



## MINI QED

A demonstration vehicle to showcase the best electric drive system in the world!



With the odd exception of some rather impractical and eccentric examples, today's electric or hybrid electric vehicles substantially under perform when compared both with high performance gasoline cars and also with theoretical limits of electric drive systems. Why are major manufacturers not putting more emphasis on in-wheel electric drive systems?

As PML is a leader in high performance motor and drive system technology, we felt it time to demonstrate what really can be achieved today using the best technology available! Produced in conjunction with our partner Synergy Innovations, the car you see today is one of 2 vehicles and is the result of 8 months of intense effort following PML's 4-year product development programme.

The MINI was chosen as the platform because of its broad appeal and iconic styling. However it is not a light vehicle and has limited space to integrate the substantial component set required for a top performance electric vehicle - if we can successfully convert this vehicle then most others should be easy by comparison!

The target specification was defined at the outset as follows:

Emissions	Zero
Autonomy	1000km
Top speed	200kph minimum
Acceleration	0-100kph in 6 seconds
Braking	No mechanical brakes
Fuel	Zero carbon
BHP	250bhp minimum

The specification as it stands today is:

Emissions	Zero - for 4 hours combined urban and extra urban driving
Autonomy	1000km (predicted from bench fuel consumption trials)
Top speed	Approaching 240kph
Acceleration	0-100kph in under 5 seconds
Braking	Regenerative only (other than handbrake for parking)
Fuel	Gasoline
BHP	> 640bhp
Fuel consumption	65 - 80mpg

The vehicle development will continue for some time, especially in the area of engine/fuel options and GPRS services and features.

Today, the vehicle incorporates the very best drive system technology available anywhere in the world.

**It is truly an outstanding example of British innovation at its best!**

BMW (UK) Ltd has requested that we mention they have no involvement with this project and that such conversions invalidate warranty!

### Some key features are:

- Independent Quad Electric Drive
- Traction control and anti-skid built into each wheel
- Regenerative braking recovers almost all energy
- Blistering acceleration and high top speed
- Efficient, range-extending onboard engine/generator
- No need to recharge (although you can "plug in" if you wish)
- Seriously attractive and feature rich in-car display

*Passion, Power and Planet in harmony!*

**QED**



## Specifications

### Motors

4 x 750Nm 1800rpm high efficiency Brushless permanent magnet sine wave Hi-Pa drive™ 24 phase water-cooled

### Drive electronics

4 x 480Amp 450V Hi-Pa drive™ 24 phase sine wave inverter IGBT water cooled  
CAN bus communications

### Battery

300V nominal 70Amp Hour Lithium Polymer 700Amp peak

### Battery Management system

Active cell balancing, temperature and voltage monitoring  
CAN bus communications

### Ultra Capacitor

350V 11 Farad 700Amp limited

### Energy re-circulator

1400Amp continuous IGBT water cooled  
CAN bus communications

### Generator

Engine	250cc 2 cylinder 4 stroke gasoline 15kW at 7000rpm
Generator	20kW continuous at 250V 80Amp
Controller	350V 80Amp water-cooled CAN bus communications

### Display

Touch screen high resolution LCD with steering wheel and 4 area screen menu indexing  
Displays battery, ultra cap, fuel status, mileage calculator, boost display and options for GPRS link to allow remote diagnostics and tracking  
Diagnostic and configuration menus  
CAN bus communications

### Software and safety features

#### Anti-skid

Dynamically monitors wheel to detect skid onset. Manages state to obtain maximum non-skid torque from wheel in either acceleration or braking modes.

### Traction control

Dynamically distributes torque when any wheel is in skid management mode to obtain optimum tractive effort and stability.

### Steering sensor

Optional addition to provide feed forward input to traction control system. Allows driver intent and wheel alignment to influence vehicle stability and tractive effort functions.

### Vehicle attitude, yaw and gyroscopic sensors

Optional addition to provide further stability inputs to traction control system. Allows vehicle orientation and direction (if different from steering wheel implied direction) to be accounted for in determining optimum tractive effort distribution.

### Differential/torque share functions

Standard feature incorporated within each wheel to allow optimum speed and torque share when cornering. Minimises tyre scrub and power wasted energy.

### Efficiency optimisation

Dynamic management of power delivery to wheel ensures best use of available power. Accounts for motor related efficiency variations across speed and torque ranges.

### Key safety items

- Dual circuit power distribution
- Dual circuit brake and accelerator systems ensure 100% redundancy
- Hi-Pa™ drive ensures multi level redundancy in critical power systems
- Dual wheel sensors
- Dual CAN bus systems
- Temperature monitors of all drive electronics, motor windings, battery cells and ultra capacitors. All temperature monitors fitted with fold-back control function.
- Software and hardware over voltage and over current monitors
- CAN watchdog
- Processor watchdogs

**PML is also active or involved in Wind turbine generators and controls; Marine and underwater motors and drives; robotics; winches and hoists; very large diameter motors and drives (i.e. 2m to 22m diameter); other integrated motor and electronics systems for various wheeled applications including lightweight plastic wheels; joysticks and sensors.**

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