

Maintenance Manual



KEB Series EDM

Table of Contents

1.	Introduction	1
	1.1 Preface	1
	1.2. Basic Tools for maintenance	2
	1.3. Maintenance Example	4
2.	1	
	2.1 System Structure	7
	2.2 .EBN EDM Parts structure and ID	9
	2.2.1 Control Box EBN1: Name, ID and Location	10
	2.2.2 Machine base EBN2: Name, ID and Location	15
3.	Wiring Description	17
	3.1 Power Controller (EBN-H): Wiring Description	17
	3.2 RIO Board (EBN-C7): Wiring Description	20
	3.3 Wiring of Side Board Connector in Control Box	22
	3.4 Wiring of Electrical Box on Machine Base	
	3.5 Wing of terminal on Machine Base	25
4.	Input/ Output (I/O) Description	
	4.1 I/O Displace	
	4.2 I/O Definition	28
	4.3 I/O Application (Using I/O for Trouble Shooting)	30
5.	Controller Setting and Reference data	31
	5.1 System Parameters Displace	31
	5.2 System Parameters Description	33
	5.3 Servo Adjustment	34
6.	EBN Series EDM Trouble Shooting.	35
	6.1 System unit functions Description	35
	6.2 Trouble Shooting and Maintenance Flow Chart	37
	6.2.1 Maintenance Flow Chart: Abnormal Machine Boot up	38
	6.2.2 Z axis movement by themselves after machine shut down	41
	6.2.3 Z axis can not move	4

EBN Series EDM Maintenance Manual

	6.2.4 W axis can not move	44
	6.2.5 Front Panel and Remote control box malfunction	45
	6.2.6 Pump can not turn on	48
	6.2.7 Spark System malfunction	50
	6.2.8 Polarity reverse switch malfunction	55
	6.2.9 Z axes won't stop while electrode touches workpiece	56
	6.2.10 Synchronize flush malfunction	57
	6.2.11 Oil Level Switch Malfunction	58
	6.2.12 Work light is not ON	59
	6.2.13 Buzzer is not ON	60
	6.2.14 Fire Alarm is not function	61
Appe	end+	
	(1) EBN-A [A Box] Wiring Diagram	
	(2) EBN-B [B Box] Wiring Diagram	
	(3) EBN-C1 【C Box 】 Wiring Diagram	
	(4) EBN-C2 [RIO Board] Wiring Diagram	
	(5) EBN-C3 【RIO Board】 Wiring Diagram	
	(6) CE Wiring Diagram	
	(7) EBN-D [D Box] Wiring Diagram	
	(8) EBN-E [E Box] Wiring Diagram	
	(9) EBN-F [F Box] Wiring Diagram	
	(10) EBN-G 【G Box】 Wiring Diagram	
	(11) EBN-H-1 【H Box】 Wiring Diagram	
	(12) EBN-H-2 【I Box】 Wiring Diagram	
	(13) EBN-I [I Box] Wiring Diagram	
	(14) EBN-J [J Box] Wiring Diagram	
	(15) EBN-K [K Box] Wiring Diagram	
	(16) EBN2- Electrical Box-1Wiring Diagram	
	(17) EBN2- Electrical Box-2Wiring Diagram	
	(18) Machine Rase Wiring Diagram	

1 Introduction

1.1 Preface

JS EDM is a PC-BASED EBN EDM Machine. The EDM System Structure combine with:

- 1. PC-BASED Controller developed by JS manufacture.
- 2. Spark power supply hardware developed by JS manufacture.
- 3. Servo System and Machine Base.

EBN-606 EDM maintenance manual includes:

- (1) System structure definition and description.
- (2) System structure function and description.
- (3) System structure error messages and trouble shooting. Basic knowledge needed:
 - (1) Familiar with EDM operation.
 - (2) Knowledge of basic Electronic and Computer •
 - (3) Basic Knowledge of mechanical Structure.
 - (4) Knowledge of using Multi Meter

1.2 Maintenance Note

Symbol used:

Symbol	Description
✓ Warning	Might cause damage to technician if not proper use
! Note	Might damage the machine if not correct wiring or incorrect
	installation.
№ Hint	Provide the information for service

! Note

- * *Please back up one copy of system parameter.
- * If there is any system parameters need to be changed, please back up one copy of the original system parameter for future used.

✓ Warning

- 1. Usually the machine is power on when technician is trouble shooting. Might cause electrical shot if not work carefully.
- 2. Do not touch the EDM when the machine is cutting. For the high voltage might cause electrical shot.
- 3. Do not put your hand in the mechanical structure while table is moving.

Mint

* parameters:

Please set up the proper parameter •

Wrong parameter might cause the machine operate not properly • Machine parameters are very important setting for correct operation.

*back up:

Parameter back up is important and necessary

1.2 Tools for Malignance

(1) Multi Meter: Multi Meter is used so often while Maintains. Digital Multi meter is suggested.

Minimum Requirement:

①Can Check ACV 0~750V

②Can Check DCV 0~250V

 $\Im \operatorname{Can} \operatorname{Check} \Omega \ 0 \sim 1 \operatorname{M} \Omega$



(2) Screw Driver: Needed when Connect or disconnect wire terminals



(3) Soldering Gun and Solder: Needed when replace electronic elements.



(4) Allen Key and Adjustable Wrench: Needed when assemble machine parts.



(5) Diagonal cutter & long nose pliers



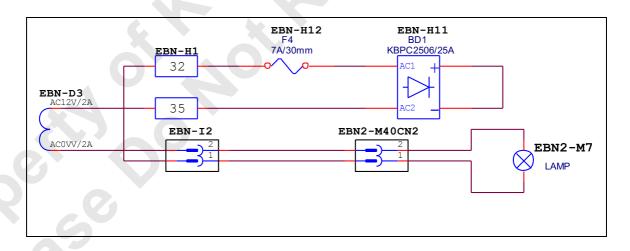
1.3 Maintenance Example

When machine is malfunction, please follow the Maintenance manual for trouble shooting.

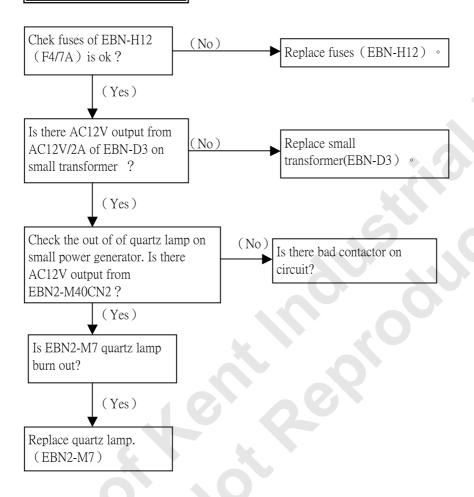
Example: "Working light is not ON" Function Failure

You can find "Working light is not ON" Trouble shooting in Chapter 6.12,

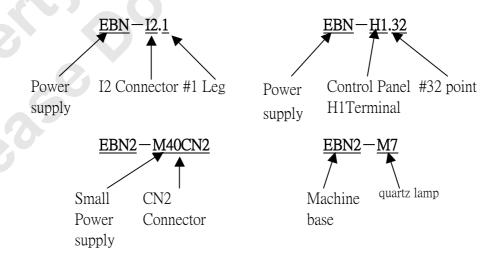
Reference Circuit



Maintenance flow chart



(1) Components symbol description:



- (2) Appendant Drawing is the schematic of EBN-600 EDM:
 - ① EBN-A.DSN——A Box schematic, includes the wiring of monitor.
 - \odot EBN-B.DSN B Box schematic, includes the wiring of servo driver.
 - \odot EBN-C1.DSN — C Box schematic, includes the wiring of controller.
 - ④ EBN-C2.DSN − − C Box schematic, includes the wiring of I/O interface.
 - \odot EBN-D.DSN D Box schematic , includes the wiring of big and small transformers.
 - ⑥ EBN-E.DSN E Box schematic, includes the wiring of all switches and press keys on Front panel.

 - EBN-G.DSN G Box schematic includes the wiring of transistors box.
 - ⊕ EBN-H1.DSN — H Box schematic , includes the wiring of Controller circuit.
 - EBN-H2.DSN H Box schematic , includes the wiring of Spark
 Control circuit.

 - ② EBN2.DSN——Small electrical Box schematic, includes the wiring of terminals and connectors on small electrical box.
 - (i) Machine Base Wiring. DSN Schematic of machine base, includes the wiring of all components.

2 EBN EDM Structure Description

2.1 System structure

JS EBN EDM machine power generator used PC-BASED controller. The spark system is developed by JS R&D department • The system specification is described as follow:

- (I) Controller: Industrial PC, Intel DX4-100 CUP is used for:
- ① I/O interface Data process.
- ② NC program compile.
- (3) Motion control
- 4 Spark control
- ⑤ motion control card. (X,Y axis control: optional)
- ⑥ One PULSE & GAP Board。
- (II) Servo: One DC SERVO DRIVER is used •
- (III) Spark POWER: There are 3 different specifications: 60A \ 120A \ 180A
- ① 60A→One high voltage board, one low voltage board ∘
- ② 120A→One high voltage board, two low voltage board ∘
- ③ 180A→One high voltage board, 3 low voltage board ∘

EBN EDM control system structure is shown as Fig. 2.1:

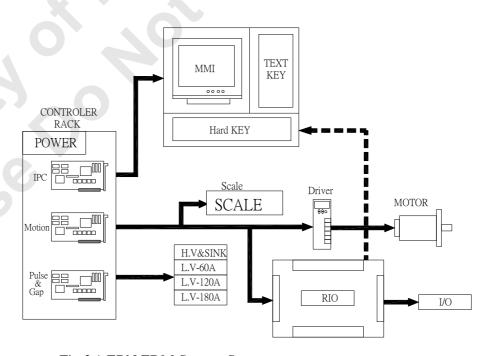


Fig 2.1 EBN EDM System Structure

EBN EDM Spark power structure is shown as Fig. 2.2.

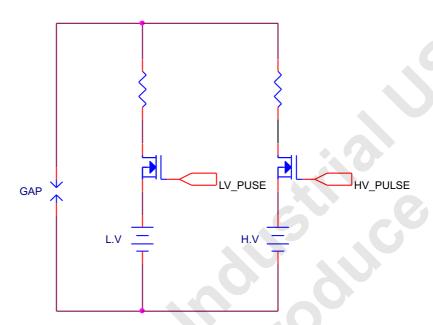


Fig. 2.2 EBN-600 Series. Schematic of Basic Spark Circuit Loop.

2.2 EBN EDM's structure and numbers for each parts

EB-600 Series: CNC EDM contains of control box and machine base. The controller and servo described above are in control box.

The drawing bellow is the main structure and parts numbers of EBN-600 CNC EDM

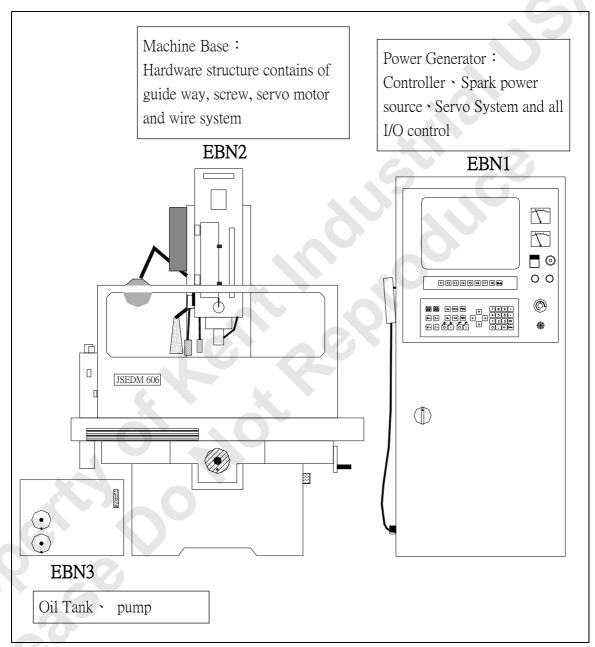


Fig. 2.3 EBN series EDM structure and numbers for each parts

2.2.1 Control box EBN1's structure and numbers for each parts

In spite of Control System and Spark System, Power Generator includes Power supply System and electrical panel. The structure is shown as follow:

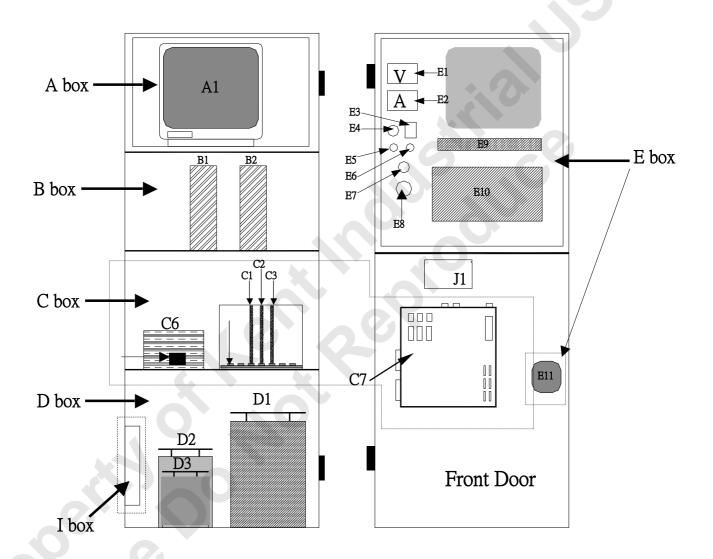


圖 2.3 EBN Front view of control box.

A box :

①EBN-A1: Monitor

B box:

①EBN-B1: X Axis motor driver ②EBN-B2: Y Axis motor driver ③EBN-B3: Z Axis motor driver ④EBN-B4: C Axis motor driver

C box:

- ①EBN-C1: IPC
- ②EBN-C2: Pulse & Gap card
- ③EBN-C3: Motion card
- **4**EBN-C4: Control board
- ③EBN-C5: Power filter of controller
- 6EBN-C6: Power supply (110V~220V/250W)
- ①EBN-C7: RIO board (IO interface board)

D box:

- ①EBN-D1: Large transformer (4.5KVA)
- ②EBN-D2: Medium transformer (1.5KVA)
- ③EBN-D3: Small transformer (1.2KVA)

E box:

- ①EBN-E1: Volt Meter (0~300V)
- ②EBN-E2: Amp Meter (0~200A)
- ③EBN-E3: Monitor switch
- 4EBN-E4: Emergency Stop (E.STOP)
- ⑤EBN-E5: [ON]
- ⑥EBN-E6: 【OFF】
- ①EBN-E7: Z Axis servo sensitivity adjustment
- **®EBN-E8**: buzzer
- @EBN-E10: Hard-Key board
- ①EBN-E11: Main Power

EBN-J1: Power source supply (provide power for RIO board)

Following is the rear view of control box:

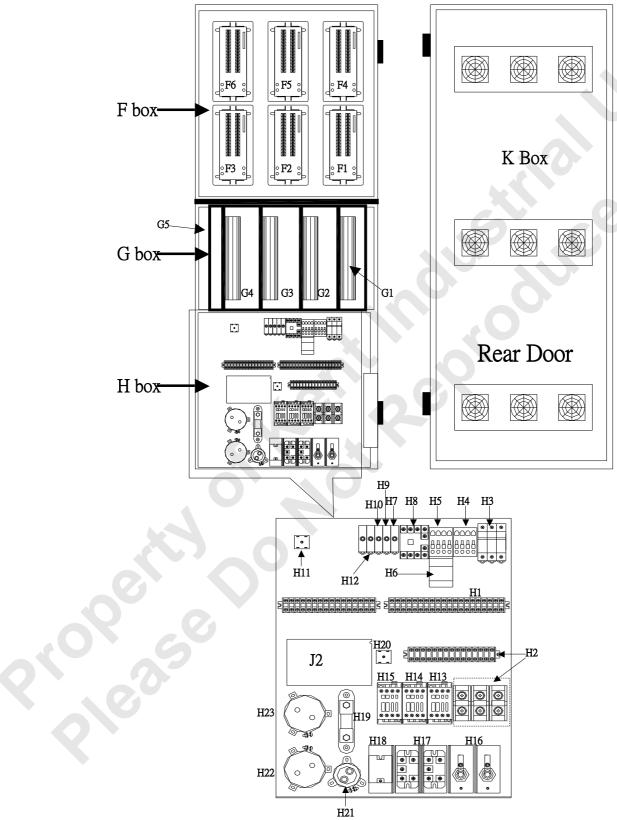


Fig2.4 EBN EDM. Rear view of control box.

Fbox: ①EBN-F1: Hi voltage current limit resistor. ②EBN-F2: Low voltage current limit resistor-1 (30A) ③EBN-F3: Low voltage current limit resistor -2 (60A) 4) EBN-F4: Low voltage current limit resistor -3 (90A) (5) EBN-F5: Low voltage current limit resistor -4 (120A) 6 EBN-F6: Low voltage current limit resistor -5 (180A) G box: ①EBN-G1: Hi voltage board ②EBN-G2: Low voltage board -1 (60A) ③EBN-G3: Low voltage board -2 (120A) 4) EBN-G4: Low voltage board -3 (180A) ③EBN-G5: G box board (transistor box board) H box: ①EBN-H1: terminal-1 (36 point) ②EBN-H2: terminal-2 (20 point) ③EBN-H3: Fuse-3P/25A (Main Power) 4EBN-H4: Relay (Control Main Power) ③EBN-H5: Relay (Control Pump) **©EBN-H6**: Overload Relay (Control Pump) ②EBN-H7: Fuse-7A (Power of controller) @EBN-H10: Fuse-3A (power of fans) ①EBN-H11: Rectifier ②EBN-H12: Fuse-2A (Power of quartz lamp) (i)EBN-H13: Relay (polarity switch control) (4) EBN-H14: Relay (Spark Control) (Spark control. For 90A and above) (6) EBN-H16: Diode ②EBN-H17: 3 phase rectifier (Low voltage spark rectifier) ®EBN-H18: 3 phase rectifier (Hi voltage spark rectifier) @EBN-H20: Rectifier (2nd Hi Voltage spark rectifier) ②EBN-H21: Capacitor (HiV Spark Filter) ②EBN-H22: Capacitor (Low V Spark Filter)

EBN-J2: Power Supply (Provide power for High and Low voltage board)

②EBN-H23: Capacitor (LowV Spark Filter. For 90A and above)

Side View of Control Box:

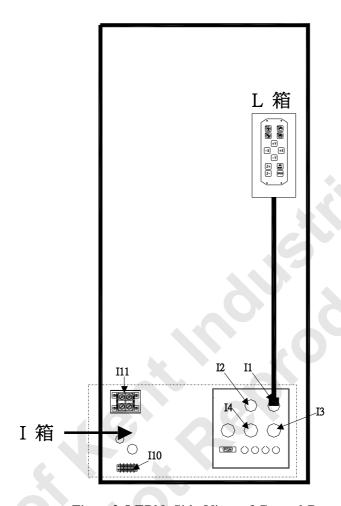


Fig. 2.5 EBN. Side View of Control Box

Ibox:

- ①EBN-I1: Remote control connector
- ②EBN-I2: Machine base wiring connector-1 (16 PIN)
- ③EBN-I3: Machine base wiring connector-2 (24 PIN)
- **4** EBN-I4 : CE connector
- ③EBN-I10: Main power connect terminal
- ⑥EBN-I11 : Polarity connect terminal

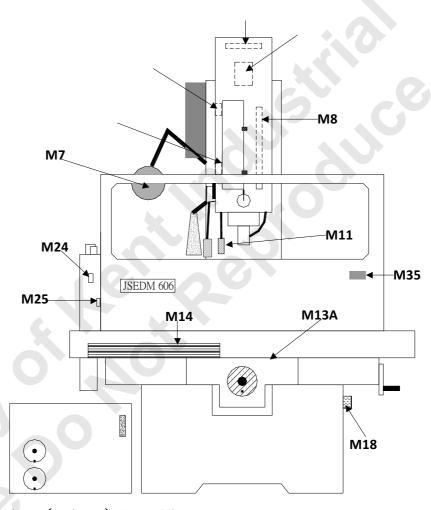
L box : Remote control

2.2.2 Machine Base EBN2's structure and numbers for each parts

Following picture is Machine Base Structure for CNC EDM , This Machine Base has 3 DC servo Motor $\,$, Control the motions of $X \cdot Y \cdot Z$ axis

Machine Base: Components locations, numbers and definition : (Machine Base symbol: M) $\,^{\circ}$

Front view of Machine base:



EBN2: Machine base (M box) -Front View

①EBN2-M1A: terminal-1

②EBN2-M3: Z axis DC servo motor

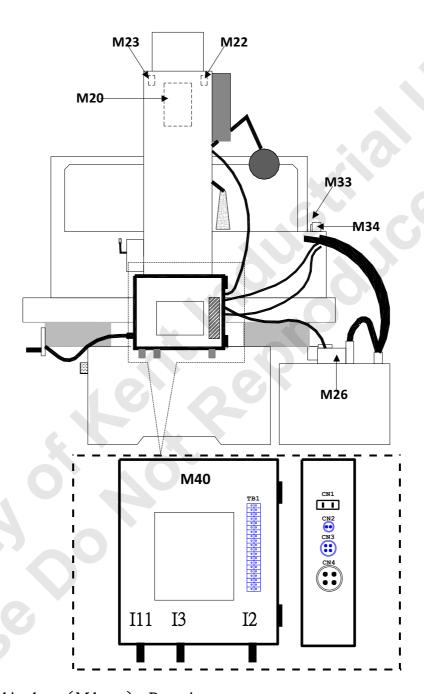
③EBN2-M5A: Z axis hardware + limit Switch

④EBN2-M5B : Z axis software + limit Switch⑤EBN2-M6 : Z axis hardware - limit Switch

©EBN2-M7 : Quartz light ⑦EBN2-M8 : Z axis DRO ®EBN2-M11 : Fire sensor ⑨EBN2-M14 : X axis DRO ©EBN2-M18 : Y axis DRO ①EBN2-M24 : synchronize flush②EBN2-M25 : Level Switch

③EBN2-M35: Oil Tank Door Limit Switch (CE Specific)

Machine Rear View:



EBN2: Machine base (M box) - Rear view

①EBN2-M20: W axis AC motor②EBN2-M22: W axis limit switch-up④EBN2-M23: W axis limit switch-down

©EBN2-M26: Inlet of Pump ©EBN2-M33: CE Emergency Stop ©EBN2-M34: CE Temp. Control switch ®EBN2-M40 : Small Control boxCN1 : AC110 connectorCN2 : Quartz lamp connector

CN3: Synchronize flush and level switch connectors

CN4: Pump connector TB1~TB4: terminal

3 Wiring Description

In this section, we provide detail description of Control Panel (EBN-H box) RIO board (EBN-C7) Connector of Side Board (EBN-I Box) Small electrical box (EBN-M40) and Terminal on Machine base (EBN-M1).

3.1 Wiring of Control panel (EBN-H Box)

Control Panel controls and provides power for all electrical Boxes, includes:

Controller Spark Servo Motor and convert power supply.

For Terminal (EBN-H1): Receives Voltage Output from Transformer, through the control loop of Control Panel, then Output to controller, convert type power supply, etc.

For Terminal (EBN-H2): Power control and Voltage, Current detect while Sparking.

M Hint

- * Refer to schematic of EBN-H Box.
- *Refer to Chapter 2 EBN-H box's components location and description
- (1) Wiring description of Terminal (EBN-H1):
 - H1.1: Connect Main power Switch (EBN-E11) Output-R •
 - H1.2: Connect Main power Input (EBN-E11) Output-S •
 - H1.3: Connect Main power Input (EBN-E11) Output-T •
 - H1.4: Connect Small Transformer (EBN-D3) Input side ACOV •
 - H1.5 : Connect Small Transformer (EBN-D3) Input side AC220V~AC415V °
 - H1.6: Connect RIO Board (EBN-C7): JP1.1 •
 - H1.7: Connect RIO Board (EBN-C7): JP1.2 •
 - H1.8: Connect Large Transformer (EBN-D1) Input SideR/AC220V~415V o
 - H1.9: Connect Large Transformer (EBN-D1) Input Side S/AC220V~415V°
 - H1.10 : Connect Large Transformer (EBN-D1) Input Side T/AC220V~415V °
 - H1.11: Connect RIO Board (EBN-C7): JP1.9 •
 - H1.12: Connect RIO Board (EBN-C7): JP1.10 •
 - H1.13: ©Connect Side Board Connector(EBN-I2)PIN3---<u>PUMP Power-R</u> ° ©Connect Medium Transformer (EBN-D2) Input side ACOV °
 - H1.14: Connect Side Board Connector (EBN-I2) PIN4---PUMP power-S •
 - H1.15: ©Connect Side Board Connector(EBN-I2)PIN5---<u>PUMP power-T</u> ° ©Connect Medium Transformer (EBN-D2) Input Side AC220V~415V °

- H1.16 : Connect Small Transformer (EBN-D3) Output Side AC110V/6A (0V) °
- H1.17 : Connect Small Transformer (EBN-D3) Output side AC110V/6A (110V) °
- H1.18 : Connect Small Transformer (EBN-D3) Output Side AC110V/2A (0V) °
- H1.19 : Connect Small Transformer (EBN-D3) Output Side AC110V/2A (110V) °
- H1.20: Connect RIO Board (EBN-C7): JP1.19 •
- H1.21: Connect RIO Board (EBN-C7): JP1.20 •
- H1.22: Connect Panel ON Key (EBN-E5) Connect point#3 °
- H1.23: Connect Panel ON Key (EBN-E5) Connect point #4 •
- H1.24 : Connect Medium Transformer (EBN-D2) Output side AC220V/1.5A (0V)
- H1.25 : Connect Medium Transformer (EBN-D2) Output side AC220V/1.5A (220V)
- H1.26: ©Connect Controller Power Filter (EBN-C5): LINE-1 ° ©Connect RIO Board Convert type power supply (EBN-J1): InputAC-1 °
 - ③Connect Side BoardEBN-I2.7, ACOV。
- H1.27: ©Connect Controller Power Filter (EBN-C5): LINE-2 ° ©Connect RIO Board Convert type power supply (EBN-J1): InputAC-2 °
- H1.28 : Connect L.V&H.V Board Convert type power supply (EBN-J2) : InputAC-1 °
- H1.29 : Connect L.V&H.V board Convert type power supply (EBN-J2) : InputAC-2 $^{\circ}$
- H1.30 : Connect power of Fan (EBN-K box) InputAC-1 •
- H1.31 : Connect power of Fan (EBN-K Box) InputAC-2 •
- H1.32 : Connect Side Board Connector (EBN-I2) PIN1---Quartz Light 0V •
- H1.33: Connect RIO Board (EBN-C7): JP5.9 •
- H1.34: Connect RIO Board (EBN-C7): JP5.10 •
- H1.35 : Connect Small Transformer (EBN-D3) Output Side AC12V/1.5A (0V) °
- (2) Wiring description of terminal (EBN-H2):
 - H2.41: Connect RIO Board (EBN-C7): JP1.5 •
 - H2.42 : Connect RIO Board (EBN-C7) : JP1.6 •
 - H2.43: Connect RIO Board (EBN-C7): JP1.7 °
 - H2.44: Connect RIO Board (EBN-C7): JP1.8 •

- H2.45 : Connect RIO Board (EBN-C7) : JP1.1 ° H2.46 : Connect RIO Board (EBN-C7) : JP1.2 °
- H2.47:
 ©Connect Volt meter (EBN-E1):+ End

 ©Connect MOTION card (EBN-C2): JP2.2
 •
- H2.48: ①Connect Volt meter(EBN-E1)的一End ②Connect MOTION card(EBN-C2): JP2.3。
- H2.49: Connect Amp meter (EBN-E2) 的+End
- H2.50: Connect Amp meter (EBN-E2) 的—End
- H2.51: Connect Transistor Board (EBN-G5): S24 point
- H2.52: Connect Transistor Board (EBN-G5): S10 point
- H2.53: Connect Transistor Board (EBN-G5): S1 point •
- H2.54: Connect Transistor Board (EBN-G5): S2 point •
- H2.55 : Connect HV Current Limit frame (EBN-F1) : S1 point •
- H2.56: Connect Transistor Board (EBN-G5): S6 point •
- H2.57: Connect Transistor Board (EBN-G5): S7 point •
- H2.58: Connect LV Current Limit frame (EBN-F2): S1 point •

3.2 Wiring of RIO Board (EBN-C7)

RIO Board provides the Output and Input function for EBN Series EDM machine. In spite of the Input/Output signal of operation Panel, all other Input and Output signals are process by RIO Board, such as Limit Switch, Polarity switch, Fire Alarm Signal, Short circuit Signal and etc.

Output/Input Signals of RIO Board are connected to the socket (JP1~JP12) . JP1.7 means Pin7 point on socket JP1.

M Hint

```
*Refer to schematic of EBN-C7
```

*Refer to Chapter 2 EBN-C Box components location and description

(1) Wiring description of socket JP1:

```
JP1.1: Connect Control Panel EBN-H1.6, Power On Signal •
```

JP1.2: Connect Control Panel EBN-H1.7, Power On Signal •

JP1.3 : Connect coil of relay (only CE) •

JP1.4 : Connect coil of relay (only CE) •

JP1.5 : Connect Control Panel EBN-H1.41 , Spark ON Signal •

JP1.6 : Connect Control Panel EBN-H1.42 , Spark ON Signal 。

JP1.7: Connect Control Panel EBN-H1.43, Polarity switch Signal

JP1.8 : Connect Control Panel EBN-H1.44 , Polarity switch Signal •

JP1.9: Connect Control Panel EBN-H1.11, PUMP On Signal

JP1.10: Connect Control Panel EBN-H1.12, PUMP On Signal

JP1.11: Fast oil PUMP On Signal (Only 707~909)

JP1.12: Fast oil PUMP On Signal (Only 707~909) •

JP1.13: Connect Side BoardEBN-I2.9, Waxis UP Signal •

JP1.14 : Connect Side BoardEBN-I2.8 , W axis common point •

JP1.15 : Connect Side BoardEBN-I2.10 , W axis Down Signal •

JP1.16: Open Loop •

JP1.17: Open Loop •

JP1.18: Open Loop •

JP1.19: Connect Control Panel EBN-H1.20, POWER ON Signal

JP1.20 : Connect Control Panel EBN-H1.21 , POWER ON Signal •

(2) Wiring description of socket JP2:

JP2.1: Connect Control Panel EBN-H2.45, Short circuit Signal + point •

JP2.2: Connect Control Panel EBN-H2.46, Short circuit Signal — point •

```
(3) Wiring description of socket JP5:
   JP5.1: Connect Oil Tank Door Limit Switch (Only CE Specific) •
   JP5.2 : Connect Oil Tank Door Limit Switch (Only CE Specific)
   JP5.3 : Open Loop •
   JP5.4 : Connect Side BoardEBN-I2.14 , Synchronize Flush Signal
   JP5.5: Open Loop。
   JP5.6: Connect Side BoardEBN-I2.13, Level Switch •
   JP5.7: Open Loop •
   JP5.8 : Connect Side BoardEBN-I2.16 , FIRE ALARM •
   JP5.9 : Connect Control Panel EBN-H1.33 , FIRE ENABLE ( + ) 。
   JP5.10 : Connect Control Panel EBN-H1.34 , FIRE ENABLE ( – ) 。
   JP5.11: Open Loop •
   JP5.12 : Connect Side BoardEBN-I2.15 , Z axis   Limit Signal   ·
   JP5.13 & JP5.14 : SHORT •
   JP5.15: Open Loop •
   JP5.16: Open Loop •
(4) Wiring description of socket JP8:
   JP8.1: Connect Side BoardEBN-I2.11, DC+24V o
   JP8.2: Connect Side BoardEBN-I2.12, GND o
(5) Wiring description of socket JP12:
   JP12.1: Opoint for Connecting E. STOP Switch (EBN-E3) on panel •
   JP12.2: Opoint for Connecting E.STOP Switch (EBN-E3) on panel •
   JP12.3: Connect Buzzer (EBN-E8) 的+End。
   JP12.4: Connect Buzzer (EBN-E8) 的一End
   JP12.5: Opoint for Connecting OFF Key (EBN-E6) on panel •
   JP12.6: Opoint for connecting [OFF] Key (EBN-E6) on panel •
```

(6) Wiring description of other sockets:

JP3: Connect Side BoardEBN-I1, Remote Box signal.

JP4: Connect JP3 of MOTION Board •

JP11: Extra I/O point •

3.3 Wiring of Side Board Connector :

Side Board (EBN-I Box) is to connect Small Electrical Box on Machine Base to Control Box • Through the Side Board can control the motion of machine base, DRO feedback, pump ON/OFF and I/O Signal of machine base. Side Board Connector is marked as EBN-I.

Example: I2.4 means PIN4 on Connector I2.

I1: connector to remote control box.

I4: Special design for the connector of CE model.

I3 is DRO $(X \cdot Y \cdot Z)$ Connector;

Following is the wiring description of Connector I2 to Small Electrical Box (EBN-M40) on machine base.

M Hint

- *Refer to the schematic of EBN-I Box •
- *Refer to Chapter 2 EBN-I box's components location and description
- (1) Wiring description of I2 Connector:
 - I2.1 : Connect to CN2.1 on Small Electrical Box (EBN2-M40) , Quartz lamp/AC12V $^{\circ}$
 - I2.2 : Connect to CN2.2 Small Electrical Box (EBN2-M40) , Quartz lamp/AC0V $^{\circ}$
 - I2.3 : Connect to CN4.1 on Small Electrical Box (EBN2-M40) , PUMP Power (R) ,
 - I2.4 : Connect to CN4.2 on Small Electrical Box (EBN2-M40) , PUMP Power (S) ,
 - I2.5 : Connect to CN4.3 on Small Electrical Box (EBN2-M40) , PUMP Power (T) $\,^\circ$
 - I2.6 : Connect to TB1.20 on Small Electrical Box (EBN2-M40) , PUMP Ground
 - I2.7: Connect to CN1.2 on Small Electrical Box (EBN2-M40), AC110V •
 - I2.8 : ① Connect to CN1.1 on Small Electrical Box (EBN2-M40) , AC0V \circ
 - ② Connect to TB1.1 on Small Electrical Box (EBN2-M40), W axis common point。
 - I2.9 : Connect to TB1.2 on Small Electrical Box (EBN2-M40) , W axis UP Signal $\,^\circ$
 - I2.10 : Connect to TB1.3 on Small Electrical Box $\,$ (EBN2-M40) $\,$, W axis Down Signal $\,$ $^{\circ}$
 - I2.11: Connect to CN3.1 on Small Electrical Box (EBN2-M40), DC24V o

- I2.12: ① Connect to CN3.2 on Small Electrical Box (EBN2-M40), DC0V °
 - ② Connect to TB1.4 on Small Electrical Box (EBN2-M40), FIRE ALARM (+) END °
- I2.13: Connect to CN3.3 on Small Electrical Box (EBN2-M40), Level Switch •
- I2.14: Connect to CN3.4 on Small Electrical Box (EBN2-M40), Synchronize Flush Signal •
- I2.15 : Connect to TB1.5 on Small Electrical Box (EBN2-M40) , Z axis ⊕ Limit Signal •
- I2.16: Connect to TB1.4 on Small Electrical Box (EBN2-M40), FIRE ALARM - END •
- (2) Wiring description of I3Connector:
 - I3.1 : Connect to TB1.7 on Small Electrical Box (EBN2-M40) , Z axis Motor Power ⊕End ∘
 - I3.2 : Connect to TB1.8 on Small Electrical Box (EBN2-M40), Z axis Motor Power ©End •
 - I3.3 : Connect to TB1.9 on Small Electrical Box (EBN2-M40) , Z axis TG +End •
 - I3.4 : Connect to TB1.10 on Small Electrical Box (EBN2-M40), Z axis TG —End •
 - I3.5 : Connect to TB1.11 on Small Electrical Box (EBN2-M40), Z axis Protect common point •
 - I3.6 : Connect to TB1.12 on Small Electrical Box (EBN2-M40), Z axis Protect Signal •
- 1010250 13.7 : Connect to TB1.13 on Small Electrical Box (EBN2-M40) , Z axis Protect Signal •

3.4 Wiring of Terminal in Small Electrical Box of Machine Base:

The main function of Small Electrical Box (EBN2-M40) is to connect the power source and control signals between Electrical Box (EBN1) and Machine Base (EBN2), and easy for connecting and trouble shooting.

Hint

- *Refer to schematic of small electrical box
- *Refer to Chapter 2 EBN2-M40 box: Component location and description

(1) Wiring description of TB1 terminal:

TB1.1: W axis common point.

TB1.2: W axis UP signal.

TB1.3: W axis DOWN signal.

TB1.4: Fire detector Signal + End.

TB1.5 : Z axis + Limit Switch Signal.

TB1.6: Fire detector Signal —End.

TB1.7 : Z axis Motor + End.

TB1.8: Z axis Motor—End.

TB1.9: Z axis Motor TG+End.

TB1.10: Z axis Motor TG—End.

TB1.11: Z axis Protect Switch common point.

TB1.12 : Z axis + Protect Switch Signal.

TB1.13: Z axis — Protect Switch Signal.

3.5 Wiring of terminal on Machine Base:

Hint

- * Refer to the schematic of Machine base Wiring •
- *Refer to Chapter 2 EBN2-M Box: Components location and Description $^{\circ}$

The wiring of terminal (EBN2-M1) is described as following:

- M1.1: Z axis Motor + End.
- M1.2: Z axis Motor—End.
- M1.3: Z axis Motor TG + End.
- M1.4: Z axis Motor TG—End.
- M1.5: Z axis Protect Switch common point.
- M1.6 : Z axis + Protect Switch Signal.
- M1.7: Z axis Protect Switch Signal.
- M1.8: ① Z axis Limit Switch common point.
 - ② Fire Detector Signal −End.
- M1.9: Z axis + Limit Switch Signal.
- M1.10: Fire Detector Signal + End.

4 Input/ Output (I/O) Description

The I/O status will show on the screen for trouble shooting •

4.1 I/O Display

I/O Displace:

(1) Press [ESC] key under Main Screen and Enter to System Screen.

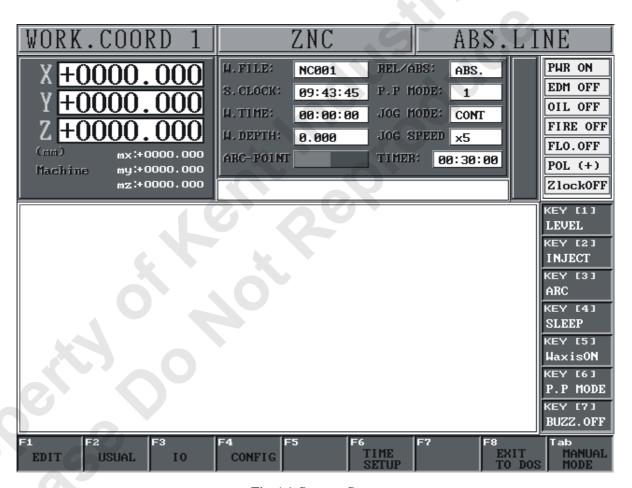
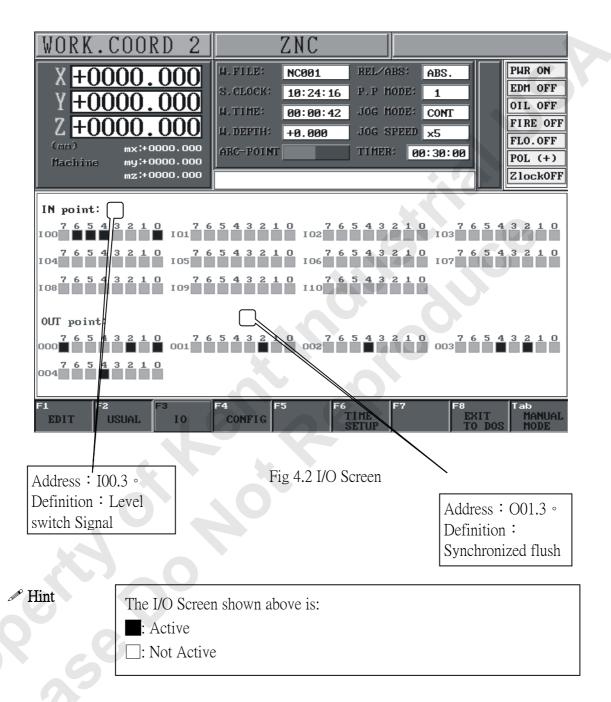


Fig 4.1 System Screen

(2) Press [F3 I/O] key and the I/O status is shown on screen.



4.2 Definition of I/O

I BIT (Input) Definition and Address

i									
		BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
	ВҮТЕ 0	Short Signal	OFF Key	Z- Limit Switch	Z+ Limit Switch	Level Switch	Oil Tank Door Switch	UPS OFF Signal	E.STOP Key
	LED Display	LED31	LED29	LED24	LED21	LED30	LED28	LED26	LED3,23
	BYTE 1	×	×	Fire Alarm Signal	XY Axis motor ON	Reserved Input 4	Reserved Input 3	Reserved Input 2	Reserved Input 1
	LED Display	*	*	LED1	LED33	LED32	LED27	LED25	LED22
	BYTE 2	Front Panel Number 7	Front Panel Number 6	Front Panel Number 5	Front Panel Number 4	Front Panel Number 3	Front Panel Number 2	Front Panel Number 1	Front Panel Number 0
	LED Display	*	*	*	*	*	*	*	*
	BYTE 3	×	+/-	End	PgDn	NO		Front Panel Number 9	Front Panel Number 8
	LED Display	*	*	*	*	*	*	*	*
	BYTE 4	×	×	W-	W+	W Axis ON	Z-	Z+	Z axis Fast UP
	LED Display	*	*	*	*	*	*	*	*
	BYTE 5	YES	Home	PgUp	Pump ON	Pump OFF	Spark ON	Spark OFF	F8
	LED Display	*	*	*	*	*	*	*	*
	ВҮТЕ 6	ENTER	CLEAR	-	+	RIGHT	LEFT	DOWN	UP
40)	LED Display	*	*	*	*	*	*	*	*
	BYTE 7	F7	F6	F5	F4	F3	F2	F1	ESC
	LED Display	*	*	*	*	*	*	*	*
	BYTE 8	Remote Control Box Slow Z-	Remote Control Box Slow Z+	Remote Control Box Fast Z-	Remote Control Box Fast Z+	Remote Control Box Pump OFF	Remote Control Box Pump ON	Remote Control Box Spark OFF	Remote Control Box Spark ON

EBN Series EDM Maintenance Manual

LED								
Display	*	*	*	*	*	*	*	*

ВҮТЕ9	×	×	×	×	Remote Control Box Y-	Remote Control Box Y+	Remote Control Box X-	Remote Control Box X+
LED Display	*	*	*	*	*	*	*	*

Note: * means no LED Display

O BIT (Output) Definition and Address

	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
ВҮТЕ 0	Z Axis Break	H. Pump Motor	Pump	Neg. Polarity Spark	Positive Polarity Spark	Main Spark Power	External Power switch	E.STOP Control
LED Display	LED15	LED10	LED9	LED7	LED6	LED5	LED4	LED3,23
BYTE 1	×	×	×	×	Synchronize Flush	XY Axes Driver	W Axis Down	W Axis UP
LED Display	*	*	*	*	LED13	LED16	LED12	LED11
BYTE 2	Reserved Output 2	Reserved Output 1	Buzzer	XY Axis Servo Motor lock	Y- axis Motion	Y+ axis Motion	X- axis Motion	X+ axis Motion
LED Display	*	*	*	LED19	LED20	LED18	LED17	LED14
BYTE 3	×	×	Pump ON LED	Pump OFF LED	Spark ON LED	Spark OFF LED	Z Axis Fast up LED	W Axis ON LED
LED Display	*	*	*	*	*	*	*	*

 $\frac{1}{2}$ Note: $\mathbb{F} * \mathbb{J}$ means no LED Display

4.3 Application of I/O (Use I/O to check Circuit)

(1) Example 1: Use INPUT to check Circuit
INPUT Address: I00.4:
Address I00.4 is Z+ Limit. When Z+ axis limit is not trigged, ☐ is shown
in the address I00.4. When $Z+$ axis limit is trigged, \blacksquare is shown in address I00.4. (address
I00.4 LED Display from \longrightarrow \bigcirc) \circ If Address I00.4 is shown as above, it means the circuit of Z
+ limit is normal.
If $Z+$ limit is not trigged and \blacksquare is shown in Address IOO.4, it means there is short circuit in Z
+ limit. Please refer to Chapter 2 and find out the Z+ limit switch. Base on the schematic for
trouble shooting till is shown in address I00.4
(2) Example 2: Use OUTPUT to check Circuit
OUTPUT Address: O00.5:
Address O00.5 is output Signal of Oil Pump. When is shown in Address
000.5, it means there is AC110V output from Point 9(AC110V) of JP1 socket on RIO board
(EBN-C7) and Point 10(AC0V) for the relay of oil pump.
While the Pump Button is pressed, the display of Address O00.5 should be changed from □→
If the Relay of oil pump is not function properly, please check the wire from JP1.9 and JP1.10 v
to Relay or replace RIO Board.

5 Controller Setting and Reference data

JS EBN EDM Controller is a PC_BASE controller. There are some internal parameters need to be preset.

5.1 Display System Parameter

Operation of display System Parameter Screen:

(1) Press [ESC] Key under Main screen and enter to system screen.

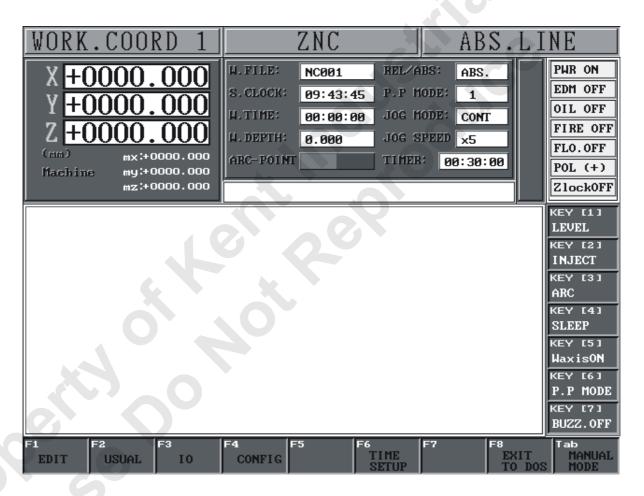


Fig 5.1 System Screen

(2) Press [F4 Parameter] and enter I/O Screen.

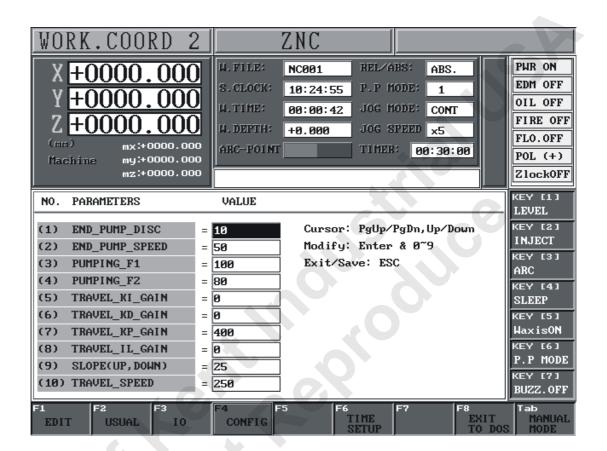


Fig 5.2 System parameter Screen

21000000

5.2 Description of System Parameter

ID	Name of Parameter	Default	Description
1	END_PUMP_DISC	40	End distance of Electrode retract to previous position (Unit: pulse)
2	END_PUMP_SPEED	5	End Speed percentage of Linear PUMPING
3	PUMPING_F1	100	Electrode Retract Speed(2 nd Step) (Unit: pulse/5ms)
4	PUMPING_F2	80	Electrode Retract Speed(3 rd Step) (Unit: pulse/5ms)
5	TRAVEL_KI_GAIN	0	KI Gain of Z axis LM628 while Traveling
6	TRAVEL_KD_GAIN	0	Differential Gain G of Feed Rate
7	TRAVEL_KP_GAIN	400	KP Gain of Z axis LM628 while Traveling
8	TRAVEL_IL_GAIN	0	Reserved
9	SLOPE(UP, DOWN)	25	Slope of Z axis when Increase/ Decrease Speed
10	TRAVEL_SPEED	250	Travel Speed of G00
11	HOME_SPEED	300	Speed of Homing.
12	EDGE_SPEED	20	Feed Rate of EDGE
13	LAG_PROTECT_REF	200	Max. LAG Value. Alarm is ON when LAG is greater than this value.
14	OPTICAL_SCALE	5	DRO Scale Value
15	MAXIMAL_CURRENT	60	Max. Spark Current
16	RESERVED4	0	Reserved
17	RESERVED3	0	
18	RESERVED2	0	Reserved
19	RESERVED1	0	Reserved
20	RESERVED0	0	Reserved

! Note

*The parameters listed above are default value from manufacture. Change any parameter might effect the performance.

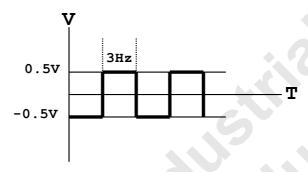
If the parameters are changed by accident, please check the Parameter Setting Table.

5.3 Servo Adjustment

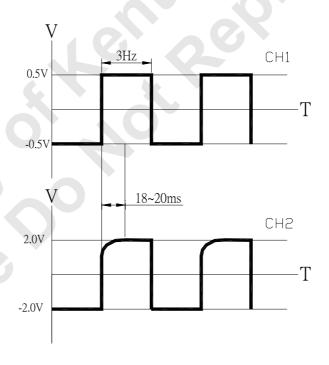
Servo Driver is the driver of Servo Motor. If the driver is not tune well, the EBN Spark performance will be loose.

Method of Adjustment:

(1) Use square wave generator to create a square wave. The voltage and frequency is shown as bellow:



- (2) Add Vim Leg to square wave.
- (3) Use oscilloscope: Use CH1 to detect Vin and GND ${}^{\circ}$ CH2 to detect TG and GND ${}^{\circ}$
- (4) Adjustment steps are shown as bellow. Use CH2 and having the Wave shown as bellow:



- ①Adjust GT GAIN and have Wave Height equal to 2.0V
- ②Adjust DC GAIN Knob and have Wave Slope equal to 18~20ms.
- 3 Adjust LAG value between 30~40.

6 EBN Series EDM Trouble Shooting

During the process of maintenance, please refer to the schematic of EBN ZNC EDM machine in the maintenance manual. With the schematic in previous chapters can help the technician for trouble shooting.

6.1 System unit functions Description

EBN series Power Controller can be classified base on its function:

- ① Spark Operation:
- ② Spark Auto operation:
- 3 Spark Signal Generate/ Control:
- © Power generator:

Table of the function:

Table of the function .				
System Name	ID	Function		
Spark Operation	EBN-E10	Main Key Board		
	EBN-E9	Function Key		
	EBN-E5/EBN-E6	ON/OFF Key		
	EBN-E11	Main power switch		
	EBN-C3	I/O Card		
	EBN-C7	RIO Interface Board		
Spark Auto operation	EBN-C1	IPC		
W. Line	EBN-C3	I/O & Motion		
	EBN-C7	RIO Interface Board		
(4,00		(1) Spark Output Control		
3' \)		(2) Polarity Switch		
		(3) Main Power/Pump		
		Power Control		
		(4) Fire Alarm Circuit Loop		
Spark Signal Generate/ Control	EBN-C2	GAP&PULSE Board		
	EBN-G1	Spark HV Output Board		
	EBN-G2	Spark LV Output Board		
	EBN-F1	HV Current Limit Frame		
	EBN-F2,F3	LV Current Limit Frame		

Spark Servo Action Control	EBN-C3	Motion card
Power Supply Parts	EBN-D1	(1)Provide HV/LV AC 3phase
		Power.
		(2) Provide Power of Pump
	EBN-D2	((1) Provide AC 110V Power
		of Servo Controller
		(2)Provide AC 110V Power of
		Servo Motor
	EBN-D3	(1)Provide AC 110V Power of
		Controller
		(2)Provide AC 110V Power of
		HV/LV Board
		(3)Provide AC 110V Power of
		Fan
		(4) Provide AC 12V Power of
		quartz Light
	EBN-J1	(1) Provide DC +12V, +5V
		for RIO Interface Board.
.10		(2)Provide AC 110V Power of
		RIO Interface Board
	EBN-J2	Provide DC +12V, +5V for
		HV/LV Board DC+5V \
		DC+12V
40.0		

6.2 Trouble Shooting and Maintenance Flow Chart

Please refer to operation manual, confirm the function of each key/ Signal LCD for trouble shooting.

Please check the following item while the machine has problem:

- (1) Status of problem:
- ① When machine has problem, the function key LED Light on panel will be On or Off and the error message will show on screen.
 - ² The status of machine motion.
 - 3 Position of working head / Status of workpiece / Status of Oil Tank
 - (2) Is operation process correct?
 - (3) Please check each abnormal unit and restart the power

✓ Danger

- 1. Be aware of electrical shot while the machine is ON during trouble shooting. Please turn off power while replace components and unplug connector.
- 2. Before restart the power, please make sure each connect

! Note

If the customer need the service from manufacturer, Please provides the following information and fax it to JSEDM. Our engineer will reply to you ASAP.

(1) Information on Machine Head:

Serial Number:

Date:

Model:

- (2) Please use the name of component and parts described in the operation manual and fax it to us:
 - ① Describe the status of problems
- ② LED Light ON/OFF of each function key and the Error Message on Screen.
 - 3 Position of working head and status of oil tank.
 - Damaged component:
 - a. Name
 - b. Parts and location
 - c. Status of damage, such as burn out, broken and not

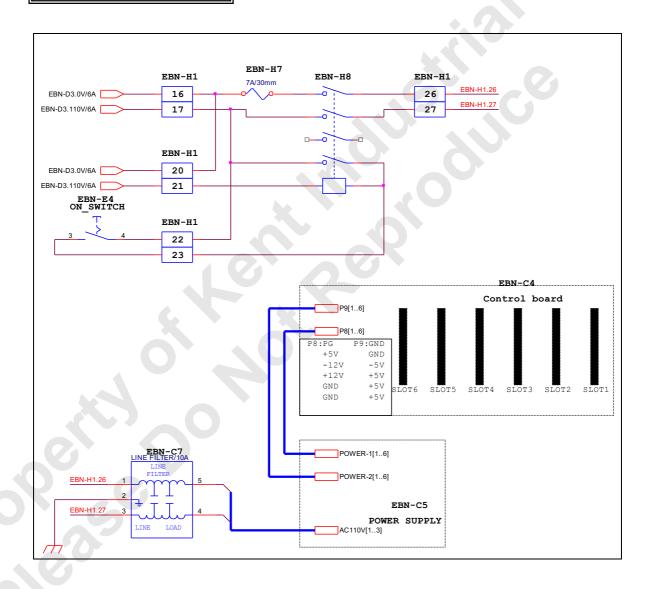
function.

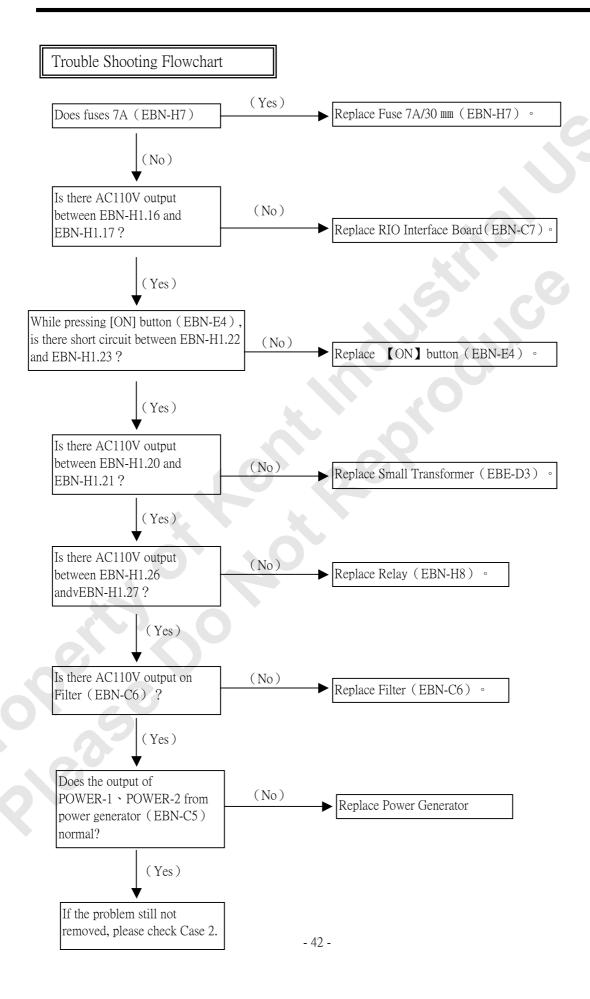
6.2.1 Maintenance Flow Chart: Abnormal Machine Boot up

Case 1: when main power is ON, press [ON] and can not turn on controller

**Refer to Schematic: EBN-C1.DSN · EBN-H1.DSN · EBN-E.DSN ·

Reference Schematic





Case 2: Can not execute EBN program. Enter system screen.

Trouble shooting Flow

turn on the power.

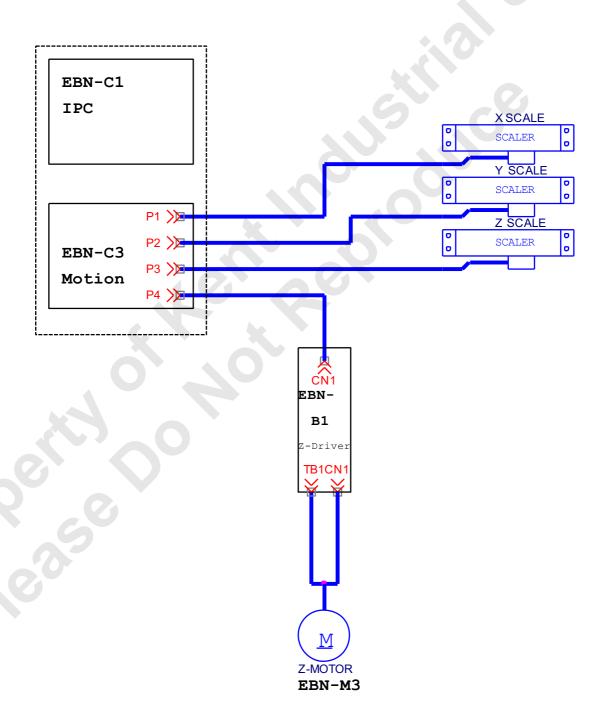
Insert "DOS" Disk. Can you enter DOS mode after reboot the controller? Finish (No) Shut down the power, replace IPC(EBN-C1),

6.2.2 Z axes movement by themselves after machine turn

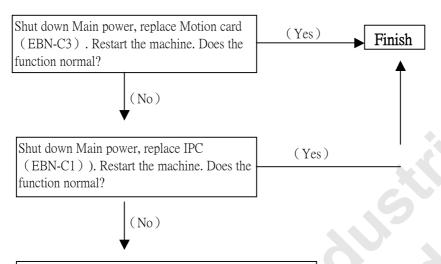
on

**Reference Schematics: EBN-B.DSN · EBN-C1.DSN · EBN-C2.DSN · EBN-C3.DSN ·

Reference Schematics



Trouble Shooting flow chart



Check the following connection base on the Reference Schematic above.

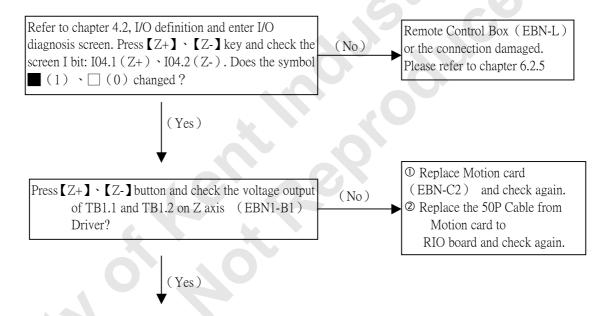
- ① From CON3 of EBN-C3 to CN1 of EBN1-B1.
- ② Z axis: CN1 of EBN-B1 to Z axis motor EBN2-M3
- ③ Z axis DRO to P3 of EBE-C7.

6.2.3 Z axis can not move

There are 4 possibilities:

- (1) 【Z+】、【Z-】 press key on remote control box damaged.
- (2) Motion card (EBN-C3) damaged.
- (3) Z axis DRIVER damaged.
- (4) Z axis motor damaged.

*Reference Schematic: Refer to the schematic in Chapter 6.2.2

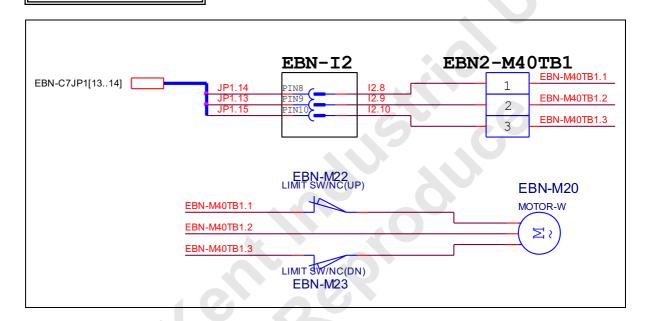


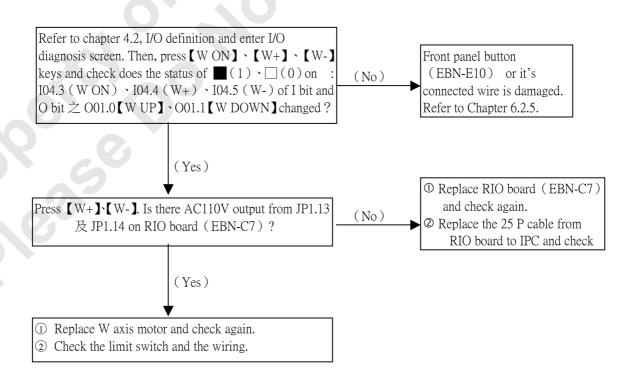
- ① Replace Z axis motor and check again.
- ② Replace Z axis Driver and check again.
- 3 Check limit switches and the circuit. Make sure the function is normal.

6.2.4 W axis function is abnormal.

**Reference Schematics: EBN-C7.DSN EBN-small electrical box. DSN EBN-Machine Base wiring. DSN •

Reference Schematics





6.2.5 Front Panel and Remote control box malfunction

FAQ of Front Panel:

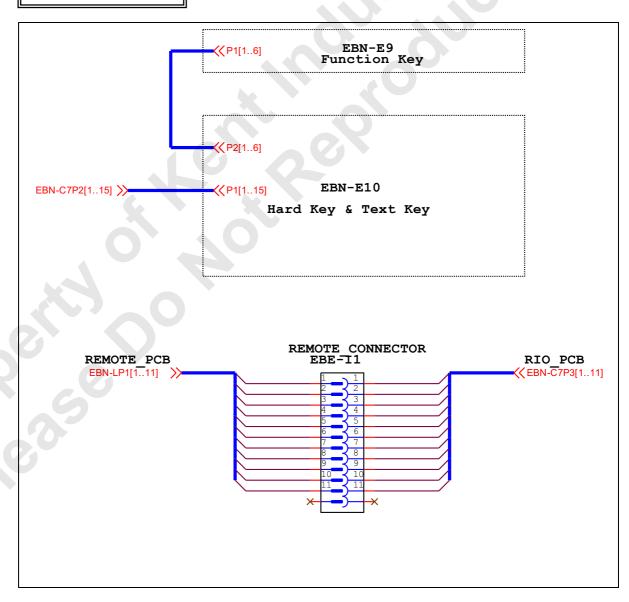
- (1) Press Key on Panel is not valid.
- (2) LED is not ON

FAQ of Remote Control Box:

- (1) Press Key on Remote Control Box is not valid.
- (2) LED is not ON

**Reference Schematics: EBN-E.DSN · EBN-C1.DSN · EBN-C2.DSN ·

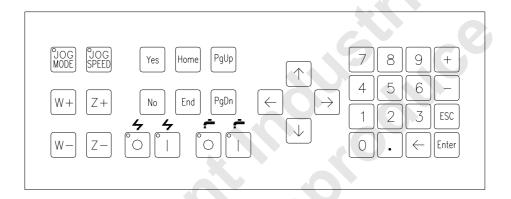
Reference Schematics

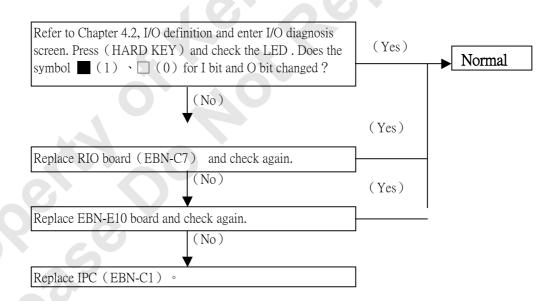


Trouble shooting Flow Chart

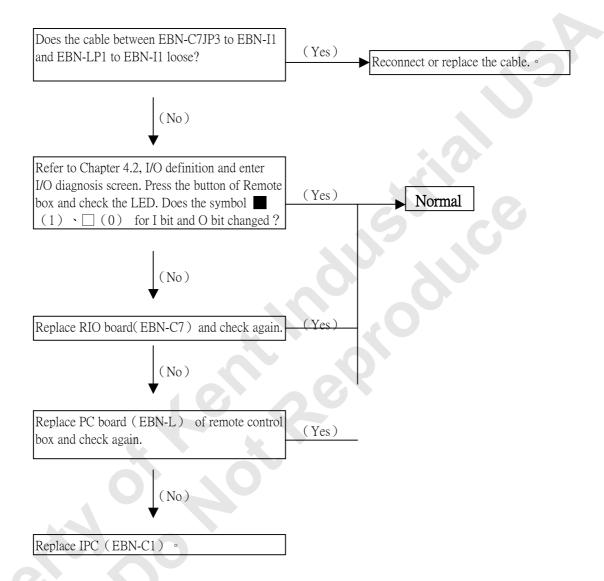
For Front Panel:







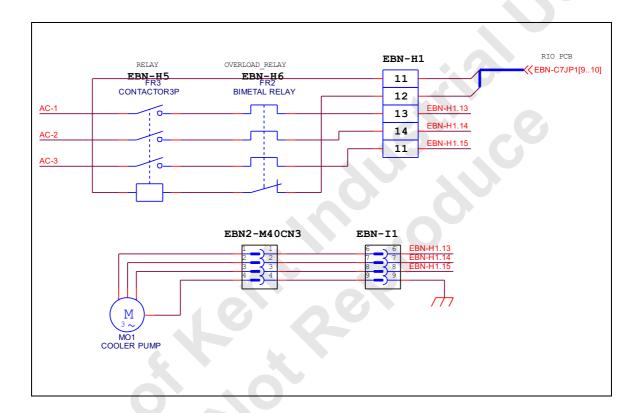
Trouble Shooting Flow Chart for Remote Control Box:



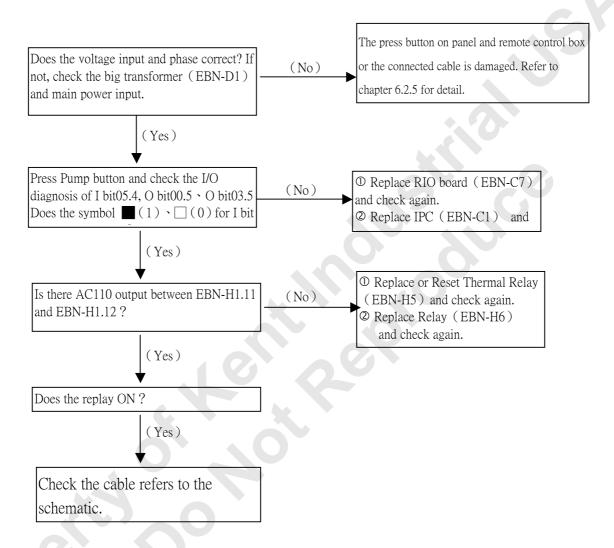
6.2.6 Pump can not turn on

**Reference Schematics: EBN-H1.DSN · EBN-C2.DSN · EBN-I.DSN ·

Reference Schematics



Trouble Shooting Flow Chart



M Hint

- 1. Check the turning direction of pump is correct. If not, switch the power inlet AC-1 and AC-2.
- 2. When the pump is dry run:
 - ① Check the pump is full of oil.
- ② If the pump can not fill the oil, check the pump is leaking or the valve is damaged.

LV_PUSE

LV_PUSE

H.V Resistance

H.V Resistance

H.V Resistance

H.V Resistance

SINK Resistance

SINK Resistance

6.2.7 Spark System malfunction Spark power structure of EBN is shown as below:

There are 3 group of DC power in JSEDM system:

Group 1: Provides the energy for Arc Spark and High Voltage spark. Called H.V.

Group 2: Provides the Spark energy. Called L.V.

Group 3: Protection Power for L.V and H.V. Called SINK •

Control Spark System is consist of 3 Circuit Boards:

1. PULSE card (EBN-C3)

Detect and Control the Spark Status.

2. HV Board (EBN-G1)

HV Board guides the Spark Gap and HV Spark Control.

With SINK circuit, machine can protect the MOSFET on HV and LV Board.

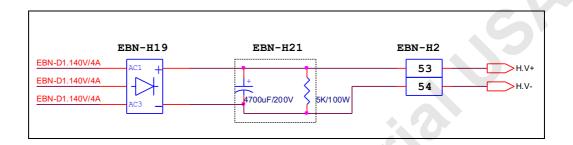
3. LV Board (EBN-G2). [60A: 1 set, 120A: 2 set, 180A: 3 set]

LV board can select level of High Frequency and High Current. It can select the energy while EDMing.

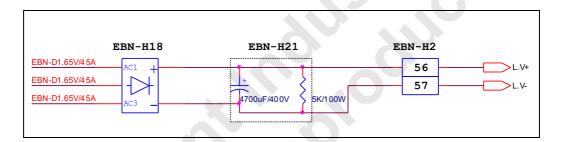
In spite of MOSET of LV board in Main Spark Circuit, there are series connected with limit current resistance. Therefore, MOSFET won't burn out if the Peak Current is too high.

Description of each AC current and circuit:

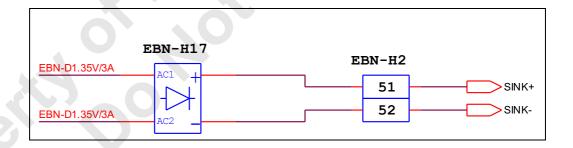
H.V: Provides the energy for HV Board while guiding the spark gap and HV spark.



L.V: Provides the energy for LV Board while Sparking. The circuit is shown as below:



SINK: Provides the protection power for HV and LV board.



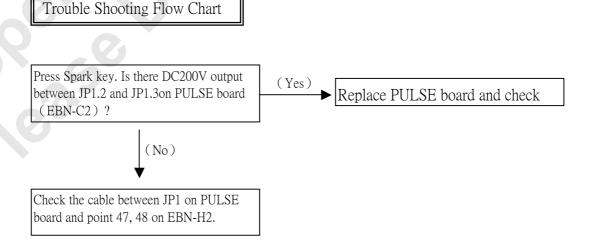
FAQ of Spark:

- ① Can not enter spark procedure.
- ② After press Spark button, Z axis moving up and down but with no spark.
- 3 LV current too low.
- HV current too low.
- © No voltage for LV.
- © No voltage for HV.
- ② Arcing.

Can not enter Spark procedure:

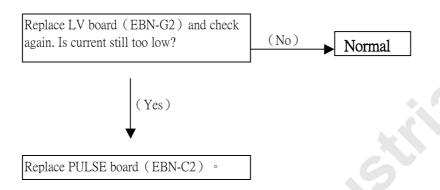
Trouble Shooting Flow Remove the problem of Short Circuit and (Yes) Does the short circuit LED ON? the LED is not ON. Check again. (No) ① If EDMing with no submerge workpiece, set the Level Control OFF. Does the oil level to low while the Level (Yes) ② If EDMing with submerge workpiece, make sure the oil level is reach to the setting. (No) (Yes) Move the $X \cdot Y \cdot Z$ and leave the limit Does Z axis touch limit switch? (No) Does the working Coordinate exceed the Reset the software limit value. (No) Trouble shooting for the Error message. If can't. (Yes) Is any message shown in Error message eboot the machine and try again.

Press Spark button, Z axis moving up and down but with no spark:



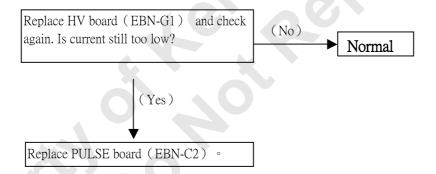
LV Current too low

Trouble Shooting Flow Chart



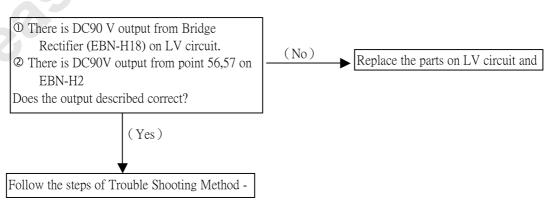
HV current too low

Trouble Shooting Flow



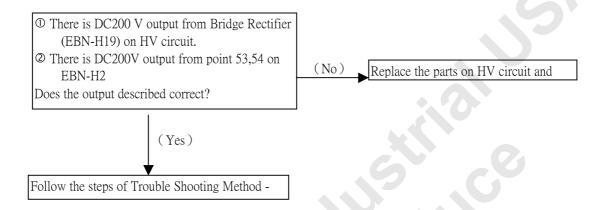
No Voltage in LV

Trouble Shooting Flow

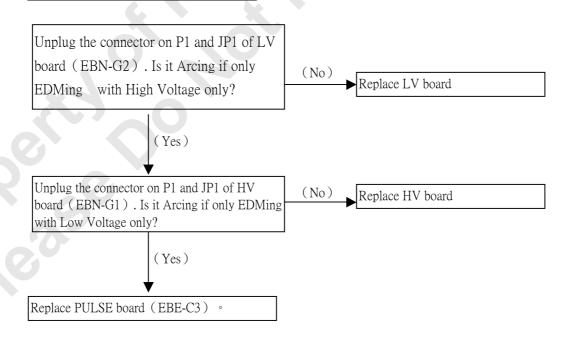


No voltage in HV

Trouble Shooting Flow



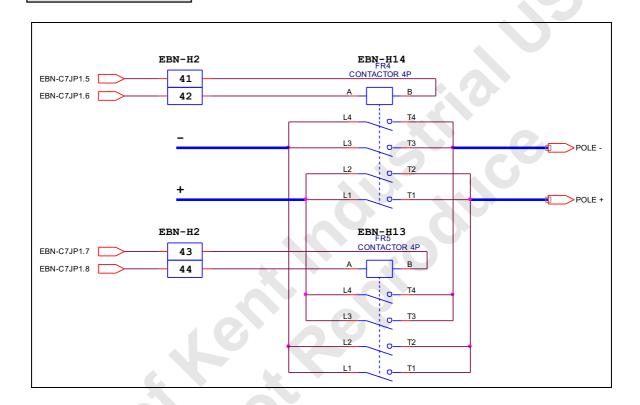
Arcing



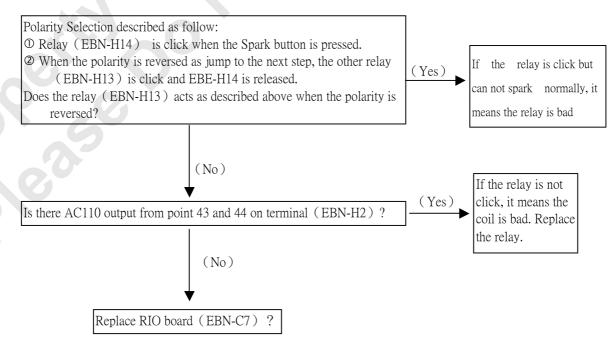
6.2.8 Polarity reverse switch malfunction

**Reference Schematics: EBN-H2.DSN . EBN-C1.DSN .

Reference Schematics



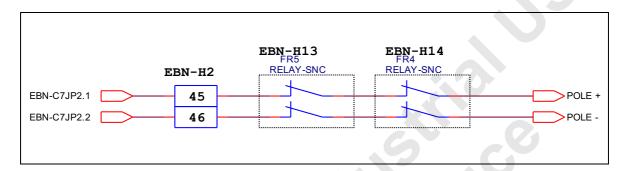
Trouble Shooting Flow



6.2.9 Z axes won't stop while electrode touches work piece

**Reference Schematics: EBN-H2.DSN · EBN-C1.DSN ·

Reference Schematics



Trouble Shooting Flow Chart

When the workpiece touch electrode:

① Buzzer is ON (unless Buzzer function is OFF)
② Short Circuit LED is ON.
③ Z axis is frozen.

Check 1:
Buzzer is not ON and the Short Circuit LED is not ON as workpiece touch electrode.
Check the wire and connect point base on Reference Schematic.

Replace RIO board (EBN-C7) and check again.

Replace IPC (EBN-C1) and check again.

Check 2:

Replace Motion card if Z still can move while workpiece touch electrode.

6.2.10 Synchronize flush malfunction

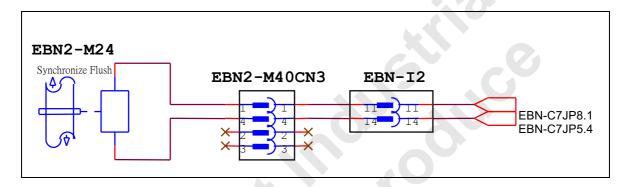
Synchronize flush is ON when the following buttons is pressed.

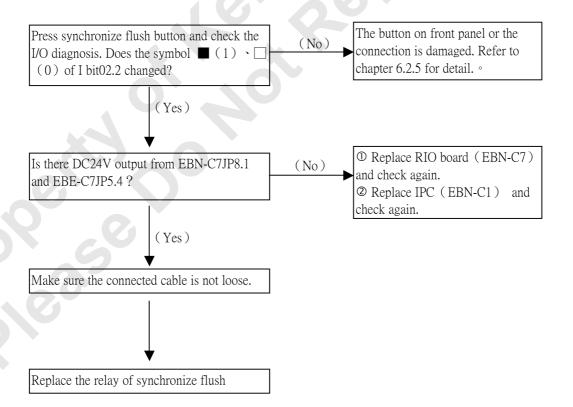
- (1) In Spark status, press
- key
- (2) Press the function key 【KEY 2】
- °___

Synchronize flush ON.

**Reference Schematics: EBN-C1.DSN \ EBN-I.DSN \ EBN-Electrical Box.DSN

Reference Schematics





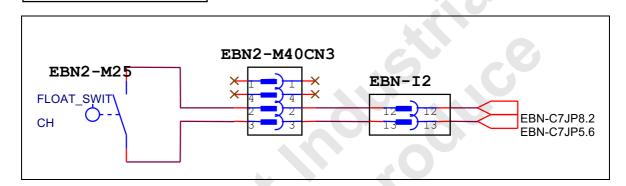
6.2.11 Oil Level Switch Malfunction

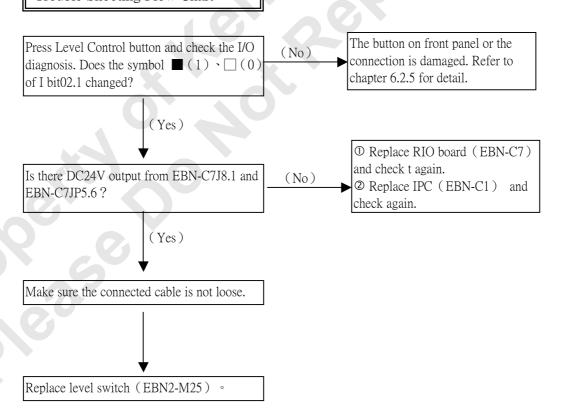
Level Control is ON when the following buttons is pressed.

- (1) Press function key 【KEY 1】, turn on Oil Level Function
- (2) (2) Press key under Spark status.

**Reference Schematics: EBN-C1.DSN \cdot EBN-I2.DSN \cdot EBN-small electrical box.DSN \cdot \cdot EBN-small electrical box.DSN \cdot \cdo

Reference Schematics

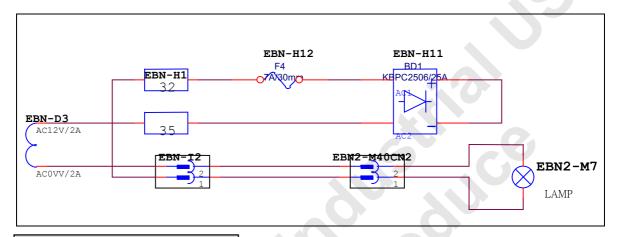


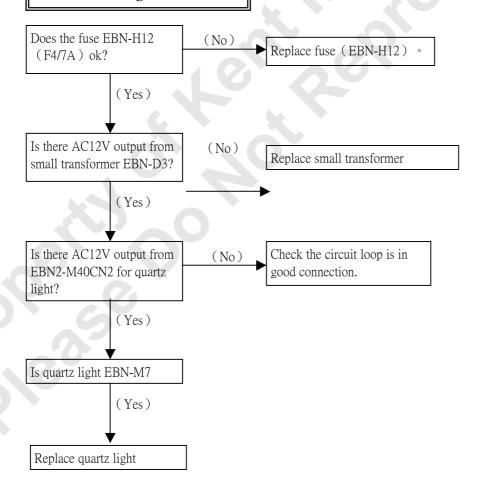


6.2.12 Work light is not ON

**Reference Schematics: EBN-C2.DSN \cdot EBN-I.DSN \cdot EBN-H1.DSN \cdot EBN-D.DSN \cdot \cdot

Reference Schematics





6.2.13 Buzzer is not ON

Even the buzzer LED

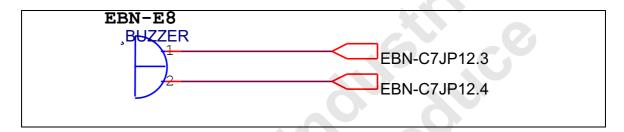


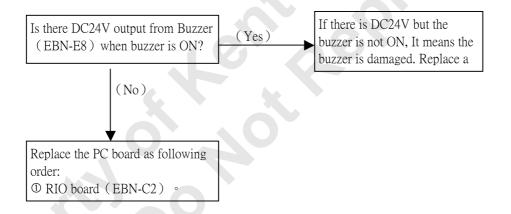
is OFF, buzzer still ON while:

(1) Fire Alarm is ON

**Reference Schematics: EBE-C7.DSN \cdot EBE1-E.DSN \cdot

Reference Schematics





6.2.14 Fire Alarm is not function

Cover the photo sensor by hand for couple seconds. Turn the photo sensor toward light source and uncover it. The following fire alarm action should appear:

- (1) Fire Alarm LED is ON
- (2) Spark Power off
- (3) Buzzer is ON with a short interval break.

Turn on (EBN2-M7) and REST fire alarm signal. The machine will back to normal.

**Reference Schematic: EBN-C1.DSN · EBN-small electrical box.DSN ·

Trouble Shooting Flow Chart

Replace the PC board as following order. Restart the machine and check again.

① RIO board (EBN-C7) 。

② IPC (EBN-C1) 。

Replace Photo Sensor if the machine still not working normally after replacing the PC board.



Kent Industrial USA, Inc.

1231 Edinger Ave., Tustin, CA 92780
Tel: (714) 258-8526 | Fax: (714) 258-8530
Toll-free: 1-800-KENT-USA (1-800-536-8372)

E-mail: sales@kentusa.com