

Application Solutions Case Study

Portable, Lightweight Military Robot

Featured Product – **Hornet 5/60**
Integrated solution for
extreme environmental conditions



Elmo
Motion Control
www.elmomc.com

The Requirements: Compact Size & High Power Under Extreme Conditions

The challenge:
high power drives
in a small space
for extreme
environmental
conditions

This case study shows how one of our customers, a leading defense systems company, used the **Hornet** servo drive for a portable, lightweight military robot application. This paper will interest you if you would like to:

- Get up to 3.3 kW peak power using a matchbox sized servo drive.
- Place your drive almost anywhere within your machine.
- Receive MIL-STD qualification and extreme conditions ratings for your products.
- Minimize your development time, resulting in short time-to-market.

Machine Description

This portable robot is an innovative, two-wheeled, unmanned vehicle with a wide range of military applications. Its most unique feature is the ability of the wheels to “expand” and become a track with support wheels on each side of the principal wheel. This allows the robot to adapt dynamically to changing surface conditions and continue operations while overcoming obstacles. The wheel-to-track technology also enables the versatile robot to climb stairs.

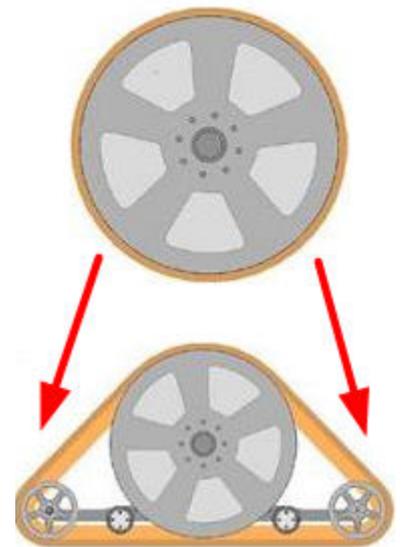
An operator controls the robot’s movement and actions via a radio-operated console and eye-piece camera as it navigates through the varied obstacles that are found in warfare settings. The robust robot can also be used for homeland security functions, such as the controlled diffusion of a bomb that was placed in the urban cityscape.

The robot is very versatile and can take a number of different payloads, such as a camera, sensors, pistol, grenade launcher and task-oriented tools, etc. Some payloads can be mounted simultaneously, such as a camera and bomb disposal device.

The robot also incorporates a “bridge” – two rods whose primary purpose is to give balance to the robot when it is operating in rugged terrain.

Five **Hornet** servo drives from Elmo’s ExtriQ series of products are incorporated in the robot:

- One for each of the two wheels.
- One in each wheel to enable the expansion into the track device.
- A fifth **Hornet** controls the motion of the “bridge”, which changes position as the robot moves.



The robot's dimensions give it stealth like qualities with an overall size of just 46 x 46 x 23 cm. Its small footprint is further emphasized by its weight – only 11.4 kg, exclusive of the variable payload. This enables it to be carried in a soldier's battle kit.

Application Challenges

The unmanned vehicle must be very small and perform reliably under extreme environmental conditions

The manufacturer's main aims for the unmanned robotic vehicle were:

- The ability to implement the wheel-to-track technology in a robotic application.
- Lightweight: The robot must be light enough to be carried by field soldiers.
- Minimal footprint: The robot must be small enough to fit easily into a soldier's kit, and avoid detection by opposing combatants.

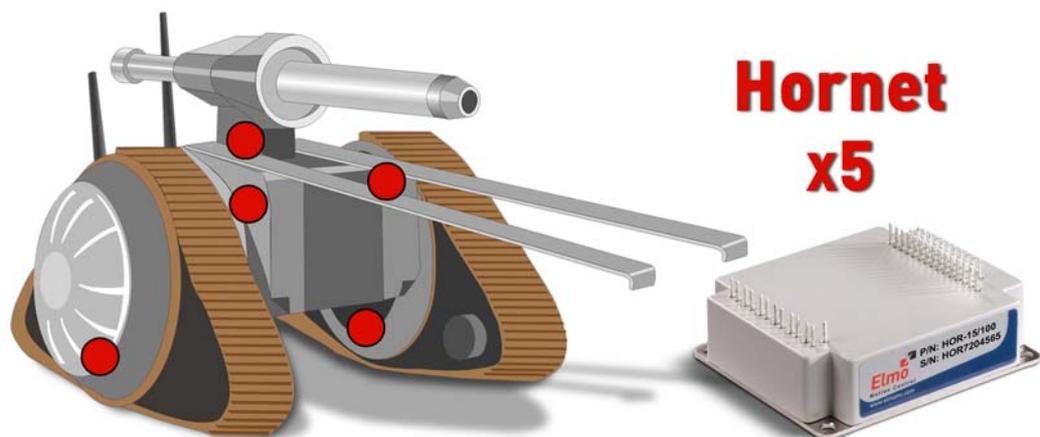
In addition, due to the wide range of potential battlefield conditions, the robot must cope with extreme environmental conditions (EEC) without compromising performance. This involves operating in the extremes of temperature, both high and low, with potentially high humidity.

All components used in the UGV (Unmanned Ground Vehicle) must withstand mechanical shock and continue functioning in the noisy, challenging and unpredictable conditions of the modern battlefield.

The robot needs to be highly reliable with an extended MTBF (Mean Time Between Failures) for all its different motion functions.

As the product incorporates a 360° turning base, the commands must be delivered swiftly and accurately to enable precise motion in challenging and delicate operations.

The compact size of the robot demands motion control products that can supply high power density within a small unit.



Elmo's Solution

Matchbox sized, PCB mountable drive that can provide up to 3.3 kW of peak power

The **Hornet** digital drive was chosen for this application, due to its compact size and light weight. It is PCB-mounted and can therefore be integrated into the robot.

The **Hornet** is very compact, measuring just 55 x 15 x 46.5 mm and weighing only 50 g. It delivers up to 3.3 kW of peak power and 1.6 kW of continuous power.



Hornet Intelligent Digital Servo Drive

Five drives of the type HOR-15/60 were chosen to be installed in the robot.

The **Hornet** is a member of Elmo's ExtrlQ product family, designed especially for rugged and EEC conditions. This allows the **Hornet** to operate in the following extended conditions:

- Ambient temperature: -40 °C to +70 °C
- Temperature shock: -40 °C to +70 °C within three minutes
- Mechanical shock: ±20g; half sine, 11 msec
- Upwards of 90% relative humidity
- Vibration – up to 2,000 Hz
- Altitude: -400 m to 155,000 m
- Reduced EMI and minimal RFI

Our experienced engineers will help you get it right the first time.

The five **Hornets** are installed on a single PCB within the compact confines of the robot and require minimal cabling. The connector types and locations were chosen to optimize the robot's production and reduce maintenance. Elmo's engineers worked with the design team in order to ensure that the products were successfully integrated, thus shortening the time-to-market.

Elmo supplies detailed documentation and consulting services for product integration on the PCB, enabling the best possible fit for the application.

The **Hornet** drives already include the capability to perform sophisticated motion control loops for precise movement, feedback inputs, programming capabilities and communication support. Its excellent connectivity reduces time-to-market and eliminates the need for extra components.

The **Hornet** drives are very reliable and can meet the exertions of the battlefield while protecting the lives of the soldiers who rely on the robot's capabilities.

Elmo's proprietary Elmo Studio software is used to program the commands for the **Hornet** and this enables the robot to perform the precise tasks that require rapid and accurate movement.

Why Elmo

- Compact, pin-based, PCB-mounted products that have a small footprint.
- High power density and intelligence within a small package.
- The ExtrIQ product range for military and EEC applications meets the demands of battlefield applications and is ready for the extreme.
- Dedication of support engineers to the successful implementation of solutions.
- Fast, precise and smooth motion control.
- High reliability in demanding military environments.
- Standard communication protocols.

For more information on Elmo:

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