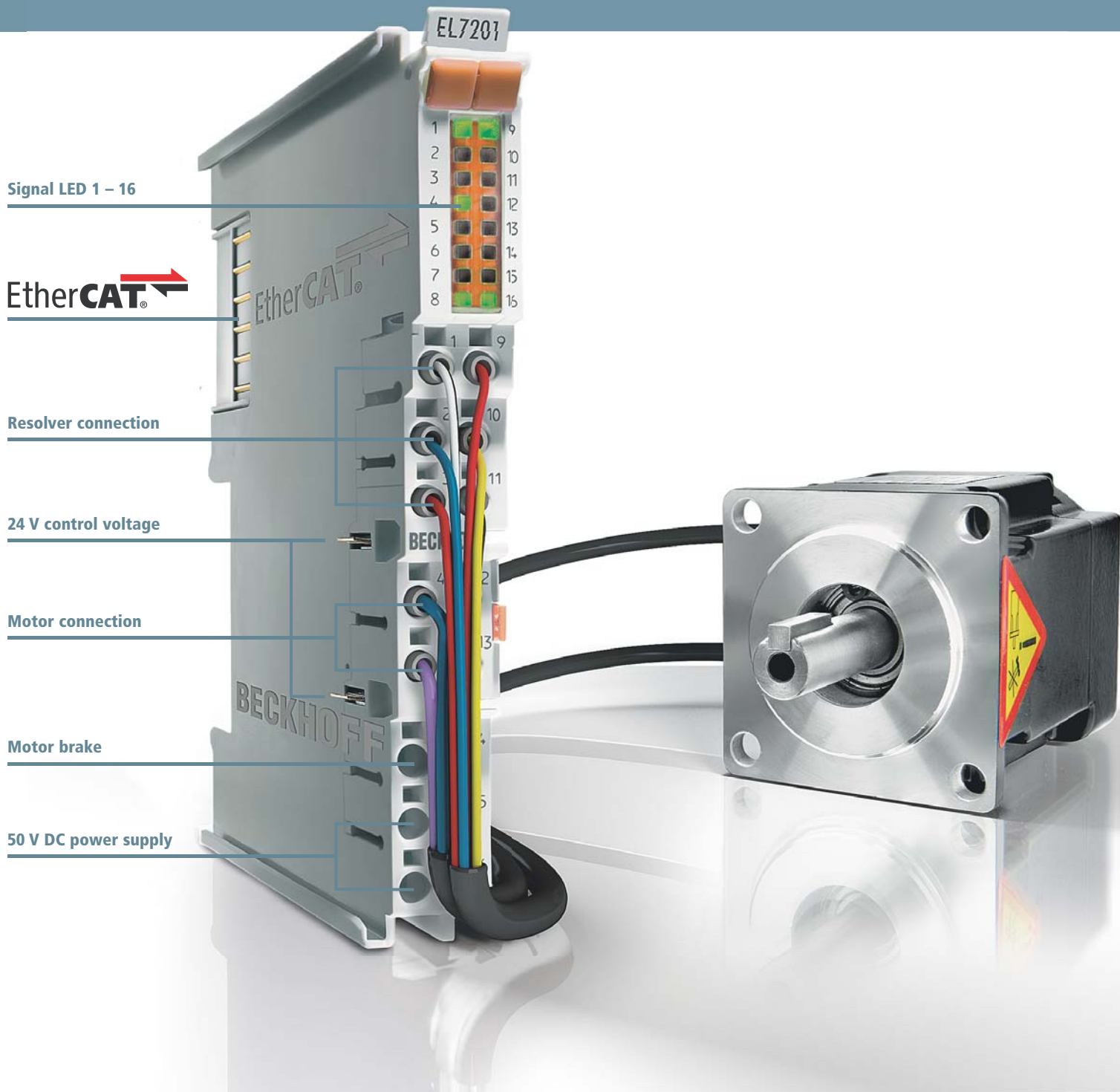


Directly connect servomotor and resolver to a 12 mm Bus Terminal

## Complete Servo Drive in a compact EtherCAT Terminal

The new EL7201 servo terminal for the Beckhoff EtherCAT Terminal system integrates a complete Servo Drive for motors up to 200 W into a standard 12 mm terminal housing. Efficient integration into the EtherCAT I/O system simplifies cabling and commissioning considerably while reducing space requirements and costs.





In the past, an applications engineer may have asked for many projects, “Do I really need servomotors for this machine segment or are stepper motors a possible solution?” In these cases, some of the advantages of servomotors were often passed up. Decisive for this was that using servomotors in an application was always a very expensive consideration. The reasons for that are clear. For the operation of a servomotor, a large amount of electronics is usually required. Accurate positioning is only achievable with a feedback system. Both of these aspects have a big effect on the price. From this viewpoint, the use of stepper motors was the more attractive variant for many applications. By internally counting their steps they can reach a specified position, avoiding the need for a feedback system. A further cost advantage is the simpler means of controlling the stepper motor. A servomotor requires a considerably more comprehensive and complicated drive circuit than a stepper motor. This usually requires large efforts in wiring and parameterization. In addition, present-day Servo Drives take up a lot of space. They need to be located in the control cabinet, separate from the controllers and connected to the controllers by means of a suitable bus system. This leads to increased requirements for space, wiring and costs.

“But why use a servomotor at all, if the stepping motor can position itself without a feedback system?” asks the application engineer. This legitimate question can be answered with a look at the details. The positioning of a stepper motor with internal step counting is of limited accuracy because, with a changing load, the motor’s position can vary within one step. A further drawback is the reduction of torque with increasing speed. This can also lead to positioning errors. The reduced torque when the load is too high can result in steps being lost, so the internal counter “gets the count wrong.” A suitable feedback system can prevent this. In the end, the cost advantage of the stepper motor over the servomotor dwindles.

The servomotor provides many advantages that can lead to a more efficient and capable application.

- | Servomotors have a significantly higher efficiency.
- | The Servo Drive achieves very high accuracy for high-precision requirements.

#### Technical data in summary

|                              |   |
|------------------------------|---|
| Number of channels           | 1 servomotor, resolver, motor brake               |
| Connection technology        | direct motor connection                           |
| Load type                    | permanently excited synchronous motors, inductive |
| Rated voltage                | 8 ... 50 V DC                                     |
| Motor current ( $I_n$ )      | 4 A   |
| Peak current ( $I_p$ )       | 8 A, 1 s  |
| Frequency range              | 0...1 kHz   |
| PWM clock frequency          | 8 or 16 kHz                                       |
| Current controller frequency | double PWM clock frequency                        |
| Speed controller frequency   | 16 kHz  |
| Motor brake output voltage   | 24 V DC (+6 %/-10 %)                              |
| Motor brake output current   | max. 0.5 A  |

- | A servomotor is overloadable and therefore has much higher dynamics than a stepper motor.

- | The high torque is independent of the load up to a high rotation rate.

- | Using a servomotor reduces maintenance to a minimum.

All these benefits are available to the user of the new Beckhoff EL7201 servo terminal. Integration into the controls and the low space requirement of the terminal has various advantages. Firstly, the terminal makes an additional communications interface to the controller unnecessary and secondly, it leads to a considerable reduction in space requirements.

With the EtherCAT servomotor terminal the user can build compact and economical systems without foregoing the benefits of a servomotor.

#### The Beckhoff servo terminal

The EL7201 is a fully capable Servo Drive for direct connection to servomotors in the lower performance range. There is no need for further modules or wiring to make a connection to the control system. This results in a very compact control system solution. The E-Bus connection of the EL7201 makes the full functionality of EtherCAT available to the user. This includes in particular the short cycle time, low jitter, simultaneity and easy diagnostics provided by EtherCAT. With this level of performance, the dynamics a servomotor can achieve is being used optimally. With a rated voltage up to 50 V DC and a rated current of up to 4 A, the EL7201 enables the user to operate a servomotor with a power of up to 200 W. Permanent magnet synchronous motors

Javier Manchado is in product management of I/O systems with Beckhoff: "With the integration of a complete Servo Drive into a standard EtherCAT Terminal only 12 mm wide, Beckhoff is breaking new ground in terms of compact size."



with a rated current of up to 4 A can be connected as loads. The monitoring of numerous parameters, such as overvoltage and undervoltage, over-current, terminal temperature or motor load, offers maximum operational reliability. Modern power semiconductors guarantee minimum power loss and enable feedback into the DC link when braking.

With the integration of a complete Servo Drive into a standard EtherCAT Terminal that is only 12 mm wide, Beckhoff is breaking new ground in terms of compact size. The small manufactured housings are possible thanks to the latest semiconductor technology and the resulting very high power factor. And yet, despite the small dimensions, nothing has to be sacrificed in terms of functionality.

The integrated fast control technology, with a field-oriented current and PI speed control, supports highly dynamic positioning tasks. In addition to the direct connection of a motor and resolver, the connection of a motor holding brake is also possible.

### Connection to the control system

A further big advantage of the EL7201 is the easy incorporation into the overall control solution. The complete integration into the control system simplifies commissioning and parameterization. As with all the other Beckhoff I/O terminals, the EL7201 is simply inserted into the terminal network. Then the full terminal network can be scanned by the TwinCAT System Manager or manually added by the application engineer. The EL7201 can be linked in System Manager with TwinCAT NC and parameterized. The handling can be compared with that of an AX5000 Servo Drive from Beckhoff. Basic parameters are set with the aid of the Drive Manager that can be integrated into the TwinCAT System Manager.

### Scalable motion solution

The new servo terminal complements the product range of compact drive solutions for Beckhoff I/O systems that are already available for stepper motors, AC and DC motors. With the EL7201, the range of Servo Drives becomes even more finely scalable: from the miniature Servo Drive up to 200 W in an EtherCAT Terminal up to the AX5000 Servo Drive with 118 KW, Beckhoff offers a wide range of options to accommodate servomotors.

| ID#      | Name  | Act Value | Set Value | Unit               |
|----------|---|-----------|-----------|--------------------|
| S-0-0051 | Bipolar velocity limit value                | 7593      | 7593      | rpm                |
| S-0-0100 | Velocity loop proportional gain             | 0.200     | 0.200     | A/(s...            |
| S-0-0101 | Velocity loop integral action time          | 6.0       | 6.0       | ms                 |
| S-0-0106 | Current loop proportional gain 1            | 58.0      | 58.0      | V/A                |
| S-0-0107 | Current control loop integral action time 1 | 0.5       | 0.5       | ms                 |
| S-0-0109 | Motor peak current                          | 6.300     | 6.300     | A                  |
| S-0-0111 | Motor continuous stall current              | 1.590     | 1.590     | A                  |
| S-0-0113 | Maximum motor speed                         | 8000      | 8000      | rpm                |
| S-0-0136 | Positive acceleration limit value           | 6283.18   | 6283.18   | rad/s <sup>2</sup> |
| S-0-0137 | Negative acceleration limit value           | 6283.18   | 6283.18   | rad/s <sup>2</sup> |

Figure 1: Parameterization in the Drive Manager

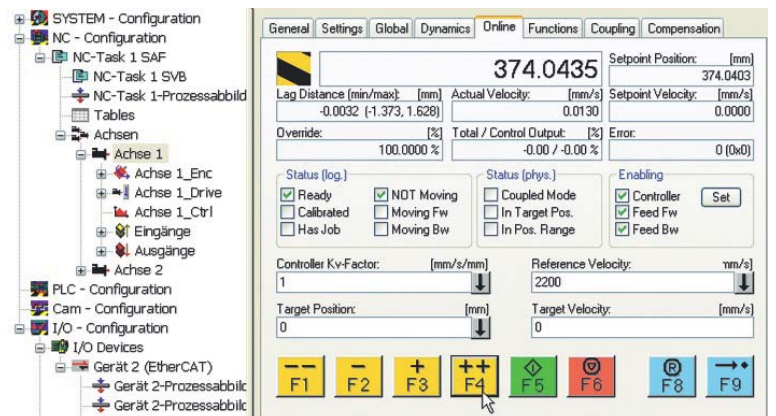


Figure 2: Link with TwinCAT NC software

### Application examples

The various advantages of the servomotor make the EL7201 servo terminal particularly compelling for a large range of applications.

The excellent dynamics are very suitable, for example, in industrial robotics. With the EL7201, very compact, but very powerful mini-industrial robots can be made for Pick & Place, welding and various other applications.

A servomotor is also well suited for other applications such as in machine tools and packaging machines. The high positioning accuracy available with a Servo Drive makes it possible to achieve exceptional coordination and synchronization on several axes. The advantages of the Servo Drive combined with the EL7201 enable the creation of very dynamic, accurate and compact applications.