ABB motion control

User's manual
NextMove ES motion controller

MN1928WEN

Power and productivity
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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. Only qualified personnel should attempt to start-up, program or troubleshoot this equipment.

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 MEDICAL DEVICE / PACEMAKER DANGER: Magnetic and electromagnetic fields in the vicinity of current carrying conductors and industrial motors can result in a serious health hazard to persons with cardiac pacemakers, internal cardiac defibrillators, neurostimulators, metal implants, cochlear implants, hearing aids, and other medical devices. To avoid risk, stay away from the area surrounding a motor and its current carrying conductors.

CAUTION 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.

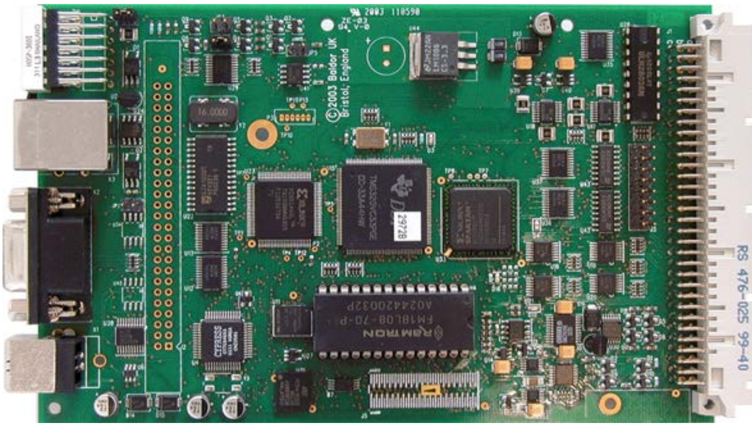
CAUTION Improper operation or programming may cause violent motion of the motor shaft and driven equipment. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment. Peak torque of several times the rated motor torque can occur during control failure.

NOTICE 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.

NOTICE Electrical components can be damaged by static electricity. Use ESD (electrostatic discharge) procedures when handling this controller.

2.1 NextMove ES features

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



NextMove ES features the Mint motion control language. Mint 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, Mint includes a wide range of powerful commands for complex applications.

Standard features include:

- Control of 2 servo axes and 4 or 6 stepper axes (model dependent).
- Point to point moves, software cams and gearing.
- 20 general purpose digital inputs, software configurable as level or edge triggered.
- 12 general purpose digital outputs and 1 error output.
- 2 differential analog inputs with 12-bit resolution.
- 2 single-ended analog outputs with 12-bit resolution.
- USB 1.1 serial port (compatible with USB 2.0 and USB 3.0).
- RS232 or RS485 serial port (model dependent).
- CANopen or proprietary Baldor CAN protocol for communication with Mint controllers and other third party devices.
- Programmable in Mint.

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

The chapters should be read in sequence.

The *Basic Installation* section describes the mechanical installation of the NextMove ES. 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 Mint WorkBench releases by visiting the website www.abbmotion.com.

2.2 Receiving and inspection

When you receive your NextMove ES, 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 ES.
2. Remove the NextMove ES from the shipping container but do not remove it from its anti-static bag until you are ready to install it. The packing materials may be retained for future shipment.
3. Verify that the catalog number of the NextMove ES 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 ES for external damage during shipment and report any damage to the carrier that delivered it.
5. If the NextMove ES 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

NextMove ES cards are available with a number of optional backplane connector cards. As a reminder of which products have been installed, it is a good idea to write the catalog numbers in the space provided below.

NextMove ES catalog number: **NES002-50** _____________

Backplane catalog number: **BPL010-50** ________________

Installed in: ____________________________________ **Date:** ____________

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

Catalog number	Description
NES002-501	NextMove ES controller card: 4 stepper axes*, 2 servo axes. USB and RS232 serial connections.
NES002-502	NextMove ES controller card: 4 stepper axes*, 2 servo axes. USB and RS485 serial connections.
BPL010-501	Backplane card: Non-isolated digital inputs and outputs
BPL010-502	Backplane card: Opto-isolated with ‘PNP’ (current sourcing) digital outputs and ‘active high’ digital inputs.
BPL010-503	Backplane card: Opto-isolated with ‘NPN’ (current sinking) digital outputs and ‘active low’ digital inputs.

* Optional firmware provides 2 more stepper axes by reassigning four of the digital outputs. See sections 4.2.2 and 4.5.1. Firmware available from www.abbmotion.com.

2.3 Units and abbreviations

The following units and abbreviations are used in this manual:

V. . . . . Volt (also V AC and V DC)
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)
N·m . . . . 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
Mbps . . . . megabits/s
MB . . . . megabytes
(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 ES. This section describes the mechanical installation of the NextMove ES.

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 ES are shielded correctly.

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

CAUTION: Avoid locating the NextMove ES 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 ES is designed to be mounted in a IEC297 / DIN41494 rack with card frames and guides to support the card.
- The NextMove ES must be installed in an ambient temperature of 0 °C to 40 °C (32 °F to 104 °F).
- The NextMove ES 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 40 °C (104 °F), non-condensing.
- The NextMove ES 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.

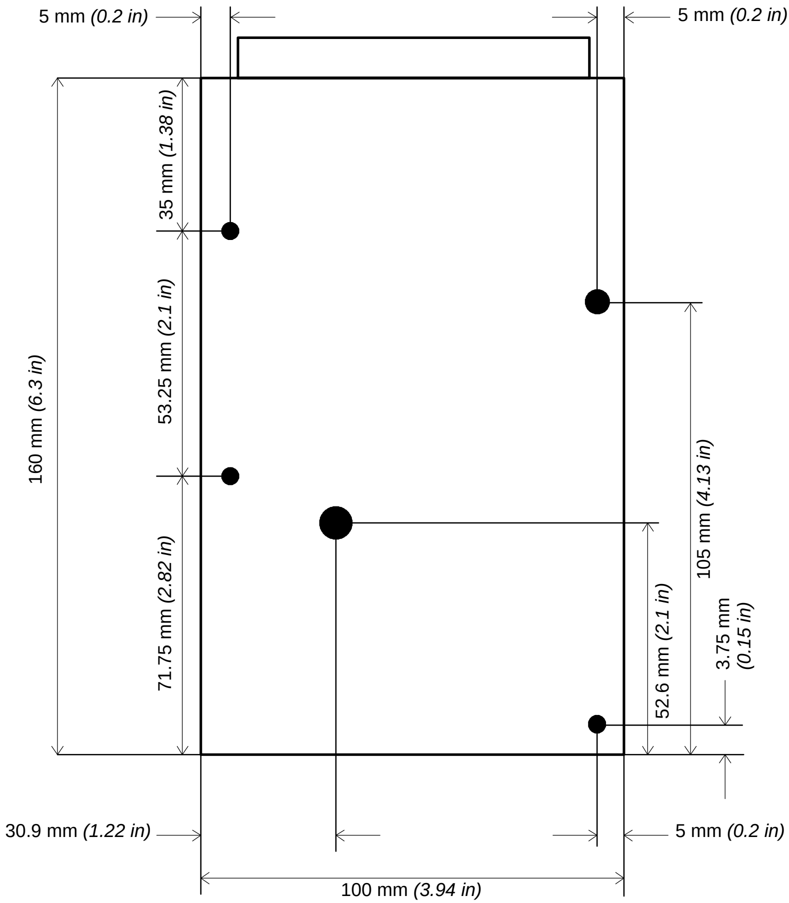
3.1.2 Installing the NextMove ES card

CAUTION Before touching the card, 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 card.

The NextMove ES is designed to be mounted in a IEC297 / DIN41494 rack with card frames and guides to support the card. An additional backplane card is recommended (see section 5).

1. Mount the backplane connector card (optional) at the rear of the rack system.
2. Slide the NextMove ES card into the guide rails, ensuring that it plugs securely into the backplane connector.
3. Confirm that any neighboring cards or equipment are not touching the NextMove ES card.

3.1.3 Dimensions and hole positions



3.1.4 Other requirements for installation

The components you will need to complete the basic installation are:

- The NextMove ES requires +5 V and ±12 V power supplies. The total power requirement (excluding any option cards) is +5 V at 1 A, +12 V at 50 mA and -12 V at 50 mA. If digital outputs are to be used, a supply will be required to drive them - see section 4.4.2.
- A PC that fulfils the following specification:

	Minimum specification
Processor	1 GHz
RAM	512 MB
Hard disk space	2 GB
CD-ROM	A CD-ROM drive
Serial port	USB port or RS232 or RS485 serial port (depending on NextMove ES model)
Screen	1024 x 768, 16-bit color
Mouse	A mouse or similar pointing device
Operating system	Windows XP or newer, 32-bit or 64-bit

Software installation will be described later, in section 6.

- A USB cable, or a serial cable connected as shown in section 4.5.4.
- Your PC operating system user manual might be useful if you are not familiar with Windows.

4.1 Introduction

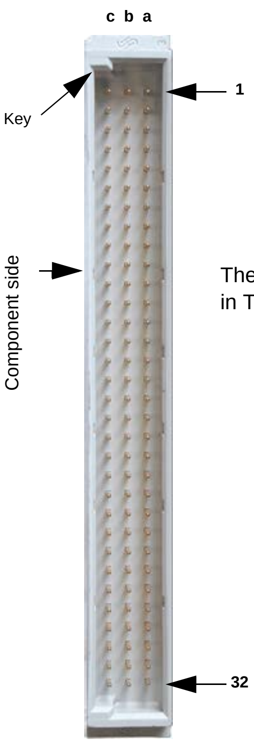
This section describes the input and output capabilities of the NextMove ES.

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

Most external connections to the NextMove ES card are made using an optional backplane card, described in section 5.

4.2 96-pin edge connector



The pin assignment for the 96-pin DIN41612 connector is shown in Table 1.

4.2.1 96-pin connector pin assignment - standard firmware

	Row		
Pin	**c**	**b**	**a**
1	+5 V DC	+5 V DC	+5 V DC
2	+5 V DC	+5 V DC	+5 V DC
3	DGND	DGND	DGND
4	DOUT6	DOUT7	OUT COM
5	DOUT3	DOUT4	DOUT5
6	DOUT0	DOUT1	DOUT2
7	Encoder 1 CHB+	Encoder 0 CHA+	Encoder 0 CHB+
8	Encoder 1 CHZ+	Encoder 0 CHZ+	Encoder 1 CHA+
9	Encoder 1 CHA-	Encoder 0 CHZ-	Encoder 1 CHZ-
10	Encoder 0 CHB-	Encoder 0 CHA-	Encoder 1 CHB-
11	DIN16	Error Out	DGND
12	*(NC)*	DGND	DGND
13	DGND	DOUT9	DOUT8
14	STEP2	STEP1	STEP0
15	DIR2	DIR1	DIR0
16	DOUT10	DGND	*(NC)*
17	DGND	AOUT2	*(NC)*
18	DIN4	DIN15	DIN2
19	DIN3	DIN5	DIN7
20	DIN6	DIN1	RXD *(RX- on RS485)*
21	DIN0	RTS *(TX+ on RS485)*	TXD *(TX- on RS485)*
22	DOUT11	AOUT3	CTS *(RX+ on RS485)*
23	DIN14	STEP3	DIR3
24	DIN17	DIN13	DIN10
25	DIN18	DIN9	DIN11
26	DIN12	DIN19	DIN8
27	Demand0 (AOUT0)	Demand1 (AOUT1)	AIN1-
28	AIN1+	AIN0+	AIN0-
29	+12 V DC	+12 V DC	+12 V DC
30	AGND	AGND	AGND
31	-12 V DC	-12 V DC	-12 V DC
32	Shield	Shield	Shield

Table 1: 96-pin connector pin assignment for 4 stepper + 2 servo models

4.2.2 96-pin connector pin assignment - 6 stepper axes firmware only

	Row		
Pin	**c**	**b**	**a**
1	+5 V DC	+5 V DC	+5 V DC
2	+5 V DC	+5 V DC	+5 V DC
3	DGND	DGND	DGND
4	DOUT6	DOUT7	OUT COM
5	DOUT3	DOUT4	DOUT5
6	DOUT0	DOUT1	DOUT2
7	Encoder 1 CHB+	Encoder 0 CHA+	Encoder 0 CHB+
8	Encoder 1 CHZ+	Encoder 0 CHZ+	Encoder 1 CHA+
9	Encoder 1 CHA-+	Encoder 0 CHZ-	Encoder 1 CHZ-
10	Encoder 0 CHB-	Encoder 0 CHA-	Encoder 1 CHB-
11	DIN16	Error Out	DGND
12	*(NC)*	DGND	DGND
13	DGND	~~DOUT9~~ **DIR4**	~~DOUT8~~ **STEP4**
14	STEP2	STEP1	STEP0
15	DIR2	DIR1	DIR0
16	~~DOUT10~~ **STEP5**	DGND	*(NC)*
17	DGND	AOUT2	*(NC)*
18	DIN4	DIN15	DIN2
19	DIN3	DIN5	DIN7
20	DIN6	DIN1	RXD *(RX- on RS485)*
21	DIN0	RTS *(TX+ on RS485)*	TXD *(TX- on RS485)*
22	~~DOUT11~~ **DIR5**	AOUT3	CTS *(RX+ on RS485)*
23	DIN14	STEP3	DIR3
24	DIN17	DIN13	DIN10
25	DIN18	DIN9	DIN11
26	DIN12	DIN19	DIN8
27	Demand0 (AOUT0)	Demand1 (AOUT1)	AIN1-
28	AIN1+	AIN0+	AIN0-
29	+12 V DC	+12 V DC	+12 V DC
30	AGND	AGND	AGND
31	-12 V DC	-12 V DC	-12 V DC
32	Shield	Shield	Shield

Table 2: 96-pin connector pin assignment when using optional 6 stepper + 2 servo firmware

4.3 Analog I/O

The NextMove ES provides:

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

4.3.1 Analog inputs

The analog inputs are available on pins a28 & b28 (AIN0) and a27 & c28 (AIN1).

- Differential inputs.
- Voltage range: ±10 V.
- Resolution: 12-bit with sign.
- Input impedance: 120 kΩ.
- Sampling frequency: 4 kHz maximum, 2 kHz 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 1 kHz.

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

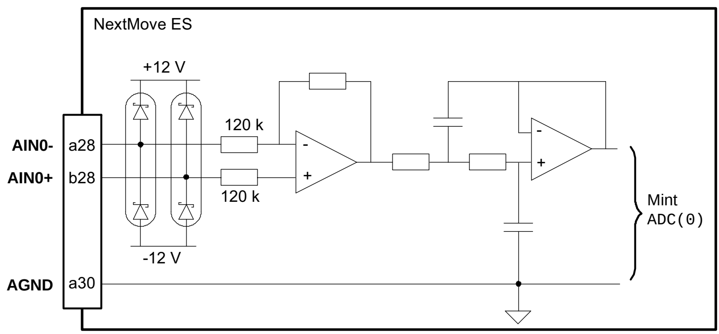


Figure 1: Analog input, AIN0 shown

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

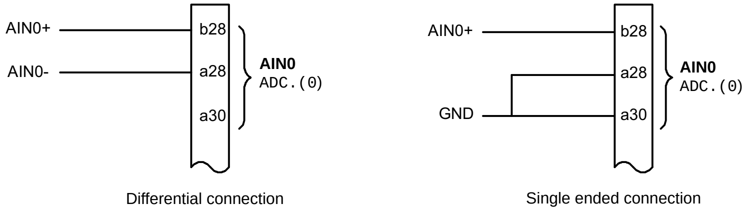


Figure 2: AIN0 analog input wiring

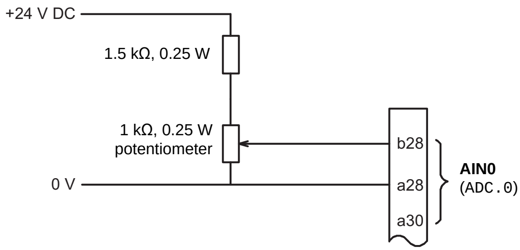


Figure 3: Typical input circuit to provide 0-10 V (approx.) input from a 24 V source

4.3.2 Analog outputs

The four analog outputs are available on a range of pins, as shown in section 4.2.1.

- Four independent analog outputs (model dependent).
- Output range: ±10 V DC (±0.1%).
- Resolution: 12-bit.
- Output current: 10 mA maximum.
- Update frequency: 10 kHz maximum (adjustable using the `LOOPTIME` keyword, factory default 1 kHz).

Mint and the Mint Motion Library use analog outputs Demand0 and Demand1 to control drive amplifiers. Demand outputs 0 and 1 are used by axes configured as servo (see section 6.4.1). The Demand2 and Demand3 outputs may be used as general purpose analog outputs. See the `DAC` keyword in the Mint help file.

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

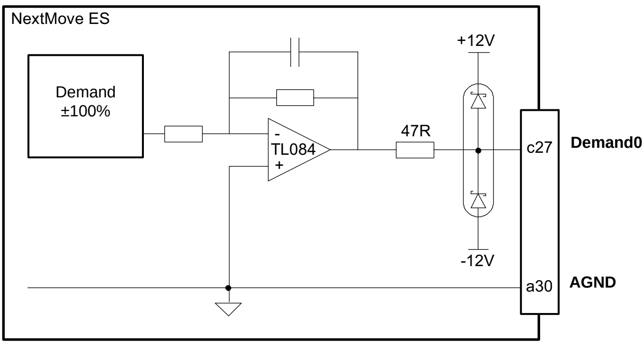


Figure 4: Analog output, Demand0 shown

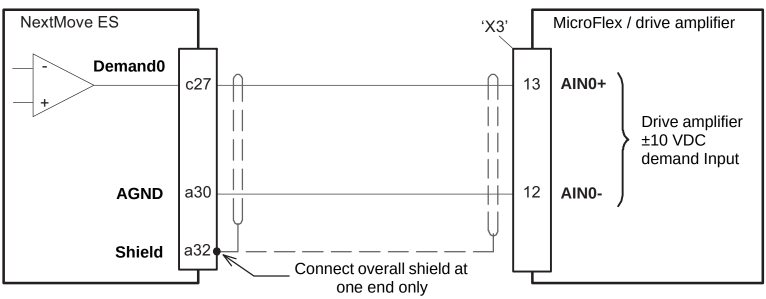


Figure 5: Analog output - typical connection to an ABB MicroFlex

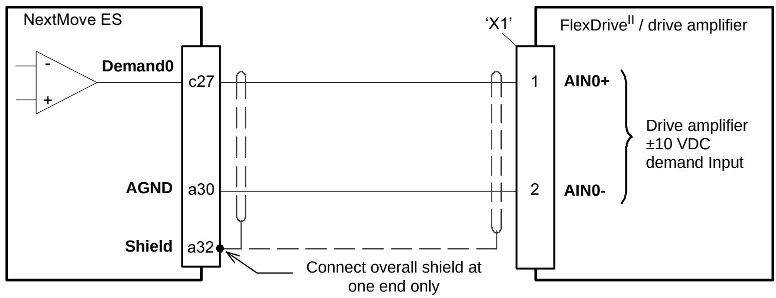


Figure 6: Analog output - typical connection to a Baldor FlexDrive*II*, Flex+Drive*II*, MintDrive*II*

4.4 Digital I/O

The NextMove ES provides:

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

4.4.1 Digital inputs

The digital inputs are available across a range of pins, as shown in section 4.2.1. All digital inputs have a common specification:

- 5 V digital inputs with internal pull-up resistors. Can also be assigned to special purpose functions such as Home, Limit, Stop and Error inputs.
- Sampling frequency: 1 kHz.

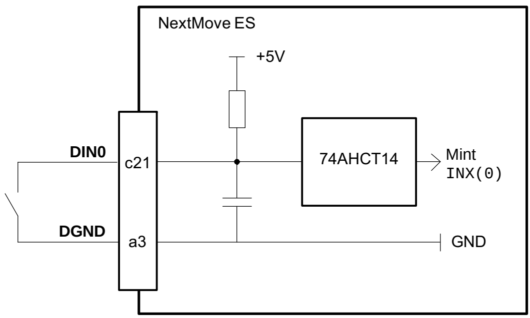


Figure 7: General purpose digital input - DIN0 shown

CAUTION

Do not connect 24 V signals to the digital inputs.

These unprotected inputs are connected directly to TTL compatible 74AHCT14 devices. If an input is configured as edge triggered, the triggering pulse must have a duration of at least 1 ms (one software scan) to guarantee acceptance by Mint. The use of shielded cable for inputs is recommended.

4.4.1.1 General purpose inputs

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 Mint 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 Mint help file.

4.4.1.2 Fast inputs 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 1 μs. 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. Do not connect mechanical switches, relay contacts or other sources liable to signal 'bounce' directly to an input that has been configured as a fast input. This could cause unwanted multiple triggering.

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

DIN17-DIN19 may also be used as an auxiliary encoder input (input 0). 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 (20 MHz 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 5 V is applied to DIN18 (or it is left unconnected) the counter will increment. If DIN18 is grounded the counter will be decremented. A minimum period of 500 μs is required between transitions on the direction and step input to guarantee the change of direction has been recognized.

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 Mint help file for details of each keyword.

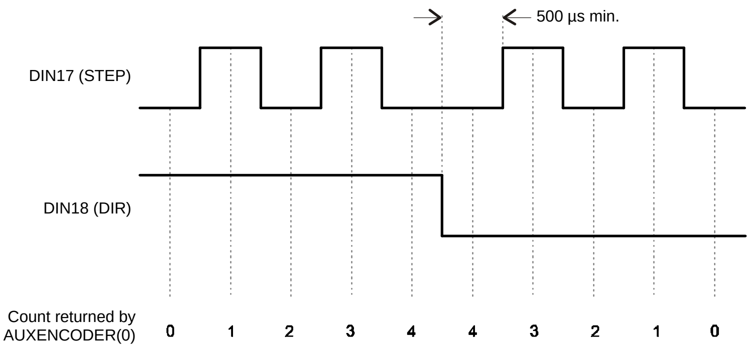


Figure 8: Auxiliary encoder input 0 (DIN17/18) - edge counting

4.4.1.4 Typical digital input wiring

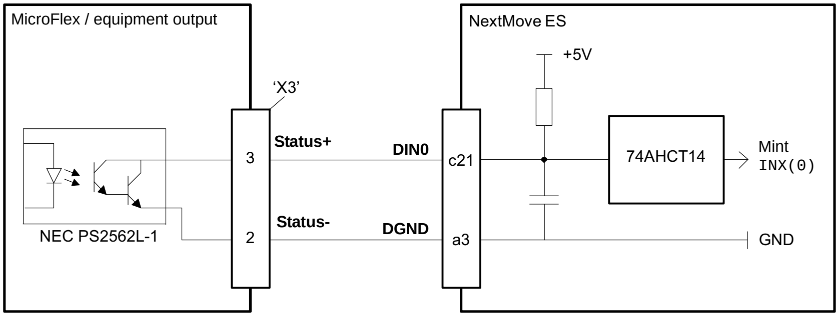


Figure 9: Digital input - typical connections from an ABB MicroFlex

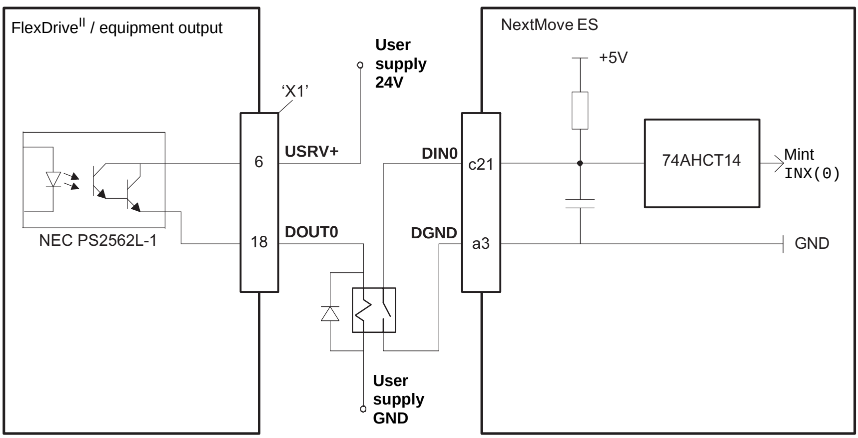


Figure 10: Digital input - typical connections from a Baldor FlexDrive*II*, Flex+Drive*II* or MintDrive*II*

4.4.2 Digital outputs

The digital outputs are available across a range of pins, as shown in section 4.2.1.

- 12 or 8 general purpose digital outputs (model dependent).
- One error output, configurable as a general purpose digital output.
- Update frequency: Immediate.

There are 12 general purpose digital outputs when using standard firmware.

There are 8 general purpose digital outputs when using the optional 6 stepper axis firmware, since DOUT8 - DOUT11 are reassigned to provide the STEP4/5 and DIR4/5 axis output signals (see section 4.2.2).

A digital output can be configured in Mint 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 Mint WorkBench (or the `OUTPUTACTIVELEVEL` keyword) to determine their active level.

4.4.2.1 DOUT0 - DOUT7

Outputs DOUT0 - DOUT7 are driven by a ULN2803 device. The outputs are designed to sink current from an external supply (typically 24 V DC), but have no overcurrent or short circuit protection. When an output is activated, it is grounded through the ULN2803.

The ULN2803 has a maximum power dissipation of 2 W at 25 °C. The total output requirements of DOUT0 - DOUT7 must not exceed this limit. The maximum current limit for an individual output is 500 mA if only one output is in use, reducing to 150 mA if all outputs are in use. These limits are for a 100% duty cycle.

If the outputs are driving inductive loads such as relays, connect the OUT COM connection to the output's power supply, as shown in Figure 11. This will connect internal clamp diodes on all outputs.

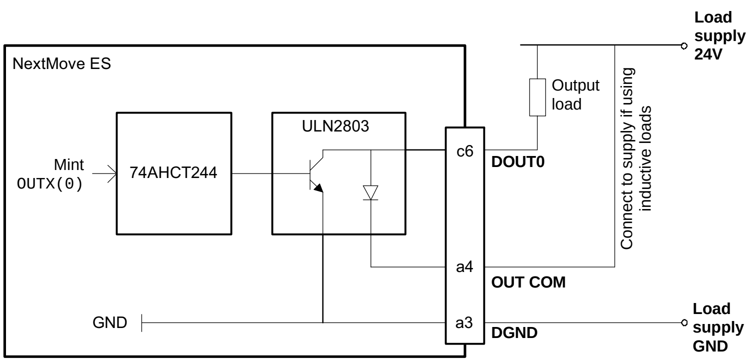


Figure 11: Digital outputs (DOUT0-7) - DOUT0 shown

4.4.2.2 DOUT8 - DOUT11

Note: When using the optional 6 stepper axis firmware, DOUT8 - DOUT11 are not available as general purpose digital outputs. The outputs are used to provide the additional STEP4/5 and DIR4/5 stepper axes outputs (see section 4.5.1).

Outputs DOUT8 - DOUT11 are driven by a ULN2003 device. The outputs are designed to sink current from an external supply (typically 24 V DC), but have no overcurrent or short circuit protection. When an output is activated, it is grounded through the ULN2003.

The ULN2003 has a maximum power dissipation of 900 mW at 25 °C. The total output requirements of DOUT8 - DOUT11 must not exceed this limit. The maximum current limit for an individual output is 400 mA if only one output is in use, reducing to 50 mA if all outputs are in use. These limits are for a 100% duty cycle.

DOUT8 - DOUT11 are sourced from the same ULN2003 device as the DIR3 and STEP3 outputs (see section 4.5.1), so the current demands of these signals must also be considered.

If an output is driving an inductive load such as a relay, a suitably rated diode must be fitted across the relay coil, observing the correct polarity. This is to protect the output from the back-EMF generated by the relay coil when it is de-energized.

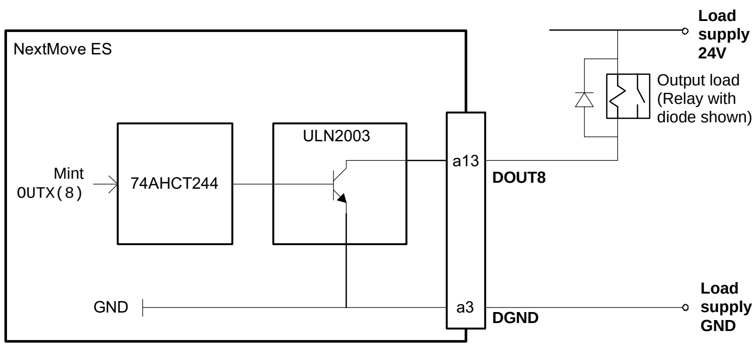
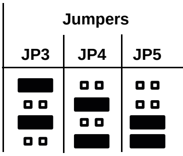


Figure 12: Digital outputs (DOUT8-11) - DOUT8 shown

4.4.3 Error output - Error Out

The error output is available on pin b11. This 100 mA output can be used to stop external equipment in the event of an error. The output level can be controlled using jumpers JP3, JP4 and JP5, which are situated at the top edge of the card. Connect the load as shown in Figure 13.



Inactive state (no error)	Inactive state (error)
Open collector	12 V
Open collector	0 V
12 V	Open collector
0 V	Open collector

* JP5 inverts the active state

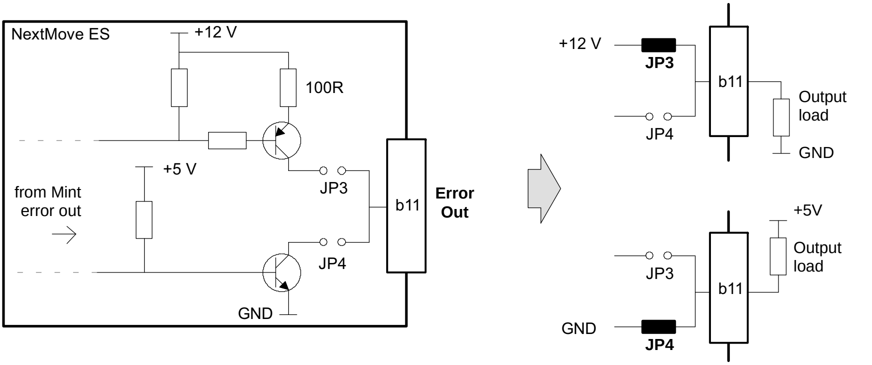


Figure 13: Error Out level configuration

There are a number of methods for controlling the error output:

4.4.3.1 GLOBALERROROUTPUT keyword

By default, the error output is used as the global error output. In the event of an error on any axis, the global error output will be deactivated. This action overrides the state of the error output defined by other methods, such as the drive enable status or `RELAY` keyword. Alternatively, the `GLOBALERROROUTPUT` keyword can be used to configure a general purpose digital output to be the global error output.

4.4.3.2 RELAY keyword

If the NextMove ES is connected to an opto-isolated backplane (optional) the output directly controls the relay (see section 5.3.1.1). For this reason, the error output can be controlled by the `RELAY` keyword. The command `RELAY(0)=1` will enable the error output; the command `RELAY(0)=0` will disable it. These commands are valid regardless of whether an opto-isolating backplane is actually connected.

4.4.3.3 DRIVEENABLEOUTPUT keyword

The `DRIVEENABLEOUTPUT` keyword can be used to configure the error output as the drive enable output. For example, the command `DRIVEENABLEOUTPUT(1)=_RELAY0` will mean that the error output will be the drive enable output for axis 1. When axis 1 is enabled, the error output will be activated and the axis enabled. If multiple axes are configured to use the error output as their drive enable output, enabling one axis will enable all of them. Similarly, if one axis is disabled, all will be disabled. The `RELAY` keyword cannot control the error output if is configured as a drive enable output.

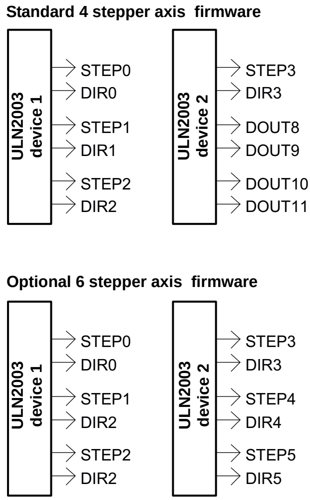
See the Mint help file for details of each keyword.

4.5 Other I/O

4.5.1 Stepper control outputs

The stepper control outputs are available across a range of pins, as shown in section 4.2.1.

There are four or six sets of stepper motor control outputs (firmware dependent), operating in the range 0 Hz to 500 kHz. Each of the step (pulse) and direction signals from the NextMove ES is driven by one channel of a ULN2003 open collector Darlington output device.



The ULN2003 has a maximum power dissipation of 900 mW at 25 °C. The total combined output requirements of STEP0 - STEP2 and DIR0 - DIR2 must not exceed this limit. The maximum current limit for an individual output is 400 mA if only one output is in use, reducing to 50 mA if all outputs are in use. These limits are for a 100% duty cycle.

When using standard firmware, STEP3 and DIR3 are sourced from the same ULN2003 device used for the DOUT8 - DOUT11 digital outputs (see section 4.4.2.2), so the current demands of these digital outputs must also be considered.

When using the optional 6 stepper axis firmware, STEP3 and DIR3 are sourced from the same ULN2003 device used for the additional STEP4 - STEP5 and DIR4 - DIR5 stepper axes outputs. In this case the ULN2003 device is providing three sets of STEP and DIR outputs, so the specifications are identical to those for STEP0 - STEP2 and DIR0 - DIR2, detailed above.

It is recommended to use separate shielded cables for the step outputs. The shield should be connected at one end only. In situations where induced noise is affecting a step or direction output, it may be necessary to connect a 470 Ω pull-up resistor between the output and the supply.

CAUTION The ULN2003 drivers are static sensitive devices. Take appropriate ESD precautions when handling the NextMove ES.

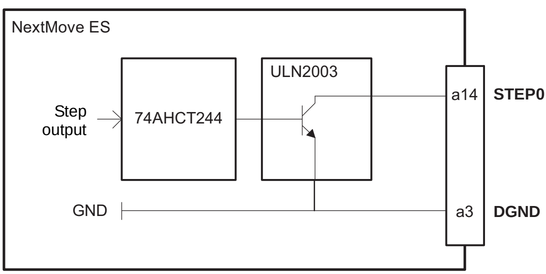


Figure 14: Stepper output - STEP0 output shown

4.5.2 Encoder inputs

The encoder inputs are available on pins a7-a10, b7-b10 and c7-c10. See section 4.2.1.

Two incremental encoders may be connected to NextMove ES, 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 with an outer braided shield is recommended. If possible, earth/ground the outer shield using 360° clamps at both ends. See section 8.1.10 for details of the encoder power supply.

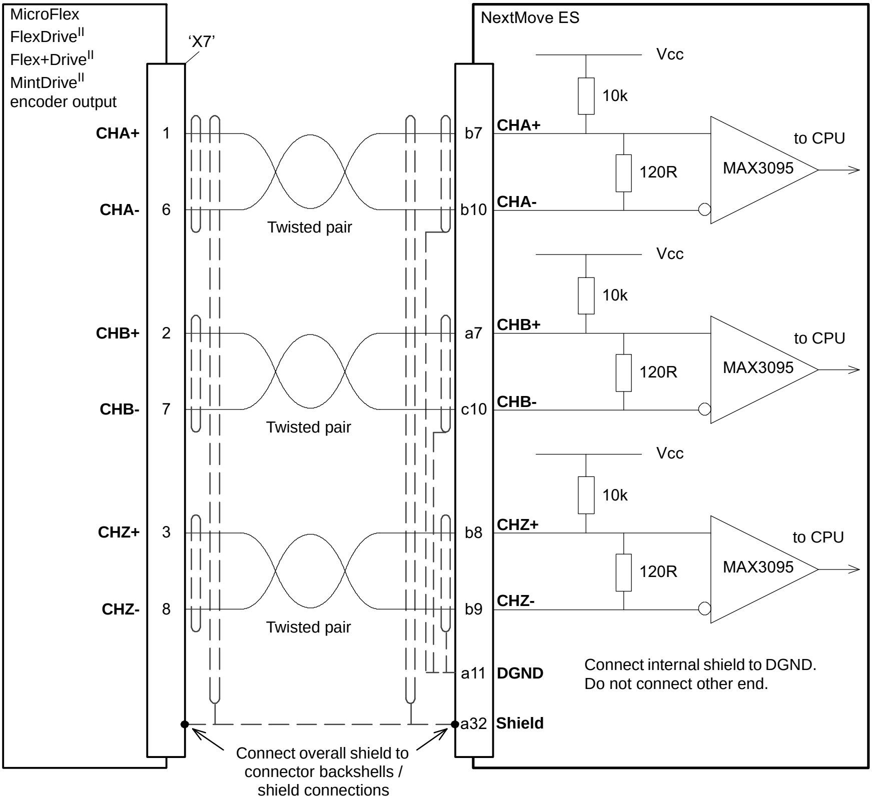


Figure 15: Encoder input 0 - typical connection from a drive amplifier (e.g. ABB MicroFlex, FlexDrive*II*, Flex+Drive*II* or MintDrive*II*)

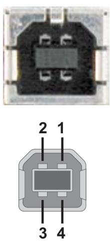
4.5.2.1 Encoder input frequency

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 5 MHz. However, the effect of cable length is shown in Table 3:

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

Table 3: Effect of cable length on maximum encoder frequency

4.5.3 USB port

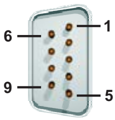


Location	USB Mating connector: USB Type B (downstream) plug	
Pin	**Name**	**Description**
1	VBUS	USB +5 V
2	D-	Data-
3	D+	Data+
4	GND	Ground

The USB connector can be used as an alternative method for connecting the NextMove ES to a PC running Mint WorkBench. The NextMove ES is a self-powered, USB 1.1 (12 Mbps) compatible device. If it is connected to a slower USB 1.0 host PC or hub, communication speed will be limited to the USB 1.0 specification (1.5 Mbps). If it is connected to a faster USB 2.0 (480 Mbps) or USB 3.0 (5 Gbps) host PC or hub, communication speed will remain at the USB 1.1 specification of the NextMove ES.

Ideally, the NextMove ES 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. The maximum recommended cable length is 5 m (16.4 ft).

4.5.4 Serial port



Location	Serial Mating connector: 9-pin female D-type		
Pin	**RS232 name**	**RS485 / RS422 name**	**96-pin connector**
1	Shield	(NC)	a32
2	RXD	RX- (input)	a20
3	TXD	TX- (output)	a21
4	(NC)	(NC)	a16*
5	DGND	0 V DGND	a3
6	(NC)	(NC)	a17*
7	RTS	TX+ (output)	b21
8	CTS	RX+ (input)	a22
9	DGND	(NC)	a3

* Pins a16 and a17 are linked on the NextMove ES.

The serial connector duplicates the signals present on the 96-pin connector. It is used to connect the NextMove ES to the PC running Mint WorkBench, or other controller. If an optional backplane is being used, its serial connector (section 5.2.14 or 5.3.14) will carry the same signals. Do not attempt to use more than one set of serial connections at the same time.
NextMove ES 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 (15 kV). When the NextMove ES is connected to Mint WorkBench, 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.

4.5.5 Using RS232

The NextMove ES 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 (RS232) RTS and CTS must be connected.

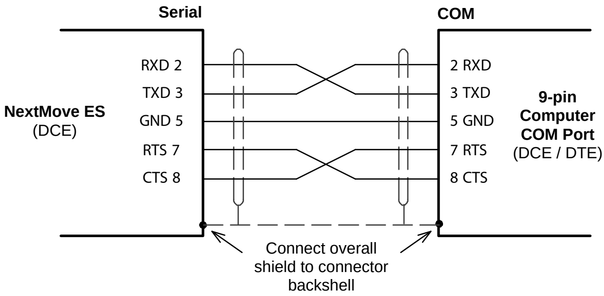


Figure 16: RS232 serial port connections

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, but since many devices will check the RTS and CTS lines, these must also be connected. Pins 4 and 6 are linked on the NextMove ES.

The maximum recommended cable length is 3 m (10 ft) at 57.6 Kbaud. When using lower baud rates, longer cable lengths may be used up to maximum of 15 m (49 ft) at 9600 baud. A suitable cable is available from ABB, part CBL001-501.

4.5.6 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 ES, a host application such as Mint WorkBench (or other custom application), or a programmable logic controller (PLC). RS422 may be used for multi-drop applications as shown in Figure 17. Four-wire RS485 may be used for single point-to-point applications involving only one 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 Mint WorkBench.

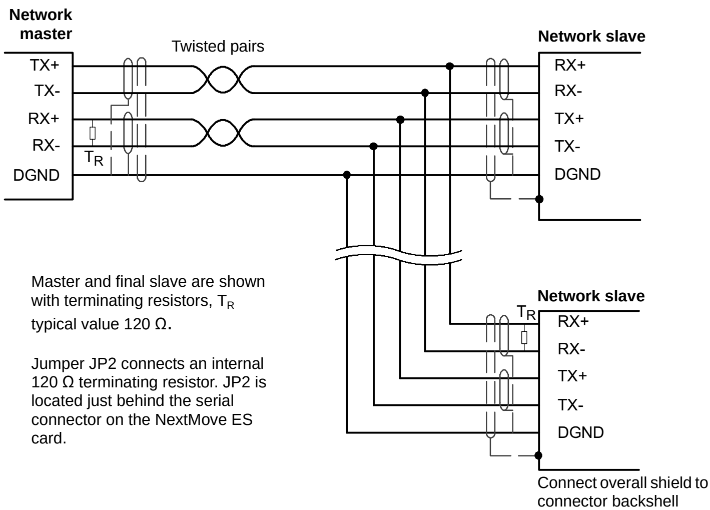


Figure 17: 4-wire RS422 multi-drop connections

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.

4.5.7 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 ES Serial connector uses a 9-pin male D-type connector. The NextMove ES may be connected with or without hardware handshaking, as shown in Figure 18:

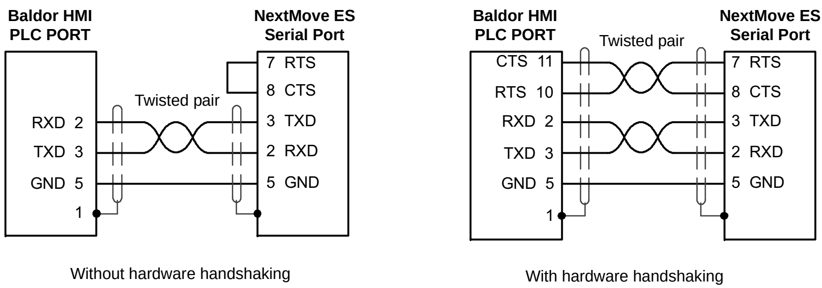


Figure 18: RS232 cable wiring

Alternatively, the Baldor HMI panel may be connected using RS485/422, as shown in Figure 19:

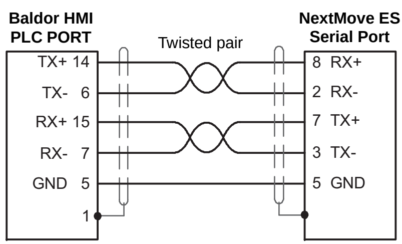


Figure 19: RS485/422 cable wiring

4.6 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.

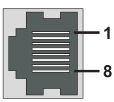
The CAN protocol only defines the physical attributes of the network, i.e. the electrical, mechanical, functional and procedural parameters of the physical connection between devices. The higher level network functionality is defined by a number of standards and proprietary protocols; CANopen is one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

In addition to supporting CANopen, Baldor has developed a proprietary protocol called Baldor CAN. Both protocols are supported by NextMove ES, but unlike other Baldor devices both cannot be supported at the same time. This is because NextMove ES 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 Mint WorkBench and connect to the NextMove ES (see section 6). At the bottom of the Mint WorkBench 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 Mint WorkBench. The firmware file can be found on the Mint Motion Toolkit CD (OPT-SW-001), or downloaded from www.abbmotion.com. See the Mint help file for details about downloading firmware.

4.6.1 CAN connector

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



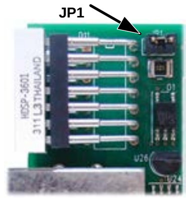
Location	NextMove ES card	
Pin	**Name**	**Description**
1	CAN+	CAN channel positive
2	CAN-	CAN channel negative
3	-	*(NC)*
4	CAN 0V	Ground/earth reference for CAN signals
5	CAN V+	CAN power V+ (12-24V)
6	-	*(NC)*
7	-	*(NC)*
8	-	*(NC)*
Description Opto-isolated CAN interface using a RJ45 connector.		

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

4.6.2 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. ABB recommends 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 120 Ω. 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 ES 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.



- All cables and connectors should have a nominal impedance of 120 Ω. Cables should have a length related resistance of 70 mΩ/m and a nominal line delay of 5 ns/m. A range of suitable CAN cables are available from ABB, with part 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 5 ns/m propagation delay and a total effective device internal in-out delay of 210 ns at 1 Mbit/s, 300 ns at 500 - 250 Kbit/s, 450 ns at 125 Kbit/s and 1.5 ms at 50 - 10 Kbit/s.

  [1] CAN baud rate not supported on Baldor CAN.

  [2] For bus lengths greater than about 1000 m, bridge or repeater devices may be needed.

CAN Baud Rate	**Maximum BUS Length**
1 Mbit/s	25 m
500 Kbit/s	100 m
250 Kbit/s	250 m
125 Kbit/s	500 m
100 Kbit/s[1]	600 m
50 Kbit/s	1000 m
20 Kbit/s	2500 m[2]
10 Kbit/s	5000 m[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 (<0.3 m at 1 Mbit/s).
- The 0 V 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 ES or CAN peripheral devices are within the common mode range of the receiver circuitry of other nodes on the network.

4.6.2.1 Opto-isolation power requirements

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

4.6.3 CANopen

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

Baldor has implemented a CANopen protocol in Mint (based on the 'Communication Profile' CiA DS-301) which supports both direct access to device parameters and time-critical process data communication. The NextMove ES 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 ABB 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 Mint Motion Toolkit CD (OPT-SW-001), or downloaded from www.abbmotion.com/supportme.

Figure 20 shows a typical CANopen network with two NextMove ES units and a Baldor HMI operator panel:

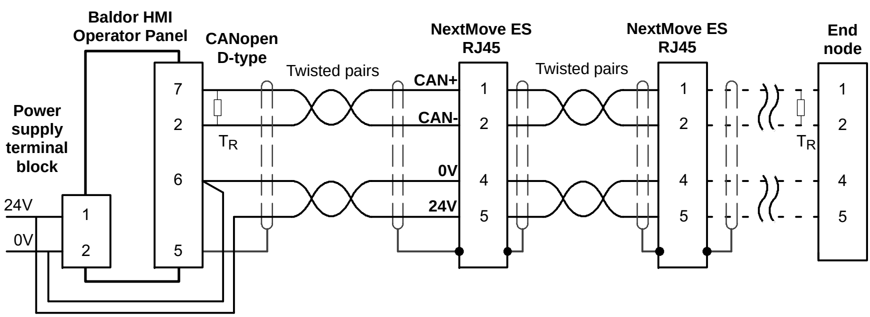


Figure 20: Typical CANopen network connections

Note: The NextMove ES CAN channel is opto-isolated, so a voltage in the range 12-24 V must be applied to pin 5 of the CAN connector. An additional adaptor (e.g. RS Components part 186-3105) or modifications to the cable may be required to facilitate the power connection.

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 ES 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 ES Manager node using the Mint `NODESCAN` keyword. If successful, the nodes can then be connected to using the Mint `CONNECT` keyword. Any network and node related events can then be monitored using the Mint `BUS1` event.

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

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

4.6.4 Baldor CAN

The NextMove ES 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 (part ION001-503) - an 8 x digital input CAN node.
- OutputNode 8 (part ION003-503) - an 8 x digital output CAN node.
- RelayNode 8 (part ION002-503) - an 8 x relay CAN node.
- IoNode 24/24 (part ION004-503) - a 24 x digital input and 24 x digital output CAN node.
- KeypadNode (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 (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 ES and a Baldor CAN operator panel is shown in Figure 18.

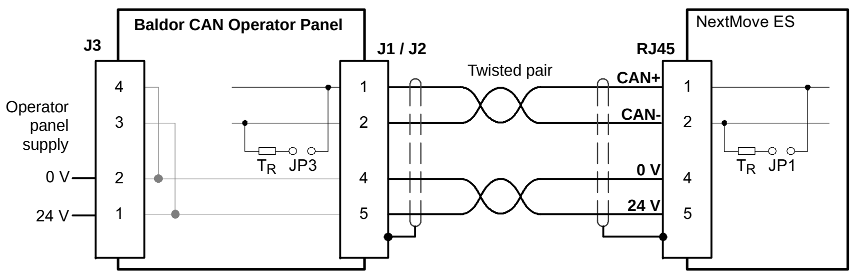


Figure 21: Baldor CAN operator panel connections

The NextMove ES CAN channel is opto-isolated, so a voltage in the range 12-24 V must be applied to pin 5 of the CAN connector. From this supply, an internal voltage regulator provides the 5 V required for the isolated CAN circuit. The required 12-24 V 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 21.

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 120 Ω 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.

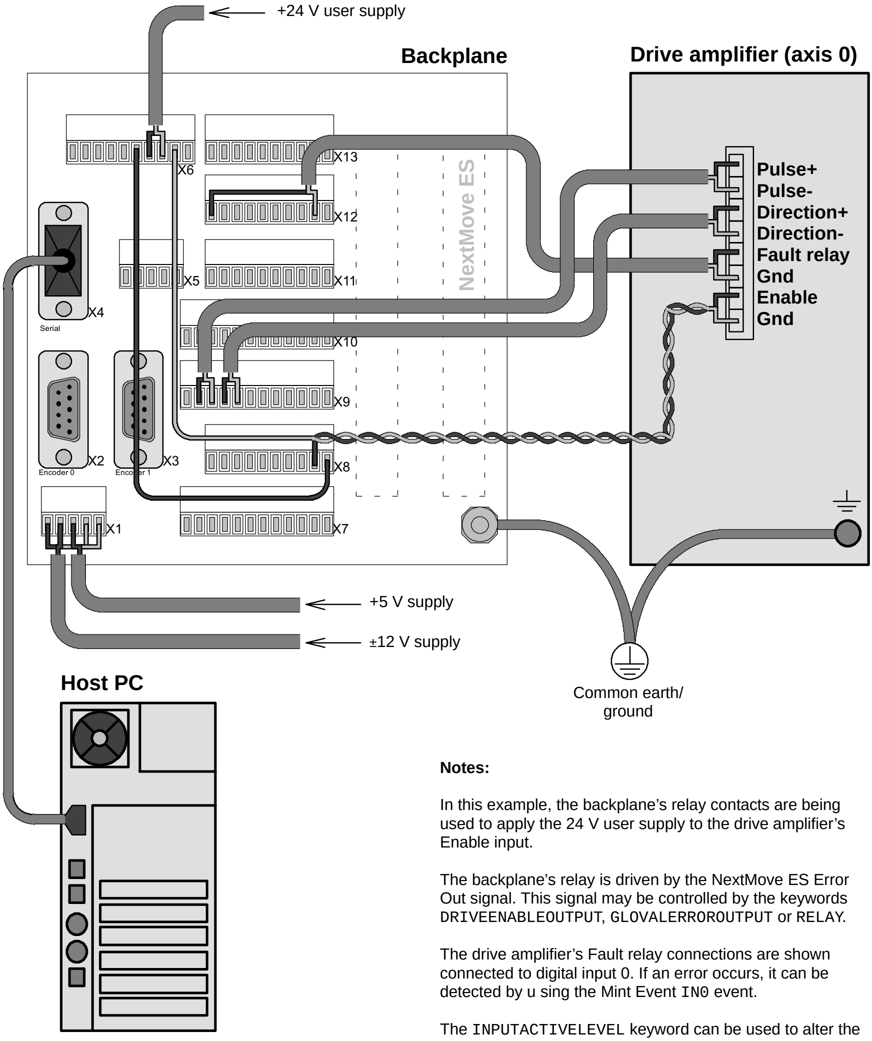
Up to 63 Baldor I/O nodes (including no more than 4 operator panels) can be added to the network by the NextMove ES using the Mint `NODETYPE` keyword. Any network and node related events can then be monitored using the Mint `BUS2` event.

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

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

4.7 Connection summary - minimum system wiring

As a guide, Figure 22 shows an example of the typical minimum wiring required to allow the NextMove ES and a single axis stepper amplifier to work together. The optional opto-isolating backplane card BPL010-502 is shown. Details of the connector pins are shown in Table 4.



Notes:

In this example, the backplane's relay contacts are being used to apply the 24 V user supply to the drive amplifier's Enable input.

The backplane's relay is driven by the NextMove ES Error Out signal. This signal may be controlled by the keywords `DRIVEENABLEOUTPUT`, `GLOVALERROROUTPUT` or `RELAY`.

The drive amplifier's Fault relay connections are shown connected to digital input 0. If an error occurs, it can be detected by u sing the Mint Event `IN0` event.

The `INPUTACTIVELEVEL` keyword can be used to alter the active state of the digital input.

Figure 22: Example minimum system wiring

Backplane card connector	Pin	Name of signal	Function	Connection on amplifier (Note: connections may be labeled differently)
X6	9	USR GND	User power supply GND	Enable signal ground
X8	9	REL NO	Switched relay contact	Enable signal input
	10	REL COM	Common relay connection (linked to USR V+)	
X9	2	STEP0-	Step signal for axis 0	Step (pulse) input
	3	STEP0+		
	4	DIR0-	Direction signal for axis 0	Direction input
	5	DIR0+		
X12	1	DIN0	Digital input 0	Fault relay output
	11	USR GND	User power supply GND	Fault relay GND

Table 4: Connector details for minimum system wiring shown in Figure 22

5.1 Introduction

This section describes the optional backplane cards available for use with the NextMove ES. These cards all provide standard wiring connections to the NextMove ES, but there are a number of variants available:

- BPL010-501: Non-isolated backplane.
- BPL010-502: Isolated PNP backplane.
- BPL010-503: Isolated NPN backplane.

It is recommended to use one of these dedicated backplanes with your NextMove ES.

Each table shows the required mating connector and the associated pin on the NextMove ES 96-pin connector. Where multiple pins exist with the same function, for example AGND, one example pin number is shown, but any identically named pin represents the same electrical connection.

See section 4.2 for details of the 96-pin connector.

5.1.1 Earth/ground connection

For improved noise immunity, always connect the backplane's earth/ground stud to the chassis earth point using a suitable earth braid.

5.2 BPL010-501 non-isolated backplane

This backplane provides direct connection to the NextMove ES signals without isolation. The electrical specifications of all signals are therefore the same as described in section 4.

In the following sections, the signals AGND, DGND and Shield are listed with nominal corresponding pins on the 96-pin connector, although they are all electrically connected on the backplane. The OUT COM pin on connector X11 is not connected to ground.

Some signals are duplicated on multiple identically named pins on the 96-pin connector.
In these cases, only the lowest numbered pin is listed.

CAUTION

Some components are static sensitive devices. Take appropriate ESD precautions when handling the backplane.

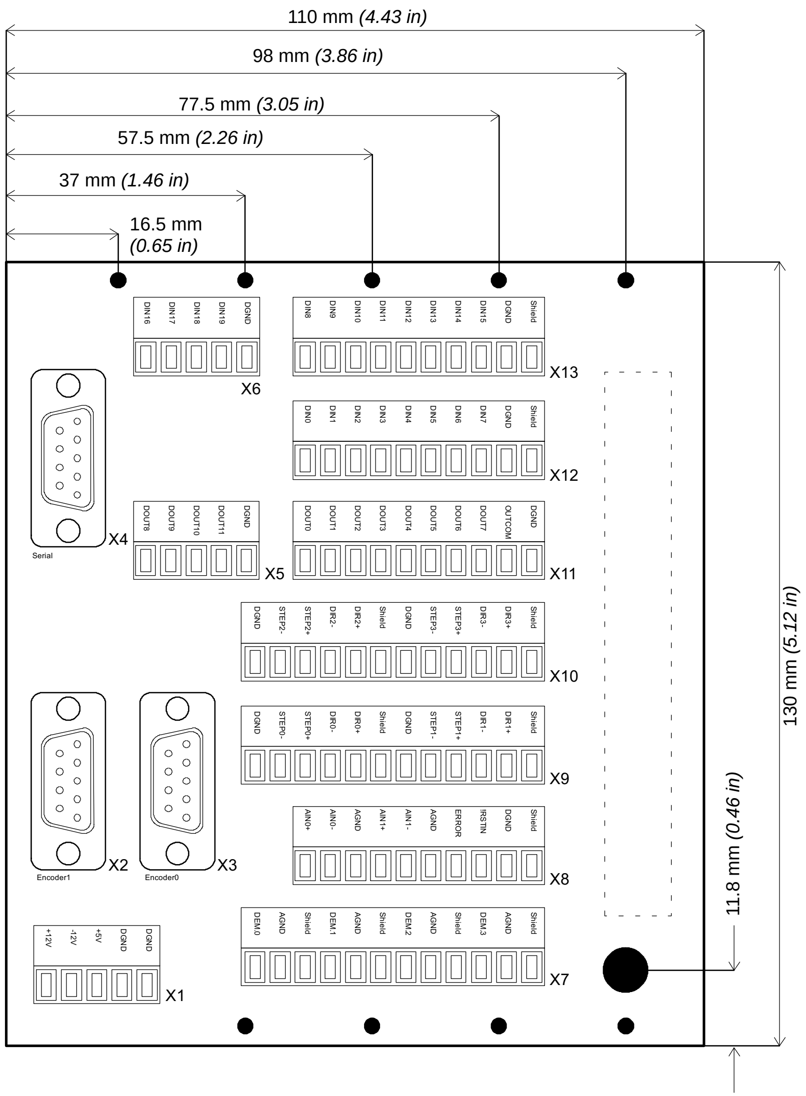


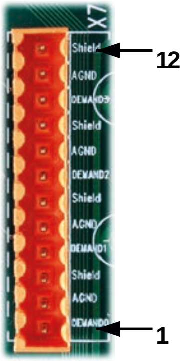
Figure 23: Backplane BPL010-501 connector layout and dimensions

5.2.1 Analog inputs

Location	X8 Mating connector: Weidmüller Omnimate BL 3.5/10		
Pin	**Name**	**Description**	**96-pin connector**
10	Shield	Shield connection	a32
9	DGND	Digital ground	a3
8	-	(NC)	c12
7	ERROR	Error output	b11
6	AGND	Analog ground	a30
5	AIN1-	Analog input AIN1-	a27
4	AIN1+	Analog input AIN1+	c28
3	AGND	Analog ground	a30
2	AIN0-	Analog input AIN0-	a28
1	AIN0+	Analog input AIN0+	b28

See section 4.3.1 for electrical specifications of the analog inputs.

5.2.2 Analog outputs (demands)



Location	X7 Mating connector: Weidmüller Omnimate BL 3.5/12		
Pin	**Name**	**Description**	**96-pin connector**
12	Shield	Shield connection	a32
11	AGND	Analog ground	a30
10	DEMAND3	Analog output AOUT3	b22
9	Shield	Shield connection	a32
8	AGND	Analog ground	a30
7	DEMAND2	Analog output AOUT2	b17
6	Shield	Shield connection	a32
5	AGND	Analog ground	a30
4	DEMAND1	Demand 1 output (AOUT1)	b27
3	Shield	Shield connection	a32
2	AGND	Analog ground	a30
1	DEMAND0	Demand 0 output (AOUT0)	c27

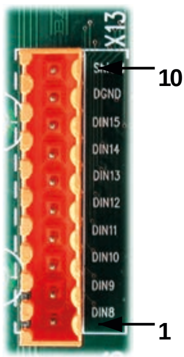
See section 4.3.2 for electrical specifications of the analog outputs.

5.2.3 Digital inputs 0-7

Location	X12 Mating connector: Weidmüller Omnimate BL 3.5/10		
Pin	**Name**	**Description**	**96-pin connector**
10	Shield	Shield connection	a32
9	DGND	Digital ground	a3
8	DIN7	Digital input DIN7	a19
7	DIN6	Digital input DIN6	c20
6	DIN5	Digital input DIN5	b19
5	DIN4	Digital input DIN4	c18
4	DIN3	Digital input DIN3	c19
3	DIN2	Digital input DIN2	a18
2	DIN1	Digital input DIN1	b20
1	DIN0	Digital input DIN0	c21

See section 4.4.1 for electrical specifications of the digital inputs.

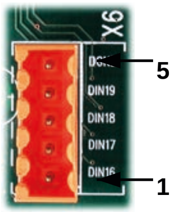
5.2.4 Digital inputs 8-15



Location	X13 Mating connector: Weidmüller Omnimate BL 3.5/10		
Pin	**Name**	**Description**	**96-pin connector**
10	Shield	Shield connection	a32
9	DGND	Digital ground	a3
8	DIN15	Digital input DIN15	b18
7	DIN14	Digital input DIN14	c23
6	DIN13	Digital input DIN13	b24
5	DIN12	Digital input DIN12	c26
4	DIN11	Digital input DIN11	a25
3	DIN10	Digital input DIN10	a24
2	DIN9	Digital input DIN9	b25
1	DIN8	Digital input DIN8	a26

See section 4.4.1 for electrical specifications of the digital inputs.

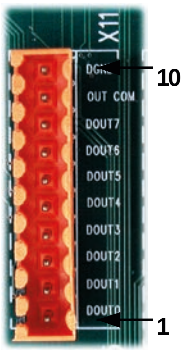
5.2.5 Digital inputs 16-19



Location	X6 Mating connector: Weidmüller Omnimate BL 3.5/5		
Pin	**Name**	**Description**	**96-pin connector**
5	DGND	Digital ground	a3
4	DIN19	Digital input DIN19	b26
3	DIN18	Digital input DIN18	c25
2	DIN17	Digital input DIN17	c24
1	DIN16	Digital input DIN16	c11

See section 4.4.1 for electrical specifications of the digital inputs.

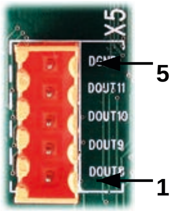
5.2.6 Digital outputs 0-7



Location	X11 Mating connector: Weidmüller Omnimate BL 3.5/10		
Pin	**Name**	**Description**	**96-pin connector**
10	DGND	Digital ground	a3
9	OUT COM	Common	a4
8	DOUT7	Digital output DOUT7	b4
7	DOUT6	Digital output DOUT6	c4
6	DOUT5	Digital output DOUT5	a5
5	DOUT4	Digital output DOUT4	b5
4	DOUT3	Digital output DOUT3	c5
3	DOUT2	Digital output DOUT2	a6
2	DOUT1	Digital output DOUT1	b6
1	DOUT0	Digital output DOUT0	c6

See section 4.4.2 for electrical specifications of the digital outputs.

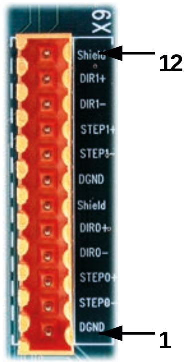
5.2.7 Digital outputs 8-11 (NES002-501 / NES002-502 only)



Location	X5 Mating connector: Weidmüller Omnimate BL 3.5/5		
Pin	**Name**	**Description**	**96-pin connector**
5	DGND	Digital ground	a3
4	DOUT11	Digital output DOUT11	c22
3	DOUT10	Digital output DOUT10	c16
2	DOUT9	Digital output DOUT9	b13
1	DOUT8	Digital output DOUT8	a13

See section 4.4.2.2 for electrical specifications of the digital outputs.

5.2.8 Stepper axes outputs 0-1



Location	X9 Mating connector: Weidmüller Omnimate BL 3.5/12		
Pin	**Name**	**Description**	**96-pin connector**
12	Shield	Shield connection	a32
11	DIR1+	Direction output 1+	b15
10	DIR1-	Direction output 1-	
9	STEP1+	Step (pulse) output 1+	b14
8	STEP1-	Step (pulse) output 1-	
7	DGND	Digital ground	a3
6	Shield	Shield connection	a32
5	DIR0+	Direction output 0+	a15
4	DIR0-	Direction output 0-	
3	STEP0+	Step (pulse) output 0+	a14
2	STEP0-	Step (pulse) output 0-	
1	DGND	Digital ground	a3

Stepper axes outputs 0-1 on the backplane are driven by DS26LS31 line drivers, providing RS422 differential outputs. See also Figures 26 and 27.

CAUTION

The DS26LS31 drivers are static sensitive devices. Take appropriate ESD precautions when handling the backplane. When connecting the outputs to single ended inputs as shown in Figures 26 and 27, do not connect the STEP*x*- or DIR*x*- outputs to ground; leave them unconnected.

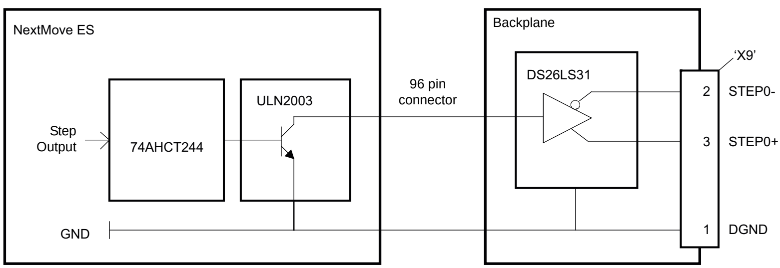
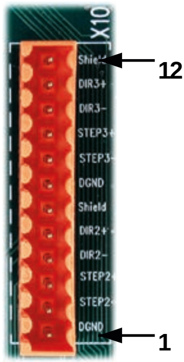


Figure 24: Stepper output - STEP0 output shown

5.2.9 Stepper axes outputs 2-3



Location	X10 Mating connector: Weidmüller Omnimate BL 3.5/12		
Pin	**Name**	**Description**	**96-pin connector**
12	Shield	Shield connection	a32
11	DIR3+	Direction output 3+	a23
10	DIR3-	Direction output 3-	
9	STEP3+	Step (pulse) output 3+	b23
8	STEP3-	Step (pulse) output 3-	
7	DGND	Digital ground	a3
6	Shield	Shield connection	a32
5	DIR2+	Direction output 2+	c15
4	DIR2-	Direction output 2-	
3	STEP2+	Step (pulse) output 2+	c14
2	STEP2-	Step (pulse) output 2-	
1	DGND	Digital ground	a3

Stepper axes outputs 2-3 on the backplane are driven by DS26LS31 line drivers, providing RS422 differential outputs.

CAUTION

The DS26LS31 drivers are static sensitive devices. Take appropriate ESD precautions when handling the backplane. When connecting the outputs to single ended inputs as shown in Figures 26 and 27, do not connect the STEP*x*- or DIR*x*- outputs to ground; leave them unconnected.

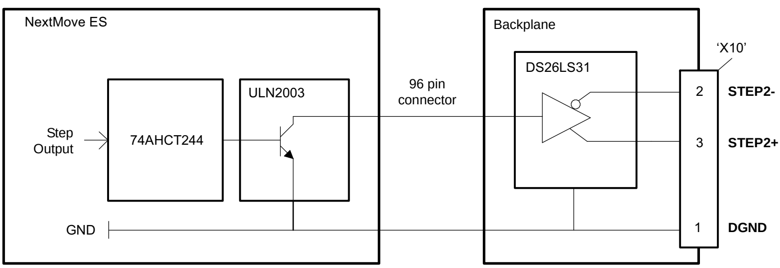


Figure 25: Stepper output - STEP2 output shown

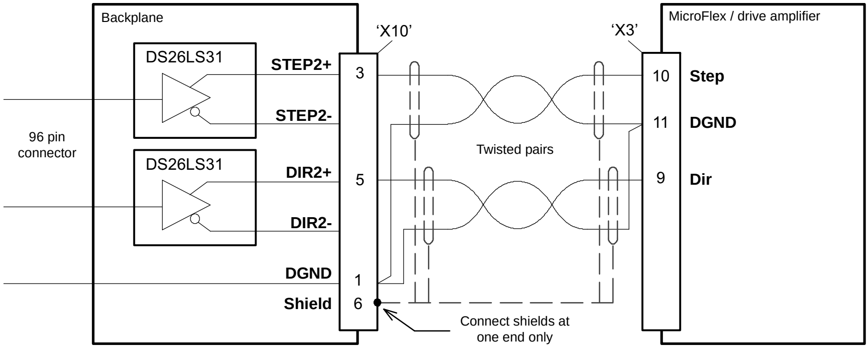


Figure 26: Stepper output STEP2 - typical connection to an ABB MicroFlex

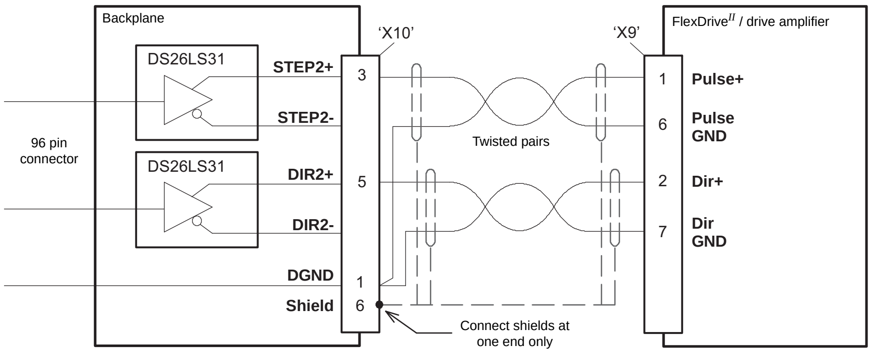
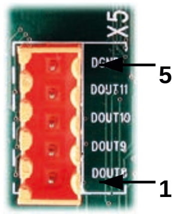


Figure 27: Stepper output STEP2 - typical connection to a Baldor FlexDrive^{II}, Flex+Drive^{II} or MintDrive^{II}

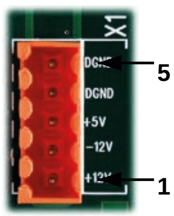
5.2.10 Stepper axes outputs 4-5 (6 stepper axis firmware only)



Location	X5 Mating connector: Weidmüller Omnimate BL 3.5/5		
Pin	**Name**	**Description**	**96-pin connector**
5	DGND	Digital ground	a3
4	DOUT11	Direction output 5	c22
3	DOUT10	Step (pulse) output 5	c16
2	DOUT9	Direction output 4	b13
1	DOUT8	Step (pulse) output 4	a13

Stepper axes outputs 4-5 are available only when using the optional 6 stepper axis firmware. The outputs are not isolated or driven by the backplane. See section 4.4.2.2 for electrical specifications of step and direction outputs 4 and 5.

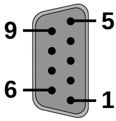
5.2.11 Power inputs



Location	X1 Mating connector: Weidmüller Omnimate BL 3.5/5		
Pin	**Name**	**Description**	**96-pin connector**
5	DGND	Digital ground	a3
4	DGND	Digital ground	a3
3	+5V	+5 V input	a1
2	-12V	-12 V input	a31
1	+12V	+12 V input	a29

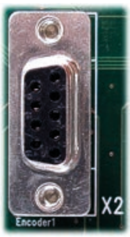
See section 3.1.4 for power requirements.

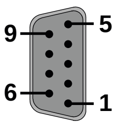
5.2.12 Encoder input 0



Location	X3 Encoder0 Mating connector: 9-pin male D-type		
Pin	**Name**	**Description**	**96-pin connector**
1	CHA+	Channel A signal	b7
2	CHB+	Channel B signal	a7
3	CHZ+	Index channel signal	b8
4	Shield	Shield connection	a32
5	DGND	Digital ground	a3
6	CHA-	Channel A signal complement	b10
7	CHB-	Channel B signal complement	c10
8	CHZ-	Index channel signal complement	b9
9	+5 V out	Power supply to encoder	a1

5.2.13 Encoder input 1

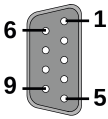




Location	X2 Encoder1 Mating connector: 9-pin male D-type		
Pin	**Name**	**Description**	**96-pin connector**
1	CHA+	Channel A signal	a8
2	CHB+	Channel B signal	c7
3	CHZ+	Index channel signal	c8
4	Shield	Shield connection	a32
5	DGND	Digital ground	a1
6	CHA-	Channel A signal complement	c9
7	CHB-	Channel B signal complement	a10
8	CHZ-	Index channel signal complement	a9
9	+5V out	Power supply to encoder	a1

See section 4.5.2 for specifications of the encoder inputs.

5.2.14 Serial port



Location	X4 Serial Mating connector: 9-pin female D-type		
Pin	**Name**	**Description**	**96-pin connector**
1	Shield	(NC)	a32
2	RXD	RX- (input)	a20
3	TXD	TX- (output)	a21
4	(NC)	(NC)	a16*
5	DGND	Digital ground	a3
6	(NC)	(NC)	a17*
7	RTS	TX+ (output)	b21
8	CTS	RX+ (input)	a22
9	DGND	(NC)	a3

This serial connector carries the same signals as the serial connector on the NextMove ES control card. Do not use both serial connectors at the same time.

* Pins 4 and 6 are linked on the NextMove ES.

5.3 BPL010-502/503 backplane with opto-isolator card

These backplanes are provided with an additional plug in card which provides opto-isolation for many of the NextMove ES signals.

On BPL010-502, the general purpose digital outputs are PNP (current sourcing) outputs. The general purpose digital inputs are activated when a positive voltage is applied.

On BPL010-503, the general purpose digital outputs are NPN (current sinking) outputs. The general purpose digital inputs are activated when grounded.

There are two 96-pin connectors present on the opto-isolating backplane. The male connector accepts the opto-isolator card. The female 96-pin connector nearest the edge of the backplane accepts the NextMove ES card. The backplane will not operate without the opto-isolating card.

In the following sections, the signals AGND, DGND and Shield are listed with nominal corresponding pins on the 96-pin connector, although they are all electrically connected on the backplane. The OUT COM pin on connector X11 is not connected to ground.

All terminals labeled USR GND are electrically connected on the backplane, but are not connected to the AGND, DGND or Shield terminals. USR GND forms an independent common connection for the 0V side of the external power supply used for the digital inputs and outputs. It will be necessary to link the OUT COM or USR COM terminal to USR GND to allow the digital outputs to operate. However, the OUT COM and USR COM connectors have different purposes depending on model - see sections 5.3.6.1 and 5.3.6.2.

Some signals are duplicated on multiple identically named pins on the 96-pin connector. In these cases, only the lowest numbered pin is listed.

CAUTION

Some components are static sensitive devices. Take appropriate ESD precautions when handling the backplane.

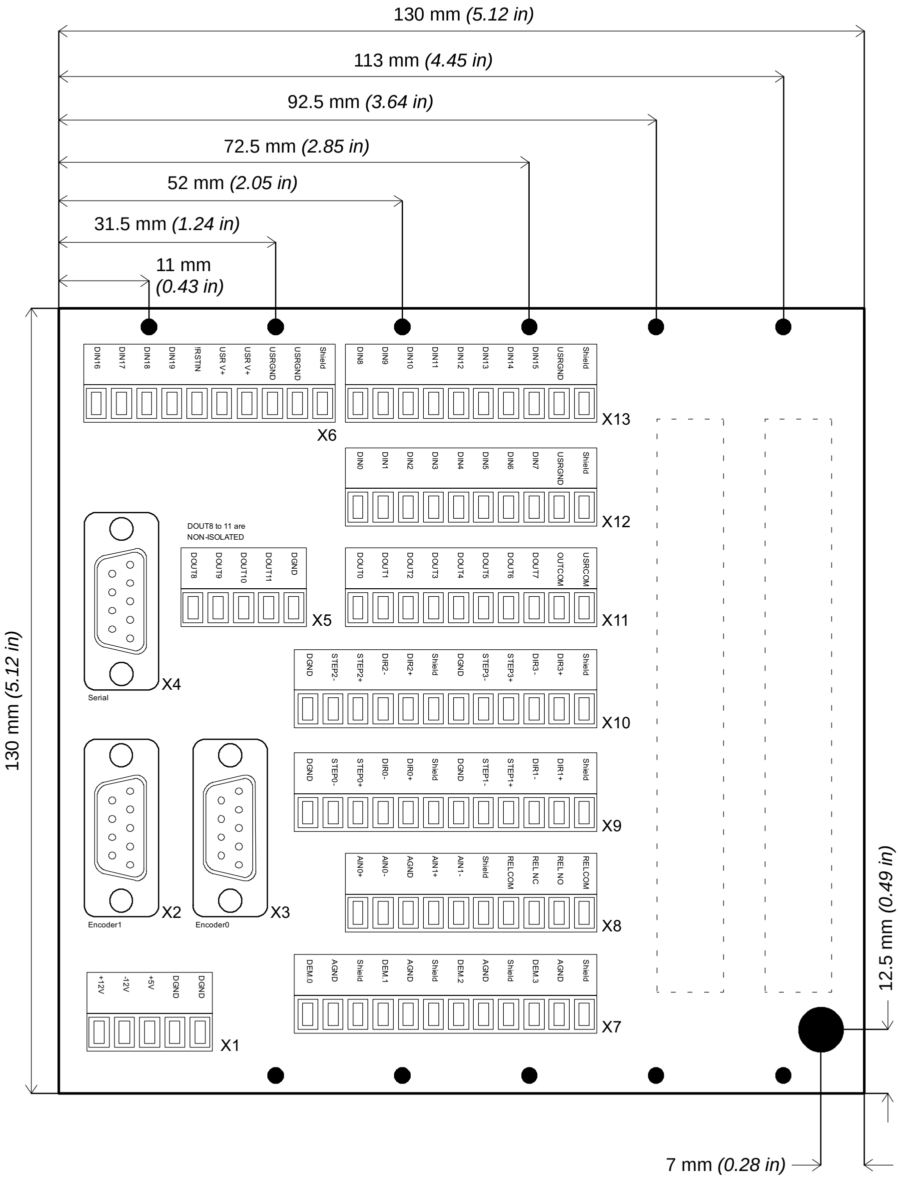


Figure 28: Backplane BPL010-502/503 connector layout and dimensions

5.3.1 Analog inputs

Location	X8 Mating connector: Weidmüller Omnimate BL 3.5/10		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
10	REL COM	Common relay contact	
9	REL NO	Normally open relay contact	
8	REL NC	Normally closed relay contact	
7	REL COM	Common relay contact	
6	Shield	Shield connection	a32
5	AIN1-	Analog input AIN1-	a27
4	AIN1+	Analog input AIN1+	c28
3	AGND	Analog ground	a30
2	AIN0-	Analog input AIN0-	a28
1	AIN0+	Analog input AIN0+	b28

The analog inputs on the backplane are connected directly to the NextMove ES and do not pass through any circuitry on the opto-isolator card. See section 4.3.1 for electrical specifications of the analog inputs.

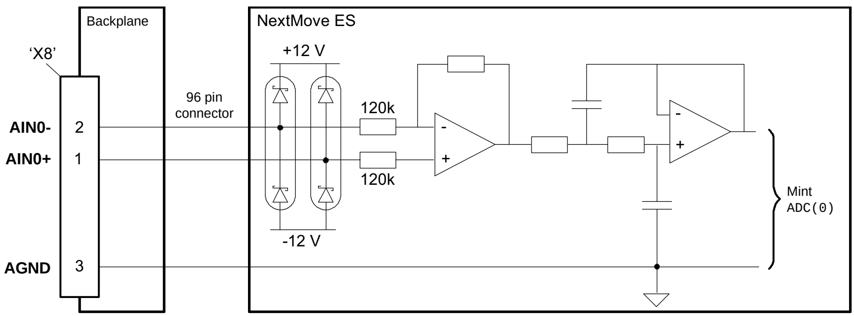


Figure 29: Analog input, AIN0 shown

5.3.1.1 Error relay connections

The double-pole relay on the opto-isolator card is controlled directly by the Error Out signal (section 4.4.3), as shown in Figure 30.

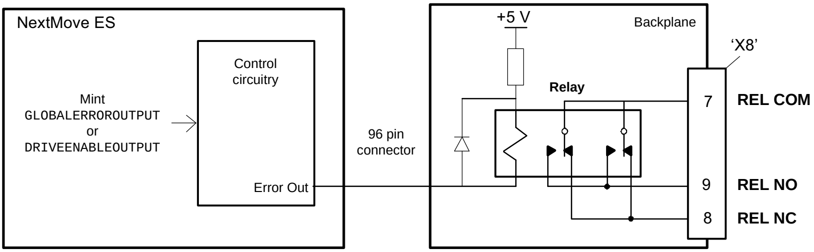


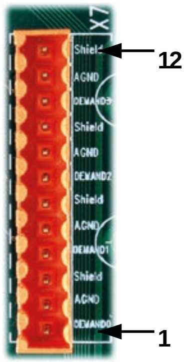
Figure 30: Relay connections

The error output can be controlled by the `RELAY` keyword, and can be configured as the global error output by setting `GLOBALERROROUTPUT` to 1000 (`_RELAY0`). See the Mint help file.

While there is no error, the relay is energized, and REL COM is connected to REL NO. When an error occurs, the relay is de-energized, and REL COM is connected to REL NC.

CAUTION It is important that the NextMove ES jumper settings are correct to allow it to control the backplane relay. JP4 and JP5 must be fitted. Jumper JP3 must be removed. See section 4.4.3 for jumper locations.

5.3.2 Analog outputs (demands)



Location	X7 Mating connector: Weidmüller Omnimate BL 3.5/12		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
12	Shield	Shield connection	a32
11	AGND	Analog ground	a30
10	DEMAND3	Analog output AOUT3	b22
9	Shield	Shield connection	a32
8	AGND	Analog ground	a30
7	DEMAND2	Analog output AOUT2	b17
6	Shield	Shield connection	a32
5	AGND	Analog ground	a30
4	DEMAND1	Demand 1 output (AOUT1)	b27
3	Shield	Shield connection	a32
2	AGND	Analog ground	a30
1	DEMAND0	Demand 0 output (AOUT0)	c27

The outputs on the backplane are connected directly to the NextMove ES and do not pass through any circuitry on the opto-isolator card. See section 4.3.2 for electrical specifications and how to connect an output to a typical drive amplifier.

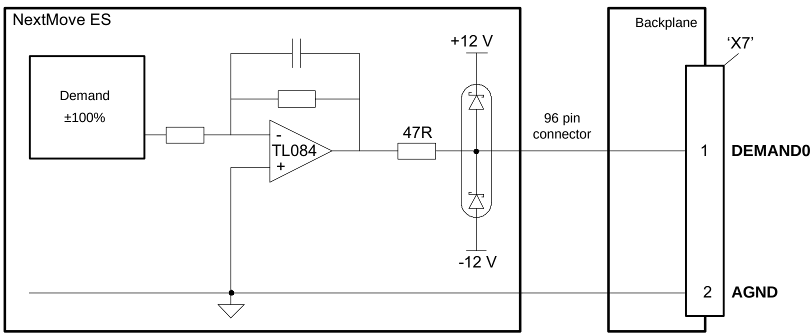
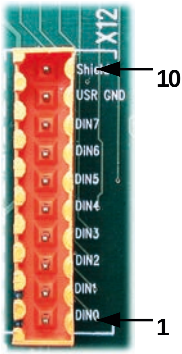


Figure 31: Analog output, DEMAND0 shown

5.3.3 Digital inputs 0-7



Location	X12 Mating connector: Weidmüller Omnimate BL 3.5/10		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
10	Shield	Shield connection	a32
9	USR GND	Customer power supply ground	
8	DIN7	Digital input DIN7	a19
7	DIN6	Digital input DIN6	c20
6	DIN5	Digital input DIN5	b19
5	DIN4	Digital input DIN4	c18
4	DIN3	Digital input DIN3	c19
3	DIN2	Digital input DIN2	a18
2	DIN1	Digital input DIN1	b20
1	DIN0	Digital input DIN0	c21

The BPL010-502 and BPL010-503 opto-isolating cards use different input configurations. Sections 5.3.5.1 and 5.3.5.2 describe the two input types.

5.3.4 Digital inputs 8-15

Location	X13 Mating connector: Weidmüller Omnimate BL 3.5/10		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
10	Shield	Shield connection	a32
9	USR GND	Customer power supply ground	
8	DIN15	Digital input DIN15	b18
7	DIN14	Digital input DIN14	c23
6	DIN13	Digital input DIN13	b24
5	DIN12	Digital input DIN12	c26
4	DIN11	Digital input DIN11	a25
3	DIN10	Digital input DIN10	a24
2	DIN9	Digital input DIN9	b25
1	DIN8	Digital input DIN8	a26

The BPL010-502 and BPL010-503 opto-isolating cards use different input configurations. Sections 5.3.5.1 and 5.3.5.2 describe the two input types.

5.3.5 Digital inputs 16-19

Location	X6 Mating connector: Weidmüller Omnimate BL 3.5/10		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
10	Shield	Shield connection	a32
9	USR GND	Customer power supply ground	
8	USR GND	Customer power supply ground	
7	USR V+	Customer power supply	
6	USR V+	Customer power supply	
5	-	(NC)	c12
4	DIN19	Digital input DIN19	b26
3	DIN18	Digital input DIN18	c25
2	DIN17	Digital input DIN17	c24
1	DIN16	Digital input DIN16	c11

The BPL010-502 and BPL010-503 opto-isolating cards use different input configurations. Sections 5.3.5.1 and 5.3.5.2 describe the two input types.

5.3.5.1 BPL010-502 - Active high inputs

The user power supply connection USR GND is common to all inputs. To activate an input, a voltage must be applied that is sufficient to cause at least 5 mA in the input circuit. To ensure that an input becomes inactive, the current must be less than 1 mA. The internal pull-up resistor on the NextMove ES allows the input to be left floating when inactive or not being used.

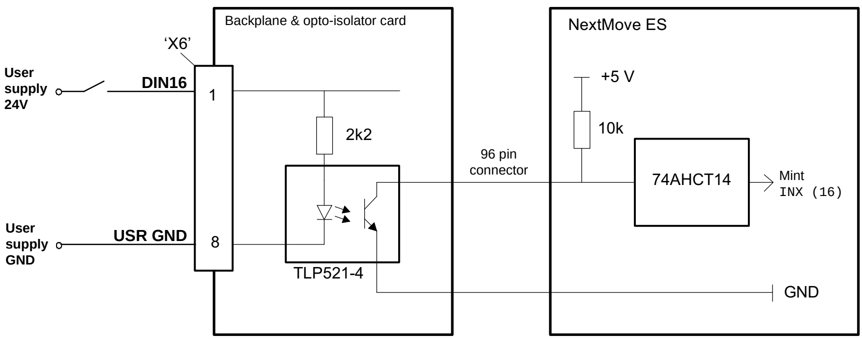


Figure 32: Digital input circuit (DIN16) with 'active high' inputs

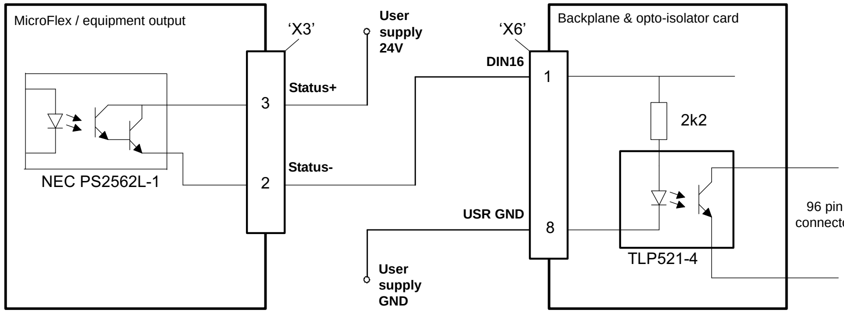


Figure 33: Digital input - typical connections from an ABB MicroFlex

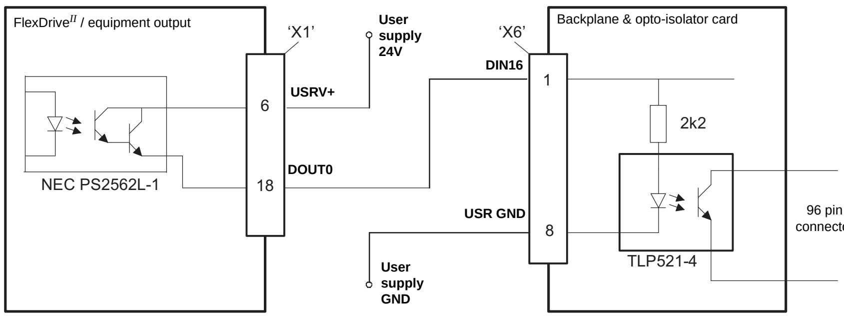


Figure 34: Digital input - typical connections from a Baldor FlexDrive*II*, Flex+Drive*II* or MintDrive*II*

5.3.5.2 BPL010-503 - Active low inputs

The user power supply connection USR V+ is common to all inputs. To activate an input it must be grounded to the 0 V side of the user power supply (USR GND). The internal pull-up resistor on the NextMove ES allows the input to be left floating when inactive or not being used.

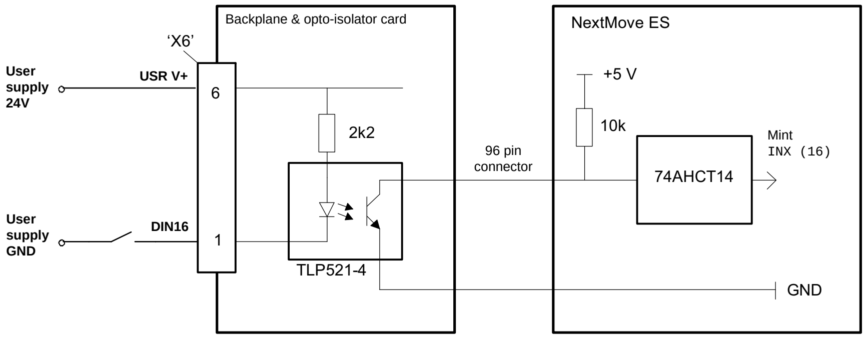


Figure 35: Digital input circuit (DIN16) with 'active low' inputs

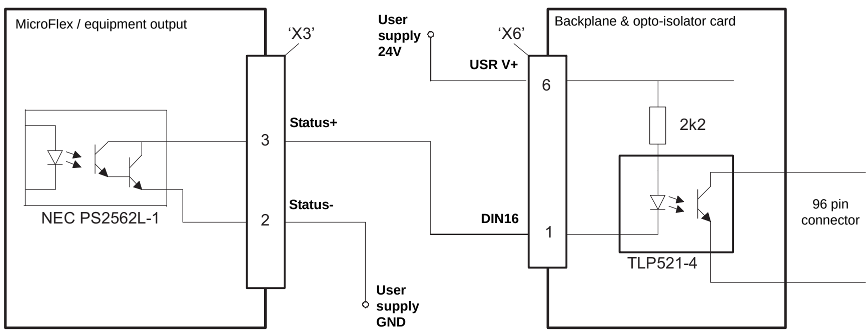


Figure 36: Digital input - typical connections from an ABB MicroFlex

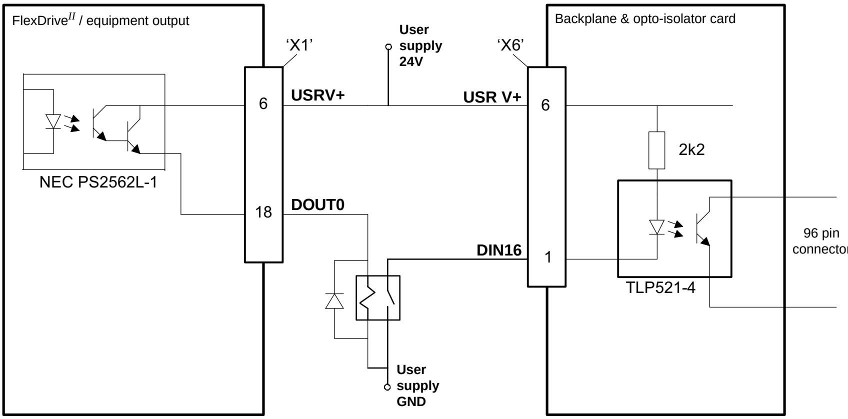
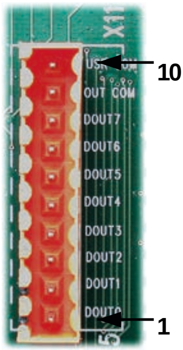


Figure 37: Digital input - typical connections from a Baldor FlexDrive*II*, Flex+Drive*II* or MintDrive*II*

5.3.6 Digital outputs 0-7



Location	X11 Mating connector: Weidmüller Omnimate BL 3.5/10		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
10	USR COM	Common supply connection*	a3
9	OUT COM	Common*	a4
8	DOUT7	Digital output DOUT7	b4
7	DOUT6	Digital output DOUT6	c4
6	DOUT5	Digital output DOUT5	a5
5	DOUT4	Digital output DOUT4	b5
4	DOUT3	Digital output DOUT3	c5
3	DOUT2	Digital output DOUT2	a6
2	DOUT1	Digital output DOUT1	b6
1	DOUT0	Digital output DOUT0	c6

The digital outputs DOUT0 - DOUT7 are buffered by the opto-isolator card.

* The BPL010-502 and BPL010-503 opto-isolating cards use different output driver ICs, as shown in Figures 38 and 39. Due to the pin configuration of these ICs, the functions of the X11 connector’s USR COM and OUT COM pins are different on the PNP and NPN cards. Sections 5.3.6.1 and 5.3.6.2 describe the two output types.

5.3.6.1 BPL010-502 - PNP outputs

An external supply (typically 24 V DC) is used to power the UDN2982 output devices, as shown in Figure 38. When an output is activated, current is sourced from the user supply through the UDN2982, which can source up to 75 mA per output (all outputs on, 100% duty cycle). Connect OUT COM to the user supply GND. This will connect internal transient suppression diodes on all outputs. If an output is used to drive a relay, a suitably rated diode must be fitted across the relay coil, observing the correct polarity (see Figure 40). The use of shielded cable is recommended.

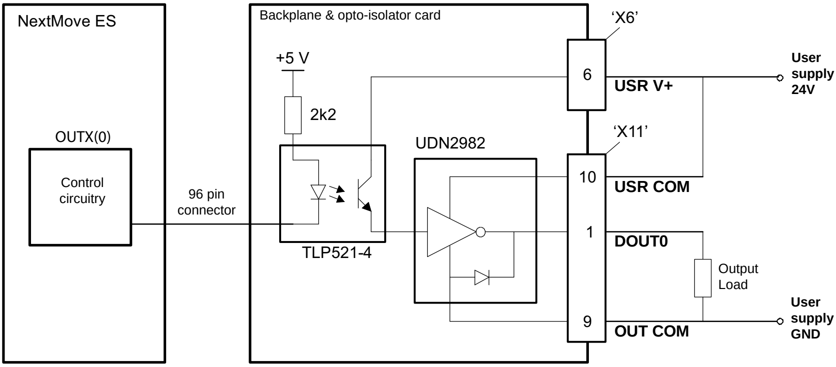


Figure 38: Digital output circuit (DOUT0-7) with 'PNP' current sourcing module - DOUT0 shown

5.3.6.2 BPL010-503 - NPN outputs

An external supply (typically 24 V DC) is used to power the UDN2803 output devices and drive the load, as shown in Figure 39. When an output is activated it is connected to USR COM through the ULN2803, which can sink up to 150 mA per output (all outputs on, 100% duty cycle). Connect OUT COM to the user supply 24 V. This will connect internal transient suppression diodes on all outputs. If an output is used to drive a relay, a suitably rated diode must be fitted across the relay coil, observing the correct polarity (see Figure 40). The use of shielded cable is recommended.

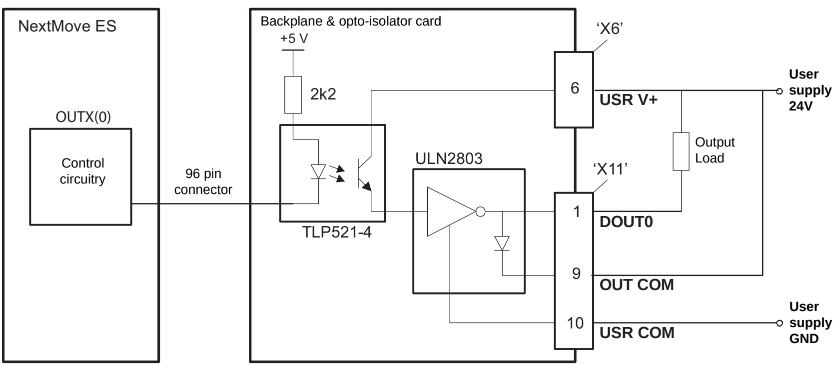
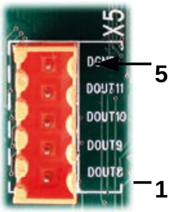


Figure 39: Digital output circuit (DOUT0-7) with 'NPN' current sinking module - DOUT0 shown

5.3.7 Digital outputs 8-11 (NES002-501 / NES002-502 only)



Location	X5 Mating connector: Weidmüller Omnimate BL 3.5/5		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
5	DGND	Digital ground	a3
4	DOUT11	Digital output DOUT11	c22
3	DOUT10	Digital output DOUT10	c16
2	DOUT9	Digital output DOUT9	b13
1	DOUT8	Digital output DOUT8	a13

CAUTION

Digital outputs DOUT8 - DOUT11 on the backplane are *not* buffered by the opto-isolator card; they are connected directly to the NextMove ES outputs.

When an output is activated, it is grounded through the ULN2003, which can sink up to 50 mA per output (all outputs on, 100% duty cycle). If an output is used to drive a relay, a suitably rated diode must be fitted across the relay coil, observing the correct polarity. This is to protect the output from the back-EMF generated by the relay coil when it is de-energized.

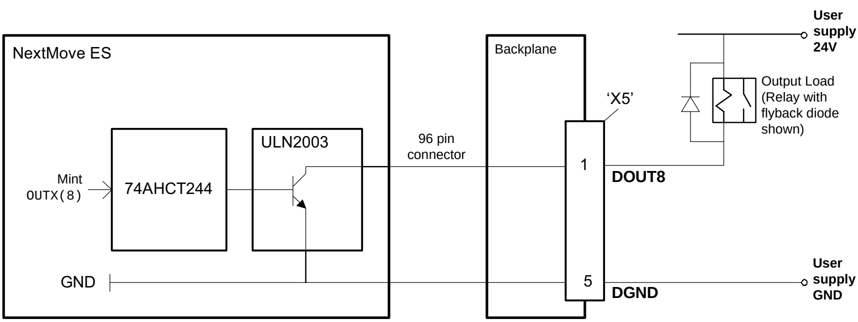
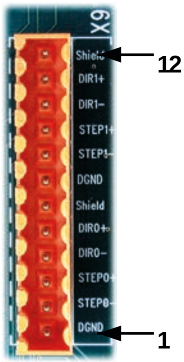


Figure 40: Digital output circuit (DOUT8-11) - DOUT8 shown

5.3.8 Stepper axes outputs 0-1



Location	X9 Mating connector: Weidmüller Omnimate BL 3.5/12		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
12	Shield	Shield connection	a32
11	DIR1+	Direction output 1+	b15
10	DIR1-	Direction output 1-	
9	STEP1+	Step (pulse) output 1+	b14
8	STEP1-	Step (pulse) output 1-	
7	DGND	Digital ground	a3
6	Shield	Shield connection	a32
5	DIR0+	Direction output 0+	a15
4	DIR0-	Direction output 0-	
3	STEP0+	Step (pulse) output 0+	a14
2	STEP0-	Step (pulse) output 0-	
1	DGND	Digital ground	a3

Stepper axes outputs 0-1 on the backplane are driven by DS26LS31 line drivers, providing RS422 differential outputs. See also Figures 43 and 44.

CAUTION

The DS26LS31 drivers are static sensitive devices. Take appropriate ESD precautions when handling the backplane. When connecting the outputs to single ended inputs as shown in Figures 43 and 44, do not connect the STEP*x*- or DIR*x*- outputs to ground; leave them unconnected.

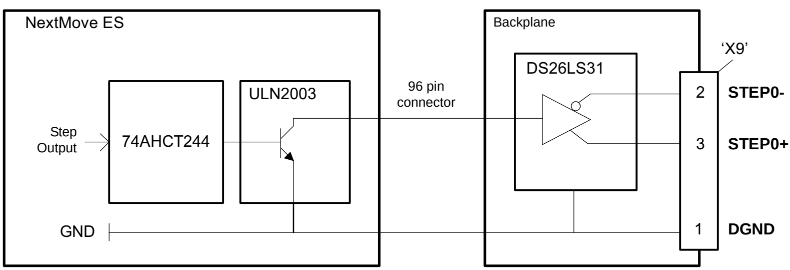
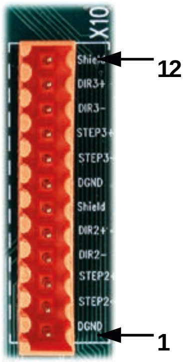


Figure 41: Stepper output - STEP0 output shown

5.3.9 Stepper axes outputs 2-3



Location	X10 Mating connector: Weidmüller Omnimate BL 3.5/12		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
12	Shield	Shield connection	a32
11	DIR3+	Direction output 3+	a23
10	DIR3-	Direction output 3-	
9	STEP3+	Step (pulse) output 3+	b23
8	STEP3-	Step (pulse) output 3-	
7	DGND	Digital ground	a3
6	Shield	Shield connection	a32
5	DIR2+	Direction output 2+	c15
4	DIR2-	Direction output 2-	
3	STEP2+	Step (pulse) output 2+	c14
2	STEP2-	Step (pulse) output 2-	
1	DGND	Digital ground	a3

Stepper axes outputs 2-3 on the backplane are driven by DS26LS31 line drivers, providing RS422 differential outputs.

CAUTION

The DS26LS31 drivers are static sensitive devices. Take appropriate ESD precautions when handling the backplane. When connecting the outputs to single ended inputs as shown in Figures 43 and 44, do not connect the STEP*x*- or DIR*x*- outputs to ground; leave them unconnected.

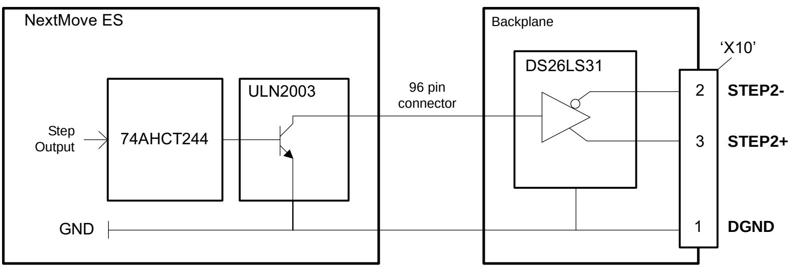


Figure 42: Stepper output - STEP2 output shown

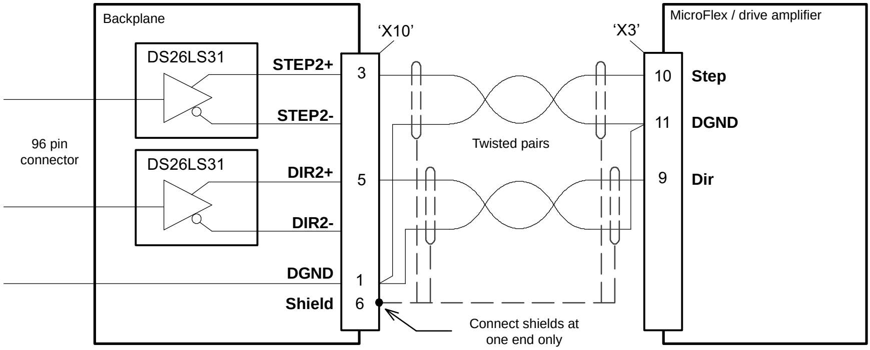


Figure 43: Stepper output STEP2 - typical connection to an ABB MicroFlex

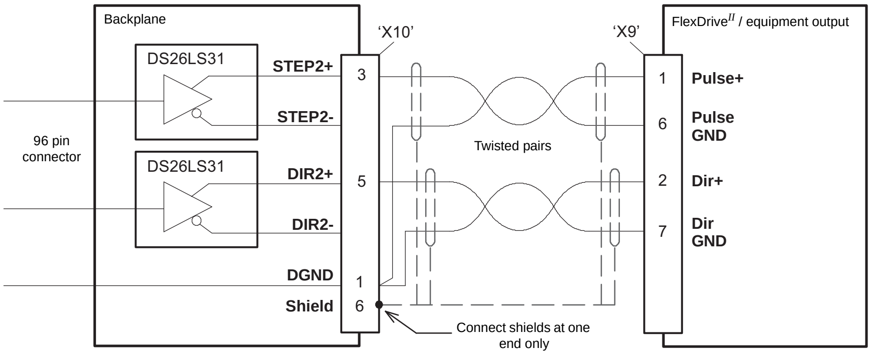
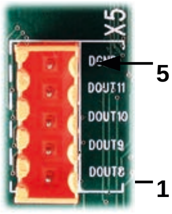


Figure 44: Stepper output STEP2 - typical connection to a Baldor FlexDrive^{II}, Flex+Drive^{II} or MintDrive^{II}

5.3.10 Stepper axes outputs 4-5 (6 stepper axis firmware only)



Location	X5 Mating connector: Weidmüller Omnimate BL 3.5/5		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
5	DGND	Digital ground	a3
4	DOUT11	Direction output 5	c22
3	DOUT10	Step (pulse) output 5	c16
2	DOUT9	Direction output 4	b13
1	DOUT8	Step (pulse) output 4	a13

Stepper axes outputs 4-5 are available only when using the optional 6 stepper axis firmware.

CAUTION

Stepper axes outputs 4-5 on the backplane are *not* buffered by the opto-isolator card; they are connected directly to the NextMove ES outputs.

When an output is activated, it is grounded through the ULN2003, which can sink up to 50 mA per output (all outputs on, 100% duty cycle). If an output is used to drive a relay, a suitably rated diode must be fitted across the relay coil, observing the correct polarity. This is to protect the output from the back-EMF generated by the relay coil when it is de-energized.

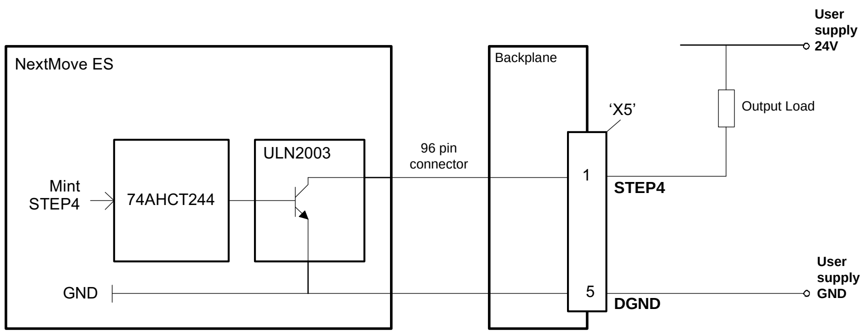
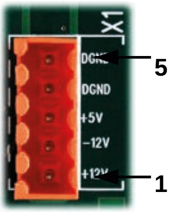


Figure 45: Stepper output - STEP4 shown

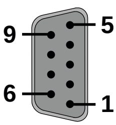
5.3.11 Power inputs



Location	X1 Mating connector: Weidmüller Omnimate BL 3.5/5		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
5	DGND	Digital ground	a3
4	DGND	Digital ground	a3
3	+5V	+5 V input	a1
2	-12V	-12 V input	a31
1	+12V	+12 V input	a29

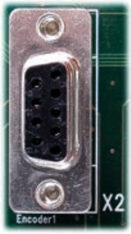
See section 3.1.4 for power requirements.

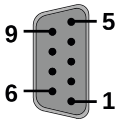
5.3.12 Encoder input 0



Location	X3 Encoder0 Mating connector: 9-pin male D-type		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
1	CHA+	Channel A signal	b7
2	CHB+	Channel B signal	a7
3	CHZ+	Index channel signal	b8
4	Shield	Shield connection	a32
5	GND	Digital ground	a3
6	CHA-	Channel A signal complement	b10
7	CHB-	Channel B signal complement	c10
8	CHZ-	Index channel signal comp.	b9
9	+5 V out	Power supply to encoder	a1

5.3.13 Encoder input 1

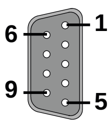




Location	X2 Encoder1 Mating connector: 9-pin male D-type		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
1	CHA+	Channel A signal	a8
2	CHB+	Channel B signal	c7
3	CHZ+	Index channel signal	c8
4	Shield	Shield connection	a32
5	GND	Digital ground	a1
6	CHA-	Channel A signal complement	c9
7	CHB-	Channel B signal complement	a10
8	CHZ-	Index channel signal comp.	a9
9	+5 V out	Power supply to encoder	a1

See section 4.5.2 for specifications of the encoder inputs.

5.3.14 Serial port



Location	X4 Serial Mating connector: 9-pin female D-type		
Pin	**Name**	**Description**	**NextMove ES 96-pin connector**
1	Shield	(NC)	a32
2	RXD	RX- (input)	a20
3	TXD	TX- (output)	a21
4	(NC)	(NC)	a16*
5	DGND	Digital ground	a3
6	(NC)	(NC)	a17*
7	RTS	TX+ (output)	b21
8	CTS	RX+ (input)	a22
9	DGND	(NC)	a3

This serial connector carries the same signals as the serial connector on the NextMove ES control card. Do not use both serial connectors at the same time.

* Pins 4 and 6 are linked on the NextMove ES.

6.1 Introduction

Before powering the NextMove ES you will need to connect it to the PC using a USB or serial cable and install the Mint WorkBench software. This includes a number of applications and utilities to allow you to configure, tune and program the NextMove ES. Mint WorkBench and other utilities can be found on the Mint Motion Toolkit CD (OPT-SW-001), or downloaded from www.abbmotion.com.

6.1.1 Connecting the NextMove ES to the PC

The NextMove ES 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 ES Serial connector. If you are using an intermediate RS232 to RS485 converter, connect this as specified by the manufacturer. Mint WorkBench can scan all the PC's COM ports, so you can use any port. If you are not using the serial cable CBL001-501, your cable must be wired in accordance with Figure 16 in section 4.5.5.

To use USB, connect a USB cable between a PC USB port and the NextMove ES USB connector. Your PC must be running Windows XP or a newer version of Windows.

6.1.2 Installing Mint WorkBench

The Windows user account requires administrative user rights to install Mint WorkBench.

6.1.2.1 To install Mint WorkBench from the CD (OPT-SW-001)

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 Mint WorkBench.

6.1.2.2 To install Mint WorkBench from the website

To install Mint WorkBench from www.abbmotion.com, download the application and run it.

6.1.3 Starting the NextMove ES

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 ES.

6.1.4 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 ES is properly earthed/grounded.
- Check all signal wiring for accuracy.

6.1.5 Power on checks

1. Turn on the 5 V and ±12 V supplies.
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. A green surface mount LED (D16) near the center of the NextMove ES should also be flashing once every two seconds. The NextMove ES is now ready to be configured using Mint WorkBench.

Note: If the red LED (D4) near the center of the NextMove ES remains illuminated, then the supply voltage is too low. See section 7.2.2 for LED locations. If the status display shows one of the digits 0 - 7 with a flashing decimal point, this indicates that the NextMove ES has detected a fault and cannot be started. In this unlikely event, please contact ABB technical support.

6.1.6 Installing the USB driver

When the NextMove ES is powered, Windows will automatically detect the controller and request the driver.

1. Windows will prompt for the driver. On Windows XP, click Next on the following dialogs and Windows will locate and install the driver. For Windows Vista and newer, no interaction should be necessary.
2. When installation is complete, a new Motion Control category will be listed in Windows Device Manager.

The NextMove ES is now ready to be configured using Mint WorkBench.

Note: If the NextMove ES 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 ES to the original USB port where it will be recognized in the usual way.

6.2 Mint Machine Center

The Mint Machine Center (MMC) is installed as part of the Mint WorkBench software. It is used to view the network of connected controllers in a system. Individual controllers and drives are configured using Mint WorkBench.

Note: If you have only a single NextMove ES connected to your PC, then MMC is probably not required. Use Mint WorkBench (see section 6.3) to configure the NextMove ES.

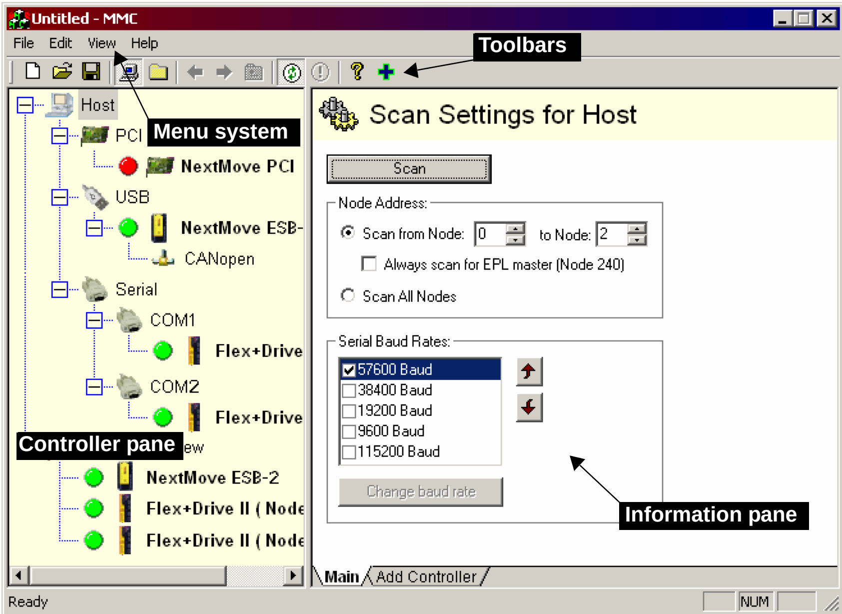


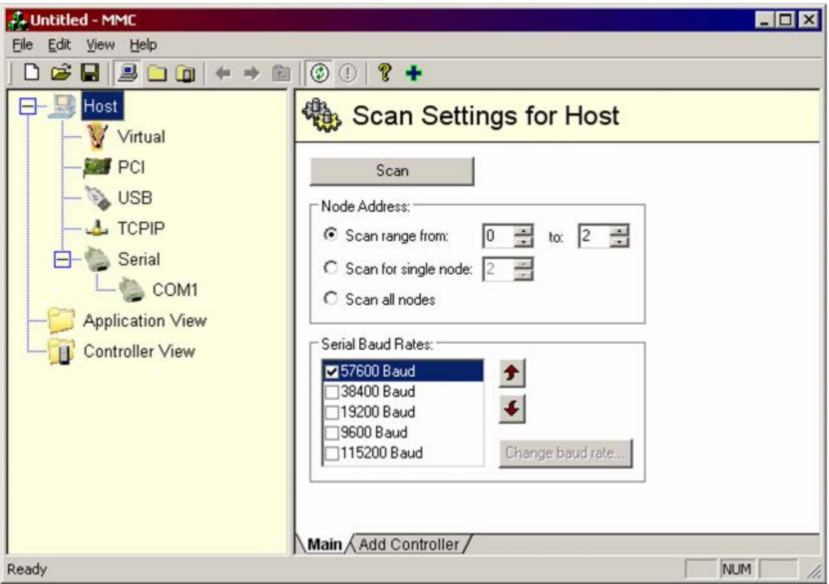
Figure 46: The Mint Machine Center software

The Mint Machine Center (MMC) provides an overview of the controller network currently accessible by the PC. The MMC contains a controller pane on the left, and an information pane on the right. In the controller pane select the Host item, then in the information pane click **Scan**. This causes MMC to scan for all connected controllers. Clicking once on a controller's name causes various options to be displayed in the information pane. Double-clicking on a controller's name launches an instance of Mint WorkBench that is automatically connected to the controller.

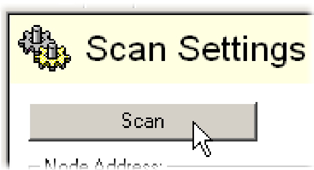
Application View allows the layout and organization of controllers in your machine to be modelled and described on screen. Controllers can be dragged onto the Application View icon, and renamed to give a more meaningful description, for example "Conveyor 1, Packaging Controller". Drives that are controlled by another product, such as NextMove ES, can be dragged onto the NextMove ES icon itself, creating a visible representation of the machine. A text description for the system and associated files can be added, and the resulting layout saved as an ‘MMC Workspace’. When you next need to administer the system, simply loading the workspace automatically connects to all the required controllers. See the Mint help file for full details of MMC.

6.2.1 Starting MMC

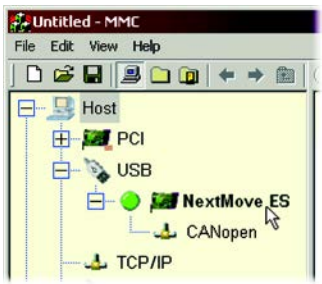
1. On the Windows **Start** menu, select Programs, Mint WorkBench, Mint Machine Center.



2. In the controller pane, ensure that Host is selected. In the information pane, click **Scan**.



3. When the search is complete, click once on 'NextMove ES' in the controller pane to select it, then double click to open an instance of Mint WorkBench. The NextMove ES will be already connected to the instance of Mint WorkBench, ready to configure.



6.3 Mint WorkBench

Mint WorkBench is a fully featured application for programming and controlling the NextMove ES. The main Mint 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.

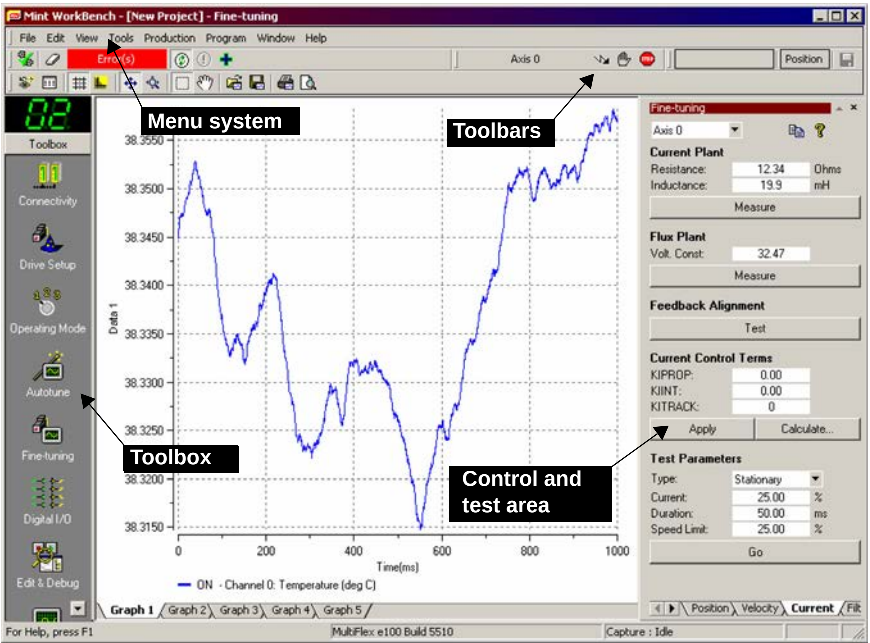


Figure 47: The Mint WorkBench software

6.3.1 Help file

Mint WorkBench includes a comprehensive help file that contains information about every Mint keyword, how to use Mint 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.

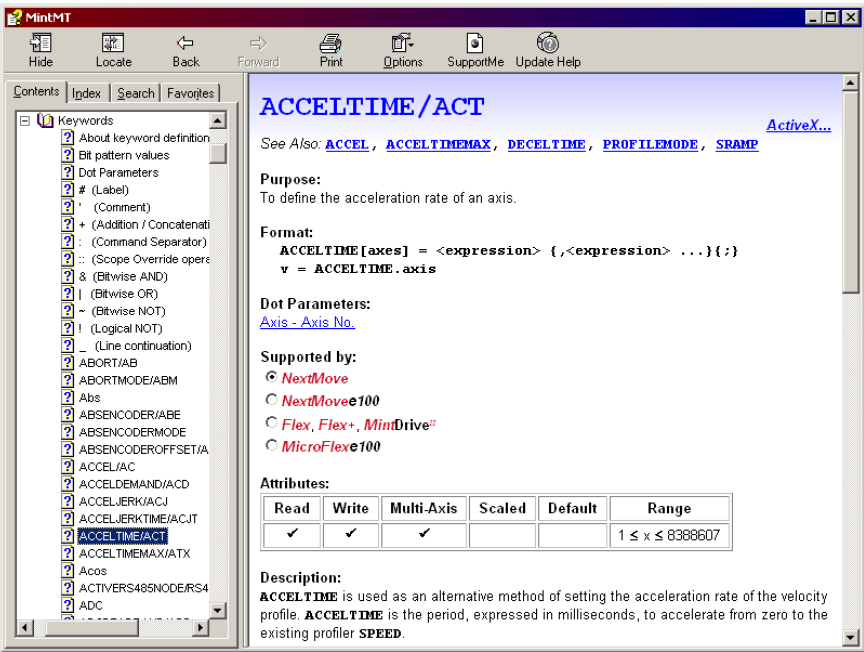


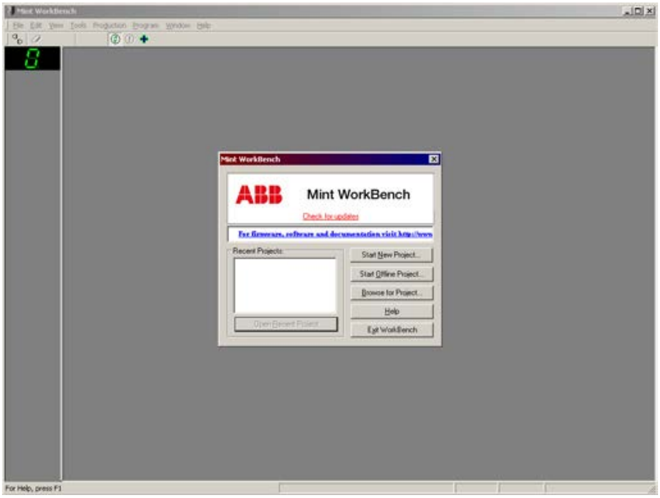
Figure 48: The Mint WorkBench help file

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

6.3.2 Starting Mint WorkBench

Note: If you have already used MMC to install firmware and start an instance of Mint WorkBench, go straight to section 6.4 to continue configuration.

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

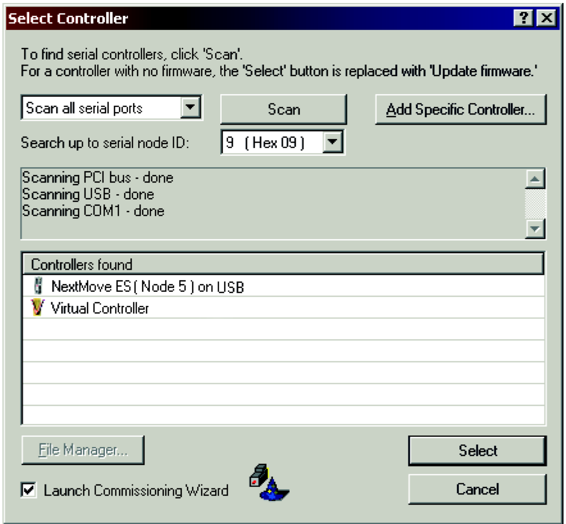


2. In the opening dialog box, click **Start New Project...** ..

3. In the Select Controller dialog, go to the drop down box near the top and select **Do not scan serial ports**.

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

   When the search is complete, click ‘NextMove ES’ in the list to select it, then click **Select**.



Note: If the NextMove ES is not listed, check the USB or serial cable between the NextMove ES and the PC. Check that the NextMove ES is powered correctly, and has completed its startup sequence (indicated by the node number being displayed by the Status display). Click **Scan** to re-scan the ports.

4. A dialog box may be displayed to tell you that Mint WorkBench has detected new firmware.

   Click **OK** to continue. Mint WorkBench reads back data from the NextMove ES. When this is complete, Edit & Debug mode is displayed. This completes the software installation.

6.4 Configuring an axis

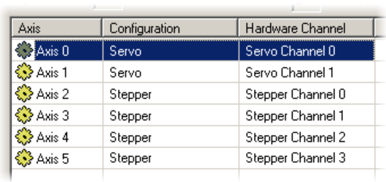
The NextMove ES is capable of controlling 4 stepper and 2 servo axes. This section describes how to configure both types of axis.

6.4.1 Selecting the axis type

An axis can be configured as either a servo axis or a stepper axis. The factory preset configuration sets all axes as unassigned (off), so it is necessary to configure an axis as either stepper or servo before it can be used. The number of servo and stepper hardware channels defines how many axes of each type may be configured. In the following example, the Mint WorkBench Axis Config Wizard will be used to assign axes:

1. In the Toolbox, click the Axis Config icon.

2. For each required axis, click in the Configuration column and select Servo or Stepper from the drop down box.



Axis	Configuration	Hardware Channel
Axis 0	Servo	Servo Channel 0
Axis 1	Servo	Servo Channel 1
Axis 2	Stepper	Stepper Channel 0
Axis 3	Stepper	Stepper Channel 1
Axis 4	Stepper	Stepper Channel 2
Axis 5	Stepper	Stepper Channel 3

   The Axis Config Wizard automatically assigns a Hardware Channel to the axis. For example, Servo Channel 0 indicates the servo axis will use the controller's Demand0 output; Stepper Channel 1 indicates the stepper axis will use the controller's STEP1 and DIR1 outputs. Optionally, the default hardware channel assignment can be altered by clicking in the Hardware Channel column and choosing an alternative channel. This means the axis will no longer use the correspondingly numbered physical outputs (Demand*x* or STEP*x* & DIR*x*), so extra care must be taken when connecting the NextMove ES to drive amplifiers.

3. Click **Finish** to complete the Axis Config Wizard. The axis configuration will be downloaded to the NextMove ES.

Note: If a "Hardware channel required is in use" or "Hardware not available" error message is displayed, the configuration is not downloaded. It is likely that the number of selected servo or stepper axes exceeds the number of physical axes of that type available on the NextMove ES. An error is also caused if the same hardware channel has been selected for more than one servo axis, or for more than one stepper axis.

It is recommended that unused axes are always set to OFF, as this provides more processing time for the axes that are in use. Setting an axis to Virtual means that it can be used to simulate motion within the controller, but uses no physical outputs (hardware channel).

See the Mint help file for details of the `CONFIG` and `AXISCHANNEL` keywords.

6.4.2 Selecting a scale

Mint 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 Mint command that involves distance, speed, or acceleration may need to use a large number to specify a significant move. For example `MOVER(0)=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(0)=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 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**.

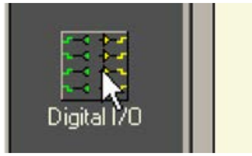
   This immediately sets the scaling factor for the selected axis, which will remain in the NextMove ES until another scale is defined or power is removed from the NextMove ES. See section 6.11 for details about saving configuration parameters.

6.4.3 Setting the drive enable output

A drive enable output allows NextMove ES to enable the external drive 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.

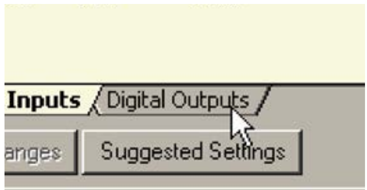
The drive enable output can either be a digital output or the error output (see section 4.4.3). If the NextMove ES is connected to an ABB backplane with opto-isolating card, the error output controls the relay.

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



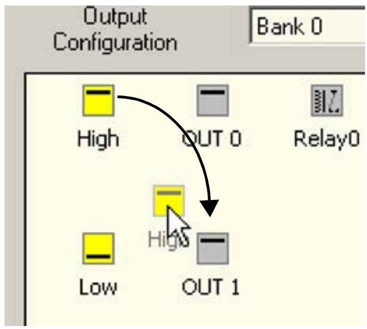
2. At the bottom of the Digital I/O screen, click the **Digital Outputs** tab.

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

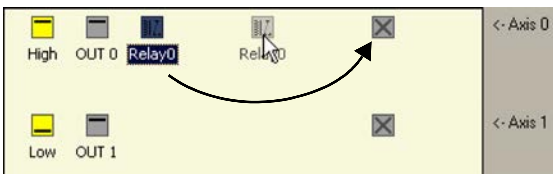


3. If you are going to use the relay, ignore this step and go straight to step 4.

   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.



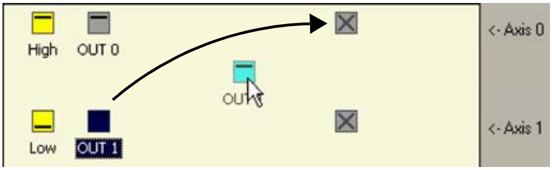
4. If you are going to use the relay, drag the Relay0 icon to the grey Drive Enable OP icon on the right of the screen.



Note: The error output is represented by the Relay0 icon. This is because the error output always controls a relay when the NextMove ES is used in conjunction with an opto-isolating backplane. When the NextMove ES is not used with an opto-isolating backplane, the Relay0 icon still represents the error output.

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

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



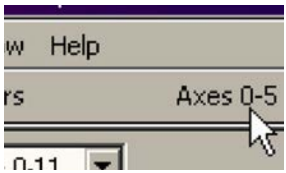
To configure multiple axes with the same drive enable output, repeat this step for the other axes.

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

   See section 6.11 for details about saving configuration parameters.

6.4.4 Testing the drive enable output

1. On the main Mint WorkBench toolbar, click the Axis 0-5 button. In the Select Default Axes dialog, select the axes to be controlled. Click **OK** to close the dialog.



2. On the main Mint WorkBench toolbar, click the Drive enable button. Click the button again. Each time you click the button, the drive enable outputs for the selected axes are toggled.
   When the button is in the pressed (down) position the drive amplifier should be enabled. When the button is in the raised (up) position the drive amplifier should be disabled.

   If this is not working, or the action of the button is reversed, check the electrical connections between the backplane and drive 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 drive amplifier.

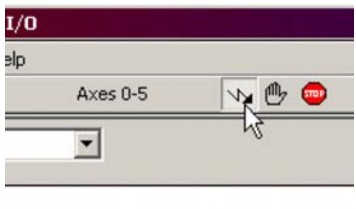
6.5 Servo axis - testing and tuning

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

6.5.1 Testing the demand output

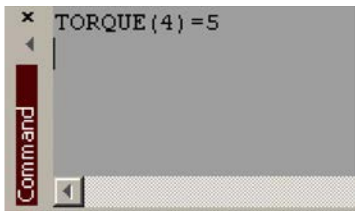
This section tests the operation and direction of the demand output for axis 0. The example assumes that axis 4 has already been configured as a servo axis, using the default hardware channel 0 (see section 6.4.1). It is recommended that the motor is disconnected from the load for this test.

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



2. In the Toolbox, click 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 (0.5 V) to be produced at the DEMAND0 output (backplane connector X7, pin 1). In Mint WorkBench, 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 the backplane.

   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 Mint help file.

   See section 4.3.2 for details of the demand outputs.

5. To repeat the tests for negative (reverse) demands, type:

   ```
   TORQUE(4)=-5
   ```

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

7. To remove the demand and stop the test, type:

   ```
   STOP(4)
   ```

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

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 can be used to invert the demand output voltage. The ENCODERMODE keyword must 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 Mint help file for details of each keyword.

6.5.2 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 6.6.1.

When there is a requirement to move an axis, the NextMove ES control software translates this into a demand output voltage. This is used to control the drive 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 ES 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 ES) is to stay exactly level with* Demand, *looking out of the window to measure your position*].

The main term that the NextMove ES 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 ES 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 1 ms sampling interval can be changed using the `LOOPTIME` keyword to either 2 ms, 500 µs, 200 µs or 100 µs.

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.

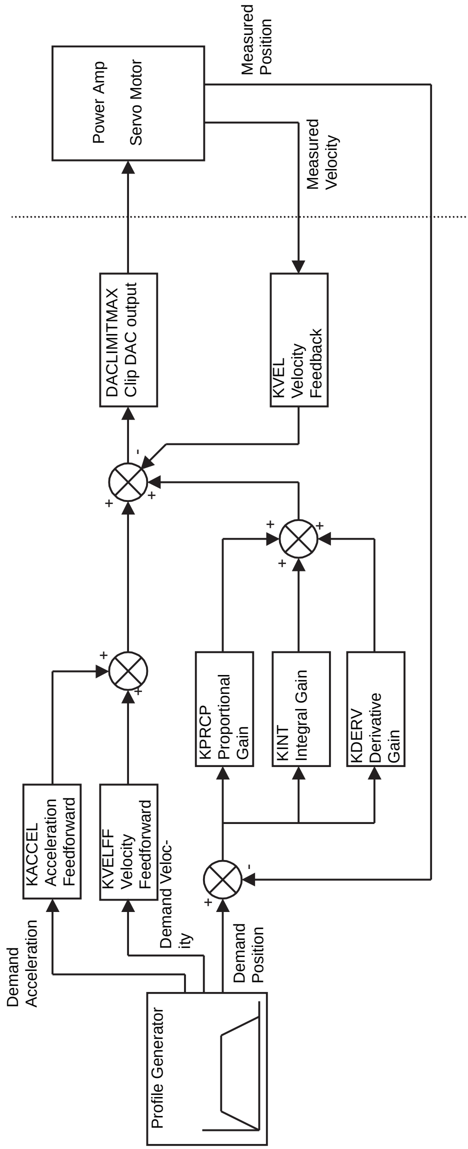


Figure 49: The NextMove ES servo loop

6.6 Servo axis - tuning for current control

6.6.1 Selecting servo loop gains

All servo loop parameters default to zero, meaning that the demand output will be zero at power up. Most drive amplifiers can be set to current (torque) control mode or velocity control mode; check that the drive 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 6.8. 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 drive 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.

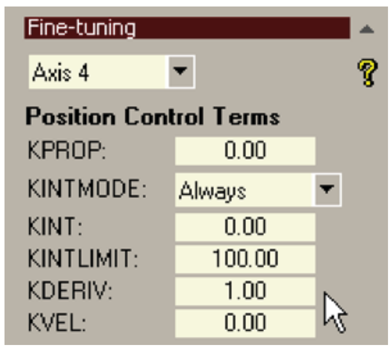
1. In the Toolbox, click the Fine-tuning icon.

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

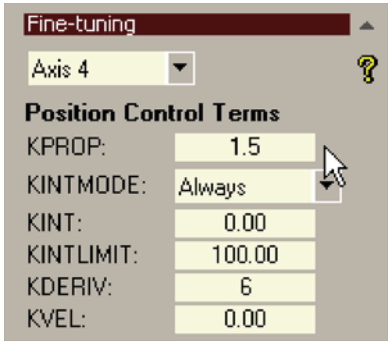
2. In the Fine-tuning window, click in the Axis selection box at the top and select Axis 4 (assuming axis 4 has already been configured as a servo axis - see section 6.4.1).

   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.

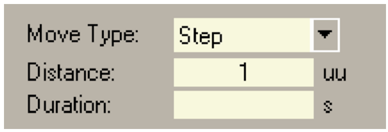


3. Click in the KPROP box and enter a value that is approximately one quarter of the value of KDERIV. If the motor begins to vibrate, decrease the value of KPROP or increase the value of KDERIV until the vibration stops. Small changes may be all that is necessary.



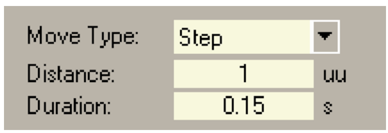
4. In the Move Type drop down box, check that the move type is set to Step.

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.

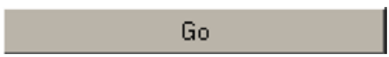


Note: The distance depends on the scale set in section 6.4.2. If you set a scale so that units could be expressed in revolutions (or other unit of your choice), then those are the units that will be used here. If you did not set a scale, the amount you enter will be in encoder counts.

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.



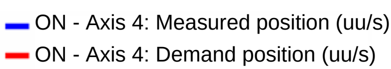
7. Click **Go**.



The NextMove ES will perform the move and the motor will turn. As the soon as the move is completed, Mint WorkBench will upload captured data from the NextMove ES. 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.



6.6.2 Underdamped response

If the graph shows that the response is underdamped (it overshoots the demand, as shown in Figure 50) 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.

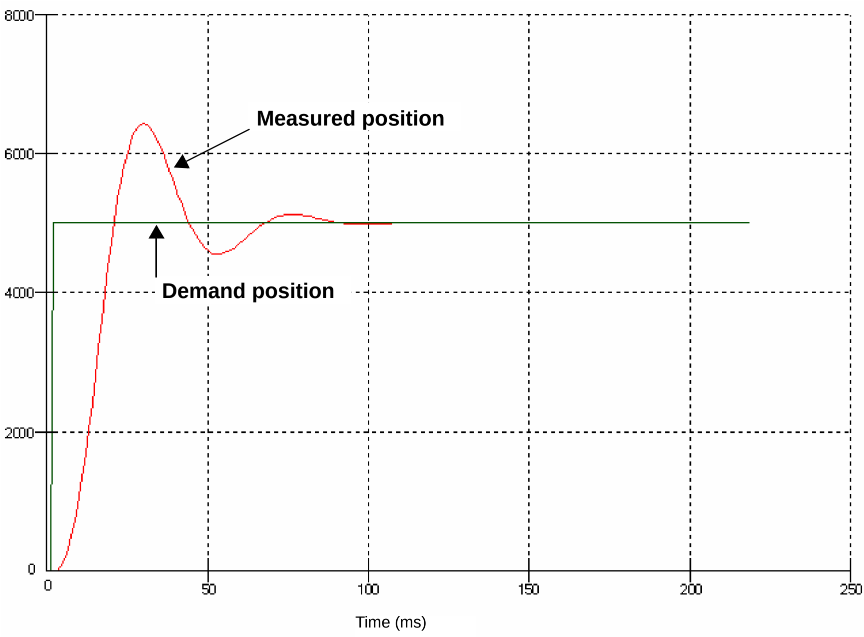


Figure 50: Underdamped response

9. Click in the KDERIV and/or KPROP boxes and make the required changes. The ideal response is shown in section 6.6.4.

6.6.3 Overdamped response

If the graph shows that the response is overdamped (it reaches the demand too slowly, as shown in Figure 51) 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.

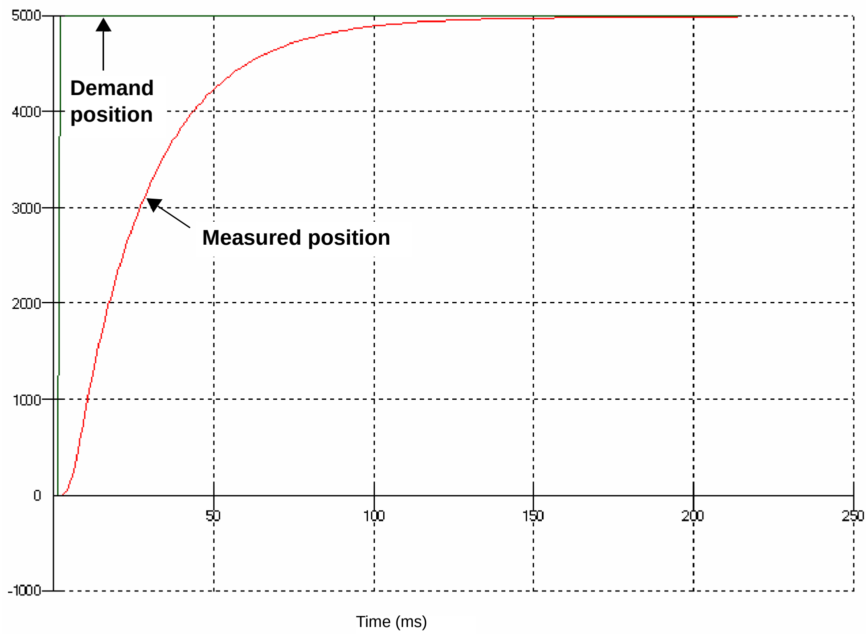


Figure 51: Overdamped response

10. Click in the KDERIV and/or KPROP boxes and make the required changes. The ideal response is shown in section 6.6.4.

6.6.4 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 52.

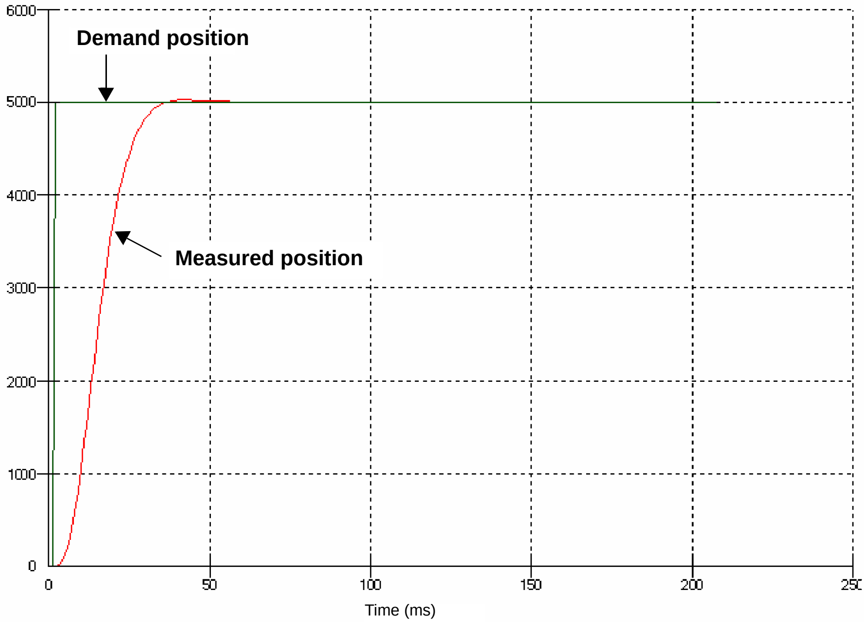


Figure 52: Critically damped (ideal) response

6.7 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 amplifier 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 drive amplifiers 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 ES, 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.

6.8 Servo axis - tuning for velocity control

Drive amplifiers 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 49). 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 drive amplifier have been connected, and that a positive demand causes a positive feedback signal.

6.8.1 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 (+10 V) is applied to the drive amplifier.
- The setting for `LOOPTIME`. The factory preset setting is 1 ms.
- 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 3000 rpm when a maximum demand (+10 V) is applied to the drive amplifier:

   Revolutions per second = 3000 / 60
   = 50

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

   Revolutions per servo loop = 50 x 0.001 seconds
   = 0.05

3. Now calculate how many quadrature encoder counts there are per revolution. The NextMove ES 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
   = 4000

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

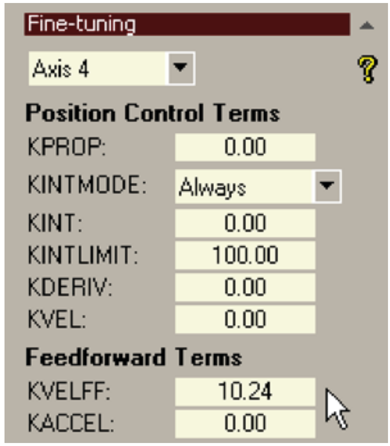
   Quadrature counts per servo loop = 4000 x 0.05
   = 200

The analog demand output is controlled by a 12-bit DAC, which can create output voltages in the range -10 V to +10 V. This means a maximum output of +10 V 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:

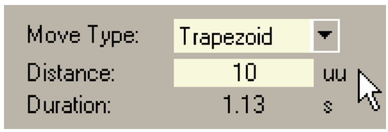
KVELFF = 2048 / 200
= **<u>10.24</u>**

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.



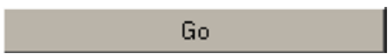
6. In the Move Type drop down box, check that the move type is set to Trapezoid.



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 6.4.2. 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 ES will perform the move and the motor will turn. As the soon as the move is completed, Mint WorkBench will upload captured data from the NextMove ES. 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.

ON - Axis 4: Measured velocity (uu/s)
ON - Axis 4: Demand velocity (uu/s)

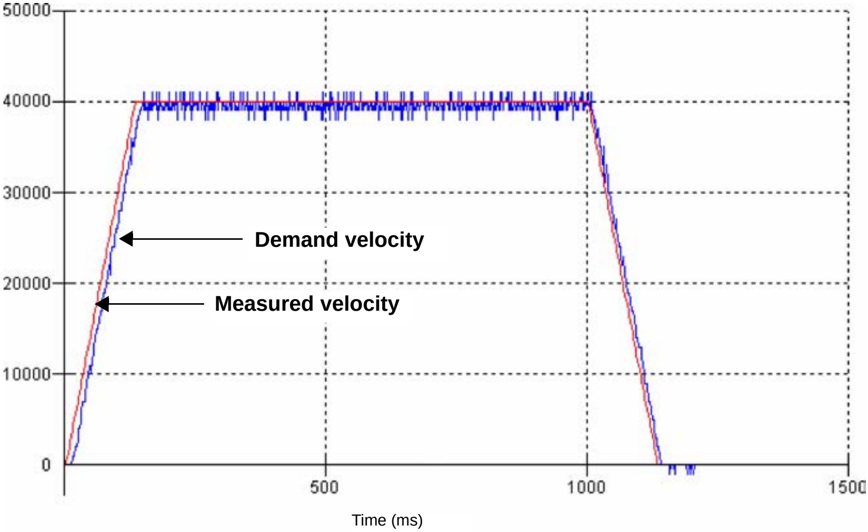


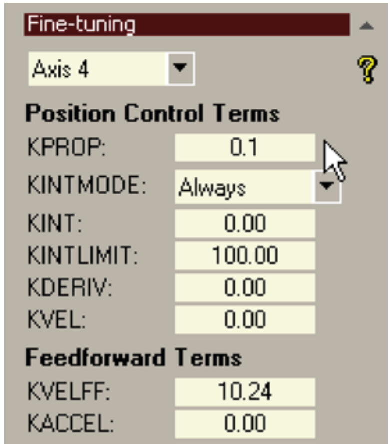
Figure 53: Correct value of KVELFF

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 53.

6.8.2 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.

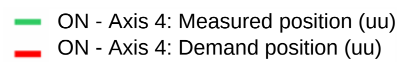


2. Click **Go**.

The NextMove ES will perform the move and the motor will turn. As the soon as the move is completed, Mint WorkBench will upload captured data from the NextMove ES. 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.



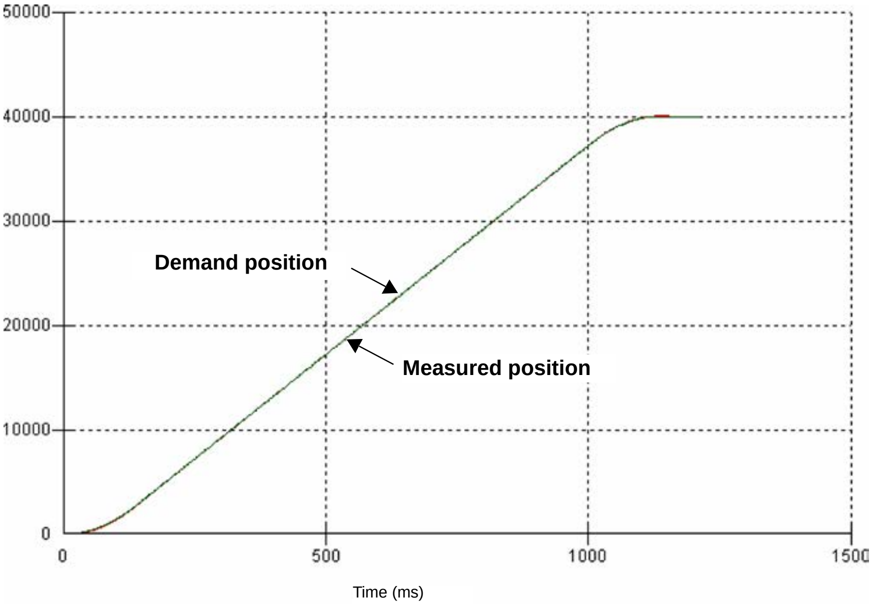


Figure 54: Correct value of KPROP

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 54.

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.

6.9 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.

6.9.1 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).

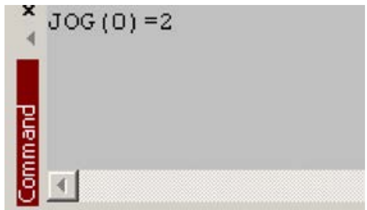
2. In the Toolbox, click the Edit & Debug icon.

3. Click in the Command window.

4. Type:
   `JOG(0)=2`

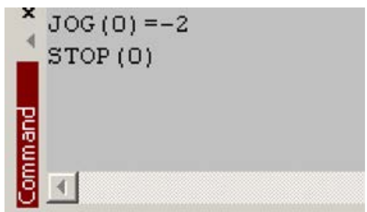
   where 0 is the axis (stepper output) to be tested and 2 is the speed.

   The `JOG` command specifies the speed in user units per second, so the speed is affected by `SCALEFACTOR` (section 6.4.2). 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 6.4.2) `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 the assigned STEP*x* and DIR*x* outputs.



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

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



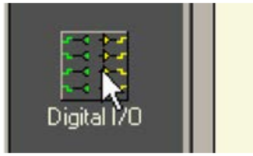
6.10 Digital input/output configuration

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

6.10.1 Digital input configuration

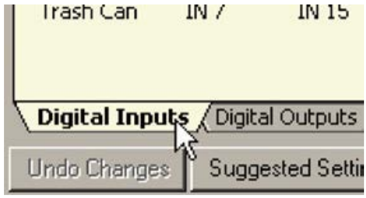
The Digital Inputs tab allows you to define how each digital input will be triggered, and if it should be assigned to a special purpose function such as a Home or Limit input. In the following example, digital input 1 will be set to trigger on an active low input, and allocated to the forward limit input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

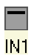
1. In the Toolbox, click the Digital I/O icon.

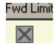


2. At the bottom of the Digital I/O screen, click the **Digital Inputs** tab.

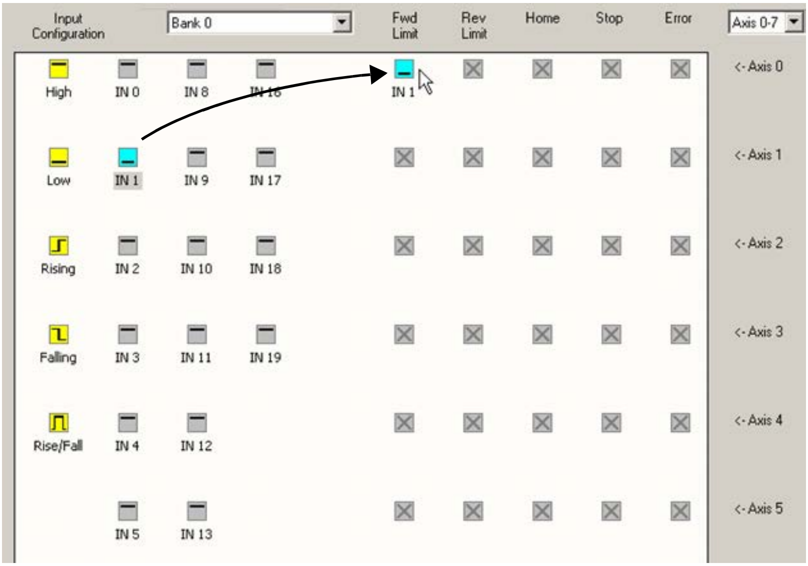
   The left of the screen shows a column of yellow icons - High, Low, Rising, Falling and Rise/Fall. These describe how the input will be triggered.



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 ES.

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

6.10.2 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 6.4.3). Remember to click **Apply** to send the changes to the NextMove ES.

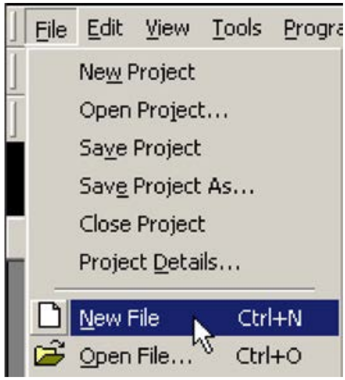
6.11 Saving setup information

When power is removed from the NextMove ES 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**.

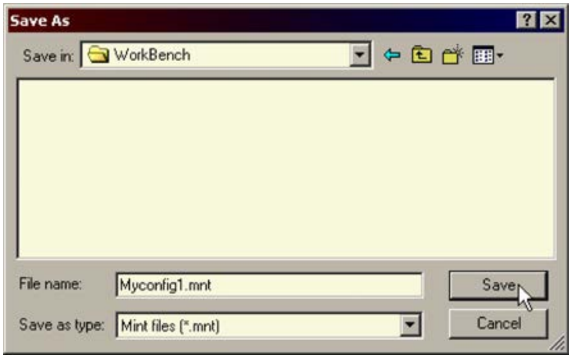
   A new program editing window will appear.



3. On the main menu, choose **Program**, **Generate Mint Startup Block**.

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

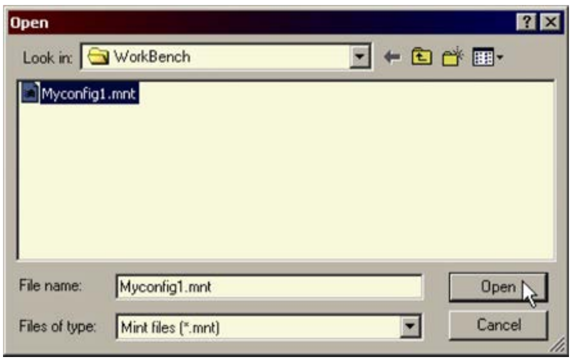
4. On the main menu, choose **File**, **Save File**. Locate a folder, enter a filename and click **Save**.



6.11.1 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 ES will be correctly configured. Remember that every drive/motor combination has a different response. If the same program is used on a different NextMove ES installation, the Startup block will need to be changed.

7.1 Introduction

This section explains common problems and their solutions. If you want to know the meaning of the LED indicators, see section 7.2.

7.1.1 Problem diagnosis

If you have followed all the instructions in this manual in sequence, you should have few problems installing the NextMove ES. If you do have a problem, read this section first.
In Mint WorkBench, 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.

7.1.2 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 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 ES (if known).
- Use the Help, SupportMe menu item in Mint WorkBench to view details about your system.
- The type of drive 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 Mint WorkBench, 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.

7.2 NextMove ES indicators

7.2.1 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 Mint 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.

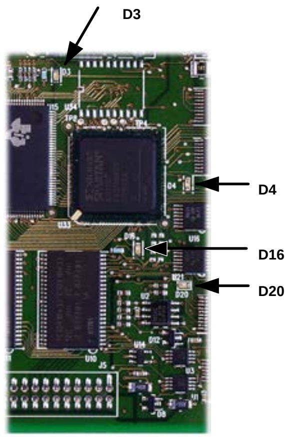
2	Spline. A spline move is being performed. See the SPLINE keyword and related commands.
8	Axis enabled.
9	Torque mode. The NextMove ES is in Torque mode. See the TORQUE keyword and related commands.
A	Hold to Analog. The axis is in Hold To Analog mode. See the HTA keyword and related commands.
d	Follow 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).
ꟻ	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 6.4.4. Click the **Drive enable** button in Mint WorkBench.
=	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 ES.
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 Mint help file for details of each keyword.

7.2.2 Surface mount LEDs D3, D4, D16 and D20

The NextMove ES card contains a number of surface mount LEDs that indicate hardware status:



D3 (yellow):
Indicates that the FPGA is being initialized at startup. If this LED remains illuminated after power up, download a system file (which includes FPGA firmware) from Mint WorkBench.

D4 (red):
Indicates that the card is in a hardware reset. If this LED remains illuminated after power up, the supply voltage to the card is too low. Check power supply connections.

D16 (flashing green):
Flashes at 0.5 Hz to indicate normal operation. If this LED stops flashing, the firmware has stopped running. Power cycle the card to cause a reset.

D20 (flashing orange during serial communication)
Indicates that the card is performing serial communication. If this LED fails to illuminate, download a system file (which includes communications firmware) from Mint WorkBench.

7.2.3 Communication

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

Symptom	Check
Cannot detect NextMove ES	Check that the NextMove ES 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 the USB connector socket pins for damage or sticking. Check that the USB device driver has been installed; a “USB Motion Controller” device should be listed in Windows Device Manager.
Cannot communicate with the controller.	Verify that Mint WorkBench is loaded and that NextMove ES is the currently selected controller.
Cannot communicate with the controller after downloading firmware.	After firmware download, always power cycle the controller (remove 24 V power and then reconnect).

7.2.4 Motor control

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

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 Mint WorkBench to perform the basic system tests (see section 6.5 or 6.9). Confirm that the drive enable output has been configured (see section 6.4.3). Ensure that while the NextMove ES is not in error the drive is enabled and working. When the NextMove ES 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 6.5.2 to 6.7.

Symptom	Check
Motor runs uncontrollably when controller is switched on.	Verify that the NextMove ES 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 section 5.2.12) and is functioning correctly. Check that the drive is connected correctly to the NextMove ES and that with zero demand there is 0 V at the drive's demand input. See section 6.5.1.
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` to zero.
Motor is under control, but vibrates or overshoots during a move.	(*Servo outputs only*) Servo loop gains may be set incorrectly. See sections 6.5.2 to 6.7.
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 backplane and drive are correctly grounded to a common ground point. *(Servo outputs only)* Using an oscilloscope at the backplane connectors, 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 ES end. (*Stepper outputs only*) The motor is not maintaining synchronization with the NextMove ES 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.

7.2.5 Mint WorkBench

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 (500 ms is recommended).
Firmware download fails	Confirm that you have the correct version of firmware. Attempting to download certain older versions of firmware (intended for models without USB), will cause the download to fail. Download the latest version of firmware.
Cannot communicate with the controller after downloading firmware.	After firmware download, always power cycle the controller (remove 24 V power and then reconnect).
Mint WorkBench loses contact with NextMove ES while connected using USB	Check that the NextMove ES is powered. Check that a “USB Motion Controller” device is listed in Windows Device Manager. If not, there could be a problem with the PC's USB interface.

7.2.6 CANopen

Symptom	Check
The CANopen bus is ‘passive’	This means that the internal CAN controller in the NextMove ES is experiencing a number of Tx and/or Rx errors, greater than the passive threshold of 127. Check: ■ 12-24 V 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 ES should recover from the ‘passive’ state once the problem has been rectified (this may take several seconds).

Symptom	Check
The CANopen bus is 'off'	This means that the internal CAN controller in the NextMove ES has experienced 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: ■ 12-24 V 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 Mint `BUSRESET` keyword, or by resetting the NextMove ES.
The Manager node cannot scan/ recognize a node on the network using the Mint `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 Mint `NODESCAN` keyword. ■ Check that the node in question has been assigned a unique node ID. ■ The node must support the node guarding process. NextMove ES 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 an ABB CANopen node, communication is still possible using a set of general purpose Mint keywords. See the Mint 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. ■ ABB controller nodes are automatically connected to after being scanned. ■ Nodes that conform to DS401, DS403 must have the connections made manually using the Mint `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.

7.2.7 Baldor CAN

Symptom	Check
The Baldor CAN bus is ‘passive’	This means that the internal CAN controller in the NextMove ES is experiencing a number of Tx and/or Rx errors, greater than the passive threshold of 127. Check: ■ 12-24 V 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 ES 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 ES has experienced 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: ■ 12-24 V 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 Mint BUSRESET keyword, or by resetting the NextMove ES.

8.1 Introduction

This section provides technical specifications of the NextMove ES card. Separate specifications for the optional opto-isolating backplanes are shown where necessary.

8.1.1 Input power

Description	**Value**
Input power	+5 V (±2.5%), 1 A +12 V (±5%), 50 mA -12 V (±5%), 50 mA

8.1.2 Analog inputs

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

8.1.3 Analog outputs

Description	**Unit**	**Value**
Type		Bipolar
Output voltage range	**V DC**	±10
Output current (per output)	**mA**	2.5
Output DAC resolution	**bits**	12
Equivalent resolution	**mV**	±4.9
Update interval	**μs**	100 - 2000 (same as `LOOPTIME`; default = 1000)

8.1.4 Digital inputs (non-isolated)

Description	Unit	Value
Type		+5 V inputs, non-isolated
Input voltage Maximum Minimum High Low	**V DC**	 5.5 0 >3.5 V <1.5 V
Input current (approximate, per input)	**mA**	0.5
Sampling interval	**ms**	1

8.1.5 Digital inputs (opto-isolated)

This specification is for the optional opto-isolating backplanes BPL010-502 or BPL010-503, when used in conjunction with the NextMove ES card.

Description	Unit	Value
Type		Opto-isolated
USR V+ supply voltage Maximum Minimum	**V DC**	 30 12
Input voltage BPL010-502 ‘active high’ inputs BPL010-503 ‘active low’ inputs	**V DC**	 Active: >12 V Inactive: <2 V Active: 0 V Inactive: Unconnected
Input current (maximum per input, USR V+ = 24 V)	**mA**	10

8.1.6 Digital outputs - general purpose (non-isolated)

This specification is for the NextMove ES card when used separately or in conjunction with the optional non-isolating backplane BPL010-501:

Description	Unit	Value	
Load supply voltage (maximum)	**V**	50	
Output current	**mA**	DOUT0-7	DOUT8-11
Max. sink per output, one output on		500	500
Max. sink per output, all outputs on		150	50
Update interval		Immediate	

8.1.7 Digital outputs - general purpose (opto-isolated)

This specification is for the optional opto-isolating backplanes BPL010-502 or BPL010-503, when used in conjunction with the NextMove ES card.

Description	Unit	Value	
USR V+ supply voltage			
Maximum	**V DC**	30 V	
Minimum		12 V	
Output current (BPL010-502)	**mA**	DOUT0-7	DOUT8-11
Max. source per output, one output on		350	400
Max. source per output, all outputs on		75	50
Output current (BPL010-503)	**mA**	DOUT0-7	DOUT8-11
Max. sink per output, one output on		500	400
Max. sink per output, all outputs on		150	50
Update interval		Immediate	
Switching time			
No load on output		100 ms	
With 7 mA or greater load		10 μs	

8.1.8 Digital output - error output (non-isolated)

This specification is for the NextMove ES card when used separately or in conjunction with the optional non-isolating backplane BPL010-501:

Description	Unit	Value
Output voltage	**V**	5
Output current (maximum)	**mA**	100
Update interval		Immediate

8.1.9 Error relay (opto-isolated backplanes)

This specification is for the optional opto-isolating backplanes BPL010-502 or BPL010-503, when used in conjunction with the NextMove ES card. See sections 4.4.3 and 5.3.1.1.

All models	**Unit**	**All models**
Contact rating (resistive)		2 A @ 28 V DC or 0.5 A @ 125 V AC
Operating time (max)	**ms**	6

8.1.10 Encoder inputs

Description	**Unit**	**Value**
Encoder input		RS422 A/B Differential, Z index
Maximum input frequency (quadrature)	**MHz**	20
Output power supply to encoders		5 V, 500 mA max. (total for both encoders)
Maximum recommended cable length		30.5 m (100 ft)

8.1.11 Stepper control outputs

Description	**Unit**	**Value**
Output type		RS422 step (pulse) and direction
Maximum output frequency	**kHz**	500
Output current (maximum sink, per output)	**mA**	100

8.1.12 Serial RS232/RS485 port

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

8.1.13 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

8.1.14 Environmental

Description	Unit	Value	
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	
Shock		10 G according to DIN IEC 68-2-6/29 or equivalent	
Vibration		1 G, 10-150 Hz according to DIN IEC 68-2-6/29 or equivalent	

See also section 3.1.1.

8.1.15 Weights and dimensions

Description	Unit	Value
Weight		Approximately 140 g (0.3 lb)
Nominal overall dimensions		160 mm x 100 mm (6.3 in x 3.937 in)

A.1 Feedback cables

The cables listed in Table 5 connect the ‘Encoder Out’ signal from a drive amplifier (for example MicroFlex, FlexDrive^{II}, Flex+Drive^{II} or MintDrive^{II}) to the ‘Encoder In’ connector on the NextMove ES backplane. One cable is required for each servo axis. See sections 5.2.12, 5.2.13, 5.3.12 and 5.3.13 for the connector pin configuration.

Cable assembly description	Part	Length	
		m	ft
Drive Amplifier to NextMove ESB Feedback Cable, with 9-pin D-type male connectors at both ends (one male, one female)	CBL005MF-E3B	0.5	1.6
	CBL010MF-E3B	1	3.3
	CBL015MF-E3B	1.5	5
	CBL020MF-E3B	2.0	6.6
	CBL030MF-E3B	3.0	9.8
	CBL040MF-E3B	4.0	13.1
	CBL050MF-E3B	5.0	16.4

Table 5: Drive amplifier to NextMove ES feedback cables

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

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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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