



Solar Panel Rapid Shutdown Safety Solution



The Ultimate Emergency Solar Panel Rapid Shutdown Safety Solution

The FireRaptor from IMO is an innovative solar panel rapid shutdown safety solution that takes your safety seriously. Offering three ways to shut down your solar panels to ZERO volts, a 20 YEAR WARRANTY, and compatibility with ALL string inverters, the FireRaptor is the safety product of choice.

Easy to install and operate and fully compliant with NEC2017 & NEC2020, the FireRaptor is also available with temperature monitoring and hardwire or mobile communication alarm signalling (SMS, email etc.).

The FireRaptor is the first product of its kind on the market to not function by utilising Power Line Communications. This speaks of the truly agnostic and mechanical nature of the device thus not allowing it to cause interference with other components downstream, such as inverters and charge controllers.

We have left no stone unturned, and are proud to inform you that the FireRaptor has achieved UL PVRSS (Photovoltaic Rapid Shutdown System) and PVRSE (Photovoltaic Rapid Shutdown Equipment) listing and has additionally been tested by UL to ensure its non-interference with inverter AFCI detection systems when part of a PVRSS installation.



Keeping Solar Safe



FireRaptor Solar Panel Safety Shutdown Solution

MADE IN EUROPE

- Manual Shutdown to 0V within 1 second
- Automatic Shutdown to 0V on AC Supply Cut-Off
- Automatic Shutdown to 0V at >87°C (188°F) Temperature
- Compatible with ALL String Inverters
- SunSpec Exempt - No Powerline Communications
- NEC 2017 & NEC 2020 Compliant
- UL PVRSS (Photovoltaic Rapid Shutdown System) Listed
- UL PVRSE (Photovoltaic Rapid Shutdown Equipment) Listed
- Tested to UL AFCI Requirements Under PVRSS Listings
- Suitable for New Installations or Retro-Fit



PATENT
PENDING



FireRaptor Overview

See <https://downloads.imopc.com/fireraptor-limited-warranty.pdf> for terms

The IMO FireRaptor is designed to be installed at solar panel level and provides safety shutdown of the DC supply to ZERO VOLTS in case of emergency. Shutdown is initiated in 3 ways - Manual Operation, AC Supply Cut-Off or Temperature Rise Trigger as follows:

Manual Operation

Manual shutdown is initiated within less than 1 second of operation by pressing the emergency pushbutton on the Emergency Rapid Shutdown Switch (Part no FRS-ESWx). The Emergency Switch can be conveniently located at ground level for easy access or multiple switches can be installed in different multi-level building zones.

AC Supply Cut-Off

Disconnection of the external AC supply, by whatever means, causes automatic remote operation of the Emergency Rapid Shutdown Switch and solar panel shutdown.

Temperature Rise Trigger

Automatic shutdown occurs if the temperature sensor onboard the FireRaptor detects an ambient temperature rise above its programmed trigger level. The two FireRaptor versions available shutdown in different ways.

The **FRS-01** shuts down only the panel(s) connected to it upon sensing an ambient temperature rise above 87°C (188°F). Provided the temperature does not exceed 92°C (198°F), the unit will re-engage the panel(s) if the temperature drops back below 87°C (188°F), otherwise a manual reset of the Emergency Switch is required.

The **FRS-02** shuts down the entire string connected to it upon sensing an ambient temperature rise above 92°C (198°F) and resetting of the Emergency Switch by a professional installer is then required. The shut-down signal can be configured to provide connection to the building's central alarm system or notification via mobile communication (SMS, email etc.).

Inverter Compatibility

The FireRaptor operates in the same way as an isolator/disconnect switch but is located at solar panel level. Like an isolator/disconnect, the FireRaptor is compatible with all string inverters and does not affect their operation or performance in any way.

Fail-Safe Operation

The FireRaptor is designed for fail-safe operation ensuring that, once operated, subsequent damage to the FireRaptor (e.g. by fire) will not compromise the solar panel isolation and shutdown status. Indeed, the FireRaptor has been fire tested to destruction by TUV in Germany, maintaining full zero volt isolation throughout the test procedure. A copy of the TUV test report is available to view on our website.

Emergency Shutdown Switches

The Emergency Shutdown Switches for both the FRS-01 and the FRS-02 are offered with a 24VDC power supply suitable for up to 40 panel operation. They are available with either a “twist-to-release” pushbutton or keylock pushbutton, both with LED indicator to signal FireRaptor supply status (ON indicates the 24VDC supply is live).

For larger installations, the Emergency Shutdown Switch is available in custom format with:

- Various power supply options for increased number of panels
- Multi connection terminals for increased number of strings
- Temperature monitoring unit with hardwire or mobile communication alarm signaling (FRS-02)

Contact IMO for further information on any of these options.



North American Solar Market Approvals

The FireRaptor has been extensively tested by UL to meet the various PV standards required within the North American market.

UL1741 PVRSE Certification

The FireRaptor is fully certified to UL1741 PVRSE (PV Rapid Shutdown Equipment) for use as an independent Rapid Shutdown Device (RSD) in North America.

As a dedicated RSD operating as a safety switching without communications protocols, the FireRaptor is compatible with any PV inverter unit.

UL1741 Forthcoming AFCI Compatibility Requirements

The first Rapid Shutdown Device (RSD) to do so, the FireRaptor is certified for use with a number of solar inverters in accordance with the new UL AFCI specifications intended to ensure that the RSD operation does not interfere with the inverter's onboard arc fault detection function.

The FireRaptor's status as a benign unit without Powerline Communications helps ensure that arc fault detection is in no way compromised as a result of its installation.

SunSpec Compliance

The SunSpec Interoperability Specification specifically provides for the exemption of products such as the FireRaptor, stating at Section 1:

"It is possible to achieve NEC compliance without a Rapid Shutdown System communication protocol. This specification does not apply in that case."

UL1741 PVRSS Certification with FRONIUS Inverters

The FireRaptor has been fully certified to UL1741 PVRSS (PV Rapid Shutdown System) for use as an independent Rapid Shutdown Device (RSD) with the FRONIUS PRIMO range of inverters from 3.8kW to 15kW.

In order to comply with the requirements of NEC 2017 and NEC 2020, the installation requires incorporation of the FRS-CBLD2 Bleed Box (see Section below) which ensures that the voltage stored in the inverter's capacitance circuit is reduced to the required NEC 2017/2020 stipulated voltage level when Rapid Shutdown is engaged. See FireRaptor Installation Guide for full details.



UL1741 PVRSS Certification with SMA Inverters

The FireRaptor has been independently certified to UL1741 PVRSS (PV Rapid Shutdown System) for use as an independent Rapid Shutdown Device (RSD) with the SMA Sunny Boy range of inverters from 3.0kW to 7.7kW and the SMA TRIPOWER range of inverters from 33kW to 62kW.

No further equipment is required in order to comply with the requirements of NEC 2017/2020. See FireRaptor Installation Guide for full details.



UL1741 PVRSS Certification with FIMER Inverters

The FireRaptor has been fully certified to UL1741 PVRSS (PV Rapid Shutdown System) for use as an independent Rapid Shutdown Device (RSD) with the Fimer UNO range of inverters from 1.2kW to 6kW and the Fimer PVS range of inverters from 50kW to 60kW.

In order to comply with the requirements of NEC 2017 and NEC 2020 the installation requires incorporation of the FRS-CBLD Bleed Box (see section below) which ensures that the voltage stored in the inverter's capacitance circuit is reduced to the required NEC 2017/2020 stipulated voltage level when Rapid Shutdown is engaged.

See FireRaptor Installation Guide for details.



UL1741 Certified NEC 2017/2020 Compliant Bleed Boxes

IMO has a number of UL1741 Certified, NEC 2017 Compliant Bleed Box units available:

FRS-CBLD

Standard version for use in systems where the inverter is grounded on DC- (for use with FIMER UNO & PVS ranges of PV inverter)

FRS-CBLD1

DC- grounded version for use in Systems where the inverter is not grounded

Note: CHECK THAT NO DAMAGE OCCURS TO THE INVERTER AS A RESULT OF GROUNDING

FRS-CBLD2

For use ONLY with the FRONIUS PRIMO range of PV inverters

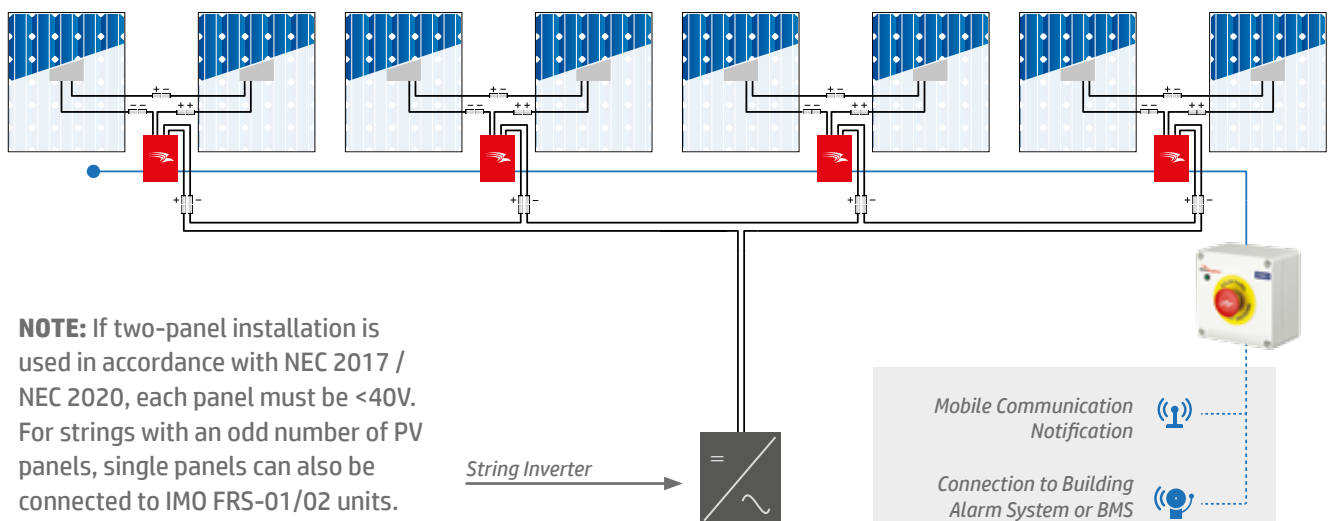


Installation

The FireRaptor is easy to install, requires no set-up and is suitable for both new and retro-fit installations. It is designed to shutdown two panels or it can be mounted in single panel configuration if preferred. The diagram below shows a typical two-panel installation.

The FireRaptor is manufactured using original Multi Contact MC4 connectors on the DC cables ensuring high quality integration and compatibility. The Emergency Switch control cable is fitted with Tyco SuperSeal connectors ensuring quick and easy (plug & play) installation.

FRS-01 & FRS-02 (Series Connection)



Only available with FRS-02 version

CASE STUDY:

UK Gatwick Airport Boeing GoldCare Hangar Facility

● 560 PV Modules ● 280 FireRaptors

We were approached by a specialist PV installer who was seeking a solar panel rapid shutdown solution for Boeing GoldCare's 16,000sqm aviation hangar facility which housed 560 PV modules on a single-ply membrane roof at Gatwick airport in the UK.

Fire safety was of paramount importance to the customer due to the high value of the hangar contents, and also due to the location of the hangar inside the Gatwick airport grounds. Having looked into the rapid shutdown offerings in the market, the installer settled upon the FireRaptor Rapid Shutdown Solution due to its international approvals and compatibility with all string inverters ensuring easy retro-fit to existing installations.

Each FireRaptor rapid shutdown unit can shut down up to two connected PV modules where the combined rating of the two panels does not exceed the 700W rating of the FireRaptor. 280 FireRaptor units were wired in series to the 560 PV modules to ensure the entire roof installation could be isolated as necessary.

NOTE: 1-to-1 configuration may be required in certain regions in order to meet regulatory compliance.

The installer was impressed with the FireRaptor's cost and ease of installation and the FireRaptor remains its number one choice for solar panel rapid shutdown.



"The IMO FireRaptor is a great product, cost-effective, easy to install and performs as described. I would highly recommend it. We will continue using the IMO FireRaptor in our solar PV projects. Many thanks."

Managing Director, Specialist PV Installer

CASE STUDY: USA 18MW Rooftop PV Installation

● 65,000 PV Modules ● 65,000 FireRaptors

The customer was a major US-based EMC (a solar company that provides PV System Engineering, Procurement and Construction) working on a project comprising over 18MW of solar energy in the South West of the United States.

Operations and ongoing maintenance requirements of the entire installation were key concerns for the EMC in their assessment of the most appropriate Rapid Shutdown solution. AFCI (Arc Fault Circuit Interruption) was a particular area of interest given recent concerns regarding possible interference from system components.

An assessment of the installation specification determined a need for a 1:1 configuration of 65,000 FireRaptor FRS-01 modules over the entire project. Custom made control boxes were supplied to accommodate the sectionalised shut-down requirements the customer wanted to achieve.

With such a large-scale project, the FireRaptor's easy installation and set-up without the need for more complex implementation was appreciated as was the 20 year warranty giving peace of mind and long term confidence in the product's reliability.



"We have found the FireRaptor to be exactly as advertised, easy to install and use. O&M was a major concern for us, but with the IMO product we feel confident in the long term outcome of this project."

Lead Engineer, EMC

CASE STUDY: USA Community Project



● 310 PV Modules ● 310 FireRaptors

We were contacted by the PV systems integrator supervising the community project for the Flemingington Area Food Pantry in Flemingington, New Jersey (USA). The project was intended to improve self-sufficiency of the Food Pantry and reduce energy supply costs. An NEC 2017 compliant Rapid Shutdown solution was required for insurance purposes and to help protect the volunteer staff and ambient food reserves in the event of fire or other such emergency.

The project was already well underway with First Solar Series 4 PV modules already specified and the system integrator was having some difficulty identifying a rapid shutdown solution that could accommodate the high voltage (VOC) requirements of the First Solar panels.

Under evaluation, it was found that a 1:1 configuration of 310 FireRaptor FRS-01 units was required providing up to 150V individual PV module capacity and easily meeting requirements.



"The IMO FireRaptor was the only product that met our criteria technically for this project. An added benefit is that it's always nice to partner with a company that enjoys giving back to the community as we do."

Project Manager, Systems Integrator

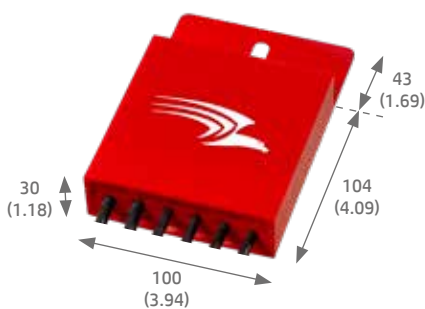
Technical Specification

| | FRS-01 / FRS-02 |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Emergency Shutdown Cable | 2x1mm ² cable + Tyco SuperSeal 2-pole plug/connector (male/female) |
| DC Power Supply | 24VDC - See ordering information overleaf |
| Maximum System Input Power | 700W single panel or 350W per panel (two panels in series) |
| Maximum System Input Voltage | 150V single panel or 75V per panel (two panels in series) |
| FireRaptor Control Requirements | 12-28V at nomi. 10mA/unit |
| Maximum System Input Current | 12A |
| Maximum Isolation Voltage | 1500V |
| Input Protection | Over voltage & transient voltage suppression |
| Maximum System Output Current | 12A (99.5% efficiency) |
| Breakdown Voltage | 1500VAC for 1 minute |
| Maximum System Output Voltage | 150V single panel or 75V per panel (two panels in series) |
| Output Protection | Over voltage, over current & transient voltage suppression |
| Max. Input Short Circuit Current | 15A |
| Operating Temperature | -30°C to +95°C |
| Ambient Operating Temperature | -30°C to +55°C |
| IP Class Protection | >IP68, NEMA 4X |
| PV Casing | Flame retardant Polycarbonate - UL94-V0 |
| Limited Warranty | FRS-0(X) : 20 Years, FRS-ESW(X)(-K) : 5 Years (See https://downloads.imopc.com/fireraptor-limited-warranty.pdf for terms) |
| Weight (without cables) | 400g |
| Panel Cable Length | 120mm |
| String & Signal Cable Length | 1800mm |
| Standard Compliance | EN 61000, EN 61646, EN 61215, IEC 62716 draft C (NH ₃ resistant), VDE-AR-E 2100-712, BS 7671-712, UL 1741 |
| PV Connectors | Original Multi Contact MC4 |

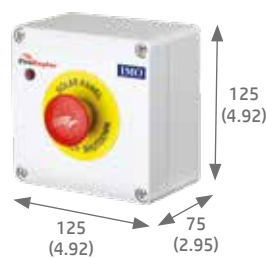
Dimensions mm (inches)

Tolerance ±0.5mm (±0.03")

FRS-0(X)



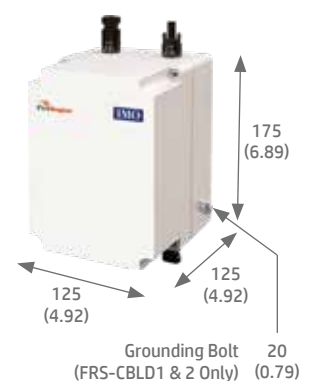
FRS-ESW1 / FRS-ESW2



FRS-ESW1-K / FRS-ESW2-K



FRS-CBLD / 1 / 2



| Emergency Shutdown Switches | Dimensions mm (inches) - Height x Width x Depth |
|---------------------------------|-------------------------------------------------|
| FRS-ESW(X)/FRS-ESW(X)-K | 125mm x 125mm x 75mm (4.92" x 4.92" x 2.95") |
| FRS-ESW(X)-24/FRS-ESW(X)-24-K | 125mm x 175mm x 75mm (4.92" x 6.89" x 2.95") |
| FRS-ESW(X)-310/FRS-ESW(X)-310-K | 175mm x 250mm x 100mm (6.89" x 9.84" x 3.93") |
| FRS-ESW(X)-610/FRS-ESW(X)-610-K | 175mm x 250mm x 100mm (6.89" x 9.84" x 3.93") |
| FRS-ESW1-1010 | 175mm x 250mm x 100mm (6.89" x 9.84" x 3.93") |

| Certified Bleed Boxes | Dimensions mm (inches) - Height x Width x Depth |
|-----------------------|-------------------------------------------------|
| FRS-CBLD | 175mm x 125mm x 125mm (6.89" x 4.92" x 4.92") |
| FRS-CBLD1 / 2* | 175mm x 145mm x 125mm (6.89" x 5.71" x 4.92")* |

* FRS-CBLD1 & FRS-CBLD2 with includes grounding bolt (adds 20mm to width)

Ordering Information

| Part Number | Description |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| FRS-01 | FireRaptor Rapid Shutdown Unit for connection to 2 solar panels |
| FRS-02 | FireRaptor Rapid Shutdown Unit with Temp Alert for connection to 2 solar panels |
| FRS-ESW1 | Emergency Rapid Shutdown Switch for FRS-01, max 40 solar panels (UL) |
| FRS-ESW1-24 | Emergency Rapid Shutdown Switch for FRS-01, max 100 solar panels (UL) |
| FRS-ESW1-310 | Emergency Rapid Shutdown Switch for FRS-01, max 150 solar panels (UL) |
| FRS-ESW1-610 | Emergency Rapid Shutdown Switch for FRS-01, max 250 solar panels (UL) |
| FRS-ESW1-1010 | Emergency Rapid Shutdown Switch for FRS-01, max 420 solar panels (UL) |
| FRS-ESW1-K | Emergency Rapid Shutdown Switch with Key Lock for FRS-01, max 40 solar panels (UL) |
| FRS-ESW1-24-K | Emergency Rapid Shutdown Switch with Key Lock for FRS-01, max 100 solar panels (UL) |
| FRS-ESW1-310-K | Emergency Rapid Shutdown Switch with Key Lock for FRS-01, max 150 solar panels (UL) |
| FRS-ESW1-610-K | Emergency Rapid Shutdown Switch with Key Lock for FRS-01, max 250 solar panels (UL) |
| FRS-ESW2 | Emergency Rapid Shutdown Switch for FRS-02, max 40 solar panels (UL) |
| FRS-ESW2-24 | Emergency Rapid Shutdown Switch for FRS-02, max 100 solar panels (UL) |
| FRS-ESW2-310 | Emergency Rapid Shutdown Switch for FRS-02, max 150 solar panels (UL) |
| FRS-ESW2-610 | Emergency Rapid Shutdown Switch for FRS-02, max 250 solar panels (UL) |
| FRS-ESW2-K | Emergency Rapid Shutdown Switch with Key Lock for FRS-02, max 40 solar panels (UL) |
| FRS-ESW2-24-K | Emergency Rapid Shutdown Switch with Key Lock for FRS-02, max 100 solar panels (UL) |
| FRS-ESW2-310-K | Emergency Rapid Shutdown Switch with Key Lock for FRS-02, max 150 solar panels (UL) |
| FRS-ESW2-610-K | Emergency Rapid Shutdown Switch with Key Lock for FRS-02, max 250 solar panels (UL) |
| FRS-SIGCAB1.8-F | 1.8m (71") cable with Tyco female connector for initial string connection |
| FRS-CBLD | Standard Certified Bleed Box for use in systems where inverter is grounded on DC- (for use with FIMER UNO & PVS ranges of inverter) |
| FRS-CBLD1 | DC Grounded Certified Bleed Box for use in systems where inverter is not grounded |
| FRS-CBLD2 | DC Grounded Certified Bleed Box for use ONLY with Fronius PRIMO range of inverters |

PLEASE NOTE: All ESW Emergency Switches are supplied with 2 cable glands and a waterproof end-stop.

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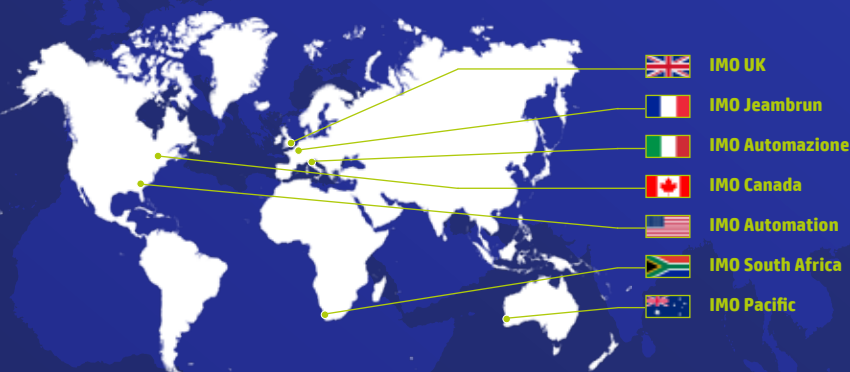
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