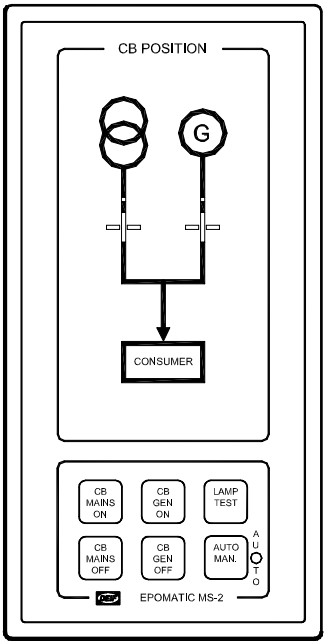
Type MS-2

Mains Supervision Unit

4189340233C



Technical Manual

DEIF A/S

DEIF A/S
Frisenborgvej 33, DK-7800 Skive
Denmark

Tel.: (+45) 9614 9614
Fax: (+45) 9614 9615
E-mail: deif@deif.com

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EPOMATIC-2

The association of MS-2 and EC-2 forms the “EPOMATIC-2” system for supervision of the mains and the engine. It carries out an automatic changeover from the mains to emergency generator on mains failure and from emergency generator to the mains when the mains is restored.

The EPOMATIC-2 is basically constructed for fully automatic “blackin” and “blackout” operation of one single emergency generator.

By means of the DEIF fully automatic synchronising relay type FAS-113DG, resynchronisation of the emergency generator may be carried out to avoid blackout at reconnection to the mains (See page 17).

For full information re Engine Controller EC-2: See Technical Manual No. 2.10/90E.

Changes Made to MS-2 Compared with MS-1

The MS-2 is an upgraded version of MS-1 but can in most cases replace this in installations with minor changes.

The most important changes made to MS-2 are:

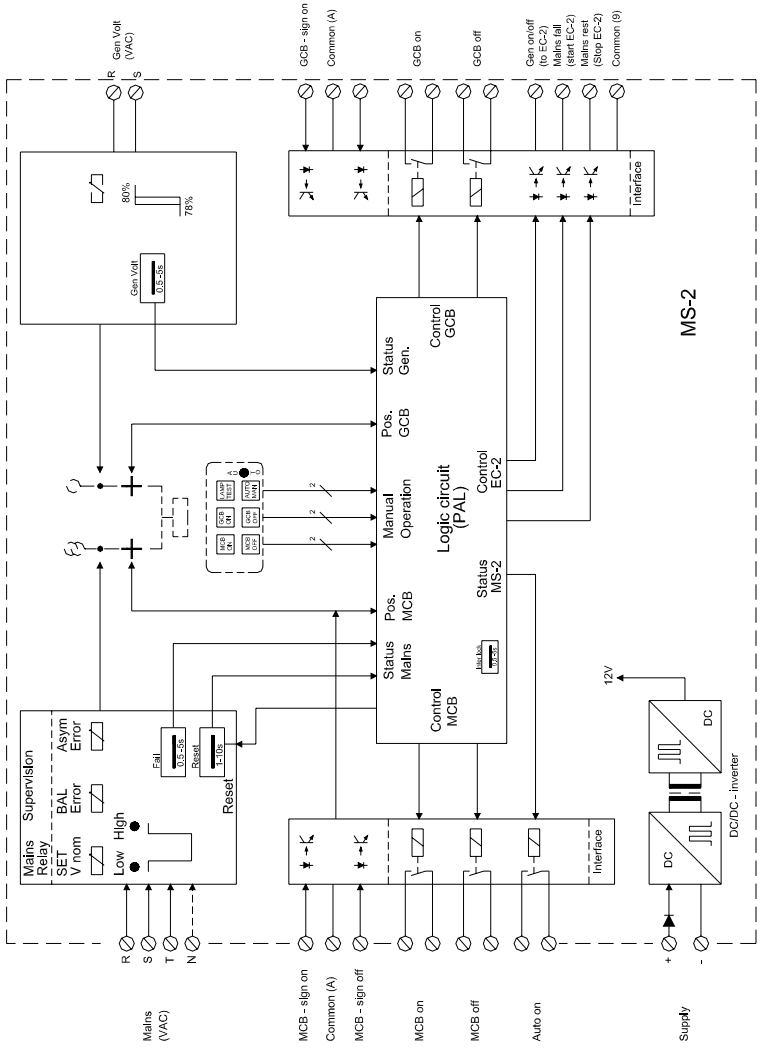
- LOCK function has been removed
- Simplification of MANUAL operation
- Relay output for AUTO/MANUAL operation
- Change of the control signals for the circuit breakers
- Automatic reconnection to the mains in case of generator failure
- Change of connection of supply voltage

Construction

The MS-2 consists of the following internal circuits:

- VOLTAGE SUPPLY	
- MAINS SUPERVISION RELAY	(3-phase, adjustable)
- GENERATOR VOLTAGE RELAY	(2-phase, fixed to 80%)
- INTERLOCK SYSTEM	for the circuit breakers
- FRONT PANEL	with MAINS VOLTAGE INDICATOR - GENERATOR VOLTAGE INDICATOR - POSITION INDICATOR for circuit breakers - PUSH-BUTTONS for manual operation
LOGIC CIRCUITS for control of:	START/STOP signals to the EC-2 ON/OFF signals to the circuit breakers.

Block Diagram



Modes

The MS-2 may be set to AUTO MODE or MANUAL MODE. On connection of the auxiliary voltage the unit is always set to the AUTO MODE by means of an internal power up circuit. Change from AUTO MODE to MANUAL MODE and vice versa is made by activation the push-button AUTO/MAN as described below.

Protection of Front Panel

To replace the bezel the MS-2 (and EC-2) may be equipped with a transparent protective cover with hinges at the upper edge of the cover. The cover may be locked with a coded key to prevent unwanted operation of the units. At the same time the cover provides mechanical protection of the front plate.

Manual Mode

Operation of Push-buttons

"LAMP TEST": May be activated in both AUTO MODE and MANUAL MODE. On activation of this push-button switched off LEDs will be lit, and already lit LEDs will change colour without this effecting the function of the unit.

"AUTO/MAN": This push-button functions as a toggle switch, changing position each time the push-button is activated. The actual position is indicated by means of the green LED to the right of the push-button.

AUTO MODE: LED is lit (green).
At the same time the relay output AUTO ON is activated, i. e. the relay is activated and the contact closes.

MAN. MODE: LED is switched off.
Below push-buttons for direct connection and disconnection of the circuit breakers CAN ONLY BE ACTIVATED IN MANUAL MODE.

"CB MAINS ON": The mains circuit breaker MCB closes immediately, if the generator circuit breaker GCB is open (See Note 1 – page 6).

"CB MAINS OFF": The mains circuit breaker MCB is opened.

"CB GEN ON": The generator circuit GCB closes immediately, if the mains circuit breaker MCB is open (See Note 1 – page 6).

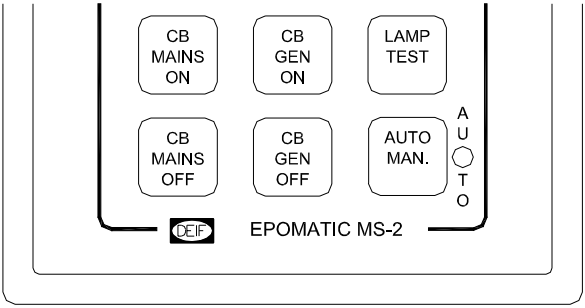
"CB GEN OFF": The generator circuit breaker GCB is opened.

At Manual Operation of the Circuit Breakers

The MAINS REST and INTERLOCK timers are cancelled to ensure rapid change of the circuit breaker positions.

No START and STOP signals are transmitted from MS-2 to EC-2. START and STOP of the engine must be carried out manually on the EC-2.

NOTE 1: If the circuit breakers are provided with a zero voltage relay, they will only close provided that mains voltage/generator voltage is present.
Further information: See page 8.



Auto Mode

The EPOMATIC-2 system will only carry out the below automatic functions provided that:

a. The MS-2 has been set to AUTO MODE
   AND
b. The EC-2 has been set to AUTO MODE

Both the MS-2 and the EC-2 transmit relay signals to indicate their present mode.

NOTE: The switches S201.1 and S201.2 have been set to the NORMAL MODE position (See page 15).

Mains to Generator Sequence

At mains failure the following sequence will be executed:

1. The mains voltage indicator changes from green to red light
2. The timer MAINS FAIL is started for 0.5 to 5 secs.
3. The timer MAINS FAIL expires, if the mains has not been restored
4. The control signal MCB ON is cancelled
5. The control signal MAINS FAIL is transmitted to input START of the EC-2
6. The engine is started by EC-2*
7. The MS-2 detects when the generator voltage exceeds 80% of V_{nom}*
8. The control signal GEN ON is transmitted to input GEN ON/OFF of EC-2*
9. The LED “RUNNING” is lit on the EC-2*
10. The timer DELAY, GEN VOLT is started for 0.5 to 5 secs.*
11. The timer DELAY, GEN VOLT expires if the generator voltage is still present*
12. The generator voltage indicator switches from red to green light*
13. The control signal MCB OFF is transmitted to the MCB
14. The position signal MCB SIGN OFF is received when the MCB is open
15. The MCB position indicator switches from green to red light
16. The timer DELAY, INTERLOCK is started for 0.5 to 5 secs.
17. The timer DELAY, INTERLOCK expires
18. The control signal MCB OFF is cancelled
19. The control signal GCB ON is transmitted to the GCB
20. The position signal GCB SIGN ON is received when the GCB is closed
21. The GCB position indicator switches from red to green light

* Steps 6 to 12 are missed if the engine is running and generator voltage is present!

Generator to Mains Sequence

At restoration of the mains the following sequence will be executed:

1. The timer MAINS REST is started for 1 to 10 min.
2. The mains voltage indicator switches from red to flashing green light
3. The timer MAINS REST expires if a new mains failure is not detected
4. The mains voltage indicator switches to continuous green light
5. The control signal MAINS FAIL is cancelled to input START of the EC-2
6. The control signal GCB OFF is transmitted to the GCB
7. The position signal GCB SIGN OFF is received when the GCB is open
8. The GCB position indicator switches from green to red light
9. The timer DELAY, INTERLOCK is started for 0.5 to 5 secs.
10. The timer DELAY, INTERLOCK expires
11. The control signal GCB OFF is cancelled
12. The control signal MCB ON is transmitted to the MCB
13. The position signal MCB SIGN ON is received when the MCB is closed
14. The MCB position indicator switches from red to green light
15. The control signal MAINS REST is transmitted to input STOP of the EC-2
16. The engine is stopped after the COOLING DOWN PERIOD by the EC-2
17. The MS-2 detects when the generator voltage is less than 80% of V_{nom}
18. The generator voltage indicator switches from green to red light

Circuit Breakers or Contactors

The circuit breakers are controlled by the relay outputs:
GCB ON – GCB OFF – MCB ON – MCB OFF

When a control signal is transmitted to the circuit breaker, the relay is activated and the relay contact closes (make contact).

Immediate connection of circuit breakers to the MS-2 is thus possible.

If the circuit breakers are not designed for a continuous ON signal, the control signals GCB ON/MCB ON are connected over a N/C auxiliary contact on the circuit breakers.

Contactors with hold-on circuit may be applied by using an auxiliary relay for each contactor.

A circuit breaker or a contactor with hold-on circuit will not receive a disconnection signal from MS-2 until the other voltage source is present, which ensures complete certainty of supply.

Contactors without hold-on circuit may be controlled solely by the GCB ON signals and the MCB ON signals.

On cancellation of these signals, the actual contactor disconnects.

Transmission of Circuit Breaker Signals in AUTO MODE

(S201.1 = OFF, S201.2 = ON – See Automatic Functions on page 6 as well)

GCB ON
is only transmitted when:
The timer GEN VOLT (0.5 to 5 secs.) has expired
AND
The position signal MCB SIGN OFF is received
AND
The timer INTERLOCK (0.5 to 5 secs.) has expired
is cancelled when:
The output GEN VOLT ON/OFF changes to OFF (high).

GCB OFF
is only transmitted when:
The output MAINS REST is ON (low)
is only cancelled when:
The position signal GCB SIGN OFF is received
AND
The timer INTERLOCK (0.5 to 5 secs.) has expired.

MCB ON is only transmitted when:
The timer MAINS REST (1 to 10 min.) has expired
AND
The position signal GCB SIGN OFF is received
AND
The timer INTERLOCK (0.5 to 5 secs.) has expired
is only cancelled when:
The output MAINS REST changes to OFF (high)

MCB OFF is only transmitted when:
The timer GEN VOLT has expired
is only cancelled when:
The position signal MCB SIGN OFF is received
AND
The timer INTERLOCK (0.5 to 5 secs.) has expired

Transmission of Circuit Breaker Signals at MANUAL MODE

GCB ON is transmitted when:
The push-button CB GEN ON is activated
AND
The position signal MCB SIGN OFF is received
is cancelled when:
The push-button CB GEN OFF is activated

GCB OFF is transmitted when:
The push-button CB GEN OFF is activated
is cancelled when:
The push-button CB GEN OFF is released
OR
The position signal GCB SIGN OFF is received

MCB ON is transmitted when:
The push-button CB MAINS ON is activated
AND
The position signal GCB SIGN OFF is received
is cancelled when:
The push-button CB MAINS OFF is activated

MCB OFF is transmitted when:
The push-button CB MAINS OFF is activated
is cancelled when:
The push-button CB MAINS OFF is released
OR
The position signal MCB SIGN OFF is received

Safety Functions

Internal Interlock System

Prevents two circuit breakers/contactors being closed simultaneously. A control signal to close a circuit breaker/contactor is not transmitted until MS-2 has received a position signal from the other circuit breaker/contactor to indicate that this is open. If a position signal fails to arrive (cable breakage or contact fault) this will not result in an incorrect connection. The interlock system is NOT protected against short-circuited position signals.

External Interlock System

However, the establishing of a further external interlock system by direct cross-connection of N/C auxiliary contacts is highly recommended.

Connection of a Circuit Breaker/Contactor

The control signal MCB ON is transmitted in AUTO MODE only if mains voltage is present. The control signal GCB ON is transmitted in AUTO MODE only if generator voltage is present.

Disconnection of a Circuit Breaker/Contactor

If the mains voltage drops out, the control signal MCB ON is reset, but a MCB OFF signal will not be transmitted until generator voltage is present.

If the generator voltage drops out, the control signal GCB ON is reset, but a GCB OFF signal is not transmitted until the mains voltage is present.

Consequently the disconnection of a circuit breaker or a contactor with hold-on circuit may be determined by MS-2 or by the breaker if provided with an undervoltage coil/relay.

NOTE: Measurement of generator voltage is only carried out between 2 phases. It is hence recommended to connect the undervoltage coil/relay of a circuit breaker/contactor between two other phases.

Failure during Starting Up of the Generator

If mains voltage is restored before the generator voltage is present, the speed of the MAINS REST timer is increased by 10, until generator voltage is detected (GEN ON signal is transmitted). When the GCB is closed (the position signal GCB SIGN ON is received), the timer is reset and then runs at normal speed. If the timer expires without generator voltage being detected, the MS-2 returns to mains mode.

Adjustment of the MAINS REST Timer

As this timer determins the time set aside to start up the engine, this must be taken into consideration when setting the timer (see page 20: Adjustment of Timers (Delay) – MAINS REST).

Failure during Generator Mode

If a serious engine failure occurs, the EC-2 disconnects the generator circuit breaker/contactor and immediately stops the engine (shutdown stop). In case of engine failure, generator voltage drop-out or generator circuit breaker/contactor drop-out, the MS-2 will – provided that mains voltage is present – carry out an accelerated reconnection to mains mode:

The speed of the MAINS REST timer is increased by 10 and the mode is changed to mains mode when it expires. The increased speed is indicated by the flashing frequency of the mains voltage indicator being increased accordingly.

Stop of the Generator

The signal MAINS REST which is the stop signal for the EC-2 is not transmitted until the position signals MCB SIGN ON and GCB SIGN OFF have been received by the MS-2, i. e. the stop signal will not be transmitted until absolute certainty of supply from the mains has been guaranteed.

Manual Mode

When the MS-2 is set to manual mode, the MAINS REST and INTERLOCK timers are cancelled, enabling a rapid change from generator mode to mains mode:

1. The push-button AUTO/MAN is activated (change to manual mode)
2. The push-button CB GEN OFF is activated
3. The push-button CB MAINS ON is activated
4. The push-button AUTO/MAN is activated (change to auto mode)

NOTE: If steps 2-3 are missed, the change to mains mode will be carried out automatically, i. e. the sequence GENERATOR TO MAINS MODE, steps 4 to 8 and 11 to 18, is carried out (see page 7).

Lamp Test

At activation of the push-button LAMP TEST all LEDs mounted on the front plate are tested.

Supply Voltage

The MS-2 can be connected to 12V DC, 24V DC or 48V DC according to the specifications on the rear of the unit.

Max. consumption: Approx. 6W.

Operating range:
- 12V: 10-16V
- 24V: 20-32V
- 48V: 40-64V

The SUPPLY terminals are protected against wrong polarization of the supply voltage.

The MS-2 is supplied over a transformer coupled DC/DC inverter, adapting the SUPPLY voltage to the internal supply voltage, at the same time providing a galvanic separation between the auxiliary voltage and all other circuits, except the four circuit breaker position inputs which are fed from the auxiliary voltage.

NOTE: The supply voltage is connected to terminals 28 (+V DC) and 29 (-V DC) (unlike the MS-1 where the voltage was connected to terminals 27 and 29).

Functions upon Connection of the Supply Voltage

When the supply voltage is connected simultaneously to the MS-2 and the EC-2, the following mode is selected:

1. The MS-2 is set to AUTO mode
2. The EC-2 is set to AUTO mode, if jumper S8 is set to position “AUTO” (see 4189340232/ EC-2)
3. The EC-2 is set to MANUAL mode, if jumper S8 is set to position “MAN” (see 4189340232 / EC-2)

If jumper S8 is set to AUTO mode, it is recommended to connect the auxiliary voltage to EC-2 first and then change the EC-2 to MANUAL mode by activating the push-button “AUTO/MAN”.

If the EC-2 is set to MANUAL mode, the circuit breakers/contactors will not change their positions, nor will the diesel generator be started automatically.

If the EC-2 then is set to AUTO mode, the automatic sequences will be carried out provided that the conditions here of are fulfilled (see page 6).

Functions of MS-2 upon Supply Voltage Drop-out below 75%

As the MS-2 and the EC-2 normally are sourced from the same battery a LOW VOLTAGE BATTERY alarm will be released by the EC-2 if the battery voltage drops below 75% - AFTER start of the engine. This alarm remains inhibited for approx. 3 secs. after start of the engine, as low voltage is normal during starting up.

The circuit breaker signals MCB ON, MCB OFF, GCB ON, GCB OFF are transmitted only when the relays are activated. At a battery voltage below approx. 75%, the relays cannot be activated and new circuit breaker signals will hence not be transmitted, whereas existing signals may be cancelled depending on how low the battery voltage drops.

If active signals are applied to control the circuit breakers, these will not change position, whereas if deactivation of the signals MCB ON and GCB ON is applied to disconnect the contactors, these may be disconnected.

All other functions, inclusive of voltage and position indicators, remain unaffected by the low battery voltage, provided that the battery voltage is higher than approx. 45%.

Setting of Internal Switches

As access to these switches may be complicated if other units are mounted beside the MS-2, setting of these switches before the MS-2 is mounted in the panel is recommended whenever possible.

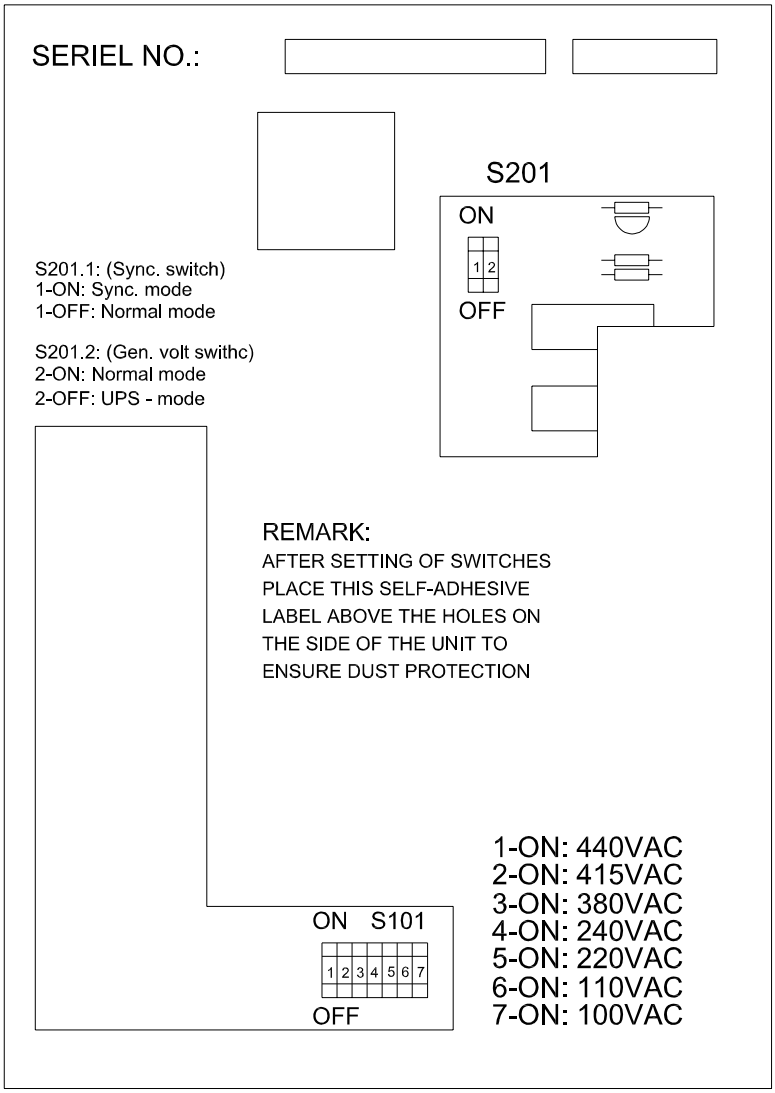
If required, the clamps and the two-piece terminals are separated and the housing is pulled out through the front of the panel without demounting of the cables. On delivery a label showing all settings is fixed to the right side of the housing. This label is easily removed to give access to the switches through the housing cut-outs.

After setting, the self-adhesive label is placed above the holes to ensure protection of the inner parts of the unit against dust and mechanical damage. If the setting of the switches is required changed later on, the label may be carefully removed. Provided that the adhesive is not exposed to dust the label may be replaced after change of the setting. Indicating the positions of the switches on the label by means of a ballpoint pen or the like is recommended.

Setting on Delivery

The unit will on delivery be set to the positions mrk. “*” – unless otherwise specified in the customer’s order.

Location of Internal Switches



Setting of Rated Voltage Range

This setting is valid for the mains voltage as well as the generator voltage. The range is set by means of switches S101.1...7 as follows:

440V AC:	S101.1 is ON
415V AC:	S101.2 is ON
380V AC:	S101.3 is ON*
240V AC:	S101.4 is ON
220V AC:	S101.5 is ON
110V AC:	S101.6 is ON
100V AC:	S101.7 is ON

Setting of “SYNC” Switch

S201.1 is OFF* The normal function for MS-2 is selected, i. e.:

At change from generator mode to mains mode the GCB is opened before the control signal MCB ON is transmitted and the MCB is closed.

This means that the bus bar is “dead” for a short period of time but resynchronising of the bus bar to the mains is not necessary.

S201.1 is ON The SYNC function for MS-2 is selected, i. e.:

At change from generator mode to mains mode the GCB is NOT opened until the control signal MCB ON is transmitted.

The synchronising relay (terminal 9-10) or the automatic synchroniser FAS-113DG has to be connected in parallel with the shown external interlock contact from GCB.

When the conditions for synchronisation are fulfilled, the synchronising relay contacts (terminal 9-10) will close and thus cancel the external interlock system and the MCB will close. (see detailed diagram on page 22).

Setting of “GEN VOLT” Switch

S201.2 is ON* The normal function for MS-2 is selected, i. e.:

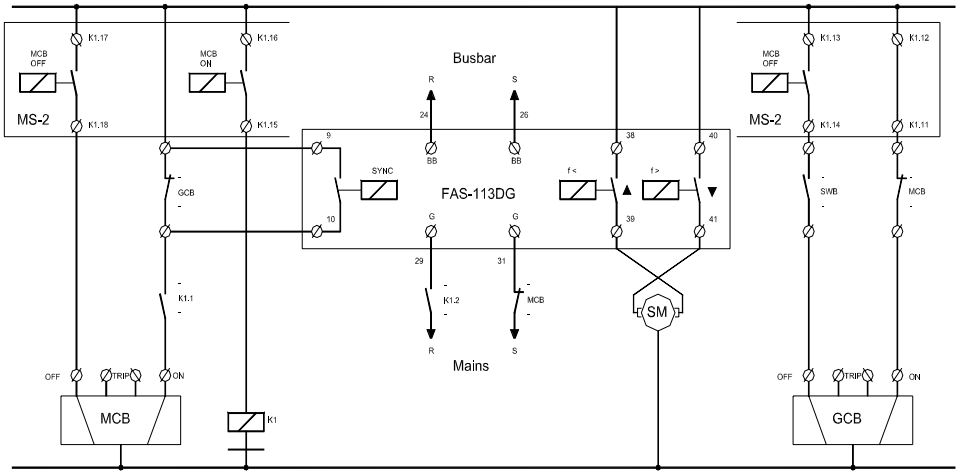
At change from mains mode to generator mode the MCB is opened ONLY if the generator has been >80% for a period of time (set by the timer DELAY GEN VOLT in MS-2).

S201.2 is OFF The following function is selected:

At change from mains mode to generator mode the MCB is opened IMMEDIATELY after the mains failure has been detected.

NOTE: This function is recommended only if an UPS unit is paralleled to the bus bar or supplies the most essential consumers.

Special Applications



X1: TERMINAL BLOCK OF MS-2

Resynchronisation of Generator to the Mains

The internal SYNC switch (S201.1) has to be ON.

The shown N/C contacts in series with the ON terminals of the MCB and GCB from an external interlock of the circuit breakers.

When the control signal MCB ON is transmitted, the relay K1 will be energized. The contacts (K1.2) of this relay will activate the fully automatic synchronising relay type FAS-113DG if the MCB is open.

The output relays of the frequency regulator in FAS-113DG control the servomotor of the mechanical speed governor (or the “Electronic Potentiometer” in the case of an electric governor) until the generator frequency is 0.05 to 1.0 Hz (set by “freq” on FAS-113DG*) lower than the mains frequency.

NOTE: As an additional feature it is recommended to start an external timer – by means of a N/O contact of K1 – when K1 is energized.

If this timer expires (e. g. set to 60 secs.) and the MCB is still open, a SYNC FAILURE signal can be transmitted to the alarm system.

Parallel Switch

When the position signal MCB SIGN ON is received after closing of the MCB, the control signal GCB OFF is transmitted.

SWB is CLOSED: The GCB will be OPENED

SWB is OPEN: The GCB will NOT be opened and the generator can continue running in parallel with the mains until SWB is CLOSED.

In this mode the generator power has to be controlled automatically, e. g. by the Diesel Generator Controller – LSU-112DG.

At the shown connection of the automatic synchronising relay the generator will be deloaded approx. 10% when the MCB closes.

NOTE: The MAINS REST signal which is the STOP signal for the EC-2 is not transmitted until both position signals MCB SIGN ON and GCB SIGN OFF have been received by the MS-2.

Adjustments

Adjustment of Mains Failure Limits

WARNING! It is recommended to set the MS-2 to MANUAL MODE during the below mentioned adjustments to prevent unwanted operation of the circuit breakers.

Rapid Adjustment of Limits

1. Connect the SUPPLY voltage according to the specifications on the rear
2. Check that S101 is set to the actual voltage range (see Setting of Internal Switches, page 13).
3. Connect terminals 22 – 23 – 25 – (26) to the mains voltage
4. Turn BAL. V-ERROR fully counterclockwise.
   Adjust SET V_{nom} to the centre of the "window" where the two LEDs, "LOW" and "HIGH" on the rear are switched off simultaneously. (See Note 1 below)
   The "window" has a width of ±3% of V_{nom}
5. Adjust BAL. V-ERROR to the requested value (range: ±3 to ±25% of V_{nom})
6. Adjust ASYM. V-ERROR to the requested value (range: ±3 to ±25% of v_{nom})

NOTE 1: If the LEDs cannot be switched off simultaneously, the setting of S101 should be checked.

NOTE 2: Please remember to reset MS-2 to AUTO MODE, if required.

NOTE 3: If more accurate adjustments of the three potentiometers are requested, see the following pages.

Accurate Adjustment of the Potentiometer BAL. V-ERROR

REMARK! By this mode of adjustment the MS-2 will detect a phase breakage, and the mains voltage indicator on the front will be lit (RED) continuously.

1. Connect the SUPPLY voltage according to the specifications on the rear
2. Check that S101 is set to the actual voltage range (See Setting of Internal Switches page 13)
3. Disconnect terminals 22 –23 –25 – (26) from the mains
4. Connect terminals 22 – 23 – 25 together
   Connect the secondary of a single phase “vario” transformer to terminal 26 (N) and to terminals 22 – 23 – 25 (R + S + T)
5. Measure the secondary voltage with a precision AC voltmeter
6. Connect the primary of the “vario” transformer between NEUTRAL and one of the phases of the mains or any other voltage source
7. Set the “vario” transformer to the NEUTRAL to PHASE voltage = V_{nom}/root 3 (See Note 4 below)
8. Turn BAL. V-ERROR fully counterclockwise
   Adjust SET V_{nom} to the centre of the “window” where the two LEDs, “LOW” and “HIGH” on the rear are switched off simultaneously (See Note 5 below)
   The “window” has a width of ±3% of V_{nom}
9. Adjust BAL. V-ERROR until the LEDs “LOW” and “HIGH” are lit exactly at the requested voltage limits by varying the “vario” transformers

NOTE 4: If the low and high limits are requested to be asymmetrically related to the normal voltage, SET V_{nom} has to be adjusted at the average value of the requested low and high limits.

NOTE 5: If the LEDs cannot be switched off simultaneously, the setting of S101 should be checked.

Accurate Adjustment of the Potentiometer ASYM. V-ERROR

1. Connect the DC supply voltage according to the specifications on the rear
2. Check that S101 is set to the actual voltage range (See Setting of Internal Switches, page 13)
3. Connect terminal 22 (R) to the secondary of a single phase “vario” transformer.
   Connect terminal 23 (S) – 25 (T) – 26 (N) to the mains directly
4. Connect the primary of the “vario” transformer between NEUTRAL and phase R of the mains
5. The neutral to phase voltages are measured on the terminals of MS-2
6. The mains voltages have to be inside BAL. V-ERROR limits
7. By varying the “vario” transformer asymmetric voltage errors can be simulated
8. The ASYM. V-ERROR is adjusted until the MAINS VOLTAGE INDICATOR on the front of MS-2 switches to RED light at the requested value of asymmetry between the phases.

Adjustment of Generator Voltage Relay

The set point is STANDARD set to 80% on delivery and cannot be readjusted by means of a potentiometer. However, if a resistor (0.25W) is connected in series with terminal 20, the set point can be increased to 81-95% of V_{nom}.

Resistance = 4kΩ per percentage above 80% (Tolerance of resistor: ±5%).

Adjustment of Timers (DELAYS)

MAINS FAIL: When a mains failure is detected, the automatic change to generator mode is delayed for a preset period of time (0.5 to 5 secs)

If the mains is restored before the timer has expired, the timer will be reset, i. e. the failure must occur continuously during the preset period in order to start the automatic change to generator mode.

GEN VOLT: When the generator voltage exceeds 80% of the set V_{nom}, the signal GEN ON is transmitted immediately but the control signal MCB OFF is delayed for a preset period of time (0.5 to 5 secs.) – before being transmitted.

This delay ensures that the generator voltage has been stabilized before the automatic mains to generator mode sequence is continued.

INTERLOCK: When a circuit breaker/contactor has been opened, the control signal for closing of the other circuit breaker/contactor is delayed for a preset period of time (0.5 to 5 secs.) – before being transmitted.

One timer is used for both circuit breakers.

MAINS REST: FUNCTION AT GENERATOR MODE:

If the mains voltage is not restored before the system has changed to generator mode, the automatic change to mains mode will be delayed for a preset period of time (1 to 10 min.).

If a new mains failure is detected before the timer expires, the timer is reset, implying that mains voltage has to be present and within the preset voltage limits during the complete preset period of time before automatic change to mains mode is carried out.

FUNCTION AT STARTING UP OF A GENERATOR

If the mains voltage is restored before the system has changed to generator mode, the speed of this timer is increased by 10. When the position signal GCB SIGN ON is received, the timer is reset and then runs at normal speed (See Function at Generator Mode, page 20)

NOTE: As the actual MAINS REST time normally is uncritical, setting the timer to a delay corresponding to at least 10 times max. starting time will be more expedient.

EXAMPLE:
If the following settings has been made for EC-2:

Number of start attempts: 3
The timer START PREP.: 6 secs.
The timer START ON: 5 secs.
The timer START OFF: 4 secs.

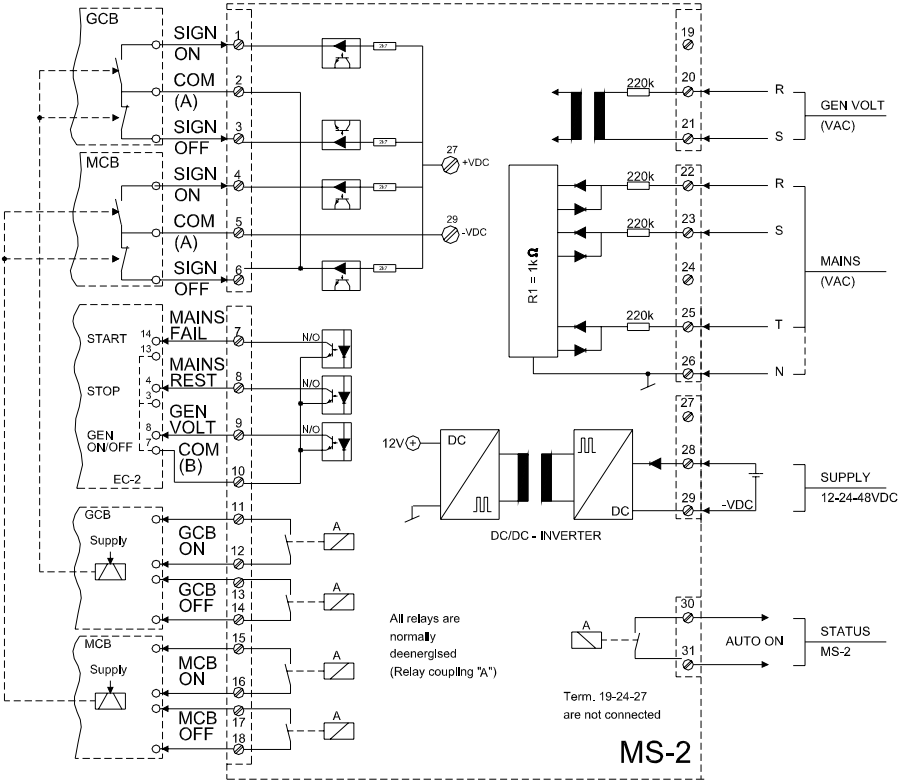
The complete max. starting time will be:
6 secs. + 3 x (5 +4) secs. = 33 secs.

After the third start attempt has been carried out the EC-2 transmits a START FAILURE signal.

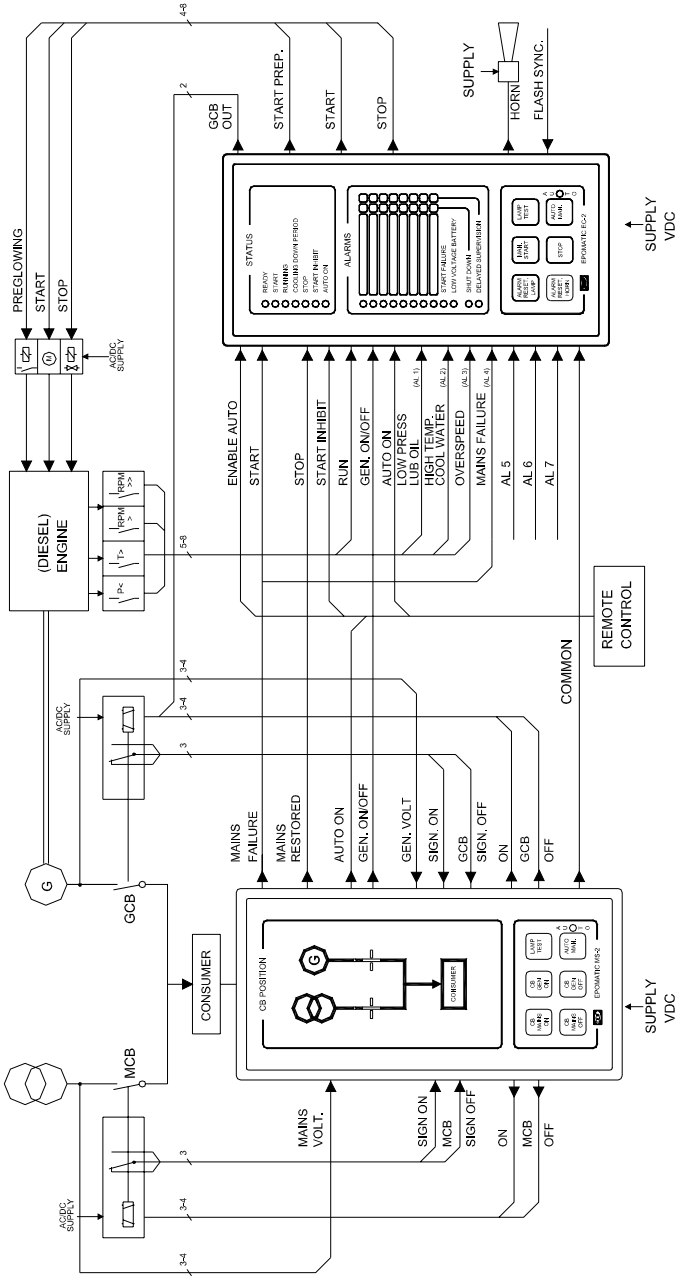
If the engine has not been started when the timer MAINS REST expires, the MS-2 will then automatically change to mains mode, if mains is OK.

Consequently the timer MAINS REST should in this case not be set to less than 10 x 33 secs. = 330 secs. (5.5 min.).

Input and Output Circuits



Typical Application



Technical Specifications

AMBIENT TEMPERATURE: -25°C to +70°C (working)
-40°C to +70°C (storage)

GALVANIC SEPARATION:

Input Position Signals Mutually	None
Input Position Signals to Auxiliary Supply	None
Input Position to Remaining Circuits	2Kv -50Hz-1min.
Outputs START-STOP-GEN ON/OFF Mutually	None
Outputs START-STOP-GEN ON/OFF to other Circuits	2kV-50Hz-1min.
Outputs with Relays Mutually & to other Circuits	2kV-50Hz-1min.
Input GEN VOLT R-S to other Circuits	2kV-50Hz-1min.
Input MAINS R-S-T-N to other Circuits	2kV-50Hz-1min.

For further information, see Input and Output Circuits, page 22

POSITION SIGNALS: Min. 5mA at closed contact. Supplied from "+V DC SUPPLY".
"COMMON (A)", terminals 2 + 5 are connected to "-V DC SUPPLY".

RELAY OUTPUTS: 1 make contact on all relays.

Max. 250V-2A-400VA (AC) or max. 250V-2A-50W (DC):
At resistive load: 2 mill. operations
Mechanical life: 20 mill. operations

TIME DELAYS: MAINS REST timer:
Adjustment range: 1 to 10 min. ±20%

Other timers:
Adjustment range: 0.5 to 5 secs. ±20%

Temperature drift: Max. ±0.5% per °C setting.

MAINS FAILURE:	Balanced voltage error: Adjustment range: ±3 to ±25% of V_{nom} Unbalanced voltage error: Adjustment range: ±3 to ±25% of V_{nom} Phase breakage also at reflected voltage from motors. Continuously during the delay MAINS FAIL: 0.5 to 5 secs.
AUXILIARY VOLTAGE:	12V DC (10-16V), 24V DC (20-32V) or 48V DC (40-64V) (see page 12) Comsumption: Max. 6W. Built-in DC/DC inverter with transformer. Protected against wrong polarization.
CLIMATE:	Class HSE, according to DIN 40040.
EMC:	To EN 50081-1/2, EN 50082-1/2, SS 4361503 (PL4) and IEC 255-22-1 (class 3).
VIBRATIONS:	5-50Hz: 20mm/sec., 3 directions for 3 x 2 hours, according to DNV, Class A.
SHOCK:	5 attempts with 15g in 3 directions, according to VDE 0410.
PROTECTION:	Front: IP40. Terminal: IP00. according to DIN 40050 and IEC Publ. 529/56.
MATERIALS:	Self-extinguishing plastic materials, according to UL94-VO.
TERMINALS:	Two-piece terminals with screws. Max. 1.5mm^2 (single/multi-stranded).
DIMENTIONS:	Bezel: 192 x 96mm, acc. to DIN 43700 Cut-Out: 186 x 92mm, acc. to DIN 43700 Depth behind panel: 165mm inclusive of cables.
WEIGHT:	Approx. 1.5 kgs.