ACS GEN7

# ACS inverters/motor controllers

The ACS GEN7 is a family of inverters/motor controllers that gives you the freedom to design your vehicles with the functions your customers want. Developed with traction, hydraulic pump, and generator applications in mind, the ACS is an ideal choice for most battery-powered electric vehicles. Choose between different nominal input voltages and a range of output power levels. The weather protection ensures a reliable performance without the need for maintenance, even for your off-road vehicles. The ACS meets industry standards for cybersecurity, functional and electrical safety to let you focus on your core business without worrying about service issues.
Our PLASMA software platform offers you a highly customizable collection of standard vehicle functions that meet demanding functional safety requirements. With PLASMA, you benefit from many years of experience with different kinds of applications.

Inmotion is a long-term, global supplier of electric motors, motor controllers, inverters and auxiliary equipment for commercial vehicles. Our "In-region, for-region" manufacturing strategy brings our production facilities closer to yours. This gives you higher quality at a lower cost and shorter lead time. We work in close cooperation with you to integrate and configure our products to your specific needs. Realize your vehicles for emission-free transport solutions.

## ACS is a flexible standard platform

- **Power** levels **4-80 kVA** and nominal voltages **24-96 V**
- Supports **AC induction**, **AC synchronous** and **brushless DC motors**
- **Standard firmware** with **extensive configurability** ensures optimal system functionality
- Application software **can be configured by you** or by Inmotion
- **ARM processor** capable of **parallel execution of motor control** and **customized** vehicle control **tasks**
- **Auto tuning** functionality for pairing the controller with a motor already installed in a vehicle
- Support for **traction, pump or generator applications** including functions such as hill-hold, programmable braking/acceleration characteristics and dual traction
- **CAN** communication, **J1939** and/or **CANopen** (slave or master) with support for diagnostics and software download

## Monitoring of operation for optimal performance

- **I/O version** allows **vehicle control** to reside **in the ACS**, directly interfacing vehicle sensors and actuators
- State of the art **vector control** with optimal efficiency throughout the full speed range

## Safety and protection

- Supports **safety functions** according to ISO13849-1 category 2, PL= c/d
- **Dual motor feedback channels** facilitate sensor cross-monitoring
- **Dual CPUs** (option) allow for category 3 safety functions, PL = c/d
- **Limitation** of the **output** as a function of motor speed, motor and controller temperature, battery voltage, DC power, DC current and/or motor torque to **protect powertrain components**
- **Overvoltage protection** for PM machines with high back-EMF (available on selected ACS models)

## Maximize operating time by minimizing service time

- **Software quality** is assured through development and review processes in compliance with **Automotive SPICE©** and **ISO 13849-1**
- Extensive and powerful **event handling** and **data logging** simplify **troubleshooting** and minimize vehicle down time
- **Multi-axle option** (ACS M), which reduces size, shares components and simplifies cabling and mounting
- Best in class **quality** and **reliability**, achieved through superior design, world class manufacturing processes and **field experience**
- Rugged design **protected** against ingress of dust and water according to **IP65**

## GENERAL

| | |
|---|---|
| Motor type | Induction AC, Synchronous AC, Brushless DC |
| Communication | CAN (CANopen, J1939) |
| Switching frequency | 4, 8, 12, 16 kHz |
| Operating stator frequency | 0-599 Hz |
| Control mode | Speed (rpm), Torque (Nm), Current (ARMS) or Voltage (VDC) |
| Connector | AMP SEAL 23-pin or AMP SEAL 35-pin |
| Operating temperature | - 40 °C to + 55 °C |
| Maximum operating altitude above sea level | 2 000 m |
| Short-term storage/transportation recommendations:<br>Temperature<br>Relative humidity | <br>- 40 °C to + 85 °C<br>< 60 % (non-condensing) |
| Long-term storage recommendations:<br>Temperature<br>Relative humidity | <br>+ 10 °C to + 30 °C<br>< 60 % (non-condensing) |
| Protection class | IP65 |
| Standards | UL 583 and EC declaration of incorporation of partly completed machinery according to directive 2006/42/EC and 2014/30/EU i.e. C-standard EN 1175-1 and EN 12895 |

## I/O SUMMARY[1]

| | ACS 23-pin basic | ACS 35-pin premium | ACS 35-pin resolver[4] | ACS Dual 35-pin |
|---|---|---|---|---|
| Dedicated HW ID | 2 | - | - | - |
| Multifunction I/O[2] | 3 | 5 | - | 5 |
| Digital inputs | - | 9 | 9 | 5 |
| Analog inputs | - | 2 | 2 | - |
| High side in/out | 1 | 1 | 1 | 1 |
| Sensor supply | 1 | 2 | 2 | 2 |
| Current control output | 2 | 2 | 2 | 4 |
| PWM control output | - | 2 | 2 | - |
| On/off output | - | 2 | 2 | - |
| CAN[3] | 2 | 1 | 1 | 2 |
| Motor temp | 1 | 1 | 1 | 2 |

[1] The 23-pin interface (23P) is optimized for slave units in a CAN network, with limited I/O capacity. The 35-pin interface (35P) has a larger number of I/O to be used by the application software for standalone operation, vehicle control, or as distributed I/O in a vehicle network. The dual inverter I/O (35P-D) requires more motor interface pins

[2] Multifunction I/O can be used as motor feedback, analog in, or digital in. Motor feedback supported is encoder, UVW (6-step), analog sin/cos

[3] CAN interface consists of CAN_HIGH, CAN_LOW and CAN_GND. The 23P and 35P-D versions have two of each pin for daisy-chaining in a network. All inverters have a CAN_120 pin that terminates the CAN bus if a jumper is placed in the wiring harness

[4] Support for resolver motor feedback sensor only. Selected ACS models only

## OPTIONS

| ACS model | Power terminals | Multi-axle control |
|---|---|---|
| W | Threads | - |
| S | Threads | - |
| M | Studs or threads | - |
| MD | Studs or threads | Two three-phase motors |
| L | Studs or threads | - |

## CURRENT AND OUTPUT RATINGS

| ACS model | Nominal DC supply voltage [V DC] | Rated current S2, 2 min [ARMS][1] | Rated current S2, 1 h [ARMS][2] | Rated power S2, 2 min [kVA][1] | Rated power S2, 1 h [kVA][2] |
|---|---|---|---|---|---|
| **ACS W** | | | | | |
| ACS24W24[3] | 24 | 240 | 120 | 7.1 | 3.5 |
| ACS48W18[3] | 36/48 | 180 | 90 | 7.9/11 | 4.0/5.3 |
| ACS80W11[4] | 80 | 115 | 50 | 11 | 4.9 |
| ACS96W11[4] | 96 | 115 | 48 | 14 | 5.6 |
| **ACS S[3]** | | | | | |
| ACS24S35 | 24 | 350 | 150 | 10 | 4.4 |
| ACS48S28 | 36/48 | 280 | 120 | 12/16 | 5.3/7.1 |
| **ACS M and ACS MD[3]** | | | | | |
| ACS24M55 | 24 | 550 | 275 | 16 | 8.1 |
| ACS48M35 | 36/48 | 350 | 175 | 15/21 | 7.7/10 |
| ACS48M45 | | 450 | 225 | 20/26 | 9.9/13 |
| ACS48M55 | | 550 | 275 | 24/32 | 12/16 |
| ACS80M23 | 80 | 230 | 115 | 23 | 11 |
| ACS80M35 | | 350 | 175 | 34 | 17 |
| ACS80M40 | | 400 | 200 | 39 | 20 |
| ACS96M23 | 96 | 230 | 115 | 27 | 14 |
| ACS96M35 | | 350 | 175 | 41 | 21 |
| ACS96M40 | | 400 | 180 | 47 | 21 |
| **ACS L** | | | | | |
| ACS48L70 | 36/48 | 700 | 350 | 31/41 | 15/21 |
| ACS48L90 | | 900 | 450 | 40/53 | 20/26 |
| ACS80L50 | 80 | 500 | 250 | 49 | 24 |
| ACS80L60 | | 600 | 300 | 59 | 29 |
| ACS80L70 | | 700 | 350 | 69 | 34 |
| ACS96L50 | 96 | 500 | 250 | 59 | 29 |
| ACS96L60 | | 600[5] | 300 | 71 | 35 |
| ACS96L70 | | 700[5] | 350 | 82 | 41 |

[1] 2 minute rating at 8 kHz switching frequency and 25 ºC ambient temperature

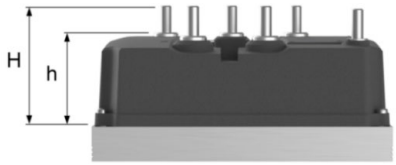
[2] 1 hour rating at 8 kHz switching frequency. 40 ºC ambient temperature. Contact Inmotion for required air flow through finned heat sink

[3] Available with 35-pins I/O connector only

[4] Available with 23-pins I/O connector only

[5] Current rating limited to S2 90 seconds

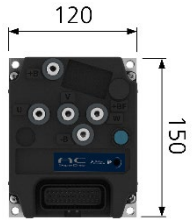
## ACS GEN7 HEIGHT WITHOUT HEAT SINK



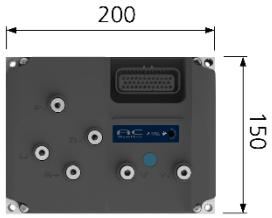

[1] With optional studs
[2] Without optional studs

| ACS model | H[1] [mm] | h[2] [mm] |
|---|---|---|
| W | - | 47.0 |
| S | - | 50.4 |
| M | 72.3 | 52.3 |
| MD | 72.3 | 52.3 |
| L | 79.7 | 59.7 |

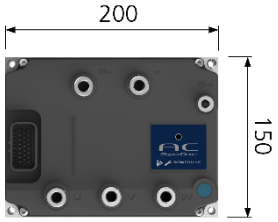
## ACS FOOTPRINTS [mm]



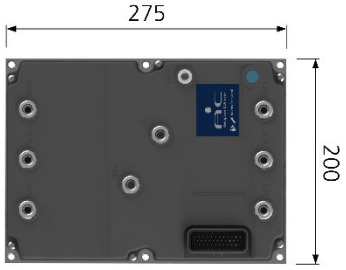

**ACS W**



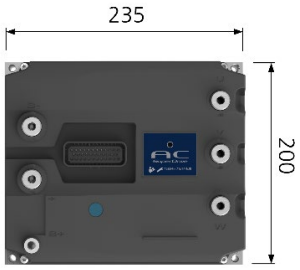

**ACS S**



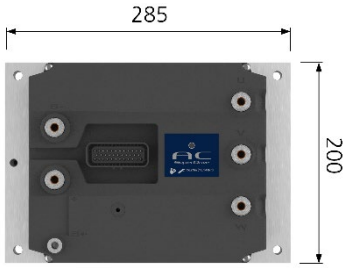

**ACS M**




**ACS MD**

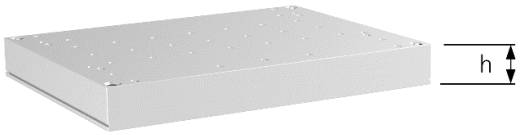
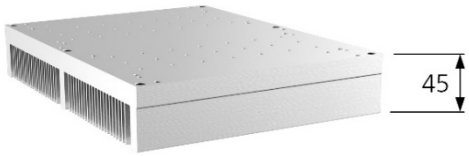
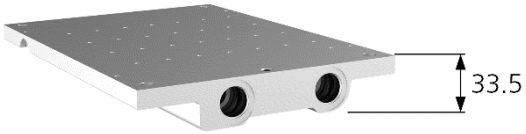
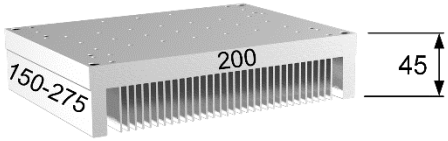



**ACS L**




**ACS L with heat sink type W**

## HEAT SINKS

| Heat sink type | Height [mm] | ACS compatibility |
|---|---|---|
| C (flat) |   | W (h = 11) M (h = 23)<br>S (h = 23) L (h = 23)<br>MD (h = 23) |
| Q (finned) |   | MD |
| T (finned) |   | S<br>M |
| W (liquid-cooled) |   | L |
| Y (finned) |   | S<br>M<br>MD<br>L |