XYZ Machine Tools Proturn Lathes
ProtoTrak® RLX CNC
Safety, Maintenance, Service and Parts List Manual

Part Number:	19242
Version:	161221

Covers Current Models:

XYZ RLX 1630
XYZ RLX 355
XYZ RLX 425
XYZ RLX 555
XYZ RLX780

XYZ Machine Tools Ltd.
Woodlands Business Park
Burlescombe, Tiverton, Devon EX16 7LL
T: 01823 674200 F: 01823 674201
www.xyzmachinetools.com

XYZ Machine Tools Ltd
Woodlands Business Park
Burlescombe
Devon EX16 7LL
Phone 01823 674200 ▪ Fax 01823 674201
www.xyzmachinetools.com

CONTENTS

1 Safety

1.1 Safety in Maintenance, Servicing and Repair (MSR)

This machine should only be maintained, serviced and repaired by suitably competent personnel who understand and know how to manage the risks involved.

Wherever possible, the machine should be maintained/serviced with electrical and pneumatic power removed, furthermore:

- Electrical and pneumatic power supplies should be locked out to prevent reconnection whilst working on the machine (use recognised LockOut-TagOut procedures).
- The air ride tailstock or any accessories using air should be operated a few times to dissipate any stored energy in the system.
- Wait 5 minutes for stored electrical energy to dissipate in the spindle and axes servo drives.

If particular activities require the machine to be powered, apply as many of the following safety precautions as permit the activity to be undertaken:

- E-stop the machine
- Open the chuck guard to disable the spindle
- Put the control into an idle state. That is, any mode except DRO, TOOL TABLE or RUN mode. Ideally press the BACK key until the CHECK SYSTEM screen appears (E-stopping the machine will do this).

A lot of items on these machines are heavy and awkward in shape and balance. Removal/refitting of such items should be properly planned. Mechanical lifting aids may be required.

Some maintenance/servicing activities require working at heights. Suitable training and access equipment is required.

During MSR activities, unauthorised personnel should be excluded from the area around the machine.

During MSR activities, workpieces and tooling should be removed from the machine.

The maintainer must be aware of all safety hazards. Such hazards include:

- Electric shock from electrical power supplies and stored energy in the spindle and axes drive units.
- Release of pressure from pressurized pipework – pneumatic and lube system
- Trapping/pinch points on moving parts
- Sharp edges
- Hot surfaces – especially the spindle brake resistors.

1.2 General, Safe Operating Information

The ProtoTrak RLX lathes are designed as toolroom lathes. As such, they have design features which, on the one hand, provide more flexibility for the user, but on the other; may increase residual risks. This flexibility (and increased risk) stems from:

- Ability to run the spindle at any speed with the main door guard open; giving better visibility and access to the job,
- Unrestricted mode selection, allowing the same operator to switch quickly between setup and cutting modes.

It is therefore very important that the responsible person (employer or machine owner/controller):

- Undertakes a Risk Assessment on the use of this machine, paying particular attention to the unique characteristics of this ProtoTrak, toolroom lathe,
- Generates and applies Safe Operating Procedures for the use of the ProtoTrak machine
- Provides any additional training, safeguarding and PPE identified by the risk assessment.
- Ensures the machine is only used by suitably trained, experienced and motivated operators.

These responsibilities fall to the machine controller under the Provision and Use of Work Equipment Regulations (1998) or equivalent local regulations.

This machine is designed for the turning of cold metal within the stated capacity of the lathe with axes movement occurring by manual use of handwheels or CNC control.

This machine must not be used for machining flammable materials (e.g. magnesium) without undertaking a risk assessment and incorporating any additional safety measures identified.

It is designed to be used in a standard workshop environment only.

All operators must read and study the ProtoTRAK RLX CNC Safety, Programming, Operating, and Care Manual (see reference section, chapter 9). The machine must not be operated until operators understand the operation and safety requirements of this machine.

The following Safety Features must be checked on a regular basis (for example at the start of every shift):

1. E-stop:
    a. Press the E-stop button, and ensure that the control flags up faults 261 (E-stop active) and 0055 (machine disabled) and that the axes and spindle cannot be started. Check the spindle is held on the emergency stop brake.
    b. Do this for each button (pendant and apron) in turn.
    c. For lathes with sliding front guards: press each of the safety edge strips (reset between each side) and check the machine goes into the E-stop condition each time.
2. Guard Interlocks:
    a. Chuck Guard: Start the spindle at maximum speed and then open the chuck guard. Check that the spindle stops quickly (around 3 to 8 seconds depending on model) and cannot be re-started.
    b. Belt Door Guard: Repeat the above for the belt door guard. **WARNING: Only open the door enough to trigger the interlock – stay well clear of the spindle drive belts!**
    c. Rear Chuck guard and Loading guard (RLX780): Repeat the above check.
    d. Main Door Guard: Open the main door guard in DRO mode. Check that the door open message appears on the screen and that maximum feedrate is limited to 2m/min (78 ipm).
1. Safety Speed Monitoring – Close the main door guard and whilst jogging at max feedrate, open the guard. Check for a fault 247 or 249, depending on which axes was jogging (max permissible feedrate exceeded).
2. Guards: Inspect the guards for signs of damage (especially the transparent panels). Replace if any part of the guard is damaged. Replace the transparent panels in accordance with the stated schedule, regardless of their apparent condition (see the FAQ on our website for why this is important).
3. Jog Stick – Check the jog stick mechanical interlock is functioning – Go into DRO mode and push the jog stick in each direction without lifting the mechanical interlock release. Check jog stick does not operate and axes do not move. **Do not** apply excessive force to the jog stick with the interlock engaged – this could eventually break the interlock.

Notes on the E-stop and Guard critical safety functions:

1. E-stop:
    - This is provided by a safety rated, hard-wired E-stop system controlled by the E-stop button on the pendant or apron. When the machine is E-stopped, the axes are disabled and the spindle is stopped quickly (if running), then put into a Safe Torque Off mode.
    - Releasing the E-stop button and pressing the Reset button, will always take the machine out of the hardware E-stop condition (unless there is a fault with the safety circuits). However, the machine may still be disabled because of the current machine mode, or on the results of software safety checks undertaken by the control (fault 0055). This an "NC Not ready" state; and should not be confused with the hardware E-stop condition.
    - If you wish to leave the machine in a hardware E-stop condition, for example, when leaving the machine unattended, always press in, and leave pressed in, one of the E-stop buttons. Do not twist to release the E-stop button until you are ready to make the machine live again.
2. Chuck and belt door Guards:
    - When these guards are opened, the spindle control system actively drives the spindle to a stop, but the spindle remains powered. After a short delay, the spindle is put into a Safe Torque Off mode, where the spindle is now completely safe.
    - Therefore, DO NOT touch the spindle until the spindle is in the Safe Torque Off Mode; wait at least 5 seconds after the spindle has stopped.

When operating this machine, always observe the following safety precautions

- Do not operate this machine without knowing the function of every control key, button, knob, or handle.
- Always wear the appropriate personal protective equipment, including safety glasses and safety shoes.
- Do not wear loose fitting gloves whilst operating this machine as they could easily get caught in moving parts.
- Never wear rings, watches, long sleeves, neckties, jewelry, or other loose items when operating the machine.
- Keep your hair away from moving parts. Wear adequate safety head gear.
- Never operate any machine tool after consuming alcoholic beverages, or taking strong medications, or while using non-prescription drugs.
- Carry out a COSHH risk assessment and use the correct protection equipment, e.g. barrier cream/latex gloves, to prevent harm from items such as cutting fluid, lubrication oil and other substances used on the machine.
- Do not use compressed air to remove swarf or clean the machine. This can damage the slideway seals and create coolant mist which can be harmful. XYZ recommend the use of BioConcept cutting fluids which do not present a risk to the respiratory tract.
- Always ensure the appropriate guarding is in place for the machinery operation being undertaken. Never reach around a guard to access the tool, part or fixture.
- Always close the Door Guard when cutting, even in DRO mode.
- Observe and understand the warning and safety information labels affixed to this machine.
- Do not attempt to tamper with or override any guarding/safety device fitted to the machine.
- Do not exceed the maximum RPM rating of the work holding device (chuck, faceplate etc.).
- Take special care to set a safe, maximum RPM when working with unbalanced work pieces or using work holding devices with independent jaws.
- The safe, maximum RPM value must always be entered into the ProtoTrak control before the spindle is started.
- Stop the machine spindle and ensure that the CNC control is in the STOP mode:
    - Before changing tools.
    - Before changing parts.
    - Before you clear away the Swarf, oil or coolant. Always use a chip scraper or brush.
    - Before you make an adjustment to the part, chuck, coolant nozzle or take measurements.
    - Before you open any guards.
- Do not rotate the spindle by hand unless the chuck guard is open.
- Keep the working area clear and remove all tools (spanners, chuck keys, etc.) from the machine before you start the machine running. Loose items can become dangerous flying projectiles.
- Keep work area well lit. Ask for additional light if needed.
- Be aware that the machine can move unexpectedly so do not lean on the machine while it is running.
- To prevent slippage and personal injury, keep the working area around the machine dry and clean. Ensure there is no swarf, oil, coolant and obstacles of any kind around the machine.
- Avoid getting pinched in places where the spindle, carriage, cross slide or guard doors create "pinch points" whilst the machine is in motion.
- Securely clamp and properly locate the workpiece in the vice/chuck or in a fixture. Use proper tool holding equipment.
- Long workpieces must not be machined without suitable supports from the tailstock and/or steadies. The maximum, unsupported workpiece length **MUST NOT EXCEED 300mm**.
- Material extending out of the back of the headstock can present a whipping hazard. Ensure the workpiece is supported with the correct equipment prior to starting the spindle.
- Use the correct tooling for the process being undertaken. Never use damaged or worn tools and ensure the correct cutting parameters (speed, feed, and depth of cut) are used in order to prevent tool breakage.
- Prevent damage to the workpiece or the cutting tool. Never start the machine (including the rotation of the spindle) if the tool is in contact with the part.
- Avoid large overhangs on cutting tools when not necessary.
- To prevent fires, keep flammable materials and fluids away from the machine, hot swarf and workpieces.
- Never change gears when the spindle is rotating
- Stop and disconnect the power to the machine before undertaking any machine cleaning or maintenance

1.3 Release of Trapped Persons.

Because of the size of these machines or lack of fully enclosed guarding, persons are unlikely to be trapped inside the machine. However, in the event of persons being trapped by moving machine parts:

1. Hit any E-stop button to kill all power to the spindle and axes.
2. Open the chuck guard to ensure the spindle is in the Safe Torque Off mode.
3. If trapped by chuck/workpiece, reset the E-stop to release the spindle brake or turn off power to the machine. Then rotate the chuck by hand to free the trapped person.
4. If trapped by the axes, remove the relevant axes drive cover and wind the ballscrew by hand to clear the trapped persons. Alternatively, reset the E-stop (leave chuck guard open), put the control into DRO mode, select FINE feedrate and use the Electronic Handwheels to move the axes slowly clear of the trapped person.

1.4 Danger, Warning, Caution, and Note Labels and Notices Used in this Manual

DANGER - Immediate hazards that ***will*** result in severe personal injury or death. Danger labels on the machine are red in color.

WARNING - Hazards or unsafe practices that ***could*** result in severe personal injury and/or damage to the equipment. Warning labels on the machine are amber in color.

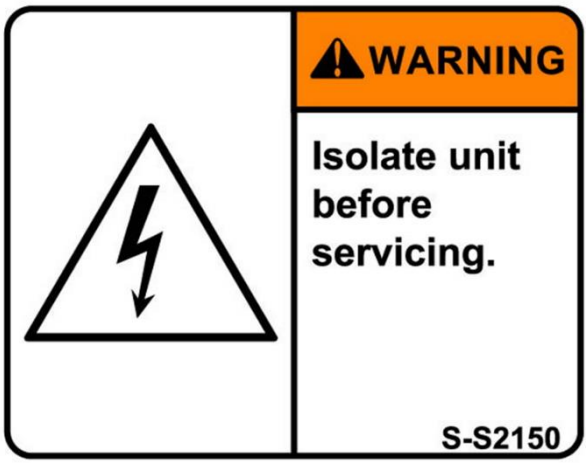
CAUTION - Hazards or unsafe practices that ***could*** result in minor personal injury or equipment/product damage. Caution labels on the machine are Yellow in color.

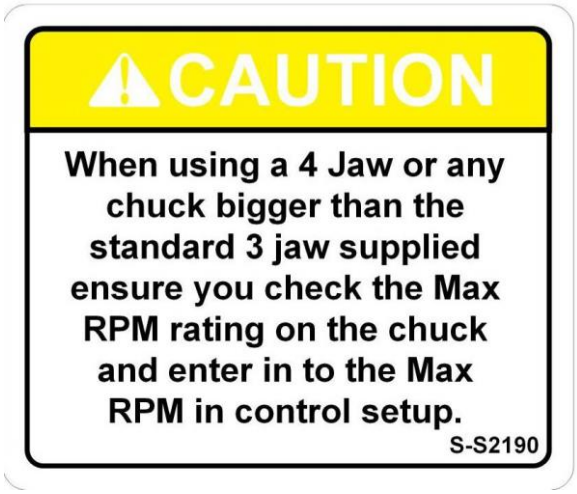
NOTE - Call attention to specific issues requiring special attention or understanding.

1.5 Airborne Noise Emissions

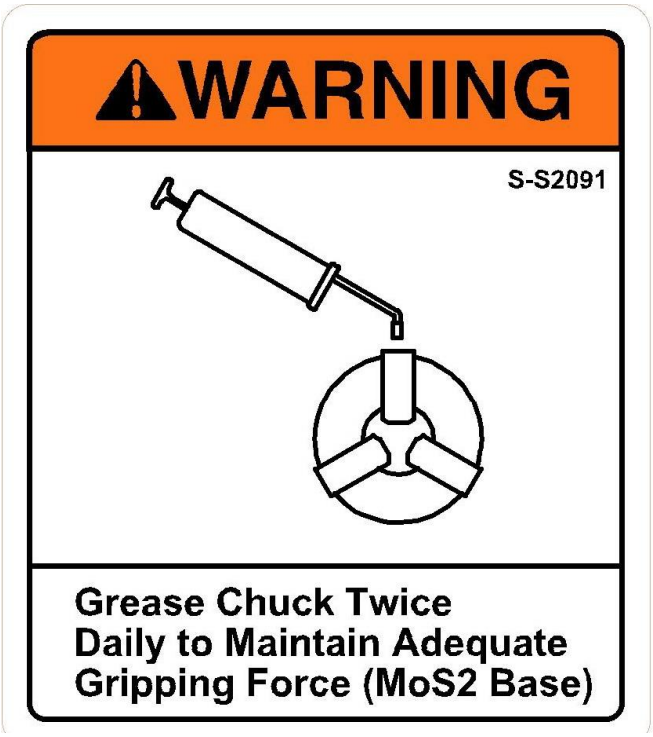
The A-weighted emission sound pressure level at the operator's workstation is 73dB(A).

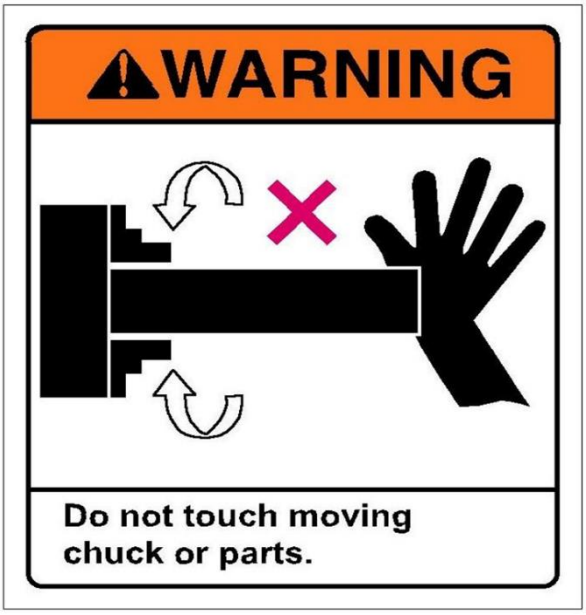
The figures quoted are emission levels and are not necessarily safe working levels. Whilst there is a correlation between the emission and exposure levels, this cannot be used reliably to determine whether or not further precautions are required. Factors that influence the actual level of exposure of the workforce include characteristics of the work room and other sources of noise, i.e. the number of machines and other adjacent processes. Also, the permissible exposure level can vary from country to country. This information, however, will enable the user of the machine to make a better evaluation of the hazard and risk.





Safety & Information Labels Used on Proturn RLX Lathes

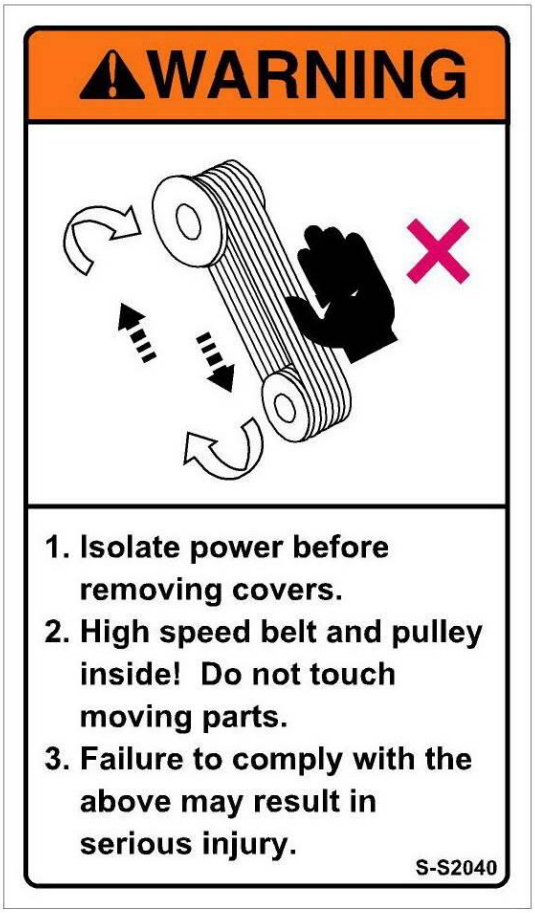




S-S2060

Safety & Information Labels Used on Proturn RLX Lathes

Safety & Information Labels Used on Proturn RLX Lathes

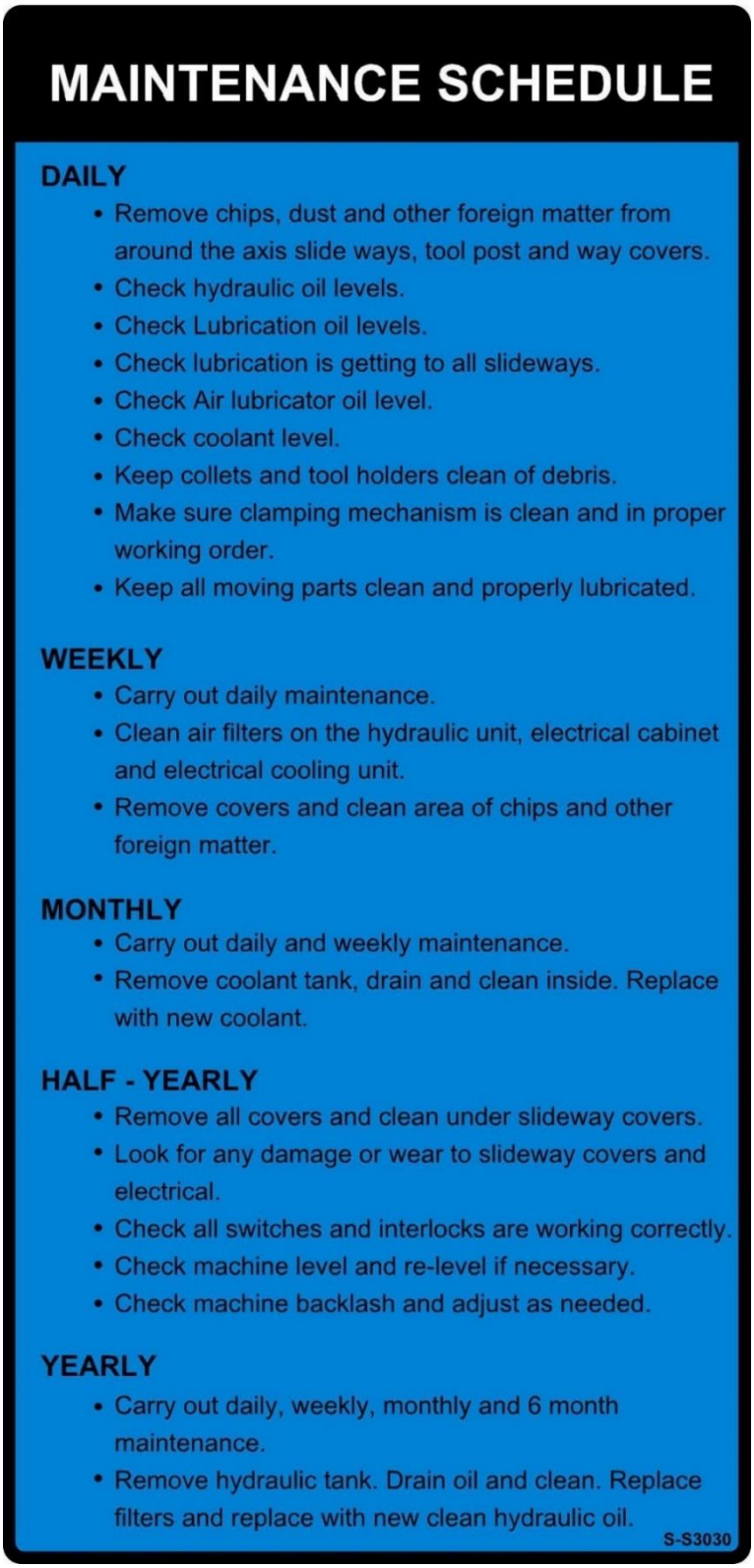


(RLX780 and 555x3m only)

Safety & Information Labels Used on Proturn RLX Lathes

Safety & Information Labels Used on Proturn RLX Lathes

Safety & Information Labels Used on Proturn RLX Lathes



Safety & Information Labels Used on Proturn RLX Lathes

2 Description

2.1 Overview

The RLX range of lathes are horizontal, turning machines of conventional design, fitted with the RLX CNC control system.

The RLX control system provides both manual and automatic control over:

- Axes movements (manually, using electronic handwheels or jog stick or by automatic programme instructions),
- Spindle speed and direction (note: spindle start is never automatic),
- Other machine functions such as lube and coolant pump.

The control system comprises:

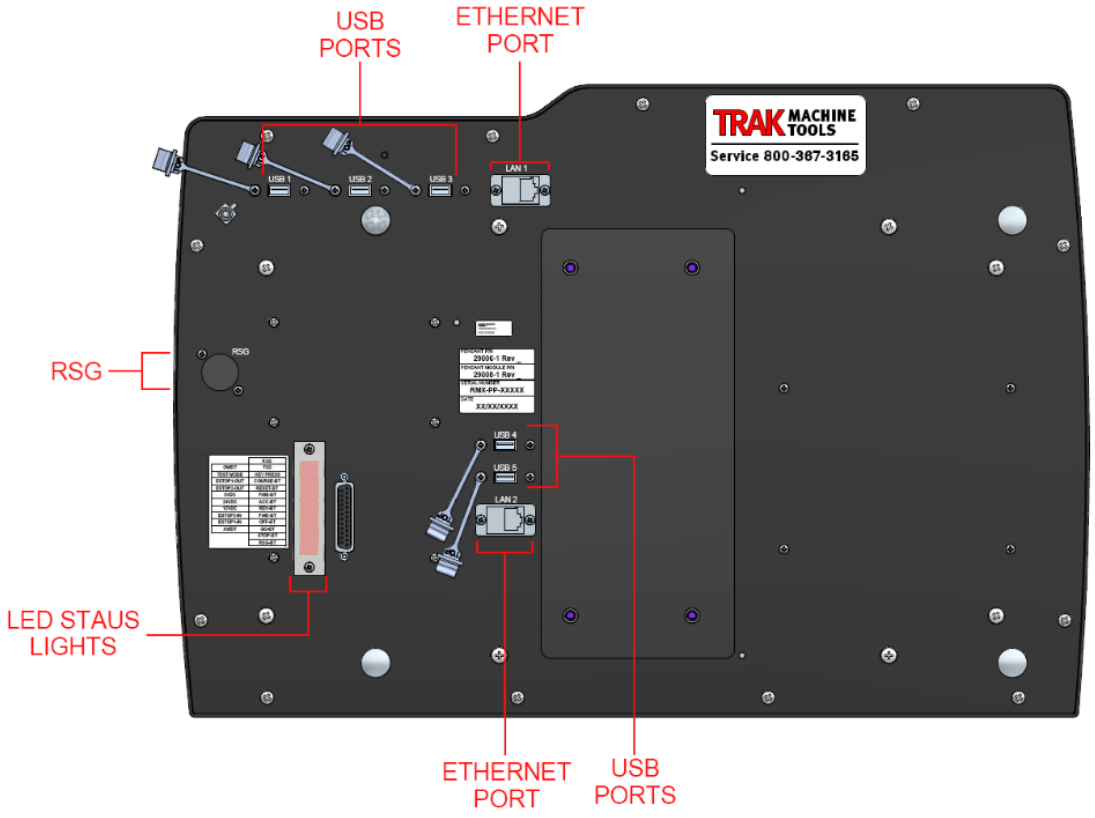
- A control pendant, which provides the user operating and programming interface,
- Motion Control Computer Module, located in the electrical cabinet,
- Spindle, variable frequency drive (Yaskawa),
- AC Servo Drives and Motors (Delta Electronics), including positional feedback encoders.

Other machine equipment includes:

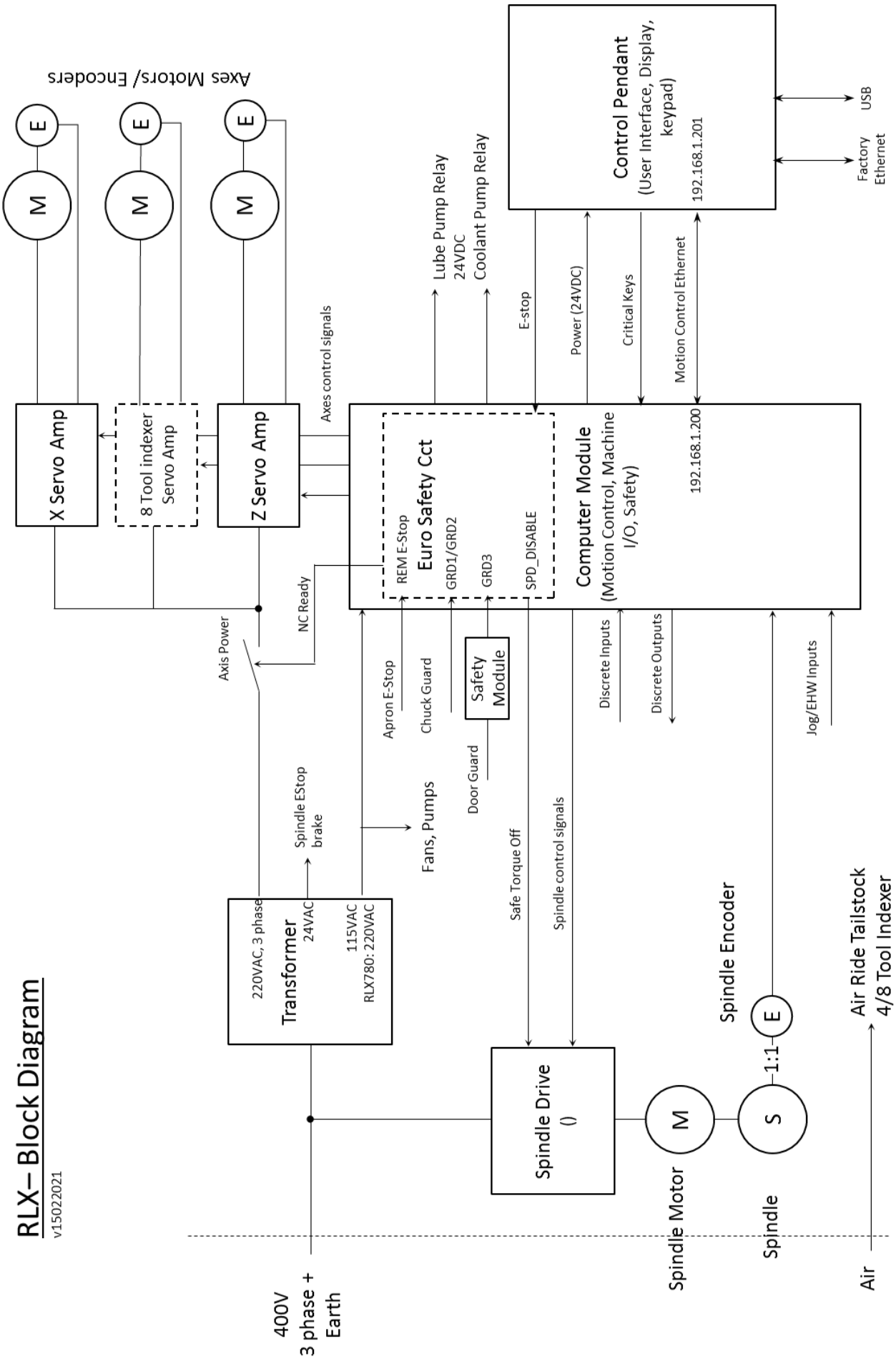
- Machine electrical equipment:
    - lube pump
    - coolant pump
    - task lighting
- Mechanical, emergency stop spindle brake for rapid spindle stopping in E-stop conditions.
- Chuck guard(s),
- Full guarding for the machining compartment with full-width, up and over door or sliding saddle guard (on the larger machines).
- Air ride tailstock (not 1630)

See the RLX programming/operating manual for more information on how to use the pendant controls.

RLX Control Pendant – Front View



RLX Control Pendant – Rear View


RLX– Block Diagram
v15022021
Axes Motors/ Encoders
X Servo Amp
8 Tool indexer Servo Amp
Z Servo Amp
Axes control signals
Lube Pump Relay
24VDC
Coolant Pump Relay
E-stop
Power (24VDC)
Critical Keys
Motion Control Ethernet
Control Pendant
(User Interface, Display, keypad)
192.168.1.201
USB
Factory Ethernet
Euro Safety Cct
REM E-Stop
GRD1/GRD2
GRD3
SPD_DISABLE
Computer Module
(Motion Control, Machine I/O, Safety)
192.168.1.200
Axis Power
NC Ready
Safety Module
Door Guard
Apron E-Stop
Chuck Guard
Fans, Pumps
Discrete Inputs
Discrete Outputs
Jog/EHW Inputs
Spindle EStop brake
Safe Torque Off
Spindle control signals
220VAC, 3 phase
Transformer
24VAC
115VAC
RLX780: 220VAC
Spindle Drive
()
Spindle Encoder
1:1
Air Ride Tailstock
4/8 Tool Indexer
Spindle Motor
Spindle
Air
400V
3 phase +
Earth

2.2 Machine Specifications

Refer to the reference section (chapter 9) for full machine specifications and GA drawings

3 Installation and Commissioning

Because of the size and weight of these machines, they must be delivered, installed and commissioned by suitably trained, XYZ personnel. Should you wish to undertake any of these activities yourself, please contact XYZ Service to discuss.

The Customer is responsible for providing the following:

1. Electrical Supply
    a. 400V, three phase and Protective Earth, 50/60Hz.
    b. Machine rating is quoted in table above and in the commissioning form we send you so that you can design and install a suitably rated supply.
    c. Please read carefully the notes supplied with the commissioning form regarding supply rating and earth leakage.
    d. All RLX machines have a high earth leakage; up to 50mA (150mA for the RLX780). The Circuit Protective Conductor must be a minimum of $10mm^2$ copper, or else the supply must adopt other recognised measures for supplies to high earth leakage equipment.
    e. The machine must be wired to the electrical supply before we commission the machine.
2. Compressed air supply:
    a. Compressed air requirements are given on the commissioning form we send you so that you can install a suitable supply. The RLX1630 does not require an air supply unless the 4 tool indexer is fitted.
    b. The machines have a PCL standard adaptor and we recommend a flexible hose supply.
3. Coolant
    a. Please ensure the machine is filled with coolant so that we can check coolant pump operation during commissioning. XYZ recommend the use of BioConcept fluids for health reasons.

There are some customisable user settings which you may wish to modify. See the Programming and User manual for more information (especially the Status and Defaults windows).

See maintenance section (4.0) for levelling and tailstock alignment instructions.

3.1 Floor Plan, Layout and space Requirements

A suitable location must be provided for the machine:

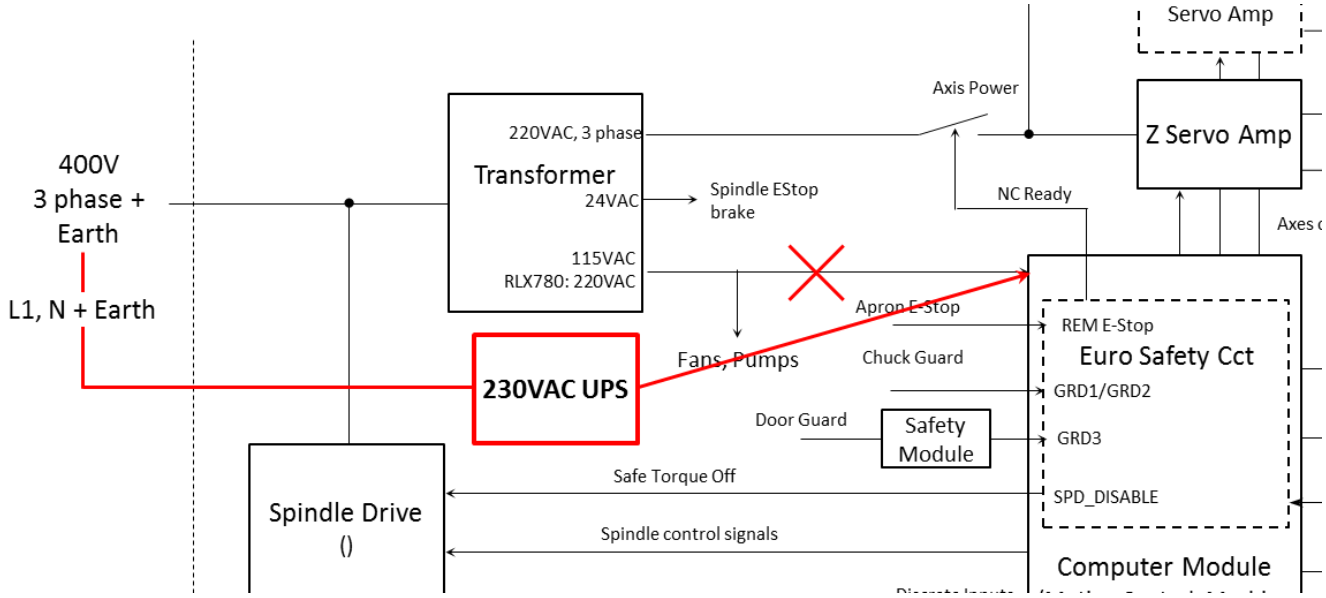
1. Space Requirement: Sufficient space must be provided to allow the machine to be installed, operated and maintained safely. Allow enough clearance at the rear to open the electrical cabinet door fully. Refer to the space claim on the commissioning form we send you,
2. Floor surface: level to within 20mm over the floor plan area.
3. Floor strength: Adequate to accommodate the machine (plus max workpiece) weight, distributed over a number of levelling pads of area $100cm^2$ (assume max pad load = 150% x average load). See the relevant installation drawing for the number of pads.

3.2 Notes on use of an Uninterruptible Power Supply

The RX computer module provides the low power, control power supplies for the whole machine CNC system. If you wish to protect your control from supply outages, then the computer module is the ideal place to insert a UPS, as it need only be rated for the control power requirements, not the whole machine (3-phase) power requirements. The computer module can also be safely powered from 230VAC, allowing commonly available UPS systems to be used.

The UPS should be capable of supplying 3A, for as long as you wish to ride-through a power outage. XYZ suggests at least 5 minutes; long enough to allow (an attended) machine to be shutdown properly. Obviously, you will not be able to run the machine during the outage.

Please apply your UPS as per the following diagram. Some modification to the machine wiring is required, and this should only be done by an electrically competent person. Please contact XYZ if you require further information.



3.3 Notes on Phase converters

The smaller RLX lathes can theoretically be run from a single phase supply using a phase converter. However, there are a number of important considerations:

1. Use a rotary phase converter only (not static),
2. If using a digital phase converter – you MUST use an output sine filter to eliminate switching pulses,
3. Follow manufacturer's guidance explicitly with regard to ratings and installation,
4. Rating must be adequate for the current drawn by the machine. Because RX machines have "soft start" motors, you can use the multi motor rating of the converter (if given). Ratings required are:
   a. RLX1630: 18kVA
   b. RLX355: 18kVA
   c. RLX425: 22kVA

For RLX 555 and RLX780, the machine power requirements cannot be met by a single phase supply.

In practice, the rating of your single phase supply may not permit a sufficiently large phase converter to be used. The ratings here are worst case; you may be able to get away with a smaller rated device if you are not working the machine hard and have a "stiff" single phase supply. However, XYZ can accept no responsibility for correct machine operation if you choose to go to a lower rated converter.

4 Maintenance

!! DANGER !!
Please read the safety instruction in section 1.1 before undertaking any maintenance.

The Following Maintenance Schedule must be followed. Annual servicing by XYZ is also recommended.

4.1 DAILY Maintenance

Area	Action	Check
Safety Systems	Check the following Safety Features as per section 1.2 of this manual: 1. E-stop 2. Chuck and Door Guard Interlocks 3. Safety Speed Monitoring 4. Guard structure, especially the vision panels.	☐
Machine	Clean away swarf from the slideways and way covers. Use a brush; do not use compressed air to remove swarf or clean the machine. This can damage the slideway seals, force swarf into the moving parts and create coolant mist which can be harmful. Check the general condition of the machine, e.g. for loose fittings or damaged electrical wiring. Rectify any defects. Check air regulator pressure is set to 65 to 70 psi (if fitted).	☐
Slideway Auto Lube system	Check the oil level in the Auto lube system reservoir (located on the front or end of each machine). If low, top up with slideway oil. Do not use slideway oil with tackifiers as this can block the fine, oil metering orifices on the machine. The lube pump will beep continuously when the oil level is too low (**NOT** RLX 1630).	☐
Headstock	Grease the chuck. RLX1630: Check for good oil flow in the sight glass when the spindle is running. RLX355: Check the oil level at the gearbox sight glass with the spindle off (open belt door to access - **Keep clear of drive belts!**). Top up oil if required. All other Lathes: Check oil level at the lower headstock sight glass with the machine in E-stop. Top up oil if required. Check oil appears at the top sight glass when the machine is reset from E-stop. Then open the belt door and check the pressure gauge on the oil filter housing (**keep clear of drive belts!**). Replace the filter if the gauge is in the yellow section.	☐

4.2 WEEKLY

Area	Action	Check
Headstock	RLX1630: Check the oil level in the sight glass on the LH end of the headstock (remove cover to access). Top up oil if required.	
Quill	Top up the oil cups on top of the quill with slideway oil. Clean and oil the bedways on which the tailstock slides	☐
Pneumatics	Drain any moisture from the pneumatic water trap. Check and replenish the pneumatic oiler. Check the oil dispense rate whilst operating the air ride tailstock. Correct setting is one drop every 3 seconds. Adjust with the screw on top of the lubricator, if required.	☐

Control System	Shutdown the control system. This is not mandatory and the interval is not critical, but failure to reboot regularly may cause the control to run slowly. For example, the INFO screens may move in and out slowly. Take advantage of the SAVE TEMP feature prior to shut down.	☐

4.3 MONTHLY (or as specified) Maintenance

Area	Action	Check
Machine	Undertake a more thorough clean of the machine, removing swarf from all moving parts. Do not use compressed air to remove swarf or clean the machine. Clean the control pendant – see guidance in section 4.8.	☐
Level	Check and adjust machine level.	☐
Headstock 1630	For the RLX1630, after the **FIRST** 150 hrs of spindle running, change the gearbox oil (then, the change interval is 2,000hrs)	☐

4.4 Every 6 Months

Area	Action	Check
Axes	Run Repeatability Check – see section 4.7 Check and adjust the gibs – see section 4.8.	☐

4.5 Yearly

Area	Action	Check
Axes	Check belt tension and backlash and adjust if needed– see section 8.4.	☐
Slideway Auto Lube system	Check oil supply lines for leaks, damaged or pinched pipes etc. Inspect for adequate flow by running the lube pump in service code 300 a few times and observe oil appears at the saddle and cross-slide bearing surfaces. Check visually, or by feel, for oil at the ballnut (**Power off or E-stop the machine** before putting your hands into the mechanism and wear suitable gloves!) For the X axis, this is ideally done when checking the gibs. Be careful not to get any dirt or other contamination into the lube system – clean the area thoroughly first. Ensure there are no leaks after pipes have been reconnected.	☐
Headstock	Replace the lube oil. Note, for RLX1630, the interval is 2,000hrs of spindle operation. Replace the oil filter (where fitted).	☐
Tailstock	Check and adjust tailstock alignment.	☐
Electrical Cooling fans	Remove any dirt from the fan guards. Inspect the fans for correct operation. Replace any fans which are non-functioning or noisy. Don't forget the brake	☐

	resistor fans under the cover on the top of the electrical cabinet. See also checking the spindle drive electronics fan life using monitor U4-04 Note: fans will normally continue to operate satisfactorily for many years. So do not expect to change fans regularly, if at all. However, inefficient/failed fans can lead to overheating and a shortening of the life of other electrical/electronic components in the machine, so inspection is important and change if in any doubt.	
Spindle Drive electronics	Check the internal maintenance monitors U4-04 to U4-07. If any values exceed 90(%) replace the drive (see section 7.5 for information on how to access the monitors). Note the fan (U4-04) can be changed on its own, if preferred. Note: values are likely to approach 90% only after a very long service life, perhaps as much as 10 years of heavy usage and maybe never if the machine is lightly used.	☐
Guard vision Panels	**Every Three Years**: Replace the vision panels, regardless of their apparent condition (refer to the life sticker attached to each panel.). These should also be inspected as part of the daily safety checks and replaced if condition is suspect.	☐

4.6 Recommended Lubricants

Area	Specification	Recommended Lubricant
Auto Lube System	Slideway oil ISO VG68 No tackifiers	Mobil Vactra No. 2 Shell Tonna S2 M68 Castrol Magna SW 68 Chevron Way Lubricant ISO 68
Headstock Gearbox	Gear Oil ISO VG68	BP Energol GR-XP 68 Mobil Gear XMP 68 Shell Omala 68 Chevron Ultra Gear 68 BECHEM Staroil G 68 CPC HD68
Chuck Grease	MoS2 based NLGI #2	BP Energrease L21 M Mobil XHP 322 special Shell Gadus S3 V460D 2 Chevron Molytex EP2 BECHEM Highlub FA 40 MO
Quill	Slideway oil ISO VG32 No tackifiers	Mobil Vactra No.1 Shell Tonna S2 M32 Castrol Magna SW 32 Chevron Way Lubricant ISO 32
Pneumatic Oiler	Hydraulic oil ISO VG32	B.P Energol HLP 32 AW Mobil DTE 24 Shell Tellus 32 Chevron Hydraulic Oil AW32 BECHEM Staroil NR 32

4.7 Coolant

Coolant maintenance is very important for the health of the machine operator. Always follow the coolant supplier's instructions for inspection, maintenance and replacement of the coolant.

Regularly remove tramp oil from the coolant, preferably using an automatic skimmer. Run the skimmer when the coolant pump has not been used for a while (e.g. overnight). This gives a chance for the oil to settle out on top of the coolant.

XYZ recommend the use of BioConcept cutting fluids which do not present a risk to the respiratory tract.

4.8 Notes on Cleaning the Control Pendant

Clean the outside of the pendant regularly using a mild detergent solution.

Be careful not to

- Flood the pendant – use cleaning solution sparingly
- Force dirt into the connectors on the back of the pendant. Leave the USB covers in place when not using these ports.
- Scratch the touch screen. See instructions below

Before cleaning the touchscreen, shutdown the control and turn off the machine. If you clean the screen with the power on, you are likely to trigger unwanted control functions! Use a mild detergent solution or any proprietary window cleaning solution to get any debris off the screen. It is preferable to use a lint-free cloth when cleaning.

4.9 Levelling

Machine should be adjusted such that it is level without any twist in the bed.

Determine the level by placing two, horizontal levels on the cross slide; one parallel with the Z axis, the other with the X axis.

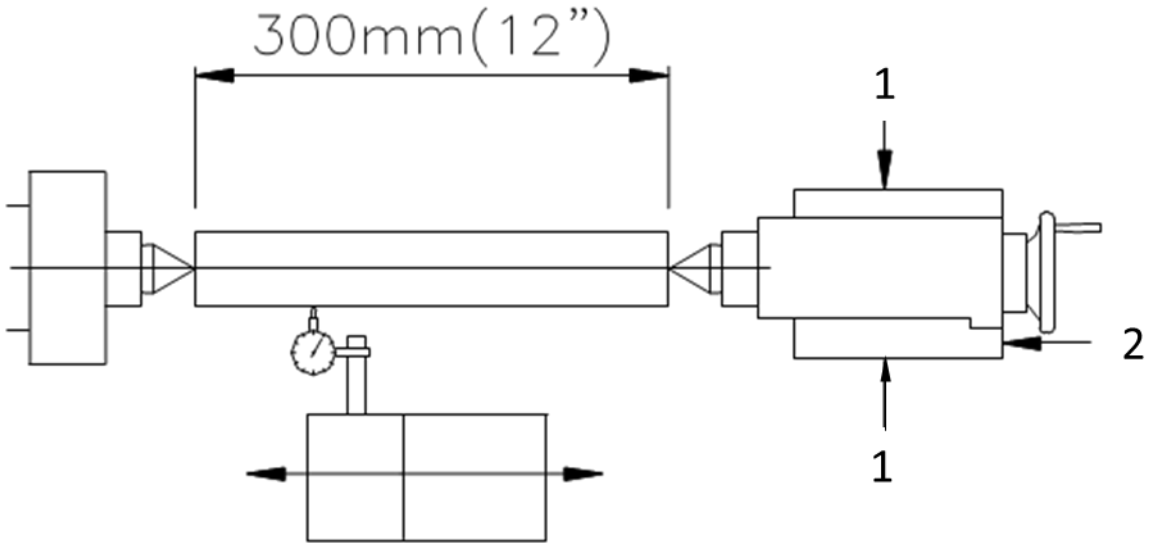
Use the adjustable feet (sitting on the rest pads) underneath the bed to achieve level within 0.02mm/m.

Check the level with the saddle at either end and in the middle of the bed. Take up any slack in the feet under the headstock and re-check level.

Please call XYZ Service if you require further support or advice.

4.10 Tailstock alignment

1. Mount a 300mm (12”) long ground steel bar between centres. If not available, turn a constant diameter onto a piece of stock bar held firmly by a centre in the headstock.
2. Run a test indicator along the centreline of the bar.
3. Taper should be better than 20µm over 150 mm.
4. If adjustment is required, release the tailstock clamp levers, slacken the rear locating screw (1) and then adjust the screws (2) on each side of the tailstock to move the tailstock in X as required.
5. Tighten all fittings then recheck alignment.



4.11 Repeatability check

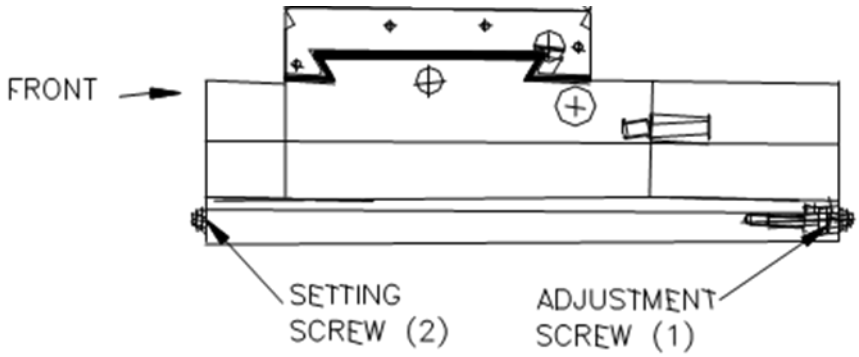
1. Mount a dial indicator in the spindle
2. Touch off a fixed surface either in the X or Z-axis direction and then set the dial indicator and DRO display to 0.
3. Crank away about 100mm and then touch off again at the same place (until the dial inicator shows zero again).
4. If the DRO reading has not returned to 0, zero the display and repeat the procedure.
5. If the measurement continues not to repeat, you have a repeatability problem that must be resolved.
6. Expected repeatability numbers should be 10µm or less

4.12 Gib Adjustments

The objective of adjusting the gibs is to eliminate as much play in the cross slide and carriage sliding surfaces as possible without having the tightness of the gib interfere with their free movement and cause a decrease in the accuracy and/or performance of the machine due to excessive friction.

4.12.1 Gib Adjustment - Z-Axis – All models

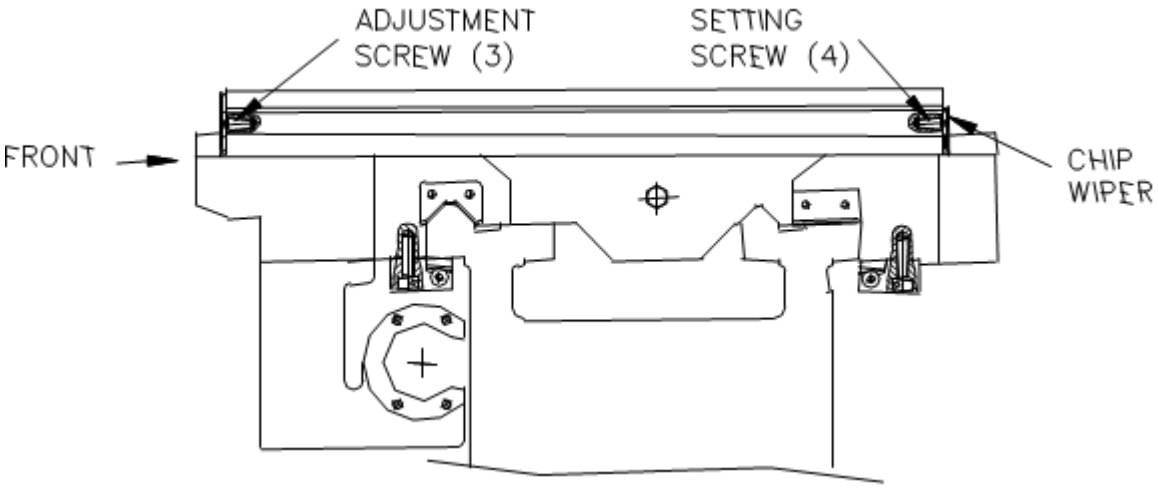
1. Clean all swarf, dirt and excess oil from the cross slide, saddle and Z ball screw.
2. Remove the chip wipers to expose the gib adjustment screw and setting screw.
3. Loosen the gib setting screw (2).
5. Adjust the gib by turning the gib adjustment screw (1) using a flat head screwdriver. Tighten such that all play is removed
6. If you wish, you can, remove the ballscrew cover and un-bolt the ball-nut from the saddle. This will allow you to check that the saddle moves freely along the bed.
7. Alternatively use rolling torques to set the gibs (aim for 1.1 to 1.7Nm) but you will have to disconnect the motor power cables to get meaningful figures - see section 8.4.
4. Tighten the setting screw (2).
5. Re-assemble the Z axis ballnut and covers and motor power cable (if removed).



RLX Z Axis gib adjustment points

4.12.2 Gib Adjustment - X-Axis – – All models

1. Clean all swarf, dirt and excess oil from the cross slide, saddle and X ball screw.
2. Remove the chip wipers on the cross slide to expose the gib adjustment screw and setting screw.
3. Loosen the gib setting screw (4).
4. Adjust the gib by turning the gib adjustment screw (3) using a flat head screwdriver. Tighten such that all play is removed.
5. If you wish, you can un-bolt the ball-nut from the slide. This will allow you to check that the slide moves freely along the saddle. To do this, move the slide to the back of the machine and remove the motor and motor mounting bracket to gain access to the ball nut,
6. Alternatively use rolling torques to set the gibs (aim for 1.1 to 1.7Nm) but you will have to disconnect the motor power cables to get meaningful figures - see section 8.4.
7. Tighten the setting screw (4).
6. Re-assemble in the reverse order



RLX Cross slide gib

4.13 Calibration & Backlash Constants

Calibration and backlash constants are set during manufacture. They should be re-set when indicated in the Troubleshooting section or after the replacement of the Computer module (unless you run service codes 141 and 142), or any parts of the drive train.

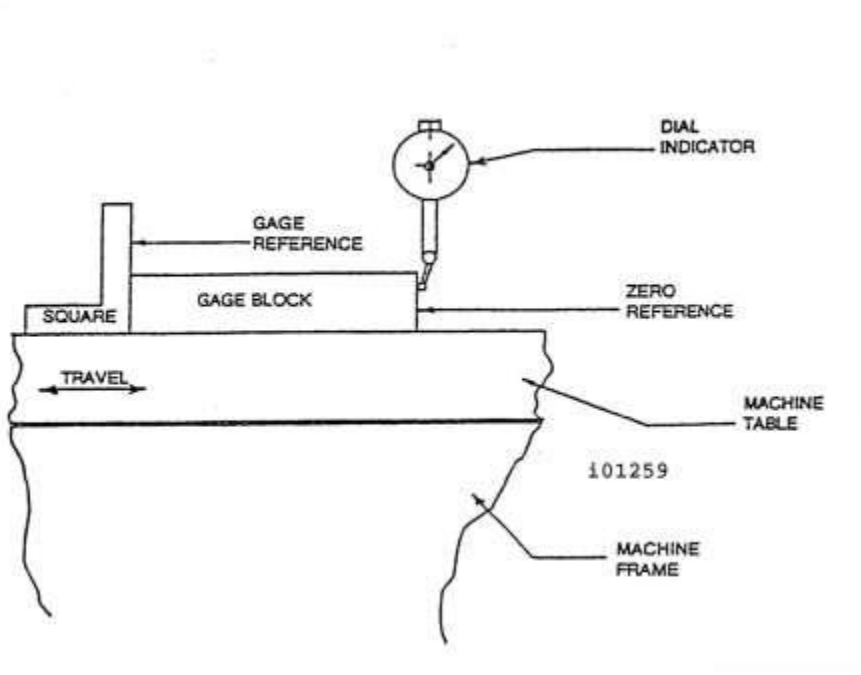
Note, the default calibration constants are calculated from the encoder resolution, drive ratio and ballscrew pitch. All these parameters are constant except for the tolerance in the ballscrew. RLX lathes are fitted with high quality ballscrews of guaranteed accuracy class C3 for Z axis and C1 for X

axis (actual accuracy is usually better). Consequently, the default calibration is adequate for most machining requirements. This also explains why calibration factors in service code 122 are often exactly 1.

4.13.1 X, and Z Calibration

Calibration is used teach the machine a known distance. We typically calibrate our machines over a 150 mm distance. There is no realistic limit to the distance over which the machine can be calibrated.

1. Set-up a gauge block or standard and indicate it parallel to the axis you are calibrating. Note: Put the display in Inch or mm to match your gauge block.
2. Go to SETUP, SERV CODES and enter code 123.
3. Select the axis you want to calibrate X or Z.
4. Set a 2µm indicator in the spindle and move one side of the gauge block or standard up to the indicator.
5. Zero the indicator
6. Follow the instructions on the screen to complete calibration.
7. Calibration can also be done using service code 122 – see on-screen instructions for details.



RLX Calibration Setup.

4.13.2 Backlash Compensation

Service Code 128 allows you to enter the backlash compensation values, manually for each axis. It displays the value after it is entered.

To measure the backlash, do the following:

1. Go into Service Code 128, make a note of the backlash values, then zero out the backlash compensation value for the relevant axis/axes.
2. Set a 10µm dial indicator in the spindle and load the indicator to zero from one direction against a block and zero out the DRO.
3. Move the axes around 0.2 mm in the same direction (do not exceed travel) and then back to zero. Do not overshoot 0, otherwise start over.
4. Whatever number appears on the screen is the backlash value.
5. Enter this value into service code 128.

6. After entering this number redo the process. The DRO and indicator should now both read close to 0.
7. For X especially, when changing the handwheel direction, do not move the handwheel too slowly, otherwise the change may not be recognised by the backlash compensation function and it will appear as if no compensation has been applied.

4.14 Notes on Changing Chucks/Faceplates

When changing chucks or faceplates:

1. Follow the manufacturer's mounting instructions explicitly to ensure the chuck/faceplate is safely secured to the spindle,
2. If necessary, replace the original chuck guard with the correct guard for the workholding device in question. XYZ offers sells suitably sized chuck guards for all the chucks and faceplates it offers.

If in doubt, please contact XYZ Service for further support or advice

5 Trouble Shooting By Symptom

5.1 Problems Relating to Machining Results

5.1.1 Poor Finish

Symptom: The part finish is rough. Poor finish can be caused by a number of factors; including speeds, feeds, tooling, machine setup and chatter.

Run the following Service Codes:

- **Code 33:** Check all software is up to date – see the XYZ website for the latest software and update instructions.
- **Code 128**: Enter backlash compensation

Possible Cause	Check This
Too much backlash entered under code 128	Verify nothing is mechanically loose, re-run backlash procedure (see section 4.11) and enter value in code 128.
Machine Tool & Setup problem	Check for any looseness in the setup (Tool, Tool post, part or chuck/faceplate). Check the condition and type of cutter being used, type of material, RPM and Feedrate, etc.
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way surfaces are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines.
X and Z Gibs are not adjusted properly	Check the adjustment of the gibs. See section 4.10.
X & Z-axis Drive Trains are loose	Check repeatability. Step by step, carefully inspect the Drive Train for any looseness.
Way surfaces are pocked, scarred, or excessively worn	Visually check the condition of all the Way surfaces. For machines that may have excessively worn Way surfaces you may need to adjust the Gibs in this area. This will affect performance when using the machine outside of this area. Check lubrication to affected areas.

5.1.2 Turning Diameters Out of Round

Note, the 3-jaw, self centring chucks, supplied as standard, have a centring error of at least 45µm (for the smallest chuck; increasing with increasing chuck size). Therefore do not expect unrealistic circularity from parts cut on these machines. If you require tight circularity, use a 4-jaw chuck, collet chuck or machine soft jaws.

5.1.3 Cutting taper

Parts are considered to be cut on a taper if there is a difference in diameter of more than 20µm over 150 mm.

Possible Cause	Check This
Machine set-up problem	Machine not levelled properly. See Levelling - Section 4.9.
Tooling problem	Improper tooling; Work piece not properly supported. Use steady rest or follow rest, reduce overhang from chuck headstock or tailstock.
Headstock and/or tailstock not aligned	Tailstock alignment. See Section 4.10.
Looseness in the gib or misalignment of ball screw	Gib adjustment (section 4.12). Z Ball screw Alignment (Section 8.4.5)
Loose bearing problem	Spindle bearings. (Section 8.3.3) Mechanical drive train (Section 8.4.5). Spindle Bearing Preload (Section 8.3.3)

5.1.4 Parts have Incorrect Dimensions

Parts are being machined with dimensions that are different than those programmed.

Run the following Service Codes:

- **Code 33**: Check all software is up to date – see the XYZ website for the latest software and update instructions.
- **Code 123**: Calibration.
- **Code 128**: Enter backlash compensation.

Possible Cause	Check This
Machine Tool & Setup problem	See Machine Tool & Setup Section 7.1
Programming Error	In the program, look for common errors in programming such as transposing numbers, tool diameters, and pressing INC SET when ABS SET is meant. This is especially suspected if the dimensional errors are large. See the Programming manual.
Configuration file that contains calibration file and backlash constants has been erased or corrupted.	Verify machine ID is correct (Code 33). Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy.
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash. Check Repeatability and Positional Accuracy.

X and Y-axis Drive Trains are loose	Check Repeatability. Step by step, carefully inspect the Drive Train for any looseness.

5.1.5 X and Z-Axis Measurements Do Not Repeat

Run the repeatability check, section 4.11.

Possible Cause	Check This
Machine Tool & Setup problem	Check for any looseness in the setup. See Machine Tool & Setup Section 7.1
X and Z-axis Gibs are loose	Check the adjustment of the Gibs.
X and Y-axis Drive Trains are loose	Check Repeatability using the Repeatability procedure. Step by step, carefully inspect the Drive Train for any looseness.
Faulty Motor encoder	Refer to section 7.6.

5.1.6 Threading Problems

Threads can be cut with and an unlimited number of pitches and up to 10 leads.

To reduce the relief area when threading up to a shoulder the spindle speed should be reduced as much as possible. The slower the speed of the spindle, the closer the cutting tool can come to the end of the programmed thread before it pulls out and retracts. If a nut must be turned all the way up to a shoulder, machine a relief area behind the last thread. No machine can thread up to a shoulder and instantaneously pull out.

A correctly functioning encoder is essential to the threading function.

Perform the following service codes:

- Code 510 Spindle encoder test.
- Code 521 (see checking encoder in section 7.2)

5.1.6.1 Cross Threading

Possible Cause	Check This
Looseness in the Gib	Gib adjustment
Looseness in the drive train	See Mechanical Drive Train (X, Z) - Section 8.4.5.
Calibration	See Section 4.1.3.
Failure of the spindle encoder	Check encoder in service code 510 and 521.

5.1.6.2 Not Threading

Possible Cause	Check This
Spindle speed too fast	Slow down spindle speed.
Failure of the spindle encoder	Check encoder in service code 510 and 521.
Broken or slipping encoder coupling	Check/replace coupling
Broken or loose encoder belt	Check/replace belt

5.2 Problems Regarding the Motion of the Machine

See also Computer module and axes diagnostics (sections 7.4 and 7.6)

5.2.1 Unexpected Axis Movement

The axis makes an unwanted move at rapid speed in one direction and quickly faults out. Critical Errors 42 or 44 may be displayed. This is usually caused by a motor or encoder signal fault.

Run the following Service Codes:

- **Code 33** Software Identification. Check all software is up to date – see the XYZ website for the latest software and update instructions.
- **Code 521** Hardware Tester – See checking motors and motor encoders in chapter 7.2.

Possible Cause	Check This
The home positions or tools are not set correctly and hence the machine moves to location that is surprising to the operator.	See the Controls Programming, Operations and Care manual.
Bad Motor Encoder	Run service code 521. Refer to servo system diagnostics, section 7.6.2, for more details.

5.2.2 Axis Will Not Move

The system powers up but will not respond to the EHW or jog stick commands. Generally, when this happens, you will see a fault on one of the axes.

Run the following Service Codes:

- **Code 33:** Software Identification. Check all software is up to date – see the XYZ website for the latest software and update instructions.
- **Code 132**: Check EHW inputs
- **Code 521:** Hardware Tester – Check EHW and Jog stick inputs. Check motors and motor encoders (see chapter 7.2).

Possible Cause	Check This
Machine in NC not ready state	Twist to release each E-stop button, then press the power reset button and confirm the LED is lit. Clear any warning messages from the screen. See section 7.7.1 if the machine will not come out of E-stop.
Electronic Handwheel or Jog stick Fault	Check EHW's in service code 132 Check jog stick in service code 521.
Servo Drive failure	Especially, if only one axis will not move. See servo system diagnostics – section 7.6.2
Motor has failed	See servo system diagnostics – section 7.6.2
Poor cable or wiring connections	Check all Electrical Connection
Computer Module failed	If the drive/motor appear good and you have power, then the computer module may need to be replaced. See computer module diagnostics – section 7.4.2

5.2.3 Spindle will not Run

Symptom: Spindle does not start when the FWD or REV keys are pressed (or turns off unexpectedly).

Run the following Service Codes:

- **Code 33** Software Identification. Check all software is up to date – see the XYZ website for the latest software and update instructions.
- **Code 521** Hardware Tester – See checking spindle in chapter 7.2.

Possible Cause	Check This
Machine in NC not ready state	See above (section 5.2.2)
Machine not in a spindle enabled mode	For safety reasons, the spindle is only allowed to run when essential for machine operation. Spindle can only be run in • DRO • RUN • TOOL TABLE, and • Certain service codes, like spindle encoder check (510)
Chuck/belt door guards not closed	These guards must be closed to run the spindle
Chuck guard safety circuit fault	Refer to section 7.7.2 and computer module diagnostics – especially Euro safety H/W LEDs and Spindle port LEDs.
Faulty Keypad on Pendant	Run Service Code 81 to check keys are working properly, if not change the pendant cable/pendant (see section 7.3 for further details).
Faulty Computer module	Follow computer module diagnostics in section 7.4.
Faulty spindle drive or motor	Follow spindle diagnostics in section 7.5.

5.2.4 Spindle Stalls during Machining

During machining, the spindle slows down significantly and may even stop.

Possible Cause	Check This
Machine Tool and Setup problem	Check tooling, depth of cut, speeds and feeds are appropriate for the job. Remember, the RLX1630 does not have a gearbox. Torque at low speed will be less than you would get from the same size spindle motor driving through a multi-speed gearbox.
Spindle Overloaded	The spindle can run for about 60secs with a 150% overload. After about a minute (or shorter for larger overloads or very low RPM's) the spindle drive will fault out to protect the spindle motor. You will see a Critical Error 105 on the control pendant (and an OL1 on the spindle drive). Reduce the load on the motor. Follow spindle diagnostics in section 7.5 if the fault persists with lower loads.
Drive Belts slipping	Check the condition, and tension of the drive belts.

5.2.5 Axis Motor Motion is not Smooth

While under motor power, the motion is not smooth. The motion appears to be "rough" or jerky".

Run the following Service Codes:

- **Code 33:** Software Identification. Check all software is up to date – see the XYZ website for the latest software and update instructions.
- **Code 128** Enter backlash compensation
- **Code 521** Hardware Tester – See checking motors and motor encoders in chapter 7.2.

Possible Cause	Check This
X and Z-axis Gibs are not adjusted properly	Check the adjustment of the Gibs.
Calibration or Backlash problem	Recalibrate the machine. Reset the Backlash
Binding in the Drive Train	Check Repeatability using the Repeatability procedure. Check the rolling torque reading of the Drive Train (acceptable values are between 1.1Nm and 1.7 Nm). Step by step, carefully inspect the Drive Train for any binding. See Mechanical Drive Train (X, Z), section 8.4.5.

5.2.6 Vibration/Noise in Motion

There is vibration or noise coming from the X or Y axis, during motion.

Run the following Service Codes:

- **Code 128** Enter backlash compensation.
- **Code 123** Calibrate axes.

Possible Cause	Check This
Too much backlash entered in Code 128.	Recheck the machines backlash.
Inadequate or no Lubrication to Ballscrews and Way surfaces	Make sure all the Way surfaces are getting proper lubrication. If not, check to make sure that the lube pump is functioning properly. Also check for any pinched or blocked oil lines. See Lubrication section
X and Z-axis Gibs are not adjusted properly	Check the adjustment of the Gibs.
Gibs not making good contact.	Pull gibs out and mark with a blue die to check where the gibs are making contact. It is recommended that the gibs uniformly contact at least 80% of the surface.
Binding or looseness in the Drive Train	Check Repeatability using the Repeatability procedure. Check the torque reading of the Drive Train (acceptable values between 1.1Nm and 1.7 Nm). Step by step, carefully inspect the Drive Train for any binding or looseness. See Mechanical Drive Train, section 8.4.5.
Axis Motor belt too tight.	Loosen belt.
Misalignment of ball screw	See Mechanical Drive Train, section 8.4.5

5.3 Problems Relating to the Operation of the Control

5.3.1 Pendant Does Not Power On

Possible Cause	Check This

No power to pendant	Check the 24VDC LED on the back of the pendant. If off, then there is no power getting to the pendant. The fault is with the computer module or cable. Check the 110VAC supply to the computer module and follow computer module diagnostics in section 7.4.
Faulty Pendant	Check 12VDC and 5VDC LEDS on the back of the pendant are lit. If not, the pendant is faulty – replace. Also see the pendant diagnostics section 7.3.

5.3.2 Can't Reset the Servo system

Symptom: Pressing the Power Reset Button does not put the machine into the NC ready state e.g. LED does not come on, servo sequence fails or Servo not ready errors in DRO.

The Reset button must be pressed to enable the servo system:

- On first power up
- After any E-stop button has been activated
- After the control puts the machine into an NC not ready state due to some kind of fault or error (critical error [0055] will be displayed).

Before running any diagnostics, try simply pressing in an E-stop button, wait a few seconds, twist to release, then try the Power REST button again. In many cases, simply retrying the reset sequence will bring the machine into the ready state.

Possible Cause	Check This
E-STOP Button pressed in	Check all E-stop buttons, including any on accessories, are out (twist to release). You should see error 261 in this case. Try Reset again.
Fault in E-stop wiring	See E-stop safety circuit diagnostics, section 7.7
Fault in computer module	See Computer module diagnostics in section 7.4
Fault in Axes or Spindle drive	See spindle/axis drive diagnostics in sections 7.5 and 7.6

5.3.3 DRO display is Not Counting

The DRO display for one axis is not counting, but the axis is moving. Usually this will give a critical error 42/44.

Perform the following Service Codes:

- **Code 33:** Software Identification. Check all software is up to date – see the XYZ website for the latest software and update instructions.
- **Code 521** Hardware Tester – See checking motors and motor encoders in chapter 7.2.

Possible Cause	Check This
Motor Encoder not counting	Check with service code 521, section 7.2. See also servo drive monitor display in section 7.6.2.
Pendant Failure	If no error 42/44 is flagged, then the servo control loop has not detected a problem with the axis motion, hence the error is likely to be just in the pendant display. Try shutting down and rebooting the control, otherwise replace the pendant.

Computer failure	Check computer is reading motor encoder with service code 521, section 7.2. See also servo drive monitor display in section 7.6.2 and computer diagnostics, section 7.4.

5.3.4 X & Z-Axis Electronic Handwheels Count in the Wrong Direction

The default Electric Handwheel directions are:

- X-axis – Clockwise direction == negative axis motion (i.e. away from the operator.
- Z-axis – Clockwise direction == positive axis motion (i.e. away from the chuck)

If necessary/desired, the handwheel direction can be reversed in Service Code 308.

5.3.5 Fault in X or Z servo axis

The program run or jogging operation is interrupted with a Fault Message on the display (usually Critical Errors 42/44 or 96/98).

Run the following Service Codes:

- **Code 33** Software Identification. Check all software is up to date – see the XYZ website for the latest software and update instructions.
- **Code 521** Hardware Tester – See checking motors and motor encoders in chapter 7.2.

Possible Cause	Check This
Cable connection problems	Check all cable connections.
X and Y Gibs are adjusted extremely tight	Check the adjustment of the X and Y Gibs.
Binding or looseness in the Drive Train	Inspect drive trains
Incoming electrical power	Incoming voltage too low. Should be 380 to 420 Volts.
Motor encoder not working properly	Check in service code 521.
Motor or Servo Drive failure	Check drive display for any faults, and check fault history (section 7.6). You should see a fault 96, 97 or 98 if there is a drive fault. Swap cables from computer module to servo drive between axes to see if cable is faulty.
Computer module failure	If problem does not follow motor or cable, then replace computer module.

5.3.6 Pendant Does not Respond and Appears to be Locked Up

The pendant is not responding. E.g:

- No Beep when any button is pressed or touch screen is pressed,
- Screen does not respond when touched,
- USB Keyboard does NOT respond.

Possible Cause	Check This
Bad USB device plugged in	Remove all USB devices and network connections and try again (reboot from Windows if necessary). DO NOT plug anything else other than keyboards/mice and memory sticks into the USB ports (do not use to charge phones etc., unless

	you use a charging only cable with NO data connection).
Processing large programmes or programme files	Wait a few minutes for control to respond.
Can't connect to the computer module on bootup	See Networking problems, section 5.4.
Faulty Keypad	Use an external keyboard to check the pendant keypad using service code 81.
Faulty pendant	Check to see if Windows is still running (press Windows button on external keyboard or swipe-out keyboard. If so, shutdown the control using the Windows shutdown option. Cycle power and reboot. If the problem persists try reloading software (code 316), otherwise replace the pendant.

5.3.7 USB Not Working on Pendant

When plugging in a USB device the control does not recognise it.

Possible Cause	Check This
Faulty USB device	Try a different device
Device driver not installed	Most USB keyboards and memory sticks will work with the device drivers already installed. Always try a different device before thinking about installing additional device drivers. You can use service code 540 to install device drivers, but we do not recommend this. ALWAYS VIRUS CHECK USB sticks before inserting into a control running service code 540 (or code 316)
Faulty pendant.	Most likely will affect more than one USB port. Change the pendant.

5.3.8 Door Guard Interlock Problems

Symptom: Door Guard Open Message stays on Screen when door is closed

The Door guard must be closed to run:

- automatic RUN mode,
- Power Feed (DRO) mode and
- RETURN HOME (DRO) mode

For diagnostics see section 7.4 and 7.7.

5.3.9 Auxiliary Functions Not Working

The Auxiliary Functions will not turn on or off at the programmed times.

There are 2 Auxiliary Functions in the AUX programme event:

1. Coolant,
2. AUX O/P

For diagnostics see the relevant sections in chapter 7.

5.4 Networking Troubleshooting

5.4.1 External (User) Network

Pendant will not connect to your external network

Possible Cause	Check This
Incorrect setup.	Ensure your network is connected to the User LAN port (the one at the top of the pendant) Ensure you follow the Networking instructions in the programming manual exactly. The control will only connect to a network using Workgroups. It will not connect to a Domain.
IP Address conflict.	The ProtoTrak control uses IP addresses 192.168.1.200 and 192.168.1.201 for the motion control ethernet connection. If there are devices on the **user** LAN with these addresses, there may be problems with the user network. Ensure these addresses are NOT in use on the user network or cannot be allocated by the DHCP server on the user network.
Ethernet port hardware failure	Using the swipe out or an external keyboard, press the Windows key and go into Network and Sharing centre. Check there are two networks shown – one is the machine network ("Local area connection 2" or "Motion LAN") and the other should be your network. If only LAN2 is shown, temporarily remove the machine ethernet connection and use a short patch lead to connect the two ethernet ports together. If you still do not see two networks, the ethernet port on the pendant has failed – change the pendant.

5.4.2 Motion Control Ethernet

If you get a failure to connect to motion control during boot up, do the following:

Possible Cause	Check This
Incorrect setup.	The IP address of the pendant must be fixed at 192.168.1.201 Using the swipe out or an external keyboard, press the Windows key and go into Network and Sharing centre. Check the IP Address has not been changed. If it is wrong, run service code 540 then change the IP address in Windows.
IP Address conflict.	The ProtoTrak control uses IP addresses 192.168.1.200 and 192.168.1.201 for the motion control ethernet connection. If there are devices on the **user** LAN with these addresses, there may be problems with the motion control network. Ensure these addresses are NOT in use on the user network or cannot be allocated by the DHCP server on the user network.

Hardware failure (Ethernet port or cable)	Using the swipe out or an external keyboard, press the Windows key and go into Network and Sharing centre. Check there is a network called "Local Area Connection 2" or "Motion LAN". If LAN2 or Motion LAN is not shown, temporarily remove the machine ethernet connection and use a short patch lead to connect the two ethernet ports together. If you still do not see LAN2/Motion LAN, the ethernet port on the pendant has failed – change the pendant. If LAN2/Motion LAN appears, then suspect the ethernet cable to the computer module, or the computer module itself. Try a new cable (or repeat the above test using the machine ethernet cable). If you have a second RX machine nearby (lathe or mill), connect the pendant of one machine to the computer module of the other to determine if the computer module is faulty. DO NOT attempt to run the machines connected this way, KEEP THEM BOTH E-STOPPED!!– once you have determined the faulty unit, shutdown both machines.
Computer module has stopped working	This could be a failure to execute the motion control software. Use the Windows Command Prompt to Ping the computer module (ping 192.168.1.200). If the ping succeeds, then the ethernet connection is OK, but the motion control software is not functioning correctly. Try reloading software, else change the computer module. For advanced users, connect to the computer module using cerhost.exe on the pendant and check for any error messages (e.g. MotionControl-Ethernet.exe has stopped working).

NOTE: If the control is unresponsive (due to failure to connect to motion control) or the Control panel window is permanently hidden behind the ProtoTrak window, hit the PAUSE BREAK key a few times (on an external keyboard) to close the ProtoTrak software. Or end the ProtoTrak software from Task Manager. Remember to shutdown the Pendant using the Windows shutdown option before turning off power.

6 Troubleshooting by Error Code

The RX control will display error codes whenever it encounters an error.

The on-screen error message will give some guidance. For detailed guidance on troubleshooting the more common, hardware errors refer to the reference section (chapter 9).

Note, most errors will disable the control, whereupon a critical error 0055 will be displayed. Furthermore, if the independent Safety monitoring system detects a problem, it will disable the control autonomously also leading to an error 0055 and possibly servo errors (42 to 44) if the axes were moving at the time.

Consequently, the control will flag a number of errors. Do not be unnecessarily alarmed by a long list of errors; the true cause of the machine fault is usually just the first error reported.

Some error codes will relate to the Y axis. On an RLX lathe, the "Y"axis refers to the servo axis and associated drive/motor equipment used to operate the 8 station indexer. If you do not have an 8 station indexer, then a turret jumper plug must be installed to provide error-free feedback to the computer module. If you do have an 8 station indexer, then the error codes relate to this equipment.

7 Sub System Description & Diagnostics

!!DANGER!!

Inappropriate or incorrect work practices can present a risk of serious injury to personnel during some diagnostic activities from electrical and mechanical hazards. Ensure all personnel read and understand the section on safety during MSR activities in chapter 1.1

7.1 General Information

7.1.1 Machine, tooling and Job Setup

If machined parts are not coming out right, before looking to faults with the machine control system, it is worth checking that the machine/tooling/job setup is OK.

Common problems which may be due to setup are:

- Dimensions incorrect size or not repeating,
- Circles out of round,
- Tapers on straight moves,
- Poor finish,
- Tool chatter.

Check for:

1. Machine Level:
    a. Leveling is one of the most important aspects of setting up the machine properly. Improper leveling can lead to a variety of machining problems.
    b. See Leveling Procedures, Section 4.9.
2. Machine setup:
    a. Is lubrication system working correctly? A failure in the auto lube system will lead to premature wear on way surfaces and ballscrews and increased play/backlash.
    b. Are gibs correctly adjusted (too loose or too tight)? If excessively worn, twisted or otherwise defective, gibs should be replaced.
    c. Are spindle bearings worn?
3. Machining setup:
    a. Are speeds and feeds correct?
    b. Is depth of cut realistic?
    c. Are you using the best tool for the job?
    d. Are tools sharp?
    e. Is the tool/job adequately clamped?
    f. Are tools correctly set in Tool Table?

7.1.2 Mechanical Drive Train (X and Z)

Some machining problems may be related to issues with the drive train such as looseness or binding. Determination of the exact cause of the problem may require a systematic stripdown, inspection and rebuild of the drive train.

No instructions are given here for this type of activity. It is assumed that the reader is sufficiently qualified/experienced to be able to undertake work on these parts without detailed instructions.

To assist in disassembly, spare part identification and re-assembly, illustrated parts lists are available. Refer to the Reference Section, chapter 9.

Before embarking on a major inspection of the drive train, please ensure, other, more easily checked, variables have been exhausted.

If in doubt, please request a visit from an XYZ Service Engineer.

7.1.3 Service Codes

The RX control has a number of user initiated, built in test and diagnostic facilities. These are known as Service Codes and can be accessed by pressing the SETUP mode key followed by SERV CODES.

Service codes are described, where relevant, in the following diagnostic sections, except for code 521 which warrants its own section.

A summary of the most commonly used Service Codes is here:

Code No.	Title	Description
1	Program, Configuration File, Log Back up	Service code 1 captures important data from the RX machine. This includes the user's program, master and slave configuration files, master and slave message logs and fault logs etc. This information is invaluable in helping XYZ solve problems with your machine. The files are saved to a Zip file which can be e-mailed to XYZ. ALWAYS run service code 1 **IMMEDIATELY** you have a problem, otherwise important information may be lost. If you cannot run SC1 because the control is locked up, shutdown, reboot and run SC1 immediately the control is back on-line.
33	Software, Firmware and PLC versions	Displays current software versions, master and slave operating system versions, machine ID key and software option versions. Master and slave versions must always be the same (ignore the numbers in square brackets) – run code 316 if there any discrepancies.
81	Keyboard test	Enables pendant keys to be checked for correct functioning.
123	Calibration Mode	Use to calibrate the RLX control with a standard.
128	Backlash Calibration Constant	Use to load backlash compensation for each axis.
131	Manual DRO	Displays motor encoder readings for each axis. Note; due to Euro S/W safety checks, this code is not particularly effective – use SC521 instead.
132	EHW test	Displays electronic Handwheel inputs in raw counts – 4000 per revolution (note reset button)
141	Load configuration file from USB thumb drive	To load configuration files from a USB thumb drive to the RX control. Does not save hardware specific configuration like spindle calibration – run SC510 for this.
142	Save configuration file to USB thumb drive	To save the configuration files for reloading later. When a computer replacement is necessary, saving the settings to a thumb drive for reloading them later is highly desirable.
300	Lube Pump Switch Discharge	Allows the user to manual discharge the lube pump
301	Set Lube Pump Cycle Time	Sets the time in minutes between pumping cycles
302	Set Lube Pump Discharge Time	Sets the time in seconds for how long to pump for each cycle.

316	Update Software	Used to update to the latest ProtoTrak software release. Always virus check the USB before plugging into the control.
318	Converter and Software Options	Displays which software options are turned on. Options in bold letters mean the option is active.
510	Calibrate RPM	Runs an automatic spindle calibration routine to calibrate out any errors in the spindle speed output from the computer module. Run this code whenever the computer module is changed.
	Encoder Check	This service code does not check the (once per revolution) index pulse which is important for threading – use SC521 for a more thorough check.
521	Hardware Tester	See next section.
522	Diagnostic Charting Tool	This is a versatile tool for plotting machine variables/data over time for diagnostic purposes. It is not envisaged that operators will need to use this tool, so no instructions are given here. Please note, the tool places a high burden on the pendant computer processor. If you do use this tool, you will find that display/LED/key beep updates are very slow. This is normal, but avoid pressing pendant keys in quick succession to eliminate confusion or apparent problems where the pendant display is out of sync with the machine operation.

7.2 Service Code 521

SC521 is a particularly useful and powerful service code. It is actually a completely separate, diagnostic routine which runs instead of the ProtoTrak machine software application. It is used to interrogate inputs and force outputs.

7.2.1 Important Safety Notices

!!DANGER!!

THIS IS A SERVICE CODE DESIGNED FOR TRAINED AND EXPERIENCED SERVICE PERSONEL ONLY.

FOR MAXIMUM UTILITY, IN THIS SERVICE CODE:

- **THERE ARE NO SOFTWARE SAFETY CHECKS RUNNING.**
- **HARDWARE LIMIT SWITCHES ARE INACTIVE.**
- **IT IS POSSIBLE TO OVERRIDE THE STANDSTILL AND SAFE SPEED MONITORING SUCH THAT THE MACHINE CAN BE RUN AT MAXIMUM FEED RATES WITH THE DOOR GUARD OPEN.**

THE ONLY SAFETY SYSTEMS WHICH REMAIN FULLY OPERATIONAL IN THIS MODE ARE:

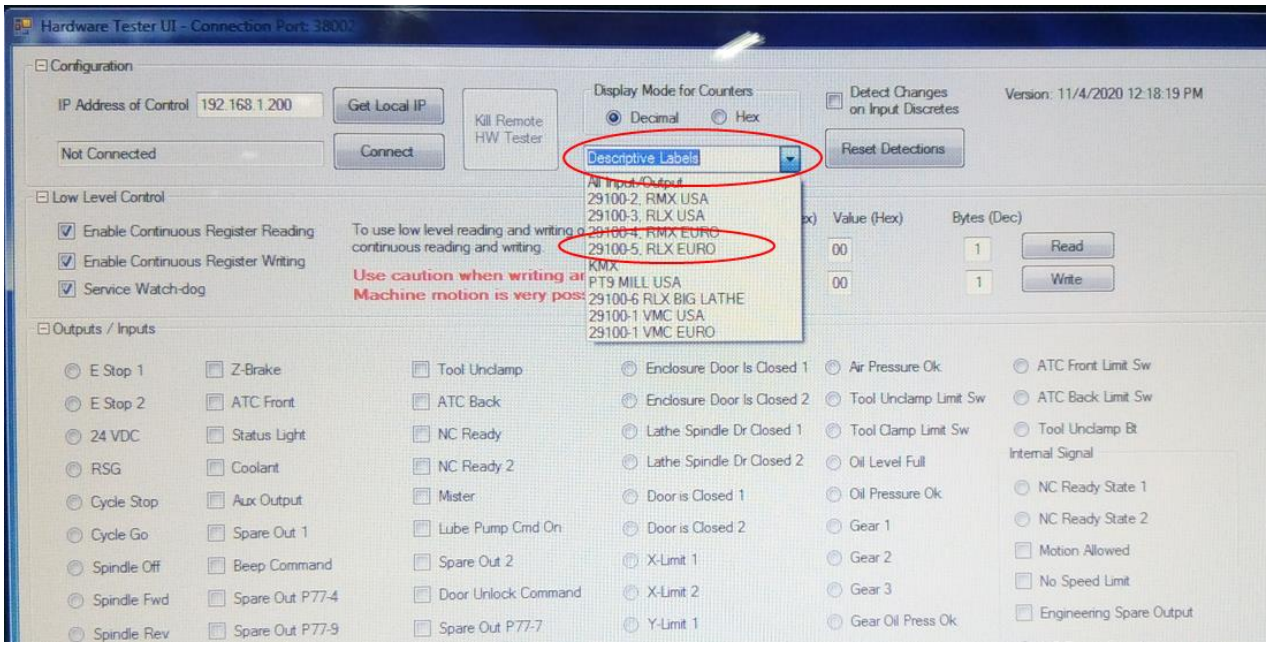
- **EMERGENCY STOP**
- **SPINDLE INHIBIT (STO) WITH THE CHUCK GUARDS OPEN**

!!USE WITH CAUTION!!

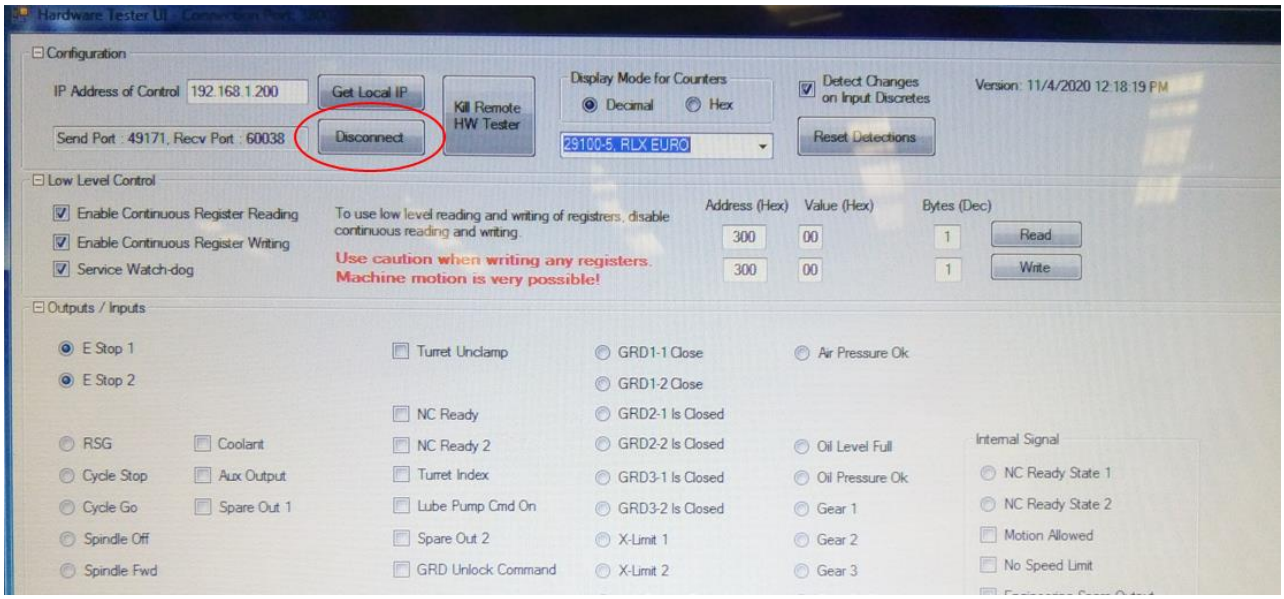
7.2.2 Starting the Hardware Tester

1. Go into Service Codes and enter 521.
2. Press OK to confirm. Note you will lose DRO position, programmes etc.

3. When the Hardware tester screen appears, Select M/C type (under "Descriptive Labels") to limit display to applicable functions:

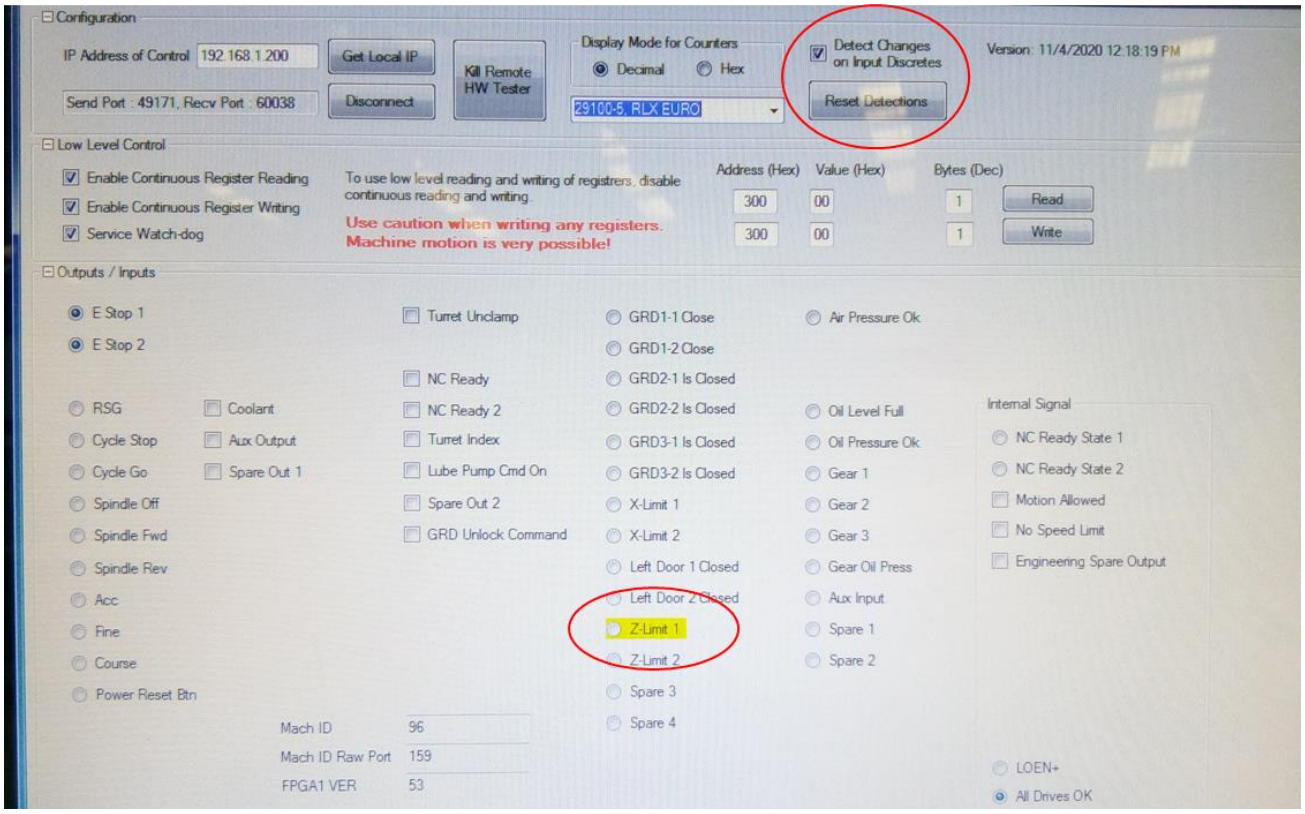


4. Press the Connect button to connect to the computer module (which here shows Disconnect as the connection has already been made):



7.2.3 Using the Hardware Tester

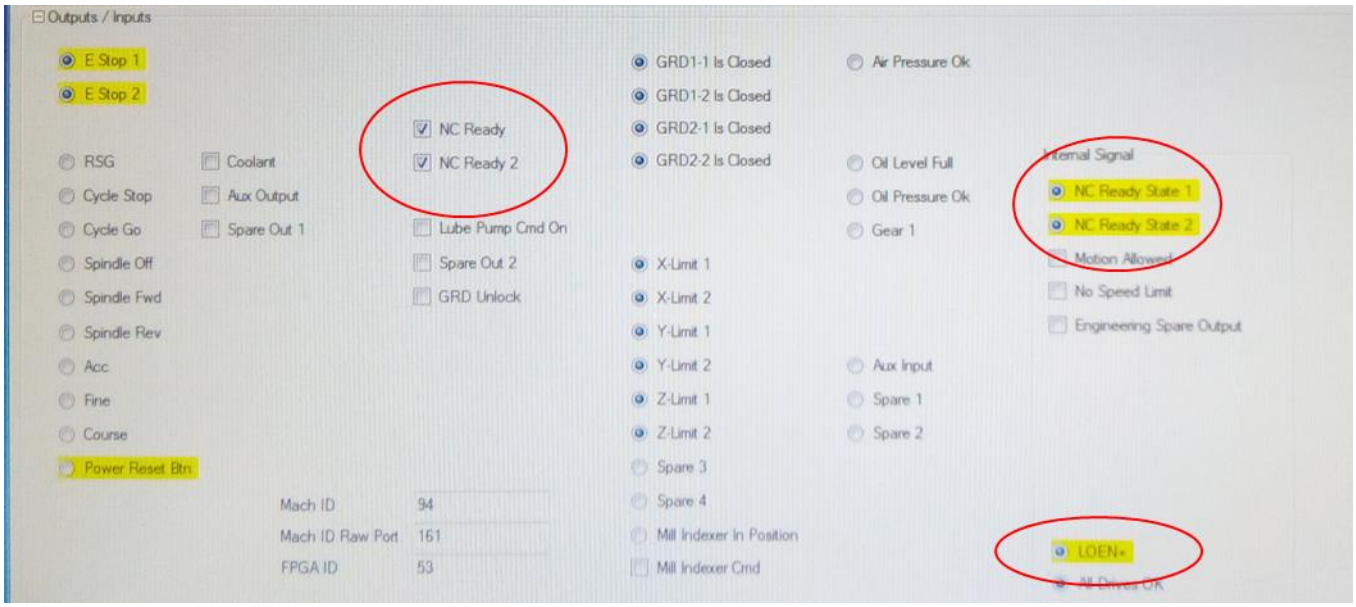
At this stage, the Hardware tester can be used to display the status of machine control inputs, such as guards and limit switches. Note the check box marked "Detect Changes on Input Discretes". When checked, any changes on inputs will be highlighted – this is particularly useful if fault finding on your own (e.g. operating limit switches where you cannot see the display):



The Hardware tester can also be used to force outputs and control the spindle and axes. But this requires the outputs to be enabled and the machine to be forced into an NC Ready state:

1. Make sure all E-stop buttons are released,
2. Press the reset button to reset the hardware E-stop safety circuit,
3. Check NCRdy1 and NCRdy2 to activate the internal NC ready signals.

You should see the NC Ready State 1, NC Ready State 2 and LOEN+ signals go active (note, faults in the servo drives will not allow the NC Ready State):

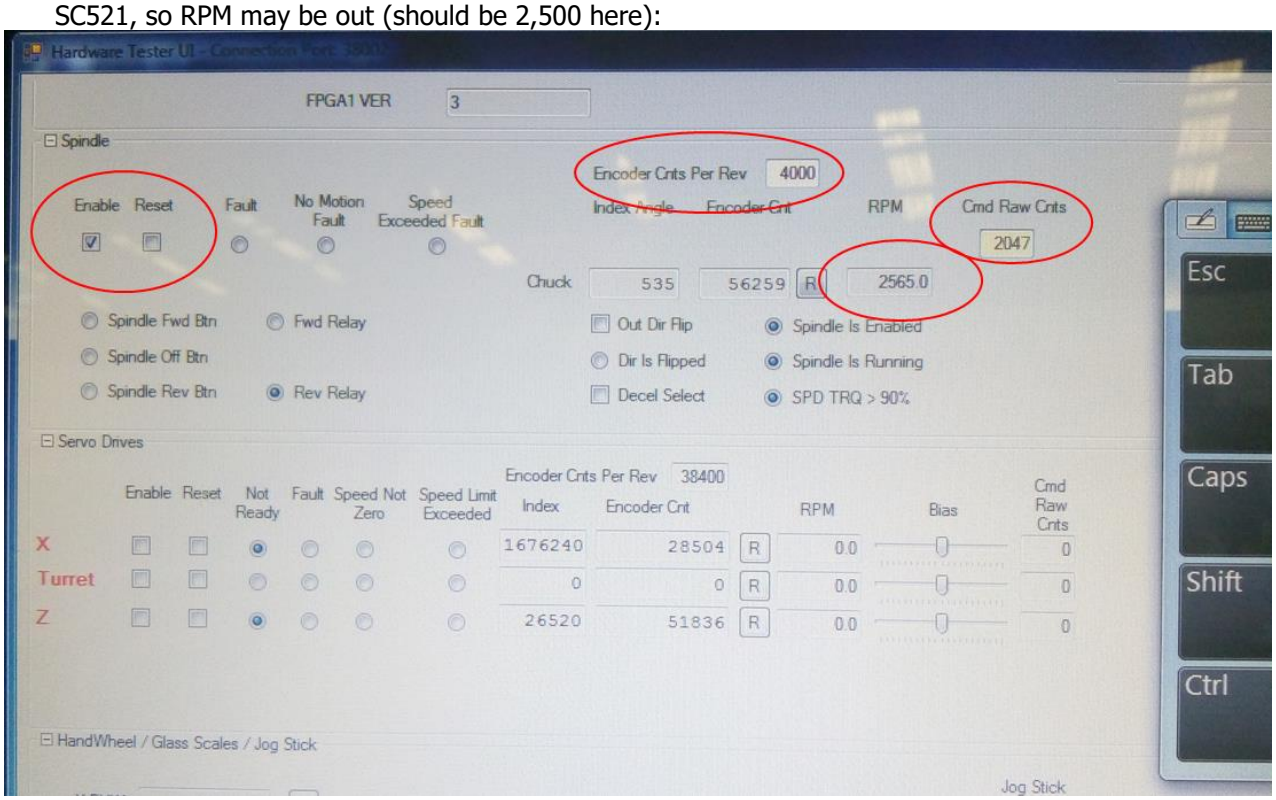


You can now turn on things like lube pumps and aux function outputs by checking the applicable box.

7.2.3.1 Spindle Section

To run the spindle

1. Close the chuck guard,
2. Click on enable drive (click on reset as well, if a fault is showing),
3. Select spindle speed by entering a number into the "Cmd Raw Cnts" box (using the swipe-out or a USB keyboard). Max RPM is at 2047 counts. This function is useful with the analog voltage in monitor of the AC drive, to check the CM DAC output.
4. Change the encoder counts per Rev to read 4000
5. Press the FWD/REV/OFF Keys on the pendant, as required (note, the pendant critical key LEDS do not change when using the Hardware tester). Spindle speed is uncalibrated in SC521, so RPM may be out (should be 2,500 here):



To check the spindle encoder:

1. Open the chuck guard (wait for the STO delay) and rotate the chuck by hand. Rotate in the direction which causes the Index Angle to increment (it's easier that way).
2. Stop when the index angle resets to zero (if it doesn't, the encoder is probably faulty)
3. Mark the position of the chuck relative to the headstock and press R to reset the Encoder Cnt box.
4. Continue to rotate the chuck and check both counts go up together.
5. Stop when the Index Angle resets to zero again. Check the chuck is back in the reference position relative to the headstock and check the Encoder Cnt box displays 4000 (within 1 count).
6. Continue rotating for a further revolution and check the Encoder Cnt box reads 8000, then rotate in the opposite direction until the Index Angle resets to zero again. Check the Encoder Cnt box displays 4000 again.
7. If not, the encoder or computer module is faulty. Repeat with a new encoder – do the test with the encoder in your hand first! If the test is now OK, then fit the new encoder. Otherwise, change the computer module.

7.2.3.2 Servo Drive Section

On Euro machines, SC521 provides a better way of checking encoder counts compared to code 131.

!!WARNING!!

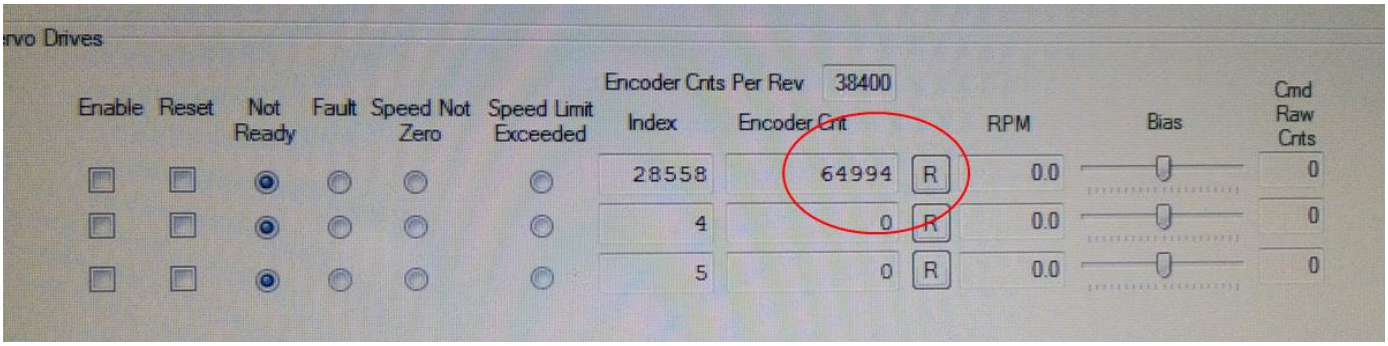
E-stop the machine before rotating ballscrews manually!

Reset the encoder count to zero ("R" box), then rotate the ballscrew. One turn of a ballscrew is:

	RLX 160, 355	RLX 425, 555 (short bed)	RLX425, 555 (long bed)	RLX 780
X	64, 985	64,985	23,079*	
Z	64, 985	64,985	23,079*	

Notes:

- Z Axis for 425/55 long bed: one ballscrew revolution is 88,615 counts, but when the encoder counts get to 65,536, the display will roll over to 0 and then the display will show the remaining counts (23,079).
- The encoder count runs from 0 to 65,535 so it is much easier if you turn the ballscrew in the direction which counts up first!
- It can be difficult to turn the ballscrew exactly one turn, so expect to be out by up to ±200 counts (about 1°). Anything more than this should be investigated.
- Check the count returns close to zero when you turn the ballscrew the other way.



One turn of the motor is 9,600 counts (for all axes and all lathes).

If an 8-tool indexer is fitted, then the turret drive will show Not Ready as above. If no turret is fitted (jumper fitted), then the drive will always show as Ready (as in the previous photo).

To move the axes in SC521:

1. Reset the hardware E-stop and NC Ready signals, if required
2. Enable the relevant drive and reset if the drive is showing Not Ready
3. Select speed by entering a number into the "Cmd Raw Cnts" box. Max speed is at 4095, but see warnings!

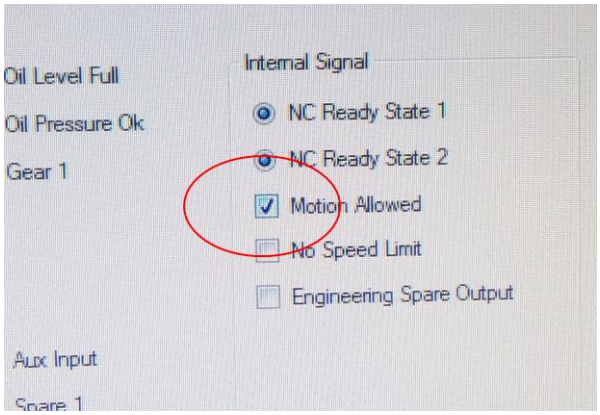
!!WARNING!!

The servo drives are running open loop and will creep continuously even with 0 demand!

Limit switches are inactive!

Some important notes:

- You can trim out some of the creep using the Bias slider.
- The zero speed limit is enabled by default, if you enter a speed faster than the equivalent of 15mm/min, then the speed limit hardware will kick in and disable the drives. Once the axis has slowed down the drive will be re-enabled and start moving again, and so on. This gives the impression the axes are vibrating (and is actually a useful check of the safety function).
- To disable the zero speed limit, check the Motion Allowed box:



- The Safe speed limit is also enabled by default. The same behaviour will be demonstrated if you demand a speed faster than the equivalent of 2m/min.
- To disable the safe speed limit check on the No Speed Limit box – but remember **LIMIT SWITCHES ARE INACTIVE in SC521 (and max speed is 10m/min)!**
- Unclamp the 8 station indexer or the servo will fault out with an overload. Return to HOME and clamp when finished.

Recommendation

For simplicity and safety, we suggest:

- **Leaving all Safe Speed limits active.**
- **Change axes speed by using the Bias slider (leaving Raw Cmd Cnts at zero) which will restrict speeds to a low level.**

7.2.4 Exiting the Hardware Tester

When finished:

1. E-stop the machine,
2. Close the Hardware tester window,
3. Shutdown Windows 7 using the Windows shutdown facility (DO NOT just turn off power!),
4. Turn off power at the back of the machine (you MUST cycle power to stop the hardware tester and restart the motion control software on the computer module.

7.3 ProtoTrak Control Pendant

7.3.1 Description

The control pendant is mounted onto a swinging arm on the LHS of the machine (or sliding door guard for RLX780). A locking lever is provided.

For RLX1630, the pendant is fixed.

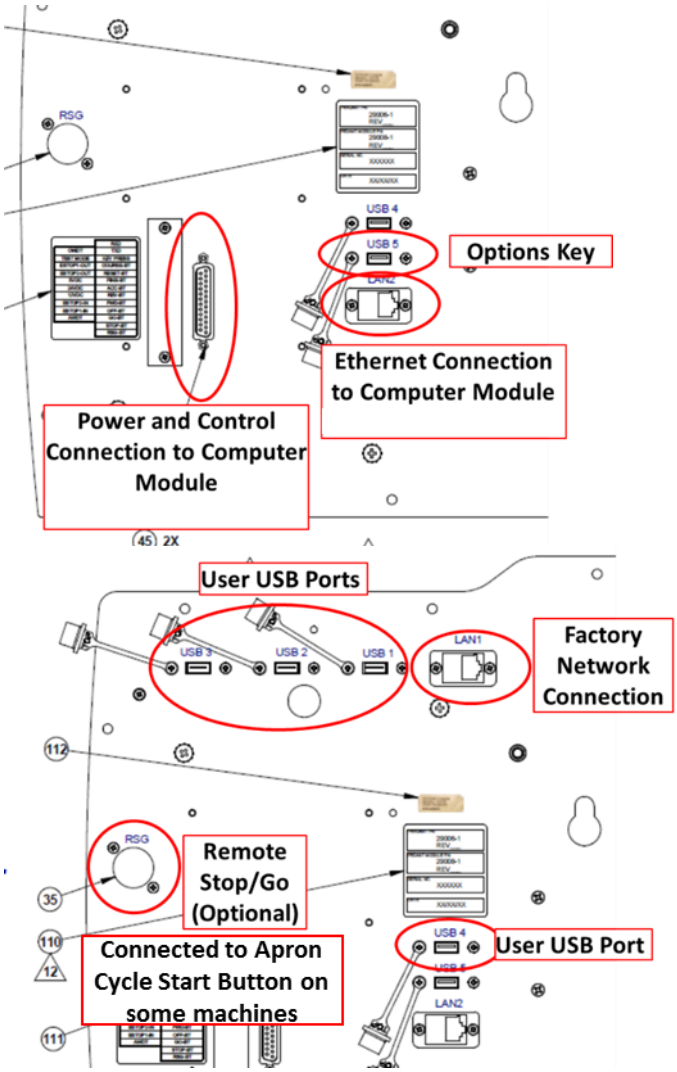
The pendant is connected to the computer module via a 25-way cable and ethernet cable. It provides the user-machine operating and programming interface.

It comprises:

- Emergency stop button (wired in series with the table guard E-stop button),
- LCD Display,
- Touch Screen,
- Numeric keypad for data input,
- Special function (critical) keys, such as:

- Cycle stop/go,
- Spindle control,
- Accessories (coolant pump) control,
- EHW fine/course selection,
- Reset button (to reset hardware E-stop and put machine into NC Ready state).

- Motion Control Ethernet port for communication with the computer module. This handles all data communications expect for those routed via the 25-way, Dsub connector,
- Power and hardwired Functions connector (25-way Dsub connector):
  - 24VDC from computer module,
  - E-stop button wiring (dual chanel),
  - Critical key wiring.
- USB Options key,
- RSG port,
- User USB and networking (ethernet) ports.



7.3.2 Diagnostics

The following Service codes are useful for diagnostic purposes:

Code 81: Check key and LED functioning.

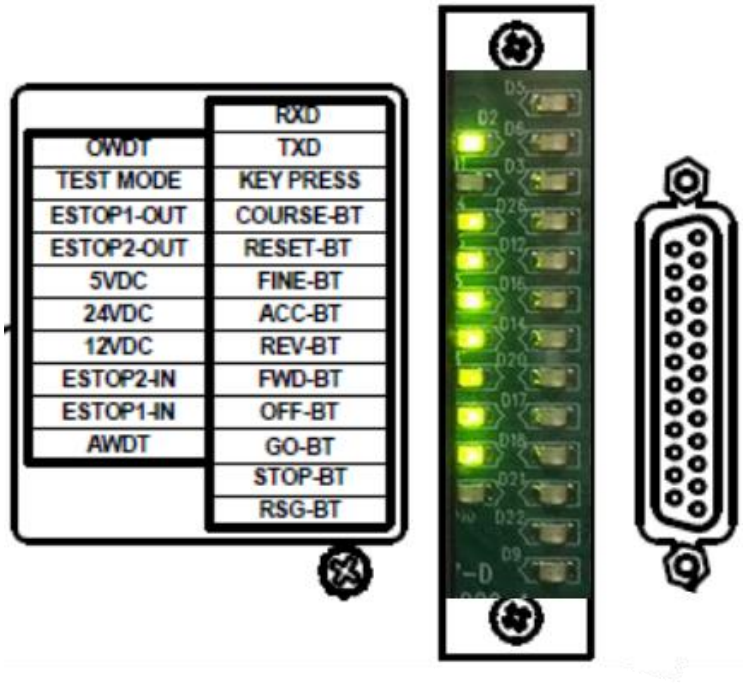
Code 33: Check all software is up to date and matched (Master and slave software MUST be the same version number – ignore the numbers in square brackets). Check machine ID matches actual machine.

Code 316: For updating S/W.

Diagnostic LEDs are provided on the rear of the display:

<table>
<tr><th>LED</th><th>Normal State</th><th>Notes</th></tr>
<tr><td>OWDT</td><td>Permanently ON</td><td colspan="4">If OFF: Pendant has internal fault, replace pendant.</td></tr>
<tr><td>TEST MODE</td><td>Permanently OFF</td><td colspan="4">If ON: Pendant has internal fault, replace pendant.</td></tr>
<tr><td rowspan="6">ESTOP1/2-OUT
ESTOP1/2 IN</td><td rowspan="6">Varies</td><td colspan="4">The pendant E-stop button is wired in series with, and after, the Apron E-stop button. Wiring is dual channel (channels 1 and 2), so channels 1 and 2 should always reflect the same state. LED status should agree with the following. If different:
• Check Apron E-stop button,
• Check E-stop wiring (wiring to Apron E-stop can be checked using diagnostic LEDs at the computer module, see section 7.4),
• Check 25-way cable (compare LEDs between CM and pendant)
• Replace pendant.</td></tr>
<tr><td>Apron E-stop</td><td>Pendant E-stop</td><td>ESTOP1/2 IN</td><td>ESTOP1/2 OUT</td></tr>
<tr><td>IN</td><td>Any state</td><td>OFF</td><td>OFF</td></tr>
<tr><td rowspan="2">OUT</td><td>OUT</td><td rowspan="2">ON</td><td>OFF</td></tr>
<tr><td>IN</td><td>ON</td></tr>
<tr><td>Any state</td><td>Any state</td><td colspan="2">Ch 1 LEDS should always match Ch 2 LEDs.</td></tr>
<tr><td>24VDC</td><td>Permanently ON</td><td colspan="3">Monitors 24VDC supply from CM (24DC-2).
If OFF, check 24VDC-2 LED on CM and continuity of 25 way cable. Try new cable if CM OK, otherwise replace pendant.</td></tr>
<tr><td>5VDC
12VDC</td><td>Permanently ON</td><td colspan="3">These LEDs monitor voltages generated internally to the pendant (from the external 24VDC supply). If OFF replace pendant.</td></tr>
<tr><td>AWDT</td><td>Permanently OFF</td><td colspan="3">Note, may be ON during the bootup sequence; this is normal.
Otherwise if ON, replace pendant.</td></tr>
<tr><td>RXD/TXD</td><td>Varies.</td><td colspan="3">RXD/TXD monitors the internal communication between the front panel interface and pendant computer. Normally OFF, but will flash briefly whenever any front panel key is pressed.
If different, try a new 25Way cable, otherwise replace the pendant.</td></tr>
<tr><td>KEY PRESS</td><td>Varies.</td><td colspan="3">KEY PRESS LED will light for the duration of any pendant key press (except for the critical keys).
Double check with service code 81. Otherwise, replace the pendant.</td></tr>
</table>

LED	Normal State	Notes
COURSE-BT, thru to RSG -BT	Varies	Each LED monitors the critical keys with the same name. Normally OFF, but ON for the duration of the key press. Double check with service code 81 and also compare with the same LED on the CM, to see if the fault is with the pendant or 25-way cable.



7.3.3 Repair Procedures

There are no user serviceable parts inside the pendant; repair is by replacement. XYZ offer factory refurbished Service Exchange units.

7.4 ProtoTrak Motion Control Computer

7.4.1 Description

The computer module is installed in the electrical cabinet at the rear of the machine; held in place by 6 off M5 screws. It is powered by 110VAC (from the control transformer and a 4A fuse).

It provides:

- Motion control processing (on a single board computer, running Windows CE).
- Interface to machine HW (on a special purpose applications board), including:
  - Spindle Variable Frequency Drive unit,
  - Axes servo drives,
  - Spindle encoder,
  - EHWs and Jog stick,
  - limit switches,
  - Lube and coolant pump relays,
  - Other machine electrical systems (e.g task lighting).
- Euro safety circuits (for E-stop and Chuck guards).

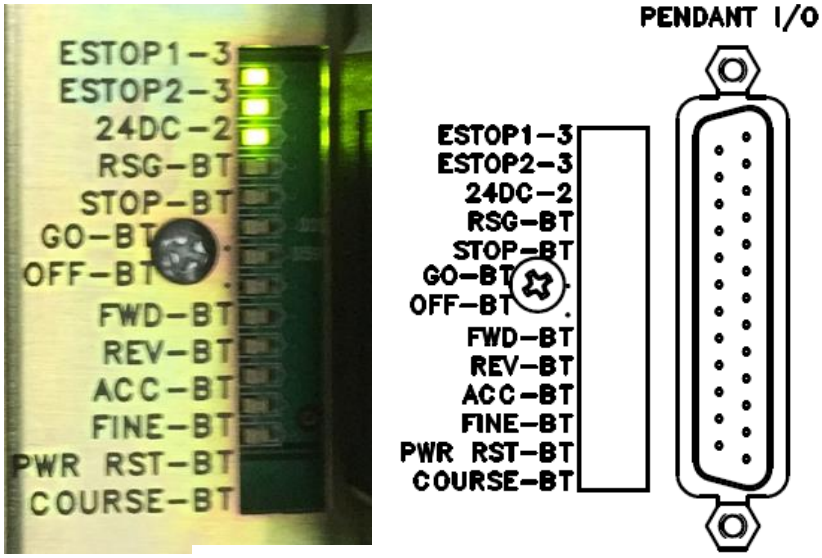
- Machine ID key port - a coded key inserted here tells the control what machine it is connected to. Machine ID can be checked in Service Code 33 (note, until the pendant establishes communication with the computer module, it does not know what machine it is connected to – hence lathes will initially boot up showing RMX). An incorrect machine ID will lead to serious machine problems.
- Low voltage power supplies (including 24VDC used by pendant and machine I/O).
- Motion control ethernet connection to pendant.
- USB ports and COM ports (for manufacturer's use only).

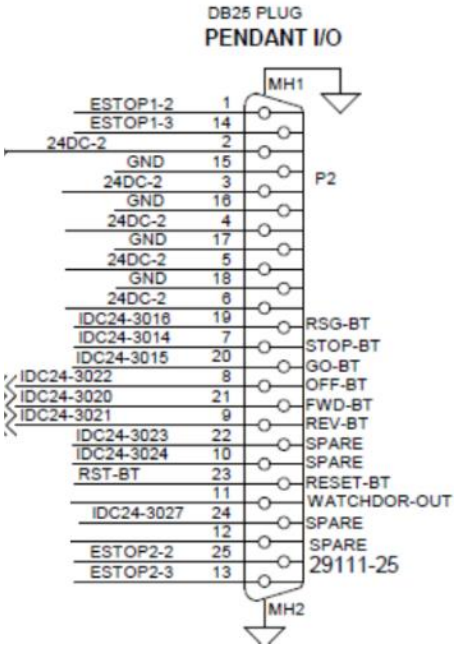
7.4.2 Diagnostics

7.4.2.1 Pendant Connectivity

Diagnostic LEDS are available next to the 25 way, pendant connector.

LED	Normal State	Notes
E-STOP1-3 ESTOP2-3	Varies	These LEDs monitor the E_STOP circuit from the pendant. They should mirror exactly what the pendant, ESTOP 1/2 OUT LEDS show (see section 6.3.2). If not, check continuity of the 24 way cable. Try a new cable if pendant OK, otherwise replace the Computer Module.
24VDC-2	Permanently ON	Monitors the 24VDC supply from the CM to the pendant. If OFF, remove the 24 way cable. If the LED now lights, there is a short in the cable or pendant. Remove the cable from the pendant end instead, to determine if the fault is with the cable or pendant. Replace the faulty part.
RSG -BT thru to COURSE-BT,	Varies	Monitor the special function keys with the same name. Normally OFF, but ON for the duration of the key press. Double check with service code 81 and also compare with the same LED on the pendant, to see if the fault is with the computer module or 25 way cable.



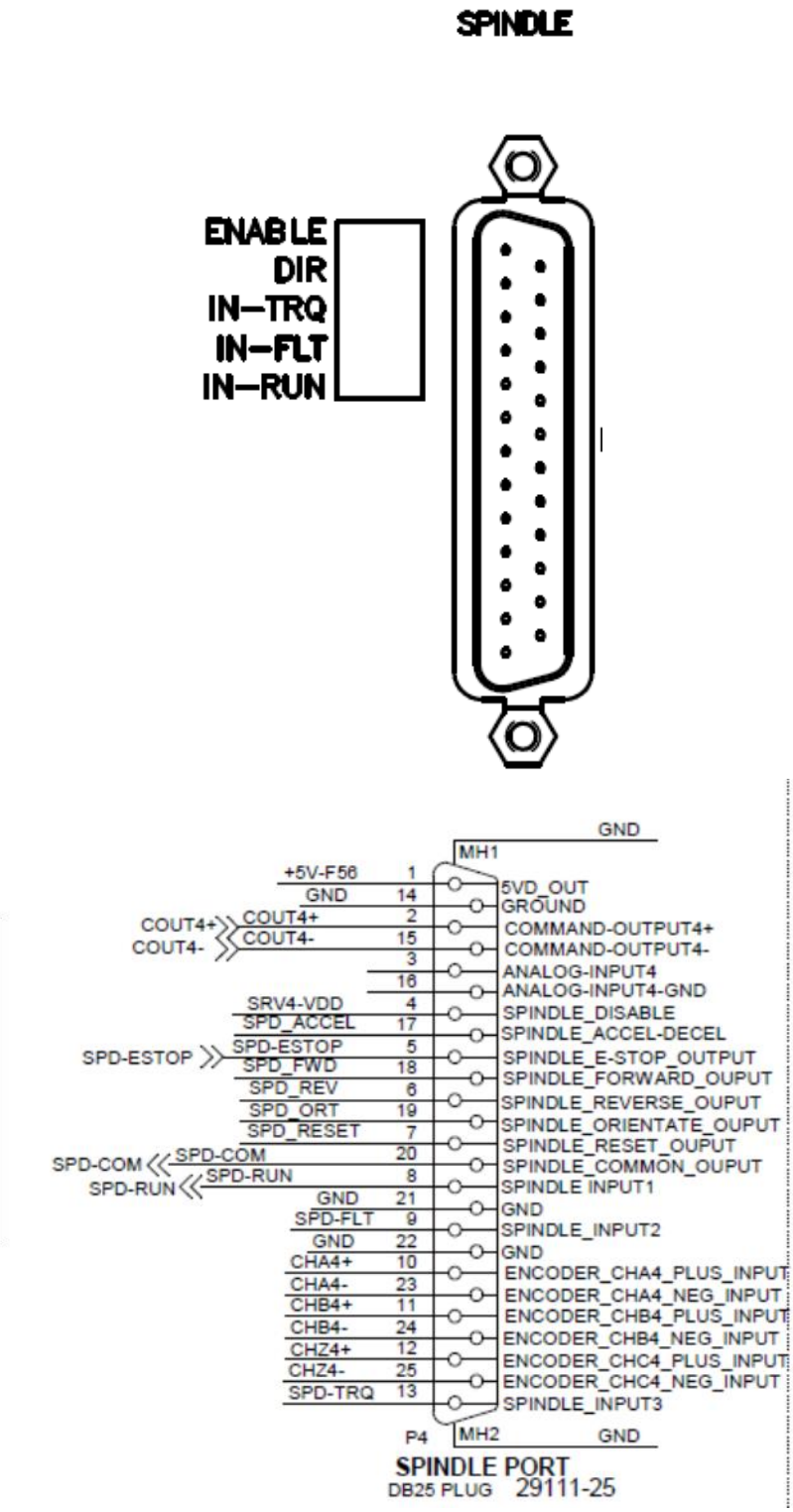


7.4.2.2 Spindle Port

Diagnostic LEDS are available next to the 25-way, spindle drive connector.

LED	Normal State	Notes
ENABLE	Varies	Indicates the state of the internal spindle enable signal. It should only be ON if: 1. The machine is in the NC ready state (i.e. out of E-stop and no machine/control faults), and 2. The chuck guard safety circuit is closed, and 3. The control is in a spindle enabled mode (DRO, TOOL TABLE or RUN). With the spindle running, at the end of a programme run or if you press the spindle OFF key in DRO or TOOL TABLE, the enable will turn OFF for about ½ second to turn off the spindle.

LED	Normal State	Notes
		Without the spindle enable signal, the spindle cannot run, so check this signal and the conditions for it to be ON, if there are problems with the spindle not starting or stopping unexpectedly. This signal can be forced on in service code 521.
DIR	Varies	Signal used by control system to reverse the current spindle direction. Normally OFF for most lathes (where the spindle motor is under the headstock), but will be on to reverse the spindle when tapping. Normally ON for lathes where the spindle motor sits outside the headstock (RLX555x3m and RLX780) to account for the reversed driving direction. If LED does not follow these rules, then change the computer module. This signal can be forced on in service code 521.
IN-TRQ IN-FLT IN-RUN	Varies	Status signals from the spindle drive unit – see "Digital Outputs", in section 7.5.2

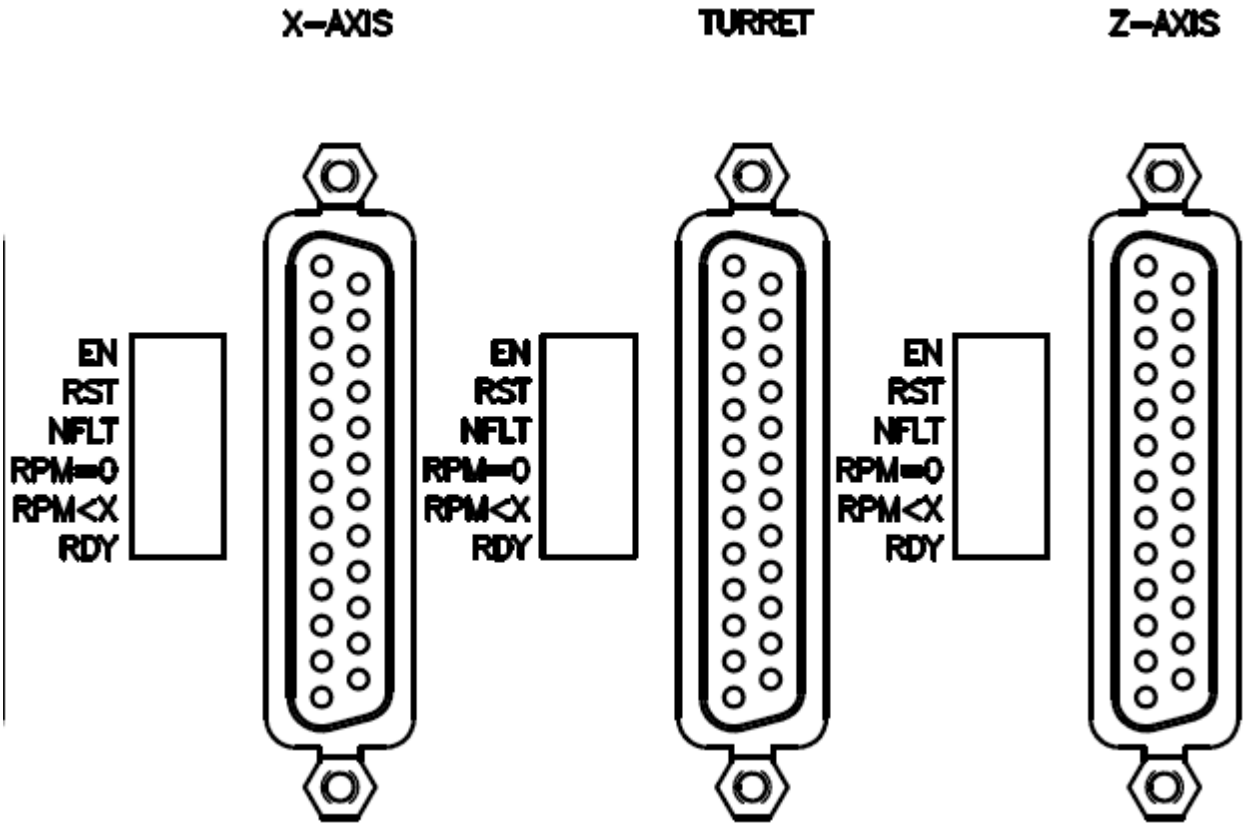


7.4.2.3 Axes Port

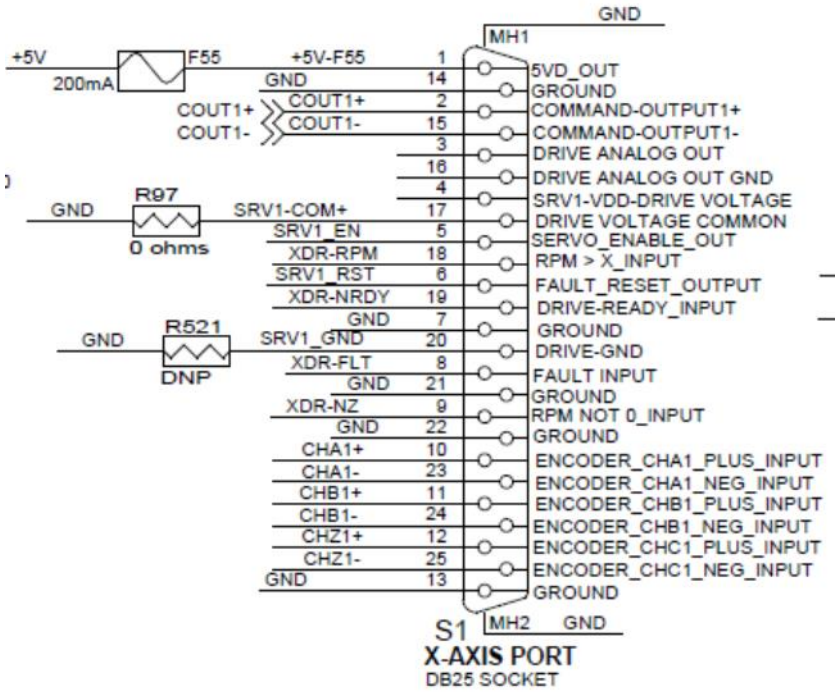
Diagnostic LEDS are available next to the 25-way, axes drive connectors.

LED	Normal State	Notes
ENABLE	Varies	Indicates the state of the internal drive enable signal. It will be OFF except when the control is in a drive enabled mode (DRO, TOOL TABLE or RUN). Note, the 8-tool indexer servo is only enabled whilst changing tools (specifically; unclamped).

LED	Normal State	Notes
		Any other behaviour indicates a fault with the computer module. Without the drive enable signal, the axes cannot move, so check this signal if there are problems with axes motion. This signal can be forced on in service code 521.
RST	Varies	Shows status of the internal drive reset signal. Wil normally be OFF. Comes on briefly when the POWER RESEST button is pressed from the E-stop/NC not ready state. Any other behaviour indicates a fault with the computer module. This signal can be forced on in service code 521.
NFLT RPM=0 RPM<X RDY	Varies	Status signals from the axes drive units – see "Digital Outputs", in section 7.6.2



Each Input:

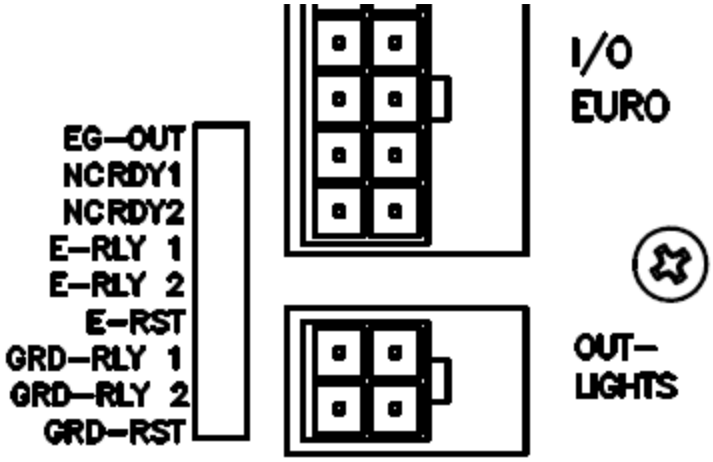


7.4.2.4 Euro Safety Hardware LEDs

Diagnostic LEDS show the status of the hardware Euro safety circuits (E-stop and Chuck Guard spindle interlock):

LED	Normal State	Notes
EG-OUT	OFF	For manufacturer's use only
NCRDY1 NCRDY2	Varies	Indicates the state of the internal NC Ready signals. Both LEDs should come on shortly after the POWER RESET button is pressed. Both LEDs should be off if there is a fault or the machine is in hardware E-stop. Any other behaviour indicates a fault with the computer module or an axes/spindle drive fault; preventing a power reset (see sections 7.5 and 7.6). These signals must be forced on in service code 521 to enable axes to move/spindle to run.
E-RLY1 E-RLY2	Varies	Indicates the state of the internal, hardware E-stop safety relays. Both LEDs should come on after the POWER RESET button is pressed. Both LEDs should be off when the hardware E-stop is active Any other behaviour indicates a fault with the computer module or the external E-stop circuit. Check (use relevant diagnostic LEDs to assist, see also section 7.7): • E-stop buttons, • E-stop button wiring. • K1 feedback contacts on I/O NC ready connector: The E-stop cannot be reset if the circuit between RST-BT and

LED	Normal State	Notes
		24DC-RB11 remains open circuit when the machine is in the E-stopped state) • Reset button Refer to the Ladder Diagram on the machine electrical schematic for information on the internal configuration of the E-stop circuit.
E-RST	OFF	This LED comes ON whilst the POWER RESET button is pressed, providing there is no fault in the E-stop circuit; preventing a reset. Diagnose faults as for E-RLY1 and E-RLY2.
GRD-RLY1 GRD-RLY2	Varies	Indicates the state of the internal, chuck guard safety relays Both LEDs should come ON immediately the chuck guard(s), or belt door, are closed. When the chuck guard is opened, these LEDs should begin to dim, then after the STO delay (about 7 to 25 seconds depending on model), these LEDs should both turn OFF. Any other behaviour indicates a fault with the computer module or the external guard circuit. Check (use the relevant diagnostic LEDs, see also section 7.7): • Guard switches, • Guard wiring. • Guard reset feedback circuit on I/O Euro connector. The guard circuit will reset automatically when the guards are closed providing there is a closed circuit between 24DC-D22 and 24DC-D30. These signals are broken out to a pair of terminal blocks which have a shorting jumper installed. However, if certain accessories are fitted, then there may be NC contacts inserted into this circuit which must be closed when the guards are open to allow a reset. DO NOT bypass these contacts except temporarily for testing, as the safety of the machine will be reduced. Refer to the Ladder Diagram on the machine electrical schematics for information on the internal configuration of the table guard circuit.
GRD-RST	OFF	This LED comes ON briefly when the chuck guard is closed; indicating a successful reset. This LED also comes on briefly if the POWER RESET button is pressed and the guards are closed (assuming no faults in the E-stop or guards circuit). Diagnose faults as for GRD-RLY1 and GRD-RLY2.

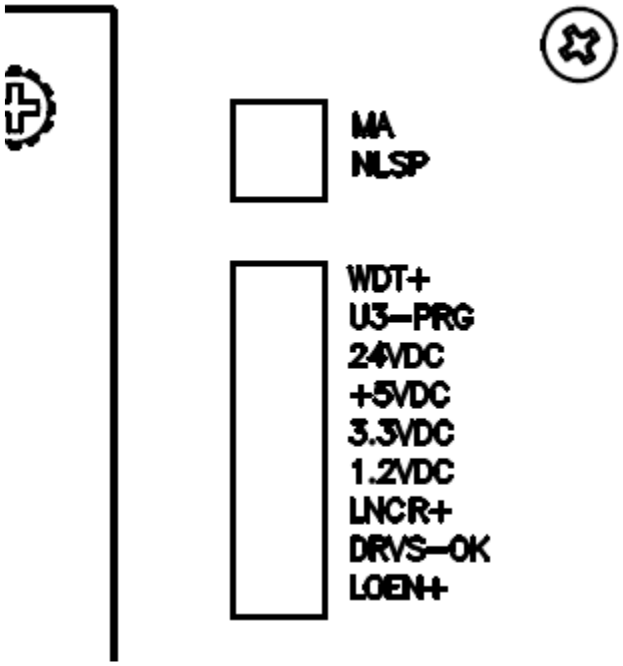


7.4.2.5 Motion Control Status LEDs

LED	Normal State	Notes
MA NLSP	Varies	Indicates the status of the Motion Allowed and (Not) Limit Safe Speed signals which are used as part of the safety Standstill and Safe speed monitoring circuits. Motion is only expected in certain modes like DRO. Speed is limited to less than 2m/min whenever the door guard is open. Machine speeds which do not comply with these rules flag safety faults such as error 229 etc. Generally, these speeds should not be violated, so such faults should not occur. If they do check these signals are active during the correct machine mode/state. See table below for status as a function of mode and table guard state. Possible faults causes are: • Certain operator actions (such as opening guards whilst jogging at high feedrates) will flag software monitoring errors when none actually exist. Refer to the "Normal Error Codes" document (see chapter 9) for more information. • Door guard circuit fault. • Servo drives/cabling fault, particularly digital outputs 2 and 3 (zero speed and speed limit). • Internal computer module fault.
WDT+	OFF	Internal watch dog. If ON at any time, other than during bootup, replace the computer module.
U3-PRG	FLASHING	Internal hardware monitor. If NOT flashing, replace the computer module.
24VDC +5VDC 3.3VDC 1.2VDC	ON	LEDs monitoring internal power supplies. If any of these LEDS are OFF, there is a fault with the computer module.
LNCR+	Varies	Monitors NCRDY1 & NCRDY2 signals. Should come on after pressing POWER RESET. Diagnose as for the NCRDY1/2 signals.
DVRS-OK	ON	LED ON indicates no faults with any axis or spindle drive unit. If OFF, diagnose as per axis/spindle drive sections.

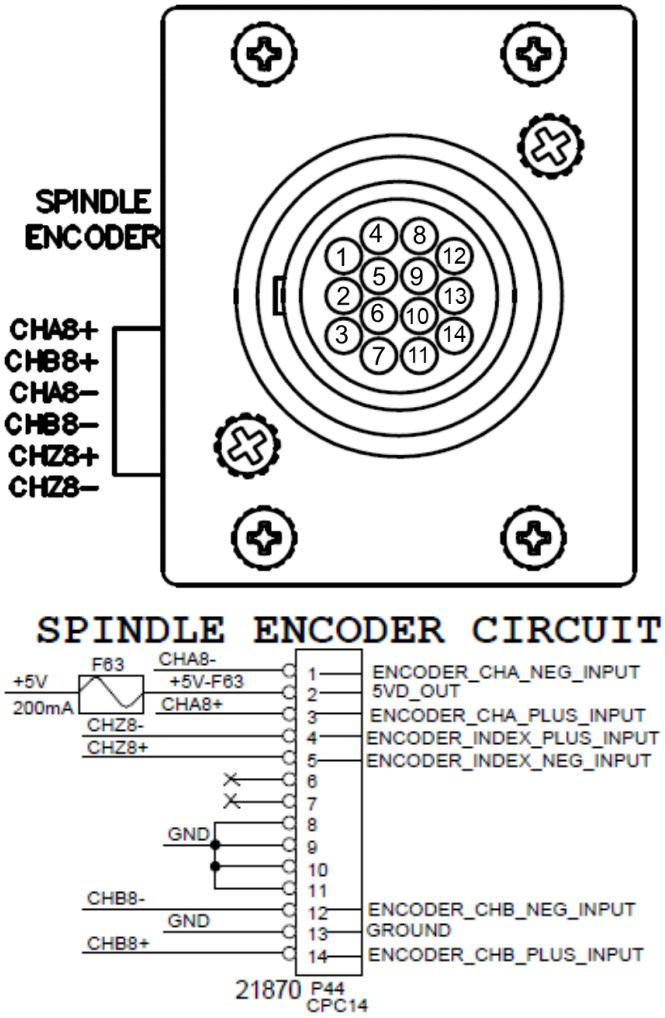
LED	Normal State	Notes
LOEN+	Varies	Internal signal which enables all computer module outputs. Should be ON after pressing POWER RESET unless there is a fault with the drives (see DVRS-OK) or internal hardware (see WDT+). If OFF after a power reset, diagnose as for E-stop faults or else change the computer module.

Door guard Status	Mode	MA	NLSP
Open	DRO	1	0
	RUN	0	0
	Tool TABLE	1	0
	Any other Mode	0	0
Closed	DRO	1	1
	RUN	0 when entering mode, Changes to 1 when START pressed.	0 when entering mode, Changes to 1 when START pressed.
	TOOL TABLE	1	1
	Any other Mode	0	0



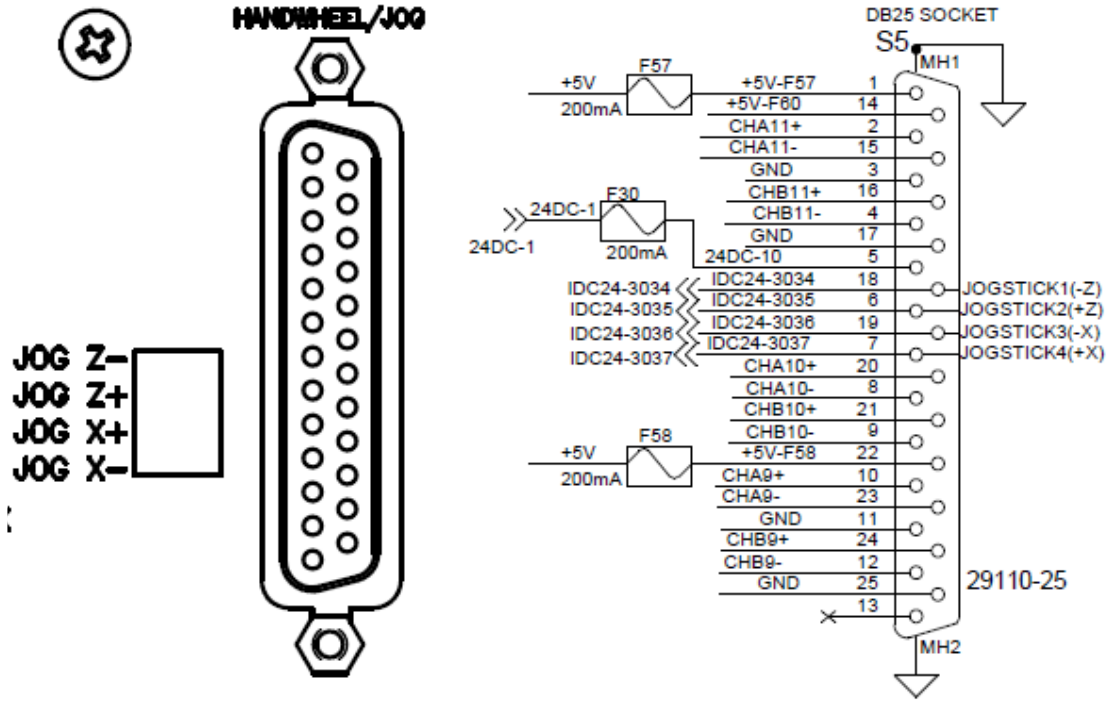
7.4.2.6 Spindle Encoder Input

LED	Normal State	Notes
CHA8+ CHB8+ CHA8- CHB8- CHZ8+ CHZ8-	Varies	These LEDs monitor the spindle encoder signals. The encoder is a quadrature encoder which has three channels, CHA8, CHB8 and the index pulse (once per rev) channel CHZ8. Each channel is transmitted as a differential signal (+ and -) to provide a reliable signal path in the presence of external electrical noise. These LEDs should flash as the spindle encoder is rotated. If any LED is permanently ON or OFF as the scale is moved, check the Quill scale connections are OK, otherwise replace the encoder head.



7.4.2.7 Handwheel/Jog Input

LED	Normal State	Notes
JOG Z- JOG Z+ JOG X+ JOG X-	Varies	These LEDs monitor the Jog stick command inputs. The relevant LED should light whilst the jog stick is operated. If not, try a new cable (route temporarily on the outside of the machine, otherwise change the jog stick or Computer Module. Jog stick operation is more easily checked in SC521. Handwheel operation can be checked in SC132 or SC521.

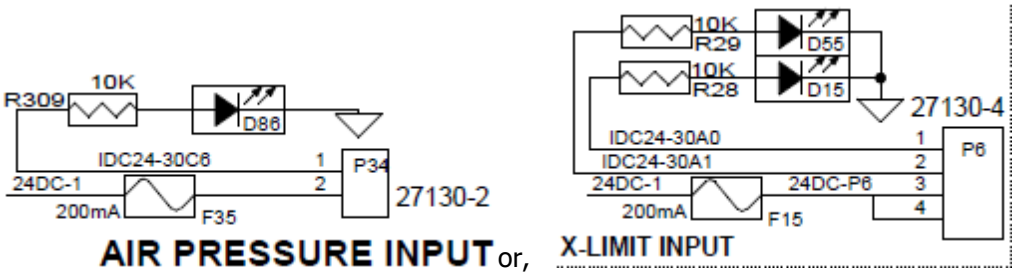


7.4.2.8 I/O Connectors

Each input and output connector has a diagnostic LED.

INPUTS:

A typical input circuit looks like this:



The LED is useful to indicate the state of the circuit connected to the input. When the external circuit is closed the LED will be ON. For example, if it is a limit switch input, the LED will be ON if the switch is closed (axis NOT on a limit switch) and OFF when the axis has tripped the limit switch.

Note, there is a self-resetting fuse protecting all 24VDC supplies powering input circuits. If the LED is always OFF, as well as checking for open circuits, also check for short circuits to ground (remove the connector in the first instance).

Inputs can be monitored in service code 521. If the LED indicates a closed external circuit, but code 521 does not register the change, then replace the computer module (rare fault).

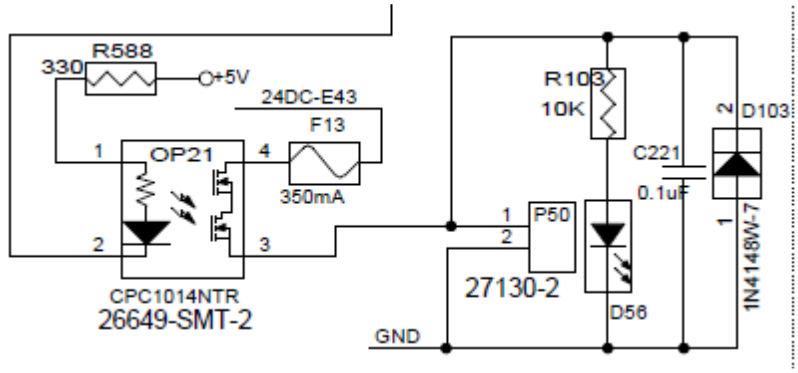
OUTPUTS:

There are two types of output circuit.

Type 1:

- Guard Unlock (not used on RLX)
- Coolant pump relay
- Lube pump relay
- Turret INDEX,
- Turret Unclamp

The output circuit looks like this (this is the coolant pump relay output):

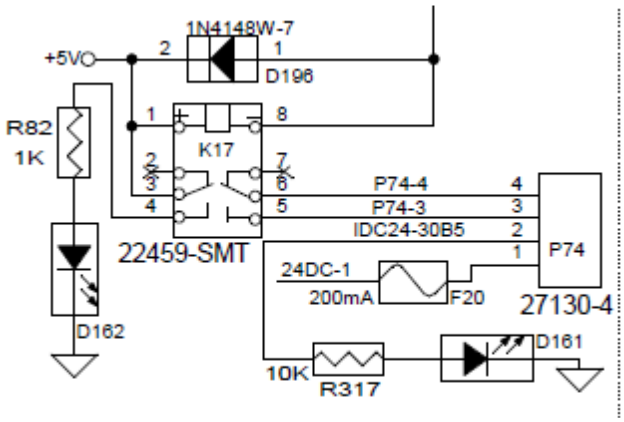


When the output is active, 24VDC will appear across the connector and the LED will be ON. Outputs are protected by self-resetting fuses, so if the LED does not come ON, check for short circuits to ground or 0V in the external circuit before considering replacing the computer module.

Type 2:

- Spare 1
- Spare 2
- AUX I/O (also an input)

These outputs are electromechanical relays and have volts free contacts. The output circuit looks like this (this is the AUX I/O output):



When the output is active, a low resistance (<2ohms) will appear on the output contacts and the LED will be ON. Always check the contact resistance as well as the LED, as they are on different contacts.

Contacts are rated at 24VDC, 1A.

All outputs can be turned on in service code 521. If the output cannot be activated in code 521 replace the computer module (rare fault).

7.4.3 Aux Output

This output is controlled by AUX events in Programme run mode. If this function is not working, check:

- Programming is correct,
- Computer Module Hardware, using service code 521.

For more information on the Aux function, see Technical Bulletin 135 (refer to chapter 9)

7.4.4 Repair Procedures

There are no user serviceable parts inside the computer module; repair is by replacement. XYZ offer factory refurbished, Service Exchange units.

7.5 Spindle Drive system

7.5.1 Description

The spindle motor is driven through a gear box (not 1630) and drive belts from an AC induction motor mounted underneath/next to the headstock. Spindle motor speed is controlled by a variable frequency inverter drive. Digital and analogue control signals from the computer module control speed, direction and other drive functions.

Machines produced up to mid-2021 were fitted with the Yaskawa V1000 drive. Subsequent machines are fitted with the GA500 drive. The drive functionality is identical, but there are minor differences in the electrical wiring (mainly the use of ferrules instead of fork terminals).

The RLX780 uses the Yaskawa GA700 drive.

To permit fast stopping of the spindle, brake resistors are mounted in a small enclosure on top of the electrical cabinet and connected to the (internal DC bus chopper of the) spindle drive.

The spindle motor has a separate, fixed speed cooling fan to provide cooling at all motor speeds. Two fans are mounted underneath the brake resistors to provide forced air cooling to the resistors and the electrical cabinet cold wall. These fans are driven from 110VAC from the control transformer via a 2A fuse.

A spindle encoder is fitted to the headstock (driven by a belt from the spindle shaft (or an idler gear on the RLX1630). The encoder generates 1000 pulses per revolution in quadrature (for a total of 4,000 counts per revolution). A single (once per revolution) index pulse is used to determine spindle position for threading events.

The RLX780 motor has a separate, encoder used for closed loop speed control and for the (chuck) Hold function. This encoder is not integrated into the ProtoTrak control system.

See the machine electrical schematics (reference section, chapter 9) for wiring details.

7.5.2 Diagnostics

7.5.2.1 Spindle motor

Spindle motor faults are rare, except for motors which have been in service for a very long time. Common faults for old motors are:

Mechanical faults such as failed bearings: Diagnose by inspection.

Electrical faults: In most cases these are detected by the spindle drive electronics unit:

- Winding Short circuit to ground: Overcurrent fault
- Lost phase winding: Motor will not start leading to Overcurrent or Overload fault from stalled motor.
- Complete open circuit: This will not generate a drive fault (although you may get spindle speed errors on the PT control), but the spindle will not turn and monitoring the motor current (see drive section) will show no current drawn.

Confirm the fault as follows:

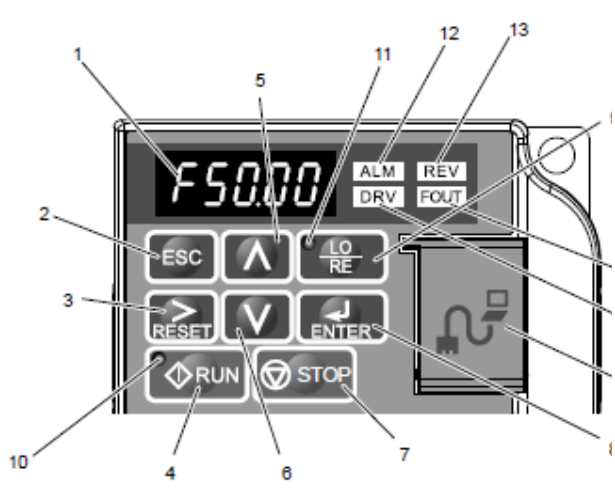
- Short circuit to ground: Measure between each motor wire (S-U, S-V, S-W) and ground. Ideally use a 500V megger, but if this is not available use an ohm meter. Resistance should be effectively open circuit.
- Lost phase winding or open circuits.: Measure between pairs of motor wires. Resistances should be approximately equal and around a few ohms. Actual resistance is not important; a fault will be obvious as a significant mismatch between one or two pairs of wires or an open circuit.

Disconnect the motor cable from the spindle drive before undertaking these measurements. Measure with the motor cable connected and then disconnected to determine if the fault lies in the motor cable or the motor itself.

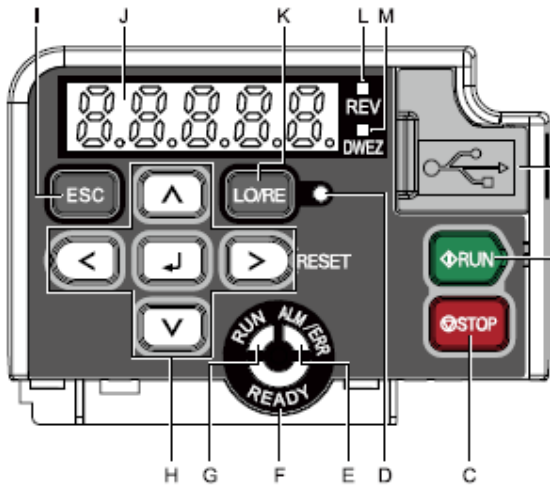
Replace the motor/cable if confirmed faulty.

7.5.2.2 Spindle Drive Electronics (V1000 and GA500)

The spindle drive electronics has a number of monitoring, built in test and fault logging functions to assist in diagnostics. These are accessed through the Digital LED Operator:



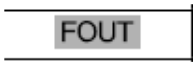
V1000



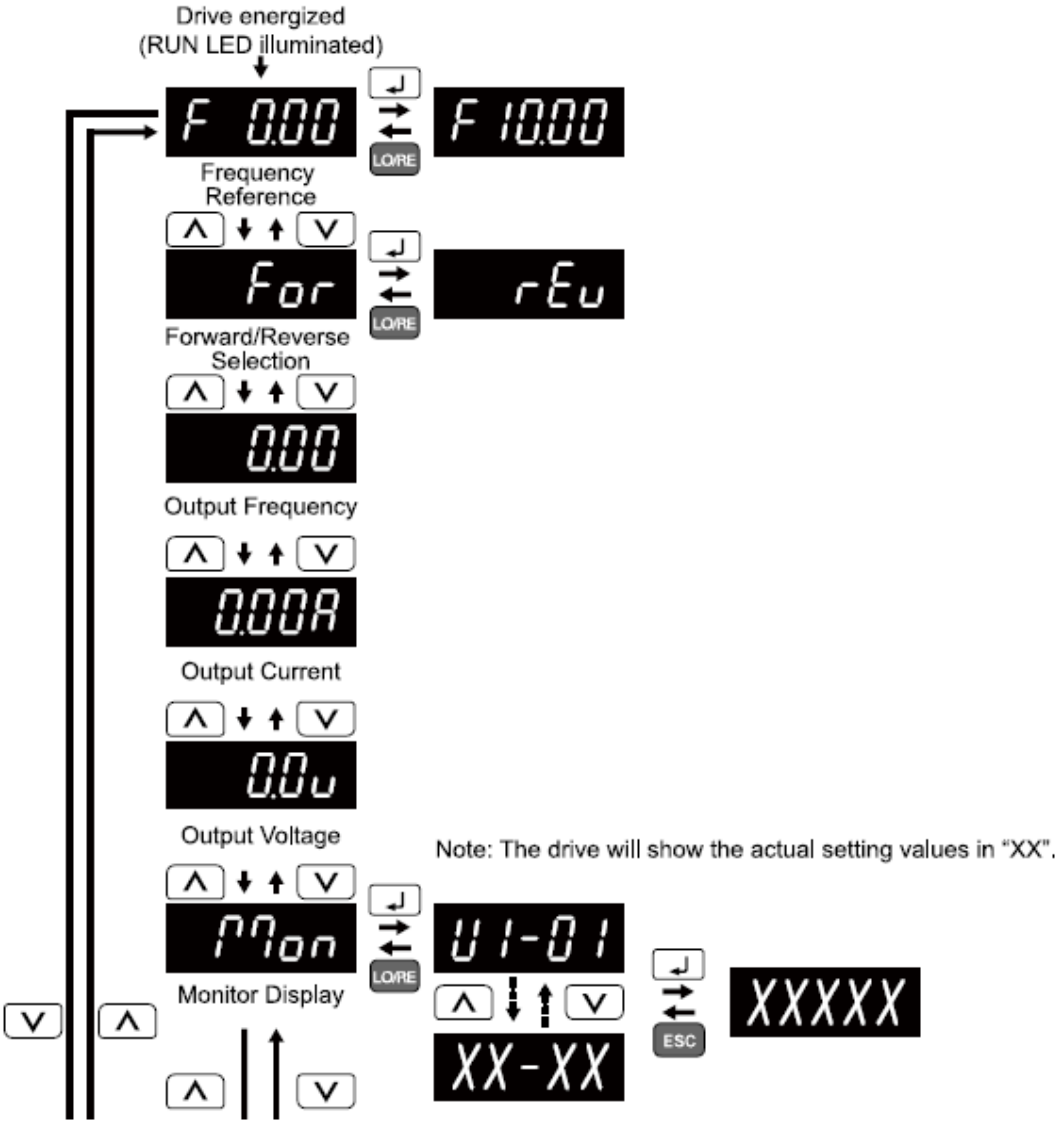
GA500

No.		Display	Name	Function
1	J		Data Display Area	Displays the frequency reference, parameter number, etc.
2	I	ESC	ESC Key	Returns to the previous menu.
3	H	>	RESET Key	Moves the cursor to the right Resets the drive to clear a fault situation.
4	B	RUN	RUN Key	Starts the motor
5	H	∧	Up Arrow Key	Scrolls up to select parameter numbers, setting values, etc.
6		∨	Down Arrow Key	Scrolls down to select parameter numbers, setting values, etc.
7	C	STOP	STOP Key	Stops the motor
8	H	↵	ENTER Key	Selects all modes, parameters, settings, etc.
9	K	LO/RE	LO/RE Selection Key	Switches drive control between the operator (LOCAL) and the computer module

No.		Display	Name	Function
10	G		RUN light	Lit while the drive is operating the motor.
11	D		LO/RE Light	Lit while the operator (LOCAL) is selected to run the drive

No		Display	Lit	Flashing	Off
12	E		Drive has detected an alarm or error, check LED display for error code. See V1000/GA500 manual, troubleshooting section for more information. See section 7.7 for information on the HbbF/STOF alarm	Alarm detected	No fault or alarm
13	L		Motor rotating in reverse	-	Motor rotating in forward
14	F		Normal drive mode	-	Programming mode
15	-		Displaying output frequency	-	Displaying input frequency (speed demand from computer module) or other parameter

Information can be accessed through the various menus:



Lo/Re Key

The Local/Remote key is used to switch between local and remote control over the drive. Local mode is extremely useful to isolate spindle faults quickly between the drive and the ProtoTrak control system. Local mode allows the spindle to be run using the control panel on the drive. If the spindle can be run satisfactorily in this mode, then the fault lies with the ProtoTrak control system, not the drive electronics or spindle motor.

It is recommended you do this test FIRST when investigating spindle faults.

Press the Lo/Re key and note the LED lights on the key. Press ENTER and select a valid drive frequency (a low value such as 10Hz is recommended). Press RUN and check to see if the spindle runs. Use the arrows keys to select reverse. Press STOP to stop the spindle.

Press the Lo/Re key to return to remote control when finished.

!!WARNING!!

The spindle will start when you press RUN in Local mode regardless of control mode or state. Only the E-stop and chuck guard interlock (after the STO delay) will disable the spindle. Ensure the spindle is safe before engaging local mode and keep all unauthorised personnel away from the spindle during testing. Close the door.

Frequency Reference (Input Frequency):

The default display on power up is the input frequency. Motor speed is controlled by controlling drive frequency (motor speed is proportional to drive frequency).

The desired frequency is set by the computer module, using an analogue voltage input over the range 0 to 10V, on terminals A1 and AC. The drive is configured to convert this voltage to drive frequency as shown in the table below.

If spindle is not running or speeds are off, check frequency and voltage values are correct against the following table. Input voltage can be checked using a meter (between terminals AC and AVI) or using the built -in monitor U1-13 (see MNTR section). If voltages are wrong, run spindle calibration (Service Code 510) and re-check. If error persists, change the computer module. Clearly, no voltage may be a cable problem – check continuity/change cable.

	Low Gear		**High Gear**	
	Minimum Value	**Maximum Value**	**Minimum Value**	**Maximum Value**
RLX1630				
RPM	150 RPM	2500 RPM		
Input Frequency[1]	7.4Hz	123Hz		
Input voltage [1] (U1-13) [2]	0.6V (6%)	10V (100%)		
RLX355				
RPM	35 RPM	1410 RPM	100 RPM	4000 RPM
Input Frequency[1]	4.8Hz	185Hz	4.8Hz	185Hz
Input voltage [1] (U1-13) [2]	0.2V (2%)	10V (100%)	0.2V (2%)	10V (100%)
RLX425				
RPM	25 RPM	300 RPM	140 RPM	2500 RPM
Input Frequency[1]	13Hz	150Hz	8.4Hz	150Hz
Input voltage [1] (U1-13) [2]	0.9V (9%)	10V (100%)	0.6V (6%)	10V (100%)
RLX555				
RPM	30 RPM	375 RPM	140 RPM	1800 RPM
Input Frequency[1]	12Hz	150Hz	12Hz	150Hz
Input voltage [1] (U1-13) [2]	0.8V (8%)	10V (100%)	0.8V (8%)	10V (100%)
RLX 780				
RPM	20 RPM	415 RPM	40 RPM	1300 RPM
Input Frequency[1]	9.4Hz	198Hz	6Hz	198Hz
Input voltage [1] (U1-13) [2]	0.5V (5%)	10V (100%)	0.3V (3%)	10V (100%)

Notes:

1. Expect small variations in these values to allow for calibration of individual drives and computer modules.
2. U1-13 displays voltage as a percentage of 10V.
3. For intermediate values, the RPM/frequency/voltage should scale linearly.

Output Frequency

This is the frequency which the drive outputs to the motor which determines the motor speed. The spindle encoder is not used to fine tune the spindle speed, so this frequency should match closely the input frequency. For the RLX780, there is a separate spindle encoder mounted to the motor, and the drive is run in closed loop speed control, hence the output frequency of the RLX780 drive will be slightly higher than the input frequency (depending on load).

If you observe any large discrepancy, investigate the spindle motor or change the drive unit (rare fault).

Output Current:

Typical values for no load current are (High Gear):

Frequency (use local mode)		**20Hz**	**50Hz**	**80Hz**	**120Hz**	**180Hz**
RLX1630 (5.5kW)	Voltage	170V	420V*	420V*	425V*	
	Current	5.7A	5.8A	3.7A	4.0A	
RLX355 (5.5 kW)	Voltage	120V	300V	420V*	420V*	425V*
	Current	4.1A	4.3A	3.7A	3.0A	3.8A
RLX 425 (7.5kW)	Voltage	123V	306V	423V*	428V*	
	Current	4.8A	5.3A	5.2A	6.4A	
RLX 555 (11kW)	Voltage	121V	302V	418V*	421V*	
	Current	7.0A	7.7A	7.1A	8.7A	
RLX 780 (20kW)	Voltage	130V	315V	335V	395V*	425V*
	Current	10.5A	10.3A	6.8A	5.5A	6.3A

* May be limited by local supply voltage.

If you see any significant differences check the spindle mechanical drive train for any tightness or the spindle motor winding resistance. If no faults are found, check the spindle drive configuration is correct (see reference section, chapter 9). Expect some fluctuation in the current due to hunting with no load on the spindle. Normal fluctuations are less than 5% for current.

Note, the spindle drive outputs chopped DC to simulate a variable frequency/variable voltage AC source. The chopping frequency is around a few kilohertz. Measuring output current using a 50/60Hz clamp meter will give wildly misleading results unless the clamp meter is specifically designed to measure variable frequency drive currents (e.g. Fluke 375 FC).

Output Voltage:

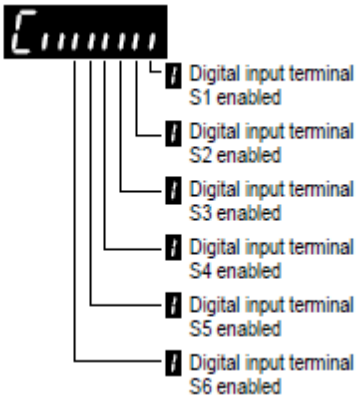
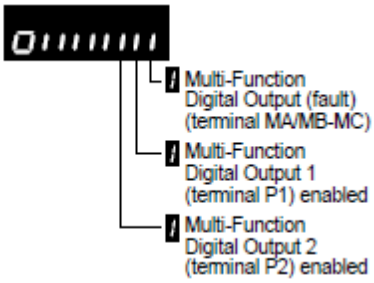
Equivalent AC Voltage output from the drive. See values in the Output Current table.

Measuring output voltage with a multimeter is not recommended for safety reasons and results will be inaccurate because of the chopped DC considerations discussed above.

Monitor (MNTR) Display

A whole host of drive information can be accessed via the monitor display. See V1000/GA500 manual for a full list and the manual's troubleshooting section for further info. Some useful ones are:

Monitor	**Name**	**Description**
U1-10	Input Terminal Status	Displays the status of the digital input control terminals

		 Control inputs are detailed below.
U1-11	Output Terminal Status	Displays the status of the digital output terminals  Control outputs are detailed below.
U1-13	Terminal A1 Input Level	Displays the analogue voltage on the A1 terminal (speed demand input from computer module) as a percentage of 10V. Useful for checking the computer module is outputting sensible speed demands.
U2-01	Present Fault	If any. See troubleshooting section of V1000/GA500 manual for more information on error codes, faults and corrective actions. Note any spindle fault will trigger a **critical error 105** on the ProtoTrak control.
U2-02	Previous Fault	Note: U2-02 to U2-17 stores various drive information valid at the time of the previous fault – can be used for a more detailed investigation into the fault, but usually unnecessary for diagnosing most spindle faults.
U3-01 to U3-10	Displays the last 10 drive faults.	Very useful for understanding the history of spindle faults, especially if no faults appear whilst on-site. Some idea of when these faults occurred can be had from the logged operation time at the time of the fault (U3-11 to U3-20)

Drive faults:

Refer to the troubleshooting section of the spindle drive manual (see reference section, chapter 9).

Note an Overvoltage fault (0v) is usually a result of one or more failed brake resistors. oV fault symptons are a spindle coasting to a stop and an error 105 on the control. Check the resistance of the brake resistor assembly between terminals B1 and B2 of the drive **WITH THE DRIVE POWERED OFF**. Resistance should be as follows. If out of specification, replace all resistors as a set. Also check the resistor fans are working correctly.

- RLX1630, RLX 355: 50 ±5 ohm (2x100ohm wired in parallel, PN 5967)

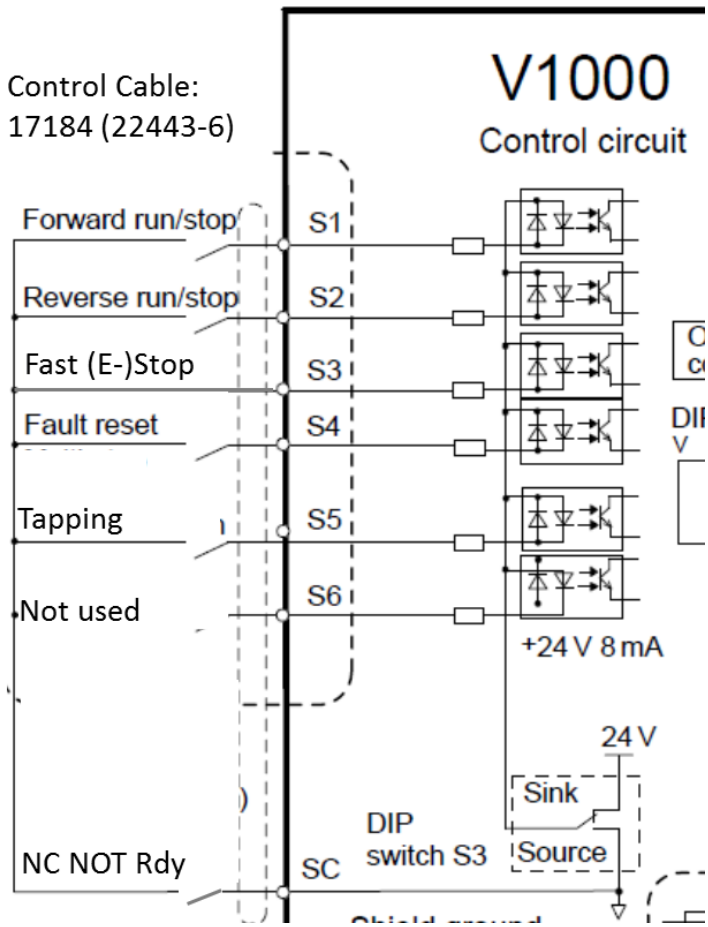
- RLX425, RLX 555: 33 ±5 ohm (3x100ohm wired in parallel, Pn 5967)
- RLX 780: 20 ±5 ohm (3x60ohm wired in parallel, Pn 18393)

Overvoltage and sometimes overcurrent (0c) faults can occur as a result of exceptionally large workpieces or chucks.

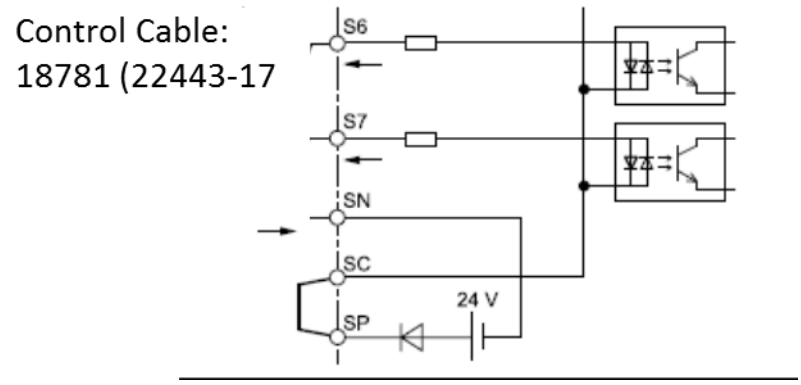
Digital Control Inputs

Inputs are wired to the SC/SN common terminal and use the drive's internal 24VDC power supply. This means an inactive input measures 24VDC with respect to SC/SN. An active input measures 0V. See also the monitor U1-10.

For V1000, ensure the dip switch, S3 is set to "Sink":



For GA500 ensure there is a link between SC and SP. Inputs S6 and S7 are not used. All other inputs are wired as for the V1000.



Drive Input	Parameter	Value	Function	Polarity	Notes
S1	H1-01	40	Run Fwd	NO	Default
S2	H1-02	41	Run REV	NO	Default
S3	H1-03	17	Fast Stop	NC	Must set fast stop time with C1-09
S4	H1-04	14	Reset	NO	Default
S5	H1-05	07	Tapping	NO	(opposite polarity to SX)
S6	H1-06	0F	No function	N/A	Not used
S7	H1-07	0F	No function	N/A	Not used

Analog Control Inputs

Drive Input	Parameter	Value	Function	Polarity	Notes
A1	H3-01	00	0-10VDC frequency reference demand	N/A	
	H3-02	00	Frequency Reference	N/A	Not used on RX
	H3-03	100 (%)	A1 gain	N/A	0-10V inputs maps directly to 0-max speed
	H3-04	0 (%)	A1 Bias	N/A	
	H3-13	0.03	Freq ref input filter	N/A	
A2	H3-10	0F	A2 not used	N/A	Not used on RX

A1 is referenced to the AC (Analogue Common) terminal (which is connected to the control system GND/0DC reference inside the CM).

Digital Outputs

These outputs are monitored by LEDs on the computer module.

Drive Output	Parameter	Value	Function	Polarity	Notes
MA/MB/MC	H2-01	102	Speed Agree	NC	Not used by CM (IN-TRQ LED)
P1	H2-02	100	During RUN	NC	IN-RUN LED
P2	H2-03	10E	Fault	NC	IN-FLT LED

For V1000: P1 and P2 are referenced to the PC (Photocoupler Common) terminal.

For GA500: P1 and P2 are referenced to the C1 and C2 terminals

All commons are connected to the control system GND/0DC reference inside the CM.

7.5.2.3 Spindle Drive Electronics - GA700 (RLX780 only)

The RLX 780 is fitted with the Yaskawa GA700 drive. This is very similar to the GA500 in operation and function, but has a few additional features:

1. Motor Encoder input: To implement the chuck hold function.
2. Motor encoder output to CM: Connected, but not currently used.
3. Jog input: To enable jogging the chuck at a slow speed to assist gear change and chuck alignment for job loading

4. Hold input: To lock the chuck in position to assist job loading.

The chuck guard must be closed to use the Jog and Hold functions (functions will also be available after the chuck is opened until the STO delay has expired).

WARNING!

DO NOT FORCE THE CHUCK ROUND WHEN IN THE HOLD MODE, THE CHUCK MAY SUDDENLY MOVE FORWARD.

Due to the none, 1:1 drive ratio between motor and spindle, there is ambiguity between the chuck position and the motor position. The spindle drive locks the chuck by reference to the motor encoder, not the spindle position. If you **force** the chuck round whilst in the hold mode, there will come a time when the motor has moved more than 180°. At this point, the position control loop will stop trying to move the motor back to the hold position, but attempt to close the loop by **rotating the motor forward** (as this is now the shortest route to the hold position).

Digital Control Inputs

Wiring is the same as for the GA500 with the addition of the jog and Hold inputs:

Drive Input	Parameter	Value	Function	Polarity	Notes
S1	H1-01	90	Run Fwd (DWEZ)	NO	These inputs are used by the internal PLC (DWEZ) to run the spindle forward/reverse in normal or HOLD modes.
S2	H1-02	91	Run REV (DWEZ	NO	
S3	H1-03	17	Fast Stop	NC	Must set fast stop time with C1-09
S4	H1-04	14	Reset	NO	Default
S5	H1-05	07	Tapping	NO	(opposite polarity to SX)
S6	H1-06	12	Fwd Jog	NO	Activated by the JOG button.
S7	H1-07	0F	No function	N/A	Not used
S8	H1-08	0097	Hold (DWEZ)	NO	Used by internal PLC to enable the spindle hold function.

Analog Control Inputs

Drive Input	Parameter	Value	Function	Polarity	Notes
A1	H3-01	00	0-10VDC frequency reference demand	N/A	Frequency reference is set by internal PLC using either external 10V input (normal mode) or internal demand in JOG/HOLD mode.
	H3-02	30	Frequency Reference (DWEZ)	N/A	
	H3-03	100 (%)	A1 gain	N/A	0-10V inputs maps directly to 0-max speed
	H3-04	0 (%)	A1 Bias	N/A	
	H3-13	0.03	Freq ref input filter	N/A	
A2	H3-10	0F	A2 not used	N/A	Not used on RX

A1 is referenced to the AC (Analogue Common) terminal (which is connected to the control system GND/0DC reference inside the CM).

Digital Outputs

These outputs are monitored by LEDs on the computer module.

Drive Output	Parameter	Value	Function	Polarity	Notes
M1-M2	H2-01	100	During RUN	NC	IN-RUN LED
M3-M4	H2-02	10E	Fault	NC	IN-FLT LED
M5-M6	H2-03	0017	Torque Detection	NC	Not used by CM (IN-TRQ LED)

M1-M2 etc., are volts-free, relay contacts, but M2/4/6 are connected to the control system GND/0DC reference inside the CM.

7.6 Axes Servo System

7.6.1 Description

Each axis is controlled by a brushless, AC servo motor driven from a dedicated servo driver, through a toothed drive belt.

The motors have a shaft encoder with a resolution of 9,600 ppr (38,400 counts per revolution) used for positional and speed servo loops. The motor encoder also contains one index pulse per revolution, but this is not used on RX.

The servo drivers are located in the electrical cabinet at the rear of the machine. The power supply is split into a power and control section:

- Power Section: 220VAC, 3-phase (via K1 for isolation in E-stop or NC NOT Ready states),
- Control Section: 220VAC, single phase, permanently connected.

Both supplies are derived from the control transformer via fuses.

The computer module outputs a speed command to each servo drive in the form of a DC voltage of amplitude ±10VDC. The sign of the voltage dictates the direction the motor rotates and the higher the voltage; the faster the motor will turn.

The servo drives have a fixed configuration. The drives are sophisticated enough to cope with variations between machines without the need for individual tuning (assuming the machine mechanical systems are set correctly).

See the machine electrical schematics (reference section, chapter 9) for wiring details.

Power Ratings and XYZ spare part numbers are:

Machine		X Axis	Z Axis
RLX1630	Power	750W	2kW
	Servo Driver	17610	17620
	Servo Motor	13639	17647
RLX355	Power	750W	2kW
	Servo Driver	17609	17619
	Servo Motor	13639	17647
RLX425	Power	750W	2kW
	Servo Driver	x1.25m: 17611	x1.25m: 17621
		x2m: 17612	x2m: 17622
	Servo Motor	13639	x1.25m: 17647
			x2m: 17661

RLX555	Power	750W	2kW
	Servo Driver	x1m: 17611	x1m: 17621
		X1.75m: 17612	X1.75m: 17622
	Servo Motor	13639	x1m: 17647
			X1.75m: 17661
RLX555 x 3m	Power	750W	3kW
	Servo Driver	17612	17623 *
	Servo Motor	13639	17662
RLX780	Power	1kW	3kW
	Servo Driver	18365	17623
	Servo Motor	13641	17662

* 555 x 3m with 5mm pitch on Z ballscrew is 17624.

8 Station, Turret servo drive is: (200W): 17459

Servo Driver Parts

Description of the Digital Keypad

The digital keypad includes the display panel and function keys. The Figure 4.1 shows all of the features of the digital keypad and an overview of their functions.

Name	Function
LCD Display	The LCD Display (5-digit, 7-step display panel) shows the monitor codes, parameter settings and operation values of the AC servo drive.
Charge LED	The Charge LED lights to indicate the power is applied to the circuit.
MODE Key	MODE Key. Pressing MODE key can enter or exit different parameter groups, and switch between Monitor mode and Parameter mode.
SHIFT Key	SHIFT Key. Pressing SHIFT key can scrolls through parameter groups. After a parameter is selected and its value displayed, pressing SHIFT key can move the cursor to the left and then change parameter settings (blinking digits) by using arrow keys.
UP and DOWN Key	UP and DOWN arrow Key. Pressing the UP and DOWN arrow key can scroll through and change monitor codes, parameter groups and various parameter settings.
SET Key	SET Key. Pressing the SET key can display and save the parameter groups, the various parameter settings. In monitor mode, pressing SET key can switch decimal or hexadecimal display. In parameter mode, pressing SET key can enter into parameter setting mode. During diagnosis operation, pressing SET key can execute the function in the last step. (The parameter settings changes are not effective until the SET key is pressed.)

Digital Keypad on Servo Driver

7.6.2 Diagnostics

Servo drive faults will trigger critical errors 96, 97 and 98 (X, 8 tool indexer and Z) on the ProtoTrak control. Inspection of the servo drive display will provide more information about the current fault.

Servo Drive Fault Messages

Fault Message Display

Display Message	Description
	When the AC servo drive has a fault, LCD display will display "ALnnn". "AL" indicates the alarm and "nnn" indicates the drive fault code. For the list of drive fault code, please refer to parameter P0-01 or refer to Chapter 11 (Troubleshooting).

Fault Message Display on Servo Drive

The following is the list of servo drive fault messages likely to be encountered. Please refer to the Troubleshooting section (Chapter 9) of the Delta, ASDA-B2 manual for a full list and more information on the potential causes and corrective actions for these faults. See the reference section, chapter 9.

Faults can be cleared by pressing the Servo on button except for faults 4, 11, 23 through 29, 31 and 35, which require power to be cycled.

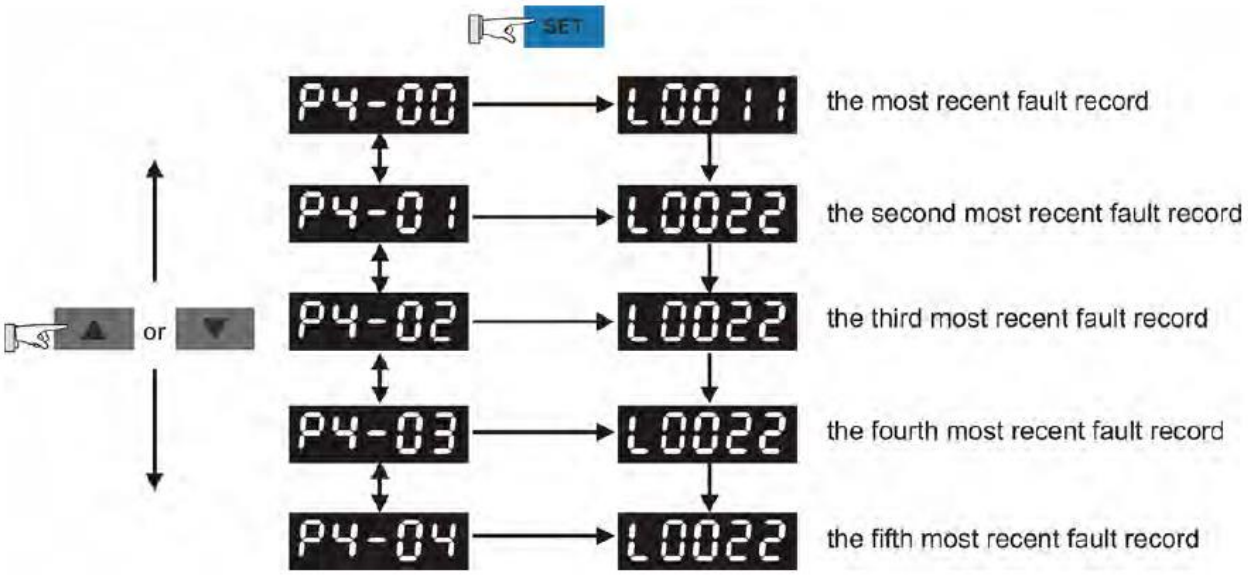
Display	Alarm Name	Alarm Description	Servo Status
AL001	Over current	The current of the main circuit is 1.5 times more than the instantaneous current of the motor.	Servo Off
AL002	Over voltage	The voltage of the main circuit is higher than the standard voltage	Servo Off
AL003	Under voltage	The voltage of the main circuit is lower than the standard voltage.	Servo Off
AL004	Motor Combination Error	The drive corresponds to the wrong motor.	Servo Off
AL005	Regeneration Error	Regeneration control is in error.	Servo Off
AL006	Overload	The motor and the drive have been overloaded.	Servo Off
AL007	Over speed	The control speed of the motor exceeds the normal speed.	Servo Off
AL011	Encoder Error	Error in motor encoder signal.	Servo Off
AL012	Adjustment Error	When executing electrical adjustment, the adjusted value exceeds the allowable value.	Servo Off
AL016	IGBT Overheat	The temperature of the internal power electronics is above normal	Servo Off
AL017	Abnormal EEPROM	Error when DSP accesses EEPROM.	Servo Off
AL018	Abnormal signal output	Error in motor encoder signal (overspeed).	Servo Off
AL022	Main Circuit Power Phase Loss	Loss of phase of input power	Servo Off
AL023	Early Warning for Overload	To warn that the servo motor and drive is going to overload. This alarm will display before ALM006, when the overload reaches 120%.	Servo On
AL024	Encoder initial magnetic field error	The magnetic field of the encoder U, V, W signal is in error.	Servo Off
AL025	Encoder internal error	The internal memory of the encoder and the internal counter are in error	Servo Off
AL026	Encoder Data Error	An encoder data error is detected three times.	Servo Off
AL027	Encoder internal error	Internal encoder fault (reset signal)	Servo Off
AL028	Encoder internal error	Internal encoder fault (phase signals)	Servo Off
AL029	Encoder internal error	Internal encoder fault (address)	Servo Off
AL030	Motor Torque Overload	Motor torque exceeds 300% motor rating for 1 second	Servo Off
AL031	U,V,W, GND wiring error	The wiring connections of U, V, W (for servo motor output) and GND (for grounding) are in error.	Servo Off
AL035	Encoder over-Temperature	Motor/Encoder over-temperature (>105°C)	Servo Off

Display	Alarm Name	Alarm Description	Servo Status
AL048	Excessive encoder output error	The encoder output errors or the output pulse exceeds hardware tolerance.	Servo Off
AL067	Encoder temperature warning	Encoder temperature exceeds the warning level. (But it is still within the protective range.)	Servo Off
AL083	Output Over-current	Output current from servo drive exceeds drive rating.	Servo Off
AL085	Regeneration error	Regeneration control is in error.	Servo Off
AL555	System Failure	DSP processing error	switch off drive
AL880	System Failure	DSP processing error	switch off drive

Servo Fault Messages

The drive records the last 5 faults under parameters P4-00 to P4-04. This is very useful for understanding the history of drive faults, especially if no faults appear whilst investigating the machine. Access the values as follows:

1. Press MODE button on display.
2. Press SHIFT button until you get to P4.
3. Press arrow up or down button to get to P4-00, P4-01, etc.
4. Press SET button to see the fault code.
5. Hit MODE to get out of each parameter.



Fault History Display

Monitor and Diagnostics Display

The servo driver displays can show a number of operational parameters. The value shown on power up is controlled by parameter P0-02. The factory default is 0, which displays motor encoder feedback pulses. Other information can be displayed either by changing the value of P0-02 or by using the up/down button to scroll through the available display types:

P0-02 Setting	Monitor Displayed Symbol	Description	Unit
0	FbPUU	Motor feedback pulse number (after the scaling of electronic gear ratio) (User unit)	[user unit]
1	C-PUU	Input pulse number of pulse command (after the scaling of electronic gear ratio) (User unit)	[user unit]
2	ErPUU	The difference of error pulse number between control command pulse and feedback pulse number (User unit)	[user unit]
3	FbPLS	Motor feedback pulse number (encoder unit, 1600000 pulse/rev)	[pulse]
4	C-PLS	Input pulse number of pulse command (before the scaling of electronic gear ratio) (encoder unit)	[pulse]
5	ErPLS	Error pulse number (after the scaling of electronic gear ratio) (encoder unit)	[pulse]
6	CP-Fr	Input frequency of pulse command	[Kpps]
7	SPEEd	Motor speed	[r/min]
8	CSPd1	Speed input command	[Volt]
9	CSPd2	Speed input command	[r/min]

P0-02 Setting	Monitor Displayed Symbol	Description	Unit
10	C-t91	Torque input command	[Volt]
11	C-t92	Torque input command	[%]
12	AvG-L	Average load	[%]
13	PE-L	Peak load	[%]
14	U buS	Main circuit voltage	[Volt]
15	J-L	Load / Motor Inertia Ratio (Please note that if the display is 130, it indicates that the actual inertia is 13.0)	[0.1times]
16	IGbt.t	IGBT temperature	[°C]
17	rSnFr	Resonance frequency (Low byte is the first resonance and high byte is the second one)	[Hz]
18	diFF2 	The absolute pulse number of encoder Z phase equals to the homing value, 0. It will be +5000 or -5000 pulse when rotating in forward or reverse direction.	-

Monitor Display Options

Some of the more useful displays are:

- Fb.PLS (P0-02 = 03): Displays the motor encoder output.
  - Scale is 160,000 for one motor revolution.
  - Note the drive display has only 5 digits, so the display will appear to count 0-99,999 then 0-59,999. You can see the 6th digit by pressing the SHIFT button.
  - Check display counts up and down smoothly as the motor/ballscrew is rotated.
- CSPd1 (P0-02 = 12): Use to check speed demand (volts) from computer module:
  - Jog in DRO with different max rapid feedrates set under DEFAULTS, or
  - use Service code 521
- AvG-L or PE-L (P0-02 = 12, 13): Check load on motor
  - the display will show the load on the motor as a percentage of maximum. When an axis accelerates, you will see a spike in the displayed numbers. This is a useful check if the drives are flagging overload errors (AL001 or AL006) or to check the mechanics by seeing how much current it takes to drive an axis.
- U buS (P0-02 = 14): Check drive's, internal DC bus
  - This should be fairly constant around 315V (actual value depends on machine supply voltage). If significantly different, check the incoming supply voltage and the taps on the control transformer are OK.
  - Check value when accelerating an axis, it may dip a little, but if it drops a significant amount, check for a blown fuse (F7, F8 or F9) and check the "stiffness" of your machine's electrical supply.

Note, the servo drives are operated in a speed mode only, using an analog voltage input. Consequently, the following monitors are not relevant:

- FB.PUU, C-PUU, Er.PUU, C-PLS, Er.PLS, CP-Fr and,
- C-t91 and C-t92.

A number of diagnostic parameters can also be displayed:

- P4-07: Display Digital Input status
- P4-09: Display Digital Output status

NB: These displays are **NOT** dynamic; they only display a snapshot of the terminal status.

See section 4.4 of the ASDA-B2 user manual for more information on monitor and diagnostics display.

Troubleshooting Axis Faults

Rarely do two or more axes motor/servo systems fail at the same time and in the same way. If the symptom involves two or more axes, the source of the problem is something that all motors have in common such as the power supply or computer module.

Only motors/servos of the same power rating are interchangeable, so fault finding by swapping components between axes is restricted to cables only on lathes.

Start by checking motor/encoder operation using SC521. Then, narrow down the problem to one of: mechanical problem (drive train), computer module, servo drive, axis motor or cables.

Symptoms	Diagnostics
Constant Axes Faults - a given axis will not run and axis or following error fault is on the screen	1. Run service code 521 to check the motor encoders are counting correctly. 2. Check for cable faults. Swap cables from different axes to see if the fault moves with the cables. If so check/replace cables. 3. Check the computer module is not the problem. For this scenario, let's assume you are seeing an X axis fault. Swap the X and Z cables at the computer module that run to the servo. This means the X axis port of the computer module is now going to move the Z axis servo and motor. If the Z axis motor now moves, this means the computer module is not part of the problem. This test is best done in SC521, otherwise you might get servo faults due to the unexpected characteristics of the new axis! 4. Confirm the drive trains are not binding and causing the fault. If a fault is happening due to a mechanical problem, there is a good chance you will get an overcurrent or overload fault (AL001 or AL006) on the drive. 5. Check all the wiring connections to the servo drive and motor.
Intermittent Axis Fault	1. Identify the fault code on the axis that is faulting. Check parameters P4-01 through P4-04 for a history of the most recent faults. The nature of the axis fault will now dictate the direction you go from a troubleshooting standpoint. 2. It is always a good idea to rule out a mechanical drive train issue.
Servo Error AL011 (Encoder error)	1. Check cable connections, especially the encoder cable to the motor, both ends of cable. If the cable was loose or had a poor connection, fix problem and cycle power to the machine.
Servo error AL001 or AL006 – Overcurrent/Overload	1. Check motor and cable for short circuits or coolant ingress. Check motor resistances (with and without cable connected): • Measure between each motor wire (U, V, W) and ground. Ideally use a 500V megger, but if this is not available use an ohm meter. Resistance should be effectively open circuit. • Measure between pairs of motor wires. Resistances should be approximately equal and around an ohm. Actual resistance is not important; a fault will be obvious as a significant mismatch between one or two pairs of wires or an open circuit. 2. Check axes for binding etc. Check rolling torques (acceptable values are 1.1Nm to 1.7 Nm). If mechanics check out OK, then remove axis belt and run motor with no load to see if problem still exists.

Digital Control Inputs

See cable drawing 22443-8 for pin allocations.

Input	Servo Parameter	Value	Function	Polarity	Notes
DI1	P2-10	0x0101	Servo On	NO	
DI2	P2-11	0x0102	Reset	NO	
DI3 – DI8	P2-12 to -17	0x0000	No function	N/A	

Digital Outputs

Output	Servo Parameter	Value	Function	Polarity	Notes
DO1	P2-18	0x0007	Fault output	NC	
D02	P2-19	0x0103	Motor at Zero Speed	NO	Zero Speed defined by P1-38
DO3	P2-20	0x0004	Speed Limit reached	NC	Speed limit defined by P1-39
DO4	P2-21	0x0101	Servo ready	NO	
DO5	P2-22	0x0000	No function	N/A	

7.7 Safety Circuits (E-stop & Spindle Guard)

7.7.1 E-stop Circuit

The machine Emergency stop is controlled by two E-stop buttons (on the pendant and apron control panel). Pushing either of these buttons will put the machine into a hardware E-stop condition.

On RLX 780, a third E-stop button is fitted to the Hand held EHW (MPG). Activating the pressure sensitive strips on either side of the saddle guard will also put the machine into E-stop.

Releasing the E-stop button (by twisting) and pressing the Reset button, will always take the machine out of the hardware E-stop condition (unless there is a fault with the safety circuits). However, the machine may still be disabled because of the current machine mode, or based on the results of software safety checks undertaken by the control. This is an "NC Not ready" state; and should not be confused with the hardware E-stop condition.

For safety reliability, the safety circuit is dual (redundant) channel with built in fault monitoring.

Only the hardware E-stop is safety rated. Always use the hardware E-stop to disable the machine for maintenance or when accessing moving parts for diagnostic purposes.

In hardware E-stop:

- All Axes power is removed by K1, and
- Servo drives are disabled via the control interface from the computer module.
- A fast stop is triggered on the drive; bringing the spindle to a rapid stop (controlled by parameter C1-09 in the drive).
- The emergency stop, mechanical brake is applied to assist in the rapid deceleration of the spindle. The brake remains applied all the time the machine is in the E-stop condition. The brake is active on, so will be released when the machine is powered off.
- Note: the spindle emergency (fast) stop is very short (much shorter than the normal decel time). Depending on chuck/job size and drive train condition, belts may slip during an emergency stop. Condition of the belts should be checked if belts are heard to slip. The emergency stop should not be used for normal spindle stops; it should be used for emergency stops only.
- Note: there is **NO mechanical brake on the RLX780;** and E-stop decel time is the same as the normal decel time.

- After a delay, the drive is put into the Safe Torque Off state (Hbb or STO displayed on the drive display). The STO delay interval is implemented to permit the drive to be stopped from max speed (EN60204 category 1 stop). The same STO delay is used for both E-stop and spindle (chuck) guards open condition and so must allow time for the spindle to stop from maximum RPM at the normal (not emergency) stopping speed. This means the spindle will not be in the STO state until some time after the emergency stop. DO NOT work on, or touch the spindle until the delay has expired (see section 7.7.2 for timings).

The E-stop safety circuit comprises:

- E-stop buttons on Pendant and apron panel, and associated wiring
- For RLX 780: MPG E-stop button, safety edge strips and controller.
- Euro Safety circuits inside the computer module
- Axes power relay, K1
- Spindle brake relay, K9
- K1 and K9 feedback monitoring circuit (NC contacts of K1/K9 – these check for correct opening of K1 and K9 relays on E-stop)
- Accessories power feedback monitoring. E-stopped contactors, which control power to any accessories, should have feedback monitoring included in the feedback monitoring circuit.
- Power reset button on pendant.
- Spare, safety rated E-stopped safety contacts are available between ER1 and ER4 (used by K9). Non-safety rated contacts are available between ESPARE1 and ESPARE2.

Within the computer module are the NC ready relays (K111 and K112). These are wired in series with the E-Stop circuit to permit the control system to put the machine into the NC NOT Ready state based on safety inputs in addition to the emergency stop buttons. This provides for many more safety states than simply E-stop.

In NC not ready:

- All Axes power is removed by K1, and
- Servo drives are disabled via the control interface from the computer module.
- Instead of triggering a fast stop, the spindle is disabled; removing any run commands and isolating the spindle FWD/REV keys on the pendant. If running, the spindle will decelerate to a stop in the normal stop time.

NC not ready is activated by:

1. Hardware which monitors the spindle and axes drives (fault, standstill and safe speed limit monitoring) – DRVS-OK+
2. Motion Control Software NC ready signals which will be activated if various fault conditions are detected such as unexpected motion.

If the machine enters the NC not ready state due to a fault, it will show critical Error 0055 – machine disabled.

The E-stop circuit has built in monitoring to ensure correct operation. If there is a fault in the system, it will NOT be possible to reset the E-stop. Check:

- E-stop buttons and associated wiring
    - Both channels must break on activation
    - Both channels must make on release of the E-stop button
    - Use LEDs on computer module and pendant to check correct operation.
- The edge strip safety controller (RLX 780).
    - Power LED should be ON steady
    - Ch1 and CH2 LEDs should be off, except when the edge strips are activated.
    - The relay should auto reset when the edge strips are no longer activated
    - See reference section for the device instruction manual.
- K1 and K9 relays

    - Check K1 and K9 relays drops out when E-stop is activated.
    - Check the spindle brake is on in E-stop.
    - Note K9 also controls power to the cutting compartment work lights.
    - Check NC contacts are closed when K1/K9 are de-energised (this circuit must be closed to permit reset)
    - Check feedback wiring for any accessories.
- Computer Module Euro safety circuits:
    - See section on Euro Safety Hardware LEDs in section 7.4.2
    - Check associated wiring, especially to I/O NC Ready and I/O Euro circuit connectors.
- NC Ready Circuit:
    - See section on Euro Safety Hardware LEDs in section 7.4.2
    - Check spindle and axes drives for faults.
    - Check ProtoTrak error code.

Refer to the Ladder Diagram on the machine electrical schematics for information on the configuration of the Euro safety circuits.

7.7.2 Spindle (Chuck) Guard Interlock:

The spindle is interlocked to the chuck guard(s) and belt door. Opening any of these guards causes:

- The spindle to be actively decelerated to a stop by disabling the spindle thus removing any run commands from the spindle drive. This is an EN60204, category 1 stop.
- Activation of the Safe Torque Off (STO) state of the spindle drive. This is the same STO state (and same STO delay) that is triggered by E-stop.

Closing the guard causes the safety circuit to reset automatically, providing no faults are detected. Reset takes about 300msecs; attempting to start the spindle during reset will cause the spindle drive to lock out and the spindle will not start. This is an alarm condition for the drive (not a fault condition), so no error 105 is flagged, but error 263 will be flagged on the ProtoTrak control when it detects the spindle did not start (after a 1.5secs timeout from the spindle FWD/REV key press).

For safety reliability, the safety circuit has dual (redundant) channels with built in fault monitoring.

The Guard interlock safety circuit comprises:

- E-stop circuit – the E-stop circuit will also trigger the spindle guard safety circuit to disable the spindle.
- Switches on chuck guard(s)/belt door and associated wiring. For RLX 780, the spindle guard circuit also includes the rear chuck guard and loading guard.
- Euro Safety circuits inside the computer module.
- Spindle drive electronics unit and associated wiring (O/P Spd disable on CM and H1/H2/HC input on drive).
- Accessories feedback monitoring circuit (24DC-D22 and 24DC-D30) – this circuit is usually jumpered as there are unlikely to be any accessories fitted which require to be interlocked to the spindle guards.
- Power reset button on pendant.
- Spare, safety rated contacts are available between DR1 and DR4.

The spindle guard circuit has built in monitoring to ensure correct operation. If there is a fault in the system, it will NOT be possible to start the spindle after closing the guards. Check:

- Guard switches and associated wiring
    - both channels must break on activation
    - Both channels must make when the guards are closed
    - Use LEDs on the computer module to check correct operation.
- Computer Module Euro safety circuits:

- See section on Euro Safety Hardware LEDs in section 7.4.2
- Check associated wiring, especially to GRD1, GRD2 and I/O Euro circuit connectors.

- Spindle drive display:
  - The display should show the frequency reference input if the drive is enabled (guard closed).
  - Displays of Hbb/STO or HbbF/STOF (V1000/GA500) means the drive is still in the STO state and the spindle cannot be started.
  - Hbb/STO means the drive is in the STO state and has detected no fault in the STO input (H1/H2/HC). This means both channels (H1 and H2) are disabled – the normal input state for STO. Check:
    - Spindle disable cable – a break in the HC (common connection) will give an Hbb/STO condition always.
    - LEDS on the computer module – if both GRD-RLY1 & 2 LEDs are not lit, this accounts for the Hbb/STO display, but is not correct if the guard is closed. There is a fault elsewhere in the guard circuit. See above.
    - STO input on drive – temporarily short H1, H2 and HC to see if the Hbb/STO is cleared, if not, change drive – (rare fault). **REMEMBER** to remove the jumpers and re-instate the Spindle Disable cable connections.
  - HbbF/STOF means the drive is in the STO state, but has detected a fault in the dual channel, STO input. H1 is closed, but H2 is open (or vice versa). Check:
    - Spindle disable cable – a break in either H1 or H2 will give an HbbF condition always.
    - LEDS on the computer module – if only one of the GRD-RLY1 & 2 LEDs are lit, this accounts for the HbbF display, but is not correct if the guard is closed. There is a fault elsewhere in the guard circuit. A dual input disagree error on the ProtoTrak control may help to isolate the fault to the guard switches. Also see previous fault finding tips.
    - STO input on drive – temporarily short H1, H2 and HC to see if the HbbF is cleared, if not, change the drive – (rare fault). REMEMBER to remove the jumpers and re-instate the Spindle Disable cable connections.
    - On early computer modules, there could be a significant difference in the STO delay times between channels (up to 1 second). Should the operator be unfortunate to close the guards when one channel had completed its STO delay period, but the other had not, the difference in channel states at reset would be interpreted as a potential fault in the safety circuit; inhibiting the reset. This condition would show as an HbbF fault with one of GRD-RLY1/2 on and the other off. It can be cleared simply by opening the guards and waiting long enough for the STO delay time to expire for both channels (Hbb on drive display); allowing a reset to proceed when the guards are closed. A hardware modification was introduced in 2021 to eliminate this problem.

Nominal STO delay times are:

Machine	Jumper		GK104/5-n (see schematic)	STO Delay	Normal Stopping time (from Max RPM)
	SWI Pn	XYZ Pn			
RLX1630	29115-3	17318	-2	5.0s	2.5s
RLX355					3.5s
RLX425	29115-4	18383	-4	7.3s	6.0s
RLX555					6.0s
RLX780	29115-6	18771	-8	16s *	14.5s

* Note: the RLX780 uses a different Euro circuit adaptor inside the CM to achieve longer delays for the same jumper settings.

If the spindle begins coasting to a stop at some point during a stop initiated by opening the spindle guards (with no error 105), suspect the STO delay time is too short due to a failure of the timing capacitors. Check timing against the table above. Replace the computer module if timing is significantly different (more than ±20%).

Refer to the Ladder Diagram on the machine electrical schematics for information on the configuration of the Euro safety circuits.

7.7.3 Door Guard Safety Circuit

The Door guard (saddle guard for 780 and 555x3m) is fitted with a dual channel, safety switch to detect the position of the guard.

- When closed: Machine can run in automatic mode. Feed rate is unrestricted (up to 10m/min or the max value set in Defaults)
- When Open: Run mode is inhibited. Feed rate is limited to 2m/min. A door open message is displayed on the control in DRO and RUN modes.

The door guard switch is monitored by a safety module, K3 which checks for correct operation of each channel of the switch and for wiring faults.

There are four safety outputs, used as follows:

1. Terminals 13-14: Door input into computer module (GRD3). Used to inhibit run mode and trigger the 2m/min speed restriction and safety speed monitoring
2. Terminals 23-24: as above (dual redundant channels)
3. Terminals 33-34: Used to inhibit rotation of the 4 tool indexer (option) with the door open.
    a. Inhibits the turret index solenoid.
4. Terminals 43:44: Used to inhibit rotation of the 4 tool or 8 tool indexer (option) with the door open.
    a. 4 tool: The contacts disable the air on solenoid; removing the air supply from the indexing solenoid (dual redundant channels).
    b. 8 tool: The contacts de-energise K7; removing power from the indexer servo amp (dual redundant channel with Servo enable signal from computer module).

Terminals 33/34 and 43/44 may be used for other accessories which require interlocking with the door guard, if not used for the indexers.

Correct operation of the contactor K7 is achieved by monitoring its NC contacts via terminals T31-T33. K3 will auto reset when the door guard is closed providing no faults are detected with the safety circuit.

In the event of a failure to reset when the door is closed, check:

- LEDs at GRD3 input: These should both be on.
    - If both OFF, K3 has not reset, has failed or there is a cabling fault – check LEDs on K3 (see below) and check cable from K3 to CM.
    - If one is ON, K3 has detected a fault with the door guard switch or has failed or there is a cabling fault – check LEDs on K3 (see below) and check cable from K3 to CM.
    - If both ON, the relay has reset correctly, but if the DOOR OPEN Message is still on, check the GRD3 inputs in SC521 and change CM if door input is not recognised (rare fault).
- LEDs on K3:
    - PWR LED (green): ON, steady, if operation is normal.
        - if OFF – check for 24VDC at 24VDC-F47. If no 24VDC, remove all loads to check for short circuit, otherwise change CM.
        - If flashing, see other LEDs for nature of possible fault

- IN1/IN2: Indicates the state of the safety inputs (guard switch). These should be both ON when the door is closed (and both OFF when open). LEDs will flash if there is a fault in the switch /switch circuit. Check the door switch continuity (each channel) and check the door switch cable for faults.
- OUT: Indicates the status of the safety outputs (to GRD3 etc). Turns ON, when the safety outputs are ON, so should be consistent with GRD3 LEDs on CM. Will flash if there is a fault in the outputs– replace K3 in this case.

See also the Fault detection section of the G9SE user manual (chapter 9) for more information

7.8 Headstock and Tail stock Assemblies

The RLX lathes are fitted with conventional headstock and tailstock assemblies.

- Spindle
  - RLX355: A pre-assembled spindle cartridge is bolted to the head casting
  - All other lathes: The spindle runs in oil lubricated, ball/roller bearings.
- Gear Box (not 1630):
  - RLX3555: Separate gearbox with belt drive to the spindle cartridge.
  - All other lathes: Two or three-speed gearbox integral with the headstock.
- Headstock Lubrication:
  - RLX355: the spindle cartridge is greased for life. Gear box is splash lubricated.
  - RLX1630: A mechanical oil pump is integrated into to the Headstock and driven from the spindle shaft. An oil level sight glass is fitted at the base of the headstock and a flow check glass to the top of the headstock.
  - All other lathes have an electrically pumped oil lubrication system with cooler. Oil is drawn from a sump in the bottom of the headstock. Pressure is monitored by a switch connected to the IN-GEAR PRESSure Input on the computer module.
- Spindle motor:
  - All lathes have a spindle motor driving the gearbox input shaft (or spindle) via a multi-belt drive.
- Tailstock:
  - All lathes have a tailstock with quill. The tailstock can be locked to the bed using a dedicated locking lever. The quill can be fed using a handwheel at the rear of the quill and also locked in place. The tailstocks of all lathes (except 1630) have an air ride system to assist in moving the tailstock. This comprises A filter/regulator/oiler (set to 85-100psi), flexible hose and manual operating lever, attached to the tailstock. A PCL standard nipple is fitted for connection of the user's air supply.

The design and functioning of these items are very conventional. It is assumed the reader has sufficient knowledge/experience to diagnose any faults; no further information is given here.

Illustrated parts lists for the headstock and tail stock assemblies can be found in the reference section (chapter 9).

If you need further assistance call for an XYZ service engineer.

7.9 LubricationSystem

7.9.1 Axes Lubrication

7.9.1.1 Description

The Auto lube system consists of a pump, with oil tank fitted to the machine. Fixed and flexible pipework and manifolds distribute the oil to the slide ways, ballscrews etc. Flow regulators are fitted to ensure the correct amount of oil is delivered to the different, moving parts of the axes.

The auto lube system is factory set to pump oil for 5 seconds for every 20 minutes of accumulated, axis motion and the discharge pressure is set to approximately 100-150 PSI.

Should you wish to change these settings, use the following settings:

Service Code	Title	Description
300	Lube pump discharge switch	This allows the user to manual discharge the lube pump
301	Set lube pump cycle time	This sets the time in minutes between discharge cycles
302	Set the lube pump discharge time	This sets the time in seconds for how long pump for each cycle.

Too much oil can not harm the machine, so if you feel the need to alter the factory settings, XYZ recommend increasing the oil supply rather than reducing it (decrease cycle time and/or increase discharge time).

To adjust the amount of Discharge Pressure displayed on the lube pump gauge, loosen the jam nut and turn the adjustment screw located on the top right side of the lube pump while the lube pump is activated.

Note: When the ProtoTrak control is first turned on, the lube pump is cycled automatically to provide oil to the way surfaces.

7.9.1.2 Lube Pump Diagnostics

The pump runs off 110VAC from the control transformer via a 4A fuse (same fuse for coolant pump). It is turned on and off automatically by the ProtoTrak control, via relay K4.

If the lube pump is not working, go into service code 521 and turn on the pump. Note, the lube pump is only rated for intermittent operation. When operating the pump continuously from code 521, the pump will turn off after a few minutes due to the internal overload protection function. This is normal behaviour and the overload will automatically reset after about 5 minutes.

Check:

1. Relay output from Computer module – LED next to connector should be lit (section 7.4). If not, replace computer module.
2. Check relay energises and 24VDC is present across relay coil. Check for 110VAC on the relay output contacts. If not, check fuse/wiring to relay and replace fuse/relay/wiring as appropriate.
3. Remove the lube pump cover and check for 110VAC at the lube pump. if not, check cabling to pump,
4. Check the internal fuse at the lube pump. If blown, replace the fuse.
5. Otherwise, replace the lube pump assembly.

7.9.2 Headstock Lubrication.

7.9.2.1 RLX1630

The RLX 1630 has an internal oil pump, gear-driven from the spindle, for lubricating the spindle. An oil level sight glass is fitted to the LH end of the headstock (remove the external cover to locate the sight-glass). An oil flow sight glass is fitted to the front of the headstock, visible to the operator. Check for good oil flow here when the spindle is running.

No diagnostic or repair instructions are given here. Refer to the parts lists (chapter 9) to assist in locating the relevant components.

7.9.2.2 RLX355

The RLX355 has a spindle cartridge with sealed bearings – no maintenance is possible. The gearbox is splash lubricated. An oil level sight glass is fitted to the end of the gearbox (open the belt door to access the sight glass). Check oil level with the spindle off.

7.9.2.3 RLX 425/555/780

These lathes have an electrically driven oil pump feeding oil into the headstock bearings and gears. The pump is driven from 400V (220V for RLX 780), 3-phase via fuses F20, F21 and F22 and K1 (so the pump is off when the machine is E-stopped/NC not ready). See electrical schematics in chapter 9.

The pump drives oil, through a filter, oil cooler and then into the headstock. Oil drains to the bottom of the headstock where it is drawn back into the pump. The oil filter has a pressure drop gauge to monitor the state of the filter. Replace as per schedule or if the gauge shows yellow.

A pressure switch monitors the oil pressure fed into the headstock. Correct setting is:

- Range: 9-10psi
- Differential: 0psi.

In the event of low oil pressure, a warning will be displayed on the control. The spindle will continue to run for a few minutes and then stop automatically. It will not be possible to start again until pressure is restored.

If there is a pressure drop showing on the filter gauge and the pump appears to be running (listen to/feel the pump housing), check:

1. Oil viscosity is correct,
2. Switch – temporarily reduce setting to see if switch activates, if it does not activate or activates at a very low setting, replace switch,
3. Wiring from switch to CM (also check LEDs at oil pressure switch connector),
4. Filter pressure drop, using gauge on filter housing, replace filter if pressure drop is in the yellow or red zones.
5. Mechanical failure of pump – not possible to check other than by trying a new pump (unlikely failure).

If the pump is not running, check:

1. Fuses F20 to F22,
2. K1 and associated wiring,
3. Pump windings (see spindle motor section for instructions on checking 3-phase motor windings). The pump is only 1/4HP (1/2HP for 780) so normal winding resistance will be around 190ohms (15ohms),

If all is correct and as a last resort, reduce the pressure switch setting slightly – do not go less than 8psi. E-stop the machine and check the LED on the pressure switch input to the CM goes out after a few seconds – if not, the setting is too low and it will not detect a genuine loss of oil pressure.

7.10 Electronic Handwheels and jogstick

Electronic handwheels and a jogstick are fitted to the Apron control panel. Handwheels are active in DRO, TOOL TABLE and RUN modes. The jogstick is active in DRO mode only. Handwheels can be turned on and off in the STATUS Window.

For Diagnostics refer to the following service codes:

- 308: Reverse Electronic Handwheel direction
- 132: EHW input check
- 521: EHW and jogstick input check

There are no user serviceable parts inside. Repair is by replacement.

7.11 Machine Electrical equipment

See the machine electrical schematics (reference section, chapter 9) for wiring details of machine electrical equipment.

7.11.1 Coolant pump

The coolant pump is mounted on the coolant tank (1630: in the RH foot casting of the bed).

The pump runs off 110VAC from the control transformer via a 4A fuse (same fuse for lube pump). It is turned on and off using the accessories button on the pendant. Operating this button activates the coolant pump relay output and energises relay K5.

If the coolant pump is not working, the fault is usually due to a failed or blocked coolant pump. For further diagnostics, go into DRO mode and operate the Accessories key, then check:

1. Accessories key LED lights up – if not run service code 81/check ACC-key LEDs and replace pendant/25-way cable if ACC key is not working.
2. Relay output from Computer module – the LED next to connector should be lit and 24VDC should be on the connector (see section 7.4 for more information). If not, replace the computer module.
3. Check relay energises and 24VDC is present across relay coil. Check for 110VAC on the relay output contacts. If not, check fuse and wiring to relay and replace fuse/relay/wiring as appropriate.
4. Check for 110VAC at the coolant pump. if not, check cabling to pump and replace cabling/pump as appropriate.

Note for RLX780, the pump is run from 400V, 3-phase supply, via an E-stopped contactor, K14, and overload relay Q5.

7.11.2 Lighting

One or more (depending on model) LED striplights are fitted inside the machining compartment. These are powered from 110VAC from the control transformer via a 2A fuse. There is no manual on/off switch; lights are controlled by the E-stop system via K9 (off when the machine is in E-stop). If the lights are not working, check the fuse and the operation of K9 (see E-stop diagnostics)

An adjustable, LED worklamp is also fitted (not 1630). An on/off switch is fitted to the lamp housing. The lamp is powered from a dedicated, 24VDC supply on the Computer module.

For RLX780, the worklamp is fixed to the roof of the sliding, saddle guard.

If the light is not working, check the LED next to the computer module connector is lit. If yes, replace the lamp. If not, remove the connector, if the LED now comes on there is a short circuit somewhere in the spotlamp assembly. If the LED is still off, replace the computer module (rare fault, and a loss of the CM 24VDC supply would usually produce more significant problems).

7.11.3 Fans

A number of fans are fitted to the machine. Please refer to the machine electrical diagram for details.

All fans are powered from an E-stopped 110VAC supply via K1 and a fuse. If all fans are not working, check out the fuse, E-stop circuit and K1. Otherwise check wiring to fans and replace wiring/fan as required.

For RLX780, fans are powered from 220VAC via E-stopped contactor, K14 and F14/F15.

Note, a fan is installed inside the spindle drive electronics units. This may be replaced, refer to the drive manual. Fans are also installed in the axes drive electronics units; these are not replaceable.

However, note that fan failures are rare.

7.11.4 Electrical switchgear

All electrical switch gear is mounted inside the electrical cabinet at the rear of the machine. Please refer to the machine electrical diagram (chapter 9) for details. Diagnostics is by inspection and standard electrical fault-finding techniques. No further information is given in this manual.

7.11.5 Gear Switches

Gear switches (not 1630) are mounted on the headstock and controlled by cams mounted to the gear change shaft.

Switches are wired normally open and close when the relevant gear is selected. Switches are connected to Gear1, 2 and 3 inputs on the computer module:

- Gear 1: Low Gear,
- Gear 2: Medium Gear (425), High Gear all other machines,
- Gear 3: High gear (425 only).

Use the diagnostic LED on the computer module input connector and Service Code 521 to check correct operation.

7.12 Limit Switches

Limit switches (not 1630) are fitted to stop axes hitting mechanical stops. Two switches are fitted to each axis, to limit travel at either end. Limit switches can be enabled/disabled using service code 312.

Limit switches must be set to two input using service code 338 to work correctly (otherwise only the positive switch will work).

For fault finding:

- Check service codes 312 and 338.
- Use the LEDs adjacent to each limit switch connector on the computer module, and
- Service code 521 to monitor switch status.

Each switch is wired normally closed (when the limit switch is not activated) and should open when the operating plunger is depressed (when the relevant cam trips the switch).

If behaviour is different, check cabling, limit switch adjustment, or else change the switch.

7.13 Indexer Options

Two Indexer options are available for the RLX lathes:

- 4 station, pneumatically operated indexer.
- 8 Station, servo motor operated indexer.

For description, fault finding and spare parts lists, see separate service manuals (chapter 9)

Some cautionary notes when working on the pneumatic system:

1. Before starting work, remove the air line and operate the unclamp valve manually to depressurise the system.
2. Take care to exclude dirt from the system.
3. Many of the pipework fittings are push fit:
   a. Ensure the ends of the pipes are cut clean with no burrs to avoid damaging seals.
   b. Ensure pipes are fully pushed home to ensure proper sealing and retention.
4. Route and secure pipework carefully to avoid trapping pipes during machine movement.

8 Sub System and Component Replacement Procedures

Illustrated parts lists are available to help you identify the correct parts for your machine, see the reference section in chapter 9. See also the Spares and tooling website (accessible from our main website). You can also call the XYZ spares department for assistance.

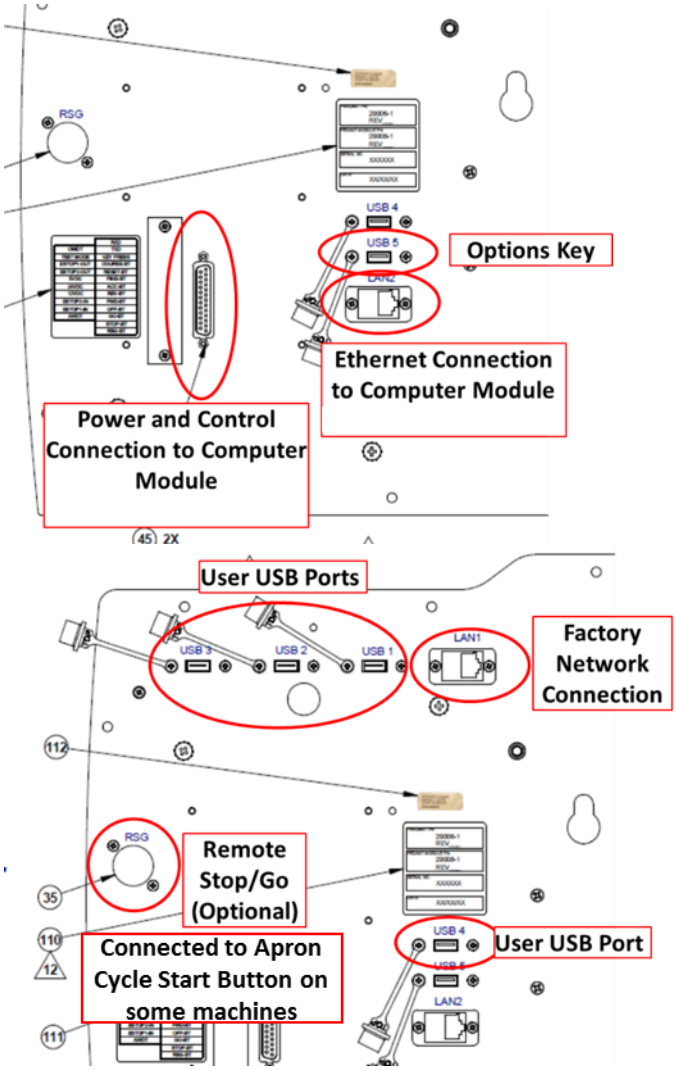
XYZ Machine Tools stocks spare parts from the original equipment manufacturers to ensure correct performance in your machine. It is also the official ProtoTrak Control service centre in Europe. All service exchange units are refurbished to the original manufacturer's specification and configuration using OEM components.

!!DANGER!!

Inappropriate or incorrect work practices can present a risk of serious injury to personnel during sub-system or component replacement, from electrical and mechanical hazards. Ensure all personnel read and understand the section on safety during MSR activities in chapter 1.1

8.1 ProtoTrak Control Pendant

1. If possible, Run Service code 142 to save machine configuration settings and User profiles. Save any programme.
2. Shutdown the control and turn off the power to the machine.
3. Unplug all connectors and accessories from the rear of the pendant (remove the protective shield on 555x3m and 780 lathes).
4. Remove the options key and keep in a safe place.
5. Slacken, then remove the 4off M6 cap head screws securing the pendant to the bracket. There is a shouldered screw to assist in supporting the pendant during removal and installation, but as a precaution, always support the pendant whilst removing the screws.
6. Carefully lift off the pendant and put in a safe place, temporarily.
7. Remove the new pendant from its packaging and check the part number is correct (29006-2)
8. Lift the new pendant onto the bracket and secure with 4 off M6 cap head screws and washers.
9. Replace the USB options key and cables/accessories (and cover).
10. Run Service Codes:
    a. 316: to ensure all software (Master and Slave) is up to date,
    b. 530: to update the pendant serial number.
11. Check original fault has been fixed, then run Service Code 141 (to load up machine configuration and user profiles). If fault returns, the configuration maybe corrupt – restore defaults (code 123, 510 and 128) and setup machine from scratch.
12. Check the Pendant E-stop button works correctly,
13. Place the old pendant in the new pendant packaging with the Returns paperwork.



8.2 ProtoTrak Motion Control Computer

1. Shutdown the control and turn off the power to the machine.
2. Isolate the machine supply, then open the electrical cabinet.
3. Unplug all connectors from the computer module. Ensure all cables/connectors are clearly labelled to ensure correct re-connection.
4. Remove the Machine ID key, STO delay jumper and turret jumper and keep in a safe place.

5. Slacken, but do not remove all mounting screws (6 off M5 cap heads), then remove the lower 3 screws.
6. Carefully lift the computer module from the mounting plate by sliding to the right then lowering to disengage the top three, screws.
7. Remove the new computer module from its packaging and check the part number is correct (29100-5 or 29100-6 for 780)
8. Lift the new computer module onto the top, three screws and fit the remaining three screws. Tighten all screws.
9. Replace the Machine ID key and cables/connectors; ensuring connectors are plugged into the correct receptacles.
10. Power up the machine
11. Run Service Codes:
    a. 33: to check machine ID is correct and ensure all software is up to date (get the latest software from the XYZ website – load software with code 316)
    b. 530: to update the computer module serial number.
    c. 510: to calibrate the spindle.
12. Check all safety functions work correctly (see section 1.2)
13. Check the Euro Safety Hardware LEDs behave as expected (see section 7.4.2.4)
14. Check the drive displays Hbb (V1000) or STO (GA500) whenever the machine is E-stopped or the chuck guard is opened (after the STO delay).
15. If any of the safety checks show an error, do not use the machine until the fault is rectified.
16. Place the old module in the new module packaging with the Returns paperwork.

8.3 Spindle Drive system

8.3.1 Spindle motor.

Refer to the illustrated parts list (chapter 9) for information on how the spindle motor is installed.

8.3.2 Spindle Drive Belts.

Refer to the illustrated parts list (chapter 9) for information on how the spindle drive belts are installed.

Note: replace all three belts as a set.

Tension the belts so that it is possible to turn the belt no more than ¼ turn, midway between the pulleys.

8.3.3 Other Spindle Drive Components

The RLX lathes are conventional with respect to the design and assembly of the headstock and spindle drive. It is assumed that the reader is sufficiently qualified/experienced to be able to undertake maintenance on these parts without detailed instructions.

To assist in disassembly, spare part identification and re-assembly, illustrated parts lists are available. Refer to the Reference Section, chapter 9.

If in doubt, please request a visit from an XYZ Service Engineer.

8.3.4 Spindle Drive Electronics Unit

1. Shutdown the control, turn off and isolate the power to the machine.
2. Open the electrical cabinet (2 screws, turn isolator handle to open position) .and identify the spindle drive electronics unit.
3. **Ensure at least 5 minutes has elapsed** since power was removed to dissipate stored energy (the charge light should be extinguished or at least quite dim).
4. Remove the front covers and disconnect all external wiring. Make a note of how the wires are connected first.

5. Slacken 4 off M5 screws holding the drive to the back panel – but do not remove completely. Then remove the top two screws and lift the drive off the bottom two screws.
6. Fit the new drive by reversing the removal process. Note, if present, you MUST remove the wire link between terminals H1, H2 and HC and replace with the wires from the spindle disable cable.
7. Note, the new drive is supplied fully configured for your machine, no adjustments are required.
8. Test the drive safety features. Check the drive displays Hbb/STO (after the STO delay) whenever:
    a. The machine is E-stopped (with the table guards closed), and
    b. When the table guards are opened.
9. If not, do not use the machine until the fault is rectified (see spindle drive fault finding, section 7.5.2)

If replacing an older V1000 drive with the newer GA500, the procedure is identical except for:

- Minor differences in the control terminal layout: To simplify the installation please replace the control cable with the GA500 version (18781) at the same time.
- Differences in the power terminal types: The GA500 power terminals can only accept bootlace ferrules – please cut off the existing spade terminals and replace with bootlace ferrules.

8.4 Axes Servo System

8.4.1 Axes Motors

Note: XYZ recommend renewing belts whenever motors are replaced (unless obviously in very good condition).

Refer to the illustrated part list (chapter 9) for more information on motor mounting arrangements.

1. Move the saddle to permit easy access to the X motor through the rear access covers.
2. Shutdown the control, turn off and isolate the power to the machine.
3. Remove applicable covers.
4. Disconnect electrical plugs.
5. Slacken the four screws holding the motor to the motor bracket and withdraw the motor.
6. Fit the new motor in reverse
7. Tension belt.

8.4.2 Axes drive belt Replacement

1. Move the saddle to permit easy access to the X motor through the rear access covers.
2. Shutdown the control, turn off and isolate the power to the machine.
3. Remove applicable covers.
4. Slacken the four screws holding the motor to the motor bracket and release the belt tension. Remove the belt.
5. Fit the new belt
6. Tension belt.

8.4.3 Belt tensioning

Since the positional encoder is mounted on the motor shaft, belt tension is very important to minimising backlash.

Tension the belt such that it is possible to twist the belt no more than ¼ turn in the middle of its longest run. Tightening the lower motor mounting bolts, before the top bolts, will assist in achieving adequate tension.

This approach will be difficult for the Z axis, due to the shortness of the belt. Aim to minimise the amount of deflection in the mid-point of the belt run.

8.4.4 Axes Servo drives

Drives are located inside the electrical cabinet.

1. Shutdown the control, turn off and isolate the power to the machine.
2. Open the electrical cabinet (2 screws, turn isolator handle to open position) .and identify the spindle drive electronics unit.
3. **Ensure at least 5 minutes has elapsed** since power was removed, to dissipate stored energy (the charge light should be extinguished or at least quite dim).
4. Make a note of how the wires and cables are connected first. See also the electrical schematic (Reference Section).
5. Remove the digital cables at CN1 and CN2 (slacken the captive, locking screws).
6. Slacken but do not remove screws on power terminals and withdraw the power and motor wires x8.
7. Remove ground wires – do not loose screws.
8. Slacken 3 off M5 screws holding the drive to the back panel – but do not remove completely. Then remove the top two screws and lift the drive off the bottom screw.
9. Fit the new drive by reversing the removal process. Ensure earth wires are connected.
10. Note, the new drive is supplied fully configured for your machine, no adjustments are required.
11. Test the machine safety features (see section 1.2).

8.4.5 Other drive Train Components

The RLX lathes are conventional with respect to the design and assembly of the axes drive trains. It is assumed that the reader is sufficiently qualified/experienced to be able to undertake maintenance on these parts without detailed instructions.

To assist in disassembly, spare part identification and re-assembly, illustrated parts lists are available. Refer to the Reference Section, chapter 9.

If in doubt, please request a visit from an XYZ Service Engineer.

8.5 Headstock and Tail stock Assemblies

The RLX lathes are conventional with respect to the design and assembly of the headstocks and tailstocks. It is assumed that the reader is sufficiently qualified/experienced to be able to undertake MSR activities on these parts without detailed instructions.

To assist in disassembly, spare part identification and re-assembly, illustrated parts lists are available. Refer to the Reference Section, chapter 9.

If in doubt, please request a visit from an XYZ Service Engineer.

Some cautionary notes when working on the air ride tailstock pneumatic system:

1. Before starting work, remove the air line and operate the air lever a few times to depressurise the system.
2. Take care to exclude dirt from the system.
3. Many of the pipework fittings are push fit:
   a. Ensure the ends of the pipes are cut clean with no burrs to avoid damaging seals.
   b. Ensure pipes are fully pushed home to ensure proper sealing and retention.
4. Route and secure pipework carefully to avoid trapping pipes during machine movement.

8.6 Lube System

The RLX lathes are conventional with respect to the design and assembly of the lube system. It is assumed that the reader is sufficiently qualified/experienced to be able to undertake MSR activities on these parts without detailed instructions.

To assist in disassembly, spare part identification and re-assembly, illustrated parts lists are available. Refer to the Reference Section, chapter 9.

If in doubt, please request a visit from an XYZ Service Engineer.

8.7 Machine Electrical equipment

The RLX lathes are conventional with respect to the design and assembly of the machine electrical system. It is assumed that the reader is sufficiently qualified/experienced to be able to undertake MSR activities on these parts without detailed instructions.

To assist in disassembly, spare part identification and re-assembly, refer to the electrical schematic and illustrated parts lists in the Reference Section, chapter 9.

If in doubt, please request a visit from an XYZ Service Engineer.

Ensure power and signal cables are kept separate for EMC reliability reasons.

8.8 Safety Components

The following components are critical to the safe operation of the machine.

Please observe the following when replacing any of these items:

1. Replace components with exact originals. Do not substitute any alternative parts. All parts are available from XYZ.
2. Good workmanship is essential.
3. Ensure any wiring associated with safety components is correctly installed and protected from damage. Replace any suspect wiring immediately.
4. After any replacements are fitted, the safety checks detailed in section 1.2 must be undertaken. Check to see if there are any additional safety checks specified in the relevant replacement section.

Item	OEM	OEM Part number	Notes
PT10 Euro Computer Module and Control Pendant	SWI	29100-5 (-6 for RLX 780) 29006-2	Including: • Euro Safety circuit adaptor • Emergency Stop button
Spindle variable Frequency Drive	Yaskawa	CIMR-VC4A00xxFAA, or GA50C40xxABA xx = rating depending on model RLX780 only: GA70C4060BBA	STO to EN 954, category 3.
Chuck Guard switch	Schneider	ZCP27+ZCE02+ZCPEG11	Positive opening, NC contacts in accordance with IEC 60947-5-1.
Belt and Main Door Guard switches	Schneider	XCS-PA791	Positive opening, NC contacts in accordance with IEC 60947-5-1.
Saddle & Loading Guard switches (55x3m and 780)	Allen-Bradley	Switch 440G-T27121 Actuator 440G-A27143	Positive opening, NC contacts in accordance with IEC 60947-5-1.
Apron Emergency stop switch	Schneider, or	Contacts (x2) ZBE1026 Head ZB5AS844 A-R plate ZB5AZ902 Collar ZB5AZ009	Red, mushroom operator, dia 40mm. Latching, twist to release. Positive opening, NC contacts in accordance with IEC 60947-5-1.
	Allen-Bradley	Contacts (x2) 800F-X01 Head 800FM-MT44 Latch 800F-ALP	
Edge Safety Strips (RLX 555x3m and 780)	ASO Safety Solutions	SKL 15-10TT	Safety Strips – available ready assembled from XYZ
		ELMON Rail 39-726	Safety Strip controller

Spindle Brake Relay (K9)	Omron	G7SA2A2B	Forcibly guided safety relay
Contactors (K1, K7, K14)	Schneider	LC1D18BL LC1D25BL	Mechanically linked NC contact to IEC60947-4-1, Annex F.
MCCB	Fuji Electric	BW50EAG-3P0xx xx = current rating depending on model.	For protection against shock from indirect contact
Guard windows	Derstrong Hamilton Erskine	LMT-C2A (original fitment) SCT 6-12 (spares)	For protection against ejected parts
Jog Stick	Euchner	WKT1234VW	With mechanical interlock

9 Reference Section

This section contains links to supporting documentation (drawings etc). Not all this information is currently available on-line. Contact XYZ if you need any of this information.

9.1 Machine Specifications

TBD

9.2 Software

The most up to date RX software is available here: https://xyzmachinetools.com/software-downloads/

9.3 Electrical Schematics

Schematics:

- RLX 1630: 29106-10-SCH: TBD
- RLX 355: 29106-11-SCH: TBD
- RLX 425: 29106-12-SCH: TBD
- RLX 555: 29106-13-SCH: TBD
- RLX 555 x 3m: 29106-15-SCH: TBD
- RLX 780: 29106-18-SCH: TBD

9.4 Drawings, Parts Lists etc

Spare Electrical Parts List: TBD

Mechanical Illustrated Parts List: TBD

Installation Requirements: TBD

9.5 Fault Finding Guides

Fault Finding by Error Code: TBD

9.6 Technical Bulletins

TB 125 – spindle drive config: TBD
TB 131 – Normal RX error codes: TBD
TB 135 (RX Aux function): TBD
TB 136 – replacing V1000 with GA500: TBD

9.7 Equipment Manuals

4 Tool Indexer Service Manual: https://xyzmachinetools.com/customer-support/downloads-manuals/
8 Tool Indexer Service Manual: TBD
Yaskawa V1000 manual: https://www.yaskawa.eu.com/services/download-center
Yaskawa GA500 manual: https://www.yaskawa.eu.com/services/download-center
Yaskawa GA700 manual: https://www.yaskawa.eu.com/services/download-center
Delta, ASDA B2 manual: https://downloadcenter.deltaww.com/en-US/DownloadCenter?v=1
Elmon 39-726 manual (RLX780): https://www.asosafety.co.uk/downloads/manuals/elmon-relay-safety-relays/
Omron G9SE manual (K3): https://industrial.omron.co.uk/en/products/g9se#manual
AutoLube manual: TBD
Programming manual: https://xyzmachinetools.com/customer-support/downloads-manuals/

Off-line manual: https://xyzmachinetools.com/customer-support/downloads-manuals/

9.8 Abbreviations and Glossary

CM	Computer Module
DAC	Digital to Analogue Converter (used to convert digital speed demand in control to analogue voltage to control spindle/axes speeds)
DIR	Direction (associated with spindle direction)
E-STOP	Emergency Stop (also E-xxx used to qualify internal E-stop safety relays or E-stop reset signals)
EHW	Electronic Handwheel
FLT	Fault (also NFLT for Not in fault)
FRL	Filter, Regulator and Lubricator (for pneumatic system, inlet air preparation)
FWD	Forward
GRD	Guard (refers to chuck guard and Door switch inputs on CM, also GRD-xxx used to qualify internal guard safety relays or guard reset signals
HBB	Hardware baseblock (same function as Safe Torque Off)
MNA	Motion Not Allowed (status of S/W speed monitoring system)
MSR	Maintenance, Service and Repair
NCRdy1/2	Numerical Control Ready 1/2 (internal signals indicating the NC control system is ready)
NLSP	Not Limiting Speed (status of S/W speed monitoring system)
RDY	Ready (usually associated with spindle/axes drives)
RLY	Relay (usually associated with an internal relay status, e.g.. GRD, E-stop)
REV	Reverse
RST	Reset (associated with RESET button on pendant, or GRD-RST and E-RST)
RXD	Receive Data (on serial communications between pendant and CM)
SC	Service Code
STO	Safe Torque Off
TRQ	Torque (associated with torque limit input from spindle drive)
TXD	Transmit Data (on serial comms between pendant and CM)

XYZ Machine Tools Ltd.

ProtoTrak UK Warranty Policy

Warranty

ProtoTrak products are warranted to the original purchaser to be free from defects in workmanship and materials for the following periods:

Product	Warranty Period
New ProtoTrak Controlled Machine	12 Months
Any Exchange Unit or Spare Part	6 Months

The warranty period starts on the date of the invoice to the original purchaser from XYZ Machine Tools Ltd (XYZ) or their authorised distributor. If a unit under warranty fails, it will be repaired or exchanged at our option for a properly functioning unit in similar or better condition. Such repairs or exchanges will be made carriage paid within the UK mainland.

Disclaimers of Warranties This warranty is expressly in lieu of any other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular purpose, and of any other obligations or liability on the part of XYZ (or any producing entity, if different). Warranty repairs/exchanges do not cover incidental costs such as installation, labour, etc.

- XYZ is not responsible for consequential damages from use or misuse of any of its products.
- ProtoTrak products are precision mechanical/electromechanical measurement systems and must be given the reasonable care that these types of instruments require.
- Replacement of slideway wipers and covers is the responsibility of the customer. Consequently, the warranty does not apply if swarf or coolant have been allowed to enter the mechanism.
- This machine is designed to cut common, metallic engineering materials (such as steel and aluminium). DO NOT use to cut special materials (such as graphite, composites or abrasives) without agreement from XYZ Machine Tools. Any damage caused to the machine by processing such materials will not be covered by the warranty.
- Accidental damage, beyond the control of XYZ, is not covered by the warranty. Thus, the warranty does not apply if an instrument has been abused, dropped, hit, disassembled or opened.
- Improper installation by or at the direction of the customer in such a way that the product consequently fails, is considered to be beyond the control of the manufacturer and outside the scope of the warranty.