



14" X 40" GEARHEAD METAL LATHE



MODEL: KC-1440ML-2

INSTRUCTION MANUAL

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WARRANTY INFORMATION

**2-YEAR
LIMITED WARRANTY
FOR THIS 14" X 40" METAL LATHE**

**KING CANADA TOOLS
OFFERS A 2-YEAR LIMITED WARRANTY
FOR INDUSTRIAL USE.**

PROOF OF PURCHASE

Please keep your dated proof of purchase for warranty and servicing purposes.

PARTS DIAGRAM & PARTS LISTS

Refer to the Parts section of the King Canada web site for the most updated parts diagram and parts list.

LIMITED TOOL WARRANTY

King Canada makes every effort to ensure that this product meets high quality and durability standards. King Canada warrants to the original retail consumer a 2-year limited warranty as of the date the product was purchased at retail and that each product is free from defects in materials. Warranty does not apply to defects due directly or indirectly to misuse, abuse, normal wear and tear, negligence or accidents, repairs done by an unauthorized service centre, alterations and lack of maintenance. King Canada shall in no event be liable for death, injuries to persons or property or for incidental, special or consequential damages arising from the use of our products.

To take advantage of this limited warranty, return the product at your expense together with your dated proof of purchase to an authorized King Canada service centre. Contact your retailer or visit our web site at www.kingcanada.com for an updated listing of our authorized service centres. In cooperation with our authorized serviced centre, King Canada will either repair or replace the product if any part or parts covered under this warranty which examination proves to be defective in workmanship or material during the warranty period.

NOTE TO USER

This instruction manual is meant to serve as a guide only. Specifications and references are subject to change without prior notice.

KING CANADA INC. DORVAL, QUÉBEC, CANADA H9P 2Y4

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GENERAL & SPECIFIC SAFETY INSTRUCTIONS FOR METAL LATHES



GENERAL SAFETY INSTRUCTIONS

- 1. KNOW YOUR TOOL**
Read and understand the owners manual and labels affixed to the tool. Learn its application and limitations as well as its specific potential hazards.
- 2. GROUND THE TOOL.**
This tool is equipped with an approved 3-conductor cord. The green conductor in the cord is the grounding wire. **NEVER** connect the green wire to a live terminal.
- 3. KEEP GUARDS IN PLACE.**
Keep in good working order, properly adjusted and aligned.
- 4. REMOVE ADJUSTING KEYS AND WRENCHES.**
Form habit of checking to see that keys and adjusting wrenches are removed from tool before turning it on.
- 5. KEEP WORK AREA CLEAN.**
Cluttered areas and benches invite accidents. Make sure the floor is clean and not slippery due to wax and sawdust build-up.
- 6. AVOID DANGEROUS ENVIRONMENT.**
Don't use power tools in damp or wet locations or expose them to rain. Keep work area well lit and provide adequate surrounding work space.
- 7. KEEP CHILDREN AWAY.**
All visitors should be kept a safe distance from work area.
- 8. MAKE WORKSHOP CHILD-PROOF.**
Use padlocks, master switches or remove starter keys.
- 9. USE PROPER SPEED.**
A tool will do a better and safer job when operated at the proper speed.
- 10. USE RIGHT TOOL.**
Don't force the tool or the attachment to do a job for which it was not designed.
- 11. WEAR PROPER APPAREL.**
Do not wear loose clothing, gloves, neckties or jewelry (rings, watch) because they could get caught in moving parts. Non-slip footwear is recommended. Wear protective hair covering to contain long hair. Roll up long sleeves above the elbows.
- 12. ALWAYS WEAR SAFETY GLASSES.**
Always wear safety glasses (ANSI Z87.1). Everyday eye-glasses only have impact resistant lenses, they are **NOT** safety glasses. Also use a face or dust mask if cutting operation is dusty.
- 13. DON'T OVERREACH.**
Keep proper footing and balance at all times.
- 14. MAINTAIN TOOL WITH CARE.**
Keep tools sharp and clean for best and safest performance. Follow instructions for lubricating and changing accessories.
- 15. DISCONNECT TOOLS.**
Before servicing, when changing accessories or attachments.
- 16. AVOID ACCIDENTAL STARTING.**
Make sure the switch is in the "OFF" position before plugging in.
- 17. USE RECOMMENDED ACCESSORIES.**
Consult the manual for recommended accessories. Follow the instructions that accompany the accessories. The use of improper accessories may cause hazards.
- 18. NEVER STAND ON TOOL.**
Serious injury could occur if the tool tips over. Do not store materials such that it is necessary to stand on the tool to reach them.
- 19. CHECK DAMAGED PARTS.**
Before further use of the tool, a guard or other parts that are damaged should be carefully checked to ensure that they will operate properly and perform their intended function. Check for alignment of moving parts, breakage of parts, mounting, and any other conditions that may affect its operation. A guard or other parts that are damaged should be properly repaired or replaced.
- 20. NEVER LEAVE MACHINE RUNNING UNATTENDED.**
Turn power "OFF". Don't leave any tool running until it comes to a complete stop.

SPECIFIC SAFETY INSTRUCTIONS FOR METAL LATHES

- 1. CLEANING MACHINE:** To avoid entanglement and lacerations, do not clear chips by hand. Use a brush, and never clear chips while the lathe is operating.
- 2. USING CORRECT TOOLING:** Always select the right cutter for the job, and make sure cutters are sharp. The right tool decreases strain on the lathe components and reduces the risk of unsafe cutting.
- 3. ELIMINATING PROJECTILE HAZARDS:** Always remove the chuck key, and never walk away from the lathe with the chuck key installed. Always make sure workpiece is securely held in chuck before starting lathe. A workpiece thrown from the chuck could cause severe injury.
- 4. AVOIDING OVERLOADS:** Always use the appropriate feed and speed rates.
- 5. PREVENTING A CUTTING TOOL/CHUCK CRASH:** Always release automatic feeds after completing a job, and never leave lathe unattended while it is running.
- 6. AVOIDING STARTUP INJURIES:** Make sure workpiece, cutting tool, and tool post have adequate clearance before starting lathe. Check chuck clearance and saddle clearance before starting the lathe. Make sure spindle RPM is set correctly for part diameter before starting the lathe. Large parts can be ejected from the chuck if the chuck speed is set too high.
- 7. CHUCK SAFETY:** Chucks are surprisingly heavy and awkward to hold, so protect your hands and the lathe ways. Always use a chuck cradle or piece of plywood over the lathe ways.
- 8. WORKPIECE SUPPORT:** Support a long workpiece if it extends from the headstock so it will not wobble violently when the lathe is turned ON. If workpiece extends more than 2.5 times its diameter from the chuck, support it by a center or steady rest, or it may deflect and fall out of the chuck while cutting.
- 9. AVOIDING ENTANGLEMENT INJURIES:** Never attempt to slow or stop the lathe chuck by hand. Tie back long hair, ponytails, loose clothing, and sleeves so they do not dangle.



ELECTRICAL & TECHNICAL INFORMATION

ELECTRICAL INFORMATION

WARNING!

ALL ELECTRICAL CONNECTIONS MUST BE DONE BY A QUALIFIED ELECTRICIAN. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY! ALL ADJUSTMENTS OR REPAIRS MUST BE DONE WITH THE METAL LATHE DISCONNECTED FROM THE POWER SOURCE. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY!

POWER SUPPLY

WARNING:

THIS METAL LATHE MUST BE 'HARDWIRED' (connected directly to the circuit breaker without the use of a plug). We recommend that only a qualified electrician do the initial 'Hardwiring' of this metal lathe.

WARNING:

YOUR METAL LATHE MUST BE CONNECTED TO A 240V, 15-AMP (MINIMUM) BRANCH CIRCUIT WITH A 15-AMP TIME DELAY FUSE OR CIRCUIT BREAKER. FAILURE TO CONNECT IN THIS WAY CAN RESULT IN INJURY FROM SHOCK OR FIRE.

THIS METAL LATHE MUST BE GROUNDED. IF NOT PROPERLY GROUNDED, THIS METAL LATHE CAN CAUSE ELECTRICAL SHOCK, PARTICULARLY WHEN USED IN DAMP LOCATIONS. TO AVOID SHOCK OR FIRE, IF THE POWER CORD IS WORN OR DAMAGED IN ANY WAY, HAVE IT REPLACED IMMEDIATELY.

TECHNICAL INFORMATION KC-1440ML-2

Main Specifications

Max. swing over bed 14" (355mm)
Max. swing over cross slide 8-5/8" (219mm)
Distance between centers 40" (1016mm)

Headstock

Spindle bore diameter 2" (52mm)
Spindle bore taper MT#6
Spindle speed range 8 (70-2000 R.P.M.)

Gear Box

Thread cutting: Inches 34 (4-56 T.P.I.)
..... Metric 26 (0.4 - 7mm)

Tool Post, Saddle, Tailstock

Top Slide travel 3-1/2" (88mm)
Cross Slide travel 6-3/16" (157mm)
Tailstock taper MT#3
Tailstock quill travel 4" (100mm)
Diameter of Tailstock quill 1-1/4" (32mm)

Motor

Horsepower 2 HP
Voltage 240V, 1 phase
Amperage 11 Amp.
Motor R.P.M. 1720 R.P.M.
Motor frequency 60Hz

GETTING TO KNOW YOUR LATHE, CLEANING & PRETEST RUN

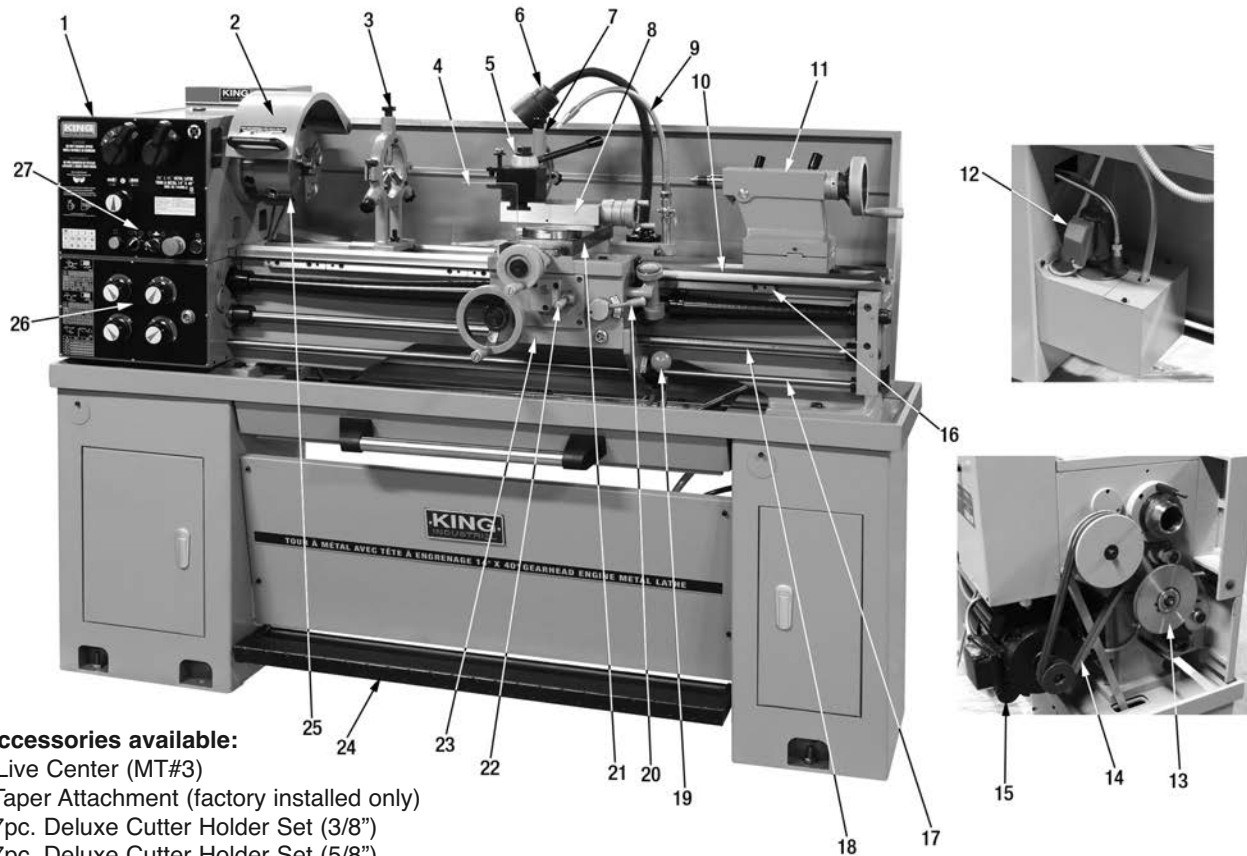


FIGURE 1

Optional Accessories available:

- KLC-3M -Live Center (MT#3)
- KM-054 -Taper Attachment (factory installed only)
- KM-047 -7pc. Deluxe Cutter Holder Set (3/8")
- KM-057 -7pc. Deluxe Cutter Holder Set (5/8")

- | | | |
|----------------------------------|------------------------------|--------------------------------|
| 1- Headstock | 10- Bedway | 19- Start |
| 2- Chuck safety guard | 11- Tailstock | 20- Half nut lever |
| 3- Steady rest | 12- Coolant pump | 21- Cross slide |
| 4- Tool post safety guard | 13- Quick change gear system | 22- Feed selector lever |
| 5- Tool post | 14- V-belts | 23- Carriage |
| 6- Halogen Lamp | 15- Motor | 24- Foot brake |
| 7- Follow rest (not fully shown) | 16- Gear rack | 25- Chuck (D1-5) |
| 8- Top slide | 17- Feed shaft | 26- Gearbox & gearbox controls |
| 9- Collant hose | 18- Leadscrew | 27- Control switches |

Warning! Before operating this metal lathe, read this instruction manual and familiarize yourself with the required adjustments, operation procedures, maintenance and lubrication.

CLEANING & PREPARING LATHE BEFORE THE FIRST TEST RUN

After unpacking, remove the paper (or grease found on unpainted ground surfaces) from the machine and using a non-volatile solvent and a brush, remove grease.

During transport and unpacking, it is likely that debris will be present on top of the lathe. Do not move the carriage and the tailstock until the rest of the metal lathe (mainly the bed) has been thoroughly cleaned.

Remove all accessories and machine parts from the tool box and install all the handles and knobs. Fix the follow rest to the carriage using 2 cap screws and fix the steady rest in between the chuck and the carriage.

Make sure that all lubrication points and oil levels have been inspected before putting your metal lathe into operation. See "Lubrication Points" in the maintenance section in this manual before operating your lathe.

This machine is equipped with 2 V-belts from the motor to the lower rear pulley. It is advisable to check the belt tension before starting the metal lathe. There should be no more than a 1/2" center deflection with light finger pressure. Adjust the V-belt tension as necessary. V-belts which are tensioned too tightly will damage the bearing.

Before performing test runs, set the changing lever on the lowest speed and let the machine operate for 20 minutes. If everything is functioning normally, increase the spindle speed step by step until the highest speed, each step operating for 5 minutes.

Metal Lathe Operating Levers (Fig.2)

Headstock Levers

- Lever 1 is the H/L speed selector, this lever allows you to set the speed to H (high) or L (low).
- Lever 2 is the 4-step speed selector which allows you to set the spindle speed.
- Dial 3 is the spindle direction selector. Do not change this setting while the machine is running.

Quick Change Gearbox Knobs

- Selector knobs 4, 5, 6 & 7 set the gearbox feed rate. Turning these knobs can provide many feed rates and inch thread pitches as indicated in the charts in the metal lathe plates. With the use of metric change gears, these levers can also provide metric threads using the "MM Gear Change" chart which is also found in the metal lathe plates.

Caution: Always stop the spindle before engaging any of the above knobs (knobs 4-7).

Carriage Assembly Levers

- Handwheel 8 is used to manually move the carriage along the bed.
- The crossfeed handwheel 10 is used to manually move the cross slide in or out.
- The feed lever 11 is used to engage either the longitudinal or cross feed. This lever has a safety interlock to prevent accidental engagement of the half nuts when the lathe is in feed mode. There are 3 positions; the upper position engages the power longitudinal feed, the lower position engages the power cross feed and the centre

position is the disengaged position.

- The thread lever 12 is used to engage the half nuts when threading.
- The top slide handwheel 17 is used to manually move the tool post. The top slide is fully adjustable to any angle and is also used for threading or machining an angle on a workpiece.
- The thread cutting dial 16 is used to engage the half nuts with the leadscrew in the same thread that has been previously cut. Please note: Use any line of the dial for even pitches of threads, but for odd pitches of threads you must use the same starting line. Example: When cutting a shaft with 10 TPI, engage the half nuts at any number on the thread dial, when creating an odd pitch (ex. 9, 11), if you start the cut using 1 or a 3, continue to use the 1 or the 3 until the thread is finished.
- The clamp lever 18 is used to secure the tool post block.
- The start lever 15 is used to start the metal lathe.

Tailstock levers

- The handwheel 13 is used to feed or retreat the tailstock quill. Tip: Turning the handwheel completely counterclockwise until a full stop will automatically eject the turning tool used.
- The tailstock clamp lever 14 locks the tailstock to the bedway. Lever 19 locks the tailstock quill.

Stand

- Foot brake 9 stops the spindle. This allows you to stop the spindle quickly and then change the rotation if needed.

Control Buttons

- Indicator light 19 lights up when machine is connected to power.
- Power On button 20, must be placed in the on position before operating.
- Coolant system On/Off 21.
- Emergency stop 22. Once you push down on the emergency stop button, twist the button clockwise until it pops up, only then will you be able to restart the machine.
- Inching/Jogging button 23.

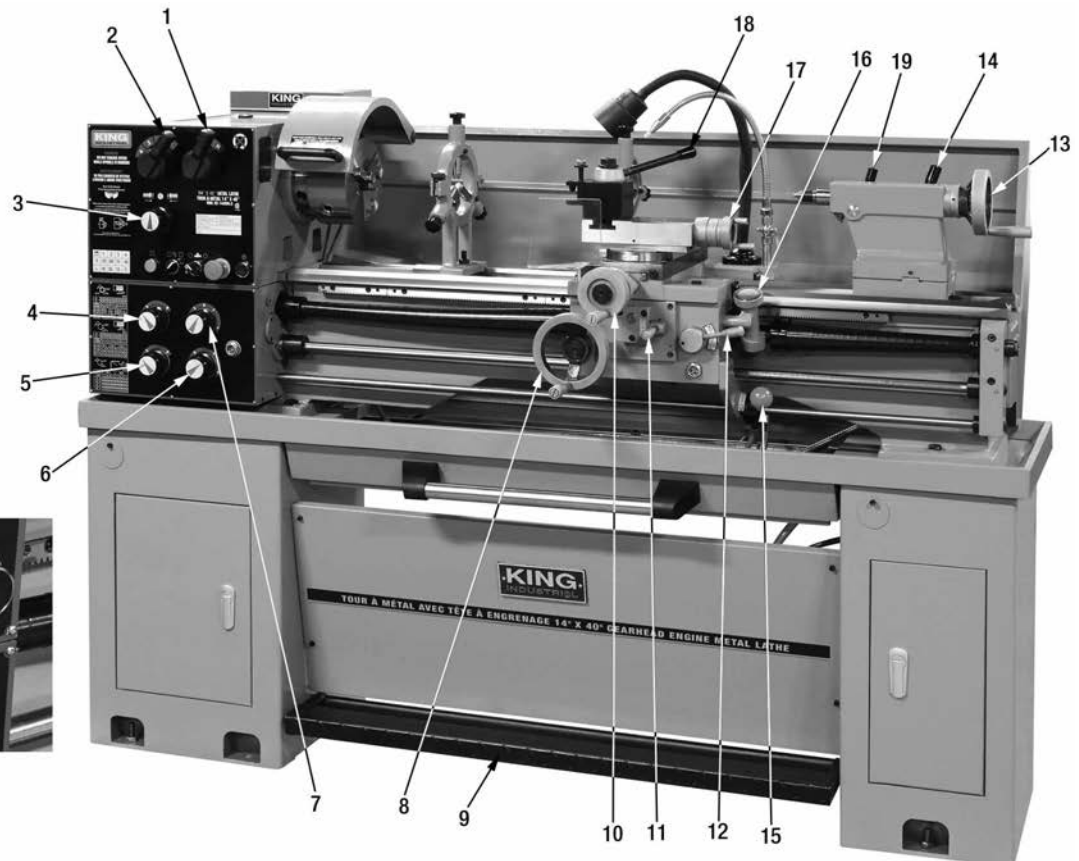


FIGURE 2

CHARTS ON METAL LATHE



Metal Lathe Charts

Below are all the charts which are found on the metal lathe plates. We have included these charts in this manual for reference purposes, in case one or many plates have been damaged and are no longer readable.

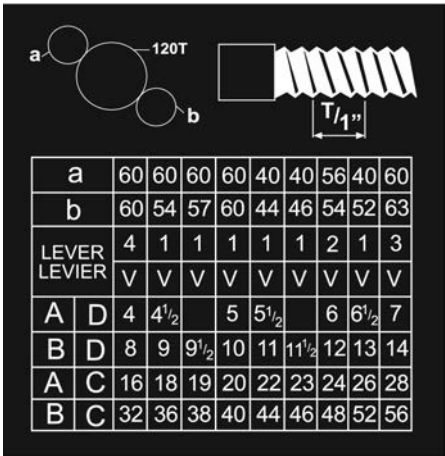


FIGURE 3- Inch Thread Pitch Chart

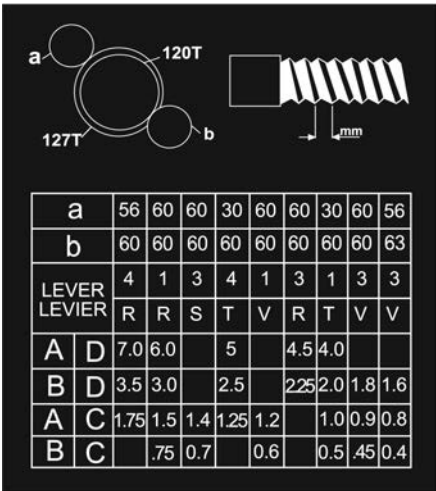


FIGURE 4- Metric Thread Pitch Chart

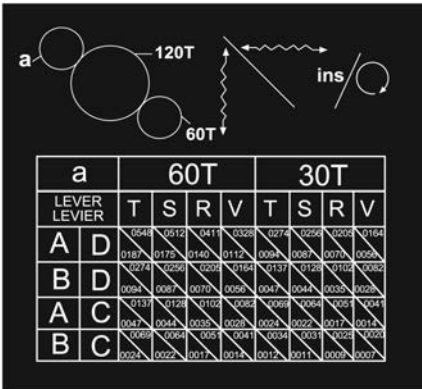


FIGURE 5A- Imperial Feed Rate Chart

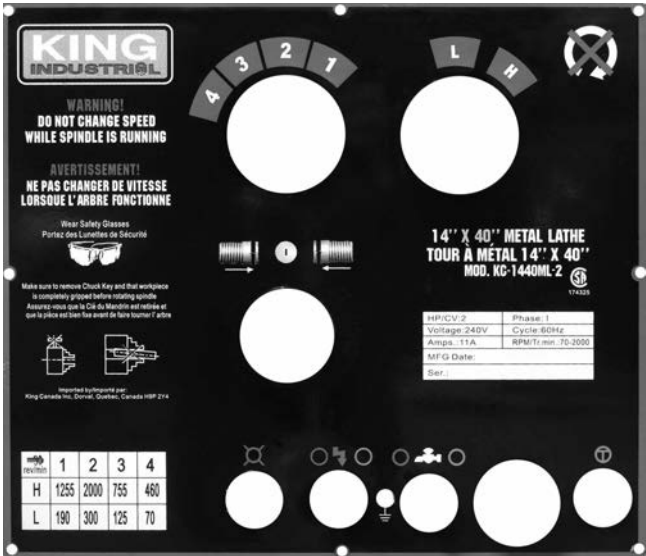


FIGURE 6- 8 Step Spindle Speed Chart



FIGURE 7- Thread Dial Indicator Chart

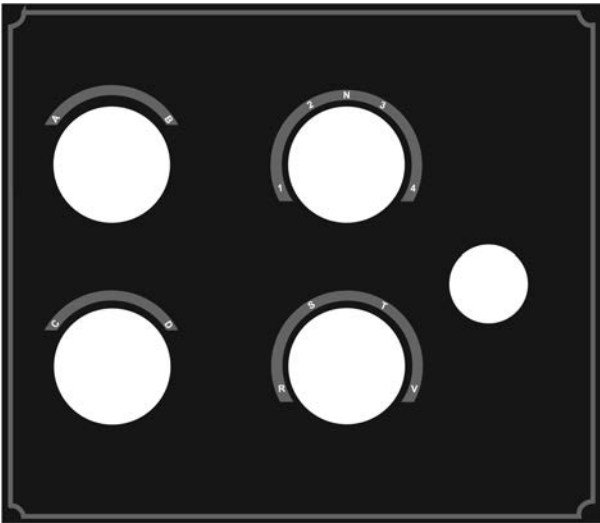


FIGURE 5B- Feed Rate/Thread Selection Chart

Mounting or removing chuck or face plate

The 3-jaw chuck comes installed on the lathe, all three jaws move in unison when adjusted. The supplied 4-jaw chuck has independant jaws and is used for square or unevenly shaped workpieces. If neither chuck can hold your workpiece, the faceplate can be mounted using its t-bolts and slots to secure workpiece. The chucks and faceplate come with a D1-5 camlock mount. Before mounting a chuck or face plate, it is very important that the mounting surfaces on both the spindle nose and the attachment are extremely clean.

All the camlocks (A) Fig.8 should be in their release position, the camlock mark line (B) line up with the spindle nose mark line (C). Mount the chuck or faceplate onto the spindle nose, once in position, each camlock must be tightened and locked into place. Camlocks (A) are tightened by turning them clockwise using the provided Camlock Key. The cams are properly locked into place when the camlock mark line (B) is in between the 2 V's (D) on the spindle nose, see Fig.8.

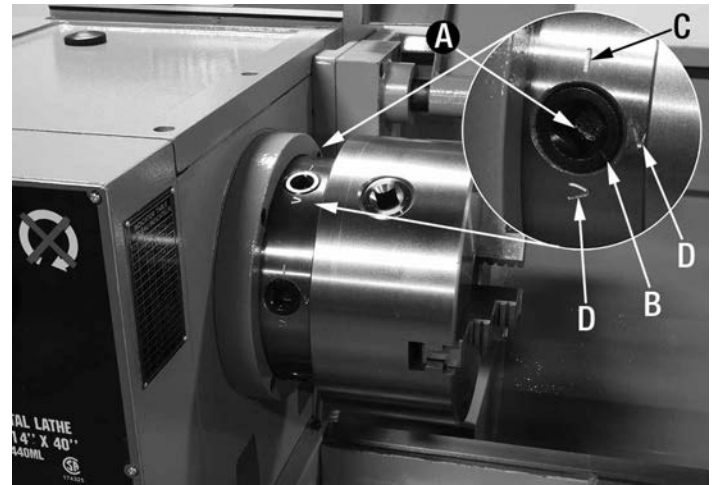


FIGURE 8

Adjusting and reversing chuck jaws

Chuck jaws (A) Fig.9 can be opened or closed by using the camlock key in the jaw adjustment cams (B). Turning the camlock key (C) clockwise will close the jaw opening and counterclockwise will open the jaw opening.

Before reversing the direction of the chuck jaws, two major points must be followed every time.

- 1) The chuck jaws are numbered (ex.: 3 jaw chuck- 1,2,3) and must be placed in numerical order into the chuck.
- 2) If the chuck jaws are to be removed, you must replace them in the identical slot which they were taken out of. (Make sure they are also in numerical order).

To remove chuck jaws, open jaw opening all the way using camlock key until the jaws practically fall out. Do not let the jaws fall, hold them while you open the jaw opening. Change the direction of each jaw and apply pressure on them towards the center of the chuck. Turn camlock key clockwise and make sure all jaws engage the spiral mechanism.

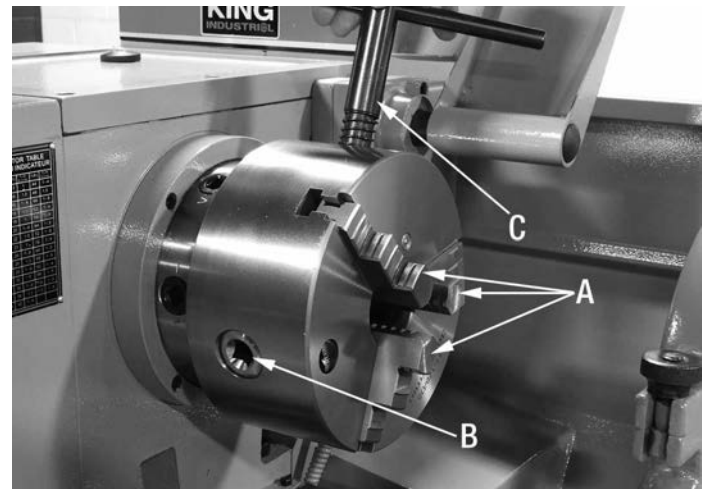


FIGURE 9

Installing and operating follow rest and steady rest

The follow and steady rests serve as workpiece supports during operations. Install the follow rest (A) Fig.10 to the saddle (B) using 2 cap screws. Install the steady rest (C) to the bedway (D) (in between the carriage and the chuck) using the clamp shoe, bolt and lock nut assembly.

The follow rest is installed near the cutting tool to give additional support. If the follow rest would not be used, the cutting tool pressure on the workpiece could warp your workpiece and give undesired results.

Position workpiece in the steady rest and the follow rest. Secure workpiece in rests by tightening the centres but do not overtighten.

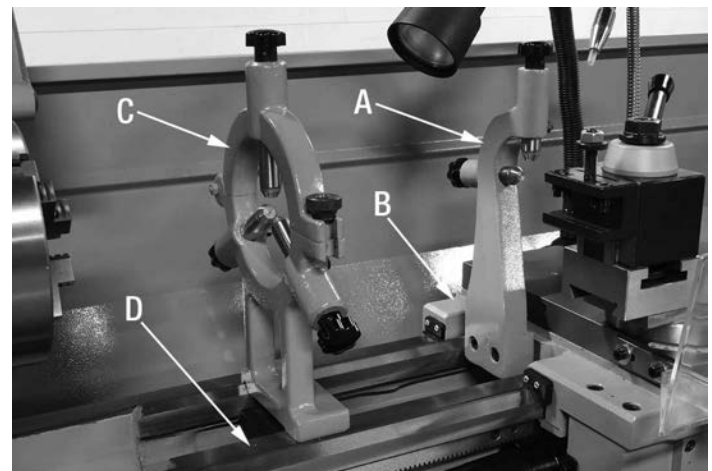


FIGURE 10

ADJUSTMENTS & OPERATION



Tailstock Adjustments & Operation

The tailstock (A) Fig.11 can be moved freely on the bedway and fastened at any position using the tailstock lock lever (B). The tailstock quill (C) can be moved in and out by using handwheel (D) and then locked in place using quill locking lever (E). Dead centers or drill chucks are normally installed in the tailstock quill.

An important adjustment and verification must be done in order to obtain the best results using your tailstock. The tailstock must be perfectly aligned with the chuck. Fix a ground steel bar in between the chuck centre and the tailstock centre. Using a precise measuring tool, make sure the distance at both ends of the ground steel bar are the same using the top slide as starting reference point, see Fig.12. If the distance is not the same, then a cross-wise adjustment to the tailstock is necessary.

To make a cross-wise adjustment, unlock tailstock lever (B) Fig.11 and adjust set screws (F) on both sides of the tailstock until the distance at both ends of the ground steel bar are the same.

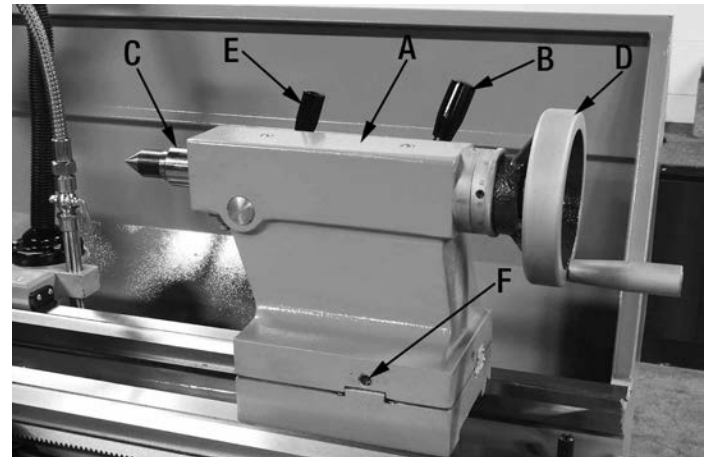


FIGURE 11

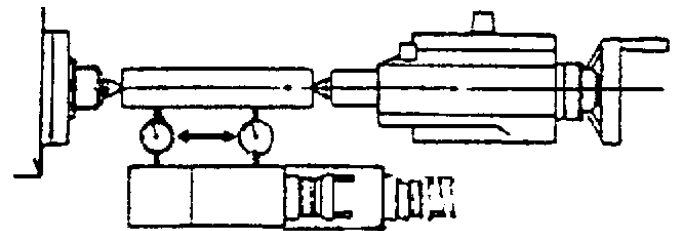


FIGURE 12

Tool Post Adjustments & Operation

The tool post assembly (A) Fig.13 is used to lock the cutting tool into place at the desired height and angle. The tool post can pivot 360° for various cutting situations. To pivot the tool post assembly, loosen lock nut (B) and pivot tool post, retighten lock nut. The tool post comes with a tool holder (C) which can be adjusted to a desired height using the shaft and nuts mechanism (D) to raise or lower the tool holder. Once the height of the tool holder is determined, use tool post lock handle (E) to lock tool holder in place. The tool holder has 4 locking set screws (F) which lock the cutting tool in place.

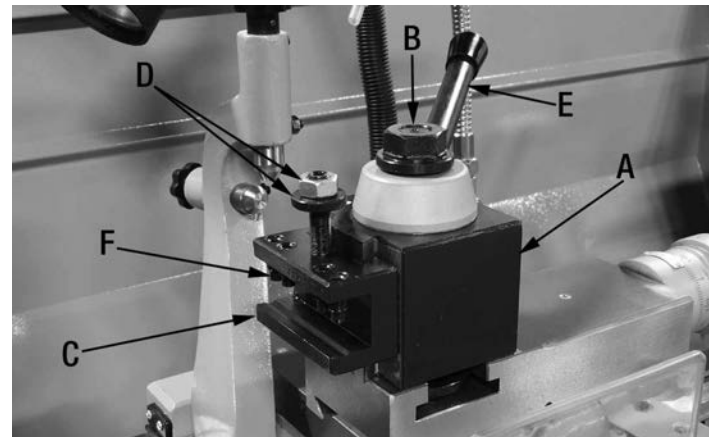


FIGURE 13

Cross & Top Slide Adjustments & Operation

The cross slide handwheel (A) Fig.14 is used to feed the cross slide, top slide and tool post with cutting tool towards the workpiece. After time the cross slide gib (B) may become loose or too tight and an adjustment may be necessary. To adjust the gib (B), tighten or loosen the flat head bolt (C) until the cross slide moves freely without play.

The top slide handwheel (D) feeds the top slide and tool post with cutting tool towards the chuck or the tailstock end of the lathe. After time the top slide gib may become loose or too tight and an adjustment may be necessary.

The top slide can be pivoted to a desired angle, to adjust the angle of the top slide simply loosen cap screws (E) on both sides of the top slide base.

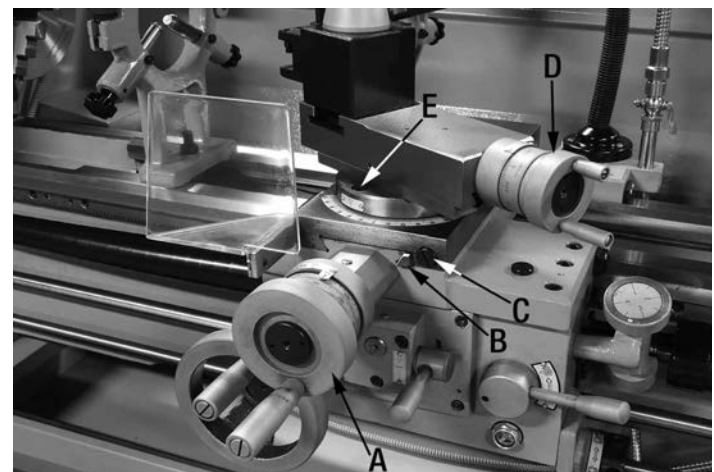


FIGURE 14



ADJUSTMENTS & OPERATION

Feed and Thread Selection

To set the desired feed rate and thread selection, it may be necessary to change the gear configuration, refer to charts in Fig's.3, 4, 5A & 5B. 36 feed speeds are possible in either the longitudinal or cross direction Fig.5A. Once you have determined the job at hand (feed speed and thread), place the selector knobs (A -D) Fig.15 in the appropriate positions.

If you desire Metric Threads, mm change gears must be installed as indicated in chart Fig.4 and as described below.

Change gears

To obtain metric threads the proper change gears must be installed inside the left side cover. Remove the 2 lock nuts which hold the left side cover to the headstock and then remove the side cover.

Before changing gears, determine the threads per mm desired and look at which gear configuration is needed, see chart Fig.4 as reference. The large middle gear (A) Fig.16 is the only gear which does not get interchanged. To replace the top gear (B), remove nut (C) which holds it in place. Replace with appropriate gear and secure with nut. To replace the bottom gear (D), remove gear cap screw (E). Once the change gears are in place, reposition the side cover and lock it using the same lock nuts removed previously.

Automatic Power Feed- Longitudinal or Cross Feed

The power feed lever (A) Fig.17 is used to engage either the longitudinal or cross feed. This lever has a safety interlock to prevent accidental engagement of the half nuts when the lathe is in feed mode. There are 3 positions: the upper position engages the power longitudinal feed, the lower position engages the power cross feed and the center position is the disengaged position.

Make sure the correct gear configuration is set as shown in charts Fig.3, 4, 5A & 5B. Place the feed/thread selector to ANY position and make sure the thread cutting engagement lever (B) Fig.17 is disengaged before operating.

Thread Cutting Operation

In order to obtain the desired thread, all change gears must be installed in accordance to the thread charts. Failure to do so will give incorrect threads.

Move the thread cutting engagement lever (B) Fig.17 downwards, this will make it engage with the leadscrew for longitudinal travel of the carriage. Make sure the power feed lever (A) is disengaged (in neutral position) before operating the thread cutting engagement lever (B).

Note: A safety interlock prevents accidental engagement of the half nuts when the lathe is in feed mode.

Thread Cutting Dial Operation

The thread cutting dial (C) Fig.17 is used to engage the half nuts with the leadscrew in the same thread that has been previously cut.

Note: Use any line of the dial for even pitches of threads, but for odd pitches of threads you must use the same starting line.



FIGURE 15

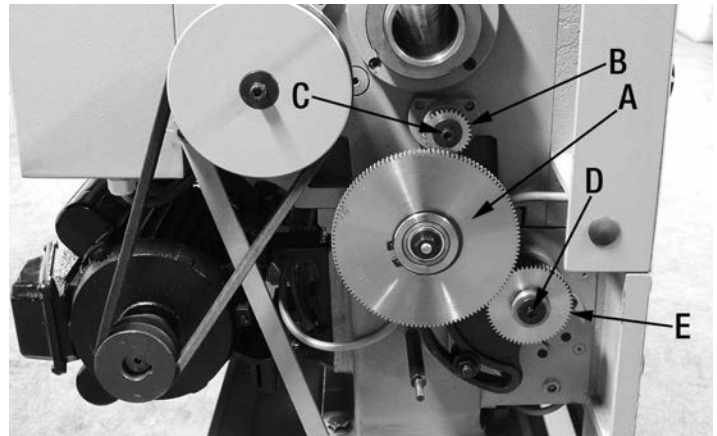


FIGURE 16

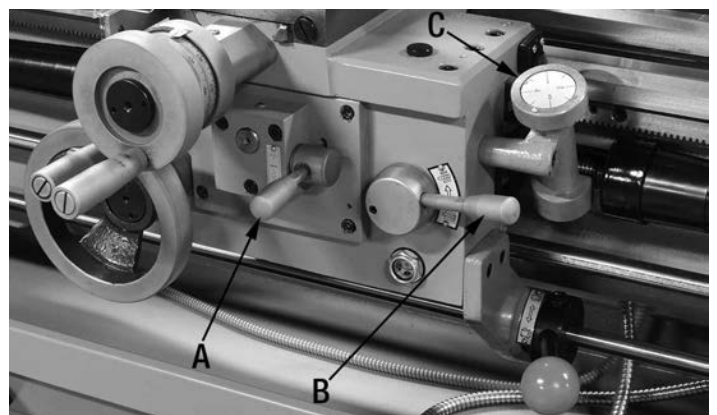


FIGURE 17

Example: When cutting a shaft with 10 TPI, engage the half nuts at any number on the thread dial, when creating an odd pitch, if you start the cut using 1 or a 3, continue to use the 1 or the 3 until the thread is finished. See Fig.7 for thread cutting dial chart.

COOLANT SYSTEM & LUBRICATION POINTS



Coolant System

It is suggested to use the coolant system during operations involving high speed cutting. Excessive heat and damage to your cutting tool will be avoided if the coolant system is on with the spout directed towards the cutting tool and the work area during the cutting operation.

The coolant system operates by recycling the coolant flow from the coolant pump (A) Fig.18 up through the coolant spout (B), then falls into the chip tray and drains back down through the screen to the coolant pump and the cycle is repeated. To fill the system with coolant, simply pour coolant into the chip tray, it will flow down into the coolant bucket. Be careful not to overflow. The amount of flow is controlled by a valve (C) Fig.18 at the base of the coolant spout. For maximum flow, open the valve completely.

Warning! BIOLOGICAL AND POISON HAZARD. Use appropriate personal equipment when handling coolant fluid. Follow fluid manufacturer requirements for handling and disposal.

Warning! Coolant pump damage will result if it is operated for a period of time without coolant in the reservoir.

Lubrication & Lubrication Points

Before operating the metal lathe, check the oil level and lubricate all sliding surfaces such as the bed, half-nut, worm gear, leadscrew, feed rod, handle rod, tailstock quill before and after operating. For best performance, do not leave metal chips and coolant fluid on the bed, wipe down and oil the lathe after use.

Carriage, cross slide and top slide

The carriage oil level should be checked regularly. Change carriage oil after the first 3 months and once every year after. The carriage oil drain plug is found under the carriage, drain oil. Reinstall drain plug. The carriage is filled with 200 ml of SAE-30 motor oil through the filling plug (A) Fig.19 on the top of the carriage. Fill oil until it reaches the 3/4 mark on the oil level indicator (B). Lubricate the ball oilers (C) with regular machine oil, most are shown in Fig.19.

Drive gears, headstock and gearbox

Lubricate the change gears (A) Fig.20 with thick bearing grease once a month.

After running for the first 3 months, change headstock oil. Change oil once a year after first initial oil change. To drain oil from the headstock, remove left end cover, remove oil drain bolt (B) Fig.20 and drain oil. Reinstall drain bolt. Open the top oil plug (C) and fill with 3 Litres of EP68 hydraulic oil.

To drain oil from the gearbox, remove left end cover, remove oil drain bolt (D) Fig.20 and drain oil. Reinstall drain bolt. Remove oil fill bolt (A) Fig.21 and fill with 1 Litre of SAE-30 motor oil until it reaches the 3/4 mark on the oil level indicator (B).

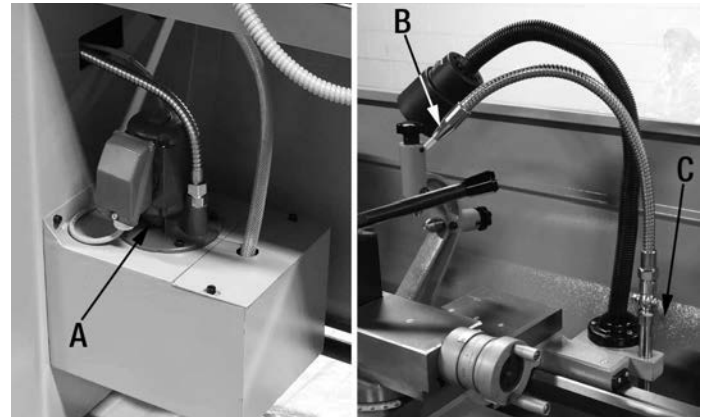


FIGURE 18

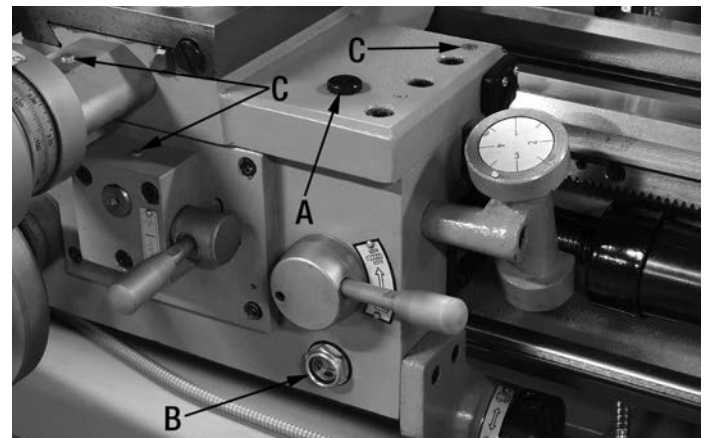


FIGURE 19

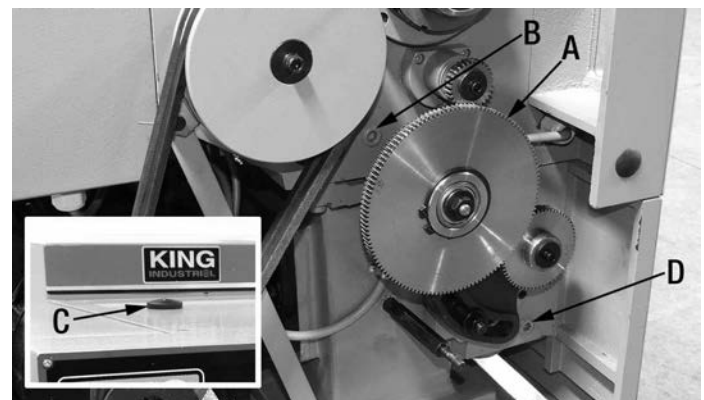


FIGURE 20

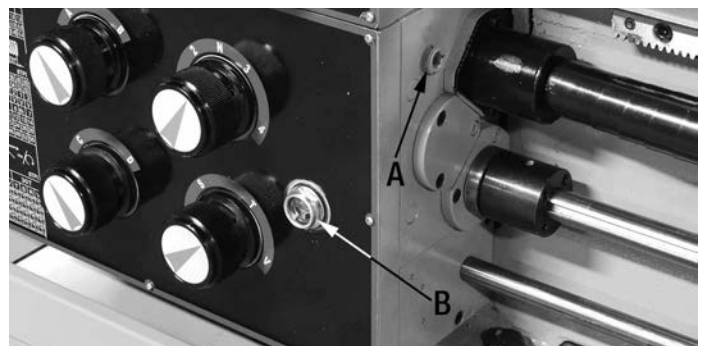


FIGURE 21

Tailstock

Lubricate the tailstock ball oilers (A) Fig.22 with regular machine oil. Oil the tailstock quill (B) weekly with regular machine oil. It is recommended to remove the tailstock monthly to wipe down the bed ways and relubricate.

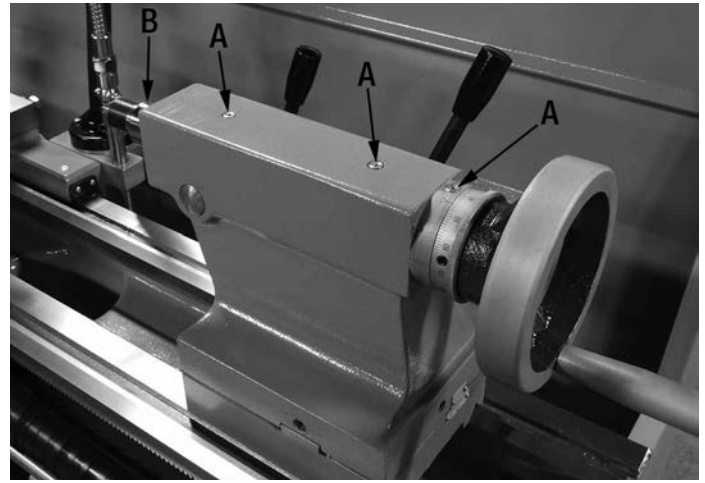


FIGURE 22

Leadscrew, Feed Rod, Switch Control Rod, Rack and Guide ways

Make sure to lubricate the leadscrew (A) Fig.23, feed rod (B) and switch control rod (C) with machine oil. Apply machine oil to the racks (D) and guide ways (E). Make sure they are clean before lubricating. Lubricate the ball oilers (F) with regular machine oil.

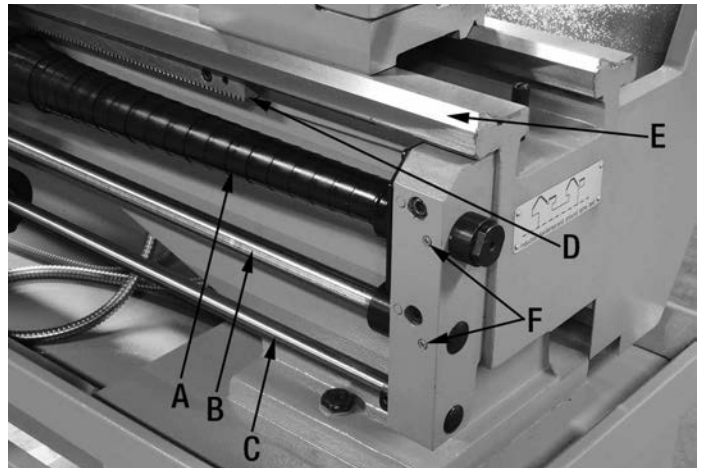


FIGURE 23

Changing/Tensioning V-belts

After 10 hours of operation, it may be necessary to tension the V-belts to compensate for belt stretching and/or wear. If V-belts are damaged they will need to be replaced.

- 1) Remove the side cover.
- 2) Loosen the 4 hex. bolts which secure the motor (A) Fig.24 to the motor bracket. This will allow you to raise the motor to remove tension on the V-belts (B). Raise motor and retighten hex. bolts.
- 3) If the V-belts are damaged, remove them from the pulleys and install new V-belts.
- 4) Loosen the 4 hex. bolts which secure the motor to the motor bracket, and lower motor to tension V-belts. Proper belt tension is achieved when there is approximately 1/2" belt deflection on each belt when pressed firmly in the centre between the pulleys.
- 5) Once properly adjusted, retighten the 4 hex. bolts which secure the motor to the motor bracket and reinstall side cover.

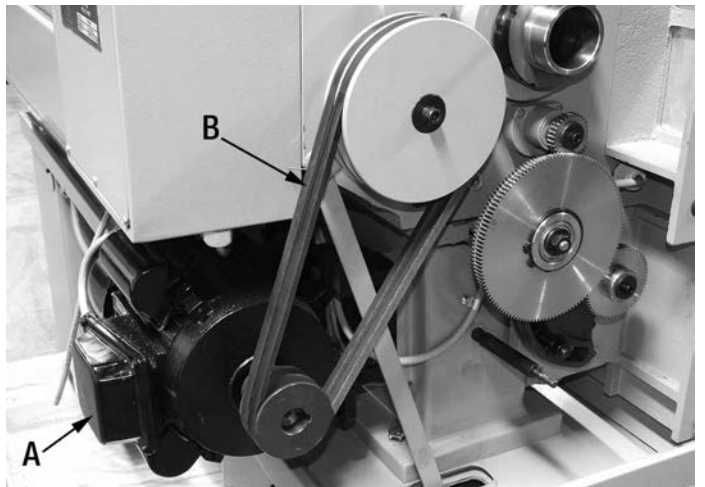


FIGURE 24

PARTS DIAGRAM & PARTS LISTS

Refer to the Parts section of the King Canada web site for the most updated parts diagram and parts list.

LCD

DIGITAL READOUT

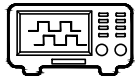
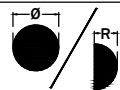
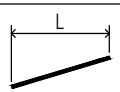
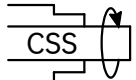
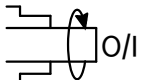


Driven by Innovation

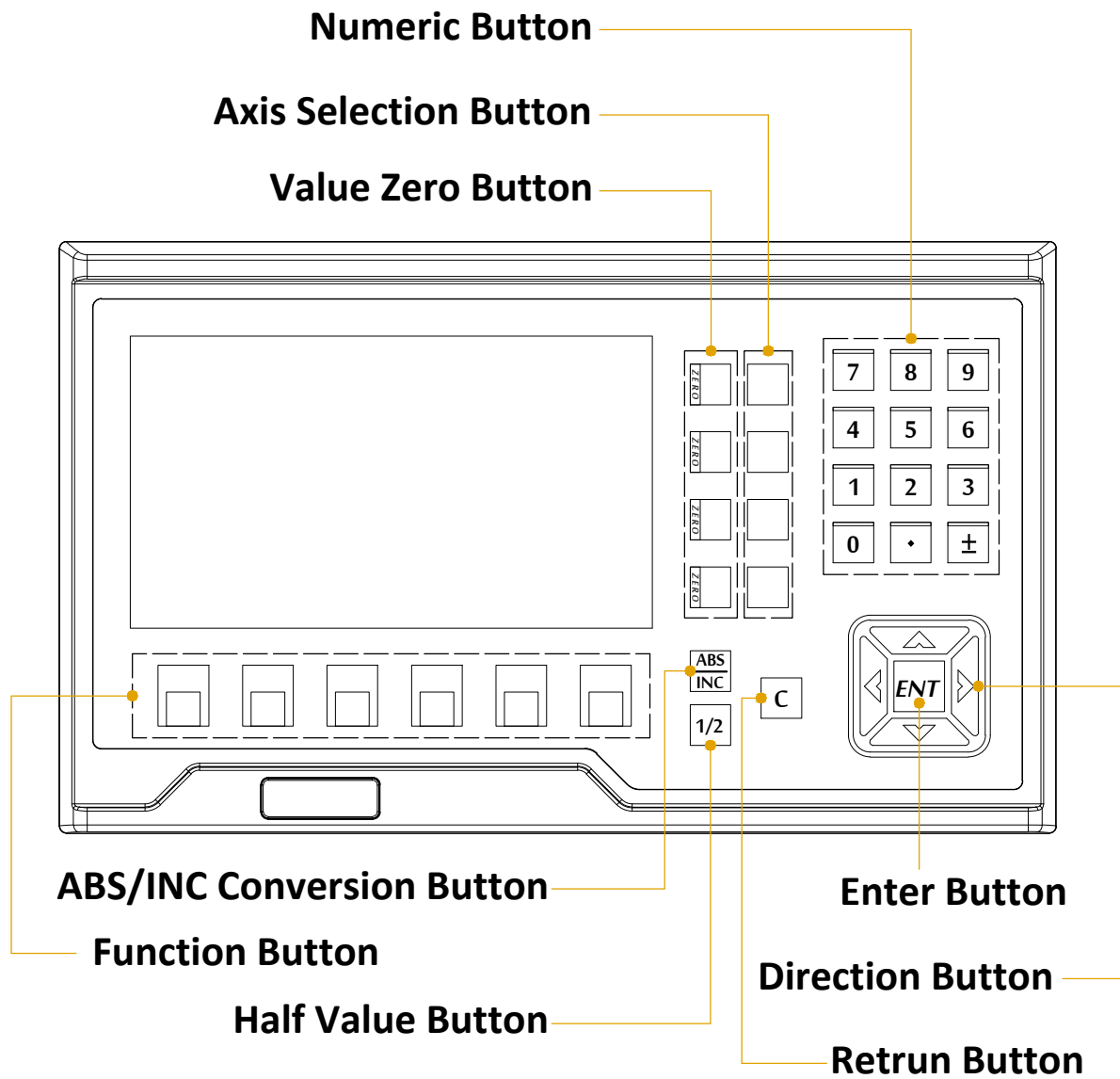
Operation Manual

(Version 5.0)

Softkey Indication

	System Parameter Setting		Bolt Hole Function
ABS INC	ABS/INC Conversion		Grid Hole Function
MM INCH	Metric/Imperial Conversion		Simple R Function
SDM	SDM Coordinate		Smooth R Function
1/2	Value Half		Pocket Function
	Calculator		Probe Measuring
	Axis Summing		Foot Switch Function
	Signal Test		Radius/Diameter Conversion
COMP.	Compensation		Vectoring Function
	REF Function		Taper Measuring
	Help		Tool Offsets Function
	Distance to Go		Relay Output
	Sleep	V₀	Value Zero of V axis
	Set	V	Value Preset of V axis
	Enter		Projected Length Measuring
	Exit		Angle Measuring Function
	Find the edge		Circle Measuring
	Find the center between 2 points		Constant Surface Speed Function
	CSS ON/OFF		

Keypad Layout



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1. System Parameter Setting

1.1 DRO Setting

DRO setting includes:

- Machine Type
- Number of Axis
- Value Recovery
- Feed rate
- Brightness
- Background
- Dynamic Displaying
- Language
- Buzzer



- **Machine Type:**
Press set button to switch.(Milling,Lathe,Grinder,EDM)
- **Number of Axis:**
Press set button to set the number of axis to be displayed.
- **Value Recovery:**
Press set button to enable or disable value recovery.
- **Feed rate:**
Press set button to set the unit to be MM/Sec or MM/Min.
- **Brightness:**
Press set button to adjust the brightness of the screen.
- **Background:**
Press set button to switch background.
- **Dynamic Display:**
Press set button to switch the dynamic displaying.
(Dynamic Preposition or OFF)
- **Language:**
Press set button to switch the language.

1. System Parameter Setting

- **Buzzer:**

Press set button to enable or disable the buzzer.

1.2 Axis Setting

Axis setting includes:

- Axis Selection
- Encoder Selection
- Resolution Setting
- Direction Setting
- Thread Pitch
- Decimal Digits
- Port Mapping

DRO Setting	Axis	: X
Axis Setting	Encoder	: Linear Scale
Axis Summing	Resolution	: 5.0
Data Clear	Direction	: 1
Keypad Test	Thread Pitch	: NA
RPM Setting	Decimal	: 3
	Port Mapping	: 1



- **Axis Selection:**

Press set button to switch the axis which shall be set.

- **Encoder Selection:**

Press set button to switch the encoder type for the corresponding axis.

(1) Linear Scale:

Connect linear scale to measure the linear length.

(2) 1-Rotary Encod:

Connect with rotary encoder to measure the degree, displaying as degree.

(3) 2-Rotary Encod:

Connect with rotary encoder to measure the degree, displaying as degree/minute/second

(4) 3-Rotary Encod:

Connect with rotary encoder, basing the thread pitch, to measure the linear length.

- **Resolution Setting:**

(1) When the encoder type has been set as linear scale.

Here we could switch the resolution to the target one.

(Range: 0.1, 0.2, 0.5, 1.0, 2.0, 2.5, 5.0, 10, 20, 25, 50, 100 μ m)

1. System Parameter Setting

(2) When the encoder type has been set as 1-Rotary Encod, 2-Rotary Encod,3-Rotary Encod,press numerical button or set button to input the corresponding resolution.

- **Decimal Digits:**

Press set button to set the decimal digits under metric mode.

- **Port Mapping:**

Press set button to change the value displaying on another axis
(For example,when the encoder has been connected with X axis port, you could set here to display the value on Y axis).

1.3 Axis Summing

Axis summing includes:

- Axis Selection
- Summing Selection
- Switch ON or OFF



- **Axis Selection:**

Press set button to switch the axis which shall be set.

- **Axis Summing:**

Press set button to select the axis which shall be summed.

- **Switch ON or OFF:**

Press set button to enable or disable.

1.4 Data Clear

Data clear includes:

- SDM Clear,
- Factory Reset



1. System Parameter Setting

- **SDM Clear:**
Clear all memorized SDM coordinates.
- **Factory Reset:**
Clear all data memorized in DRO.

Operation: Select the item, and press the set button.

The DRO will remind if it will carry out the data clear.

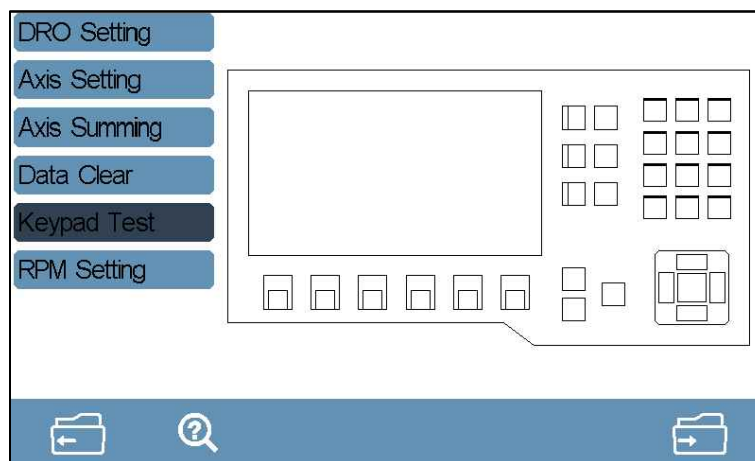
Press YES, then it will go for data clear. Press NO, the DRO will quit clearing.

1.5 Keypad Test

Operation: Once enter this function. Press the mechanical button to test.

If it works well, then the button on screen will change color.

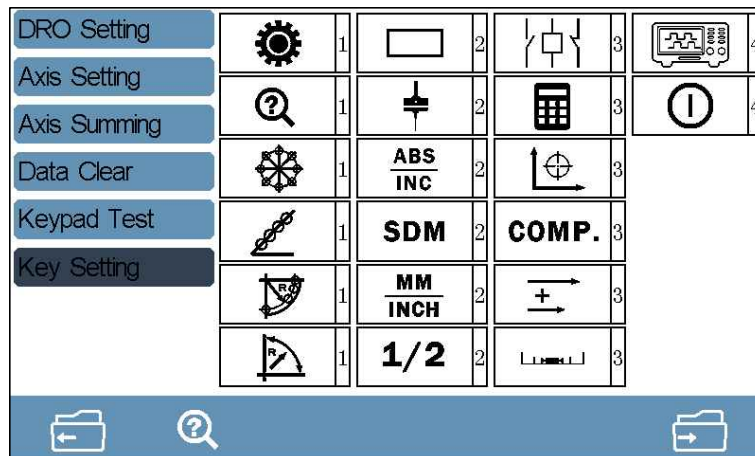
If it gets problem, the button on screen will remain without change.



1.6 Function Key Setting

Operation: Enter the function key setting. Press the direction key to select the function icon. Once selected well, press set button to confirm and direction button to locate the new position of the selected icon. Press set button again to confirm the adjustment.

1. System Parameter Setting



1.7 RPM Setting (Optional)

The sensor for the RPM could be hall sensor or rotary encoder.

RPM setting includes:

- RPM Display
- Sensor Selection
- Setting for resolution of rotary encoder or number of magnets
- Teeth Number of Master Gear
- Teeth Number of Pinion



1. System Parameter Setting

- **RPM Display:**

Press set button to enable or disable the RPM displaying.

- **Sensor Selection:**

Press set button to switch the sensor.(Hall Sensor or Rotary Encoder)

When the sensor has been set as rotary encoder,
press numeric or set button to input the resolution.

When the sensor has been set as hall sensor,
press numeric to input the number of magnets.

- **Teeth Number of Master Gear:**

Press numeric to input the gear number.

- **Teeth Number of Pinion:**

Press numeric to input the gear number.

Detail parameter setting of RPM, please refer appendix 4.3

1.8 Communication (Optional) (RS232 or CSS)

Communication protocol setting includes:1.Function 2.Baud Rate 3.Parity
3.Stop Bits 5.Address

DRO Setting	Function : ON
Axis Setting	Baud Rate : 9600
Axis Summing	Parity : OFF
Data Clear	Stop Bit : 1
Keypad Test	Address : 1
Key Setting	
RPM Setting	
Communication	



1. System Parameter Setting

- **Function :**

Press set button to switch on or off.

- **Baud Rate:**

Press numeric button to input the baud rate.

- **Parity:**

Press set button to select the checking way.

- **Stop Bits:**

Press set button to select the number of stop bit.

- **Address:**

Press numeric key to input the communication address.

For details of RS232 communication protocol, please refer appendix 4.5

2. Fundamental Function

2.1 Zero,Value Recovery

- **Zero**

Pressing the zero button,operator could zero the value on windows.

- **Value Recovery**

When the value displayed on windows has been zeroed wrongly, pressing zero button again could get back the former value.

Note: When the zero function has been switched off in DRO Setting, the value could not be get back.

2.2 Imperial and Metric Conversion

Press the MM/INCH button to switch the displaying under imperial or metric unit.

2.3 Coordinate Inputting

Press the axis button,and press the numeric button to input the value. Once input,press ENT to confirm.

2.4 1/2 Function

Press the axis button and 1/2 button to half the value for corresponding axis.

2.5 ABS and INC Conversion

The DRO gets two sets of standard coordinate system,namely ABS(Absolute) and INC (Relative) Coordinate.

User could set the zero point of work-piece in ABS coordinate,then switch to INC coordinate for machining.Zeroing at any position in INC coordinate would not affect the length value from zero point to current point in ABS coordinate The process in ABS would change according to the machining status.

User could switch the coordinate back to ABS for checking.

Press ABS/INC button to switch.

2. Fundamental Function

2.6 Power-off Memory

In case of sudden power off during the machining process, the DRO gets the data memorize function. Once the power on, the data before power off will recover automatically.

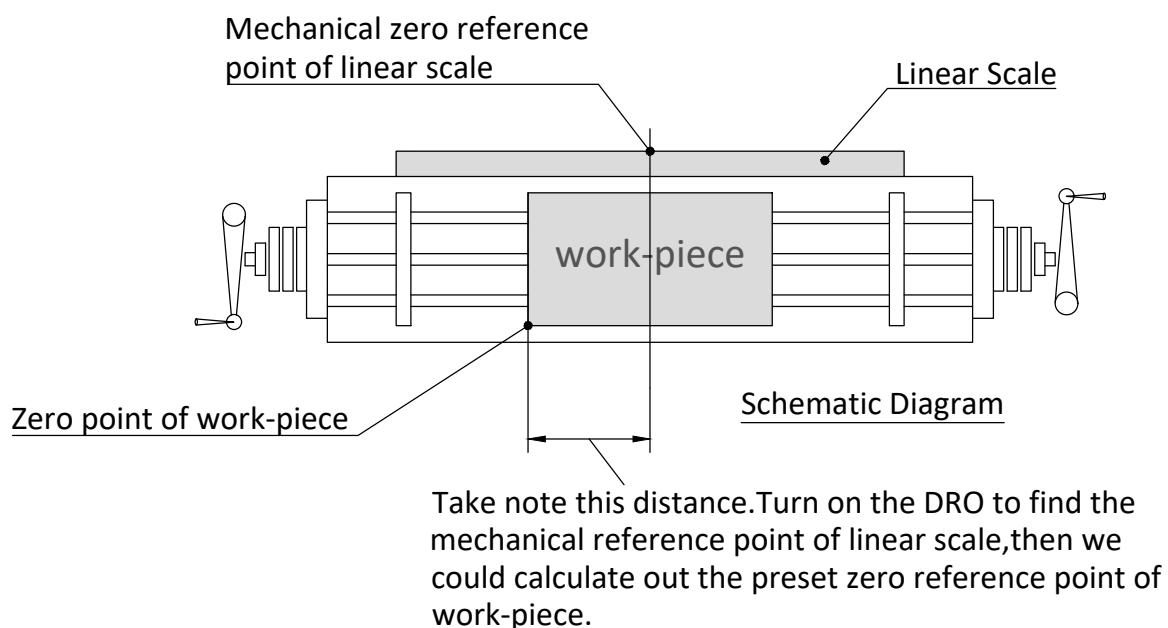
2.7 REF Function

In daily machining, operator may encounter power failure.

If losing the zero point of the work-piece, we have to retrieve the zero point again.

For the convenience to retrieve the zero point, the DRO could memorize the mechanical zero reference point of linear scale.

This enable the users to retrieve the zero point of work-piece quickly.



Note: To use the REF function, we need to set the mechanical zero reference point of linear scale in DRO. In this way, the DRO could memorize the zero point of work-piece. For the following zeroing, centre and value input for re-locate the zero point of work-piece under ABS model, the DRO will memorize the distance between new zero point of work-piece and mechanical zero reference point of linear scale. Once the mechanical reference point of linear scale has been set well, operator could retrieve the zero point of work-piece very quickly.

2. Fundamental Function

While DRO is powered on,
press the REF function button.
In the function interface, select
the target item for parameter
setting by pressing up and
down direction button.

REF Function

Axis : X

Function : Set Ref. Point

Hint : OFF

X -0.4

Y -3.56

Z 3.486

- **Axis:**
Press set button to select the corresponding axis for setting.
- **Function:**
press set button to switch the function to set the reference point or find reference point.
- **Hint:**
Press SET button to enable or disable the REF reminding function.

Set the Reference Point Steps:

Step 1: Press the set button to select the axis which shall be set.

Step 2: Press down direction button to switch to function setting, and press set button to set the function to find the reference point. Press ENT button to enter next interface, then traverse the linear scale to find the reference point. Once the point has been found, the DRO will remind with the messages of found the reference point.

At this moment,the reference point setting of this axis is completed.

Retrieve the Zero Point of Work-piece:

Step 1: Take note of X,Y and Z axis under ABS model once the DRO self-checking process completed.

Step 2: Enter the REF function,select the axis which shall be set,then press down direction button for function setting.

Set the function to find the reference point.

Then press the ENT button to enter the finding interface.

Traverse the linear scale. Once the reference point has been found.

2. Fundamental Function

The DRO will remind with the message of found of reference point.
At this moment,the reference point of this axis has been found successfully.

Step 3: Traverse the linear scale of this axis to be the value which we took note.At this time,this point is the one we stopped for last machining.

Note: Only operator has set the reference point for each axis before machining,then the zero point of work-piece could be get back.

Note: REF Reminding only applies with the scale which only has one reference point.

2.8 200 sets of SDM Coordinates

DRO provides ABS and INC coordinate.

But sometimes it is not enough for daily machining.

This DRO provides 200 groups of SDM auxiliary coordinate to compensate the shortage of ABS and INC function.

But SDM is not just a simple additional INC coordinate.

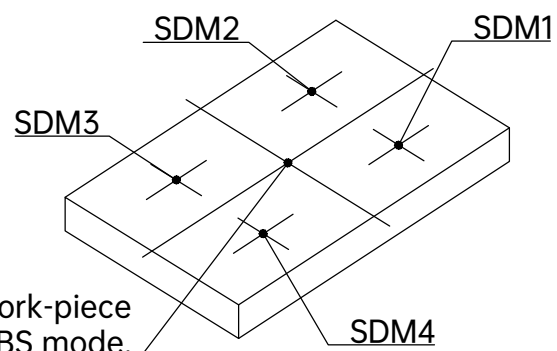
The below is the difference between ABS/INC and SDM.

- INC is completely independent.No matter how zero point in ABS changed,the zero point in INC will not change.But the zero point of SDM is basing on ABS.When the zero point in ABS changed,all coordinate in SDM will change accordingly.
- The distance between SDM and ABS coordinate could be input directly.

Applications for SDM Coordinates:

Operator could memorize the machining points of work-piece in SDM coordinates.

Press up or down direction button to switch.



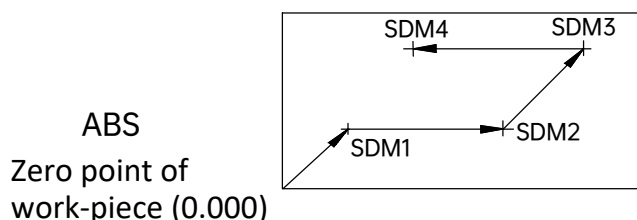
2. Fundamental Function

SDM application during medium or small batch machining:

SDM function could memorize a batch of working point.

User could input these working points when machining the first work-piece.

Then adjust the zero point in ABS mode for machining the following work-pieces. The SDM coordinate is basing the zero point in ABS mode.



When the DRO is under SDM mode, press SDM button to input the SDM coordinate, or press up and down direction button to switch the coordinate. Traverse the linear scale until the value on each axis become 0. At this moment, this point is the machining point.

2.9 Compensation Function

Compensation function enable operator input the linear compensation, non-linear and backlash compensation value to improve the machining accuracy.

Press compensation function button to enter the interface.

Press the up or down direction button to select the item for setting.

Compensation Function	
Axis : X	
Comp. Type : Linear	
Backlash : NA	
Actual Length : 0.000	
Comp. Value : 0.000	
	X 0.000
	Y 0.000
	Z 0.000

Navigation icons: Back, Search, Settings

2. Fundamental Function

1. Linear Compensation

- **Axis:**
Select the axis for setting.
- **Comp. Type:**
Select the compensation type(Linear or Non-linear)
- **Backlash:**
Only the encoder type has been set as 3-Rotary Encod,there could be set.
- **Actual Length:**
Press numeric button to input the actual moving length of table.
This length value is getting from more accurate measuring instrument than linear scale.
- **Comp. Value:**
Press numeric button to input the compensation value.

Note: Formula for compensated value:

Compensation Value =

(Actual length-DRO Displayed length) / (Actual Length/1000)mm/m

Compensation range: -1.9mm/m to +1.9mm/m

Take X axis as an example (same operation to other axis)

Move the table of X axis direction for 1000.000mm of actual moving length.The displayed value on DRO is 999.880mm.

The calculation of compensation value is like the below:

Compensation Value=(1000.000-999.880)/(1000.000/1000.000)=0.120

Step 1: Confirm the starting point

Zero the value of X axis,press the COMP button to enter the function.

Then set the axis to be X.

Step 2: Select the compensation type

Press down direction button to switch the compensation type setting and select it as Linear Compensation.

2. Fundamental Function

Step 3: Input the compensation value

Move the table of X axis direction to be exact 1000mm

(basing other more accurate measuring instrument).

Then press the up or down direction button to select the actual measuring length, and input 1000.

Or select the compensation value to input 0.120.

Note: When selecting to input the actual measuring length. We need zero the value of corresponding axis first. Otherwise the compensation value will be calculated wrongly.

2. Non-linear compensation

- **Axis:**

Select the axis for setting.

- **Comp. Type:**

Select the compensation type (Linear or Non-linear)

- **Backlash:**

Only the encoder type has been set as 3-Rotary Encod, there could be set.

- **Comp. Segment:**

Press the numeric button to input the compensation segments.

The maximum could be 100.

Compensation Function	
Axis : X	
Comp. Type : Non-linear	
Backlash : NA	
Comp. Segment : 10	
Comp. Length : 50.000	
Start Point : Endpoint	
	X 0.000
	Y 0.000
	Z 0.000



2. Fundamental Function

- **Comp. Length:**

Press numeric button to input the actual length of every segment.

This length should be get from more accurate measuring instrument.

- **Start Point:**

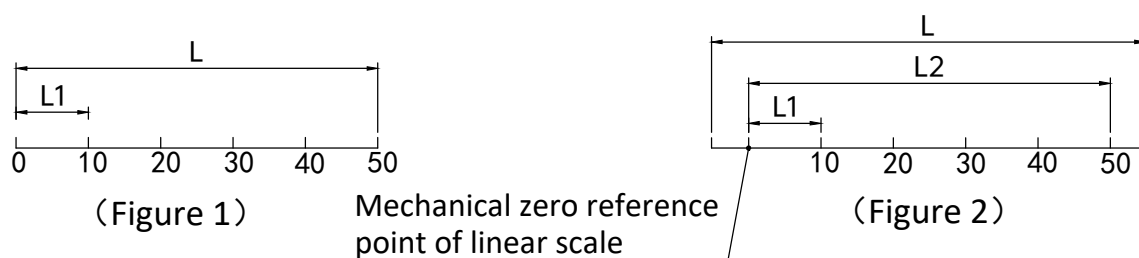
Press set button to select the start point.

(Endpoint or mechanical reference point of linear scale)

Non-linear compensation function takes the mechanical reference point or endpoint of linear scale as the starting point. The DRO will compensate the displayed value according the input err list. Please note Linear compensation and Non-linear compensation function could not be used at the same time.

The DRO gets two ways for non-linear compensation:

1. Take the linear scale end point as the starting point for compensation.
(Figure 1)
2. Take the first mechanical zero reference point of linear scale as the starting point for compensation.(Figure 2)



Take X axis setting as an example (same operation to other axis)

Step 1: Press the COMP. Button to enter the compensation function,
and select the axis as X.

Step 2: Select the compensation type to be Non-linear.

Step 3: Input the the Compensation segments as 6.

Step 4: Input the compensation length for every segment as 10.000

2. Fundamental Function

Step 5: Select the starting point as the endpoint of linear scale.

And press ENT to go for next

Step 6: Move the table of X axis direction to one of the endpoint,
and press ENT to confirm the point.

(When the start point has been set as mechanical reference point of linear scale,once the point has been captured,the DRO will enter next step automatically).

Step 7: Using other more accurate measuring instruments as reference to move the table to be the value as input in compensation length which is 10.000,and press ENT to confirm.

Step 8: Repeat the operation of step 7 to complete all segments.Once the compensation finished,the DRO will exit compensation automatically.

Note: When the start point has been set as endpoint,the data in REF function will be cleared.Only the start point has been set as mechanical reference point,the REF and non-linear compensation could be used together.

3. Backlash Compensation

This setting could be set with the condition of encoder has been set 3-Rotary Encod.Press the numeric button to input the compensation

2.10 Calculator

Press the calculator button to enter the function.Once the calculation finished,operator could press axis button to transfer the value from calculator to axis.Press zero key,operator could transfer the value from axis to calculator.

Calculator	
	0.000
X	0.000
Y	0.000
Z	0.000
◀ RESET + - × ÷ = ▶	

•Press zero key to transfer the value on axis to calculator

•Press axis key to transfer the value on calculator to axis

3. Special Function

3.1 Grid Hole Function

This function is for drilling equal hole on vertical and horizontal direction.

Once operator input the required parameter, the DRO will calculate the position of each hole, and set the coordinate of each hole to be (0.000,0.000).

Operator could move the table to the target position for machining the hole.

There are two ways for grid hole function:

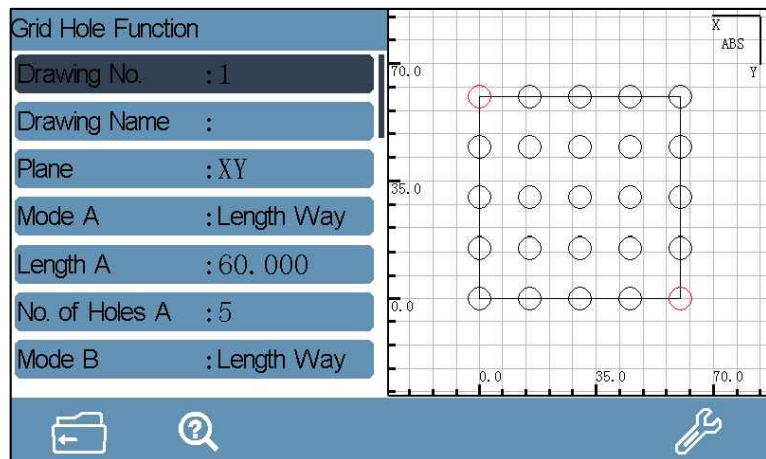
1. Length way:

Input the total length of the line

2. Step way:

Input the length between two holes

Press the grid hole function button to enter the interface. Press up and down direction button to select the parameter for setting.



- **Drawing No.:**
DRO could memorize 4 sets of drawing. Press set button to switch.
- **Drawing Name:**
Press set button to input the drawing name. Press ENT to confirm.
- **Plane:**
Select the plane for machining. 2 axis DRO only gets XY plane.
For DRO with 3 or more axis, it could be switch among XY,XZ,YZ.
- **Mode A:**
Press set button to set the mode to be Length or Step way for horizontal direction.
- **Length A:**
Press numeric button to input the length of horizontal direction.

3. Special Function

- **No. Of Holes A:**
Press numeric button to input the hole number of horizontal direction.
- **Mode B:**
Press set button to set the mode to be Length or Step way for Vertical direction.
- **Length B:**
Press numeric button to input the length of Vertical direction.
- **No. Of Holes B:**
Press numeric button to input the hole number of Vertical direction.
- **Rotate Angle:**
Press numeric button to input the rotated angle of drawing.

Once the parameter has been set, press ENT to enter the machining interface.
Press right or left button to switch the hole.

3.2 Bolt Hole Function

This function is for drilling equal hole on a circle. Once operator input the required parameter, the DRO will calculate the position of each hole, and set the coordinate of each hole to be (0.000,0.000). Operator could move the table to the target position for machining the hole.

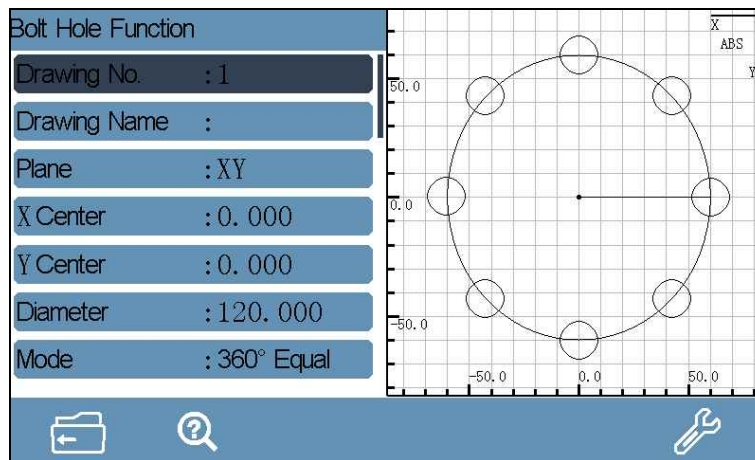
There are 3 ways for bolt hole function.

1. **360°Equal:**
Drilling equal holes on a circle.
2. **Equal Angle:**
Drilling holes with same angle between two holes.
3. **Rand. Angle:**
Drilling equal holes on any random angle.

3. Special Function

Press bolt hole function button to enter the interface.

Press up and down direction button to select the parameter for setting.



- **Drawing No.:**
DRO could memorize 4 sets of drawing. Press set button to switch.
- **Drawing Name:**
Press set button to input the drawing name. Press ENT to confirm.
- **Plane:**
Select the plane for machining. 2 axis DRO only gets XY plane.
For DRO with 3 or more axis, it could be switch among XY, XZ, YZ.
- **X Center:**
Press the numeric button to input the circle center of X axis.
- **Y Center:**
Press the numeric button to input the circle center of Y axis.
- **Diameter:**
Press numeric button to input the diameter.
- **Mode:**
Press set button to switch the machining mode among 360°Equal, Equal Angle and Rand. Angle.
- **Start Angle:**
Press numeric button to input the starting angle.
- **End Angle:**
Press numeric button to input the end angle.

3. Special Function

- **No. Of Holes:**

Press numeric button to input the hole number.

Once the parameter has been set, press ENT to enter the machining interface.
Press right or left button to switch the hole.

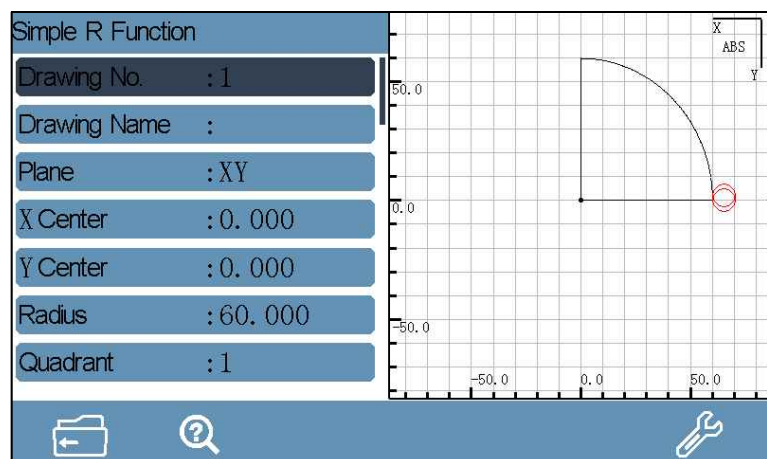
3.3 Simple R Function

This function is for machining 90° arc. Once operator input the required parameter, the DRO will calculate the position of each machining point, and set the coordinate of each machining point to be (0.000,0.000).

Operator could move the table to the target position for machining the machining point.

Press Simple R function button to enter the interface.

Press up and down direction button to select the parameter for setting.



- **Drawing No.:**

DRO could memorize 4 sets of drawing. Press set button to switch.

- **Drawing Name:**

Press set button to input the drawing name. Press ENT to confirm.

- **Plane:**

Select the plane for machining. 2 axis DRO only gets XY plane.

For DRO with 3 or more axis, it could be switch among XY, XZ, YZ.

- **X Center:**

Press the numeric button to input the circle center of X axis.

- **Y Center:**

Press the numeric button to input the circle center of Y axis.

3. Special Function

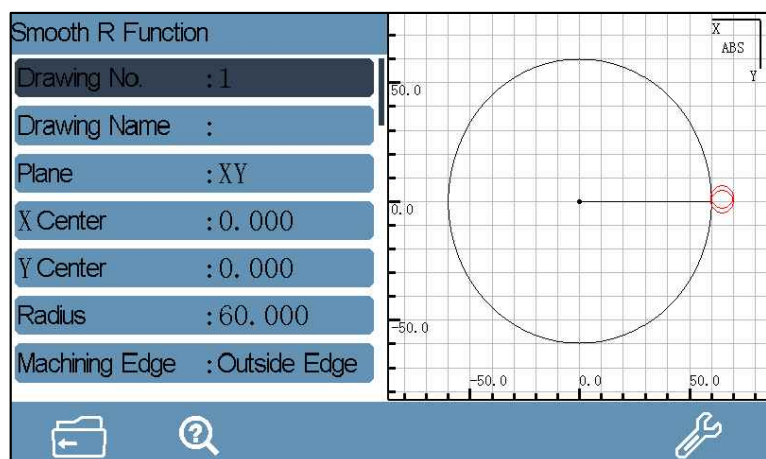
- **Radius:**
Press numeric button to input the radius.
- **Quadrant:**
Press set button to set the quadrant which the arc will be machined.
- **Machining Edge:**
Press the set button to set the edge. When the plane is not in XY plane.
The edge is determined by the set quadrant.
- **Direction:**
Press set button to set the machining direction.
- **Max-Cutting:**
Press numeric button to input the maximum cutting amount.
- **Tool Diameter:**
Press numeric button to input the tool diameter.

Once the parameter has been set, press ENT to enter the machining interface.
Press right or left button to switch the machining point.

3.4 Smooth R Function

This function is for machining any angle arc. Once operator input the required parameter, the DRO will calculate the position of each machining point, and set the coordinate of each machining point to be (0.000, 0.000). Operator could move the table to the target position for machining the machining point.

Press Smooth R function
button to enter the interface.
Press up and down direction
button to select the parameter
for setting.



3. Special Function

- **Drawing No.:**
DRO could memorize 4 sets of drawing. Press set button to switch.
- **Drawing Name:**
Press set button to input the drawing name. Press ENT to confirm.
- **Plane:**
Select the plane for machining. 2 axis DRO only gets XY plane.
For DRO with 3 or more axis,it could be switch among XY,XZ,YZ.
- **X Center:**
Press the numeric button to input the circle center of X axis.
- **Y Center:**
Press the numeric button to input the circle center of Y axis.
- **Radius:**
Press numeric button to input the radius.
- **Machining Edge:**
Press the set button to set the edge.
- **Start Angle:**
Press numeric button to input the starting angle.
- **End Angle:**
Press numeric button to input the end angle.
- **Max-Cutting:**
Press numeric button to input the maximum cutting amount.
- **Tool Diameter:**
Press numeric button to input the tool diameter.

Once the parameter has been set,press ENT to enter the machining interface.
Press right or left button to switch the machining point.

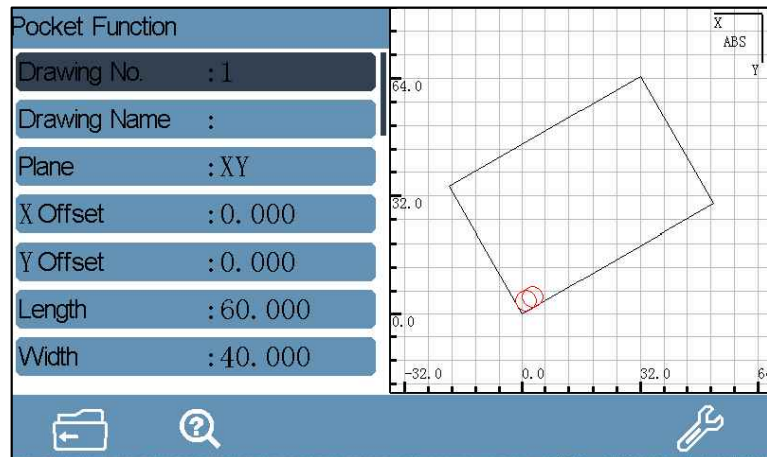
3. Special Function

3.5 Pocket Function

This function is for machining rectangular. Once operator input the required parameter, the DRO will calculate the position of each machining point, and set the coordinate of each machining point to be (0.000,0.000). Operator could move the table to the target position for machining the machining point.

Press Pocket function button to enter the interface.

Press up and down direction button to select the parameter for setting.



- **Drawing No.:**
DRO could memorize 4 sets of drawing. Press set button to switch.
- **Drawing Name:**
Press set button to input the drawing name. Press ENT to confirm.
- **Plane:**
Select the plane for machining. 2 axis DRO only gets XY plane.
For DRO with 3 or more axis, it could be switch among XY, XZ, YZ.
- **X Offset:**
Press numeric button to input the value of X axis.
This value is basing the zero point of work-piece.
- **Y Offset:**
Press numeric button to input the value of Y axis.
This value is basing the zero point of work-piece.
- **Length:**
Press numeric button to input the length of rectangle.
- **Width:**
Press numeric button to input the width of rectangle.

3. Special Function

- **Machining Edge:**

Press the set button to set the edge.

- **Rotate Angle:**

Press numeric button to input the rotated angle of drawing.

Once the parameter has been set, press ENT to enter the machining interface.
Press right or left button to switch the machining point.

3.6 Probe Measuring

This function is for measuring the work-piece during or after machining.
There are two modes for measuring.

1. **NO Probe:**

Take other tools like end mill or edge finder to locate the coordinate manually.

2. **With Probe: (Optional)**

Connect with 3D touch probe to locate the coordinate automatically.

This function provides 5 measuring method to get different measuring value.

1. **Find the edge:**

To find the edge of the workpiece.

2. **Find the center between 2 points:**

To find the center point between any two points.

3. **Circle Measuring:**

To measure the center, radius, diameter of a circle.

4. **Projected Length Measuring:**

To measure the projected length for each axis.

5. **Intersection Angle Measuring:**

To measure the intersection angle of two lines.

Press Probe Measuring function button to enter the interface.

Press up and down direction button to select the parameter for setting.

3. Special Function

With
Probe
Mode

Probe Measuring	
Measure Mode : With Probe	
Probe : 1	
Probe Diameter : 2.000	
Deflect Comp. : 0.010	
X	27.685
Y	-90.540
Z	88.550

NO
Probe
Mode

Probe Measuring	
Measure Mode : NO Probe	
Probe Diameter : 0.000	
X	0.000
Y	0.000
Z	0.000

- **Measuring Mode:**

Press set button to set the mode.(Only the DRO gets the With Probe mode,this item could be set)

When the mode set as NO Probe.

- **Probe Diameter:**

Press the numeric button to input the diameter of end mill or edge finder.

When the mode set as With Probe.

- **Probe:**

Press the numeric button to select the probe.

- **Probe Diameter:**

Press numeric button to input the diameter.

- **Deflect Comp.:**

Press numeric button to input the deflection compensation value.

3. Special Function

- **RS232: (Optional)**

Press SET button to enable or disable the data transmission which captured by touch probe.

Once the parameter set well, press the measuring method button to enter the measuring interface.

When the mode set as NO Probe, operator could move the table to locate the coordinate manually, and then press ENT to confirm every point.

When the mode set as With Probe, operator could move the table, once the 3D touch probe come in contact with the work-piece. The DRO will locate the coordinate automatically. Operator could press ENT to confirm this point or press C to cancel this point.

Once the required point has been all captured, the DRO will calculate the value automatically.

Get to the center point of the circle : Once the circle measuring finished, operator could press the center point button and traverse the table to get to the center point of the circle. When the value of X and Y axis be (0.0), this coordinate is the center point of the circle.

Find the edge : Press the function button, then select the corresponding axis to proceed the edge finding.

Find the center between 2 points : Press the function button, then select the corresponding axis to proceed.

Detail Parameter setting of touch probe, please refer appendix 4.4

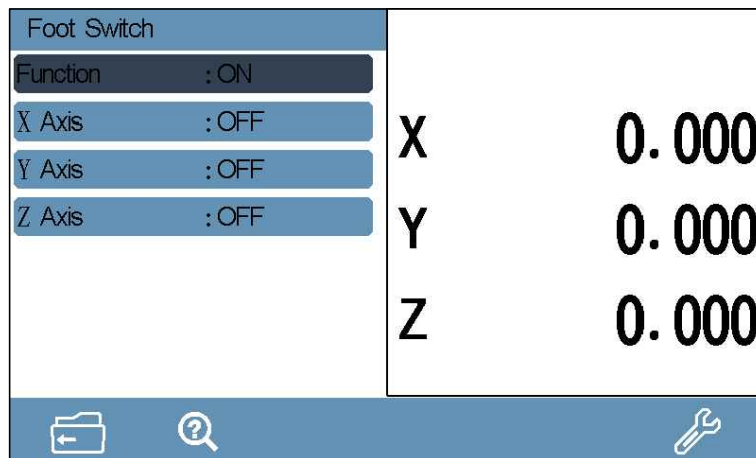
3. Special Function

3.7 Foot Switch Function(Optional)

Function introduction:

The DRO enable operator zero the value of any axis or all the axis with the conjunction usage of foot switch.

When the DRO is in the interface of any function which involves the point machining, with the foot switch, operator could switch to the next or previous machining point very quickly. Press the foot switch function button to enter the interface, press the up or down direction button to select the item to set.



- **Function ON/OFF:**

Press the set button to enable or disable the function.

When the function is enabled, operator could switch to the next machining point by a quick step on foot switch, or get back to the previous machining point by long step on foot switch when the DRO is under the interface of function which involves the point machining.

- **X Axis Zero:**

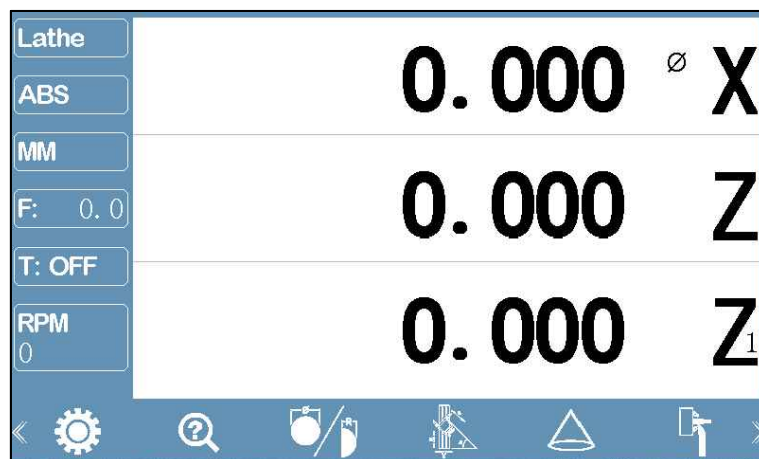
Press the set button to enable or disable the value zero function of this axis.(Same operation to other axis)

3. Special Function

3.8 Radius and Diameter Conversion

This function enable operator switch between radius and diameter.
when the DRO has been set lathe mode.

Press the radius and diameter conversion button to switch. Once the diameter activated ,the X axis will display a icon of diameter.



3.9 Vectoring Function

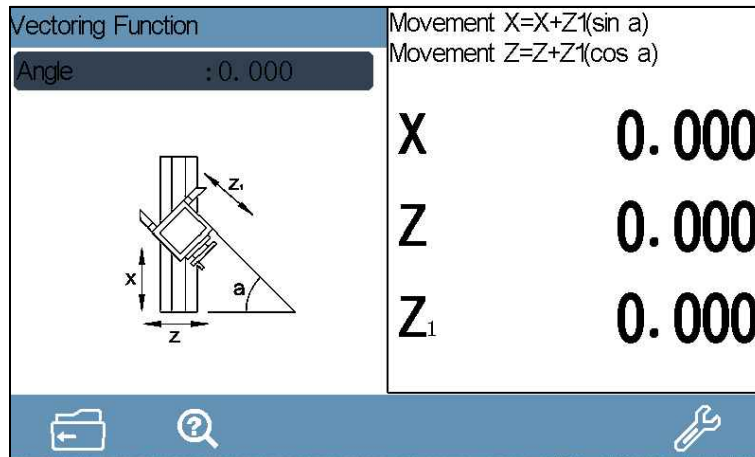
This function is for turning taper. Once operator input the required parameter, the DRO will calculate the position of each machining point, and set the coordinate of each machining point to be (0.000,0.000).

Operator could move the table to the target position for machining the machining point.

3. Special Function

Press vectoring function button to enter the interface.

Press up and down direction button to select the parameter for setting.



- **Angle:**

Press the numeric button to input the angle.

Once the angle has been input, move the table of Z1 direction.

The DRO will calculate the movement value of X and Z axis.

Movement $X=X+Z1(\sin \alpha)$

Movement $Z=Z+Z1(\cos \alpha)$

3.10 Taper Measuring Function

This function is for measuring the taper of work-piece.

Press the taper measuring function button to enter.

Operation:

Once the dial indicator set well. Move the table until the indicator come in contact with the surface of work-piece. Take note of the current value, and press ENT to confirm the current coordinate. Move the table again to locate another point until the value is same with the former one. Press ENT to confirm. At this moment, the DRO will calculate the taper and angle automatically.

3. Special Function

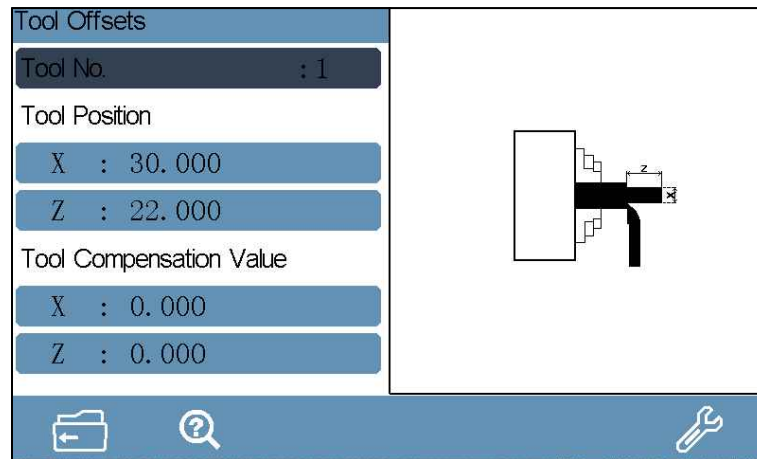
3.11 Tool Offsets Function

This function is for memorizing the position of different tools.

Once the required parameter set well, the DRO will calculate and memorize the coordinate.

Switch the coordinate mode to be INC. Press the tool offsets function button.

Press up and down direction button to select the parameter for setting.



Tool No.: Press numeric button to switch the tool number. (Maximum 48 sets)

Setting when the tool No. is OFF:

Base Tool: Press numeric button or right and left button to change the base tool. (Maximum 48 sets)

Setting when the tool No. is ON:

Tool Position

X: coordinate value for X axis

Z: coordinate value for Z axis

Tool Compensation Value

X: Compensation value for X axis

Z: Compensation value for Z axis

Select the item and press the numeric button to input the corresponding parameter.

3. Special Function

- **Operation of tool clamping for the first time:**

Clamp a tool and switch the coordinate system to be INC.

Then start the machining. Once the machining is completed, measure the length of X and Z axis direction. Then enter the tool offsets function and set this tool as No.1, input the length value into the tool position.

At this time the first tool has been set. Same operation to the rest tool.

- **Operation for adding or changing a tool:**

Switch the coordinate system to be INC and select a tool which has been set. Then enter the tool offsets function. Set the base tool and Tool No. to the current tool. Once set well, get back to INC interface to machine a end face of X axis and zero the value of Z axis. Then machine a certain length of Z axis and measure the length of X axis. Input this length value into X axis. Switch the tool to be the one which will be added or changed, and start the machine again in X and Z axis. Once machined well, measure the length of X and Z axis. Then enter the tool offsets function, and select the tool No. which will be changed or added, input the value into X and Z axis which just measured.

3.12 Relay output (Optional)

The relay will output an ON or OFF signal when reaching the preset value to control the external equipment.

Relay Output	
Drawing No.	: 3
Drawing Name	:
Axis	: X
Exit mode	: Deferred Exit
Output Mode	: 0
Deferred Time	: 0 Second
I. Depth	: 10.000

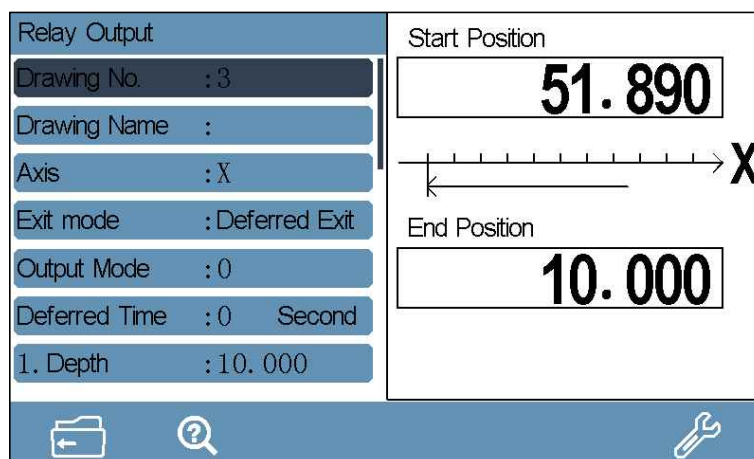
Start Position

51.890

End Position

10.000

X

The image shows a 'Relay Output' screen from a CNC control system. On the left, there is a list of parameters: Drawing No. (3), Drawing Name (empty), Axis (X), Exit mode (Deferred Exit), Output Mode (0), Deferred Time (0 Second), and I. Depth (10.000). On the right, there is a 'Start Position' field showing 51.890 and an 'End Position' field showing 10.000. Below these fields is a horizontal scale with a vertical line at the start position and an arrow pointing to the end position, labeled 'X'. At the bottom of the screen, there are three icons: a folder, a magnifying glass, and a wrench.

3. Special Function

Press Relay output function button to enter the interface.

Press up and down direction button to select the parameter for setting.

- **Drawing No.:**

DRO could memorize 4 sets of drawing. Press set button to switch.

- **Drawing Name:**

Press set button to input the drawing name. Press ENT to confirm.

- **Axis:**

Press the set button to select the axis.

- **Exit Mode:**

Press set button to set.

1. Deferred Exit: Once the machining completed, the machining will exit according to the deferred time which has been set.
2. Manual Exit: Once the machining completed, the machining will exit manually by operator.

- **Output Mode:**

Press set button to set the mode. (0 or 1)

Mode 0:

- a. When power off, the relay coil is OFF.
- b. When the CPU is not initialized, the relay coil is OFF.
- c. When output 1 under normal status after the DRO power on, the relay coil is ON.
- d. When output 1 once the relay output function has been activated, the relay coil is ON.
- e. When output 0 once the target height has been reached, the relay coil is OFF.

Mode 1:

- a. When power off, the relay coil is OFF.
- b. When the CPU is not initialized, the relay coil is OFF.
- c. When output 0 under normal status after the DRO power on, the relay coil is OFF.

3. Special Function

- d. When output 1 once the EDM function has been activated, the relay coil is ON.
- e. When output 0 once the target height has been reached, the relay coil is OFF.

- **Deferred Time:**

Press numeric button to set the time. This only could be set when the exit mode has been set as deferred exit.

- **Depth:**

Press numeric button to input the depth.

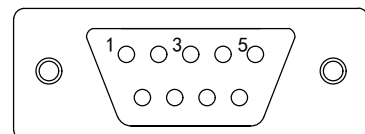
Press ENT button to enter the machining interface once the parameter has been set well.

Output Port :

Parameter:

1.0A 30VC / 0.5A 125VAC / 0.3A60VDC

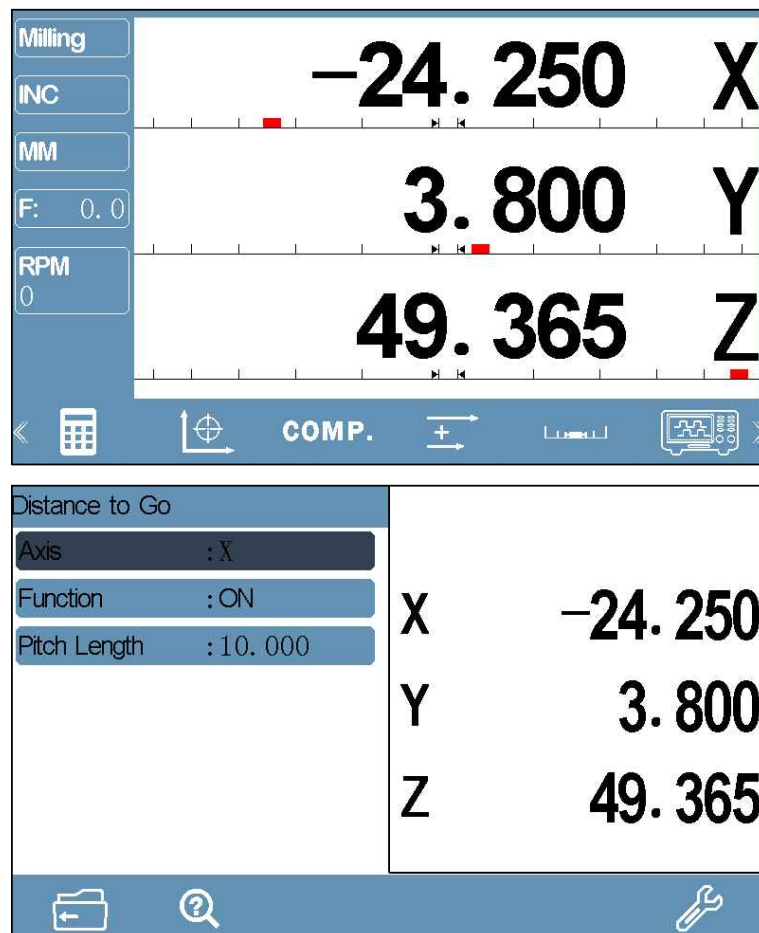
DB9 Pin	Signal Type	Pin Color
1	OFF	Black
3	COM	Yellow
5	NO	Red



3. Special Function

3.13 Distance to Go

When the DRO is under INC or SDM mode, it provides a dynamic graphic for displaying the current position of tool. The small square in the scale which is under the window's value represents the tool. This function could help the operator locate the tool once the requested parameter has been set well.



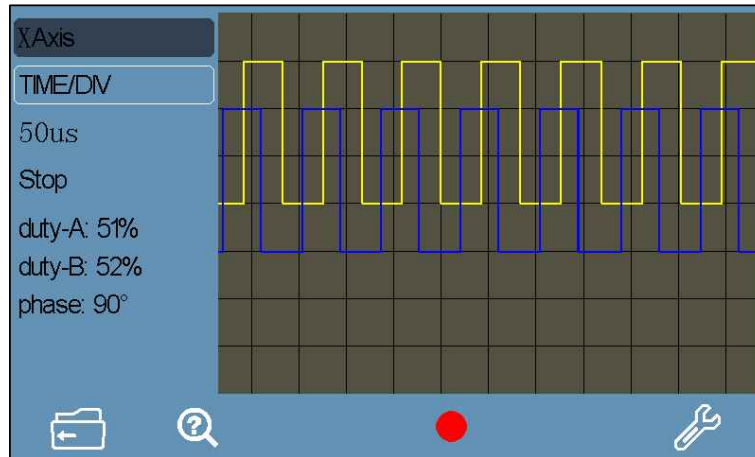
- **Axis:**
Press set button to select the axis for setting.
- **Function:**
Press set button to switch ON or OFF for this axis.
- **Pitch Length:**
Press the numeric button to input the pitch length.

Note: 1. This function is only available when the axis is displaying the linear length, could not be used for angle measuring.
2. This function is not available for 5 axis displaying.

3. Special Function

3.14 Signal Test Function

This function is for checking the signal of linear scale. Once operator connect the linear scale to X or Y port and set the corresponding parameter, then the oscillogram, duty ratio, phase difference could be tested.



- **Axis:**
Press set button to switch X or Y port for checking.
- **Time/DIV:**
Press set button to set the time for every cell.
Press the green light button to run or stop.

Note:

Once this function is activated, the current value and non-linear compensation data of the axis which is used as the checking port will lose.

To prevent the data losing, please set the mechanical reference point first (refer the REF Function).

If the reference has been set, operator could enter this function directly, once exit this function, traverse the linear scale, the DRO will search the mechanical reference point, and the value could be recovered automatically once the reference point has been captured.

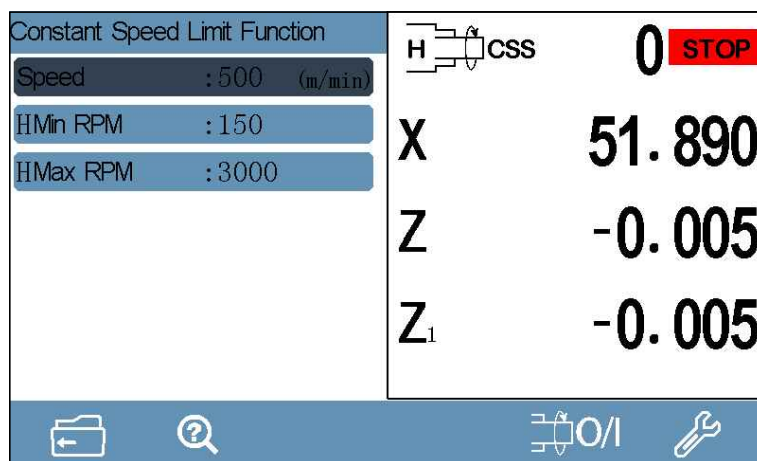
3. Special Function

3.15 Constant Surface Speed Function (Optional)

(This function should be used with the control box of IOA300)

Introduction: This function is for constant surface speed machining on variable speed lathe. Meanwhile there are protection for overspeed of both spindle and motor.

Press the function key of CSS to enter the parameter setting.



- **Speed:**
Press the numeric key to input the speed.
- **Min RPM:**
Min RPM: Press the numeric key to input the minimum RPM.
- **Max RPM:**
Press numeric key to input the maximum RPM.

Other corresponding setting:

1. RPM Setting(Chapter 1.7) 2. Communication Setting(Chapter 1.8)

RPM Display: ON

Sensor: USART

Function: ON

Baud Rate: 9600

Parity: OFF

Stop Bist: 1

Address: 1

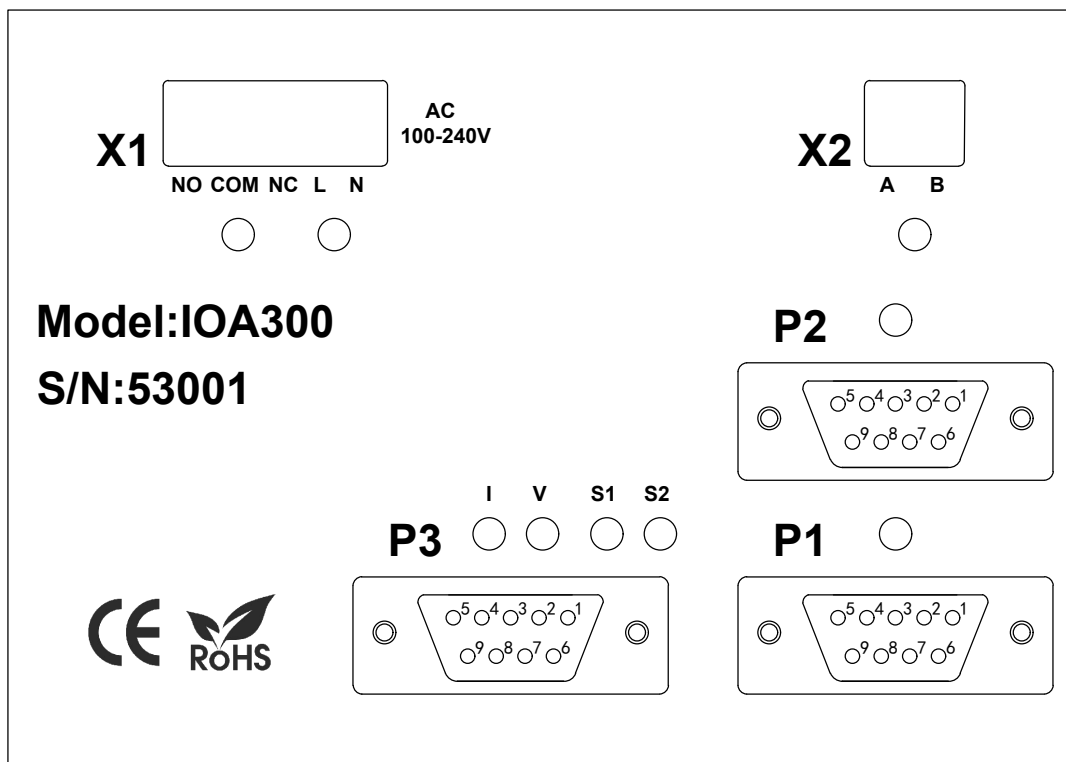
Note: The parameter in both RPM and Communication setting should be same as above.

3. Special Function



- **Speed:**
Press the Function key to enter and input the machining speed.
- **Max RPM:**
Press the function key to input the maximum RPM speed for corresponding gear.

Introduction of IOA300



3. Special Function

X1 Port :

NO : Protection relay (NO).

COM : Protection relay (Common).

NC : Protection relay (NC).

L : AC Power.

N : AC Power.

X2 Port :

A : A signal of RS485 communication protocol(Red wire).

B : B signal of RS485 communication protocol(Blue wire).

P1 Port :

PIN2 : 0V.

PIN7 : 5V.

PIN9 : Signal of sensor.

P2 Port :

PIN2 : 0V.

PIN7 : 5V.

PIN9 : Signal of sensor.

P3 Port :

PIN1 : 4-20MA analog output signal (Green wire).

PIN 2 : 0V of analog signal(Blue wire).

PIN3 : 0-10V analog output signal (Red wire).

PIN 6 : Gear Control(Yellow wire).

PIN 7 : 0V of Gear (Brown wire).

Pin 8 : Alternate Port (Black wire).

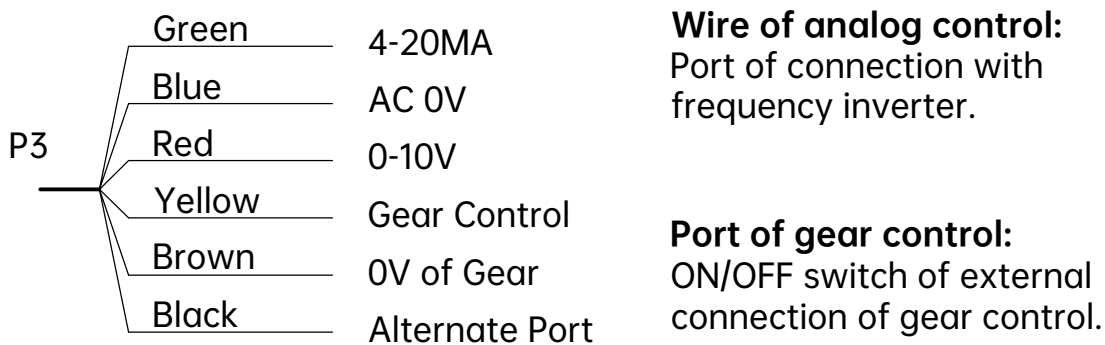
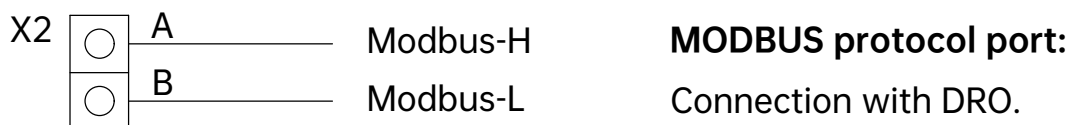
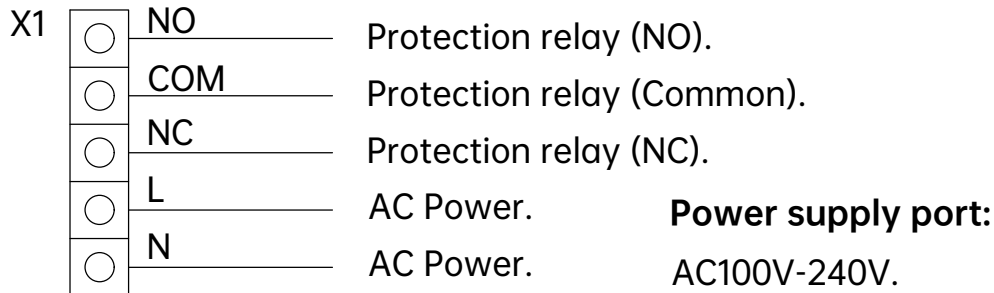
3. Special Function

Relay for protection of overspeed:

Maximum switching Voltage: 440V@AC; 300V@DC

Maximum switching current:16A

Recommend to connect the external motor ON/OFF contractor or emergency stop.



4. Appendix

4.1 Parameter

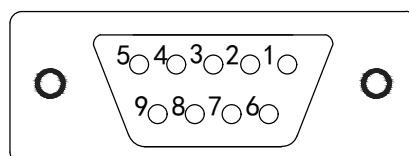
- **Voltage:** AC 100V--240V ; 50-60HZ
- **Power:** 15W
- **Displaying:** 7" true color LCD screen
- **Working Temperature:** -10°C--60°C
- **Storage Temperature:** -30°C--70°C
- **Relative Humidity:** <90% (25) >
- **Axis Number:** 1 axis,2 axis,3 axis,4 axis,5 axis
- **Input Signal:** 5V TTL/5V RS422
- **Input signal Frequency:** <50MHZ
- **Resolution (Linear Encoder):** 0.1 um, 0.2 um, 0.5 um, 1 um, 2 um, 2.5 um, 5 um, 10 um, 20 um, 25 um, 50 um, 100 um
- **Highest Resolution(Rotary Encoder):** <1000000ppr
- **Weight:** 1.5KGS
- **Dimension:** 295*175*65mm
- **DB9 Pin diagram:**

DB9-5V TTL

Pin	1	2	3	4	5	6	7	8	9
Signal	Empty	0V	Empty	Empty	Empty	A	+5V	B	Z
Color		Black				Yellow	Red	Green	Brown

DB9-5V RS422

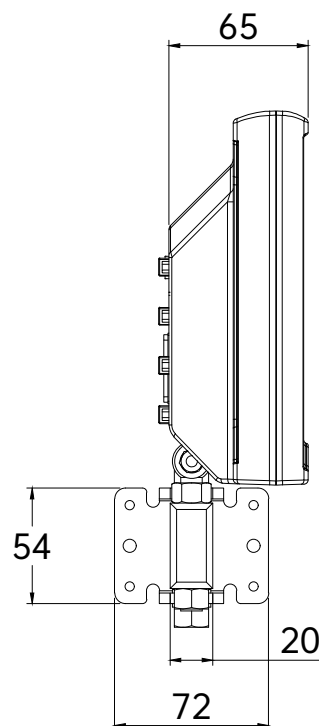
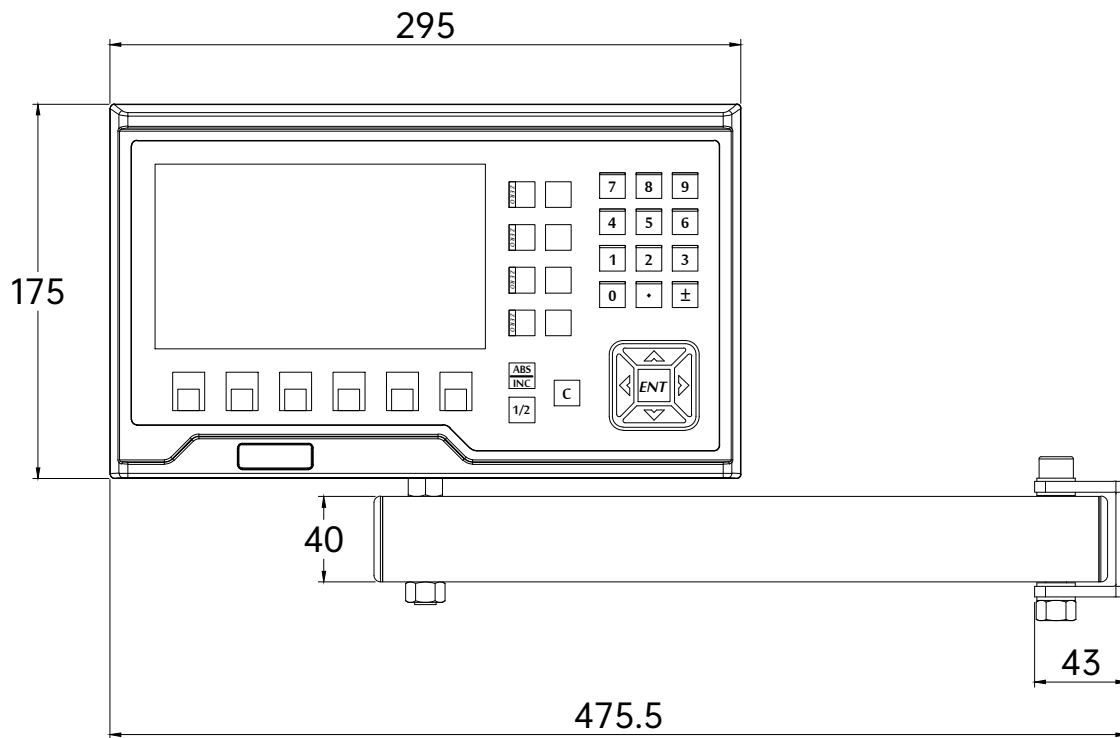
Pin	1	2	3	4	5	6	7	8	9
Signal	A-	0V	B-	Empty	Z-	A	+5V	B	Z
Color	Orange	Black	Blue		White	Yellow	Red	Green	Brown



4. Appendix

4.2 Dimension

Unti:mm



4.3 Hall Sensor(Optional)

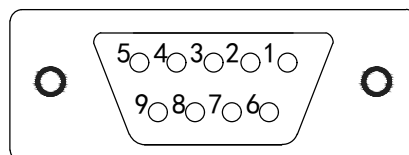
Hall Sensor Installation Precautions:

1. Hall sensor includes permanent magnet sensor chip (hereinafter referred to chip) and Hall sensor head (hereinafter referred to as head).
2. The mounting distance between the head and the chip should not exceed 10mm, the chip should be installed firmly to ensure it will not loosen and fall down when the speed measurement device is rotating.
3. Permanent magnetic sensor chip has two different parts which is positive and negative, only the positive part of the permanent magnetic sensor chip is against the Hall sensor head ,then it will work.
4. The method of detecting the front and back side of the chip:
Turn on DRO and connect with Hall sensor, then put the chip (face to face) against to the Hall sensor head (distance is less than 10mm) when the Hall sensor head induction lamp is on, it means on working; If it is not, please turn it over .

- **Hall sensor pin-out diagram:**

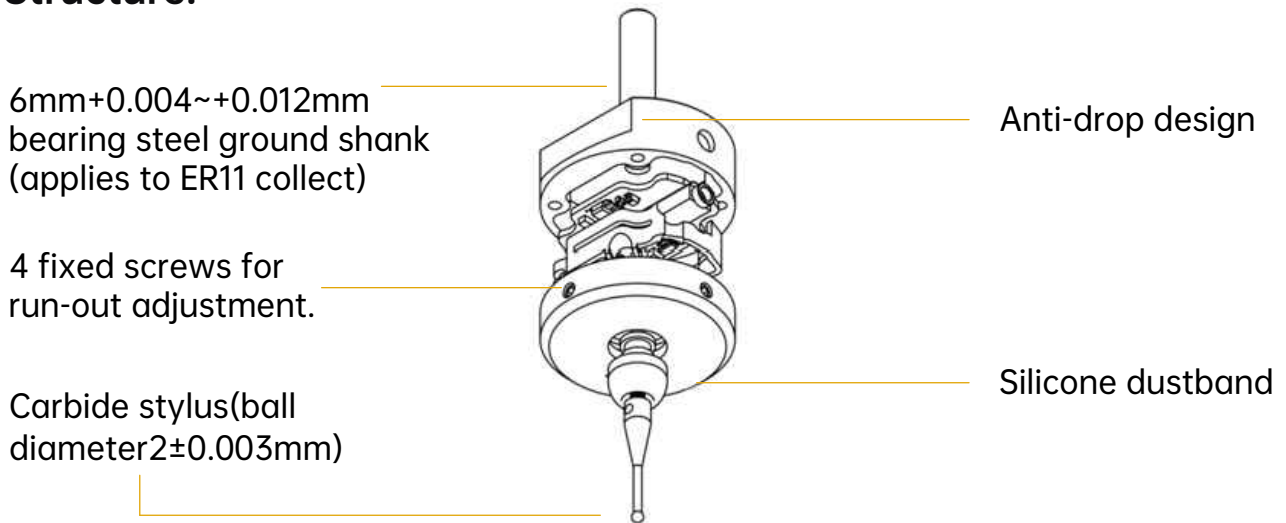
DB9-RPM

Pin	1	2	3	4	5	6	7	8	9
Signal	Empty	0V	Empty	Empty	Empty	Empty	+5V	Empty	OUT
Color		Black					Blue		Brown



4.4 3D Touch Probe (Optional)

Structure:

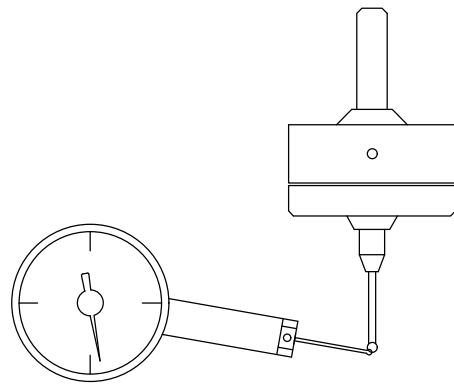


Installation:

Once the touch probe has been clamped well, use the dial test indicator to check the run-out. Adjust the 4 screws to make the run-out to be less than 0.01mm.

Note:

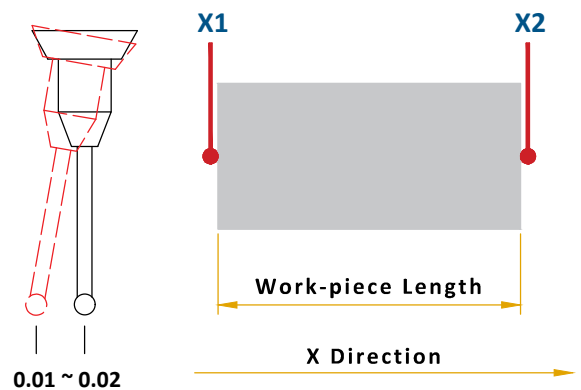
The run-out of touch probe has been adjusted to be 0.05mm in the factory. Operator need to adjust again once it is clamped for using. Use AAA class ER11 collect to clamp the touch probe, otherwise the run-out for clamping again could not be guaranteed.



4. Appendix

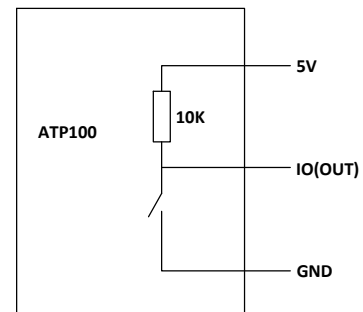
Method for calculating the deflection compensation value.(Deflection value: The projected error between the touch point and the actual triggering point in measuring direction)

1. Clamp a accurate block on table(like gauge block)
2. Use the touch probe to measure the two sides of X direction.(X1,X2)
3. Deflection Value=(X2-X1-Ball Diameter-Block Length)/2



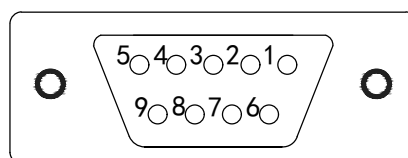
Technical Parameter:

- Connection: 5mm diameter headset plug
- Red Wire: 5V
- White Wire: NPN Open
- Black Wire: 0V
- LED Light: Green-IO output high level signal,Red-touch occurs,IO output low level signal
- Unidirectional Repeatability: 0.01mm
- Ball Diameter: $2.0 \pm 0.003\text{mm}$
- Stylus overtravel: XY $\pm 15^\circ$, Z+ 3 mm.
- Wire Length: 2M



DB9-3D Touch

Pin	1	2	3	4	5	6	7	8	9
Signal	Empty	0V	Empty	Empty	Empty	Empty	+5V	Empty	OUT
Color		Black					Red		White



4.5 : RS232 serial communication protocol (Optional)

Communication Protocol: Baud Rate 115200,8, N, 1

Generally, it takes the "41H""61H", "53H"as examples.

1. Sending data continuously: PC sends hexadecimal(41H) to Digital Readout, Digital Readout sends data continuously to PC.
2. Sending data one time, PC sends hexadecimal(61H) to Digital Readout, Digital Readout sends data one time to PC.
3. Stopping sending data: When Digital Readout received 53H, it will stop sending data to PC.
4. Other keys definition, please refer the following table

Data format

Data ASCII

ASCII Code array format

[axis sign bit] [value] [value] [value] [value] [value] [value]
[value] [value] [value] [value] [value] [0X0D] [0X0A]

The decimal point is not fixed which will change as the resolution changes.

Example:

X+1234.567 (resolution=1,2,5,10) (three decimal places)

[X] [blank] [blank] [blank] [1] [2] [3] [4] [.] [5] [6] [7] [0X0D] [0x0A]

Y-123.4567 (resolution=0.1, 0.2, 0.5) (four decimal places)

[Y] [blank] [blank] [-] [1] [2] [3] [.] [4] [5] [6] [7] [0X0D] [0x0A]

Z 12.34567 (I/N=I inch I/M=M metric)(five decimal places)

[Z] [blank] [blank] [blank] [1] [2] [.] [3] [4] [5] [6] [7] [0X0D] [0x0A]

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Angle display:

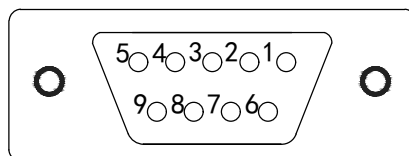
X+123.4567° (Angle display)

[X] [blank] [blank] [blank] [1] [2] [3] [4] [.] [5] [6] [7] [0X0D] [0x0A]

Y-123°45'57" (Angle display with unit of degree, minutes and seconds)

[X] [-] [1] [2] [3] [.] [4] [5] ['] [5] [6] ["] [0X0D] [0x0A]

Transmission Connecting Way



2.PIN:TXD
3.PIN:RXD
5.PIN:GND

RS232 serial communication protocol key table

Virtual key table:

Character	Function	Function explanation
0x61(a)	Send data once	Send data
0x41(A)	Send data continuously	Send data
0x53(S)	Stop sending data	Stop sending data
0xa1	Send data one time for X axis	Send data
0xa2	Send data one time for Y axis	Send data
0xa3	Send data one time for Z axis	Send data
0xa4	Send data one time for U axis	Send data
0xa5	Send data one time for V axis	Send data

4. Appendix

Key Table:

Character	Corresponding key	Character
0x30(0)	0	Data input
0x31(1)	1	Data input
0x32(2)	2	Data input
0x33(3)	3	Data input
0x34(4)	4	Data input
0x35(5)	5	Data input
0x36(6)	6	Data input
0x37(7)	7	Data input
0x38(8)	8	Data input
0x39(9)	9	Data input
0x2d(-)	±	Data input
0x2e(.)	.	Data input
0x45(E)	ENT	Data input
0x43(C)	C	Return key
0x52(R)	→	Right move code
0x4c(L)	←	Left move code
0x50(P)	↑	Up move code
0x44(D)	↓	Down move code
0x58(X)	X	X axis input
0x59(Y)	Y	Y axis input
0x5a(Z)	Z	Z axis input
0x55(U)	U	U axis input
0x78(x)	X0	X zeroing key
0x79(y)	Y0	Y zeroing key
0x7a(z)	Z0	Z zeroing key
0x75(u)	U0	U zeroing key
0xf1	F1	Function key
0xf2	F2	Function key
0xf3	F3	Function key
0xf4	F4	Function key
0xf5	F5	Function key
0xf6	F6	Function key
0xf7	ABS/INC	Absolute/Relative coordinates transformation key
0xf8	1/2	1/2function key

4. Appendix

4.6 Troubleshooting

The following troubleshootings are just the preliminary methods.

If the problems still exist, please do not dismantle the DRO by yourself, but contact our company or the dealers for help in time.

Faults	Fault Causes	Solutions
The DRO doesn't display anything	1. The power is not on ? 2. The power switch is not closed ? 3. The supply voltage is not appropriate 4. The internal supply of the linear scale is in short circuit.	1. Check whether the power line and power plug are plugged in. 2. Close the power switch. 3. Make sure the supply voltage between 80V-240V. 4. Pull out the connector of the linear scale.
One axis of the DRO doesn't count	1. Operate the machine after swapping with the linear scale of another axis. 2. Some special functions of the DRO are being used.	1. If counting, it's the fault of the linear scale; if not, it's the fault of the DRO. 2. Exit the special function
The counting of DRO is not accurate (it can't zero)	1. The linear scale isn't installed according to the requirements or the accuracy is not enough. 2. After being used for a long time, the vibration of the machine tool makes the fixed reading head or the screws loosen. 3. The accuracy of the machine tool is not good. 4. The DRO resolution isn't consistent with the linear scale.	1. Reinstall the linear scale and adjust the level. 2. Tighten all the fixed screws. 3. Overhaul the machine tool. 4. Reset the DRO resolution.
The counting of DRO is in error, The displayed operation distance isn't consistent with the actual distance	1. The machine tool and the DRO shell are not connected to ground. 2. The accuracy of the machine tool is not good. 3. The running speed of the machine tool is too fast. 4. The linear scale isn't installed according to the requirements and the accuracy is not enough. 5. The DRO resolution isn't consistent with the linear scale. 6. The operating size unit is not consistent with the displayed Metric/British units. 7. The linear error compensation setting of the DRO is not appropriate. 8. The linear scale exceeds the operating range of length or the read head is broken.	1. Connect the machine tool and the DRO shell to earth. 2. Overhaul the machine tool. 3. Reduce the running speed of the machine tool. 4. Reinstall the linear scale and adjust the level. 5. Reset the DRO resolution. 6. Switch the displayed Metric/British units. 7. Reset the linear error compensation of the DRO. 8. Repair the linear scale.

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Faults	Fault Causes	Solutions
The linear scale doesn't count	1. The linear scale exceeds the operating range of length or the read head is broken. 2. The read head of linear scale rubs the ruler shell leading to the aluminum scraps accumulated. 3. The gap between the read head of linear scale and the ruler body is too wide. 4. The metal tubes of the linear scale are damaged, which causing the short circuit or disconnection in internal wiring.	1. Repair the linear scale 2. Repair the linear scale 3. Repair the linear scale 4. Repair the linear scale
The linear scale doesn't count sometimes	1. The small box of the linear scale is separated from the steel ball. 2. The grating glass in the read head of the grating ruler is abraded. 3. There is dirt on the grating glass in the shell of the linear scale. 4. The elasticity of small box spring in the read head of the linear scale is not enough.	1. Repair the linear scale 2. Repair the linear scale 3. Repair the linear scale 4. Repair the linear scale

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