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1. INTRODUCTION

The Twister 2X is a highly sophisticated industrial radio control system. The versatile features of the Twister 2X permits a wide range of industrial applications. The Twister 2X industrial radio control system can be used to control all types of cranes, building construction equipment, automatic control systems, mining equipment, and many others.

The Twister 2X incorporates numerous safety circuits that guaranty maximum security and ensure the system is resistant to other radio interference. The major features of the Twister 2X industrial radio control system is as follow:

- * Highly evolved software that have redundant error checking and correcting capabilities to ensure 100% error-free transmission, decoding, and control of output relays. These software designs include CRC (Cyclical Redundancy Check Code) and Hamming Codes (Error Recovery).
- * The encoding system utilizes an advanced microprocessor for 100% error-free data transmission. The availability of 65,536 sets of unique security ID codes will ensure that only commands from the matching control transmitter can be carried out without any interference from other radio systems.
- * The decoding system utilizes dual advanced microprocessors, which ensures 100% error-free calculation, bit checking, and correction of incoming transmitted data.
- * The system also utilizes an additional central microprocessor for data comparison and cross checking between the two decoding microprocessors to ensure 100% error-free decoding and control of all output relays. When faults are detected via this central microprocessor, for maximum safety, the entire system will be shutdown within 0.50 second to avoid any undesired crane movements.
- * The system utilizes PLL synthesized RF for means of data transmission. It allows the user to select from a wide range of frequency channels best suited for the environment. The frequency channel is selected via a dip-switch in the transmitter unit and LCD control panel in the receiver box. The receiver system also has the ability to auto scan from a wide range of frequency channels. The receiver system will search and locked on to the intended matching transmitter unit.
- * Optional dual advanced receiving system for optimum receiving capability.
- * The Twister 2X systems are equipped with numerous self-diagnosing features. These include transmitter low voltage detection warning system automatic shutdown, faulty pushbutton and joystick contact switches detection, faulty MAIN contact relay detection, faulty relay boards detection, faulty EEPROM detection, faulty PLL synthesizes RE unit detection, and incorrect security ID code detection.

2. SAFETY INSTRUCTIONS

The Twister 2X system is relatively simple to use. However, it is very important to observe the proper safety procedures during operation. When used properly the Twister 2X systems will enhance productivity and efficiency in the workplace.

The following instructions should be strictly followed:

1. Make a daily check of the transmitter casing, joysticks, and pushbuttons. Should it appear that anything could inhibit the proper operation of the transmitter unit, it should be immediately removed from service.
2. The transmitter voltage should be checked on a daily basis. If the voltage is low, the battery pack should be recharged or replaced.
3. The emergency stop pushbutton (EMS) should be checked at the beginning of each shift to ensure they are in the proper working order.
4. In the event of an emergency, activate the emergency stop pushbutton immediately. Then turn the power "off" from the main power source of the equipment.
5. The power switch should be turned "off" after use and should never be left the power "on" when the unit is unattended.
6. Do not use the same RF channel and ID code as any other unit in use at the same facility (within 300-meter range / 900 feet).
7. Ensure the waist belt is worn at all time during operation to avoid accidental dropping.
8. Never operate a crane or equipment with two (2) transmitter units at the same time with same RF channel and ID code.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operations.

Changes or Modifications not expressly approved by the party responsible for compliance could void the users' authority to operate the device.

3. SYSTEM FUNCTIONS

Transmitter Joystick

Each transmitter unit is equipped with up to two (2) joysticks with single or double axis per joystick. Please see the table below for different joystick settings:

TYPE	FUNCTION
Linear (step-less)	
1-Speed	No acceleration.
2-Speed	Shared acceleration relay.
2-Speed	Separate acceleration relay.
2-Speed	Separate acceleration relay / 1 st and 2 nd speed relay interlocked (refer to note A).
3-Speed	Shared acceleration relay.
4-Speed	Shared acceleration relay.
5-Speed	Shared acceleration relay.
0-Speed Contact Relay	0-speed (neutral position) can also be equipped with contact relay for connection to crane's braking system.

Note A: When 2nd speed contact relay is activated, the 1st speed contact relay will be deactivated.

Transmitter Pushbuttons

There are many different types of pushbuttons and switches available for the Twister 2X; please refer to the chart below.

TYPE	FUNCTION
1-Step Pushbutton	Standard non-toggled pushbutton
2-Step Pushbutton	Standard non-toggled pushbutton
Mechanical Toggle Pushbutton	Standard toggled pushbutton
Electronic Toggle Pushbutton	Resets itself when the transmitter unit is turned “off”
Rocker Switch	0-T (refer to note 1 & 2)
Rocker Switch	0-R (refer to note 1)
Rocker Switch	R-0 (refer to note 1)
Rocker Switch	T-0-T (refer to note 1 & 2)
Rocker Switch	R-0-T (refer to note 1 & 2)
Rocker Switch	T-0-R (refer to note 1 & 2)
Rocker Switch	R-0-R (refer to note 1)
Selector Switch	0-T (refer to note 1 & 2)
Selector Switch	0-R (refer to note 1)
Selector Switch	T-0-T (refer to note 1 & 2)
Selector Switch	T-0-R (refer to note 1 & 2)
Selector Switch	R-0-T (refer to note 1 & 2)
Selector Switch	R-0-R (refer to note 1)
ON / OFF Pushbuttons	2 pushbuttons per set / interlocked / will reset to “off” position when transmitter unit is turned “off”

- Note 1: 0 Original position.
 T Maintain position (toggled).
 R Retract to the 0-position (non-toggled).

Note 2: Pushbuttons, rocker switches, and selector switches with T (toggled) settings can also have their contact relay in the receiver to stay activated even if the transmitter unit is turned “off”.

Emergency Stop Button (EMS)

In case of an emergency, press the Emergency Stop Button will immediately deactivates the transmitter unit and the receiver MAIN Contact Relay.

Power Key Switch

Key switch for activating the power of the transmitter unit (please refer to Fig. 2 on page 7).

Start Pushbutton

After turning “on” the transmitter unit via power key switch, press the START pushbutton will activate the receiver MAIN. After resetting the emergency stop button, pressing the START pushbutton will also activate the receiver MAIN.

Removable Relay Cards

The special designed relay cards with main motherboard for future system expandability and replacements.

Auto Scanning Receiver

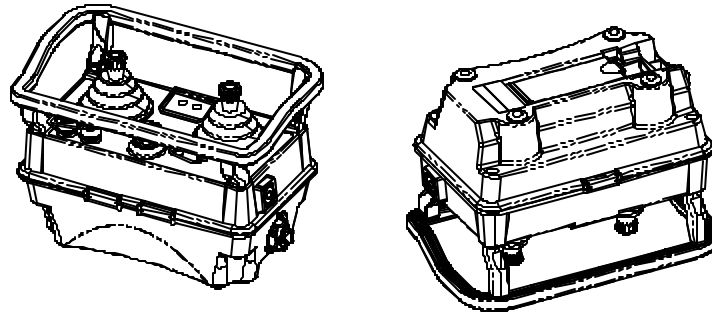
When the transmitter unit’s frequency channel is changed, the receiver unit will search and locked on to the intended matching transmitter unit.

Optional Features

1. Pitch and Catch Mode – This feature allows two operators controlling one crane system from opposite ends of a long travel.
2. Tandem Mode – This feature allows two operators controlling two crane systems independently or one operator controlling two crane systems simultaneously.
3. Random Access – This function allows for up to eight operators randomly accessing eight crane systems via an eight-position selector switch.

4. TRANSMITTER OUTLINE

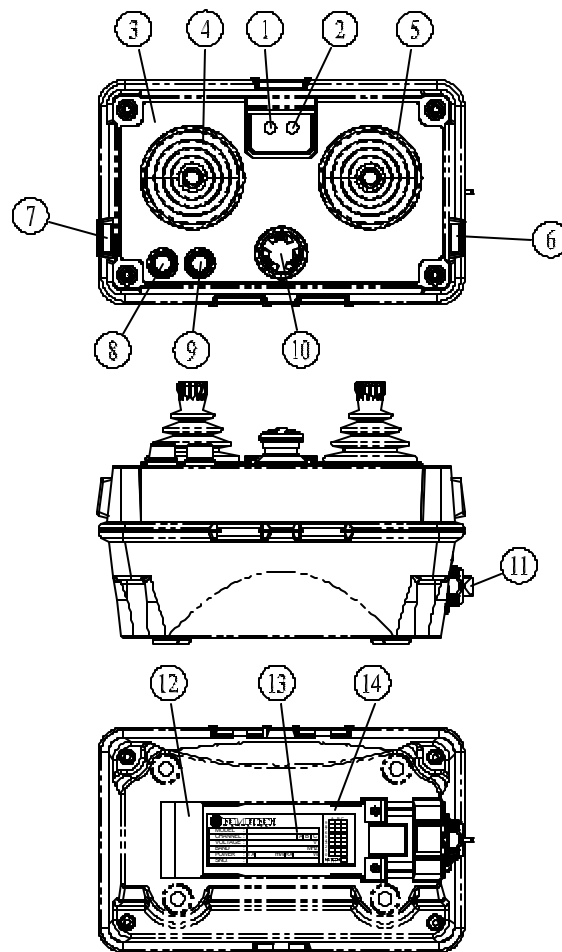
4.1 Transmitter Box



(Fig. 1)

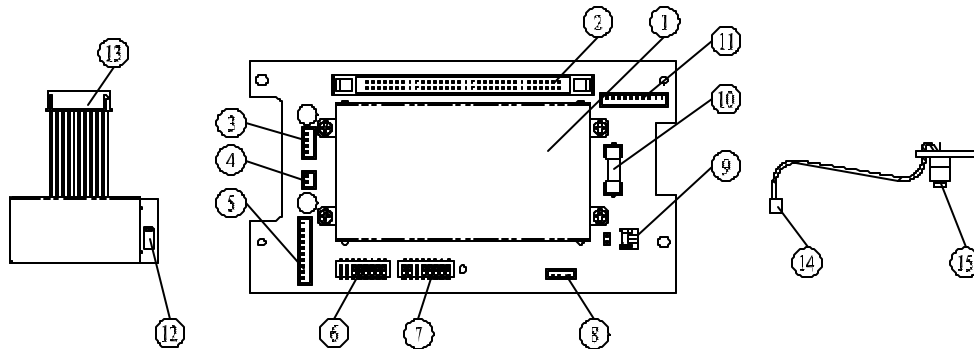
4.2 Detailed Parts

1. Power Status LED Display
2. Signal Status LED Display
3. Information Plate (engraved)
4. Left Joystick Rubber Boot
5. Right Joystick Rubber Boot
6. START Pushbutton
7. AUX/RES Pushbutton
8. AUX/RES Pushbutton
9. AUX/RES Pushbutton
10. Emergency Stop Button (EMS)
11. Power Key Switch (removable)
12. Battery Contact
13. System Information
14. Battery slot



(Fig. 2)

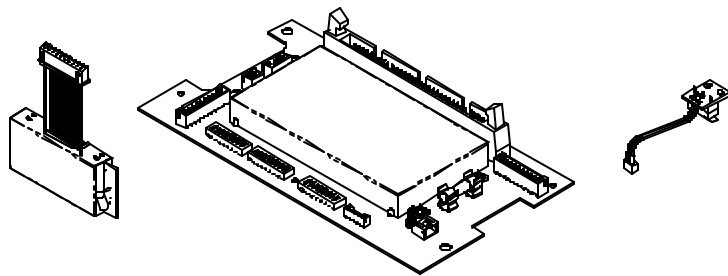
4.3 Encoder Board and PLL Module



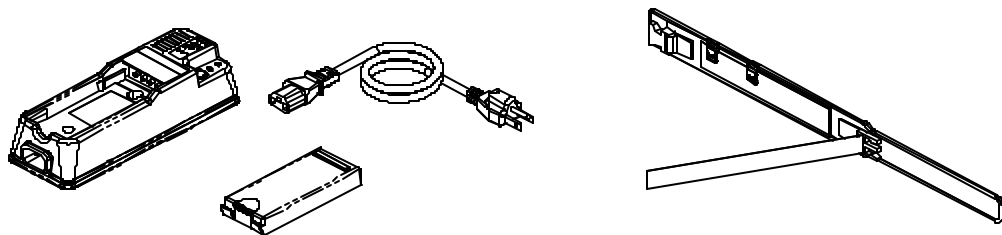
(Fig. 3)

- | | |
|---------------------------------|------------------------------------|
| 1. Encoder Shield Plate | 9. Power Key Switch Connector Port |
| 2. Ribbon Type Connector Port | 10. Power Fuse (0.25A) |
| 3. Power Input Connector Port | 11. Infrared Interface Port |
| 4. Charger Connector Port | 12. Antenna Port |
| 5. TX Module Connector Port | 13. TX module Connector |
| 6. ID Code Dip-Switch | 14. Power Key Switch Connector |
| 7. Frequency Channel Dip-Switch | 15. Power Key Switch |
| 8. Programming Port | |

(Fig. 4)



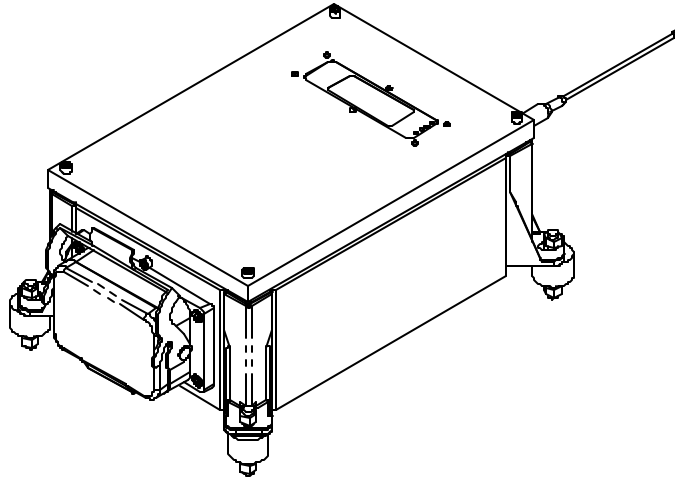
4.4 Intelligent Charger, 600mA Battery Pack x 2, Waist Belt, and Shoulder Strap (Not Pictured)



(Fig. 5)

5. RECEIVER OUTLINE

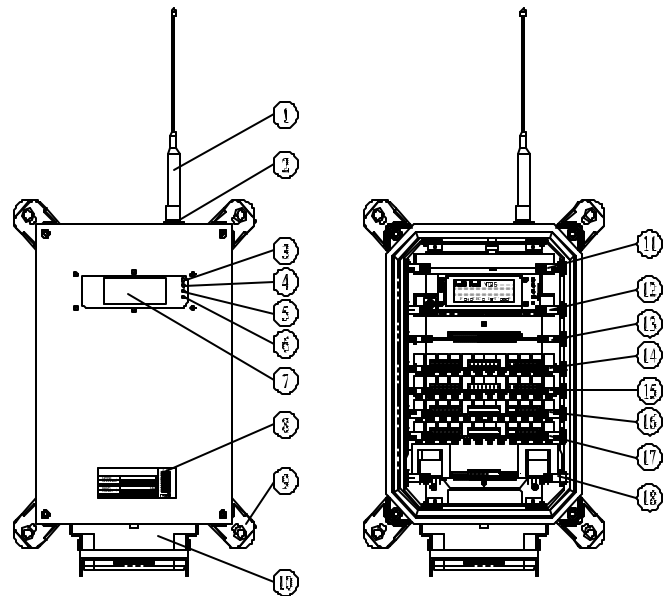
5.1 Receiver Box



(Fig. 6)

5.2 Detail Parts

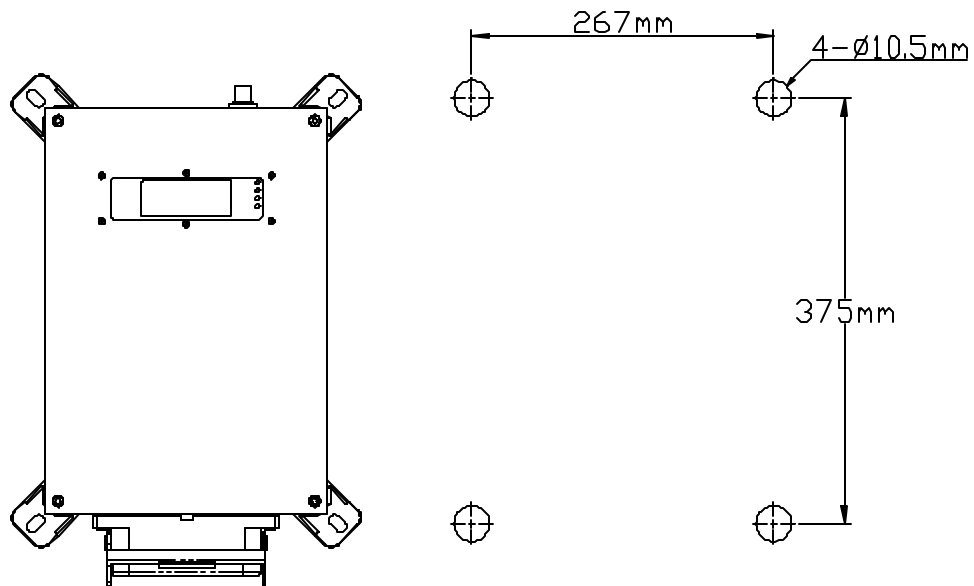
1. Antenna
2. Antenna Port
3. Power Display
4. SQ-1 Display (RX-1)
5. SQ-2 Display (RX-2)
6. Central CPU Status Display
7. System LCD Display
8. System Information Plate
9. Shock Absorber Leg
10. Heavy Duty Cable Connector
11. RX Module Card
12. Decoder Card
13. Reserved Relay Card
14. Relay Card - 1



(Fig. 7)

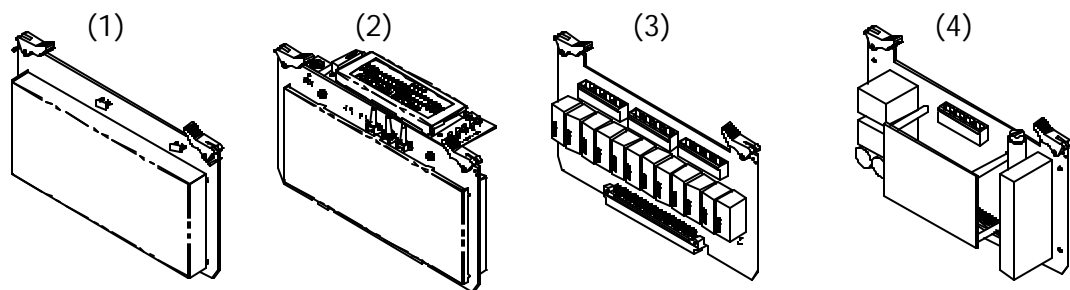
15. Relay Card - 2
16. Relay Card - 3
17. Relay Card - 4
18. Power Transformer Card

5.3 Shock Absorbers



(Fig. 8)

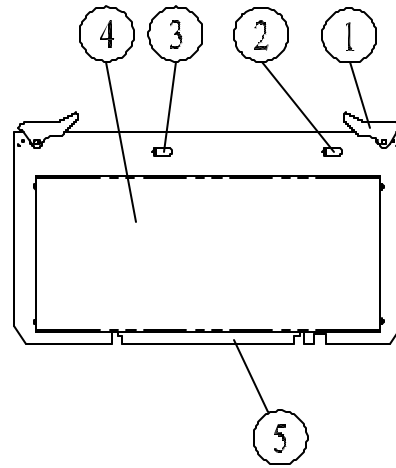
5.4 RX Module Card (1), Decoder Card (2), Relay Card (3), Power Supply Card (4)



(Fig. 9)

RX Module Card

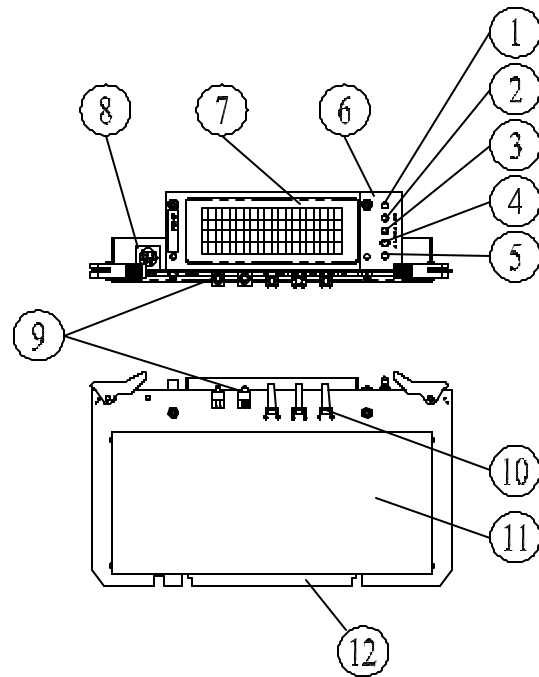
1. RX Module Card Release Clip
2. RX-1 Antenna Port
3. RX-2 Antenna Port
4. RX module Shield Plate
5. RX Module Card-to-Motherboard Connector



(Fig. 10)

Decoder Card

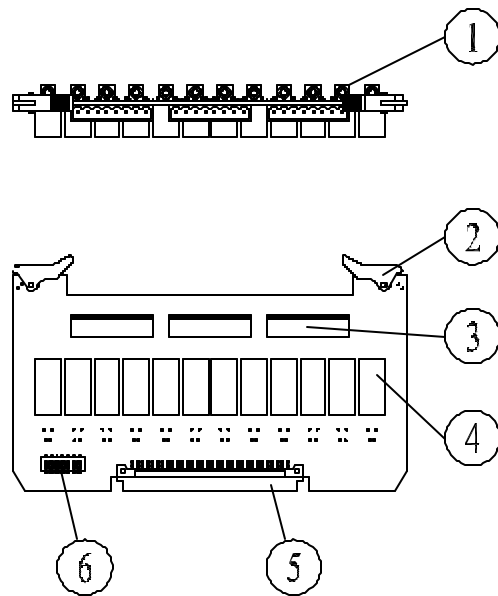
1. Power Display (LED-1)
2. SQ-1 Display (LED-2)
3. SQ-2 Display (LED-3)
4. Central CPU Status Display (LED-4)
5. Reserved Function Display (LED-5)
6. LED Panel
7. LCD Panel
8. RS 232 Serial Port
9. Dual Decoding CPU Status Display (LED-6 and LED-7)
10. Function Settings Buttons
11. Decoder Shield Plate
12. Decoder Card-to-Motherboard Connector



(Fig. 11)

Relay Card

1. LED Relay Display
2. Relay Card Release Clip
3. Relay Connector Port
4. Relays
5. Relay Card-to-Motherboard Connector
6. Relay Card Position/Address Dip-Switch (see note A).



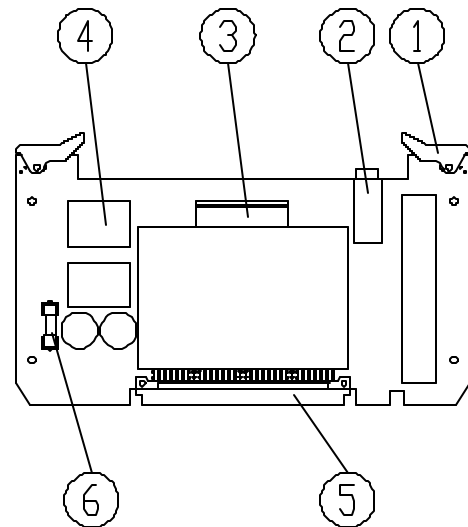
(Fig. 12)

Note A: The relay card position/address dip-switch must be adjusted according to the wiring diagram sheet located on the backside of the receiver cover plate.

Relay Card Position 1	address: 0000000
Relay Card Position 2	address: 0000001
Relay Card Position 3	address: 0000010
Relay Card Position 4	address: 0000011
Relay Card Position 5	address: 0000100

Power Supply Card

1. Power Supply Card Release Clip
2. Power Fuse
3. VAC Input / DVC Output Connector
4. MAIN Contact Relay
5. Power Supply Card-to-Motherboard Connector
6. VDC Fuse



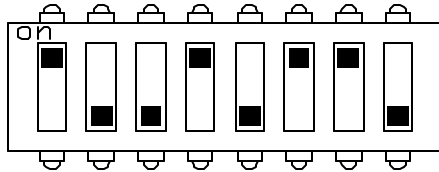
(Fig. 13)

6. SYSTEM SETTINGS

6.1 Transmitter ID Code Settings

Id code settings are set via dip-switch located on the encoder board (refer to fig. 3 on page 8). For receiver ID code settings please refer to page 15 ~ 16.

Example : ID code 10010110

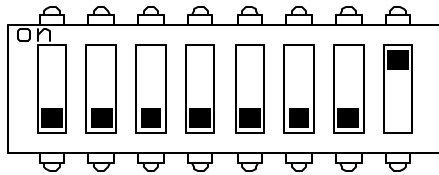


Top location : "1" Bottom location : "0"

6.2 Transmitter Frequency Channel Settings

Frequency channel settings are set via dip-switch located on the encoder board. Please refer to fig. 3 on page 8 for dip-switch location and frequency channel table on page 15. For receiver frequency channel settings please refer to page 15 ~ 16.

Example: Frequency 433.075MHz / channel 01 (00000001)



Top location : "1" Bottom location : "0"

6.3 Transmitter Special Functions Settings

Special function settings can be programmed via IBM compatible computer with special window based software or in-house designed programmer unit. Please contact your dealer for more details.

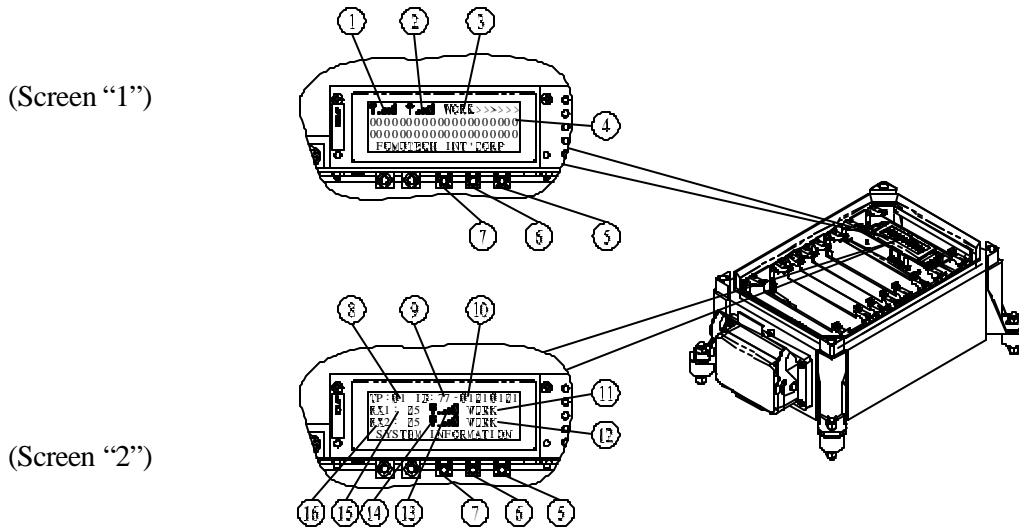
6.4 Frequency Channel Table

Via dip-switch located inside the transmitter box and receiver LCD panel, the frequency channel of the system can be altered.

FREQUENCY	DIP-SWITCH SETTING	CHANNEL
433.075 MHz	00000001	01
433.100 MHz	00000010	02
433.125 MHz	00000011	03
433.150 MHz	00000100	04
433.175 MHz	00000101	05
433.200 MHz	00000110	06
433.225 MHz	00000111	07
433.250 MHz	00001000	08
433.275 MHz	00001001	09
433.300 MHz	00001010	10
433.825 MHz	00001011	11
433.850 MHz	00001100	12
433.875 MHz	00001101	13
433.900 MHz	00001110	14
433.925 MHz	00001111	15
433.950 MHz	00010000	16
433.975 MHz	00010001	17
434.000 MHz	00010010	18
434.025 MHz	00010011	19
434.050 MHz	00010100	20

Note A: Other frequency channels are also available upon request.

6.5 Receiver LCD Outline

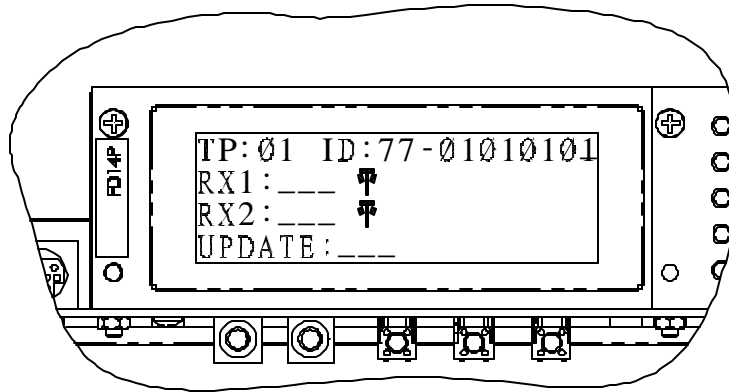


(Fig. 14)

- | | |
|--|----------------------------------|
| 1. RX-1 Signal Strength | 9. ID Code – 1 (country code) |
| 2. RX-2 Signal Strength | 10. ID Code – 2 (system ID code) |
| 3. System at Work | 11. Decoder System – 1 |
| 4. Relay Activation Display
"0" relay OFF; "1" relay ON | 12. Decoder System – 2 |
| 5. EXIT/DOWN (-) Button (PS1) | 13. RX-1 Signal Strength |
| 6. EDIT/UP (+) Button (PS2) | 14. RX-2 Signal Strength |
| 7. MODE/ENTER Button (PS3) | 15. RX-1 Frequency Channel |
| 8. System Type (depending on system features) | 16. RX-2 Frequency Channel |

6.6 Receiver ID Code and Frequency Settings

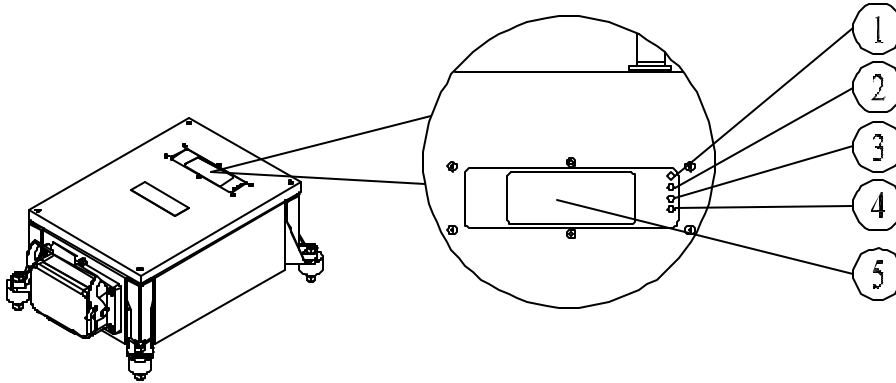
(Screen “3”)



- 1) To enter into screen-2, press MODE/ENTER button one time.
- 2) To enter into Screen-3, press EDIT/UP button for up to 5 seconds.
- 3) TP (System type) and Country code can not be changed.
- 4) Press EXIT/DOWN (-) and EDIT/UP (+) to change values of the ID code.
- 5) Press MODE/ENTER button to proceed to the RX-1 setting column.
- 6) Press EXIT/DOWN (-) and EDIT/UP (+) to change frequency channel of the RX1.
- 7) Press MODE/ENTER button to proceed to the RX-2 setting column.
- 8) Press EXIT/DOWN (-) and EDIT/UP (+) to change frequency channel of the RX2.
- 9) Press MODE/ENTER button to proceed to the UPDATE setting column.
- 10) Press EDIT/UP to input “YES” (save changes).
- 11) Press EXIT/DOWN to input “NO” (cancel changes).

Note: If new values are not inputted within 25 seconds, the system will exit the setup screen (screen 3) and returned to screen 1.

7. RECEIVER SYSTEM STATUS DISPLAYS



(Fig 15)

- | | |
|-------------------------------|-----------------------------------|
| 1. Receiver Power Display | 4. Central CPU Status Display |
| 2. SQ-1 (RX-1) Status Display | 5. LCD System Information Display |
| 3. SQ-2 (RX-2) Status Display | |

Receiver Power Display

Should be lid at all time during power “on”.

SQ-1 and SQ-2 Status Displays

Lights “on”	Transmitted Signals Received.
Lights “off”	No Transmitted Signals.
Blinking Lights	Strong Outside Radio Interference.

Dual Decoding CPU Status Display (refer to Fig. 11 on page 11)

Lights “on” 0.1 second / “off” 1.0 second	Decoders on Standby.
Lights “on” 0.1 second / “off” 0.1 second	Decoding in Process.

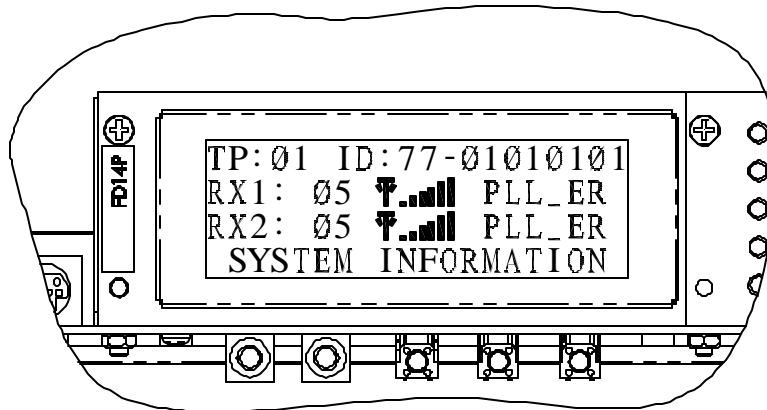
Central CPU Status Display

LED INDICATION	REASON
Slow Blinks (Green)	Standby
Fast Blinks (Green)	Transmitted signals received
Fast Blinks (Red)	Motion contact relays or the MAIN contact relays are locked
3 Fast Blinks (Red)	PLL RX module defected
4 Fast Blinks (Red)	EEPROM error
5 Fast Blinks (Red)	Incorrect transmitted ID code
6 Fast Blinks (Red)	Incorrect system type

Other System Status Display Feature

Some of the system status indications described on page 17 are also displayed on the receiver LCD screen for easy readout (on screen 2).

- | | |
|------------|---|
| 1) ID_ER | Incorrect transmitted ID code |
| 2) MAIN_ER | Defected MAIN contact relay or relays |
| 3) PLL_ER | Defected PLL RX module |
| 4) WORK | Transmitted signals received and decoded |
| 5) SEARCH | System on standby |
| 6) SCAN | System scanning for new frequency channel |



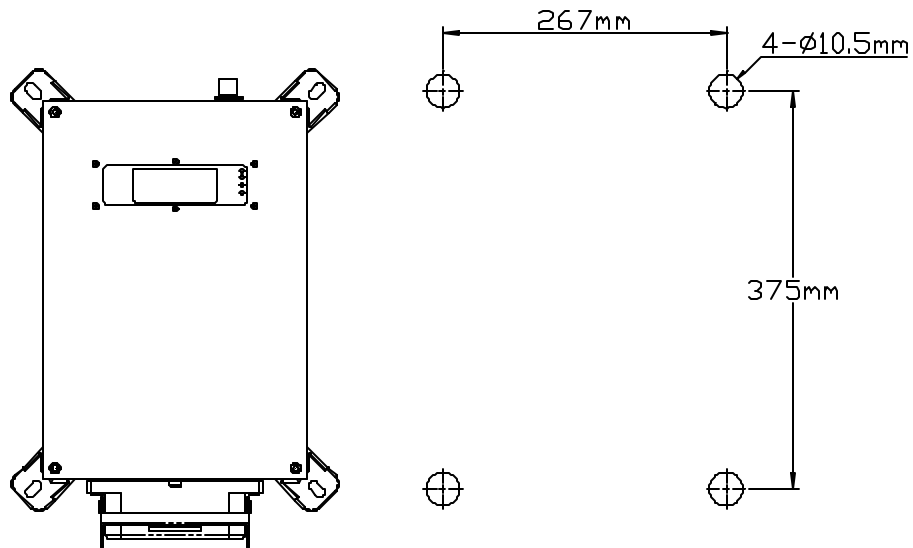
8. RECEIVER INSTALLATION

8.1 Preparation

- 1) Flat Head Screwdriver (-)
 - 2) Phillips Head Screwdriver (+)
 - 3) Multi-Meters
 - 4) 14 mm Wrench X 2
 - 5) Power Drill with 10.5 ~ 11mm Drill-Bit
 - 6) Output Cables
-
1. Ensure receiver is not set to the same channel and ID code as any other units in operation at the same facility within 300 meters/900 feet.
 2. Prior to installation, make sure that the crane system itself is working properly.
 3. Use the multi-meter to check the voltage source available and ensure receiver voltage setting is correct for this voltage.
 4. Prior to installation, switch off the main power source to the equipment.

8.2 Step By Step Installation

1. Select a suitable location to mount the receiver.
2. The location selected should have the antenna visible from all areas where the transmitter is to be used.
3. The location selected should not be exposed to high levels of electrical noise.
4. Ensure the selected location has adequate space to accommodate the receiver enclosure.
5. The distance between the antenna and the control panel should be as far apart as possible.
5. Drill four holes on the control panel (10.5mm).
6. Tightened all screws provided.
7. For system wiring, please refer to the wiring diagram located on the last page of this manual and on the backside of the receiver cover plate.
8. Ensure all wiring is correct and safely secured and all screws are fastened.



(Fig. 16)

8.3 System Testing

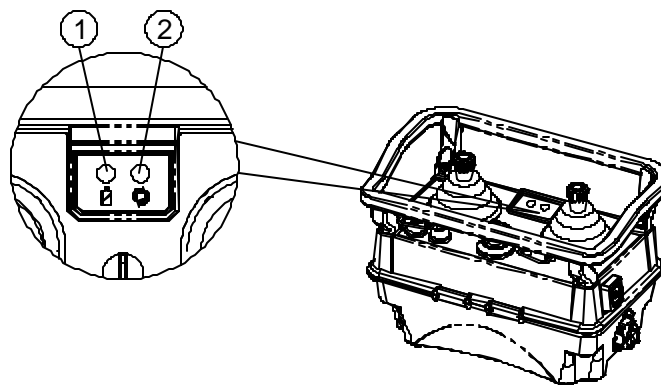
1. Connect the power source to the receiver and test the operation of each function to ensure it operates in the same manner as the pendant controller.
2. Ensure the MAIN contact relay can be properly controlled by the remote control.
3. Ensure the limit switches on the crane that limit all travels are working properly.
4. Ensure the pendant controller is located in a safe location where it would not interfere with remote operation.

9. OPERATING INSTRUCTION

9.1 Power “ON” the System

1. Insert the power key switch into the key slot located on the right side of the transmitter unit.
2. Push in the key and turn the key clockwise (forward) to “1” position.
“1” “ON” “0” “OFF”
3. Make sure both joysticks are in their neutral (0-speed) position.
4. Make sure that the red emergency stop button (EMS) is in its elevated position.
5. To activate the receiver MAIN, press and hold the “START” pushbutton located on the right side of the transmitter box for 2.0 seconds.
6. After system start up, if the operator did not give any command by pressing any pushbuttons or moving the joysticks to a non-neutral position, the transmitter unit will go into sleep mode with receiver MAIN contact relays temporarily deactivated. To resume operation, just press any pushbutton or move the joysticks again to re-activate the system.
7. After 1 hours of system non-usage, the entire system will be deactivated.
8. If the frequency channel of the transmitter unit is changed via a dip-switch inside the transmitter box (refer to page 13), you must then also change the frequency channel in the receiver box (refer to page 15~16). If the receiver unit is equipped with an auto-scanning feature, after changing the frequency channel of the transmitter unit, you must then press START button for up to 20 seconds after transmitter unit power “on” in order for the auto-scanning receiver to identify the newly selected channel.

9.2 Transmitter System Status Displays



(Fig. 17)

1. Battery Power LED Display
2. Transmitting Status LED Display

Transmitter Battery Power LED Display

POWER DISPLAY	REASON
Constant Green	Battery level normal
Slow Blinking Red	Low battery level (1 st warning)
Fast Blinking Red	Low battery level (2 nd warning) Transmitter unit will stop transmitting at anytime
Constant Red	Low battery level (3 rd warning) Transmitter and receiver unit deactivation

Transmitter Status LED Display

STATUS DISPLAY	REASON
No Light Displayed	No transmitting signals outputted
Slow Blinks (Green)	Neutral position signals transmitted (refer to note A)
Fast Blinks (Green)	Active command signals transmitted
Constant Red Light	Jammed or defected pushbutton or joysticks at system Power “on”
Fast Blinks (Red)	The contact point currently in use is ok (refer to note B)
3 Fast Blinks (Red)	PLL TX module defected
4 Fast Blinks (Red)	EEPROM error

Note A: If equipment is equipped with Selector switches, active commands are transmitted at all time during transmitter power “on”.

Note B: When there is defected or jammed contact (pushbutton and joystick), the status LED will display a constant red light without flashes. To find out which contact point is defected or jammed, activate each pushbutton and joystick by pressing and moving each pushbutton and joystick speed one step at a time. Activating a non-defected pushbutton or joystick contact will display a fast blinking red light on the status LED. This fast blinking red light is to show the operator that the contact point currently activating is not defected. On the other hand, if the defected or jammed contact point is activated, the status LED will remain constant red with out any flashes. The main purpose of function is to let the operator realize which contact point is not working properly.

10. BATTERY CHARGING

1. Plug in the power cord and the power indicator will light up.
2. When a battery pack is inserted, the green charging light will blink to indicate charging is taking place at the current moment.
3. If discharging of battery pack is desired (strongly recommended), press the “DISCHARGE” button. At discharging mode, the green blinking light will now turned into a constant red light indicating that the battery pack is now being discharged. If you want to cancel the discharge, just press “DISCHARGE” button again.
4. When discharging is completed, it will automatically switch to the charging mode where the green blinking light will appear again.
5. The charging time for a battery pack is approximately 3~6 hours (600mA).
6. When charging is completed, a constant green light will appear to indicate that the battery pack is fully charged.
7. When the battery pack is at 90% charged state, trickle charging will take over to ensure the longevity of the battery pack and as well as to ensure the battery pack is 100% charged.
8. When the battery pack's temperature exceeds 50 , the charger will go into protective mode and charging will be discontinued.
9. To prolong the life of the battery pack, it is recommended that the battery pack be fully discharged prior to every re-charging.

11. SYSTEM SPECIFICATION

11.1 Transmitter Unit

Frequency Range	:	PLL 433 MHz
Transmitting Range:	:	100 meters / 300 feet *
Continuous Operating Time	:	8 Hours (600mA) / 16 Hours (1400mA)
Security ID Code	:	65,536 sets (16 + 1 bit)
Channel Spacing	:	25KHz
Hamming Distance	:	6
Frequency Control	:	Quartz Crystals + PLL
Frequency Drift	:	< 3ppm @ -20 ~ 70
Frequency Deviation	:	< 1ppm @ 25
Spurious Emission	:	> 60dBc
Transmitting Power	:	0.1mW
Emission	:	F1D
Antenna Impedance	:	50 ohms
Enclosure	:	IP-65
Source Voltage	:	7.2 V (600mA) or 7.2 V (1400mA)
Current Drain	:	~80mA
Operating Temp.	:	-20 ~ 70
Dimension	:	247mm X 154mm X 182mm
Weight	:	1,600g (with battery pack)

* Longer transmitting-receiving range available upon request.

11.2 Receiver Unit

Frequency Range	:	PLL 433 MHz
Channel Spacing	:	25KHz
Hamming Distance	:	6
Frequency Control	:	Quartz Crystals + PLL
Frequency Drift	:	< 3ppm @ -20 ~ 70
Frequency Deviation	:	1ppm @ 25
Sensitivity	:	< 0.18µV
Decoding	:	FSK
Antenna Impedance	:	50 ohms
Data Decoder Reference	:	Quartz Crystals
Responding Time	:	100mS ~ 300mS
Enclosure	:	IP-65
Source Voltage	:	100 ~ 240VAC @ 50/60 Hz.*
Power Consumption	:	36VA
Operating Temp.	:	-20 ~ 70
Output Contact Rating	:	250V @ 10A
Dimension	:	417mm X 309mm X 167mm
Weight	:	8,800g

* Other types of source voltage are also available upon request.