2 & 3 AXIS DIGITAL READOUT
OPERATION MANUAL
(3 AXIS SHOWN)

2012/03/15

CONTENTS

FOREWORD

Thanks for choosing DRO (Digital Read-Out) COUNTER. This manual could help the user to understand the operation of the DRO COUNTER.

There are some useful hints for the normal troubleshooting situations included in Chapter 6 in case of any operational Q&A. Please read this manual thoroughly for ensuring the installation quality to boost the productivity of your machine.

PRECAUTIONS

THIS IS PRECISION EQUIPMENT. PLEASE HANDLE IT WITH CARE.
Neither bumps nor applied excessive force to any part of the DRO counter.

INSTALLATION IN THE PROPER ENVIRONMENT
In order to keep its stable measurements with highly accuracy, please install the DRO counter in a place that meets all the following conditions.

- The installation place should not subject the counter to any cutting oil, chip, dirt, dust, or vibration.
- Please do not expose it to the direct sunlight.
- Please do not operate it as any explosive gas nearby.
- Please do not operate it as any high-voltage or large-current equipment nearby.
- The ambient temperature should be between 0℃ and 50℃ and the humidity should be between 20% and 80%.
- POWER SUPPLY AND GROUNDING CONNECTION. Please use a DC 8~24V power adaptor to connect the DRO counter. For the safety consideration, please always keep the grounding connection of the counter.
- Please use MRT 1.2A FUSE to eliminate a fire hazard and to prevent damage the internal circuits.
- DO NOT DISASSEMBLE WITHOUT any professional engineer. There are some high significant electronically elements inside the counter, please do not disassemble this counter for avoiding failures.

ALL SPECIFICATIONS ARE SUBJECTED TO CHANGE WITHOUT NOTICE.

OVERVIEW

1.1 General Description

The DRO COUNTER is a Microcontroller-based Digital Read-Out (DRO) System especially suitable to the Linear Optical Scales. It is designed to facilitate the operation control of measurement just by touching keys set on the front panel of the DRO.

The DRO counter functions are counting and display the precise measured readings which is retrieved by and transferred from the collocating Linear Scale. The DRO counter can save the readings as Power OFF situation. And the ERROR compensation values can be kept in EEPROM (Electrically erasable and programmable read only memory) for more than 10 years even in Power OFF condition. The counter has a unique feature of Machine Error compensation for each axis through the setting of the programmable system parameters.

All the necessary usable information about the Linear Scales and DRO counter is contained in this manual. Please pay more attention on reading it page by page.

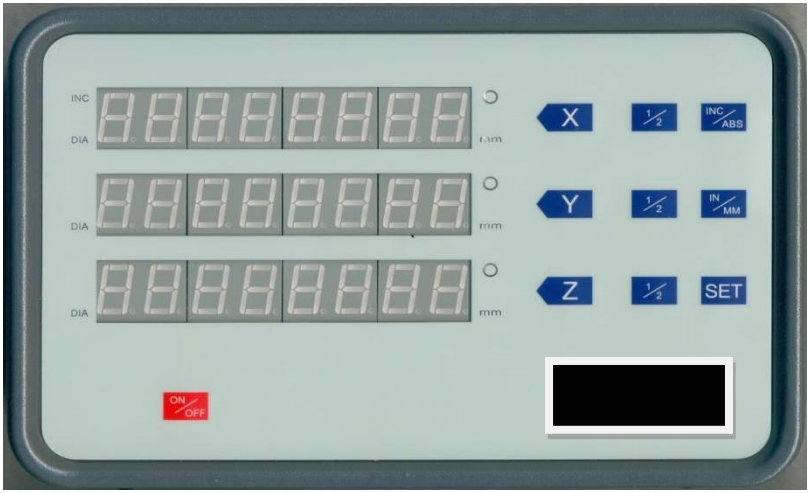
Please do adhere to the instructions given in this manual as using the system.

1.2 Panel Introduction

This section introduces you the name and function for the main parts of the DRO counter. Furthermore, a description of the display is also given.

1.2.1 Main parts of the DRO counter

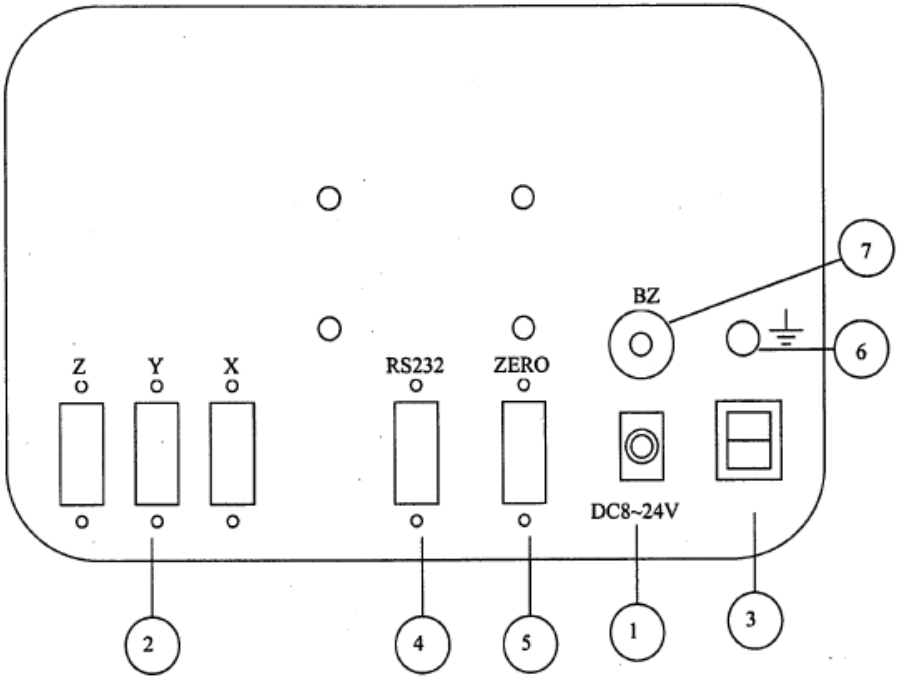
● Front panel of the DRO counter



(1) Main Display: This is used to display the count readings of the X, Y, Z-axes in 1-digit sign and a 7-digit numeral format. Two or three LEDs represent the DIA (Diameter) mode of each corresponding axis. Five or seven LEDs indicate the INC (Incremental coordinates) mode, the Metric system (as the measured unit system of length) or the Angle mode.

(2) General operation keys and indicators: Seven or nine keys are used to control the general functions.

● Rear panel of the counter



(1) DC JACK (which connects to the power cord of the DC adapter).

(2) Linear Scale connectors (each connects to the linear scale unit of the X, Y, or Z axis).

(3) Power Switch (which is used to turn ON and OFF the power).

(4) RS232 port.

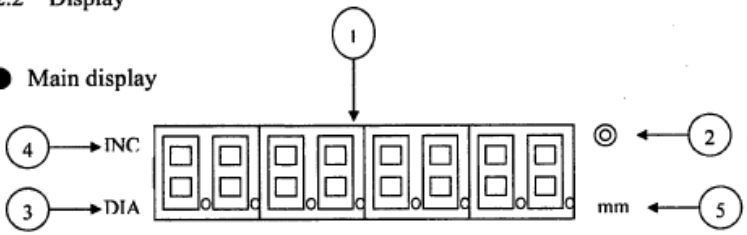
(5) External-reset port.

(6) Grounding port (used to connect the EARTH grounding connection).

(7) Buzzer.

1.2.2 Display

● Main display



(1) 7-digit numeral LED with rows: It is used to represent the reading values of the X, Y or Z axis; or used to display the numerical data with a maximum of eight digits and decimal points.

(2) The Angle mode: It indicates that the counter is at the angle mode if light on.

(3) The Diameter mode: It indicates that the counter is at the diameter mode if light on.

(4) The Coordinate mode: It indicates that the counter is at the coordinate mode if light on.

(5) The Metric unit: It indicates that the counter is at the Metric unit mode if light on.

1.3 Names and Functions of Keys

This section introduces the name and function of the general operation keys.

Symbol and Name	Function
1  Reset key of each axis	Reset the displayed reading value of each X, Y, or Z axis to zero.
2  1/2 Key	Use to halve a display value
3  Switching key for changing length measuring unit system	It is used to switch the display between Metric system and British system of measurement. It provides direct conversion for either unit system at any time. The enlightened corresponding LED indicates the selected mode. The decimal point will shift from the 4th LED display to the 5th LED display when INCH is selected.
4  Switching key for selecting the coordinate system	It is used to switch the display coordinates between INC (Incremental coordinates) and ABS (Absolute Coordinates). LED light for indicating the INC mode.
5  Set key	It is used to set parameters.

CHAPTER 2
SETUP

After unpacking the DRO Counter, please check that the package is completed and all parts are not damaged during shipping.

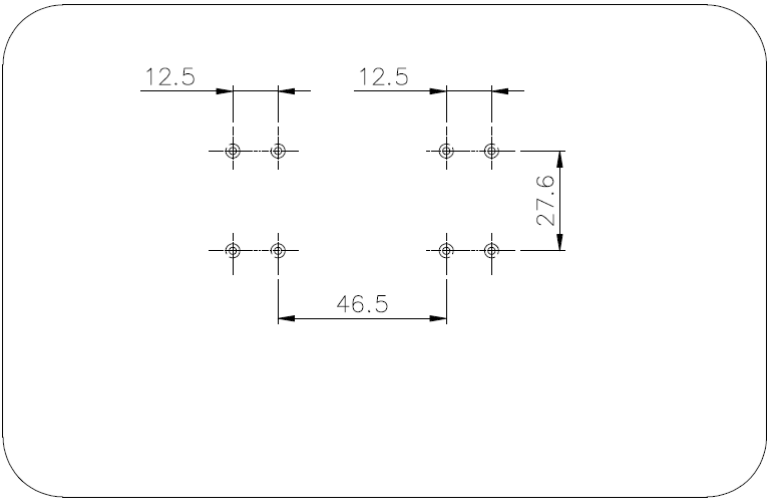
For installing the DRO counter on the machine, please install the mounting brackets (standard accessories) first. Please be sure to connect all the cables of the DRO counter to the external devices correctly before operating. Before installing the bracket of the DRO counter, please drill four symmetric holes in the appropriate places on the mounting surface by referring to the dimensions shown on the following figure.

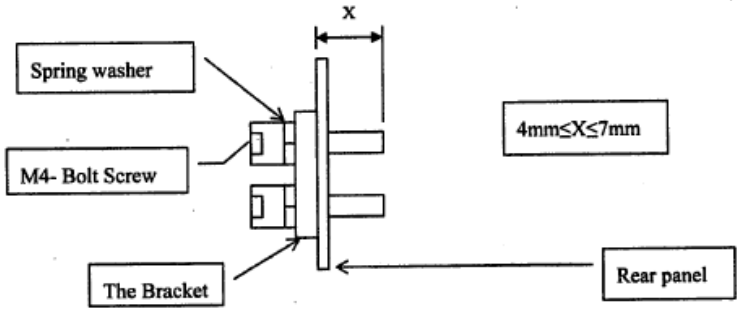
The operation function of the DRO counter depends on the basic parameter settings. Please check the basic parameter settings and revise as required. In this chapter, the following sections introducing the setup steps of the DRO counter.

2.1 About the Mounting Brackets

The mounting bracket is supplied and used for installing the DRO counter on the machine surface or the extended stand. The mounting bracket is a standard accessory for the DRO counter.

On the rear panel of the DRO counter fix, there are four holes for installing the mounting bracket with screws (M4*20). Then the whole set could be installed on the appropriate place on the machine. Please refer to the dimensions of these holes symmetric positions shown on the following figure.





Warning:

- The distance X between the installed screw-ends and the rear panel must be within the range of 4mm to 7mm (4mm ≤ X ≤ 7mm) for avoiding to broken the main-board.

2.2 Installation of the DRO Counter

1. Please unpack and retrieve the DRO counter. Ensure all the received parts are in good condition.

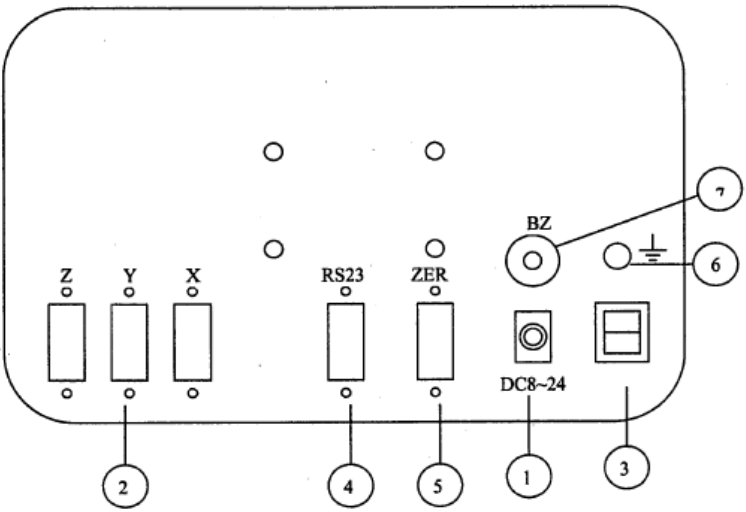
2. Please read carefully about the CAUTION LABEL of the SUPPLY VOLTAGE on the rear panel and ensure the installation location using the same supply voltage.

   IT IS EXTREMELY IMPORTANT TO ENSURE THAT THE GROUNDING CONNECTION IS PROPER AND CORRECT BECAUSE IT ALREADY APPLIES SOME INTERNAL FILTERING COMPONENTS WHICH COULD ACHIEVE EXCELLENT NOISE SUPPRESSION.

3. Please mount the DRO counter to the mounting bracket supplied as the standard accessory and refitting the whole set to the machine through the holes of the rear panel.

4. Routing the cables of the DRO counter carefully to the external devices without entangling anywhere or anything during machine use.

5. Connecting the DC main power cable from the DC jack on the DRO counter through the adapter to the nearest AC outlet. If possible, please DO use the power supply outlet with the fixed load without connecting other devices such as lighting etc. Please ensure that the power supply voltage condition meets the following values by using a voltmeter.
   - LINE-NEUTRAL: 85V～264V
   - NEUTRAL-EARTH GROUNDING: Less than 3V
   - LINE-EARTH GROUNDING: 85V～264V



6. Steps of the connection:
   - Ensuring the DC power cable is disconnected with the DC jack (1) and the power switch (3) is OFF.
   - Connecting the earth grounding cable to the Grounding port (6) for safety concerns.
   - Connecting each cable of the linear scale unit to the corresponding Linear Scale connector (2).
   - Plugging the DC power adaptor cable to the DC jack (1).
   - Switching on the Power Switch (3).

CAUTION

When connecting the counter, observe the following precautions.

1. Confirming that the power switch (3) is turned off.
2. Only using the supplied power adaptor for the DC jack (1).
3. Always keeping correct grounding connection of the grounding port (6).
4. Using a dedicated AC power supply for the DRO counter.

CHAPTER 3
BASIC OPERATION

This chapter describes the basic operations of the DRO COUNTER as following topics.

3.1 Getting Starts

When power is initially turned on, the display of 8 LEDs each row flashes once and displays the software version about 1 second.

As the display is flashing, please press the SET mm/inch keys while the init_EE message prompted on displays to initiate the internal memory.

And please refer the paragraph 4.1 about the parameters settings. The parameter value of default is below:

code	description	default
rA	1(diameter),0(radial)	0
dir	0(positive),1(negative)	0
L Scale	Linear scale	L Scale
u	Resolution 0.0005~10mm	0.005
L	Linear error compensation(0-9999)	0

code	description	default
En dP	0(degree),1(degree ,minute, second)	0
dir	0(positive),1(negative)	0
o Encod	Rotary Encoder	L Scale
E	Resolution (1-999999) pulses	1800
L	Linear error compensation(0-9999)	0

3.2 Turning on the DRO Counter

As the power switch of the DRO counter is turned on. You can read the version number shown on the displays as following format and then the last measured values.

EXAMPLE: VER1.0 DISPLAY | CS30 1.0 |

3.3 Resetting the Displayed Values

. 1.245 mm is a measured value shown on the display as an example.

. 0.000 mm is the displayed value after pressing the reset key of the X or Y or Z axis.

* P.S. When the reset key is set at the ABS mode, which the LED of the INC is OFF, the measured values both of the ABS coordinates and the INC coordinates are setting to zero. But if the reset key is set at the INC mode, which the LED of the INC is ON, only the measured value of the INC coordinates is reset to zero.

3.4 Switching to the Metric System or the British System

. 25.400 mm is a measured value of the Metric system shown on the display as an example.

. 1.0000 inch is the displayed value of the British system after pressing the mm inch key.

The current display unit is switched to the inch unit. As the key is pressed each time, the display unit of all axes is changed to another system at the same time.

3.5 Halving the Displayed Value

. 10.000 mm is a measured value shown on the display as an example.

. 5.000 mm is the displayed value after pressing the $\frac{1}{2}$ key.

The displayed value is halved.

3.6 Switching between two Coordinate Systems

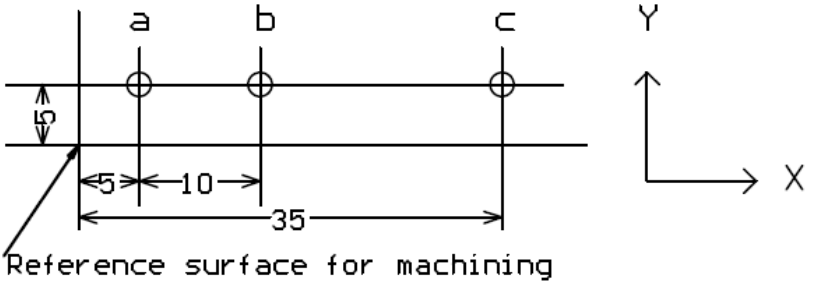
. 1.000 mm is a measured value shown on the display as an example of the ABS coordinates.

. 1.175 mm is the displayed value based on the INC coordinate after pressing the INC/ABS key.

The value is shown now based on the INC coordinate system.

Application Example of the ABS and INC Coordinates Systems

The DRO counter has two INC and ABS coordinate systems. For applying effectively, these coordinates systems could enhance the machining operation much more easily and the performance much more precisely. The following example is described how to use the two coordinate systems.



In the ABS coordinate system, please reset the reference point to zero and then start the machining process as following:

X [0.000] : Being at the ABS mode, reset to zero, ABS = 0, INC = 0.

MOVE X [5.000] & Y [5.000] : Moving the cutter to the point "a" and drilling a hole.

Inc/ABS X [5.000] : Pressing the (INC ABS) key for switching to the INC coordinates.

X [0.000] : Resetting the displayed value of the X-axis.

MOVE X [10.000] : Moving the cutter to the point "b" and drilling a hole.

Inc/abs X [10.000] : Pressing the (INC ABS) key for switching to the ABS coordinate system.

MOVE X [35.000] : Moving the cutter to the point "c" and drilling a hole.

CHAPTER 4
PARAMETERS

When the DRO counter and the linear scale units are installed in a machine, a scale reference point must be set for each axis for the moving direction and the detecting direction of the measuring operation. Furthermore, the DRO counter is allowed to set the coefficient of expansion/contraction for molding requirement and to set the various compensation errors constants occurred as the machine operating for improving the operating flexibility and the machining accuracy. These constants and various constants are called and set as "parameters".

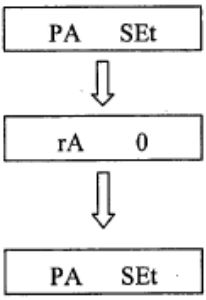
Each parameter consists of a parameter code and the setting data. The setting data of some specific items could be selected from the setting menu, and the other setting data could be entered directly from the keypad. All the set parameters are stored in memory even after the power is turned off. The setting data of every stored parameter can be confirmed or initialized (which means to load the factory setup defaults).

This chapter describes the function and the setting procedure of each parameter.

4.1 Setting the Parameters

1. Turning on the power.
2. Pressing the (SET) key as the display is flashing.
3. The [PA. SEt] message is shown on the display.
4. Pressing the reset key of the chosen axis ((X), (Y) or (Z)) which is planned to start the parameters setting menu.

4.2 Setting the Diameter / Radius



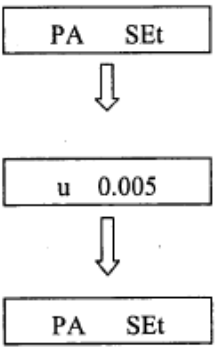
Pressing the (X) key until the "[rA 0]" message is shown on the X axis display for starting the diameter/radius setting.

Pressing the (1/2) key to change values (0→radius, 1→diameter), and pressing the (X) key to start another parameters setting.

Please press the (SET) key to exit the setting as completing and repeat the same procedure for the other axis as required.

4.3 Setting the Resolutions

4.3.1 Linear Scale:



Pressing the (X) key four times until "[u 0.005]" is shown on the X axis display for starting the Linear Scale resolution setting.

Pressing the (1/2) key to change values (0.0005~10mm) , and pressing the (X) key to start another parameters setting.

Pressing the (SET) key to exit as the setting is completed. Please repeat the same procedure for the other axis as required.

RESOLUTION FOR THE LINEAR AXIS

Resolution	Display (mm)	Display (inch)	Resolution	Display (mm)	Display (inch)
0.5um	0.0005	0.00002	0.1mm	0.1	0.005
1um	0.001	0.00005	0.2mm	0.2	0.01
2um	0.002	0.0001	0.5mm	0.5	0.02
5um	0.005	0.0002	1mm	1	0.05
10um	0.01	0.0005	2mm	2	0.1
20um	0.02	0.001	5mm	5	0.2
50um	0.05	0.002	10mm	10	0.5

RESOLUTION OF THE ENCODER

4.3.2 Encoder:

PA SEt

⇩

Pressing the (X) key 3 times until "L ScALE" is shown on the X axis display to start the encoder resolution setting. And pressing the (1/2) key till the " o Encod " is shown then pressing the (1/2) key.

E001800

⇩

PA SEt

Please press the (1/2) key to increase the pulse number of the 1st address, press the (INC ABS) key for changing to the 2nd address and press the (1/2) key to increase the pulse number of the X axis. The (1/2) key is used for increment and the (INC ABS) key is for changing address. Please press the (SET) key to exit as completion and repeat the same procedure for the other axis as required.

P.S. The resolution of the encoder formula is shown as below:

E-res=360°/pulse number

4.3.3 The Angle Units Setting:

En dP 0

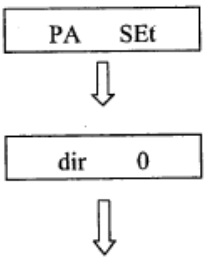
⇩

Pressing the (X) key till the En dP 0 message is shown. Pressing the (1/2) key to change units (0→ degree, 1→ radian), and then pressing the (X) key to start another parameters setting.

PA SEt

Pressing the (SET) key to exit after completing the setting, and repeating the procedure for the other axis as required.

4.4 Setting the Direction:



Pressing the (X) key 2 times till the "dir 0" message is shown on the X axis display to set the Linear Scale direction.

Pressing the (1/2) key to change value which "0" is one direction and "1" is the opposite direction, and then pressing the (X) key to another parameters setting.

Pressing the (SET) key to exit after completing the setting, and then repeating the same procedure for the other axis if required.

4.5 Setting the Linear Compensation

To apply the linear error correction, a Master must be inspected to determine the amount of error for the length of the Master, which means to set up the standard.

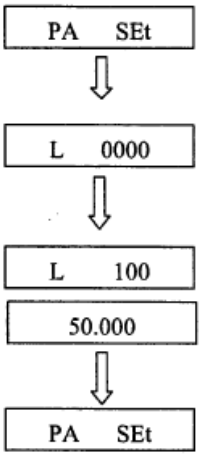
An example will be used below to demonstrate how this feature can be applied.
EC: error compensation S: master value (standard) O: observation value

$$EC=(S-O)/O*1000000$$

EXAMPLE: 50.000 Master
49.995 is shown on the display as the Master inspected
The error is 0.005mm per 50.000mm.
So the compensation data is 5 μm x 1000mm/50 = 100 μm/M

NOTE: The compensation unit is micro-meter per meter(μm/M)

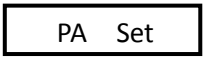
Setting the linear error compensation of the Linear Scales:



Setting the compensation parameters by pressing the (X) key 5 times till the "L 0000" message is shown on the X display.

Pressing the (mm inch) key to select the positive or negative compensation, then pressing the (1/2) key to increase the value in the compensation 1st address, and pressing the (INC ABS) key for changing to the next address. Pressing the second row (1/2) key to show the value of adjustment (X, Z axes shown by pressing the second row 1/2 key and Y axis shown by only pressing the first row 1/2 key) until the master value to X-axis is reaching. As finishing the setting, please press the (SET) key to exit. Please repeat the same procedure for the other axis if required.

4.6 Saving the Parameters and Exiting the Setup Mode:



When message shown on displayed and Press "SET" key to save and leave setup mode.

CHAPTER 5
MAINTENANCE

5.1 DRO Counter Maintenance

No maintenance attention is required because the electronic and electrical circuits within the counter are made of the solid-state type. The only attention for daily use is only cleaning or dusting the display filter and the extension surfaces.

The front panel or the cover may be stained or dirty with greasy dirt, dusts or oil. Please use a soft tissue paper with some soap water for cleaning. The tissue paper moistened with a little soap water will easily remove these stains. Do NOT use any solvent. (If possible, please install the DRO counter in the position which is away from the splashing oil, coolant, or water etc.)

CHAPTER 6
TROUBLESHOOTING

Before starting to do any troubleshooting, it is necessary to ensure that the DRO Counter and the Linear Scales are installed exactly as their specifications.

For the DRO Counter, the AC power supply voltage should be connected to a separate point differed from the Line and Neutral wires without connecting any high capacity switching or inductive load.

It is absolutely necessary to connect an EARTH grounding cable to the grounding port of the DRO counter to ensure a trouble-free operation. Please connect a separate conducting thick wire (2.5 mm) between the port on the rear panel and the suitable point on the installed machine.

For the installed linear scales, please ensure that the linear scales MUST be installed to meet all the requirements given in the Linear Scale Manual.

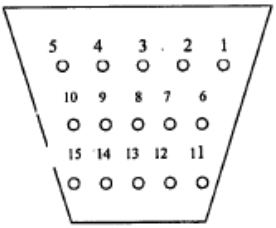
Now, the construction of the DRO Counter is briefing as following.

6.1 Removal of the Cover

To remove the rear panel, please loose the four screws from the rear side and the fixed screws of the X, Y, Z, RS232, and EXT-RESET ports.

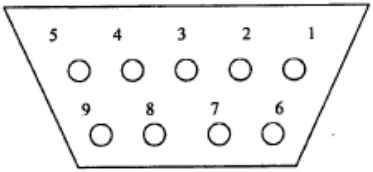
6.2 Connector Types of the DRO Counter:

6.2.1 The Output Connector of the Linear Scales:



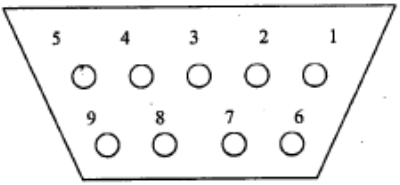
Pin-No.	Signal	Pin-No.	Signal	Pin-No.	Signal
1	+5V	6	FG	11	NC
2	GND	7	NC	12	NC
3	Phase-A	8	NC	13	NC
4	Phase-B	9	NC	14	NC
5	RI	10	NC	15	NC

6.2.2 The Output Connector of the RS232:
It is connecting to an external PC or display unit.



Pin-No.	Signal	Pin-No.	Signal
1	NC	6	NC
2	TXD	7	NC
3	RXD	8	NC
4	NC	9	NC
5	GND		

6.2.3 The Input Connect of the External_Reset



Pin-No.	Signal	Pin-No.	Signal
1	NC	6	GND
2	NC	7	Z-ZERO
3	NC	8	Y-ZERO
4	NC	9	X-ZERO
5	NC		

6.3 Error Messages and Solutions

There are four error messages for the DRO counter, and are listed as following content. If any of these error messages are shown, please try to isolate the cause and resolve it with an appropriate suggestion listed as following.

Error Message Code	Explanation	Solutions
Error 1	The input signal of the Linear scale is not stable.	• Please change the axes of the linear scales. • Please check the I/O • Connectors and cables of The linear scales if defects.
Error 2	Voltage is not stable.	• Please check the voltage. • Please ensure the proper grounding connection.

6.4 Troubleshooting and Solutions

Problem	Possible Cause	Suggested Solutions
The power can't be turned on.	• The connection to the power outlet is bad. • The DC power adaptor is broken.	• Please perform a conductivity test on the power cord and the fuse by using a circuit tester. If any failed, please replace it. • Please check the DC power adaptor's output voltage within 8V~24V.
There is no message on the display.	• The input connector of the linear scale is not firmly connected. • It is not in a ready condition for counting.	• Please confirm the signal input connector of the linear scale is connected firmly. • Please check the settings to understand the condition for counting.
The DRO miscounts.	• The signal input connector of the linear scale is not connected firmly. • The grounding connection is poor. • The electrical interference exists.	• Please confirm the input connector is connected firmly. • Please check that the grounding connections of the DRO counter and/or the machine is good. • Please check if there is any noise source near the DRO counter.
The display resolution is improper.	• The resolution of the counter parameters setting does not match the linear scale's specification. • The RAD/DIA parameter is set improperly. • The INCH/MM mode is set improperly.	• Please reset the resolution parameters of the linear scale of the DRO counter. • Please check and revise the parameters of the RAD/DIA. • Please check and reset the INCH/MM mode.

CHAPTER7
SPECIFICATIONS

Power Adaptor Supply	Input:AC85V~265V 50HZ/60HZ Output:DC12V
Power Consumption	5Watt max.
Operating Temperature Humidity	0℃~50℃ 20%~80%
Storage Temperature Humidity	0℃~55℃ 20%~80%
Linear Scale Interface Input Signal Level	TTL/CMOS
Frequency	100KHZ
External Interface	● RS232 ● External Zero (optional)
Resolution	0.0005mm~10mm
Display Turnover-rate	60HZ(min)
Dimension	214mm(W)*139mm(H)*29.5mm(D)
Weight	900g