DEIF A/S

Emergency power automatics

Type EPOMATIC MS-2, EC-2

4921240002D

EC-2

MS-2

- ***All necessary functions:***
  - ***mains supervision***
  - ***start/supervision/stop of diesel engine***
  - ***control of circuit breakers and contactors***
- ***High resistance to shock, vibrations and transients***
- ***All output are 2A relay contacts***
- ***May be fitted with lockable cover for front panel***

CE

Typical applications

EPOMATIC-2 (Emergency Power Automatics) provides supervision of the normal mains supply and the engine of the emergency generator.

The system carries out an automatic changeover from mains to emergency generator on mains failure, and from emergency generator to mains when the mains is restored.

EPOMATIC-2 is robust and well suited for use in harsh environments and is CE marked for residential, commercial and light industry plus industrial environment. It can thus be applied in all types of emergency plant, e.g. in:

- Hospitals
- Factories
- Data processing centres
- Marine vessels

Function

EPOMATIC-2 carries out the following major functions on mains failure:

- Automatic start of engine
- Change of circuit breakers to generator operation
- Supervision of engine during operation
- Automatic shutdown of engine in case of serious failures
- Change of circuit breakers to mains operation when mains voltage has been restored
- Automatic stop of engine

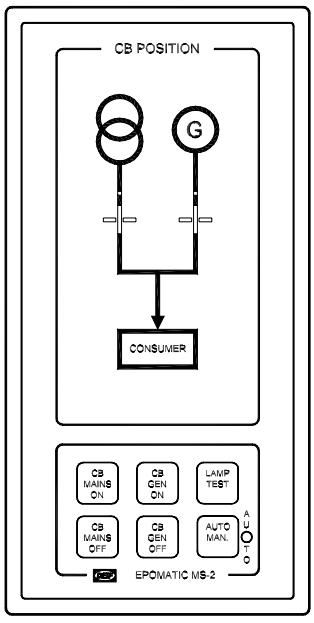
EPOMATIC-2 consists of two units, which can also be applied separately. Two or more MS-2 units may be connected to one EC-2, thus providing supervision of the power supply and ensure emergency power supply of more than one incoming power lines.

MS-2: Mains supervision unit

Control of: All types of engine start/stop units.

MS-2 monitors the mains and generator voltages. The unit transmits the required start and stop signals to the Engine Control Unit, and furthermore controls the opening and closing of the circuit breakers.

The position of the circuit breakers and the status of the mains/generator voltages are shown by means of red and green light emitting diodes (LEDs) in the mimic diagram on the front panel.



Manual control of the circuit breakers is possible by means of push-buttons on the panel. A built-in interlock system prevents simultaneous closing of both circuit breakers.

Remote indication on change between automatic and manual operation.

If the engine fails to start, or failure occurs during emergency operation, a swift change-over to mains operation is automatically carried out, provided mains voltage has been restored.

For use in conjunction with motor-driven circuit breakers and contactors with or without hold-on circuit.

Mains failure is registered if just one of the following failures exists continuously for more than 0.5..5 s:

A) Overvoltage/undervoltage (adjustable ±3..25% of $V_{nom.}$)

B) asymmetric voltage (adjustable ±3..25% of $V_{nom.}$)

C) Phase loss (at reflected voltage as well).

On mains failure::

1) Transmission of a start signal to EC-2 after 0.5..5 s.
2) (The engine is started by EC-2)
3) Opening of the mains circuit breaker, when the generator voltage has exceeded 80% of $V_{nom.}$ for 0.5..5 s.
4) Closing of the generator circuit breaker after a 0.5..5 s time delay.
(The MS-2 first having checked that the mains circuit breaker is open).

When mains is restored:

1) Opening of the generator circuit breaker after a 1..10 min. time delay.
2) Closing of the mains circuit breaker after a 0.5..5 s time delay.
(The MS-2 first having checked that the generator circuit breaker is open).
3) Transmission of a stop signal to the EC-2 - provided that mains voltage remains normal.
4) (The engine is stopped by EC-2).

EC-2: Engine control unit

Control of:

- Engines with generator
- Engines without generator (e.g. pumps)
- Generator sets running in parallel with the mains
- Generator sets in island operation

This unit starts and stops the engine, indicates the status of operation and transmits alarm signals. In case of serious failures, a shutdown of the engine and opening of the generator circuit breaker are at the same time carried out. Manual start and stop of the engine is possible by means of push-buttons on the operation panel of the unit.

EC-2 can be supplemented by DEIF alarm panels type AL8-2 if more alarm channels are required.

All relevant functions of the EC-2 are provided with adjustable timing facilities.

Main functions of the unit

1) Activation of the pre-heater and/or lubricating pump of the engine upon receipt of a start signal from the MS-2 or by activation of the MAN. START push-button.

2) Activation of the starter motor for 2..8 start attempts. In case of start failure an alarm signal is transmitted.

3) Supervision of alarm points during operation. In case of failure an alarm signal is transmitted and if required, a shutdown of the engine and opening of the generator circuit breaker are carried out.

4) Carrying out of a cooling down procedure upon receipt of a stop signal from MS-2.

"Status" section
7 LEDs indicate the actual operational status of the engine.

"Alarm" section
The 12 LEDs have the following functions:

1-7: Available alarms: Inhibit of alarm and shutdown function possible.

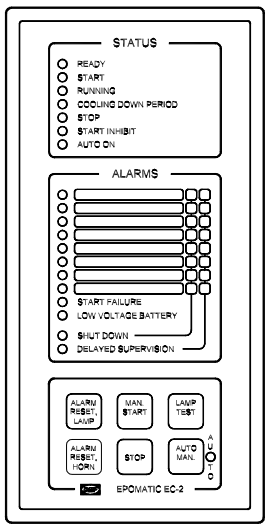
8: "TACHO FAILURE" alarm: Released if the tacho generator fails (see page 4)

9: "START FAILURE" alarm: Released in case of start failure.

10: "LOW VOLTAGE BATTERY" alarm: Released if the voltage drops below 75%.

11: "SHUTDOWN" indicator: Lit if an alarm with shutdown function is received from alarms 1..7.

12: DELAYED SUPERVISION: Lit for the preset period of time after start of the engine. Prolonged inhibit of connected alarms.



For marking of alarms 1-8 a plastic sheet is enclosed on delivery. This is easily placed under the front plate when the front bezel is removed. Texts may be selected from 30 adhesive pre-printed texts supplied with the unit, or printed directly on the sheet by means of a typewriter.

Marking of inhibit and shutdown functions for each channel is likewise possible on the sheet.

Connection diagram

The diagram (page 5) shows how the EPOMATIC-2 is in principle connected in emergency plants with one generator.

Indication of circuit breaker positions
In the mimic diagram on the front plate of MS-2 the actual position of the circuit breakers is shown by LEDs.

A closed circuit breaker is indicated by a vertical green line, and an open circuit breaker by a horizontal red line.

The presence of the mains and generator voltages is likewise indicated by means of red and green LEDs.

Interlock of circuit breakers
The MS-2 is provided with an interlock function preventing simultaneous closing of both circuit breakers.

If protection against failures in the electronics is furthermore required, the circuit breakers can be provided with an external interlock circuit via the auxiliary contacts of the circuit breakers.

"Running" signals
The EC-2 is based on a "RUN" signal being received from an external tacho relay and a "GEN. ON" signal being received, when the engine is running.

If a "RUN" signal is not received or is later on interrupted, a "TACHO FAILURE" alarm is released.

If only one of these signals is needed to indicate that the engine is running, this signal is connected to both input terminals of the EC-2. In this case a possible tacho failure will not be registered.

Further applications
EPOMATIC-2 can in conjunction with other DEIF products for control and protection of generators be applied in more advanced emergency plants with one or more generators.

The following functions can e.g. be carried out:

- Automatic re-synchronisation to the mains of one or more generators
  ensuring continuous supply without blackout when returning to mains operation.
- Automatic load sharing between more generators in emergency operation.
- Automatic load sharing between one or more generators and the mains.
- Complete protection of generators against:

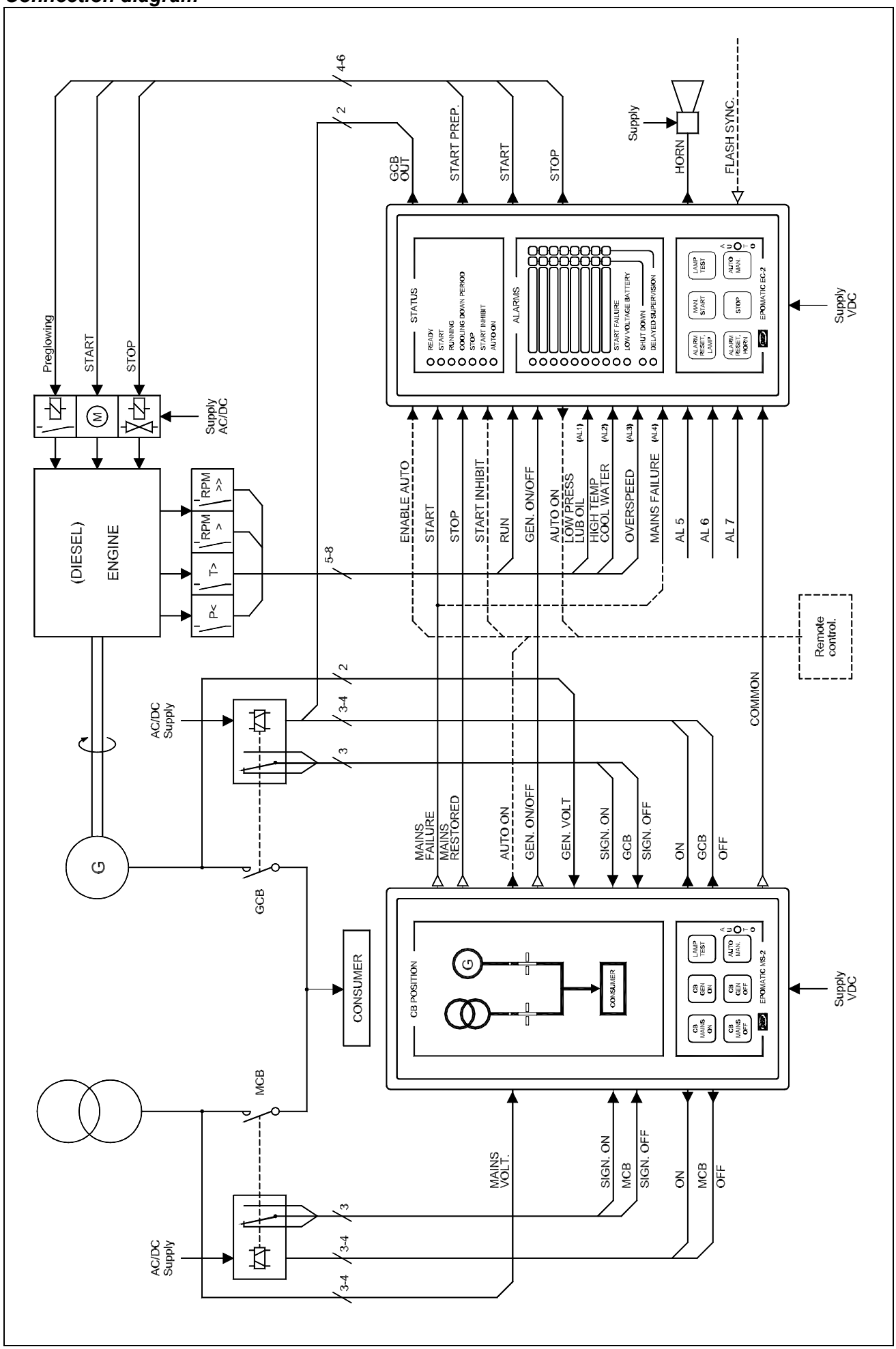
  - reverse power

  - overload/overcurrent

  - short-circuit current

  - faulty insulation, etc.

Connection diagram



Adjustment of MS-2

All potentiometers are accessible on the rear of the MS-2, whereas dip switches are set on the side of the housing. No dismounting of cables is required if the unit is pulled out from the panel (two-piece terminals).

"SET V-NOM.":	Nominal/actual mains voltage (fine adjustment). Voltage range is selected by means of an internal 7 position dip switch.
"BAL. V-ERROR":	Max. allowable undervoltage and overvoltage: ±3...25% of V_{nom}.
"ASYM. V-ERROR":	Max. allowable asymmetry between the phases: ±3...25% of V_{nom}.
(DELAY) GEN. VOLT.:	Delay of generator voltage signal (V_{gen} > 80% of V_{nom}.): 0.5...5 s.
(DELAY) INTERLOCK:	Delay of closing signal after opening of the other circuit breaker: 0.5...5 s.
(DELAY) MAINS FAIL.:	Delay of automatic start signal to EC-2 on mains failure: 0.5...5 s.
(DELAY) MAINS REST.:	Delay of automatic stop signal to EC-2 after the mains has been restored: 1...10 min.

Adjustment of EC-2

All timers are accessible on the rear of the EC-2, whereas dip switches are set on the side of the housing. No dismounting of cables is required if the unit is pulled out from the panel (two-piece terminals).

Alarms 1-7:	The functions of each alarm point are set by means of 3 sets of dip switches: 1. switch: **closed**: The alarm is inhibited during start and stop of the engine. 2. switch: **closed**: The alarm is released when the ext. contact OPENS (N/C). 3. switch: **closed**: The alarm causes a shutdown stop of the engine and opening of the generator circuit breaker.
Alarm 6:	Delay of alarm for 2..10 s. Adj. by means of the potentiometer "DELAY AL 6".
Alarm 7:	Delay of alarm for 2..10 s. Adj. by means of the potentiometer "DELAY AL 7".
Alarm flashing:	Synchronous alarm flashing of multiple alarm panels: Set jumper marked "FLASH" to position "EXT." and connect an external flash signal to the terminals marked "FLASH SYNC.". Below timers are standard set to 2...10 s, except: "COOL. DOWN PERIOD" = 2..10 min. and "STOP TIME" = 6..60 s.
"START PREP.":	Typically used for pre-heat. The LED marked "START" is lit at half intensity, the output relay "START PREP." is energized, and the relay contact closes for the preset period of time.
"START ON":	Activation time of the starter motor. After the time "START PREP." the LED marked "START" is lit at full intensity, the output relay "START" is energized and the relay contact closes for the preset period of time.
"START OFF":	Waiting time of the starter motor. After the activation time the LED marked "START" is switched off, the output relay "START" is de-energized and the relay contact opens for the preset period of time.
"DELAY SUPERVISION":	Prolonged inhibit of alarms after start of the engine. Upon receipt of the "RUNNING" signal, a timer is started and the LED marked "DELAYED SUPERVISION" is lit for the preset period of time.
"COOL. DOWN PERIOD":	Cooling down period. When the EC-2 receives an automatic stop signal, a timer is started for 2...10 min. and the LED marked "COOLING DOWN PERIOD" is lit. If the push-button "MAN. STOP" is activated, or a shutdown alarm is received within this period of time, the cooling down procedure is interrupted, the generator circuit breaker is opened and the engine is stopped immediately. If the EC-2 receives an automatic start signal, the cooling down procedure is likewise interrupted, enabling reloading of the generator.
"STOP TIME EXT.":	Prolongation of stop sequence, lasting the preset period of time after the "RUNNING" signal has been interrupted. The LED marked "STOP" remains lit during the whole stop sequence.
Stop function:	The relays "STOP" and "GCB OUT" can be set to function in conjunction with a "running coil" (the relays are de-energized on stop) or a "stop coil" (the relays are energized on stop).
Start attempts:	The number of start attempts is as a standard set at 3, but can by means of an internal rotary switch be set at 2...8 attempts. **Note:** Is set to required number + 1.

Signals to/from MS

Term.	Function	Type	Designation	Application	Remarks
1 + 2	Input	N/O opto	GCB-SIGN. ON	Position signal from generator circuit breaker	Opto coupler
3 + 2	Input	N/O opto	GCB-SIGN. OFF	Position signal from generator circuit breaker	Opto coupler
4 + 5	Input	N/O opto	MCB-SIGN. ON	Position signal from mains circuit breaker	Opto coupler
6 + 5	Input	N/O opto	MCB-SIGN. OFF	Position signal from mains circuit breaker	Opto coupler
7 + 10	Output	N/O opto	MAINS FAIL.	Automatic start signal to EC-2	Opto coupler
8 + 10	Output	N/O opto	MAINS REST.	Automatic stop signal to EC-2	Opto coupler
9 + 10	Output	N/O opto	GEN. ON/OFF	U_{gen} > 80%: "GEN. ON" signal to EC-2	Opto coupler
11 + 12	Output	N/O	GCB ON	Control signal to generator circuit breaker	
13 + 14	Output	N/O	GCB OFF	Control signal to generator circuit breaker	
15 + 16	Output	N/O	MCB ON	Control signal to mains circuit breaker	
17 + 18	Output	N/O	MCB OFF	Control signal to mains circuit breaker	
20 + 21	Input	Analog	GEN. VOLT. R-S	Measurement of generator voltage: R + S	
22 + 23	Input	Analog	MAINS R-S	Measurement of mains voltage: R + S	
25 + 26	Input	Analog	MAINS T-N	Measurement of mains voltage: T + (N)	(Neutral)
28 + 29	Supply	±V DC	SUPPLY	Aux. supply: 12, 24 or 48V DC -3W	Isolated
30 + 31	Output	N/O	AUTO ON	Relay contact closes in auto mode	

Input (analog): Input (N/O opto): Output (N/O): Output (N/O opto):	100-110-220-240-380-415-440V AC. Calibrated using 7 dip switches and 1 potentiometer. From potential free contact. Internal supply voltage: +12V/4-8mA with "pull up" resistor. Relay contact: Max. 250V-2A-400VA (AC), 250-2A-50W (DC) resistive load. NPN transistor in opto coupler, supplied from the input of the EC-2.
Mains failure: Failure 1: Failure 2: Failure 3: Timers:	Registration of failure(s) continuously during preset period of time (DELAY MAINS FAIL.) Voltage deviation: ±3...25% of $V_{nom.}$ Set using potentiometer "BAL. V-ERROR". Asymmetrical voltage: ±3...25% of $V_{nom.}$ Set using potentiometer "ASYM. V-ERROR" Phase loss (also at reflected voltage from motors). "DELAY MAINS REST.": 1...10 min. (±20%), "DELAY INTERLOCK": 0.5...5 s (±20%). "DELAY MAINS FAIL.": 0.5...5 s (±20%), "DELAY GEN. VOLT.": 0.5...5 s (±20%).

Signals to/from EC

Term.	Function	Type	Designation	Application	Remarks
1 + 2	Input	Opto	FLASH SYNC.	0-8..60V DC from external flash signal	Opto coupler
3 + 4	Input	N/O	STOP	Automatic stop signal (cooling down period)	(From MS-2)
5 + 6	Input	N/O	RUN	RPM > $RPM_{ign.}$ from external tacho relay	
7 + 8	Input	N/O	GEN. ON/OFF	V_{gen} > 80% $V_{nom.}$ from ext. voltage relay	(From MS-2)
9 + 10	Input	N/O	START INHIBIT	Inhibit of all start attempts	
11 + 12	Input	N/O	ENABLE AUTO	Enabling of automatic start/stop	
13 + 14	Input	N/O	START	Automatic start signal	(From MS-2)
15 + 16	Input	N/O-N/C	AL7 - DELAYED	ALARM 7: (Shutdown and/or inhibit)	Timer: 2...10 s
17 + 18	Input	N/O-N/C	AL6 - DELAYED	ALARM 6: (Shutdown and/or inhibit)	Timer: 2...10 s
19 + 20	Input	N/O-N/C	AL5	ALARM 5: (Shutdown and/or inhibit)	
21 + 22	Input	N/O-N/C	AL4	ALARM 4: (Shutdown and/or inhibit)	
23 + 24	Input	N/O-N/C	AL3	ALARM 3: (Shutdown and/or inhibit)	
25 + 26	Input	N/O-N/C	AL2	ALARM 2: (Shutdown and/or inhibit)	
27 + 28	Input	N/O-N/C	AL1	ALARM 1: (Shutdown and/or inhibit)	
29 + 30	Output	N/O	STOP	Control of "running coil"/"stop coil"	"S4+S5+S6+S7"
31 + 32	Output	N/O	START PREP.	Pre-heat or similar of engine before start	Timer: 2...10 s
33 + 34	Output	N/O	START	Activation of relay for starter motor	Timer: 2...10 s
35 + 36	Output	N/C	HORN	Relay contact closes on alarm	
37 + 38	Output	N/O	AUTO ON	Relay contact closes in auto mode	
39 + 41	Output	C/O	GCB OUT	Opening of GCB on shutdown/manual stop	Changeover contact
42 + 43	Supply	±V DC	SUPPLY	Aux. supply: 12, 24 or 48V DC -6W	Isolated

Input (N/O-N/C): Output (N/O-N/C): Timers (tol. ±20%):	From potential free contact/opto coupler. Int. aux. supply: +12V/2kΩ "pull-up" resistor. Relay contacts: Max. 250V-2A-400VA (AC), 250-2A-50W (DC) resistive load. "COOLING DOWN": 2...10 min., "STOP TIME": 6...60 s, others: 2...10 s.

Common technical specifications

Temperature: -10...55°C (nominal), -25...60°C (operating), -25...70°C (storage).

Galvanic separation:

All digital input signals mutually	None
Between input signals and remaining circuits	2kV - 50Hz - 1 min.
All analog input signals mutually	2kV - 50Hz - 1 min.
Between input, “flash sync.” and remaining circuits	2kV - 50Hz - 1 min.
All output signals mutually	2kV - 50Hz - 1 min.
Between output signals and remaining circuits	2kV - 50Hz - 1 min.
Between aux. supply and remaining circuits	2kV - 50Hz - 1 min.

Climate: Class HUE, to DIN 40040.

EMC: To EN 50081-1/2, EN 50082-1/2, SS4361503 (PL4) and IEC 255-22-1 (class 3).

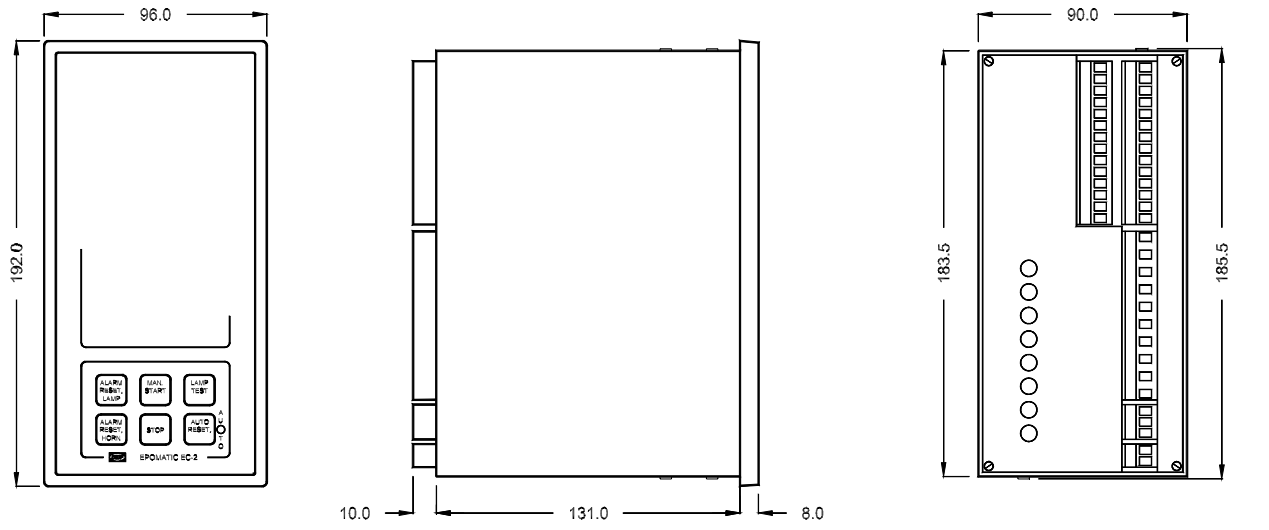
Materials: All plastic parts are self-extinguishing, to UL94 (V0).

Connections: Two-piece terminals with screws. Max. 1.5 mm² (single/multi-stranded).

Protection: IP52 (front), IP20 (rear), to EN 60529 and IEC529.

Dimensions

All dimensions in mm



MS-2/EC-2 Weight: MS-2: approx. 0.900 kg EC-2: approx. 0.950 kg

Order specifications

Type:	**MS-2** and/or **EC-2**
Range of time delay:	Specify designation of timer and time delay **if non-standard.** EC-2 timers with range 2..10 s may be prolonged to max. 20...100 s.
Auxiliary voltage:	12V DC, 24V DC or 48V DC

Due to our continous development we reserve the right to supply equipment which may vary from the described.

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