Introduction
ADVANCED Motion Controls® DigiFlex® Performance™ servo drives offer a variety of network options for connecting servo drives in a multi-axis configuration. Choosing the right network depends on a variety of factors such as required bandwidth, update rate, performance, and cost. The network options supported in ADVANCED Motion Controls’ DigiFlex Performance servo drives are outlined below.

CANOpen (CAN)
A robust serial protocol that is low cost and offers enhanced diagnostic and control capabilities with reasonable bandwidth. DigiFlex Performance CANOpen drives also support RS232 as a secondary communication channel. DriveWare software can run over the RS232 channel during operation to monitor quantities in real time making system design and commissioning fast. Visit http://www.can-cia.org/ for more information. Some of the strengths of CANOpen are:

- 3-wire bus is all that is needed to connect drives together (CAN_H, CAN_L and GND).
- Differential transmission for noise immunity.
- Up to 1Mbit/sec speeds possible.
- Up to 128 nodes per CAN network.
- Robust message arbitration with collision detection/prevention built into the physical layer.
- Many microcontrollers have built in CAN ports.
- CAN Hardware for many different platforms readily available (Desktop, PC/104, etc.)
- Many different operating systems supported (Windows, VxWorks, Linux)
- Bi-directional (non-poll) communication possible.
- PVT – Position, Velocity Time trajectory interpolated by the drive from points sent by the host. Reduces overhead at the host. Countless trajectories possible.
- Coordinated motion capabilities.

How Fast Can Messages Be Sent?
The average CAN message is 130 bits, so it takes 130μsec per message PER NODE to physically send out a message. Different CAN message types improve on this time, but update rates close to 1Khz are possible.

RS232 / RS485 (serial)
The serial drives offer an economical asynchronous interface. RS232 supports single-axis solutions with reasonable diagnostics better suited toward low-bandwidth applications. The DPR series supports RS232/485, and the DPC series supports RS232 as a secondary interface.

- RS232
  - Inexpensive hardware
  - Simple 3 wire bus (TX, RX, and GND)
  - Speeds up to 115.2K baud are possible

- RS485
  - Supports multiple nodes (up to 32)
  - Speeds higher than RS232 supported, up to 921.6K.
  - Full-Duplex (RS485 4-wire only) or Half-Duplex (RS422 2-wire).

How Fast is Serial?
Serial messages can be longer than CAN. A read command to a 16-bit index takes 8 databytes. The reply is another 12 bytes. The serial interfaces are asynchronous, and have a typical delay of 150μS between master and drive messages.

RS232 at 115.2K
8 Bytes Out: 64 bits / 115.2K = 560μsec
Typical Asynchronous Delay = 150μsec
12 Bytes In: 96 bits / 115.2K = 834μsec
Total Time = 1.544msec.

RS485 at 921.6K
8 Bytes Out: 64 bits / 921.6K = 70μsec
Typical Asynchronous Delay = 150μsec
12 Bytes In: 96 bits / 921.6K = 104μsec
Total Time = 324μsec.

Some drive processes cause the delay between the messages to increase, particularly those involving NVM. If synchronous data is required, consider CANopen or EtherCAT products.
**EtherCAT®**

A high-performance Ethernet based deterministic network protocol developed by Beckhoff. Visit the EtherCAT Technology Group [http://www.ethercat.org](http://www.ethercat.org) for more information. Some important features of EtherCAT are:

- Transmission rates up to 2x 100Mbit/sec.
- Based off standard Ethernet for 100baseT.
- Real-time down to the I/O level.
- Multiple topologies possible - Line, Star, Tree, Daisy Chain + Drop Lines. Can be used in any combination.
- Requires no special Ethernet hardware – Standard Network Interface Cards (NIC) can be used for EtherCAT.
- CANopen over EtherCAT (CoE) allows use of CANopen protocol and feature set over EtherCAT.
- Off-the-shelf EtherCAT masters available that implement full language features of IEC 61131.
- Open protocol – Designers can implement their own EtherCAT master.
- Secondary USB port for direct connection to DriveWare. Can monitor quantities using DriveWare without interrupting over EtherCAT.

**How Fast Is EtherCAT?**

EtherCAT is based off 100BaseT physical layer and can send multiple datagrams per EtherCAT packet. Cycle times can reach as low as 100μsec.

---

### Network Options Comparison

<table>
<thead>
<tr>
<th>Type</th>
<th>CANOpen</th>
<th>RS232</th>
<th>RS485 2wire</th>
<th>RS485 4wire</th>
<th>EtherCAT®</th>
<th>POWERLINK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Speed (bit/sec)</td>
<td>Serial 1M</td>
<td>Serial 115.2K</td>
<td>Serial 921.6K</td>
<td>Serial 921.6K</td>
<td>100BaseT 2x100M</td>
<td>100BaseT 100M</td>
</tr>
<tr>
<td>Transfer Mode</td>
<td>Half Duplex</td>
<td>Half Duplex</td>
<td>Half Duplex</td>
<td>Full Duplex</td>
<td>Full Duplex</td>
<td>Full Duplex</td>
</tr>
<tr>
<td>Message Time</td>
<td>130 μsec</td>
<td>1.54 msec</td>
<td>324 μsec</td>
<td>324 μsec</td>
<td>~ 65535</td>
<td>~ 240</td>
</tr>
<tr>
<td>Max Nodes</td>
<td>DPCANxx</td>
<td>DPRxxxx</td>
<td>DPRxxxx</td>
<td>DPRxxxx</td>
<td>DPPxxxx</td>
<td>DPPxxxx</td>
</tr>
<tr>
<td>DigiFlex Part Number</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Wires To Node</td>
<td>RS232</td>
<td>N/A</td>
<td>RS232</td>
<td>RS232</td>
<td>USB</td>
<td>USB</td>
</tr>
<tr>
<td>Secondary Channel</td>
<td>Relative Cost</td>
<td>$$</td>
<td>$</td>
<td>$$</td>
<td>$$</td>
<td>$$</td>
</tr>
</tbody>
</table>