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Soft Starter control

Motor starter control for soft starting



| Document version: | 0.10 |
|-------------------|--|
| Author: | M. Kurmann |
| Version: | SS20 + SS20Z (standard with possible option such as timer) |
| Project: | 140117-05-xx |

Version overview

| Date | Version | Description |
|-------------|---------|--|
| 09.12.2013 | 0.1 | Created |
| 12.12.2013 | 0.2 | Various references added and error description improved |
| 26.05.2014 | 0.3 | Switch arrangement changed, parameter FA = 4 factory setting. |
| 06.06.2014 | 0.4 | Parameter adjusted and setting parameter FP particularly highlighted. |
| 10.03.2015 | 0.5 | Parameter FU added |
| 02.03.2016 | 0.6 | General revision and insertion of version table of the soft starter Table 4, page 10 |
| 26.12.2016. | 0.7 | Description of software update 4.0 and description that F4 has no function. |
| 09.01.2017 | 0.8 | Parameter F0 increased |
| 18.06.2019 | 0.9 | Adaptation of the CE Declaration of Conformity |
| 18.09.2019 | 0.10 | Adjusting the enclosure dimensions |

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1 Introduction

The soft starter control mainly starts continuously rotating motors such as agitators, fans, water pumps, etc., which do not have large initial torques. The motor is started manually via a rotary switch on the control cabinet or via two external inputs that can be selected via a selector switch. Via these inputs the engine can be turned automatically on and off using a timer or a radio remote control.

The 3-phase controlled motor control starts the motors gently and protects them against various anomalies (under / over voltage, phase loss, asymmetric phase load, excessive motor temperature, excessive soft starter temperature underload and short circuit).

It is equipped with a lockable main switch according to the requirements of Machinery Directive 2006/42/EC and complies with the latest European standards (CE).

2 Operating conditions

| Mains supply voltage | AC 400V +/- 10% |
|-----------------------------------|---|
| Supply frequency | 50Hz +/- 3% |
| Connection standard control | 3L + PE (neutral is required only when using options such as timer, hour counter, etc.) |
| Power section of the soft starter | Thyristors in all three phases |
| Supported engine type | 3-phase asynchronous squirrel cage motor |
| Supported engine power | 5.5 to 15kW or 15 to 22kW. Please check parameter FP at the soft starter |
| Degree of protection complete | IP54 (protection against splashes of water on all sides) |
| Start-up cycles | Do not turn on / off more than 12 times per hour |
| Operating temperature | -15°C - +50°C |
| Relative humidity | 90% without frost |



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3 Safety information



The installation, service and settings of the controller may only be carried out by electrically trained personnel. It is imperative that all installation and safety standards are adhered to.



Before activation, check the receiver type plate to see if the correct operating voltage is used in terms of power and voltage.



The switchgear must not be operated unearthed.



The control box may only be opened when de-energised.



Never work on the terminals or on the controller under voltage!



Never wash out the device with water or clean it with a high pressure hose.



If the device is installed on a vibrating surface, the control must be mounted on rubber buffers in order to reduce any vibrations so that the service life is not restricted.



The soft starter control must NOT be used for safety-critical applications where a defect or malfunction of the product may endanger persons or cause material damage.



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4 Intended use

The controller may only be used for starting asynchronous motors.



This product must **NOT** be used for safety-critical applications where a defect or malfunction of the product may endanger persons or cause serious material damage.

5 Foreseeable Misuse

- 1. After installation / commissioning, check that the direction of rotation of the motor is correct
- 2. Check that your motor is protected with a Klixon switch and not with a PTC resistor. **NEVER** connect the motor PTC to Klixon terminals! This would require a separate evaluation unit!



Before commissioning the motor, the parameter FP (rated motor current) must be set according to the motor rating plate. See Table 5, page 10 to 13!



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6 Connection

6.1 General

All functions are wired to terminals (1) and can therefore be easily and clearly connected (for schematics see section 6.2, page 7)

Fig 1: Controller connection and terminals





Never work on the terminals or on the controller under voltage!



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6.2 Diagram

See separate wiring diagram with the drawing number 140117-05-xx. The label xx indicates the version of the schematics.

1.1 Motor

Check the motor nameplate to see if the motor windings are rated for 230 or 400V. The motor must then be connected accordingly in a star or in a triangle.

Table 1: Motor connection triangle

| Motor winding | Motor winding 400V, if 400/690V indicated on the nameplate. | | | | | | | | ist therefore be d in a triangle. |
|--------------------------|---|--|--------------------|----------|------------|---------------|---------------|--|---|
| l | | | | | | | | | W2 with U1 and U2 with 2 with W1! |
| | | | | | | | | L1 is con | nected at U, |
| | | | | | | | | L2 at V a controller rotation is motor wir with L2 | nd L3 at W on the . If the direction of s to be changed, the e L1 can be swapped |
| | Dutchi Van Older The Neth | Motors B.V. nbarneveldtstraat erlands - 6828 2 | 85a ZN Arnhem | | GI | _@) 0034-1 | CE | and | |
| 3-motor No.: | 336 | 3212900 | 02 | ALCONT. | | | | | |
| The second second | M 1 | 200L2 | IMB5 IP 55 | Rtg | S1 | 220 k | g Ins.cl: F-B | TV | W2[12]V2 |
| · V | Hz | kW | A | COSP | Conn | - mda | Eff | | |
| 400/690 | 50 | 30 | 52.7/30.6 | 0.90 | Δ/Y | 2940 | EFF2-91.4% | TV | |
| | 60 | 33-34.5-36 | 52.7-52.7-52.7 | 0.90 | Δ | 3525 | | | i rwirviru |
| -voltage range: Δ | 380-400- | 420V 50Hz (A 44 | 0-460-480V 60Hz)/Y | 660-690- | 720V 50H | z(Y 760-7 | 90-830V 60Hz) | | |
| Brgs.DE: 6 | 312ZZC3 | NDE: 6 | S12ZZC3 | - • r | mai | rath | non° | TKTK | L1L2L3 PE |
| PTC 150° | C | | | 52 | | elec | ctric | 1.0000-000 | 0 1001 |
| | | | | | | | | | 3~4004 |



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7 Operation

7.1 Control in general

Fig 2: Operating elements of soft starter control in general



Table 2: Overview of operating elements of soft starter control in general

| Position | Function | Description |
|----------|----------------------------------|---|
| 1 | Main switch | Lockable main switch which disconnects the controller from the mains. |
| 2 | manual - 0 - auto | Operation selector switch "manual - 0 - auto": Position "0": switched off Position "manual": manual, permanently on Position "auto": control switches depending on switch 3 |
| 3 | Remote - time or Fk1 - Fk2 | Selector switch "remote - time", only valid if switch 2 has the "auto" position selected. Position "remote" / Fk1: can be started via external, potential-free contact by short-circuiting terminal 1.2 with 1.3. (e.g. with MiniPilot or AgroPilot) Position "time" / Fk2 switches on / off via internal timer or via terminal 1.4 / 1.5 |



If you want to start the engine via "remote" or "time", the operation selector switch (2) must be in the "auto" position and the rotary switch (3) must be in the "remote" or "time" position!



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7.2 Soft starter

7.2.1 General

The soft starter control offers a variety of setting options. The parameters for the corresponding engine power are delivered as standard. Thus, the commissioning engineer only has to set the start / stop times and the initial voltages according to the application

Fig 3: Soft starter controls



Table 3: Overview of soft starter controls

| Display | Description |
|-----------------|--|
| Ready light | When the soft starter is ready to start, this lamp lights up. |
| Bypass light | After starting with the set ramp-up time, the bypass light comes on. The KM1 contactor (bypass contactor) switches at the same time as the bypass light, and the motor no longer runs via the semiconductor thyristors but via the KM1 contactor. However, the motor is still protected by the soft starter SS1. |
| Error light | If an error occurs, the ERROR light comes on (See List of Errors section 7.2.7, page 15) |
| Parameters | Pressing the SET button (4) will enter the parameter adjustment mode. The parameter code is displayed on the left two digits (see Parameter Code section 7.2.5, page 10). |
| Parameter value | Pressing the SET button (4) will enter the parameter adjustment mode. The parameter value is displayed on the right three digits (see Parameter Values section 7.2.5, page 10) |
| Ampere | If you press the YES button (1) after starting the control, you can use the UP (2) or DOWN (5) button to query various actual values (see Actual Value Query section 7.2.4, page 10). If the unit of the actual value is amperes, the A-lamp lights up. |
| Percent | See ampere description, but for the percent unit |
| Seconds | See ampere description, but for the seconds unit |

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7.2.2 Setting parameters

If you want to set a parameter, proceed as follows:

- 1. The display must read "READY". If this is not the case, press the Stop / Reset button (6).
- 2. Press the "SET" button (4)
- The last set parameter appears
 The desired parameter code can be selected using the UP (2) or DOWN (5) button. The two left digits indicate the parameter code.
- 5. Press the SET button (4) again to enter the edit mode of the corresponding parameter. This is indicated by the flashing of the two display dots (separator characters).
- 6. The desired parameter value can now be set using the up (2) or down (5) button. The three right digits indicate the parameter value.
- The parameter is saved by pressing the "YES" button.
 If the parameter was saved successfully, the display shows "GOOD".

7.2.3 Resetting parameters to factory settings

If you want to reset the parameters to factory settings, proceed as follows:

- 1. Turn off the controller
- 2. Press the YES button (1) and switch on the control (keep the YES button pressed when switching on)
- 3. After approx. 3 secs. the parameters are reset to factory settings (except parameter FE)

7.2.4 Display of the actual values on the display

If you want to show the actual values on the display, proceed as follows:

- 1. The display must read "READY". If this is not the case, press the Stop / Reset button (6).
- Press the "YES" button (1)
 The desired actual value can be read using the up (2) or down (5) button according to the following table

| Display | Description | | | | |
|---------|--|--|--|--|--|
| AC 405 | The supply voltage is 380 / 400VAC | | | | |
| 15.0-3 | Soft starter power (15kW). A 7.5kW control may also have 15kW but the rated current has been set accordingly (see parameter F6). | | | | |
| H1: E05 | The last error message (here Err05) to occur. | | | | |
| H2 | More older errors | | | | |
| H1: E00 | If Err00 shows no error has occurred | | | | |
| Uer4.0 | Software version of the soft starter. Version 4.0 | | | | |
| Lxxxx | Specifies the number of successful starts | | | | |
| RUNxx | Gives the last soft start time in seconds | | | | |

Table 4: Note on software version of the soft starter

| Version | Change |
|---------|--|
| 1.7 | Software does not yet contain the parameters E1 (phase monitoring), E2 (current coefficient) and E3 (voltage coefficient). Parameter FU is for the underload monitoring, however this is switched off with $FU = 0$ or 1. Parameter FE has initial value (7) for terminal function 3/4. However, this parameter has no influence for our purposes. |
| 3.0 | Parameters E1, E2 and E3 have been newly integrated (see Table 5page 10). Initial value parameter FE is (6). Since this parameter has no influence on our application, this is not relevant. Parameter FU is the bypass pickup delay time after reaching the start ramp. If this value is $FU = 0$, the bypass does not switch on. FU must therefore be set to 1. This parameter is backward compatible. Thus, even with version 1.7, this value can be set to 1. |
| 4.0 | Improvement of software in the field of thermal protection. Version 3.0 may no longer be used! |

7.2.5 Parameter Codes

Table 5: Parameter code list

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| Code | Short explanation | Area | Factory setting | Setting Meier Elektronik AG | Description |
|------|------------------------------|----------------|-----------------|-----------------------------------|--|
| F0 | Initial voltage | 30 - 70% | 30% | 60% | Starting voltage for voltage-controlled startup (F9 = 1). If current-limited startup is set (F9 = 0), the value is fixed at 40%. |
| F1 | Soft start time | 2.60 secs. | 16 secs. | 4 secs. | Start time until 100% of the voltage $(400V)$ is reached. In current-limited startup (F9 = 0), this value is invalid. |
| F2 | Soft stop time | 0.60 secs. | 0 secs | 0 secs | If the value is set to 0, a "phasing out" is activated. |
| F3 | Start-up time delay | 0-999 secs. | 0 secs | 0 secs | Start delay after the start command. If the value is set to 0, the time delay is deactivated. |
| F4* | Time delay relay output | 0-999 secs. | 0 secs | 0 secs | Not supported in this version. |
| F5 | Start-up current limitation | 50 - 500% | 400% | 400% | Setting is only active in the current- limited startup (F9 = 0). If voltage- controlled startup is active (F9 = 1), the value is always set to 400%. |
| F6 | Maximum motor current | 50-200% | 100% | 115% | Setting the maximum motor current during operation. Based on the set current in parameter FP. |
| F7 | Under-voltage- protection | 40-90% | 80% | 80% | If the operating voltage falls below the set value, an error occurs and the motor is switched off. |
| F8 | Overvoltage protection | 100- 130% | 120% | 120% | If the operating voltage exceeds the set value, an error occurs and the motor is switched off. |
| F9 | Start mode | 0-5 | 1 | 1 | 0: current-limited startup 1: Voltage-controlled startup 2: Torque-optimised startup current limited 3: Torque-optimised startup with voltage ramp 4: Current startup 5: Voltage / current -imited startup See Table 6, page15 for the different starting behaviours. |
| FA | Motor protection | 0-4 | 4 | 4 | 0: switched off: 1: light load 2: standard load 3: heavy load 4: heavy load with optimum protection See 5 page21 |



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| Code | Short explanation | Area | Factory setting | Setting Meier Elektronik AG | Description | | | | |
|------|------------------------------|------|-----------------|-----------------------------------|---|---|--|---|--|
| FB | Start/stop mode | 0-7 | 1 | 1 | starter may | Value | Keypad start/stop | Terminals start/stop | RS485 start/stop |
| | | | | | soft : | 0: | Ok | Х | х |
| | | | | | the | 1: | Ok | Ok | х |
| | | | | | arce | 2: | х | Ok | х |
| | | | | | i sol | 3: | х | Ok | Ok |
| | | | | | hich | 4: | Ok | Ok | Ok |
| | | | | | m w and | 5: | Ok | х | Ok |
| | | | | | g fro rted | 6: | х | х | Ok |
| | | | | | ettin. e sta | 7: | х | х | Х |
| | | | | | ů ů | | | | |
| FC | Access restriction | 0-2 | 1 | 2 | 0: pai 1: pai locke 2: all | rameters rameters d paramete | can not l marked ers releas | be chang with * ren sed for eo | ed nain diting |
| FD* | Communication address | 0-63 | 0 | 0 | RS48 | 5 bus ad | dress | | |
| FE* | Relay output terminal 3/4 | 0-19 | 6 | 7 | 0: rela 10: rela 11: rela 11: rela 12: rela 12: rela 13: rela 13: rela 14: rela 15: rela 16: rela 17: rela 17: rela 18: rela 19: rela 19: rela | ay closes elay open ay closes | at start of s at start at start s at start s at start s when by s when b s at stop of s at stand s at stand s at stand s at stand s in event s in event s in vorki s in ready s in ready s during s s during s s during s s in bypas | command comman p up pass act pypass ac comman still dstill of error ng condit state y state tartup startup startup ss conditi | d ive ctive d ion ition |

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| Code | Short explanation | Area | Factory setting | Setting Meier Elektronik AG | Description |
|------|----------------------------|--------------|--------------------|-----------------------------------|--|
| FF* | Stop current limit | 30 - 100% | 80% | 80% | Current limitation of set rated current (F6), provided F2> 0 is set. |
| FP* | Motors rated current | | Rated current | Rated current | Motor rated current in amperes |
| FU | Bypass delay time | 1.30 | 5 | 1 | After startup, the bypass will only be activated after this set time. CAUTION: Increasing the value can heat the semiconductors unnecessarily and limit the lifetime. MAY NOT BE ADJUSTED! CAUTION: Setting 0, bypass off |
| E1 | 3 phase monitoring | 0-1 | 1 | 1 | 0: switched off: 1: switched on (only available as of soft starter software version 3.0. See Table 4) |
| E2 | Electricity coefficient | 50-150% | 100% | 100% | For adjusting the current shown on the display to the measured current. (only available as of soft starter software version 3.0. See Table 4) |
| E3 | Voltage coefficient | 50-150% | 100% | 100% | For adjusting the voltage shown on the display to the measured voltage. (only available as of soft starter software version 3.0. See Table 4) |

* Parameters are blocked by FC!

Parameters should be adapted according to the application during commissioning



It is imperative that parameter FP is set according to the present motor (rated current). If this value is set incorrectly, the motor is not sufficiently protected or the thermal protection triggers too early!

Fig 1: Important note



The parameter set according to Table 5 the above can be applied to the soft starter controllers with software version 1.7 and 3.0. Only in version 1.7 the parameters E1, E2 and E3 are not available.

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7.2.6 Different starting behaviours

The soft starter control supports various engine start procedures to meet a wide variety of applications. The following table explains the setting of parameter F9.

Table 6: Startup behaviour

| Startup behaviour | Explanation | Parameters |
|-------------------|--|------------|
| | The diagram shows the motor current when switching on. The voltage rises very fast and the turn-on motor current is limited by F5. | F9=0 |
| | The diagram shows the motor voltage when switching on. Depending on the starting voltage (F0) and starting time (F1), the curve adapts accordingly. | F9 = 1 |
| | The diagram shows the motor voltage during torque-optimised switching on (kickstart) with limited current. When switching on, a "jerk" can be generated to produce a larger breakaway torque. | F9 = 2 |
| | The diagram shows the motor voltage during torque-optimised switch-on (kickstart) with subsequent voltage-controlled startup. When switching on, a "jerk" can be generated to produce a larger breakaway torque. | F9 = 3 |
| | The diagram shows the motor current when switching on. I1 can be set by parameter F5 and T1 by parameter F1. The starting process can be used with bipolar motors. | F9 = 4 |

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7.2.7 Errors and troubleshooting

The following table explains the possible errors and their causes.

Table 7: Errors and troubleshooting

| Error | Description | Troubleshooting |
|----------------------|--|--|
| Err00 | No error | |
| Err01 | The instantaneous stop is active | Terminals 7 and 10 must be closed or PTC thermistor has tripped or there is a cable break on temperature sensor PTC. |
| Err02 | The soft starter has over-heated | The soft starter has been started or overloaded too often. The error is not cleared until the temperature drops to <55°C. |
| Err03 | The start time is longer than 60 secs. | Start time set incorrectly or connected load is too big |
| Err04 | Input phase error | One of the three input phases is not connected correctly or parameter FA is set incorrectly. |
| Err05 | Output phase error | One of the three output phases is not connected correctly or a semiconductor or bypass contactor KM1 is defective or motor is not connected. |
| Err06 | Phases asymmetry | Too much power between phases. Check the motor to see whether the windings are still in order and to see whether there is 400V at all the motor windings U, V, and W. |
| Err07 | Overload on startup | Overload or the motor is not connected. |
| Err08 | Overload during operation | Overload or parameter F6 is set incorrectly. |
| Err09 | Undervoltage | Check input voltage or parameter F7 is set incorrectly. |
| Err10 | Excess voltage | Check input voltage or parameter F8 is set incorrectly. |
| ERR11 | Wrong parameters | Check the parameters or perform a "factory reset". See section 7.2.3, page 10 |
| ERR12 | Short circuit | Check the motor or the thyristor semiconductor is defective or overloaded |
| Err13 | Restart wiring wrong | Check the wiring |
| Err14 | Wiring error for start / stop soft starter | Check wiring or the RUN button on soft starter has been pressed although switch 2 is OFF. |
| Err15 | Underload | Too small a load is connected for the soft starter. |
| Motor does not start | Fuse F1 has blown | Switch F1 back on |
| Motor does not start | Thermal protection (PTC) of the motor has blown by R2. DEF lights up at R2 | Let the engine cool down |



If you want to operate the soft starter autonomously via the RUN/STOP keyboard, set the parameter FB = 0. In this configuration, however, starting via the switches is no longer possible.

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7.3 **Operation of digital timer (optional)**

Technical specifications 7.3.1

| 1.1 | | | | - Take |
|---------|---------|---|----------|--------|
| PRODUCE | DIGICAL | 0 | | |
| AHC | CE | | O Callin | |

| Specification | Digital weekly timer |
|--------------------|----------------------|
| Operating voltage | 230V AC |
| Frequency | 50 Hz |
| Contact type | Changeover contact |
| Number of channels | 1 |
| Min. interval | 1 min. |
| Reserve | approx. 3 years |
| Assembly | DIN rail |

7.3.2 Operating system introduction

- 1. The reset button must be pressed for initial commissioning
- 2. Setting the time:
 - Hold down for 5s to select time format 12h (am / pm) or 24h. a. Õ
 - Hold down and press D+ to set day of the week. b. Ō
 - Hold down and press H+ to set hours. c.
 - Θ d. Hold down and press M+ to set minutes.
- 3. Programming switching cycles:
 - a. Press the P key
 - b. Set start time of channel 1 with D+ for the day(s), H+ for the hours and M+ for the minutes
 - Press the P key c.
 - Set end time of channel 1 with H+ for hours, and M+ for minutes d.
 - e. Press the P key
 - Set start time of channel 2 ... f.
 - g. Perform procedure for setting the desired number of max. 16 switching cycles by repeating steps a to d.
- 4. Selecting operating status:
 - a. Manual operation
 - i. AUTO OFF → timer now turned off

 - ii. ON→ permanently on iii. ON AUTO→ timer now turned on
 - iv. OFF→ permanently off

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8 Motor protection

The soft starter control protects the motor in a variety of ways. The following table gives an overview:

Table 8: Motor protection

| Protective function | Response time | Explanation | Responsible parameter |
|---|--|---|-----------------------|
| Overtemperature protection of soft starter | 80°C+/-5°C | If the temperature drops back below 55°C, the error is cleared | - |
| Input phase loss | <3 secs. | When an input phase is lost, an error occurs | - |
| Output phase loss | <3 secs. | When an output phase is lost, an error occurs | - |
| Phase current asymmetry | <3 secs. | If the difference in current between the phases is > 50% +/- 10%, an error will be triggered | - |
| Overload | Depending on overload current | Depending on the set current limit, an error is triggered | F6 |
| Under-voltage protection | U<40% = 0.5 secs. U<80% = 3 secs. | Depending on the set undervoltage threshold, an error is triggered | F7 |
| Surge protection | U>130% = 0.5 secs. U>120% = 3 secs. | Depending on the set overvoltage threshold, an error is triggered | F8 |
| Short circuit protection | < 0.1 secs. | If a short circuit is detected, an error is triggered immediately | - |
| Underload protection | 5 secs. | Depending on the set underload threshold, an error is triggered | FU |

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Fig 2: Motor protection curve (overload time)



le = rated current I = actual motor current



If, for example, the actual motor current is 5x greater than the set maximum motor current (F6) with a setting of FA = 2, an error is triggered after approx. 6 secs!

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9 Housing dimensions

3Fig: Housing dimensions





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10 CE Declaration of Conformity

According to the EC Machinery Directive 2006/42/EC, Annex II B for machines to be installed

Manufacturer: Meier Elektronik AG, Gewerbezone 61, CH-6018 Buttisholz

Trademark:Soft starter control standard 15kW

Type:standard

Factory no .:140117-05

The undersigned, acting as authorised representatives, declare that the equipment mentioned above complies with the following plant, EMC and electrical safety requirements

DIRECTIVE 2006/42/EC: Machinery Directive

DIRECTIVE 2014/30/EU Electromagnetic Compatibility (EMC)

DIRECTIVE 2014/35 / EU Low Voltage Directive (LVD)

DIRECTIVE 2011/65 / EU Restriction of Hazardous Substances (RoHS)

EN 60204-1, Safety of machinery, Electrical equipping of machines, Part 1: General requirements

Full technical documentation is available.

Documentation manager (according to MRL 2006/42(EC)): Markus Kurmann

The instruction manual for the control cabinet is available in the language of the user country.

Buttisholz, 18.06.20

H. Clummy

Managing Director

Place, Date

Signature of the authorised person

Function of the authorised person