GEFRAN

GFX4-IR

4-ZONE MODULAR POWER CONTROLLER FOR IR LAMPS AND INDUCTIVE LOADS

Main features

Stand-alone unit for independent control of four electrical power control loops.
Extremely compact, with independent controls and advanced diagnostics. Used to control power for single-phase and 3-phase loads, including high and low temperature coefficient resistive loads, short wave infrared lamps and transformer primaries.

Unit consisting of:
- *Controller*
- *30, 60, 80kW solid state relay*
- *Current transformers*
- *Fuses-holder (option)*
- *4 universal main inputs*
- *4 heat/cool independent PID*
- *4 main output internally wired to the SSR*
- *4 auxiliary analog inputs (option)*
- *4 configurable output (option): relay / logic / TRIAC / continuous*
- *2 configurable relay alarm output*
- *2 digital inputs*
- *Standard digital communication: Modbus RTU*
- *Optional Fieldbus communication: Profibus DP, CANopen, Euromap66, DeviceNet, Modbus RTU, Modbus TCP, Ethernet IP*
- *DIN rail or panel mounting*

Main application

- *Thermoforming*
- *Blowing*
- *Hot runners for injection presses*
- *Fiber weaving*
- *Heat treatment furnaces*
- *Wood-working machines*
- *Glass hardening furnaces*

PROFILE

GFX4-IR is a four independent loop controller, designed to manage electrical power.
GFX4 is a compact unit bounding different technological elements like:
- *controller*
- *solid state relay*
- *current transformers*
- *fuses-holders (option)*

The final result is a cost saving in terms of space and cabling.
The GFX4-IR is managed by a microprocessor that independently controls the four control loops and also runs functions specifically designed to manage single-phase and 3-phase loads, with low and high temperature coefficient, medium and short wave infrared lamps, and transformer primary circuits.
The multiple activation methods are all software-configurable, and include:
- *Zero crossing with constant cycle time for conventional loads*
- *Burst firing with variable cycle time for systems with low thermal inertia, medium wave IR lamps*
- *Single cycle for short wave IR lamps with reduced flickering (half single cycle)*
- *Phase angle control with current limit for short wave IR lamps, transformer primaries, with assignment of soft start up and soft stop down options with limitation of max. rms current.*

GFX4IR runs complete diagnostics of current, voltage, and temperature levels:

<u>Current</u>
- *Total and partial interrupted load alarm*
- *"Teach-in" function for self-learning of alarm threshold for interrupted load*
- *SCR in short circuit alarm*
- *Load in short circuit or in overcurrent alarm*
- *Unbalanced 3-phase load alarm*

<u>Voltage</u>
- *Phase loss in case of 3-phase configurations*
- *Check of correct phase sequence alarm*

<u>Temperature</u>
- *Overtemperature alarm*

Various feedback functions in the absence of PID control have been developed for complete control of loads in all types of applications:
- *Voltage feedback (V) with current limit*
- *Current feedback (I)*
- *Power feedback with maximum power limit*

Configuration is changed by setting simple parameters with a software tool that guides the user to a correct and safe configuration.
GFX4-IR dialogs with the operator terminals according to the most popular protocols: from the simple and efficient Modbus to (via a second optional fieldbus communication) the by-now indispensable Profibus DP, CANopen, DeviceNet, Modbus RTU, Ethernet Modbus TCP, Ethernet IP.
The product comes with a standard configuration that is simple and quick to modify, for example, to assign different functions to outputs.

MODELS

(see table in order code)
3 different sizes, depending on the electric power managed, are available.

GFX4-IR 80
Maximum contemporaneous power up to 80kW@480V.
Each zone could reach up to 19,2 kW.
This limit could be extend to 23,7 kW using the “smart power management” (not all the zone contemporaneous).
Nominal current 40A for zone, not contemporary maximum 57A.

GFX4-IR 60
Maximum contemporaneous power up to 60kW@480V.
Each zone could reach up to 15,3 kW.
Nominal current 32A for zone. Fuse holder could be provide as an option.

GFX4-IR 30
Maximum contemporaneous power up to 30kW@480V.
Each zone could reach up to 7,6 kW.
Nominal current 16A for zone. Fuse holder could be provide as an option.

INPUTS

Process analogue
4 universal process input could accept:
- thermocouple
- thermoresistance
- current and tension linear.

The type could be choose by software and no external converting device are require.

Digital
2 digital input.
The functionality could be selected within a wide range including setpoint selection, MAN/AUTO, alarm memory reset and many other.

Incorporated CT
Four CTs are integrated in the product to control currents delivered to each zone and to manage the related alarms (HB...).

Auxiliary analogue (option)
4 further analogue inputs are available, typically for external current transformer reading.

OUTPUTS

Output alarms configurable via software.

Heating control
For each zone an heating control internally connected to power unit is present, then no further connections needed between power unit and controller.

Cooling control (option)
For each zone a cooling control is present 4 types of outputs are available: relay, logic, triac, continuous.
A current transformer is furnished with TRIAC output.

Alarms
Two relay output configurable as minimum and maximum alarm are available for each unit.

LEDs

Eight monitoring led are available in order to provide diagnostic information.

RN	RUN state of the CPU
ER	error
DI1	DI1 digital input state
DI2	DI2 digital input state
O1	Outupt 1 state
O2	Outupt 2 state
O3	Outupt 3 state
O4	Outupt 4 state

By default a different meaning is applicable.

POWER

Power is controlled with double SCR in anti-parallel, zero crossing switching principle, with configurable proportional cycle time.

Configurable start-up modes
ZC - Zero Crossing constant cycle time (settable in range 1-200sec)
BF - Burst Firing variable cycle time (GTT)
HSC - Half Single Cycle corresponds to Burst Firing that includes a single conduction cycle or a half non conduction cycle.
Useful for reducing flicker with short wave IR loads (applied only to single-phase load or 3-phase open delta 6 leads)
PA - Phase Angle with current limit

Load type:
4 single-phase
3 independent single-phase in open delta
1 3-phase open delta, 6 leads
1 3-phase delta, 3 leads
1 3-phase star without neutral, 3 leads
1 3-phase star with neutral, 4 leads

FUSES (OPTION)

The fuses are orderable on the GFX4-IR 30KW and 60kW model. Thanks to this, you save time, wiring is simplified, and dimensions in the panel are reduced.

PROGRAMMING

The module is configured by setting simple parameters. No knowledge of programming language is required.
The module can be configured in various ways:
• using GFX-OP
• using GF_eXpress tool software
• using Industrial PC or PLC.

FUNCTIONS

Control
The Geflex control algorithm works with any type of thermal process.
Different control modes are available: from a simple ON/OFF control to PID single or double acting heat/cool (for cooling, simply indicate the fluid used).
Sophisticated and efficient automatic tuning algorithms for control parameters provide precise process control without the presence of an operator.

Alarms
There are 8 alarm assignable to each single canal or to all (AND / OR logic) and configurable as absolute, relative, direct, reverse, window, latching or not, inhibit at power-on.

Diagnostics
Geflex assures efficient process monitoring from a thermal and electrical point of view, allowing the operator to foresee breakdowns or malfunctions and take timely action (for example, in case the temperature safety limit is exceeded, broken probe, load fault).
The LBA alarm precisely checks the control loop.

Current read (RMS)
√ HB alarm load interrupted or partially interrupted
√ Calibration of HB alarm threshold via automatic procedure starting from load current level.
Alarm threshold is determined from settable %
(ex.: if measured current =10A and %=20, HB alarm threshold = 8A)
The procedure includes:
- start of requested power to maximum
- sampling of load current
- return to previous requested power level for 3-phase load, three separate alarm thresholds

√ SCR in short circuit alarm
√ Load in short circuit or overcurrent alarm
√ Unbalanced 3-phase load

Voltage read (RMS)
√ Phase loss in 3-phase load configuration
√ Over temperature alarm

The software can be used to define the state of alarm outputs or a preset power level to be supplied in case of broken probe.

This assures continuity of service in the individual zone.

Tuning
- Self-tuning: calculation of PID parameters at system art.
- Auto-tuning continuous:continuous adjustment of PID
- Autotuning one-shot: output modulation and event-driven automatic PID parameters re-calculation

Special functions
- Software Off:
  disabling of the control, outputs are turned of.
- Inputs\outputs: direct management of inputs/outputs, independently from internal firmware.
- Simulation of four independent Geflex units.
- Smart power management.
- Option for ZC, BF, HSC
  - Soft start-up at timed power-on with or without control of maximum current reactivation if a settable off time (ex.: 5 seconds) lapses
  - Current limit in Burst Firing, during ON cycles the phase angle is limited based on current limit as % of rated current
  - DT: Delay Triggering 0-90° on first cycle (for inductive loads)
- Option for PA
  - Soft start-up at timed power-on with or without control of maximum current reactivation if a settable off time (ex.: 5 seconds) lapses.
  - Soft stop-down at times power-off
- Feedback modes:
  - **V** Voltage feedback with current limit: modifies requested power in proportion to change in voltage.
  - **I** Current feedback: modifies requested power in proportion to change in load current due to change in impedance
  - **W** Power feedback with maximum power limit: modifies requested power in proportion to change in power, compensating both change in voltage and change in load current due to change in impedance

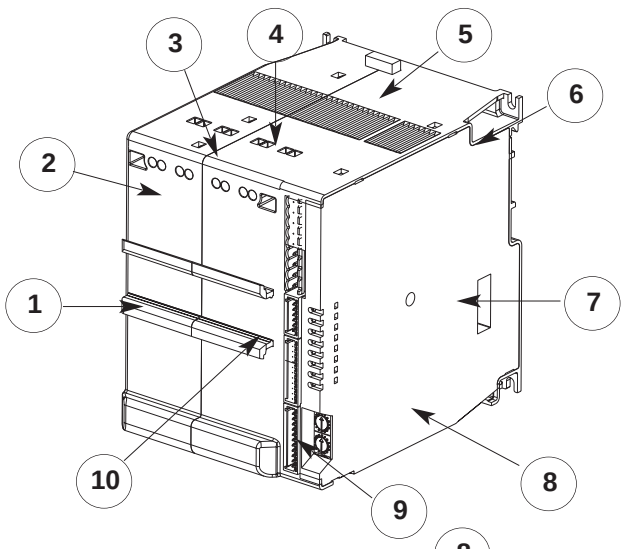
You have to set the autocalibration parameter each time you change feedback mode.

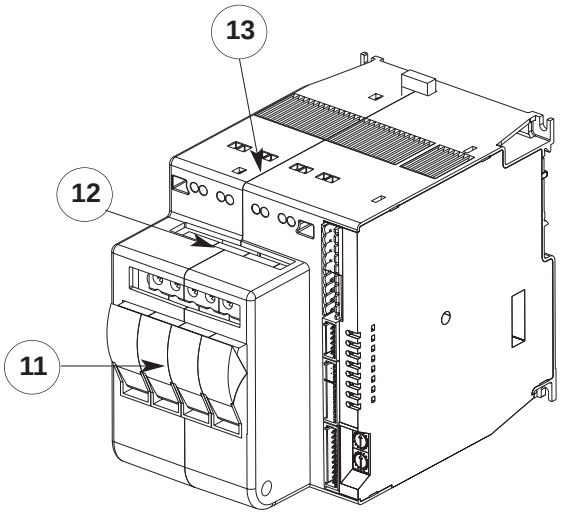
DIGITAL COMMUNICATION

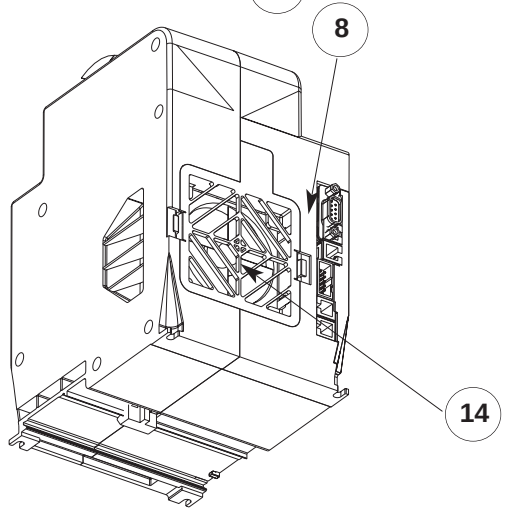
The product is furnished with standard digital communication [PORT 1] used as GFX4 connection to a HMI or Industrial PC.
Also by a dedicated connector (10 pins) it's possible to connect the actual range of Gefllex.
A second standard digital communication (PORT 2) configurable by most popular protocol:
CANopen, Euromap66, DeviceNet, Profibus DP, Modbus RTU Modbus TCP, Ethernet IP is available as option.

Net address
Assigned by two rotative selectors.

GENERAL DESCRIPTION



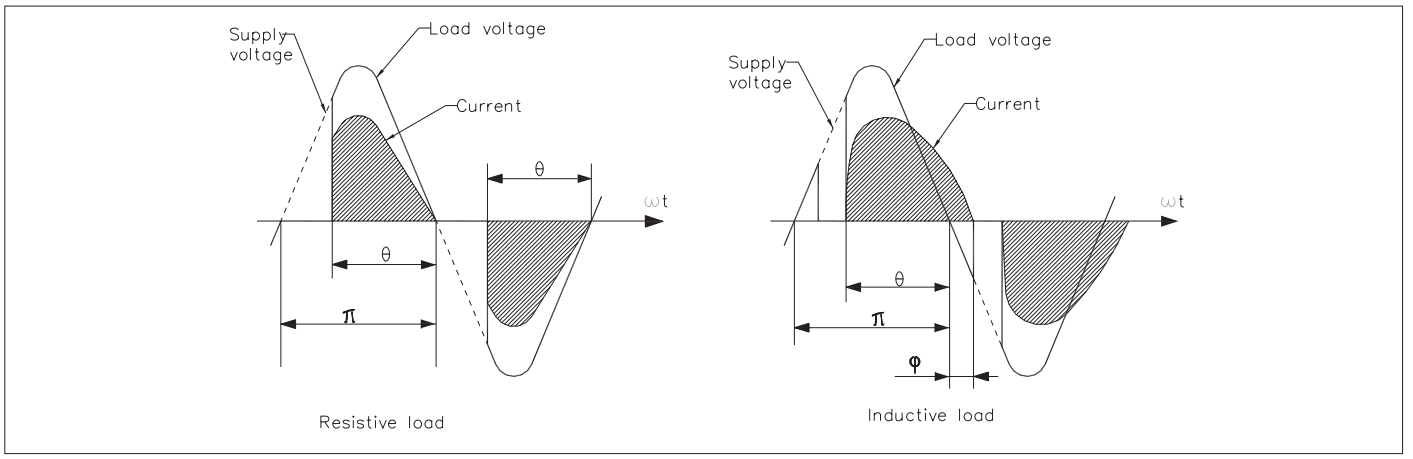




1. DIN rail frontal
2. power terminal: screws
3. power terminal
4. ventilation grid (attention NOT obstruct)
5. hook/release device back DIN rail
6. hole for screws
7. microswitchs of configuration
8. standard digital communication
9. rotative selector switch
10. connectors J1, J2, J3, J4
11. fuses-holder (only for 30KW and 60KW models)
12. fuses-holder terminal (F1, F2, F3, F4/N)
13. power terminal (U1, U2, U3, U4)
14. ventilation grid (attention NOT obstruct)

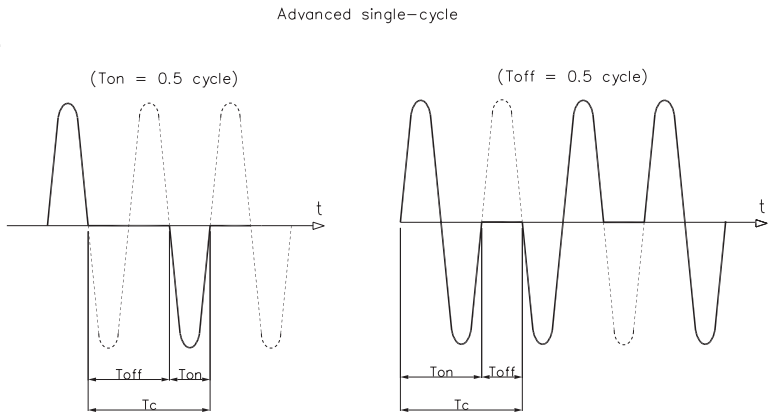
Trigger modes
The GFX4-IR provides the following power control modes:
- modulation via variation of phase angle
- modulation via variation of number of conduction cycles with “zero crossing” trigger”

PA - Phase angle
This mode manages power on the load via modulation of angle θ
if power to be transferred to the load is 100%, θ = 180°
if power to be transferred to the load is 50%, θ = 90°

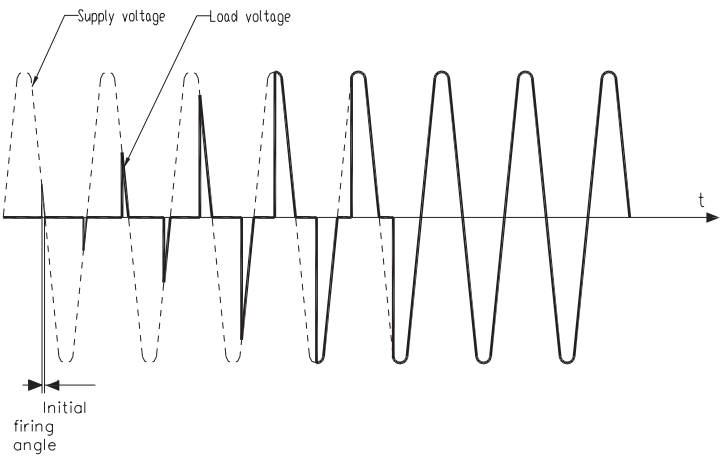


HSC - Half single cycle
This mode corresponds to Burst Firing that includes single conduction cycles and half non-conduction cycles.

Example of operation in HSC mode with power at 33 and 66%.

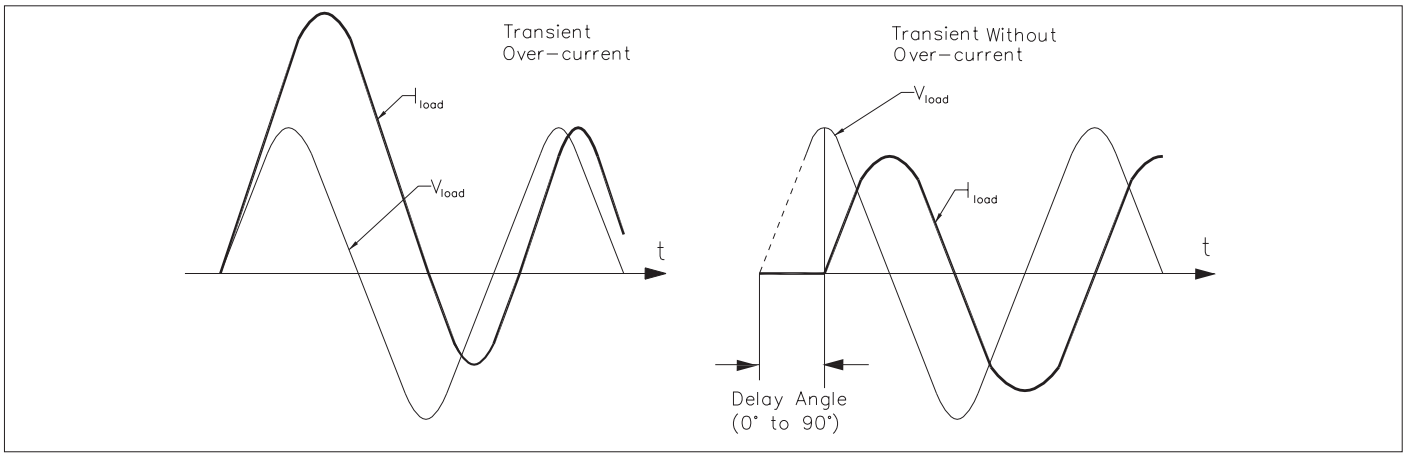


Softstart or Ramp at power-on
This type of start can be enabled in either phase control or pulse train mode.
In pulse train mode, the ramp is defined by the number of cycles after which conduction is complete at full wave. With phase control, the increment of firing angle θ stops at the corresponding power value to be transferred to the load.
The control of maximum current spike can be enabled during the ramp phase (this is useful in case of short circuit on the load or loads with other temperature coefficients to automatically adjust the start time of the load).
The ramp is automatically re-enabled if the GFX4-IR remains off for a (settable) time.

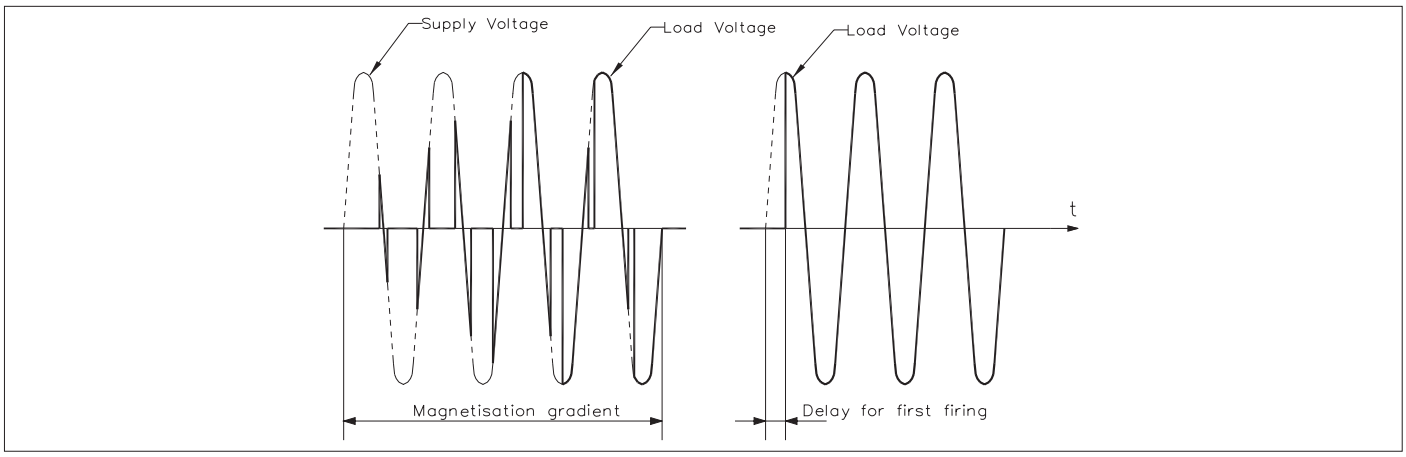


Start ramp for resistive loads.

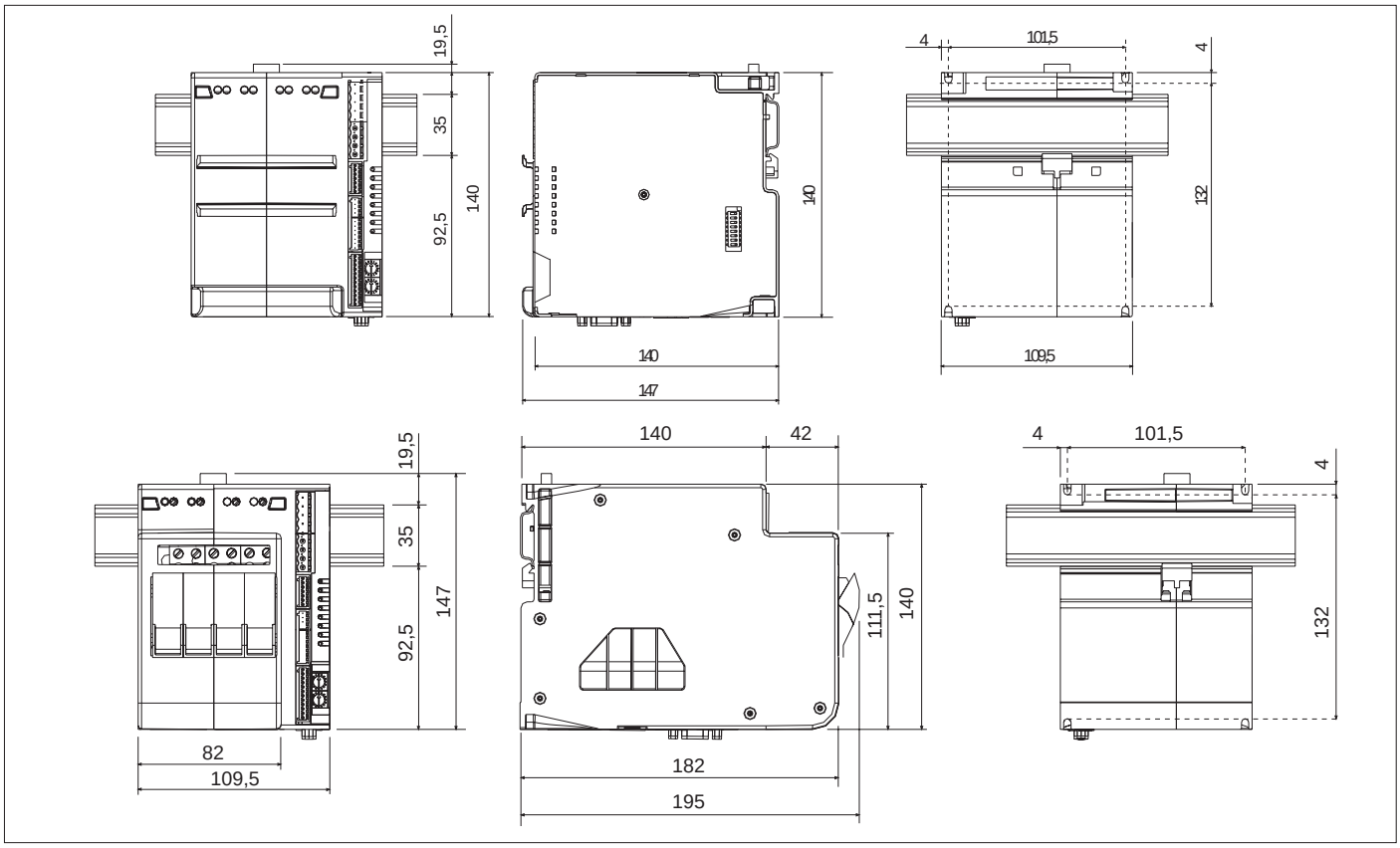
DT - “Delay triggering” of fisrt cycle (only for control modes ZC, BF, HSC)
Settable from 0° to 90°.
Useful for inductive loads (transformer primaries) to prevent current spike that could in certain cases trip the high-speed fuses that protect the SCRs.



Example of start ramp with trigger delay for transformer primary.



DIMENSIONS - INSTALLATION



TECHNICAL DATA

INPUTS

IN1...IN4 [process analog inputs]
Connector: J4
Function
default process variable (configurable)
Sampling time: 120msec the four inputs
Accuracy: 0,2% FS ±1 steps at 25°C. (16000 points)
Thermal drift: 0,005% FS/°C
Type
- *Thermocouples ITS90:* J, K, R, S, T, custom (IEC584-1, CEI EN 60584-1, 60584-2).
  Internal cold junction compensation with automatic compensation.
  Selectable temperature range: °C/°F
- *Thermoresistance:* Pt100 DIN 43760
  Max. resistance 20Ω
  Selectable temperature range: °C/°F
- *Voltage:* range 0/12...60mV, Ri > 1MΩ
  0/0,2…1V, Ri > 1MΩ
  custom 60mV at 32 sections
- *Current:* range 0/4...20mA , Ri = 50Ω
  custom 20mA at 32 sections

IN5...IN8 [auxiliary analogue inputs]
Connector: J3
Function
default analog inputs reading
Sampling time: 480msec per TC, voltage
Accuracy: 1% FS ±1 steps at 25°C.
Type
- *Thermocouple ITS90:* J, K, R, S, T, custom (IEC584-1, CEI EN 60584-1, 60584-2).
  Internal cold junction compensation with automatic compensation.
- *Voltage:* range 0/12...60mV, Ri > 1MΩ

Sampling time for current and voltage:
0,25msec (50Hz)
0,20msec (60Hz)
Accuracy: 1% FS ±1 steps at 25°C (internal CT input).

DI1, DI2 [digital inputs]
Connector: J2
Function
default not enable (configurable)
Type
PNP, 24Vdc, 8mA (isol. 3500V)

OUTPUTS

OUT 1...4 [heating control]
outputs connected to solid state relay
Function
default heating control (configurable)

OUT 5...8 [cooling control]
Connector: J1
Function
default cooling control (configurable)
Type
- Relay*:* NO, max 3A, 250V/30Vdc, cosφ = 1 resistive load
- *Logic:* 24Vdc, 35mA
- *Continuous* - voltage: 0/2...10V, ±10V, max 25mA short circuit protection
- current: 0/4...20mA, 500Ω max
- insulation: 1500V
- *Triac:* 230V/4Amp AC5 (0,8A for four) (1,6A for two)

OUT 9...10 [alarms]
Connector: J1a/J1
Function
default alarms (configurable)
Type
Relay: NO, max 5A, /30Vdc, cosφ = 1

LEDs

RN . . . . . .RUN state of the CPU
ER . . . . . .error
DI1 . . . . . .DI1digital input state
DI2 . . . . . .DI2digital input state
O1 . . . . . .Out.1 main input state
O2 . . . . . .Out.2 main input state
O3 . . . . . .Out.3 main input state
O4 . . . . . .Out.4 main input state

COMMUNICATION PORTS

PORT 1 [local bus]
Connectors: S1/S2/S3

Function
local bus

Protocol
Modbus RTU

Baud Rate
115Kbps (default)
setting 1200...115Kbps

Node address
setting by double rotative selector

Connectors S1 / S2
2xRJ10 pins for flat cable 4-4, RS485 2 wires insul. 1500V

Connettore S3
10 pins for flat cable

PORT 2 [fieldbus]
Connectors: S4 / S5

Function
external fieldbus

Protocol
Modbus RTU _____115Kbps
CANopen/Euromap 66___10K...1Mbps
Profibus DP _____9,6...12Mbps
DeviceNet _____125K..500Kbps
Ethernet IP/Modbus TCP_10/100Mbps

See accessories

MICROSWITCHES

8 dip switches are available to select wiring mode and different functionalities.

POWER

Load type

AC51 resistive or low-inductance loads
AC55b short-wave infrared lamp (SWIR)
AC56a transformers, resistive loads with high temperature coefficient

Switch-on modes

ZC Zero crossing constant cycle time (1-200sec)
BF Burst Firing variable cycle times (GTT) minimum or optimized)
HSC Half Single Cycle corresponds to Burst Firing that includes Semi-cycles of on and off. Useful to reduce flickering with short-wave infrared loads
ZC Phase Angle

SSR [integrated power element]
Rated voltage: 480Vac
Work voltage range: 24...530Vac
Non-repetitive voltage: 1200Vp
Rated frequency: 50/60Hz self-adjusting
Rated current AC51 for zone
- GFX4 30KW: 16A
- GFX4 60KW: 32A
- GFX4 80KW: 40A (single channel 57A)

Non-repetitive overcurrent [t=20msec]
- GFX4 30KW: 400A
- GFX4 60KW: 600A
- GFX4 80KW: 1150A

I^2t per fusione [t=1...10msec]
- GFX4 30KW: 645A^2s
- GFX4 60KW: 1010A^2s
- GFX4 80KW: 6600A^2s

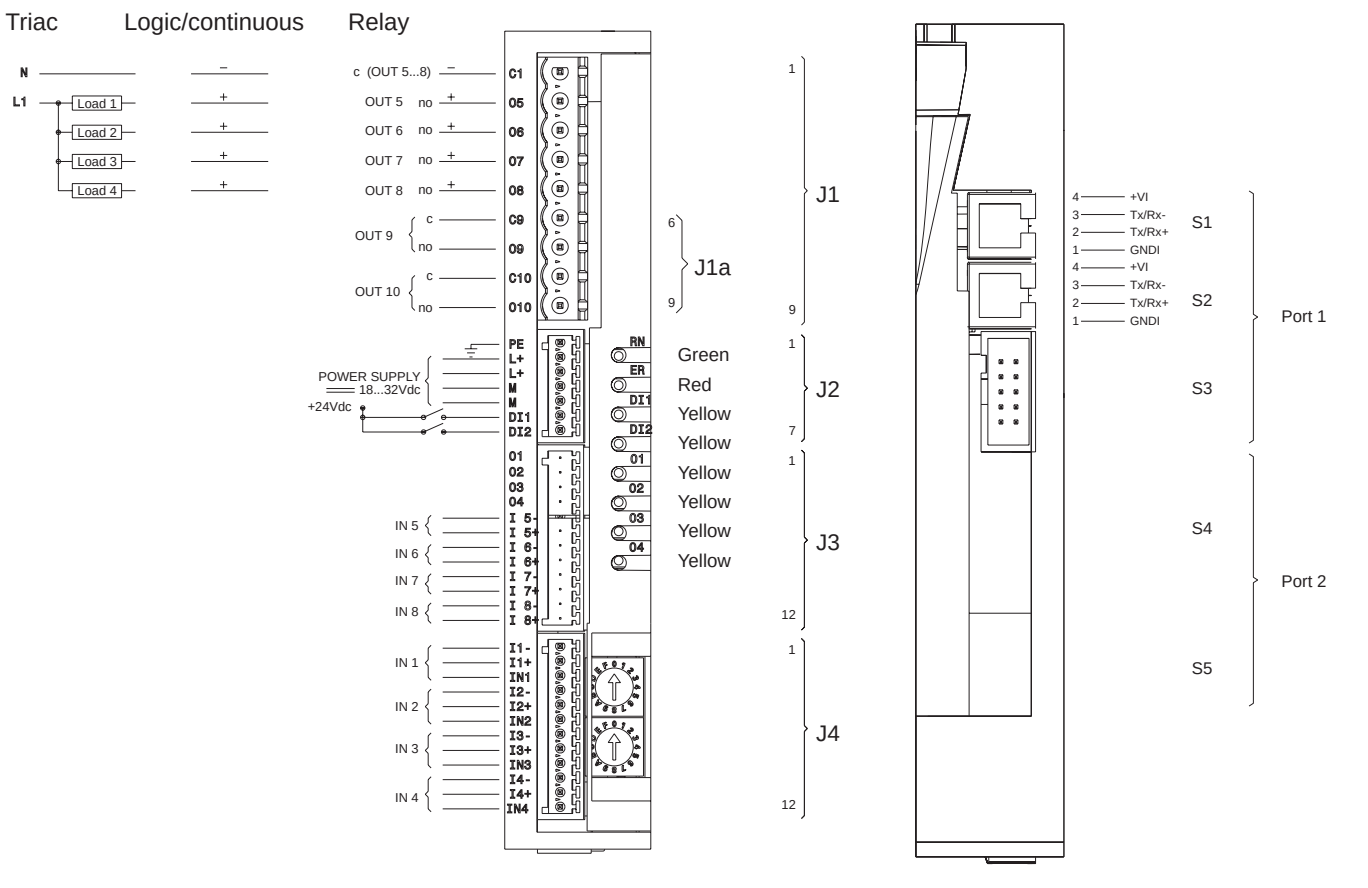
Dv/dt critical with deactivated output: 1000V/µsec
Rated insulation voltage In/Out: 4000V

GENERAL FEATURES

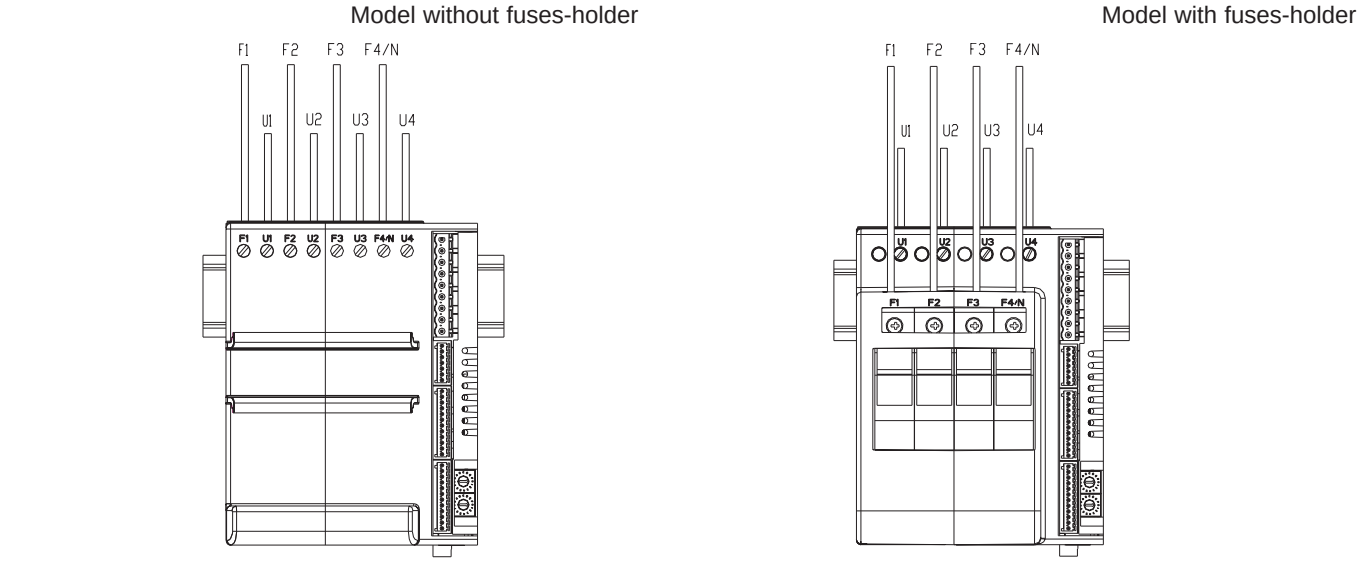
Power supply: 24Vdc ±25%, max 8VA
Protection class: IP20
Working temperature range: 0...50°C (see dissipation curves)
Storage temperature range: -20...+70°C
Relative humidity: 20...85% UR non-condensing
Installation: DIN EN50022 rail or panel by screw
Dimensions: see dimensions and installation

Weight:
models 30/60/80: 1200g.
models 30/60 with fusesolder:1600g.

ELECTRICAL CONNECTIONS



power



Model	30kW		60kW		80kW	
max current	16A		32A (30A)*		57A (40A)*	
rigid	**0,2 - 6mm²**	**24-10AWG**	**0,2 - 6mm²**	**24-10AWG**	**0,5 - 16mm²**	**20-6AWG**
flexible	**0,2 - 4mm²**	**24-10AWG**	**0,2 - 4mm²**	**24-10AWG**	**0,5 - 10mm²**	**20-7AWG**
	0,25 - 4mm²	**23-10AWG**	**0,25 - 4mm²**	**23-10AWG**	**0,5 - 10mm²**	**20-7AWG**
	0,25 - 4mm²	**23-10AWG**	**0,25 - 4mm²**	**23-10AWG**	**0,5 - 10mm²**	**20-7AWG**
	0,5 - 0,6Nm		**0,5 - 0,6Nm**		**1,2 - 1,5Nm**	

* UL certification

ORDER CODE

Model GFX4	Current (Amp) max for channel		Voltage (Vac) range	Voltage (Vac) nominal	Voltage (Vac) working	Power (kW) total contemporary	Power (kW) single channel	Power (kW) max for single channel
30 (4x16A)	16		24...530	480	110	(4x16x110) **7**	(16x110) **1,7**	(1x16x110) **1,7**
					230	(4x16x230) **14,7**	(16x230) **3,6**	(1x16x230) **3,6**
					400	(4x16x400) **25,6**	(16x400) **6,4**	(16x400 **6,4**
					480	(4x16x480) **30,7**	(16x480) **7,6**	(1x16x480) **7,6**
60 (4x32A) (4x30A)*	32 (30)*		24...530	480	110	(4x32x110) **14**	(32x110) **3,5**	(32x110) **3,5**
					230	(4x32x230) **29,4**	(32x230) **7,3**	(1x32x230) **7,3**
					400	(4x32x400) **51,2**	(32x400) **12,8**	(1x32x400) **12,8**
					480	(4x32x480) **61,4**	(32x480) **15,3**	(1x32x480) **15,3**
80 (4x40A)	40*	57	24...530	480	110	(4x40x110) **17,6**	(40x110) **4,4**	(1x57x110) **62,7**
					230	(4x40x230) **36,8**	(40x230) **9,2**	(1x57x230) **13,1**
					400	(4x40x400) **64**	(40x400) **16**	(1x57x400) **22,8**
					480	(4x40x480) **76,8**	(40x480) **19,2**	(1x57x480) **27,3**

* UL Certification

GFX4-IR □ □ □ □ □

NOMINAL POWER	
30KW	30
60KW	60
80KW	80

AUXILIARY OUTPUTS	
Absent	0
Relay	R
Logic	D
Continuous	C
Triac	T

FIELDBUS - Port 2	
0	Absent
M	Modbus RTU
P	Profibus DP
C	CANopen
C1	Euromap 66
D	DeviceNet
E	Ethernet Modbus TCP
E1	Ethernet IP

FUSES	
0	Absent
F	fuses-holder + fuses extrarapid (*)

(*) Available only for 30, 60kW power.

AUXILIARY INPUTS	
2	Absent
4	4 Linear inputs (**)

(**) Option NOT available with E1 fieldbus

CE The instrument conforms to the European Directives 2004/108/CE and 2006/95/CE with reference to the generic standards:
- CEI-EN 61000-6-2 (immunity in industrial environments) - **EN 50081-1** (emission in residential environments) - **EN 61010-1** (safety)

GEFRAN

GEFRAN spa via Sebina, 74 - 25050 Provaglio d'Iseo (BS)
Tel. 03098881 - fax 0309839063
Internet: http://www.gefran.com