BALDOR
MOTION PRODUCTS

MOTION CONTROL

NextMove ESB
Motion Controller

Installation Manual

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Safety Notice

Only qualified personnel should attempt to start-up, program or troubleshoot this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury.

Precautions

WARNING: Do not touch any circuit board, power device or electrical connection before you first ensure that no high voltage is present at this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury.

WARNING: Be sure that you are completely familiar with the safe operation and programming of this equipment. This equipment may be connected to other machines that have rotating parts or parts that are controlled by this equipment. Improper use can cause serious or fatal injury.

WARNING: The stop input to this equipment should not be used as the single means of achieving a safety critical stop. Drive disable, motor disconnect, motor brake and other means should be used as appropriate.

WARNING: Improper operation or programming may cause violent motion of the motor shaft and driven equipment. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment. Peak torque of several times the rated motor torque can occur during control failure.

CAUTION: The safe integration of this equipment into a machine system is the responsibility of the machine designer. Be sure to comply with the local safety requirements at the place where the machine is to be used. In Europe these are the Machinery Directive, the Electromagnetic Compatibility Directive and the Low Voltage Directive. In the United States this is the National Electrical code and local codes.

CAUTION: Electrical components can be damaged by static electricity. Use ESD (electrostatic discharge) procedures when handling this drive.

2.1 NextMove ESB features

NextMove ESB is a high performance multi-axis intelligent controller for servo and stepper motors.

NextMove ESB features the MintMT motion control language. MintMT is a structured form of Basic, custom designed for stepper or servo motion control applications. It allows you to get started very quickly with simple motion control programs. In addition, MintMT includes a wide range of powerful commands for complex applications.

Standard features include:

- Control of 4 stepper and 3 servo axes.
- Point to point moves, software cams and gearing.
- 20 general purpose digital inputs, software configurable as level or edge triggered.
- 11 general purpose digital outputs.
- 2 differential analog inputs with 12-bit resolution.
- 4 single-ended analog outputs with 12-bit resolution.
- USB serial port.
- RS232 or RS485 serial port (model dependent).
- CANopen or proprietary Baldor CAN protocol for communication with MintMT controllers and other third party devices.
- Programmable in MintMT.

Included with NextMove ESB is the Baldor Motion Toolkit CD. This contains a number of utilities and useful resources to get the most from your MintMT controller. These include:

- Mint WorkBench v5
  This is the user interface for communicating with the NextMove ESB. Installing Mint WorkBench v5 will also install firmware for NextMove ESB.
- PC Developer Libraries
  Installing Mint WorkBench v5 will install ActiveX interfaces that allow PC applications to be written that communicate with the NextMove ESB.

This manual is intended to guide you through the installation of NextMove ESB.

The chapters should be read in sequence.

The *Basic Installation* section describes the mechanical installation of the NextMove ESB. The following sections require knowledge of the low level input/output requirements of the installation and an understanding of computer software installation. If you are not qualified in these areas you should seek assistance before proceeding.

Note: You can check that you have the latest firmware and WorkBench v5 releases by visiting the website *www.supportme.net*.

2.2 Receiving and inspection

When you receive your NextMove ESB, there are several things you should do immediately:

1. Check the condition of the packaging and report any damage immediately to the carrier that delivered your NextMove ESB.
2. Remove the NextMove ESB from the shipping container and remove all packing material. The container and packing materials may be retained for future shipment.
3. Verify that the catalog number of the NextMove ESB you received is the same as the catalog number listed on your purchase order. The catalog/part number is described in the next section.
4. Inspect the NextMove ESB for external damage during shipment and report any damage to the carrier that delivered it.
5. If the NextMove ESB is to be stored for several weeks before use, be sure that it is stored in a location that conforms to the storage humidity and temperature specifications shown in section 3.1.1.

2.2.1 Identifying the catalog number

Different models of NextMove ESB are available. As a reminder of which product has been installed, it is a good idea to write the catalog number in the space provided below.

NextMove ESB catalog number: **NSB002-501 or NSB002-502**

Installed in: ____________________________________ **Date:** __________

A description of the catalog numbers are shown in the following table:

Catalog number	Description
NSB002-501	NextMove ESB controller with USB and RS232 serial connections
NSB002-502	NextMove ESB controller with USB and RS485 serial connections

2.3 Units and abbreviations

The following units and abbreviations may appear in this manual:

V . . . . Volt (also VAC and VDC)
W . . . . Watt
A . . . . Ampere
Ω . . . . Ohm
mΩ . . . . milliohm
μF . . . . microfarad
pF . . . . picofarad
mH . . . . millihenry

Φ . . . . phase
ms . . . . millisecond
μs . . . . microsecond
ns . . . . nanosecond

mm . . . . millimeter
m . . . . meter
in . . . . inch
ft . . . . feet
lbf-in . . . . pound force inch (torque)
Nm . . . . Newton meter (torque)

ADC . . . . Analog to Digital Converter
ASCII . . . . American Standard Code for Information Interchange
AWG . . . . American Wire Gauge
CAL . . . . CAN Application Layer
CAN . . . . Controller Area Network
CDROM . . . . Compact Disc Read Only Memory
CiA . . . . CAN in Automation International Users and Manufacturers Group e.V.
CTRL+E . . . . on the PC keyboard, press **Ctrl** then **E** at the same time.
DAC . . . . Digital to Analog Converter
DS301 . . . . CiA CANopen Application Layer and Communication Profile
DS401 . . . . CiA Device Profile for Generic I/O Devices
DS403 . . . . CiA Device Profile for HMIs
EDS . . . . Electronic Data Sheet
EMC . . . . Electromagnetic Compatibility
HMI . . . . Human Machine Interface
ISO . . . . International Standards Organization
Kbaud . . . . kilobaud (the same as Kbit/s in most applications)
LCD . . . . Liquid Crystal Display
MB . . . . megabytes
Mbps . . . . megabits/s
(NC) . . . . Not Connected
RF . . . . Radio Frequency

3.1 Introduction

You should read all the sections in *Basic Installation*.
It is important that the correct steps are followed when installing the NextMove ESB.
This section describes the mechanical installation of the NextMove ESB.

3.1.1 Location requirements

<u>You must read and understand this section before beginning the installation</u>.

⚠ **CAUTION**: To prevent equipment damage, be certain that input and output signals are powered and referenced correctly.

⚠ **CAUTION**: To ensure reliable performance of this equipment be certain that all signals to/from the NextMove ESB are shielded correctly.

⚠ **CAUTION**: Avoid locating the NextMove ESB immediately above or beside heat generating equipment, or directly below water steam pipes.

⚠ **CAUTION**: Avoid locating the NextMove ESB in the vicinity of corrosive substances or vapors, metal particles and dust.

The safe operation of this equipment depends upon its use in the appropriate environment. The following points must be considered:

- The NextMove ESB is designed to be mounted indoors, permanently fixed and located.
- The NextMove ESB must be secured by the slots in the metal case.
- The NextMove ESB must be installed in an ambient temperature of 0°C to 45°C (32°F to 113°F).
- The NextMove ESB must be installed in relative humidity levels of less than 80% for temperatures up to 31°C (87°F) decreasing linearly to 50% relative humidity at 45°C (113°F), non-condensing.
- The NextMove ESB must be installed where the pollution degree according to IEC664 shall not exceed 2.
- There shall not be abnormal levels of nuclear radiation or X-rays.

3.1.2 Mounting the NextMove ESB

CAUTION: Before touching the unit be sure to discharge static electricity from your body and clothing by touching a grounded metal surface. Alternatively, wear an earth strap while handling the unit.

Ensure you have read and understood the location requirements in section 3.1.1. Mount the NextMove ESB using the supplied M4 screws. For effective cooling, the NextMove ESB must be mounted on a smooth non-flammable vertical surface. Orientation must be as shown in Figure 1, with the two slots in the metal carrier / heat sink assembly at the bottom.

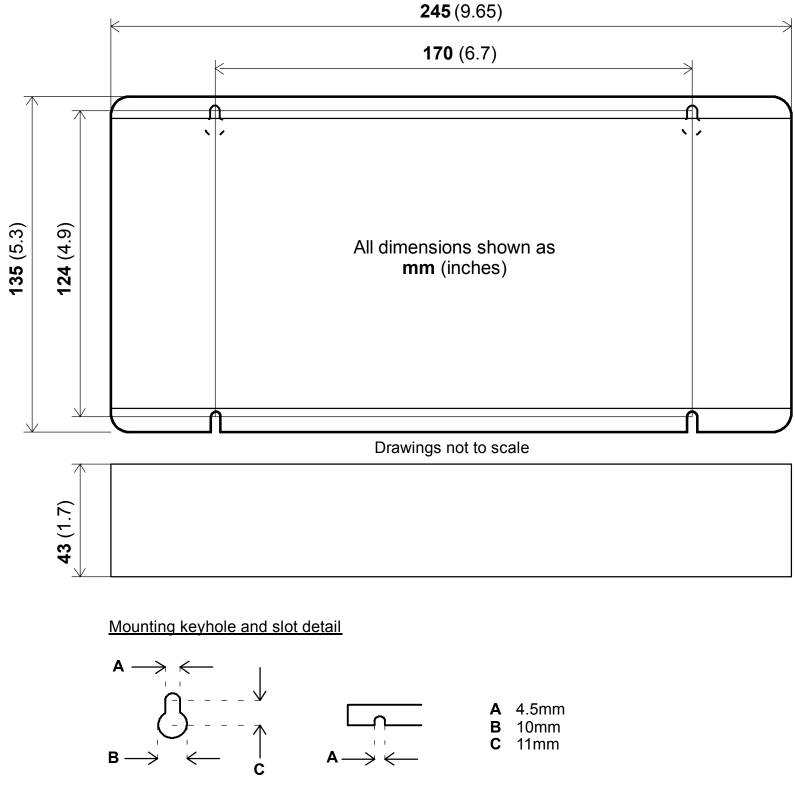


Figure 1 - Package dimensions

There must be at least 20mm (0.8 in) clearance between the NextMove ESB and neighboring equipment to allow sufficient cooling by natural convection. Remember to allow additional space around the edges to accommodate the mating connectors and associated wiring. For example, 70mm (2.8 in) clearance will be required for connection of the serial port cable.

3.1.3 Other requirements for installation

- The NextMove ESB requires +24V power supply capable of supplying 2A continuously. If digital outputs are to be used, a supply will be required to drive them - see section 4.3.2.
- A PC that fulfills the following specification:

	Minimum specification	Recommended specification
Processor	Intel Pentium 133MHz	Intel PentiumII 400MHz or faster
RAM	32MB	128MB
Hard disk space	40MB	60MB
CD-ROM	A CD-ROM drive	
Serial port	USB port or RS232 or RS485 serial port (depending on NextMove ESB model)	
Screen	800 x 600, 256 colors	1024 x 768, 16-bit color
Mouse	A mouse or similar pointing device	
Operating system	Windows 95, Windows NT	Windows 98*, Windows ME*, Windows NT*, Windows 2000 or Windows XP

* For USB support, Windows 2000 or Windows XP is required. Software installation will be described later, in section 5.

- A serial cable (connected as shown in section 4.4.4) or USB cable.
- Your PC operating system user manual might be useful if you are not familiar with Windows.

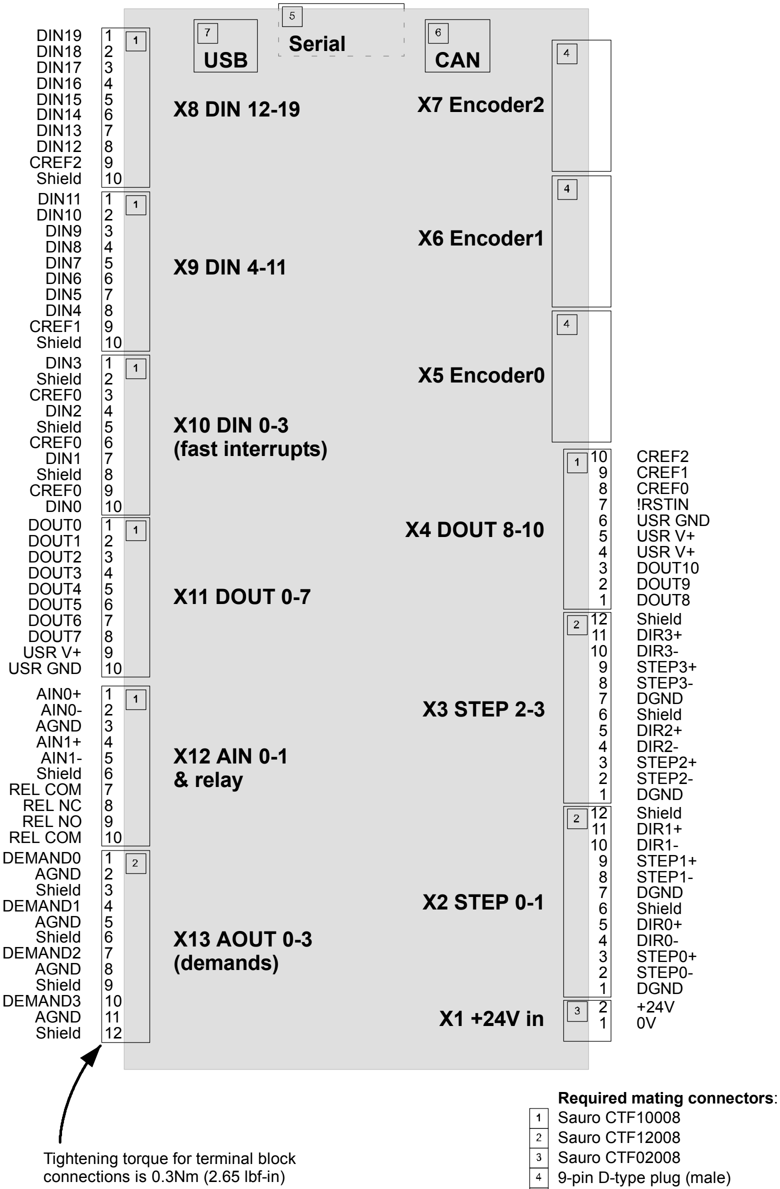
4.1 Introduction

This section describes the input and output capabilities of the NextMove ESB.

The following conventions will be used to refer to the inputs and outputs:

I/O . . . . Input / Output
DIN . . . . Digital Input
DOUT . . . . Digital Output
AIN . . . . Analog Input
AOUT . . . . Analog Output

4.1.1 Connector locations



Required mating connectors:

1 Sauro CTF10008
2 Sauro CTF12008
3 Sauro CTF02008
4 9-pin D-type plug (male)
5 9-pin D-type socket (female)
6 RJ45 plug
7 USB type B plug

4.2 Analog I/O

The NextMove ESB provides:

- Two 12-bit resolution analog inputs.
- Four 12-bit resolution analog outputs.

4.2.1 Analog inputs

The analog inputs are available on connector X12, pins 1 & 2 (AIN0) and 4 & 5 (AIN1).

- Differential inputs.
- Voltage range: ±10V.
- Resolution: 12-bit with sign (accuracy ±4.9mV @ ±10V input).
- Input impedance: 120kΩ.
- Sampling frequency: 4kHz maximum, 2kHz if both inputs are enabled.

The analog inputs pass through a differential buffer and second order low-pass filter with a cut-off frequency of approximately 1kHz.

Both inputs are normally sampled at 2kHz. However, an input can be disabled by setting `ADCMODE` to 4 (`_acOFF`). With one input disabled, the remaining input will be sampled at 4kHz. In MintMT, analog inputs can be read using the `ADC` keyword. See the MintMT help file for full details of `ADC`, `ADCMODE` and other related `ADC`... keywords.

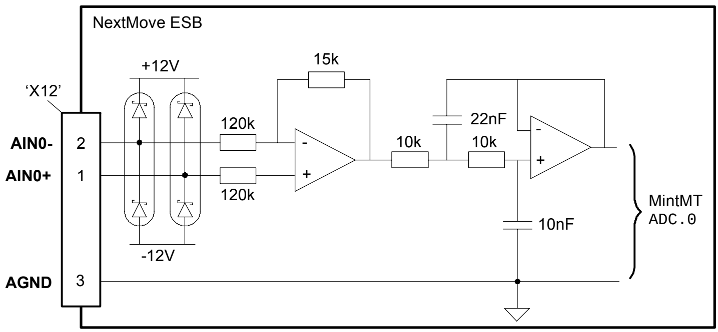


Figure 2 - Analog input, AIN0 shown

For differential inputs connect input lines to AIN+ and AIN-. Leave AGND unconnected.

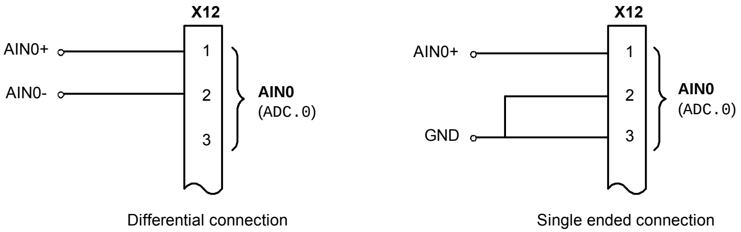


Figure 3 - AIN0 analog input wiring

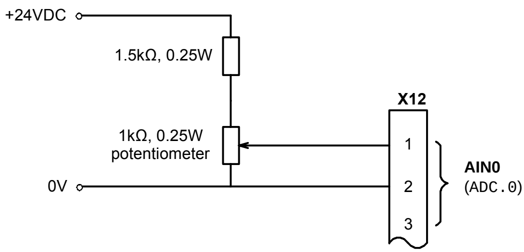


Figure 4 - Typical input circuit to provide 0-10V (approx.) input from a 24V source

4.2.2 Analog outputs

The four analog outputs are available on connector X13, as shown in section 4.1.1.

- Four independent bipolar analog outputs.
- Output range: ±10VDC (±0.1%).
- Resolution: 12-bit (accuracy ±4.9mV).
- Output current: 10mA maximum.
- Update frequency: 10kHz maximum (adjustable using the `LOOPTIME` keyword, factory default 1kHz).

MintMT and the Mint Motion Library use analog outputs Demand0 to Demand2 to control servo axes 0 to 2 respectively. The Demand3 output may be used as general purpose analog output. See the `DAC` keyword in the MintMT help file.

The analog outputs may be used to drive loads of 1kΩ or greater. Shielded twisted pair cable should be used. The shield connection should be made at one end only.

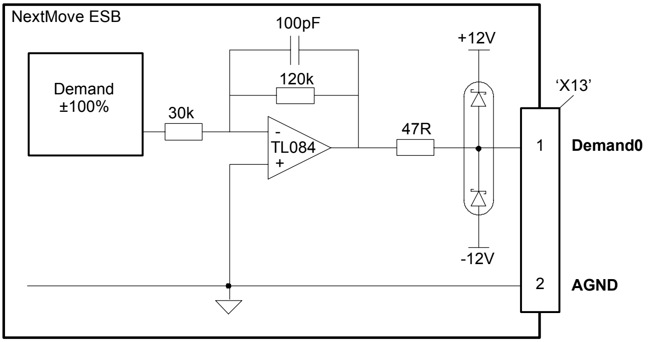


Figure 5 - Analog output - Demand0 shown

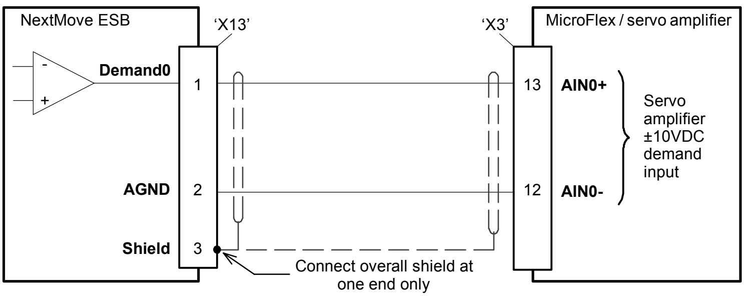


Figure 6 - Analog output - typical connection to a Baldor MicroFlex

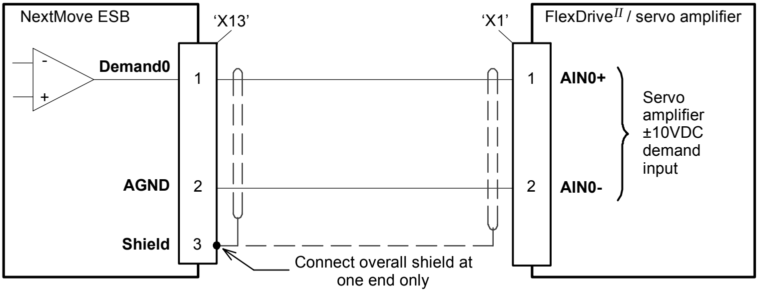


Figure 7 - Analog output - typical connection to a Baldor FlexDrive^{II}, Flex+Drive^{II} or MintDrive^{II}

4.3 Digital I/O

The NextMove ESB provides:

- 20 general purpose digital inputs.
- 11 general purpose digital outputs.

4.3.1 Digital inputs

Digital inputs are available on connectors X8, X9 and X10, as shown in section 4.1.1.
The digital inputs are arranged in three groups, each with their own common connection. This allows each group to be configured independently for ‘active high’ or ‘active low’ operation.

The general purpose digital inputs DIN0 - DIN19 can be shared between axes, and are programmable in Mint (using a range of keywords beginning with the letters `INPUT`...) to determine their active level and if they should be edge triggered. The state of individual inputs can be read directly using the `INX` keyword. See the MintMT help file.

A general purpose digital input can be assigned to a special purpose function such as a home, limit, stop or error input. See the keywords `HOMEINPUT`, `LIMITFORWARDINPUT`, `LIMITREVERSEINPUT`, `STOPINPUT` and `ERRORINPUT` in the MintMT help file.

4.3.1.1 DIN0 - DIN3

Digital inputs DIN0 to DIN3 can be assigned as fast interrupts. These are used as high speed position latches, allowing any combination of axes to be captured by the hardware. The latency between input triggering and capture is 1µs. Special Mint keywords (beginning with the letters `FAST`...) allow specific functions to be performed as a result of fast position inputs becoming active. See the Mint help file for details.

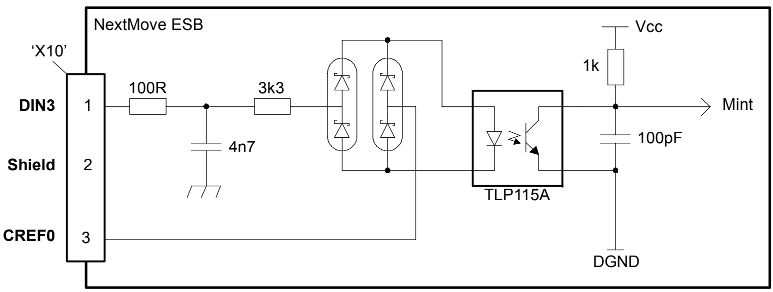


Figure 8 - Fast interrupt digital input - DIN3 shown

Digital inputs DIN0 to DIN3 use CREF0 as their common connection.

Note: The fast inputs are particularly sensitive to noise, so inputs must use shielded twisted pair cable. Do not connect mechanical switches, relay contacts or other sources liable to signal ‘bounce’ directly to the fast inputs. This could cause unwanted multiple triggering.

4.3.1.2 DIN4 - DIN11

Digital inputs DIN4 to DIN11 have a common specification:

- Opto-isolated digital inputs.
- Sampling frequency: 1kHz.

Digital inputs DIN4 to DIN11 use CREF1 as their common connection.

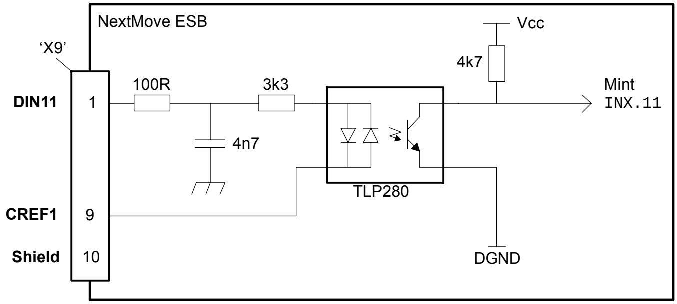


Figure 9 - General purpose digital input - DIN11 shown

If an input is configured as edge triggered, the triggering pulse must have a duration of at least 1ms (one software scan) to guarantee acceptance by MintMT. The use of shielded cable for inputs is recommended.

4.3.1.3 DIN12 - DIN19

Digital inputs DIN12 to DIN19 have the same electrical specification as DIN4-11, except that they use CREF2 as their common connection.

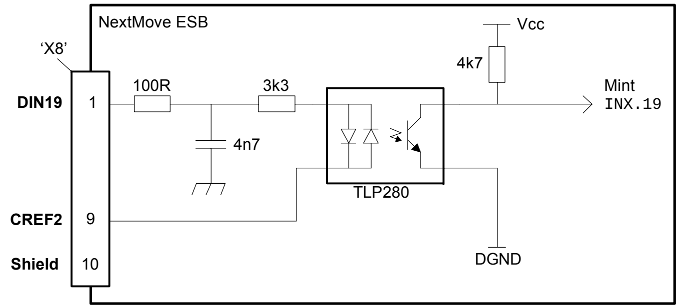


Figure 10 - General purpose digital input - DIN19 shown

4.3.1.4 Auxiliary encoder inputs - DIN17 (STEP), DIN18 (DIR), DIN19 (Z)

DIN17-DIN19 may also be used as an auxiliary encoder input. DIN17 accepts step (pulse) signals and DIN18 accepts direction signals, allowing an external source to provide the reference for the speed and direction of an axis. The step frequency (20MHz maximum) determines the speed, and the direction input determines the direction of motion. Both the rising and falling edges of the signal on DIN17 cause an internal counter to be changed. If 5V is applied to DIN18 (or it is left unconnected) the counter will increment. If DIN18 is grounded the counter will be decremented.

Typically, one channel of an encoder signal (either A or B) would be used to provide the step signal on DIN17, allowing the input to be used as an auxiliary (master) encoder input. The input can be used as a master position reference for cam, fly and follow move types. For this, the `MASTERSOURCE` keyword must be used to configure the step input as a master (auxiliary) encoder input. The master position reference can then be read using the `AUXENCODER` keyword.

Since a secondary encoder channel is not used, DIN18 allows the direction of motion to be determined. The Z signal on DIN19 can be supplied from the encoder's index signal, and may be read using the `AUXENCODERZLATCH` keyword.

See the MintMT help file for details of each keyword.

4.3.1.5 Digital inputs - reset

The reset input !RSTIN is available on connector X4, and uses CREF1 as its common connection. When the reset input is activated it will cause a hardware reset of the NextMove ESB. This is equivalent to power-cycling the NextMove ESB. Due to the internal pull-up resistor, the reset input may be left floating.

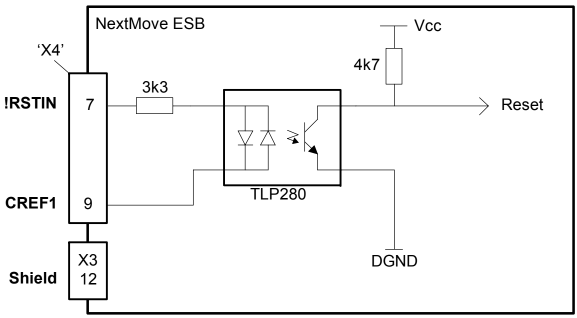


Figure 11 - Reset input

4.3.1.6 Typical digital input wiring

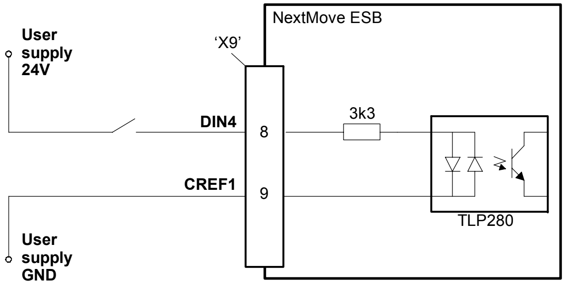


Figure 12 - Digital input - typical 'active high' input connection using a switch

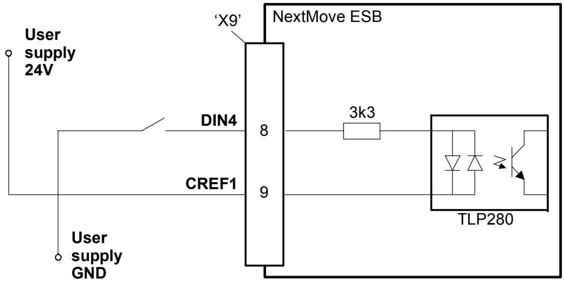


Figure 13 - Digital input - typical 'active low' input connection using a switch

Note: The circuits shown in Figures 12 and 13 are not suitable for use with fast inputs DIN0 to DIN3. Using a mechanical switch, relay contacts or other source liable to signal 'bounce' could cause unwanted multiple triggering.

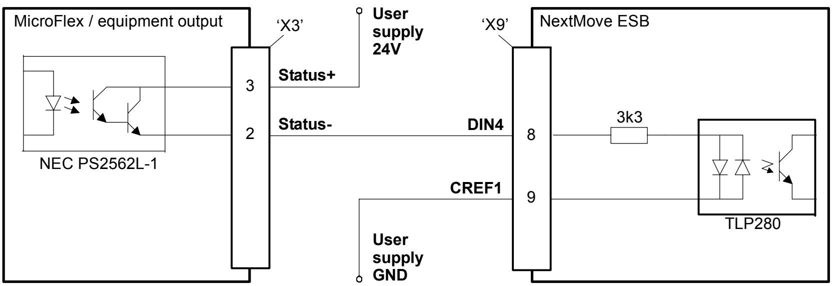


Figure 14 - Digital input - typical connections from a Baldor MicroFlex

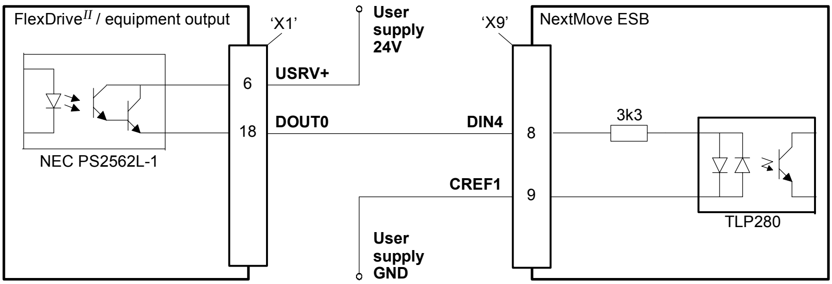


Figure 15 - Digital input - typical connections from a Baldor FlexDrive^{II}, Flex+Drive^{II} or MintDrive^{II}

4.3.2 Digital outputs

The digital outputs are available on connectors X4 and X11, as shown in section 4.1.1.
A digital output can be configured in MintMT as a general purpose output, a drive enable output or a global error output. Outputs can be shared between axes and can be configured using WorkBench v5 (or the `OUTPUTACTIVELEVEL` keyword) to determine their active level.

4.3.2.1 DOUT0 - DOUT7

An external supply (typically 24VDC) is used to power the UDN2982 output devices, as shown in Figure 16. When an output is activated, current is sourced from the user supply through a UDN2982 output driver.

- A total of 500mA may be sourced by DOUT0 - DOUT7, providing an average 62.5mA per output when all outputs are on (100% duty cycle, 24V supply).
- A maximum continuous current of 350mA may be sourced on any single output.
- The maximum allowable power dissipation for the UDN2982 driver is 1.5W.

If an output is used to drive an inductive load such as a relay, a suitably rated diode must be fitted across the relay coil, observing the correct polarity. The use of shielded cable is recommended.

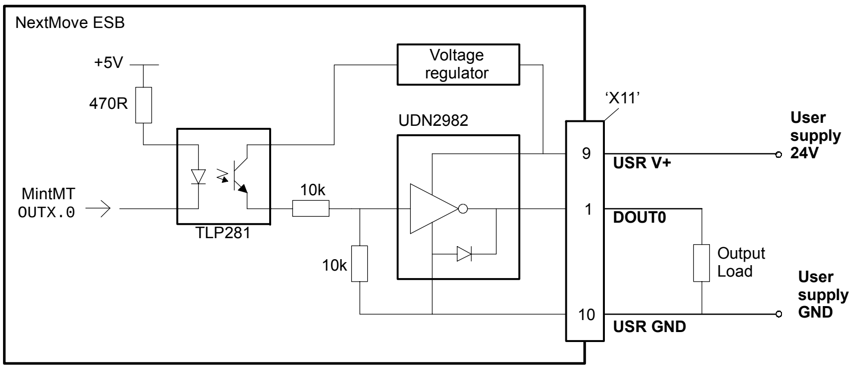


Figure 16 - Digital outputs (DOUT0-7) - DOUT0 shown

4.3.2.2 DOUT8 - DOUT10

DOUT8 - DOUT10 use the same type of output circuitry as DOUT0 - DOUT7, with their own UDN2982 output driver. Because only three of the UDN2982's eight outputs are being used, the average current available on DOUT8 - DOUT10 is increased:

- A total of 500mA may be sourced by DOUT8 - DOUT10, providing an average 166mA per output when all outputs are on (100% duty cycle, 24V supply).
- A maximum continuous current of 350mA may be sourced on any single output.
- The maximum allowable power dissipation for the UDN2982 driver is 1.5W.

4.4 Other I/O

4.4.1 Stepper control outputs

The stepper control outputs are available on connectors X2 and X3, as shown in section 4.1.1.

There are four sets of stepper motor control outputs, operating in the range 0Hz to 500kHz. Each of the step (pulse) and direction signals from the NextMove ESB is driven by DS26LS31 line drivers, providing RS422 differential outputs.

It is recommended to use separate shielded cables for the step outputs. The shield should be connected at one end only.

The `FREQ` keyword can be used to directly control the output frequency, between 60Hz and 500kHz - see the MintMT help file.

CAUTION: The DS26LS31 drivers are static sensitive devices. Take appropriate ESD precautions when handling the NextMove ESB.

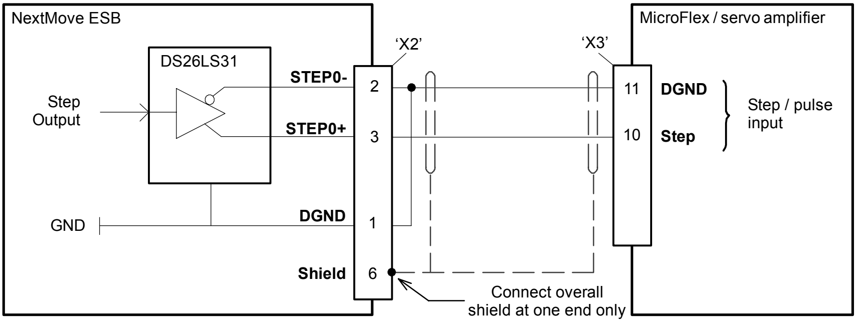


Figure 17 - Stepper output - typical connection to a Baldor MicroFlex

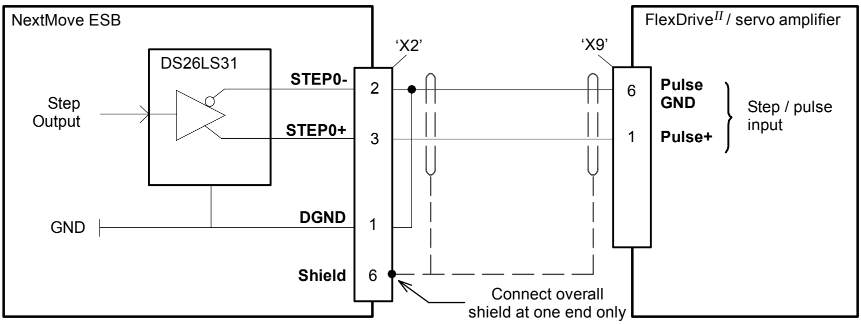
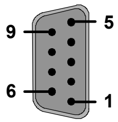


Figure 18 - Stepper output - typical connection to a Baldor FlexDrive*II*, Flex+Drive*II* or MintDrive*II*

4.4.2 Encoder inputs 0-2



Location	X5, X6, X7 Mating connectors: 9-pin male D-type	
Pin	**Name**	**Description**
1	CHA+	Channel A signal
2	CHB+	Channel B signal
3	CHZ+	Index channel signal
4	Shield	Shield connection
5	GND	Digital ground
6	CHA-	Channel A signal complement
7	CHB-	Channel B signal complement
8	CHZ-	Index channel signal complement
9	+5V out	Power supply to encoder

Three incremental encoders may be connected to NextMove ESB, each with complementary A, B and Z channel inputs. Each input channel uses a MAX3095 differential line receiver with pull up resistors and terminators. Encoders must provide RS422 differential signals. The use of individually shielded twisted pair cable is recommended. See section 7.1.7 for details of the encoder power supply.

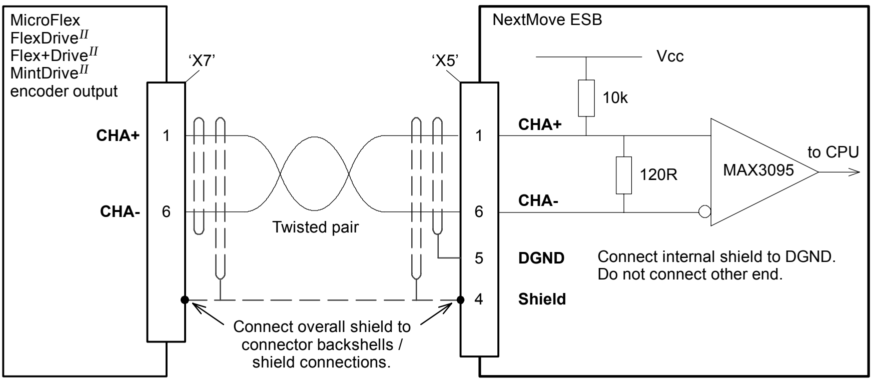


Figure 19 - Encoder channel input - typical connection from a servo amplifier (e.g. Baldor MicroFlex, FlexDrive^{II}, Flex+Drive^{II} or MintDrive^{II})

4.4.2.1 Encoder input frequency

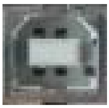
The maximum encoder input frequency is affected by the length of the encoder cables. The theoretical maximum frequency is 20 million quadrature counts per second. This is equivalent to a maximum frequency for the A and B signals of 5MHz. However, the effect of cable length is shown in Table 1:

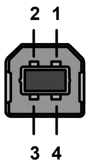
A and B signal frequency	Maximum cable length	
	meters	feet
1.3MHz	2	6.56
500kHz	10	32.8
250kHz	20	65.6
100kHz	50	164.0
50kHz	100	328.1
20kHz	300	984.2
10kHz	700	2296.6
7kHz	1000	3280.8

Table 1 - Effect of cable length on maximum encoder frequency

The maximum recommended cable length is 30.5m (100ft).

4.4.3 USB port



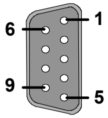


Location	USB Mating connector: USB Type B (downstream) plug	
Pin	**Name**	**Description**
1	VBUS	USB +5V
2	D-	Data-
3	D+	Data+
4	GND	Ground

The USB connector can be used as an alternative method for connecting the NextMove ESB to a PC running WorkBench v5. The NextMove ESB is a self-powered, USB 1.1 (12Mbps) compatible device. If it is connected to a slower USB1.0 host PC or hub, communication speed will be limited to the USB1.0 specification (1.5Mbps). If it is connected to a faster USB2.0 (480Mbps) host PC or hub, communication speed will remain at the USB1.1 specification of the NextMove ESB.

Ideally, the NextMove ESB should be connected directly to a USB port on the host PC. If it is connected to a hub shared by other USB devices, communication could be affected by the activity of the other devices. A 2m (6.5 ft) standard USB cable is supplied. The maximum recommended cable length is 5m (16.4 ft).

4.4.4 Serial port



Location	Serial Mating connector: 9-pin female D-type	
Pin	**RS232 name**	**RS485 / RS422 name**
1	Shield	*(NC)*
2	RXD	RX- (input)
3	TXD	TX- (output)
4	*(NC)*	*(NC)*
5	DGND	0V DGND
6	*(NC)*	*(NC)*
7	RTS	TX+ (output)
8	CTS	RX+ (input)
9	DGND	*(NC)*

NextMove ESB is available with either an RS232 or RS485 serial port (see section 2.2.1). The port is fully ESD protected to IEC 1000-4-2 (15kV). When the NextMove ESB is connected to WorkBench v5, the Tools, Options menu item can be used to configure the serial port. The configuration can also be changed using the Mint keyword `SERIALBAUD` (see the Mint help file for details). It is stored in EEPROM and restored at power up. The port is capable of operation at up to 115.2 Kbaud on RS232.

4.4.5 Using RS232

The NextMove ESB has a full-duplex RS232 serial port with the following preset configuration:

- 57.6 Kbaud
- 1 start bit
- 8 data bits
- 1 stop bit
- No parity
- Hardware handshaking lines RTS and CTS must be connected.

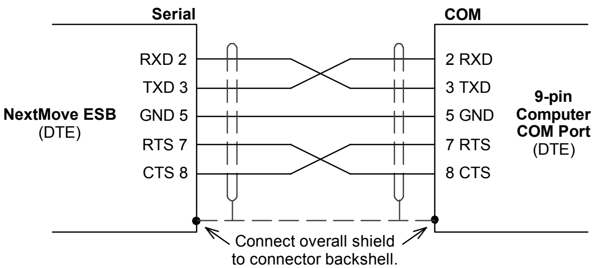


Figure 20 - RS232 serial port connections

The RS232 port is configured as a DCE (Data Communications Equipment) unit so it is possible to operate the controller with any DCE or DTE (Data Terminal Equipment). Full duplex transmission with hardware handshaking is supported. Only the TXD, RXD and 0V GND connections are required for communication. Pins 4 and 6 are linked on the NextMove ESB.

The maximum recommended cable length is 3m (10ft) at 57.6 Kbaud (the factory preset rate). When using lower baud rates, longer cable lengths may be used up to maximum of 15m (49ft) at 9600 baud.

4.4.6 Multidrop using RS485 / RS422

Multidrop systems allow one device to act as a ‘network master’, controlling and interacting with the other (slave) devices on the network. The network master can be a controller such as NextMove ESB, a host application such as WorkBench v5 (or other custom application), or a programmable logic controller (PLC). RS422 may be used for multi-drop applications as shown in Figure 21. Four-wire RS485 may be used for single point-to-point applications involving only one Baldor controller. If firmware is updated over RS485/RS422, it can only be downloaded to the controller that was chosen in the Select Controller dialog in WorkBench v5.

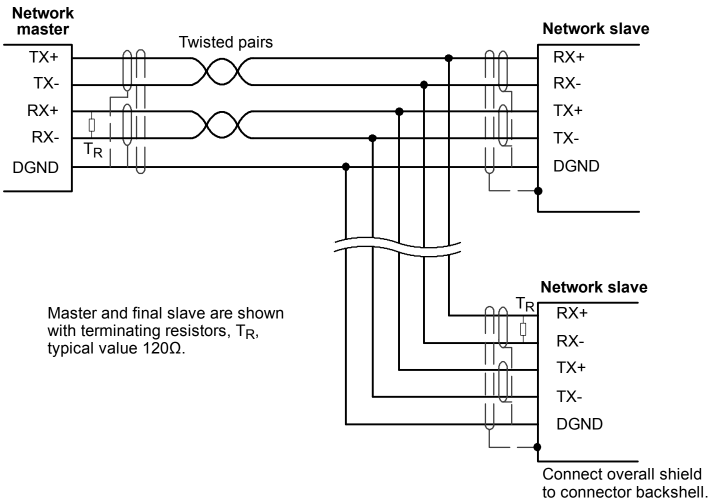
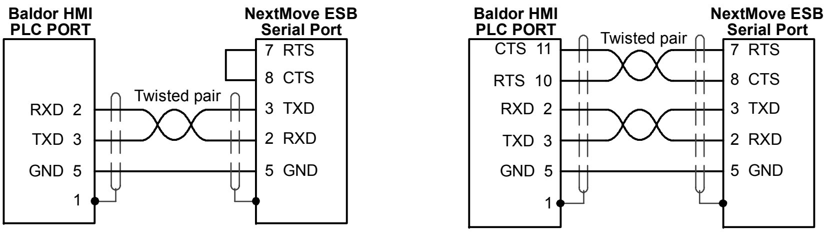


Figure 21 - 4-wire RS422 multi-drop connections

Each transmit/receive (TX/RX) network requires a termination resistor at the final RX connection, but intermediate devices must not be fitted with termination resistors. An exception is where repeaters are being used which may correctly contain termination resistors. Termination resistors are used to match the impedance of the load to the impedance of the transmission line (cable) being used. Unmatched impedance causes the transmitted signal to not be fully absorbed by the load. This causes a portion of the signal to be reflected back into the transmission line as noise. If the source impedance, transmission line impedance, and load impedance are all equal, the reflections (noise) are eliminated. Termination resistors increase the load current and sometimes change the bias requirements and increase the complexity of the system.

4.4.7 Connecting serial Baldor HMI Operator Panels

Serial Baldor HMI Operator Panels use a 15-pin male D-type connector (marked PLC PORT), but the NextMove ESB Serial connector uses a 9-pin male D-type connector. The NextMove ESB may be connected with or without hardware handshaking, as shown in Figure 22:



Without hardware handshaking **With hardware handshaking**

Figure 22 - RS232 cable wiring

Alternatively, the Baldor HMI panel may be connected using RS485/422, as shown in Figure 23:

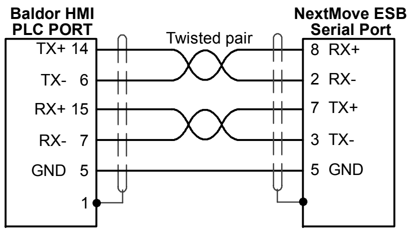


Figure 23 - RS485/422 cable wiring

4.5 CAN

The CAN bus is a serial based network originally developed for automotive applications, but now used for a wide range of industrial applications. It offers low-cost serial communications with very high reliability in an industrial environment; the probability of an undetected error is 4.7×10^{-11}. It is optimized for the transmission of small data packets and therefore offers fast update of I/O devices (peripheral devices) connected to the bus.

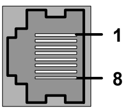
The CAN protocol only defines the physical attributes of the network, i.e. the electrical, mechanical, functional and procedural parameters of the physical connection between devices. The higher level network functionality is defined by a number of standards and proprietary protocols; CANopen is one of the most used standards for machine control within industries such as printing and packaging machines.

In addition to supporting CANopen, Baldor have developed a proprietary protocol called Baldor CAN. Both protocols are supported by NextMove ESB, but unlike other Baldor devices both cannot be supported at the same time. This is because NextMove ESB only has a single hardware CAN channel. Separate firmware builds are available to support each of the protocols.

To determine which firmware is currently installed, start WorkBench v5 and connect to the NextMove ESB (see section 5). At the bottom of the WorkBench v5 window, the status bar will show the name of the controller, followed by 'CANopen' or 'Baldor CAN'. If the correct option is not shown, it will be necessary to download alternative firmware by using the Install System File and/or Download Firmware menu items in WorkBench v5. The firmware file can be found on the Baldor Motion Toolkit CD supplied with your product, or downloaded from www.supportme.net. See the MintMT help file for details about downloading firmware.

4.5.1 CAN connector

The CAN connection is made using the RJ45 connector on the NextMove ESB.



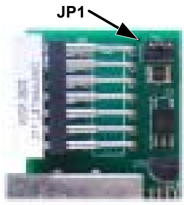
Location	NextMove ESB	
Pin	**Name**	**Description**
1	CAN+	CAN channel positive
2	CAN-	CAN channel negative
3	-	*(NC)*
4	CAN 0V	Ground/earth reference for CAN signals
5	CAN V+	CAN power V+ (12-24V)
6	-	*(NC)*
7	-	*(NC)*
8	-	*(NC)*
Description Opto-isolated CAN interface using a RJ45 connector.		

The maximum (default) transmission rate on NextMove ESB is 500Kbit/s.

4.5.2 CAN wiring

A very low error bit rate over CAN can only be achieved with a suitable wiring scheme, so the following points should be observed:

- The two-wire data bus line may be routed parallel, twisted and/or shielded, depending on EMC requirements. Baldor recommend a twisted pair cable with the shield/screen connected to the connector backshell, in order to reduce RF emissions and provide immunity to conducted interference.
- The bus must be terminated at both ends only (not at intermediate points) with resistors of a nominal value of 120Ω. This is to reduce reflections of the electrical signals on the bus, which helps a node to interpret the bus voltage levels correctly. If the NextMove ESB is at the end of the network then ensure that jumper JP1, located just behind the status display, is in position. This will connect an internal terminating resistor. To access the jumper it will be necessary to remove the top cover from the NextMove ESB. Before removing the top cover be sure to discharge static electricity from your body and clothing by touching a grounded metal surface. Alternatively, wear an earth strap while handling the unit.



- All cables and connectors should have a nominal impedance of 120Ω. Cables should have a length related resistance of 70mΩ/m and a nominal line delay of 5ns/m. A range of suitable CAN cables are available from Baldor, with catalog numbers beginning CBL004-5... .
- The maximum bus length depends on the bit-timing configuration (baud rate). The table opposite shows the approximate maximum bus length (worst-case), assuming 5ns/m propagation delay and a total effective device internal in-out delay of 210ns at 1Mbit/s, 300ns at 500 - 250Kbit/s, 450ns at 125Kbit/s and 1.5ms at 50 - 10Kbit/s.

(1) CAN baud rate not supported on Baldor CAN.
(2) For bus lengths greater than about 1000m, bridge or repeater devices may be needed.

CAN Baud Rate	Maximum Bus Length
1Mbit/s	25m
500Kbit/s	100m
250Kbit/s	250m
125Kbit/s	500m
100Kbit/s (1)	600m
50Kbit/s	1000m
20Kbit/s	2500m(2)
10Kbit/s	5000m(2)

- The compromise between bus length and CAN baud rate must be determined for each application. The CAN baud rate can be set using the `BUSBAUD` keyword. It is essential that all nodes on the network are configured to run at the same baud rate.
- The wiring topology of a CAN network should be as close as possible to a single line/bus structure. However, stub lines are allowed provided they are kept to a minimum (<0.3m at 1Mbit/s).
- The 0V connection of all of the nodes on the network must be tied together through the CAN cabling. This ensures that the CAN signal levels transmitted by NextMove ESB or CAN peripheral devices are within the common mode range of the receiver circuitry of other nodes on the network.

4.5.2.1 Opto-isolation

On the NextMove ESB, the CAN channel is opto-isolated. A voltage in the range 12-24V must be applied to pin 5 of the CAN connector. From this supply, an internal voltage regulator provides the 5V at 100mA required for the isolated CAN circuit. CAN cables supplied by Baldor are ‘category 5’ and have a maximum current rating of 1A, so the maximum number of NextMove ESB units that may be used on one network is limited to ten. Practical operation of the CAN channel is limited to 500Kbit/s owing to the propagation delay of the opto-isolators.

4.5.3 CANopen

The NextMove ESB must have the CANopen firmware loaded to use this protocol.

Baldor have implemented a CANopen protocol in MintMT (based on the 'Communication Profile' CiA DS-301) which supports both direct access to device parameters and time-critical process data communication. The NextMove ESB design does not comply with a specific CANopen device profile (DS4xx), although it is able to support and communicate with the following devices:

- Any third party digital and analog I/O device that is compliant with the 'Device Profile for Generic I/O Modules' (CiA DS-401).
- Baldor HMI (Human Machine Interface) operator panels, which are based on the 'Device Profile for Human Machine Interfaces' (DS403).
- Other Baldor controllers with CANopen support for peer-to-peer access using extensions to the CiA specifications (DS301 and DS302).

The functionality and characteristics of all Baldor CANopen devices are defined in individual standardized (ASCII format) Electronic Data Sheets (EDS) which can be found on the Baldor Motion Toolkit CD supplied with your product, or downloaded from www.supportme.net.

Figure 24 shows a typical CANopen network with two NextMove ESB units and a Baldor HMI operator panel:

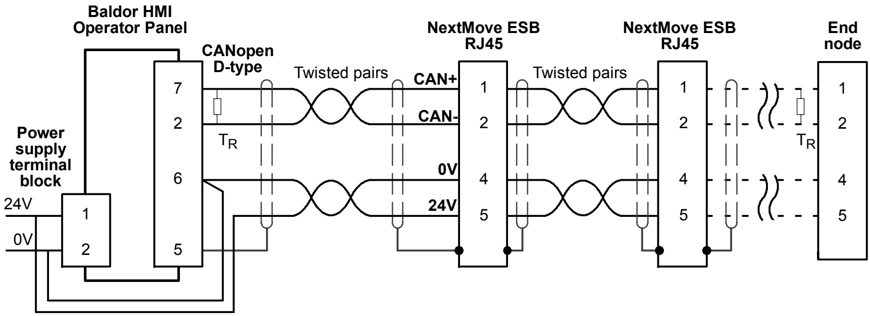


Figure 24 - Typical CANopen network connections

Note: The NextMove ESB CAN channel is opto-isolated, so a voltage in the range 12-24V must be applied to pin 5 of the CAN connector.

The configuration and management of a CANopen network must be carried out by a single node acting as the network master. This role can be performed by the NextMove ESB when it is configured to be the Network Manager node (node ID 1), or by a third party CANopen master device.

Up to 126 CANopen nodes (node IDs 2 to 127) can be added to the network by a NextMove ESB Manager node using the MintMT `NODESCAN` keyword. If successful, the nodes can then be connected to using the MintMT `CONNECT` keyword. Any network and node related events can then be monitored using the MintMT `BUS1` event.

Note: All CAN related MintMT keywords are referenced to either CANopen or Baldor CAN using the 'bus' dot parameter. Although the NextMove ESB has a single physical CAN bus channel that may be used to carry either protocol, MintMT distinguishes between the protocols with the 'bus' dot parameter. For CANopen the 'bus' dot parameter must be set to 1.

Please refer to the MintMT help file for further details on CANopen, MintMT keywords and dot parameters.

4.5.4 Baldor CAN

The NextMove ESB must have the Baldor CAN firmware loaded to use this protocol.

Baldor CAN is a proprietary CAN protocol based on CAL. It supports only the following range of Baldor CAN specific I/O nodes and operator panels:

- InputNode 8 (Baldor part ION001-503) - an 8 x digital input CAN node.
- OutputNode 8 (Baldor part ION003-503) - an 8 x digital output CAN node.
- RelayNode 8 (Baldor part ION002-503) - an 8 x relay CAN node.
- IoNode 24/24 (Baldor part ION004-503) - a 24 x digital input and 24 x digital output CAN node.
- KeypadNode (Baldor part KPD002-501) - an operator panel CAN node with 4 x 20 LCD display and 27 key membrane labeled for control of 3 axes (X, Y, Z).
- KeypadNode 4 (Baldor part KPD002-505) - an operator panel CAN node with 4 x 20 LCD display and 41 key membrane labeled for control of 4 axes (1, 2, 3, 4).

A typical Baldor CAN network with a NextMove ESB and a Baldor CAN operator panel is shown in Figure 18.

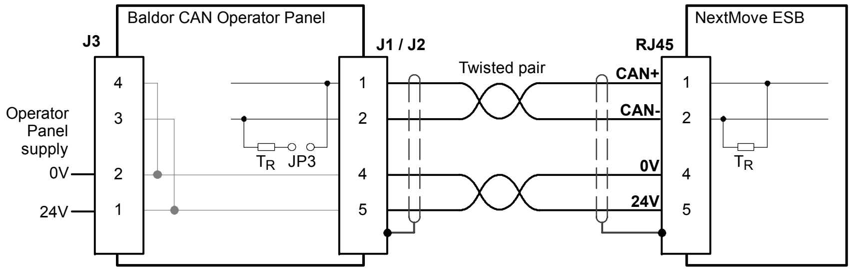


Figure 25 - Baldor CAN operator panel connections

The NextMove ESB CAN channel is opto-isolated, so a voltage in the range 12-24V must be applied to pin 5 of the CAN connector. From this supply, an internal voltage regulator provides the 5V required for the isolated CAN circuit. The required 12-24V can be sourced from the Baldor CAN I/O node or operator panel's supply, which is internally connected to the CAN connector as shown in Figure 25.

On Baldor CAN I/O nodes and operator panels, jumpers JP1 and JP2 must be set to position '1' (the lower position) for the network to operate correctly. This configures the node's CAN channel to operate on pins 1 and 2 of the RJ45 connectors. On the Baldor CAN node, jumper JP3 can be used to connect an internal 120Ω terminating resistor, provided the node is at the end of the network. Jumpers JP4 and JP5 can be used to configure the node ID and baud rate.

Up to 63 Baldor I/O nodes (including no more than 4 operator panels) can be added to the network by the NextMove ESB using the MintMT `NODETYPE` keyword. Any network and node related events can then be monitored using the MintMT `BUS2` event.

Note: All CAN related MintMT keywords are referenced to either CANopen or Baldor CAN using the 'bus' dot parameter. Although the NextMove ESB has a single physical CAN bus channel that may be used to carry either protocol, MintMT distinguishes between the protocols with the 'bus' dot parameter. For Baldor CAN the 'bus' dot parameter must be set to 2.

Please refer to the MintMT help file for further details on Baldor CAN, MintMT keywords and dot parameters.

4.6 Connection summary - minimum system wiring

As a guide, Figure 26 shows an example of the typical minimum wiring required to allow the NextMove ESB and a single axis servo amplifier to work together. Details of the connector pins are shown in Table 2.

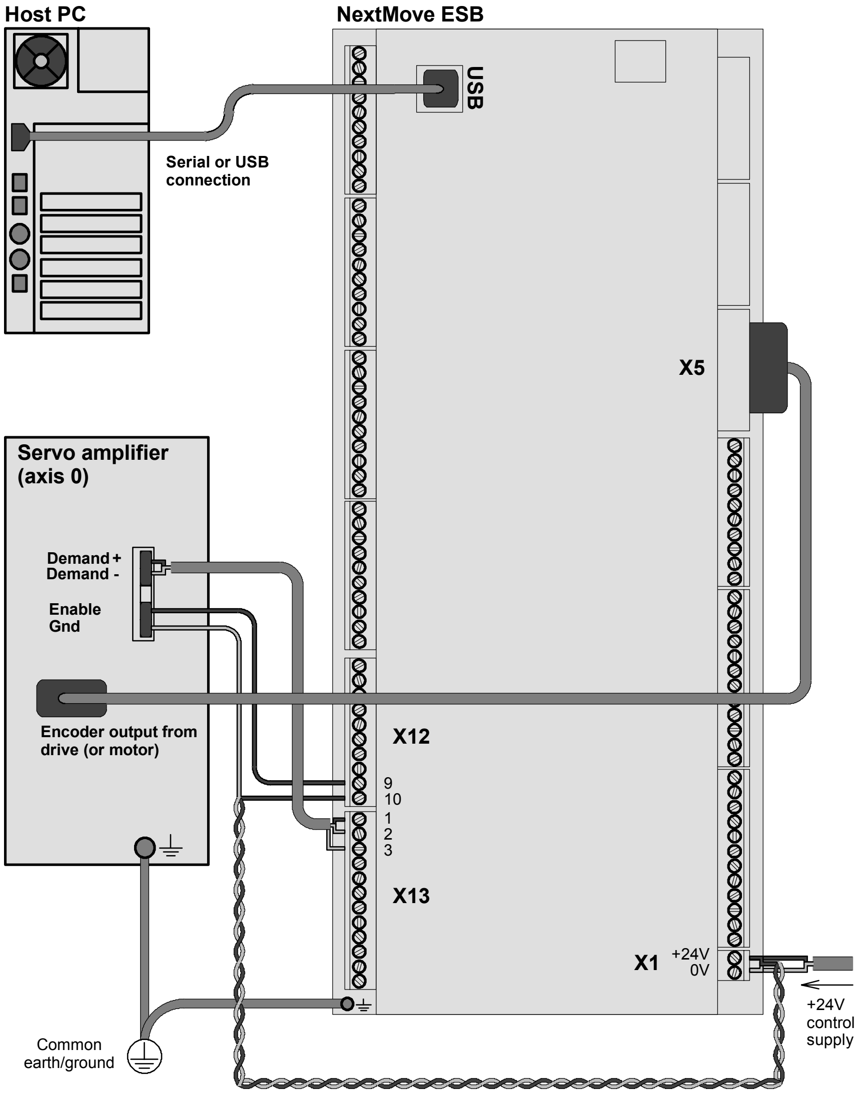


Figure 26 - Example minimum system wiring

NextMove ESB connector	Pin	Name of signal	Function	Connection on amplifier (Note: connections may be labeled differently)
X1	1	0V	Control supply ground	
	2	+24V	Control supply +24V input	
X5		Encoder0	Encoder0 feedback input	Encoder output
X12	9	REL NO	Normally open relay contact (closed to enable drive)	Enable +24V
	10	REL COM	Common relay connection	Enable GND
X13	1	Demand0	Demand output 0	Demand+
	2	AGND	Analog GND	Demand-
	3	Shield	Shield connection	*(Do not connect)*

Table 2 - Connector details for minimum system wiring shown in Figure 26

5.1 Introduction

The software provided includes a number of applications and utilities to allow you to configure, tune and program the NextMove ESB. The Baldor Motion Toolkit CD containing the software can be found separately within the packaging.

5.1.1 Connecting the NextMove ESB to the PC

The NextMove ESB can be connected to the PC using either RS232 or RS485 (model dependent), or USB (all models).

To use RS232 or RS485, connect an appropriate serial cable between a PC serial port (often labeled as “COM”) and the NextMove ESB Serial connector. If you are using an intermediate RS232 to RS485 converter, connect this as specified by the manufacturer. WorkBench v5 can scan all the PC’s COM ports, so you can use any port. If you are not using the Baldor serial cable CBL001-501, your cable must be wired in accordance with Figure 20 in section 4.4.5.

To use USB, connect a USB cable between a PC USB port and the NextMove ESB USB connector. Your PC must be using Windows 2000 or Windows XP.

5.1.2 Installing WorkBench v5

You will need to install WorkBench v5 to configure and tune the NextMove ESB.

1. Insert the CD into the drive.
2. After a few seconds the setup wizard should start automatically. If the setup wizard does not appear, select Run... from the Windows Start menu and type

   d:\start

   where **d** represents the drive letter of the CD device.

   Follow the on-screen instructions to install WorkBench v5. The setup Wizard will copy the files to appropriate folders on the hard drive. The preset folder is C:\Program Files\Baldor\MintMT, although this can be changed during setup.

5.1.3 Starting the NextMove ESB

If you have followed the instructions in the previous sections, you should have now connected the power sources, your choice of inputs and outputs, and a serial or USB cable linking the PC with the NextMove ESB.

5.1.4 Preliminary checks

Before you apply power for the first time, it is very important to verify the following:

- Disconnect the load from the motor until instructed to apply a load.
- Inspect all power connections for accuracy, workmanship and tightness.
- Verify that all wiring conforms to applicable codes.
- Verify that the NextMove ESB is properly earthed/grounded.
- Check all signal wiring for accuracy.

5.1.5 Power on checks

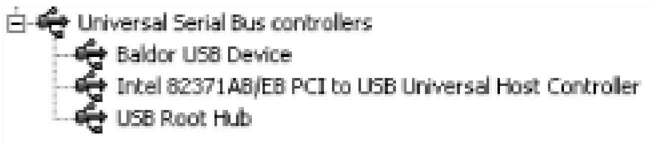
If the status display shows one of the digits 0 - 7 with a flashing decimal point during startup, this indicates that the NextMove ESB has detected a fault - see section 6.

1. Turn on the 24V control supply.
2. After a brief test sequence (8 followed by -.), the Status display should show the node number, for example 2 , the factory default. If the display is not lit then re-check the power supply connections.

5.1.5.1 Installing the USB driver

If you have connected the NextMove ESB to the PC using the USB connection, it will be necessary to install the USB driver. When the NextMove ESB is powered, Windows (2000 or XP only) will automatically detect the controller and request the driver. The driver consists of two files, *baldorusb.inf* and *baldorusb.sys*. Both files must be present for installation.

1. Follow the on-screen instructions to select and install the driver. The driver files are available on the supplied Baldor Motion Toolkit CD. If you are using a copy of the driver located on the hard disk, a floppy disk or another CD, the two driver files must be in the same folder.
2. During installation, Windows XP may report that the driver is 'unsigned'. This is normal for the NextMove ESB driver, so click the Continue Anyway button to continue with the installation. When installation is complete, a new Baldor USB device will be listed in the *Universal Serial Bus controllers* section of Windows Device Manager.



The NextMove ESB is now ready to be configured using WorkBench v5.

Note: If the NextMove ESB is later connected to a different USB port on the host computer, Windows may report that it has found new hardware. Either install the driver files again for the new USB port, or connect the NextMove ESB to the original USB port where it will be recognized in the usual way.

5.2 WorkBench v5

WorkBench v5 is a fully featured application for programming and controlling the NextMove ESB. The main WorkBench window contains a menu system, the Toolbox and other toolbars. Many functions can be accessed from the menu or by clicking a button - use whichever you prefer. Most buttons include a 'tool-tip'; hold the mouse pointer over the button (don't click) and its description will appear.

5.2.1 Help file

WorkBench v5 includes a comprehensive help file that contains information about every MintMT keyword, how to use WorkBench and background information on motion control topics. The help file can be displayed at any time by pressing F1. On the left of the help window, the Contents tab shows the tree structure of the help file; each book contains a number of topics. The Index tab provides an alphabetic list of all topics in the file, and allows you to search for them by name. The Search tab allows you to search for words or phrases appearing anywhere in the help file. Many words and phrases are underlined and highlighted with a color (normally blue) to show that they are links. Just click on the link to go to an associated keyword. Most keyword topics begin with a list of relevant *See Also* links.

Figure 27 - The WorkBench help file

For help on using WorkBench v5, click the **Contents** tab, then click the small plus sign ⊞ beside the **WorkBench v5** book icon. Double click a topic name to display it.

5.2.2 Starting WorkBench v5

1. On the Windows **Start** menu, select Programs, WorkBench v5, WorkBench v5.

   WorkBench v5 will start, and the Tip of the Day dialog will be displayed.

   You can prevent the Tip of the Day dialog appearing next time by removing the check mark next to Show tips at startup.

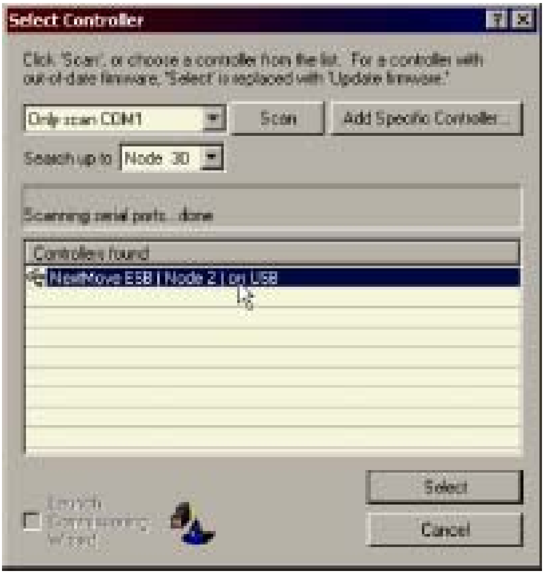
   Click **Close** to continue.

2. In the opening dialog box, click **Start New Project...**

3. In the Select Controller dialog, go to the drop down box near the top and select the PC serial port to which the NextMove ESB is connected. If you are unsure which PC serial port is connected to the drive, select **Scan all serial ports**. If the NextMove ESB is connected using USB, it will be scanned automatically.

   Click **Scan** to search for the NextMove ESB.

   When the search is complete, click 'NextMove ESB' in the list to select it, and then click **Select**.



Note: If the NextMove ESB is not listed, check the serial or USB cable between the NextMove ESB and the PC. Check that the NextMove ESB is powered correctly. Click **Scan** to re-scan the ports.

4. A dialog box may be displayed to tell you that WorkBench v5 has detected new firmware. Click **OK** to continue. WorkBench v5 reads back data from the NextMove ESB. When this is complete, Edit & Debug mode is displayed. This completes the software installation.

5.3 Configuring an axis

The NextMove ESB is capable of controlling 4 stepper and 3 servo axes. This section describes the basic setup for both types of axis. Commands typed in the Command window have immediate effect - they do not need to be separately downloaded to the NextMove ESB.

5.3.1 Selecting a scale

MintMT defines all positional and speed related motion keywords in terms of encoder quadrature counts (for servo motors) or steps for stepper motors. The number of quadrature counts (or steps) is divided by the `SCALEFACTOR` allowing you to use units more suitable for your application. The unit defined by setting a value for scale is called the *user unit* (uu).

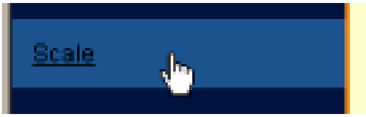
Consider a servo motor with a 1000 line encoder. This provides 4000 quadrature counts for each revolution. If `SCALEFACTOR` is not set, a MintMT command that involves distance, speed, or acceleration may need to use a large number to specify a significant move. For example `MOVER=16000` (Move Relative) would rotate the motor by 16000 quadrature counts - only four revolutions. By setting a `SCALEFACTOR` of 4000, the user unit becomes revolutions. The more understandable command `MOVER=4` could now be used to move the motor four revolutions.

The same concept applies to stepper motors, where the scale can be set according to the number of steps per revolution. Typically, this would be 200 for a motor with a 1.8° step angle, or 400 if driven in half step mode. By setting a `SCALEFACTOR` of 200 (or 400 if driven in half step mode), the user unit becomes revolutions.

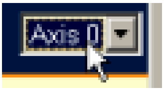
In applications involving linear motion a suitable value for `SCALEFACTOR` would allow commands to express values in linear distance, for example inches, feet or millimeters.

1. In the Toolbox, click **Setup**, then click the Parameters icon.

2. Click the Scale tab.



3. Click in the Axis drop down box to select the axis. Each axis can have a different scale if required.



4. Click in the Scale box and type a value.

5. Click **Apply**.

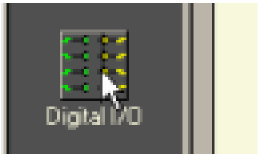
   This immediately sets the scaling factor for the selected axis, which will remain in the NextMove ESB until another scale is defined or power is removed from the NextMove ESB. See section 5.10 for details about saving configuration parameters.

5.3.2 Setting the drive enable output

A drive enable output allows NextMove ESB to enable the external amplifier to allow motion, or disable it in the event of an error. Each axis can be configured with its own drive enable output, or can share an output with other axes. If an output is shared, an error on any of the axes sharing the output will cause all of them to be disabled.

The drive enable output can either be the relay or a digital output.

1. In the Toolbox, click the Digital I/O icon.

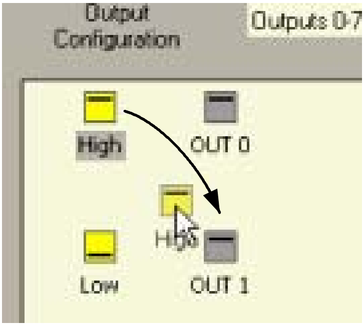


2. At the bottom of the Digital I/O screen, click the **Digital Outputs** tab.

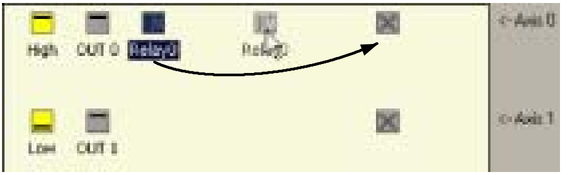
   The left of the screen shows yellow High and Low icons. These describe how the output should behave when activated (to enable the axis).

3. If you are going to use the relay, ignore this step and go straight to step 4.

   If you are going to use a digital output, drag the appropriate yellow icon to the grey OUT icon that will be used as the drive enable output. In this example, OUT1 is being used. The icon's color will change to bright blue.

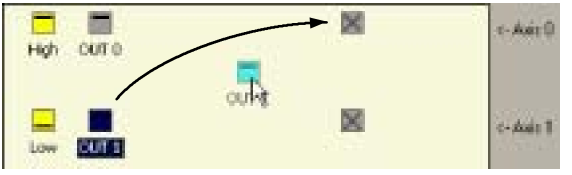


4. If you are going to use the relay, drag the Relay0 icon to the grey Drive Enable OP icon on the right of the screen.



To configure multiple axes to use the error output, repeat this step for the other axes.

If you are using a digital output, drag the bright blue OUT icon to the grey Drive Enable OP axis icon on the right of the screen.



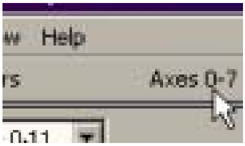
To configure multiple axes with the same drive enable output, repeat this step for the other axes.

5. Click **Apply** at the bottom of the screen. This sends the output configuration to the NextMove ESB.

See section 5.10 for details about saving configuration parameters.

5.3.3 Testing the drive enable output

1. On the main WorkBench v5 toolbar, click the Axis 0-7 button. In the Select Default Axes dialog, select the axes to be controlled. Click **OK** to close the dialog.



2. On the main WorkBench v5 toolbar, click the Drive enable button. Click the button again. Each time you click the button, the drive enable output(s) for the selected axes are toggled.

   When the button is in the pressed (down) position the amplifier should be enabled. When the button is in the raised (up) position the amplifier should be disabled.

If this is not working, or the action of the button is reversed, check the electrical connections between the NextMove ESB and amplifier. If you are using the relay, check that you are using the correct normally open (REL NO) or normally closed (REL NC) connections.

If you are using a digital output, check that it is using the correct high or low triggering method expected by the amplifier.

5.4 Stepper axis - testing

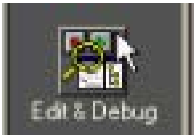
This section describes the method for testing a stepper axis. The stepper control is an open loop system so no tuning is necessary.

5.4.1 Testing the output

This section tests the operation and direction of the output. It is recommended that the system is initially tested with the motor shaft disconnected from other machinery.

1. Check that the Drive enable button is pressed (down).

2. In the Toolbox, click the Edit & Debug icon.



3. Click in the Command window.

4. Type:
   `JOG.0=2`

   where 0 is the axis (stepper output) to be tested and 2 is the speed.

   The `JOG` command specifies the speed in user units per second, so the speed is affected by `SCALEFACTOR` (section 5.3.1). If you have not selected a scale, the command `JOG.0=2` will cause rotation at only 2 half steps per second, so it may be necessary to increase this figure significantly, to 200 for example. If you have selected a scale that provides user units of revolutions (as described in section 5.3.1) `JOG.0=2` will cause rotation at 2 revolutions per second. If there appears to be no step or direction output, check the electrical connections to connector X2, pins 2 and 3 (for axis 0).

5. To repeat the tests for reverse moves, type:
   `JOG.0 = -2`

6. To remove the demand and stop the test, type:
   `STOP.0`

5.5 Servo axis - testing and tuning

This section describes the method for testing and tuning a servo axis. The amplifier must already have been tuned for basic current or velocity control of the motor.

5.5.1 Testing the demand output

This section tests the operation and direction of the demand output for axis 4. By default, axis 4 is a servo axis (although it can be reassigned as a stepper - see section A.1). It is recommended that the motor is disconnected from the load for this test.

1. Check that the Drive enable button is pressed (down).

2. In the Toolbox, click **Application** then click the Edit & Debug icon.

3. Click in the Command window.

4. Type:
   `TORQUE.4=5`

   where 4 is the axis to be tested. In this example, this should cause a demand of +5% of maximum output (0.5V) to be produced at the DEMAND0 output (connector X13, pin 1). In WorkBench v5, look at the Spy window located on the right of the screen. In the Axis selection box at the top, select Axis 4.

   The Spy window's Command display should show 5 percent (approximately). If there seems to be no command output, check the electrical connections to X13.

   The Spy window's Velocity display should show a positive value. If the value is negative check that the DEMAND0 output, and the Encoder0 A and B channels, have been wired correctly. If necessary, the `ENCODERMODE` keyword can be used to swap the encoder A and B channels, thus reversing the encoder count - see the MintMT help file.

   By default, axis 4 uses demand output 0 and encoder 0, axis 5 uses demand output 1 and encoder 1, and axis 6 uses demand output 2 and encoder 2. See section 4.2.2 for details of the demand outputs.

5. To repeat the tests for negative (reverse) demands, type:
   `TORQUE.4=-5`

   This should cause a demand of -5% of maximum output (-0.5V) to be produced at the DEMAND0 output. Correspondingly, the Spy window's Velocity display should show a negative value.

6. To remove the demand and stop the test, type:
   `STOP.4`

   This should cause the demand produced at the DEMAND0 output to become 0V.

If it is necessary for the motor to turn in the opposite direction for a positive demand, then the `DACMODE` and `ENCODERMODE` keywords should be used. The `DACMODE` keyword is used to invert the demand output voltage. The `ENCODERMODE` keyword must then also be used to reverse the incoming feedback signal, to correspond with the inverted demand output. Note that if `ENCODERMODE` had *already* been used to compensate for a reversed encoder count (as described in step 4. above), it will be necessary to change it back to its original setting to correspond with the inverted demand output set using `DACMODE`. See the MintMT help file for details of each keyword.

5.5.2 An introduction to closed loop control

This section describes the basic principles of closed loop control. If you are familiar with closed loop control go straight to section 5.6.1.

When there is a requirement to move an axis, the NextMove ESB control software translates this into a demand output voltage. This is used to control the drive (servo amplifier) which powers the motor. An encoder or resolver on the motor is used to measure the motor's position. Every 1ms* (adjustable using the `LOOPTIME` keyword) the NextMove ESB compares the demanded and measured positions. It then calculates the demand needed to minimize the difference between them, known as the **following error**.

This system of constant measurement and correction is known as closed loop control.
[*For the analogy, imagine you are in your car waiting at an intersection. You are going to go straight on when the lights change, just like the car standing next to you which is called* Demand*. You're not going to race* Demand *though - your job as the controller (NextMove ESB) is to stay exactly level with* Demand, *looking out of the window to measure your position*].

The main term that the NextMove ESB uses to correct the error is called **Proportional gain** (**KPROP**). A very simple proportional controller would simply multiply the amount of error by the Proportional gain and apply the result to the motor [*the further* Demand *gets ahead or behind you, the more you press or release the gas pedal*].

If the Proportional gain is set too high overshoot will occur, resulting in the motor vibrating back and forth around the desired position before it settles [*you press the gas pedal so hard you go right past* Demand. *To try and stay level you ease off the gas, but end up falling behind a little. You keep repeating this and after a few tries you end up level with* Demand, *traveling at a steady speed. This is what you wanted to do but it has taken you a long time*].
If the Proportional gain is increased still further, the system becomes unstable [*you keep pressing and then letting off the gas pedal so hard you never travel at a steady speed*].

To reduce the onset of instability, a term called **Velocity Feedback gain** (**KVEL**) is used. This resists rapid movement of the motor and allows the Proportional gain to be set higher before vibration starts. Another term called **Derivative gain** (**KDERIV**) can also be used to give a similar effect.

With Proportional gain and Velocity Feedback gain (or Derivative gain) it is possible for a motor to come to a stop with a small following error [Demand *stopped so you stopped too, but not quite level*]. The NextMove ESB tries to correct the error, but because the error is so small the amount of torque demanded might not be enough to overcome friction.

This problem is overcome by using a term called **Integral gain** (**KINT**). This sums the error over time, so that the motor torque is gradually increased until the positional error is reduced to zero [*like a person gradually pushing harder and harder on your car until they've pushed it level with* Demand].

However, if there is large load on the motor (it is supporting a heavy suspended weight for example), it is possible for the output to increase to 100% demand. This effect can be limited using the `KINTLIMIT` keyword which limits the effect of KINT to a given percentage of the demand output. Another keyword called `KINTMODE` can even turn off integral action when it's not needed.

***** The 1ms sampling interval can be changed using the `LOOPTIME` keyword to either 2ms, 500μs, 200μs or 100μs.

The remaining gain terms are **Velocity Feed forward** (**KVELFF**) and **Acceleration Feed forward** (**KACCEL**) described below.

In summary, the following rules can be used as a guide:

- KPROP: Increasing KPROP will speed up the response and reduce the effect of disturbances and load variations. The side effect of increasing KPROP is that it also increases the overshoot, and if set too high it will cause the system to become unstable. The aim is to set the Proportional gain as high as possible without getting overshoot, instability or hunting on an encoder edge when stationary (the motor will buzz).
- KVEL: This gain has a damping effect on the whole response, and can be increased to reduce any overshoot. If KVEL becomes too large it will amplify any noise on the velocity measurement and introduce oscillations.
- KINT: This gain has a de-stabilizing effect, but a small amount can be used to reduce any steady state errors. By default, KINTMODE is always on (mode 1).
- KINTLIMIT: The integration limit determines the maximum value of the effect of integral action. This is specified as a percentage of the full scale demand.
- KDERIV: This gain has a damping effect dependent on the rate of change of error, and so is particularly useful for removing overshoot.
- KVELFF: This is a feed forward term and as such has a different effect on the servo system than the previous gains. KVELFF is outside the closed loop and therefore does not have an effect on system stability. This gain allows a faster response to demand speed changes with lower following errors, for example you would increase KVELFF to reduce the following error during the slew section of a trapezoidal move. The trapezoidal test move can be used to fine-tune this gain. This term is especially useful with velocity controlled servos
- KACCEL: This term is designed to reduce velocity overshoots on high acceleration moves.

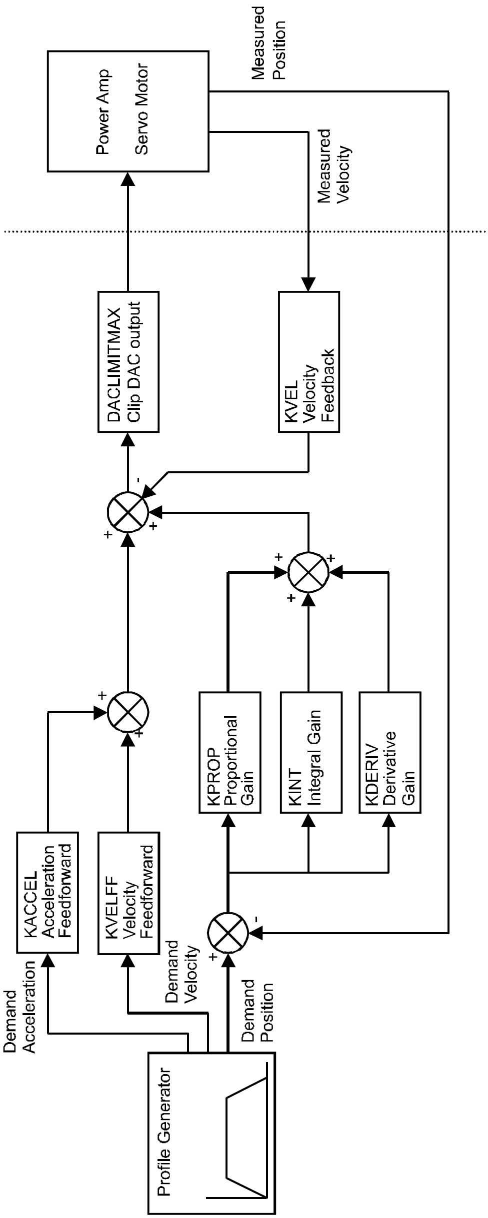


Figure 28 - The NextMove ESB servo loop

5.6 Servo axis - tuning for current control

5.6.1 Selecting servo loop gains

All servo loop parameters default to zero, meaning that the demand output will be zero at power up. Most servo amplifiers can be set to current (torque) control mode or velocity control mode; check that the servo amplifier will operate in the correct mode. The procedure for setting system gains differs slightly for each. To tune an axis for velocity control, go straight to section 5.8. It is recommended that the system is initially tested and tuned with the motor shaft disconnected from other machinery. Confirm that the encoder feedback signals from the motor or servo amplifier have been connected, and that a positive demand causes a positive feedback signal.

Note: The method explained in this section should allow you to gain good control of the motor, but will not necessarily provide the optimum response without further fine-tuning. Unavoidably, this requires a good understanding of the effect of the gain terms.

1. In the Toolbox, click the Fine-tuning icon.

   The Fine-tuning window is displayed at the right of the screen. The main area of the WorkBench v5 window displays the Capture window. When tuning tests are performed, this will display a graph representing the response.

2. In the Fine-tuning window, click in the Axis selection box at the top and select Axis 4. By default, axis 4 is a servo axis (although it can be reassigned as a stepper - see section A.1).

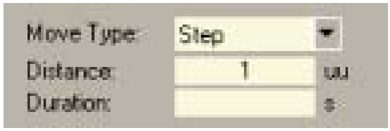
   Click in the KDERIV box and enter a starting value of 1.

   Click **Apply** and then turn the motor shaft by hand. Repeat this process, slowly increasing the value of KDERIV until you begin to feel some resistance in the motor shaft. The exact value of KDERIV is not critical at this stage.

3. Click in the KPROP box and enter a value that is approximately one quarter of the value of KDERIV. If the motor begins to vibrate, decrease the value of KPROP or increase the value of KDERIV until the vibration stops. Small changes may be all that is necessary.

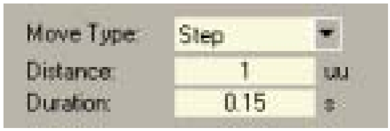
4. In the Move Type drop down box, check that the move type is set to Step.

5. Click in the Distance box and enter a distance for the step move. It is recommended to set a value that will cause the motor to turn a short distance, for example one revolution.



Note: The distance depends on the scale set in section 5.3.1. If you set a scale so that units could be expressed in revolutions (or other unit of your choice), then those are the units that will be used here. If you did not set a scale, the amount you enter will be in encoder counts.

6. Click in the Duration box and enter a duration for the move, in seconds. This should be a short duration, for example 0.15 seconds.



7. Click **Go**.

The NextMove ESB will perform the move and the motor will turn. As the soon as the move is completed, WorkBench v5 will upload captured data from the NextMove ESB. The data will then be displayed in the Capture window as a graph.

Note: The graphs that you see will not look exactly the same as the graphs shown here! Remember that each motor has a different response.

8. Using the check boxes below the graph, select the traces you require, for example Demand position and Measured position.

5.6.2 Underdamped response

If the graph shows that the response is underdamped (it overshoots the demand, as shown in Figure 29) then the value for KDERIV should be increased to add extra damping to the move. If the overshoot is excessive or oscillation has occurred, it may be necessary to reduce the value of KPROP.

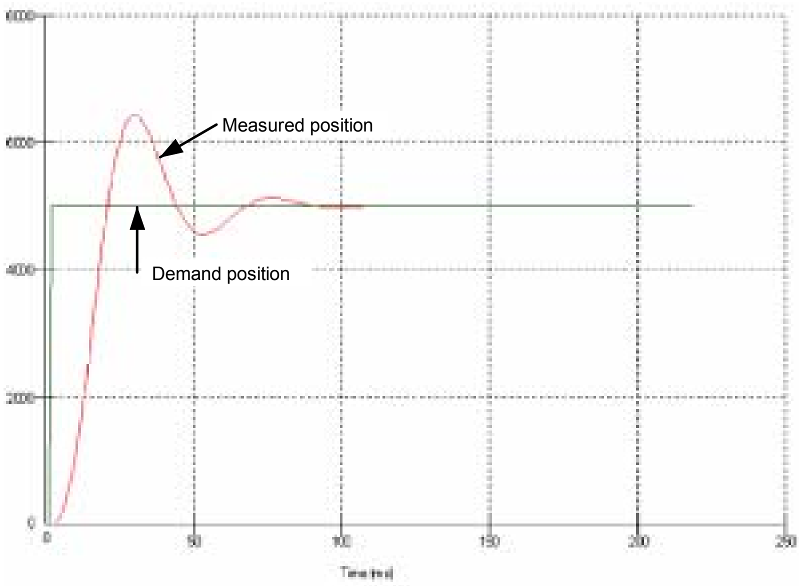


Figure 29 - Underdamped response

9. Click in the KDERIV and/or KPROP boxes and make the required changes. The ideal response is shown in section 5.6.4.

5.6.3 Overdamped response

If the graph shows that the response is overdamped (it reaches the demand too slowly, as shown in Figure 30) then the value for KDERIV should be decreased to reduce the damping of the move. If the overdamping is excessive, it may be necessary to increase the value of KPROP.

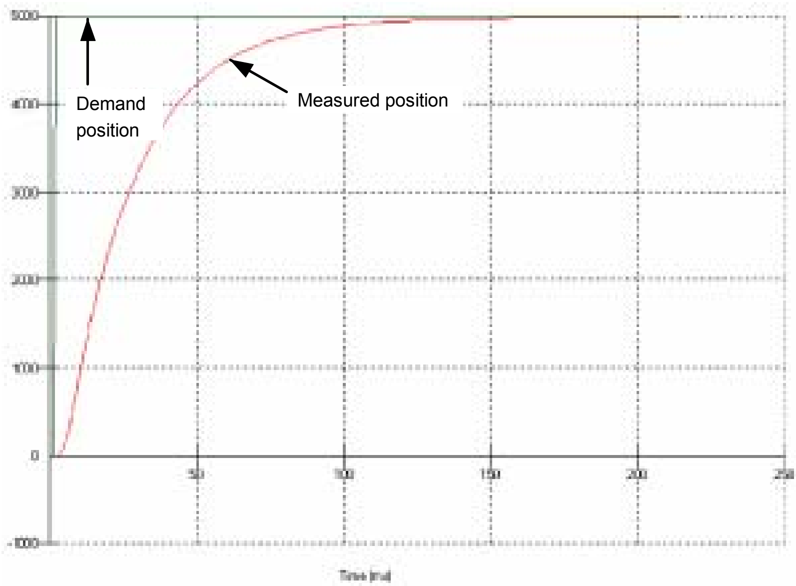


Figure 30 - Overdamped response

10. Click in the KDERIV and/or KPROP boxes and make the required changes. The ideal response is shown in section 5.6.4.

5.6.4 Critically damped response

If the graph shows that the response reaches the demand quickly and only overshoots the demand by a small amount, this can be considered an ideal response for most systems. See Figure 31.

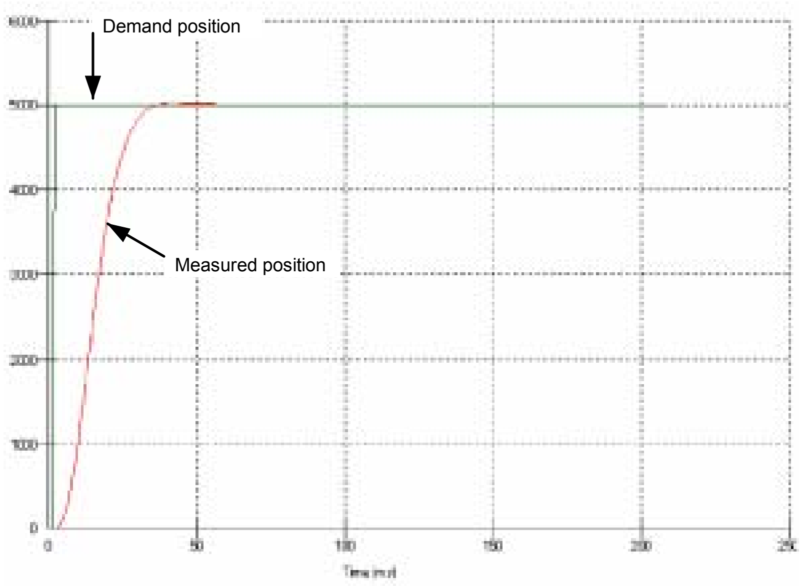


Figure 31 - Critically damped (ideal) response

5.7 Servo axis - eliminating steady-state errors

In systems where precise positioning accuracy is required, it is often necessary to position within one encoder count. Proportional gain, KPROP, is not normally able to achieve this because a very small following error will only produce a small demand for the drive which may not be enough to overcome mechanical friction (this is particularly true in current controlled systems). This error can be overcome by applying integral gain. The integral gain, KINT, works by accumulating following error over time to produce a demand sufficient to move the motor into the required position with zero following error.
KINT can therefore overcome errors caused by gravitational effects such as vertically moving linear axes. With current controlled drives a non-zero demand output is required to hold the load in the correct position, to achieve zero following error.

Care is required when setting KINT since a high value will cause instability during moves.
A typical value for KINT would be 0.1. The effect of KINT should also be limited by setting the integration limit, KINTLIMIT, to the smallest possible value that is sufficient to overcome friction or static loads, for example 5. This will limit the contribution of the integral term to 5% of the full demand output range.

1. Click in the KINT box and enter a small starting value, for example 0.1.

2. Click in the KINTLIMIT box and enter a value of 5.

With NextMove ESB, the action of KINT and KINTLIMIT can be set to operate in various modes:

- Never - the KINT term is never applied
- Always - the KINT term is always applied
- Smart - the KINT term is only applied when the demand speed is zero or constant.
- Steady State - the KINT term is only applied when the demand speed is zero.

This function can be selected using the KINTMODE drop down box.

5.8 Servo axis - tuning for velocity control

Drives designed for velocity control incorporate their own velocity feedback term to provide system damping. For this reason, KDERIV (and KVEL) can often be set to zero.

Correct setting of the velocity feed forward gain KVELFF is important to get the optimum response from the system. The velocity feed forward term takes the instantaneous velocity demand from the profile generator and adds this to the output block (see Figure 28). KVELFF is outside the closed loop and therefore does not have an effect on system stability. This means that the term can be increased to maximum without causing the motor to oscillate, provided that other terms are setup correctly.

When setup correctly, KVELFF will cause the motor to move at the speed demanded by the profile generator. This is true without the other terms in the closed loop doing anything except compensating for small errors in the position of the motor. This gives faster response to changes in demand speed, with reduced following error.

Before proceeding, confirm that the encoder feedback signals from the motor or servo amplifier have been connected, and that a positive demand causes a positive feedback signal.

5.8.1 Calculating KVELFF

To calculate the correct value for KVELFF, you will need to know:

- The speed, in revolutions per minute, produced by the motor when a maximum demand (+10V) is applied to the drive.
- The setting for `LOOPTIME`. The factory preset setting is 1ms.
- The resolution of the encoder input.

The servo loop formula uses speed values expressed in *quadrature counts per servo loop*. To calculate this figure:

1. First, divide the speed of the motor, in revolutions per minute, by 60 to give the number of revolutions per second. For example, if the motor speed is 3000rpm when a maximum demand (+10V) is applied to the drive:

   Revolutions per second = 3000 / 60
   = <u>50</u>

2. Next, calculate how many revolutions will occur during one servo loop. The factory preset servo loop time is 1ms (0.001 seconds), so:

   Revolutions per servo loop = 50 x 0.001 seconds
   = <u>0.05</u>

3. Now calculate how many quadrature encoder counts there are per revolution. The NextMove ESB counts both edges of both pulse trains (CHA and CHB) coming from the encoder, so for every encoder line there are 4 ‘quadrature counts’. With a 1000 line encoder:

   Quadrature counts per revolution = 1000 x 4
   = <u>4000</u>

4. Finally, calculate how many quadrature counts there are per servo loop:

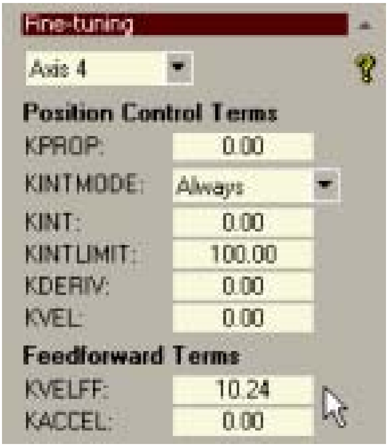
   Quadrature counts per servo loop = 4000 x 0.05
   = <u>200</u>

The analog demand output is controlled by a 12-bit DAC, which can create output voltages in the range -10V to +10V. This means a maximum output of +10V corresponds to a DAC value of 2048. The value of KVELFF is calculated by dividing 2048 by the number of quadrature counts per servo loop, so:

KVELFF	=	2048 / 200
	=	**<u>10.24</u>**

5. Click in the KVELFF box and enter the value.

   The calculated value should give zero following error at constant velocity. Using values greater than the calculated value will cause the controller to have a following error ahead of the desired position. Using values less than the calculated value will cause the controller to have following error behind the desired position.



6. In the Move Type drop down box, check that the move type is set to Trapezoid.

7. Click in the Distance box and enter a distance for the step move. It is recommended to set a value that will cause the motor to make a few revolutions, for example 10.

   Note: The distance depends on the scale set in section 5.3.1. If you set a scale so that units could be expressed in revolutions (or other unit of your choice), then those are the units that will be used here. If you did not set a scale, the amount you enter will be in encoder counts.

8. Click **Go**.

   The NextMove ESB will perform the move and the motor will turn. As the soon as the move is completed, WorkBench v5 will upload captured data from the NextMove ESB. The data will then be displayed in the Capture window as a graph.

   Note: The graph that you see will not look exactly the same as the graph shown here! Remember that each motor has a different response.

9. Using the check boxes below the graph, select the Measured velocity and Demand velocity traces.

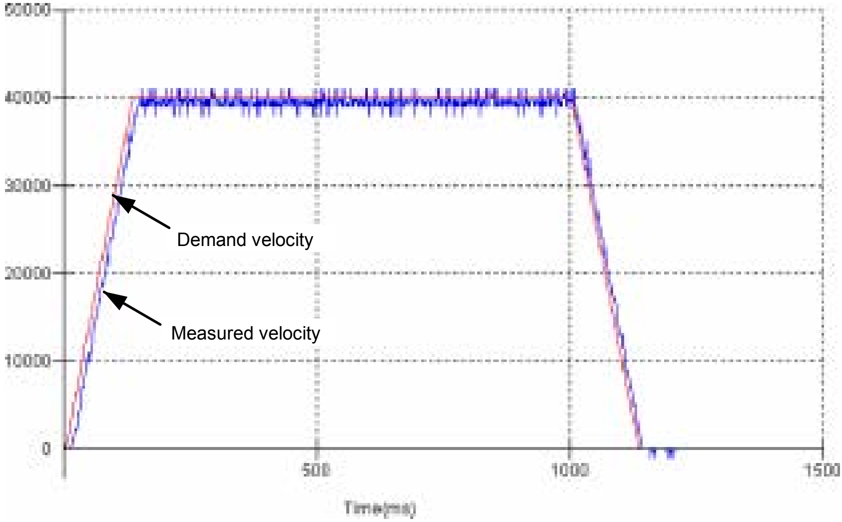


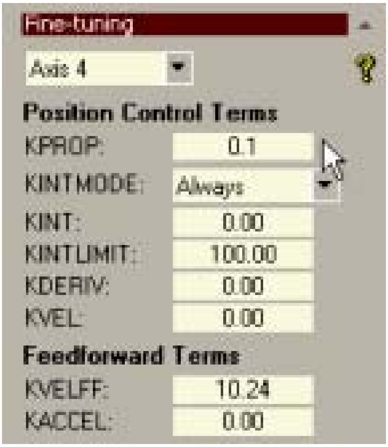
Figure 32 - Correct value of KVELFF

It may be necessary to make changes to the calculated value of KVELFF. If the trace for Measured velocity appears above the trace for Demand velocity, reduce the value of KVELFF. If the trace for Measured velocity appears below the trace for Demand velocity, increase the value of KVELFF. Repeat the test after each change. When the two traces appear on top of each other (approximately), the correct value for KVELFF has been found as shown in Figure 32.

5.8.2 Adjusting KPROP

The KPROP term can be used to reduce following error. Its value will usually be much smaller than the value used for an equivalent current controlled system. A fractional value, for example 0.1, will probably be a good starting figure which can then be increased slowly.

1. Click in the KPROP box and enter a starting value of 0.1.

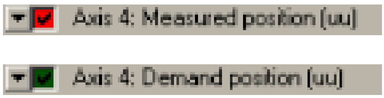


2. Click **Go**.

The NextMove ESB will perform the move and the motor will turn. As the soon as the move is completed, WorkBench v5 will upload captured data from the NextMove ESB. The data will then be displayed in the Capture window as a graph.

Note: The graph that you see will not look exactly the same as the graph shown here! Remember that each motor has a different response.

3. Using the check boxes below the graph, select the Measured position and Demand position traces.



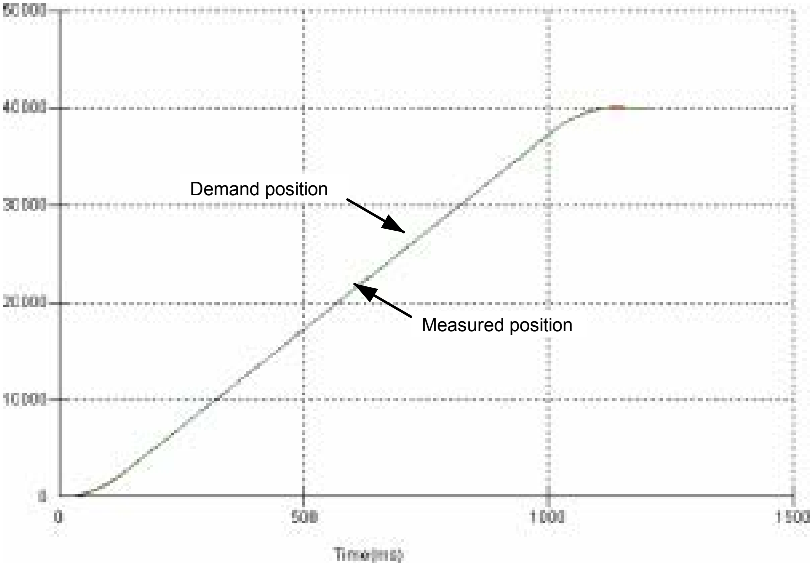


Figure 33 - Correct value of KPROP

The two traces will probably appear with a small offset from each other, which represents the following error. Adjust KPROP by small amounts until the two traces appear on top of each other (approximately), as shown in Figure 33.

Note: It may be useful to use the zoom function to magnify the end point of the move. In the graph area, click and drag a rectangle around the end point of the traces. To zoom out, right-click in the graph area and choose Undo Zoom.

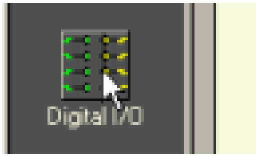
5.9 Digital input/output configuration

The Digital I/O window can be used to setup other digital inputs and outputs.

5.9.1 Digital input configuration

The Digital Inputs tab allows you to define how each digital input will be triggered, and if it should be assigned to a special purpose function such as a Home or Limit input. In the following example, digital input 1 will be set to trigger on an active low input, and allocated to the forward limit input of axis 0:

1. In the Toolbox, click the Digital I/O icon.



2. At the bottom of the Digital I/O screen, click the **Digital Inputs** tab.

   The left of the screen shows a column of yellow icons - High, Low, Rising, Falling and Rise/Fall. These describe how the input will be triggered.

3. Drag the **Low** icon  onto the **IN1** icon . This will setup IN1 to respond to a low input.

4. Now drag the **IN1** icon  onto the **Fwd Limit** icon .

   This will setup IN1 as the Forward Limit input of axis 0.

5. Click **Apply** to send the changes to the NextMove ESB.

   Note: If required, multiple inputs can be configured before clicking **Apply**.

5.9.2 Digital output configuration

The Digital Outputs tab allows you to define how each digital output will operate and if it is to be configured as a drive enable output (see section 5.3.2). Remember to click **Apply** to send the changes to the NextMove ESB.

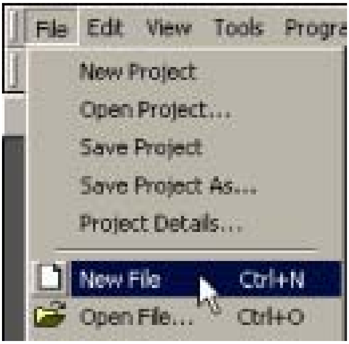
5.10 Saving setup information

When power is removed from the NextMove ESB all data, including configuration and tuning parameters, is lost. You should therefore save this information in a file, which can be loaded when the unit is next used.

1. In the Toolbox, click the Edit & Debug icon.

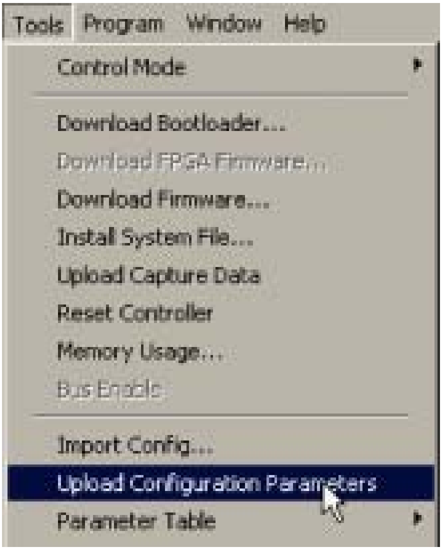
2. On the main menu, choose **File**, **New File**.

   A new program editing window will appear.



3. On the main menu, choose **Tools**, **Upload Configuration Parameters**.

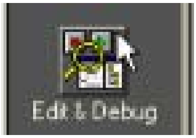
   WorkBench v5 will read all the configuration information from the NextMove ESB and place it in a Startup block. For details of the Startup block, see the MintMT help file.



4. On the main menu, choose **File**, **Save File**. Locate a folder, enter a filename and click **Save**.

5.10.1 Loading saved information

1. In the Toolbox, click the Edit & Debug icon.



2. On the main menu, choose **File**, **Open File...**
   Locate the file and click **Open**.

A Startup block should be included in every Mint program, so that whenever a program is loaded and run the NextMove ESB will be correctly configured. Remember that every drive/motor combination has a different response. If the same program is used on a different NextMove ESB installation, the Startup block will need to be changed.

6.1 Introduction

This section explains common problems and their solutions. If you want to know the meaning of the LED indicators, see section 6.2.

6.1.1 Problem diagnosis

If you have followed all the instructions in this manual in sequence, you should have few problems installing the NextMove ESB. If you do have a problem, read this section first.
In WorkBench v5, use the Error Log tool to view recent errors and then check the help file.
If you cannot solve the problem or the problem persists, the SupportMe feature can be used.

6.1.2 SupportMe feature

The SupportMe feature is available from the Help menu, or by clicking the  button on the motion toolbar. SupportMe can be used to gather information which can then be e-mailed, saved as a text file, or copied to another application. The PC must have e-mail facilities to use the e-mail feature. If you prefer to contact Baldor technical support by telephone or fax, contact details are provided at the front of this manual. Please have the following information ready:

- The serial number of your NextMove ESB (if known).
- Use the Help, SupportMe menu item in WorkBench v5 to view details about your system.
- The type of servo amplifier and motor that you are using.
- A clear description of what you are trying to do, for example performing fine-tuning.
- A clear description of the symptoms that you can observe, for example error messages displayed in WorkBench v5, or the current value of any of the Mint error keywords `AXISERROR`, `AXISSTATUS`, `INITERROR`, and `MISCERROR`.
- The type of motion generated in the motor shaft.
- Give a list of any parameters that you have setup, for example the gain settings you have entered.

6.2 NextMove ESB indicators

6.2.1 Status display

The Status LED normally displays the unit's node number. To display information about a specific axis, use the LED keyword (see the MintMT help file). When a specific axis is selected, the following symbols may be displayed by the Status LED. Some characters will flash to indicate an error.

2	Spline. A spline move is being performed. See the SPLINE keyword and related commands.
8	Axis enabled.
9	Torque mode. The NextMove ESB is in Torque mode. See the TORQUE keyword and related commands.
A	Hold to Analog. The axis is in Hold To Analog mode. See the HTA keyword and related commands.
d	Follow and offset. When an axis is following a demand signal it may be necessary to advance or retard the slave in relation to the master. To do this an offset move is performed in parallel with the follow. See the FOLLOW and OFFSET keywords.
C	Circle. A circle move is being performed. See the CIRCLEA or CIRCLER keywords.
c	Cam. A Cam profile is being profiled. See the CAM keyword.
E.	General error. See the AXISERROR keyword. The motion toolbar displays the status of AXISERROR, which is a bit pattern of all latched errors. See also the *Error Log* topics in the help file.
e.	Error input. The ERRORINPUT has been activated and generated an error.
F	Flying shear. A flying shear is being profiled. See the FLY keyword.
F.	Position following error. A following error has occurred. See the AXISERROR keyword and associated keywords. Following errors could be caused by a badly tuned drive/motor. At higher acceleration and deceleration rates, the following error will typically be greater. Ensure that the drive/motor is adequately tuned to cope with these acceleration rates. The following error limit can be adjusted to suit your application (see the FOLERRORFATAL and VELFATAL keywords). Following error could also be the cause of encoder/resolver loss (see also the FEEDBACKFAULTENABLE keyword).
7	Follow mode. The axis is in Follow mode. See the FOLLOW keyword.
h	Homing. The axis is currently homing. See the HOME keyword.
I	Incremental move. An incremental move is being profiled. See the INCA and INCR keywords.
J	Jog. The axis is jogging. In the Mint help file, see the topics JOG, JOGCOMMAND and *Jog mode*.

o	Offset move. The axis is performing an offset move.
P	Positional Move. The axis is performing a linear move. See the `MOVEA` and `MOVER` keywords.
S	Stop. A `STOP` command has been issued or the stop input is active.
-	Axis disabled. The axis/drive must be enabled before operation can continue. See section 5.3.3. Click the **Drive enable** button in WorkBench v5.
=	Suspend. The `SUSPEND` command has been issued and is active. Motion will be ramped to zero demand whilst active.
⊢.	Reverse software or hardware limit. A reverse software limit has been activated. See `AXISERROR` and/or `AXISSTATUS` to determine which applies.
⊣.	Forward software or hardware limit. A forward software limit has been activated. See `AXISERROR` and/or `AXISSTATUS` to determine which applies.
≡	Firmware being updated (horizontal bars appear sequentially). New firmware is being downloaded to the NextMove ESB.
i.	Initialization error. An initialization error has occurred at power on. See the *Error Log* or `INITERROR` topics in the help file. Initialization errors should not normally occur.

When a node number between 1 and 15 is displayed, it is shown in hexadecimal format (1 - F). For node numbers greater than 15, three horizontal bars are displayed. User defined symbols can be made to appear using the keywords `LED` and `LEDDISPLAY`. See the MintMT help file for details of each keyword.

If the status display shows one of the digits 0 - 7 with a flashing decimal point during startup, this indicates that the NextMove ESB has detected a fault and cannot be started. In this unlikely event, please contact Baldor technical support.

6.2.2 Communication

If the problem is not listed below please contact Baldor technical support.

Symptom	**Check**
Cannot detect NextMove ESB	Check that the NextMove ESB is powered. For serial connections, check that the serial cable is wired correctly and properly connected. Check that no other application on the PC is attempting to use the same serial port. For USB connections, check that the cable is properly connected. Check that the USB device driver has been installed.
Cannot communicate with the controller.	Verify that WorkBench v5 is loaded and that NextMove ESB is the currently selected controller.

6.2.3 Motor control

Symptom	Check
Controller appears to be working but will not cause motor to turn.	Check that the connections between motor and drive are correct. Use WorkBench v5 to perform the basic system tests (see section 5.5 or 5.4). Confirm that the drive enable output has been configured (see section 5.3.2). Ensure that while the NextMove ESB is not in error the drive is enabled and working. When the NextMove ESB is first powered up the drive should be disabled if there is no program running (there is often an LED on the front of the drive to indicate status). *(Servo outputs only)* Check that the servo loop gains are setup correctly - check the Fine-tuning window. See sections 5.5.2 to 5.7.
Motor runs uncontrollably when controller is switched on.	Verify that the NextMove ESB and drive are correctly grounded to a common ground. *(Servo outputs only)* Check that the correct encoder feedback signal is connected to the encoder input, the encoder has power (if required, see sections 4.4.2 and 7.1.7) and is functioning correctly. Check that the drive is connected correctly to the NextMove ESB and that with zero demand there is 0V at the drive's demand input. See section 5.5.1.
Motor runs uncontrollably when controller is switched on and servo loop gains are applied or when a move is set in progress. Motor then stops after a short time.	*(Servo outputs only)* Check that the encoder feedback signal(s) are connected to the correct encoder input(s). Check the demand to the drive is connected with the correct polarity. Check that for a positive demand signal, a positive increase in axis position is seen. The `ENCODERMODE` keyword can be used to change encoder input direction. The `DACMODE` keyword can be used to reverse DAC output polarity. Check that the maximum following error is set to a reasonable value. For setting up purposes, following error detection may be disabled by setting `FOLERRORMODE=0`.
Motor is under control, but vibrates or overshoots during a move.	*(Servo outputs only)* Servo loop gains may be set incorrectly. See sections 5.5.2 to 5.7.

Symptom	Check
Motor is under control, but when moved to a position and then back to the start it does not return to the same position.	Verify that the NextMove ESB and drive are correctly grounded to a common earth point. *(Servo outputs only)* Check: ■ all encoder channels are free from electrical noise; ■ they are correctly wired to the controller; ■ when the motor turns, the two square wave signals are 90 degrees out of phase. Also check the complement signals. Ensure that the encoder cable uses shielded twisted pair cable, with the outer shield connected at both ends and the inner shields connected only at the NextMove ESB end. *(Stepper outputs only)* The motor is not maintaining synchronization with the NextMove ESB drive output signals due to excessive acceleration, speed or load demands on the motor. Check that the acceleration, speed and load are within the capabilities of the motor.

6.2.4 WorkBench v5

Symptom	Check
The Spy window does not update	The system refresh has been disabled. Go to the Tools, Options menu item, select the System tab and then choose a System Refresh Rate (500ms is recommended).

6.2.5 CANopen

Symptom	Check
The CANopen bus is 'passive'	This means that the internal CAN controller in the NextMove ESB is experiencing a number of Tx and/or Rx errors, greater than the passive threshold of 127. Check: ■ 12-24V is being applied to pin 5 of the RJ45 CAN connector, to power the opto-isolators. ■ There is at least one other CANopen node in the network. ■ The network is terminated *only* at the ends, not at intermediate nodes. ■ All nodes on the network are running at the same baud rate. ■ All nodes have been assigned a unique node ID. ■ The integrity of the CAN cables. The NextMove ESB should recover from the 'passive' state once the problem has been rectified (this may take several seconds).
The CANopen bus is 'off'	This means that the internal CAN controller in the NextMove ESB has experiencing a fatal number of Tx and/or Rx errors, greater than the off threshold of 255. At this point the node will have switched itself to a state whereby it cannot influence the bus. Check: ■ 12-24V is being applied to pin 5 of the RJ45 CAN connector, to power the opto-isolators. ■ There is at least one other CANopen node in the network. ■ The network is terminated *only* at the ends, not at intermediate nodes. ■ All nodes on the network are running at the same baud rate. ■ All nodes have been assigned a unique node ID. ■ The integrity of the CAN cables. To recover from the 'off' state the bus must be reset. This can be done using the MintMT BUSRESET keyword, or by resetting the NextMove ESB.

Symptom	Check
The Manager node cannot scan/recognize a node on the network using the MintMT `NODESCAN` keyword.	Assuming that the network is working correctly (see previous symptoms) and the bus is in an 'Operational' state, check the following: ■ Only nodes that conform to DS401, DS403 and other Baldor CANopen nodes are supported by the MintMT `NODESCAN` keyword. ■ Check that the node in question has been assigned a unique node ID. ■ The node must support the node guarding process. NextMove ESB does not support the Heartbeat process. ■ Try power-cycling the node in question. If the node in question does not conform to DS401 or DS403 and is not a Baldor CANopen node, communication is still possible using a set of general purpose MintMT keywords. See the MintMT help file for further details.
The node has been successfully scanned / recognized by the Manager node, but communication is still not possible.	For communication to be allowed, a connection must be made to a node after it has been scanned. ■ Baldor controller nodes are automatically connected to after being scanned. ■ Nodes that conform to DS401, DS403 must have the connections made manually using the MintMT `CONNECT` keyword. If a connection attempt using `CONNECT` fails then it may be because the node being connected to does not support an object which needs to be accessed in order to setup the connection.

6.2.6 Baldor CAN

Symptom	Check
The Baldor CAN bus is 'passive'	This means that the internal CAN controller in the NextMove ESB is experiencing a number of Tx and/or Rx errors, greater than the passive threshold of 127. Check: ■ 12-24V is being applied to pin 5 of the RJ45 CAN connector, to power the opto-isolators. ■ There is at least one other Baldor CAN node in the network, with jumpers JP1 and JP2 in the '1' (lower) position. ■ The network is terminated *only* at the ends, not at intermediate nodes. ■ All nodes on the network are running at the same baud rate. ■ All nodes have been assigned a unique node ID. ■ The integrity of the CAN cables. The NextMove ESB should recover from the 'passive' state once the problem has been rectified.
The Baldor CAN bus is 'off'	This means that the internal CAN controller in the NextMove ESB has experiencing a fatal number of Tx and/or Rx errors, greater than the off threshold of 255. At this point the node will have switched itself to a state whereby it cannot influence the bus. Check: ■ 12-24V is being applied to pin 5 of the RJ45 CAN connector, to power the opto-isolators. ■ There is at least one other Baldor CAN node in the network, with jumpers JP1 and JP2 in the '1' (lower) position. ■ The network is terminated *only* at the ends, not at intermediate nodes. ■ All nodes on the network are running at the same baud rate. ■ All nodes have been assigned a unique node ID. ■ The integrity of the CAN cables. To recover from the 'off' state the bus must be reset. This can be done using the MintMT BUSRESET keyword, or by resetting the NextMove ESB.

7.1 Introduction

This section provides technical specifications of the NextMove ESB.

7.1.1 Input power

Description	**Value**
Input power Nominal input voltage Power consumption	 24V (±20%) 50W (2A @24V)

7.1.2 Analog inputs

Description	**Unit**	**Value**
Type		Differential
Common mode voltage range	**VDC**	±10
Input impedance	**kΩ**	120
Input ADC resolution	**bits**	12 (includes sign bit)
Equivalent resolution (±10V input)	**mV**	±4.9
Sampling interval	**μs**	500 (both inputs enabled) 250 (one input disabled)

7.1.3 Analog outputs

Description	**Unit**	**Value**
Type		Bipolar
Output voltage range	**VDC**	±10
Output current (maximum)	**mA**	10
Output DAC resolution	**bits**	12
Equivalent resolution	**mV**	±4.9
Update interval	**μs**	100 - 2000 (same as `LOOPTIME`; default = 1000)

7.1.4 Digital inputs

Description	Unit	Value
Type		Opto-isolated
USR V+ supply voltage Nominal Minimum Maximum	**VDC**	 24 12 30
Input voltage Active Inactive	**VDC**	 > 12V < 2V
Input current (maximum per input, USR V+ = 24V)	**mA**	7

7.1.5 Digital outputs - general purpose

Description	Unit	Value	
USR V+ supply voltage Nominal Minimum Maximum	**VDC**	 24V 12V 30V	
Output current Max. source per output, one output on Max. source per output, all outputs on Maximum total output current	**mA**	DOUT0-7 350 62.5 500	DOUT8-10 350 166 500
Update interval		Immediate	

7.1.6 Relay output

All models	Unit	All models
Contact rating (resistive)		1A @ 24VDC or 0.25A @ 30VAC
Operating time (max)	**ms**	5

7.1.7 Encoder inputs

Description	Unit	Value
Encoder input		RS422 A/B Differential, Z index
Maximum input frequency quadrature, encoder inputs 0 and 1 quadrature, encoder input 2	**MHz**	 20 8
Output power supply to encoders		5V, 500mA (maximum total for all axes)
Maximum allowable cable length		30.5m (100ft)

7.1.8 Stepper control outputs

Description	Unit	Value
Output type		RS422 step (pulse) and direction
Maximum output frequency	**kHz**	500
Output current (maximum, per output pair)	**mA**	20

7.1.9 Serial RS232/RS485 port

	Unit	All models
Signal		RS232 non-isolated CTS/RTS or RS485 non-isolated (model dependent)
Bit rates	**baud**	9600, 19200, 38400, 57600 (default), 115200 (RS232 only)

7.1.10 CAN interface

Description	Unit	Value
Signal		2-wire, isolated
Channels		1
Protocols		CANopen or Baldor CAN (selected by choice of firmware)
Bit rates CANopen Baldor CAN	**Kbit/s**	 10, 20, 50, 100, 125, 250, 500, 1000 10, 20, 50, 125, 250, 500, 1000

7.1.11 Environmental

Description	Unit		
Operating temperature range		**Min**	**Max**
	°C	0	+45
	°F	+32	+113
Maximum humidity	**%**	80% for temperatures up to 31°C (87°F) decreasingly linearly to 50% relative humidity at 45°C (113°F), non-condensing (according to DIN40 040 / IEC144)	
Maximum installation altitude (above m.s.l.)	**m** **ft**	2000 6560	

See also section 3.1.1.

7.1.12 Weights and dimensions

Description	**Value**
Weight	Approximately 700g (1.5 lb)
Nominal overall dimensions	245mm x 135mm x 43mm (9.65in x 5.32in x 1.69in)

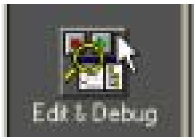
A.1 Axis renumbering

The factory preset axis numbering assigns axes 0 - 3 as stepper axes and axes 4 - 6 as servo axes. However, it is possible to alter the axis numbering scheme. For example, you might wish axes 0 and 1 to refer to the servo axes, and axes 2 to 5 to refer to the stepper axes. There are certain hardware limitations that must be considered when altering the axis numbering scheme:

- A maximum of 3 servo axes and 4 stepper axes may be assigned.
- Axes 0 and 4 share an internal hardware channel. This means they cannot both be servo or stepper axes. If one is servo, the other must be stepper. The servo demand output for axis 0 or 4 is always the DEMAND0 output, with Encoder0 as the feedback channel. The stepper output is always STEP0.
- Axes 1 and 5 share an internal hardware channel. This means they cannot both be servo or stepper axes. If one is servo, the other must be stepper. The servo demand output for axis 1 or 5 is always the DEMAND1 output, with Encoder1 as the feedback channel. The stepper output is always STEP1.
- Axes 2 and 6 share an internal hardware channel. This means they cannot both be servo or stepper axes. If one is servo, the other must be stepper. The servo demand output for axis 2 or 6 is always the DEMAND2 output, with Encoder2 as the feedback channel. The stepper output is always STEP2.
- Axis 3 is always a stepper axis; it cannot be reassigned as a servo axis.
  Its output is always STEP3.

Before axes can be reassigned, they must be turned off. This removes their existing servo / stepper assignments and inhibits their electrical outputs. In the following example, axis 4 will be reassigned as a stepper axis, and axis 0 as a servo axis:

1. In the Toolbox, click **Application**, then click the Edit & Debug icon.



2. Click in the Command window.

3. Type the command:

   CONFIG[0,1,2,3,4,5,6]=_cfOFF;

   This will turn off all axes. There will now be no electrical output for any of the axes.

4. Now type:

   CONFIG.4=_cfSTEPPER

   where 4 is the axis to be configured. Press Enter to enter the value. This immediately configures axis 4 to be a stepper axis.

5. To configure axis 0 as a servo axis, type:

   CONFIG.0=_cfSERVO

Other axes can be assigned as required, subject to the limitations described above. It is recommended that unused axes are always turned off. This provides more processing time for the axes that are in use. Attempting to assign an axis when there is not an appropriate hardware channel available, or the axis is already in use, will result in a “Hardware channel required is in use” or “Hardware not available” error message. See the MintMT help file for details of the `CONFIG` and `AXISCHANNEL` keywords.

A.2 Feedback cables

The Baldor cables listed in Table 3 connect the 'Encoder Out' signal from a servo amplifier (for example MicroFlex, FlexDrive^{II}, Flex+Drive^{II} or MintDrive^{II}), to the 'Enc0', 'Enc1' and 'Enc2' encoder input connectors on the NextMove ESB. One cable is required for each servo axis. See section 4.4.2 for the connector pin configuration.

Cable assembly description	Baldor catalog number	Length	
		m	ft
Servo Amplifier to NextMove ESB Feedback Cable, with 9-pin male D-type connectors at both ends	CBL005MF-A2 CBL010MF-A2 CBL015MF-A2 CBL020MF-A2	0.5 1 1.5 2.0	1.6 3.3 5 6.6

Table 3 - Servo amplifier to NextMove ESB feedback cables

If you are not using a Baldor cable, be sure to obtain a cable that is a shielded twisted pair 0.34mm^2 (22 AWG) wire minimum, with an overall shield. Ideally, the cable should not exceed 30.5m (100ft) in length. Maximum wire-to-wire or wire-to-shield capacitance is 50pF per 300mm (1ft) length, to a maximum of 5000pF for 30.5m (100ft).

B.1 Outline

This section provides general information regarding recommended methods of installation for CE compliance. It is not intended as an exhaustive guide to good practice and wiring techniques. It is assumed that the installer of the NextMove ESB is sufficiently qualified to perform the task, and is aware of local regulations and requirements. Baldor products that meet the EMC directive requirements are indicated with a "CE" mark. A duly signed CE declaration of conformity is available from Baldor.

B.1.1 EMC Conformity and CE marking

The information contained herein is for your guidance only and does not guarantee that the installation will meet the requirements of the council directive 89/336/EEC.

The purpose of the EEC directives is to state a minimum technical requirement common to all the member states within the European Union. In turn, these minimum technical requirements are intended to enhance the levels of safety both directly and indirectly.

Council directive 89/336/EEC relating to Electro Magnetic Compliance (EMC) indicates that it is the responsibility of the system integrator to ensure that the entire system complies with all relative directives at the time of installing into service.

Motors and controls are used as components of a system, per the EMC directive. Hence all components, installation of the components, interconnection between components, and shielding and grounding of the system as a whole determines EMC compliance.

The CE mark informs the purchaser that the equipment has been tested and complies with the appropriate standards. It rests upon the manufacturer or his authorized representative to ensure the item in question complies fully with all the relative directives in force at the time of installing into service, in the same way as the system integrator previously mentioned. Remember that it is the instructions of installation and the product that should comply with the directive.

B.1.2 NextMove ESB compliance

When installed as directed in this manual, NextMove ESB units meet the emission limits for an 'industrial' environment, as defined by the EMC directives (EN50081-2: 1994). To meet the more stringent emission limits of the 'residential, commercial and light industrial' environment (EN50081-1: 1992), the NextMove ESB must be mounted in a suitable metal cabinet incorporating 360° screened cable glands.

B.1.3 Use of CE compliant components

The following points should be considered:

- **Using CE approved components will not guarantee a CE compliant system!**
- The components used in the controller, installation methods used, materials selected for interconnection of components are important.
- The installation methods, interconnection materials, shielding, filtering and earthing/grounding of the system as a whole will determine CE compliance.
- The responsibility of CE mark compliance rests entirely with the party who offers the end system for sale (such as an OEM or system integrator).

B.1.4 EMC installation suggestions

To ensure electromagnetic compatibility (EMC), the following installation points should be considered to help reduce interference:

- Earthing/grounding of all system elements to a central earth/ground point (star point).
- Shielding of all cables and signal wires.

B.1.5 Wiring of shielded (screened) encoder cables

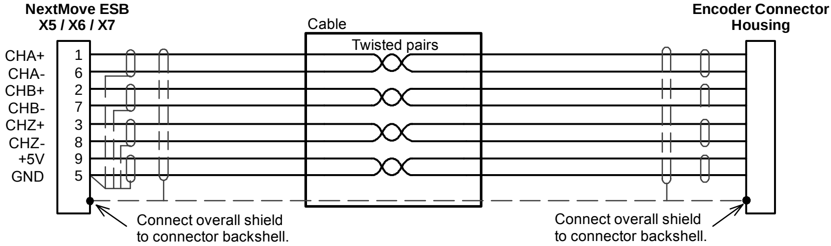


Figure 34 - Encoder signal cable grounding

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If you have any suggestions for improvements to this manual, please let us know. Write your comments in the space provided below, remove this page from the manual and mail it to:

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Baldor UK Ltd
Mint Motion Centre
6 Bristol Distribution Park
Hawkley Drive
Bristol
BS32 0BF
United Kingdom.

Alternatively, you can e-mail your comments to:

manuals@baldor.co.uk

Comment:
continued...

Thank you for taking the time to help us.

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