TDE MACNO Spa

AC&DC Drives, Servos and Drive System

AFE converters for Renewable Energies
Regenerative (active) power supply
(Active Front End)

Automation and Control Systems
Experience, eXpertise, Performance

The Innovative technology in the Motion Control

Complete drive automation solution from 0,4kW to 2 MW
Innovative technology

**OPD EXP is extremely flexible with 6 modes of operation:**

- Open loop V/Hz vector AC drive
- Close loop vector AC Drive (FOC)
- AC servo for rotative, linear and torque motors
- Regenerative (Active) power supply (Active Front End)
- Chopper mode to control DC motors
- Reluctance motor control

New generation 32 bit floating point DSP (Texas TMSF28335, 150Mips)

PLC on board programmable according to IEC 61131-3

OPD EXPLORER configuration tool for drive programming

Safe Torque Off (STO) function according to EN-ISO 61800-5-2 (SIL=2) EN-ISO 13849-1 (Performance Level=d) Certificate of conformity by TUV (only in OPD EXP)
OPENDRIVE EXP

- AC Input: L1 – L2 – L3 (3 x 200 V / 460V)
- DC Input: +, - (280 V – 750 V)
- Safe Torque Off (STO) (option)
- Regulation Power Supply 24Vdc necessary from 3A to 60A size; optional back-up functions above 60A
- Keypad & display
- Connector for the removable keypad
- RS 485 Modbus communication port for PC programming and device interfacing
- Memory key
- I/O analog / digital
- CanBus / Profibus / Ethernet, Anybus Port
- CanBus Port
- 1° feedback sensor
- 2° feedback sensor
- Simulated encoder output and motor thermal probes (PTC, NTC, KTY84)
- U – V – W motor power + and F braking resistor external
Pulse - Width - Modulation Inverter

Basic Power Circuit from 1.1 kW to 30 kW
Pulse - Width - Modulation Inverter

Basic Power Circuit from 37 kW to 250 kW
**OPENDRIVE EXP**

**Digital and analog I/O:**

- 4 configurable digital inputs (optoisolated)
- 2 configurable digital outputs (1 relay output + 1 optoisolated)
- 2 configurable analog inputs (12 bit) - current or voltage selectable by dip switch
- 1 configurable analog output +/- 10V (10 bit)
- Frequency input max 400 kHz
- 4 configurable digital inputs (optoisolated)
- 2 configurable digital outputs (1 relay output + 1 optoisolated)
- 1 configurable analog input (12 bit) - current or voltage selectable by dip switch
- 1 configurable analog output +/- 10V (10 bit)

**Reference voltage**

- $V_{ref} = +10$ V
- $V_{ref} = -10$ V
- $AGND = 0$ V
## Feedback sensors and simulated encoder output

### 2 feedback sensors

The drive manages 2 feedback sensors (one on the motor and one external)
Ex. management of two encoder for precision positioning operations with backlash mechanism

**Resolver for applications that need a robust feedback**

- **Encoder TTL line driver**
- **Encoder TTL line driver and Hall sensors**
- **Maximum input frequency 400 kHz**
- **Incremental and absolute sin / cos Encoder for high precision and maximum dynamics**
- **Encoder Endat 2.1 and 2.2**
  - Possibility of multi-turn positioning

**Biss Encoders.** The Biss interface is an open and license-free communication standard. It is a fully digital bidirectional sensor interface that is based on a master/slave structure. These digital interfaces enable synchronous, fast and secure reading of sensor data

### Simulated encoder output

**Encoder simulation for conventional positioning using +/- 10V interface**

- **Simulated encoder output (freq. out) = frequency input**
- **Simulated encoder output (freq. out) = referred to 1st sensor**
- **Simulated encoder output (freq. out) = referred to 2nd sensor**

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[Image of feedback sensors and simulated encoder output]
### Fieldbus

<table>
<thead>
<tr>
<th>Management of 2 lines: in / out on the same Can Bus line, or 2 independent lines for the communication between the drive and outside, with interchangeable bus.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can Open DS 301 – DS 402. Possibility to extend the I/O via Can Bus. CANopen inside with DS 402 Position, interpolated position</td>
</tr>
<tr>
<td>Profibus DP – V1</td>
</tr>
<tr>
<td>Ethercat (under development)</td>
</tr>
<tr>
<td>Other fieldbus with Anybus CC module (DeviceNet, Ethernet/IP, etc.)</td>
</tr>
</tbody>
</table>
## Advanced Features

<table>
<thead>
<tr>
<th>Advanced features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output frequency</td>
</tr>
<tr>
<td>Switching frequency (PWM)</td>
</tr>
<tr>
<td>Speed loop bandwidth:</td>
</tr>
<tr>
<td>Current loop bandwidth:</td>
</tr>
</tbody>
</table>

### UPDATE CYCLE INTERNAL LOOP
- speed loop,
- current loop,
- positioning loop, and speed task PLC,
- equal to the PWM cycle selectable from 3 to 16 kHz

<table>
<thead>
<tr>
<th>PWM</th>
<th>5 kHz</th>
<th>200 microsec</th>
<th>10 kHz</th>
<th>100 microsec</th>
<th>12 kHz</th>
<th>83 microsec</th>
<th>16 kHz</th>
<th>62.5 microsec</th>
</tr>
</thead>
</table>

**Feed – forward torque to increase the bandwidth of the speed loop**

**3 fast inputs with sampling time 150 MHz**
OPENDRIVE EXP
DC Bus power supply

DC Bus

Can Bus

Canbus

Profibus

Ethercat
### Universal control for electric motors

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPD EXP V</td>
<td>INVERTER</td>
<td>Field Oriented Control – Vector V/F</td>
</tr>
<tr>
<td>OPD EXP B</td>
<td>BRUSHLESS</td>
<td>With feedback and weakening</td>
</tr>
<tr>
<td>OPD EXP S</td>
<td>BRUSHLESS</td>
<td>sensorless</td>
</tr>
<tr>
<td>OPD EXP A</td>
<td>ACTIVE FRONT END</td>
<td>Sinusoidal regeneration unit</td>
</tr>
<tr>
<td>OPD EXP E</td>
<td>ENERGY</td>
<td>for solar, wind, turbines</td>
</tr>
<tr>
<td>OPD EXP C</td>
<td>CHOPPER</td>
<td>for DC motors</td>
</tr>
<tr>
<td>OPD EXP M</td>
<td>STARTER</td>
<td>For motors and generators start-up</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and line synchronization</td>
</tr>
<tr>
<td>OPD EXP R</td>
<td>RELUCTANCE</td>
<td>for reluctance motors</td>
</tr>
</tbody>
</table>
Frequency converters for standard and special asynchronous motors
Field Oriented vector Control (FOC) or V/F control selectable from parameters

<table>
<thead>
<tr>
<th>OPD</th>
<th>EXP</th>
<th>INVERTER</th>
<th>V/F Vector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Boost for the start-up of the motor (2 times rated Torque)
- Good torque control up to 0.5 Hz
- Excellent control stability in weakening area (4-5 times the rated speed)
- Slip compensation
- Selectable frequency jump
- Motor Autotuning
- Overmodulation function (output voltage up to +10% compared to the input)
- Motor flying restart
- Energy Saving function for fans
- Special function for pumps management
Frequency converters for standard and special asynchronous motors
Field Oriented vector Control (FOC) or V/F selectable from parameters

<table>
<thead>
<tr>
<th>OPD</th>
<th>EXP</th>
<th>INVERTER</th>
<th>Field Oriented Control</th>
</tr>
</thead>
</table>
| • Speed sensor parameters check  
• Motor electrical characteristics self-acquisition (resistor, leakage inductance, exciting current, stator and rotor time constant).  
• Autotuning of current and flux loop  
• Speed loop gains variation according to the motor speed  
• Two parameters memory banks (for the management of two different motors)  
• Management of micro power failure  
• Excellent dynamic performances  
• Starter function for the start-up and line synchronization of the motors |
Frequency Converter for Brushless Motors and Generators

<table>
<thead>
<tr>
<th>OPD EXP  B - S</th>
<th>BRUSHLESS</th>
<th>Standard, Torque, Linear, Sensorless</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Control for standard brushless motors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Control for Torque, Linear motors and Generators up to 160 poles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Management of incremental feedback (auto-phasing at each turn-on of the drive)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Special functions:**

• Motor control in weakening area
• Control of sensorless motors and generators using the motor BEMF
• Sensorless control of the motor from 0 rpm with good performances
## Frequency converter for DC motors

<table>
<thead>
<tr>
<th>OPD EXP C</th>
<th>CHOPPER</th>
<th>4 quadrants</th>
</tr>
</thead>
</table>

- DC motors control with separate excitation circuit
- Autotuning for the identification of the motor characteristics
- Power supply from AC line or DC bus
- Braking module option
- Excellent dynamic performances
- Tachogenerator and encoder feedback
- Same power unit like the inverter series
<table>
<thead>
<tr>
<th>OPD EXP M</th>
<th>STARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Converter for the start-up and line synchronization of asynchronous motors and generators</td>
<td></td>
</tr>
</tbody>
</table>
## Low harmonic content regenerative unit

<table>
<thead>
<tr>
<th>OPD EXP A</th>
<th>ACTIVE FRONT END</th>
<th>ENERGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Low harmonic content regenerative unit with unity cos θ and sinusoidal wave</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Line voltage changement compensation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Energy saving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Bus control even with main voltage fluctuations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Power unit bidirectional flow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Adjustable power factor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• THD lower than 3%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conventional diode rectifier AC Drive

AFE drive without LCL filter

AFE drive with LCL filter

INPUT CURRENT COMPARISON

1-3% reactance

6-Diode Bridge Inverter

AFE drive without LCL filter

LCL Filter 10% reactance

Active Bridge Inverter

AFE drive with LCL filter

AFE with LCL filter produces no current harmonics!
**OPENDRIVE EXP range from 1,5 kW to 30kW**

<table>
<thead>
<tr>
<th>Size</th>
<th>S</th>
<th>M</th>
<th>L</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power kW</td>
<td>1,5</td>
<td>5,5</td>
<td>11</td>
<td>15</td>
</tr>
<tr>
<td>400V ac</td>
<td>3</td>
<td>7</td>
<td>22</td>
<td>32</td>
</tr>
<tr>
<td>Rated Current (Arms)</td>
<td>3</td>
<td>12</td>
<td>15</td>
<td>32</td>
</tr>
<tr>
<td>Overload</td>
<td></td>
<td>120% x 30 s – 150% x 30 s – 200% x 3 s + 150% x 40 s – 200% x 30 s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sizes (mm)</td>
<td>H= 310 x L=86 x P=240</td>
<td>H= 310 x L=113 x P=240</td>
<td>H= 310 x L=134 x P=240</td>
<td>H= 310 x L=190 x P=240</td>
</tr>
</tbody>
</table>
### OPENDRIVE EXP range from 37 kW to 250 kW

<table>
<thead>
<tr>
<th>Size</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power KW 400V ac</strong></td>
<td>37</td>
<td>45</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>132</td>
<td>160</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>I rated (A rms)</strong></td>
<td>70</td>
<td>90</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>175</td>
<td>220</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>310</td>
<td>370</td>
</tr>
<tr>
<td></td>
<td>460</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Overload</strong></td>
<td>120% x 30 s – 150% x 30 s – 200% x 3 s +150% x 40 s – 200% x 30 s</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sizes (mm)</strong></td>
<td>H= 875 x L=251 x P=290</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>H= 905 x L=476 x P=296</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>H= 905 x L=678 x P=296</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OPENDRIVE EXP range from 315 kW to 2MW
400 Vac – 690 Vac
Thanks to its high performances, configuration and flexibility level, OPD Exp is suitable for a wide range of applications.

Typical application fields could be:

**Plastic and rubber**
- Extruders
- Calenders
- Injection moulding machines
- Winders & unwinders
- Blow moulding machines

**Printing**
- Sheet-fed printing
- Commercial printing
- Label printing
- Web printing
- Bindery machines
**Paper & paperboard, film & foil converting**

- Calendering
- Slitter
- Coating
- Sheeter
- Laminating
- Winders
- Pulp

**Material handing**

- Cranes and hoist
- Automatic storage
- Elevators and lift
- Pick and place systems
- Conveyors
- Palletising
**TYPICAL APPLICATIONS**

**Other industries and applications**
- High speed machines
- Energy saving with fans and pumps
- Woodworking machinery
- Flying and rotary shear
- Packaging machinery
- Wire & cable drawing machines
- Food and beverage
- Metal production and processing
- Marine applications
- Water and waste water
- Mining and Quarry

**Textile**
- Knitting/weaving machines
- Needle punching machines
- Fibre processing machines
- Spinning/speeder machines
- Textile coating machines
KEY BENEFITS

• Drive options and flexibility mean saving costs, it also means you may fit the features you need, removing complexity

• The same control philosophy for the whole drives family, reduces the learning time

• Friendly programming environments reduce development time
• OPD Exp can be easily configured to operate as a regenerative active front end with power factor control, eliminating harmonics and returning excess braking energy to the supply

• The intelligence inside the drive reduces the required cabinet size and increases system performance, especially with high speed machines and motion applications
• OPD Exp can easily be integrated in an automation system using optional modules. Profibus, DeviceNet, Ethercat, CanOpen, SERCOS

• V/Hz vector control, a standard feature on OPD Exp, is a step forward to sensorless motor control

• Compact design and reduced weight achieved through advanced thermal design and the use of low losses IGBTs

• Safe Torque Off feature reduces system costs in the machine safety design

• Ethernet/Web connectivity allows global drive access for monitoring, configuration and troubleshooting

• Operation with global power supplies – 200V, 400V and 690V