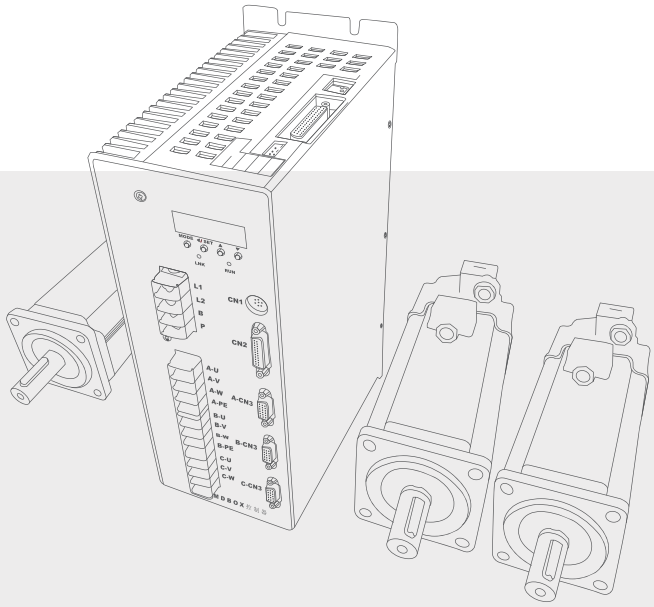
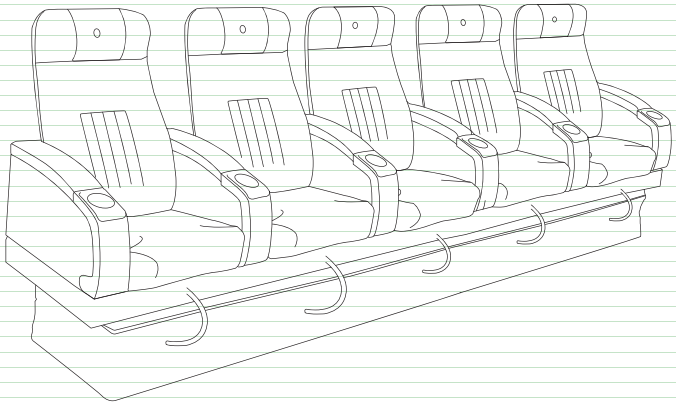
SYNTRON

MDBOX Dynamic Platform Integrated Controller User Mannual





This manual is prepared based on governing laws and regulations' requirements and relevant industrial standards. During your use of our products, if you have any question about any description in this manual, please consult the sales clerks who have sold you the products, or dial our customer service hotline, or send an inquiry email to our company's email address.

As our products are upgraded from time to time, HollySys Motor reserves the right to change any of the products and their specifications and parameters that are contained in this manual without prior notice. We remind the customers hereby to use the latest edition of the manual.

Rev. No. 06/2015

Danger： This symbol is used to indicate that wrong use of the item described is dangerous and may cause bodily injury or death.

Attention： This symbol is used to indicate that wrong use of the item described is harmful, and may cause minor or moderate harm to the operator, or damage to the equipment. But, due to differences in actual situations, wrong use of any item marked by this symbol may also cause a severe accident.

Prohibited： This symbol is used to indicate that the item described may never be performed.

Important： This symbol is used to indicate that the item marked by it doesn’t fall into the category of that marked with Danger or Attention, but the user is still required to follow the instruction given by it.

■ Opening the Case and Check

 Attention	
If the driver is damaged, or some of its parts are missing, never install such driver	Failure to follow the instruction will cause danger of injury

■ Installation

 Attention	
Please mount it on an uninflammable metal plate, and never mount it near any inflammable material	Failure to follow the instruction will cause danger of fire
Please do tighten the driver's mounting screws	Loose screws may cause the driver to drop, or injury of people
Don't mount it in an environment with flammable gases	Failure to follow the instruction is likely to cause explosion

■ Wiring

危险 Danger	
Before connecting the wires, please ensure the power supply is cut off	Failure to follow the instruction will cause danger of electric shock and fire
Work on terminals of the driver's main circuit may only be performed when the power has been off for more than 15 minutes and the capacitors' discharge has completed	Failure to follow the instruction will cause danger of electric shock
Please have the wire connection be performed by professional electricians	Failure to follow the instruction will cause danger of electric shock and fire
Please do ensure the grounding terminal is reliably grounded (grounding resistance is less than 4Ω)	Failure to follow the instruction will cause danger of electric shock and fire
Never directly connect P/B and PE terminals, and never connect the zero line to the PE terminal	Failure to follow the instruction will cause short-circuiting of the rectifier bridge, which will burn out the main circuit
Never connect the high-voltage lines to the driver's control terminals	Failure to follow the instruction will cause burn-out of the control panel
Please provide the driver with an external emergency stop and lock circuit	Failure to follow the instruction will cause danger of injury (the user himself shall be responsible for connection)
Never directly touch any terminal in the main circuit after the power is on	Failure to follow the instruction will cause danger of electric shock and short-circuiting

⚠注意 Attention	
Please confirm whether the main circuit's AC incoming power has the same voltage as the driver's rated voltage	Failure to follow the instruction will cause danger of injury and fire
Please never perform at will breakdown and insulation tests on the driver	Failure to follow the instruction will damage the semiconductor parts and other parts inside the driver
Please connect the external braking resistor as shown by the wiring diagram	Failure to follow the instruction will cause danger of fire
Please never connect the AC incoming power line to the main circuit's output terminals U, V and W	Failure to follow the instruction will cause internal damage to the driver
Please use a suitable torque value to tighten the terminals of the driver's main circuit and control circuit	Failure to follow the instruction will cause danger of fire and driver's misoperation
Please never connect the phase-shift electrolytic capacitor and LC/LR noise filter to the output circuit	Failure to follow the instruction will cause internal damage to the driver
Please never connect the electromagnetic switch and electromagnetic contactor to the output circuit for the purpose of connecting or disconnecting the load	Failure to follow the instruction will cause surges to trigger action of the driver's protection circuit when the driver is working with a load.

■ Trial Running

危险 Danger	
After turning on the power, please never directly touch any terminal of the driver's main circuit	Failure to follow the instruction will cause danger of electric shock and short-circuiting
Confirm the input and output signals to ensure operation safety	Failure to follow the instruction will cause the system's misoperation, which will cause bodily injury or death, damage the work piece and peripheral equipment
The alarm may be reset only after the enabling signal is confirmed to have been cut off; if alarm's reset is done in the "enabled" status, a sudden restart will occur	Failure to follow the instruction will cause danger of injury
If a driver has been stored for a long time, confirm there's no water and condensation of moisture inside it	Failure to follow the instruction will cause danger of burn-out of the driver
If a driver has been stored in a cold environment for a long time, it shall be kept in an environment warmer than 0°C for a period of time before being used	Failure to follow the instruction will cause danger of burn-out of the driver
During the operation, never let your hand touch the driver's connecting terminals or the rotating motor shaft	Failure to follow the instruction will cause danger of electric shock, which may cause bodily injury or death

注意 Attention	
After running starts, the driver and motor may have a big temperature rise, please don't touch them at will	Failure to follow the instruction will cause danger of scald
The external braking resistor will have a big temperature rise due to discharge, please don't touch it	Failure to follow the instruction will cause danger of scald and electric shock
Please never change the driver's setting at will	Failure to follow the instruction will cause equipment damage and accidents, and generate danger
Please pay attention to the operation like changing of internal parameter values during running	Failure to follow the instruction will cause wrong operation, which will cause equipment damage and accidents, and consequent danger

Chapter I Introduction to the Products 1
1.1 Brief Introduction to the MDBOX Dynamic Platform Integrated Controller 1
1.2 Model Naming Rule of MDBOX Dynamic Platform Integrated Controllers 2
1.3 Technical Characteristics of MDBOX Dynamic Platform Integrated Controller's Servo Driver section 2
1.4 Technical Characteristics of MDBOX Dynamic Platform Integrated Controller's Motion Control Section 2
1.5 Solution to Application of MDBOX Dynamic Integrated Controller to a Single 3-DOF Platform 3
1.6 Ethernet Control-based Solution to Application of MDBOX Dynamic Integrated Controller to Multiple 3-DOF Platforms 4
1.7 Analog Control-based Solution to Application of MDBOX Dynamic Integrated Controller to Multiple 3-DOF Platforms 6
1.8 Mixed-control Solution to Application of MDBOX Dynamic Integrated Controller to Multiple 3-DOF Platforms 7
Chapter II Installation and Wiring 9
2.1 Principal View of MDBOX Dynamic Platform Integrated Controller 9
2.2 Vertical View of MDBOX Dynamic Platform Integrated Controller 10
2.3 Outer Dimensions of MDBOX Dynamic Platform Integrated Controller 11
2.4 Connection of MDBOX's Power Terminals 11
2.5 Connection of MDBOX's Control Terminals 12
2.5.1 MDBOX's Monitoring Communication Interface CN1 12
2.5.2 Bus Resistance-matching Jumper for MDBOXes 12
2.5.3 MDBOX Servo Drive Section's Expanding Interface CN2 13
2.5.4 MDBOX's Servo Drive Section Interface CN2 to be Connected to Input of External Position-limit Sensors 15
2.5.5 MDBOX's Servo Drive Section Interface CN2 for Connection with an External Relay for Controlling Electromagnetic Brake 16
2.5.6 MDBOX's Servo Drive Section Interface CN3 for Connection with Motor Encoder 17
2.5.7 MDBOX's Motion Control Section I/O Interface CN4 18
2.5.8 EtherNet MDBOX Motion Control Section's Ethernet Interface EtherNet 20
Chapter III Keyboard Display Interface 21
3.1 Panel Display 21
3.2 Description of the Panel 21
3.3 Description of Display of Indicator Lights 22
3.4 Definition of Push Keys' Functions 24
3.5 Example of Status Parameter Inquiry 24

3.6 Example of Inquiry about and Editing of a Configuration Parameter 25
Chapter IV Ethernet Bus Communication Protocol 28
4.1 Brief Introduction to MBOX Ethernet Communication 28
4.2 MBOX Ethernet Communication Protocol 28
4.2.1. Basic Frame of MBOX's Ethernet Communication 28
4.2.2. UDP Data Method for MBOX Ethernet Information Transmission 28
4.2.3. MBOX's Active Report of Designated Status Information 30
4.2.4. Reading of MBOX's Register 30
4.2.5. Writing in MBOX's Register 31
4.2.6. Operation of MBOX Absolute Playing Time Data (3-axis Platform Mode) 31
4.2.7. Operation of MBOX Absolute Playing Time Data (6-axis Platform Mode) 33
4.2.8. MBOX Relative Playing Time Data Operation (3-axis Platform Mode) 35
4.2.9. MBOX Relative Playing Time Data Operation (6-axis Platform Mode) 37
4.2.10. CX MBOX's Control Register 39
4.3 Establishment of Connection between MBOX and Ethernet and Monitoring 40
4.3.1. Use of PING Command to Test Ethernet Connection Status 40
4.3.2. Use of TCP Debugging Assistant to Debug Ethernet Communication Protocol 41
4.3.3. Use of WireShark to Chieve Monitoring of Ethernet Communication 41
4.4 MATLAB Example of MBOX Ethernet Communication 43
4.5 Example of Capturing MBOX Ethernet Communication Data Packets 44
4.5.1. Resetting Operation of the Dynamic Platform 44
4.5.2. Emergency Stop Operation of Dynamic Platform 44
4.5.3. Operation of Cancelling Dynamic Platform's Emergency Stop 45
4.5.4. Operation of Digital Output of Dynamic Platform's Effect 45
4.5.5. Operation of Upper Computer's Reading of the Dynamic Platform's Digital Input 45
4.5.6. Operation of Dynamic Platform's Absolute Playing Time Data (3-axis) 47
4.5.7. Operation of Dynamic Platform's Absolute Playing Time Data (6-axis) 47
4.5.8. Operation of Dynamic Platform's Relative Playing Time Data (3-axis) 47
4.5.9. Operation of Dynamic Platform's Relative Playing Time Data (6-axis) 48
Chapter V Running Setting of Dynamic Platform 49
5.1 Mode of Stop in Case of Dynamic Platform's Fault 49
5.2 Dynamic Platform's Initial Positioning Parameters 49
5.3 Dynamic Platform Playing Control Parameter 50
5.3.1 MBOX's Digital Output Synchronization Setting 50
5.3.2 Setting of MBOX's Analog Output Synchronization 50
5.3.3 Setting of MBOX's Position Operation Synchronization 51
5.3.4 Setting of MBOX's Inching Mode Execution Time 51
5.3.5 Setting of MBOX's Backward-Mode Execution Time 52
5.3.6 Judgment of MBOX's Fast Forward Mode and Setting of Execution Time 52
5.3.7 Setting of MBOX's Emergency Stop Mode Execution Time 53
5.3.8 Way of Processing Ethernet Play Position Data 53
5.4 MBOX's IP Address and UDP Port No 53

5.4.1 Setting of MBOX's IP Address 53
5.4.2 Setting of MBOX's UPD Port 54
5.5 Host Computer's IP Address and UDP Port No. 54
5.5.1 Setting of Upper Host Computer's IP Address 54
5.5.2 Setting of Upper Host Computer's UDP Port 54
5.6 Setting of MBOX's Active Report 54
5.7 Setting of MBOX's Ethernet Port Indicator Light 55
5.8 MBOX's Timeout Measurement of Status of Ethernet without Play Data 55
5.9 Setting of MBOX's CAN Bus Communication 56
5.10 Setting of MBOX's Local MODBUS Communication 56
5.11 MBOX's Record of Fault History 56
5.12 Setting of MBOX's Analog Output Signals 57
5.13 Range Setting of Analog Output Signals 57
5.14 Channel Setting of Analog Output Signals 57
5.15 Zero Setting of Analog Output Signals 57
5.16 Bit and Setting of Analog Output Signals 58
5.17 Setting of MBOX Digital Output Signals 58
5.17.1 Selection of Digital Output Control Mode 58
5.17.2 Selection of Digital Output Control Channel 58
5.17.3 Selection of Digital Output Control Logic 58
5.17.4 Selection of Digital Output's Initial Value and Safe Value 59
5.18 Setting and Processing of MBOX's Digital Input Signals 59
5.19 Setting of Digital Input Signals' Logic Reversion 59
5.20 Setting and Processing of Digital Input Signal of Emergency Stop 60
5.21 Setting of MBOX's Expanded Digital Output Signals (Reserved) 61
5.21.1 Selection of Expanded Digital Output's Control Mode 61
5.21.2 Selection of Digital Output Control Channel 61
5.21.3 Selection of Expanded Digital Output Control Logic 61
5.21.4 Selection of Expanded Digital Output's Initial Value and Safe Value 62
5.22 Relation between Motions of Electric Cylinder Body and Servo Motor 62
5.22.1 Electric Cylinder Body's Parameter and Limit on Its Travel 62
5.22.2 Relation between Motions of Electric Cylinder and Servo Motor 62
5.22.3 Limit on Electric Cylinder's Initial Positioning Torque 63
5.23 Limit on Dynamic Platform's Accumulated Working Time 63
5.23.1 Dynamic Platform's Accumulated Working Time 63
5.23.2 Limit on Dynamic Platform's Accumulated Working Time 63
5.24 Setting of MBOX Analog Input Signals 63
5.25 Version No. of MBOX Dynamic Platform System Software 64
Chapter VI Working Status Monitoring and Diagnosis of Dynamic Platform 65

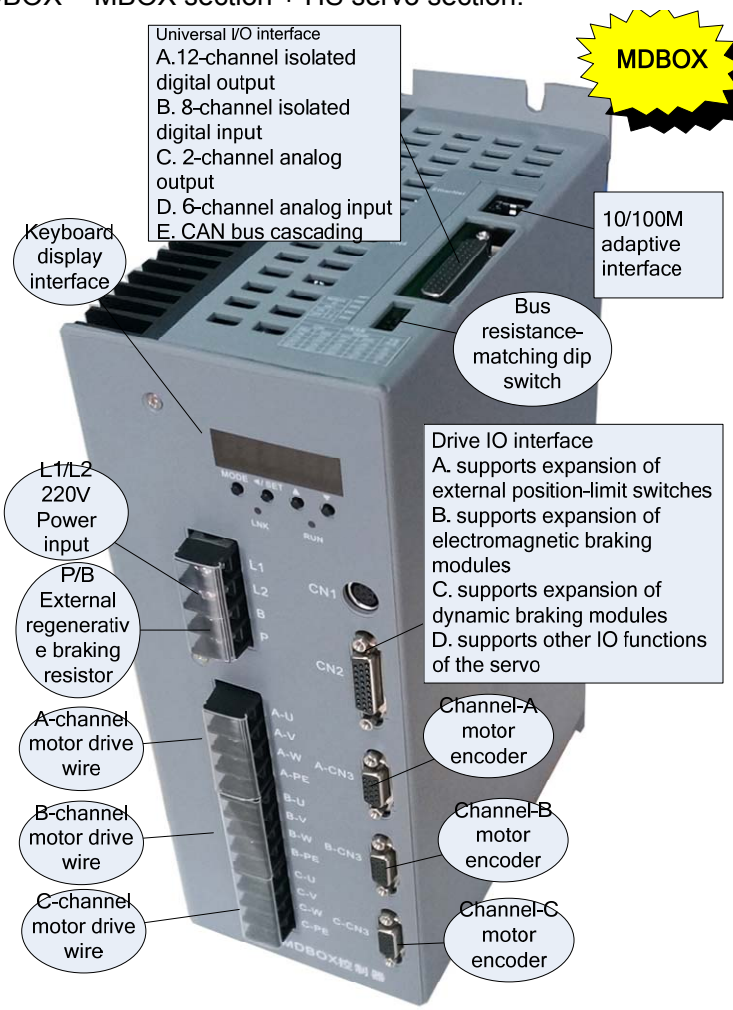
6.1 List of Dynamic Platform's Working Status 65
6.1.1 HS Servo Drive Section's Working Status 65
6.1.2 MBOX Fault Code 67
6.1.3 MBOX's Working Control Word and Status Word 67
6.1.4 MBOX Playing Operation Speed 67
6.1.5 MBOX's Ethernet Data Status 67
6.1.6 MBOX's Ethernet Port Status 67
6.1.7 Status of MBOX Analog Input's ADC Conversion Result 68
6.1.8 MBOX's Digital Input Status 68
6.1.9 MBOX's DAC Data Status 68
6.1.10 MBOX Digital Output Data Status 68
6.1.11 Monitoring of MBOX's UDP Input Position Command 69
6.1.12 Dynamic Platform's Accumulated Working Time 69
6.1.13 Dynamic Platform's Accumulated Load Factor-weighted Effective Working Time 69
6.2 Keyboard Display-based Local Working Status Monitoring 70
6.3 MODBUS-based Local Working Monitoring 70
6.4 Ethernet-based Remote Working Status Monitoring 70
6.5 Dynamic Platform's Fault Code and Diagnosis 70

Chapter I Introduction to the Products

1.1 Brief Introduction to the MDBOX Dynamic Platform Integrated Controller

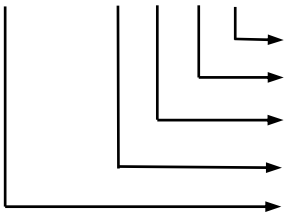
The dynamic platform system mentioned herein only refers to the multi-electric-cylinder MDOF platform system, which can be widely used in motion simulation, robots, simulators of spacecraft rendezvous and docking, ship and automobile driving simulators, accurate motion simulation of new-type machining tools, satellites, missiles and other flying vehicles, 4D dynamic seats, 6-DOF platforms, etc, making it a necessary type of equipment for national defense industry, aerospace industry, auto making industry, machine industry and testing and training in various complicated environments.

The first generation of control chips based on HS series networked servo drivers and MBOX communication have already stood the test in its wide application in the dynamic platform industry. In order to further improve their reliability and cost-performance ratio, Beijing HollySys Motor Technology Co., Ltd. has released its second-generation in-depth integration solution, namely MDBOX = MBOX section + HS servo section.



1.2 Model Naming Rule of MDBOX Dynamic Platform Integrated Controllers

MDBOX—NV 3 020 A



Control mode	A: Analog command E: Ethernet Command
Current	020：20A 030：30A
Number of shafts	3: 3 shafts 6: 6 shafts
Incoming power supply	LV: low voltate NV：220V HV：380V
Series code	Dynamic platform integrated controller

1.3 Technical Characteristics of MDBOX Dynamic Platform Integrated Controller's Servo Driver section

1) CAN bus motion control function: control of position/speed/torque, shifting between modes
2) Quick current loop floating-point CLA kernel processing featuring a good dynamic tracking ability
3) Built-in network voltage compensation control capable of automatically adapting to network voltage's fluctuation
4) 2 channels of optional built-in resonance low-pass filters and 2 stages of resonance notch filters capable of effectively dealing with mechanical resonance
5) Dedicated built-in intelligent regenerative braking control technology
6) Built-in torque measuring technology capable of automatically adapting to change of the load
7) Controlled gain capable of shifting or internally adaptive matching
8) Built-in dynamic braking control providing extra safety assurance to the driver
9) Aumatic anti-overloading load-decrease algorithm providing parameter-based selection of whether to enable anti-overloading protection and parameter-based setting of the automatic smooth load decreasing and overload recovery capacity
10) Support to RS485 communication interface employing MODBUS protocol, to provide the capability of direction communication with the upper computer, touch screen, etc.
11) Support to CAN bus interface with a built-in dedicated communication protocol to make it easy to provide custom solutions to the customers
12) The control ports supports software-based distribution, logic setting, and programmable filtering making their use flexible, convenient and reliable
13) 2 channels of analog output capable of observation of the driver's internal status to facilitate on-site debugging
14) Built-in electromagnetic braking control providing to the dynamic platform anti-dropping safety guarantee based on rigorous logic
15) Built-in prevention of overcurrent, overvoltage of power devices, etc. to guarantee reliable drive
16) Reliability managing function with record of fault history and other characteristics

1.4 Technical Characteristics of MDBOX Dynamic Platform Integrated Controller's Motion Control Section

1) The Ethernet interface for communication connection with the upper computer or Ethernet switch has a strong expandability, making on-site wiring very easy

2) A 6-channel ADC input interface provided for connection with the upper computer's analog signals, enabling motion control based on DAC chips
3) 12 channels of digital output supporting digital effect control based on programmable parameters
4） 2 channels of analog output supporting continuous and fine analog effect control
5) Multi-function application of 8 channels of digital input and other signal ports
6) No need to use an electronic ruler for position feedback and rectification, saving cost and improving reliability
7) Applications supporting totally position-limit-switch-free modes; the upper limit function supporting software position limit
8) Easy monitoring and diagnosis, with RS232 used for local monitoring of motion control
9) Convenient and flexible construction of networks; the motion-control single groups are built into the complete system via Ethernet, all the single groups can be arranged as an whole integrated unit, line groups, column groups or a dot matrix to achieve the desired control of designated motions
10) RS232 interfaces provided for expanded connection to all the external equipment that supports MODBUS communication protocol
11) A keyboard display interface provided to enable real-time monitoring and changing of motion-control single groups' status parameters
12) Ability to send to the upper computer feedback of each servo motor's position, speed, load factor and control status, and based on the specific working condition, to set the running parameters of the application communication controller
13) High reliability and excellent cost-performance ratio

1.5 Solution to Application of MDBOX Dynamic Integrated Controller to a Single 3-DOF Platform

The diagram below shows a solution to application of MDBOX dynamic integrated controller to a single 3-DOF platform; this solution supports use of an Ethernet bus interface or analog interface.

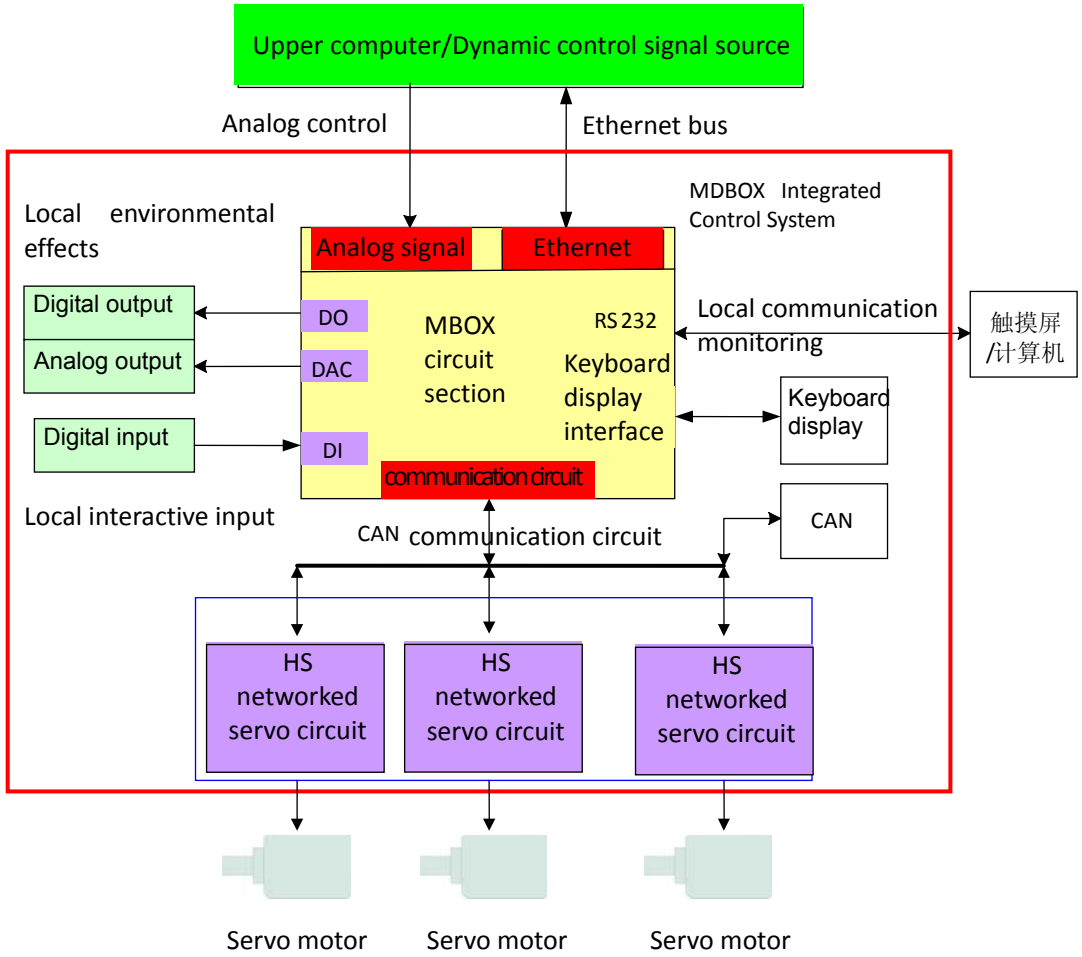


Figure 1-2 Solution to Application of MDBOX Dynamic Integrated Controller to a Single 3-DOF Platform

1.6 Ethernet Control-based Solution to Application of MDBOX Dynamic Integrated Controller to Multiple 3-DOF Platforms

Connect the MDBOX's Ethernet interfaces together via switchers, if one switcher cannot provide enough interfaces, use additional switchers to expand interfaces. In the application, each MDBOX is assigned an ID No. which is expressed in the form of its Ethernet IP address like 192.168.1.100. Each control node constituted by a MDBOX, as a whole unit, needs only one 220V power line and an Ethernet wire for connection with external equipment, which greately simplifies on-site wiring. Plus, the Ethernet communication, which is 10M/100M adaptive, features a high data transmitting rate, high reliability, big capacity, etc.

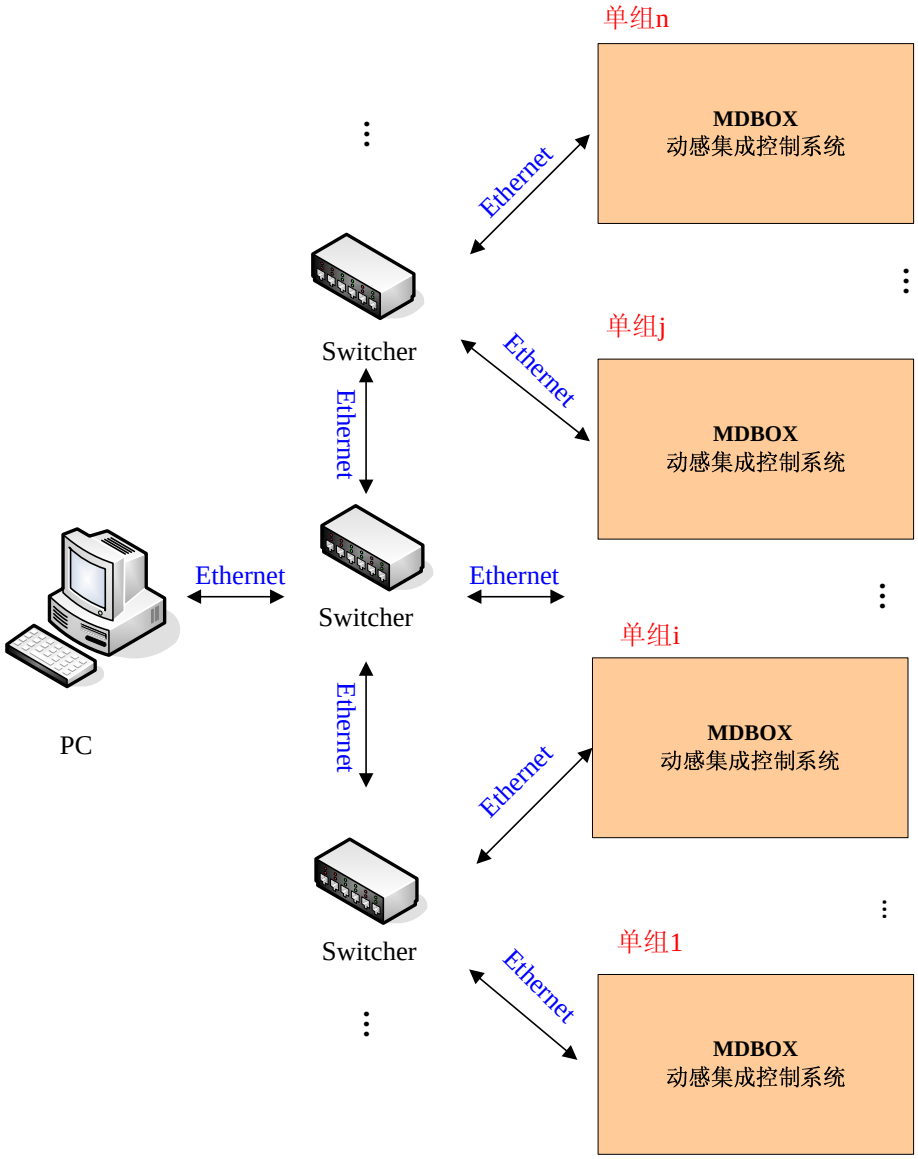


Figure 1-3 Networked Servo Control Solution Based on MDBOX-constituted Ethernet Control Nodes

单组 n ： Single group n 单组 j ： Single group j 单组 i： Single group I 单组 l： Single group l
MDBOX 动感集成控制系统：MDBOX Dynamic Integrated Control System

1.7 Analog Control-based Solution to Application of MDBOX Dynamic Integrated Controller to Multiple 3-DOF Platforms

This solution is an upper computer control technological pattern that mainly facilitates use of DAC chips to control.

The MDBOX analog ports are connected together via the upper computer's DAC output buffer circuit; voltage on each analog port is 0~10V; the electric cylinder position corresponding to the analog signal can be set with MDBOX's parameters. The diagram below is an example of solution based on analog signals:

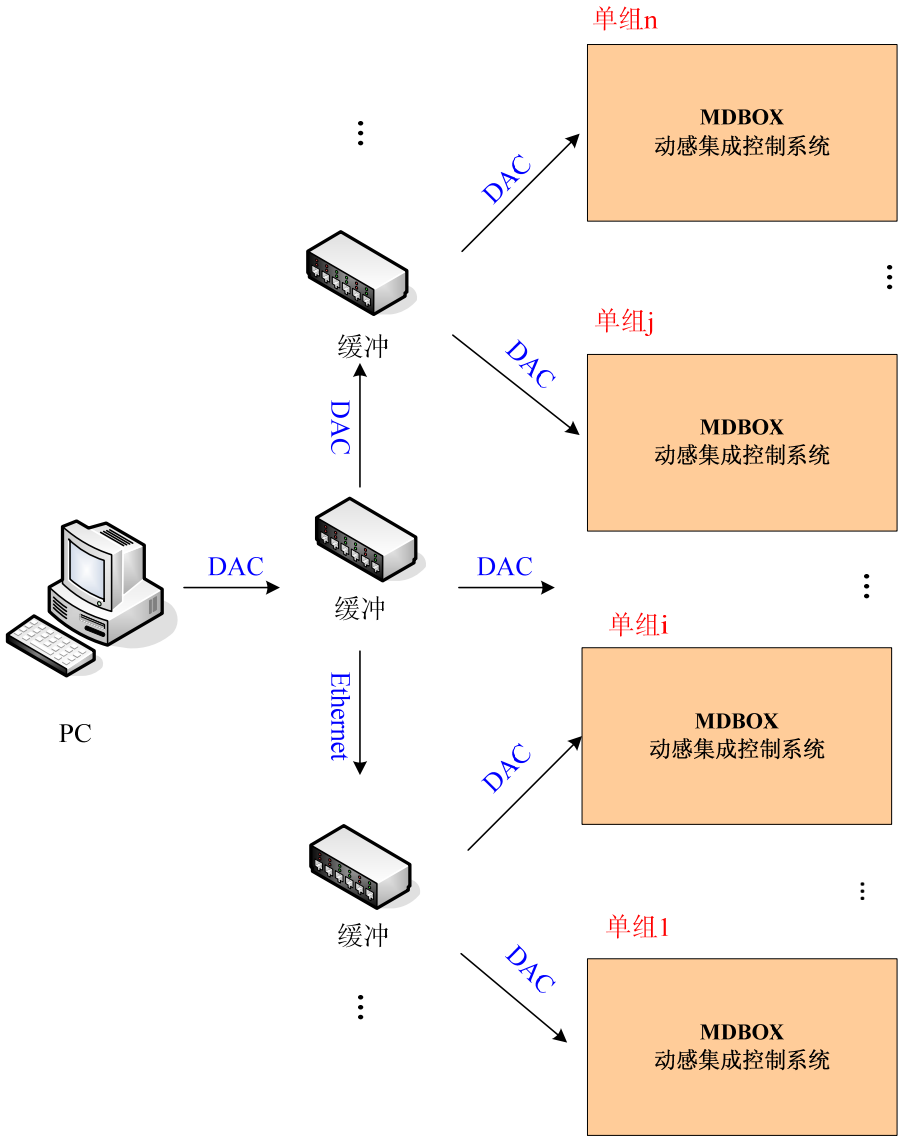


Figure 1-4 Application Solution Based on Analog Signal-Controlled MDBOX-constituted Nodes

单组 n： Single group n 单组 j ： Single group j 单组 i ： Single group I 单组 l ： Single group l
MDBOX 动感集成控制系统：MDBOX Dynamic Integrated Control System
缓冲：Buffer

1.8 Mixed-control Solution to Application of MDBOX Dynamic Integrated Controller to Multiple 3-DOF Platforms

The first MDBOX's analog ports are connected to the upper computer via the upper computer's DAC output buffer circuit, and the voltage on the analog ports is 0~10V. The MDBOX working with analog signals will automatically send out UDP data packets similar to those of the upper computer's Ethernet, and the packets can be used for synchronous motion control of other MDBOXes that are cascaded via routers. Advantages of such solution are simplified development of the upper computer's software, while the advantages of the Ethernet-based solution are retained.

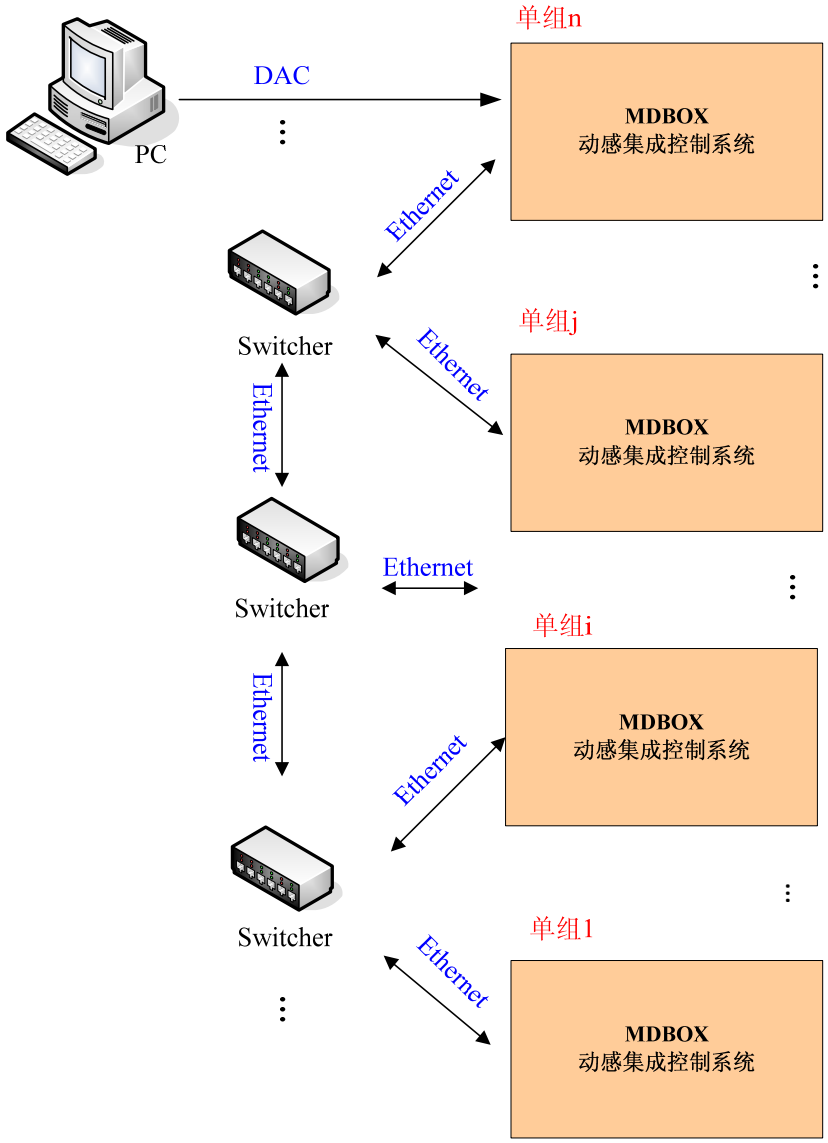


Figure 1-5 Mixed-control Solution Based on MDBOX-constituted Ethernet Control Nodes

单组 n ： Single group n　　单组 j ： Single group j　单组 i： Single group I　单组 l ： Single group l

Based on the mature and reliable first-generation HS networked servo driver and MBOX communication control chip technology, and through in-depth integration, MDBOX dynamic integrated control system is designed and developed. As a kind of customized motion-control solution for the servo driver industry and dynamic simulation industry, it satisfies the customers' needs and achieves the optimal engineering implementation of the technical scheme and target project.

Chapter II Installation and Wiring

2.1 Principal View of MDBOX Dynamic Platform Integrated Controller

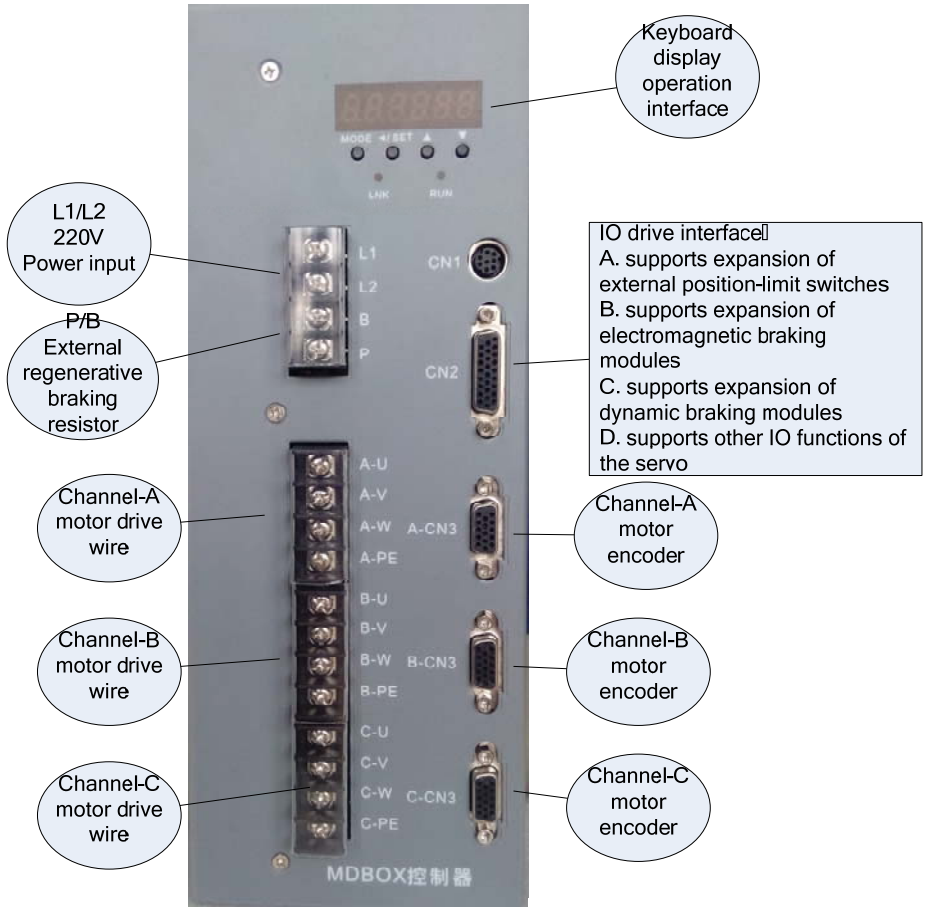


Figure 2-1 Principal View of MDBOX Dynamic Platform Integrated Controller

2.2 Vertical View of MDBOX Dynamic Platform Integrated Controller

Figure 2-2 Vertical View of MDBOX Dynamic Platform Integrated Controller

CN4: 通用输入输出接口 CN4: Universal I/O interface

A. 12 路隔离数字输出 A. 12-channel isolated digital output

B. 8 路隔离数字输入 B. 8-channel isolated digital input

C. 2 路隔离模拟量输出 C. 2-channel analog output

D. 6 路模拟量输入 D. 6-channel analog input

E. CAN 总线级联 E. CAN bus cascading

键盘显示接口 Keyboard display interface

总线电阻匹配拨码开关 Bus resistance-matching dip switch

10/100M 自适应以太网接口 10/100M adaptive Ethernet interface

2.3 Outer Dimensions of MDBOX Dynamic Platform Integrated Controller

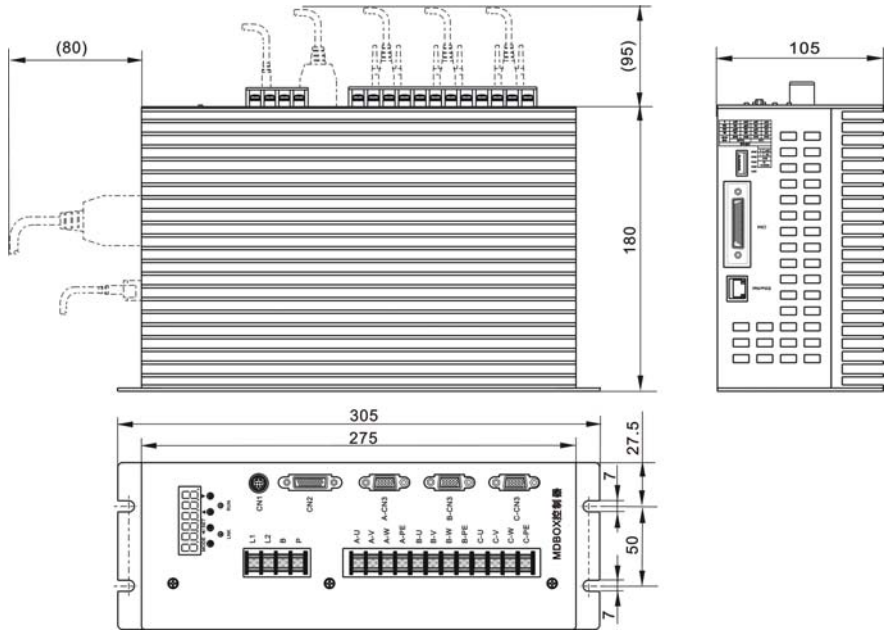


Figure 2-3 Outer Dimensions of MDBOX Dynamic Platform Integrated Controller

2.4 Connection of MDBOX's Power Terminals

The table below describes MDBOX's power terminals:

Name		Function	Precaution
L1 / L2		Power supply's one-phase AC input terminal, 220V, 50/60Hz	It is recommended to use an independent external air-break switch to facilitate on-site use
P / B		Connection of external braking resistors between P/B	Standard capacity of the external braking resistors is 100W/50 Ω
A	U / V / W	Channel-A motor driver output terminal	Their connection pattern must be consistent with the motor's phase sequence
	PE	Channel-A motor grounding terminal	Grounding resistance ≤ 4 Ω
B	U / V / W	Channel-B motor driver output terminal	Their connection pattern must be consistent with the motor's phase sequence
	PE	Channel-B motor grounding terminal	Grounding resistance ≤ 4 Ω
C	U / V / W	Channel-C motor driver output terminal	Their connection pattern must be consistent with the motor's phase sequence
	PE	Channel-C motor grounding terminal	Grounding resistance ≤ 4 Ω

Figure 2-1 Description of Function of and Precautions for MDBOX's Power Terminals

2.5 Connection of MDBOX's Control Terminals

The MDBOX′s control terminals include:
CN1: for management of communication monitoring
CN2: for control of servo section's 2-channel isolated input and 2-channel isolated output
CN3: divided into Section A, Section B and Section C, respectively for connection to the encoders corresponding to 3 motors
CN4: for control of output and input of MDBOX's motion control section
EtherNet: an Ethernet signal interface used by MDBOX's motion control section

2.5.1 MDBOX's Monitoring Communication Interface CN1

As the interface for MDBOX′s monitoring communication terminals, CN1 is usually used only for the purpose of on-site debugging and testing.

Communication interface CN1's pin distribution and definition are as shown in the diagram below:

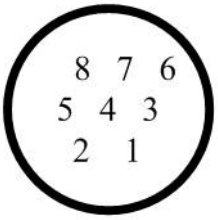


Figure 2-4 Pin Distribution of Communication Interface CN1

Signal definition of communication interface CN1 is as shown in the table below:

Communication Type	S/N of Pin	Signal Definition	MDBOX's Related Module
RS232	2 (brown)	RS232_TXD	MBOX PART
	8 (purple)	RS232_RXD	
	5 (yellow)	RS232-GND	
CAN	6 (green)	CAN_H	MBOX+DRIVE
	1 (black)	CAN_L	
RS485	7 (blue)	RS485_A	DRIVE PART
	4 (orange)	RS485_B	
GND	3 (red)	GND	

2.5.2 Bus Resistance-matching Jumper for MDBOXes

As shown in the figure below, when a CAN bus and an RS485 bus constitute a network, 2 120Ω resistors need be connected at the network's 2 terminating ends to balance resistance, and to ensure good communication performance meeting the governing norms and regulations.

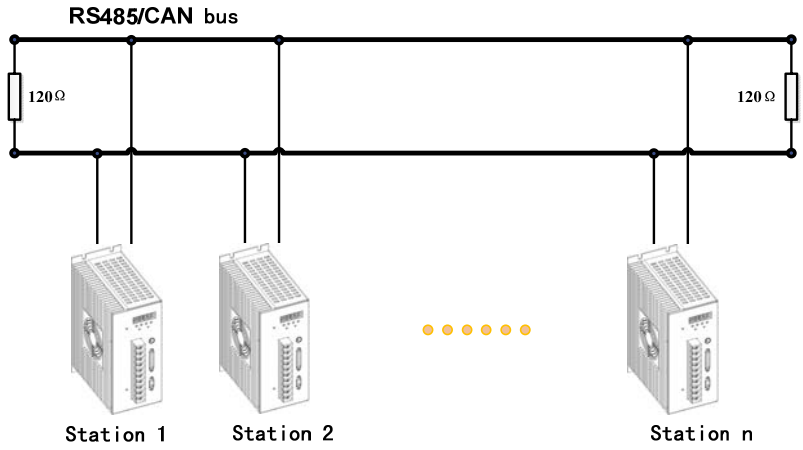


Figure 2-5 Principle of CAN Bus and RS485 Bus' 120Ω Resistance Balancing

To make the user's use of network more convenient, a device for selecting jumpers of the balancing termination resistors is provided, so that the user can easily balance resistance as per his actual needs. The table below shows the jumper setting:

MDBOX Termination-End Balancing Resistor Jumper Setting				
CAN BUS		RS485 BUS		Total Resistance (Ω)
SW2	SW3	SW4	SW5	
ON *	ON *	ON	ON	60
ON	OFF	ON	OFF	120
OFF	ON	OFF	ON	120
OFF	OFF	OFF *	OFF *	NONE

*: default ex-works setting

2.5.3 MDBOX Servo Drive Section's Expanding Interface CN2

As an expanding interface for MDBOX's servo drive section, CN2 is capable of providing 2 digital-input channels and 2 digital-output channels for each of the totally 3 channels of servo drive.

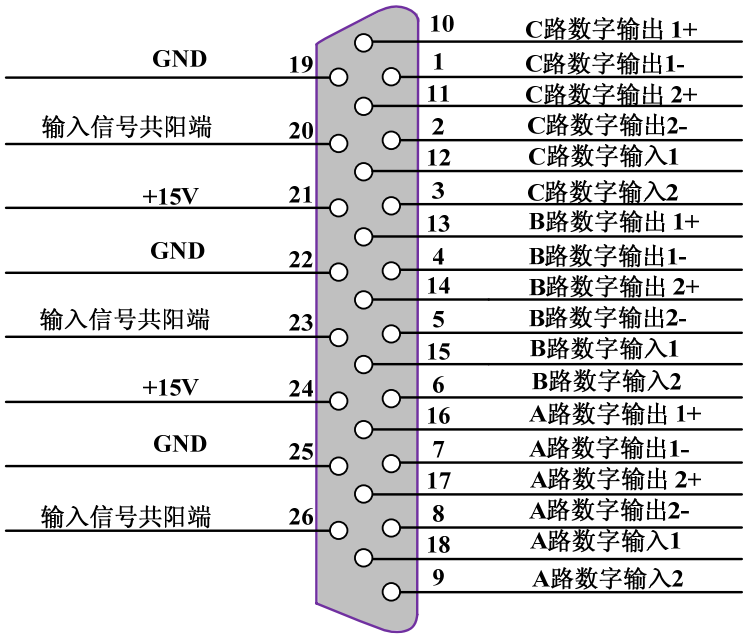


Figure 2-6 Pin Definition of Expanding Interface CN2 for MDBOX's Servo Drive Section

输入信号共阳端 Input signals' common anode
A 路数字输出 Channel A digital output
A 路数字输入 Channel A digital input
B 路数字输出 Channel B digital output
B 路数字输入 Channel B digital input
C 路数字输出 Channel C digital output
C 路数字输入 Channel C digital input

Digital input channels can be reserved for external connection with the servo drive signals for forward rotation prohibition, backward rotation prohibition and other functions.

Digital output channels can be reserved for external connection with the servo motor signals for electromagnetic braking control, dynamic braking control or fault, or ready for running and other control signals or commands.

Digital input signals are connected in a pattern featuring a common anode (common anode is used in standard models, and common cathode is an option for custom models) and optocoupler isolation, a 2.4kΩ built-in current-limiting resistor is connected in series, and can meet the needs of supplying an interface whose power voltage requirement is 12~24V. When the optocoupler for digital input is on, the input physical signal is defined as 1 (or High/H).

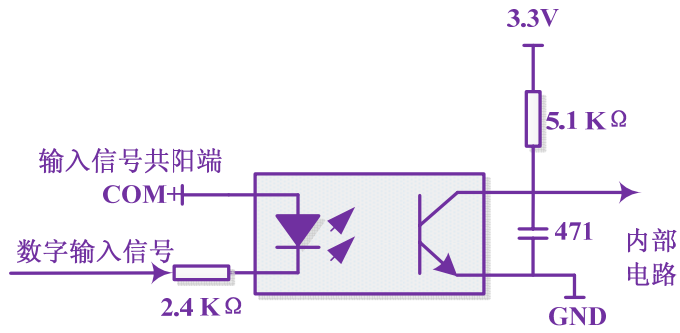


Figure 2-7 Digital Input Interface of MDBOX's Servo Section

输入信号共阳端 Input signals' common anode
数字输入信号 Digital input signal
内部电路 Internal circuit

Digital output signal is based on optocoupler isolation, and optocoupler's maximum driving capacity is DC30V/DC50mA.

Figure 2-8 Digital Output Interface of MDBOX's Servo Section

Note: under normal conditions, use of CN2 interface is not needed. When the user has any special need of servo control interface, not only the hardware of interface, but also setting of the parameters of MDBOX's servo drive section is needed; normally, such setting is made through the communication interface. Please contact our company's technicians for the setting.

2.5.4 MDBOX's Servo Drive Section Interface CN2 to be Connected to Input of External Position-limit Sensors

MDBOX dynamic platform integrated controller completely supports purely position-limit-sensor-free initial positioning of the dynamic platform and its normal running, except for the applications involving the following combination of conditions:

1) the electric cylinder has no device inside it for prevention of rotation
2) joining of the electric cylinder's and platform's moving parts is achieved with a ball-and-socket member

When the electric cylinder and its mounting fall into the combined conditions above, the electric cylinder's linear motion and the motor's rototary motion are no capable of repeated positioning, the motor's rototary motion will cause the electric cylinder's repeated "slippage" in a certain direction during its linear motion, the slippage will build up until the electric cylinder is pressed against anything immovable. Normally, such problem will occur when the electric cylinder's anti-rotation device is cancelled by the electric cylinder manufacturer to reduce cost, and the manufacturer of electric cylinder integration and application uses a ball-and-socket structure for joining (if the joining

employs a fisheye joint or universal joint, the buildup of slippage that leads to the electric cylinder's being pressed against an immoveable part can also be avoided).

In order to avoid buildup of the electric cylinder's slippage and subsequently the electric cylinder's being pressed against an immoveable part, and the consequent damage to the motor, normally 2 position-limit sensors will be installed on the electric cylinder's 2 ends. The sensors will be normally connected to the servo driver's overtravel input interface, so as to enable forward rotation prohibition and backward rotation prohibition, and avoid overtravel of the electric cylinder.

Under normal conditions, connection of the upper position-limit sensor may be omitted to reduce cost. If it is omitted, it is recommended to use software protection through settting the electric cylinder's relevant parameters.

When the user decides to install position limit sensors on the electric cylinder, no extra external power supply is needed; the user may use the MDBOX to provide a power supply of 12V (with current not higher than 100mA), so that the external position-limit switches are directly connected to the MDBOX, and the cost and wiring of the external power supply is saved.

2.5.5 MDBOX's Servo Drive Section Interface CN2 for Connection with an External Relay for Controlling Electromagnetic Brake

In some applications with rigorous requirements, the dynamic platform's drive control is required to be capable of preventing the dynamic platform from dropping under the effect of gravity when the driver's power is off and the driver is unable to control the platform. In such cases, the motor need be equipped with an electromagnetic braking module (also a mechanical braking module, commonly known as a band-type brake), and the MDBOX need be connected to an external relay for the motor's electromagnetic braking.

MDBOX's X-DOUT1+ and X-DOUT1- (X=A,B,C) are designated by default for controlling the electromagnetic brake relay; by using the external relay and power supply to turn on and off the motor braking coil's power, the user can control the electromagnetic brake. The figure below shows their working principle:

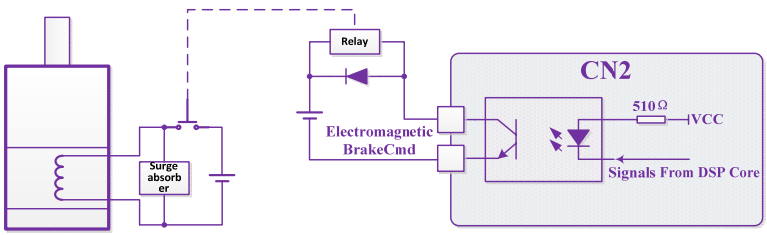


Figure 2-9 Working Principle of Digital Output Interface's Control of the Electromagnetic Brake

In order to facilitate the user's direct connection and control of the electromagnetic brake, MDBOX is equipped with a 3-channel intermediate relay drive circuit board as shown in the figure below. In the example below, X Axis servo drive digital output channel is used to control the electromagnetic brake of the X Axis motor equipped with a braking coil. The circuit board provides totally 3 channels (X, Y, Z) of intermediate relay drive, and can also be used as intermediate relay drive for general purposes.

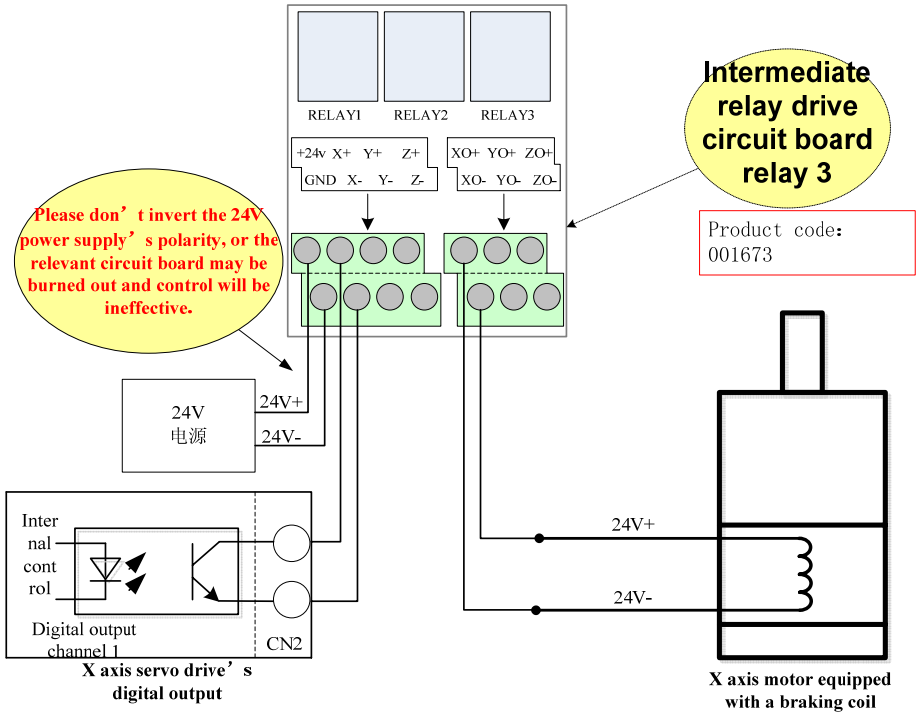


Figure 2-10 MDBOX Digital Output Interface's Control of Electromagnetic Brake via the Intermediate Relay

2.5.6 MDBOX's Servo Drive Section Interface CN3 for Connection with Motor Encoder

MDBOX's motor encoder interface CN3 has 3 channels (A, B, C), please do connect them as per the corresponding motor's phase sequence, or the encoder cannot decode correctly.

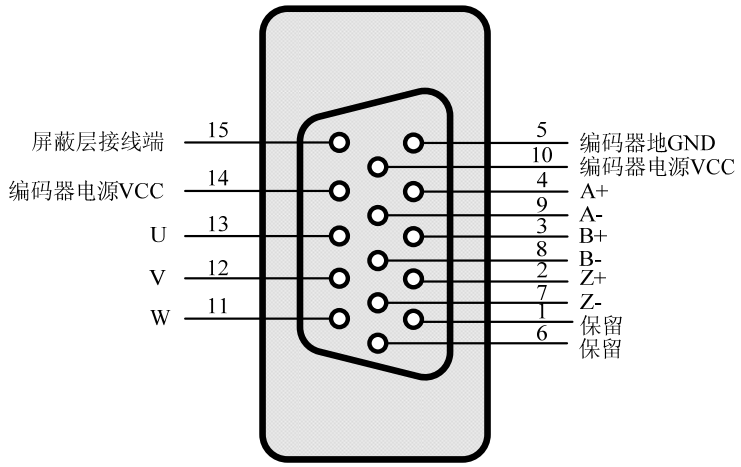


Figure 2-11 Pin Distribution of Encoder Interface

屏蔽层接线端 Shielding layer's connecting terminal

编码器电源 VCC Encoder power supply VCC
编码器地 GND Encoder ground GND
保留 Reserved

2.5.7 MDBOX's Motion Control Section I/O Interface CN4

MDBOX's motion control I/O interface CN4 is a DB44 connector as shown in the figure below:

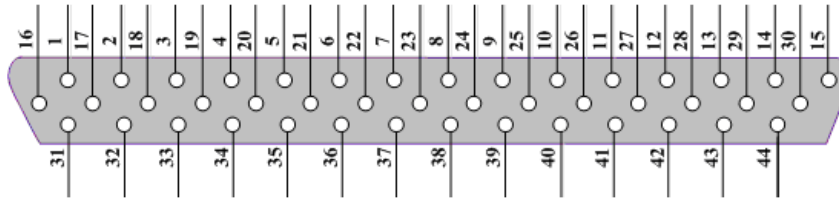


Figure 2-12 Pin Distribution of MDBOX I/O Interface CN4

Interface CN4 has 12 channels of isolated digital output, 8 channels of isolated digital input, 2 channels of analog output, 6 channels of analog input, etc.

1) 12 channels of isolated digital output signals

Pin connection and definition of the 12 channels of MDBOX motion control section's digital output signals are as shown in the table below:

Signal Definition	Pin	Remark
M-SOUT1	CN4-6	MDBOX digital output 1
M-SOUT2	CN4-7	MDBOX digital output 2
M-SOUT3	CN4-5	MDBOX digital output 3
M-SOUT4	CN4-22	MDBOX digital output 4
M-SOUT5	CN4-4	MDBOX digital output 5
M-SOUT6	CN4-21	MDBOX digital output 6
M-SOUT7	CN4-3	MDBOX digital output 7
M-SOUT8	CN4-20	MDBOX digital output 8
M-SOUT9	CN4-2	MDBOX digital output 9
M-SOUT10	CN4-19	MDBOX digital output 10
M-SOUT11	CN4-1	MDBOX digital output 11
M-SOUT12	CN4-18	MDBOX digital output 12
M-COM-	CN4-23	Common cathode of MDBOX's digital output

Digital output is based on OC optocoupler isolation, and the optocoupler's maximum driving capacity is DC30V/DC50mA. The figure below shows the interface circuit structure:

Figure 2-13 MDBOX Servo Section's Digital Output Interface

2) 8 channels of isolated digital input signals

Pin connection and definition of the 8 channels of MDBOX motion control section's digital input signals are as shown in the table below:

Signal Definition	Pin	Remarks
M-COM+	CN4-17	Common anode of MDBOX's digital input
M-SIN1	CN4-32	MDBOX digital input 1
M-SIN2	CN4-33	MDBOX digital input 2
M-SIN3	CN4-34	MDBOX digital input 3
M-SIN4	CN4-35	MDBOX digital input 4
M-SIN5	CN4-36	MDBOX digital input 5
M-SIN6	CN4-37	MDBOX digital input 6
M-SIN7	CN4-38	MDBOX digital input 7
M-SIN8	CN4-39	MDBOX digital input 8

Digital input signals are connected in a pattern featuring a common anode (common anode is used in standard models, and common cathode is an option for custom models) and optocoupler isolation, a 2.4kΩ built-in resistor is connected in series, and can meet the needs of supplying an interface whose power supply requirement is 12~24V. When the optocoupler for digital input is on, the input physical signal is defined as 1 (or High/H).

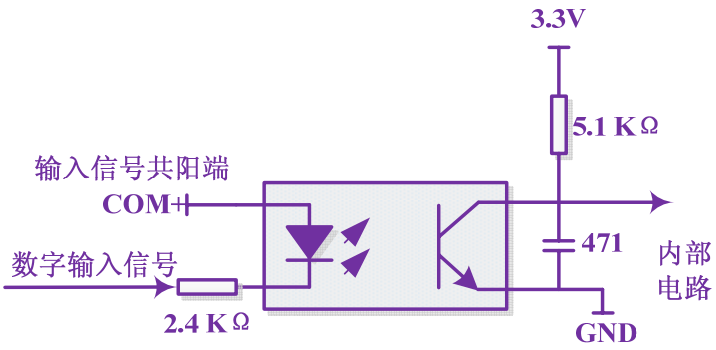


Figure 2-14 MDBOX Motion Control Section's Digital input Interface

内部电路 Internal circuit
数字输入信号 Digital input signal　输入信号共阳端 Common anode of input signals

3)　2 channels of isolated DAC output

Pin connection and definition of the 2 channels of MDBOX motion control section's isolated analog output signals are as shown in the table below:

Signal Definition	Pin	Remarks
M-ISODAC1	CN4-44	MDBOX's isolated analog output 1
M-ISODAC2	CN4-43	MDBOX's isolated analog output 2
ISO-15V	CN4-42	MDBOX's 15V power supply for isolated analog output (reserved only for testing, not allowed to be used by users)
ISO-GND	CN4-41	Reference ground of MDBOX's isolated analog output

CN4 interface's 15V isolated power supply and isolated ground constitute DAC's power supply. DAC output can be used for Ethernet remote analog control and monitoring of MDBOX internal status; DAC output range is 0V ~ +10V.

4) 6 channels of analog input

Pin connection and definition of the 6 channels of MDBOX motion control section's analog input are as shown in the table below:

Signal Definition	Pin	Remarks
M-ADCIN1	CN4-8	Analog position command input 1
M-ADCIN2	CN4-9	Analog position command input 2
M-ADCIN3	CN4-10	Analog position command input 3
M-ADCIN4	CN4-11	Analog position command input 4
M-ADCIN5	CN4-12	Analog position command input 5
M-ADCIN6	CN4-13	Analog position command input 6
M-GND	CN4-25	Analog signal reference ground
M-GND	CN4-26	Analog signal reference ground
M-GND	CN4-27	Analog signal reference ground
M-GND	CN4-28	Analog signal reference ground
M-GND	CN4-29	Analog signal reference ground
M-GND	CN4-30	Analog signal reference ground
M-REF10V	CN4-14	Analog 10V reference power supply (reserved only for testing, not allowed to be used by users)

5) CAN bus cascading expansion interface

CAN bus cascading expansion interface is reserved for MDBOX's expansion cascading, which is used for control of 6-DOF dynamic platforms.

Signal Definition	Pin	Remarks
CAN-H	CN4-31	CAN bus high
CAN-L	CN4-16	CAN bus low

1） Others

Signal Definition	Pin	Remarks
PE	CN4-15	MDBOX driver case protective ground

2.5.8 EtherNet MDBOX Motion Control Section's Ethernet Interface EtherNet

MDBOX supports standard 10/100M Ethernet interfaces, which use the same RJ45 interfaces as the computers.

Figure 2-15 MDBOX's RJ45 Ethernet Interface

Chapter III Keyboard Display Interface

3.1 Panel Display

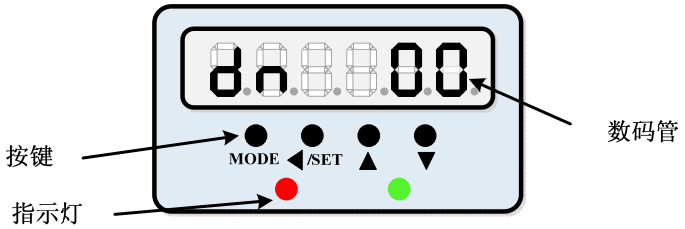


Figure 3-1 Diagram of the Operation Panel

按键 Push key　　指示灯 Indicator light　　数码管 Numerating tube

As shown in the figure above, the operation panel is mainly composed of 2 indicator lights, 4 push keys and 6 sets of numerating tubes,. The indicator lights work with numerating tubes to show MDBOX's current working status; the push keys are used to select and edit parameters. Numerating tubes are used to display current working status, function codes and parameter values. Below is the look-up table of displayed numbers and letters

Number	1	2	3	4	5	6	7	8	9	0	Decimal point	
Letter	A	b	c	d	E	F	G	H	J	L	n	o
	P	q	r	S	T	U	V	y	Null	-		

3.2 Description of the Panel

The numerating tubes' display interface is divided into three layers: current working status interface, function code selecting Interface (including for "Fn xxx" configuration parameters and "Dn xx" status parameters) and parameter observing interface (for "Dn xx" status parameter values) and editing interface (for "Fn xxx" configuration parameters); for description of each layer, please refer to the table below. By touching the push keys, the user can shift between the three layers

【Note】: ▸ ▾ ◂ ▸ means the current digit position is flashing

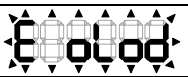
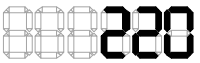
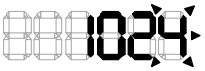
S/N	Display Interface	Display Definition	Description	
1	Current running status interface	Default status	MDBOX self-test is completed, but CAN bus connection has not been established	CAN bus connection is established, the dynamic platform is waiting for operation
				
			When the dynamic platform is being operated, the default display is current running time or current number of frames already played	When a fault alarm occurs, the current alarm code appears and flashes
				
2	Function code selecting interface	Status parameters		
		Configuration parameters		
3	Parameter observing and editing interface	Status parameter's observed value		
		Configuration parameter's edited value		

Table 3-1 Description of Numerating Tubes' Display

3.3 Description of Display of Indicator Lights

Different status of red and green indicator lights represents different operating status of the MDBOX dynamic platform integrated controller; the table below gives detailed description of the indicator light status:

Indicator Light	Definition	Operation Description
Red	Ethernet indicator light	Off: Ethernet connection is not established On: Ethernet connection has already been established
Green	Working status indicator light	Off: MDBOX is in the process of initial positioning On: MDBOX's initial positioning is completed and MDBOX is waiting for running Slow flashing: MDBOX is running Quick flashing: MDBOXhas a fault

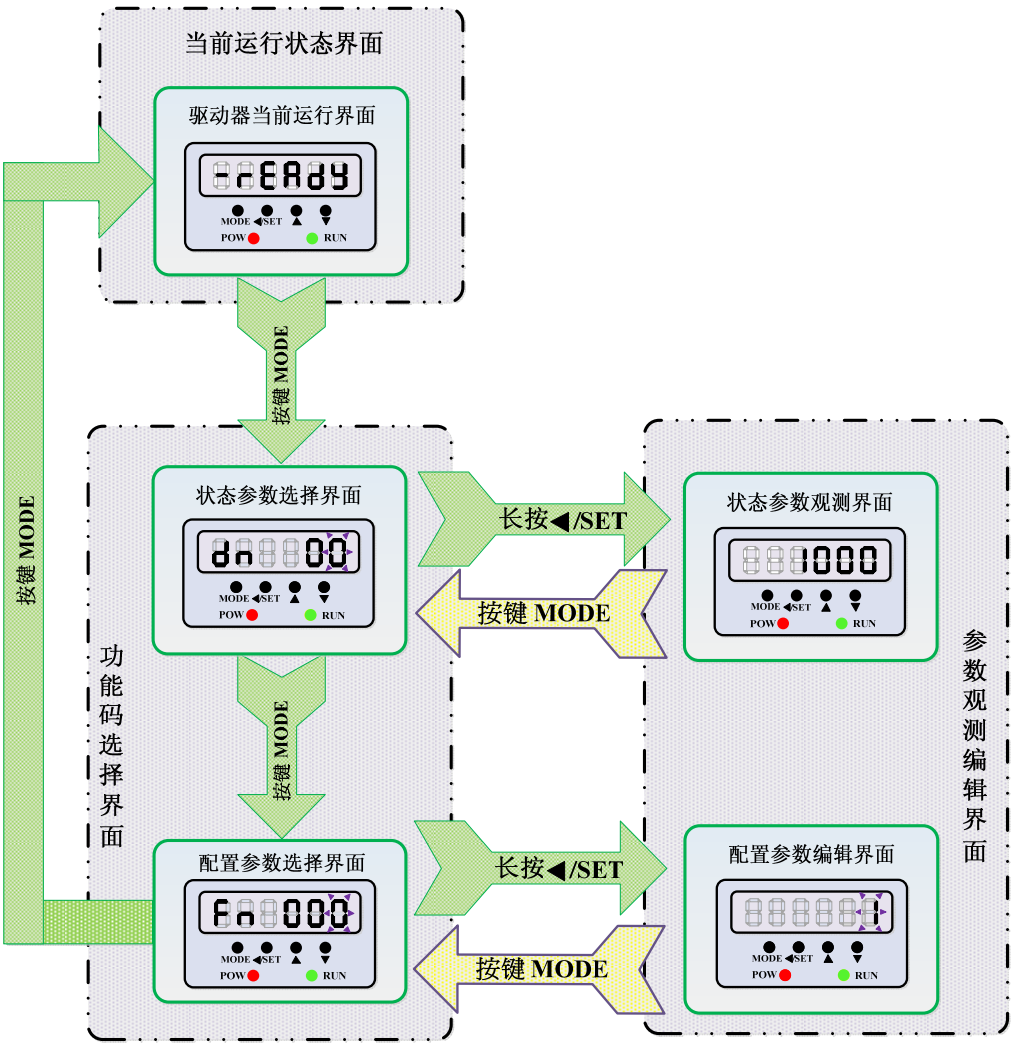


Figure 3-2 Shifting between Numerating Tubes' Display Interfaces

当前运行状态界面　Interface of Current Working Status
驱动器当前运行界面　Interface of Driver's Current Working Status
按键　MODE Push the MODE key
功能码选择界面　Interface for Selecting the Function Code
状态参数选择界面　Interface for Selecting the Status Parameter
状态参数观测界面　Interface for Observing the Status Parameter
长按◀/SET　A long push on the ◀/SET key
参数观测编辑界面　Interface for Observing and Editing the Parameter
配置参数选择界面　Interface for Selecting the Configuration Parameter
配置参数编辑界面　Interface for Editing the Configuration Parameter

3.4 Definition of Push Keys' Functions

The push keys are provided for the user's selection, observation and editing of parameters; detailed definition of the keys are as shown in table below.

Push Key	Definition	Operation Description
MODE	Interface shifting	It is used for shifting between the "Interface of Current Working Status", "Interface for Selecting the Status Parameter" and "Interface for Selecting the Configuration Parameter" It is used for returning from "Interface for Observing and Editing the Parameter" to the "Interface for Selecting the Function Code" when the user is observing or editing the driver's internal parameters
◄/SET	Confirm & move between digits	In the "Interface for Selecting the Function Code" and "Interface for Editing the Configuration Parameter", by giving a normal short push on the key, the user can select the function code and the digit position of the parameter value he wants to change, the digit position he has selected for change will flash In the "Interface for Selecting the Function Code", if the user has selected a parameter's No., and held down the key for 1 second, he will enter the "Interface for Observing and Editing the Parameter" In the "Interface for Editing the Configuration Parameter", by holding down the key for 1 second, the user can confirm and save the changed parameter value
▲	Progressive increase key	In the "Interface for Selecting the Function Code" and "Interface for Editing the Configuration Parameter", the digit that is selected by the user for change will flash, and show increase of its value by increments of "1"
▼	Progressive decrease key	In the "Interface for Selecting the Function Code" and "Interface for Editing the Configuration Parameter", the digit that is selected by the user for change will flash, and show decrease of its value by increments of "-1"

3.5 Example of Status Parameter Inquiry

System status parameters of MDBOX are marked by "Dn xx"; during debugging, the operator can observe values of the status parameters he is interested in by using the "Dn xx" status parameters

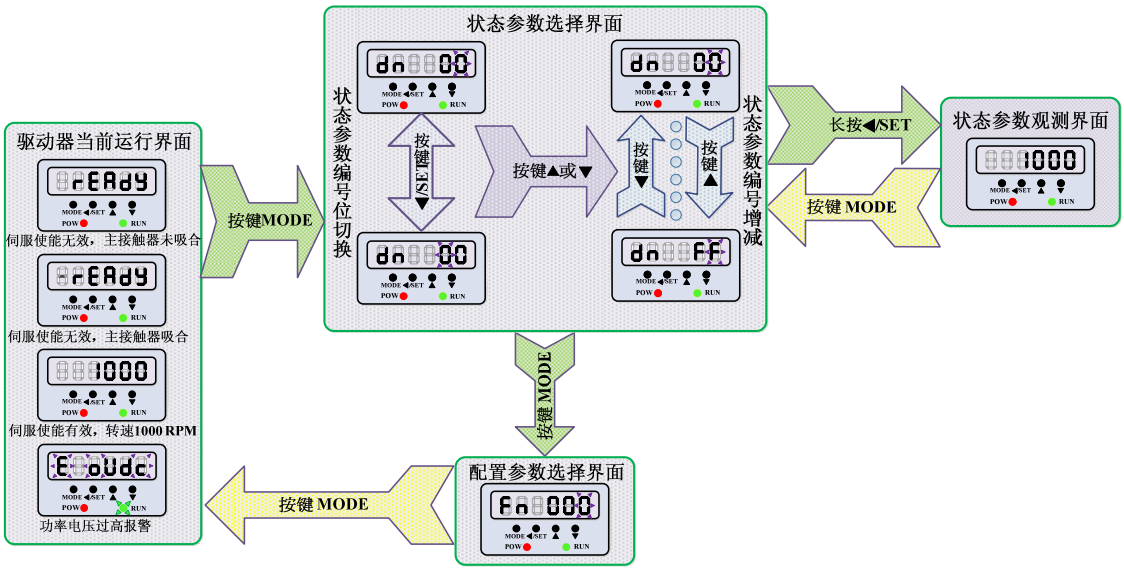
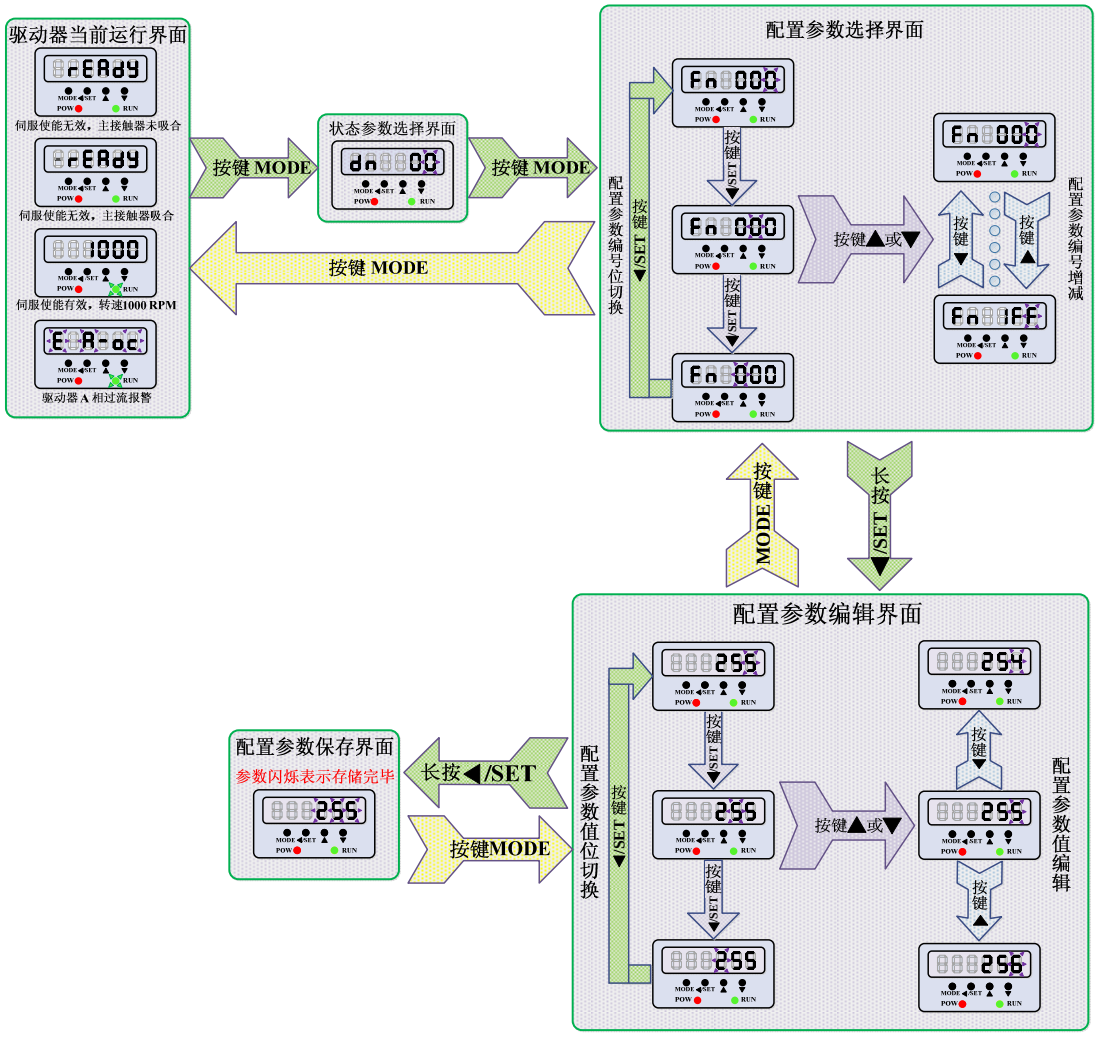


Figure 3-3 Ordinary Diagram of Status Parameter Inquiry

状态参数选择界面　　Interface for Selecting the Status Parameter
状态参数编号位切换　　Shifting between Digit Positions of the Status Parameter No.
按键▼/SET　　Push ▼/SET key
按键▼　　Push ▼ key
按键▼或▲　　Push ▼or ▲ key
按键▲　　Push ▲ key
按键 MODE　　Push MODE key
长按◀/SET　　A long push on ◀/SET key
状态参数编号增减　　Increase and Decrease of Status Parameter No.
驱动器当前运行界面　　Interface of Driver's Current Working
伺服使能无效，主接触器未吸合　　Servo enabling is ineffective, master contactor isn't closed
伺服使能无效，主接触器吸合　　Servo enabling is ineffective, master contactor is closed
伺服使能有效，转速 1000 RPM　　Servo enabling is effective, rotation speed is 1000 RPM
功率电压过高报警　　Alarm of DC-link bus overvoltage
配置参数选择界面　　Interface for Selecting the Configuration Parameter
状态参数观测界面　　Interface for Observing the Status Parameter

3.6 Example of Inquiry about and Editing of a Configuration Parameter

Configuration parameters of MDBOX are marked by "Fn xx"; when the user has bought the product, he needs to set the relevant configuration parameters based on the differences between applications. The figure below shows an ordinary example of inquiry about and editing of a configuration parameter.



驱动器当前运行界面　　Interface of Driver's Current Working
伺服使能无效，主接触器未吸合　　Servo enabling is ineffective, master contactor isn't closed
伺服使能无效，主接触器吸合　　Servo enabling is ineffective, master contactor is closed
伺服使能有效，转速 1000 RPM　　Servo enabling is effective, rotation speed is 1000 RPM
驱动器 A 相过流报警　　Alarm of overcurrent of Driver's Phase A
按键 MODE　　Push MODE key
按键▲或▼　　Push ▲ or ▼ key
长按◄/SET　　A long push on ◄/SET key
按键▼/SET　　Push ▼/SET key
按键◄/SET　　Push ◄/SET key
按键▼或▲　　Push ▼or ▲ key
按键▲　　Push ▲ key
按键▼　　Push ▼key
状态参数选择界面　　Interface for Selecting the Status Parameter
配置参数选择界面　　Interface for Selecting the Configuration Parameter
配置参数编号位切换　　Shifting between digit positions of configuration parameter No.
配置参数编号增减　　Increase and decrease of configuration parameter No.

配置参数编辑界面 Interface for Editing the Configuration Parameter
配置参数保存界面 Interface for Saving the Configuration Parameter
参数闪烁表示参数存储完毕 Flashing of the parameter indicates completion of parameter saving
配置参数值位切换 Shifting between digit positions of configuration parameter value
配置参数值编辑 Editing of the configuration parameter value

Chapter IV Ethernet Bus Communication Protocol

4.1 Brief Introduction to MBOX Ethernet Communication

This system employs an Ethernet LAN+CAN bus control scheme to achieve networked servo control of the dynamic platform; in the scheme, MBOX Ethernet data communication is based on UDP communication protocol.

4.2 MBOX Ethernet Communication Protocol

The following sections introduce the basic frame of MBOX's Ethernet communication and the specific communication protocol.

4.2.1. Basic Frame of MBOX's Ethernet Communication

Ethernet communication employs UDP communication protocol (the table below shows basic format of UDP). Through MAC address, IP address and the UDP source port No. and destination port No. specially defined by the user, the Ethernet data's flow direction is controlled. The dynamic platform's interactive control information is contained in the UDP data.

MAC Header (14 Bytes)		
DA	SA	TYPE
$.$.$.$.$.$	$.$.$.$.$.$	0x0800

IP Header (20 Bytes)									
Ver HeadLength	Diff Services	Total Length	Id	Flag Offset	TTL	Protocol Type	Check Sum	Souce IP	Destination IP
0x45	$	$.$	$.$	$.$	$	0x11	$$	$.$.$.$	$.$.$.$

UDP Header (8 Bytes)			
Source Port	Destination Port	Length	CheckSum
$.$	$.$	$.$	$.$

UDP Data		
AppControlField	AppWhoField	AppDataField
$.$.$.$.$.$.$.$	$.$.$.$	$.$. .$.$

MAC Frame Check Sequence (4 Bytes)
$.$.$.$

4.2.2. UDP Data Method for MBOX Ethernet Information Transmission

This communication method for the dynamic cinema's broadcast with effect can

achieve point-to-point interactive and broadcast communication, and point-to-multipoint interactive and broadcast communication. Addressing is achieved through MAC address, IP address and port No. When the MAC address is FFFFFFFFFFFF, it means physical-address broadcast, when IP segment address is FFFFFFFF, it means logic-address broadcast.

In this manual, Ethernet UPD data are divided into 3 subfields, respectively application control field (AppControlField), application processor field (AppWhoField) and application data field (AppDataField).

UDP Data		
AppControlField	AppWhoField	AppDataField

The application control field (AppControlField) is used for UDP data message's confirmation (Confirm Code), encryption (PassCode), function selection (FunctionCode) and object channel selection (ObjectChannel). The table below shows the structure of application control field:

AppControlField			
Confirm	Pass	Function	Object
Code	Code	Code	Channel

The application processor field (AppWhoField) is used for marking how the MBOX should process the meassage it has received.

AppWhoField	
Who	Who
Accept	Reply
$.$	$.$

The $ in the table stands for 1 byte of data, and $.$ stands for 2 bytes of data…, and the rest may be deduced by analogy.

In general, the WhoAccept code in the application processor field (AppWhoField) is used for confirming the receiver of the message, and it means selection of the position defined by row coordinate and column coordinate. When WhoAccept code = ff.ff, it means all-area receiving; when WhoAccept code = xx.ff, it means column receiving; when WhoAccept code = ff.xx, it means row receiving; when WhoAccept code = xx.yy, it means point receiving. In the meassage sent from the main broadcasting station; when WhoAccept code = 00.00, it means the message need not be received; in the message from MBOX slave station, it means only the main broadcasting station needs to receive the message.

In general, the application processor field (AppWhoField)'s WhoReply code is used to confirm the message's responder; it means selection of the position defined by the positions on rows and columns. When WhoReply = ff.ff, it means all-area response; when WhoReply = xx.ff, it means column response; when WhoReply = ff.xx, it means row response; when WhoReply = xx.yy, it means point response. In the message sent from the main broadcasting station, when WhoReply = 00.00, it means no need to response.

Through different position information (horizontal coordinate and vertical coordinate) in the application processor field (AppWhoField), request-response mode or broadcast mode information interaction, whether involving the whole area, a row,

column or dot, can be achieved between the broadcasting computer and the matrix composed of multiple MBOXes.

The application data field (AppDataField) means the data corresponding to different selected function codes. MBOX supports the following function codes for UPD data communcaiton and basic operation of application data field (AppDataField):

1) MBOX's active report of designated status information
2) Main broadcasting station's reading of MBOX's register
3) Main broadcasting station's writing in MBOX's register
4) Main broadcasting station's transmission of information about MBOX play data

4.2.3. MBOX's Active Report of Designated Status Information

When MBOX monitoring is being used and regular alarm or fault alarm need be actively performed, running status information is reported to the Ethernet main station.

Data to be reported: DX starting address + DX data length

The starting address and data length are set by MBOX's corresponding FX parameters; please refer to 错误！未找到引用源。 for details.

UDP Data								
AppControlField				AppWhoField		AppDataField		
Confirm	Pass	Function	Object	Who	Who	RegStart	Reg	Reg
Code	Code	Code	Channel	Accept	Reply	Address	Num	Data
$.$	$.$	$.$	$.$	$.$	$.$	$.$	$.$	$..$
0x55aa	0x0000	ReportReg	0: DX	0: Host	0：None	X.X	X.X	X..X
		0x1001		X: Don't Care	X: Don't Care			

4.2.4. Reading of MBOX's Register

UDP data format for host computer's request

UDP Data								
AppControlField				AppWhoField		AppDataField		
Confirm	Pass	Function	Object	Who	Who	RegStart	Reg	Extra
Code	Code	Code	Channel	Accept	Reply	Address	Num	Data
$.$	$.$	$.$	$.$	$.$	$.$	$.$	$.$	$..$
0x55aa	0x0000	ReadReg	0: DX	0：None	0：None	X.X	X.X	X..X
		0x1101	1: FX	ff.ff：All	ff.ff：All			
				ff.xx：Num	ff.xx：Num			
				xx.ff：Group	xx.ff：Group			
				Mid: Me	Mid: Me			

UDP data format for MBOX's correct response

UDP Data								
AppControlField				AppWhoField		AppDataField		
Confirm	Pass	Function	Object	Who	Who	RegStart	Reg	Reg
Code	Code	Code	Channel	Accept	Reply	Address	Num	Data
$.$	$.$	$.$	$.$	$.$	$.$	$.$	$.$	$..$
0x55aa	0x0000	ReadReg RightReply	0: DX	0：Host	0：None	X.X	X.X	X..X
		0x1102	1: FX					

UPD data format for MBOX's error response

UDP Data								
AppControlField				AppWhoField		AppDataField		
Confirm	Pass	Function	Object	Who	Who	RegStart	Reg	Error
Code	Code	Code	Channel	Accept	Reply	Address	Num	Code

$.$	$.$	$.$	$.$	$.$	$.$	$.$	$.$	$..$
0x55aa	0x0000	ReadReg FalseReply	0: DX	0：Host	0：None	X.X	X.X	X..X
		0x1103	1: FX					

4.2.5. Writing in MBOX's Register

UPD data format for host computer's request

UDP Data								
AppControlField				AppWhoField		AppDataField		
Confirm	Pass	Function	Object	Who	Who	RegStart	Reg	Reg
Code	Code	Code	Channel	Accept	Reply	Address	Num	Data
$.$	$.$	$.$	$.$	$.$	$.$	$.$	$.$	$..$
0x55aa	0x0000	WriteReg	0: FXm	0：None	0：None	X.X	X.X	X..X
		0x1201	1: FX	ff.ff：All	ff.ff：All			
			2: CX	ff.xx：Num	ff.xx：Num			
				xx.ff：Group	xx.ff：Group			
				Mid: Me	Mid: Me			

UDP data format for MBOX's correct response

UDP Data								
AppControlField				AppWhoField		AppDataField		
Confirm	Pass	Function	Object	Who	Who	RegStart	Reg	Reg
Code	Code	Code	Channel	Accept	Reply	Address	Num	Data
$.$	$.$	$.$	$.$	$.$	$.$	$.$	$.$	$..$
0x55aa	0x0000	WriteReg RightReply	1: FX	0：Host	0：None	X.X	X.X	X..X
		0x1202	2: CX					

UPD data format for MBOX's error response

UDP Data								
AppControlField				AppWhoField		AppDataField		
Confirm	Pass	Function	Object	Who	Who	RegStart	Reg	Error
Code	Code	Code	Channel	Accept	Reply	Address	Num	Code
$.$	$.$	$.$	$.$	$.$	$.$	$.$	$.$	$..$
0x55aa	0x0000	WriteReg FalseReply	1: FX	0：Host	0：None	X.X	X.X	X..X
		0x1203	2: CX					

In the items in the table, FX means parameter register, CX means control register that can control operation of playing, reset after a fault, etc.; FXm means change of parameter register's data without the power-off saving function.

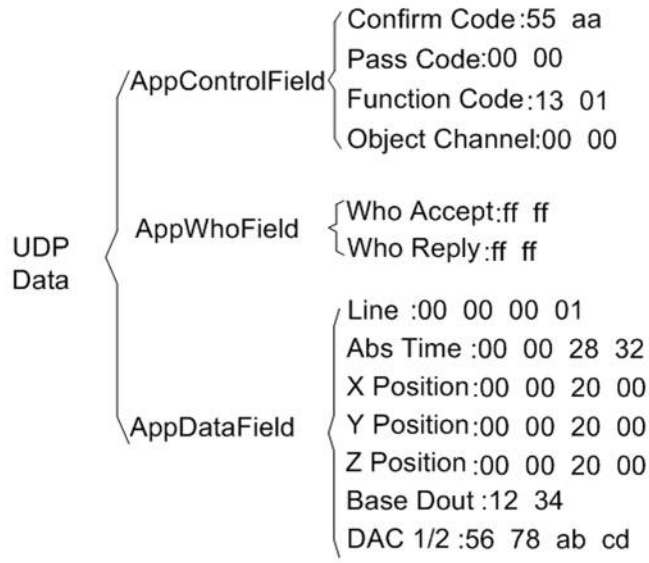
4.2.6. Operation of MBOX Absolute Playing Time Data (3-axis Platform Mode)

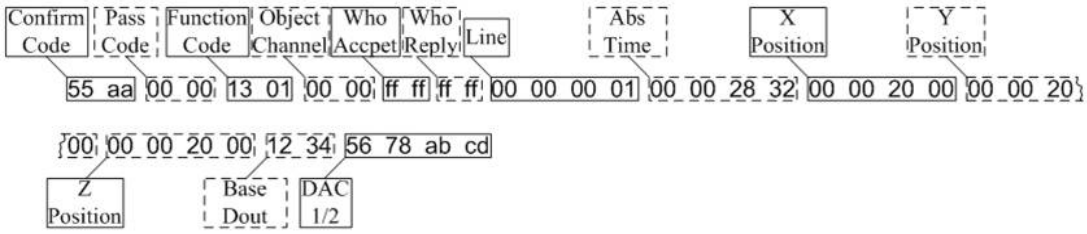
Function code of MBOX's absolute playing time and position is 1301; 3-axis dynamic platform's corresponding object channel selection (ObjectChannel) is 0.

1) UDP data format for host computer's sending

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line.	Abs Time	XYZ Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L..L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	AbsTime PlayAll	0：3 轴模式 0: 3-axis mode	0：None	0：None	L.	L.	L.L.L	X.X	$.$.$.$	X.X
		0x1301		ff.ff：All	ff.ff：All						
				ff.xx：Num	ff.xx：Num						
				xx.ff：Group	xx.ff：Group						
				Mid: Me	Mid: Me						

UDP data example for illustrating operation of MBOX absolute playing time data (3-axis platform mode):





2) UDP data format for MBOX's correct response

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line.	Abs Time	XYZ Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L..L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	AbsTime PlayAllRight	0：3 轴模式 0: 3-axis mode	0：Host	0：Host	L.	L.	L.L.L	X.X	$.$.$.$	X.X
		0x1302									

3) UDP data format for MBOX's error response (cause of error: internal buffer is full)

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	$.$ X.X	Object Channel	Who Accept	Who Reply	Line	Abs Time	XYZ Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L..L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	AbsTime PlayAllErr1	0：3 轴模式 0: 3-axis mode	0：Host	0：Host	L.	L.	L.L.L	X.X	$.$.$.$	X.X
		0x1303									

4) UDP data format for MBOX's error response (cause of error: data length of data frame is inadequate)

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	$.$ X.X	Object Channel	Who Accept	Who Reply	Line	Abs Time	XYZ Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L..L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	AbsTime PlayAllErr2	0：3 轴模式 0: 3-axis mode	0：Host	0：Host	L.	L.	L.L.L	X.X	$.$.$.$	X.X
		0x1304									

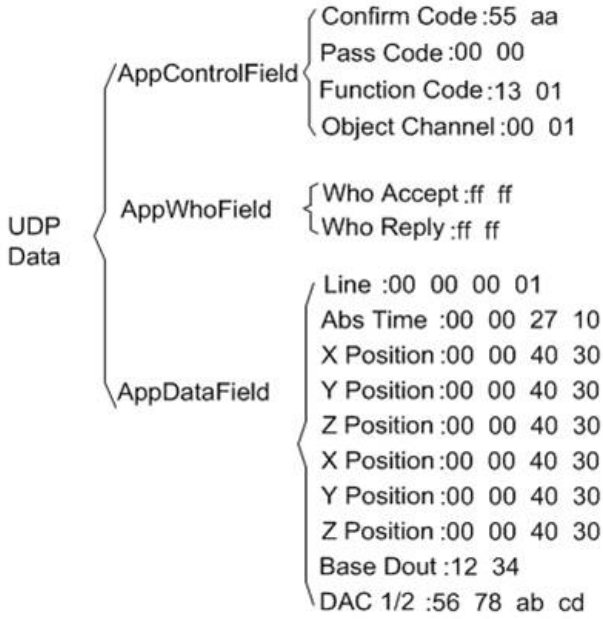
4.2.7. Operation of MBOX Absolute Playing Time Data (6-axis Platform Mode)

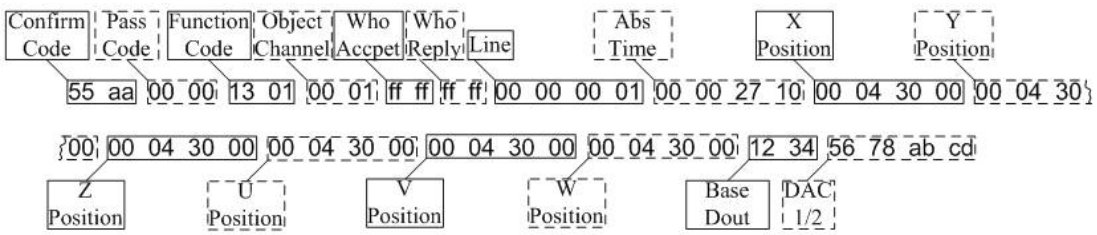
Function code of MBOX's absolute playing time and position is 1301; 6-axis dynamic platform's corresponding object channel selection (ObjectChannel) is 0.

1) UDP data format for host computer's sending

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line.	Abs Time	XYZUVW Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L.L.L.L.L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	AbsTime PlayAll	1：6 轴模式 1: 6-axis mode	0：None	0：None	L.	L.	L.L.L.L.L.L	X.X	$.$.$.$	X.X
		0x1301		ff.ff：All	ff.ff：All						
				ff.xx：Num	ff.xx：Num						
				xx.ff：Group	xx.ff：Group						
				Mid: Me	Mid: Me						

UDP data example for illustrating operation of MBOX absolute playing time data (6-axis platform mode):





2) UDP data format for MBOX's correct response

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line.	Abs Time	XYZUVW Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L.L.L.L.L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	AbsTime PlayAllRight	1：6 轴模式 1: 6-axis mode	0：Host	0：Host	L.	L.	L.L.L.L.L.L	X.X	$.$.$.$	X.X
		0x1302									

3) UDP data format for MBOX's error response (cause of error: internal buffer is full)

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line	Abs Time	XYZUVW Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L.L.L.L.L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	AbsTime PlayAllErr1	1：6 轴模式 1: 6-axis mode	0：Host	0：Host	L.	L.	L.L.L.L.L.L	X.X	$.$.$.$	X.X
		0x1303									

4) UDP data format for MBOX's error response (cause of error: data length of data frame is inadequate)

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line	Abs Time	XYZUVW Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L.L.L.L.L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	AbsTime PlayAllErr2	1：6 轴模式 1: 6-axis mode	0：Host	0：Host	L.	L.	L.L.L.L.L.L	X.X	$.$.$.$	X.X
		0x1304									

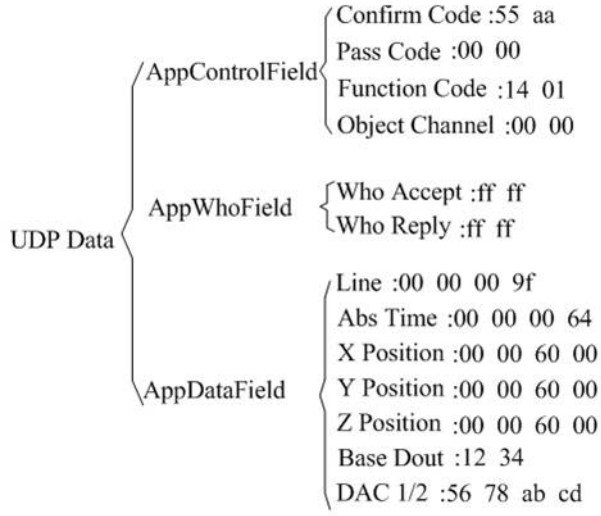
4.2.8. MBOX Relative Playing Time Data Operation (3-axis Platform Mode)

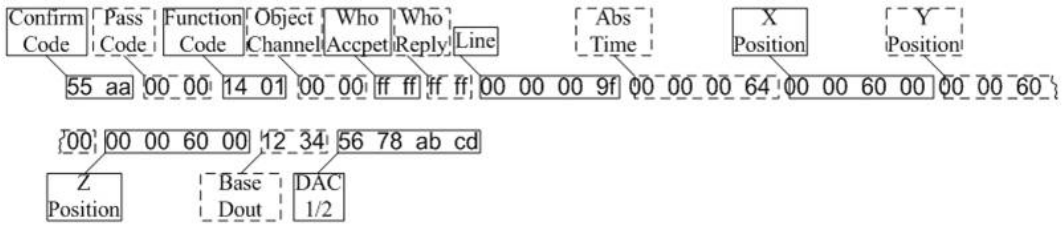
Function code for MBOX's relative playing time format and position is 1401; 3-axis dynamic platform's corresponding object channel selection (ObjectChannel) is 0.

1) UDP data format for host computer's sending

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line.	Delta Time	XYZ Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L..L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	DeltaTime PlayAll	0：3 轴模式 0: 3-axis mode	0：None	0：None	L.	L.	L.L.L	X.X	$.$.$.$	X.X
		0x1401		ff.ff：All	ff.ff：All						
				ff.xx：Num	ff.xx：Num						
				xx.ff：Group	xx.ff：Group						
				Mid: Me	Mid: Me						

Example:





2) UDP data format for MBOX's correct response

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line.	Delta Time	XYZ Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L..L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	DeltaTime PlayAll	0：3 轴模式 0: 3-axis mode	0：Host	0：Host	L.	L.	L.L.L	X.X	$.$.$.$	X.X
		0x1402									

3) UDP data format for MBOX's error response (cause of error: internal buffer is full)

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	$.$ X.X	Object Channel	Who Accept	Who Reply	Line	Delta Time	XYZ Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L..L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	DeltaTime PlayAll	0：3 轴模式 0: 3-axis mode	0：Host	0：Host	L.	L.	L.L.L	X.X	$.$.$.$	X.X
		0x1403									

4) UDP data format for MBOX's error response (cause of error: data length of data frame is inadequate)

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	$.$ X.X	Object Channel	Who Accept	Who Reply	Line	Delta Time	XYZ Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L..L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	DeltaTime PlayAll	0：3 轴模式 0: 3-axis mode	0：Host	0：Host	L.	L.	L.L.L	X.X	$.$.$.$	X.X
		0x1404									

Note: When DeltaTime = 0, use internal inching time parameter instead of DeltaTime; see 错误！未找到引用源。 for details.

When DeltaTime < 0, use internal fast backward time parameter instead; see 5.3.5 for details.

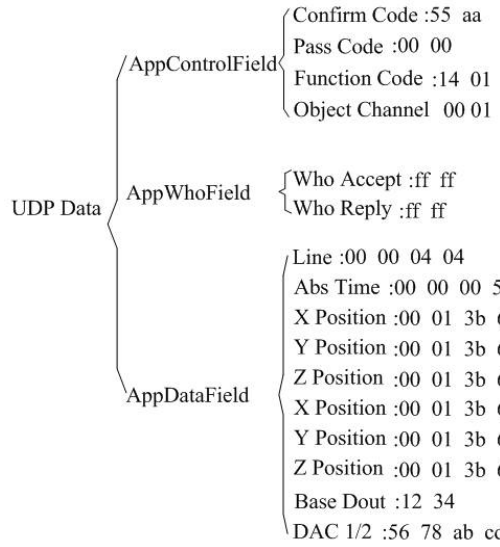
4.2.9. MBOX Relative Playing Time Data Operation (6-axis Platform Mode)

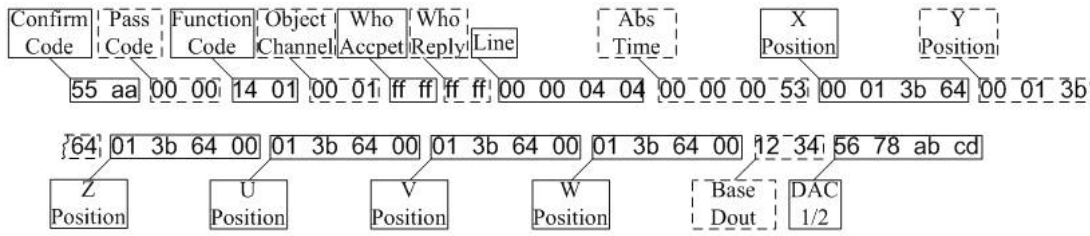
Function code for MBOX's relative playing time and position is 1401; 6-axis dynamic platform's corresponding object channel selection (ObjectChannel) is 1.

1) UDP data format for host computer's sending

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line.	Delta Time	XYZUVW Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L.L.L.L.L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	DeltaTime PlayAll	1：6 轴模式 1: 6-axis mode	0：None	0：None	L.	L.	L.L.L.L.L.L	X.X	$.$.$.$	X.X
		0x1401		ff.ff：All	ff.ff：All						
				ff.xx：Num	ff.xx：Num						
				xx.ff：Group	xx.ff：Group						
				Mid: Me	Mid: Me						

Example:





2) UDP data format for MBOX's correct response

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line.	Delta Time	XYZUVW Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L.L.L.L.L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	DeltaTime PlayAll	1：6 轴模式 1: 6-axis mode	0：Host	0：Host	L.	L.	L.L.L.L.L.L	X.X	$.$.$.$	X.X
		0x1402									

3) UDP data format for MBOX's error response (cause of error: internal buffer is full)

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line	Delta Time	XYZUVW Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L.L.L.L.L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	DeltaTime PlayAll	1：6 轴模式 1: 6-axis mode	0：Host	0：Host	L.	L.	L.L.L.L.L.L	X.X	$.$.$.$	X.X
		0x1403									

4) UDP data format for MBOX's error response (cause of error: data length of data frame is inadequate)

UDP Data											
AppControlField				AppWhoField		AppDataField					
Confirm Code	Pass Code	Function Code	Object Channel	Who Accept	Who Reply	Line	Delta Time	XYZUVW Position	Base Dout	DAC 1/2	Ext Dout
$.$	$.$	$.$	$.$	$.$	$.$	L.	L.	L.L.L.L.L.L	$.$	$.$.$.$	$.$
0x55aa	0x0000	DeltaTime PlayAll	1：6 轴模式 1: 6-axis mode	0：Host	0：Host	L.	L.	L.L.L.L.L.L	X.X	$.$.$.$	X.X
		0x1404									

4.2.10. CX MBOX's Control Register

MBOX's control register CX is used for upper computer's MBOX communication control.

Each CX register is 16-bit; the functions currently already defined are shown in the table below.

Cn	DEC No. DEC	HEX No. HEX	Definition	Description
Cn	0	0	MBOXPlayControlWord	MBOX play control word
Cn	1	1	MBOXDoutControlWord	MBOX digital output control word
Cn	2	2	MBOXDac1ControlWord	MBOX analogl output channel 1 control word
Cn	3	3	MBOXDac2ControlWord	MBOX analogl output channel 2 control word

Cn	4	4	MBOXExtDoutControlWord	MBOX expanded digital output control word
Cn	5	5	Reserved	Reserved
Cn	6	6	Reserved	Reserved
Cn	7	7	Reserved	Reserved

1) Description of play control word Cn_00

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
														SON	RST

B0 :RST(FaultReset).	In case MBOX has a fault, when cause of fault has already been removed, if this bit is set as 1, MBOX can exit from the fault status.
B1: SON(SwitchOn)	When SwitchOn = 0, the operator can use upper computer communication command to achieve dynamic platform's automatic returning to zero.
B2-B15	Reserved

2) Cn_01: MBOX digital output control word

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Reserved				12-channel digital output's setting value											

3) Cn_02: MBOX analog output channel 1 control word

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
DAC1 output's setting value															

4) Cn_03: MBOX analog output channel 2 control word

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
DAC2 output's setting value															

5) Cn_04: MBOX expanded digital output control word

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Reserved				12-channel expanded digital output's setting value											

4.3 Establishment of Connection between MBOX and Ethernet and Monitoring

The user can use PING command (Ethernet ICMP protocol) to judge whether connection between MBOX and computer is already established.

Besides, Wireshark software can be used to achieve packet capturing and monitoring of MBOX's Ethernet operation data.

4.3.1. Use of PING Command to Test Ethernet Connection Status

When MBOX is connected to Ethernet, the user can use PING command to test whether Ethernet is successfully connected.

In normal conditions, it is recommended to set the upper computer and MBOX in the same LAN segment.

In the example below, MBOX's IP address is set as 192.168.15.201.

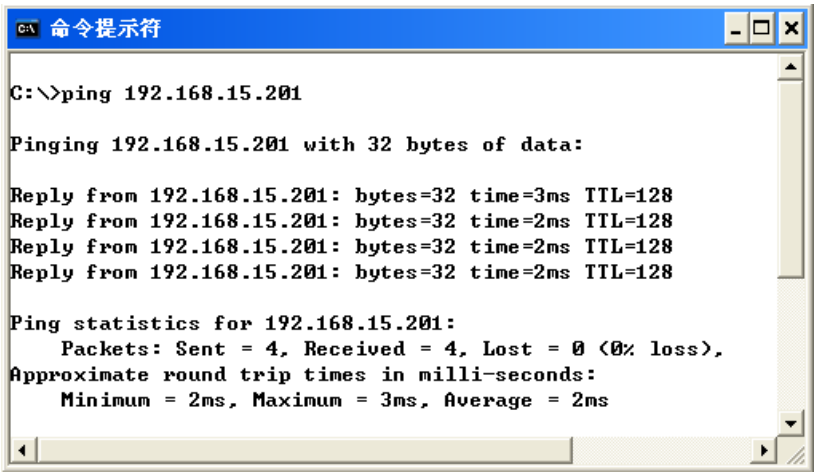
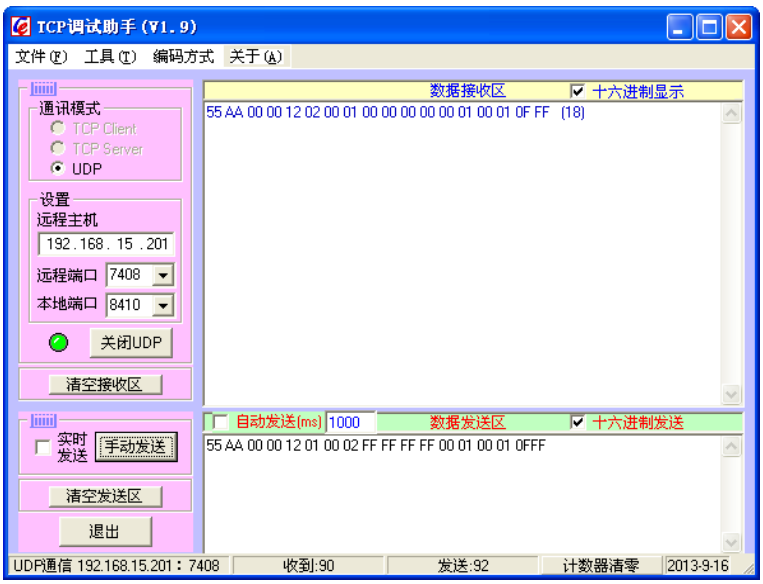


Figure 4-1 Use of PING Command to Test Ethernet Connection Status

The resut of the PING command test above shows that master control computer has already been reliably connected to MBOX.

4.3.2. Use of TCP Debugging Assistant to Debug Ethernet Communication Protocol

By using the small software named TCP Debugging Assistant, the user can perform simple application test on and debugging of Ethernet communication protocol, so as to make subsequent programming easier.

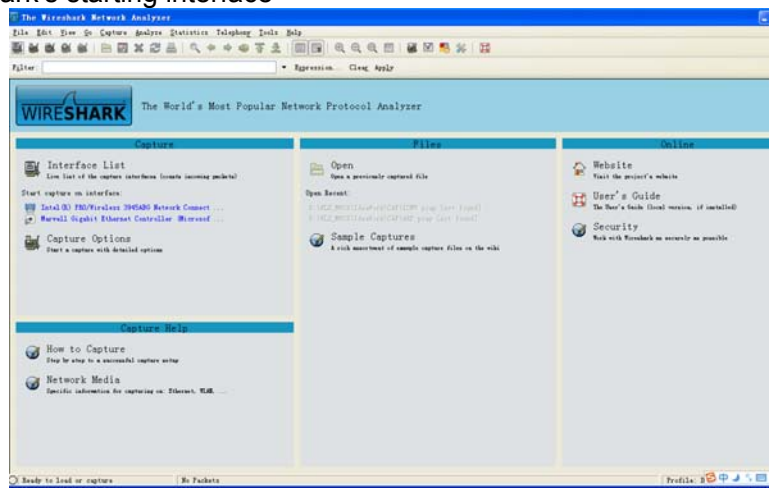


4.3.3. Use of WireShark to Chieve Monitoring of Ethernet Communication

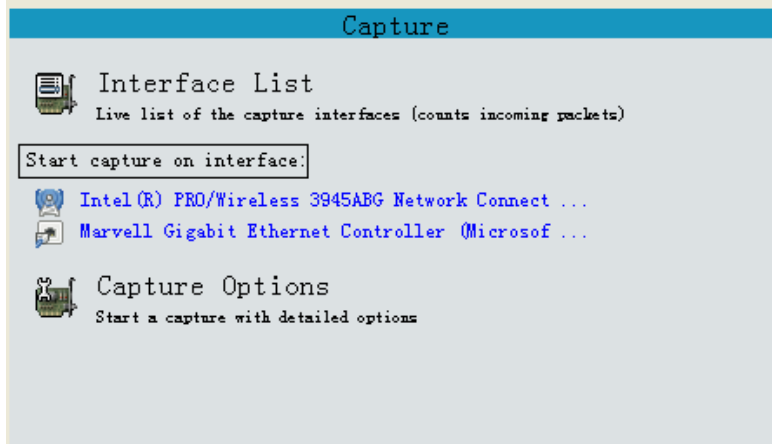
WireShark is a kind of open-source and easy-to-use Ethernet protocol working status monitoring software. By use of this software, the user can easily understand this

system's communication protocol, and effectively help writing and testing of master control computer's software.

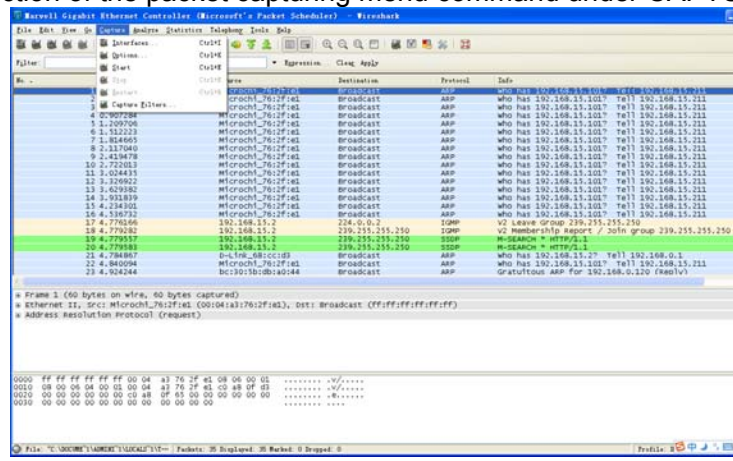
WireShark's starting interface



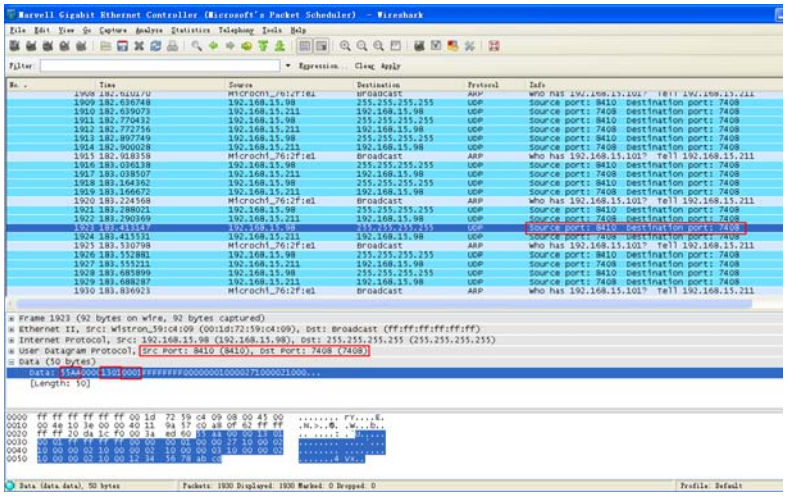
1) Selection of network card interface



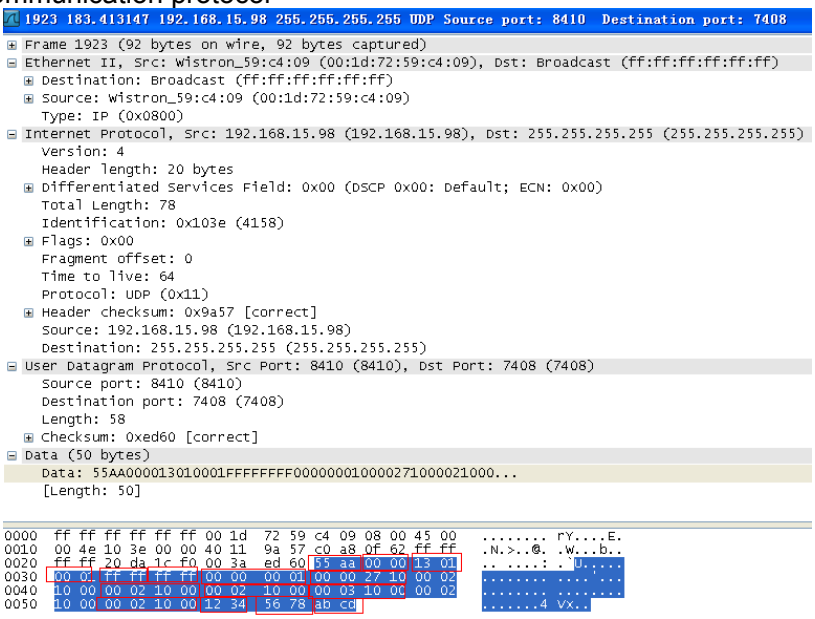
2) Selection of the packet capturing menu command under CAPTURE



3) Capturing of the UDP data packet



4) Comparison between underlined part of UDP data packet and the communication protocol



4.4 MATLAB Example of MBOX Ethernet Communication

The example includes:

Operation of reading MBOX register Reference code

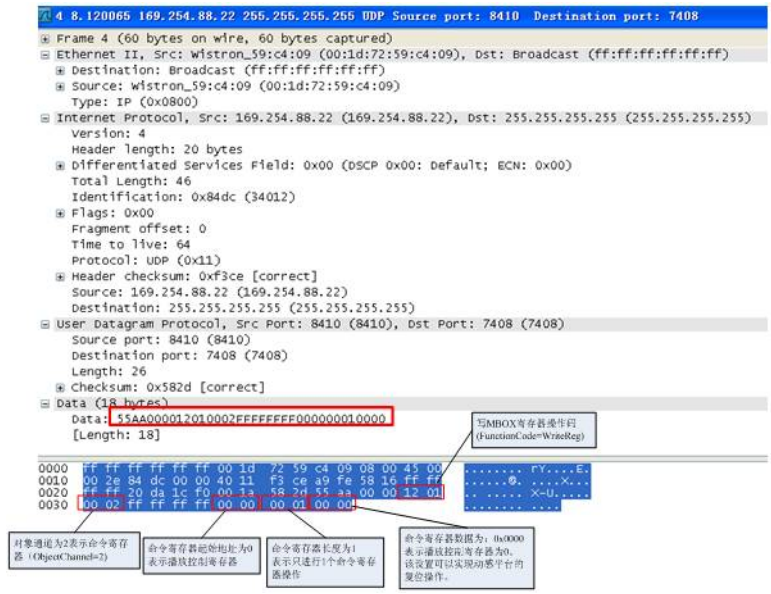
Operation of writing MBOX register Reference code

Operation of writing MBOX play Reference code

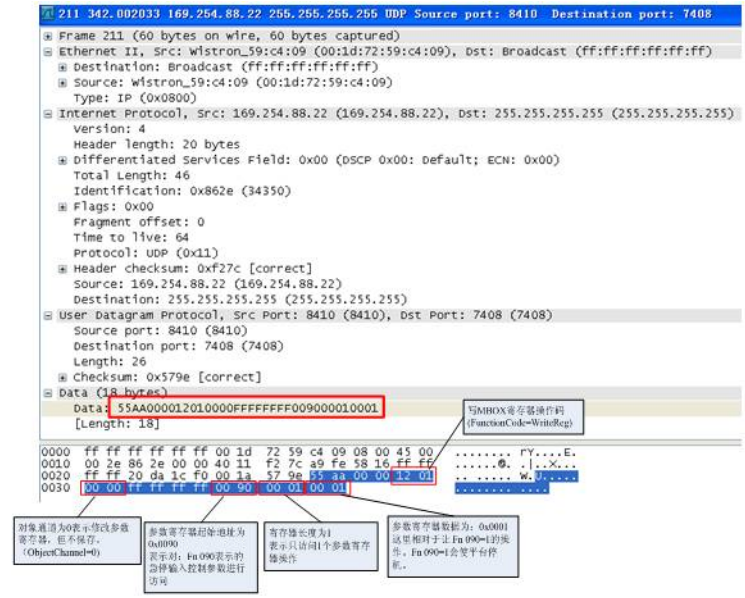
In the example, there is detailed explanation of codes; for concrete codes, please contact Beijing HollySys Motor Technology Co., Ltd.

4.5 Example of Capturing MBOX Ethernet Communication Data Packets

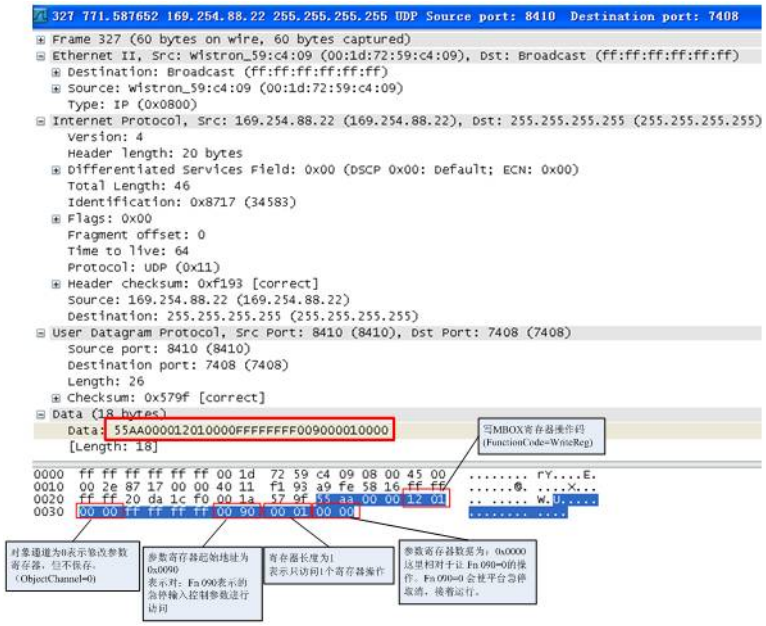
4.5.1. Resetting Operation of the Dynamic Platform



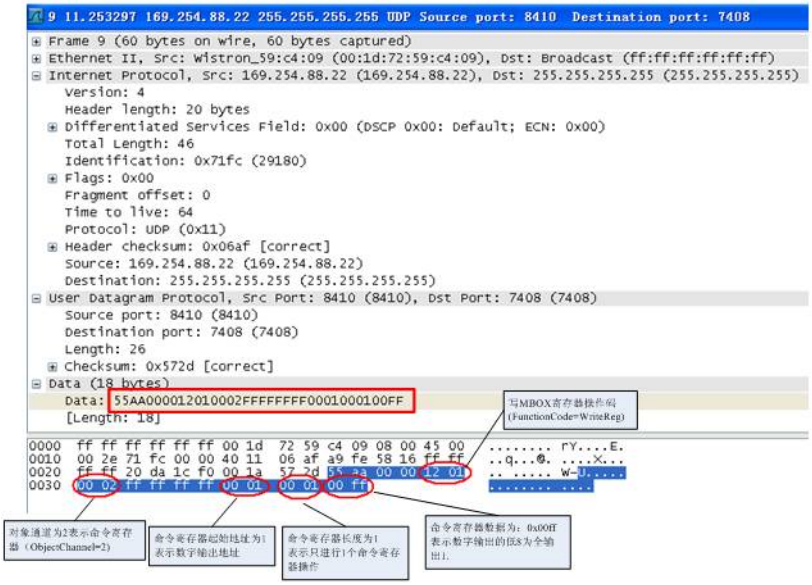
4.5.2. Emergency Stop Operation of Dynamic Platform



4.5.3. Operation of Cancelling Dynamic Platform's Emergency Stop

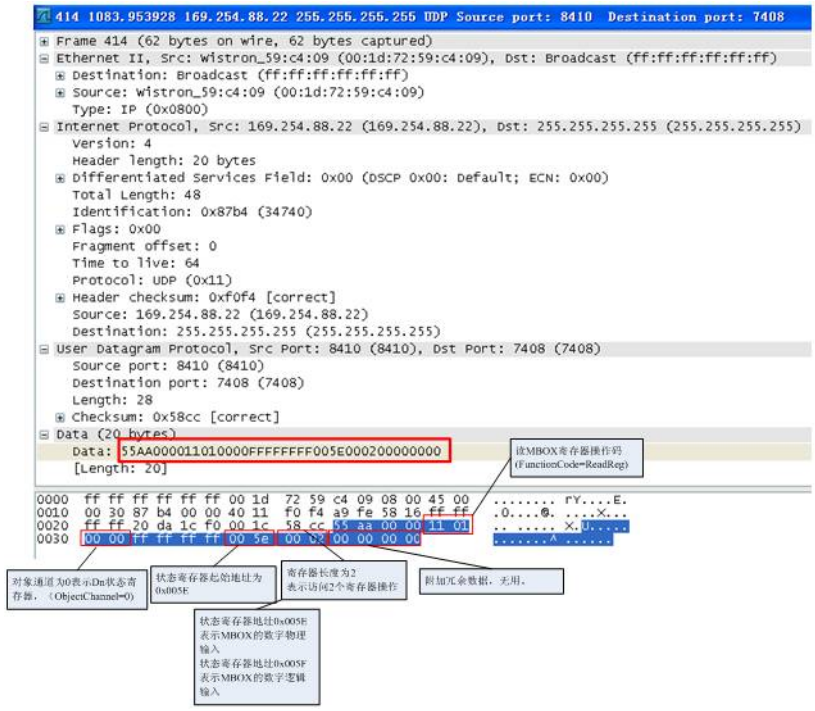


4.5.4. Operation of Digital Output of Dynamic Platform's Effect

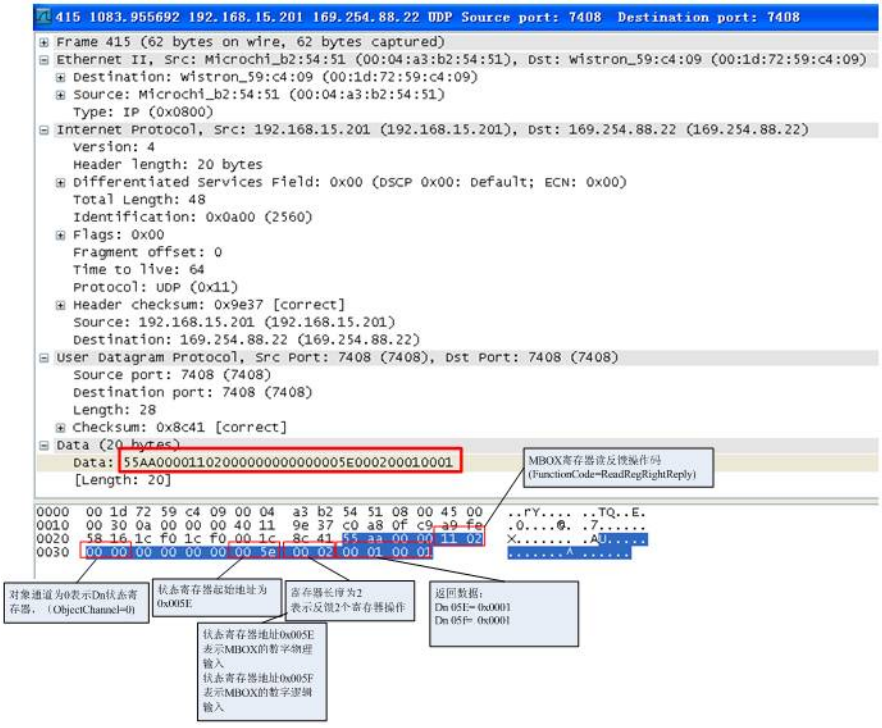


4.5.5. Operation of Upper Computer's Reading of the Dynamic Platform's Digital Input

Upper computer sends the operating code for reading MBOX status register:

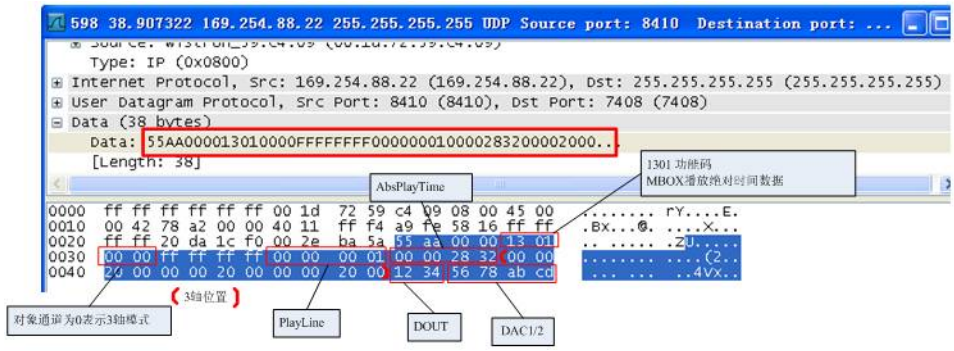


Operating code for feedback from MBOX to status register:

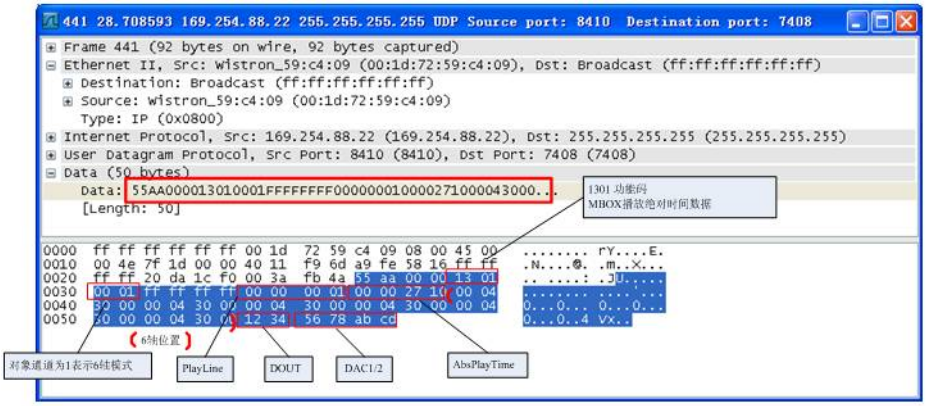


Operating code for MBOX register reading feedback (FunctionCode=ReadRegRightReply)

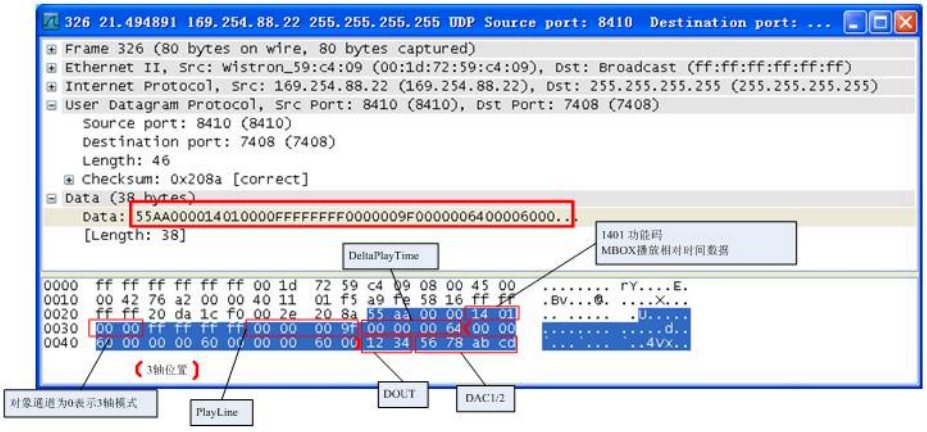
4.5.6. Operation of Dynamic Platform's Absolute Playing Time Data (3-axis)



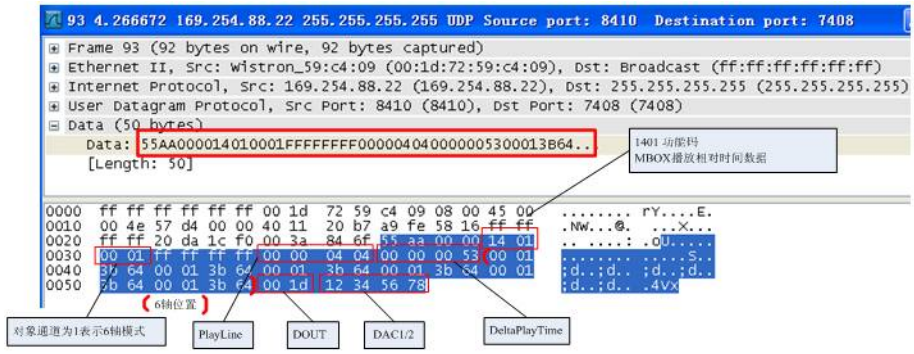
4.5.7. Operation of Dynamic Platform's Absolute Playing Time Data (6-axis)



4.5.8. Operation of Dynamic Platform's Relative Playing Time Data (3-axis)



4.5.9. Operation of Dynamic Platform's Relative Playing Time Data (6-axis)



Chapter V Running Setting of Dynamic Platform

5.1 Mode of Stop in Case of Dynamic Platform's Fault

When detecting a fault, MBOX dynamic platform controller has two ways of stopping.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 00A	MBOX's way of stopping after detecting a fault: 0: stop with servo enabling stopped 1: stop with servo maintaining position	0~1	-	1

Way 0 of stop can totally shut off the servo driver. When the HS servo driver is equipped with a dynamic brake and relevant dynamic brake operating parameters are set, the platform's mechanical section can be passively braked, or the platform's mechanical section is in totally mechanically free status.

Way 1 of stop can maintain the platform's servo drive shaft-related mechanical section that still works normally in the status when the fault occurs.

5.2 Dynamic Platform's Initial Positioning Parameters

When the dynamic platform is initially turned on, initial positioning has to be done first. MBOX's initial positioning setting parameters include:

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 00B	Error band allowed for initial positioning	100~10000	Pulse	500
Fn 00C	Motor speed during initial positioning	10~1000	RPM	100/300
Fn 00D	Distance between motor positioning original point to overtravel point (Unit: 100 pulses). When this parameter = -1, it means for each of the platform's axes, the distance between motor positioning original point and overtravel point is to be set independently	-1~10000	100Pulse	500

When drive ratio between dynamic platform′s shafts is 1:1, parameter Fn 00D (not lower than zero) can be uniformly used for the distance between motor positioning original point and overtravel point, or Fn 00D need be set as -1, which means distance between motor positioning original point and overtravel point is to be independently set for each shaft. Setting parameters for each distance is shown in the table below:

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0B1	Distance between 1# axis' motor positioning original point and overtravel point (Unit: 100 pulses)	0~10000	100Pulse	500
Fn 0B2	Distance between 2# axis' motor positioning original point and overtravel point (Unit: 100 pulses)	0~10000	100Pulse	500
Fn 0B3	Distance between 3# axis' motor positioning original point and overtravel point (Unit: 100 pulses)	0~10000	100Pulse	500
Fn 0B4	Distance between 4# axis' motor positioning original point and overtravel point (Unit: 100 pulses)	0~10000	100Pulse	500
Fn 0B5	Distance between 5# shaft's motor positioning original point and overtravel point (Unit: 100 pulses)	0~10000	100Pulse	500
Fn 0B6	Distance between 6# axis' motor positioning original point and overtravel point (Unit: 100 pulses)	0~10000	100Pulse	500

5.3 Dynamic Platform Playing Control Parameter

5.3.1 MBOX's Digital Output Synchronization Setting

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 010	It marks synchronized update and running of DOUT and PlayData. When it is 1, DOUT data are updated from PlayData, or data in PlayData are omitted, and update is only from CX	0~1	-	1

When MBOX's digital output is used for dynamic platform body's environmental effect, Fn 010 is set as 1, so as to achieve synchronization with dynamic platform's play data.

MBOX's digital output can also be independently used for the overall environmental effect: when Fn 010 is set as 0, synchronization with the dynamic platform's play data can be cancelled; by writing MBOX register CX, the upper computer can independently control digital output of 12 channels of environmental effect.

5.3.2 Setting of MBOX's Analog Output Synchronization

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 011	It marks synchronized update and running of DAC and PlayData. When it is 1, DOUT data are updated from PlayData, or data in PlayData are omitted, and update is only from CX	0~1	-	1

When MBOX's analog output is used for dynamic platform body's environmental

effect, Fn 010 is set as 1, so as to achieve synchronization with dynamic platform's play data.

MBOX's analog output can also be independently used for overall environment effect: when Fn 010 is set as 0, synchronization with the dynamic platform's play data can be cancelled; by writing MBOX register CX, the upper computer can independently control analog signals of 2 channels of environmental effect.

5.3.3 Setting of MBOX's Position Operation Synchronization

There is a small difference between MBOX's clock and upper computer's clock, so in order to ensure timely execution of Ethernet play data after they enter MBOX, and to ensure synchronization of position control and playing, the user can use change of Fn 012 to accerlate completion of actions, so that he avoids an overly large buildup of data in Ethernet data buffer which could result in lagging of dynamic platform's execution.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 012	It is for MBOX playing action control. When playing rate is less than 1000: use automatic play rate adjusting mode; when it is 1000 or higher: use FX setting parameter	-1~10000	-	1200

When this parameter is set as 1000, it means play is going on at the rated speed. The bigger this parameter's value is, the faster the playing's execution is, which could make the dynamic platform feel like stepping during its running. The smaller the parameter's value is, the lower the playing rate is, which could lead to execution lagging of the dynamic platform. The default value 1200 can normally meet the requirement of both the platform playing synchronization and smoothness.

When Fn 012's value is under 1000, it means if the user wants the playing rate to be automatically adjusted as per the desired lagging magnitude, MBOX will automatically perform the adjustment. Relevant parameters are shown in the table below:

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 01D	It is for MBOX's playing action control. Playing rate automatically adjusts delay tolerance (unit: ms)	1~30000	ms	100
Fn 01E	It is MBOX playing rate control's K parameter	1~1000	0.01	50
Fn 01F	It is MBOX playing rate control's T parameter	0~10000	ms	50

5.3.4 Setting of MBOX's Inching Mode Execution Time

When MBOX receives zero relative-move time, or time point of the new absolute-time play data PlayTime is not changed, inching mode is believed to be used, which means position change is to be made directly as per the time designated by internal parameter Fn 013.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 013	When the command's time point is not changed, this parameter directly changes motor position's moving time (for inching mode, unit: ms)	10~30000	ms	100

MBOX's inching mode can be used to conveniently adjust the dynamic platform's position and posture.

5.3.5 Setting of MBOX's Backward-Mode Execution Time

When MBOX receives a negative relative-move time or new absolute-time play data, if PlayTime's time point is smaller than the previous time point, backward mode is believed to be used, and the time designated by internal parameter Fn 014 is directly used to change position.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 014	When command's time points indicate backward move (negative time increment), this parameter directly changes moving time (fast backward moving time) of motor position (unit: 0.1s)	1~300	0.1s	10

MBOX's backward mode can be used to conveniently perform control of dynamic platform's replay from the start.

5.3.6 Judgment of MBOX's Fast Forward Mode and Setting of Execution Time

When MBOX receives new play data, if time value of PlayDeltaTime is bigger than the set value of parameter Fn 015, fast forward mode is judged to be used.

When Fn 015's value is 0, judgment of fast forward mode is cancelled.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 015	When command's time point moves fast forward, this parameter sets the threshold value for judging fast forward commands (fast forward judgment threshold, unit: 0.1s)	0~300	0.1s	30

Under fast forward mode, the time designated by internal parameter Fn 016 is directly used to change position.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 016	Under fast forward mode, this parameter directly changes moving time of motor position (fast forward moving time, unit: 0.1s)	1~300	0.1s	10

MBOX's fast forward mode can conveniently perform the dynamic platform's fast forward skipping.

5.3.7 Setting of MBOX's Emergency Stop Mode Execution Time

When MBOX detects a signal from the emergency stop input switch (sensor), or MBOX is forcibly set as emergency stop effective by communication, Parameter Fn017 is used to set the execution time of emergency stop.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 017	Execution time when emergency stop is effective (unit: 0.1s)	1~300	0.1s	10
Fn 018	Execution time when emergency stop is cancelled (unit: 0.1s)	1~300	0.1s	10

MBOX's emergency stop mode can conveniently achieve maintaining of dynamic platform's stop or automatic return to zero position.

5.3.8 Way of Processing Ethernet Play Position Data

Inside itself, MBOX puts the command of Ethernet play position in the FIFO buffer. When the user wants MBOX to always execute the latest play position command, he sets Fn 01C as 0. When the user wants all play position commands that enter MBOX through Ethernet to be executed, he sets Fn 01C as 1.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 01C	This parameter is a UDP FIFO buffer enabling switch. 0: FIFO is not used, the latest position data are used to ensure execution of the latest command; 1: execute position commands in the FIFO principle to ensure all commands are executed.	0~1	-	1

5.4 MBOX's IP Address and UDP Port No

Setting of MBOX's IP address and the port for sending and receiving UDP information is as follows:

5.4.1 Setting of MBOX's IP Address

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 020	MBOX_IP address setting A	0~255	-	192
Fn 021	MBOX_IP address setting B	0~255	-	168
Fn 022	MBOX_IP address setting C	0~255	-	15
Fn 023	MBOX_IP address setting D	0~255	-	201

5.4.2 Setting of MBOX's UPD Port

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 024	Port No. for MBOX's sending of UDP information	0~32767	-	7408
Fn 025	Port No. for MBOX's receiving of UDP information	0~32767	-	7408

5.5 Host Computer's IP Address and UDP Port No.

5.5.1 Setting of Upper Host Computer's IP Address

MBOX can actively report the current running information to the upper host computer; the IP address of the upper host computer that receives the report is set as in the table below:

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 030	MBOX report receiving host computer IP address setting A	0~255	-	192
Fn 031	MBOX report receiving host computer IP address setting B	0~255	-	168
Fn 032	MBOX report receiving host computer IP address setting C	0~255	-	15
Fn 033	MBOX report receiving host computer IP address setting D	0~255	-	101

5.5.2 Setting of Upper Host Computer's UDP Port

Setting of upper host computer's port for sending and receiving UDP information is as shown in the table below:

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 034	UDP service sending port No. for host computer's sending/MBOX's receiving	0~32767	-	8410
Fn 035	UDP service sending port No. for MBOX's sending/host computer's receiving	0~32767	-	8410

5.6 Setting of MBOX's Active Report

MBOX can actively report current working information to the upper host computer; setting of the concrete report is as shown in the table below:

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 040	MBOX report mode. 0: report is prohibited; 1: active report at fixed intervals; 2: report at fixed intervals in case of fault	0~2	-	0
Fn 041	MBOX report interval: positive number: unit enlarged by 1000 times, low-frequency reporting; negative number: unit is 1, high-frequency reporting	-30000~ 30000	-	3

Fn 042	MBOX report's DX starting address	0~255	-	0
Fn 043	MBOX report's DX length	0~32	-	32

5.7 Setting of MBOX's Ethernet Port Indicator Light

MBOX supports standard 10/100M Ethernet, the Ethernet port has 2 indicator lights for monitoring working status of the Ethernet; normally default value applies to the indicator lights' setting.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 051	Ethernet indicator light A working mode configuration	0~15	-	2
Fn 052	Ethernet indicator light B working mode configuration	0~15	-	6

When indicator lights are used for special testing, the concrete setting described in the table below applies; the indicator lights' status can be set as per the user's needs. Meaning of the set values is as shown in the table:

0	0000 = Off (pin is driven low)
1	0001 = On (pin is driven high)
2	0010 = Display link state; pin is driven high when linked
3	0011 = Display collision events; pin is temporarily driven high when a collision occurs
4	0100 = Display transmit events; pin is driven high while a packet is being transmitted
5	0101 = Display receive events; pin is driven high while a packet is being received
6	0110 = Display transmit and receive events; pin is driven high while a packet is either being received or transmitted
7	0111 = Display duplex state; pin is driven high when the PHY is in full duplex (PHYDPX (ESTAT<10>) is '1') and a link is present
8	1000 = Display speed state; pin is driven high when in 100 Mbps mode and a link is present
9	1001 = Display link state, transmit events; pin is driven high when a link is present and driven low while a packet is being transmitted
10	1010 = Display link state, receive events; pin is driven high when a link is present and driven low while a packet is being received
11	1011 = Display link state, transmit and receive events; pin is driven high when a link is present and driven low while a packet is being received or transmitted
12	1100 = Display link state, collision events; pin is driven high when a link is present and driven low temporarily when a collision occurs
13	1101 = Reserved
14	1110 = Display link and duplex state, transmit and receive events(1)
15	1111 = Display link and speed state, transmit and receive events(1)

5.8 MBOX's Timeout Measurement of Status of Ethernet without Play Data

When MBOX is working and a new UDP play command is detected, the keyboard display section will display the UDP play command's absolute time value or current number of frames already displayed. When there're no new UDP play data, keyboard display section will display READY, which means MBOX is waiting for new UDP play data commands.

Parameter Fn053 can set the length of time window for detecting appearance of the new play command.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 053	Timeout measurement of status of Ethernet without play data	50~10000	4ms	100

5.9 Setting of MBOX's CAN Bus Communication

MBOX performs communication monitoring through CAN bus and HS servo driver. When using the monitoring function, the user has to ensure MBOX and HS servo driver have the same baud rate.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 061	CAN bus' baud rate for communication between MBOX and servo driver (Unit: kbps)	1~1000	kbps	500

5.10 Setting of MBOX's Local MODBUS Communication

MBOX supports MODBUS communication-based RS232 (default hardware) or RS422/USB serial communication (COM); communication setting parameters are as shown in the table below:

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 069	MODBUS communication baud rate	1~192	100bps	96
Fn 06A	MODBUS communication node address	1~255	-	1

For users of MODBUS communication, it is very convenient to perform parameter batch setting and working status monitoring for MBOX.

5.11 MBOX's Record of Fault History

MBOX's record of fault history is used for observing the latest 8 faults, and the user cannot change the recorded values.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 070	Latest No. 1 alarm's fault code	-	-	0
Fn 071	Latest No. 2 alarm's fault code	-	-	0
Fn 072	Latest No. 3 alarm's fault code	-	-	0
Fn 073	Latest No. 4 alarm's fault code	-	-	0
Fn 074	Latest No. 5 alarm's fault code	-	-	0
Fn 075	Latest No. 6 alarm's fault code	-	-	0
Fn 076	Latest No. 7 alarm's fault code	-	-	0
Fn 077	Latest No. 8 alarm's fault code	-	-	0

【Note】Fault code value of 0 means no fault has occurred. For concrete meaning of fault codes and diagnosis of fault, please refer to the section Diagnosis of Dynamic Platform's Faults

5.12 Setting of MBOX's Analog Output Signals

MBOX's 2 channels of analog output are updated by the upper computer through Ethernet UDP communication; the latest data are stored in DX_ID_UdpDataEtherDAC1/2. When the play data are used for synchronous updating, the data being processed currently in digital output buffer are DX_ID_UdpDataFifoDAC1/2.

Name of Dn ID	Dn ID No.
DX_ID_UdpDataEtherDAC1	96
DX_ID_UdpDataEtherDAC2	97
DX_ID_UdpDataFifoDAC1	98
DX_ID_UdpDataFifoDAC2	99

MBOX has 2 channels of isolated analog output, which can be used for observing internal status DX. The user can use configuration parameters to set signal sources and amplitude values of the two DAC channels. The maximum output range of two DAC channels are 0 ~ +10V; parameter-based selection of output mode and channel is provided for analog output to facilitate the user's debugging and use.

5.13 Range Setting of Analog Output Signals

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 078	Setting of DAC1's maximum value under normal mode/DAC command value under manual testing mode	1~32767	-	10000
Fn 079	Setting of DAC2's maximum value under normal mode/DAC command value under manual testing mode	1~32767	-	10000

5.14 Channel Setting of Analog Output Signals

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 07A	DAC1 signal source selection: -1: sawtooth wave testing mode 0-255: DX status 256: manual output mode	-1~256	-	96
Fn 07B	DAC2 signal source selection: -1: sawtooth wave testing mode 0-255: DX status 256: manual output mode	-1~256	-	97

【Note】when Fn 07A/ Fn 07B=-1, DAC channel outputs a sawtooth wave for DAC output channel's self-test.

5.15 Zero Setting of Analog Output Signals

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 07C	DAC1's zero	-1000~1000	-	0
Fn 07D	DAC2's zero	-1000~1000	-	0

5.16 Bit and Setting of Analog Output Signals

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 07E	DAC1 bix xor parameter; for development testing. Aftr power is on, the parameter is automatically set at the default value. It is used for bit monitoring of status value	-32768~ 32767	-	0xffff
Fn 07F	DAC2 bit and parameter; for development testing. Aftr power is on, the parameter's value is automatically set at the default value. It is used for bit monitoring of status value	-32768~ 32767	-	0xffff

5.17 Setting of MBOX Digital Output Signals

MBOX has 12 channels of isolated digital output, and the maximum driving capacity is 50mA/30V. Digital output is equipped with parameter-based selection of output mode and channel selection, etc., to facilitate the user's debugging and use.

5.17.1 Selection of Digital Output Control Mode

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 080	Digital output mode. -1: working mode; 0: all-output logic 0 test mode; 1: all-output logic 1 test mode; 2: reversed output logic test mode;	-1~2	-	-1

【Note】After MBOX is turned on, digital output mode will be automatically set as working mode. Values 0, 1 and 2 are normally only used for post-power-on provisional debugging.

5.17.2 Selection of Digital Output Control Channel

MBOX's 12 channels of digital output are updated by the upper computer through Ethernet UDP communication. The latest data are stored in UdpDout. When play data are used for synchronous updating, the data currently being processed in the digital output buffer are UdpFifoDout.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 08x	Dox digital output selection. 1: forced output; 0: forced shut; -1~-16: signal on UdpDout's corresponding bit; -17~-32: signal on corresponding UdpFifoDout bit;	-32~1	-	-1

【Note】x=1,2,3,4,5,6,7,8,9,A,B,C respectively stands for DO1,DO2,...DO12

5.17.3 Selection of Digital Output Control Logic

When MBOX's externally connected digital output needs negative logic, the user can use Fn 080D to set the negative logic directly, and need not change digital output's logic value through the upper computer.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 08D	Output XOR and reversion control bit, to be set with 0 and 1 on each bit. 1 means reversion.	0~4095	-	0

Relation between bit setting and DO channel is as shown in the table below:

B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
DO12	DO11	DO10	DO9	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1

Example: when the user wants to use negative logic for DO1 and DO4's output, Fn08D is set as 9.

Bit	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
DO	DO12	DO11	DO10	DO9	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1
Binary	0	0	0	0	0	0	0	0	1	0	0	1
Decimal	9											

5.17.4 Selection of Digital Output's Initial Value and Safe Value

After the system power is on and before data communication with the upper computer is established, if the user wants MBOX's digital output value to be a given initial value, he can use Fn08E to set it.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 08E	Digital output's initial value (used for digital safe output after power is initially on)	-32768~ 32767	-	0

After the system has a fault, if the user wants MBOX's digital output value to be a given safe value, he can use parameter Fn08F to set it.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 08F	Digital output's safe value (used for digital safe output in case of occurrence of a fault, etc.)	-32768~ 32767	-	0

5.18 Setting and Processing of MBOX's Digital Input Signals

MBOX has 8 channels of isolated digital input; when the input optocoupler is on, digital input's original value is correspondingly 1, or it is 0. The user can use Dn_05E to observe digital input's original value.

DIN	DIN8	DIN7	DIN6	DIN5	DIN4	DIN3	DIN2	DIN1
Bit	B7	B6	B5	B4	B3	B2	B1	B0
Dn 05E	When input optocoupler is on, digital input's original value is correspondingly 1, or it is 0							

5.19 Setting of Digital Input Signals' Logic Reversion

When the user wants to use negative logic to be used for the input signals, he can use parameter Fn 09D to perform reversion, and then get the digital input's logic value.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 09D	Input for the input XOR and reversion control bit. Use 0 and 1 on each bit to set the parameter. 1 means reversion	0~255	-	0

Digital input's original value can be observed through Dn_05E; digital input's logic value can be observed through Dn_05F.

Dn_05F = Dn_05E xor Fn 09D

When Fn 09D=0, Dn_05F = Dn_05E.

5.20 Setting and Processing of Digital Input Signal of Emergency Stop

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 090	Emergency stop input control. 0: forced shut; 1: forced enabling; -1~-8: enabling is to be determined by 8 channels of digital input	-8~1	-	0

【Note】During MBOX's post-power-on initial positioning, if Fn 090 = 1, it will be automatically cleared and set as 0.

Fn 090=0 means forced emergency stop signal is ineffective; Fn 090=1 means forced emergency stop signal is effective;

Fn 090= -n (n=1 ~ 8) means judging the emergency stop signal by the digital input port.

When MBOX detects an effective emergency stop signal (QuickStop), it will quickly stop the dynamic platform; the way of stopping is to be selected through parameter Fn 091 as shown in the table below:

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 091	Way of quick stop. 0: return to initial positioning's original point; 1: remain at the current position; 2: keep current verage of X\Y\Z position; -n: horizontally remain at the position on No. n axis (N=1,2,3)	-3~2	—	1

When MBOX detects signal of emergency stop input switch (sensor) signal, or MBOX is forcibly set as emergency stop effective through communication, use parameter Fn017 to set the execution time for emergency stop, and use parameter Fn018 to set the execution time for cancelling emergency stop.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 017	The execution time when emergency stop is effective (unit: 0.1s)	1~300	0.1s	10
Fn 018	The execution time when emergency stop is cancelled (unit: 0.1s)	1~300	0.1s	10

MBOX's emergency stop mode can conveniently keep the dynamic platform stopped or let it automatically return to zero position.

5.21 Setting of MBOX's Expanded Digital Output Signals (Reserved)

MBOX reserves support to 12 expanded extra channels of isolated digital output; the maximum driving capacity is 50mA/30V. Digital output provides parameter-based selection of output mode, channel, etc., to facilitate the user's debugging and use.

Note: MDBOX's current hardware version doesn't support expanded digital output. This function is reserved for MDBOX, so as to achieve compatibility with MBOX-V2 motion control module that supports expanded digital output.

5.21.1 Selection of Expanded Digital Output's Control Mode

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0A0	Digital output mode. -1: working mode; 0: all-output logic 0 test mode; 1: all-output logic 1 test mode; 2: reversed output logic test mode;	-1~2	-	-1

Note: After MBOX is turned on, expanded digital output mode will be automatically set as working mode. Setting the parameter as 0, 1 and 2 is normally used only for the purpose of post-power-on provisional test.

5.21.2 Selection of Digital Output Control Channel

MBOX's 12 channels of expanded digital output are updated by the upper computer through Ethernet UDP communication. The latest data are stored in UdpExtDout. When the play data are used for synchronous updating, the data current being processed in digital output buffer are UdpExtFifoDout.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0Ax	Selection of ExtDOx expanded digital output. 1: forced output; 0: forced shut; -1~-16: signal on UdpExtDout's corresponding bit; -17~-32: signal on UdpExtFifoDout's corresponding bit;	-32~1	-	-1

【 Note 】 x=1,2,3,4,5,6,7,8,9,A,B,C respectively refer to ExtDO1,ExtDO2,…ExtDO12.

5.21.3 Selection of Expanded Digital Output Control Logic

When MBOX's externally connected expanded digital output needs negative logic, the user can use Fn 0AD to set the negative logic directly, and need not change expanded digital output's logic value through the upper computer.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0AD	Output XOR and reversion control bit, to be set with 0 and 1 on each bit. 1 means reversion.	0~4095	-	0

Relation between bit setting and ExtDO channel is as shown in the table below:

B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
DO12	DO11	DO10	DO9	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1

Example: when the user wants to use negative logic for ExtDO1 and ExtDO4's output, Fn 0AD is set as 9.

Bit	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
DO	DO12	DO11	DO10	DO9	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1
Binary	0	0	0	0	0	0	0	0	1	0	0	1
Decimal	9											

5.21.4 Selection of Expanded Digital Output's Initial Value and Safe Value

After the system power is on and before data communication with the upper computer is established, if the user wants MBOX's expanded digital output value to be a given initial value, he can use Fn 0AE to set it.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0AE	Expanded digital output's initial value (used for digital safe output after power is initially on)	-32768~ 32767	-	0

After the system has a fault, if the user wants MBOX's expanded digital output value to be a given safe value, he can use parameter Fn 0AF to set it.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0AF	Expanded digital output's safe value (used for digital safe output in case of occurrence of a fault, etc.)	-32768~ 32767	-	0

5.22 Relation between Motions of Electric Cylinder Body and Servo Motor

5.22.1 Electric Cylinder Body's Parameter and Limit on Its Travel

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0C0	Electric cylinder's effective travel (unit: 0.1mm). When the parameter's value is 0, it means no maximum travel limit or protection is used for the electric cylinder	0~30000	0.1mm	0

5.22.2 Relation between Motions of Electric Cylinder and Servo Motor

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0C1	Number of pulses for every 1mm of the electric cylinder's movement. This parameter can be used with parameter Fn_0C0 for calculating MBOX's maximum allowed position value	1~30000	Pulse	2000
Fn 0C2	Travel corresponding to every turn of the electric cylinder (unit: 0.1mm, used for calculating the time needed for initial positioning)	1~1000	0.1mm	50

5.22.3 Limit on Electric Cylinder's Initial Positioning Torque

When the electric cylinder (not equipped with position-limit sensors) is receiving a test of its zero point performed with its rotor blocked, parameter Fn 0C7 is used to set the torque value for locking the rotor.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0C7	Percentage of limit on electric cylinder's initial positioning torque	1~300	-	50

5.23 Limit on Dynamic Platform's Accumulated Working Time

The platform's accumulated working time is internally set by MBOX system, and cannot be changed by the user in general conditions. It is mainly used for record and time limit.

5.23.1 Dynamic Platform's Accumulated Working Time

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0C8	Platform's accumulated working time: number of days	0~30000	Day	0
Fn 0C9	Platform's accumulated working time: number of hours	0~24	Hour	0
Fn 0CA	Platform's accumulated working time: number of minutes	0~60	Minute	0
Fn 0CB	Platform's accumulated working time: number of seconds	0~60	Second	0

5.23.2 Limit on Dynamic Platform's Accumulated Working Time

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0CF	Maximum number of days of continuous working. 0: no limit; n: n days as maximum limit; when time limit is reached, E_tout sends the alarm and stops the dynamic platform	0~30000	天	0

5.24 Setting of MBOX Analog Input Signals

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0FF	Interval for analog position value's low-pass filtering (unit: ms)	0~10000	ms	10
Fn 100	Interval for analog position value's sampling (unit: ms)	10~10000	ms	10
Fn 101	ADC zero drift of analog input position 1's channel	0~256	-	0
Fn 102	ADC zero drift of analog input position 2's channel	0~256	-	0
Fn 103	ADC zero drift of analog input position 3's channel	0~256	-	0
Fn 104	ADC zero drift of analog input position 4's channel	0~256	-	0

Fn 105	ADC zero drift of analog input position 5's channel	0~256	-	0
Fn 106	ADC zero drift of analog input position 6's channel	0~256	-	0
Fn 107	Number of motor's 100-pulse cycles corresponding to analog input 1's channel	1~30000	100Pulse/v	200
Fn 108	Number of motor's 100-pulse cycles corresponding to analog input 2's channel	1~30000	100Pulse/v	200
Fn 109	Number of motor's 100-pulse cycles corresponding to analog input 3's channel	1~30000	100Pulse/v	200
Fn 10A	Number of motor's 100-pulse cycles corresponding to analog input 4's channel	1~30000	100Pulse/v	200
Fn 10B	Number of motor's 100-pulse cycles corresponding to analog input 5's channel	1~30000	100Pulse/v	200
Fn 10C	Number of motor's 100 pulse-cycles corresponding to analog input 6's channel	1~30000	100Pulse/v	200

5.25 Version No. of MBOX Dynamic Platform System Software

Version No. of MOX dynamic platform system software is expressed by parameter Fn_1FF.

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 01FF	Version No. of system software	-	-	-

Chapter VI Working Status Monitoring and Diagnosis of Dynamic Platform

6.1 List of Dynamic Platform's Working Status

6.1.1 HS Servo Drive Section's Working Status

Working status of X, Y and Z servo drivers is as shown in the table below:

No. DEC	Dn	No. HEX	Definition
0	Dn	0	X Axis servo's speed
1	Dn	1	Y Axis servo's speed
2	Dn	2	Z Axis servo's speed
3	Dn	3	X Axis servo's load factor
4	Dn	4	Y Axis servo's load factor
5	Dn	5	Axis z servo's load factor
6	Dn	6	X Axis motor's absolute position (unit: encoder pulse)
7	Dn	7	
8	Dn	8	Y Axis motor's absolute position (unit: encoder pulse)
9	Dn	9	
10	Dn	A	Z Axis motor's absolute position (unit: encoder pulse)
11	Dn	B	
12	Dn	C	Absolute position command for X Axis motor (unit: encoder pulse)
13	Dn	D	
14	Dn	E	Absolute position command for Y Axis motor (unit: encoder pulse)
15	Dn	F	
16	Dn	10	Absolute position command for Z Axis motor (unit: encoder pulse)
17	Dn	11	
18	Dn	12	X Axis servo's general status word
19	Dn	13	Y Axis servo's general status word
20	Dn	14	Z Axis servo's general status word
21	Dn	15	X Axis servo's application status word
22	Dn	16	Y Axis servo's application status word
23	Dn	17	Z Axis servo's application status word
24	Dn	18	X Axis servo's fault code
25	Dn	19	Y Axis servo's fault code
26	Dn	1A	Z Axis servo's fault code

Working status of U, V and W servo drivers is as shown in the table below:

DEC No. DEC	Dn	HEX No. HEX	Definition
27	Dn	1B	U Axis servo speed
28	Dn	1C	V Axis servo speed
29	Dn	1D	W Axis servo speed
30	Dn	1E	U Axis servo load factor
31	Dn	1F	V Axis servo load factor
32	Dn	20	W Axis servo load factor
33	Dn	21	Motor's absolute position on U Axis (unit: encoder pulse)
34	Dn	22	
35	Dn	23	Motor's absolute position on V Axis (unit: encoder pulse)
36	Dn	24	
37	Dn	25	Motor's absolute position on W Axis (unit: encoder pulse)
38	Dn	26	
39	Dn	27	Command of motor's absolute position on U Axis (unit: encoder pulse)
40	Dn	28	
41	Dn	29	Command of motor's absolute position on V Axis (unit: encoder pulse)
42	Dn	2A	
43	Dn	2B	Command of motor's absolute position on W Axis (unit: encoder pulse)
44	Dn	2C	
45	Dn	2D	U Axis servo's general status word
46	Dn	2E	V Axis servo's general status word
47	Dn	2F	W Axis servo's general status word
48	Dn	30	U Axis servo's application status word
49	Dn	31	V Axis servo's application status word
50	Dn	32	W Axis servo's application status word
51	Dn	33	U Axis servo's fault code
52	Dn	34	V Axis servo's fault code
53	Dn	35	W Axis servo's fault code

6.1.2 MBOX Fault Code

No. DEC	Dn	No. HEX	Definition
56	Dn	38	Current sampled system fault code
57	Dn	39	Last sampled system fault code
58	Dn	3A	Fault code of MBOX's alarm
59	Dn	3B	Code of MBOX's severe fault

6.1.3 MBOX's Working Control Word and Status Word

No. DEC	Dn	No. HEX	Definition
62	Dn	3E	MBOX system's overall status ID
63	Dn	3F	MBOX initial positioning process ID
64	Dn	40	MBOX application control word
65	Dn	41	MBOX application status word
66	Dn	42	MBOX auxiliary status word

6.1.4 MBOX Playing Operation Speed

No. DEC	Dn	No. HEX	Definition
68	Dn	44	Time difference between header and trailer of data in UDP buffer
69	Dn	45	(Actual) playing speed adjustment factor (basic value: 1000). When it is 0, it means no UDP data have come

6.1.5 MBOX's Ethernet Data Status

No. DEC	Dn	No. HEX	Definition
72	Dn	48	UDP buffer write pointer
73	Dn	49	UDP buffer read pointer
74	Dn	4A	Depth measurement for new data received by UDP buffer
75	Dn	4B	Depth measurement for current data in UDP buffer

6.1.6 MBOX's Ethernet Port Status

No. DEC	Dn	No. HEX	Definition
82	Dn	52	MBOX's Ethernet status
83	Dn	53	MBOX's MAC address
84	Dn	54	
85	Dn	55	

6.1.7 Status of MBOX Analog Input's ADC Conversion Result

No. DEC	Dn	No. HEX	Definition
86	Dn	56	ADCIN1 conversion result
87	Dn	57	ADCIN2 conversion result
88	Dn	58	ADCIN3 conversion result
89	Dn	59	ADCIN4 conversion result
90	Dn	5A	ADCIN5 conversion result
91	Dn	5B	ADCIN6 conversion result

6.1.8 MBOX's Digital Input Status

No. DEC	Dn	No. HEX	Definition
94	Dn	5E	MBOX digital input's physical value (1 when optocoupler is on)
95	Dn	5F	MBOX digital input's logic value (physical value XOR reversion result)

6.1.9 MBOX's DAC Data Status

No. DEC	Dn	No. HEX	Definition
96	Dn	60	Latest DAC1 Ethernet data
97	Dn	61	Latest DAC2 Ethernet data
98	Dn	62	DAC buffer reads current data, which is an operation effective only when MBOX has entered OperationEnabled status
99	Dn	63	DAC buffer reads current data, which is an operation effective only when MBOX has entered OperationEnabled status

6.1.10 MBOX Digital Output Data Status

No. DEC	Dn	No. HEX	Definition
100	Dn	64	DOUT's latest Ethernet data update
101	Dn	65	DOUT buffer reads current data, which is an operation effective only when MBOX has entered OperationEnabled status
102	Dn	66	MBOX digital output's logic value
103	Dn	67	MBOX digital output's physical value

6.1.11 Monitoring of MBOX's UDP Input Position Command

No. DEC	Dn	No. HEX	Definition
106	Dn	6A	UDP X Axis position command
107	Dn	6B	
108	Dn	6C	UDP Y Axis position command
109	Dn	6D	
110	Dn	6E	UDP Z Axis position command
111	Dn	6F	
112	Dn	70	UDP U Axis position command
113	Dn	71	
114	Dn	72	UDP V Axis position command
115	Dn	73	
116	Dn	74	UDP W Axis position command
117	Dn	75	

6.1.12 Dynamic Platform's Accumulated Working Time

No. DEC	Dn	No. HEX	Definition	No. DEC
Fn 0C8	Platform's accumulated working time: number of days	0~30000	Day	0
Fn 0C9	Platform's accumulated working time: number of hours	0~24	Hour	0
Fn 0CA	Platform's accumulated working time: number of minutes	0~60	Minute	0
Fn 0CB	Platform's accumulated working time: number of seconds	0~60	Second	0

6.1.13 Dynamic Platform's Accumulated Load Factor-weighted Effective Working Time

For the dynamic platform's each servo driver, MBOX can accumulate the load factor-weighted effective working time, which can be used for reliability management such as service life assement of servo motors or electric cylinders. (Note: This function will be effective only after setting of a high-grade password and given parameters)

Parameter No.	Parameter Description	Setting Range	Setting Unit	Ex-works Setting
Fn 0D0	X Axis motor/electric cylinder's load factor-weighted effective working time	-	Second	0
Fn 0D1				0
Fn 0D2	Y Axis motor/electric cylinder's load factor-weighted effective working time	-	Second	0
Fn 0D3				0

Fn 0D4	Z Axis motor/electric cylinder's load factor-weighted effective working time	-	Second	0
Fn 0D5				0
Fn 0D6	U Axis motor/electric cylinder's load factor-weighted effective working time	-	Second	0
Fn 0D7				0
Fn 0D8	V Axis motor/electric cylinder's load factor-weighted effective working time	-	Second	0
Fn 0D9				0
Fn 0DA	W Axis motor/electric cylinder's load factor-weighted effective working time	-	Second	0
Fn 0DB				0

Note: 32-bit accumulated time variant: the lower 16 bits precede the higher 16 bits. For example: Fn 0D0 stands for the lower 16 bits; Fn 0D1 stands for the higher 16 bits.

6.2 Keyboard Display-based Local Working Status Monitoring

By using keyboard parameters Fn xxx, Dn xxx and En xxx, the user can monitor MBOX's working status via parameter setting collection status and fault monitoring.

6.3 MODBUS-based Local Working Monitoring

MBOX′s RS232 port supports MODBUS communication, and can conveniently perform local monitoring of dynamic platform′s working status. The user himself can write upper computer or touch screen monitoring software.

Beijing HollySys Electric Technology Co., Ltd. provides touch screen-based local monitoring solutions; please contact our company if you need such solutions.

6.4 Ethernet-based Remote Working Status Monitoring

MBOX′s Ethernet communication protocol supports all parameters and status visit; the user himself can write remote monitoring software for the upper computer.

In order to help the user get familiar with this system, Beijing HollySys Electric Technology Co., Ltd. provides free software MBOXPlay for the dynamic platform′s debugging and testing interface; please contact our company if you need such software.

6.5 Dynamic Platform's Fault Code and Diagnosis

Through the keyboard, local MODBUS monitoring or remote Ethernet monitoring software, the user can conveniently perform dynamic platform fault monitoring and diagnosis. Commonly used fault codes and their description are as shown in the table below:

Error Code	LED Display	Fault Description
1401	E_dnRE	Alarm of motor driver's error of no response
1500	E EnAb	Encoder AB signal alarm
1510	E EncU	Encoder UVW signal alarm
1600	E_FrAE	Error of FRAM data writing operation check
1700	E GEAr	Abnormal electronic gear parameter
2200	E LUdc	Undervoltage alarm

2500	E oc-A	Phase A overcurrent alarm
2501	E oc-b	Phase B overcurrent alarm
2502	E oc-C	Phase C overcurrent alarm
2510	E oLod	Overload alarm
2520	E oSPE	Maximum speed limit is exceeded
2530	E oUdc	Overvoltage alarm
2600	E PArA	Error of FRAM parameter overflow
2610	E PEOU	Position deviation counter overflow
2620	E PHAS	Phase failure alarm
2630	E PHot	Power device's temperature is too high
2631	E PoEr	Power device fault alarm
2640	E PorF	Power supply failure fault
2645	E PosE	Position overtravel alarm
2650	E PoUt	FRAM reading and writing timeout
2660	E PS1E	Alarm of 1 phase's abnormal zero point
2661	E PS2E	Alarm of 2 phases' abnormal zero point
2900	E SPEE	Stall alarm
3000	E Tcon	Alarm of temperature sensor's broken wire
3100	E Ubrt	Alarm of motor vibration
3110	E USPn	Code to indicate the motor's model is not supported
3600	E 2LoS	Alarm of encoder Pluse-Z loss
3601	E 2EtE	Alarm of too many times of encoder Pluse-Z loss
NONE	ConErr	Alarm of abnormal keyboard display information

References

[1] TCP/IP Protocol Suite Fourth Edition. Behrouz A. Forouzan ISBN 978-0-07-337604-2 Published by McGraw-Hill

[2] A Kind of CAN Bus System and Its Application-layer Communication Method Patent No.: 200910090385.4 Han Li, etc. Beijing HollySys Electric Technology Co., Ltd.

BEIJING HOLLYSYS ELECTRIC TECHNOLOGY CO.,LTD.

Manufacturer:Beijing Hollysys Electric Technology Co.,Ltd.(formerly Stone Electric)
Add: 10th Floor, Block A, Hui Zhi Tower, 9 Xueqing Road, Haidian District, Beijing
Zip Code: 100085
Postal add: P.O. Box 2877, Beijing
Telephone operator: +86 10 62932100
Sales hotline: +86 10 62927938
Fax: +86 10 62927946
Website: http://www.syn-tron.com

Nanjing Office:
Add: Rm 1807, Block B, Huangpu Science and Technology Building, 2 Huangpu Road, Nanjing City
Tel: +86 25 84293632/37/52/53
Fax: +86 25 84514509

Shenzhen Branch:
Add: Rm 2-004A, Tianxia IC Industrial Park, 115 Yiyuan Road, Nanshan District, Shenzhen
Tel: +86 755 26581960/61/62/63
Fax: +86 755 26581969

06/2015 by hollysys electric