High Temperature Downhole Electronics

Products and Services for Oil and Gas Applications

www.wattandwell.com
At the forefront of innovation, WATT&WELL continues its mission of providing the best power electronics systems for high temperature applications aimed to operate in the harshest environments, which is in line with the specific requirements of the Oil and Gas field. From power architecture to series production, we design, prototype, qualify and fabricate high reliability electronics that meet the needs of downhole tools designers. Our experienced engineers are dedicated to the success of your project and to overcome the most demanding technology challenges. Therefore you will find us by your side to ensure the integration and maintenance of our products in your tools.
As new technology challenges arise in the ever-expanding O&G exploration, WATT&WELL has developed a wide range of technology blocks and products capable of operating in the increasingly harsh environments of downhole tools. These include Nar downhole electronics family of power supplies, motor drivers, control units, data loggers, modems and magnetics. They are designed for drilling (MWD, LWD), well intervention (wireline, coiled tubing) and completion applications.
Wireline

HV BUS

NAR MODEM
NAR SBPS
NAR POWER
NAR HM
NAR MOTION
NAR CONTROL
NAR TNMC

CAN BUS

CUSTOMER SPECIFIC PAYLOAD

SENSOR 1
SENSOR 2

24 V Bus

M
Completion / Testing

CUSTOMER SPECIFIC PAYLOAD

Completion / Testing

Drilling

ALTERNATOR

NAR MOTION

Drilling

NAR POWER

NAR MOTION

NAR CONTROL
Discover Nar Products Range, Your High Temperature Solution

WATT&WELL designed a whole range of high temperature electronics which can be used in simple and complex electronic systems. Nar products range is the solution to the technical challenges inherent to the oil and gas industry. Besides its high reliability, all Nar systems are customizable to best fit your system.
Nar High Voltage Motor Drive

Nar Motion is an innovative high temperature motor controller providing optimal operation and high reliability in harsh environments.

Features

- Operating temperature: up to 180°C
- Wide input range: up to 3 kW - 600 V
- Field Oriented Control for higher efficiency with BCLD or PMSM motors
- Hall effect, Resolver position and Sensorless compatible operation
- Independent speed, torque and power limitations
- Advanced system protection and monitoring
- Full digital control and monitoring via integrated CAN 2.0B bus
- Available protocols: Can-Open and Watt Protocol (simple and fully documented)

Customization Options

- Input voltage: 30 V – 600 V
- Power rating: 300 W – 3 kW
- Compatibility with Hall Effect, Sensorless Control Algorithms
- Fault Management (UVLO, OVLO, OCP, OTP)
- Dimensions, Footprint, Form Mechanics

Versions

<table>
<thead>
<tr>
<th></th>
<th>Rotor position sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>NM-40-600-10 RESO</td>
<td>Resolver sensor</td>
</tr>
<tr>
<td>NM-40-600-10 HALLA</td>
<td>Hall Effect sensor</td>
</tr>
<tr>
<td>NM-40-600-10 SLES</td>
<td>Sensorless</td>
</tr>
</tbody>
</table>

Custom Designed Nar Motion

Nar Motion Demo Board
Nar 10 W Step Down HV Power Supply

High voltage power supply with wide input voltage range (up to 1200 V) and settable output voltage. Typical uses include local power supply (housekeeping) and boot power supply in downhole tools.

Features

• 300 mm x 40 mm x 20 mm
• DC input range: 350 V to 1200 V
• Output power capability: up to 10 W
• Operating temperature: up to 175 °C
• Non isolated output voltage
• Input OVLO UVLO
• Output short circuit protection
• Flying wires connections

Customization Options

Dimensions, Footprint
Form factor
Output voltage

Versions

<table>
<thead>
<tr>
<th></th>
<th>V_{OUT}</th>
<th>I_{OUT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVPS124</td>
<td>24 V</td>
<td>420 mA</td>
</tr>
<tr>
<td>HVPS112</td>
<td>12 V</td>
<td>800 mA</td>
</tr>
<tr>
<td>HVPS105</td>
<td>5 V</td>
<td>1.2 A</td>
</tr>
</tbody>
</table>

Nar Step Down HV Power Supply
Tiny Nar Motor Control

Tiny Nar Motor Control (TNMC) integrates most of the functions required for brushless DC motor control (BLDC and PMSM) with Hall Effect sensors into one compact package. This device performs speed mode control in a small form factor. TNMC is supplied with a range of voltage between 20 V and 48 V. I/O pins permits to enable or disable the motor, control the speed and the direction, brake the motor, and detect faults.

Features

- 20 mm x 110 mm x 11 mm
- Capability to drive DC brushless with hall sensor
- DC input range: 14 V to 48 V
- Power drive capability up to 50 W at 150 °C
- Operating temperature: up to 175°C
- Maximum operating temp: 175 °C
- Two directions of rotation
- Speed Variation capability by sending an analog signal between 0V - 1 V
- Hall effect sensor configurable: 120° by default, 60° - available on demand

Customization Options

- Hall effect sensor configurable: 120° by default, 60°
- Sensorless Mode
- Fine tuning of control
- Dimensions, Footprint, Form

Mechanics

Versions

<table>
<thead>
<tr>
<th>TNMC (L, W, H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
</tr>
<tr>
<td>20 x 130 x 12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.78 x 5.11 x 0.51</td>
</tr>
</tbody>
</table>
Micro Nar Motor Control

This is a universal motor controller driver for DC brushless motors (BLCD, PMSM) with sensored or sensoreless speed mode in a very small form factor.

Features

- 25 mm x 70 mm x 14 mm
- Capability to drive DC brushless motor with or without hall sensor
- Power drive capability: up to 5 W
- DC input range: 5 V to 30 V
- Operating temperature: up to 200°C
- Two directions of rotation

Customization Options

- Speed Tuning
  - Hall effect sensor configurable: 120° by default, 60°
- Sensorless Mode

Mechanics

Versions

<table>
<thead>
<tr>
<th></th>
<th>VDC\text{_in}</th>
</tr>
</thead>
<tbody>
<tr>
<td>MNMC001</td>
<td>5 - 10 V</td>
</tr>
<tr>
<td>MNMC002</td>
<td>10 - 30 V</td>
</tr>
</tbody>
</table>

Micro Nar Motor Control integrated to its mechanics
Nar Power products cover a large range of DC/DC conversion needs in downhole systems. The table below describes the basic technology blocks combined to provide these power supplies. Nar Power supplies can also be isolated, or have multiple outputs (that could be isolated as well). These Hi Temp Hi Rel converters could be customizable as well to have their features better adapted to your system.

### Customization Options
- **Input voltage**
- **Output voltage**
- **Power at 180°C**
- **Embedded board environment recorder (Nar HM)**
- **Communications**
- **Isolation level**
- **Dimensions, Footprint, Form**
- **Mechanics**

### Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>5 to 30</th>
<th>150 to 240</th>
<th>300 to 600</th>
<th>600 to 1200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage (VDC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output voltage (VDC)</td>
<td>-5 to 20</td>
<td>10 to 24</td>
<td>12 to 30</td>
<td>30 to 600</td>
</tr>
<tr>
<td>Power at 180°C (W)</td>
<td>10</td>
<td>50 to 100</td>
<td>100 to 500</td>
<td>200 to 2000</td>
</tr>
</tbody>
</table>
Nar Small Boot Power Supply

Nar Small Boot Power Supply is a high temperature DC/DC power converter that can handle a wide voltage input range for a regulated low voltage output. It is designed to provide steady low voltage output 12 V from a high non-regulated voltage range (100 VDC to 400 VDC). Its performance and features make it a must have for every system starting with a high voltage input. It can include differential and common mode filters to facilitate integration.

Features

- Non isolated DC/DC converter
- DC input range: up to 400 V
- Regulated DC output of 12 V
- Operating temperature: up to 175°C
- Output short circuit protection
- Input reverse polarity protection
- Common and differential mode filters

Customization Options

- EMC filter mode input
- Common EMC filter mode input
- Common and differential EMC filters mode output

Dimensions, Footprint, Form Factor

Mechanics

Versions

<table>
<thead>
<tr>
<th></th>
<th>$V_{IN}$</th>
<th>$V_{OUT}$</th>
<th>$I_{OUT}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP-40-12-0.4</td>
<td>400 V</td>
<td>12 V</td>
<td>0.42 A</td>
</tr>
</tbody>
</table>

Nar Small Boot Power Supply
**Nar HVPS**

High voltage power supply with wide input voltage range, up to 1200 V and adjustable output voltage.

### Features

- 300 mm x 40 mm x 20 mm
- Operating temperature: 175 °C (max.)
- Input voltage: 350 V to 1200 V
- Non-isolated output: 10 W power
- Output short-circuit protection
- Fying wire
- UVLO, OVLO input protection

### Customization Options

- Fault Management (UVLO, OVLO)
- Dimensions, Footprint, Form Factor
- Mechanics

### Versions

<table>
<thead>
<tr>
<th></th>
<th>$V_{\text{OUT}}$</th>
<th>$I_{\text{OUT}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVPS124</td>
<td>24 V</td>
<td>420 mA</td>
</tr>
<tr>
<td>HVPS112</td>
<td>12 V</td>
<td>800 mA</td>
</tr>
<tr>
<td>HVPS105</td>
<td>5 V</td>
<td>1.2 A</td>
</tr>
</tbody>
</table>

Nar High Voltage Power Supply
This DC/DC power converter handles a wide voltage input range for a regulated voltage output. It offers performance, reliability, high efficiency and robustness.

Features

• Non-isolated power supply
• DC input range: 400 V to 1100 V
• DC output: 600 V regulated
• Output power: Up to 2 kW
• Efficiency: Up to 98%
• Maximum operating temp: 180 °C
• Input reverse polarity protection

Nar 2 kW Step Down DC/DC

Customization Options

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>Options for input voltage</td>
</tr>
<tr>
<td>Output voltage</td>
<td>Options for output voltage</td>
</tr>
<tr>
<td>Power at 180 °C</td>
<td>Power at specified temperature</td>
</tr>
<tr>
<td>Embedded board environment recorder</td>
<td>Embedded board environment recorder options</td>
</tr>
<tr>
<td>(Nar Health Monitoring)</td>
<td>Embedded health monitoring options</td>
</tr>
<tr>
<td>Communications</td>
<td>Communications options</td>
</tr>
<tr>
<td>Isolation level</td>
<td>Isolation level options</td>
</tr>
<tr>
<td>Dimensions, Footprint, Form Factor</td>
<td>Dimensions, footprint, form factor</td>
</tr>
<tr>
<td>Mechanics</td>
<td>Mechanics options</td>
</tr>
</tbody>
</table>

Versions

<table>
<thead>
<tr>
<th>Version</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVP5600</td>
<td>680 mm long, OD 60 mm</td>
</tr>
</tbody>
</table>
Nar 200 W Step Down DC/DC

High temperature isolated step-down DC/DC power converter handling a wide voltage input range for a regulated voltage output. It is designed to regulate from a 200 V - 900 V input supply a 48 V output voltage.

Features

- Isolated power supply
- DC input range: 200 V – 600 V
- Output power: 200 W
- Maximum operating temp 175°C (347°F)
  (chassis temperature)
- UVLO/OVLO protection
- Overcurrent protection
- Thermal Shutdown

Customization Options

- Fault Management (UVLO, OVLO)
- Dimensions, Footprint, Form Factor
- Mechanics

Versions

<table>
<thead>
<tr>
<th>Standard</th>
<th>V_{IN}</th>
<th>V_{OUT}</th>
<th>I_{OUT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP-38-600-48-2</td>
<td>200 – 600 V</td>
<td>48 V</td>
<td>2 A</td>
</tr>
<tr>
<td>NP-38-600-24-4</td>
<td>200 – 600 V</td>
<td>24 V</td>
<td>4 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High Power</th>
<th>V_{IN}</th>
<th>V_{OUT}</th>
<th>I_{OUT}</th>
</tr>
</thead>
<tbody>
<tr>
<td>NP-38-600-48-4</td>
<td>200 – 600 V</td>
<td>48 V</td>
<td>4.1 A</td>
</tr>
<tr>
<td>NP-38-600-24-4</td>
<td>200 – 600 V</td>
<td>24 V</td>
<td>8.2 A</td>
</tr>
</tbody>
</table>

Nar Modem
Nar HM

Nar HM is an on-board high temperature data logger. It is mounted as a component on an equipment PCB and monitors environmental conditions of it throughout its life cycle, and enables preventive maintenance. Nar HM module can generate flags on outputs, like thermal shutdowns or warranty ended signal. By its high reliability design, Nar HM is more reliable than most of the equipment it monitors.

Features

- 24 mm x 24 mm
- 5 analog recordable inputs
- Operating temperature: up to 175 °C
- Low power consumption: 14 mW at 4 V
- 5 configurable digital inputs/outputs
- Graphical User Interface (GUI)
- Integrated temperature sensor
- 16 Mbit of storage
- 1,000 hours at 175 °C with microcontroller,
- 10,000 hours at 125 °C

Customization Options

- RealTime Clock
- GPS/GSM
- Accelerometer:
  - Shocks levels, shocks counter, inclinometer
- Increase the capacity of recorded data
- FGPA, external ADC Version sensor
- MCM version up to 210°C Operation
- Wireless dumping: Wifi/Radio…
- Different environment package options:
  - Case able to withstand severe shocks
  - External humidity & pressure sensors
- Logging frequency
- Input measurements
- Alarms and protections
- Dimensions, Footprint, Form

Versions

<table>
<thead>
<tr>
<th></th>
<th>Dimension</th>
<th>Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBER201</td>
<td>24 x 24 mm 0.94 x 0.94 inches</td>
<td>16 Mbits</td>
</tr>
</tbody>
</table>

Nar Health Monitoring
Nar Modem provides telemetry between downhole tools and surface equipment, optimized for mono-cable applications. Its high voltage ratings and high current rating make it suitable for the most demanding applications while its integrated filtering accommodates any downhole tool impedance.

Features

• 200 mm x 38 mm x 20 mm
• Communication: CAN, RS485, SPI
• High cable voltage: up to 1200 V
• Wireline input current: up to 2.7A
• Rated temperature: -30°C to 175°C
• Low Power: 2 W typical

Customization Options

Fault Management (UVLO, OVLO)
Measurement calibration
Baud rate:
up to 10 kbit/s for 10 km monocable
Dimensions, Footprint, Form Factor
Mechanics

Versions

<table>
<thead>
<tr>
<th></th>
<th>Baud Rate</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDEM001</td>
<td>10 kbit/s</td>
<td>CANopen</td>
</tr>
</tbody>
</table>
The NarD-RDC is a complete tracking resolver to-digital converter, including excitation generation and the full acquisition chain to a digital bus output. The system features a high bandwidth tracking algorithm that outputs angular position and rotor speed.

Features

- Isolated power supply
- Supply Voltage: 12 to 32V
- Consumption: 2 W
- Resolution: 12-bit
- Accuracy: ±TBD arc minutes (highly dependent on the chosen resolver)
- Data: Absolute position and velocity outputs
- Error: System fault detection
- Operating ambient temperature: -40 °C to 175 °C with short term operation up to 190 °C
- Programmable sine wave excitation (factory setting with default value 10 kHz)

Customization Options

- Optional Hall Effect sensor emulation
- Fault Management (UVLO, OVLO)
- Dimensions, Footprint, Form Factor
- Mechanics

Versions

<table>
<thead>
<tr>
<th></th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRDC001</td>
<td>SPI Bus</td>
</tr>
<tr>
<td>NRDC002</td>
<td>CAN bus</td>
</tr>
</tbody>
</table>
Nar Magnetics

WATT&WELL offers a wide range of magnetic components, magnetic design and manufacturing for downhole applications. Being some of the most critical components of power electronics design, our transformers and inductors are designed to perform. Therefore, they undergo a number of tests and verifications including: inductance, transformation ratio, endurance and dielectric strength.

Features

• High frequency inductors and transformers: up to 3 MHz
• High power: up to 10 kW
• High voltage: up to 40 kV
• Operating temperature: -50°C to 250°C
• Planar technologies

Customization Options

Downsizing
Power ratings
Cores and self shapes (including planars)
Input/Output voltages

Versions

<table>
<thead>
<tr>
<th>Version</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NMA-SR</td>
<td>Sizing Report</td>
</tr>
<tr>
<td>NMA-MF</td>
<td>Manufacturing Files</td>
</tr>
<tr>
<td>NMA-PL</td>
<td>Prototype Lot</td>
</tr>
</tbody>
</table>

Nar Magnetics
# WATT & WELL Services

## Simulation & Engineering
- Definition of power architecture and power topologies
- Simulation of system parameters (electrical, thermal, mechanical and EMI)
- Simulation of system control (Matlab Simulink™, LtSpice™, Altium™, PSIM™)
- Electrical and mechanical design
- FW and SW development
- Interactive design approach

## Production
- Dedicated production facilities
- Production of 10 to 1000 units a year
- Quality management under ISO9001
- Highly responsive after sales service

## Qualification
- Component, subsystem and system qualification tests
- Life times test
- Thermal cycling
- Vibration and shocks
- EMC tests and analysis

## Prototyping
- Electrical and mechanical CAD
- Manufacturing prototypes
- Integration to system, training
- Testing and validation
- Design optimization
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France

Test & Production
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84120 Pertuis
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Sales Department
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