ServoNode 51

Installation Guide

MN1285

Issue 2.1

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Mint
THE MOTION LANGUAGE

Limited Warranty

For a period of two (2) years from the date of original purchase, BALDOR will repair or replace without charge controls which our examination proves to be defective in material or workmanship. This warranty is valid if the unit has not been tampered with by unauthorized persons, misused, abused, or improperly installed and has been used in accordance with the instructions and/or ratings supplied. This warranty is in lieu of any other warranty or guarantee expressed or implied. BALDOR shall not be held responsible for any expense (including installation and removal), inconvenience, or consequential damage, including injury to any person or property caused by items of our manufacture or sale. (Some states do not allow exclusion or limitation of incidental or consequential damages, so the above exclusion may not apply.) In any event, BALDOR's total liability, under all circumstances, shall not exceed the full purchase price of the control. Claims for purchase price refunds, repairs, or replacements must be referred to BALDOR with all pertinent data as to the defect, the date purchased, the task performed by the control, and the problem encountered. No liability is assumed for expendable items such as fuses.
Goods may be returned only with written notification including a BALDOR Return Authorization Number and any return shipments must be prepaid.

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Safety Notice: **Only qualified personnel should attempt the start-up procedure 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. Only qualified personnel should attempt to start-up, program or troubleshoot this equipment.

Precautions:

WARNING: Do not touch any circuit board, power device or electrical connection before you first ensure that no high voltage 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 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. Only qualified personnel should attempt to program, start-up or troubleshoot this equipment.

WARNING: Be sure that you are completely familiar with the safe 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 programming of this equipment can cause serious or fatal injury. Only qualified personnel should attempt to program, start-up or troubleshoot this equipment.

WARNING: Be sure all wiring complies with the National Electrical Code and all regional and local codes. Improper wiring may result in unsafe conditions.

WARNING: **The stop input to this equipment should not be used as the single means of achieving a safety critical stop. Drive disable, motor disconnect, motor brake and other means should be used as appropriate. Only qualified personnel should attempt to program, start-up or troubleshoot this equipment.**

WARNING: **Improper operation or programming of the control 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.**

WARNING: **The motor shaft may rotate during the homing or datuming procedure. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment.**

CAUTION: **To prevent equipment damage, be certain that the input power has correctly sized protective devices installed.**

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 controller are shielded correctly.**

CAUTION: **Avoid locating this equipment above or beside heat generating equipment or below water steam pipes.**

CAUTION: **Avoid locating this equipment in the vicinity of corrosive substances or vapors, metal particles and dust.**

Manual Revision History

Issue	Date	BOCL Reference	Comments
1.0	Aug 99	UM00553-000	• First draft
1.1	Jan 00	UM00553-000	• Second draft
1.2	Jan 00	UM00553-001	• Add CE wiring details
1.3	May 00	UM00553-001	• Correct Fig 5 mounting drawing
2.0	July 00	UM00553-002	• Revision following review
2.1	August 00	UM00553-002	• Revision following second review

Introduction

1

ServoNode 51 is an single axis integrated servo drive, programmable in Mint™ to provide position, speed or torque control and with onboard CAN bus.

This chapter details instructions on receiving the ServoNode 51 and provides an overview of the ServoNode 51 hardware and software features, along with general product information and optional expansion peripherals.

1.1 Receiving and Inspection

ServoNode 51 has been thoroughly tested at the factory and carefully packaged for shipment. When you receive your ServoNode 51, there are several things you should do immediately:

1. Observe the condition of the shipping container and report any damage immediately to the commercial carrier that delivered your ServoNode 51.
2. Remove ServoNode 51 from the shipping container and remove all packing material. The container and packing materials may be retained for future shipment.
3. Verify that the catalog number of the ServoNode 51 you received is the same as the catalog number listed on your purchase order. The part number is described in the next section.
4. Inspect ServoNode 51for external physical damage that may have been sustained during shipment and report any damage to the commercial carrier that delivered your ServoNode.
5. If ServoNode 51 is to be stored for several weeks before use, be sure that it is stored in a location that conforms to published storage humidity and temperature specifications.
6. Additionally in your box you should have found:
   This installation manual
   CD-ROM at the back of this manual. The package should read Baldor Motion Toolkit.
   The Mint version 4 Programming Guide (MN1262)
7. If the above components have not been enclosed in your package, please consult your supplier as soon as possible.

1.1.1 Obtaining your Product Code/Catalog Number

The first task is to identify your ServoNode 51. This is done via the *product catalog number*, which every ServoNode 51 has marked on a silver label on the side of the unit.

✎ Before proceeding, locate your catalog number and write it down at the back of this manual.

You can now use this code to determine the following:

- The hardware features of your particular ServoNode 51 variant.
- The physical parts you should find in your box on opening your packaging.

The *catalog number* reflects the functionality of your ServoNode 51. This code is synonomous with the term *product order code.*

In the unlikely event that the ServoNode 51 you received does not correspond to the one you ordered, please contact your supplier before continuing.

1.2 Hardware and Software Overview

Figure 1: Photograph of ServoNode 51

Baldor's ServoNode 51integrates a motion controller and brushless servo amplifier into a single, compact package. This provides a flexible and powerful motion control solution for almost any single axis positioning system. Using the onboard CAN bus, multiple drives can be connected together for loosely coupled multi-axis systems.

Hardware and software features include:

- 1 axis of coordinated motion.
- 5A continuous, 10A Peak current, 140Vdc Bus.
- Separate Controller and Motor dc power connections.
- Programmable in Mint™.
- A single CAN bus interface for distributing I/O and operator interfaces, running CANopen protocol for peer-to-peer communications with other Mint controllers.
- RS232 serial communications.
- Point to point moves and software cams and gearing.
- 6 optically isolated configurable digital inputs.
- 3 optically isolated digital outputs.
- 1 set of relay outputs.
- 1 general purpose analog input.
- 2 general purpose analog outputs.
- A single high speed position latch input
- An auxiliary encoder fast position latch
- Auxiliary encoder (hand-wheel) input for following; for example software gearbox or Cams
- 64Kbyte Flash Program and 8Kbyte Flash Configuration Buffers
- Non-volatile back-up for RAM Array Data Store
- Commutating encoder feedback
- Protection includes over current, over temperature, under voltage

ServoNode 51 will operate with a large number of brushless servo motors. For information on selecting Baldor servo motors, please refer to Baldor sales catalog IBR1202.

1.2.1 The Mint™ v4 Programming Language

The Mint™ Programming Language is used to program the ServoNode. The language is a structured form of Basic which has been custom designed for motion control applications. The Mint™ language is designed for getting started quickly with motion control programs, while providing a wide range of more powerful commands for complex applications. Programming is made quick and simple by software supplied with your ServoNode. Mint™ is used within thousands of applications worldwide, servicing many high demand industries such as textiles and packaging. Applications range from simple single axis applications to complex multi-axis, multi-controller applications. These are the reasons why Mint's flexible and powerful command set and extensive features provide solutions to a vast number of industrial motion control challenges.

Example Applications:

- Packaging machines
- Multi-axis screen/shield printers
- Milling machines and lathes
- Print registration
- High precision test machines and automation
- Spin welding
- Textile robots
- Converting
- Robotics

General Mint Features:

- Easy to use Basic like motion control language compatible with other Mint based controllers.
- Support for a single axis of control or loosely coupled multi-axis control using the CAN bus network.
- Basic type programming language with commands such as **`PRINT, IF..THEN`** and **`FOR..NEXT`**
- Variable definitions where each variable can be given a meaningful name of up to 10 characters in length.
- Support for array variables.
- Subroutines are referenced by name rather than by a line number. A name can be up to 10 characters in length
- In addition to usual Basic type commands such as **`PRINT, FOR..NEXT`** and **`IF..THEN`**, Mint has a number of keywords dedicated to Motion Control and input/output (I/O). Keywords are provided for:

Speed and positional control.

Encoder following or hand-wheel functionality.

Motion Profiles such as Cam Profiling and Flying Shears.

Full control over basic motor control parameters such as the servo loop, in addition to all the digital and analog I/O on the controller.

- Trapezoidal profiles with separate acceleration and deceleration.
- Many move types including: speed control, positional control, torque control, cam profiles, flying shears, software gearboxes.
- Extensive support for terminal I/O both over the serial and CAN based operator panel known as *Keypad*Node.
- Extensive support for digital and analog I/O including the ability to generate interrupts on digital inputs.

- Error recovery from position errors, end of travel limits and external errors.
- Protected communications over single point RS232 or multi-drop RS485 links allowing data transfer to an executing program.
- Support for the open CAN bus standard **CANopen** giving the following features:

  Peer to peer capability allowing MintDrives to communicate with each other, sending data or receiving data from other nodes. Third party CAN I/O node support such as digital and analog I/O.

In addition to the motion control features, Mint provides sophisticated keywords for controlling terminal output. Keywords are available for locating the cursor on the screen, for printing messages and for formatting input and output. With the CAN Operator Panel, *Keypad*Node, it is even possible to use Mint to detect when a key is pressed. This is beneficial for operator jog control.

All keywords referred to in this manual are fully detailed in the *Mint version 4 Programming Guide* [1] (order code MN1262).

1.2.2 The Baldor Motion Toolkit

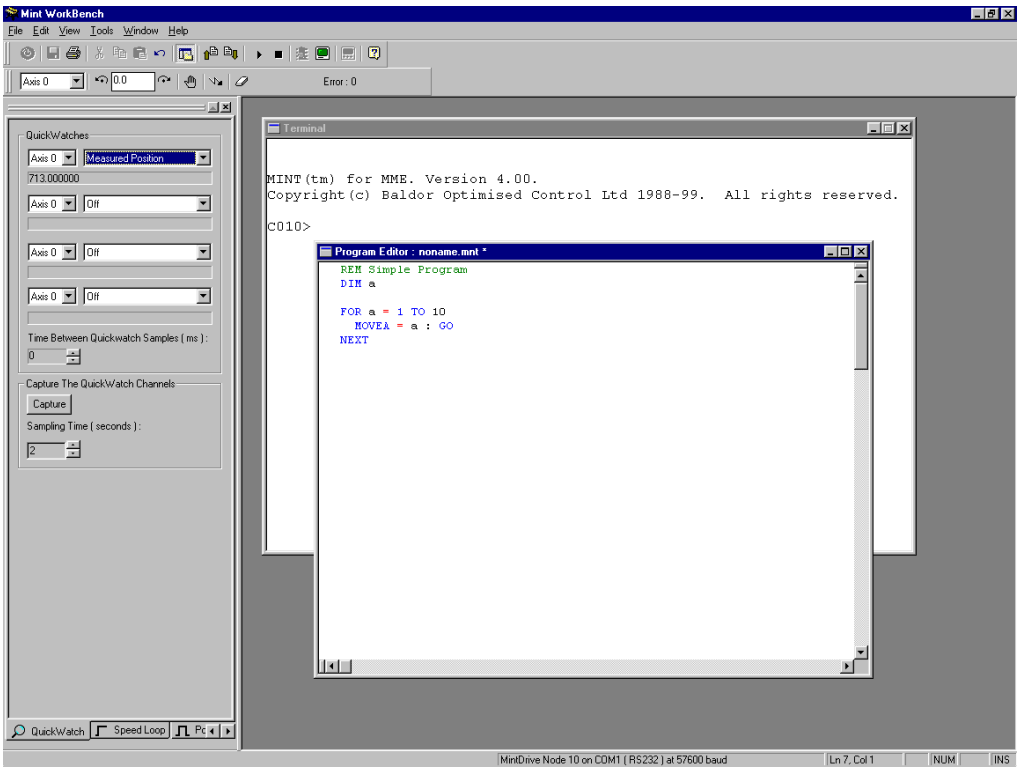


Figure 2: Mint WorkBench

You can find the Baldor Motion Toolkit CD-ROM adhered to the inside cover of this manual. When installed, the software provides you with tools (Mint WorkBench) and example programs to help you get up and running with ServoNode 51.

The Mint WorkBench features include:

- Configuration Tools.
- Terminal Emulator
- An editor for Program Buffer and Configuration Buffer with file upload/download.
- Routines for capturing and viewing velocity or following error.
- A Protected Communications Protocol watch window.
- Squash. A utility saving program buffer space by abbreviating source code.
- Full details can be found in section 6.

1.2.3 Optional CAN I/O Expansion

Digital I/O can be expanded easily on ServoNode 51 using the CAN Bus Interface. ServoNode 51 has a single CAN port, offering support for the open CAN protocol standard **CAN**open.

Utilizing a proprietary **CAN**open profile, a full peer-to-peer network can be achieved, allowing Mint nodes to communicate with each other over the bus. This is discussed in more detail in the Mint version 4 Advanced Programming Guide [3].
Supporting the standard **CAN**open I/O profile DS401 (as a master), a number of third party I/O devices can be connected to the ServoNode 51. These include both digital and analog I/O. Contact your local Baldor sales office for more details on supported devices.

Ordering Information for CANopen Accessories:

Item	Catalog Number	Description
CAN Tee Converter	OPT 031-501	RJ45 (BOCL CAN) to dual 9-way male D-type (**CAN**open)

Table 3: CANopen Accessories catalog numbers

1.3 Key to Icons

Whenever this screwdriver accompanies an instruction, it will be necessary for you to make a physical connection to the ServoNode 51 using the screw terminations on the front panel of the controller.

The pencil indicates that you might wish to write particular information down at the back of this manual, or somewhere convenient to you. Notes pages are provided at the back of this manual.

[ ] Right-angle brackets denote a key that needs to be pressed, for example:
`[Ctrl]+[E]` **indicates that you should type** `Ctrl` **and** `E` **at the same time.**

Installation

2

It is important that the correct steps are followed when installing ServoNode 51 to ensure safe and trouble free operation. This chapter covers the installation of ServoNode 51.

- ◊ Location Considerations
- ◊ Dimensions and Mounting
- ◊ User Connections and System Wiring

2.1 Location Considerations

The location of the ServoNode 51 is important. Installation should be in an area that is protected from corrosives, harmful gases or liquids, dust, metallic particles, flammable gases or vapors and vibration. Exposure to any of these can reduce operating life and degrade performance of control.

Several other factors should be carefully evaluated when selecting a location for installation:

- The ServoNode 51 should be permanently fixed, and located, so that it is not normally accessible by the operator, and can only be accessed by service personnel using tools.
- **Altitude De-rating.** Up to 1000m (3300ft) no de-rating required. De-rate the continuous and peak output current by 2% per 300m (1000ft) above 1000m.
- **Temperature de-rating.** From 0°C to 40°C ambient no de-rating required. De-rate the continuous and peak current by 2.5% per 1°C above 40°C Maximum ambient temperature is 50°C.
- **Humidity.** Maximum relative humidity levels of 80% for temperatures up to 31°C decreasingly linear to maximum 50% relative humidity at 40°C (non-condensing).
- Pollution degree according to IEC664 should not exceed 2.
- There shall not be abnormal levels of nuclear radiation or X-rays.
- For effective cooling, the ServoNode 51 should be mounted upright on a smooth, non-flammable vertical surface[1] with at least 50mm top and bottom clearance for airflow. Where possible the unit should be mounted with the larger mounting surface to a metal backplate. Provide at least 15mm between units or adjacent equipment.
- When mounted within an enclosure, it is advised that forced ventilation be provided.

2.2 Dimensions and Mounting

Provision for mounting is provided via M5 slots on two surfaces on the top and bottom of the unit, as illustrated in Figure 3.

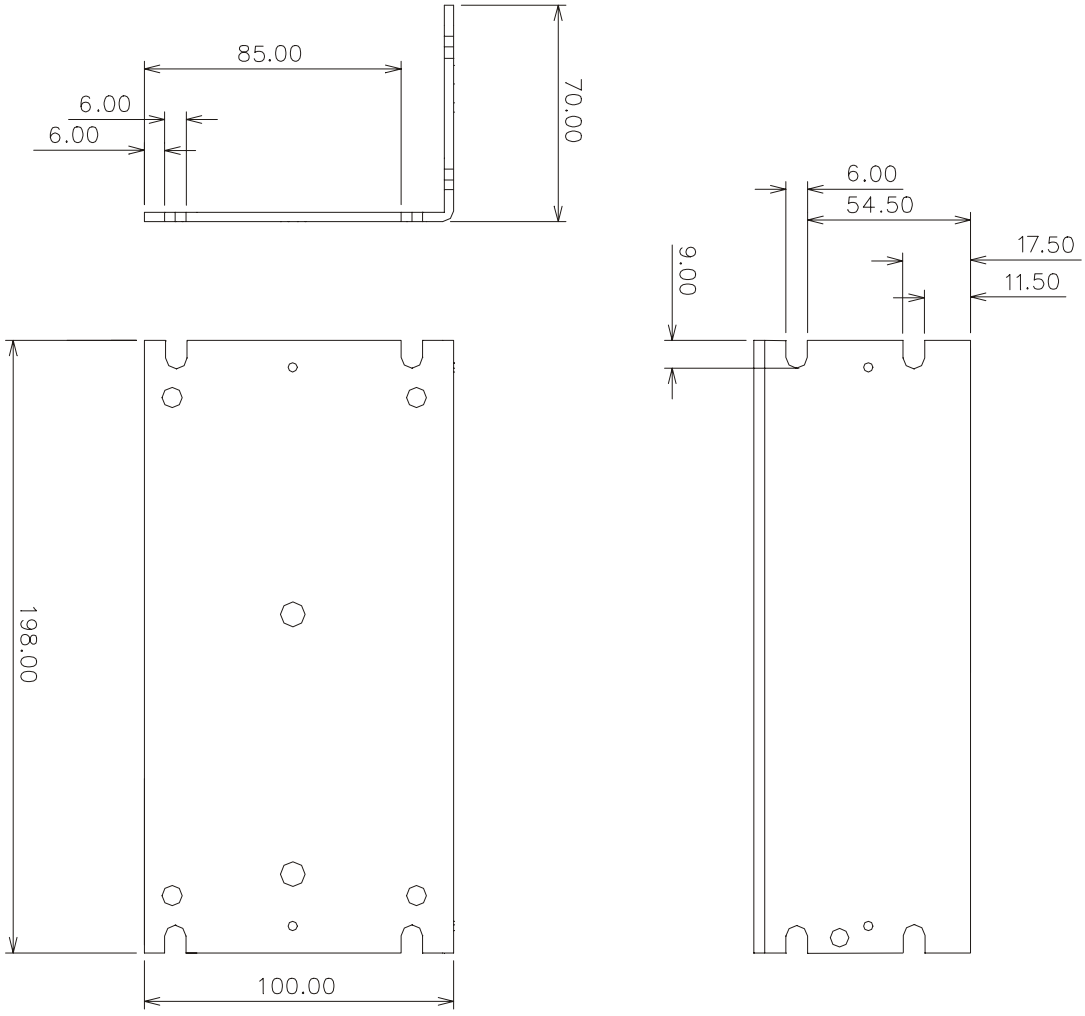
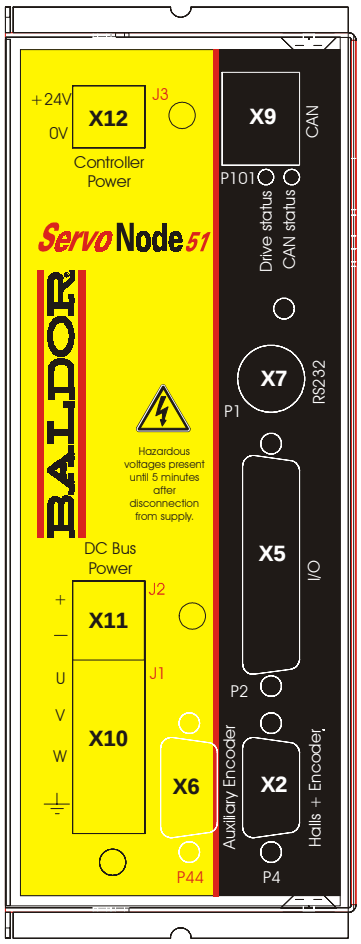


Figure 3: Dimensions and mounting data

2.3 User Connections

The following diagram details the User connections for the ServoNode 5.



J3/X12: Controller Power Connector (2 pin 5.08mm Wago, male)
+24Vdc
0V (24V return)

J2/X11: Motor Power Connector (2 pin 7.62mm Wago, male)
\+ Motor power
\- Motor power return

J1/X10: Motor Connector Block: (4 pin 7.62mm Wago, male)

U	- Motor lead U	Motor phases
V	- Motor lead V	
W	- Motor lead W	
Earth		

Earth stud - Protective Earth

KEY:

!	Complement
+	Positive
-	Negative
Opt	Optional connection
N.C.	Do not connect
GND	Ground

P44/X6: Auxiliary/Master Encoder Input (9 pin D-type, female)

1 +5V	6 !CHZ
2 CHZ	7 GND
3 !CHB	8 CHB
4 Chassis	9 !CHA

P101/X9: CAN Bus Port (RJ45, female)

1 N.C.	5 CAN PWR 12-24V
2 N.C.	6 N.C.
3 N.C.	7 CAN+
4 CAN-OV	8 CAN-

P1/X7: RS232 (8 pin mini-DIN, female)

1 RXD	5 RXD
2 CTS	6 +5V
3 TXD	7 RTS
4 0V Signal Ground	8 TXD

P2/X5: Auxiliary I/O (25 pin D-type, female)

1 DIN0/FASTIN[1]	14 DIN1
2 DIN2/AUX FASTIN[2]	15 DIN3
3 DIN4	16 DIN5
4 USER-COM	17 USER-COM
5 USER-COM	18 COM
6 COM	19 AOUT0
7 AOUT1	20 GND
8 AIN0+	21 AIN0-
9 RLY-NC	22 RLY-DIO
10 RLY-NO	23 DOUT3
11 DOUT2	24 DOUT1
12 RLY-COM	25 USR-V+
13 USR-GND	

P4/X2: Halls & Encoder (15 way hi density D-type, female)

1 CHA	9 HALL W+
2 CHB	10 HALL V+
3 CHZ (index)	11 +5V
4 HALL U+	12 N.C.
5 HALL U-	13 DGND
6 !CHA	14 HALL W-
7 !CHB	15 HALL V-
8 !CHZ (index)	

Notes:
1 DIN0 can be configured to latch the axis position or auxiliary encoder position.
2 DIN2 can be configured to latch the auxiliary encoder position.
3 Alternative connector idents with X prefix are given.

Figure 4: ServoNode 51 Connections

2.4 Power Supply Requirements

Controller Power Input:	Nominal 24Vdc (+18Vdc to +30Vdc), 1.0A capability This supply is deemed SELV
Motor Power Supply Input:	15Vdc -140Vdc (absolute max), 5A continuous, 10A peak This supply is deemed HAZARDOUS and must be installation over-voltage category II or less
Earth connection:	An connection between the HAZARDOUS source and the EARTH terminal on the Motor Connector must be made

Table 1: ServoNode 51 Power Supply Requirements

WARNING

Applying voltages greater than the maximum specified, will seriously damage your ServoNode 51. The working voltage given includes any voltages due to regeneration.

A separate 24Vdc power supply is required for the digital outputs and the digital inputs. This is referred to as the User Voltage. In order not to bridge the user I/O opto-isolation, this voltage must be sourced from a separate supply from that used for the ServoNode 51 control logic. These voltages must be declared as a SELV.

Power supply filters are required (see section 2.5.2.1) in order to comply with the CE directive to which the ServoNode 51 was tested. These should be fitted in both the Controller and Motor power feeds, mounted close to the ServoNode 51 and connected to protective earth.

2.5 System Wiring

⚠ **WARNING: Do not touch any power device or electrical connection before you first ensure that power can been disconnected and there is no high voltage present from this equipment or other equipment to which it is connected. Electrical shock can cause serious or fatal injury.**

2.5.1 Motor power and Phases

Motor power and phases are connected via the connectors J2/X11 and J1/X10 respectively. In order to maintain an Earth connection when the DC bus is applied, a single 6 way 7.62mm pitch Wago mating connector should be used. **Note**; a single connector for J1 and J2 rather than separate connectors. This is to ensure that power is removed from the unit when the motor terminals are exposed.

The protective earth stud should be bonded to a safety earth on the enclosure chassis by a conductor of at least three times the peak current rating.

To comply with CE directive 89/336/EEC appropriate filters must be installed. See section 2.5.2.1.

The motor power stage is internally fused and therefore self protected.

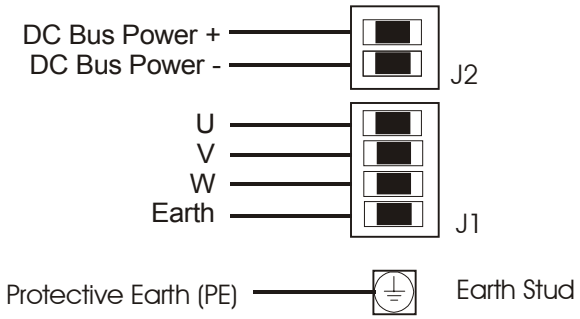


Figure 5: Motor power and phase connections

2.5.1.1 J1 Motor Power Output

Figure 6 shows the recommended wiring configuration for a ServoNode 51 and a brushless motor. In order to comply with CE requirements the motor cable should be screened, with the screen connection made to unit chassis via the M3 nut-sert on the connector face. The length of screw fixings entering the enclosure **MUST NOT** exceed 10mm. The recommended screw size is M3x10mm. This cable should also include an earth wire, which should be connected to the Earth pin of the motor connector.

The recommended maximum cable length is 10m.

For easier installation it is recommended that a colour-coded Baldor Motor Cable be used. This can be ordered with product code ASR21599 or ASR21364 for larger motors.

Caution DO NOT connect power to the Motor UVW inputs. Damage to the ServoNode 51 may result.

WARNING The motor leads must be wired in the right sequence to avoid uncontrolled motor function.

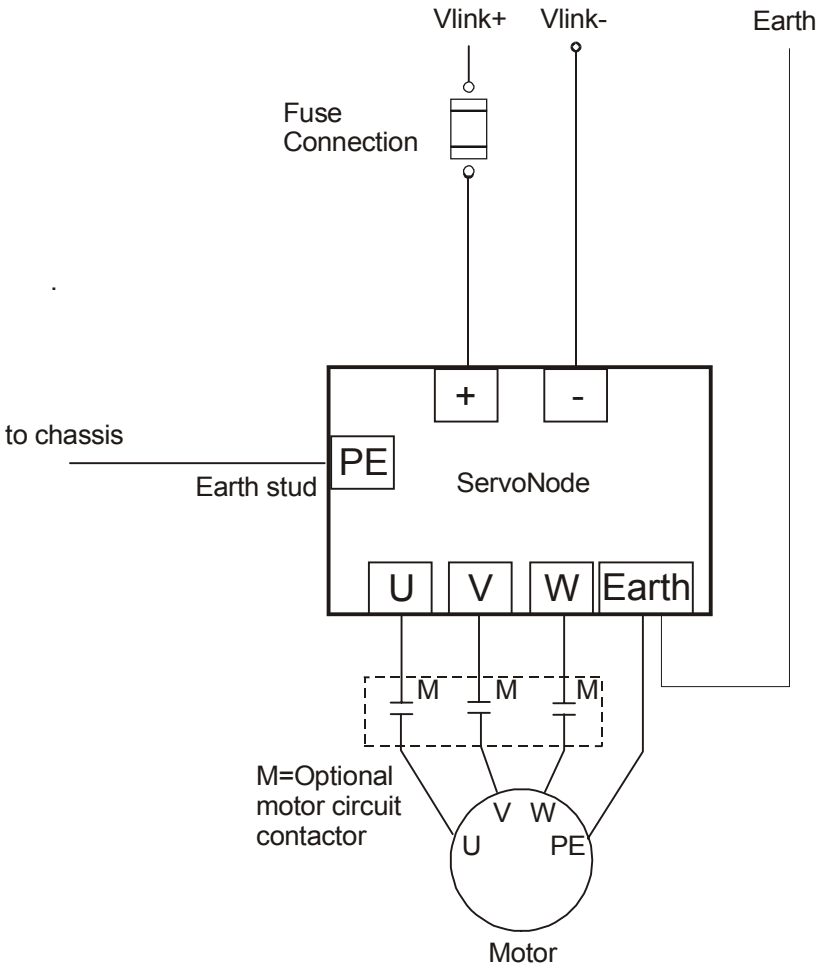


Figure 6: Brushless motor wiring

2.5.1.2 Motor Circuit Contactor

If required by local codes or for safety reason, an M-Contactor (motor circuit contactor) may be installed. However, incorrect installation or failure of the M-contactor or wiring may result in damage to ServoNode 51.

⚠ **Caution If an M-Contactor is installed, ServoNode 51 must be disabled at least 20msec before the M-Contactor is opened. If the M-Contactor is opened while ServoNode 51 is supplying voltage and current to the motor, ServoNode 51 may be damaged.**

An M-Contactor provides a positive disconnect of the motor windings from ServoNode 51. Opening the M-Contactor ensures that ServoNode 51 cannot drive the motor. This may be required during certain operations with the load (like equipment maintenance etc). See Page 15, Figure 6.

Under certain circumstances, it may also be necessary to fit a brake to the motor. This is important with gravity loads where disconnecting the motor windings could result in the load falling, resulting in damage to the machine. Contact Baldor for details on motors with integral brakes.

2.5.1.3 J2 Motor Power Input

The ServoNode is designed to operate from a DC supply of ?? to 140VDC, supplied J2/X11. ServoNode 51 has no provision for over-voltage detection or internal dump resistor. Therefore, care must be taken to ensure that the DC Bus level does not rise above the rated value, this is especially important in applications with high loads and rapid decelerations. If necessary, external protection should be provided.

In order to comply with CE requirements the motor power supply cable should be screened, with the screen connection made to unit chassis via the M3 nutsert on the connector face. The length of screw fixings entering the enclosure **MUST NOT** exceed 10mm. The recommended screw size is M3x10mm. This cable should also include an earth wire, which should be connected to the Earth pin of the motor connector.

A power disconnect should be installed between the input power source and the ServoNode 51 motor power input for a fail safe method to disconnect power. The unit will remain in powered-up condition until all input power is removed and the internal bus voltage is depleted.

Motor power supplied to the unit should be fused and be isolated from the mains using double or reinforced insulation. It is recommended to use a backup fuse of 10A max, slow blow 1¼ inch; for example Neozed type gL.

2.5.2 J3 Controller Power

The 24V DC controller power is supplied via the connector J3/X12, 5.08mm pitch 2 pin Wago. Controller power supplied to the unit should be fused and be isolated from the mains using double or reinforced insulation.

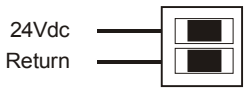


Figure 7: Controller power connections

In order to comply with CE requirements the Controller power supply cable should be screened, with the screen connection made to unit chassis via the M3 nutsert on the connector face. The length of screw fixings entering the enclosure **MUST NOT** exceed 10mm. The recommended screw size is M3x10mm.

To comply with CE directive 89/336/EEC appropriate filters must be installed. See section 2.5.2.1.

2.5.2.1 Power Filters

In order to comply with EEC directive 89/336/EEC, a power filters of the appropriate type must be connected. These must be Earthed to function. This will ensure that the unit complies with the CE mark with which it has been tested. The filters must be mounted and electrically bonded on the same PE backplane as the ServoNode51 is fitted, and should be mounted as close to the unit as practical.

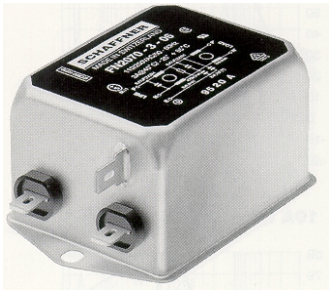


Figure 8: Typical Power Supply Filter

Schaffner filters are recommended. Details of the filters can be found in Table 2. Further details including mounting of Schaffner filters can be found on their web site www.schaffner.com.

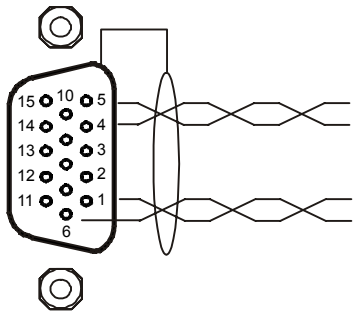
Power Port	Power Port Description	Schaffner Filter Type No.
J3	Controller power **24Vdc**	FN2060-01-06
J2	Motor power **140Vdc**	FN2070-06-06

Table 2: Power Filter information

2.5.3 P4 Motor Feedback Connections

Motor feedback connections are made via 15-pin D type female connector P4/X2**. The ServoNode 51 is designed to operate with a Commutating encoder only.**
The input receiver circuit permit only three channel (CHA,CHB,CHZ) encoders with differential (RS422) line drivers to be used. Single-ended operation is not supported. These inputs have 120 ohm terminating resistors fitted.

Inputs for three Hall effect devices are provided (Hall U,V,W). The input receiver circuit permits either differential (RS422) or single ended (RS423) line driver Hall signals to be used.
The interface also provides an isolated 5V supply for the encoder and Hall sensor electronics. This is capable of driving up to 100mA.



Pin	Function	Type
1	CHA – Channel A	Input
2	CHB – Channel B	Input
3	CHZ – Index	Input
4	Hall U+	Input
5	Hall U-	Input
6	!CHA – Channel A complement	Input
7	!CHB – Channel B complement	Input
8	!CHZ – Channel Z (index) complement	Input
9	Hall W+	Input
10	Hall V+	Input
11	+5V	Power Out (200mA)
12	*do not connect*	
13	Digital ground	Power
14	Hall W-	Input
15	Hall V-	Input

Table 3: Commutating Encoder Pin-out

In order to comply with CE, the encoder feedback should use twisted pair cable22 AWG 0.34mm^2 wire minimum, with an overall screen. The overall screen/shield should be connected to the metallic shell of the D-type connector. Each encoder/hall channel and respective complement signal should be connected as twisted pairs.

To avoid electrical noise issues always keep power and feedback signals separate by at least 100mm whenever possible.

The cable must not exceed 45m in length. Maximum wire-to-wire or wire-to-screen capacitance is 50pf per 300mm (maximum of 7500pf for 45m).

Please note that the encoder input is not optically isolated.

2.6 P2 General Purpose I/O

General purpose inputs and outputs are available on Connector P2/X5 via a 25 pin female D-type connector. These include :

- Six optically isolated AC digital inputs (DIN0 to DIN5)
- Three optically isolated digital outputs (DOUT1 to DOUT4),
- One relay output (DOUT0)
- One differential analog input (AIN0)
- Two analog outputs (AOUT0, AOUT1).

Pin	I/O	Description/Notes	Mint Keyword
1	Input	DIN0[4]/FASTIN/AUX FASTIN	IN.0 FASTPOS, FASTENCODER
2	Input	DIN2[4]/AUX FASTIN	IN.2 FASTAUXENCODER
3	Input	DIN4	IN.4
4	User Common	USR-COM	-
5	User Common	USR-COM	-
6	Common	COM	-
7	Output	AOUT1	AUXDAC.1
8	Input	AIN0+	ADC.0
9	Output	RLY-NC	OUT.0
10	Output	RLY-NO	OUT.0
11	Output	DOUT2	OUT.2
12	Output	RLY-COM	-
13	Common	USR-GND	-
14	Input	DIN1	IN.1
15	Input	DIN3	IN.3
16	Input	DIN5	IN.5
17	User Common	USR-COM	-
18	Common	COM	-
19	Output	AOUT0	AUXDAC.0
20	Common	GND	-
21	Input	AIN0-	ADC.0
22	Output	RLY-DIO	OUT.0
23	Output	DOUT3	OUT.3
24	Output	DOUT1	OUT.1
25	Common	USR-V+	-

Table 4: I/O Descriptions

The analog input and analog outputs are **NOT** optically isolated from internal generated power rails, therefore care must be taken to avoid earth loops and similar associated problems.

All USR_COM connections are connected internally within the unit, but are electrically isolated from all other internal circuitry. All COM connections are connected internally within the unit, but are electrically isolated from all other internal circuitry. USR_COM and COM connections are not linked internally within the unit.

Digital inputs and outputs must be provided with an external supply to function.

In order to comply with CE requirements screen cable should be used with all input and output connections. The overall screen/shield should be connected to the metallic shell of the D-type connector

Connector P2 can also be connected to an I/O supporting break-out board (giving screw-terminal type connections and local filtering). The Baldor catalog number for this item is OPT017-501. (See section 2.6.6)

IMPORTANT NOTE:

The isolation provided on the digital inputs, digital outputs and CAN is nominal. The primary function of the isolation is to break earth loops. Both sides of the isolation boundary must still be kept at SELV potentials with respect to ground, i.e. the difference in the 0V rail across the isolation boundary must not exceed 30V.

2.6.1 Digital Inputs

The 6 general purpose digital inputs can be used to support any of the following:

- Home input
- Error Input
- Forward limit (end of travel)
- Reverse limit (end of travel)
- Stop input (controlled)
- Interrupts (controlled from Mint)

Two digital inputs, DIN0 and DIN2, have Schmitt trigger inputs which provide additional functionality. These input are configurable as fast interrupt (FASTIN) or hardware position capture inputs.

All digital inputs are read individually using the Mint associated keywords and can therefore be configured for any number of user definable functions

The digital inputs are internally isolated and share a single common line **COM**. The entire input bank may be configured for use in PNP mode (current flows in to the inputs) sinking current by connecting COM to the negative rail of the your externally supplied power source. Alternatively the entire input bank may be configured for use in NPN mode (current flows out of the inputs) sourcing current by connecting COM to the positive rail of the your externally supplied power source.

Active High (source current) pin 6 &18 (COM) is grounded. An input will be classed active when it is at +24VDC (guaranteed to be 'ON' in the range +10VDC to +30VDC).

Active Low (sink current) pin 6 &18 (COM) is at +24VDC (±20%). An input will be classed active when it is grounded (must be less than 1V).

Active HIGH	Active LOW	CONNECTOR	
0V	+24V DC	COM pins 6 & 18	Hardwired signal
+24V DC	0V	DIN0-5 pins 1-3 & pins 14 - 16	User switched signals

The sense of the inputs can also be controlled individually in Mint using the keyword **`INPUTACTIVELEVEL.`**

I/O	Function
DIN0	Configurable as the fast interrupt (FASTIN)/hardware position capture input. The position of the axis is captured in real time and can be read using the Mint keyword **`FASTENCODER`** or **`FASTPOS`**. DIN0 can also be configured to capture the auxiliary encoder input as well as the axis position input.
DIN2	Same as DIN0, but captures the auxiliary encoder input which can be read using the Mint **`FASTAUXENCODER`** keyword.

Table 5: Special functionality on digital I/O

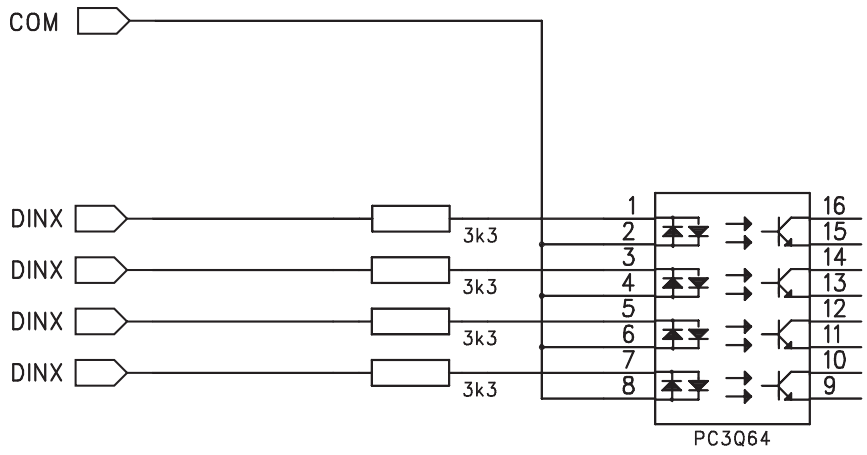


Figure 9: Digital input circuit

The inputs are compatible with mechanical switches or open-collector drivers. They are not compatible with external push-pull drivers unless an external diode is fitted, which effectively converts a push-pull driver into an open collector driver.

The inputs are guaranteed to be active in the range 10 to 30V and are guaranteed to be inactive for voltages smaller than 2V. There is a hardware propagation delay after applying an external voltage and the switch becoming active 'ON', this is no greater than 10uS. The reverse is also true it takes time for the device to switch 'OFF', when removing an external voltage this is less than 50uS.

Inputs can be read directly using the Mint IN keyword. Limits, home, stop and edge triggered inputs are sampled every servo loop (0.5ms to 2ms).

All USR_COM connections are connected internally within the unit, but are electrically isolated from all other internal circuitry. All COM connections are connected internally within the unit, but are electrically isolated from all other internal circuitry. USR_COM and COM connections are not linked internally within the unit.

Use screened/shielded cable with the screen terminated on the D-shell to ensure maximum immunity to interference.

Associated Mint keywords:

ERRORINPUT, IN, INPUTACTIVELEVEL, INPUTMODE, INPUTPOSTRIGGER, INPUTNEGTRIGGER, HOMEINPUT, LIMIT, LIMITFORWARD, LIMITREVERSE, LIMITFORWARDINPUT, LIMITREVERSEINPUT, OUT, OUTPUTACTIVELEVEL, STOPINPUT

2.6.2 Digital Outputs

The three digital outputs are optically isolated and can only be used to source current from the USR-V+ rail and return current via the load to the USR GND. There are two different power rated output types;

- DOUT1 - a single high current output, continuously rated at 500mA maximum
- DOUT2 and DOUT3 - continuously rated at 250mA maximum per output.

There is NO minimum current load requirement. The outputs are written to directly with the Mint OUT keyword.

All these MOSFET type outputs are driven from device typeVN330SP and quoted as having a maximum 'ON' resistance of 0.4Ω. Each output is protected against an under voltage, such that when a USR-V+ voltage of less than 10V is applied, the output will become inactive. The outputs are also have in built thermal protection providing both short circuit and over dissipation protection resulting in the output becoming inactive.

[If the total output current should exceed more than 5A, there is the likelihood of clearing an internal SMD fuse. If a hardware fault is suspected on these outputs, the condition can be using Mint, via the **MISCERROR** keyword. Contact Supplier if hardware fault is indicated]

If the OPTO outputs are used to directly drive a relay or an inductive load, a suitably rated flyback diode must be fitted. This diode should be connected across the relay coil or inductor, observing the correct polarity. This is to ensure that an output is protected from the reverse voltage generated when the coil is de-energized.

Associated Mint keywords:

OUT, OUTPUTACTIVELEVEL

2.6.3 Relay Output

A 1A relay output is available for switching externally connected voltages, as shown in Figure ?. The relay is controlled using the Mint Keyword OUT0.

There are four external connections.

P2- 9 RLY-NC	pin connected to RLY-COM when relay coil is *not energised*
P2- 10 RLY-NO	contact connected to RLY-COM when relay coil is *energised*
P2- 12 RLY-COM	permanent connection to relay contacts
P2- 22 RLY-DIO	pin connected to RLY-NO; connect instead of RLY-NO

The RLY_NO provides a flyback diode, type IN4001, for use with inductive loads. This ensure that the relay contact is protected from the reverse voltage generated by an inductive load when de-energized. The IN4001 has a reverse voltage rating of 50V. If larger voltage are present using a suitably rated external diode.

The relay contact rating is 1A at 24Vdc (resistive), giving an life of 200,000 operations.

Associated Mint keyword:

OUT0

2.6.4 Analog Inputs

ServoNode 51 has one differential analog input (AIN0), with 12 bit resolution in the range of ±10V. Typical use for this may be an analog sensor input, or to provide a low cost joy-stick interface. The guaranteed DC accuracy of the inputs is 2% and provides an input impedance of greater than 22kΩ.

The input circuit is shown in Figure 10.

The input is protected against transient voltages exceeding the maximum input voltage rating (+/- 10V). Permanent over voltage may damage the circuit.

The analog input signal should be connected to the system using a screened/shielded twisted pair cable, and the cable shield should be connected to the chassis at both ends. No other connection should be made to the cable shield.

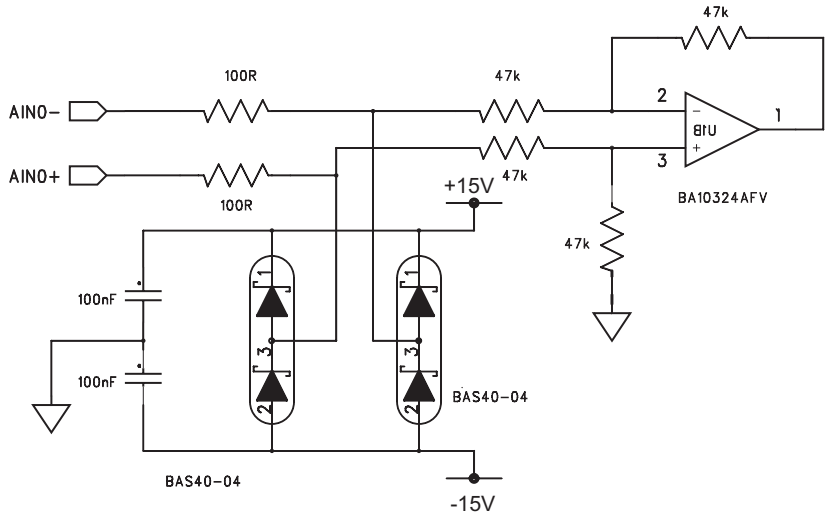


Figure 10: Analog input circuit

If the input is unused, then it is advisable to connect the unused input to the AGND pin.

The analog input can be read using the Mint keyword **ADC.0**. and is sample at the servo loop update rate (0.5 to 2ms). Mint will return the value as a percentage.

Associated Mint keywords:

ADC.0

2.6.5 Analog Outputs

There are two analog 8-bit outputs (AOUT0 & AOUT1) that are not isolated and are primarily intended for system debugging. Output voltages in the range of ±10V are achievable with a DC accuracy of better than 3%. They are derived from high-frequency PWM pulse train from the main processor. These signals are buffered by an operation and are capable of sinking or sourcing current of up to ±2mA. The outputs are protected by fast Schottky diodes against excessive transient high voltages either positive or negative in direction. The outputs may be used to power external potentiometers of an appropriate loading impedance.

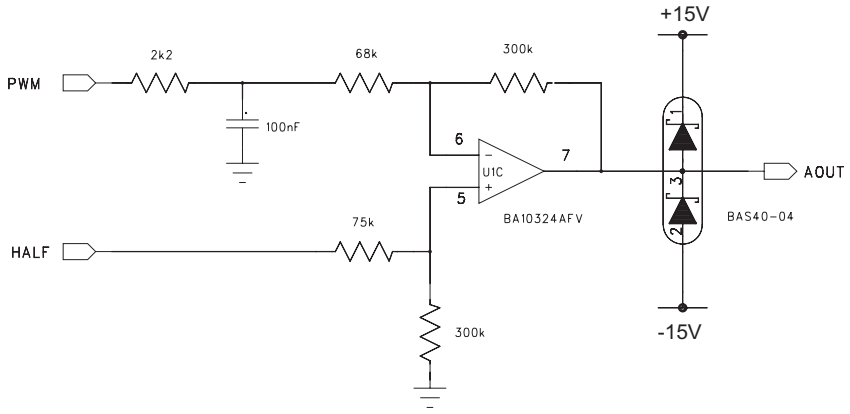


Figure 11: Analog output circuit

Caution: Both outputs will initially be at approximately at +10V following power-up or when a system reset occurs. This condition will remain for upto 5 seconds during the software initialization process, before being set to 0V by this process.

The function of the analog outputs are set using the AUXDAC keywords.

Associated Mint keywords:

AUXDAC.0, AUXDAC.1

2.6.6 Optional Breakout Board

All signals on the general purpose I/O port P2/X5 can be made available as pluggable screw connections via an optional 35mm Din rail mount break-out board. This board also provides some additional signal filtering and LED indicators.

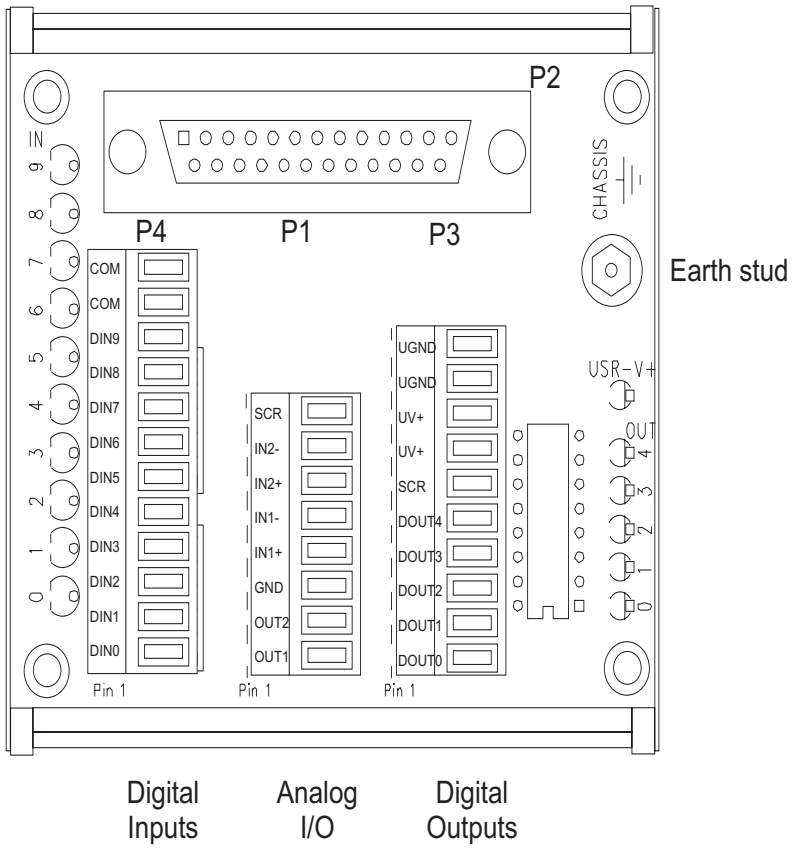
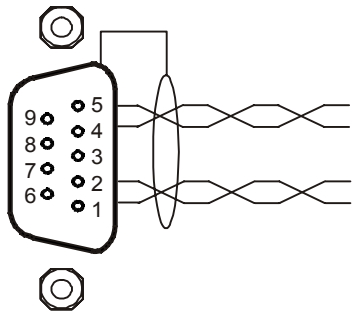


Figure 12: I/O Breakout board

The catalog number for the breakout board is OPT017-501. A 2m (6ft) cable is available with correctly shielded cables (catalog number CBL022-502).

2.7 P44 Auxiliary Encoder Input

ServoNode 51 supports an auxiliary (master or handwheel) encoder input which can be used to follow a master encoder. An interface for a three channel, incremental encoder (CHA, CHB, CHZ) is provided.



Pin	Signal Name & Function	Type
1	+5V	Output
2	CHZ	Input
3	!CHB	Input
4	Chassis	
5	CHA	Input
6	!CHZ	Output
7	0V	Input
8	CHB	Input
9	!CHA	Input

Table 6: P44 9-Pin Female D-type pin-out: Auxiliary Encoder

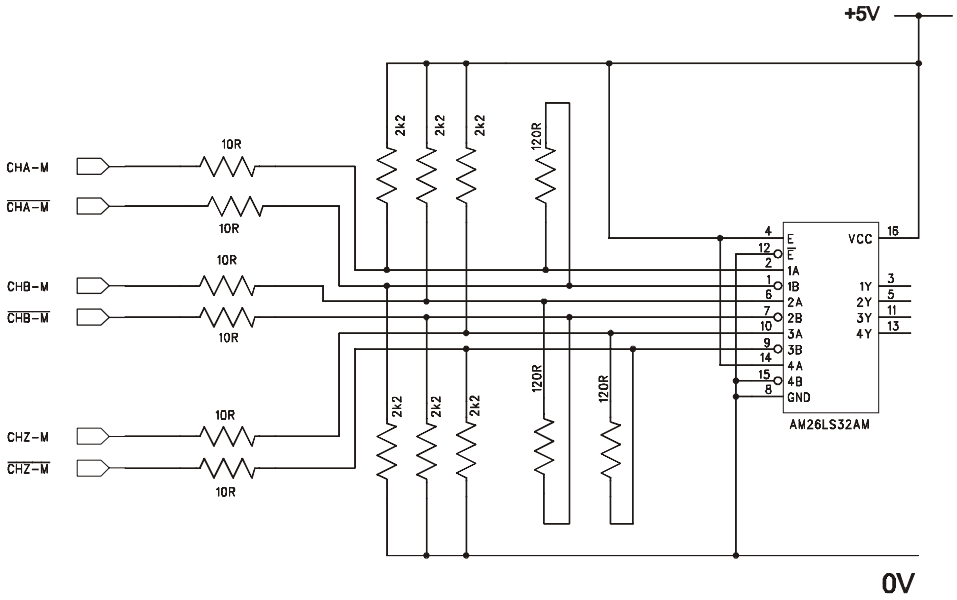


Figure 13: Auxiliary encoder circuit

The input receiver circuit allows encoders with differential line drivers (RS422) only to be used. Single-ended operation is not supported. These inputs have 120 ohm terminating resistors fitted. The interface also provides an isolated 5V supply for the encoder electronics. This is capable of driving up to 100mA. Shielded twisted pair cable is recommended.

In order to comply with CE, the encoder feedback should use twisted pair cable22 AWG 0.34mm^2 wire minimum, with an overall screen. The overall screen/shield should be connected to the metallic shell of the D-type connector. Each encoder channel and respective complement signal should be connected as twisted pairs.

To avoid electrical noise issues always keep power and feedback signals separate by at least 100mm whenever possible.

The cable must not exceed 45m in length. Maximum wire-to-wire or wire-to-screen capacitance is 50pf per 300mm (maximum of 7500pf for 45m).

Please note that the encoder input is not optically isolated.

Associated Mint Keywords:

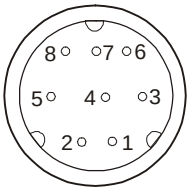
AUXENCODER, AUXENCODERSCALE, MASTERSOURCE

2.8 P1 RS232 Serial Port

ServoNode 51 has a full-duplex RS232 serial port is available via P1/X7, an 8-pin female mini-DIN connector. This port is RS232 only. It is fully ESD protected to IEC 1000-4-2 (15kV). It is not isolated.

Default configuration:

- 57,600 Baud
- 1 start bit
- 7data bits
- 1 stop bit
- No parity
- Hardware handshaking lines (RS232) RTS and CTS must be connected.



Pin	Signal Name & Function	Type
1	RXD : Receive Data	Input
2	CTS : Clear to Send	Input
3	TXD : Transmit Data	Output
4	0V : Signal Ground	Ground
5	RXD : Receive Data	Input
6	+5V	Output
7	RTS : Request to Send	Output
8	TXD : Transmit Data	Output

Table 7: P1 8-Pin Female mini-DIN pin-out (RS232)

Note: that inside the ServoNode 51, RXD is common pins 1 & 5 and TXD is common on pins 3 & 8. Pin 6 provides a current limited +5V to power external interface converters.

Mint will transmit a line feed/carriage return (<LF><CR>) combination, but only expects a carriage return (<CR>) from the host terminal. This port is capable of operation at up to 57.6 kBaud and features a 16 byte deep FIFO. The RS232 connections are brought out onto a 8-pin female mini-DIN connector. The RS232 port is configured as a DTE (Data Terminal Equipment) unit so it is possible to operate the controller with any DCE (Data Communications Equipment) or DTE equipment. Both the output and input circuitry are single ended and operate between ±12V. Note that the 8 pin mini-DIN to 9-way female D-type provided is a cross-over type, so any extensions must be wired pin to pin. Use of shielded cable is required to comply with CE.

A pre made RS232 cable is available from Baldor, order code CBL025-501.

2.9 P101 CAN

ServoNode 51 has a single CAN port , P101/X9. There are two CAN protocols available on the ServoNode 51, **CAN**open and BOCL CAN. The use of CAN is described in more detail later in the manual.

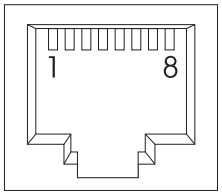


Figure 14: RJ45 Connector Pin Numbers

Pin	Signal	Function
1	**nc**	*Not connected*
2	**nc**	*Not connected*
3	**nc**	*Not connected*
4	**CAN-0V**	Ground/earth reference for CAN signals
5	**CAN-V+**	CAN remote node power V+ (12-24Vdc)
6	**nc**	*Not connected*
7	**CAN+**	CAN channel positive
8	**CAN-**	CAN channel negative

Table 8: Signals for CAN Bus

CAN is opto-isolated and practical operation is limited to 500kBaud owing to the propagation delay of the opto-isolators.

Correct operation of can only be achieved with the screened/shielded, twisted-pair cabling. CAN+ and CAN- must form a twisted pair, while the screen/shield must be connected to the connector back-shell.

CAN must be terminated with a 120 ohm resistor connected between the respective CAN+ and CAN- at both ends of the network and nowhere else. If the ServoNode 51 is at the end of the network then ensure that the CAN terminator DIP switch (switch 4, located on the front panel), is in the 'On' position so as to connect a terminating resistor.

The CAN port must be powered with a DC voltage in the range 12-24V.

2.9.1 BOCL CAN

In this mode, CAN is intended for use with Baldor's ioNODE family of CAN peripherals. This is referred to as CAN2 later in this document.

The CAN port must be powered with a DC voltage in the range 12-24V, this can be achieved by powering an ioNODE family device.

2.9.2 CANopen

In order to use CANopen it is necessary to convert from RJ45 connector to 9-way D type. A convenient way of achieving this and of wiring daisy chained CAN connections is to use a Baldor Tee connector. This converts the RJ45 (BOCL connector arrangement) of the ServoNode 51 to two 9 way male D-types (both CANopen connector arrangements). The Baldor part number is OPT 031-501.

Configuration and Tuning

3

This chapter covers the configuration and tuning of the ServoNode 51. It is important to have read chapter 2 which covers the installation of the ServoNode 51. Topics covered are:

- ◊ Installing the PC software
- ◊ Overview of closed loop control
- ◊ Tuning the motor
- ◊ Fine tuning

If you have followed all the advice in section 2 covering the installation of your ServoNode 51, you should now be ready to start commissioning the drive and setting the motion control parameters.

Before starting the tuning, a background to closed loop control is presented in section 3.3. The first task however is to get the software loaded onto the PC and to familiarize yourself with Mint.

Before powering up the ServoNode 51 for the first time, you first need to install the accompanying software onto the PC and connect the PC to the unit using a serial cable.

3.1 Software Installation

A CD-ROM can be found on the inside back cover of this manual. This contains all the programs necessary to get you started with the ServoNode 51. One of the most important programs is the Mint WorkBench. This will provide all the necessary tools for communicating with ServoNode 51 and writing Mint applications. Install the Mint WorkBench by following the installation instructions given in the section covering Mint WorkBench.

There is no need to run the Mint WorkBench just yet.

3.2 Powering ServoNode 51 for the First Time

Section 2 should have given you enough information to wire-up the 24Vdc controller supply, the motor supply, the motor UVW cable and the motor feedback cable.

This is all that is required at this stage.

If you have not already done so, connect each of the above cables to the relevant connector on the ServoNode 51 and to your motor.

Now connect the serial cable between connector P1 on the ServoNode51, and the serial port on your PC. The ServoNode supports RS232 only.

Re-check the power connections (see section 2) and confirm that you are supplying the correct voltages for your ServoNode51.

Turn on the controller supply.

The Drive and CAN LEDs should light red.

Turn on the motor supply.

If the LEDs are not lit after powering the unit, turn off the power, re-check the wiring in accordance to section 2. Power the unit again, and if the LEDs are still not lit, then refer to the troubleshooting guide at the end of this manual.

After a couple of seconds it the status monitor LED should display a minus sign.

3.2.1 Running WorkBench for the First Time

From **Start**, **Mint Tools**, **Mint WorkBench** click on the Mint WorkBench icon.
The Mint WorkBench window (detailed further in chapter 6) will open along with the Select Controller window (centered). WorkBench will scan for communications information and relay what it is doing to the gray message panel of the same window.

Select your controller type from the pull-down. If the message 'Controller with no Firmware' is offered in this selection, check your cable connections before continuing, and then click on **Rescan** before continuing.

Your selection should look something like this, with your relevant controller and your address and communications setting:

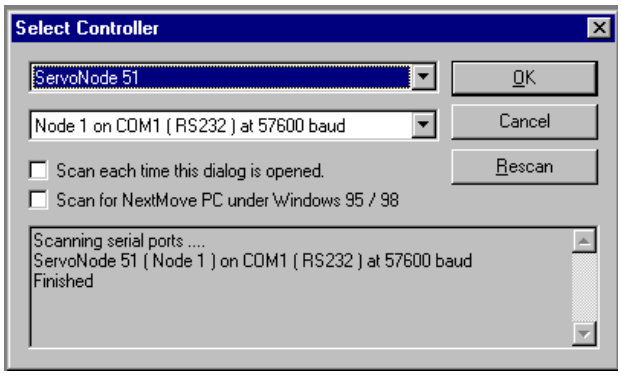


Figure 15: Select Controller window from WorkBench

If you run into problems at this stage, first check that you have indeed powered up your controller correctly, by returning to Chapter 2.

Finally open the terminal window using the  icon on the tool bar. This will bring up the terminal window. Use the mouse and place the pointer over the terminal and click the left button. This will now give the terminal window focus. Press return a few times. You should see a prompt appear on the screen, for example:

```
C001>
```

where 001 is the node number (ie Node 1) or

```
C>
```

if no node number is selected (ie Node 0).
You are now communicating with the Mint on the ServoNode 51. If you do not get a prompt, then please refer to the troubleshooting guide at the back of this manual.

Mint allows you to enter commands direct. Try typing **VER** followed by the return key. You should receive the version number of Mint:

```
Mint for MME version 4.1
Copyright © Baldor Optimised Control Ltd 1988-99. All rights reserved.
```

Now trying typing the following:

```
PRINT POS
```

This should now return the motor position. Using the up arrow on the keypad will recall the last line. Pressing enter will re-execute the line and return the position. Section 3.4 discusses checking the feedback.

Now that you have established communications, you are now ready for system tuning.

3.3 Background To Closed Loop Servo Control

Within the ServoNode 51 control software, instantaneous axis position demands produced by the ServoNode 51 software must be translated into motor currents. This is achieved by *closed loop control* of the motor. The motor is controlled to minimize the error between the demanded and measured positions (often known as the following error). An incremental encoder is used to measure the motor position. Every 2ms the ServoNode 51 compares demanded and measured positions and calculates the correct demand for the motor. The corrective signal is calculated by a PIDVF (Proportional, Integral, Derivative and Velocity Feed Forward) algorithm.

The following diagram represents the structure of the servo control algorithm within ServoNode 51.

This diagram shows the ServoNode 51 control loops positional, velocity and current. All these control loops are internal to ServoNode 51 and can be tuned using the following keywords.

Position Control

Proportional Gain	**KPROP**
Integral Gain	**KINT**[1]
Velocity Feedback	**KVEL**
Velocity Feedfoward	**KVELFF**
Derivative Gain	**KDERIV**
Acceleration feedforward	**KACCEL**

Velocity Control

Proportional Gain	**KVPROP**
Integral Gain	**KVINT**
Measurement Gain	**KVMEAS**

Current Control

Current Feedfoward	**KIR**
Proportional Gain	**KIPROP**
Integral Gain	**KIINT**

[1] Integral gain is also affected KINTMODE and KINTLIMIT.

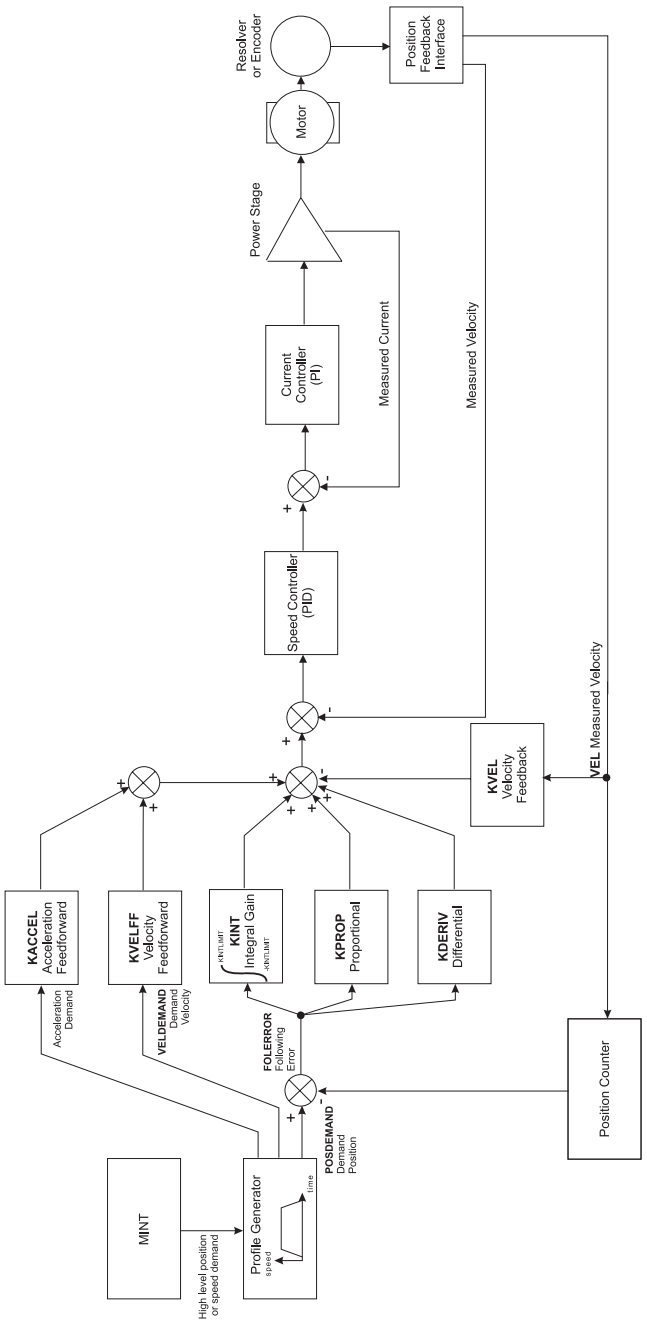


Figure 16: ServoNode 51 Servo Loop Block Diagram

It is possible that control could be achieved by applying a signal proportional to the position error alone, but this is a rather simplistic approach. If it is imagined that there is a small error between demanded and actual position, a proportional controller will simply multiply the error by some constant - the *Proportional* gain - and apply the resultant to the motor. If the gain is too high this may cause overshoot, which will result in the motor vibrating back and forth around the desired position. As the gain is increased, the ServoNode 51 will present more resistance to *positional error*, but oscillations will increase in magnitude until the system becomes unstable. To reduce the onset of instability a damping term is incorporated in the servo loop algorithm, called *Velocity feedback* gain. *Velocity feedback* acts to resist rapid movement of the motor and hence allows the proportional gain to be set higher before vibration sets in. Alternatively, *Derivative* gain (the derivative of the error) can be used for damping.

With *Proportional* and *Velocity feedback* (or *Derivative*) action it is possible for a motor at rest at a set point to exhibit a small positional error (called following error). The ServoNode 51 multiplies the error by the proportional term to produce an applied corrective torque (in current control), but for very small errors the torque may not be large enough to overcome static friction. This error can be overcome by incorporating an *integral* term in the loop calculations. *Integral action* involves summing the error over time, so that motor torque is gradually increased until the positional error falls to zero. The speed at which *integral* action works is controlled by the *Integral gain*. *Integral* action is useful to eliminate steady state positional errors, but will result in reduced dynamic response for the system. For this reason, a software selectable option is provided so that the user can select that the integrator is switched off during periods of constant velocity. This is achieved using **KINTMODE**.

With integral gain, it is possible for the output to wind up to 100% demand. This effect can be limited using the **KINTLIMIT** keyword which limits the effect of **KINT** at a defined percentage of the demand output.

The final term in the control loop is *Velocity feed forward*. This is useful for increasing the response and reducing the following error, especially with velocity controlled servos.

3.4 Checking The Feedback

At the command prompt enter:

```
scale = 1
```

The scale factor has now been set to 1.

If the Watch Window is not already open, toggle it open by selecting **View, Watch Window**. The **View** selection allows you to see whether the Watch Window is open (denoted by a tick prefix).

Select **Measured Position** from the top pull-down.

Rotate your motor shaft approximately one revolution with your fingers, keeping watch on the read back position displayed in the Watch Window.

 **Caution** **Treat this with care, the motor may move.**

After one revolution, the figure should read somewhere in the region of the number of quad counts per revolution of your particular servo motor, as a negative or positive figure, depending on which way you rotated your shaft. To check the quad counts of your motor, please refer to the user documentation that accompanied it on purchase. This may refer to the number of counts per rev as encoder lines. Multiply this number by 4 to get the number of quadrature counts.

3.5 Tuning the Current Loop

Each control loop on ServoNode 51 should be tuned separately working outwards from the current control loop to the position control loop. The first control loop that needs to be tuned is the current control loop which consists of the *Current Feedforward Term, Current Proportional gain* and *Current Integral gains*. In addition, the current limits should be set.

There are two current limits, peak (**CL**) and continuous (**CLC**). The peak current will fold to the continuous current after 1 second.

The maximum peak current is 10A, defined as 200% current, set by `CL = 200`.

The maximum continuous current is 5A, defined as 100% current, set by `CLC = 100`.

So for a motor with a rating of 3.5A continuous, 7A peak, then

`CL = 140` (ie 7/5 of 5A)
`CLC = 70` (ie 7/10 of 5A)

and for a motor with a rating of 2A continuous, 4A peak, then

`CL = 80` (ie 4/5 of 5A)
`CLC = 40` (ie 2/5 of 5A)

The current loop is best tuned with the motor shaft stationary. This can be achieved by locking the motors shaft in a vice if a brushed motor is being used or by typing the following command if a brushless motor is being used.

```
DRIVEPARAM.8 = 1
```

First, the current feedfoward term (**KIR)** should be set.

Enable the drive with

```
DE = 1
```

and enter a torque corresponding to the continuous rating of the motor. So for the 2A example above, then use 40% torque, ie

```
TQ = 40
```

The current can be directly determined using

```
?CMS
```

The value of **KIR** should be set so that the current reading corresponds to the demanded torque, that is `?CMS` returns a value in the region of 2A.
Now enter the initial values for the current loop gains in the **Speed Loop** tab.
Experience has shown that the current proportional gain should start with ten and the current integral gain should start with zero.

The current loop can be tuned by studying the current loop step response. At the Mint command line you will need to enter the following Mint program and execute it.

```
CAPTUREMODE.0 = 11
CAPTUREMODE.1 = 13
DRIVEENABLE = 1
TORQUE = 0
CAPTURE = 3
TORQUE = 10
WAIT = 50
DRIVEENABLE = 0
```

After the program has terminated upload the captured data by pressing the **Upload Captured Data From The Controller** on the **Capture** tab.

Repeat the previous two steps adjusting the gains until you are happy with the measured response.

3.6 Using Brushed or Brushless Motors

ServoNode 51 can drive either “Brushed” or “Brushless” Baldor BSM motors. By default the drive will control a brushed motor whose motor windings are connected between U and W on J1. The command for this

```
DRIVEPARAM.8 = 1
```

To control a Baldor BSM brushless motor the following command will need to be issued.

```
DRIVEPARAM.8 = 7
```

3.7 Hall / sextant mapping

The ServoNode 51 uses a default sextant/Hall mapping appropriate to Baldor BSM brushless motors.

This mapping can be changed, so motors with different sextant/Hall mapping can be used. This is achieved by forcing the motor to a sextant and determining which Hall is active. A graphical plot of the sextant to Hall relationship can be plotted and the mapping determined. This process is described here.

The motor shaft needs to be manually turned during this process, so the motor must be disconnected from its load.

Current gains need to have been set in order to make the motor move. A low torque figure should be applied, appropriate to the motor, using

```
TQ = #
```

To disable following error warnings, use the command

```
FEM = 0
```

and to enable the drive use

```
DE = 1
```

Then, set

```
DRIVEPARAM.8 = 1
```

to force the motor to sextant 1 where the Hall value can be read using

```
?HALL
```

The Hall values should be determined on a edge, at the point of zero torque, so manually turn the shaft in the direction of increasing sextant and note both Hall values. So for sextant 1, the Hall edges are being determined at the point marked a in Figure 17.

In this example, the edge is between Halls 2 & 3.

Repeat for sextants 2 through to 6, using points b to f. In this example for sextant 2, using

`DRIVEPARAM.8 = 2` and `?HALL`

gives an edge between Halls 3 & 1 at point b.

Once all edges have been found, a table can be constructed as below,

SEXTANT	HALL
1	2-3
2	3-1
3	1-5
4	5-4
5	4-6
6	6-2

and from this table, a graphical plot of Halls against sextants can be made, as in Figure 17.

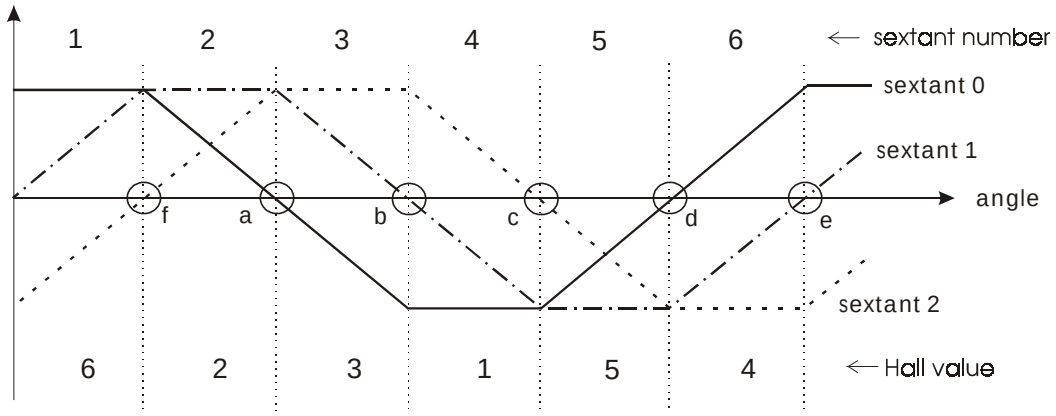


Figure 17: Hall to Sextant Mapping

From this graphical representation, read the Hall value at the point where a sextant has maximum torque. This is the resultant Hall to sextant mapping for this example, as given in the table below;

HALL	SEXTANT
0	-1
1	4
2	2
3	3
4	6
5	5
6	1
7	-1

As there are 3 Hall effect transducers (U, V & W), each being on or off, then there are 8 possible states. To complete the mapping, Hall 0 and 7 are included as illegal or null values.

The valid values can be set on the ServoNode 51 using the command format

DRIVEPARAM.hall = sextant

So for this example,

```
DRIVEPARAM.1 = 4
```

sets sextant 4 to be represented by Hall 1, and

```
DRIVEPARAM.4 = 6
```

sets sextant 6 to be represented by Hall 4. Configure all 6 valid sextant/Hall combinations , then to complete the settings for the 2 null values, use

`DRIVEPARAM.0 = 0` and `DRIVEPARAM.7 = 0`

Once all sextant/Hall values are configured, use

```
DRIVEPARAM.8 = 7
```

to force this mapping.

These commands will not be preserved after a power cycle, so all will need to be included in your configuration file.

Once set-up, check that applying a positive torque to the motor gives a positive velocity. If not, reverse the order of the sextants with respect to the Halls.

3.8 Tuning the Velocity Loop

The gains in the velocity loop on ServoNode 51 can setup to either work in a “velocity mode” or a “torque mode”. Velocity mode is used in most applications, but in some cases a customer may wish to tune the ServoNode 51 to work in a torque mode. Whichever mode is used the TOQRUE keyword will bypass the speed loop and provide an open-loop current demand to the current loop. The rest of this section will assume that the drive is being used in a velocity mode.

The following table shows how the velocity loop gains should be set for these two modes.

Gain	Velocity Mode	Torque mode
KVPROP	> 0	1
KVINT	≥ 0	0
KVMEAS	1	0

The following tuning method involves adjusting the drives gains *Speed Proportional gain* and *Speed Integral gain*. These gains can be set using the **Speed Loop** pane of the **Watch Window**, see the picture below. To reveal this pane:

If the **Watch Window** is not already open, toggle it open by selecting **View, Watch Window**. Press the **Speed Loop** tab at the bottom of the **Watch Window.**

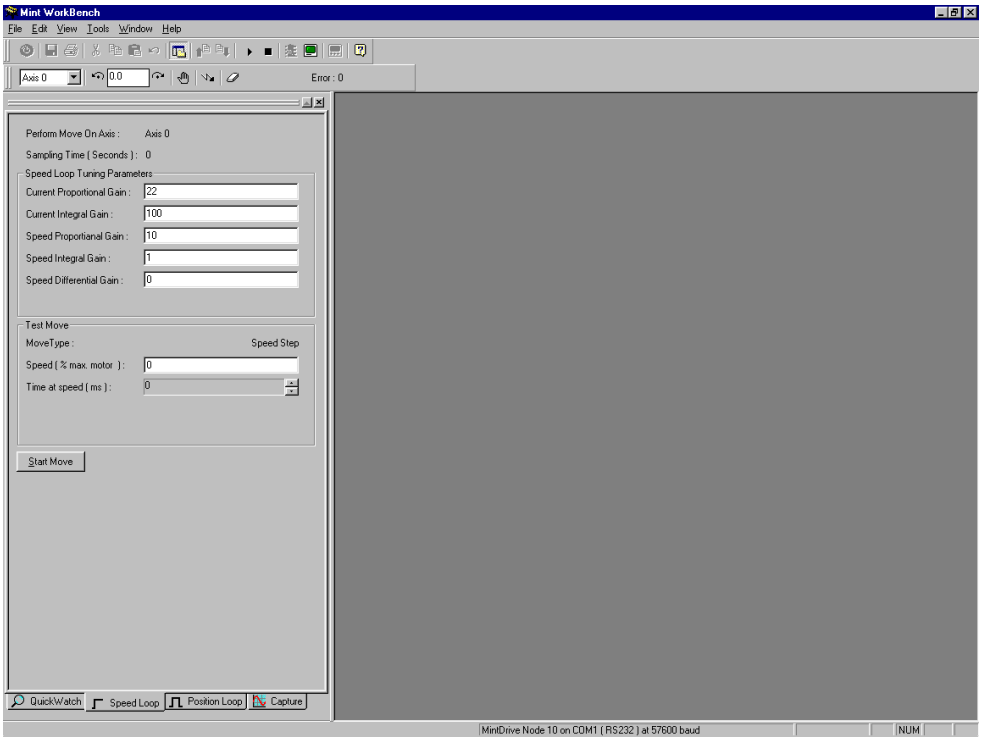


Figure 18: Speed Loop Tab

The current values of the system gains are listed in the **Speed Loop Tuning Parameters** group. These values can be adjusted by clicking over the number and then typing the new value followed by return.

This section describes an empirical method for tuning the speed loop gains. The load should not be connected to the motor during this process.

Enter your starting values for the velocity loop gains into the **Speed Loop Tuning Parameters** section.
Experience has shown you should start with a velocity proportional gain of one and a velocity integral gain of zero.

Enter a test speed (as a percentage of the maximum motor speed) into the **Speed** box within the **Test Move** section. The default is 50%.

Enter the desired duration in the **Time at Speed** box.

Press the **Start Move** button. This will automatically perform the speed step test, upload the measured response from the controller and plot the response to a window (Note: you can change both the background color and the color of the data plotted from the Capture tab).

You can now continue modifying the gains until you are satisfied with the response.

3.8.1 Basic Tuning Technique

The basic technique is as follows;

Set Current Proportional gain (`KIP`) to achieve a critically damped step response the use Current Integral gain (`KII`) to achieve the required scaling.

The Mint gains should be 0 at this time.

Note that the motor responses to the tuning parameters can be dependent on the motor voltage, so tuning should be done with the operational motor voltage applied.

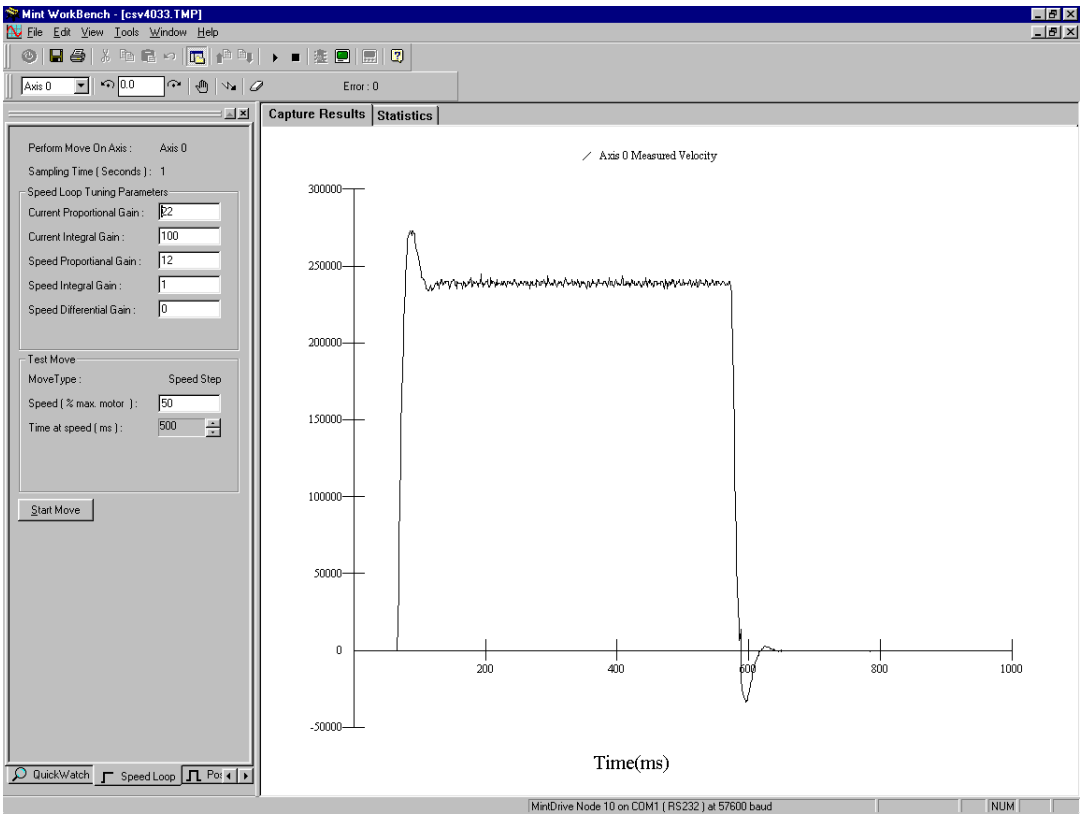


Figure 19: Feedback plot showing speed response

3.9 Selecting Servo Loop Gains

All servo loop gains default to zero, therefore the motor will have no power applied to it on power up.

The most common and practical approach to setting up the servo loop gains is by an empirical method followed by fine tuning these gains by studying the system performance to some tests.

The following tuning methods involve adjusting the servo loop gains **`KPROP`**, **`KVEL`**, **`KVELFF`**, **`KDERIV`** and **`KINT`**. These gains can be set using the **Position Loop** pane of the **Watch Window**, see the picture below. To reveal this pane:

If the **Watch Window** is not already open, toggle it open by selecting **View, Watch Window**.

Press the **Position Loop** tab at the bottom of the **Watch Window.**

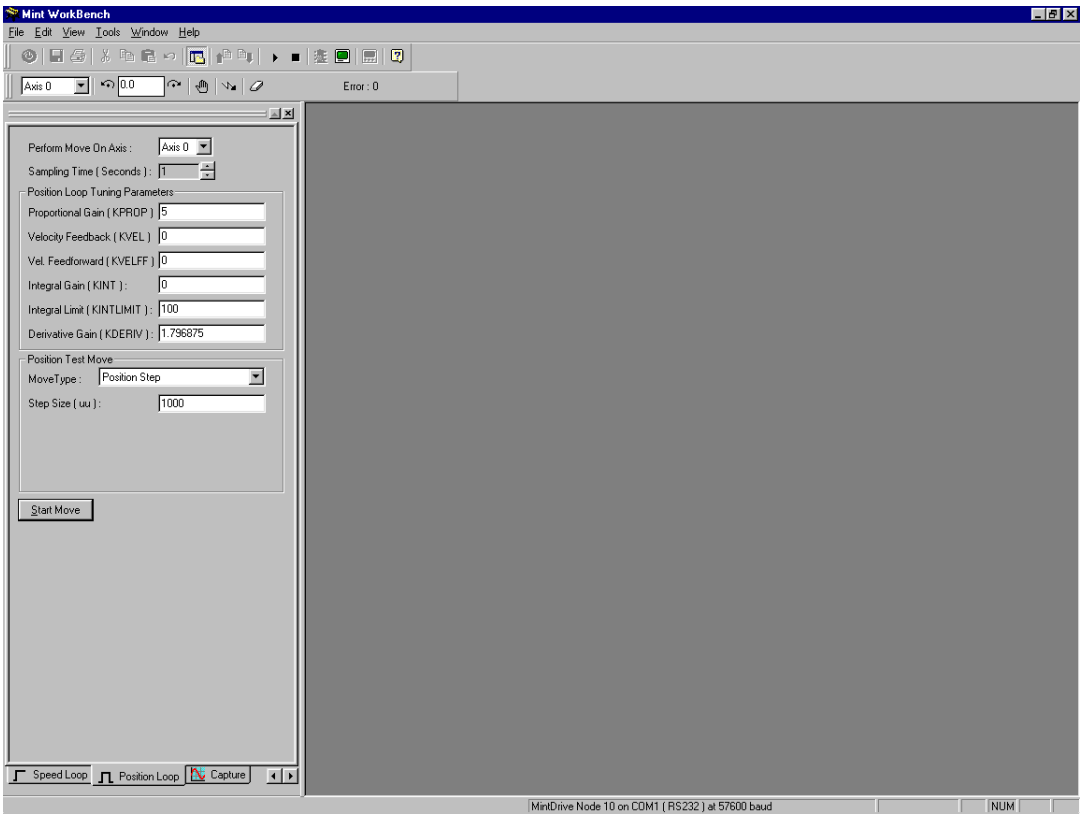


Figure 20: Position Loop Tab

The current values of the system gains are listed in the **Tuning Parameters** group. These values can be adjusted by clicking over the number and then typing the new value followed by return.

This section describes an empirical method for tuning the servo loop gains. A standard method for studying the performance of a servo loop is to look at the step response of the servo system. To confirm that the servo performance is suitable for a real application studying the response to a trapezoidal move can be used.

The load should not be connected to the motor during this process.

Mint WorkBench provides a quick method to generate these test motions and observe the measured response.

Step Response:

This will instantaneously change the demand position.

Select a step move type from the drop down list within the **Position Test Move** section of the Position Loop Tab.

Specify some proportional gain as a starting point.

Enter a move size into the **Step Size** box within the **Position Test Move** section. Start with a move size of about 100 counts (Note: the step size is specified in user units and is therefore affected by the SCALE keyword). You do not want to perform moves that saturate the DAC output. You will also need to enter the Sampling Time, typically 1 second should be sufficient.

Press the **Start Move** button. This will automatically perform the step response test, upload the measured response from the controller and plot the response to a window.

Select the **Capture** tab from the **Watch Window**. This pane allows you to select the data that is plotted and to modify the graphs properties.

Select the data you want to plot from the pull-down option box for both plot #1 and plot #2 (for example you may want to plot the Measured Position against the Demanded Position when tuning the position loop).

If you are plotting data using the same scale, ensure that the **Use same axis as plot #1** in the plot #2 area is checked.

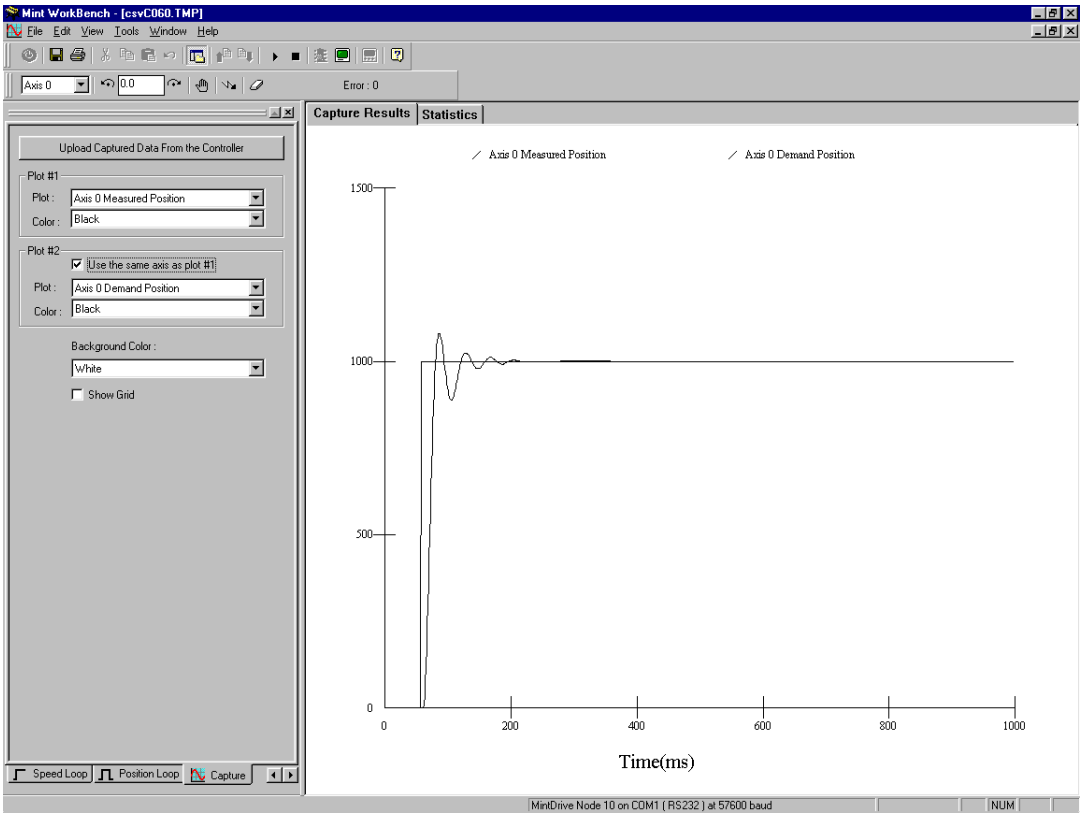


Figure 21: Example tuning plot

If you select the Statistics tab above the graph some useful statistics about the move is displayed.

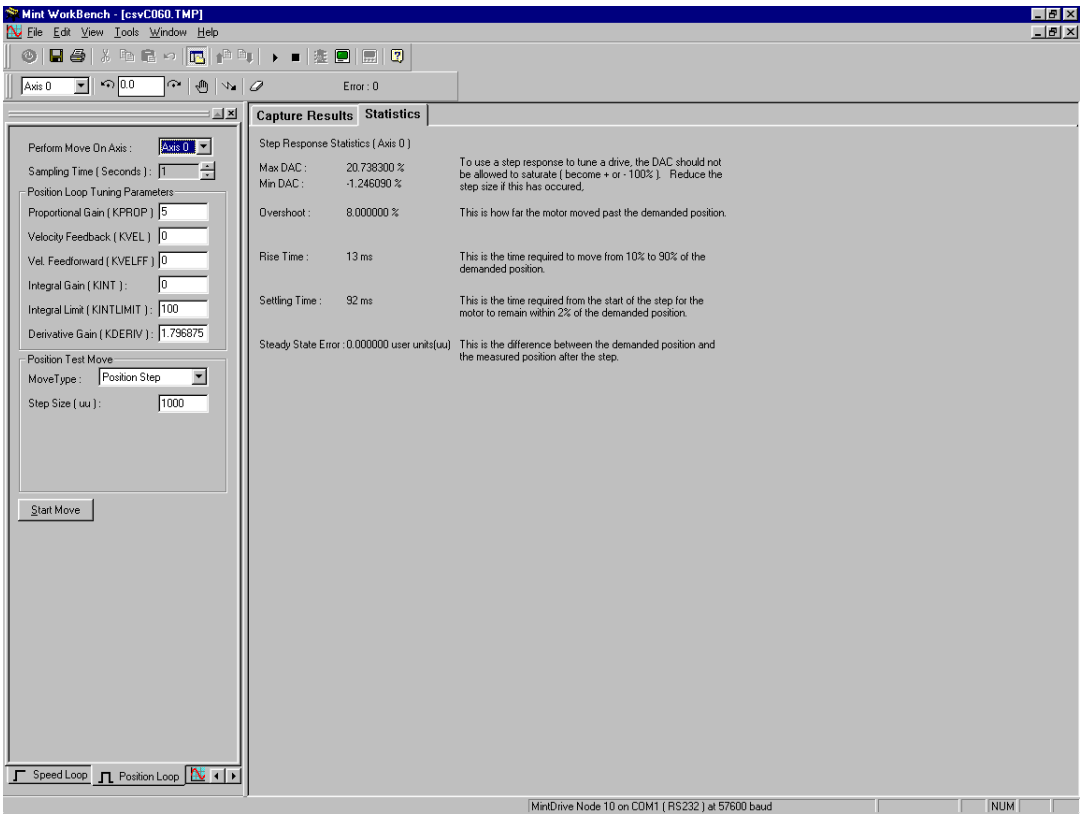


Figure 22: Tuning statistics screen

You can now continue modifying the gains until you are satisfied with the response. It is normal practice to have a step response that is slightly under damped, similar to the following response. When these gains are used with standard profiles such as trapezoidal moves or FLYs the overall response should be critically tuned.

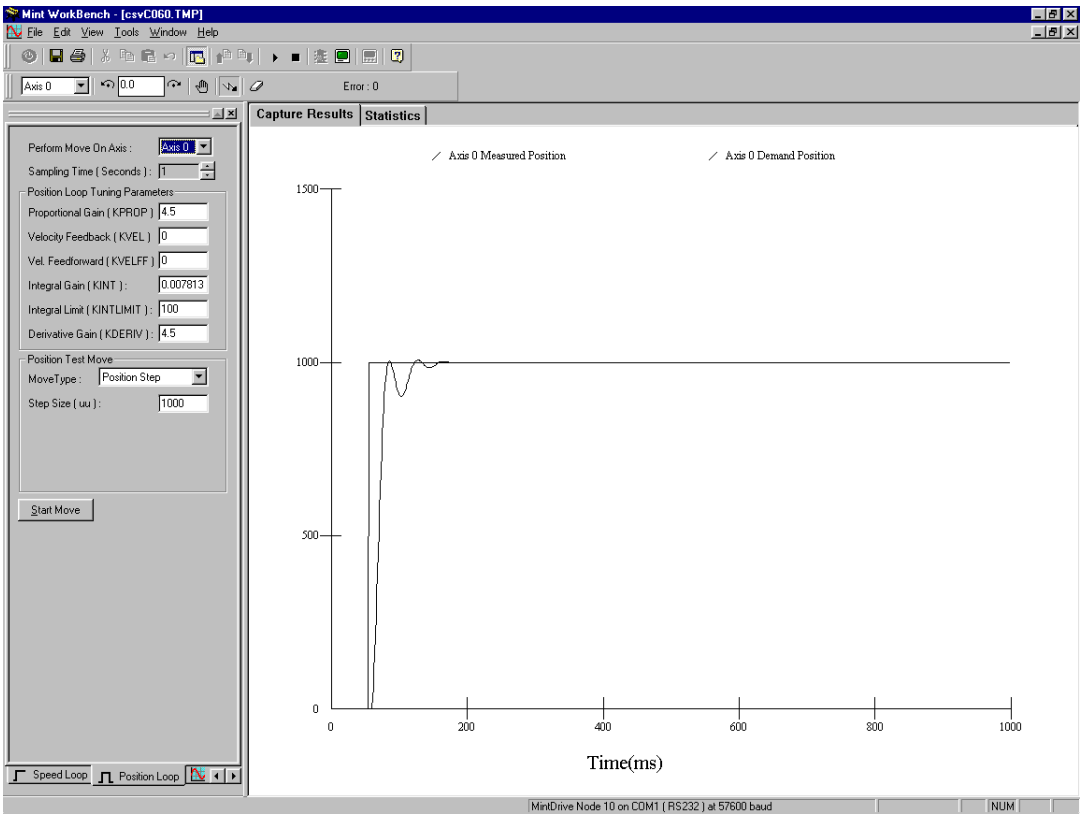


Figure 23: Feedback plot showing critically tuned motor

The following rules of thumb should help when adjusting the gains:

KPROP Increasing **KPROP** will speed up the response and reduce the effect of disturbances and load variations. The side effect of increasing this gain 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 or instability or hunting (the motor can be heard to buzz) on an encoder edge when stationary.

KVEL This gain has a damping effect. This gain can be increased to reduce any overshoot. If this gain gets 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. This term is further controlled by **KINTLIMIT** (see below) and **KINTMODE**. By default **KINTMODE** is set to ignore the **KINT** term.

KINTLIMIT The integration limit determines the maximum value of the effect of integral action, KI.Σe. This is specified as a percentage of the full scale demand.

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 to be achieved, 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.

KDERIV This gain has a damping effect. The Derivative action has the same effect as the velocity feedback, if the velocity feedback and feedforward terms are equal, but scaled by a factor of 16.

3.9.1 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 amplifier which may not be enough to overcome mechanical friction (this is particularly so for current controlled systems). This error can be overcome by applying some integral gain.

The integral gain, **KINT**, works by accumulating following error over time to produce a demand/command sufficient to move the motor into the zero following error position. **KINT** can therefore also overcome errors caused by gravitational effects, such as vertically moving linear tables, where with current controlled drives a non-zero demand output is required to achieve zero following error.

Status Indicators

4

This chapter provides detail of the user status indicators.

4.1 Status Monitors

Before proceeding with the software installation, it is worth familiarizing yourself with the following tables, as they provide general operational status information.

4.1.1 Seven Segment Display

The 7 segment display indicates general ServoNode 51 status information.

-	Drive Disabled
8	Drive Enabled
J	Jogging
P	Positional move i.e. MOVEA, MOVER
H	Homing
ɜ	Incremental move i.e. INCA, INCR
9	Torque mode
E	Drive in error
ʒ	Follow mode
L	Local
F	Flying shear
c	Cam
S	Speed Demand

Table 9: Seven-segment Status Monitor

4.1.2 CAN Monitor

Purpose: The CAN LED refer to the status of the CAN bus and have the following truth table:

CAN LED Status	Description
Illuminated GREEN	The bus is operational.
Illuminated RED	The bus is off.
Illuminated and cycling RED-GREEN	The bus is passive.
Not illuminated	No primary power to ServoNode 51.

Table 10: CAN Monitor Status

4.1.3 The Drive LED Monitor

Purpose: The front panel Drive status LED shows the status of general ServoNode 51 operation:

Drive LED Status	Description
Illuminated GREEN	Drive enabled
Illuminated RED	Drive disabled
Illuminated and cycling RED-GREEN	Drive disabled and an error condition exists on the drive
Not illuminated	No primary power to ServoNode 51.

Table 11: Drive LED Status

Getting Started with CAN and CAN Peripherals

5

This section provides an introduction to CAN1 and CAN2 peripherals and how these are configured to operate with ServoNode 51. This chapter makes use of Mint to configure both the nodes and ServoNode 51.

◊ *Topics include:*

◊ Configuring a node

◊ Selecting CAN bus channels, node numbers and Baud rates

◊ Mint keyword summary for the CAN peripherals

This section describes the use of ServoNode 51 with BOCL CAN (CAN2) Peripherals. For operation with non-BOCL CAN Peripherals, for example CANopen Peripherals, use this section in conjunction with data provided by the manufacturer of the peripheral.

This section assumes that you have a working knowledge of Mint.

A summary of the CAN2 Peripheral supported Mint keywords can be found in section 5.7.

5.1 The CAN Ports on the ServoNode51

ServoNode 51 can communicate with I/O expansion modules or other Mint based controllers via CAN (Controller Area Network), using the CANopen protocol or the Baldor Optimised Control protocol (known as BOCL CAN) if supported.

CAN offers high speed serial communications over a two wire twisted pair cable up to a maximum of 500m (approx. 1640ft) in length.

CAN offers very high reliability of communications in an industrial environment, the probability of an undetected error is $4.7x10^{-11}$.

CAN is optimized for the transmission of small data packets and therefore offers fast update of I/O devices (CAN peripheral devices) on the bus. Several CAN peripheral devices may be attached to the same controller via the CAN link, provided they conform to the same protocol. Either 127 CANopen or 63 BOCL CAN peripheral devices, of any assortment, are allowed on the ServoNode 51 CAN network. However only 4 enabled BOCL keypads are allowed at any one time.

Connection to the CAN network is via a shielded RJ45 type. The CAN channel is opto-isolated.

When ServoNode 51 is at the end of a CAN network, the terminator must be activated. The terminator is activated by setting DIP switch (4) on the front panel to ON

A very low error rate of CAN communication can only be achieved with a suitable wiring scheme. The following points should be observed:

CAN must be connected via twisted pair cabling. The connection arrangement is normally a simple multi-point drop. The CAN cables should have a characteristic impedance of 120Ω; and a delay of 5ns/m. Other characteristics depend upon the length of the cabling:

Cable length	Maximum bit rate	Specific resistance	Conductor area
40m-300m (157ft-1180ft)	200 kbit/s	< 60mΩ	0.34-0.60 mm^2
300m-600m (1180-2362ft)	100 kbit/s	< 40mΩ	0.50-0.60 mm^2
600m-1000m (2362ft-3937ft)	50 kbit/s	< 26mΩ	0.75-0.80 mm^2

Terminators should be fitted at both ends of the network only.

To reduce RF emissions and more importantly, to provide immunity to conducted interference, shielded twisted pair cabling should be used.

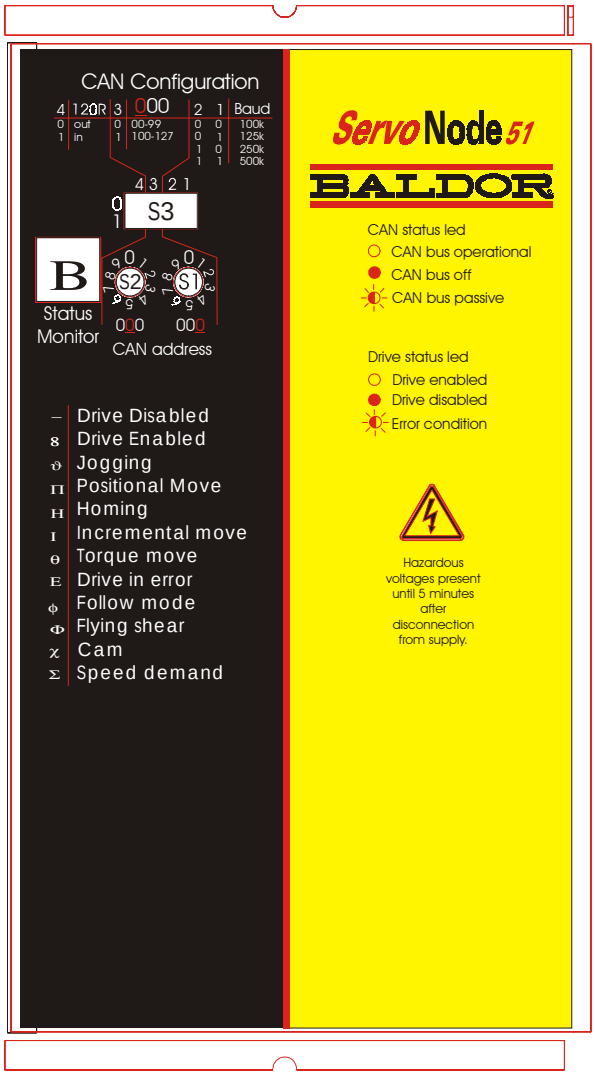
The 0V rails of all of the nodes on the network must be tied together through the CAN cabling. This ensures that the CAN signal levels transmitted by ServoNode 51 or CAN peripheral devices are within the common mode range of the receiver circuitry of other nodes on the network.

The opto-isolated CAN interface circuitry requires a nominal 24Vdc supply from the CAN network.

Cables may also be purchased from the factory.

See section 5 for more details on using CAN peripherals.

Settings appropriate to **CAN**open and BOCL CAN are made using the DIP and rotary switches on the front panel of the ServoNode 51. Configuration by software is not possible. The switch settings are described below.



Notes:
1 S1 & S2 are rotary bcd switches.
2 S3 is a quad DIP switch.

Figure 24: ServoNode 51 CAN Configuration Switches

DIP switches (S3);

Switches 1 & 2 set the CAN Baud rates:

Switch	2	1
100k	OFF	OFF
125k	OFF	ON
200k	ON	OFF
500k	ON	ON

No other CAN Baud rates are available.

Switches 3 & 4 set CAN node range and select the terminating resistor:

Switch	4	3
OFF	120 ohm terminator **not in** circuit	CAN node range 0-99 (ie **0**00)
ON	120 ohm terminator **in** circuit	CAN node range 100-127 (ie **1**00)

Rotary switches (S1 & S2) set the CAN node number.

S1 sets the UNITS in the range 0 to 9 (ie 00**0** to 00**9**)

S2 sets the TENS in the range 0 to 9 (ie 0**0**0 to 0**9**0)

Examples of CAN node number ;

S3,3=OFF, S2=1, S1=7 CAN node set to 017

S3,3=ON, S2=2, S1=3 CAN node set to 123

Please note that the legal CAN node range is 0 to 127.

Associated Mint keywords are:

CANBAUD, CANBUSRESET, CANEVENT, CANEVENTINFO, NODELIVE, NODETYPE, KEYPADNODE, READKEY, REMOTEBAUD, REMOTEDEBOUNCE, REMOTESETUP, REMOTEESTOP, REMOTEIN, REMOTEINX, REMOTEINPUTACTIVELEVEL, REMOTEOUT, REMOTEOUTX, REMOTEOUTPUTACTIVELEVEL, REMOTEOUTPUTERROR, REMOTERESET, REMOTESTATUS

5.2 Network Possibilities

ServoNode 51 supports third party CANopen Peripherals and the full range of BOCL CAN Peripherals (*InputNode 8, OutputNode 8, RelayNode 8, IoNode 24/24* and *KeypadNode)*. Any number of CAN Peripherals from a family, up to the maximum of 63 (limited by bus traffic), are supported on a network, the restriction with BOCL networks being that only four *KeypadNodes* are supported.

A network cannot contain a mix of CANopen and BOCL nodes.

Table 12 shows the BOCL nodes that are supported and their 'signatures' (type number and Mint constants). Signatures are used when adding the nodes to the network.

Type	Mint Constant	Node type
0	`_ntNONE`	Not present
1	`_ntINPUT_NODE_8`	8 digital input node
2	`_ntOUTPUT_NODE_8`	8 digital output node
3	`_ntRELAY_NODE_8`	8 relay output node
4..7		*Reserved*
8	`_ntIONODE24_24`	24/24 IO node
9	`_ntKEYPAD`	KeypadNode

Table 12: Supported Nodes and Node Signatures Used For Network Expansion

5.3 Quick Start

All CAN Peripherals have a default configuration (for BOCL, see Table 13) which is compatible with ServoNode 51 and so configuration can be achieved in minutes if the following tasks are completed:

Powering up and CAN port connection, of the ServoNode 51 and CAN Peripheral.

The running of Mint on the ServoNode 51

The addition of the CAN Peripheral to the network.

The control of remote I/O.

CAN2 Peripheral Type	Default Values	Node ID
	CAN2 Baud rate	
InputNode 8	125	1
OutputNode 8	125	7
RelayNode 8	125	7
ioNode 24/24	125	8
KeypadNode	125	14

Table 13: ServoNode 51-Compatible CAN2 Peripheral Default Configuration

If the CAN2 Peripheral's configuration has been changed then it may need to be *statically* reconfigured.

5.3.1 Jumper settings for CAN2 Peripherals

These jumpers are to be found on the CAN2 peripherals.

Ensure that jumpers JP1 and JP2 on the CAN2 Peripheral are fitted in position 2.

Ensure that jumper JP3 on the CAN2 Peripheral is fitted.

Ensure that jumpers JP4 and JP5 on the CAN2 Peripheral are not fitted.

5.3.2 Connections and Configuration

- Connect the CAN Peripheral and ServoNode 51 using a suitable CAN cable.
- Connect the CAN Peripheral to a 24Vdc supply.

Enable the ServoNode 51 terminator (set the CAN DIP switch 4 to the On position).

- Connect the ServoNode 51 to the PC using an RS232 cable

Power up the ServoNode 51

Start Mint WorkBench and open the terminal window.

Open the terminal window.

Press the return key a few times. A prompt C> should be displayed on the screen. If not, then try pressing Ctrl-E. It may be that a program is running on the ServoNode 51.

5.3.2.1 Adding Network Nodes

This section assumes that a BOCL *RelayNode 8* is being added to the network.

Enter NODETYPE.7 = _ntRELAY_NODE_8. RelayNode8 has now been added to the network.

The LED on the *RelayNode8* will start to flash green, approximately once every half-second. Each flash indicates that the *RelayNode8* is participating in CAN activity. Each time a CAN Peripheral is added, a *node live* event occurs.

_ntRELAY_NODE_8 is what is known as a 'Mint constant'. It can be used in place of the number 3. This is the signature for RelayNode 8 and informs Mint that node 7 is a relay node. What is often useful, as we shall now explore, is to monitor CAN Bus activity.

5.3.2.2 Monitoring CAN Bus Communications

> **VIEW CANEVENT**

Monitoring of the CAN Bus has now been enabled. Events or errors will be reported until **[ctrl]+[E]** pressed.

Reading the CAN event clears CANEVENT.

It is now sensible to confirm that the ServoNode 51 is able to communicate with *RelayNode8.* Before you do this, if you've not already done so, press **[ctrl]+[E]** to stop monitoring CAN Bus.

Communications are confirmed to be 'live' with the command **NODELIVE**. To demonstrate this, you might wish to determine whether a node with an ID of say, 7, is live or not.

Example

Enter

> **? NODELIVE.7**

Mint will return the value 1 (true). In other words, the node with ID 7, is indeed live, and if a 0 (false) had been returned, it would have been 'dead'.

But how would we confirm that Mint refers to the correct node *type*? Again, we use the same keyword **NODELIVE**, but this time it needs to be preceded by the keyword VIEW:

> **VIEW NODELIVE**

A list of present nodes will now appear, indicating type and status (whether *live* or *dead).* You'll probably have noticed that *live* on Node 7 has been abbreviated to **L** and that the same node is assigned as *RelayNode 8.* The outputs are now free to be controlled.

If you wish to now turn on output 3, enter the command **REMOTEOUTX.7.3 = 1**. Try this, and experiment monitoring the CAN2 Bus as described.

5.4 ServoNode 51 and CAN Peripherals

5.4.1 Selection of CAN Channel

ServoNode 51 supports CAN1 Peripherals on CAN Bus channel 1. This is the default setting.

The ServoNode 51 can be configured for CAN1 using the command.

```
BUS = 1
```

ServoNode 51 supports CAN2 Peripherals on CAN Bus channel 2. When connecting CAN2 Peripherals to a ServoNode 51 controller, CAN Bus channel 2 must be selected on the CAN2 Peripheral by fitting jumpers on JP1 and JP2 to position 2, as shown in Figure 25.

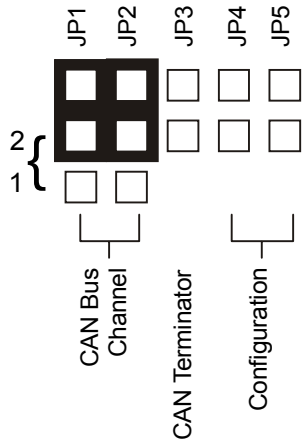


Figure 25: CAN2 peripheral channel selection jumper settings

The ServoNode 51 is configured for CAN2 using the command

```
BUS = 2
```

5.4.2 Selection Of CAN Baud Rate

The CAN Baud rate is the rate at which data is transferred over the network. The ServoNode 51 will default to the rate set by the DIP switches 1 & 2. It is recommended that 125 Kbit/s is selected, before the ServoNode 51 is powered on.

CAN2 Peripherals use a default CAN transmission rate of 125 Kbit/s. Although it is possible to alter this, it is unlikely to be necessary. At this Baud rate the network can be up to 500m (1640ft) long.

Changing the default Baud rate on the CAN2 Peripheral involves statically configuring the CAN Peripherals, explained later (Section 5.4.5).

The Baud Rate for CAN on the ServoNode 51, can be only set using the DIP switches. The rate set can be read using the keyword `CANBAUD`.

To Display the Current Selected Baud Rate

```
> PRINT CANBAUD
```

The Baud Rate is effectively hardware stored on the ServoNode 51 and will be recalled each time the unit is powered up.

5.4.3 Selection Of Node ID

Each CAN Peripheral must be given a unique Node ID within the network. The Node ID is used to filter out CAN messages that are directed at other nodes and is simply designated by a number. The Node ID is assigned to the node by the method of *Static Configuration* already mentioned (detailed in Section 5.4.5).

The rules that govern how Node IDs should be assigned for a ServoNode 51 controller are:

InputNode 8, OutputNode 8, RelayNode 8, IoNode 24/24 and KeypadNode nodes may have any Node ID between 1 and 63.

No two nodes may have the same Node ID in the same network.

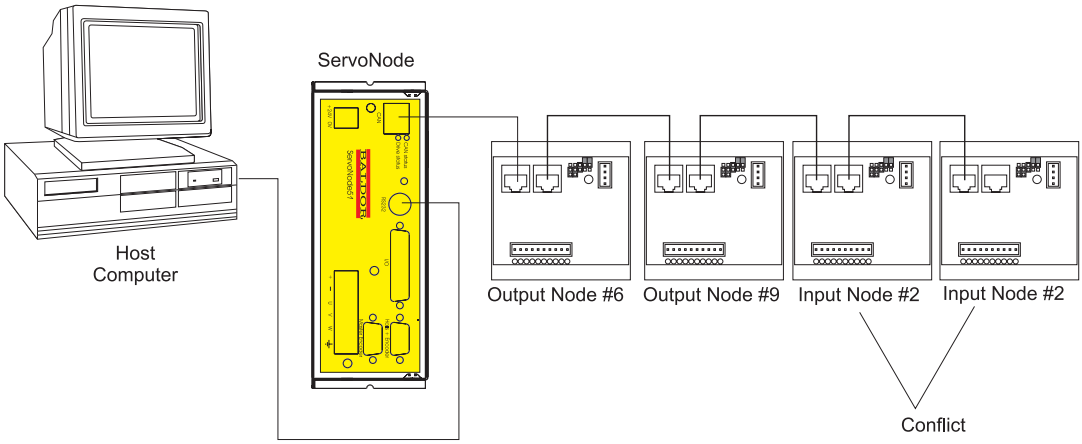


Figure 26: Conflicting Node IDs

The nodes do not have to have Node IDs that reflect the order in which they are connected on the network. To set a Node ID the node must be statically configured as described in Section 5.4.5.

5.4.4 Network Termination

Termination resistors must be fitted at the ends of the network to reduce signal reflection. The controllers and CAN Peripherals are fitted with termination resistors specifically for this purpose. Refer to *CAN Peripherals Installation Manual* for full details. On the front panel of your ServoNode 51 (page 12), the terminator should be selected by setting the CAN DIP switch 4 into the '0n' position.

On the CAN2 Peripherals, the terminator is selected by fitting a jumper to JP3, as shown in Figure 27.

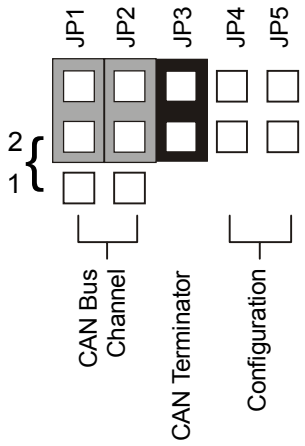


Figure 27: CAN2 peripheral network termination jumper settings

5.4.5 Static Configuration

A CAN2 Peripheral has two programmable attributes:

CAN communication Baud rate (default 125 Kbit/s)

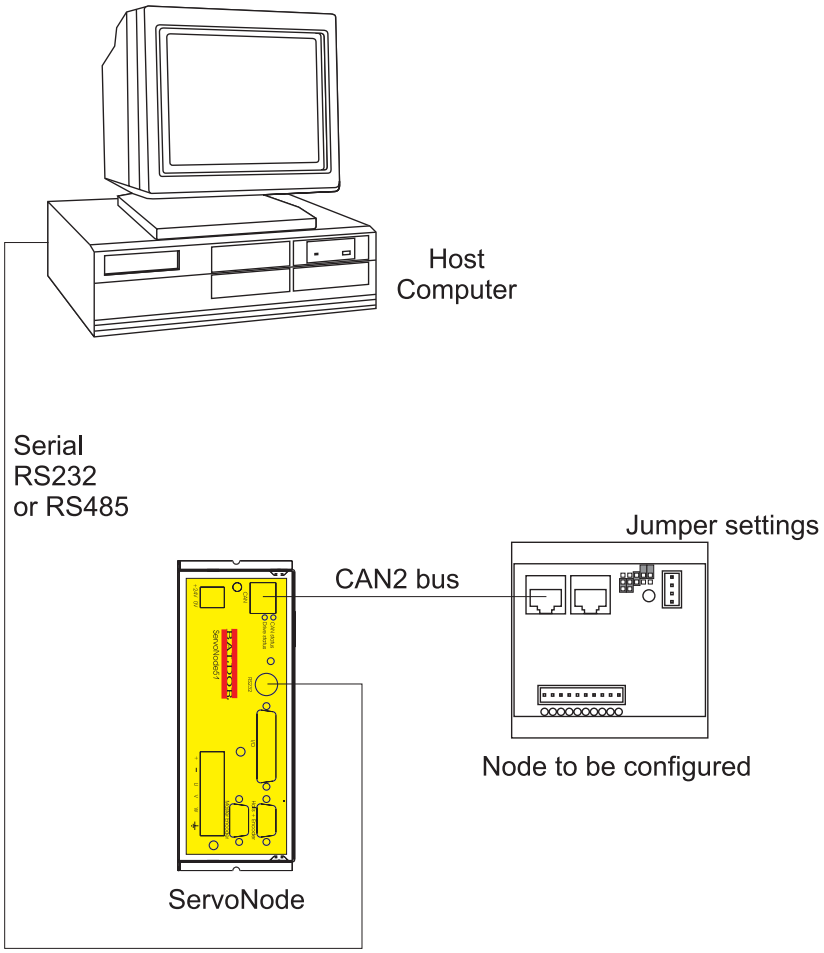
Node ID. The defaults are:

Node	Default Node ID
InputNode 8	1
OutputNode 8	7
RelayNode 8	7
IoNode 24/24	8
KeypadNode	14

Table 14: Default Node IDs for a CAN Peripheral

These attributes are altered over the CAN2 Bus. There must only be two devices in the network - the node to be configured and a CAN based configuration tool (in this case the ServoNode 51). The arrangement is clearly pictured in Figure 28 on page 66, but it is important to remember that this particular configuration must take place with the node removed from the full network; hence the term *static configuration.*

Figure 28: ServoNode 51 - Node Configuration



To statically configure a CAN2 Peripheral:

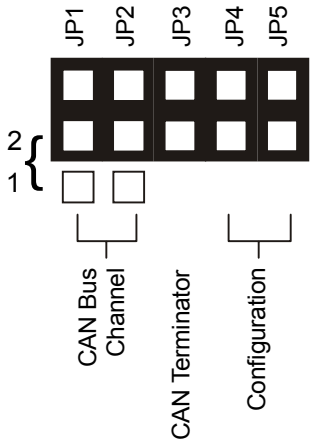


Figure 29: CAN2 peripheral static configuration jumper settings

Make sure that jumpers JP1 and JP2 (CAN2 Bus channel) on the CAN2 Peripheral are fitted in position 2, as shown in Figure 29.

Make sure that jumper JP3 (CAN terminator) on the CAN2 Peripheral is fitted, as shown in Figure 29.

Make sure that jumpers JP4 and JP5 (configuration) on the CAN2 Peripheral are fitted, as shown in Figure 29.

Connect the ServoNode 51 and the CAN2 Peripheral, over the CAN2 bus.

Power up ServoNode 51.

Start up Mint WorkBench and load the terminal window.

Make sure that Mint is running. The Mint WorkBench displays the Mint sign on message:

```
Mint™ for MME… Copyright…
```

Power up the CAN2 Peripheral. The LED on the node will show red.

Enter

```
> REMOTESETUP
```

Mint will respond with the current details of the node, followed by a prompt for the new Node ID - the number used to later reference the node.

Enter a number between 1 and 63 for the Node ID – remembering that each node must have a unique Id number.

```
Node Type = inputnode8
Current Node Number = 5
Serial Number = 00000000148420
Firmware Version = 1.00.b4
New Node Number ?
```

A prompt for the CAN Baud rate will be shown.

Enter a valid Baud rate.

```
New CAN Baud ?
```

When the node has been configured successfully Mint will display the message:

```
Remote Node is set.
```

Power down the CAN2 Peripheral.

Remove jumper JP4 and JP5 on the CAN2 Peripheral.

5.4.6 Normal Operation

When involved in CAN communication the status LEDs on the CAN2 Peripherals flash green. The controllers operate a node guarding procedure in which all nodes are regularly sent a CAN message. This procedure is seen on the CAN2 Peripheral as a flash of the green LED, approximately once every half-second.

For further details on the operation of the CAN status LED, refer to *CAN Peripherals Installation Guide [2]*.

5.5 An Example Network

To illustrate the steps required in putting a CAN network together, a network comprising the following elements can be considered:

1 ServoNode 51 controller

2 *InputNode 8* nodes

2 *OutputNode 8* nodes

1 *RelayNode 8* node

1 *IoNode 24/24* node

1 *KeypadNode* node

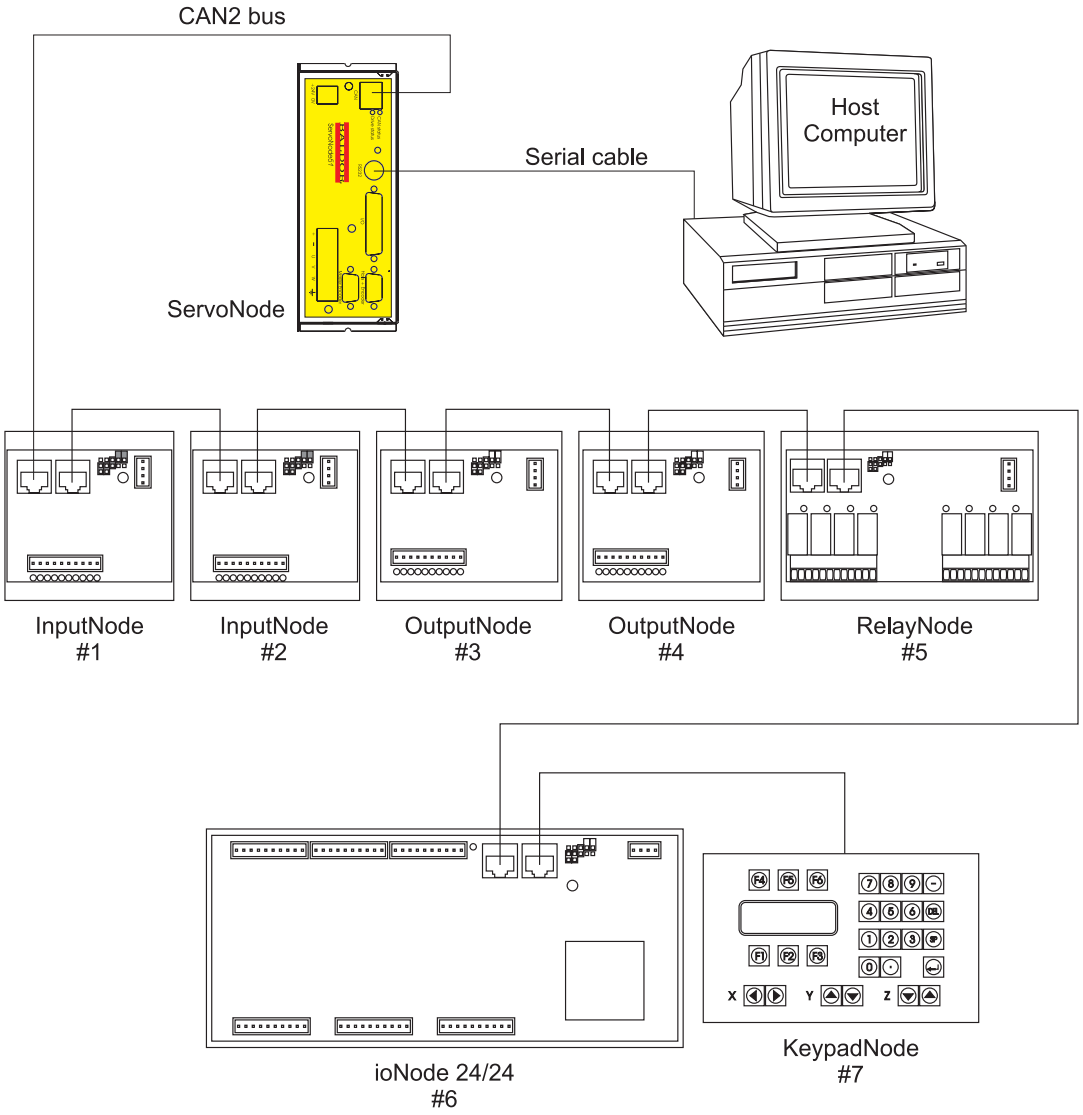


Figure 30: Example Multi-Node Network

The nodes are daisy-chained together with the controller at one end of the network and *KeypadNode* node at the other end of the network. The controller is housed a short distance from the machine. The CAN2 Peripherals are distributed over the machine locally to their respective actuators and sensors. Each node is supplied with 24Vdc from a bus supplying the machine. The CAN Baud rate used will be the default 125 Kbit/s.

Statically configure the two *InputNode 8* nodes with Node IDs 1 and 2 (refer to Section 5.4.5).

Statically configure the two *OutputNode 8* nodes with Node IDs 3 and 4 (refer to Section 5.4.5).

Statically configure the *RelayNode 8* node with Node ID 5 (refer to Section 5.4.5).

Statically configure the *IoNode 24/24* node with Node ID 6 (refer to Section 5.4.5).

Statically configure the *KeypadNode* node with Node ID 7 (refer to Section 5.4.5).

Terminate the network:

On ServoNode 51, the terminator should be selected by setting the CAN terminator DIP switch (S3.4) into the '0n' position.

If the *KeypadNode* is at the end of the network, its terminator should be selected by fitting a jumper to JP3.

The remaining nodes should have their terminator switched out by removing the jumper on JP3.

Position the CAN2 Peripherals and controller on the machine.

Power up the system.

Once Mint is running, enter the following to scan the network for nodes:

```
NODESCAN.0
```

Now type:

```
VIEW NODELIVE.2
```

This will display all the active nodes on the network.

5.6 Using A *Keypad*Node

The *Keypad*Node provides a general purpose interface suitable for stand-alone machines of all types. It is cost effective for simple functions, such as replacing thumb wheel switches and providing simple diagnostics, or it may be used as a fully interactive programming panel for special purpose machine control.

High speed CAN bus connection.

20 character by 4 line LCD display.

27 keys, numeric keypad, function keys and XYZ control keys.

Software controlled piezoelectric buzzer.

Up to 4 active keypads can be used with ServoNode 51 at any one time.

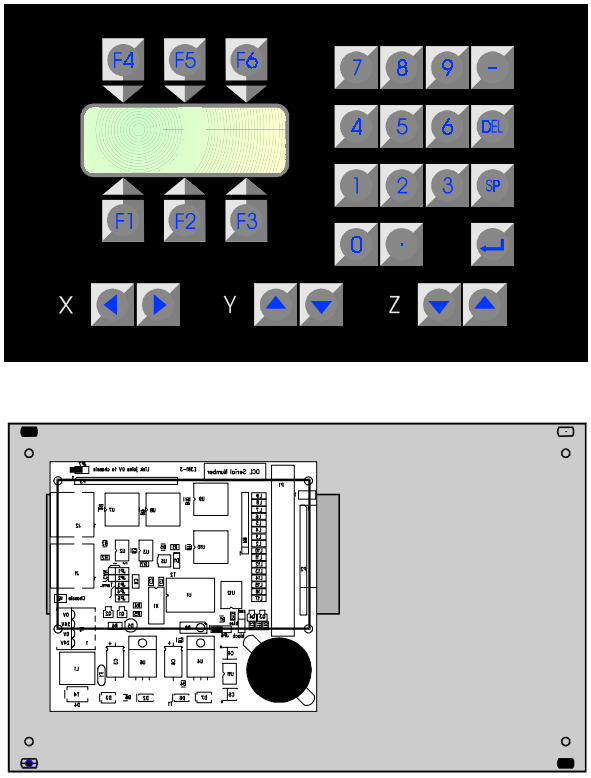


Figure 31: *Keypad*Node Front and Back view

Full details of the *Keypad*Node can be found in *CAN Peripherals Installation Manual*.

When connecting a *KeypadNode* to the CAN2 bus, the node must be added to the network as usual using the **NODETYPE** keyword. In addition to this, the **KEYPADNODE** keyword must be used to inform Mint as to the node identifier of the *KeypadNode* and the terminal channel used to communicate with this node. This is because *ServoNode 51* allows up to 4 *KeypadNode*s to be connected to the bus. Valid terminal channels for *KeypadNodes* are **_tmLCD1**, **_tmLCD2**, **_tmLCD3** and **_tmLCD4**.

Assuming the *KeypadNode* is configured as node 14 (default value), the following code is used to add the node to the network on channel **_tmLCD1**:

Example:

```
BUS=2
NODETYPE.14 = _ntKEYPAD : REM Add node to bus
PAUSE NODELIVE.14       : REM Wait for node to be live
KEYPADNODE._tmLCD1 = 14 : REM Set node 14 as the keypad node
```

Both **_ntKEYPAD** and **_tmLCD1** are predefined constants in Mint.

The **PAUSE NODELIVE** command is required to force a *wait* until the node is live before the **KEYPADNODE** keyword is executed. If this is not implemented, an error will occur as there will be a small delay while the node becomes live. It should now be possible to communicate with the device. The **TERMINAL** keyword should be used to turn on the appropriate terminal devices:

```
TERMINAL = _tmLCD1 OR _tmRS232
PRINT "Hello"
```

Hello appears on both the RS232 port and the LCD display of *KeypadNode*.

The keyword **TERMINAL** is used to set the terminal input and output channels for the ServoNode 51. By default, it is assigned to communicate with only the RS232 and CAN1 channels. It must then be set to communicate with a keypad node. Any key-presses on the *KeypadNodes* will be echoed to the host display and vice-versa, unless omitted from the **TERMINAL** keyword.

Using the following syntax, the **VIEW** keyword allows us to check that the KeypadNode has been connected and is recognized. Enter the command **VIEW NODELIVE and the** *KeypadNode* should be displayed next to its node number. An **L** indicates that the node is *live*, a **D** denotes *dead* .

Once the *KeypadNode* has been configured onto the bus, the Mint terminal keywords such as **PRINT**, **INKEY**, **LOCATE** and **CLS** can be used. Refer to *CAN Peripherals Installation Manual* for more details on *KeypadNode* and the *Mint Keyword Reference Guide* for a detailed explanation of these commands.

5.7 Summary of Mint CAN-Related Keywords

The following Mint keywords discussed in this section, are used with CAN. Full details of the use and syntax of Mint commands can be found in the Programming Guide (order code MN1262):

CANBAUD/CB
CANBUSRESET/CBR
CANEVENT/CV
CANEVENTINFO/CVI
CLS
INKEY/IK
LINE
LOCATE
NODELIVE/NL
NODETYPE/NT
PRINT/?
READKEY/RK
REMOTEDEBOUNCE/RD
REMOTEESTOP/RES
REMOTEIN/RI
REMOTEINPUTACTIVELEVEL/RIA
REMOTEINX/RIX
REMOTEOUT/RO
REMOTEOUTPUTACTIVELEVEL/ROA
REMOTEOUTPUTERROR/ROE
REMOTEOUTX/ROX
REMOTERESET/RR
REMOTESETUP/RMS
REMOTESTATUS/RS
TERMINAL/TM

Mint™ WorkBench

6

The Mint™ WorkBench is a 32 bit Windows front end for use with Windows 95, Windows 98 and Windows NT. Features include a full screen syntax highlighting editor, terminal window and tuning screens. The chapter covers:

- ◊ Installation of the WorkBench
- ◊ Overview of the WorkBench features

The Mint WorkBench is a 32 bit Windows front end designed for use with a number of Mint based products as well as the ServoNode 51. The WorkBench has the following features:

Terminal facility to communicate with the ServoNode 51 over RS232.

Editor for program and configuration files. The editor has color syntax highlighting.

Quick watch window allowing the viewing of up to 4 data values including axis position, following error and input status.

Data capture and tuning facility.

The Mint WorkBench is supplied on CD-ROM and can be found at the back of this manual.

In order to install the Mint WorkBench, the PC must conform to the minimum requirements:

Processor:	Intel Pentium or equivalent
Minimum RAM:	16 Mbytes
Hard Disk Space:	10 Mbytes
CD-ROM:	Required
Screen:	800 x 600 (minimum)
Operating System:	Windows 95, Windows 98 or Windows NT
Recommended:	Intel Pentium, 32 Mb RAM, 133 MHz, 40MB hard disk space free

To install the software insert the CD-ROM into the PC CD-ROM device. The setup wizard will automatically run, guiding you through the installation process. If the setup does not automatically start, select Run from the Start menu and type:

```
d:\setup
```

This is assuming that D: is the drive of the CD-ROM.

The Wizard allows either a complete installation of all the available software options, or a customized set-up. The on-screen instructions should be followed.

The Set-up Wizard copies the WorkBench files to appropriate directories on the hard disk. There is a choice of what drive and directory to use. The default directory is C:\Program Files\Mint v4.

6.1 Starting the Mint™ WorkBench

It is important that before you start the Mint WorkBench, that the ServoNode 51 is connected to the PC COM port and is powered up.

To start WorkBench from Windows **Start** menu, select **Programs, Mint v4Tools, Mint WorkBench**.

The WorkBench window will open, usually along with the Select Controller Window. If the Select Controller Window does not appear, it can be opened by selecting **Tools, Select Controller** from the menu. The screen will show something similar to this:

In order to start using WorkBench with ServoNode 51, WorkBench must be configured for use with the controller. This is discussed in the following section:

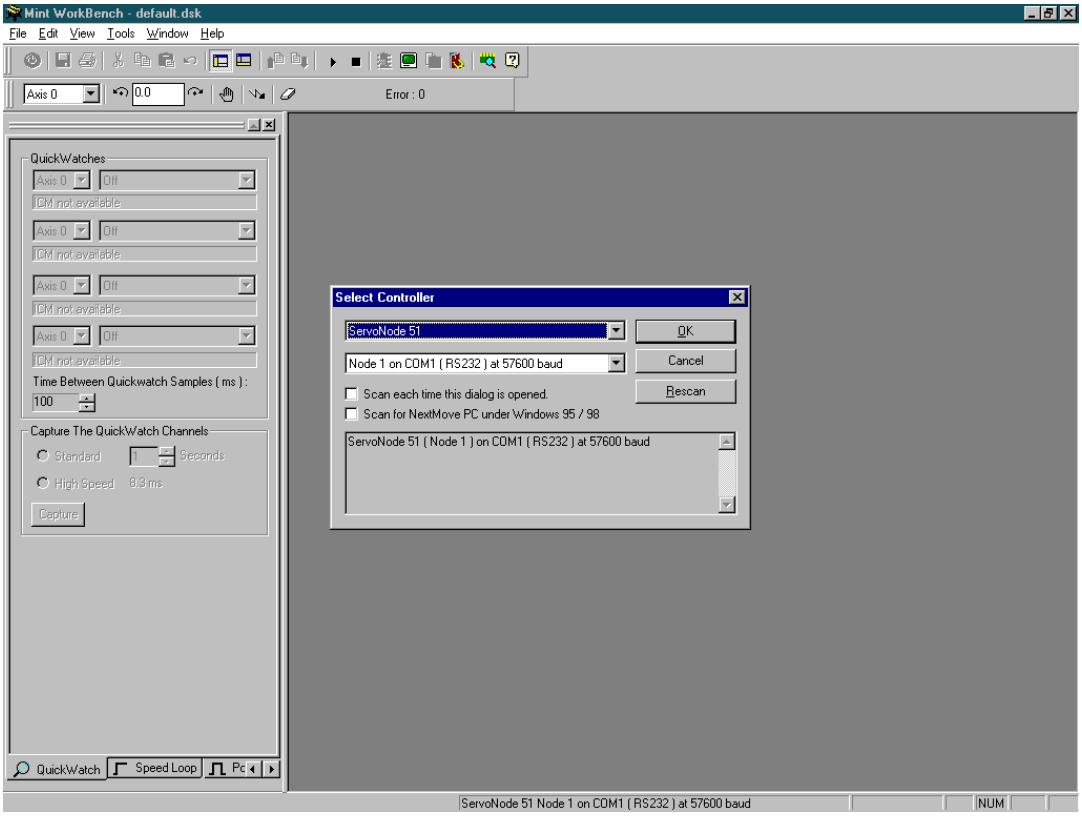


Figure 32: Default WorkBench window and Select Controller window

6.2 Selecting a Controller and COM Port

The first time WorkBench is used, you will need to configure it for use with your particular controller. When first opened, the WorkBench will open and display a dialog box similar to the one shown in Figure 33. ServoNode 51 should be shown in the Window drop down box. If not, try power cycling the ServoNode 51 and press Rescan.

If the Mint WorkBench is successfully running, the controller selection box can be opened from the **Tools, Select Controller** menu.

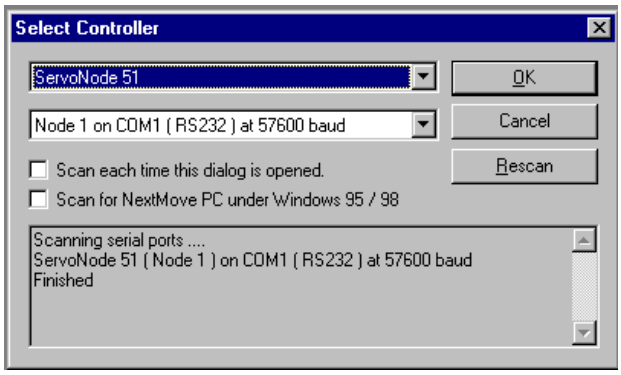
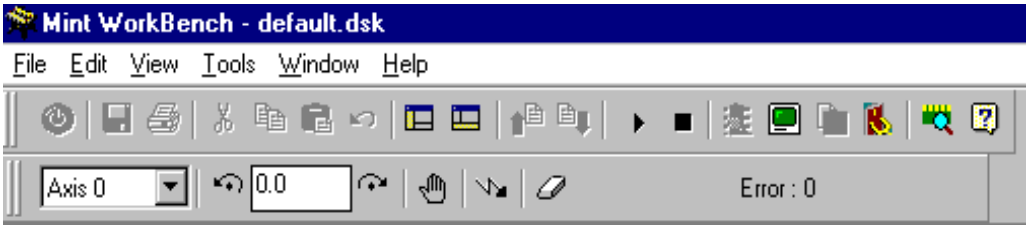


Figure 33: Select Controller window

The Select Controller pull-down allows selection of controller type and controller address. For ServoNode 51, the ServoNode 51 controller needs to be selected. If there are other Mint based controllers connected to the PC, then select the correct ServoNode 51.

Note: If your PC has more than one serial port connected you may have to select the COM port from the dropdown menu.

6.3 Navigating the Main Toolbar



Many of the tools in WorkBench can be launched from the main toolbar. The tools are described in more detail later in the manual.

 **Reset the controller** (not available on ServoNode 51).

 **Show Watch window**.

 **Show CAN window.**

 U**pload File**: if an editor is selected, the editor file will be uploaded into it. Otherwise a dialog box will prompt for the file to upload.

 **Download File**: if an editor is selected, the editor file will be downloaded. Otherwise a dialog box will prompt for the file to download.

 Send Mint `RUN` command.

 Send Mint break (**[Ctrl]** + **[E]**) command.

 Toggle the DPR Watch Window tab (applies only to NextMove PC and NextMove PCI).

 **Terminal:** for communication with the Mint command line.

 Copy Drive Tuning Parameters to clipboard

 **View Digital Inputs and Outputs**

 **Display number of axes and I/O information**

 **Display WorkBench program information**

6.4 The QuickWatch Window

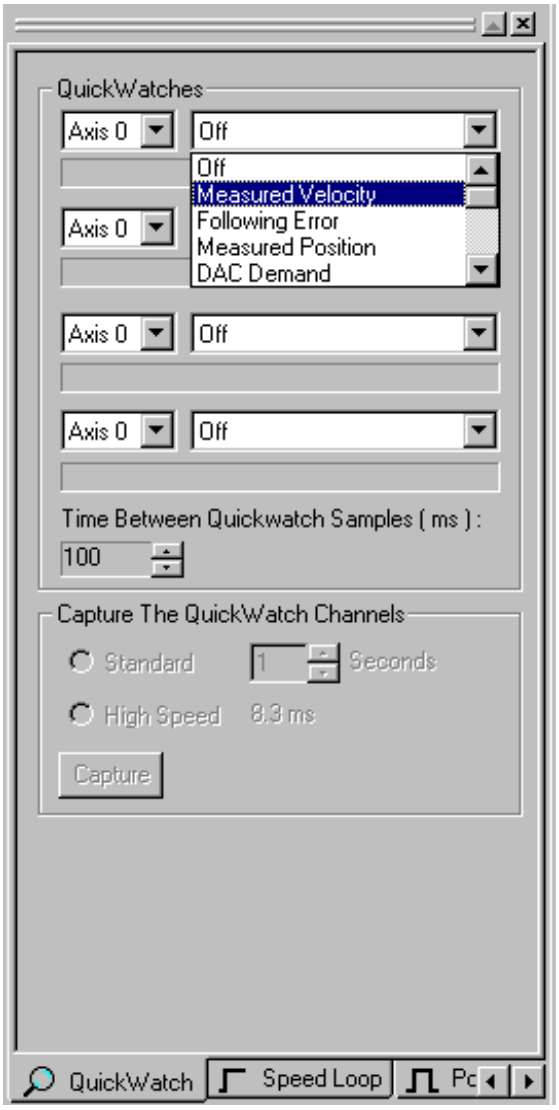


Figure 34: QuickWatch pane

The QuickWatch window on the left hand of the screen controls:

The display of up to 4 controller parameters such as position or following.

Tuning

Data capture

To remove the left hand pane, click  on the toolbar.

The QuickWatch pane selected by pressing the QuickWatch tab allows up to 4 parameters to be simultaneously displayed. These include:

Measured velocity

Following Error

Measured axis position

DAC demand

Demand position

Demand velocity

Mode

Inputs

Auxiliary encoder

Auxiliary encoder velocity

To select a variable to watch, use the drop down to chose the variable. The axis number can also be selected. For ServoNode 51, the axis number must be 0.

Once a variable is selected, the Mint WorkBench will interrogate the ServoNode 51 for the data. How often Mint WorkBench asks for this information can be changed by altering the *Time Between Quickwatch Samples*. Selecting zero will set the quickest response time but this may affect the response time of the terminal. This will depend up on the speed of your PC. Obviously, the faster the PC the better.

The data can also be captured to a graph. This is achieved by pressing the Capture button at the bottom of the Quickwatch pane. The number of seconds data is selected by changing the sampling time in the QuickWatch pane. This must be done before the Capture button is pressed. The Mint WorkBench will send instructions to the ServoNode 51 to collect the data. Once collected, this will be display in a graph as shown in Figure 35.

Selecting the Capture tab allows you to change properties of the software oscilloscope such as color of the background and color of the lines for each item of data. All four channels of the Quickwatch window will be captured, but only two are displayed. Use the plot drop downs to select the data to plot. This will not ask the controller to re-plot the data.

Data can also be saved to a CSV file (comma separated variable) for inclusion into spreadsheet packages such as Microsoft Excel. Use the **File Save As** menu to save the data file. This can be opened up in the spreadsheet be selecting Comma Separated Variable (typically has a .CSV file extension). Saving the file will save all four channels from the QuickWatch window.

Using the mouse, sections of the plot can be magnified. Select the start point with the mouse and click the left button. Keeping the left button pressed, drag the mouse to highlight the area to magnify. Release the left button and the magnified graph will be displayed. To return to the original plot, press the right button.

The plot can be printed by selecting **Print** from the **File** menu.

It is strongly recommended that you set the Baud rate of the serial port to be as high as possible. The recommended Baud rate on the RS232 port is 57,600 Baud.

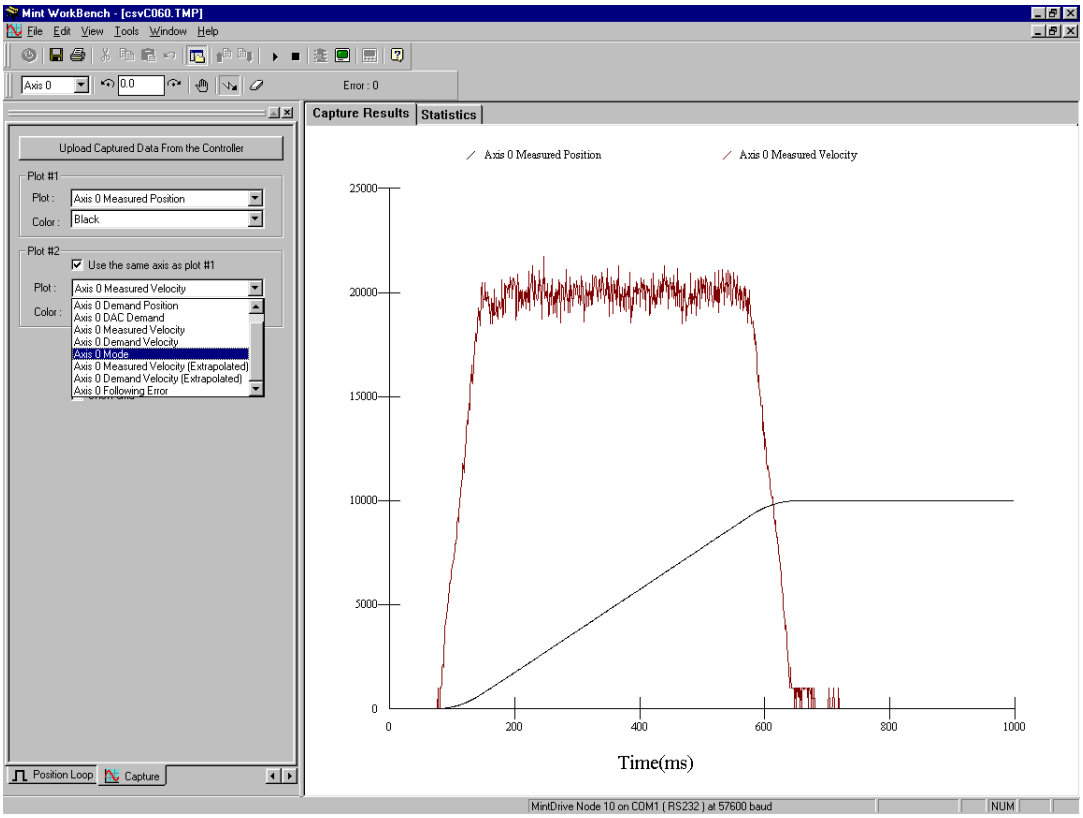


Figure 35: Software Oscilloscope

6.5 Terminal

The Terminal window provides access to the Mint command line over the RS232 port.

To enable the Terminal Window:

Select **Tools**, **Terminal** or

Click the  icon:

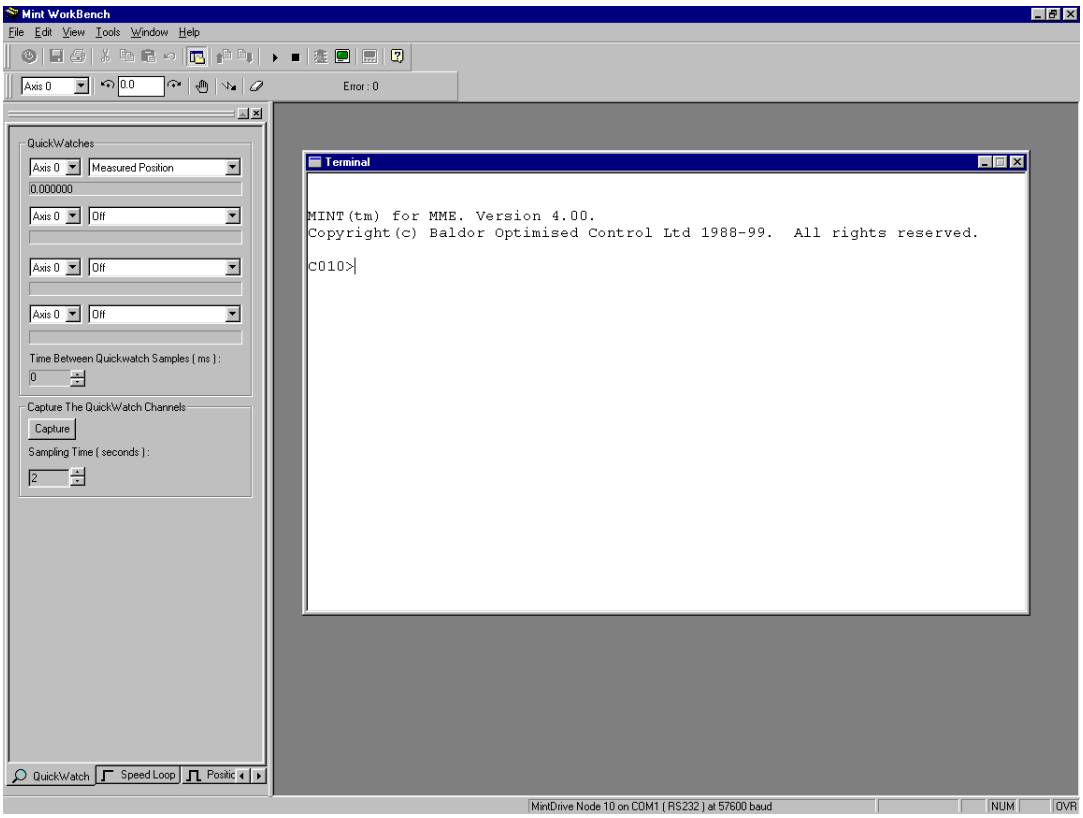


Figure 36: Terminal window shown in context of WorkBench window

The terminal can be resized by dragging the border (please refer to your Windows user documentation if you are unsure).

To check that you are communicating with the ServoNode 51, select the terminal window and hit the return/enter a key a few times. The Mint command line prompt should appear if there is no program running. Type Ctrl-E (or use ■) to stop program execution if a program is executing.

For those users familiar with Mint, the INS key will now put the terminal into overwrite mode. Once pressed, the terminal will send the necessary key strokes when a key is pressed to insert the character into the line.

6.6 Editor

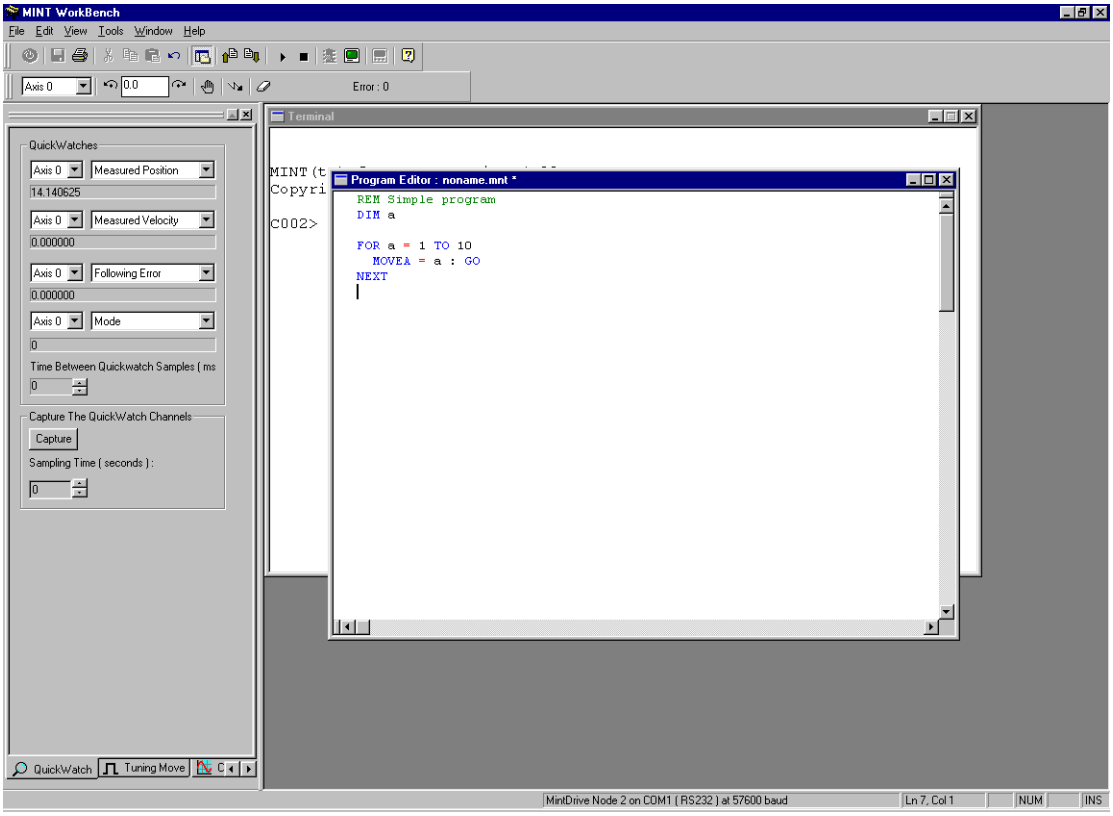


Figure 37: Full screen editor with syntax highlighting

A full screen editor is available with color syntax highlighting. This means that Mint keywords, numbers, strings and remarks (REM statements) are highlighted in different colors. Features also include cut and paste and full search and replace.

The editor is opened from the *File* menu. A new file can be selected or an existing file can be selected and opened. Separate editors are supported for both the Mint *program* and Mint *configuration buffers*.

There are several ways to initiate the editor:

To create a new file, select **File, New** and then either **Config** or **Program** or **Array**.

To open an existing file, select **File, Open** and then either **Config** or **Program** or **Array**.

To upload a program, select **File, Upload** and then either **Config** or **Program** or **Array**.

To download a program, select **File, Download** and then either **Config** or **Program** or **Array**.

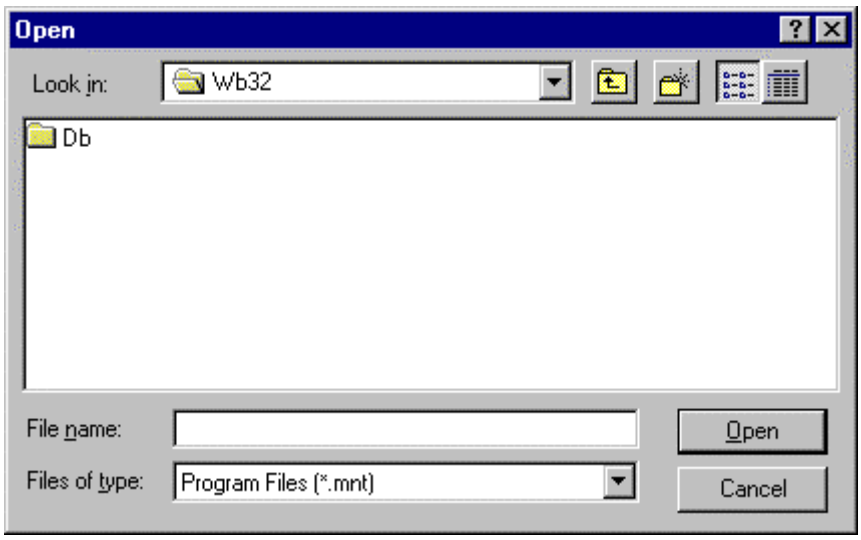


Figure 38: The Open file window for selecting existing files for editing

To provide the default program name above with a name when saving, select **File**, **Save As**.

The standard Windows Cut (Ctrl-X), Copy (Ctrl-C) and Paste (Ctrl-V) functions are available both on the toolbar and in the **Edit** menu.

Other editor functions include:

Downloading the files to the controller by using the toolbar icon . By using the **Tools, Setup Squash** selection, files can be compressed on download (see the following section for detail on squash).

Uploading the files from the controller into the current menu using the toolbar icon . WorkBench will automatically upload the correct file from the controller depending upon which editor window is open.

Ability for Mint files to be dragged from Windows Explorer onto the WorkBench desktop. This will automatically open the editor.

Printing from the editor using the Print icon on the tool bar. The file is printed to the currently installed Windows printer.

The right mouse button can be used within the editor window to provide context sensitive menus. The menu allows, for example:

Search and replace. This saves using the menu.

All white space can be displayed.

Selected text can be made upper or lower case.

The properties of the editor can be changed, for example, the color of the keywords can be changed from their default setting.

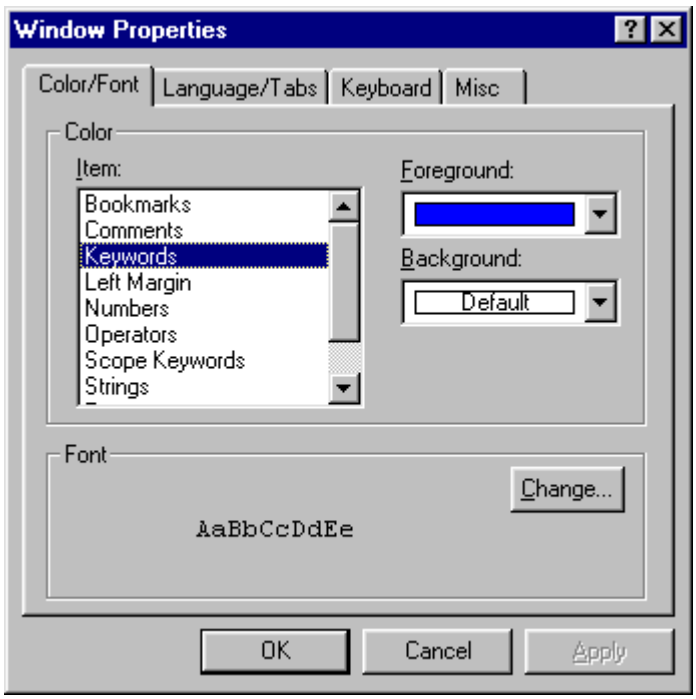


Figure 39: Properties sheet for the Mint WorkBench Editor

The tabs on the properties sheet gives access to the following:

Color/Font: The default font the editor can be changed. A mono spaced font should be selected for Mint files. The colors of keywords, numbers etc can be tailored to suit your tastes.

Language/Tabs: Only one language is supported, Mint. Always leave "Convert tabs to spaces while typing" checked.

Keyboard: The default keyboard mappings can be changed to suit your taste.

Misc: Controls whether color highlighting is used; whether scroll bars are shown; size of undo buffer etc.

All the settings are saved when the Mint WorkBench is closed down and will be available for the next session.

For syntax and keyword highlighting, it may be necessary to synchronize the editor with the latest version of Mint. This can be achieved by selecting **Edit**, **Load Syntax**. Updating the syntax should be done every time you receive a new version of Mint or a new ServoNode 51.

6.7 Squash

Squash allows a program to be compacted by removing redundant characters – blank lines for example. It is possible to save from an editor in the squashed format, or to have WorkBench Squash each time it downloads a file.

Squash can perform several operations on a file. However, some of them can make the code unreadable. Therefore, the options are individually selectable.

To initiate the *Setup Squash Parameters* dialog box, select **Setup Squash** from the **Tools** menu.

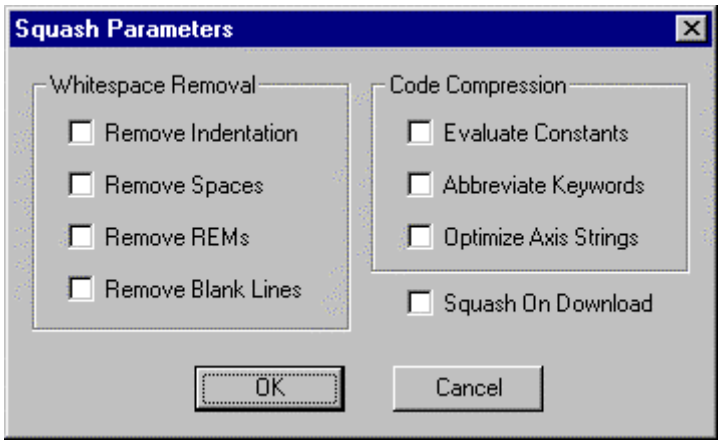


Figure 40: Setup Squash window

Whitespace removal section:

Remove Indentation - Clicking this check box removes spaces from the start of lines.

Remove Spaces - Clicking this check box removes any unnecessary spaces other than at the start of a line.

Remove REMs - Clicking this check box removes all **`REM`** statements.

Remove Blank Lines – Clicking this check box removes any blank lines.

Code compression section:

Evaluate Constants – Clicking this check box replaces Mint constants with their numeric values. For example, it replaces **`_cfservo`** with **`1.`**

Abbreviate Keywords - Clicking this check box replaces any longhand Mint keywords with their two or three letter forms.

Optimize Axis Strings - Clicking this check box will replace any single axis statements in the square bracket form with the dot form. For example: **`MA[0]`** will be squashed to **`MA.0`**

Selecting Squash on Download will always squash the program or configuration file on download. This is useful where a fully commented file can be maintained on the PC, but a space saving file is downloaded to the ServoNode 51 for execution.

6.8 Capture and Software Oscilloscope

A software oscilloscope is available in the Mint WorkBench. This works by sending an instruction to the ServoNode 51 to collect the required data. The ServoNode 51 will collect the data in its internal RAM and upload the data to the Mint WorkBench for viewing, printing or saving. There are two uses with the oscilloscope:

Capturing data for monitoring such as axis position, velocity or following error. This is discussed in section 6.4.

Axis tuning, allowing control parameters to be altered and a step response or move to be initiated and the results plotted for analysis. This is discussed in Chapter 3.

6.9 Jogging/Motion Toolbar

Using the motion toolbar, it is possible to enable a motor to be jogged. This can be useful for testing the system.

The axis number is selected using the Axis drop down. For ServoNode 51 this will be axis 0. The other buttons then control the jogging action. Finally, any error conditions are reported on the toolbar. This is given by a number. Clicking on the error will display a dialog box giving more information about the error.

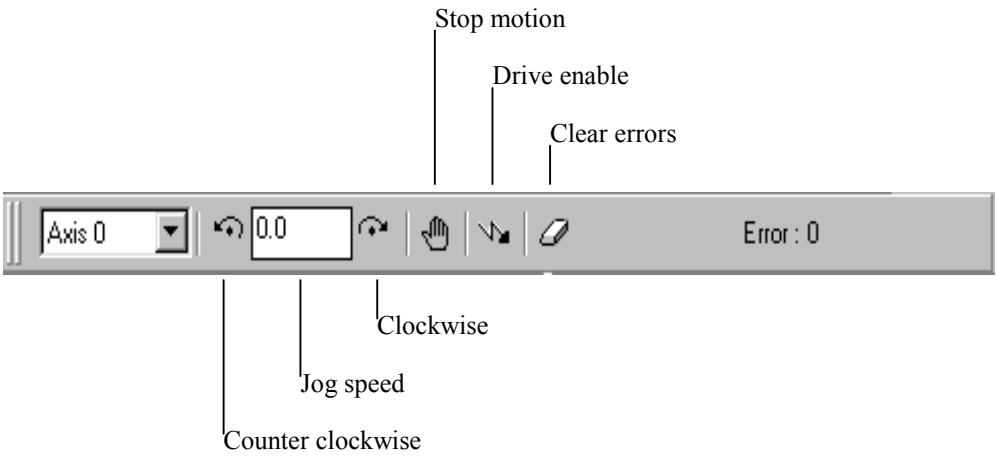


Figure 41: Motion Toolbar

The Jog Speed relies on the present acceleration, deceleration and scale values of Mint. If you wish to scale to revs for example, then the terminal window needs to be opened and the following typed at the command line:

```
SCALE = 4096
```

This assumes a 12 bit resolver or a 1024 line encoder.

With the scale factor set, the jog speed will be in revolutions per second. It is recommended that small values are used and steadily increased until motion is seen on the motor.

Before using the Jog facility, ensure that the motor is first tuned correctly. Tuning is covered in Chapter 3.

6.10 Firmware Update

The Mint firmware is stored in Flash. From time to time there may be updates to Mint, to either fix problems or to add new features. It is possible to update the Mint firmware using the RS232 serial port.

From the **Tools** menu, select **Update Firmware** and follow the onscreen instructions.

⚠ **Caution:** **The state of the analog and digital outputs cannot be guaranteed while firmware is being updated. Please disconnect any equipment which may be damaged.**

⚠ **Caution:** **It is recommended to remove any AUTO configuration file prior to updating firmware. Changes to the firmware may affect how your Mint application will work.**

⚠ **Caution:** **Updating firmware will destroy any program(s) held in the Flash memory buffers. It is recommended that you upload these into Mint WorkBench if you require these to be saved.**

Once the firmware has been updated, both the Config and Program Flash buffers will need resetting. Typing the **`NEW`** command in each Flash buffer will do this. The Mint keyword **`BUFFERSTORE`** can be used to switch between battery backed-up RAM and Flash buffers.

It is recommended to update the keyword tables supported by the controller after updating it with new firmware. This allows the Mint Workbench editor to identify keywords recognized by the controller.

To update the keyword tables, select **Load Syntax** from the **Edit** menu in Mint WorkBench.

Summary of Technical Data

7

This chapter provides a summary of technical data for the ServoNode 51 product.

7.1 General

ServoNode 51 is an integrated motion controller and brushless AC servo drive with internal power supply.

- 5A continuous
- 140Vdc (max)
- Encoder feedback
- 6 optically isolated inputs (12-24VDC ±20%). Configurable for PNP or NPN operation.
- Inputs software configurable for forward limit, reverse limit, stop, error input and home.
- Two inputs configurable for high speed position latch (FASTIN) on axis position and master encoder position.
- 3 optically isolated outputs
- One of the outputs rated at 500mA. Other outputs rated at 250mA.
- set of relay contacts for switching external voltages
- 1 RS232 serial interface.
- 1 CAN interface: configurable as CANopen DS401 master or Baldor CAN protocol.
- 1 analog input channel, usable as:
- Single ended input (0-10V), 12 bit or
- Differential input ±10V, 12 bit.
- analog output channels: bipolar outputs: ±10V; 8 bit resolution; 2mA output
- Seven segment display for diagnostics.

7.2 Power

Motor Supply

	Value	Unit
Min - max DC Bus Voltage	15 -140	V_{DC}
Nominal Phase Current (±10%)	5.0	A_{RMS}
Peak Phase Current (±10%) (2.0 +0.5/-0)s	10	A_{RMS}
Nominal Output Power	700	W
Efficiency	> 95	%
Nominal Switching Frequency	15	kHz

24V Controller Supply

	Value	Unit
Input voltage range absolute min/max V_{ripple} = ±10%	18 - 30	V_{DC}
Input Current @ 24Vdc Max	1.0	A_{dc}
Surge Current at Power On @ 24Vdc @ 100ms	2.0	A_{dc}

7.3 Environmental

Metric and *Imperial* units.

	Unit	ServoNode 51
Operating Temperature Range	ºC *ºF*	+5 ... +40ºC Derate 2.5%/ºC for 40ºC < T <= 50ºC (max) *32 ... 104* *Derate 2.5%/1.8ºF for* *104 < T <= 158*
Storage Temperature Range	ºC *ºF*	-25 … +70 *-13 ... +158*
Humidity	%	10…90; non condensing; acc. to DIN40 040 Class F
Class of Protection (Enclosure)		IP20 according to DIN40 050 / IEC144
Max. Installation Altitude/M.S.L.	m *ft*	1000 above derate 1.1% per 100m *3300* *above derate 1.1% per 330ft*
Shock	-	10G according to DIN IEC 68-2-6/29
Vibration	-	1G, 10..150Hz according to DIN IEC 68-2-6/29

7.4 Control Signals

Auxiliary (Master or handwheel) Encoder Input

	Unit	ServoNode 51
Signal	-	RS422
Operating Mode	-	A/B quadrature
Max Input Frequency (quad)	MHz	8
Sample time	ms	0.5, 1 or 2

Serial RS232 Interface

	Unit	ServoNode 51
Signal	-	RS232 with CTS/RTS non-isolated
Bit rate	Baud	9600, 19200, 57600

CAN Bus Interface

	Unit	ServoNode 51
Signal	-	2 wire isolated
Channels	-	1
Bit rate	bps	100, 125, 250, 500
Protocols	-	CANopen – CAN bus 1 BOCL CAN – CAN bus 2

Troubleshooting

8

This section provides instructions for checking your system by cross referencing tables of the most common symptoms.

8.1 Status Indicators

The ServoNode 51 has five status indicator LEDs on the front panel, which provide an indication of the status of the controller.

The “Drive” LED indicates the current state of the drive (or the processors governing the current loop).

The “CAN” LED indicates the current state of the CAN channel.

The seven-segment “Monitor LED” indicates the current state of controller and is the primary status indicator.

The meaning of each of these Status Indicators is indicated in section 0.

8.2 Problem Diagnosis

If the instructions in this manual are followed correctly then you should not have any trouble commissioning your ServoNode 51.

However, applications and ServoNode 51 / motor combinations vary and so the occasional problem may be encountered. If you do encounter a problem, the following sections should guide you through such potential problems that you may encounter when commissioning your ServoNode 51 for the first time.

Check through the Diagnosis tables / sections below first and try the suggested solutions. If you cannot find the problem listed or after trying the suggestions the problem still persists then contact Baldor Technical Support.

Before contacting Technical Support, please note down the following information (if available):

The Serial Number of your ServoNode 51;

The Catalog Number indicating the type of ServoNode 51 you have;

Assuming you have access to the command line, type “**VER**” and note down the software version number and the build number;

Assuming you have access to the command line, type “**VIEW PLATFORM**” and note down the information given;

The Catalog Number of the motor that you are using;

The version of Mint WorkBench (click “Help” => “About”) that you are using.

Give a precise and clear description of what you are trying to do, e.g.

trying to establish communications with the Mint WorkBench;

trying to run the Feedback Alignment test under the “Drive Setup” dialog;

trying to setup my Mint Gains;

Give a precise and clear description of the symptoms that you can observe, e.g.

The current state of any of the status indicators;

Error messages displayed;

The current value of any of the Mint error keywords: **AXISERROR**; **AXISSTATUS**; **MISCERROR**; **DRIVEFAULT**; **ERR** and **ERL**.

The nature of motion of the motor shaft.

Give a list of any parameters that you have setup, e.g.

The motor data you entered / selected from the “Drive Setup” dialog;

The gain settings generated by the “Drive Setup” tests;

The Mint gain settings you have entered: e.g. **KPROP**, **KINT**.

Depending upon the nature of your problem you may be asked for some or all of the above information.

8.2.1 Troubleshooting Communication Problems

Use this section to troubleshoot problems communicating with your ServoNode 51.

Symptom	Check
No LEDs are illuminated	Check that the 24Vdc power supply is correctly connected (to connector J3) and switched on.
Mint WorkBench fails to detect the ServoNode 51 – it detects another controller	Mint WorkBench automatically attempts to re-select the last controller it was connected to – select "Tools => Select Controller" on Mint WorkBench and perform a 'rescan'. In the "Select Controller" dialog box, check that a 'ServoNode 51' has been detected in the drop-down list and select it.
Mint WorkBench fails to detect the ServoNode 51 - detects "Controller with No Firmware" on the serial port.	Ensure that the ServoNode 51 is powered and the LEDs are illuminated. Check that the RS232 cable is connected in connector P1 on the ServoNode 51 and in the PC. Check the wiring of the RS232 cable (or try an alternative cable). If available on the PC, try an alternative serial port. Confirm that a mouse driver or other serial device is not conflicting with Mint WorkBench.
Cannot communicate with the ServoNode 51 over the RS232 port (cannot get `P>` of `C>` prompt by pressing return).	Check that the Mint WorkBench has detected the ServoNode 51 (indicated in the status bar at the bottom of the window). Check that the ServoNode 51 is still powered. Check that the 'focus' is on the Terminal window of the Mint WorkBench – click in the Terminal window. Check that there is not a program already running on the controller (press [Ctrl] + [E] to abort the program). Check that a program hasn't disabled the RS232 terminal using the TERMINAL keyword (pressing [Ctrl] + [E] will re-enable the RS232 serial port). Check that the "Drive" LED is illuminated. Power-cycle the ServoNode 51.

8.2.2 Troubleshooting Power-up Problems

Use this section to troubleshoot problems indicated by the status indicators at power-up.

Symptom	Check
No LEDs are illuminated	Check that the 24Vdc power supply is correctly connected (to connector J3) and switched on.
One or more of the following LEDs are not illuminated: Monitor, Drive and CAN LEDs.	Check power connections. Power-cycle the unit. If problem persists then contact Baldor Technical Support.
The "Drive" LED is illuminated red.	The drive has detected an error, interrogate the ServoNode 51 (either by typing "PRINT DRIVEFAULT" at the command line or by clicking on the error button on Mint WorkBench) to find out the fault code and refer to section 8.2.5.
The CAN LED is illuminated red or flashing red.	See section 4.1.2.
The "Drive" LED is green and the "Monitor" LED indicates 'E'	The controller has detected a motion error – interrogate the ServoNode 51 (either by typing "PRINT AXISERROR" at the command line or click on the error button on Mint WorkBench) to find out the motion error(s) present and refer to [1]
The message "Variables corrupted. Use RELEASE." is shown at power-up.	Type "RELEASE" at the command line prompt to clear variables from the variable stack. If the problem still exists contact Baldor Technical Support.
The message "Memory Corruption. Use NEW to clear buffers." is shown at power-up.	Type "NEW" in both the 'Configuration' (type "CON" to enter) and 'Program' (type "PROG" to enter) buffers to clear corrupted programs from memory. If the problem still exists contact Baldor Technical Support.
The message "Initialization Error" is shown at power-up.	Contact Baldor Technical Support.
The message "Fatal Initialization Error." is shown at power-up.	Contact Baldor Technical Support.
The message "Processor Reset Code = xx" is shown at power-up.	Has new firmware just been downloaded? If so, this message may be ignored. Has the controller been power-cycled? Power-cycle the unit again, if this problem persists then contact Baldor Technical Support. Has the firmware just reset without the unit being power-cycled? Contact Baldor Technical Support.

8.2.3 Troubleshooting Tuning the Drive Stage

Use this section to troubleshoot problems that have occurred during the motor tuning sequence.

Check whether the drive goes into error (i.e. the Drive led is illuminated red) during any of the tests, if so then refer to section 8.2.5.

Check that Mint can communicate with the drive. This can be achieved by typing

```
PRINT DRIVEFAULT
```

at the command line – if no error is reported then communication can be achieved.

Symptom	Check
Motor not tunable.	Check the motor power supply is correctly connected and switched on. Check that the motor UVW cable is correctly connected. Check that the feedback cable is correctly connected. Repeat the test. Power-cycle the unit and repeat the test. Set the gains. Enter the Current Proportional gain.

8.2.4 Troubleshooting setting Mint Gains

Use this section to troubleshoot problems encountered when setting Mint gains.

Symptom	Check
The motor is unstable	Check that the current loop has been tuned. If after removing Mint gains, the motor is still unstable, try reducing the following drive gains (Speed Proportional gain and Speed Integral gain).
I get a Following Error (AXISERROR bit 5 is set) and the drive disables when tuning the Mint gains	Set FOLERRORMODE to zero i.e. to ignore the following error while tuning the Mint gains.
I get a Software limit error (AXISERROR bits 3 or 4 set) and the drive disables when tuning the Mint gains	Set SOFTLIMITMODE to zero i.e. to ignore the software limit error while tuning the Mint gains.
I get a Hardware limit error (AXISERROR bits 1 or 2 set) and the drive disables when tuning the Mint gains	Set LIMITMODE to zero i.e. to ignore the hardware limit errors while tuning the Mint gains. Alternatively disable the hardware limit inputs.

8.2.5 "Drive LED" is illuminated Red

If the "Drive LED" is illuminated red (the "Monitor" LED will also show 'E'), then refer to the table below after determining the type of fault detected.

At the command line, type the following:

```
PRINT DRIVEFAULT
```

this will return a fault code.

Alternatively, on Mint WorkBench click on the error button on the 'motion' toolbar, which will display the drive fault detected.

If any fault codes not listed below are indicated then please contact Baldor Technical Support.

Fault Code	Fault	Description
	Encoder Loss	Encoder feedback problem is indicated Does this occur during high acceleration or deceleration? Check wiring of the encoder cable at both connector P4 and at the motor. Check that +5Vdc is being supplied to the encoder by the ServoNode 51. Check that 3.5Vdc (approx) is being returned on each of the encoder channels
	Logic supply fault	Controller power supply not working properly or supply has dropped below the minimum input voltage (18Vdc). Replace power supply. Contact Baldor Technical Support
	Under volts fault	Insufficient bus voltage on startup. Verify correct motor voltage is being supplied ServoNode 51. Check for power input line disturbances (e.g. sags caused by start-up of other equipment). Does this fault occur immediately after power-up? If so, remove the Regeneration resistor (if connected) and try again. Contact Baldor Technical Support
	Overload	The current rating of the control has been exceeded. Check the motor and feedback wiring Does this happen during high acceleration rates?

Fault Code	Fault	Description
		Decrease the Mint ACCEL parameter Reduce the motor load Check motor and load for excessive friction or improper operation such as a broken gear in a gearbox.
	Over speed fault	Motor RPM exceeded 110% of programmed MAX Motor speed. Check the setting of the maximum mechanical speed of the motor (type PRINT DRIVEPARAM.2002) against that specified in the catalog. If different, enter the value specified in the catalog. Check the Mint demanded velocity (monitor using either the quick watch window or capture window) and compare to the max. speed parameter. If the Mint demanded velocity is greater than the max. speed of the motor modify your Mint program to generate a slower demand velocity.
19	Control temp fault	Temperature of MME exceeded safe level. Check the ambient temperature around the drive. Ensure that the unit is adequately ventilated. Ensure that the unit is correctly mounted. Check correct operation of fans (if fitted) and ensure that they are clear of dirt.
22	Microprocessor reset	Controller voltage fallen below 18Vdc Power-cycle the unit. Check power-supply

8.2.6 Troubleshooting Problems with CAN

Use this section to troubleshoot any problems encountered when connecting to CAN. Full details of setting up CAN devices can be found in Chapter 5.

For error messages reported through Mint to specific CAN commands, refer to the Mint v4 Programming Guide.

Symptom	Check
The CAN LED is illuminated red – CAN Bus is off.	Is the NODE number set to 1? Type "CANBUSRESET" – does the LED go green.
The CAN LED is flashing red/green – CAN Bus is passive.	Type "CANBUSRESET" – does the LED go green.
The CAN LED is illuminated red – CAN Bus is off.	Type "CANBUSRESET" – does the LED stay red. If the LED is now green repeat the CAN command(s) that gave the problem – does the fault re-appear? Do you have any CAN I/O Nodes connected? Check that they are powered. Check that a terminator resistor is connected at each end of the CAN network. Check that the jumpers on the CAN peripherals are in the correct settings – JP1 and JP2 are set for bus 2. Check that the Baud rate of the controller (CANBAUD) is as expected. Check the Baud rate of each I/O Node on the network (this can be confirmed by doing a static configuration of a single I/O Node) – the factory setting is 125 KBaud. Are there any conflicts between the node identifiers of each I/O Node? Type "VIEW CANEVENT" to monitor the bus – refer to the Mint v4 Programming Guide for details. Reduce the network to the CAN node that you appear to be having trouble with and repeat the CAN command(s).
The CAN LED is flashing red/green – CAN Bus is passive.	Type "CANBUSRESET" – does the LED stay flashing red. If the LED is now green repeat the CAN command(s) that gave the problem – does the fault re-appear? Do you have any CAN I/O Nodes connected? Check that they are powered. Check that a terminator resistor is connected at each end of the CAN network. Check that the jumpers on the CAN peripherals are in the correct settings – JP1 and JP2 are set for bus 2.

Symptom	Check
	Check that the Baud rate of the controller (CANBAUD) is as expected. Check the Baud rate of each I/O Node on the network (this can be confirmed by doing a static configuration of a single I/O Node) – the factory setting is 125 KBaud. Make sure that each node has the same Baud rate setting as the controller. Are there any conflicts between the node identifiers of each I/O Node? Type "VIEW CANEVENT" to monitor the bus – refer to the Mint v4 Programming Guide for details. Reduce the network to the CAN node that you appear to be having trouble with and repeat the CAN command(s).

Bibliography

Bibliography

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[1] The Mint V4 Programming Guide (MN1262)
[2] CAN Peripherals Users Guide (MN1255)
[3] Mint v4 CAN Programmers Guide (MN1282)
[4] The Advanced Mint V4 Programming Guide (MN1270)

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