



Rinehart Motion Systems LLC—propelling innovation in electric propulsion

# PM100 and PM150 Family Propulsion Inverters

## PRODUCT SUMMARY

The PM Family of Propulsion Inverters are designed for on- and off-road Electric (EV) or Hybrid Electric (HEV) applications. These motor controllers convert the DC power from the vehicle ESS (Energy Storage System / Battery) to the 3-phase AC required by the motor.

## FEATURE SUMMARY

- 6 (0-5V) Analog Inputs
- 2 selectable PT100 / PT1000 RTD Inputs
- 8 Digital Inputs STB/STG
- 4 High Side Driver Outputs
- 2 Low Side Driver Outputs
- 1 Resolver Interface
- 1 Quadrature Encoder Intf
- 1 Sin-Cos Encoder Intf
- 2 CAN 2.0A/B Ports
- 1MB RS232 Programming Port

## SYSTEM INTEGRATION

Rinehart has extensive experience in automotive, motor-sports, and military vehicle propulsion and power electronics applications.

- consultation in propulsion system design,
- propulsion system integration
- vehicle development
- Multi-wheel propulsion



A Family of compact, robust, reliable, easy to integrate, and cost effective propulsion inverters for 60—200Hp class OEM and specialty heavy equipment builders. Applications include high-performance road cars, professional motor-sports, heavy vehicle hybrid propulsion, static energy conversion, hybrid range extender or ISG controller, and many more. Suitable for military COTS usage.

| Controller Model                   | PM100DX               | PM100DZ | PM150DX               | PM150DZ |                  |
|------------------------------------|-----------------------|---------|-----------------------|---------|------------------|
| DC Voltage – operating             | 50—400                | 100—800 | 50—400                | 50—800  | V <sub>DC</sub>  |
| DC Overvoltage Trip                | 420                   | 840     | 420                   | 840     | V <sub>DC</sub>  |
| Maximum DC Voltage – non-operating | 500                   | 900     | 500                   | 900     | V <sub>DC</sub>  |
| Motor Current Continuous           | 300                   | 150     | 450                   | 225     | A                |
| Motor Current Peak *               | 350                   | 200     | 450*                  | 300     | A <sub>rms</sub> |
| Output Power Peak (elect) *        | 100                   | 100     | 150                   | 150     | kVA              |
| DC Bus Capacitance                 | 440                   | 280     | 880                   | 560     | μF               |
| Size and Volume                    | 200 x 87 x 314<br>5.5 |         | 200 x 87 x 436<br>7.6 |         | mm<br>L          |
| Weight                             | 7.5                   | 7.5     | 10.7                  | 10.7    | kg               |
| Cable Gland Size                   | M25                   | M25     | M32                   | M32     |                  |
| Minimum Conductor Size             | 4                     | 4       | 2                     | 4       | AWG              |
| Maximum Conductor Size             | 1                     | 1       | 3/0                   | 1       | AWG              |
| Minimum Cable O.D.**               | 9                     | 9       | 11                    | 11      | mm               |
| Maximum Cable O.D.                 | 16.5                  | 16.5    | 21                    | 21      | mm               |

Ratings subject to change without notice—consult factory

\* peak is 10seconds, PM150DX is terminal / wire size limited.

\*\* depending on cable type, if diameter is too small it may be necessary to sleeve the cable.

Rinehart Motion Systems LLC

Hybrid vehicles, power hybrid packaging, power electronics and propulsion controls



# PM100 PM150 Propulsion Inverters

## Automotive quality design and manufacturing

- Automotive qualified or temp range components, IPC Class 3 PCB fab
- TS16949-compliant formal product development processes
- Automotive design verification and product validation with full DVPr

## Full set of flexible integrated I/O

- 5V analog power for external transducers and
- 5V digital power for external encoder operation
- All external inputs can be used by the system controller as distributed I/O

## On the fly mode switching and parameter update over CAN

- speed or torque mode on command at Start
- Torque limits can be changed every 6msec
- Active DC Link discharge on command

## Configurable as vehicle master or slave

- CAN network and throttle pot interface options
- Multi-controller coordination, DC-DC Interface, custom options

## Simplest setup and operation

- 1 motor type parameter selects 90% of required settings
- Simple file download to clone a working setup

## MOTOR FEEDBACK

AMPSEAL 23p

## MAIN LV I/O CONNECTOR

AMPSEAL 35p

## FEATURES

Easy to use CAN-based network node

Custom .dbc messaging

Standard J1939 on request

Extensive feedback broadcast messaging for datalogging

Calibration with production tools

PC-based setup and programming tools available for free

## FUNCTIONAL SAFETY

Compatible with ISO26262 vehicle safety certification (not standalone compliant)

ISO6469 High Voltage Safety

Command Safety Watchdog

## ENVIRONMENTAL

Designed to ISO16750 heavy vehicle climatic, mechanical, and environmental requirements

ISO20653 washdown / high pressure wash rated

Low-Cost cable gland interface for shielded power cable

without expensive connectors

AN6 Coolant ports—can be adapted to any standard hose fitting, any angle

Robust, fault-tolerant IGBT power stage

| Description   | Value   |
|---|---|
| Short Circuit Protection                                  | Yes   |
| Hardware Over-current, Over-voltage Protection            | Yes   |
| Vehicle System Power                                      | 9 .. 16V <sub>DC</sub> (12V Systems)                |
| Isolation – High-Voltage to Low-Voltage or to Case        | 2500V <sub>rms</sub>                                |
| Isolation – Low-Voltage to Case                           | 50V   |
| Operating Temperature Range – coolant water – no derating | -40 .. +80°C  |
| Derated Coolant Temperature Range – derate 100% -> 0%     | +80°.. +105°C                                       |
| Non-Operating Temperature                                 | -40 .. +105°C                                       |
| Storage Temperature                                       | -55 .. +105°C                                       |
| Coolant Type  | 50/50 EGW   |
| Coolant Flow Rate   | 8—10 LPM (2 GPM min)                                |
| Coolant Pressure Drop (60°C coolant at 10 LPM)            | 0.35 bar (35kPa/5psi) PM150                         |
| Maximum Coolant Pressure (absolute)                       | 4.5 bar (450kPa / 65psia)                           |
| Operating Shock (ISO 16750-3, Test 4.2.2.2)               | 500 m/s <sup>2</sup> (50g), pending                 |
| Operating Vibration (ISO 16750-3, 4.1.2.4 Test IV)        | 27.8 m/s <sup>2</sup> (3g <sub>rms</sub> ), pending |
| Environmental Protection Class (see ISO 20653)            | IP6K9K, IP67  |
| EMC compatibility   | IEC61000 / FCC Part 15 Class B, pending             |

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These Propulsion Inverter products are designed and manufactured to comply with the following international standards: ISO6469, ISO6493-3, ISO16750, ISO20653, IEC60950, <IEC61000 pending>

## Racing Version are available under special order:

- PM100DXR provides 450Arms peak current in the smallest package for 400V-class applications
  - PM150DZR provides 400Arms peak current for 800V-class applications for 300kW peak output
- These version trade useful operating life for increased peak power handling in transients.

Example applications include:

- Motorcycle racing
- LMP prototype and FormulaE constructors
- Hybrid Supercar makers

Consult factory for more information on suitability of these product variants in your application, and to place orders.

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