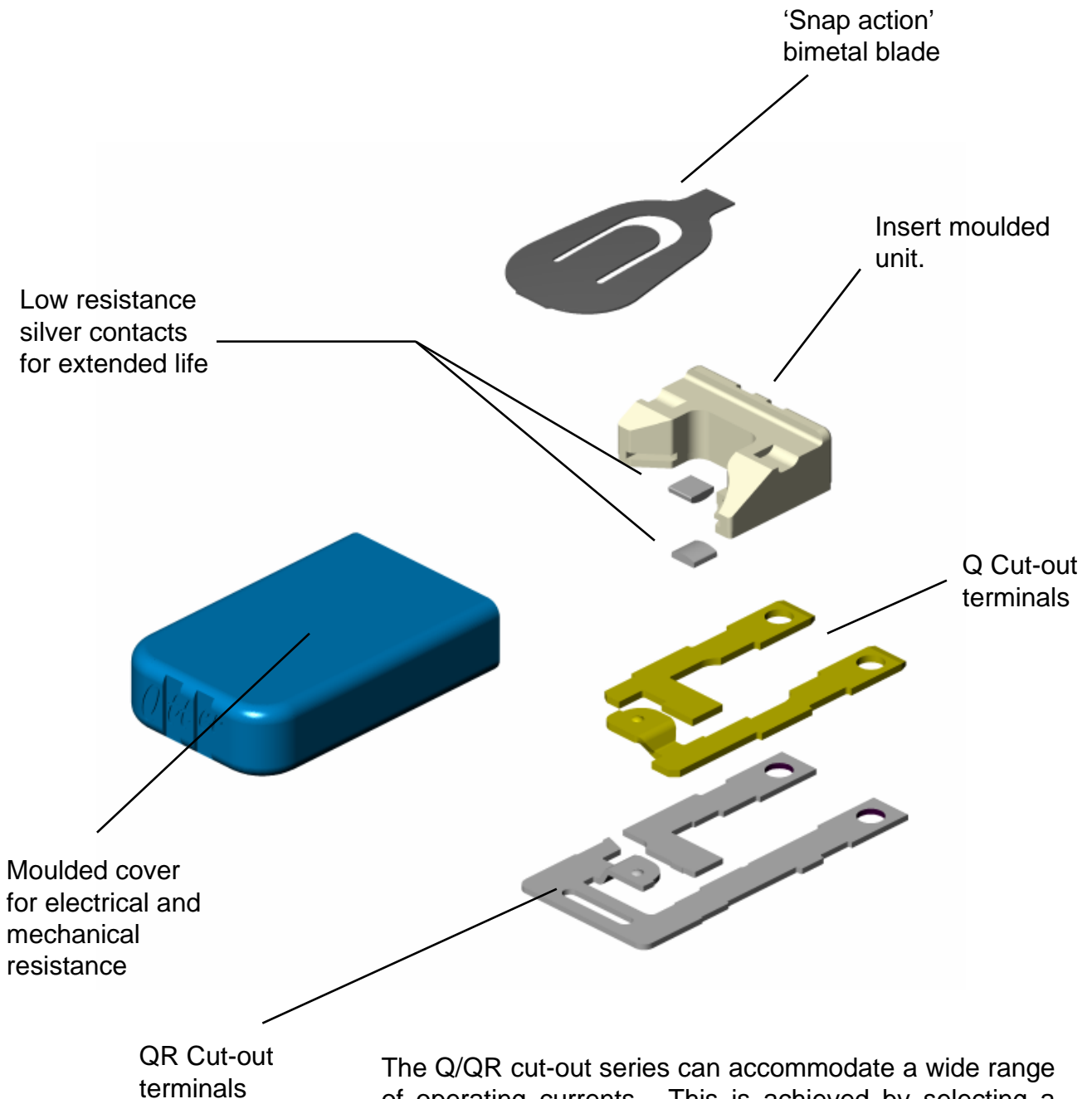
motor protector



Q/QR series design



The Q cut-out is a compact and versatile 'snap-action' auto-reset protector that has been designed to meet the challenges set by the automotive industry. Suitable for use in intermittent and continuously rated motors, the Q series combines 'snap-action'; switching and good on to off ratio, to offer excellent protection of motors.



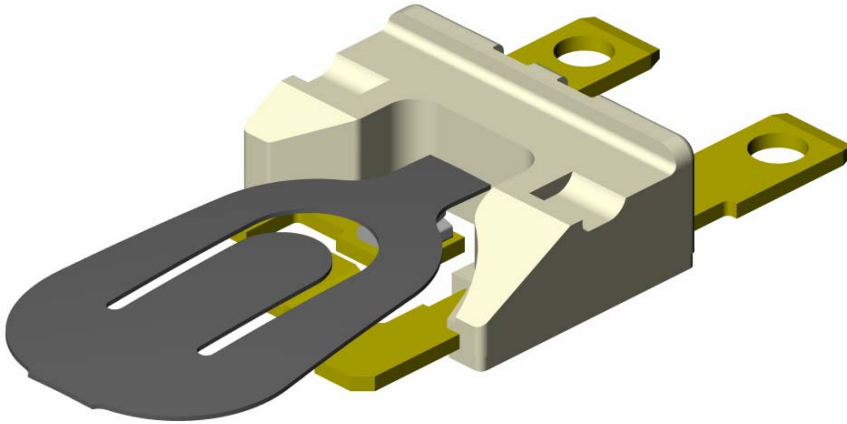
The Q/QR cut-out series can accommodate a wide range of operating currents. This is achieved by selecting a combination of unit material and bimetal grade to match the characteristics of each application.



Q series in operation



Q contacts closed

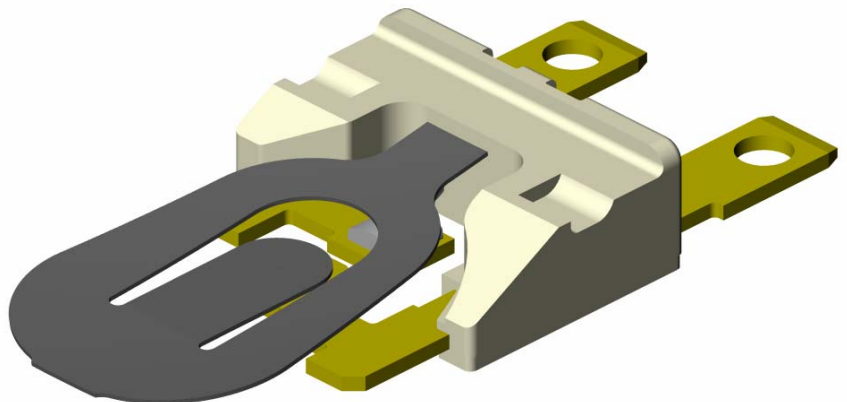


Current flows through the unit and bimetal blade. When a **fault condition** occurs, the increased current flows through the bimetal and raises the **temperature**. The bimetal blade will snap, opening the contacts to break the current.

Q contacts open

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

The QR unit has been designed to include a resistive series heater beneath the blade. This feature allows additional heat to be stored in the unit and this extends the time that the contacts remain open, allowing greater cooling of the motor.



Note:

Other terms used to describe motor protectors include, Bimetal cut-out, trips, thermo-trip, circuit breaker, switch, over current protector, etc



Q/QR engineering specification



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

1. Normal operating voltage : 12V: [9-15V] 24V: [18 - 32V]
2. Rated switching current.: 12V 6 - 50A 24V 6 - 16A
3. Operating ambient temperature range : - 40 to + 80°C
4. Operating characteristics at 20°C : See Time/Current curves on pages 10 and 11 for details.
5. Remake characteristics : above 80°C [typical]
6. Voltage drop : max 200mV
7. Insulation resistance : 1M Ω min at 500V
8. Terminal materials :

Q4	QR-4	Brass CZ108 [63% Cu, rem Zn]
Q8	QR-8	Nickel Silver NS107 [55% Cu, 18% Ni, Rem Zn]
QD		Stainless Steel 304S15 [18% Cr, 10% Ni, 2% Mn, 0.06% C]
QE		Ferry Alloy [55% Cu, 1% Fe, Rem Ni]
QC		Copper / stainless [97.5% Cu, 2.35% Fe]
9. Unit material PA 66 Glass filled
10. Cover material PA 66 Glass filled
11. Contact material 99.9% Ag [surface]
CuNi 30Fe [backing]
12. Endurance 1. 48 hour stall test in motor
2. 35 000 cycles at rated current

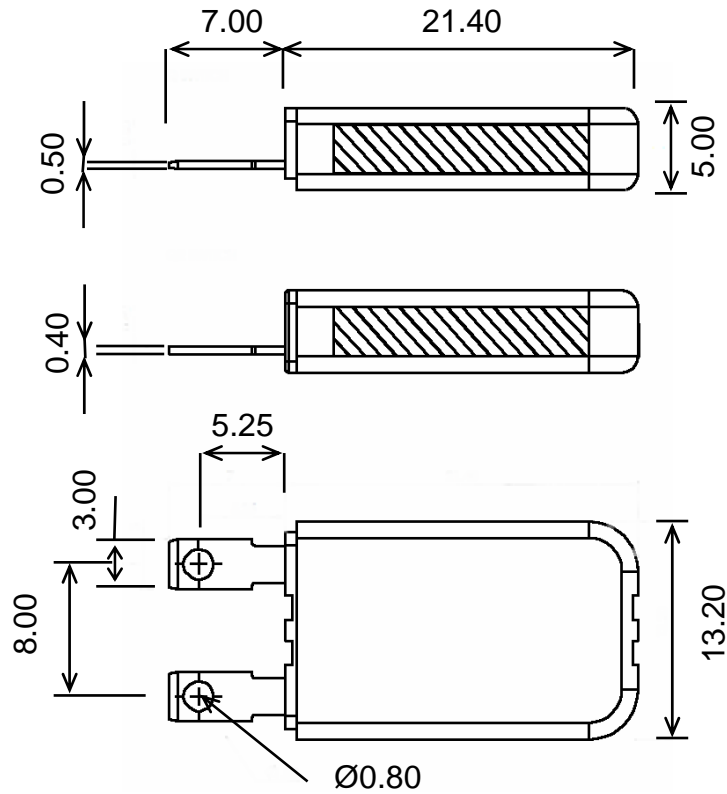
Full material content IMDS data is held at www.mdsystem.com. Please contact imds@ottercontrols.com for details.



Q/QR outline



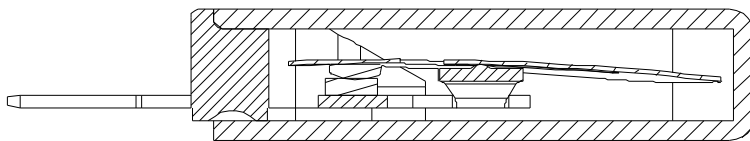
The Q/QR cut-out can be supplied with a range of terminal options to optimize installation. The views below describe the basic cut-out, with terminal options shown on following page.



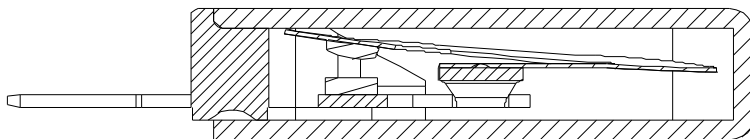
All dimensions in mm

Sectional Views of Open and Closed Contacts

Contacts Closed



Contacts Open





Q/QR Nomenclature



Q Nomenclature

1	2	3	4	5	6		7	8	9	10
Switch Range	Unit Metal	Cover Type	Bimetal Grade		Terminal Detail		Additions	Selection Method	Special Instructions	Bimetal Feature
					Terminal 1	Terminal 2				
Q	4 Brass	1 Standard	B		0 No fold or crop	No fold or crop	0 No additions	C Cabinet	C Special Ident	6 0.006" thick
	8 Nickel Silver	2 Side click	C		1 V crop, 30° fold	V crop, 30° fold	1 Plated terminal clip	T T/C set	T Standard Ident	7 0.007" thick
	9 Brass (no holes)	4 Vented	F		4 Detail crop, 21° fold	Detail crop, 21° fold	C Ringed terminal tag			
	C Dual metal	6 Side click	G		5 No crop, 30° fold	No crop, 30° fold	D Terminal winkle			
	D Stainless steel	8 Vented, side click	H		7 Straight crop, no fold	Straight crop, no fold	Z Greased contacts			
	E Ferry		J		A Detail crop, no fold	Detail crop, no fold				
	F Dual metal (no holes)		K		B No fold or crop	No fold or crop				
	H Nickel Silver (no holes)		L		C V crop, 90° fold	V crop, 90° fold				
	J Ferry (no holes)		P		G Detail crop, 90° fold	Detail crop, 90° fold				
	K Stainless (no holes)		U		H Straight crop, 90° fold	Straight crop, 90° fold				
					J No crop, 30° fold	No crop, 30° fold				
					K Detail crop, 90° fold	Detail crop, 90° fold				
					L No crop, 90° fold	No crop, 90° fold				
					M Straight crop, no fold	No crop, 90° fold				
					P No crop, 90° fold	No crop, 90° fold				
					U Detail crop, detail fold	Detail crop, detail fold				
					W No crop, 62° fold	No crop, 85° fold				
					X Detail crop, 90° fold	Detail crop, 90° fold				
					Z V crop, no fold	V crop, no fold				

QR Nomenclature

1	2	3	4	5	6	7,8	9	10
Switch Range	Unit Type	Unit Metal	Cover Type	Bimetal Grade	Terminal Features†	Additional Features	Special Instructions	
Q	R	1 No holes, no backstop	4 Brass	1 Standard	B	00 Standard straight uncropped terminals	0 No additional features	0 Not used
		3 Holes, no backstop	8 Nickel Silver	2 Side click	C	0B 90° Fold, V crop terminals	Z Greased contacts	
				4 Vented	F	A0 Straight crop terminals		
				6 Side click	H	E0 51° Terminal fold		
				8 Vented, side click	K	EE Straight crop and formed terminals		
					P	H0 Straight crop, 90° fold terminals		
					U	PO 90° terminal fold		
						PD 90° folded terminals, terminal tag addition		
						VO V crop terminals		



OTTER CONTROLS LIMITED, HARDWICK SQUARE SOUTH, BUXTON, DERBYSHIRE, SK17 6LA, UK

Tel: +44 (0) 1298 762300 Fax: +44 (0) 1298 72664

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Page - 5

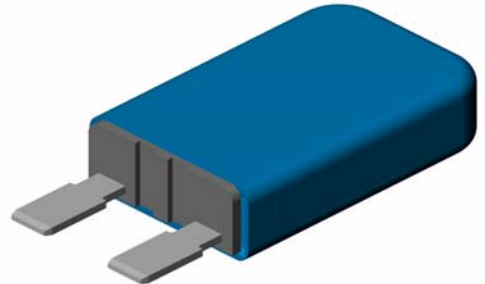
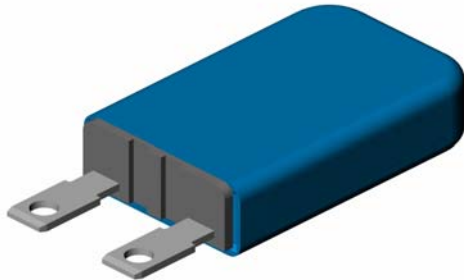
Issue 5 -
19/07/2005



Terminal variations

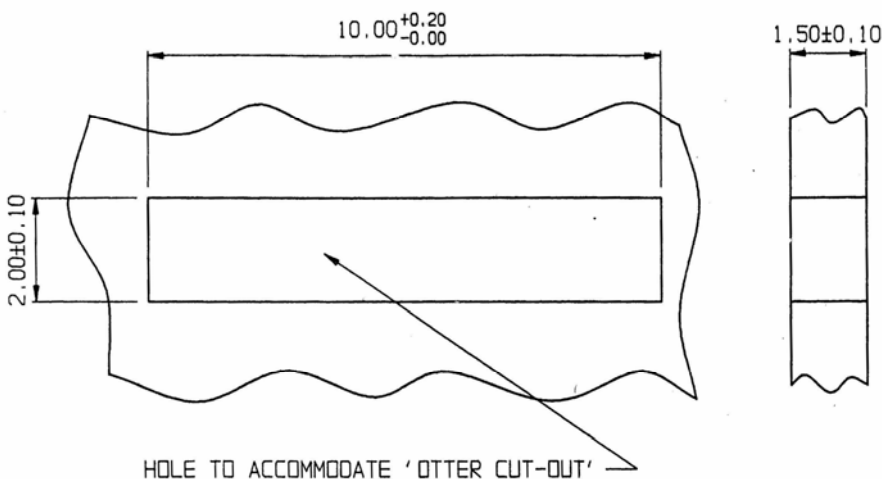


Depending on the installation methods used, the Q/QR can be supplied with or without holes in the terminals. For welding brush braids or other parts to the cut-outs, specify cut-out without holes. The terminal holes are suitable for retaining wires which are soldered to the cut-out.



Terminal Material	Q/QR	Holes	No Holes
Brass (CZ108)	Q	Q4	Q9
	QR	QR34	QR14
Nickle Silver (NS107)	Q	Q8	QH
	QR	QR38	QR18
Copper/Stainless	Q	QC	QF
Stainless Steel	Q	QD	QK
Ferry alloy	Q	QE	QJ

Q/QR Slot Dimension for side click



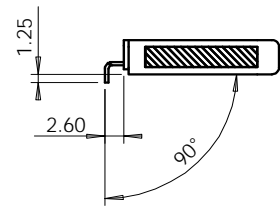
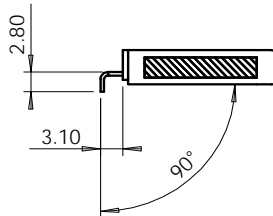
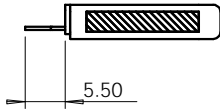
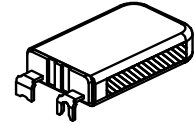
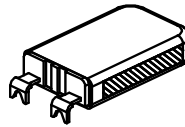
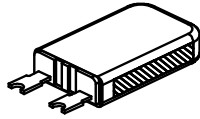
Slot dimension to accommodate **Q-2 / Q-6 / Q-6-P** side clicks shown on **page 8**.



Terminal variations



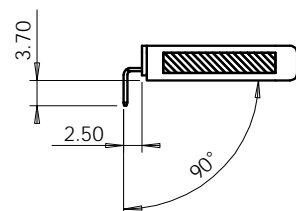
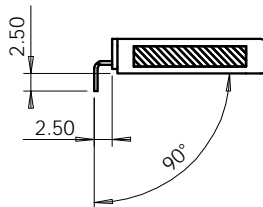
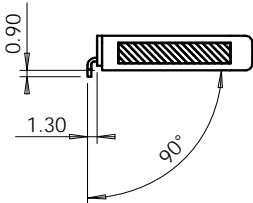
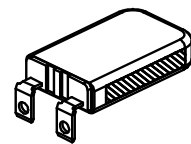
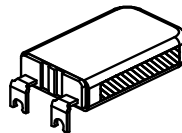
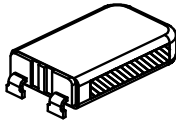
The Q/QR series can be produced with a range of folded and cropped terminal options. Contact Sales Office to confirm availability.



Q-1-A0

Q-1-C0

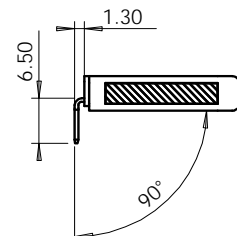
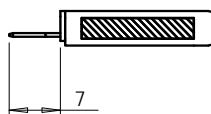
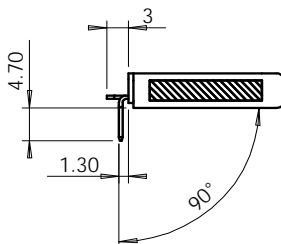
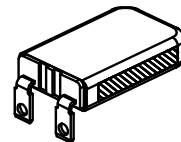
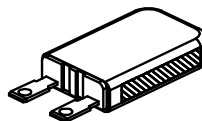
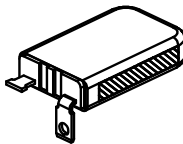
Q-1-G0



Q-1-H0

Q-1-K0

Q-1-L0



Q-1-M0

Q-1-00

Q-1-P0

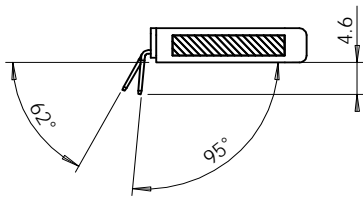
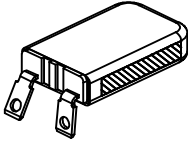
Contact the Sales Office for detailed drawings.



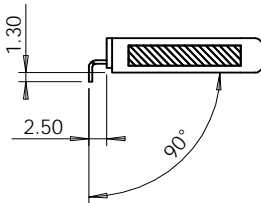
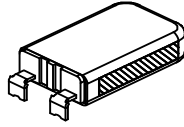
Terminal variations



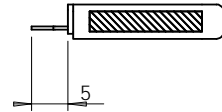
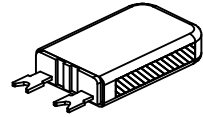
Additional.



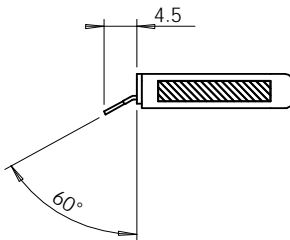
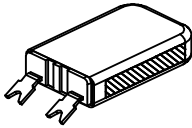
Q-1-W0



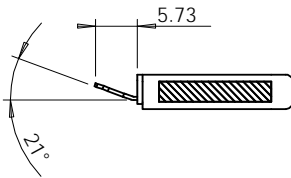
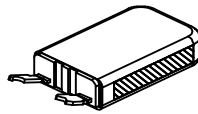
Q-1-X0



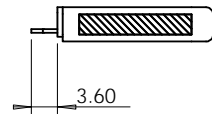
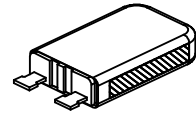
Q-1-Z0



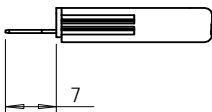
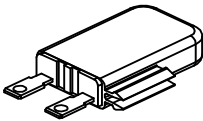
Q-1-10



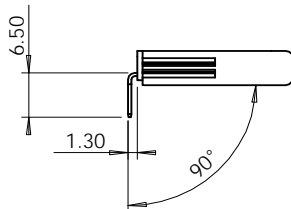
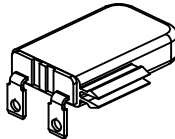
Q-1-40



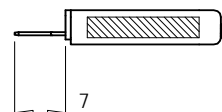
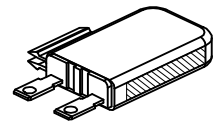
Q-1-70



Q-6-00



Q-6-P0



Q-2-00

Contact the Sales Office for detailed drawings.



Q/QR type data



The information on the following three pages is included to allow the choice of Q/QR 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 confidentiality. Just ask for assistance!

Q/QR Type Preliminary Selection

The table below designed to optimise choice to correct selection of a Q/QR 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 **6 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 Q/QR 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
Q41B	40	22	30	16
Q41C	33	18	26	14
QR181CT2	25	10	19	8
QR181CT1	23	9	15	6
QR181HT2	20	9	15	7
QR181FT2	18	8	13	6
QR181HT1	18	7	12	5
QR181FT1	16	7	11	5
QR181KT2	14	7	10	5
QR181KT1	12	6	8	4
QR181UT2	11	5	8	4
QR181UT1	10	5	6	3
QR181PT2	8	4	6	3
QR181PT1	7	4	5	2

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.

Q/QR Characteristic Graphs

The following two pages show the characteristic curves for the Q/QR series.

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 Q/QR cut-out type can carry at a given ambient.

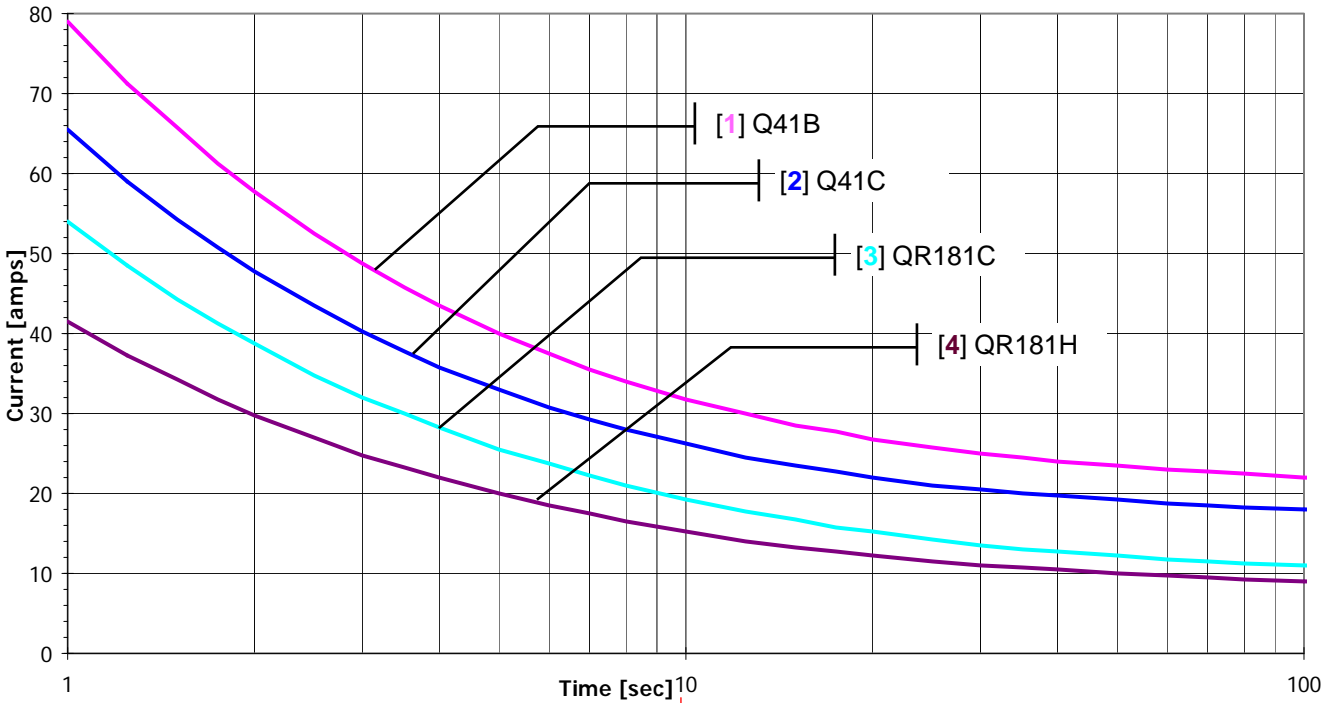




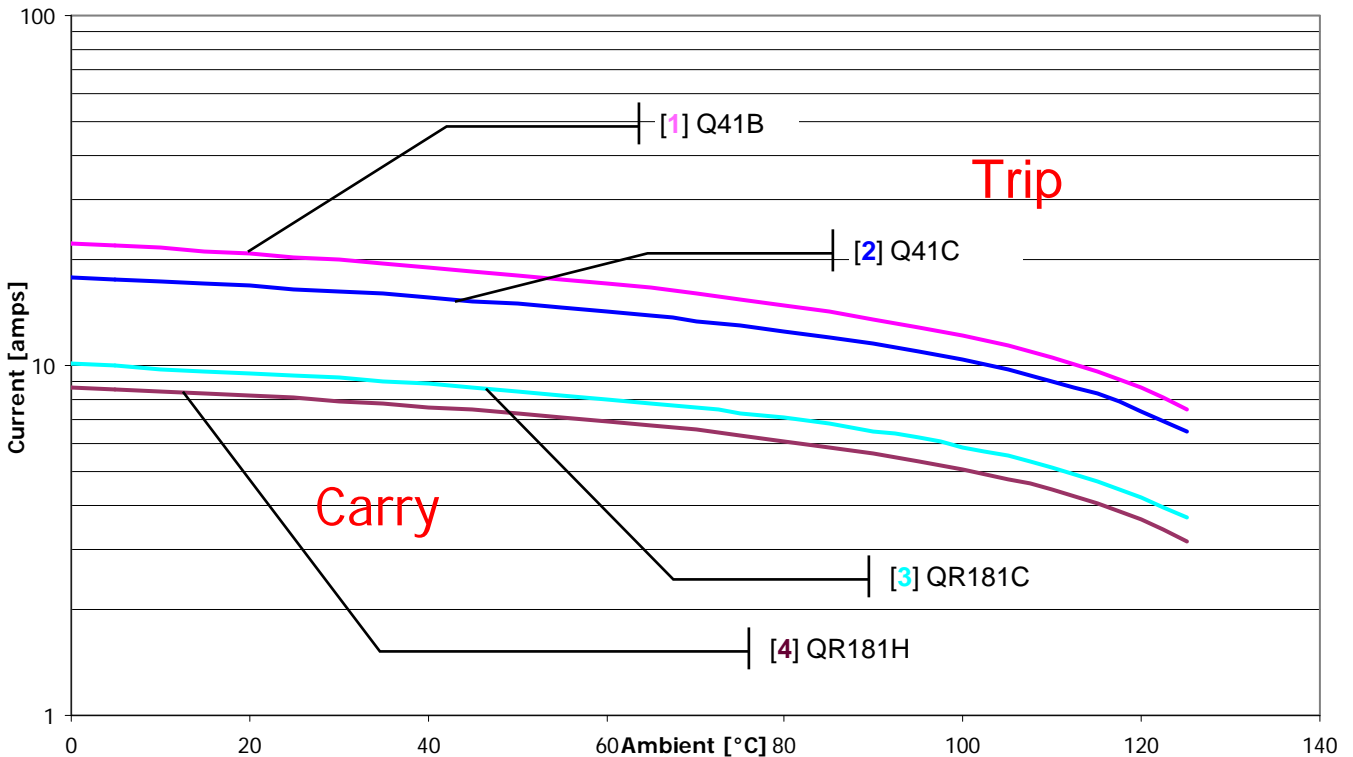
Q/QR type selection data



Time/Current Curves



Ultimate Trip Current vs. temperature



These curves are for guidance only and only show a very small part of the Q/QR product range.



OTTER CONTROLS LIMITED, HARDWICK SQUARE SOUTH, BUXTON, DERBYSHIRE, SK17 6LA, UK

Tel: +44 (0) 1298 762300 Fax: +44 (0) 1298 72664

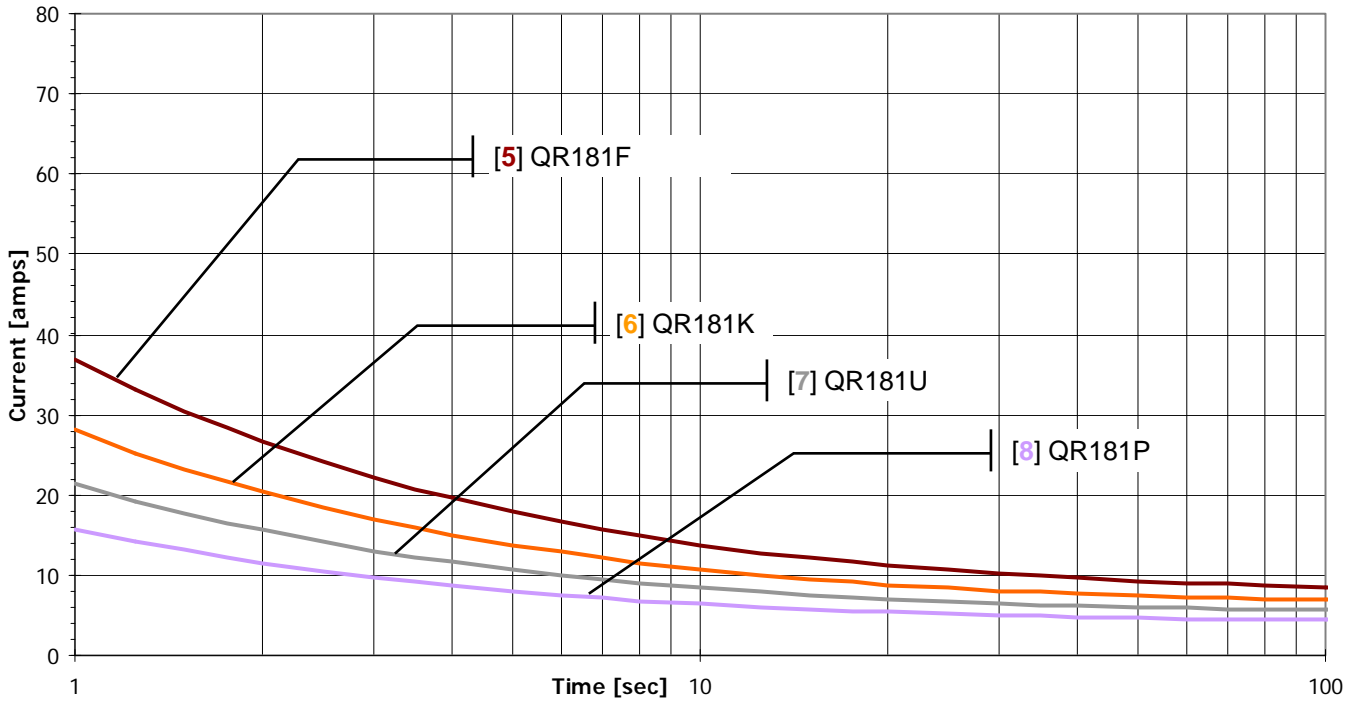
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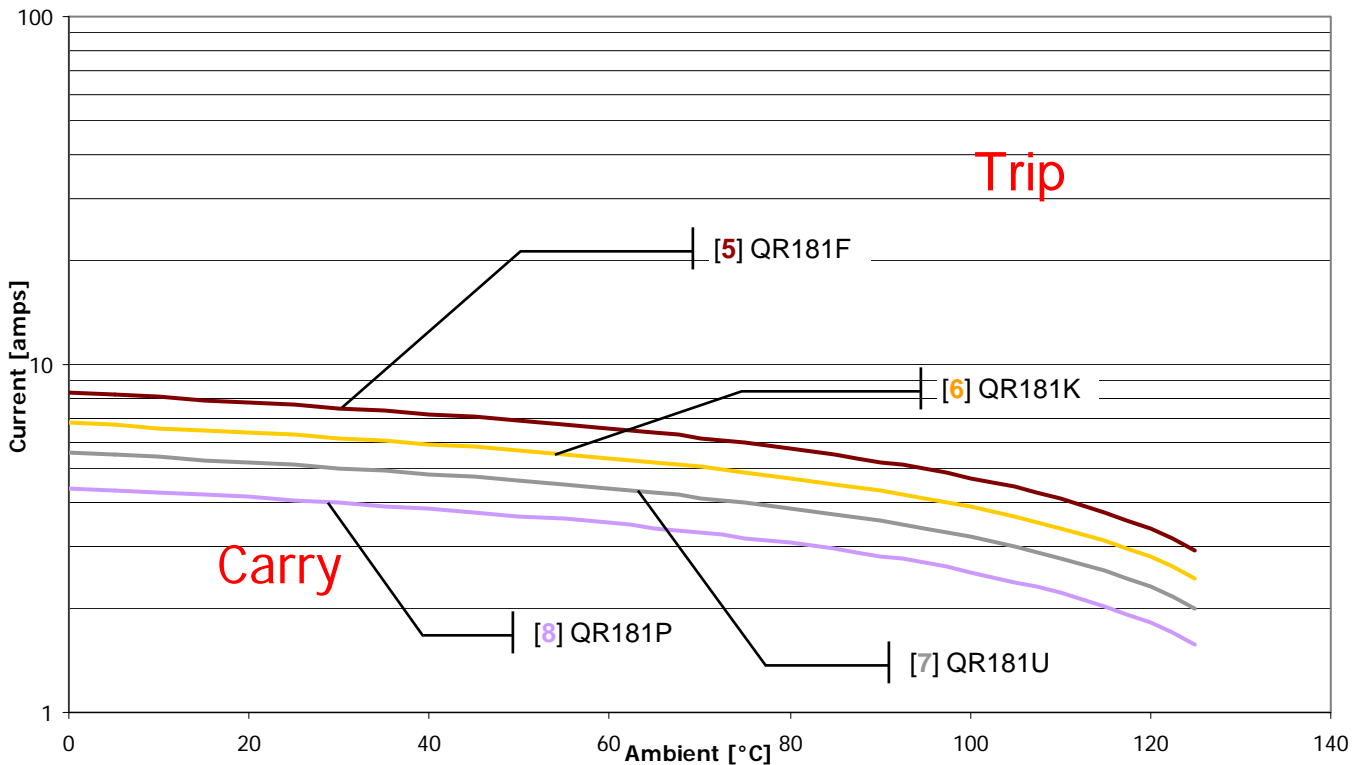
Q/QR type selection data



Time/Current Curves



Ultimate Trip Current vs. temperature



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



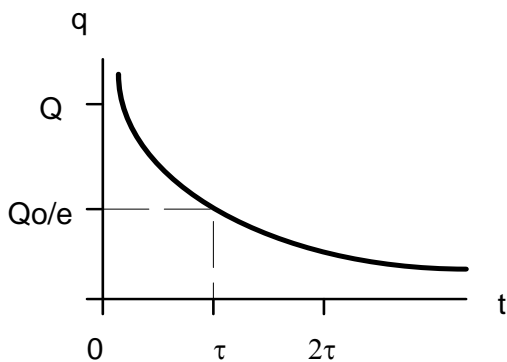
Introduction

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, $\tau = RC$

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.

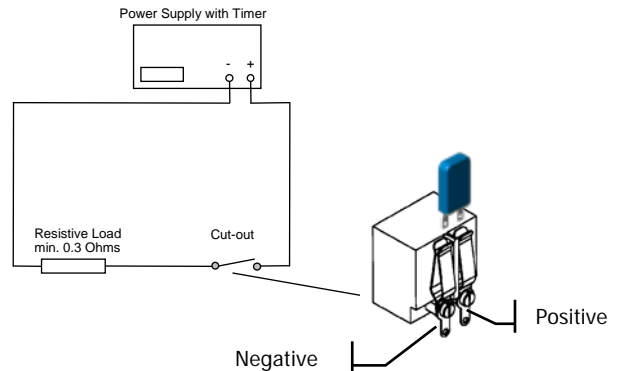
If a motor, or load is connected in series with the supply, this energy (both on Break/ and Remake) is effectively absorbed/ dissipated and does not create an arc of such high intensity or time period. This minimises any potential damage and is closer to the conditions seen within an application.

Measuring T/C performance with additional Circuit Resistance

In order to correctly measure the Time/Current response of a Q/QR 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



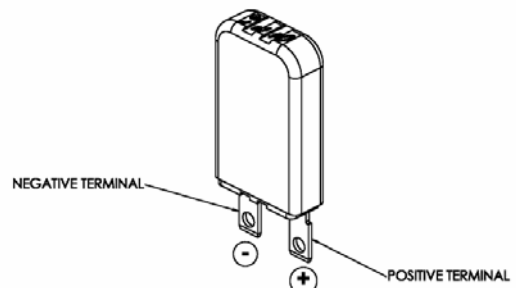
By including a load resistance in series with the cut-out (Ref. figure 1) the rate at which the power supply capacitors discharge is extended, and will ensure more consistent and repeatable Time/Current readings by avoiding damage to contact surface.

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 Q/QR 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 minimise any error resulting from the measurement procedure, ensuring T/C break times which closely correspond to Otter Production specification.



Global representation



When contacting an Otter overseas representative, use international access code before number shown.

Australia M & D CONTROLS, PO Box 53, Kilsyth, Victoria 3137.
Tel/Fax: 61 3 9735 1749

Denmark CHEMO-ELECTRIC AS, Hammerholmen 39, DK-2650 Hvidovre.
E-mail: info@chemolec.dk
Tel: 45 36 773044 Fax: 45 36 773088

Finland EL-FRESTA OY AB, Ilmeentie 3, FIN-02140 Espoo.
E-mail: yrjo.vasenius@elfresta.fi
Tel: 358 9 547 66500 Fax: 358 9 547 66510

France/Italy SICCOM SA, Z.I. Les Bordes 2 - 6 rue Gustave Madiot 91922 BONDOUFLE CEDEX.
E-mail: commercial@siccom.fr
Tel: 331 6086 8798 Fax: 331 6086 8757

Germany/Austria/Switzerland ROGELEIN GmbH, Postfach 10 40 32, D-70035 Stuttgart.
E-mail: dieter.roegelein@roegelein.de
Tel: 49 711 187790 Fax: 49 711 1877910

Hong Kong/China/Taiwan OTTER CONTROLS ASIA LTD, Unit C,D, 14/F Spectrum Tower, 53 Hung To Rd, Kwun Tong, Kowloon
E-mail: angela@otterasia.com
Tel: 852 2 1913303 Fax: 52 2 1746992

India AURO CONTROLS PVT LTD, Florina Apartment, 6th Floor,, S. No. 2/1/7, Erandwane, Off Karve Road,, Pune - 411 004 , Maharashtra , India,
E-mail: neelesh@aurocontrols.com
Tel: 91 20 433 4254/8173 Fax: 91 20 433 8173

Israel ELECTRIC INDUSTRIES LTD, PO Box 6560, Tel Aviv 61064.
E-mail: eindust@attglobal.net
Tel: 972 3 6046634 Fax: 972 3 5467452

Japan AOYAMA SPECIAL STEEL Co. Ltd 9-11, 2-Chome, Shinkawa, Chuo-Ku, Tokyo
E-mail: sales@aoyamasteel.co.jp
Tel: 81 3355 25255 Fax: 81 3 3553 1270

Korea YUHAN ACS, Room #819 Samil- Plaza Bldg, 837-26, Yeoksam-Dong, Kangnam-Ku, Seoul.

E-mail: mocom@yuhanacs.com
Tel: 82 2 555 6525 Fax: 82 2 555 4705

Malaysia TEAMTECH SDN BHD, No 12, TIB-1/2 Taman Industri Bolton, 68100 Batu Caves, Selangor Darul Ehsan. Tel: 60 3 61881228
Fax: 60 3 61889228

Norway HILLCO AGENTURER AS, Post Box 11, Leirdal, 1008 Oslo.

E-mail: halto@online.com
Tel: 47 23 17 52 80 Fax: 47 23 17 52 81

Poland TESKO, J Cybsa 8/37, PL-02-784 Warsaw.
Tel: 48 22 641 6282 Fax: 48 22 641 6282

Russia JOINT CONSULTING TRADING LTD, bld.1/2, 11, Ordzhonikidze street, 15419, Moscow, Russia.

E-mail: yuri@irca.ru
Tel: 7 (095) 2324187 Fax: 7 (095) 2324189

Spain DULLAC IMPORT-EXPORT, c/Roure Gros 29, Pol. Ind. Mas d'en Cisa, 08181 Sentmnat

E-mail: gdejuan@dullac.com
Tel: 34 93 715 45 17 Fax: 34 93 715 45 39

Sweden Promoco AB, Box 273, S184 24 Vallentuna
E-mail: sec@promoco.se

Tel: 46 8 792 9151 Fax: 46 8 792 2090

USA DAVIDON INDUSTRIES INC, 205 Hallene Road, Unit 317C, Warwick Rhode Island 02886,

E-mail: ddinuccio@davidonindustries.com
Tel: 401 737 8380 Fax: 401 737 8395

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OTTER CONTROLS LIMITED, HARDWICK SQUARE SOUTH, BUXTON, DERBYSHIRE, SK17 6LA, UK

Tel: +44 (0) 1298 762300 Fax: +44 (0) 1298 72664

www.ottercontrols.com

e-mail: sales@ottercontrols.com

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