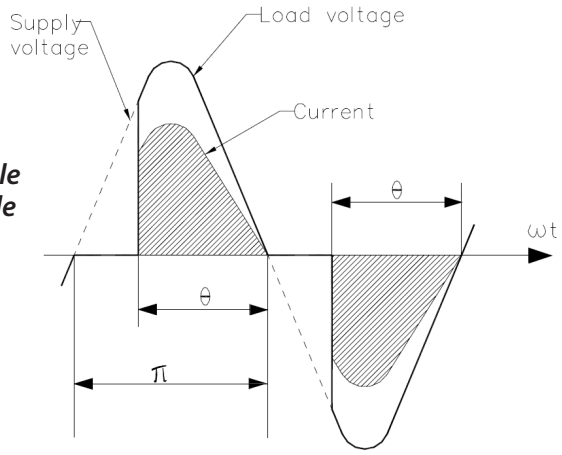
POWER CONTROLLERS
BUYING GUIDE

WHAT DO THEY DO?

Industrial heating systems typically use a PID loop to generate a continuous control output representing heat demand. A key challenge is translating a continuously varying demand signal into precise AC power control for a heating load through discrete switching of the AC waveform.

Mechanical relays and contactors are limited to simple ON/OFF control and are subject to mechanical wear and contact degradation over time. Standard solid-state relays improve reliability but still provide only basic switching of AC power without true power regulation.

Phase Angle Firing Mode



θ = regulated output of the SCR controllers

π = supplied AC signal

Topics

SCR power controllers extend beyond simple switching by precisely modulating AC power delivery to match process demand. Configurable firing modes regulate the effective power delivered to the load rather than simply switching it ON and OFF. This improves temperature stability, reduces heater stress, and extends heating element life.

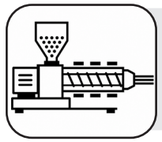
These controllers regulate the average power delivered to a heating load by controlling when AC power is applied. This is accomplished using time-proportioning methods, such as burst firing or fixed cycle time, or phase-angle control, where the SCRs conduct for only a portion of each AC half-cycle.

These devices are commonly used with resistive heating elements, infrared heaters, silicon carbide (SiC) heating elements, Super Kanthal heaters, and other electric heating loads requiring accurate and repeatable temperature control.

SCR power controllers provide the critical interface between modern PID temperature controllers and electric heating loads, allowing continuously varying process demand to be converted into precise, repeatable heater power.

APPLICATIONS

SCR power controllers are used across a wide range of industrial heating processes to deliver precise and repeatable control of electric heat. In many applications, they help maintain stable thermal conditions, improve process consistency, and extend the service life of heating elements. Proper selection ensures reliable performance under varying load types, electrical conditions, and process demands.

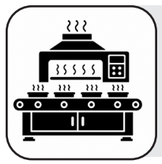


Plastic Extrusion: Provides precise control of barrel and die heaters to maintain consistent melt temperature throughout the extrusion process. Stable heating improves product quality, reduces material waste, and supports product uniformity.

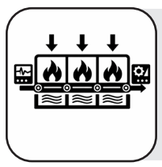
Industrial Ovens and Furnaces: Regulates electric heating elements to maintain uniform temperatures for curing, drying, annealing, and heat-treating applications. Precise power control improves process consistency while reducing heater stress and extending element life.

Infrared Heating Systems: Controls infrared lamp output while limiting the high inrush currents common to cold filament heaters. Fast response and stable power regulation improve heating uniformity and help maximize lamp service life.

Semiconductor Manufacturing: Provides accurate temperature control for thermal processing, wafer handling, and electronic assembly equipment. Stable power delivery minimizes temperature variation, and improves process repeatability and product yield.



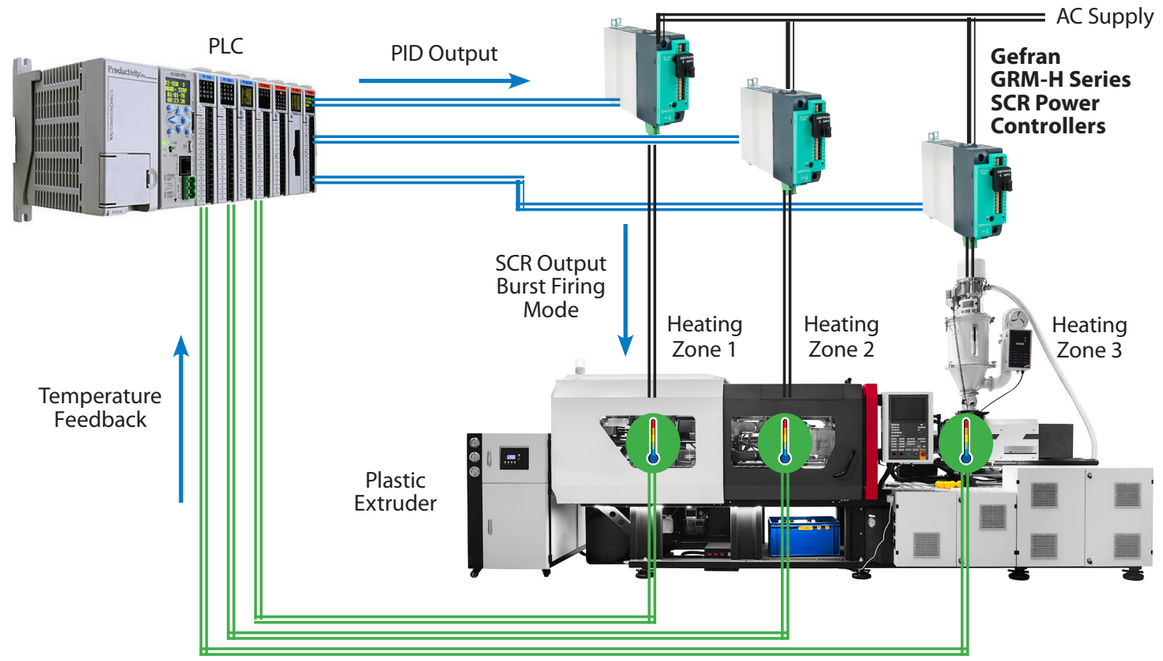
Food Processing: Maintains consistent heating in ovens, cookers, dryers, and packaging equipment where precise temperature control is essential for product quality and food safety. Reliable power regulation supports repeatable production and efficient operation.



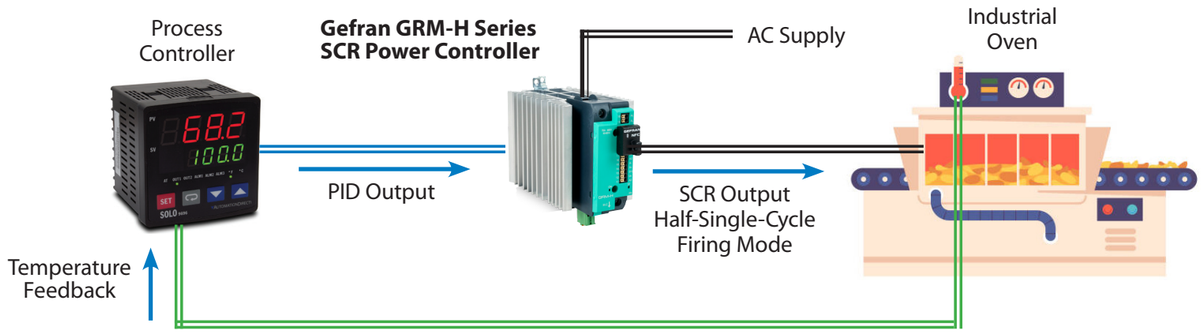
Multi-zone Process Heating: Controls power to multiple independent heating zones, maintaining precise temperature balance across the system. SCR regulation provides stable, repeatable heat control for consistent process quality and improved efficiency.

APPLICATION EXAMPLES:

- **Plastic Extrusion**: Plastic extruders use closed-loop temperature control, where the PLC's PID loops drive GRM-H power controllers to regulate each barrel heating zone. Thermocouple feedback keeps zone temperatures stable for consistent melt quality.



- **Food Processing**: Industrial food-processing ovens use PID-based temperature control, with the process controller adjusting a GRM-H power controller to modulate the heating elements. Thermocouple feedback keeps the oven at a stable setpoint for consistent product quality.



HOW TO CHOOSE

Selecting the correct GRM-H power controller is straightforward. All models share the same core functionality and are configured using software, so choosing the right controller primarily involves matching the current rating and communication requirements to the application. Heater type, control input, firing mode, and other operating parameters are configured during commissioning using the free NFC smartphone app or GF_eXpress PC software.

Step 1: Select the current rating

Choose a controller with a continuous current rating that meets or exceeds the maximum operating current of the heating load. The GRM-H series is available in 10, 25, 50, and 75A models for applications ranging from small heaters to larger industrial heating systems.

- Select a controller based on the heater's normal operating current, not its cold startup current.
- Built-in soft-start and current-limiting functions help control inrush current for loads such as infrared lamps and silicon carbide heating elements.
- Consider ambient temperature and enclosure ventilation when selecting the controller to ensure the continuous rated current can be delivered.

Step 2: Determine if network communication is required

For stand-alone heating control, standard analog models provide all required functionality. If the controller will be monitored or configured through a PLC, HMI, or supervisory control system, select a model with the Modbus RTU (RS-485) communication option. Networked models simplify system integration while providing centralized monitoring and parameter adjustment.

- Modbus RTU enables remote access to operating parameters, diagnostics, and alarm status without opening the control panel.
- RS-485 supports multi-drop networks, allowing up to 31 controllers to communicate over a single serial network.

Step 3: Select the required accessories

The GRM-H series can be configured using either a smartphone or a PC. Select the accessories that best match your preferred commissioning method and application requirements.

- **NFC Dongle (GRM-H-NFC):** Enables wireless configuration from an Android or iOS smartphone using the free NFC configuration app. No controller power or PC is required during setup. Use the NFC interface for fast commissioning, field adjustments, or service work directly at the machine
- **USB Programming Cable (GRM-H-USB-CBL):** Connects the controller to a PC running the free GF_eXpress software for configuration, parameter backup, and parameter duplication. Recommended when maintaining configuration files or commissioning multiple controllers.
- **Gefran Configuration Software (GF-EXPRESS-SW):** Free Windows-based configuration and monitoring software available as a download. Supports controller setup, parameter backup, and configuration file management. Requires the GRM-H-USB-CBL programming cable or a USB-485M USB-to-RS-485 adapter.

CONFIGURING THE CONTROLLER

Configuring the GRM-H power controller depends on three primary factors: the heating element, the control signal, and the power control method. Matching these characteristics to the application ensures reliable operation, stable temperature control, and long element life.

Step 1: Choose the heater load type

Heating elements have unique electrical characteristics that influence how power should be applied. Selecting the correct load type allows the controller to use appropriate control algorithms for stable regulation and longer element life.

- **Linear resistive heaters:** Cartridge, strip, immersion, band, and cast-aluminum heaters with stable resistance. Common in general-purpose industrial heating applications.
- **Infrared lamps:** Cold filaments draw very high inrush currents; soft-start and current-limit functions reduce electrical stress while maintaining fast thermal response.
- **Silicon carbide (SiC) elements:** Resistance increases with age; requires control that compensates for changing electrical characteristics to maintain consistent heating.
- **Super Kanthal ($MoSi_2$) elements:** high-temperature furnace elements that benefit from controlled startup and stable continuous power to maximize service life.

Step 2: Choose the control input

The controller must accept the signal generated by the machine's control system. Most systems use analog outputs from PID controllers or PLCs, though manual control, PWM, and discrete signals are also common.

- **4-20mA:** Noise-immune current loop suitable for long cable runs and stable closed-loop control.
- **0-10 VDC:** Simple voltage-based command signal compatible with general-purpose PLC and temperature controller outputs.
- **Logic/PWM:** Accepts a digital or pulse width modulated signals for time-proportioned power control using standard PLC digital outputs.

- **Potentiometer:** Allows manual power adjustment without a PLC; useful for standalone or test setups.
- **RS-485/Modbus:** Digital network control for multi-zone systems, remote configuration, and integrated diagnostics.

Step 3: Choose the control mode

SCR power controllers regulate heater power using different firing methods. The appropriate method depends on how quickly the process must respond and the electrical characteristics of the heating load.

- **Burst firing:** Applies power in groups of complete AC cycles with an automatically optimized cycle time. Provides smooth temperature control with low electrical noise and reduced thermal stress.
- **Fixed cycle time:** Switches full AC cycles ON and OFF over a user-defined fixed period (1-200 seconds). Useful when predictable switching intervals are required or when coordinating with process timing.
- **Half-single-cycle:** Switches individual half-cycles to provide finer power resolution while maintaining zero-cross operation. Generates far less EMI than phase angle.
- **Phase angle:** Adjusts the SCR firing angle within each AC half-cycle to deliver continuously variable power. Enables fast response, smooth regulation, soft-start capability, and support for nonlinear or inductive loads, though it produces more electrical noise.

CONFIGURATION SUMMARY:

The table below consolidates selection considerations into a single reference, allowing quick comparison of heater load types, control inputs, and control modes used in industrial heating applications.

Selection Step	Option	Description	Common Applications
Heater Load Type	Linear Resistive	Stable resistance; predictable heating behavior	Cartridge, strip, immersion, band, cast-aluminum heaters
	Infrared Lamps	High inrush current; fast thermal response	Quartz, tungsten, short-wave IR systems
	Silicon Carbide (SiC)	Resistance increases with age; nonlinear behavior	High-temperature process heaters, aging elements
	Super Kanthal ($MoSi_2$)	High-temperature furnace elements requiring controlled startup	Industrial furnaces, kilns, high-temp chambers
Control Input	4–20 mA	Noise-immune current loop for stable closed-loop control	PLC/PID analog outputs, long cable runs
	0–10 VDC	Simple voltage command signal	General-purpose PLC and temperature controllers
	Logic / PWM	Digital or pulse-width-modulated time-proportioning signal	PLC digital outputs, time-based control
	Potentiometer	Manual power adjustment	Standalone equipment, test setups
	RS-485 / Modbus	Digital network control with diagnostics	Multi-zone systems, remote configuration
Control Mode	Burst Firing	Groups of full AC cycles with optimized cycle time	Linear resistive heaters; low-noise environments
	Fixed Cycle Time	Full cycles switched over a fixed 1–200 s period	High-inertia heaters; coordinated timing systems
	Half-Single-Cycle	Switches individual half-cycles for finer resolution	Infrared heaters; SiC elements needing smoother control
	Phase Angle	Continuously varies conduction angle each half-cycle	IR lamps, SiC, $MoSi_2$; fast-response or nonlinear loads

PRODUCT LINEUP

GEFRAN
BEYOND TECHNOLOGY

Precision power regulation for industrial heating processes.

Industrial heating processes rely on precise power regulation to maintain stable temperatures, consistent product quality, and efficient operation. Accurate control of electric heating elements reduces thermal stress, limits startup inrush currents, and compensates for changes in line voltage or heater resistance caused by temperature or aging.

SCR power controllers provide reliable power regulation for electric heating systems used in plastic extrusion, industrial ovens, infrared heating systems, semiconductor manufacturing, food processing, glass production, and heat-treating applications. Their flexible firing modes, advanced power-control algorithms, and load monitoring capabilities improve temperature stability, reduce maintenance costs, and support predictive maintenance strategies.

POWER CONTROLLERS

Series Name	Best For	Key Attributes	Primary Benefit
GEFRAN GRM-H Series Power Controllers	Industrial heating applications	Accurate power regulation + precise heating control	Precise SCR-based AC power control

GEFRAN GRM-H SERIES POWER CONTROLLERS

STARTING AT $295.00

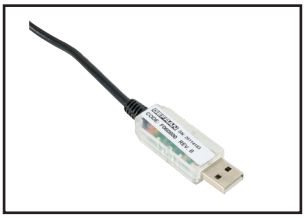
Gefran GRM-H series ultra-compact power controllers convert analog signals, PWM duty-cycle outputs, potentiometer inputs, and discrete ON/OFF commands from PLCs/PID controllers into SCR-based control of AC power for industrial heating applications. Specialized control functions, including soft-start ramping, current limiting, and closed-loop regulation reduce startup inrush currents and maintain stable output despite line voltage variation and load resistance changes caused by temperature or aging.

- 10 A to 75 A current ratings provide scalable power control for small to large heating loads
- 60 to 530 VAC operating range ensures compatibility with a variety of power systems
- Analog, PWM, potentiometer, and discrete inputs enable flexible integration with PLCs, PID controllers, and machine control systems
- Burst firing with optimized cycle time, fixed cycle time, half-single-cycle, and phase angle firing modes provide precise heat control for stable operation and fast response to changing process conditions
- NFC-based smartphone configuration and GF_eXpress software via USB or RS-485 enable fast setup, duplication, and remote commissioning
- Modbus RTU (RS-485) communication option supports networked system integration and centralized control
- All models include an integrated heatsink, eliminating the need for separate heatsink selection or sourcing
- IP20 finger-safe design supports safe installation inside industrial control panels and enclosures

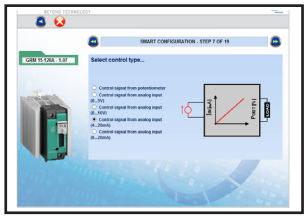
POWER CONTROLLER ACCESSORIES

Power controller accessories include an NFC dongle for wireless smartphone setup, free GF_eXpress configuration software, and a USB programming cable. These tools support device setup, parameter configuration, and system diagnostics via smartphone or PC.

Gefran NFC dongle



USB to micro-USB configuration cable



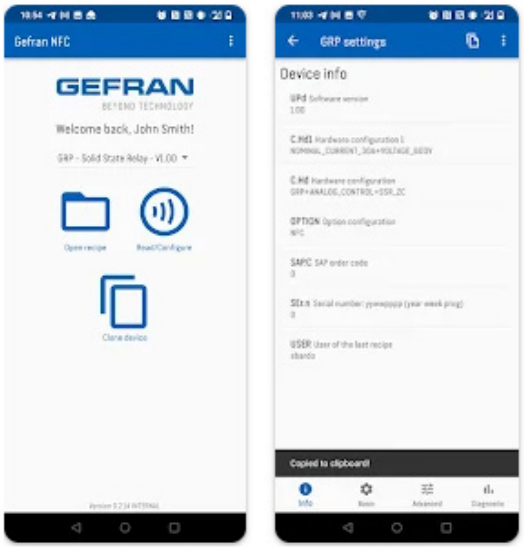
Gefran PC-based configuration software (free download only)

Gefran NFC Smartphone App

GF_eXpress

Download on the App Store

GET IT ON Google Play



This buying guide was drafted with AI assistance and edited by the AutomationDirect Technical Marketing Team