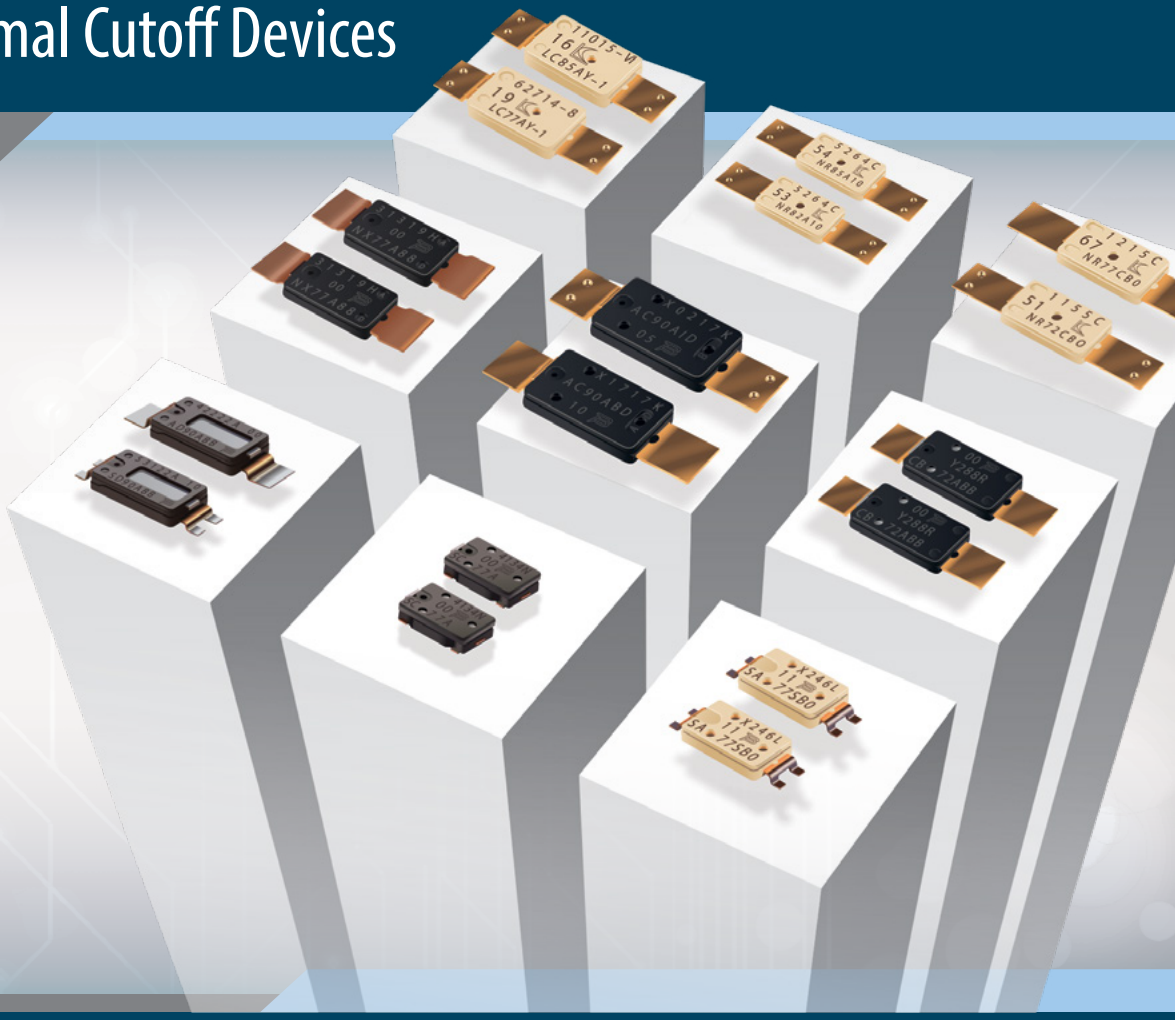
Mini-breakers

Miniature Thermal Cutoff Devices



BOURNS®

Mini-breaker Overview

INTRODUCTION

Electronics manufacturers are on a never-ending quest to make electronics safer, more energy efficient and more reliable. This quest makes the twin disciplines of circuit protection and thermal management of critical importance. An excessive generation of heat has the potential to damage and even catastrophically destroy a wide range of disparate electronic elements such as:

- Lithium-ion battery cells
- USB Type-C® cables
- Heater circuits
- MOSFETs
- Wireless charging coils

One of the latest approaches for providing a safety circuit to such elements is the use of the Bourns® Mini-breaker, which is a resettable Thermal Cutoff (TCO) device designed to provide accurate and repeatable overcurrent and overtemperature protection.

WHAT IS A MINI-BREAKER?

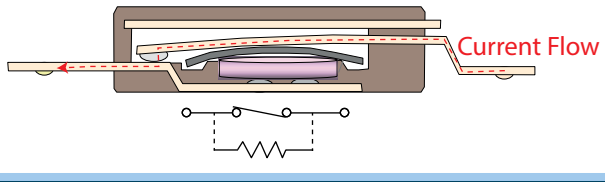
The Bourns® Mini-breaker is a combination of two common circuit protection technologies; a PTC and a bimetal switch, providing several advantages over either technology on its own. The skills developed by Bourns over 75 years in precision metal stamping, plastic injection molding and high-end assembly turn these ubiquitous technologies into a market-leading circuit protection solution. The figure on the next page provides a simple schematic of how the mini-breaker is constructed. The two terminals (arm terminal and base terminal) are connected in a normally closed position to allow current to flow through the device. Naturally, the contact point between both terminals provides a critical function and a testament to the high precision of the Bourns® Mini-breaker is that the contact resistance is as low as 1 mΩ (max.) in some model families.

HOW IT WORKS

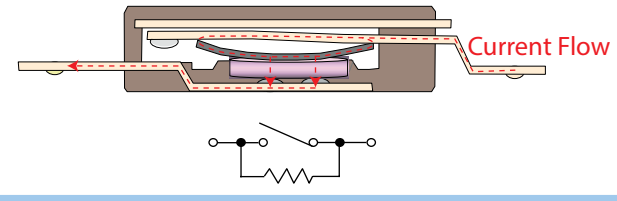
In the normal condition, current flows though the arm terminal, down through the very low resistance contact point and out through the base terminal. The key to any battery application is low resistance; hence, the contact resistance between the arm terminal and base terminal is a feature advantage integrated into all Bourns® Mini-breaker products.

The mini-breaker can be triggered by either an increase in the environmental temperature or by excessive current flow. Once the trip temperature has been reached, the bimetal disc heats and flexes, causing the arm to open. If the mini-breaker only used a bimetal disc for its protection, the arm would quickly close as the temperature cooled. However, key to the mini-breaker's design is the PTC that operates in parallel with the arm terminal. When the bimetal disc causes the arm to open, current flows though the bimetal disc and into the PTC.

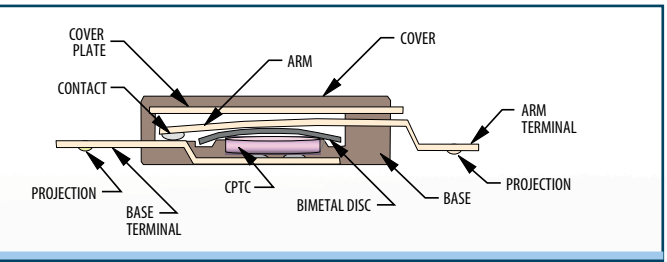
This current causes the PTC to act like a current limiting heater, which provides sufficient heat to keep the bimetal disc flexed and the arm open. The combination of the bimetal disc and the PTC prevents oscillating opening and closing of the mini-breaker arm. Instead, this design allows the arm to remain open until a lower and safer temperature level of between 40 °C and 10 °C below the lower specification limit of the mini-breaker is reached, at which point the arm will reset. As part of UL 60730 testing, Bourns® mini-breakers are tested up to 6000 cycles of this opening and closing mechanism.



Mini-breaker in the Normally Closed Position



Mini-breaker Triggered Open



Mini-breaker Product Structure

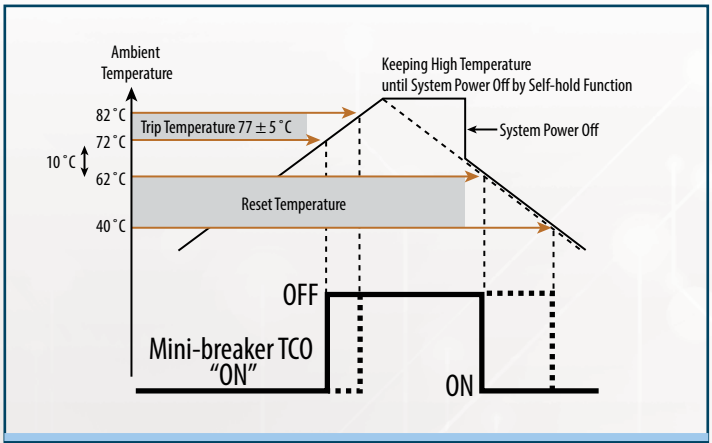
Mini-breaker Overview

MINI-BREAKER EVOLUTION

Mini-breaker TCO devices come in two distinct formats:

- Axial leaded configuration
- Surface mount configuration

The axial leaded models are the most common mini-breaker TCOs on the market. They are almost exclusively used in lithium-ion battery packs and are welded into place using secondary nickel tabs. Surface mount models are now spreading the benefits of resettable overtemperature protection to printed circuit boards.



Relationship between Trip/Reset Temperature and Bourns® Mini-breaker TCO Operation

Bourns offers three evolutionary mini-breaker series types:

1. Higher Currents – As higher current density batteries grow in popularity, whether for home energy storage or electric bicycles, mini-breakers are being tasked to handle higher currents. This trend has led to the Bourns® Model AC series, which can operate up to 18 A at 60 °C with future devices in development featuring even higher current-handling capabilities. However, the AC Series was not an AEC-Q200 equivalent compliant* product. So, in 2023, Bourns released two new versatile high current series called the AD and SD Series. This could allow TCOs to be either axial leaded (AD Series) or surface mount (SD Series), automatically resettable or non-automatically resettable and with an extended trip temperature from 55 ˚C to 150 ˚C and are AEC-Q200 equivalent compliant*.

2. Smaller Footprints – Portable electronics continue to shrink in footprint and thickness. Electronics have become wearable and are now in intimate contact with the human body. This has led to a need for greater levels of safety and smaller sizes. Bourns introduced the Model CB series, one of the smallest mini-breakers on the market. This is an ongoing trend, and Bourns will continue to develop smaller mini-breaker models without sacrificing performance.

3. Surface Mount – Mini-breakers are traditionally resistance welded into the battery pack. However, this has limited its uses in other applications. The Bourns® Model SA series is the industry's first surface mount mini-breaker. This TCO series expands usage into markets such as USB cables and consumer board electronics. The demand for these surface mount devices is a result of the combination of the higher current and smaller footprint trends mentioned above where they will need to hold greater levels of current and shrink in size. Bourns launched the SC series to meet this demand. The SD series is an SMD series with extended trip temperature from 55 ˚C to 150 ˚C

*Meets Bourns internal AEC-Q200 equivalent test plan.

Battery Management

LITHIUM-ION CELL FUNCTIONALITY

The basic function of the lithium-ion cell is to transform chemical energy into electricity. The individual lithium-ion cell is comprised of an intercalating lithium compound cathode, a carbon based (typically graphite) anode, as well as a liquated or gel type electrolyte with lithium salts through which ions travel, and a polymer separator to act as an internal insulator to the electrons.

The use of the two intercalation electrodes has led to the lithium-ion batteries being called "rocking-chair" batteries as ions shuttle back and forth between the electrodes and through the electrolyte in a lithiation/delithiation process. The separator plays a critical role in cell safety by ensuring there is no physical contact between the cathode and anode.

POTENTIAL LITHIUM-ION CELL HAZARDS

While separators have evolved from simple single layer sheets to multilayer sheets with shutdown features, they alone cannot ensure complete cell safety. The lithium-ion cell is constructed with materials that are flammable and degradable and mechanical and electrical shocks can lead to thermal runaway. The lithium-ion cell materials that are stable at lower temperatures start to breakdown when the temperature exceeds 130 ˚C.

If a cell starts to enter thermal runaway, the results can be catastrophic as seen in various news reports in recent years. Thermal runaway in a lithium-ion cell is a highly exothermic, self-propagating process that results in the venting of toxic and highly flammable gasses and releases significant energy in the form of heat greater than 1000 ˚C. Some of the newest smartphones on the market now use multiple cells so the risk becomes even greater as the failure can potentially daisy chain from one cell failure to the next.

LITHIUM-ION CELL SAFETY

In light of such obvious hazards, cell designers take a multi-layer approach to protecting against various potential hazards. Individual cells require mechanical, electrical and thermal protection and this becomes more complicated when cells are networked into various battery pack arrangements. There are numerous standards that help govern battery pack safety but for rechargeable batteries in smartphones, the IEEE 1725 standard (IEEE Standard for Rechargeable Batteries for Cellular Telephones) is a solid starting point.

This standard and the standards it references has helped guide designers into taking a layered approach to battery protection with multiple levels of redundancy being built into a pack. An integral part of maximizing battery pack efficiency and safe operation is the Battery Management System (BMS) that uses various primary and secondary protection devices as well as software and hardware elements to manage the state of charge, current, voltage and ambient battery temperatures. Mini-breaker Thermal Cutoff (TCO) devices are key elements in the protection architecture that is being increasingly used in lithium-ion battery cell arrangements.

LITHIUM-ION POUCH TYPE CELLS

While lithium-ion pouch cells boast many desirable features such as low cost, ease of large scale manufacturing, lighter non-universal sizes and high-energy densities, the technology still has the same limitations as other types of lithium-ion cells. The requirement for protection circuits to maintain the voltage and current within safe limits is one of the primary limitations of a lithium-ion battery. The soft foil cell design also adds a further disadvantage, causing the cells to visibly inflate (sometimes called pillowing) during overcharge because of internal delamination.

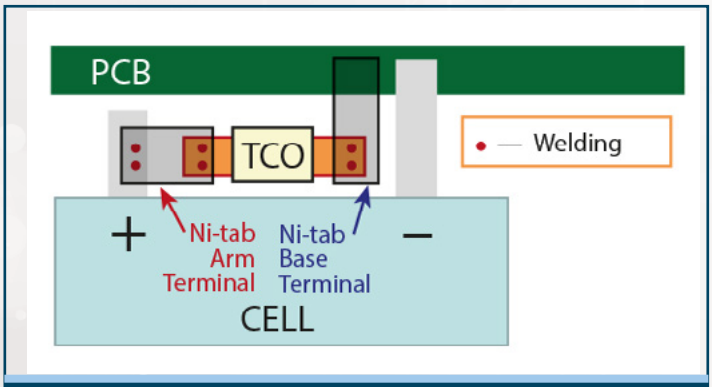
One of the latest approaches for providing a safety circuit to lithium-ion battery packs is the use of the miniature resettable Thermal Cutoff devices (TCOs). TCO devices are designed to provide accurate and repeatable overcurrent and overtemperature protection.

Applications

APPLICATIONS FOR MINI-BREAKERS

Mini-breakers typically come in an axial leaded format to allow the device to be welded to the terminals of the battery cells. The battery cell terminals are made from aluminum tabs and the mini-breakers are usually welded to nickel tabs before those nickel tabs are welded to the battery cell terminals. The advantage of welding the mini-breakers close to the battery tabs is that the mini-breakers can be situated in intimate contact with the individual battery cells and can react quickly to any unusual rises in cell temperature.

Today, mini-breakers are commonly used to protect the battery cells of notebook PCs, tablet computers, smartphones and digital cameras. As each battery pack is customized to fit the limited space within the portable electronic device, the mini-breaker is welded to nickel tabs of various sizes and formats. Bourns can offer innovative solutions to help reduce overall circuit resistance in the battery pack. For further information in relation to this, please contact your nearest Bourns representative.



Mini-breaker TCO Devices in Battery Cell Protection Circuit

BATTERY PROTECTION FOR:

- Notebook Computers
- PCs
- Tablet Computers
- Smartphones
- Digital Cameras
- Power Banks
- Electronic Cigarettes
- Wearable Electronics
  (Headphones, VR Systems, Body Cameras)

SURFACE MOUNT OVERTEMPERATURE PROTECTION

Traditionally, the Bourns® Mini-breaker has been used in an axial leaded format, typically welded close to a lithium-ion battery cell. However, since 2017, Bourns has been selling its surface mount models into a wide range of printed circuit board applications.

Some of the key applications that are available to mini-breakers for overtemperature protection are:

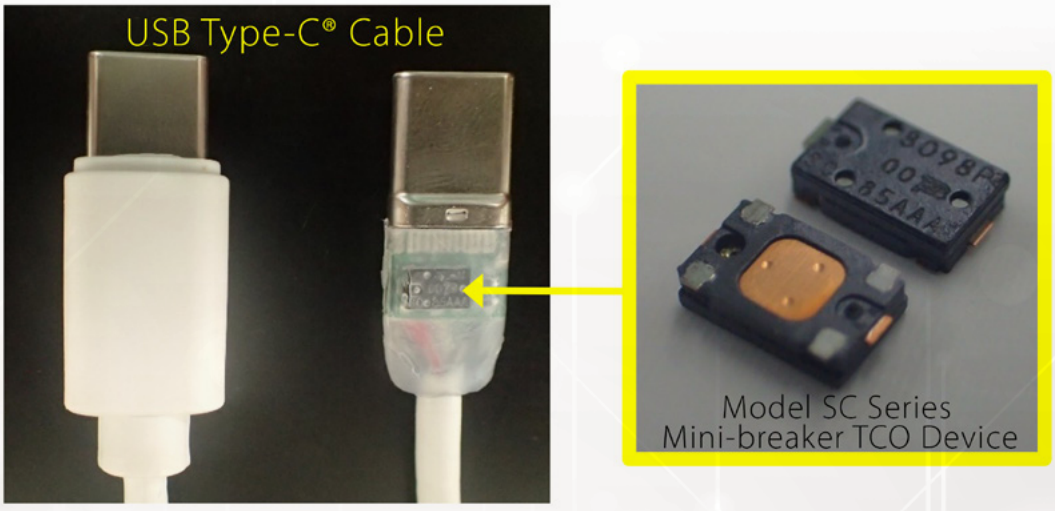
- USB Type-C® Cables
- Heaters
- MOSFET Protection
- Wireless Charging Coils

USB TYPE C CABLES

The USB Type-C® cables offer a small connector area, high pin count and higher power levels. This can lead to an increase in potential risk of overheating in these new cables. Fast charging over such cables can even result in fire damage if pins are damaged, the outer shell body is damaged or foreign material and liquids enter the plugs.

For that reason, cable designers are also embedding mini-breaker TCO devices within the charging cables themselves.

Mini-Breaker devices have been proven to protect cables from becoming damaged from overheating by acting independently of any controller. By placing the TCO device on the USB V_{bus} line, it can react to a cable overheating and then quickly cut the current and allow the cable to cool. This is rapidly becoming a popular solution. An example of cables with and without TCO device protection is shown below. The cable without the TCO device continues to overheat from the fault and the temperature increases to 100 ˚C. The cable with the TCO device almost instantly trips at a preset temperature so that the cable surface does not overheat.

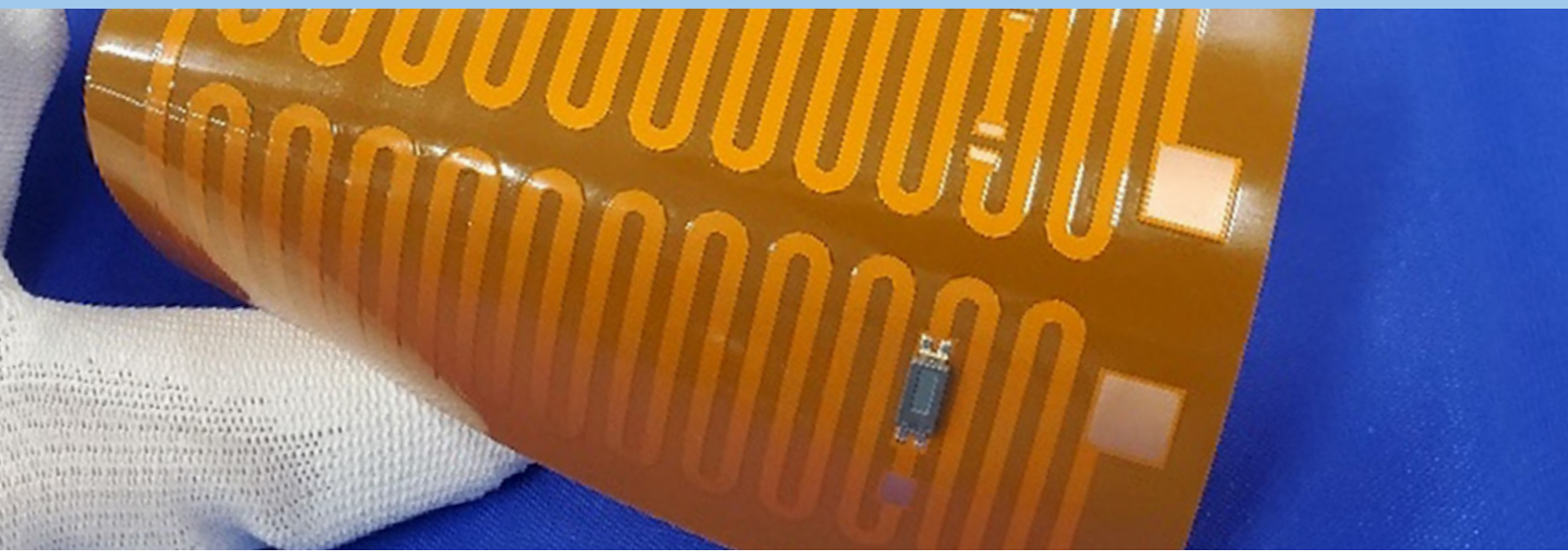


The Cable on the Left has No TCO Device to Protect Against Overheating; the Cable on the Right has TCO Protection

In May 2021, the USB Promoter Group announced its USB Power Delivery Specification revision 3.1. This specification defined the delivering of up to 240 W over USB Type-C® cables.

This level of power will add to the considerations for further cable protection and protection devices must evolve to meet these challenges.

Applications



HEATERS

Heater designs come in a wide range of options because of the varying factors that must be considered, such as power rating, watt density and required surface temperature. For that reason, there is no fixed design for heater circuits. The method to control the temperature also varies greatly, from thermostat controls to more sophisticated controls using temperature sensors (e.g., NTC thermistors, PTC thermistors and RTDs) control ICs and switching MOSFETs. Some heater designers also chose to use temperature protection circuits to provide backup safety such as single blow temperature fuses and thermostats. This is particularly important for circuits that are in contact with the human body.

No ideal circuit architecture has been identified for heater designs as there are potential risks with many existing solutions. Typically, heater control comes in the form of bimetal-based thermostats or more recently NTC thermistors and power MOSFETs. Circuits that utilize temperature sensors, control ICs and power MOSFETs can control the circuit at predetermined temperature levels and can be more energy efficient. However, MOSFETs in some applications do have some risks of thermal instability and in worst-case scenarios, can fail short. Circuits that use single blow thermal fuses can suffer nuisance trips during assembly or in the field and can prove costly to replace. Using wired components instead of surface mount components may provide control and protection in hard to reach locations but can be costly to assemble and vary because of manual installation.

The new SD and AD series help to address this challenge by boosting the trip temperature range to 55˚C up to 150˚C. This is particularly beneficial to the range of heater devices that require either low trip temperatures and high trip temperatures.

The Bourns® Model SD Mini-breaker can be surface mounted either directly onto the flexible film heaters or onto the PCB of the heater control unit. If the SMD mini-breaker is located close to the power MOSFET, it can also be used to protect that device. Attaching wires to the Model AD Series Mini-breaker can also be considered for wired heater assemblies. Resettable overtemperature in such miniature packages is a new, unique solution to these applications.

Integrating a mini-breaker TCO into the protection circuit helps to provide independent overtemperature protection and helps reduce the size of the heater control unit. The latest mini-breaker offering, the AD and SD Series have been tested to withstand up to 10,000 cycles compared to the traditional 6,000 cycles used in lithium-ion applications.

MOSFET PROTECTION

Metal-Oxide semiconductor Field-Effect Transistors (MOSFETs) are ubiquitous for fast switching and deliver higher power efficiencies. However, these devices have the potential to become thermally instable and even enter thermal runaway when internal zones allow more current to flow at the same time as temperatures start to increase.

The Bourns® Model SD Series Mini-breaker can be surface mounted in very close contact to the MOSFET and reduce the current in such situations. The Model SD Series has a trip temperature up to 150 ˚C, hence making it applicable to MOSFETs in a wide range of applications.

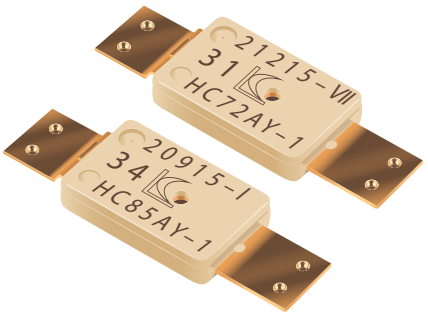
WIRELESS CHARGING COILS

Wireless charging has brought an ease of charging without the unsightly tangle of charging cables. Coffee shops and hotels are just two locations where wireless charging pads are now commonly found. The universality of this charging system means consumers are now wirelessly charging smartphones, smartwatches, as well as many other electronics.

However wireless charging is not as energy efficient as plug-in charging and energy losses during charging result in electronics heating up. In many applications, the charging coils can be located close to battery cells - so for that reason protecting the coils from excessive heat transmission is important.

The Bourns® SC Series Mini-breaker can be surface mounted in very close contact to the wireless coils, reducing the current in such situations.

High Current Series



FEATURES

- High current capacity, low impedance
- Overtemperature and overcurrent protection for lithium polymer and prismatic cells
- Controls abnormal, excessive current virtually instantaneously, up to rated limits
- Wide range of temperature options
- Original TCO package size

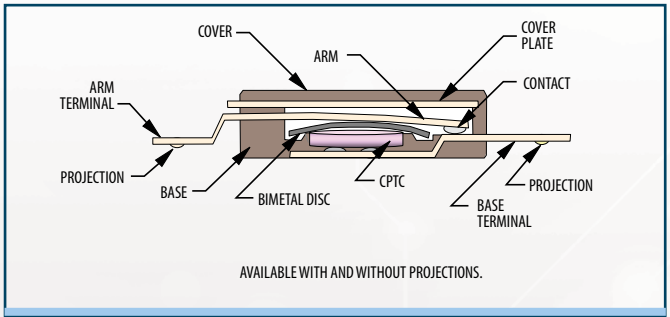
APPLICATIONS

Battery cell protection for:

- Notebook PCs
- Tablet PCs
- Smartphones
- Power Banks

HC Series – Standard Package / High Current Series

Model	Trip Temperature	Reset Temperature	Maximum Breaking Current	Maximum Voltage	Maximum Leakage Current	Resistance
HC72AY-1	72 °C ±5 °C	40 °C min.	DC5 V / 80 A,100 cycles	DC28 V / 25 A, 100 cycles	200 mA max. @ 25 °C	2.0 milliohms typ. 5.0 milliohms max.
HC77AY-1	77 °C ±5 °C					
HC82AY-1	82 °C ±5 °C					
HC85AY-1	85 °C ±5 °C					
HC90AY-1	90 °C ±5 °C					



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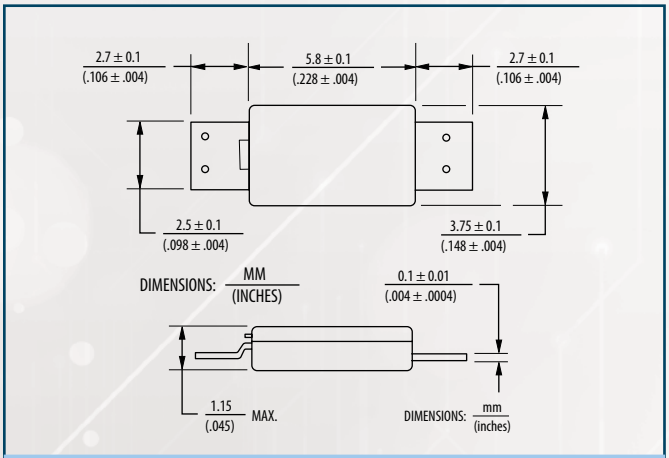

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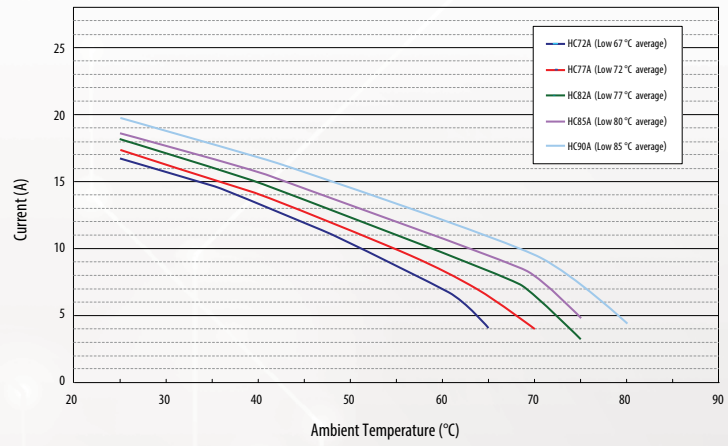
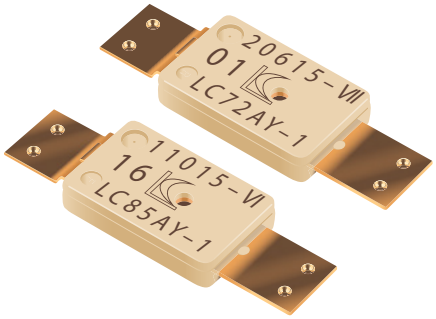


Ambient Temperature Impact on Mini-breaker Operating Currents

The above curves were derived from placing test samples in an oven at 25 ˚C, 40 ˚C, 60 ˚C and 70 ˚C, increasing current flow through the sample at a rate of 0.1 A/minute and recording the current value when the sample trips. The curves represent the lower tolerance (e.g., -5 ˚C) of the trip temperature range.

Low Current Series



FEATURES

- Low current capacity type
- Overtemperature and overcurrent protection for lithium polymer and prismatic cells
- Controls abnormal, excessive current virtually instantaneously, up to rated limits
- Wide range of temperature options
- Original TCO package size

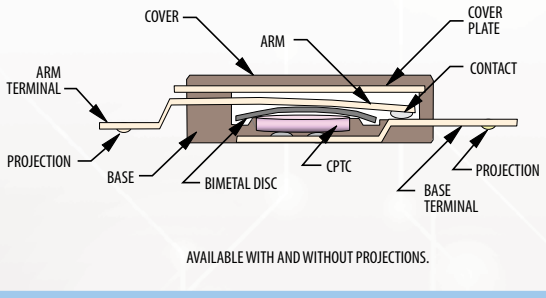
APPLICATIONS

Battery cell protection for:

- Notebook PCs
- Tablet PCs
- Smartphones
- Game Consoles
- Rechargeable Mice

LC Series – Standard Package / Low Current Series

Model	Trip Temperature	Reset Temperature	Maximum Breaking Current	Maximum Voltage	Maximum Leakage Current	Resistance
LC72AY-1	72 °C ±5 °C	40 °C min.	DC5 V / 40 A,100 cycles	DC28 V / 5 A, 100 cycles	150 mA max. @ 25 °C	7.2 milliohms typ. 15.0 milliohms max.
LC77AY-1	77 °C ±5 °C					
LC82AY-1	82 °C ±5 °C					
LC85AY-1	85 °C ±5 °C					



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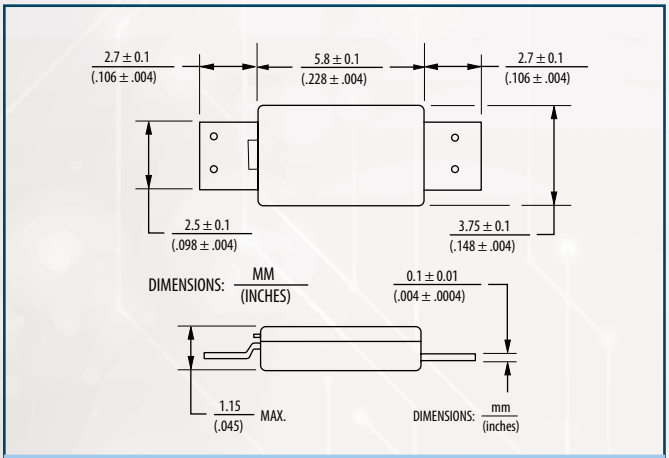

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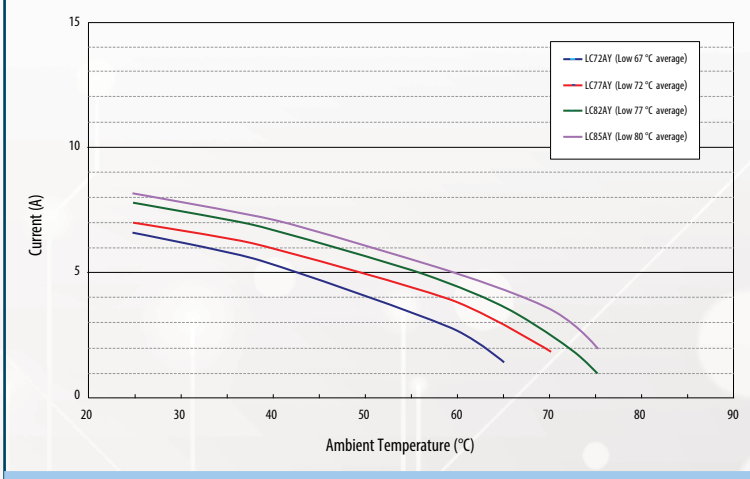

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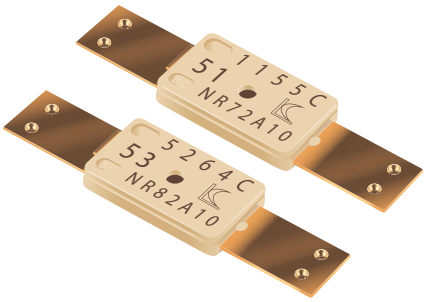
High Current Series/Miniature Package



FEATURES

- High current capacity, low impedance
- Overtemperature and overcurrent protection for lithium polymer and prismatic cells
- Controls abnormal, excessive current virtually instantaneously, up to rated limits
- Wide range of temperature options
- Miniature size, 52 % smaller than the HC Series

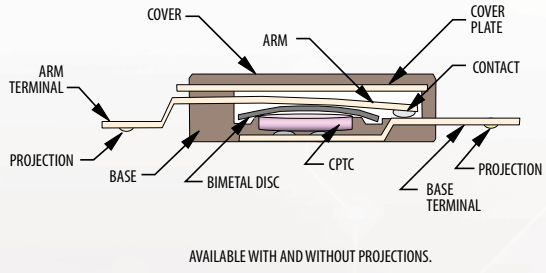
APPLICATIONS

Battery cell protection for:

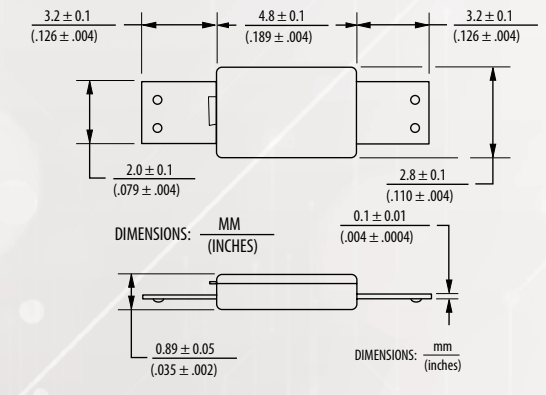
- Notebook PCs
- Tablet PCs
- Smartphones
- Power Banks
- Wearable electronics (Headphones, VR Systems, Body Cameras)

NRxxA Series – High Current Series / Miniature Package

Model	Trip Temperature	Reset Temperature	Maximum Breaking Current	Maximum Voltage	Maximum Leakage Current	Resistance
NR72ABH	72 °C ±5 °C	40 °C min.	DC5 V / 60 A,100 cycles	DC28 V / 25 A, 100 cycles	200 mA max. @ 25 °C	2.1 milliohms typ. 5.0 milliohms max.
NR77ABH	77 °C ±5 °C					
NR82ABH	82 °C ±5 °C					
NR85ABH	85 °C ±5 °C					



Product Structure



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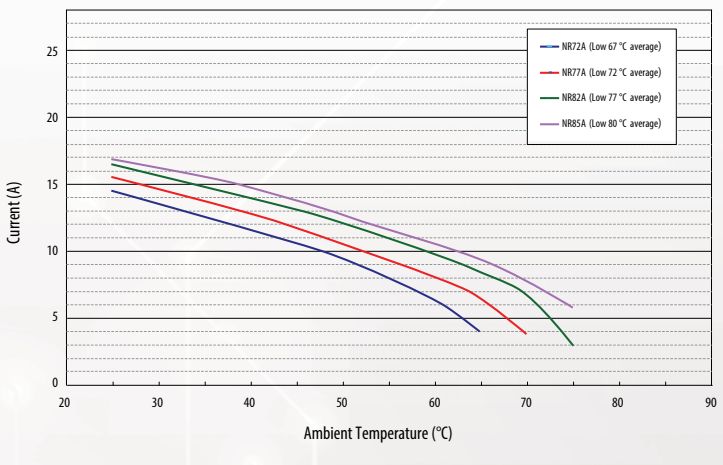

Ambient Temperature Impact on Mini-breaker Operating Currents

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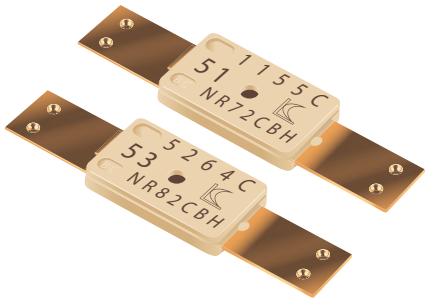
Low Current Series/Miniature Package



FEATURES

- Low current capacity type
- Overtemperature and overcurrent protection for lithium polymer and prismatic cells
- Controls abnormal, excessive current virtually instantaneously, up to rated limits
- Wide range of temperature options
- Miniature size, 52 % smaller than the LC series

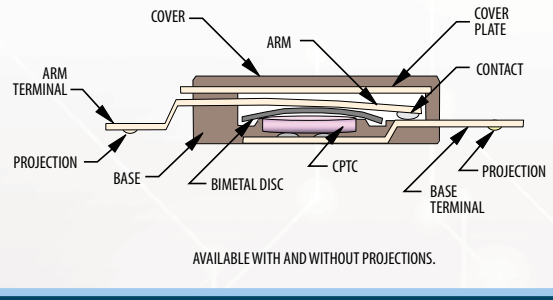
APPLICATIONS

Battery cell protection for:

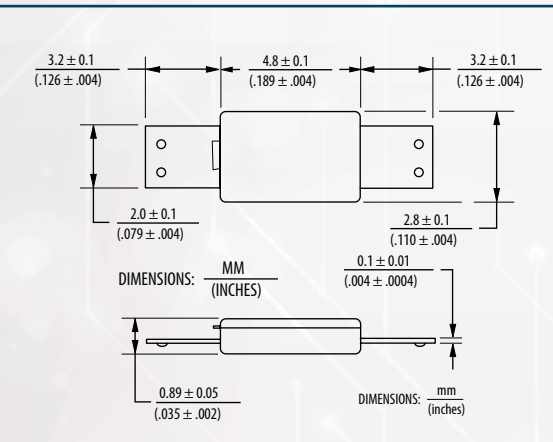
- Notebook PCs
- Tablet PCs
- Smartphones

NRxxC Series – Low Current Series/Miniature Package

Model	Trip Temperature	Reset Temperature	Maximum Breaking Current	Maximum Voltage	Maximum Leakage Current	Resistance
NR72CBH	72 °C ±5 °C	40 °C min.	DC5 V / 30 A,100 cycles	DC28 V / 12 A, 100 cycles	150 mA max. @ 25 °C	8.4 milliohms typ. 15.0 milliohms max.
NR77CBH	77 °C ±5 °C					
NR82CBH	82 °C ±5 °C					
NR85CBH	85 °C ±5 °C					



Product Structure



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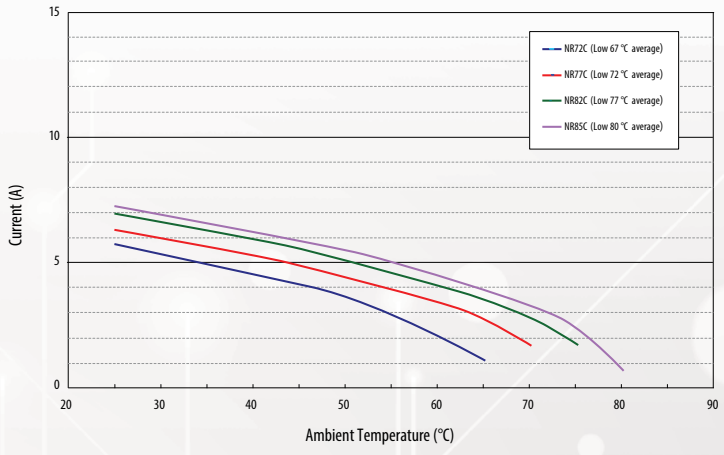
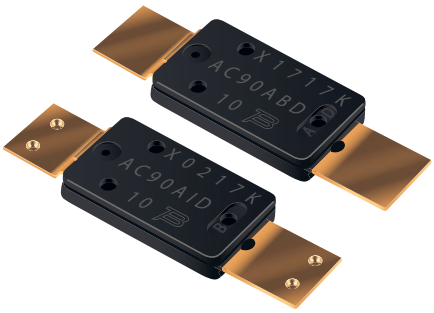


Ambient Temperature Impact on Mini-breaker Operating Currents

The above curves were derived from placing test samples in an oven at 25 ˚C, 40 ˚C, 60 ˚C and 70 ˚C, increasing current flow through the sample at a rate of 0.1 A/minute and recording the current value when the sample trips. The curves represent the lower tolerance (e.g., -5 ˚C) of the trip temperature range.

Very High Current/Low Impedance Series



FEATURES

- High current capacity, low impedance
- Overtemperature and overcurrent protection for lithium polymer and prismatic cells
- Controls abnormal, excessive current virtually instantaneously, up to rated limits
- Wide range of temperature options
- Latest generation of the high current series

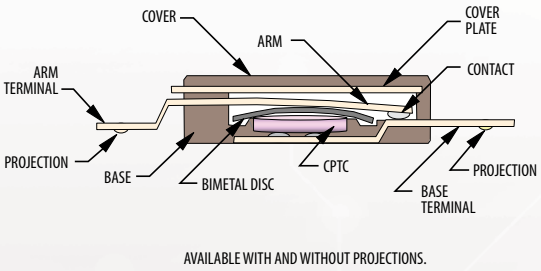
APPLICATIONS

Battery cell protection for:

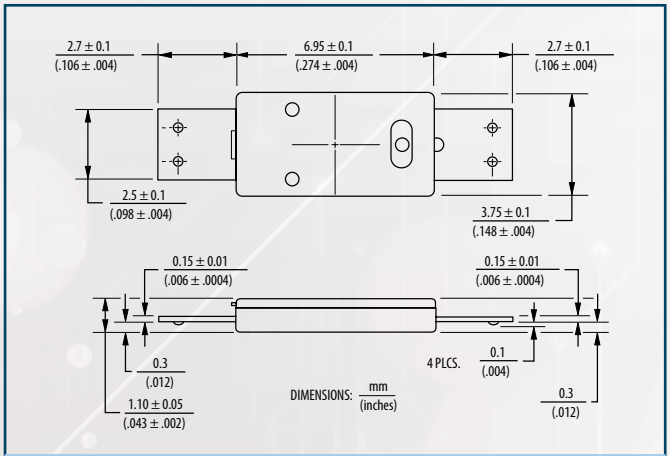
- Notebook PCs
- Tablet PCs
- Smartphones
- Gaming Notebooks
- High End & Business Notebooks
- Power Banks

AC Series – Very High Current/Low Impedance Series

Model	Trip Temperature	Reset Temperature	Maximum Breaking Current	Maximum Voltage	Maximum Leakage Current	Resistance
AC72ABD	72 °C ±5 °C	40 °C min.	DC5 V / 60 A,100 cycles	DC28 V / 35 A, 100 cycles	200 mA max. @ 25 °C	1.0 milliohms typ. 2.0 milliohms max.
AC77ABD	77 °C ±5 °C					
AC82ABD	82 °C ±5 °C					
AC85ABD	85 °C ±5 °C					
AC90ABD	90 °C ±5 °C					



Product Structure



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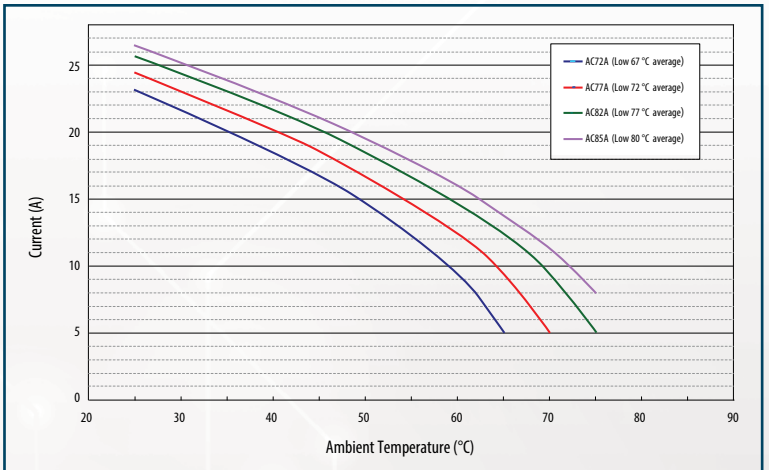

Ambient Temperature Impact on Mini-breaker Operating Currents

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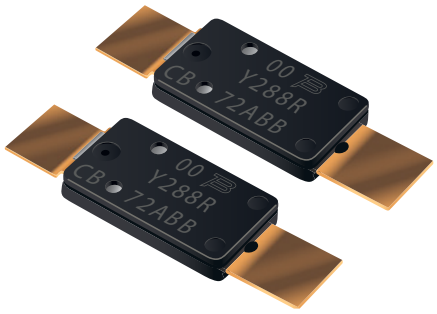
High Current Series/Smallest Size



FEATURES

- High current capacity, low impedance
- Overtemperature and overcurrent protection for lithium polymer and prismatic cells
- Controls abnormal, excessive current virtually instantaneously, up to rated limits
- Wide range of temperature options
- Smallest TCO on the market (65 % smaller than the HC series, 26.5 % smaller than the NR Series)

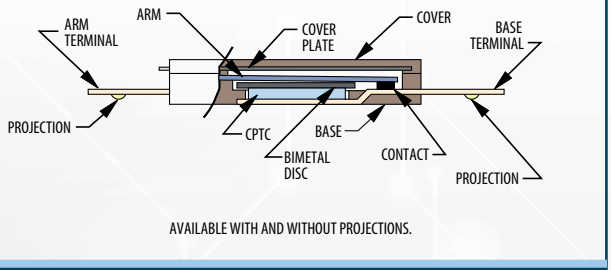
APPLICATIONS

Battery cell protection for:

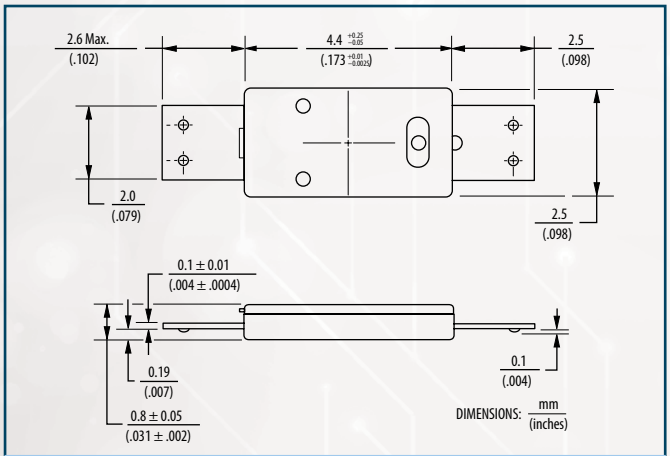
- Notebook PCs
- Tablet PCs
- Smartphones
- Wearable Electronics (Headphones, VR Systems, Body Cameras)

CB Series – High Current/Smallest Size

Model	Trip Temperature	Reset Temperature	Maximum Breaking Current	Maximum Voltage	Maximum Leakage Current	Resistance
CB72ABB	72 °C ±5 °C	40 °C min.	DC5 V / 50 A,100 cycles	DC28 V / 25 A, 100 cycles	200 mA max. @ 25 °C	2.2 milliohms typ. 5 milliohms max.
CB77ABB	77 °C ±5 °C					
CB82ABB	82 °C ±5 °C					
CB85ABB	85 °C ±5 °C					



Product Structure



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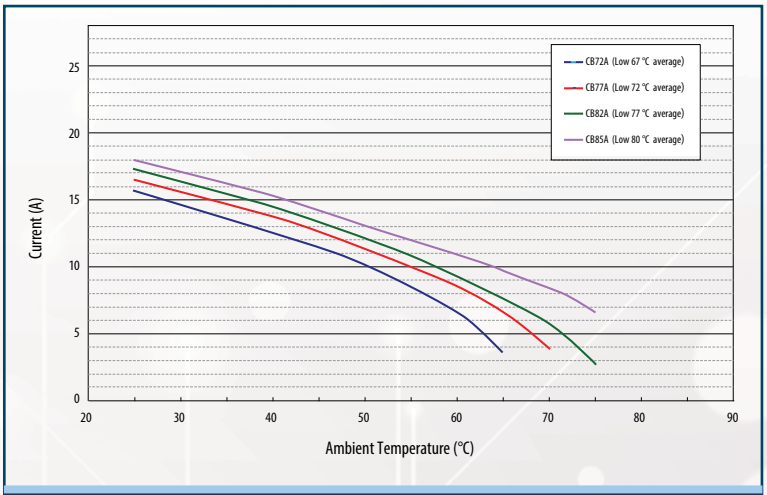


Ambient Temperature Impact on Mini-breaker Operating Currents

The above curves were derived from placing test samples in an oven at 25 ˚C, 40 ˚C, 60 ˚C and 70 ˚C, increasing current flow through the sample at a rate of 0.1 A/minute and recording the current value when the sample trips. The curves represent the lower tolerance (e.g., -5 ˚C) of the trip temperature range.

Axial Leaded, AEC-Q200 Equivalent Series

FEATURES

- Small body size
- Overtemperature and overcurrent protection
- Controls abnormal, excessive current virtually instantaneously, up to rated limits
- Wide range of temperature options
- High corrosion resistance
- AEC-Q200-equivalent compliant*

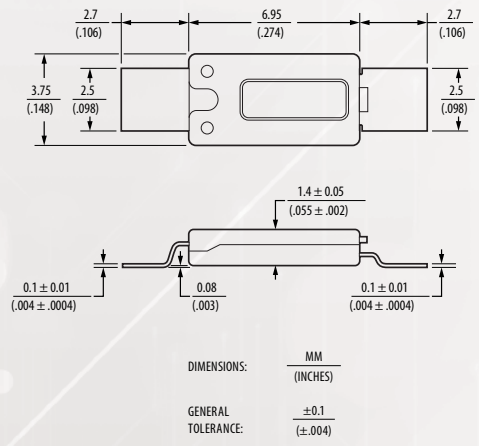
APPLICATIONS

Battery cell protection for:

- Notebook PCs
- Tablet PCs
- Smartphones
- Gaming Notebooks
- High-end & Business Notebooks
- Power Banks

AD Series – AEC-Q200 Equivalent Series

Model	Trip Temperature	Reset Temperature	Maximum Breaking Current	Maximum Voltage	Maximum Leakage Current	Resistance
AD55xBB	55 °C	20 °C min.	DC14 V / 35 A, 100 cycles	DC28 V / 8 A, 100 cycles	300 mA max. @ 25 °C	4 milliohms max.
AD60xBB	60 °C					
AD65xBB	65 °C					
AD70xBB	70 °C					
AD72xBB	72 °C	40 °C min.	DC14 V / 8 A, 10,000 cycles	DC14 V / 8 A, 10,000 cycles	N/A	
AD75xBB	75 °C					
AD77xBB	77 °C					
AD82xBB	82 °C					
AD85xBB	85 °C					
AD90xBB	90 °C					
AD95xBB	95 °C					
ADA0xBB	100 °C					
ADA5xBB	105 °C					
ADB0xBB	110 °C					
ADB5xBB	115 °C					
ADC0xBB	120 °C					
ADC5xBB	125 °C					
ADD0xBB	130 °C					
ADD5xBB	135 °C					
ADE0xBB	140 °C					
ADE5xBB	145 °C					
ADF0xBB	150 °C					



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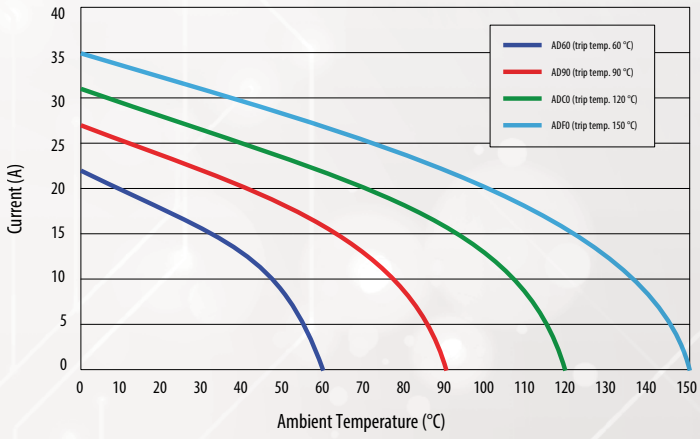


Ambient Temperature Impact on Mini-breaker Operating Currents

*Meets Bourns internal AEC-Q200 equivalent test plan.

Surface Mount, AEC-Q200 Equivalent Series

FEATURES

- Small body size
- Overtemperature and overcurrent protection
- Controls abnormal, excessive current virtually instantaneously, up to rated limits
- Wide range of temperature options
- High corrosion resistance
- AEC-Q200-equivalent compliant*

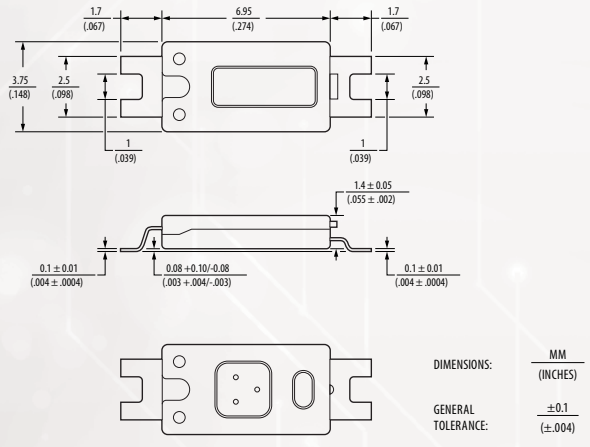
APPLICATIONS

Battery cell protection for:

- Notebook PCs
- Tablet PCs
- Smartphones
- Gaming Notebooks
- High-end & Business Notebooks
- Power Banks

SD Series – AEC-Q200 Equivalent Series

Model	Trip Temperature	Reset Temperature	Maximum Breaking Current	Maximum Voltage	Maximum Leakage Current	Resistance
SD55xBB	55 °C	20 °C min.	DC14 V / 35 A, 100 cycles	DC28 V / 8 A, 100 cycles	300 mA max. @ 25 °C	4 milliohms max.
SD60xBB	60 °C					
SD65xBB	65 °C					
SD70xBB	70 °C					
SD72xBB	72 °C	40 °C min.	DC14 V / 8 A, 10,000 cycles	DC14 V / 8 A, 10,000 cycles	N/A	
SD75xBB	75 °C					
SD77xBB	77 °C					
SD82xBB	82 °C					
SD85xBB	85 °C					
SD90xBB	90 °C					
SD95xBB	95 °C					
SDA0xBB	100 °C					
SDA5xBB	105 °C					
SDB0xBB	110 °C					
SDB5xBB	115 °C					
SDC0xBB	120 °C					
SDC5xBB	125 °C					
SDD0xBB	130 °C					
SDD5xBB	135 °C					
SDE0xBB	140 °C					
SDE5xBB	145 °C					
SDF0xBB	150 °C					



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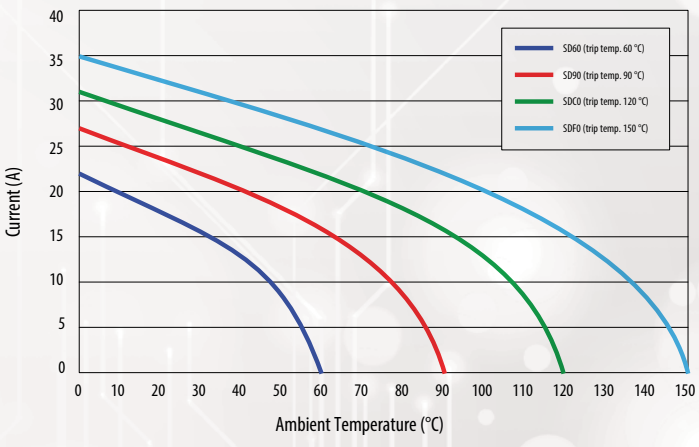
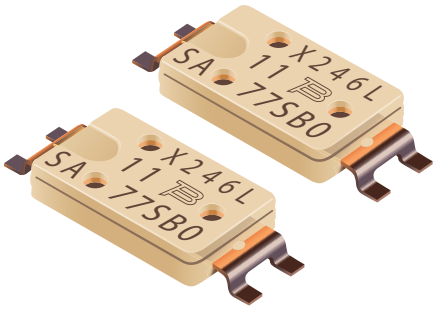


Ambient Temperature Impact on Mini-breaker Operating Currents

*Meets Bourns internal AEC-Q200 equivalent test plan.

Surface Mount/High & Low Current Series



FEATURES

- Surface mount series
- Overtemperature and overcurrent protection for lithium polymer and prismatic cells
- Controls abnormal, excessive current virtually instantaneously, up to rated limits
- Wide range of temperature options
- High and low current options available

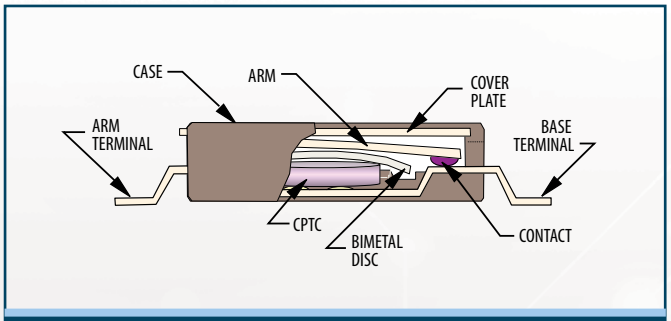
APPLICATIONS

Battery cell protection for:

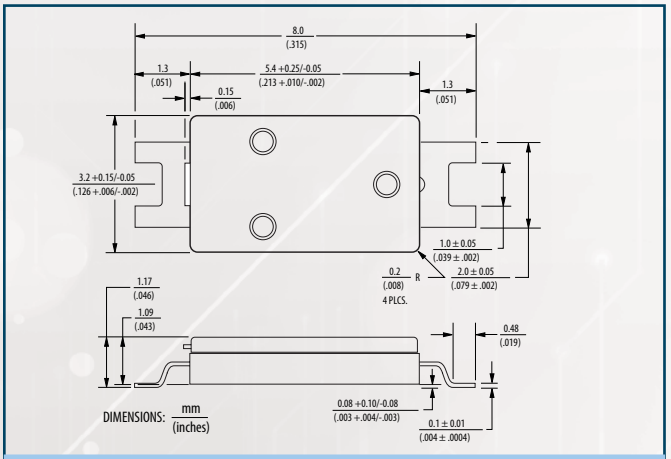
- Notebook PCs
- Tablet PCs
- Smartphones
- PCB Thermal Protection

SA Series – Surface Mount / High & Low Current

Model	Trip Temperature	Reset Temperature	Maximum Breaking Current	Maximum Voltage	Maximum Leakage Current	Resistance
High Current						
SA72SB0	72 °C ±5 °C	40 °C min.	DC5 V / 60 A,100 cycles	DC28 V / 25 A, 100 cycles	200 mA max. @ 25 °C	2.2 milliohms typ. 7.0 milliohms max.
SA77SB0	77 °C ±5 °C					
SA82SB0	82 °C ±5 °C					
SA85SB0	85 °C ±5 °C					
Low Current						
SA72CB0	72 °C ±5 °C	40 °C min.	DC5 V / 30 A,100 cycles	DC28 V / 12 A, 100 cycles	200 mA max. @ 25 °C	7.2 milliohms typ. 15.0 milliohms max.
SA77CB0	77 °C ±5 °C					
SA82CB0	82 °C ±5 °C					
SA85CB0	85 °C ±5 °C					



Product Structure



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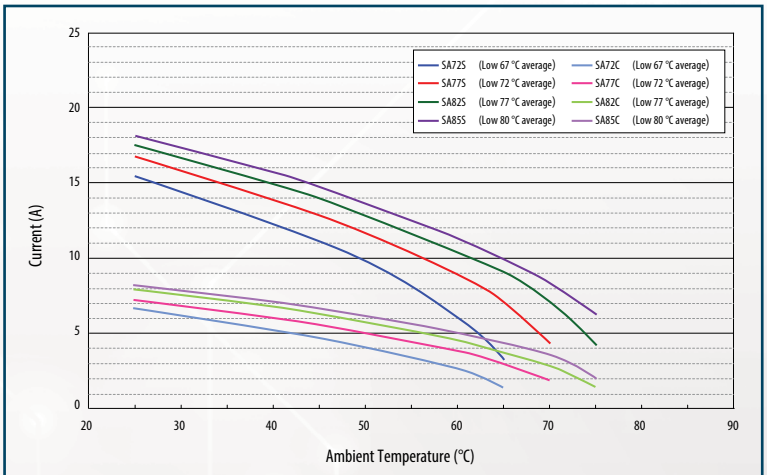

Ambient Temperature Impact on Mini-breaker Operating Currents

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Surface Mount Series

FEATURES

- Surface mount
- Overtemperature and overcurrent protection for lithium polymer and prismatic cells
- Controls abnormal, excessive current virtually instantaneously, up to rated limits
- Wide range of temperature options
- AAA version is designed to withstand high injection molding pressure during USB cable assembly
- AAB version is low profile for smartphone applications

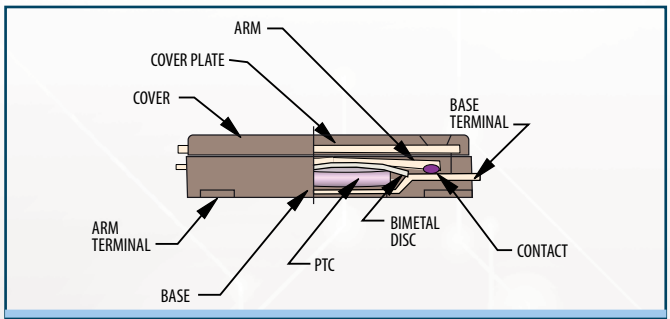
APPLICATIONS

Battery cell protection for:

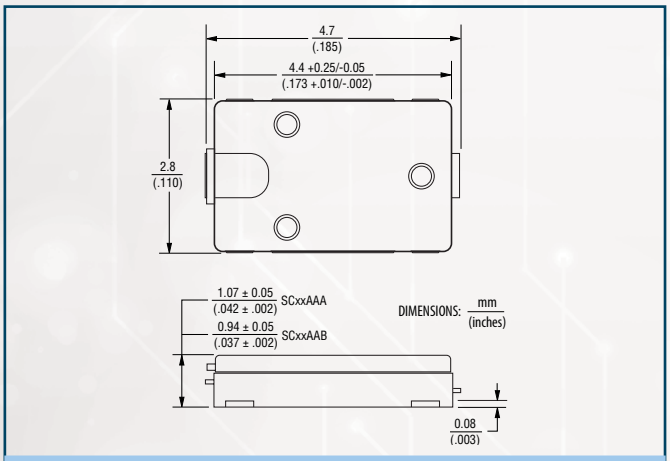
- Notebook PCs
- Tablet PCs
- Smartphones
- USB Cable Protection for Smartphones
- PCB Thermal Protection

SC Series – Next Generation Surface Mount

Model	Trip Temperature	Reset Temperature	Maximum Breaking Current	Maximum Voltage	Maximum Leakage Current	Resistance
SC72AAA SC72AAB	72 °C ±5 °C	40 °C min.	DC5 V / 50 A, 100 cycles	DC28 V / 25 A, 100 cycles	200 mA max. @ 25 °C	1.7 milliohms typ. 5.0 milliohms max.
SC77AAA SC77AAB	77 °C ±5 °C					
SC82AAA SC82AAB	82 °C ±5 °C					
SC85AAA SC85AAB	85 °C ±5 °C					



Product Structure



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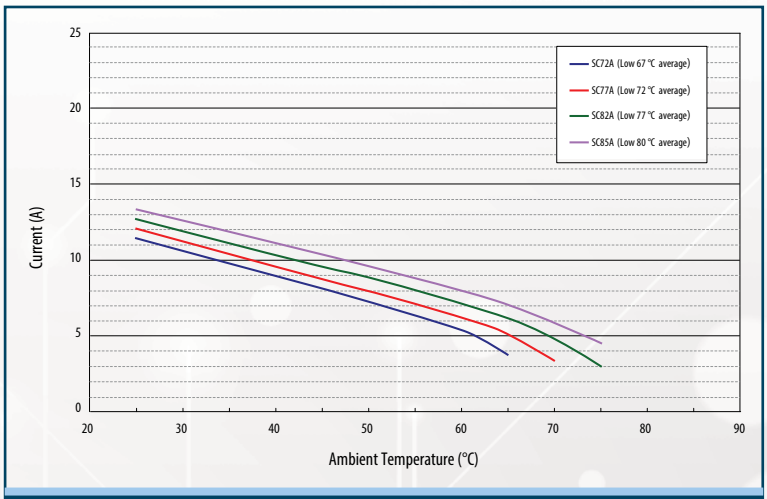

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