PROTECTOWIRE® FireSystems

# Rooftop Solar Panel Arrays
# APPLICATION GUIDE

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## INTRODUCTION

A rooftop solar power system, or rooftop PV system, is a photovoltaic (PV) system that has its electricity-generating solar panels mounted on the rooftop of a building or structure. These systems consist of various components including photovoltaic modules, mounting hardware, cables, solar inverters, electrical connectors, and other electrical accessories. As solar capacity grows worldwide, the absolute number of fire incidents naturally increases because risk scales with volume. There are several common risks linked to past fire events: wires on sharp edges, poor terminations in inverters, improperly made or mismatched connectors and incorrect mating of connectors. In addition to these risks, there are premature PV module failures due to factors such as water ingress, hot spots, and micro-cracks from the manufacturing process that allows moisture to infiltrate and damage the interior cells. The inherent potential of electrical failures in roof top solar systems leading to fires and the possibility of injury, loss of life and property damage remains a critical concern for occupants, owners and insurers.

## PV ROOFTOP SOLAR PANELS

Roof mounted solar panel installations add a significant level of complication and risk to a facility. The addition to the overall fire load from both the panels as well as electrical equipment, changes the combustion dynamics while restricting visibility and roof access introducing unique conditions. Early detection of a fire event is critical in reducing the associated risks introduced by these systems. Protectowire linear heat detection systems provide early detection along with location information to first responders allowing for the best possible response to an event.

## LINEAR HEAT DETECTION OPTIONS

The Protectowire Company offers three unique linear heat detection technologies suitable for rooftop solar applications. Each of these technologies is selected based on the requirements of the detection system, including false alarm tolerance, overall coverage area, and required monitoring data. Frequently Protectowire's Confirmed Temperature Initiation (CTI) series linear heat detector (LHD) is used to detect overheat and fire conditions in rooftop solar array applications. CTI technology provides the most effective means to meet the challenges associated with solar panel installations.

**Digital Linear Heat Detector**
The term "digital" refers to the linear heat detectors on/off mode of operation. When in normal standby operation the detector is an "off" open switch state and when activated it is in a "on" closed switch state. The sensor cable is comprised of two steel conductors individually insulated with a heat sensitive polymer. The insulated conductors are twisted together to impose a spring pressure between them, then wrapped with protective tape and finished with an outer jacket suitable for the installation environment. Protectowire is a fixed temperature digital sensor and is therefore capable of initiating an alarm once its rated activation temperature is reached.

**Confirmed Temperature Initiation (CTI) Detector**
CTI linear heat detector operates with the same switching principle as digital LHD but with the addition of thermal confirmation of the event. By using thermocouple technology, the event temperature is measured and confirmed before initializing an alarm. This method prevents non-thermal events, typically mechanical damage, from causing false alarms. This technology requires a CTM interface module which reports the event temperature and the distance to the event.

**Fiber Optic Sensor Cable** – Fiber Optic linear heat detection utilizes a specialty controller and fiber optic sensor cable which provides temperature measurement data at any location along the cable's length. A thermal profile of the entire cable length is generated in real time with programmable zone locations and alarm parameters. The sensor operates using optical signals which are immune to electrical interference (EMI/RFI) and provides a highly reliable and configurable detection system suitable for large installations.

All linear heat detection technologies can be spliced/repaired if damaged. You do not need to replace the entire run of detector. Contact Protectowire for more information on how to splice linear heat detectors.

## OPERATION OF LINEAR HEAT DETECTION

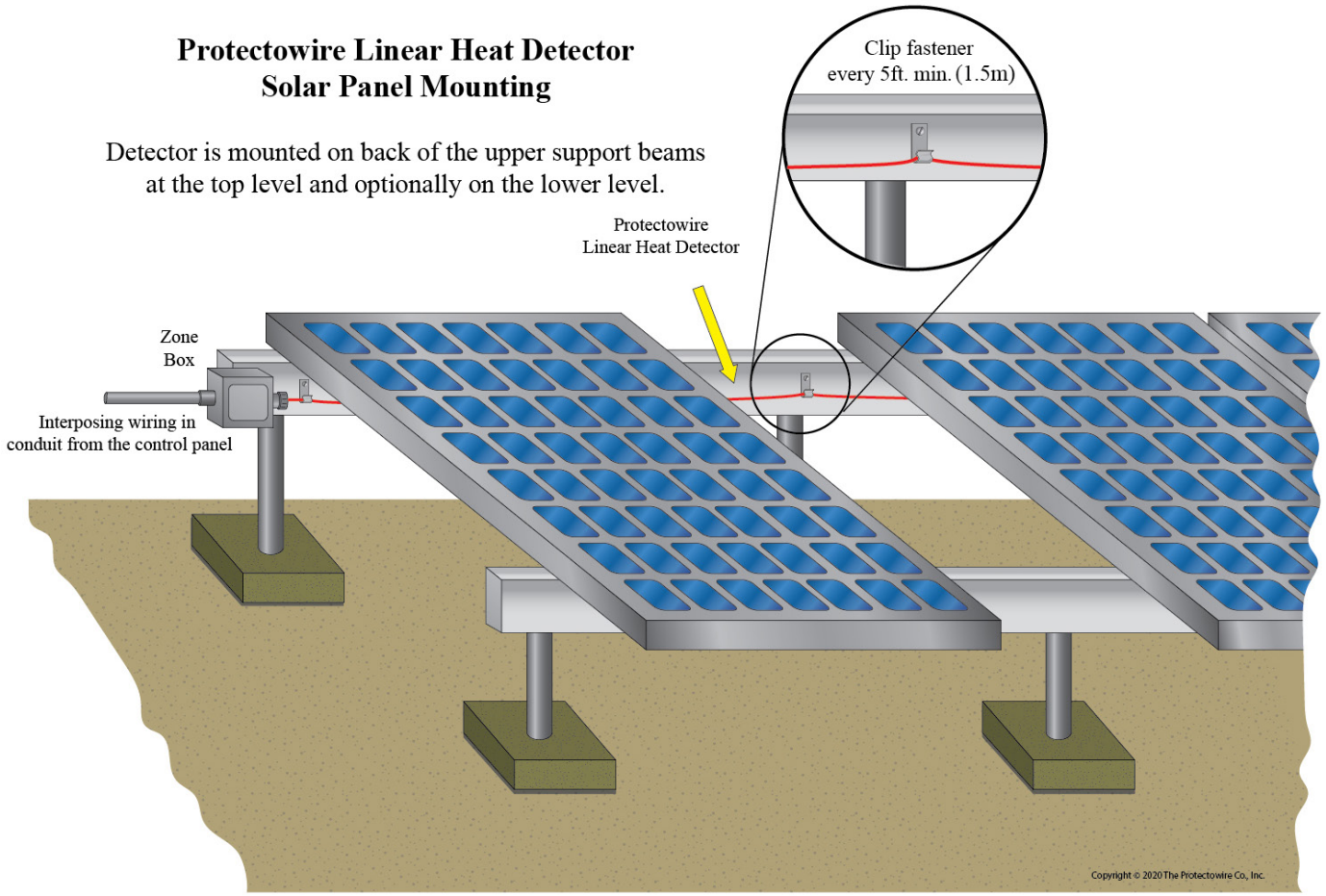
All linear heat detectors are designed to detect an overheat or fire condition. When an overheat condition is detected, an alarm condition is initiated at the control equipment. This is often the facility's fire alarm control panel (FACP). The FACP then activates the appropriate notification. Most system configurations include detection only; automatic suppression systems are not common in rooftop solar power system applications. Typically, there is an interface device in between the linear heat detection and the FACP.

## LOCATING LINEAR HEAT DETECTION IN A PV ROOFTOP APPLICATION

It is recommended that the LHD be installed on the back of the solar panel support infrastructure. Typically, the LHD is installed on the highest accessible support beam. It is optional to locate the LHD on the inside of the lower beam. The position of the detector is often different for each installation as the exact location is driven by the available panel support framework. It is important to consider all components of the PV rooftop system when installing the detector. The PV modules are the largest portion of the system, but it is also important to protect the solar inverters, cables, and other electrical accessories.

## LHD FOR PV ROOFTOP APPLICATIONS

Linear heat detection systems can be easily separated into predetermined zones on a PV rooftop application. A zone alarm could be used to open disconnect switches, initiate notification appliances, or control ventilation within the facility. For example, disabling ventilation could be a logical sequential action if the HVAC air intakes are located on the roof adjacent to the panels. Zone mapping, or recording the linear heat detection location by zone, is a proven method of providing event information (location and temperature) to first responders.



## LINEAR HEAT DETECTION OPTIONS

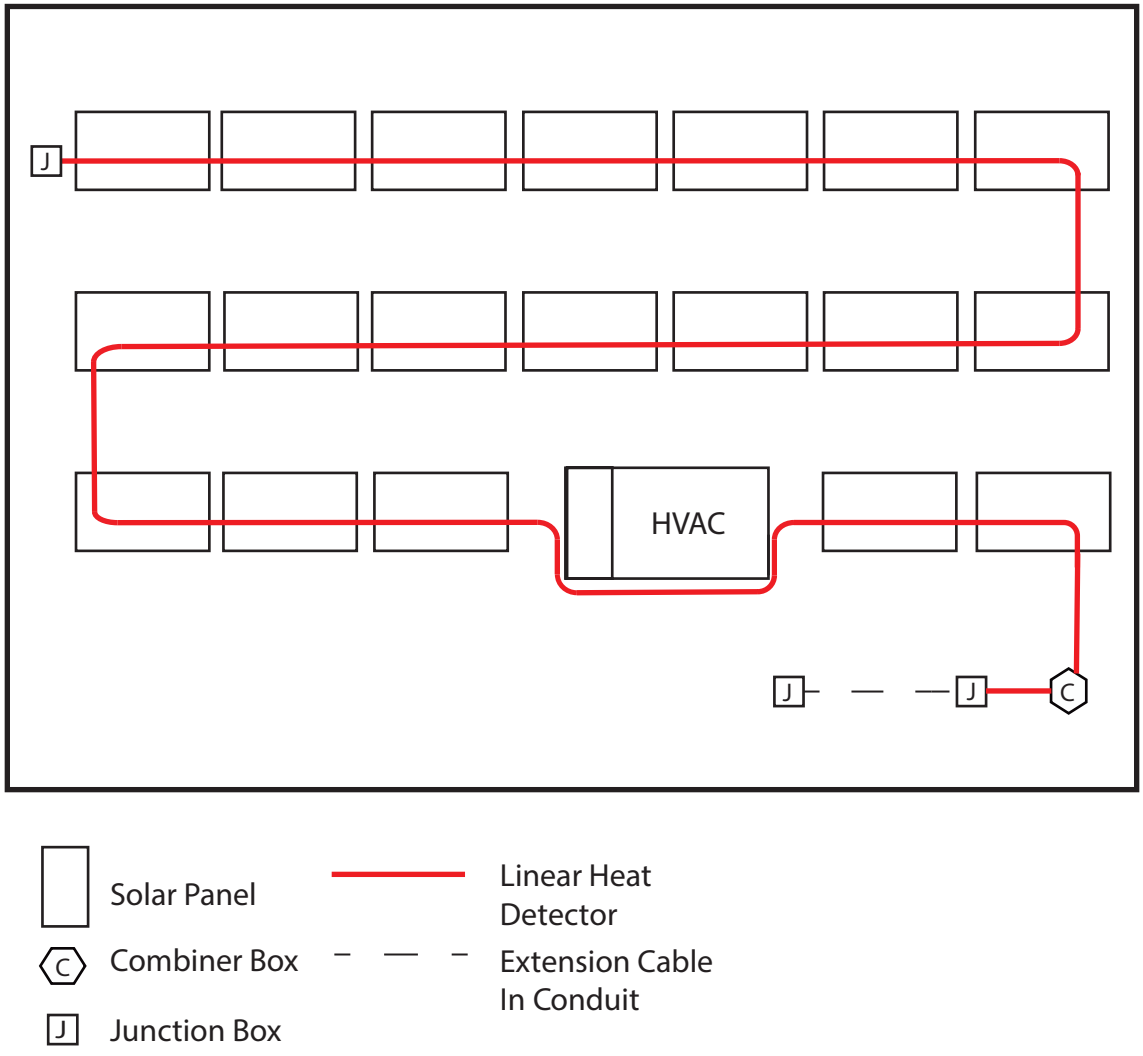
**Digital Linear Heat Detector – Direct Connection to I/O Module or Fire Control Panel Initiation Circuit**
This is the simplest configuration for a digital linear heat detector. It is compatible with any signaling control unit or I/O module that accepts a contact closure-type initiating device.

In this setup, the detector connects to a supervised initiating circuit of an approved fire protective signaling control unit. For addressable systems, this circuit may be remote from the control unit. The detector must be installed in continuous runs—without taps or branches—in accordance with NFPA 70 (National Electrical Code), NFPA 72 (National Fire Alarm Code), or as directed by the local authority having jurisdiction.

Typically, the detector connects via copper feed wire to a junction box. Since the detector has higher resistance than copper wire of the same size, it's essential to evaluate each manufacturer's control unit to ensure the linear heat detector length does not exceed the circuit's resistance specifications.

NOTE: Most fire alarm panels support limited runs of Protectowire on each circuit, as these circuits are primarily designed for spot smoke and heat detectors. Refer to the supervising circuit's datasheet or manual for the device's IDC resistance values.

Each detector input corresponds to a zone. Alarms are reported per zone, enabling targeted outputs such as ventilation control, signal notification, or suppression.



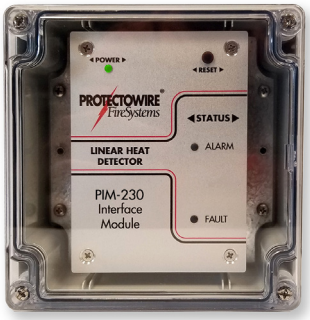
## Digital Linear Heat Detector – Connection via PIM Interface Modules

**PIM-530:**

The PIM-530 is a detection control module that interfaces between the fire alarm control panel and Protectowire digital linear heat detectors. It provides one supervised detection circuit, configurable for Class A or Class B service. This module supports up to 6,560 feet (2,000 meters) of standard PHSC or PLR series linear heat detectors. It also works with other non-resistive, normally open initiating devices. The PIM-530 includes a digital display, alarm location meter, and a 64-event history log. Outputs are available via relays, 4–20mA signals, or Modbus over RS-485. The PIM-530 is also available with an intrinsic safety barrier for classified/hazardous locations.

Each PIM-530 input represents a zone, with individual alarms reported to the panel or control device. Alarms are reported per zone, enabling targeted outputs such as ventilation control, signal notification, or suppression. During an alarm, the module displays the distance to the event, which can be mapped to specific roof sections or PV panel arrays.

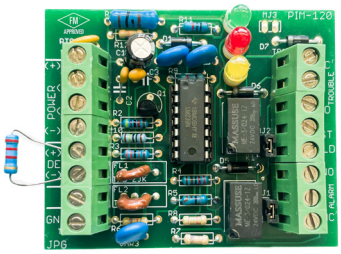
**PIM-230:**




The PIM-230 is a detection control module that interfaces between the fire alarm control panel and Protectowire digital linear heat detectors. It provides one supervised detection circuit, configurable for Class A or Class B service. This module supports up to 6,560 feet (2,000 meters) of standard PHSC or PLR series linear heat detectors. It also works with other non-resistive, normally open initiating devices. The PIM-230 outputs are available via relays or Modbus over RS-485. The PIM-230 is not intended to supervise Protectowire in classified/hazardous locations.

Each PIM-230 input represents a zone, with individual alarms reported to the panel or control device. Alarms are reported per zone, enabling targeted outputs such as ventilation control, signal notification, or suppression. The module's operating status is communicated via LEDs.

**PIM-120:**

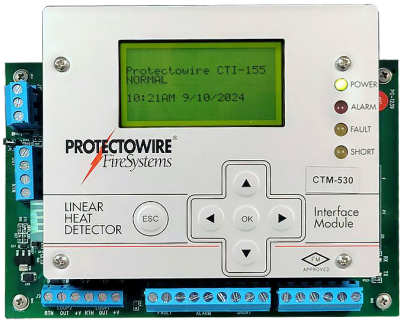



The PIM-120 is a detection control module that interfaces between the fire alarm control panel and Protectowire digital linear heat detectors. It provides one supervised Class B detection circuit. This module supports up to 6,560 feet (2,000 meters) of standard PHSC or PLR series linear heat detectors. It also works with other non-resistive, normally open initiating devices. The PIM-120 has relay outputs and is available with an intrinsic safety barrier for classified/hazardous locations.

Each PIM-120 input represents a zone, with individual alarms reported to the panel or control device. Alarms are reported per zone, enabling targeted outputs such as ventilation control, signal notification, or suppression.

## Confirmed Temperature Initiation (CTI) Detector – Connection via CTM Interface Modules

**CTM-530:**

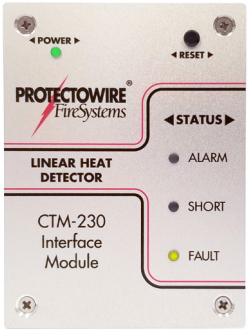



The CTM-530 is a detection control module that interfaces between the fire alarm control panel and the CTI linear heat detector. Confirmed Temperature Initiation uses short-circuit discrimination. This process distinguishes between an electrical short from mechanical damage (short fault condition) and a heat activated electrical short (alarm condition).

Each CTM-530 provides one supervised detection circuit, configurable for Class A or Class B service, and supports up to 4,000 feet (1,220 meters) of CTI linear heat detector. The CTM-530 includes a digital display, alarm location meter, and a 64-event history log. Outputs are available via relays, 4–20mA signals, or Modbus over RS-485. The CTM-530 is also available with an intrinsic safety barrier for classified/hazardous locations.

Each CTI-530 input represents a zone, with individual alarms reported to the panel or control device. Alarms are reported per zone, enabling targeted outputs such as ventilation control, signal notification, or suppression. During an alarm both the distance location and temperature are displayed, which can be mapped to specific roof sections or PV panel arrays.

**CTM-230:**




The CTM-230 is a detection control module that interfaces between the fire alarm control panel and the CTI linear heat detector. Confirmed Temperature Initiation uses short-circuit discrimination. This process distinguishes between an electrical short from mechanical damage (short fault condition) and a heat activated electrical short (alarm condition).

Each CTM-230 provides one supervised detection circuit, configurable for Class A or Class B service, and supports up to 4,000 feet (1,220 meters) of CTI linear heat detector. The CTM-230 outputs are available via relays or Modbus over RS-485. The CTM-230 is not intended to supervise Protectowire in classified/hazardous locations.

Each CTM-230 input represents a zone, with individual alarms reported to the panel or control device. Alarms are reported per zone, enabling targeted outputs such as ventilation control, signal notification, or suppression. The module's operating status is communicated via LEDs.

## Fiber Optic Sensor Cable – Connection via Protectowire Fiber System

The Protectowire PTS controller is the core of the fiber optic temperature sensing system. It connects to the fire control panel via relay inputs/outputs and uses optical signals to measure temperature through the fiber optic linear heat detection cable. Temperature is determined by the controller through analysis of backscattered light along the fiber optic cable.

Outputs include Modbus over TCP/IP and 10 standard relays. Two additional sets of 44 relays each can be added for a total of 98 relays (10+44+44).

This active monitoring system can support temperature measurements on fiber optic linear heat detectors that are up to 10 km (32,000 feet) long per channel. The PTS controller can support up to four-channels per device. The included software allows each channel to be subdivided into 2000 different zones, totaling 8000 zones per controller. Each zone can be configured to support customized alarm criteria such as fixed temperature, rate-of-rise, or zone differential.

Two types of sensor cable are available:

**Stainless Steel Core Tube:** Includes two-color coded quartz fibers, gel-free design, stainless steel braid, and an FRNC outer jacket. This detector is designed for extremely harsh environments.

**Metal-Free Sensor Cable:** Includes two-color coded quartz fibers, aramid yarn, and an FRNC outer jacket. This detector is designed for environments with high electromagnetic interference.

This high-performance system offers flexibility and is ideal for large applications requiring precise, active temperature monitoring.

## COMPLETE SYSTEM SOLUTIONS

Protectowire offers control panels and other initiating devices when a complete engineered system solution is required. Our system solutions allow for flexibility in designing the safety solutions for the special hazards industry.

**SRP-4x4 Control Panel** – This panel provides multiple features and versatility to meet the requirements of many typical special hazard projects. The versatile single board configuration eliminates custom assembly of multiple modules thus ensuring a streamlined system at a high value.

The panel contains four input circuits and four output circuits. These circuits can be configured into 16 field programmable standard operating programs by utilizing a set of simple to operate dip switches. Input circuits may be field wired in Class A or Class B configurations and are suitable for a wide range of initiating functions including smoke, heat, and flame detection, manual alarm initiating, water flow and sprinkler system supervision. Each initiation device circuit can support up to 10,000 feet (3,048 meters) of digital linear heat detection. This system can also be used with the PIM and/or CTM modules.

**FireSystems 2000 (FS2000)** - The FS2000 is an engineered modular designed fire panel. The base system comes with a power supply and features: two (2) supervised detection circuits, that may be field wired for either Class A or Class B; two (2) supervised Class B audible appliance circuits; battery charger and monitor; ground fault detection; lamp test; one (1) set of SPDT common alarm contacts, two (2) sets of Form A or B (selectable) common trouble contacts, and one (1) set of Form A or B (selectable) common supervisory contacts.

The basic FS2000 series control panel is designed for easy expansion of system capability by adding additional modules and functions to the standard system. The FS2000 series control panel will accommodate a combination of the following options:

- Protectowire alarm point location meter
- Extinguishing system release and supervision
- Water flow detection
- Fire and non-fire supervisory monitoring
- Intrinsically safe detection zones
- Supplementary relays

A list of available options and configurations are available on the FS2000 data sheet (DS 9004N-0618).

## ADDITIONAL INFORMATION

Additional information on the Linear Heat Detection System and components mentioned in this application guide can be found at www.protectowire.com

- Protectowire Linear Heat Detector (Data sheet # DS-6592)
- Protectowire CTI™ Confirmed Temperature Initiation Linear Heat Detectors (Data sheet # DS-9246)
- PIM-530 Series Protectowire Linear Heat Detector Interface Module (Data sheet # DS-9260)
- PIM-230 Series Protectowire Linear Heat Detector Interface Module (Data sheet # DS-9322)
- PIM-120 Series Protectowire Linear Heat Detector Interface Module (Data sheet # DS-9206)
- CTM-530 Series Protectowire Interface Module (Data sheet # DS-9247)
- CTM-230 Series Protectowire Interface Module (Data sheet # DS-9309)
- Protectowire FiberSystem PFS Series Fiber Optic Sensor Cable (Data sheet # DS-9405)
- Protectowire PTS Fiber System (Data sheet # DS-9376)
- SRP-4x4 Fire Alarm/Releasing Control Panel (Data sheet # DS-9189)
- FireSystem 2000 Commercial and Light Industrial Fire Alarm Control Panel (Data sheet # DS-9004)
- Protectowire Linear Heat Detector Temperature Ratings (Data sheet # DS-8476)
- Important Installation Information PHSC Linear Heat Detector (Data sheet # DS-7736)