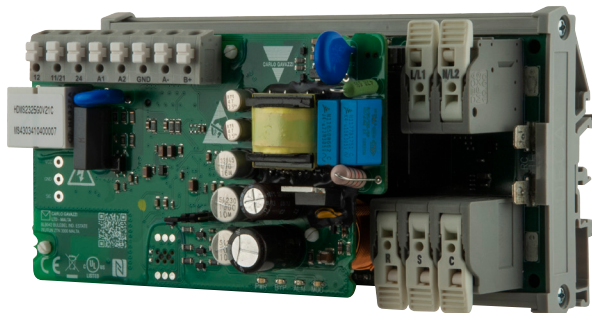


# HDMS



## Single phase dynamic motor starter



### Description

**HDMS** is a dynamic motor starter for single phase scroll compressors and submersible pumps.

Through an innovative control strategy, Capacitor Start-Capacitor Run (CSCR), motors, can now be started without a start capacitor. In case of Permanent Split Capacitor (PSC) motors, the starting current is virtually eliminated.

All the **HDMS** PCBs have conformal coating for higher resistance to harsh environmental conditions.

The ramp-up time is limited to a maximum of 1 second making it an ideal solution for scroll compressors and submersible pumps.

### Benefits

- **No start capacitor required\***. More reliability for your systems especially in weak grids.
- **Cost savings**. HDMS achieves an exceptional current reduction with respect to traditional soft starters. Lower starting current helps you save on utility contracts.
- **Less over-rating for generator driven loads**. The starting current is limited to  $< 1.8$  HDMS nominal current. This lower start current reduces the starting VA required. In case of generators, lower power generators can be used.
- **No settings required**. Optimal starts in every condition without the need for user adjustments.
- **Adapts to load conditions**. The self-learning algorithm automatically adjusts the internal start parameters in case of unbalanced pressures.
- **Faster installation**. Tool-free terminals ensure a much faster and easier installation.
- **Motor overload protection (Class 10)**. Built-in thermal model for Class 10 overload protection.
- **Integrated protection**. Diagnostic functions provide additional protection against abnormal operating conditions.
- **Complete monitoring**. The HDMS is equipped with a Modbus/RTU communication port by 2-wire RS485 connection for real time monitoring of critical parameters.
- **NFC history file download**. Through the NFC communication, users can download data of the very first 8 starts and the last 24 starts performed by HDMS. Download can be done via (Android based) smartphones and tablets or PC.
- **Faster troubleshooting**. HDMS stores the last 143 alarm events information to facilitate troubleshooting.

\*load conditions apply

### Applications

Scroll compressors, submersible pumps

### Main features

- Limits the starting current for single phase scroll compressors and submersible pumps
- Reduces light flickering when motor starts
- Monitors supply and load conditions to protect your motors in case of abnormal operation
- SCR bypassed main relay for longer lifetime

## Order code

 **HDMS 23** ☐ **G0 V2** ☐ ☐

Enter the code entering the corresponding option instead of ☐.

| Code                     | Option | Description                           | Comments                                                   |
|--------------------------|--------|---------------------------------------|------------------------------------------------------------|
| H                        | -      | High Dynamic Motor Starter            |                                                            |
| D                        | -      |                                       |                                                            |
| M                        | -      |                                       |                                                            |
| S                        | -      | Single phase control                  |                                                            |
| 23                       | -      | 110 – 230 VAC +10%, -15%              | Operational voltage (Ue)                                   |
| <input type="checkbox"/> | 12     | 12 Arms                               | Rated operational current at 65°C (40°C for 25 Arms model) |
|                          | 25     | 25 Arms                               |                                                            |
|                          | 32     | 32 Arms                               |                                                            |
|                          | 37     | 37 Arms                               |                                                            |
| G                        | -      | 110 – 230 VAC +10%, -15%              | Control signal                                             |
| 0                        | -      | Internally supplied (via L/L1 – N/L2) |                                                            |
| V                        | -      | Versions                              |                                                            |
| 2                        | -      | 2 relay outputs                       |                                                            |
| <input type="checkbox"/> | 0      | Panel mounting (on request)           |                                                            |
|                          | 1      | DIN rail mounting                     |                                                            |
| <input type="checkbox"/> | -      | No option                             | Only for 12 Arms models                                    |
|                          | C      | Modbus RTU                            |                                                            |

## Selection guide

| Rated operational current (Ie) | Versions  | Ordering code (Mounting: Panel) | Ordering Code (Mounting: DIN) |
|--------------------------------|-----------|---------------------------------|-------------------------------|
| 12 Arms                        | No Modbus | HDMS2312G0V20                   | HDMS2312G0V21                 |
|                                | Modbus    | HDMS2312G0V20C                  | HDMS2312G0V21C                |
| 25 Arms                        | Modbus    | HDMS2325G0V20C                  | HDMS2325G0V21C                |
| 32 Arms                        | Modbus    | HDMS2332G0V20C                  | HDMS2332G0V21C                |
| 37 Arms                        | Modbus    | HDMS2337G0V20C                  | HDMS2337G0V21C                |

## Selection guide

| Category    | Type        | Model selection                                                                                       |
|-------------|-------------|-------------------------------------------------------------------------------------------------------|
| Pumps       | Submersible | Choose HDMS model according to the current rating of the pump.                                        |
| Compressors | Scroll      | Model selection depends on the LRA to $I_{MAX}$ ratio. See table below for more detailed information. |

| Category    | Type   | Locked rotor amps (LRA) | Maximum operating current ( $I_{MAX}$ ) | X/Y Ratio ( $LRA / I_{MAX}$ ) | Model selection                                                               |
|-------------|--------|-------------------------|-----------------------------------------|-------------------------------|-------------------------------------------------------------------------------|
| Compressors | Scroll | X                       | Y                                       | < 5                           | No over-rating<br>Choose HDMS model according to the compressor rated current |
|             |        |                         |                                         | $\geq 5$ and < 7              | Over-rate HDMS by 1 model size                                                |
|             |        |                         |                                         | $\geq 7$                      | Over-rate HDMS by 2 model sizes                                               |

Note: For compressor models Copeland ZH13KVE and ZH38K4E an additional start capacitor (approx. 100  $\mu$ F, 300 V) may be required if starts are not done at balanced pressures.

Example:

## Selection guide

| Manufacturer                | Model       | Locked rotor amps (LRA) | Maximum operating current ( $I_{MAX}$ ) | $LRA / I_{MAX}$ | Item code      |
|-----------------------------|-------------|-------------------------|-----------------------------------------|-----------------|----------------|
| Copeland                    | ZH21K4E-PFJ | 76.0                    | 18.5                                    | 4.11            | HDMS2325G0V2.C |
|                             | ZH13KVE-PFJ | 160.0                   | 30.0                                    | 5.33            | HDMS2337G0V2.C |
| Mitsubishi Heavy Industries | AEH60VEXMT  | 121.0                   | 15.3                                    | 7.91            | HDMS2332G0V2.C |

Note: The above selection guide is provided as a reference to help you with the correct model selection. In case of any doubt please contact your Carlo Gavazzi representative.

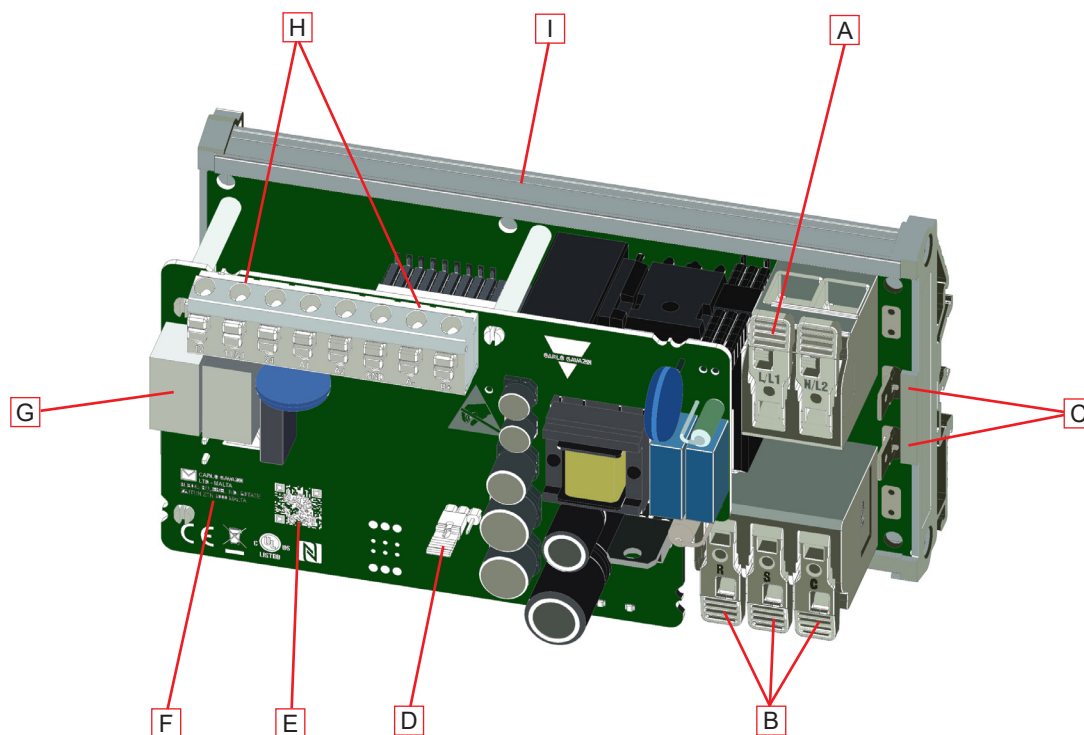
## Further reading

| Information                   | Where to find it                                                                                                                                                      |                                                                                       |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| HDMS Trouble-shooting guide   | <a href="http://www.gavazziautomation.com/document/manual/mc_hdms_qsg.pdf">http://www.gavazziautomation.com/document/manual/mc_hdms_qsg.pdf</a>                       |    |
| Modbus communication protocol | <a href="http://gavazziautomation.com/document/manual/mc_hdms_Modbus_manual.pdf">http://gavazziautomation.com/document/manual/mc_hdms_Modbus_manual.pdf</a>           |    |
| NFC mobile phone application  | <a href="https://play.google.com/store/apps/details?id=mt.com.carlogavazzi">https://play.google.com/store/apps/details?id=mt.com.carlogavazzi</a>                     |    |
| HDMS configuration software   | <a href="http://gavazziautomation.com/images/pim/OTHERSTUFF/HDMS_CGS3_SETUP_FILE.zip">http://gavazziautomation.com/images/pim/OTHERSTUFF/HDMS_CGS3_SETUP_FILE.zip</a> | -                                                                                     |
| CAD drawings (HDMS..V20)      | <a href="http://www.productselection.net/DXF/MC_HDMS_V20.zip">http://www.productselection.net/DXF/MC_HDMS_V20.zip</a>                                                 |  |
| CAD drawings (HDMS..V21)      | <a href="http://www.productselection.net/DXF/MC_HDMS_V21.zip">http://www.productselection.net/DXF/MC_HDMS_V21.zip</a>                                                 |  |

## Carlo Gavazzi compatible components

| Purpose            | Component name/code  | Notes                                                                              |
|--------------------|----------------------|------------------------------------------------------------------------------------|
| PCB standoffs      | HDMS_SMA_ADAPTER_X50 | 50 pcs per box                                                                     |
| DIN rail accessory | HDMS_DIN             | 1 pc per box                                                                       |
| Booster kit        | CF30A002240VAC       | Electromechanical relay to disengage start capacitor (for booster kit option only) |

## Structure



| Element  | Component                       | Function                                                                                                                    |
|----------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| <b>A</b> | Mains input terminals           | Supply for the HDMS internal electronics. Single phase main input.<br>L/L1 - Live wire<br>N/L2 - Neutral (or L2 connection) |
| <b>B</b> | Load output terminals           | Connection to motor.<br>R - Main winding<br>S - Start winding<br>C - Common                                                 |
| <b>C</b> | Run capacitor connection        | RC <sub>1</sub> , RC <sub>2</sub> faston connection for run capacitor                                                       |
| <b>D</b> | Jumper                          | Depending on position, user can shift the Modbus slave address by 1                                                         |
| <b>E</b> | QR code                         | Scan to link to troubleshooting guide                                                                                       |
| <b>F</b> | NFC antenna                     | Contactless readout of internal memory from NFC enabled device                                                              |
| <b>G</b> | Auxiliary relays (programmable) | Normally open for top of ramp indication (21, 24)<br>Normally closed relay for alarm indication (11, 12)                    |
| <b>H</b> | Auxiliary connections           | Terminal block for control input (A1, A2), relay output (11, 12, 21, 24) and Modbus (GND, A-, B+)                           |
| <b>I</b> | DIN clip                        | Provides an easy connection to 35 mm DIN rail                                                                               |

## Mode of operation

The HDMS series of soft starters is designed for single phase motors with a maximum start time of 1 second. It works on an innovative, self-learning algorithm (patent pending) so that no external user adjustments are required. Thanks to its advanced control strategy the HDMS does not require any start capacitor to control capacitor-start-capacitor-run (CSCR) motors. This results in fewer reliability problems within the voltage sensing relays and start capacitors (when hard-start kits are used) and less model variants when replacing traditional single phase soft starters.

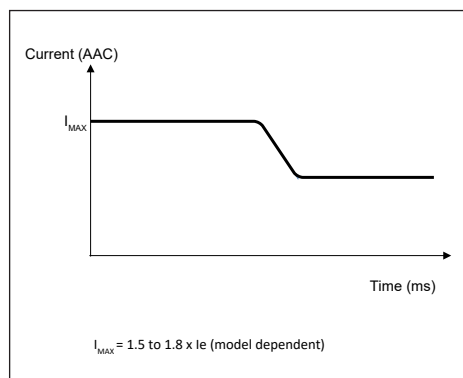
The HDMS is shipped from Carlo Gavazzi with a set of default settings for current limit equivalent to 1.5 to 1.8 times the rated HDMS current. During every motor start, the HDMS makes a number of measurements and adjusts its internal parameters to reduce the starting current during the subsequent motor start. This self-learning routine is active at every start resulting in an optimal motor starting even when the load conditions change and also when the motor ages.

If the excess ramp-up time alarm (6 flashes) is triggered, the HDMS will store the value of the current limit at which this alarm was triggered ( $ISP_{AL}$ ). As a result of this condition, the HDMS will set a minimum current limit setpoint ( $ISP_{MIN}$ ) equivalent to  $1.25 \times ISP_{AL}$  for all subsequent starts. The next start attempt, following an excess ramp-up time alarm, will be done at  $1.5 \times I_e$  (rated HDMS current). The value of  $ISP_{MIN}$  can be reset via Modbus.

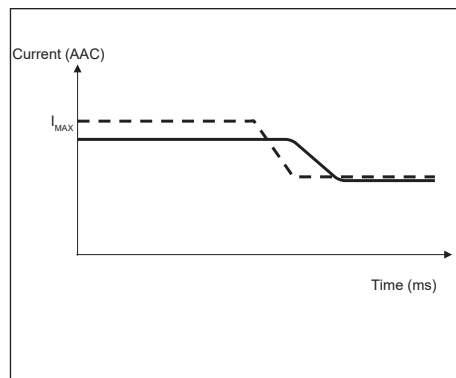
The ramp-up time is automatically limited to a maximum of 1 second making the HDMS ideal for scroll compressors and submersible pump applications.

A unique function within the HDMS is the high pressure (HP) function. The HP function is designed to detect a locked rotor condition during start. In this event, the HDMS will trigger the HP function and increase the "self-learned" current limit to a maximum of 1.5 to 1.8 times the nominal current of the HDMS to try to start the motor within 1 second. Should this not be enough the HDMS will activate the end of ramp alarm to protect the bypass relay from switching a high load current.

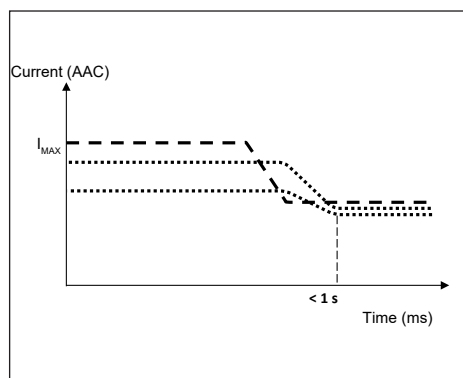
The alarms follow an automatic recovery routine to re-start the motor in case the alarm condition is cleared. This feature further reduces the machine downtime and user intervention in case of recoverable alarms.



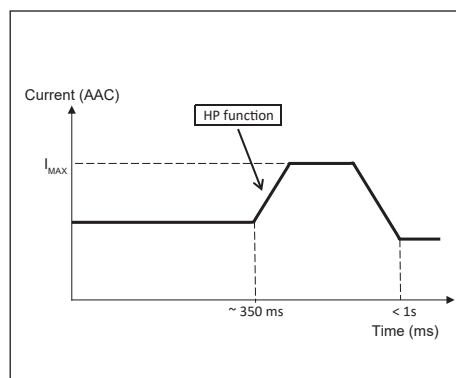
Start 1



Start 2



Start 3

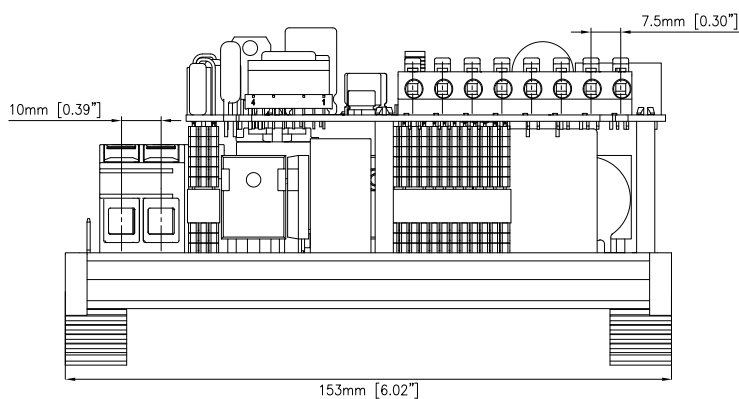


Start 4

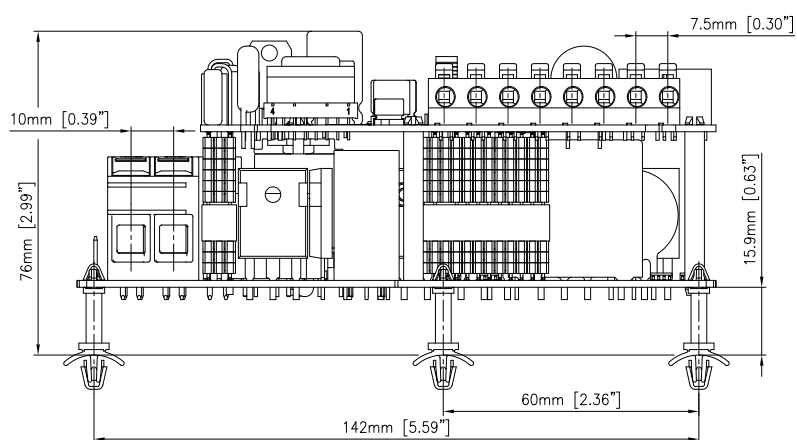
# Features

## General

|                      |                    |
|----------------------|--------------------|
| Assembly             | DIN or Panel       |
| Protection grade     | IP00               |
| Conformal coating    | Yes                |
| Cooling type         | Natural convection |
| Weight               | approx. 500 g      |
| Overvoltage category | III                |



HDMS...V21. version



HDMS...V20. versions

## Settings

|                              |                                                                                                                                    |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ramp-up time</b>          | 1 sec (non-adjustable)                                                                                                             |
| <b>Ramp-down time</b>        | 0 sec (non-adjustable)                                                                                                             |
| <b>Initial torque</b>        | Automatically determined by HDMS                                                                                                   |
| <b>FLC setting</b>           | Default: I <sub>e</sub> (soft starter rated current)<br>Can be changed via Modbus only                                             |
| <b>Modbus device address</b> | Base address: 0 (default)<br>Adjustable to Base address (+ 1) via jumper on PCB<br>Additional addresses can be selected via Modbus |

## Power Supply

|                                                          |                    |
|----------------------------------------------------------|--------------------|
| <b>Operational voltage range</b>                         | 93.5 – 253 VACrms  |
| <b>Supply current at idle</b>                            | < 30 mArms         |
| <b>Rated AC frequency</b>                                | 50/60 Hz (+/- 10%) |
| <b>Rated insulation voltage</b>                          | 275 VAC            |
| <b>Dielectric withstand voltage:<br/>Supply to input</b> | 1.5 kVrms          |
| <b>Integrated varistor</b>                               | Yes                |

## Environmental

|                              |                                                                                                                                        |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>Working temperature</b>   | -20°C to + 65°C (-4°F to + 149°F)                                                                                                      |
| <b>Storage temperature</b>   | -40°C to + 80°C (-40°F to +176°F)                                                                                                      |
| <b>Relative humidity</b>     | < 95% non-condensing @ 40°C                                                                                                            |
| <b>Pollution degree</b>      | 2                                                                                                                                      |
| <b>Installation category</b> | III                                                                                                                                    |
| <b>Installation altitude</b> | 1000 m (without derating)                                                                                                              |
| <b>Vibration</b>             | Acc. to IEC/EN 60068-2-6<br>Fc 10 Hz to 150 Hz at 0.5 g (5 m/s <sup>2</sup> ) constant acceleration                                    |
| <b>Shock</b>                 | Acc. to IEC/EN 60068-2-27<br>15 g (150 m/s <sup>2</sup> ), 11 ms pulse duration<br>3 shocks per plane, half sine positive and negative |

## Compatibility and conformity

|             |                                                                                                                                                                     |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Conformance | EN/IEC 60947-4-2<br>UL 60947-4-2                                                                                                                                    |
| Approvals   |   |

| Electromagnetic compatibility (EMC) - immunity |                                                                                                                                                                                                                                                                                                |
|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Electrostatic discharge (ESD) Immunity         | EN/IEC 61000-4-2<br>8 kV air discharge, 4 kV contacts                                                                                                                                                                                                                                          |
| Radiated radio frequency Immunity              | EN/IEC 61000-4-3<br>10 V/m from 80 MHz to 1 GHz (PC1)<br>10 V/m from 1 GHz to 2.7 GHz (PC1)                                                                                                                                                                                                    |
| Electrical Fast Transient (Burst) Immunity     | EN/IEC 61000-4-4<br>Output: 2 kV (5 kHz) (PC2)<br>4 kV (5 kHz) (PC2)<br>AC input: 2 kV (5 kHz) (PC1)<br>Signal and control: 2 kV (5 kHz) (PC1)<br>Modbus: 2 kV (5 kHz) (PC1)                                                                                                                   |
| Conducted Radio Frequency                      | EN/IEC 61000-4-6<br>10 V/m from 0.15 to 80 MHz                                                                                                                                                                                                                                                 |
| Electrical Surge                               | EN/IEC 61000-4-5<br>Output, line to line: 1 kV (PC1)<br>Output, line to earth: 2 kV (PC1)<br>AC input, line to line: 1 kV (PC2)<br>AC input, line to earth: 2 kV (PC2)<br>Signal and control, line to earth: 1 kV (PC2)<br>Modbus: Ground to earth: 2 kV (PC2)<br>A and B to earth: 2 kV (PC2) |
| Voltage Dips                                   | 0% for 10 ms (PC1)<br>0% for 20 ms (PC1)<br>40% for 100 ms (PC1)<br>40% for 200 ms (PC1)<br>40% for 1000 ms (PC1)<br>70% for 10 ms (PC1)<br>70% for 500 ms (PC1)<br>80% for 5000 ms (PC2)<br>0% for 5000 ms (PC2)                                                                              |

| Electromagnetic compatibility (EMC) - emissions |                                                                                                                                                                                       |
|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Radio Interference field emission (Radiated)    | EN/IEC 55011<br>Class B (residential): from 30 to 1000 MHz                                                                                                                            |
| Radio interference field emissions (conducted)  | EN/IEC 55011<br>Class B (residential): from 0.15 to 30 MHz                                                                                                                            |
| Clicks*                                         | EN/IEC 55014<br>Pass (exception 4)                                                                                                                                                    |
| Flicker*                                        | 12 Arms: IEC/EN 61000-3-11<br>Clause 4b where the service current capacity $I \geq 100$ A<br>25, 32, 37 Arms: IEC/EN 61000-3-11<br>Clause 4a ( $Z_{MAX}$ ) is 0.243 ohm [4 starts/hr] |
| Harmonics                                       | 12 Arms: IEC/EN 61000-3-2<br>25, 32, 37 Arms: IEC/EN 61000-3-12                                                                                                                       |

\* At rated starts per hour. Load conditions apply.

- Performance Criteria 1 (PC1): No degradation of performance or loss of function is allowed when the product is operated as intended.
- Performance Criteria 2 (PC2): During the test, degradation of performance or partial loss of function is allowed. However when the test is complete the product should return operating as intended by itself.

## Inputs

|                                                                                         |                                                                                        |
|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Control voltage (Uc)                                                                    | 110 – 230 VAC +10%, -15%, 50/60 Hz                                                     |
| Control voltage range (Uc)                                                              | 93.5 – 253 VAC                                                                         |
| Maximum pick-up voltage                                                                 | 80 VAC                                                                                 |
| Minimum drop out voltage                                                                | 18.5 VAC                                                                               |
| Supply voltage range (Us)                                                               | (Internally supplied) via L/L1 – N/L2                                                  |
| AC frequency range                                                                      | 45 – 66 Hz                                                                             |
| Rated insulation voltage (Ui)                                                           | 275 VAC                                                                                |
| Dielectric strength:<br>Dielectric withstand voltage<br>Rated impulse withstand voltage | 1.5 kVrms<br>1.5 kVrms                                                                 |
| Control input current                                                                   | 5 mArms                                                                                |
| Input to output response time                                                           | 200 ms (if mains already present)<br>1.2 s (if control is applied together with mains) |
| Integrated varistor                                                                     | Yes                                                                                    |

## Outputs

|                                                                                         | HDMS..12         | HDMS..25           | HDMS..32           | HDMS..37          |
|-----------------------------------------------------------------------------------------|------------------|--------------------|--------------------|-------------------|
| Overload cycle @ 40°C<br>surrounding temperature<br>(acc. to IEC/EN 60947-4-2)          | AC53b: 1.5-1:359 | AC53b: 1.5-0.6:360 | AC53b: 1.7-0.7:360 | AC53b:1.8-0.7:360 |
| Maximum number of starts/hr<br>@ rated overload cycle @ 40°C<br>surrounding temperature | 10               |                    |                    |                   |
| Rated operational current @ 40°C                                                        | 12 Arms          | 25 Arms            | 32 Arms            | 37 Arms           |
| Rated operational current @ 65°C                                                        | 12 Arms          | 16 Arms            | 32 Arms            | 37 Arms           |
| Minimum load current                                                                    | 1 Arms           | 1 Arms             | 5 Arms             | 5 Arms            |
| Blocking voltage                                                                        | 1200 Vp          |                    |                    |                   |

## Auxiliary relays

|                              |                                                                                                            |
|------------------------------|------------------------------------------------------------------------------------------------------------|
| Number of output relays      | 2                                                                                                          |
| Function of relays           | Alarm, Bypassed (top of ramp) indication                                                                   |
| Rated operational voltage    | 250 VAC / 30 VDC                                                                                           |
| Rated insulation voltage     | 250 VAC                                                                                                    |
| Dielectric withstand voltage | 2.5 kV                                                                                                     |
| Overvoltage category         | II                                                                                                         |
| Type of control circuit      | Electromechanical relay                                                                                    |
| Number of contacts           | Alarm and bypassed: 1                                                                                      |
| Type of contacts             | Alarm (normally closed, NC)<br>Bypassed (normally open, NO)<br>Note: relay logic may be changed via Modbus |
| Type of current              | AC / DC                                                                                                    |
| Rated operational current    | 3 Arms @ 250 VAC 3 Arms @ 30 VDC (resistive loads)                                                         |


**Modbus RTU**

|                                    |                                                                                                                                                          |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Type</b>                        | Bi-directional (static and dynamic variables and parameters)                                                                                             |
| <b>Functions</b>                   | Configuration of device<br>Start/Stop<br>Modification of set-point parameters<br>Monitoring of measured variables                                        |
| <b>Connection</b>                  | 2-wires<br>Note: To reduce the noise use a shielded cable.                                                                                               |
| <b>Address</b>                     | Default : 1<br>Selectable via software: range 1 – 247<br>Note: Base address can be shifted by +1 by changing the jumper position (see Structure section) |
| <b>Protocol</b>                    | Modbus (RTU)                                                                                                                                             |
| <b>Factory defined data format</b> | Data bits: 8<br>Parity: none<br>Stop bit: 1<br>Selectable via software: parity: none (2 stop bits), odd (1 stop bit), even (1 stop bit)                  |
| <b>Baud rate</b>                   | Default: 9.6k bits/s<br>Selectable via software: 9.6k, 19.2k, 38.4k, 57.6k bits/s                                                                        |

Note: The HDMS requires a two-wire electrical interface in accordance with EIA/TIA-485 standard. A third conductor is recommended to be connected to all the devices of the Bus, referred to as Common. Use shielded cables to avoid external noise interference. The shield should be connected to protective ground at one end of each cable. If a connector is used at this end, the shell of the connector shall be connected to the shield of the cable.

## Performance


**Current / power ratings: kW and HP @ 40°C**

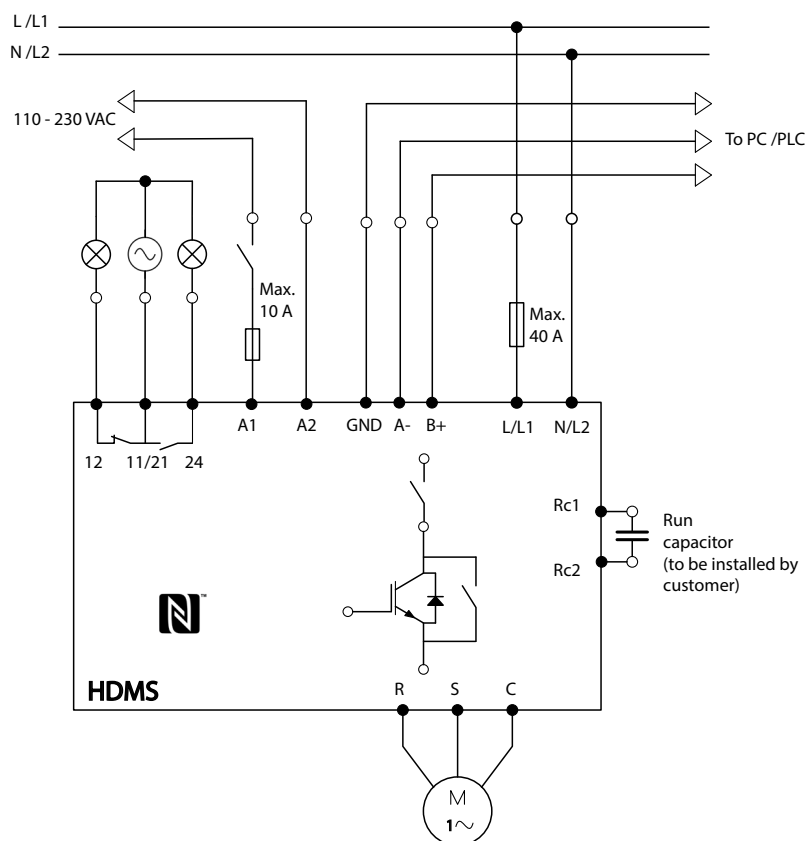
| Model       | IEC rated current | 110 – 120 VAC     | 220 – 240 VAC |
|-------------|-------------------|-------------------|---------------|
| HDMS2312... | 12 Arms           | 0.56 kW / 0.75 HP | 1.5 kW / 2 HP |
| HDMS2325... | 25 Arms           | 1.1 kW / 2 HP     | 3.7 kW / 3 HP |
| HDMS2332... | 32 Arms           | 1.5 kW / 2 HP     | 4 kW / 5 HP   |
| HDMS2337... | 37 Arms           | 2.2 kW / 3 HP     | 5.5 kW / 5 HP |

Ratings:

kW rating according to IEC/EN 60947-4-2

HP rating according to UL60947-4-2

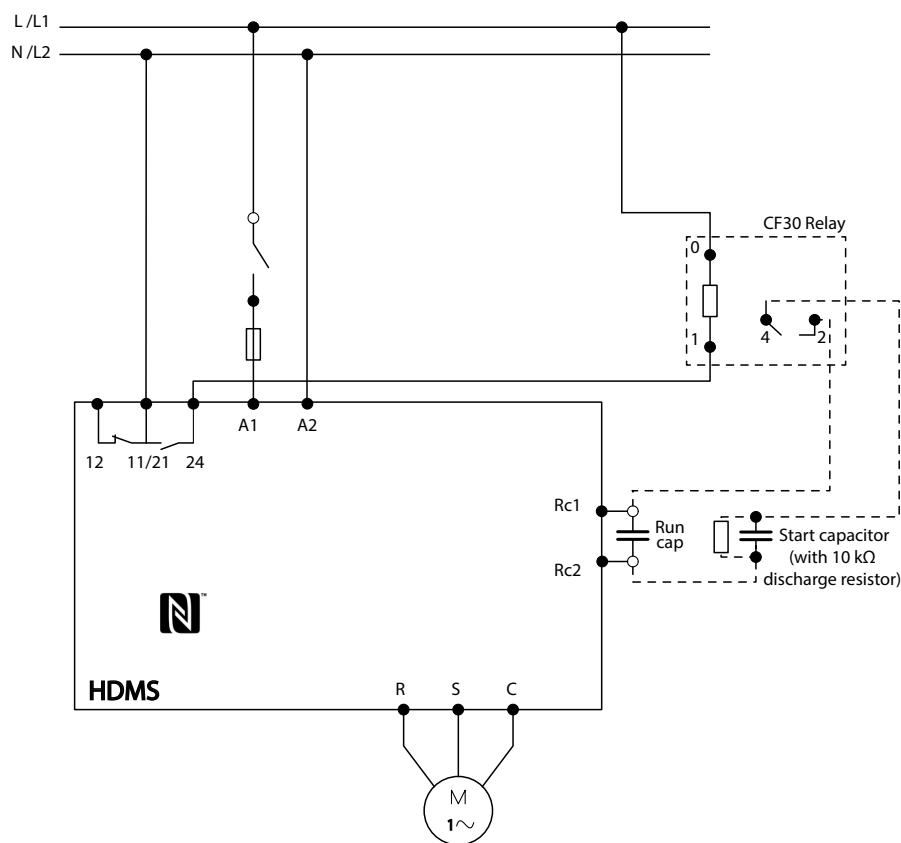
## Connection diagrams



### Terminal markings

| Marking       |                                                                                                                                                                                      |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L/L1, N/L2    | Line connections                                                                                                                                                                     |
| R, S, C       | Load connections<br>R – Main winding , S – Start winding , C – Common                                                                                                                |
| Rc1, Rc2      | Run capacitor connection<br>Note: If run capacitor is not used (or not accessible), short RC <sub>1</sub> and RC <sub>2</sub> with a cable of minimum 2.5 mm <sup>2</sup> thickness. |
| A1, A2        | Control voltage                                                                                                                                                                      |
| 11, 12        | Alarm indication                                                                                                                                                                     |
| 21, 24        | Bypass indication                                                                                                                                                                    |
| A -, B +, GND | Modbus connections                                                                                                                                                                   |

## Connection diagrams (cont.)



**HDMS Booster kit connection**

Note: When using booster kit relay logic for 21, 24 must be changed to normally closed (NC) logic. Refer to Modbus manual.

### Terminal markings

| Marking       |                                                                                                                                                                                      |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L/L1, N/L2    | Line connections                                                                                                                                                                     |
| R, S, C       | Load connections<br>R – Main winding , S – Start winding , C – Common                                                                                                                |
| Rc1, Rc2      | Run capacitor connection<br>Note: If run capacitor is not used (or not accessible), short RC <sub>1</sub> and RC <sub>2</sub> with a cable of minimum 2.5 mm <sup>2</sup> thickness. |
| A1, A2        | Control voltage                                                                                                                                                                      |
| 11, 12        | Alarm indication                                                                                                                                                                     |
| 21, 24        | Bypass indication                                                                                                                                                                    |
| A -, B +, GND | Modbus connections                                                                                                                                                                   |

## Connection specifications

| Line conductors L / L1, N / L2, R, S, C (acc. to EN60947-1) |                           |
|-------------------------------------------------------------|---------------------------|
| Flexible                                                    | 0.75 – 10 mm <sup>2</sup> |
| Rigid (solid or stranded)                                   | 0.75 – 10 mm <sup>2</sup> |
| Flexible with end sleeve (ferrule)                          | 0.75 – 10 mm <sup>2</sup> |
| Rigid (solid or stranded)                                   | 8 – 18 AWG                |
| Terminal type                                               | Lever type terminal       |
| Maximum tightening torque                                   | Not applicable            |
| Stripping length                                            | 17 – 18 mm                |

| Secondary conductors A1, A2, 11, 12, 21, 24, A-, B+, GND (acc. to EN60998) |                           |
|----------------------------------------------------------------------------|---------------------------|
| Flexible                                                                   | 0.5 – 2.5 mm <sup>2</sup> |
| Rigid (solid or stranded)                                                  | 0.5 – 2.5 mm <sup>2</sup> |
| Flexible with end sleeve (ferrule)                                         | 0.5 – 2.5 mm <sup>2</sup> |
| Rigid (solid or stranded)                                                  | 12 – 20 AWG               |
| Terminal type                                                              | Spring loaded terminal    |
| Maximum tightening torque                                                  | Not applicable            |
| Stripping length                                                           | 10 – 11 mm                |

Use 75°C copper (Cu) conductors

# Troubleshooting

## LED status indication

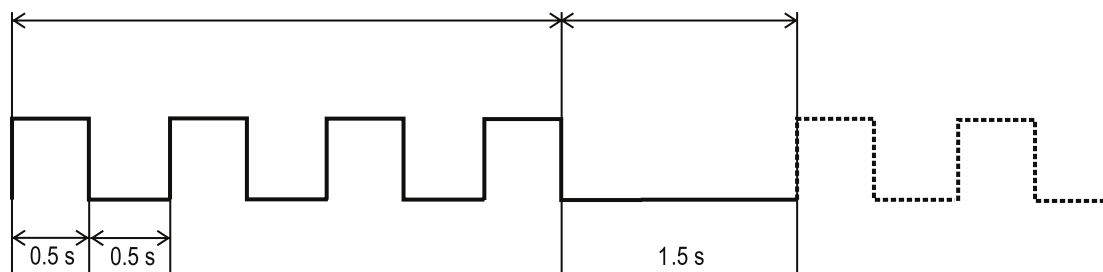
| State                       | Supply<br>(green LED) | Ramp/Bypass<br>(yellow LED) | Alarm<br>(red LED) | Modbus<br>(blue LED) |
|-----------------------------|-----------------------|-----------------------------|--------------------|----------------------|
| Idle                        | ON                    | OFF                         | OFF                | OFF/Flashing         |
| Ramping                     | ON                    | Flashing                    | OFF                | OFF/Flashing         |
| Bypass                      | ON                    | ON                          | OFF                | OFF/Flashing         |
| Alarm (Auto-recovery)       | ON                    | OFF                         | Flashing           | OFF/Flashing         |
| Internal fault              | ON                    | OFF                         | ON                 | OFF/Flashing         |
| Modbus communication active | ON                    | ON/OFF                      | ON/OFF/Flashing    | Flashing             |
| Delay time between starts   | Flashing              | OFF                         | OFF                | OFF/Flashing         |

## Relay status indication

| State                       | Alarm<br>(11, 12) | Bypass<br>(21, 24) |
|-----------------------------|-------------------|--------------------|
| OFF                         | Closed            | Open               |
| Idle                        | Closed            | Open               |
| Ramping                     | Closed            | Open               |
| Bypass                      | Closed            | Closed             |
| Alarm (Auto-recovery)       | Open              | Open               |
| Internal fault              | Open              | Open               |
| Modbus communication active | -                 | -                  |

Note: Relay logic can be modified via Modbus

## Alarms



|                                          |                                                                                                                                                             |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of flashes</b>                 | 2                                                                                                                                                           |
| <b>Alarm</b>                             | Reverse rotation                                                                                                                                            |
| <b>Alarm description</b>                 | The HDMS will trigger this alarm when it detects that the motor is rotating in reverse. This condition may happen as a result of brief power interruptions. |
| <b>Alarm recovery period</b>             | 5 minutes                                                                                                                                                   |
| <b>Consecutive alarms for hard reset</b> | 5                                                                                                                                                           |
| <b>Action to recover alarm</b>           | The alarm will self-recover.                                                                                                                                |
| <b>Troubleshooting</b>                   | <ul style="list-style-type: none"> <li>• Check for voltage interruptions on the mains input.</li> </ul>                                                     |

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of flashes</b>                 | 3                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Alarm</b>                             | Line voltage out of range                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Alarm description</b>                 | <p>At every power-up the HDMS automatically detects the supply voltage level and determines whether it is working on a 110 or 230 VAC supply. The under- or over- voltage alarm level is then set at a level of -20% and + 20% (from the measured supply voltage level) respectively.</p> <p>If the supply voltage level is out of these limits for more than 5 seconds, then the line voltage out of range alarm will be triggered.</p> |
| <b>Alarm recovery period</b>             | 5 minutes                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Consecutive alarms for hard reset</b> | 5                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Action to recover alarm</b>           | The alarm will self-recover (in auto-recovery mode) after 5 minutes from when the supply voltage is within limits.                                                                                                                                                                                                                                                                                                                       |
| <b>Troubleshooting</b>                   | <ul style="list-style-type: none"> <li>• Check supply voltage level across L1, N terminals.</li> <li>• Check for possible disturbances on the voltage network (such as unfiltered variable frequency drives).</li> </ul>                                                                                                                                                                                                                 |

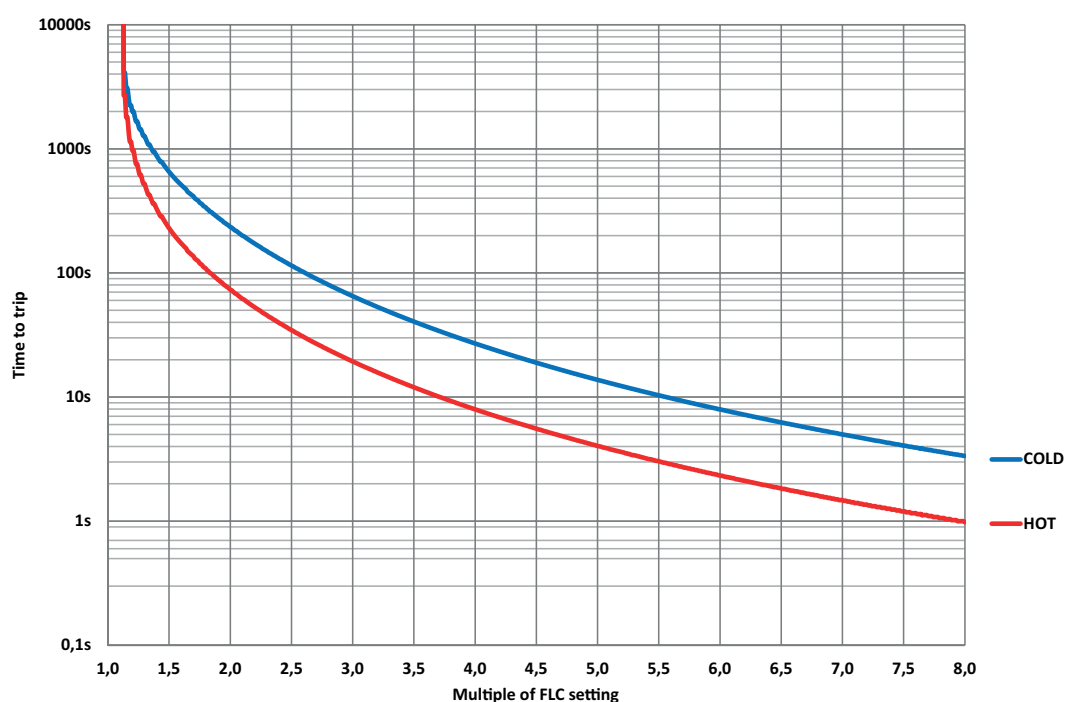
|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of flashes</b>                 | 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Alarm</b>                             | Wiring fault                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Alarm description</b>                 | If the HDMS measures a current $\leq 750$ mA for 2 mains cycles (40 ms approx.) when control is applied, the HDMS will trigger this alarm. This alarm may trigger in case there is a fault in the run capacitor, compressor start winding or if run capacitor is not connected to RC <sub>1</sub> and RC <sub>2</sub> terminals.                                                                                                                                                                                                                                        |
| <b>Alarm recovery period</b>             | 5 minutes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Consecutive alarms for hard reset</b> | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Action to recover alarm</b>           | The alarm will self-recover after 5 minutes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Troubleshooting</b>                   | <ul style="list-style-type: none"> <li>• Check that the leads of the run capacitor are properly connected to the HDMS faston terminals.</li> <li>• Check that the run capacitor is not faulty. In case it is faulty replace with a new one.</li> <li>• Check the resistance on the start winding.</li> <li>• Check the connection from the HDMS to the compressor start winding (S) + common (C).</li> <li>• If run capacitor is not used (or not accessible), short RC<sub>1</sub> and RC<sub>2</sub> with a cable of minimum 2.5 mm<sup>2</sup> thickness.</li> </ul> |

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of flashes</b>                 | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Alarm</b>                             | Locked rotor                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Alarm description</b>                 | <p>This alarm is triggered when <math>I_{\text{RUN}} \geq 8 \times \text{FLC}</math> or <math>I_{\text{TOT}} \geq 8 \times \text{FLC}</math> for at least 5 mains cycles (100 ms approx.)</p> <p><math>I_{\text{RUN}}</math> = current measured on main winding (R)<br/> <math>I_{\text{TOT}}</math> = current measured on L/L1 (current drawn from mains)<br/> Note: Unless the value of FLC is modified via Modbus, the default value of FLC = I<sub>e</sub>.</p> |
| <b>Alarm recovery period</b>             | 5 minutes                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Consecutive alarms for hard reset</b> | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Action to recover alarm</b>           | The alarm will self-recover after 5 minutes.                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Troubleshooting</b>                   | <ul style="list-style-type: none"> <li>• Check that the HDMS model is suitably rated for the motor.</li> <li>• Check motor windings resistance to check if motor is damaged.</li> </ul>                                                                                                                                                                                                                                                                             |

|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of flashes</b>                 | 6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Alarm</b>                             | Excess ramp-up time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Alarm description</b>                 | The HDMS limits the maximum motor start time to a maximum of 1 second. If the motor does not reach full speed within this time, the HDMS will trigger this alarm.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Alarm recovery period</b>             | 5 minutes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Consecutive alarms for hard reset</b> | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Action to recover alarm</b>           | The alarm will self-recover after 5 minutes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Troubleshooting</b>                   | <ul style="list-style-type: none"> <li>• Check that the HDMS model is suitably rated for the motor.</li> <li>• Check motor windings resistance to check if motor is damaged.</li> <li>• Check for high pressure difference during start. In case of unbalance, allow enough delay time for pressures to balance.</li> <li>• Check the mains voltage level during motor start. In case the voltage is too low, the HDMS might not supply enough current to start the load.</li> <li>• Check that the run capacitor has the correct capacitance value according to manufacturer recommendations.</li> <li>• Check that main (R) winding is connected properly.</li> <li>• Install a booster kit to inverse starting torque.</li> </ul> |

|                                          |                                                                                                                                                                                                                                                                                               |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of flashes</b>                 | 7                                                                                                                                                                                                                                                                                             |
| <b>Alarm</b>                             | Over-temperature                                                                                                                                                                                                                                                                              |
| <b>Alarm description</b>                 | The HDMS is equipped with a NTC sensor. If the measured temperature $\geq 90^{\circ}\text{C}$ (and lower than $-30^{\circ}\text{C}$ ) for $\geq 0.5$ s the HDMS will trigger this alarm.                                                                                                      |
| <b>Alarm recovery period</b>             | 5 minutes<br>(or longer depending on the cooling time required for the temperature to settle to within the permissible temperature limits)                                                                                                                                                    |
| <b>Consecutive alarms for hard reset</b> | 5                                                                                                                                                                                                                                                                                             |
| <b>Action to recover alarm</b>           | The alarm will self-recover.                                                                                                                                                                                                                                                                  |
| <b>Troubleshooting</b>                   | <ul style="list-style-type: none"> <li>• Check the HDMS surrounding temperature and ensure that there is enough ventilation around it.</li> <li>• Check for sources with high heat dissipation.</li> <li>• Make sure that the number of starts per hour specified is not exceeded.</li> </ul> |

|                                          |                                                                                                                                                                                                                                                  |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of flashes</b>                 | 8                                                                                                                                                                                                                                                |
| <b>Alarm</b>                             | Overload                                                                                                                                                                                                                                         |
| <b>Alarm description</b>                 | The overload alarm can be triggered in case of the following conditions:<br>Measured current $> 1.05 \times I_e$ during bypass.<br>If load current $> \text{FLC}$ , then trip time will vary according to Trip Class 10.                         |
| <b>Alarm recovery period</b>             | Depends on the cooling period.<br>The HDMS will only recover if the internal temperature is within safe limits.                                                                                                                                  |
| <b>Consecutive alarms for hard reset</b> | 5                                                                                                                                                                                                                                                |
| <b>Action to recover alarm</b>           | The alarm will recover automatically. The recovery time will vary according to the cooling time required by HDMS. In any case it will be 5 minutes or longer.<br>Note: allow enough time for the motor to cool before attempting the next start. |
| <b>Troubleshooting</b>                   | <ul style="list-style-type: none"> <li>• Make sure that the FLC setting is according to the current on the motor name plate.</li> <li>• Check for any blockages in the load.</li> </ul>                                                          |



|                                          |                                                                                                                                                                             |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of flashes</b>                 | 9                                                                                                                                                                           |
| <b>Alarm</b>                             | Microcontroller reset                                                                                                                                                       |
| <b>Alarm description</b>                 | In the case there is a microcontroller reset during power-up sequence (i.e. when user applies mains power), the HDMS will trigger this alarm.                               |
| <b>Alarm recovery period</b>             | 5 minutes                                                                                                                                                                   |
| <b>Consecutive alarms for hard reset</b> | 1                                                                                                                                                                           |
| <b>Action to recover alarm</b>           | The alarm will self-recover (in auto-recovery mode) after 5 minutes.                                                                                                        |
| <b>Troubleshooting</b>                   | <ul style="list-style-type: none"> <li>• Check for possible external noise sources such as large mechanical contactors installed in close proximity to the HDMS.</li> </ul> |

|                                          |                                                                                                                                                                                   |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of flashes</b>                 | 10                                                                                                                                                                                |
| <b>Alarm</b>                             | Shorted power unit                                                                                                                                                                |
| <b>Alarm description</b>                 | The HDMS will trigger this alarm when it detects a current flow during idle state or when voltage is present on main winding when main relay SCRs are energised.                  |
| <b>Alarm recovery period</b>             | 5 minutes                                                                                                                                                                         |
| <b>Consecutive alarms for hard reset</b> | 1                                                                                                                                                                                 |
| <b>Action to recover alarm</b>           | The alarm does not self-recover.                                                                                                                                                  |
| <b>Troubleshooting</b>                   | <ul style="list-style-type: none"> <li>• Check if problem is cleared by resetting the power.</li> <li>• If problem persists contact your Carlo Gavazzi representative.</li> </ul> |

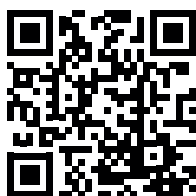
|                                          |                                                                                                                                                                                  |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Number of flashes</b>                 | Fully ON                                                                                                                                                                         |
| <b>Alarm</b>                             | Internal fault                                                                                                                                                                   |
| <b>Alarm description</b>                 | In case there is an internal fault in the HDMS circuitry, the Red LED will remain continuously ON.                                                                               |
| <b>Alarm recovery period</b>             | -                                                                                                                                                                                |
| <b>Consecutive alarms for hard reset</b> | 1                                                                                                                                                                                |
| <b>Action to recover alarm</b>           | Note: this alarm is not resettable and it is suggested to replace the unit and contact a Carlo Gavazzi representative should this alarm occur.                                   |
| <b>Troubleshooting</b>                   | <ul style="list-style-type: none"> <li>• Check if problem is cleared by resetting the power through L1/L, L2/N.</li> <li>• If the alarm persists, replace the device.</li> </ul> |

## Short circuit protection

Type 1 protection implies that after a short circuit, the device under test will no longer be in a functioning state. The product variants listed in the table hereunder are suitable for use on a circuit capable of delivering not more than 5,000 symmetrical Amperes, 240 Volts maximum when protected by fuses. Tests at 5,000 A were performed with Class RK5 fuses; please refer to the table below for maximum allowed Ampere rating of the fuse. Use fuses only.

### Protection co-ordination Type 1 according to UL 60947-4-2

| Item No.    | Max. fuse size [A] | Current [kA] | Class | Max. voltage [VAC] | Max. cross-sectional area  |
|-------------|--------------------|--------------|-------|--------------------|----------------------------|
| HDMS2312... | 40                 | 5            | RK5   | 240                | 10 mm <sup>2</sup> / AWG 8 |
| HDMS2325... |                    |              |       |                    |                            |
| HDMS2332... |                    |              |       |                    |                            |
| HDMS2337... |                    |              |       |                    |                            |



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